

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

January 24, 2022

E.A. Palaniappan, Ph.D., P.E.

D. R. Horton, Inc.

5419 North Loop 1604 East San Antonio, Texas 78247

Attention: Ms. Leslie Ostrander, P.E. Email: lkostrander@drhorton.com

Re: Subsurface Exploration and Pavement Analysis

Proposed New Streets

Riverstone Tract

San Antonio, Texas

InTEC Project No. S191159-P-A6

Ladies & Gentlemen:

Integrated Testing and Engineering Company of San Antonio (InTEC) has completed a subsurface exploration and pavement thickness evaluation report (InTEC Project No. S191159-P dated November 07, 2019 and a revised report dated May 20, 2021) at the above referenced project site. As requested, concrete pavement sections are presented in this addendum. All other recommendations remain the same as in the original 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, L.P.

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



E. A. Palaniappan, Ph. D, P.E., Chief Engineer



Street Classification	Reinforced Concrete, Inches	Subgrade Thickness, Inches
Local Type A (without bus traffic)	6.0	*
Local Type A (with bus traffic)	8.0	*
Local B / Collector	10.0	*

Table No. 1 – Summary of Recommended Options – Rigid Pavement **

Subgrade Notes (*):

- Cut and fill data are not available at this time.
- Based on the review of geologic and soils map, we anticipate the final pavement subgrade Plasticity Index value to be less than or equal to 20.
- If the subgrade Plasticity Index values are less than or equal to 20, as per City of San Antonio or Bexar County requirements, subgrade stabilization / treatment is not needed.
- However, if the final street subgrade Plasticity Index values are greater than 20, then one of the following options may be followed:
 - Remove the clays soils (with Plasticity Index values greater than 20) and replace with fill material with Plasticity Index values less than or equal to 20.

Fill Material:

• If fill is used to raise the grade, fill material underneath the pavement should be approved fill material, free of deleterious material and with a minimum CBR value of 4.0 and a maximum plasticity index value of 20. The material should be placed as per applicable city or county guidelines.

General Notes (**):

- Input parameters are shown in Table No. 3. 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.
- Pavement section recommendations are based on a subgrade CBR value of 4.0. The pavement recommendations are not based on the shrink / swell characteristics of the underlying soils. 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. Use of geogrid help reduce shrink / swell related pavement distress.
- If water is allowed to get underneath the asphalt or if moisture content of the base or subgrade changes significantly, then pavement distress will occur. External vertical moisture barrier, such as a deeper curb extending a minimum of 6 inches into subgrade, will reduce water getting underneath the asphalt.

Subgrade Verification:

The final pavement subgrade should be verified by InTEC at the time of construction.



Reinforced Concrete

Concrete pavement, material, and installation, should conform to Item 209 of the City of San Antonio Standard Specifications for Construction, June 2008.

Concrete Pavement

Concrete pavement slabs should be provided with adequate steel reinforcement. Proper finishing of concrete pavements requires the use of sawed and sealed joints which should be designed in accordance with current Portland Cement Association guidelines. Dowel bars should be used to transfer loads at transverse joints. Related civil design factors such as drainage, cross-sectional configurations, surface elevations and environmental factors which will significantly affect the service life must be included in the preparation of the construction drawings and specifications. Normal periodic maintenance will be required, especially for open jointed areas which may allow surface water infiltration into the subgrade.

Reinforcement:	#3 reinforcing steel bars (grade 60) at 18 inches on center each way and #4 at		
	12 inches on center each way for 10 inch thick concrete		
Contraction joint spacing:	10 feet each way for 6 inch thick concrete		
	12 feet each way for 8 inch thick concrete		
	15 feet each way for 10 inch thick concrete		
	The saw cuts should be planned based on features such as inlets, manholes,		
	valves, etc. The saw cuts are recommended to be made the same day.		
Contraction joint depth:	At least one-fourth (¼) of pavement thickness		
Contraction joint width:	One-fourth (1/4) inch or as required by joint sealant manufacturer		
Expansion joint:	Expansion joints are not recommended		
Isolation joint:	Features such as concrete inlet structures, man-holes, and valve covers should		
	be isolated using isolation joints.		

Table No. 2 – Concrete Pavement Reinforcement



	Local Type A (without bus traffic)	Local Type A (with bus Traffic)	Local B / Collector		
ESAL	ESAL= 150,000	ESAL= 1,500,000	ESAL= 3,000,000		
Reliability Level	R-70	R-70	R-90		
Initial and Terminal Serviceability	4.5 and 2.0	4.5 and 2.0	4.5 and 2.5		
Standard Deviation	0.35	0.35	0.35		
Service Life	30 years	30 years	30 years		
If repetitive truck traffic or heavy truck traffic is anticipated, please contact us for revised recommendations					
Flexural S	Strength	600 psi			
Modulus o	f Elasticity	4,000,000 psi			
Modulus of Sub	Modulus of Subgrade Reaction		i/inch		

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



		Wi	nPAS		
	1993 AASHTO Gu	ide for De	ss besign According to	IIFAS	
	Amer	ican Concrete	Pavement Association	u163	
Rigid Pavement Desig	n/Evaluation				
Concrete Thickness	5.01	inches	Load Transfer Coefficient		2.90
otal Rigid ESALs	150,000	LACIDEDE.	Modulus of Subgrade Reaction	le internet	250 psi/in.
cellability Overall Standard David	70.00 0.35	percent	Initial Serviceability		1.00
Flexural Strength	400	psi	Terminal Serviceability		2.00
Modulus of Elasticity	4,000,000	psi			0.000
L L	epth to Rigid Foundati .oss of Support Value (on 0,1,2,3)	0.0		
	Modulus of Subgrade	Reaction	250	psi/in.	
-					
ubsurface Explorat	ion and Pavement <i>i</i>	Analysis	Local A–	-No Bus	Traffic

Modulus of Subgrade Reaction 2:00 2:00 Modulus of Elasticity 1.500,000 1:00 Modulus of Subgrade Reaction 2:00 Modulus of Elasticity 4:00 psi 4:00 Modulus of Elasticity 4:00 psi 2:00 Modulus of Subgrade Reaction (K-value) Determination 0:0 0:0 0:0 Modulus of Subgrade Reaction (K-value) Determination 0:0 0:0 0:0 Modulus of Subgrade Reaction (K-value) Determination 0:0 0:0 0:0 Dept to Rigid Foundation 0:0 0:0 0:0 0:0 Loss of Subgrade Reaction 0:0 0:0 0:0 0:0 Modulus of Subgrade Reaction 0:0 0:0 0:0 0:0 Modulus of Subgrade Reaction 2:0 psi/in 0:0 0:0 Modulus of Subgrade Reaction 2:0 psi/in 0:0 0:0 Modulus of Su	1993 .	Pave AASHTO Gu Ame	Wi ement Thickne ide for D rican Concret	nPAS ess Design According to esign of Pavements Structure e Pavement Association	es	
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	San Antonio, Texas			S191159-P-A6	01/24/2022	

WinPAS Pavement Thickness Design According to 1993 AASHTO Guide for Design of Pavements Structures American Concrete Pavement Association				
Rigid Pavement Desig	n/Evaluation			
Concrete Thickness	9.77	inches	Load Transfer Coefficient	4.20
Total Rigid ESALs	3,000,000		Modulus of Subgrade Reaction	250 psi/in.
Reliability	90.00	percent	Drainage Coefficient	1.00
Overall Standard Devia	ition 0.35		Initial Serviceability	4.50
Modulus of Elasticity	4.000.000	psi	reminal serviceability	2.00
c L	epth to Rigid Foundat oss of Support Value (ion 0,1,2,3)	0.00 0.0	
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Subsurface Exploration and Pavement Analysis Proposed New Streets Riverstone Tract San Antonio, Texas	InTEC Project Number: S191159-P-A6	Date: 01/24/2022

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, clients can benefit from a lowered exposure to the subsurface problems 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 below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs 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. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnicalengineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full*.

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project 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.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- 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, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been 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 your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

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

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment 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 from project start to project finish, so the individual can provide 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 judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed 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 confirmationdependent recommendations if you fail to retain that engineer to perform construction observation*.

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnicalengineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time 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 on hand quickly 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 observation.

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 informational 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, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. 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. 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 geotechnicalengineering report does not usually relate any 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 yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

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, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled 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 buildingenvelope or mold specialists*.



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