Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

InTEC Project No. S221465
January 11, 2023

3200 Earhart
Carrolton, Texas 75006

InTEC **Integrated Testing and Engineering Company of San Antonio, L.P.**
Geotechnical & Environmental Engineering • Construction Services • Geologic Assessment

January 11, 2023

ONX Homes

3200 Earhart
Carrolton, Texas 75006

Attention: **Mr. Curtis Cogburn**

Re: Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

InTEC Project No. S221465

Ladies & Gentlemen:

Integrated Testing and Engineering Company of San Antonio (InTEC) has completed a **subsurface exploration and pavement thickness evaluation report** at the above referenced project site. The results of the exploration are presented in this report.

We appreciate and wish to thank you for the opportunity to be of service to you on this project. If we can be of additional assistance during the foundations explorations, and materials testing-quality control phase of construction, please call us.

Sincerely,

InTEC of San Antonio

MURALI SUBRAMANIAM
102417

InTEC of SAN ANTONIO
F-7623

01/14/2023

Murali Subramaniam, Ph. D., P.E.

Vice President

EXECUTIVE SUMMARY

The soil conditions at the location of the **proposed new streets at Timms Subdivision, Phases 4 & 5 in San Antonio, Texas** were obtained from **excavating nine test pits to depths of 6 to 8 feet.** Laboratory tests were performed on selected specimens to evaluate the engineering characteristics of various soil strata encountered in the test pits.

- The subsurface soils at the test pit locations consist of brown sandy clays, dark brown sandy clays, tan sandy clays, and tan and gray sandy clays.
- The results of our laboratory testing and engineering evaluation indicate that the underlying fill/ shallow clays are **moderately plastic to plastic in character.** Potential vertical movement on the order of **2 ½ to 3 ¼ inches** is estimated at the existing grade elevation of the test pits.
- The proposed streets at this site may consist of flexible pavement sections.
- Cut and fill information is not available for our review at this time. Sandy Clay subgrades are anticipated. At the time of construction, if the final street subgrade consists of material other than encountered in the test pits, the recommendations may have to be revised.
- Pavement section recommendations for Local type streets are presented.
- Ground water was not encountered in the test pits at the time of excavation.

Detailed descriptions of subsurface conditions, engineering analysis, and design recommendations are included in this report.

Summary Table A – Input Parameters used in Asphalt Pavement Section Calculation

(City of San Antonio, Design Guidance Manual, June 2008)

	Local Type A (no bus traffic)	**Local Type A** (with bus traffic)	**Local Type B**
ESAL	100,000	1,000,000	2,000,000
Reliability Level	R-70	R-70	R-90
Initial and Terminal Serviceability	4.2 and 2.0	4.2 and 2.0	4.2 and 2.0
Standard Deviation	0.45	0.45	0.45
Service Life	20 years	20 years	20 years
Minimum Asphalt Thickness	2.00	2.00	3.00
If heavy truck traffic is anticipated, please contact InTEC with anticipated traffic data for revised recommendations.			

Summary Table B – Minimum Flexible Pavement Recommendations – CBR = 3.0

Street Classification	Asphaltic Concrete			Aggregate Base, Inches	Geogrid	Subgrade, Inches	Structural Number
	Type D, inches	Type C, inches	Type B, inches				
Local Type A (no bus traffic)	2.00	-	-	8.50	No	6”	2.55
	2.00	-	6.00	-	No	6”	3.40
Local Type A (with bus traffic)	3.00	-	-	12.50	No	6”	3.55
	3.00	-	-	10.50	Yes	6”	3.58
	3.00	-	6.00	-	No	6”	3.84
Local Type B	2.00	2.00	-	14.50	No	8”	4.43
	2.00	2.00	-	12.00	Yes	8”	4.44
	3.00	-	7.50	-	No	8”	4.51

Design Notes:

- The results of our laboratory testing and engineering evaluation indicate that the underlying shallow clays are **moderately plastic to plastic in character.** Potential vertical movement on the order of **2 ½ to 3 ¼ inches** is estimated at existing grade elevation and **2 to 3 inches** is estimated at the anticipated subgrade elevation.
- Subgrade Plasticity Index values greater than 20 are anticipated.
- Pavement section recommendations are based on the design CBR value of 3.0 and the input parameters. The pavement can experience cracking and deformation due to shrinkage and swelling characteristics of the soils as described in the Vertical Movements section of this report.
- Cut and fill information is not available at this time. Anticipated potential vertical movements and recommended pavement sections should be re-evaluated after cut and fill information is made available.
- Recommend stabilizing 6 or 8 inches of subgrade soils.
- Local A and Local B type street recommendations are presented.
- Input parameters are shown in Table No. 3 (Summary Table A). Please call us to provide pavement recommendations, if needed, for different input values.
- If repetitive truck or heavy truck traffic is anticipated, please contact us for revised pavement recommendations.

Subgrade Notes:

- Sandy Clay subgrades with Plasticity Index values greater than 20 are anticipated.

- Lime or cement stabilizing the subgrade to a depth of 6 or 8 inches. We recommend lime application rate of 6 percent –
    - for **6-inch depth of treatment – 29 lbs per sq yard,** and
    - for **8-inch depth of treatment – 39 lbs per sq yard.**
    - The final cut subgrade soils should be tested for soluble sulfate content prior to treatment.
- If fill is used to raise the grade, the approved fill material should have a minimum CBR value of 3.0 and a maximum Plasticity Index value of 40. The lime application rate should be re-evaluated for the fill material and the soil sulfate content should be tested. The material should be placed as per applicable city guidelines.
- Cement application rates should be determined at the time of construction.
- The subgrade, prior to placement of fill, should be proof rolled to identify weak areas. Any identified weak areas should be recompacted.

General Notes:

- If water is allowed to get underneath the asphalt or if moisture content of the base or subgrade soil changes significantly, then pavement distress will occur.
    - Minimizing moisture penetration underneath the asphalt will lower the chances of pavement distress.
    - Significant pavement distress, more often caused by water getting underneath the asphalt, is noted during home construction.
    - Sandy soils with relatively higher permeability, such as the soils encountered at this site, will increase the likelihood of water getting underneath the asphalt. Moisture penetration may be reduced by using (a) deeper curb, such as curb extending a minimum of 6 inches into subgrade and / or (b) maintaining backfilled compacted clays behind the curbs.
    - In addition, water should not be allowed to get underneath the pavement section at the time of home construction.

Geogrid:

- One layer of geogrid, (City of San Antonio: meeting TxDOT DMS 6240 Type 2 guidelines), installed on top of compacted subgrade as per manufacturer's guidelines.

Subgrade Delineation:

- At the time of construction, the final pavement subgrade should be verified by the geotechnical engineer.

Summary Table C – Summary of Pavement Materials

Pavement Section	Material	Subgrade	Thickness
Subgrade	Sandy Clays	Stabilized (Lime or Cement)	6 or 8 inches
Base	TxDOT Item 247 A1-2	-	As recommended in pavement options (maximum of 6 inches per lift)
Asphalt	Type B, C, D	-	As recommended in pavement options
Geogrid	TxDOT DMS 6240 Type 2	One layer	As per manufacturer's recommendations

See report for more details

Summary Table D – Applicable procedures and minimum density and moisture percentages

All applicable City of San Antonio Standard Specifications for Construction, June 2008, should be followed. Some of the relevant procedures are shown below.

Pavement Material	Procedure *	Density and Moisture Control
Subgrade fill (maximum 6 inch thick lifts)	Item 107	As per construction specifications
Aggregate Base TxDOT Item 247 A1 or A2 (maximum 6 inch thick lift)	Item 200	As per construction specifications
Asphalt HMAC Type B, C, D	Item 205, 206	As per construction specifications
Geogrid	Manufacturer's Guidelines	-

(*) City of San Antonio Standard Specifications for Construction, June 2008

TABLE OF CONTENTS

INTRODUCTION 8
- General 8
- Purpose and Scope of Services 8
- Project Description 9

SUBSURFACE EXPLORATION 10
- Scope 10
- Excavating and Sampling 10
- Water Level Measurements 10
- Field Logs 10
- Presentation of the Data 11

LABORATORY TESTING PROGRAM 12
- Purpose 12
- Laboratory Tests 12
- Presentation of the Data 12

GENERAL SUBSURFACE CONDITIONS 13
- Soil Stratigraphy 13
- Ground Water Observations 13

PAVEMENTS ON EXPANSIVE SOIL 14
- General 14
- Evaluation of the Shrink-Swell Potential of the Soils 14
- The Mechanism of Swelling 14
- Initial Moisture Condition and Moisture Variation 14
- Man Made Conditions That Can Be Altered 15
- Summation 17

DESIGN ENGINEERING ANALYSIS 18
- Pavement Design Considerations 18
- Vertical Movements 18

PAVEMENT GUIDELINES 20
- General 20
- Pavement Design 20
- “Alligator” type Cracks 21
- Longitudinal Cracks 21
- Periodic Maintenance 22
- Pavement Sections 22
- Subgrade Preparation 25
- Base Course 26
- Asphaltic Concrete 26
- Perimeter Drainage 26

CONSTRUCTION GUIDELINES 27
- Construction Monitoring 27
- Site Preparation 27
- Compaction 28
- Proof Rolling 28
- Select Fill 29
- General Fill 29

General Fill Compaction 29
Ground Water 30
Drainage 30
Temporary Drainage Measures 30
Temporary Construction Slopes 31
Permanent Slopes..31
Time of Construction 31
Control Testing and Field Observation 31
DRAINAGE AND MAINTENANCE..32
Dry Periods 33
LIMITATIONS 34

INTRODUCTION

General

This report presents the results of our **subsurface exploration and pavement thickness evaluation** for the **proposed new streets at Timms Subdivision, Phases 4 & 5 in San Antonio, Texas.** This project was authorized by **Mr. Curtis Cogburn.**

Purpose and Scope of Services

The purpose of our subsurface investigation was to evaluate the site's subsurface and ground water conditions and provide pavement thickness recommendations for the planning and development phases of the project. Our scope of services includes the following:

1) excavating and sampling of nine test pits – to depths of 6 to 8 feet;
2) observation of the ground water conditions during excavation operations;
3) performing laboratory tests such as Atterberg limits, California Bearing Ratio (C.B.R.), Lime Series, and Moisture content tests;
4) review and evaluation of the field and laboratory test programs during their execution with modifications of these programs, when necessary, to adjust to subsurface conditions revealed by them;
5) compilation, generalization and analyses of the field and laboratory data in relation to the project requirements;
6) estimation of potential vertical movements;
7) preparation of pavement guidelines;
8) preparation of a written geotechnical engineering report for use by the members of the design team in their preparation of construction, contract, and specifications documents.

The Scope of Services **did not include fill evaluation, slope stability, or any environmental assessment** for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site. Any statements in this report or on the Test Pit Logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.

Project Description

The proposed project involves the development of new streets at Timms Subdivision, Phases 4 & 5 in San Antonio, Texas. The proposed pavement areas are anticipated to include Local type streets. Cut and fill information are not available for our use at this time. Sandy Clay subgrades are anticipated. Based on the review of geologic and soil maps, sandstone and mudstone should be anticipated during construction, especially during utility trench excavations.

SUBSURFACE EXPLORATION

Scope

The field exploration to determine the engineering characteristics of the subsurface materials included a reconnaissance of the project site, excavating the test pits, and obtaining bulk samples.

Nine test pits were excavated at the approximate locations shown on the Test Pit Location Plan, Plate 1, included in the Illustration section of this report. These test pits were **excavated to depths of 6 to 8 feet below the presently existing ground surface**. Test pit locations were selected by the project geotechnical engineer and established in the field by the drilling crew using normal taping procedures. Test pits were excavated to recover samples from different depths.

Excavating and Sampling

The test pits were performed with a mini-excavator. Test Pit samples of the subsurface materials were obtained and the samples were identified according to test pit number and depth, encased in polyethylene plastic wrapping to protect against moisture loss, and transported to our laboratory in special containers.

Water Level Measurements

Ground water was not encountered in the test pits at the time of excavation. In relatively pervious soils, such as sandy soils, the indicated elevations are considered reliable ground water levels. In relatively impervious soils, the accurate determination of the ground water elevation may not be possible even after several days of observation. Seasonal variations, temperature and recent rainfall conditions may influence the levels of the ground water table and volumes of water will depend on the permeability of the soils.

Field Logs

A field log was prepared for each test pit. Each log contained information concerning the sampling method, samples attempted and recovered, indications of the presence of various materials such as silt, clay, gravel or sand and observations of ground water. It also contained an interpretation of subsurface conditions between samples. **Therefore, these logs included both factual and interpretive information.**

Presentation of the Data

The final logs represent our interpretation of **the contents of the field logs for the purpose delineated by our client.** The final logs are included on **Plates 2 thru 10** included in the Illustration section. A key to classification terms and symbols used on the logs is presented on **Plate 11.**

LABORATORY TESTING PROGRAM

Purpose

In addition to the field exploration, a supplemental laboratory testing program was conducted to determine additional **pertinent engineering characteristics** of the subsurface materials necessary in evaluating the soil parameters.

Laboratory Tests

All phases of the laboratory testing program were performed **in general accordance with the indicated applicable** ASTM Specifications as indicated in Table No. 1.

Table No. 1 – Laboratory Test Procedures

Laboratory Test	Applicable Test Standard
Liquid Limit, Plastic Limit and Plasticity Index of the Soils	ASTM D 4318
Moisture Content	ASTM D 2216
California Bearing Ratio	ASTM D 1883
pH	ASTM D 6276
Unconfined Compressive Strength	ASTM D 5102

In the laboratory, each sample **was observed and classified by a geotechnical engineer.** As a part of this classification procedure, the natural water contents of selected specimens were determined. Liquid and plastic limit tests were performed on representative specimens to determine the plasticity characteristics of the different soil strata encountered.

Presentation of the Data

In summary, the tests presented were conducted in the laboratory to evaluate the engineering characteristics of the subsurface materials. The results of all these tests are presented on appropriate Test Pit Logs. These laboratory test results were used to classify the soils encountered generally according to the Unified Soil Classification System (ASTM D 2487).

GENERAL SUBSURFACE CONDITIONS

Soil Stratigraphy

The soils underlying the site may be grouped into **two generalized strata** with similar physical and engineering properties. The lines designating the interface between soil strata on the logs represent approximate boundaries. Transition between materials may be gradual. The soil stratigraphy information at the test pit locations are presented in **Test Pit Logs, Plates 2 thru 10.**

The engineering characteristics of the underlying soils, based on selected samples that were tested, are summarized and presented in the following paragraph.

The project site consists of brown sandy clays, dark brown sandy clays, tan sandy clays, and tan and gray sandy clays. The underlying clays are moderately plastic to plastic with tested liquid limits varying from 42 to 53 and plasticity index values ranging from 25 to 35.

The above description presented is of a generalized nature to highlight the major soil stratification features and soil characteristics. Please refer to Test Pit Logs for soil stratigraphy information at a particular test pit location.

Soil stratigraphy may vary between test pit locations. If deviations from the noted subsurface conditions are encountered during construction, they should be brought to the attention of InTEC. We may revise the recommendations after evaluating the significance of the changed conditions.

Ground Water Observations

Ground water was not encountered in the test pits at the time of excavation. Short term field observations generally do not provide accurate ground water levels. The contractor should check the subsurface water conditions prior to any excavation activities. The low permeability of the soils would require several days or longer for ground water to enter and stabilize in the test pits. Ground water levels will fluctuate with seasonal climatic variations and changes in the land use.

It is not unusual to encounter shallow groundwater during or after periods of rainfall. The surface water tends to percolate down through the surface until it encounters a relatively impervious layer.

PAVEMENTS ON EXPANSIVE SOIL

General

There are many plastic clays that swell considerably when water is added to them and then shrink with the loss of water. Pavements constructed on these clays are subjected to large uplifting forces caused by the swelling.

In the characterization of a pavement site, two major factors that contribute to potential shrink-swell problems must be considered. Problems can arise if a) the soil has expansive and shrinkage properties and b) the environmental conditions that cause moisture changes to occur in the soil.

Evaluation of the Shrink-Swell Potential of the Soils

Subsurface sampling, laboratory testing and data analyses are used in the evaluation of the shrink-swell potential of the soils under the pavements.

The Mechanism of Swelling

The mechanism of swelling in expansive clays is complex and is influenced by a number of factors. Basically, expansion is a result of changes in the soil-water system that disturbs the internal stress equilibrium. Clay particles in general have negative electrical charges on their surfaces and positively charged ends. The negative charges are balanced by actions in the soil water and give rise to an electrical interparticle force field. In addition, adsorptive forces exist between the clay crystals and water molecules, and Van Der Waals surface forces exist between particles. Thus, there exists an internal electro-chemical force system that must be in equilibrium with the externally applied stresses and capillary tension in the soil water. If the soil water chemistry is changed either by changing the amount of water or the chemical composition, the interparticle force field will change. If the change in internal forces is not balanced by a corresponding change in the state of stress, the particle spacing will change so as to adjust the interparticle forces until equilibrium is reached. This change in particle spacing manifests itself as a shrinkage or swelling.

Initial Moisture Condition and Moisture Variation

Volume change in an expansive soil mass is the result of increases or decreases in water content. The initial moisture content influences the swell and shrink potential relative to possible limits, or ranges, in moisture content. Moisture content alone is useless as an indicator or predictor of shrink-swell potential. The relationship of moisture content to limiting moisture contents such as the plastic limit and liquid limit must be known.

If the moisture content is below or near plastic limit, the soils have high potential to swell. It has been reported that expansive soils with liquidity index[*] in the range of 0.20 to 0.40 will tend to experience little additional swell.

The availability of water to an expansive soil profile is influenced by many environmental and manmade factors. Generally, the upper few feet of the profile are subjected to the widest ranges of moisture variation, and are least restrained against movement by overburden. This upper stratum of the profile is referred to as the active zone. Moisture variation in the active zone of a natural soil profile is affected by climatic cycles at the surface, and fluctuating groundwater levels at the lower moisture boundary. The surficial boundary moisture conditions are changed significantly simply by placing a barrier such as a building floor slab or pavement between the soil and atmospheric environment. Other obvious and direct causes of moisture variation result from altered drainage conditions or man-made sources of water, such as irrigation or leaky plumbing. The latter factors are difficult to quantify and incorporate into the analysis, but should be controlled to the extent possible for each situation. For example, proper drainage and attention to landscaping are simple means of minimizing moisture fluctuations near structures, and should always be taken into consideration.

Man Made Conditions That Can Be Altered

There are a number of factors that can influence whether a soil might shrink or swell and the magnitude of this movement. For the most part, either the owner or the designer has some control over whether the factor will be avoided altogether or if not avoided, the degree to which the factor will be allowed to influence the shrink-swell process.

Antecedent Rainfall Ratio This is a measure of the local climate and is defined as the total monthly rainfall for the month of and the month prior to laying the pavement divided by twice the average monthly rate measured for the period. The intent of this ratio is to give a relative measure of ground moisture conditions at the time the pavement is placed. Thus, if a pavement is placed at the end of a wet period, the pavement should be expected to experience some loss of support around the perimeter as the wet soils begin to dry out and shrink. The opposite effect could be

---

[*] LIQUIDITY INDEX = {NATURAL WATER CONTENT - PLASTIC LIMIT} / {LIQUID LIMIT - PLASTIC LIMIT}

anticipated if the pavement is placed at the end of an extended dry period; as the wet season occurs, uplift around the perimeter may occur as the soil at the edge of the slab pavement in moisture content.

Age of Pavement The length of time since the pavement was cast provides an indication of the type of swelling of the soil profile that can be expected to be found beneath the pavement.

Drainage This provides a measure of the slope of the ground surface with respect to available free surface water that may accumulate around the pavement. Most builders are aware of the importance of sloping the final grade of the soil away from the pavement so that rain water is not allowed to collect and pond against or adjacent to the pavement. If water were allowed to accumulate next to the pavement, it would provide an available source of free water to the expansive soil underlying the pavement. Similarly, surface water drainage patterns or swales must not be altered so that runoff is allowed to collect next to the pavement.

Pre-Construction Vegetation Large amount of vegetation existing on a site before construction may have desiccated the site to some degree, especially where large trees grew before clearing. Constructing over a desiccated soil can produce some dramatic instances of heave and associated structural distress and damage as it wets up.

Post-Construction Vegetation The type, amount, and location of vegetation that has been allowed to grow since construction can cause localized desiccation. Planting trees or large shrubs near a pavement can result in loss of foundation support as the tree or shrub removes water from the soil and dries it out. Conversely, the opposite effect can occur if flowerbeds or shrubs are planted next to the pavement and these beds are kept well-watered or flooded. This practice can result in swelling of the soil around the perimeter where the soil is kept wet.

Utilities Underneath the Pavement The utilities such as sewer, water, electricity, gas, and communication lines are often installed underneath the streets. The sewer utility construction, for example, typically involves trenching to the desired depth, installing gravel a gravel bed underneath the sewer main, installing primary backfill (gravel), and placing back the secondary backfill (generally excavated soils). The secondary backfill material is compacted in lifts. In addition, sewer service lines run laterally from each house (for a typical subdivision, approximately every 50-ft). These trenches with gravel and onsite material backfill are conducive to carrying water. In addition, the sewer service lines can carry water from behind the curb. Occasionally, the sewer line may be encased in concrete which will cause ponding of any travelling water within the sewer trenches. Any water travelling within these trenches can cause expansive clays to swell. If the backfill is not adequately compacted or if excessive water is flowing in these trenches, the trench backfill can potentially settle.

Summation

It is beyond the scope of this investigation to do more than point out that the above factors have a definite influence on the amount and type of swell to which a pavement is subjected during its useful life. The design engineer must be aware of these factors as he develops his design and make adjustments as necessary according to the results of special measurements or from his engineering experience and judgment.

DESIGN ENGINEERING ANALYSIS

Pavement Design Considerations

Review of the test pits and test data indicates that the following factors will affect the pavement design and construction at this site:

1) The underlying soils at the site are moderately plastic to plastic. Structures supported on or within these soils will be subjected to potential vertical movements on the order of **2 ½ to 3 ¼ inches.**

2) The strengths of the underlying soils are adequate to support the proposed new streets.

3) Based on the stratigraphy observed at this site. The final street subgrade is anticipated to be in the Sandy Clay subgrades. The final street subgrade should be verified by InTEC at the time of construction.

4) Ground water was not encountered in the test pits at the time of excavation.

Vertical Movements

The potential vertical rise (PVR) for slab-on grade construction at the location of the structures had been estimated using Texas Department of Transportation Procedure TXDOT-124-E. This method utilizes the liquid limits, plasticity indices, and in-situ moisture contents for soils in the seasonally active zone, estimated to be about fifteen feet at the project site.

The estimated PVR value provided is based on the proposed floor system applying a sustained surcharge load of approximately 1.0 lb. per square inch on the subgrade materials**. Potential vertical movement on the order of 2 ½ to 3 ¼ inches was estimated at the existing grade elevation**. These PVR values will be realized if the subsoils are subjected to **moisture changes from the average soil moisture conditions to wet soil moisture conditions.**

The PVR values are based on the current site grades. If cut and fill operations in excess of 6 inches are performed, the PVR values could change significantly. Higher PVR values than the above mentioned values will occur in areas where water is allowed to pond for extended periods.

If proper drainage is not maintained (allowing subgrade moisture content to change significantly) and / or if the pavement is underlain by utility trenches, resulting (a) potential vertical movements will be much greater than 2 to 3 times the anticipated vertical movements and (b) the subgrade strength may be reduced significantly reduced.

If the finish grade elevation is higher than the existing grade, compacted select fill should be used to raise the grade level. Any select fill should be placed and compacted as recommended under *Select Fill* in the "Construction Guidelines" section of this report. Each lift should be compacted and tested by InTEC to verify Compaction Compliance.

It should be noted that expansive clay does not shrink/swell without changes in moisture content, and thus good site design is very important to minimize movements. Coping with problems of shrink/swell due to expansive clays is a "fact of life" in the Texas region of south western U.S.A.

PAVEMENT GUIDELINES

General

Pavement area at this unit is expected to include Local type streets. The following recommendations are presented as a guideline for pavement design and construction. These recommendations are based on a) our previous experience with subgrade soils like those encountered at this site, b) pavement sections which have proved to be successful under similar design conditions, c) final pavement grades will provide adequate drainage for the pavement areas and that water will not be allowed to enter the pavement system by either edge penetration adjacent to landscape areas or penetration from the surface due to surface ponding, or inadequate maintenance of pavement joints, or surface cracks that may develop.

Pavement Design

Pavement designs provide an adequate thickness of structural sections over a particular subgrade (in order to reduce the wheel load to a distributed level so that the subgrade can support load). The support characteristics of the subgrade are based on strength characteristics of the subgrade soils and not on the shrinkage and swelling characteristics of the clays. Therefore, the pavement sections may be adequate from a structural standpoint, may still experience cracking and deformation due to shrinkage and swelling characteristics of the soils. In addition, if the proposed new pavements are used to carry temporary construction traffic, then heavier sections may be needed. Please contact InTEC to discuss options.

It is very important to minimize moisture changes in the subgrade to lower the shrinkage and swell movements of the subgrade clays. The pavement and adjacent areas should be well drained. Proper maintenance should be performed by sealing the cracks as soon as they develop to prevent further water penetrations and damage. In our experience,

(a) majority of the pavement distress observed over the years were caused by changes in moisture content of the underlying subgrade and / or excessive moisture in the base section,

(b) pavements with a grade of one percent or more have performed better than the pavements with allowable minimum grade,

(c) pavements with no underground utilities have performed better than pavements with underground utilities and the associated laterals,

(d) pavements that are at a higher-grade elevation than the surrounding lots have performed better, and

(e) any design effort that minimizes moisture penetration into the pavement layers have performed better.

“Alligator” type Cracks

A layer of aggregate base is typically used underneath the concrete curbs around the pavement areas. This layer of aggregate base underneath the concrete curb is conducive to the infiltration of surface water into the pavement areas. Water infiltration into the subgrade and / or base layer can result in “alligator type” cracks especially when accompanied by construction traffic. Increased moisture content of the pavement sections will significantly impact its support characteristics. Moisture penetration into pavement layers can be reduced by (a) penetrating the concrete curbs at least three inches into the native clays soils, (b) installing French Drains on the outside of the curbs, or (c) installing a moisture barrier such as a trench filled with bentonite or flowable fill. Alligator type cracks are also caused by weak / soft pockets within the pavement layers. Thoroughly proof rolling the subgrade and base layers will help identify the soft softs and densify as needed.

Longitudinal Cracks

Asphalt pavements in highly expansive soil conditions, such as the soils encountered at this site, can develop longitudinal cracks along the pavement edges. The longitudinal cracking typically occurs about 1 to 4 feet inside of the pavement edges and they run parallel to the pavement edge. Longitudinal or reflective cracks may also be observed over utility trenches. The longitudinal cracks are generally caused by differential drying and shrinkage of the underlying expansive clays. The moisture content change of the underlying subgrade clays can be reduced by installing moisture barriers. Vertical moisture barriers along the edge of the pavement or horizontal moisture barriers such as paved sidewalks or geogrid will help control the development of the longitudinal cracks.

Periodic Maintenance

The pavements constructed on clay subgrades will be subjected to shrink / swell related movements. Hence, proper maintenance should be performed by sealing the cracks as soon as they develop to prevent further water penetrations and damage.

Pavement Sections

Local type residential streets may be designed with flexible pavements. The final finish street subgrade is expected to be in the Sandy Clay subgrade areas. Minimum flexible pavement sections for the anticipated subgrades are presented in Table No. 2 in the following page. The project geotechnical engineer should delineate the streets for different subgrades at the time of construction. Input parameters used in the pavement section calculations are presented in Table No. 3.

- If pavement design for parameters other than those shown in Table No. 3 is needed or if repetitive / heavy truck traffic is anticipated, please contact us for additional pavement section recommendations.
- The recommended pavement sections are based on the subgrade soil support characteristics.
- The pavement sections are not based on shrink / swell characteristics of the subgrade soils.
- The subgrade soil support characteristics will be significantly affected by changes in moisture content.

The cut and fill information is not available at this time. The final street subgrade should be verified by InTEC at the time of construction.

Table No. 2 – Minimum Flexible Pavement Recommendations – CBR = 3.0

Street Classification	Asphaltic Concrete			Aggregate Base, Inches	Geogrid	Subgrade, Inches	Structural Number
	Type D, inches	Type C, inches	Type B, inches				
Local Type A (no bus traffic)	2.00	-	-	8.50	No	6”	2.55
	2.00	-	6.00	-	No	6”	3.40
Local Type A (with bus traffic)	3.00	-	-	12.50	No	6”	3.55
	3.00	-	-	10.50	Yes	6”	3.58
	3.00	-	6.00	-	No	6”	3.84
Local Type B	2.00	2.00	-	14.50	No	8”	4.43
	2.00	2.00	-	12.00	Yes	8”	4.44
	3.00	-	7.50	-	No	8”	4.51

Design Notes:

- The results of our laboratory testing and engineering evaluation indicate that the underlying shallow clays are **moderately plastic to plastic in character.** Potential vertical movement on the order of **2 ½ to 3 ¼ inches** is estimated at existing grade elevation and **2 to 3 inches** is estimated at the anticipated subgrade elevation.
- Subgrade Plasticity Index values greater than 20 are anticipated.
- Pavement section recommendations are based on the design CBR value of 3.0 and the input parameters. The pavement can experience cracking and deformation due to shrinkage and swelling characteristics of the soils as described in the Vertical Movements section of this report.
- Cut and fill information is not available at this time. Anticipated potential vertical movements and recommended pavement sections should be re-evaluated after cut and fill information is made available.
- Recommend stabilizing 6 or 8 inches of subgrade soils.
- Local A and Local B type street recommendations are presented.
- Input parameters are shown in Table No. 3 (Summary Table A). Please call us to provide pavement recommendations, if needed, for different input values.
- If repetitive truck or heavy truck traffic is anticipated, please contact us for revised pavement recommendations.

Subgrade Notes:

- Sandy Clay subgrades with Plasticity Index values greater than 20 are anticipated.

- Lime or cement stabilizing the subgrade to a depth of 6 or 8 inches. We recommend lime application rate of 6 percent –
    - for **6-inch depth of treatment – 29 lbs per sq yard,** and
    - for **8-inch depth of treatment – 39 lbs per sq yard.**
    - The final cut subgrade soils should be tested for soluble sulfate content prior to treatment.
- If fill is used to raise the grade, the approved fill material should have a minimum CBR value of 3.0 and a maximum Plasticity Index value of 40. The lime application rate should be re-evaluated for the fill material and the soil sulfate content should be tested. The material should be placed as per applicable city guidelines.
- Cement application rates should be determined at the time of construction.
- The subgrade, prior to placement of fill, should be proof rolled to identify weak areas. Any identified weak areas should be recompacted.

General Notes:

- If water is allowed to get underneath the asphalt or if moisture content of the base or subgrade soil changes significantly, then pavement distress will occur.
    - Minimizing moisture penetration underneath the asphalt will lower the chances of pavement distress.
    - Significant pavement distress, more often caused by water getting underneath the asphalt, is noted during home construction.
    - Sandy soils with relatively higher permeability, such as the soils encountered at this site, will increase the likelihood of water getting underneath the asphalt. Moisture penetration may be reduced by using (a) deeper curb, such as curb extending a minimum of 6 inches into subgrade and / or (b) maintaining backfilled compacted clays behind the curbs.
    - In addition, water should not be allowed to get underneath the pavement section at the time of home construction.

Geogrid:

- One layer of geogrid, (City of San Antonio: meeting TxDOT DMS 6240 Type 2 guidelines), installed on top of compacted subgrade as per manufacturer's guidelines.

Subgrade Delineation:

- At the time of construction, the final pavement subgrade should be verified by the geotechnical engineer.

Table No. 3 – Input Parameters used in Asphalt Pavement Section Calculation

	Local Type A (no bus traffic)	**Local Type A** (with bus traffic)	**Local Type B**
ESAL	100,000	1,000,000	2,000,000
Reliability Level	R-70	R-70	R-90
Initial and Terminal Serviceability	4.2 and 2.0	4.2 and 2.0	4.2 and 2.0
Standard Deviation	0.45	0.45	0.45
Service Life	20 years	20 years	20 years
Minimum Asphalt Thickness	2.00	2.00	3.00
If heavy truck traffic is anticipated, please contact InTEC with anticipated traffic data for revised recommendations.			

Subgrade Preparation

It is important that any existing pavement and organic and compressible soils are removed and the exposed subgrade is properly prepared prior to pavement installation. The subgrade should be prepared as described in the applicable city or TxDOT Guidelines. Base course material should be placed immediately upon completion of the subgrade compaction operation to prevent drying of the soils due to exposure.

The finish grade elevation of the subgrade should be such that water drains downward freely towards a drainage area. At the drainage area, 3x5 rock may be provided at the subgrade level and the collected water at the drainage area should be taken out (such as into the existing concrete drainage channel). If any voids in the subgrade should be filled in with the same subgrade material and compacted in lifts.

The approved fill material should be placed in 8-inch lifts (6 inches compacted) and compacted as recommended in the Site Preparation section of the Construction Guidelines presented in this report. If the fill depth exceeds 4 feet, the potential subgrade settlement should be considered. Please contact InTEC with the cut and fill information to evaluate the effect of proposed cut and fill on the recommendations and to provide fill material and compaction recommendations.

Base Course

Based on the survey of available materials in the area, a base course of crushed limestone aggregate or gravel appears to be the most practical material for asphalt pavement project. The base course should conform to Texas State Department of Highways and Public Transportation Standard Specification, Item 247, Type A, Grade 1-2. The aggregate base material and installation should conform to City of San Antonio Standard Specifications for Construction, 2008.

At a minimum the base course should be brought to near optimum moisture conditions and compacted in lifts to at least 95 percent of maximum dry density as determined by test method TxDOT 113E.

Asphaltic Concrete

The asphaltic concrete surface course material and installation should conform to City of San Antonio Standard Specifications for Construction, 2008.

Perimeter Drainage

It is important that proper perimeter drainage be provided so that infiltration of surface water from compacted areas surrounding the pavement is minimized, or if this is not possible, curbs should extent through the base and into the subgrade. A crack sealant compatible to both asphalt and concrete should be installed at the concrete-asphalt interfaces.

Wherever there are drastic grade changes in the pavement area (such as from 3 to 4 percent grade to 1 to 2 percent grade) 3 x 5 inch gravel subgrade with a subsurface drain system (such as Akwadrain® on the sides of the pavement) and outlet should be considered. This aspect will provide for a better drainage system in this area. Please contact InTEC for drainage recommendations.

CONSTRUCTION GUIDELINES

Construction Monitoring

As Geotechnical Engineer of Record for this project, InTEC should be involved in monitoring the pavement construction and earth work activities. Performance of any pavement system is not only dependent on the pavement design, but is strongly influenced by the quality of construction. Please contact our office prior of construction so that a plan for pavement construction and earthwork monitoring can be incorporated in the overall project quality control program. The testing requirements shall comply with the minimum testing requirements as per applicable city and county guidelines.

Site Preparation

Site preparation will consist of **preparation of the subgrade, and placement of select structural fill.** The project geotechnical **engineer InTEC should approve the subgrade preparation, the fill materials, and the method of fill placement and compaction.**

In any areas where soil-supported concrete structure or pavement are to be used, vegetation and all loose or excessively organic material should be stripped to a minimum depth of six inches and removed from the site. Subsequent to stripping operations, the pavement subgrade should be proof rolled prior to fill placement and recompacted to as per City of San Antonio Standard Construction Guidelines, 2008. The exposed subgrade should not be allowed to dry out prior to placing structural fill. Each lift should be tested by InTEC geotechnical engineer or his representative prior to placement of the subsequent lift.

A review of the aerial maps indicates areas of disturbance within the project site. Additional investigation is recommended to delineate the pit boundaries and to determine the type of backfill material used and its compaction. Depending upon the outcome of this additional investigation, the existing backfill material may need to be re-installed.

Voids caused by site preparation, such as removal of trees or disturbed areas, should be compacted as described below:

Compaction

Site grading plan is not available for review at this time. If any low / wet / disturbed areas encountered during construction should be appropriately prepared and compacted. Any deleterious or wet materials should be removed and wasted. The fill placement in the low areas should not be in a “bowl shape”. The sides of the fill area should be “squared up” and the excavated bottom should be proof rolled as described in *Proof Rolling* section of this report. On site material, with no deleterious material, may be used to raise the grade. After proof rolling operation, the fill should be placed in 6-inch lifts and compacted to a minimum of **95 percent of the maximum dry density as determined by ASTM D 698 test method within optimum and three percent above optimum moisture content.** Each lift should be tested by InTEC for compaction compliance and approved before placement of the subsequent lifts. The exposed subgrade should not be allowed to dry out prior to placing structural fill. It is recommended that any given lot does not straddle filled areas and natural areas to help reduce differential movement of the structures.

The excavation boundaries should be set such that building or pavement areas do not straddle fill and natural areas. The anticipated potential vertical movement may be significantly affected after the cut and fill operations are performed in this area.

Proof Rolling

Proof rolling should be accomplished in order to locate and densify any weak compressible zones under the structure and pavement areas and prior to placement of the select fill or base. A minimum of 10 passes of a 25-ton pneumatic roller should be used for planning purposes. The operating load and tire pressure should conform to the manufactures specification to produce a minimum ground contact pressure of 90 pound per square inch. Proof rolling should be performed under the observation of the InTEC Geotechnical Engineer or his representative. The soils that yield or settle under proof rolling operations should be removed, dried and compacted or replaced with compacted select fill to grade. Density tests should be conducted as specified under *Control Testing and Filed Observation* after satisfactory proof rolling operation.

Proper site drainage should be maintained during construction so that ponding of surface run-off does not occur and cause construction delays and/or inhibit site access.

Select Fill

Any select fill used under the building should have a liquid limit less than 40 and a plasticity index in between 5 and 20 and be crushed limestone. The fill should contain no particles greater than 3 inches in diameter. **The percent passing U.S. Standard Sieve No. 4 should be in between 40 and 80 percent and Sieve No. 40 passing should be in between 10 and 50 percent. The percent passing Sieve No. 200 should be less than 20 percent**.

Crushed limestone with sufficient fines to bind the aggregate together is a suitable select structural fill material. The fill materials should be placed in loose lifts not to exceed 8 inches thick (6-inches compacted) and compacted to 95 percent of the maximum dry density as determined by ASTM D 1557 procedure at a moisture content within 2 percent of the optimum water content.

General Fill

General fill materials may consist of clean on-site material, select fill materials, or any clean imported fill material. The purpose of a general fill is to provide soils with good compaction characteristics that will provide uniform support for any non-habitable structures that are not movement sensitive. The general fill may also be used underneath the pavement areas. The pavement recommendations should be re-evaluated based on the fill material characteristics. The general fill material should be free of any deleterious material, construction debris, organic material, and should not have gravels larger than 6 inches in maximum dimension. The top two feet of fill material used underneath pavement areas should not have gravels larger than 3 inches in maximum dimension.

It should be understood that the use of the general fill may result in greater than anticipated potential vertical movements and differential movements. If the greater potential vertical movements or differential soil movements cannot be tolerated, then select fill material should be used and should conform to the Select Fill recommendations.

General Fill Compaction

The general fill materials should be placed in lifts not to exceed 8 inches thick and compacted to a minimum of 95 percent of the maximum dry density as determined by test method ASTM D 698 at a moisture content within 3 percent of the optimum water content. Each lift should be compacted and tested by a representative of a geotechnical laboratory to verify compaction compliance and approved before placement of the subsequent lifts.

The general fill compaction requirements can also be discussed and determined in consultation with the owner prior to construction.

Ground Water

In any areas where significant cuts (2-ft or more) are made to establish final grades for pavement, attention should be given to possible seasonal water seepage that could occur through natural cracks and fissures in the newly exposed stratigraphy. Subsurface drains may be required to intercept seasonal groundwater seepage. The need for these or other dewatering devices on should be carefully addressed during construction. Our office could be contacted to visually inspect final pads to evaluate the need for such drains.

The ground water seepage may happen several years after construction if the rainfall rate or drainage changes within the project site or outside the project site. If seepage run off occurs towards the pavement areas an engineer should be called on to evaluate its effect and provision of French Drains at this location.

Drainage

Ground water seepage was not encountered in the test pits at the time of excavation. However, minor ground water seepage may be encountered within the pavement areas and grading excavations at the time of construction, especially after periods of heavy precipitation. **Small quantities of seepage may be handled by conventional sump and pump methods of dewatering.**

Temporary Drainage Measures

Temporary drainage provisions should be established, as necessary, to minimize water runoff into the construction areas. If standing water does accumulate, it should be removed by pumping as soon as possible.

Adequate protection against sloughing of soils should be provided for workers and inspectors entering the excavations. This protection should meet O.S.H.A. and other applicable building codes.

Temporary Construction Slopes

Temporary slopes on the order of 1H to 1V may be provided for excavations through Strata I clays.

Fill slopes on the order of 1H to 1V may be used provided a) the fill materials are compacted as recommended and b) the slopes are temporary.

Fill slopes should be compacted. Compacting operations shall be continued until the slopes are stable but not too dense for planting on the slopes. Compaction of the slopes may be done in increments of 3 to 5-ft in fill height or the fill is brought to its total height for shallow fills.

Permanent Slopes

Maximum permanent slope of 1V to 3H is recommended in Stratum I clays. In areas where people walk on sloped areas, a slope of 1V to 5H is recommended.

Time of Construction

If the pavement is installed during or after an extended dry period, the subgrade may experience greater movement around the edges when the soil moisture content increases, such as due to rain or irrigation. Similarly, a pavement installed during or after a wet period may experience greater movement around the edges during the subsequent drying of the soils.

Control Testing and Field Observation

Subgrade preparation and base and asphalt placement should be monitored by the project geotechnical engineer or his representative of InTEC. As a guideline, at least one in-place density test should be **performed for every 100 lineal feet (or as per respective city and county requirements, whichever requires more frequent testing) of street of compacted surface lift.** However, a minimum of three density tests should be performed by InTEC on the subgrade or subsequent lifts of compaction. Any areas not meeting the required compaction should be re-compacted and retested until compliance is met.

DRAINAGE AND MAINTENANCE

Final drainage is very important for the performance of the proposed pavement. Landscaping, plumbing, and downspout drainage is also very important. It is vital that drainage be transported away from the pavement so that no water ponds around the pavement (such as behind the curbs) which can result in soil volume change under the pavement. Any leaks or drainage issues should be repaired as soon as possible in order to minimize the magnitude of moisture change under the pavement. Large trees and shrubs should not be planted in the immediate vicinity of the pavement, since root systems can cause a substantial reduction in soil volume in the vicinity of the trees during dry periods. Silt fences placed adjacent to the curb can potentially allow water to get into the pavement area.

Trench backfill for utilities should be properly placed and compacted as outlined in this report and in accordance with all applicable requirements such local City / County / SAWS Standards. Since granular bedding backfill is used for most utility lines, the backfilled trench should be prevented from becoming a conduit and allowing an access for surface or subsurface water to travel toward the new pavement. Concrete cut-off collars or clay plugs should be provided where utility lines cross curbs to prevent water traveling in the trench backfill and entering beneath the pavement. If concrete encasing is used around the sewer pipes, an alternate path for water to continue to drain should be installed.

In areas with sidewalks or other structures adjacent to the new pavement, a positive seal must be provided and maintained between the structures and the pavement or sidewalk to minimize seepage of water into the underlying supporting soils. **Post-construction movement of pavement and flat-work is not uncommon.** Maximum grades practical should be used for paving and flatwork to prevent areas where water can pond. In addition, allowances in final grades should take into consideration post construction movement of flatwork particularly if such movement would be critical. **Normal maintenance should include inspection of all joints in paving and sidewalks, etc. as well as re-sealing where necessary.**

Several factors relate to civil and architectural design and/or maintenance which can significantly affect future movements of the pavement systems:

1. Where positive surface drainage cannot be achieved by sloping away of the ground surface adjacent to the pavement, a drainage system should carry runoff water away from the completed pavement.
2. Planters located adjacent to the pavement should preferably be **self-contained**. Sprinkler mains should be located a minimum of five feet from the pavement.

3. Planter box structures placed adjacent to pavement should be provided with a means to assure concentrations of water are not available to the subsoils stratigraphy.

4. Large trees and shrubs should not be allowed closer to the pavement than a horizontal distance equal to roughly their mature height due to their significant moisture demand upon maturing.

5. Moisture conditions should be maintained **"constant" around the edge of the pavements.** Ponding of water in planters, in unpaved areas, and around joints in paving and sidewalks can cause movements beyond those predicted in this report and significantly reduce the subgrade support.

Adequate drainage should be provided to reduce seasonal variations in moisture content of soils around the pavement. The PVR values estimated and stated under Vertical Movements are based on provision and maintenance of positive drainage to divert water away from the pavement areas. If the drainage is not maintained, the wetted front may move below the assumed twelve feet depth, and resulting **PVR will be much greater than 2 or 3 times the stated values under "Vertical Movements". Utility line leaks may contribute water and cause similar movements to occur. In addition, if the soil is allowed to dry, the associated shrinkage can cause pavement cracks. Similarly, significant changes in moisture content of the underlying pavement layers, will impact the support characteristics of the subgrade.**

Dry Periods

Close observations should be made around pavements during extreme dry periods to ensure that adequate watering is being provided to keep soil from separating or pulling back from the curb and to minimize the shrinkage related cracks.

LIMITATIONS

The analyses and recommendations submitted in this report are based upon the data obtained from **nine test pits excavated at the site**. This report may not reflect the exact variations of the soil conditions across the site. The pavement recommendations presented in the report should be reviewed and confirmed based on the proposed cut and fill and observation at the time of construction.

If deviations from the noted subsurface conditions are encountered during construction, they should be brought to the attention of the geotechnical engineer.

The information contained in this report and on the Test Pit Logs is not intended to provide the contractor with all the information needed for proper selection of equipment, means and methods, or for cost and schedule estimation purposes. The use of information contained in the report for bidding purposes should be done at the contractor's option and risk.

Final plans for the proposed streets should be reviewed by the project geotechnical engineer so that he may determine if changes in the recommendations are required.

The project geotechnical engineer declares that the findings, recommendations, or professional advice contained herein have been made and this report prepared in accordance with generally accepted professional engineering practice in the fields of geotechnical engineering and engineering geology. The recommendations presented in this report should be reevaluated by InTEC if cut and fill operations are performed, any changes are made to drainage conditions. No other warranties are implied or expressed.

This report has been prepared for the exclusive use of **ONX Homes** for pavement thickness evaluation for the **proposed new streets at Timms Subdivision, Phases 4 & 5 in San Antonio, Texas.**

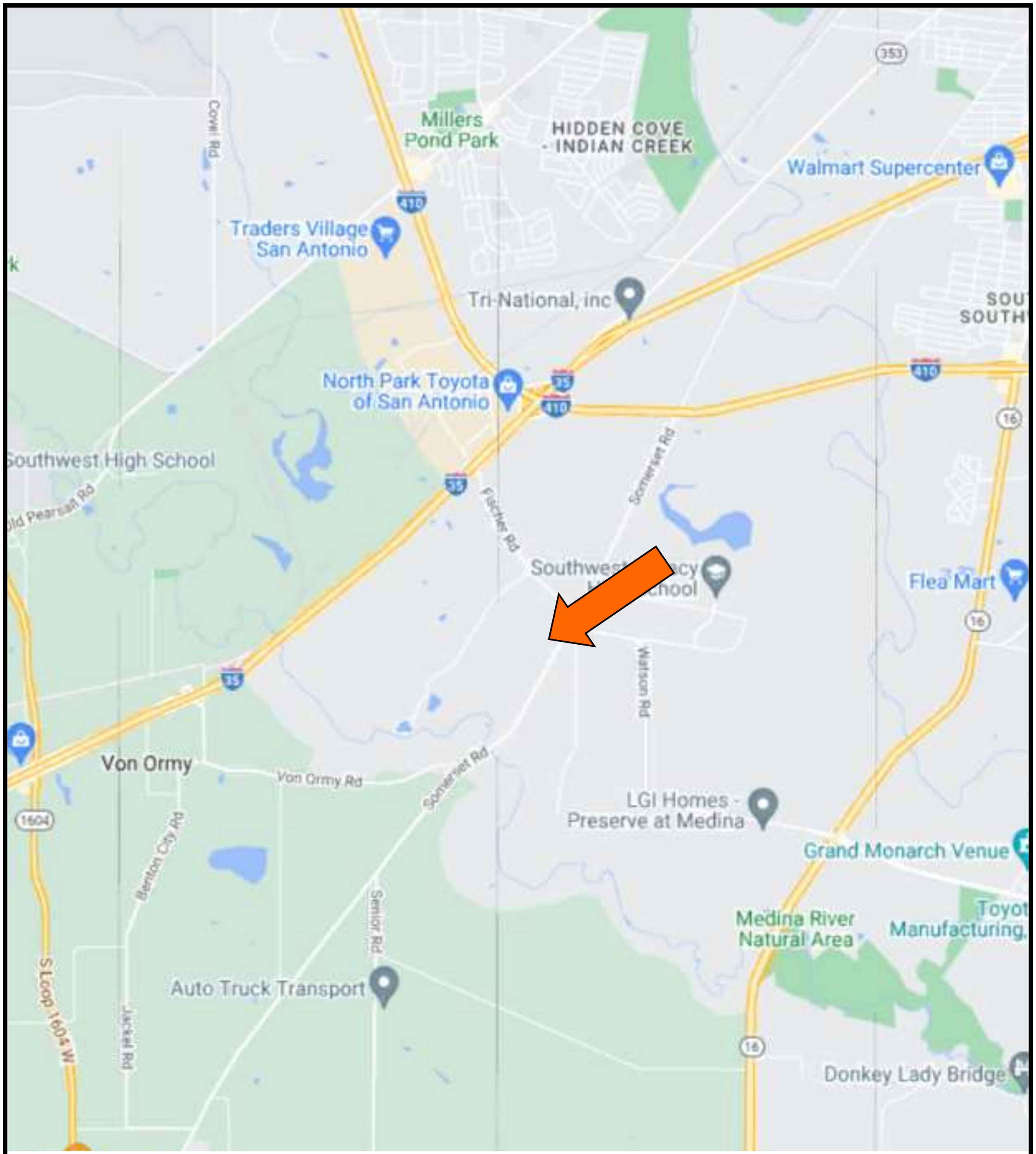
Illustration Section

Description	Plate No.
Vicinity Map	Plate 1A
Aerial Map	Plate 1B
Topographic Map	Plate 1C
Geologic Map	Plate 1D
Soil Map	Plate 1E
Approximate Test Pit Locations	Plate 1F
Test Pit Photos	Plates 1G & 1H
Test Pit Logs	Plates 2—10
Keys to Classifications and Symbols	Plate 11
Calculations	Plates 12—22
Information on Geotechnical Report	Appendix

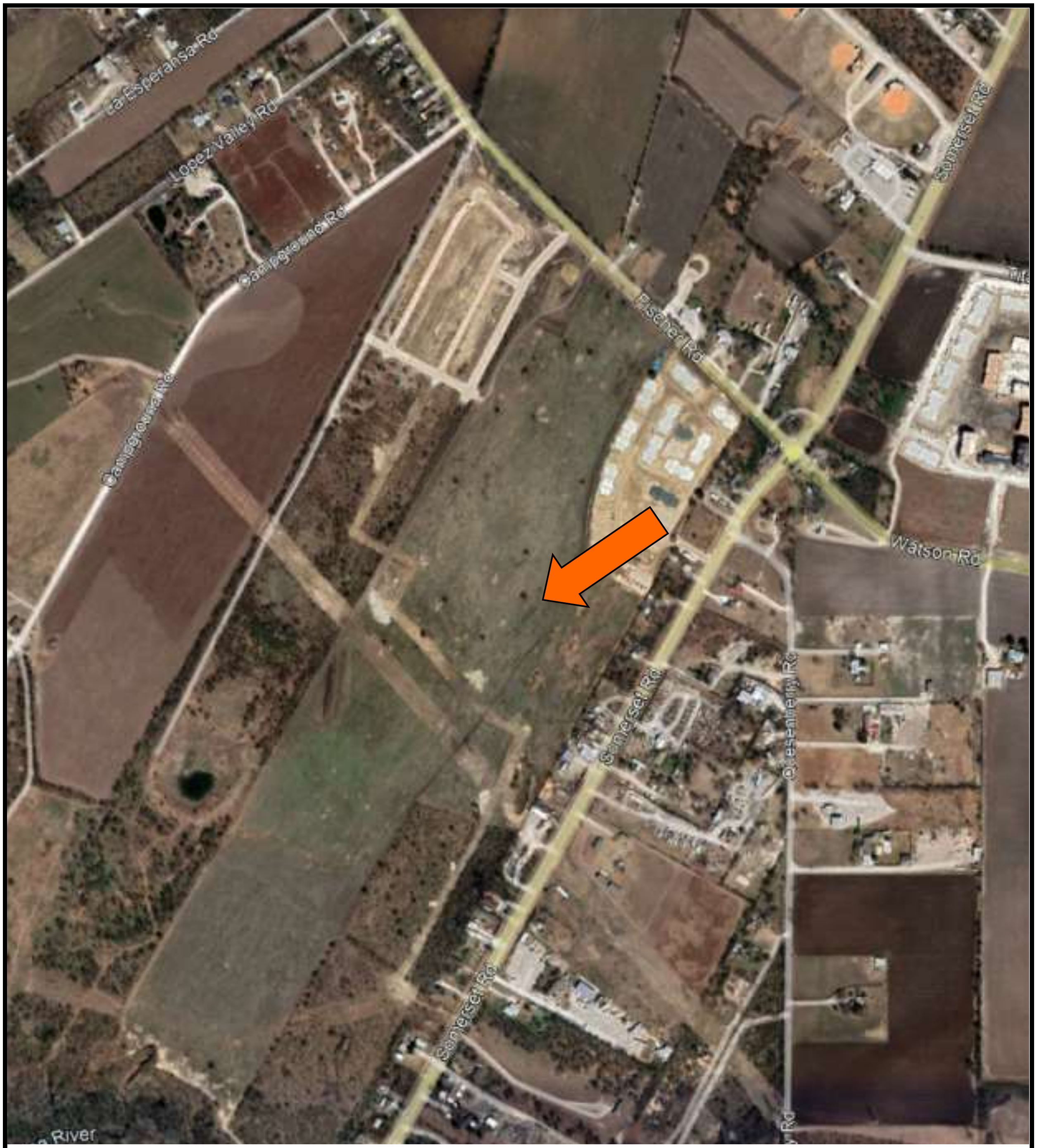
Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

InTEC Project Number:
S221465

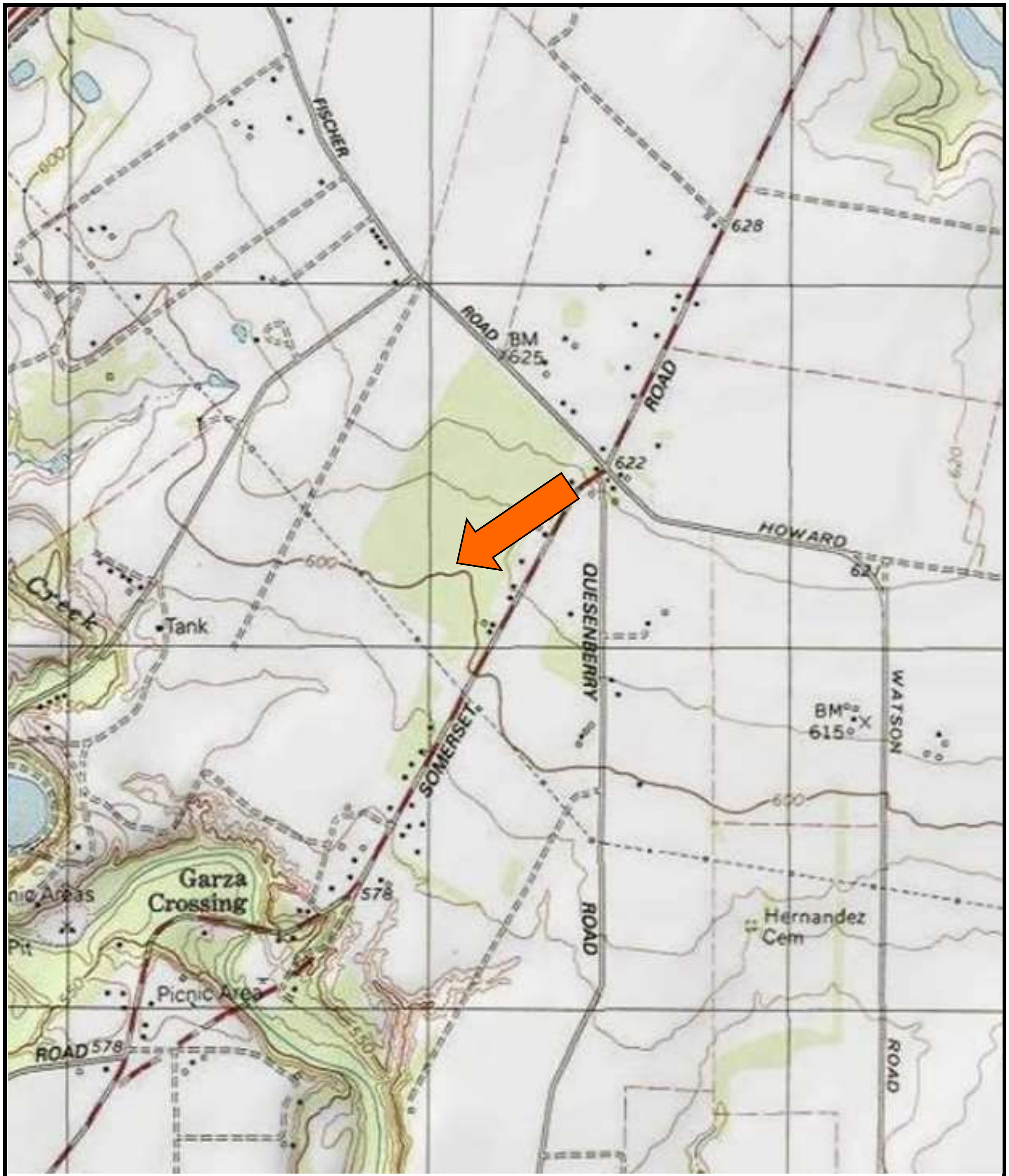
Date:
11/24/2022



Subsurface Exploration and Pavement Analysis Proposed New Streets Timms Subdivision, Phases 4 & 5 San Antonio, Texas	**Vicinity Map**	
	InTEC Project Number: **S221465**	Date: 11/24/2022



Subsurface Exploration and Pavement Analysis Proposed New Streets Timms Subdivision, Phases 4 & 5 San Antonio, Texas	**Aerial Map—Approximate Location**	
	InTEC Project Number: **S221465**	Date: 11/24/2022

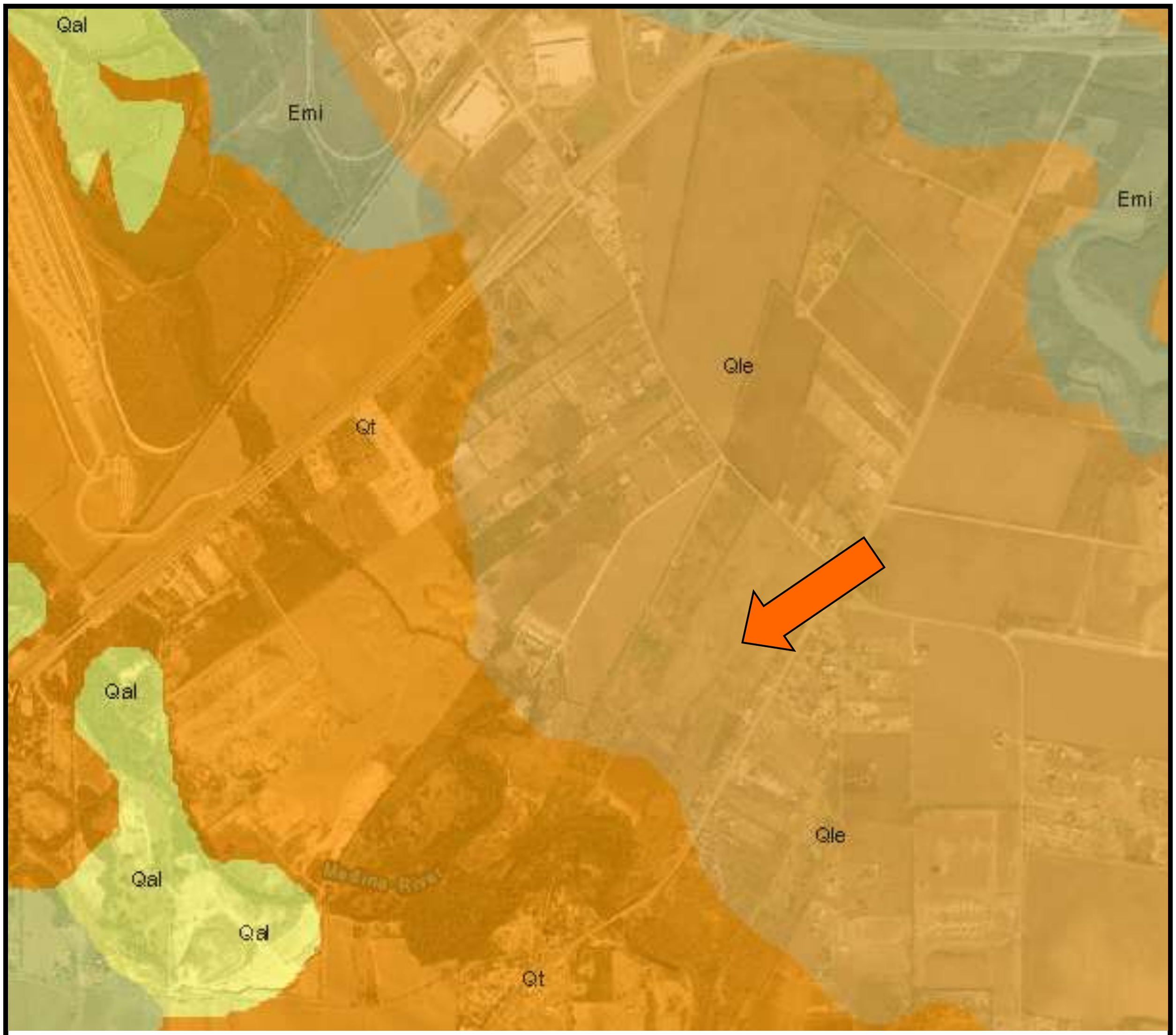


Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

Topographic Map—Approximate Location

InTEC Project Number:
S221465

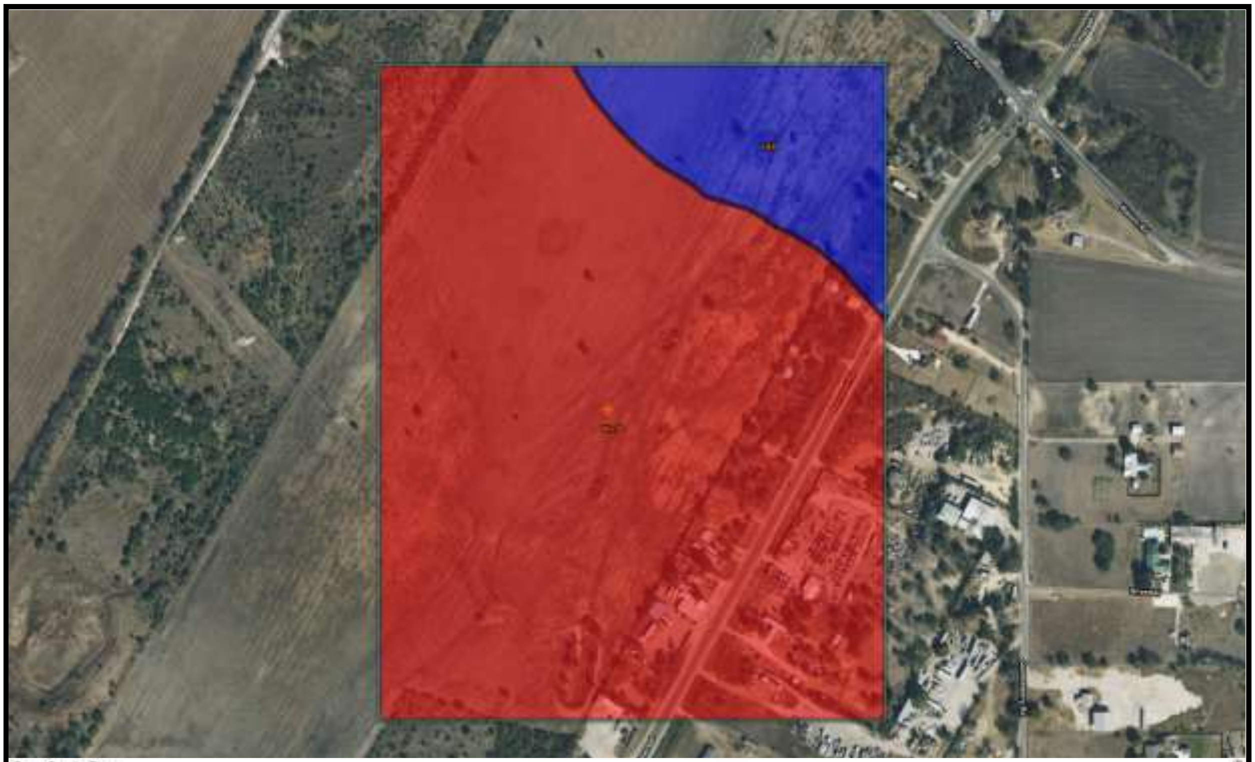
Date:
11/24/2022



Qle—Leona Formation

Fine calcareous silt grading down into coarse gravel; type locality first wide terrace of Nueces and Leona Rivers below level of Uvalde Gravel. May correlate with Onion Creek Marl of Austin Sheet

Subsurface Exploration and Pavement Analysis Proposed New Streets Timms Subdivision, Phases 4 & 5 San Antonio, Texas	**Geologic Map—Approximate Location**	
	InTEC Project Number: **S221465**	Date: 11/24/2022



Bexar County, Texas

Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H	L-R-H
HbA—Branyon clay, 0 to 1 percent slopes														
Branyon	85	D	0-12	Clay	CH	A-7-6	0- 0- 0	0- 0- 0	94-98-100	78-92-100	73-90-100	64-79- 92	59-63 -69	33-39-43
			12-72	Clay, silty clay	CH	A-7-6	0- 0- 0	0- 0- 0	95-96-100	78-92-100	69-90-100	62-83- 94	59-69 -74	39-43-47
			72-80	Silty clay, silty clay loam, clay loam, clay	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	95-96-100	79-92-100	65-91-100	60-85- 97	40-60 -64	23-34-47
WmB—Willacy loam, 1 to 3 percent slopes														
Willacy	100	B	0-14	Loam	SC-SM, SC, SM	A-2-4, A-4	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	30-38- 45	20-25 -30	3-7 -10
			14-62	Sandy clay loam, fine sandy loam	CL-ML, SC-SM, CL, SC	A-4, A-6	0- 0- 0	0- 0- 0	95-98-100	90-95-100	80-95-100	36-51- 65	25-33 -40	8-13-20

Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

Soil Map—Approximate Location

InTEC Project Number:
S221465

Date:
11/24/2022

Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

Approximate Test Pit Locations

InTEC Project Number:
S221465

Date:
11/24/2022

Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

Test Pit Photos

InTEC Project Number:	Date:
S221465	11/24/2022

Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

Test Pit Photos

InTEC Project Number:
S221465

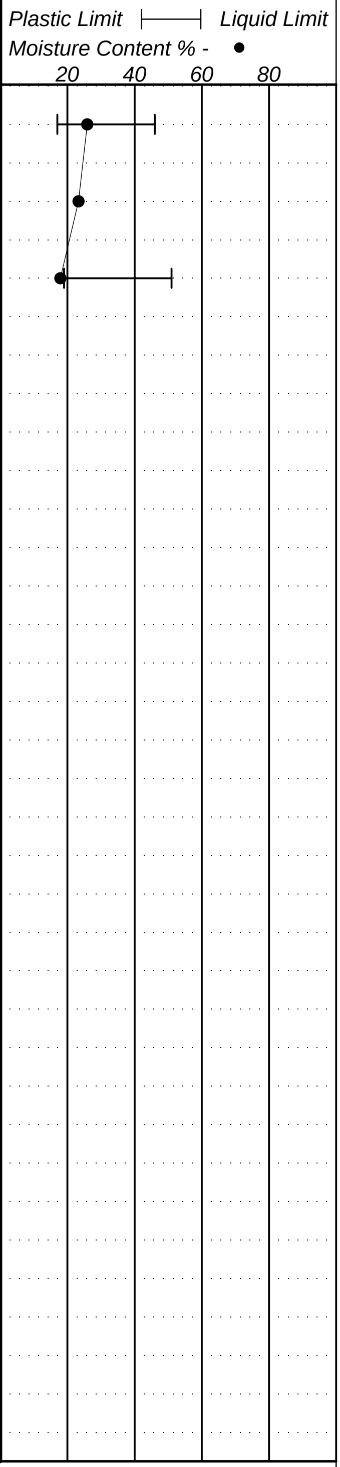
Date:
11/24/2022

PROJECT: **Timms Subdivision, Phases 4 & 5**
LOCATION: San Antonio, Texas
CLIENT: ONX Homes

PROJECT NO: **S221465**
DATE: 11/30/2022

TEST PIT NO. TP-1

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0	▨	TP	Dark Brown Sandy Clay						46	29
	▨	TP								
5	▨	TP	Tan to Tan and Gray Sandy Clay						51	32
			Mini-Excavator Refusal TP = Test Pit Sample							
10										
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 7

S.S by P.P - Shear Strength in TSF
by Hand Penetrometer

S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample

HA - Hand Auger
AU - Auger Sample

Plate: 2

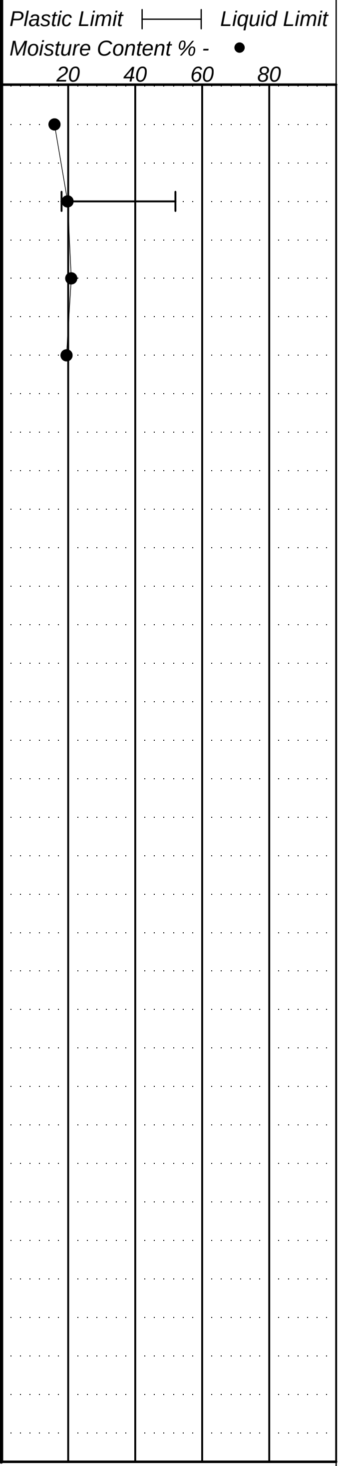
PROJECT: **Timms Subdivision, Phases 4 & 5**
LOCATION: San Antonio, Texas
CLIENT: ONX Homes

PROJECT NO: **S221465**
DATE: 11/30/2022

TEST PIT NO. TP-2

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0	▨	TP	Dark Brown Sandy Clay							
	▨	TP							52	34
5	▨	TP								
	▨	TP	Tan and Gray Sandy Clay -with Caliche							
			TP = Test Pit Sample							

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35



Notes:

Ground Water Observed: No

Completion Depth (ft): 8

S.S by P.P - Shear Strength in TSF by Hand Penetrometer
S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample
HA - Hand Auger
AU - Auger Sample

Plate: 3

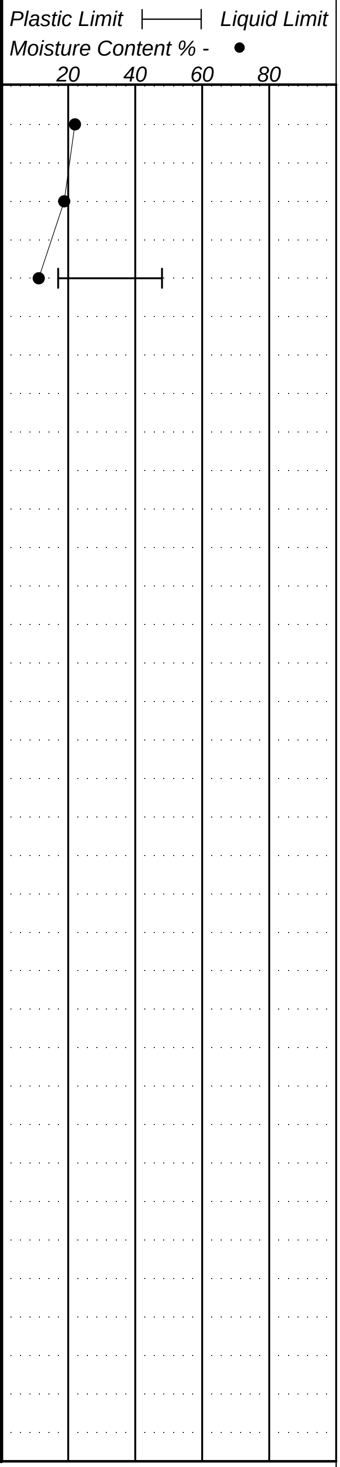
PROJECT: **Timms Subdivision, Phases 4 & 5**
LOCATION: San Antonio, Texas
CLIENT: ONX Homes

PROJECT NO: **S221465**
DATE: 11/30/2022

intec

TEST PIT NO. TP-3

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0	▨	TP	Dark Brown Sandy Clay -with Caliche							
		TP								
5	▨	TP	Tan and Gray Sandy Clay -with Caliche						48	31
			Mini-Excavator Refusal TP = Test Pit Sample							
10										
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 7

S.S by P.P - Shear Strength in TSF
by Hand Penetrometer

S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample

HA - Hand Auger
AU - Auger Sample

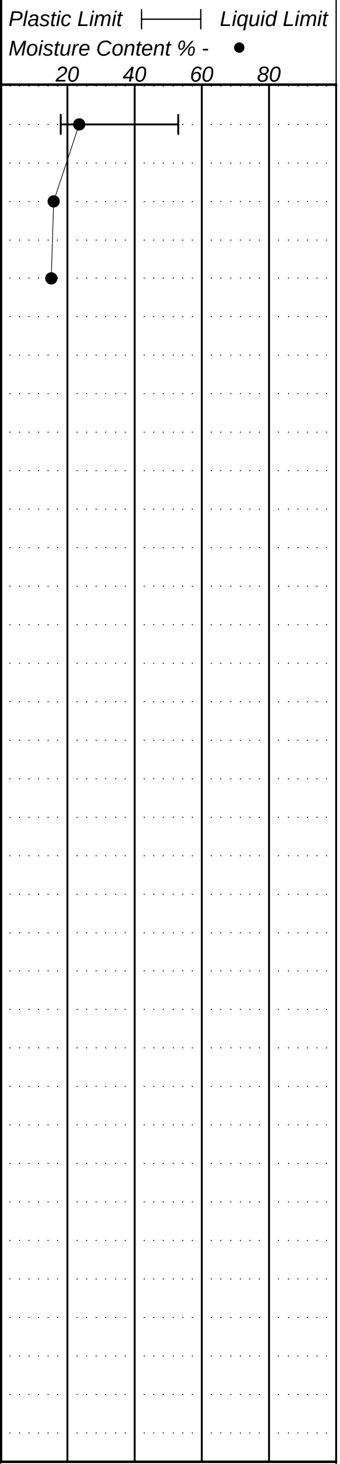
Plate: 4

PROJECT: **Timms Subdivision, Phases 4 & 5**
LOCATION: San Antonio, Texas
CLIENT: ONX Homes

PROJECT NO: **S221465**
DATE: 11/30/2022

TEST PIT NO. TP-4

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0		TP	Brown Sandy Clay						53	35
		TP								
5		TP								
			Tan and Gray Sandy Clay							
			Mini-Excavator Refusal TP = Test Pit Sample							
10										
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 6

S.S by P.P - Shear Strength in TSF
by Hand Penetrometer

S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample

HA - Hand Auger
AU - Auger Sample

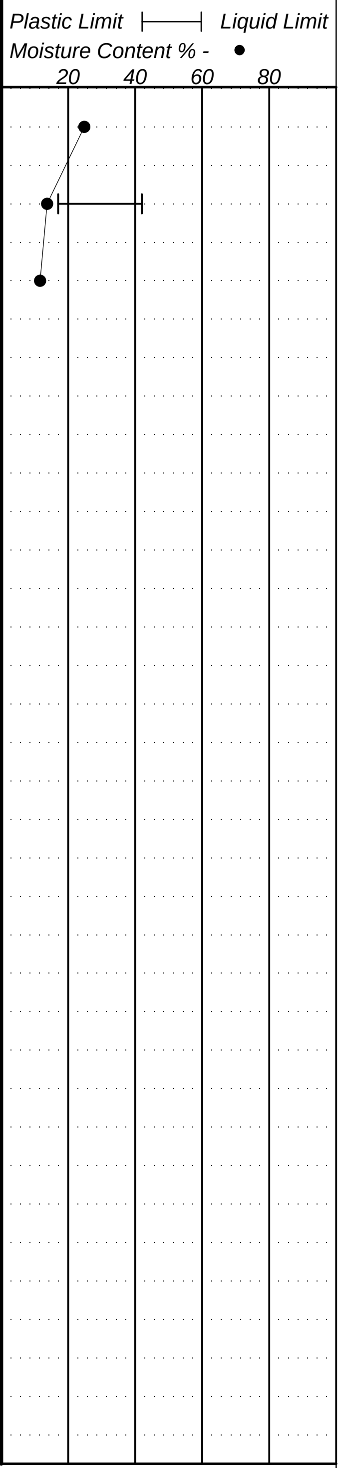
Plate: 5

PROJECT: **Timms Subdivision, Phases 4 & 5**
LOCATION: San Antonio, Texas
CLIENT: ONX Homes

PROJECT NO: **S221465**
DATE: 11/30/2022

TEST PIT NO. TP-5

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0	▨		Dark Brown to Brown Sandy Clay							
	▨	TP								
	▨	TP							42	25
	▨		Tan and Gray Sandy Clay -with Caliche							
5	▨	TP								
			Mini-Excavator Refusal TP = Test Pit Sample							
10										
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 6

S.S by P.P - Shear Strength in TSF by Hand Penetrometer
S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample
HA - Hand Auger
AU - Auger Sample

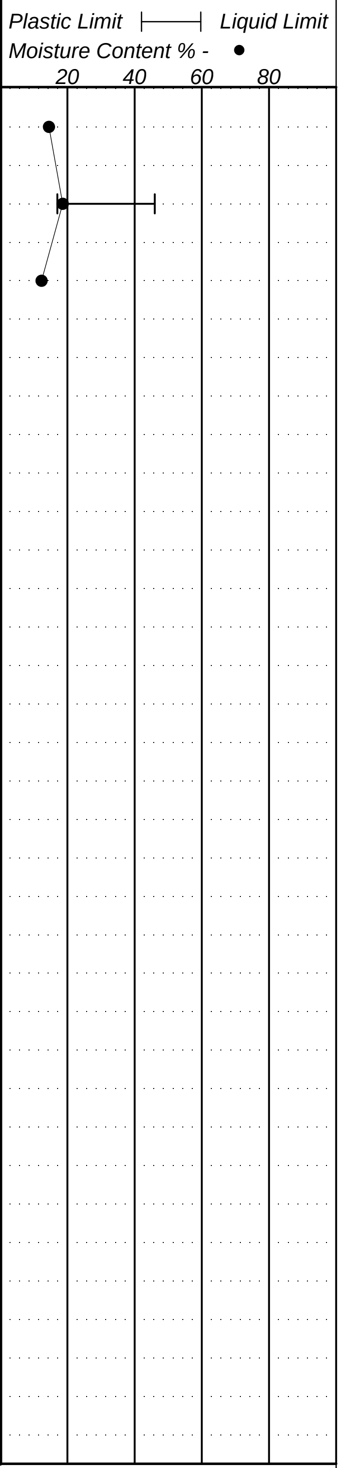
Plate: 6

PROJECT: **Timms Subdivision, Phases 4 & 5**
LOCATION: San Antonio, Texas
CLIENT: ONX Homes

PROJECT NO: **S221465**
DATE: 11/30/2022

TEST PIT NO. TP-6

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0	▨	TP	Brown Sandy Clay -with Caliche							
	▨	TP	Tan and Gray Sandy Clay -with Caliche -with Sandstone Seams						46	29
5	▨	TP								
			Mini-Excavator Refusal TP = Test Pit Sample							
10										
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 6

S.S by P.P - Shear Strength in TSF
by Hand Penetrometer

S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample

HA - Hand Auger
AU - Auger Sample

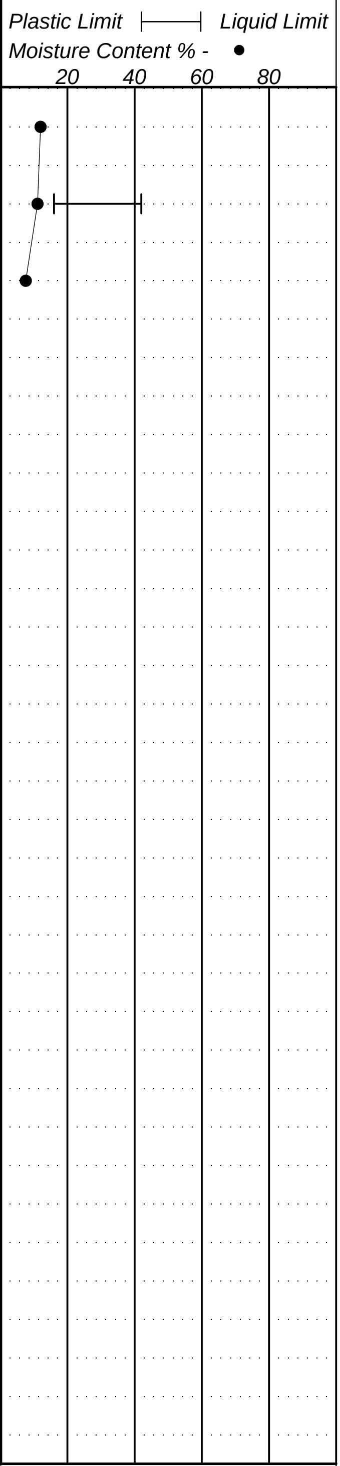
Plate: 7

PROJECT: **Timms Subdivision, Phases 4 & 5**
LOCATION: San Antonio, Texas
CLIENT: ONX Homes

PROJECT NO: **S221465**
DATE: 11/30/2022

TEST PIT NO. TP-7

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0	▨	TP	Dark Brown to Brown Sandy Clay -with Caliche							
	▨	TP	Tan Sandy Clay -with Caliche -with Sandstone Seams						42	26
5	▨	TP								
			Mini-Excavator Refusal TP = Test Pit Sample							
10										
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 6

S.S by P.P - Shear Strength in TSF
by Hand Penetrometer

S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample

HA - Hand Auger
AU - Auger Sample

Plate: 8

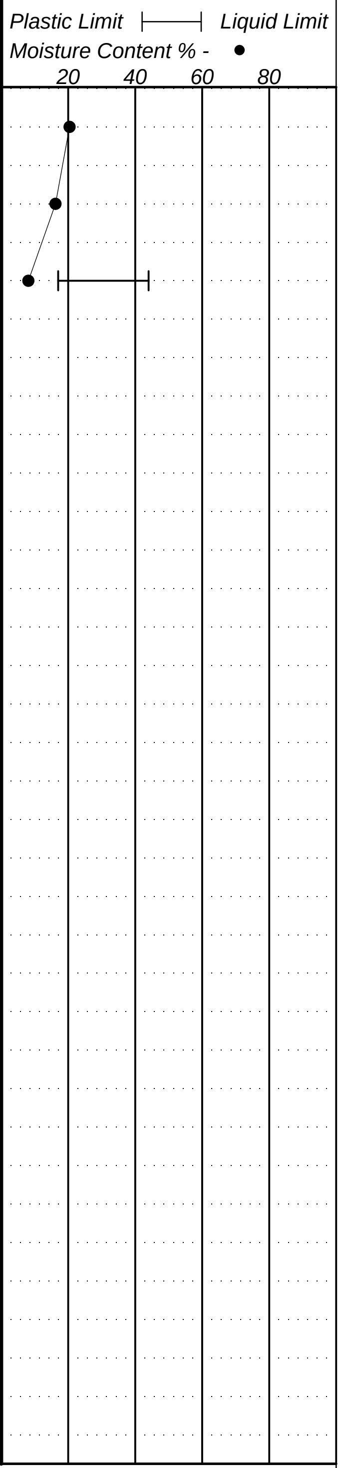
PROJECT: **Timms Subdivision, Phases 4 & 5**
LOCATION: San Antonio, Texas
CLIENT: ONX Homes

PROJECT NO: **S221465**
DATE: 11/30/2022

intEC

TEST PIT NO. TP-8

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0			Dark Brown Sandy Clay							
		TP								
		TP	Tan to Tan and Gray Sandy Clay -with Caliche							
5		TP							44	27
			Mini-Excavator Refusal TP = Test Pit Sample							
10										
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 7

S.S by P.P - Shear Strength in TSF
by Hand Penetrometer

S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample

HA - Hand Auger
AU - Auger Sample

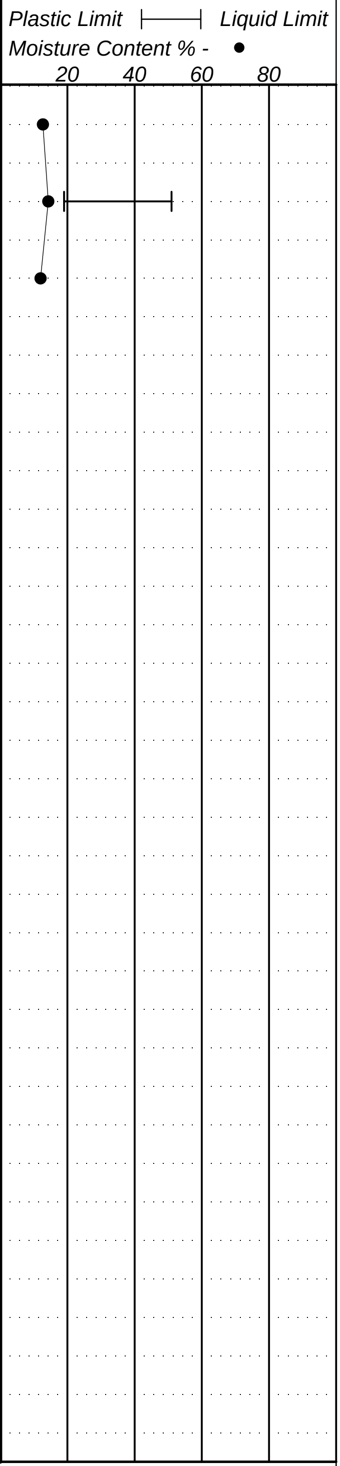
Plate: 9

PROJECT: Timms Subdivision, Phases 4 & 5
LOCATION: San Antonio, Texas
CLIENT: ONX Homes

PROJECT NO: S221465
DATE: 11/30/2022

TEST PIT NO. TP-9

DEPTH (feet)	SYMBOL	SAMPLES	SOIL DESCRIPTION	% MINUS 200 SIEVE	UNIT DRY WT IN PCF	S.S. BY P.P	BLOWS PER FOOT	SHEAR STRENGTH TSF	LIQUID LIMIT	PLASTICITY INDEX
0			Dark Brown Sandy Clay							
		TP								
		TP							51	32
5		TP	Tan Sandy Clay -with Caliche -with Sandstone Seams							
			Mini-Excavator Refusal TP = Test Pit Sample							
10										
15										
20										
25										
30										
35										



Notes:

Ground Water Observed: No

Completion Depth (ft): 7

S.S by P.P - Shear Strength in TSF by Hand Penetrometer
S.S. - Split Spoon Sample
S.T. - Shelby Tube Sample
HA - Hand Auger
AU - Auger Sample

Plate: 10

KEY TO CLASSIFICATIONS AND SYMBOLS

Soil Fractions

Component	Size Range
Boulders	Greater than 12"
Cobbles	3" - 12"
Gravel	3" - #4 (4.76mm)
Coarse	3" - ¾"
Fine	¾" - #4
Sand	#4 - #200 (0.074mm)
Coarse	#4 - #10 (2.00mm)
Medium	#10 - #40 (0.42mm)
Fine	#40 - #200 (0.074mm)
Silt and Clay	Less than #200

Soil or Rock Types
(Shown in symbols column)
(Predominate Soil Types Shown Heavy)

TERMS DESCRIBING SOIL CONSISTENCY

Description (Cohesive Soils)	Unconfined Compression TSF	Blows/Ft. Std. Penetration Test	Description (Cohesionless Soils	Blows/Ft. Std. Penetration Tests
Very Soft	0.25	<2	Very Loose	0 – 4
Soft	0.25 – 0.50	2 – 4	Loose	4 – 10
Firm	0.50 – 1.00	4 – 8	Medium Dense	10 – 30
Stiff	1.00 – 2.00	8 – 15	Dense	30 – 50
Very Stiff	2.00 – 4.00	15 – 30	Very Dense	50
Hard	>4.00	>30		

SOIL STRUCTURE

Calcareous	Containing deposits of calcium carbonate; generally nodular.
Slickenside	Having inclined planes of weakness that are slick and glossy in appearance.
Laminated	Composed of thin layers of varying color and texture.
Fissured	Containing shrinkage cracks frequently filled with fine sand or silt. Usually more or less vertical.
Interbedded	Composed of alternate layers of different soil types.
Jointed	Consisting of hair cracks that fall apart as soon as the confining pressure is removed.
Varved	Consisting of alternate thin layers of sand, silt or clay formed by variations in sedimentations during the various seasons of the year, of often exhibiting contrasting colors when partially dried. Each layer is generally less than ½" in thickness.
Stratified	Composed of, or arranged in layers (usually 1 inch or more)
Well-graded	Having a wide range of grain sizes and substantial amount of all intermediate particle sizes.
Poorly or Gap-graded	Having a range of sizes with some intermediate sizes missing.
Uniformly-graded	Predominantly of one grain size.

Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

InTEC Project Number:
S221465

Date:
11/24/2022

Calculations

CBR = 3.0

Subsurface Exploration and Pavement Analysis Proposed New Streets Timms Subdivision, Phases 4 & 5 San Antonio, Texas	InTEC Project Number: **S221465**	Date: 11/24/2022

Tensar

SpectraPave4 PRO™
Pavement Optimization Design Analysis

Thin Asphalt Pavement - TWII Edition - 20150503

Design Parameters for AASHTO (1993) Equation

Reliability (%)	= 70	Initial Serviceability	= 4.2
Standard Normal Deviate	= -.524	Terminal Serviceability	= 2.0
Standard Deviation	= 0.45	Change in Serviceability	= 2.2

Aggregate fill shall conform to following requirement:

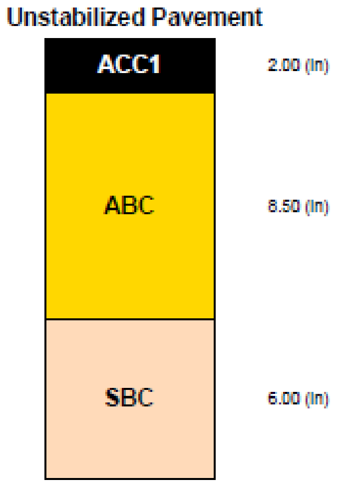
D50 <= 27mm (Base course)

Unstabilized Section Material Properties

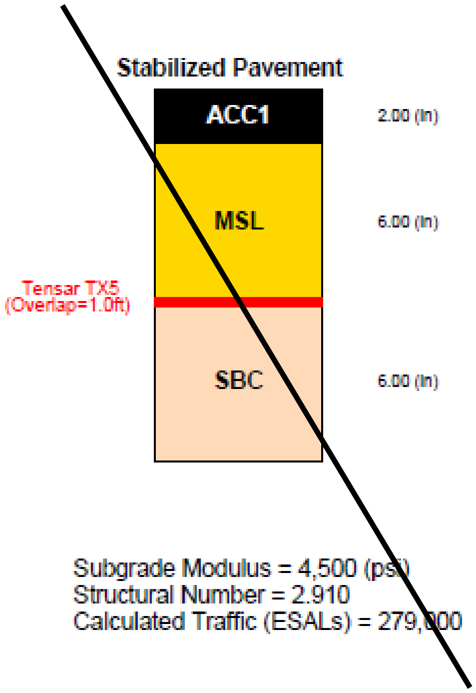
Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.440	N/A
ABC	Aggregate Base Course	20	0.140	1.0
SBC	Subbase Course	16	0.080	1.0

Stabilized Section Material Properties

Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.420	N/A
MSL	Mechanically Stabilized Base Cour	20	0.265	1.0
SBC	Subbase Course	16	0.080	1.0



Subgrade Modulus = 4,500 (psi)
Structural Number = 2.550
Calculated Traffic (ESALs) = 118,000



Subgrade Modulus = 4,500 (psi)
Structural Number = 2.910
Calculated Traffic (ESALs) = 279,000

LIMITATIONS OF THE REPORT

The designs, illustrations, information and other content included in this report are necessarily general and conceptual in nature, and do not constitute engineering advice or any design intended for actual construction. Specific design recommendations can be provided as the project develops.

3-2015 C:\Tensar International Corporation\SpectraPave4 PRO\Untitled.spdp

Subsurface Exploration and Pavement Analysis Proposed New Streets Timms Subdivision, Phases 4 & 5 San Antonio, Texas	**Local A—without Bus Traffic**	
	InTEC Project Number: **S221465**	Date: 11/24/2022

Tensar

SpectraPave4 PRO™
Pavement Optimization Design Analysis

Design Parameters for AASHTO (1993) Equation

Reliability (%)	= 70	Initial Serviceability	= 4.2
Standard Normal Deviate	= -.524	Terminal Serviceability	= 2.0
Standard Deviation	= 0.45	Change in Serviceability	= 2.2

Aggregate fill shall conform to following requirement:

D50 <= 27mm (Base course)

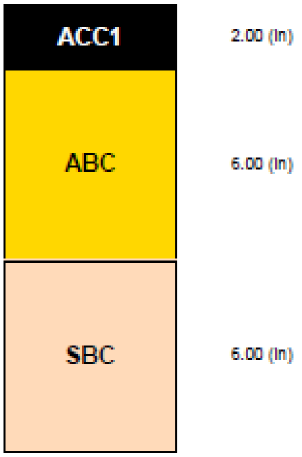
Unstabilized Section Material Properties

Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.440	N/A
ABC	Aggregate Base Course	20	0.340	1.0
SBC	Subbase Course	16	0.080	1.0

Stabilized Section Material Properties

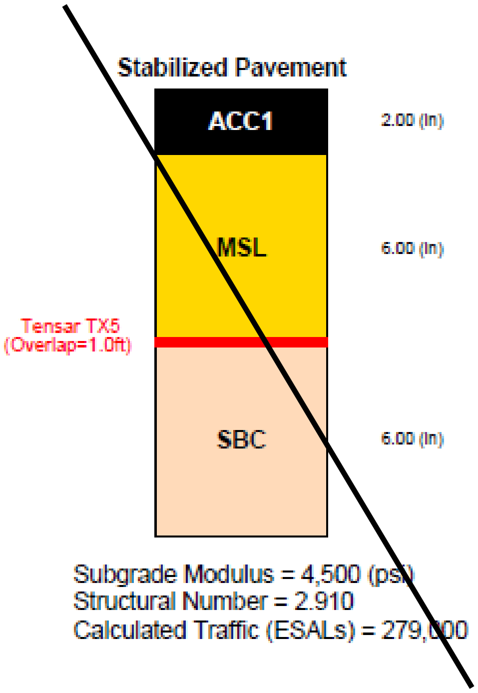
Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.420	N/A
MSL	Mechanically Stabilized Base Cour	20	0.265	1.0
SBC	Subbase Course	16	0.080	1.0

Unstabilized Pavement



Subgrade Modulus = 4,500 (psi)
Structural Number = 3.400
Calculated Traffic (ESALs) = 782,000

~~Stabilized Pavement~~



~~Subgrade Modulus = 4,500 (psi)~~
~~Structural Number = 2.910~~
~~Calculated Traffic (ESALs) = 279,000~~

LIMITATIONS OF THE R

The designs, illustrations, information and other content included in this report are necessarily general and conceptual in nature, and do not constitute engineering advice or any design intended for actual construction. Specific design recommendations can be provided as the project develops.

Subsurface Exploration and Pavement Analysis Proposed New Streets Timms Subdivision, Phases 4 & 5 San Antonio, Texas	**Local A—without Bus Traffic**	
	InTEC Project Number: **S221465**	Date: 11/24/2022

Tensar

SpectraPave4 PRO™
Pavement Optimization Design Analysis

Design Parameters for AASHTO (1993) Equation

Reliability (%)	= 70	Initial Serviceability	= 4.2
Standard Normal Deviate	= -.524	Terminal Serviceability	= 2.0
Standard Deviation	= 0.45	Change in Serviceability	= 2.2

Aggregate fill shall conform to following requirement:

D50 <= 27mm (Base course)

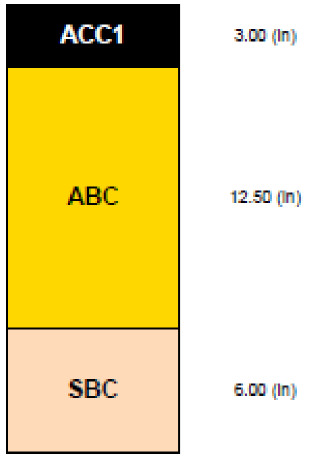
Unstabilized Section Material Properties

Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.440	N/A
ABC	Aggregate Base Course	20	0.140	1.0
SBC	Subbase Course	16	0.080	1.0

Stabilized Section Material Properties

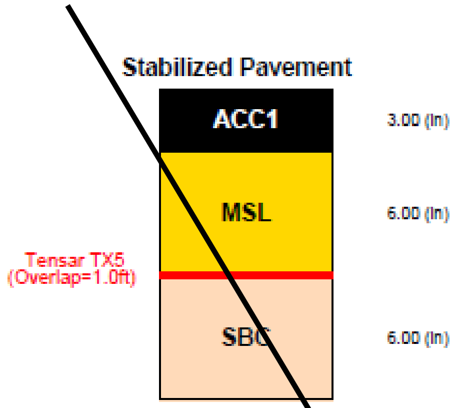
Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.420	N/A
MSL	Mechanically Stabilized Base Cour	20	0.265	1.0
SBC	Subbase Course	16	0.080	1.0

Unstabilized Pavement



Subgrade Modulus = 4,500 (psi)
Structural Number = 3.550
Calculated Traffic (ESALs) = 1,047,000

Stabilized Pavement



Subgrade Modulus = 4,500 (psi)
Structural Number = 3.330
Calculated Traffic (ESALs) = 680,000

LIMITATIONS OF THE REPORT

The designs, illustrations, information and other content included in this report are necessarily general and conceptual in nature, and do not constitute engineering advice or any design intended for actual construction. Specific design recommendations can be provided as the project develops.

Subsurface Exploration and Pavement Analysis Proposed New Streets Timms Subdivision, Phases 4 & 5 San Antonio, Texas	**Local A—with Bus Traffic**	
	InTEC Project Number: **S221465**	Date: 11/24/2022

SpectraPave4 PRO™
Pavement Optimization Design Analysis

Design Parameters for AASHTO (1993) Equation

Reliability (%)	= 70	Initial Serviceability	= 4.2
Standard Normal Deviate	= -.524	Terminal Serviceability	= 2.0
Standard Deviation	= 0.45	Change in Serviceability	= 2.2

Aggregate fill shall conform to following requirement:

D50 <= 27mm (Base course)

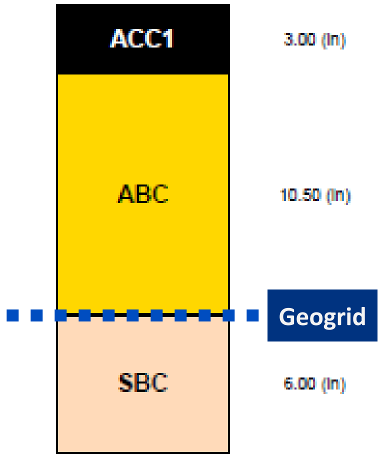
Unstabilized Section Material Properties

Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.440	N/A
ABC	Aggregate Base Course	20	0.170	1.0
SBC	Subbase Course	16	0.080	1.0

Stabilized Section Material Properties

Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.420	N/A
MSL	Mechanically Stabilized Base Cour	20	0.265	1.0
SBC	Subbase Course	16	0.080	1.0

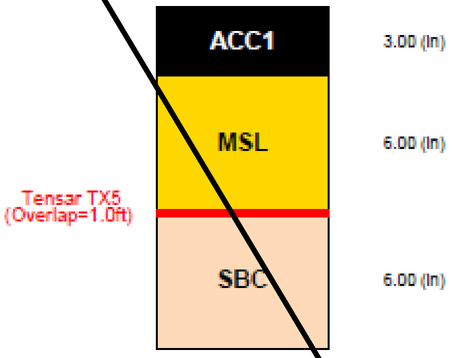
Unstabilized Pavement



Subgrade Modulus = 4,500 (psi)
Structural Number = 3.585
Calculated Traffic (ESALs) = 1,119,000

Structural Coefficient value of 0.17 for geogrid reinforced base

~~**Stabilized Pavement**~~



~~Subgrade Modulus = 4,500 (psi)~~
~~Structural Number = 3.330~~
~~Calculated Traffic (ESALs) = 680,000~~

LIMITATIONS OF THE REPORT

The designs, illustrations, information and other content included in this report are necessarily general and conceptual in nature, and do not constitute engineering advice or any design intended for actual construction. Specific design recommendations can be provided as the project develops.

Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

Local A—with Bus Traffic

InTEC Project Number:	Date:
S221465	11/24/2022

Tensar

SpectraPave4 PRO™
Pavement Optimization Design Analysis

Design Parameters for AASHTO (1993) Equation

Reliability (%)	= 70	Initial Serviceability	= 4.2
Standard Normal Deviate	= -.524	Terminal Serviceability	= 2.0
Standard Deviation	= 0.45	Change In Serviceability	= 2.2

Aggregate fill shall conform to following requirement:

D50 <= 27mm (Base course)

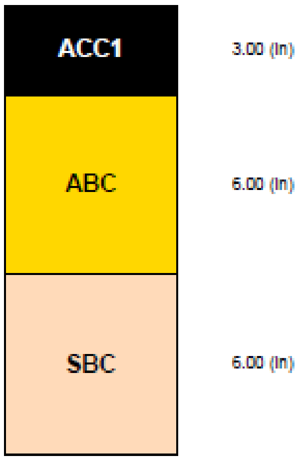
Unstabilized Section Material Properties

Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.440	N/A
ABC	Aggregate Base Course	20	0.340	1.0
SBC	Subbase Course	16	0.080	1.0

Stabilized Section Material Properties

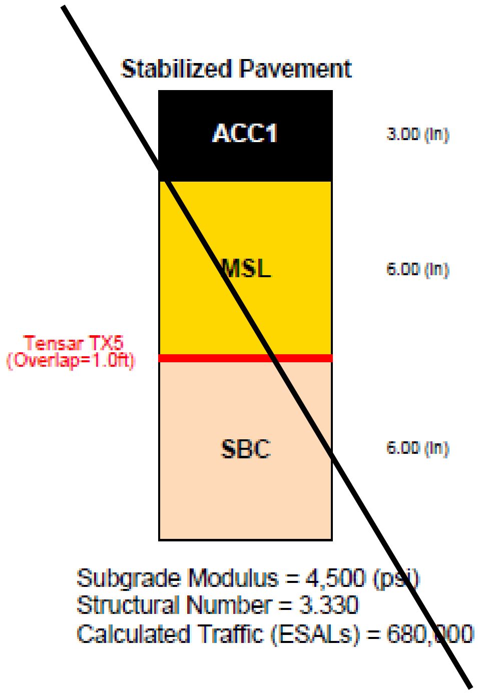
Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.420	N/A
MSL	Mechanically Stabilized Base Cour	20	0.265	1.0
SBC	Subbase Course	16	0.080	1.0

Unstabilized Pavement



Subgrade Modulus = 4,500 (psi)
Structural Number = 3.840
Calculated Traffic (ESALs) = 1,793,000

Stabilized Pavement

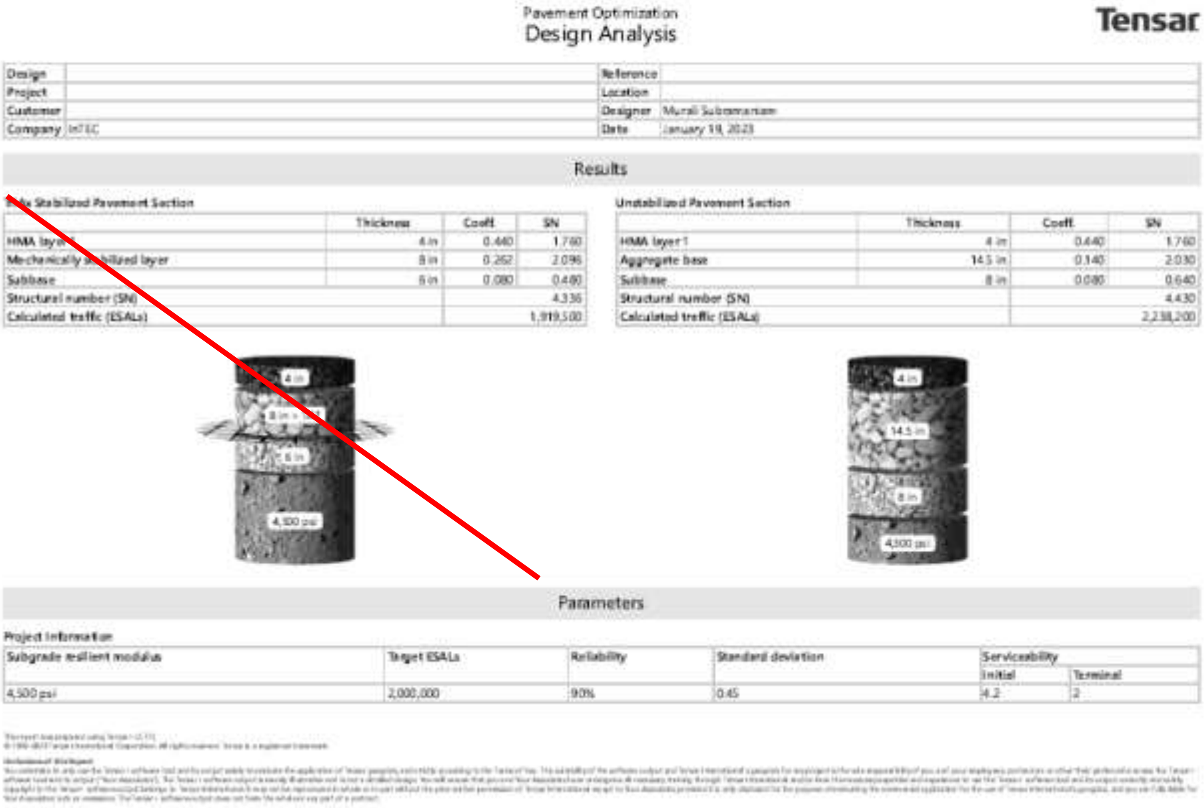


Subgrade Modulus = 4,500 (psi)
Structural Number = 3.330
Calculated Traffic (ESALs) = 680,000

LIMITATIONS OF THE REPORT

The designs, illustrations, information and other content included in this report are necessarily general and conceptual in nature, and do not constitute engineering advice or any design intended for actual construction. Specific design recommendations can be provided as the project develops.

Subsurface Exploration and Pavement Analysis Proposed New Streets Timms Subdivision, Phases 4 & 5 San Antonio, Texas	**Local A—with Bus Traffic**	
	InTEC Project Number: **S221465**	Date: 11/24/2022



Pavement Optimization

Design Analysis

Tensar

Design		Reference	
Project		Location	
Customer		Designer	Murali Subramaniam
Company	InTEC	Date	January 19, 2023

Results

Triax Stabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	4 in	0.440	1.760
Mechanically stabilized layer	8 in	0.262	2.096
Subbase	6 in	0.080	0.480
Structural number (SN)			4.336
Calculated traffic (ESALs)			1,919,500

Unstabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	4 in	0.440	1.760
Aggregate base	14.5 in	0.140	2.030
Subbase	8 in	0.080	0.640
Structural number (SN)			4.430
Calculated traffic (ESALs)			2,238,200

Parameters

Project Information

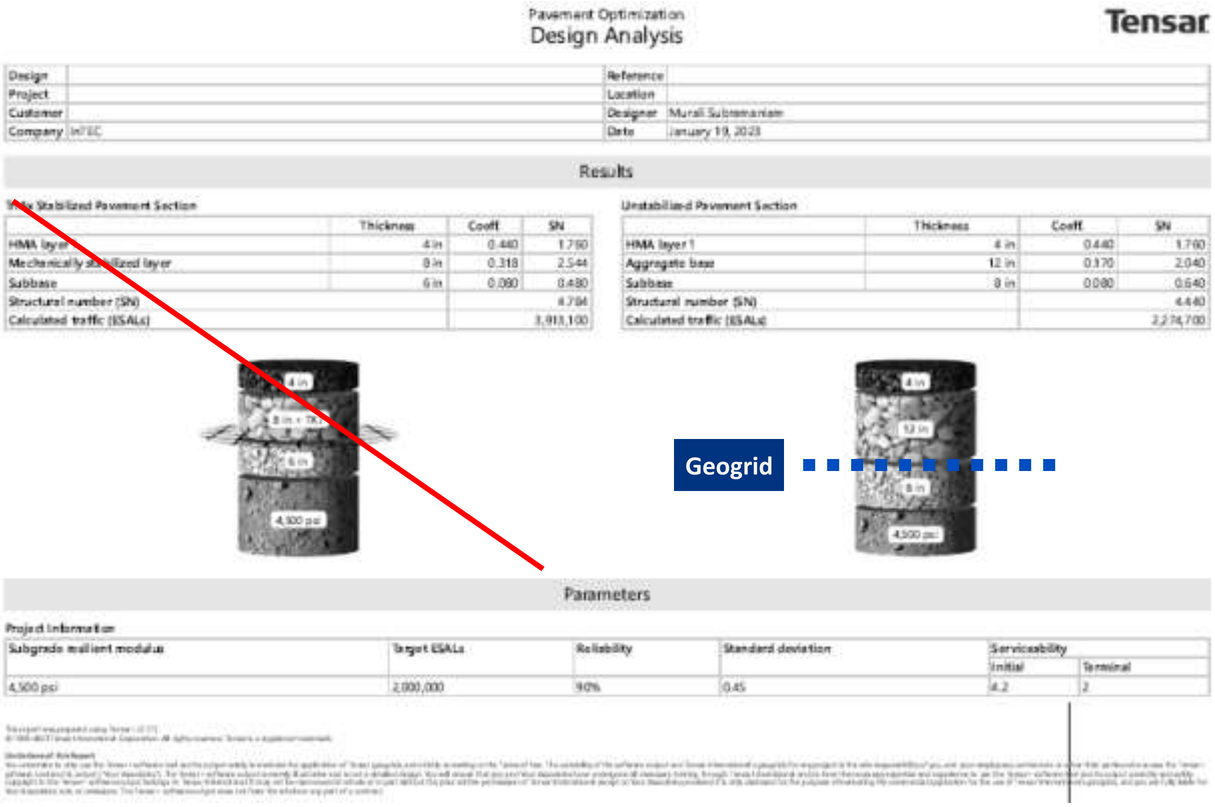
Subgrade resilient modulus	Target ESALs	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
4,500 psi	2,000,000	90%	0.45	4.2	2

Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

Local B

InTEC Project Number:
S221465

Date:
11/24/2022



Pavement Optimization

Design Analysis

Tensar

Design		Reference	
Project		Location	
Customer		Designer	Murali Subramaniam
Company	InTEC	Date	January 19, 2023

Results

[illegible] Stabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer	4 in	0.440	1.760
Mechanically stabilized layer	8 in	0.318	2.544
Subbase	6 in	0.080	0.480
Structural number (SN)			4.784
Calculated traffic (ESALs)			3,911,100

Unstabilized Pavement Section

	Thickness	Coeff.	SN
HMA layer 1	4 in	0.440	1.760
Aggregate base	12 in	0.170	2.040
Subbase	8 in	0.080	0.640
Structural number (SN)			4.440
Calculated traffic (ESALs)			2,274,700

Parameters

Project Information

Subgrade resilient modulus	Target ESALs	Reliability	Standard deviation	Serviceability	
				Initial	Terminal
4,500 psi	2,000,000	90%	0.45	4.2	2

Structural Coefficient value of 0.17 for geogrid reinforced base

Subsurface Exploration and Pavement Analysis Proposed New Streets Timms Subdivision, Phases 4 & 5 San Antonio, Texas	**Local B**	
	InTEC Project Number: **S221465**	Date: 11/24/2022

SpectraPave4 PRO™
Pavement Optimization Design Analysis

Design Parameters for AASHTO (1993) Equation

Reliability (%)	= 90	Initial Serviceability	= 4.2
Standard Normal Deviate	= -1.282	Terminal Serviceability	= 2.0
Standard Deviation	= 0.45	Change in Serviceability	= 2.2

Aggregate fill shall conform to following requirement:

D50 <= 27mm (Base course)

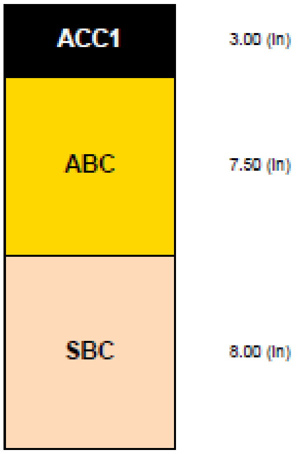
Unstabilized Section Material Properties

Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.440	N/A
ABC	Aggregate Base Course	20	0.340	1.0
SBC	Subbase Course	16	0.080	1.0

Stabilized Section Material Properties

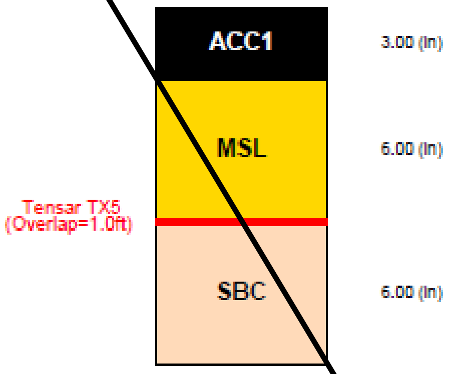
Layer	Description	Cost ($/ton)	Layer coefficient	Drainage factor
ACC1	Asphalt Wearing Course	70	0.420	N/A
MSL	Mechanically Stabilized Base Cour	20	0.265	1.0
SBC	Subbase Course	16	0.080	1.0

Unstabilized Pavement



Subgrade Modulus = 4,500 (psi)
Structural Number = 4.510
Calculated Traffic (ESALs) = 2,546,000

Stabilized Pavement



~~Subgrade Modulus = 4,500 (psi)~~
~~Structural Number = 3.330~~
~~Calculated Traffic (ESALs) = 311,000~~

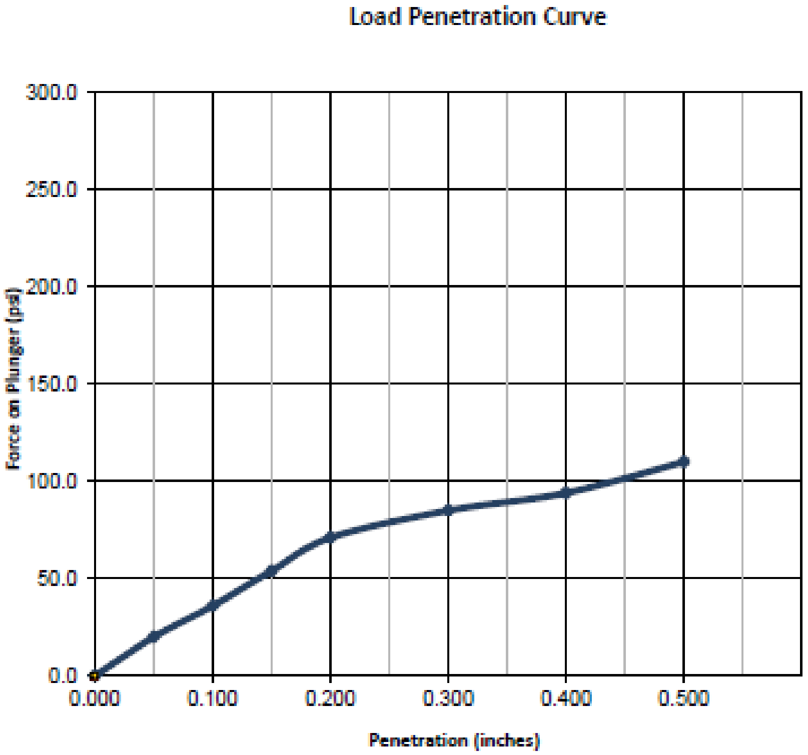
LIMITATIONS OF THE REPORT

The designs, illustrations, information and other content included in this report are necessarily general and conceptual in nature, and do not constitute engineering advice or any design intended for actual construction. Specific design recommendations can be provided as the project develops.

Subsurface Exploration and Pavement Analysis Proposed New Streets Timms Subdivision, Phases 4 & 5 San Antonio, Texas	**Local B**	
	InTEC Project Number: **S221465**	Date: 11/24/2022

InTEC of San Antonio

ASTM D-1883 California Bearing Ratio Test Report



CBR Results

Results	A	B	C	D	Average
0.1 in Pen.	3.6				
0.2 in Pen.	4.7				
Moisture (%)	16.90				
Density (pcf)	104.60				
Final Moisture (%)	24.30				
Final Density (pcf)	94.70				

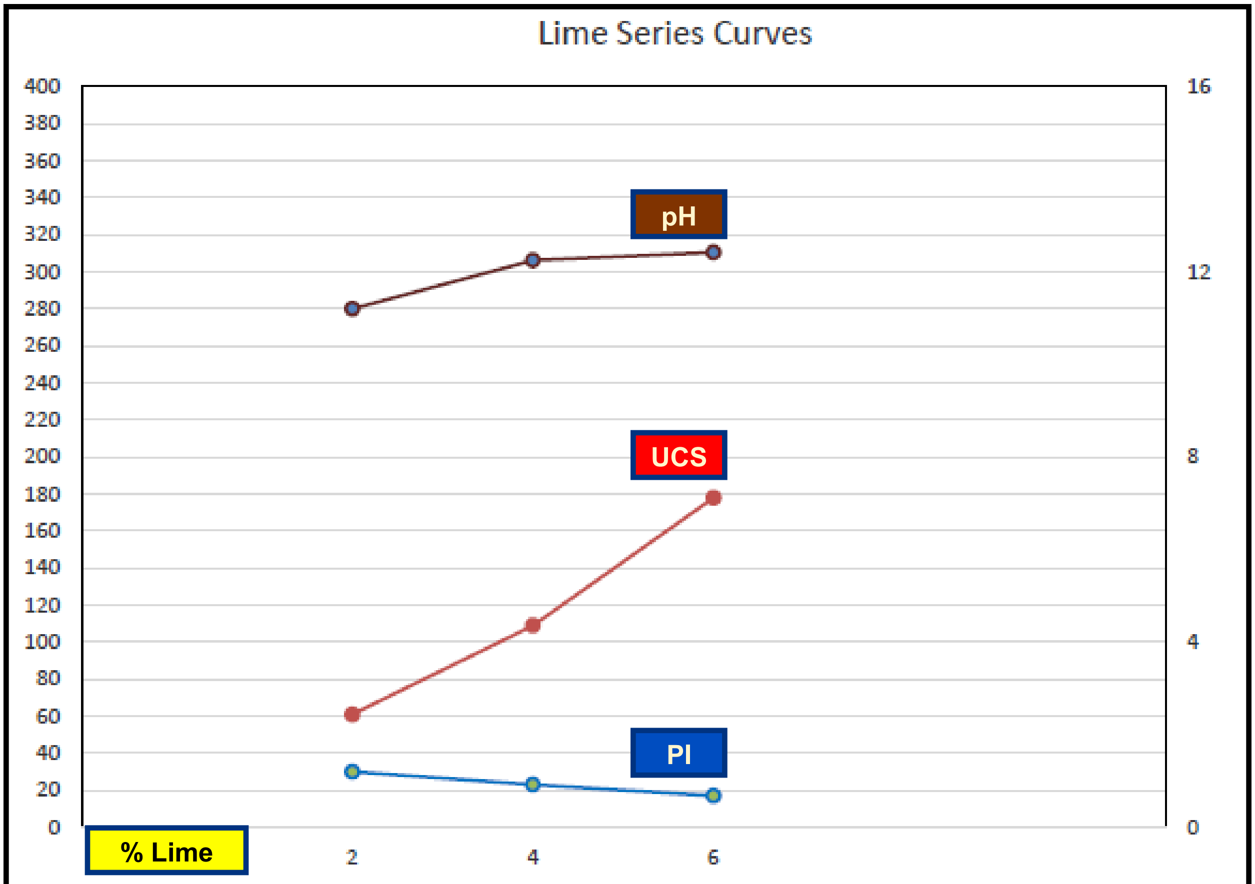
		Sample Location	
Project Number	S221465		
Project Name	Timms, Phase 4 & 5	Specimen A	In the vicinity of TP-4
Date	12/23/2022		
Client	ONX Homes	Specimen C	
		Specimen D	
Job Ref.		Liquid Limit:	54.0
Sample Num.		Plastic Limit:	14.0
Remarks	Brown Sandy Clay		

Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

CBR Test Results

InTEC Project Number: **S221465**

Date: 11/24/2022



Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

Lime Series

InTEC Project Number:
S221465

Date:
11/24/2022

Appendix

Subsurface Exploration and Pavement Analysis
Proposed New Streets
Timms Subdivision, Phases 4 & 5
San Antonio, Texas

InTEC Project Number:
S221465

Date:
11/24/2022

Important Information about This

Geotechnical-Engineering Report

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

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

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

Understand the Geotechnical-Engineering Services Provided for this Report

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

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

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

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

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

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

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

Read this Report in Full

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

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:
- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

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

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

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

This Report's Recommendations Are Confirmation-Dependent

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

This Report Could Be Misinterpreted

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

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

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

Give Constructors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

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

Geoenvironmental Concerns Are Not Covered

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

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

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

GEOPROFESSIONAL
BUSINESS
ASSOCIATION

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