



July 21, 2022

Mr. Chris Jones
Hillsborough County Division Director
Field Maintenance Services
Water Resources Department
334 N. Falkenburg Road
Tampa, FL 33619

**Re: Ground Stability Assessment – Post Stabilization
Symmes Road Lift Station
10837 Symmes Road, Riverview, FL 33534**

Dear Mr. Jones

Further to your recent request, Integrity Drilling & Geophysical Services, LLC (IDGS) is pleased to present you with this brief report detailing the findings of our Post-Stabilization Ground Stability Assessment for the lift station structure located close to 10837 Symmes Road in Riverview, Hillsborough County, Florida. This report updates our initial Ground Stability Assessment (provided to you under cover of our letter date June 15, 2022) and describes additional ground investigation carried out after the completion of polymer stabilization.

PROJECT UNDERSTANDING

The wet well slab at the Symmes Road Lift Station subsided by about 4 inches and requires repair. The well is around 8-feet in diameter and extends to a depth of 30-feet below surface. Our initial exploration revealed that the upper 10-feet of the soil profile consisted of loose to medium dense clean sands. Below about 13.5-feet depth, the soils became looser, and our Standard Penetration Test (SPT) boring B-1 found very loose (Weight of Rod strength) sandy soils between 18.5 and 28.5-feet depth (rod drop and loss of circulation indicative of subterranean void space). The soils in SPT B-2 and in the Advanced Continuous Surface Wave (ACSW) tests outside of the lift station were also looser between 18.5 and 28.5-feet depth, but no void space was indicated.

Subsequently, a stabilization program was initiated utilizing the patented Deep Horizons Injection Grouting (DHIG) system of polymer injection offered by Polymer Technologies, Inc. and deployed by Foundation Professionals of Florida, Inc. Between June 21 and July 1, 2022, a total of 2,623 gallons of polymer were injected beneath and around the wet well through four injection points, with treatment commencing at depths of between 32 and 41-feet below surface.

FIELDWORK

IDGS carried out a non-intrusive and intrusive post-stabilization ground investigation around the lift station on Thursday July 14, 2022. Three (3) SPT soil borings were advanced to depths of between 40 and 50-feet below surface in general accordance with the procedures of ASTM-D-1586. Hand auger excavation was carried out in the upper four feet as a precaution against utilities not marked by the utility locate company. Continuous sampling was performed to a depth of 10 feet, to detect variations in the soil profile at shallow depths, followed by sampling at 5-feet-on-center to the boring termination depths.

The basic procedure for the Standard Penetration Test is as follows: A standard split-barrel sampler is driven into the soil by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler 1-foot, after seating 6 inches, is designated the penetration resistance, or N-value; this value is an index to soil strength and consistency.

Soil samples were collected and transported in sealed glass jars to our laboratory for further classification and testing. The soil samples were visually classified in general accordance with ASTM D 2488. Samples will remain in our custody for 60 days after original exploration, after which, the samples will be discarded. Longer storage periods can be accommodated at your request. The boring logs are presented in Attachment B.

The ACSW seismic technique was used to determine the shear wave velocity characteristics of the in-situ soils around the structure. A total of seven (7) ACSW tests were completed, giving a layered profile of shear wave velocity to a depth of up to around 45-feet below surface. The test locations are indicated on the Site Plan in Attachment A to this report, which also indicates the locations of the SPT borings. ACSW tests CSW08 through CSW14 were completed using the same geophone arrays as the initial pre-stabilization tests, to allow stiffness comparisons to be made.

ACSW testing carried out by IDGS is a proprietary engineering testing system developed by Ground Stiffness Surveys LLC (GSS) based on the general methodology for Continuous Surface Wave testing set out in Heymann, 2007¹. Surface Rayleigh wave velocities over a range of frequencies are accurately measured using a short array of geophones to produce a *dispersion curve* plot of Rayleigh wave velocity (v_r) against frequency. These data can then be used to generate a reliable shear wave velocity (v_s) with depth profile, which in turn can be converted to a stiffness profile using standard relationships.

For a layered deposit with increasing stiffness with depth (a '*normally dispersive*' profile), the form of the dispersion curve should be an even polynomial curve with a single inflection point within the lower frequencies. Changes from this form can indicate, for example, where significantly stiffer or softer layers are present (an '*inversely dispersive*' profile). Very rapid oscillations or breaks in the profile can

¹ Heymann, G. (2007) Ground stiffness measurement by the continuous surface wave test. *Journal of the South African Institution of Civil Engineering*. Vol.49, No.1, p25-31.

indicate the presence of sharp stiffness contrast boundaries, which cannot be addressed by the available advanced inversion analysis methods but are reported when assessing the quality of data.

Advanced inversion of the ACSW data involves the generation of a layered stiffness profile from the dispersion curve data. Published algorithms, selected depending on the extent of *multimodal* data, are used to generate a *synthetic dispersion curve* from an assumed ground profile, which is then compared with the *field dispersion curve* using standard model constraints in line with guidance given in Foti *et al* 2017². An appropriate automatic iterative search methodology is then selected, which refines the model until the minimum statistical misfit between the field and synthetic dispersion curve is achieved. Checks are made in the modelling process against the *simple inversion* profile, adjacent test locations and, where available, any information on known ground profiles.

Graphs of v_s against depth for the ACSW data collected at the Symmes Road Lift Station pre- and post-stabilization are included in Attachment B.

FINDINGS

Figure 1 below illustrates a graphical representation of SPT N-value against depth for the pre-stabilization (B-1 & B-2) and post-stabilization (B-3 through B-5) SPT borings. Note that in the former zone of rod drop found in B-1 between 18.5- and 28.5-foot depth, the post-stabilization borings B-3 and B-4 record medium dense soil conditions. Samples of polymer up to 120 mm in length were retrieved from the split spoon during sampling:

² Foti, S. *et al.* (2017) Guidelines for the good practice of surface wave analysis: a product of the InterPACIFIC project *Bull Earthquake Eng* DOI 10.1007/s10518-017-0206-7

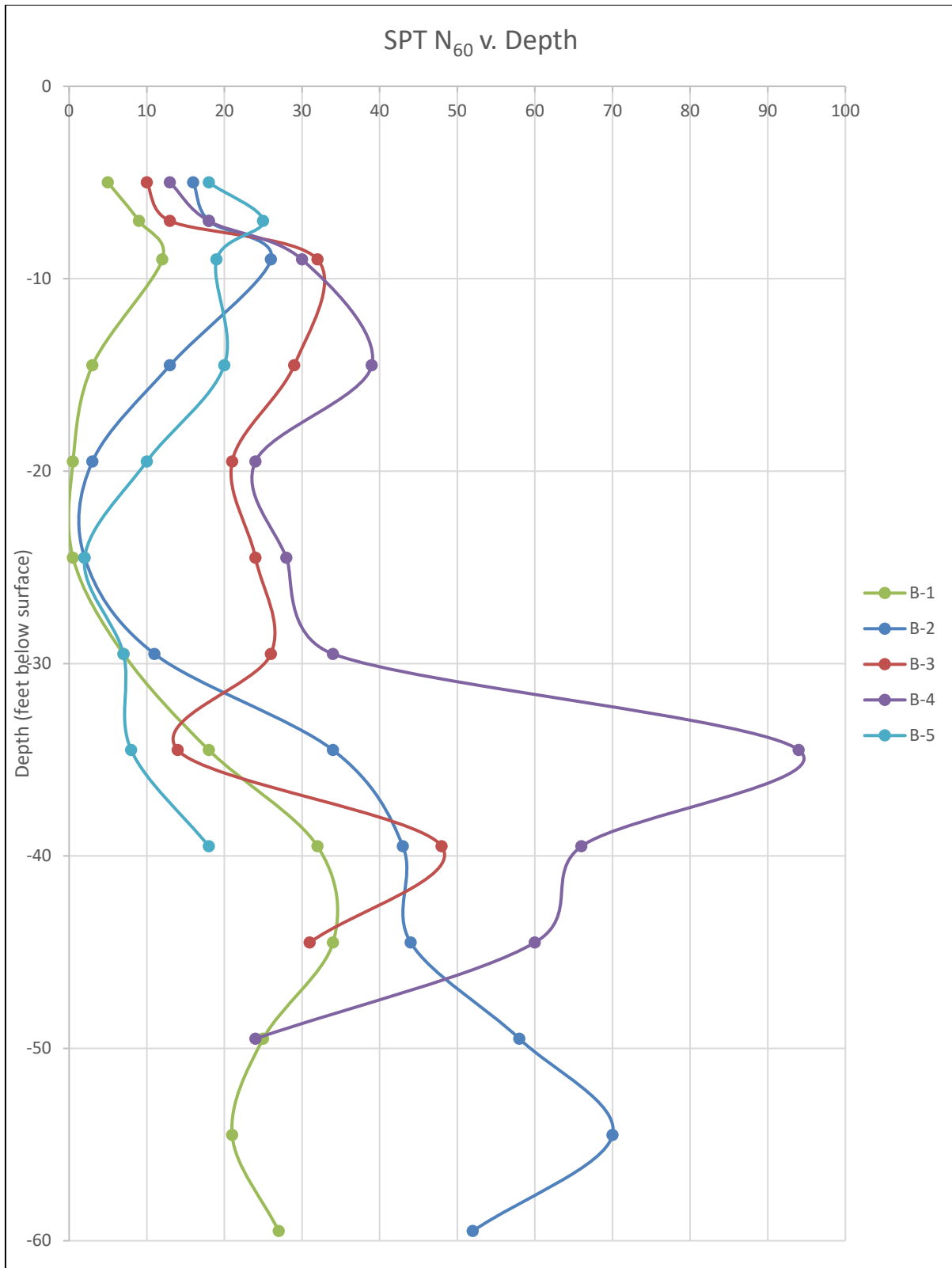


Figure 1 – SPT N₆₀ vs. Depth (Pre- and Post-Treatment)



**Plate 1 – Polymer Retrieved in Split Spoon Boring B-3 from 23.5 to 25-feet below grade
(N=24 medium dense – previously WR)**



Plate 2 – Close up of Polymer retrieved from SPT at 25-feet

Figure 2 presents v_s values measured during ACSW testing within the area of soil stabilization plotted against depth below surface. The graph includes vertical marker bars showing v_s derived equivalent SPT N_{60} values (using the Hasancebi & Ulusay³ correlation) together with v_s values derived from SPT borings B-1, B-3 and B-4 using the same correlation, allowing a relative soil density against depth profile to be visualized for both techniques. The pre-treatment results are shown in “red” while the post-treatment results are shown in “green”.

CSW13 was carried out post stabilization at the location of CSW06. Similarly, CSW14 was carried out post-stabilization at the location of CSW07. The ACSW system determines a “bulk” soil stiffness across the 10-foot-long surface geophone array, so is less sensitive to individual solid polymer layers than the SPT sampler spoon. Both CSW13 and CSW14 show an increase from a “very loose to loose” condition pre-treatment to a “medium dense to dense” condition post-treatment:

³ Hasancebi, N. and R. Ulusay, 2007. Empirical correlations between shear wave velocity and penetration resistance for ground shaking assessments. Bull. Eng. Geology and the Environment, **66**: 203 - 213.

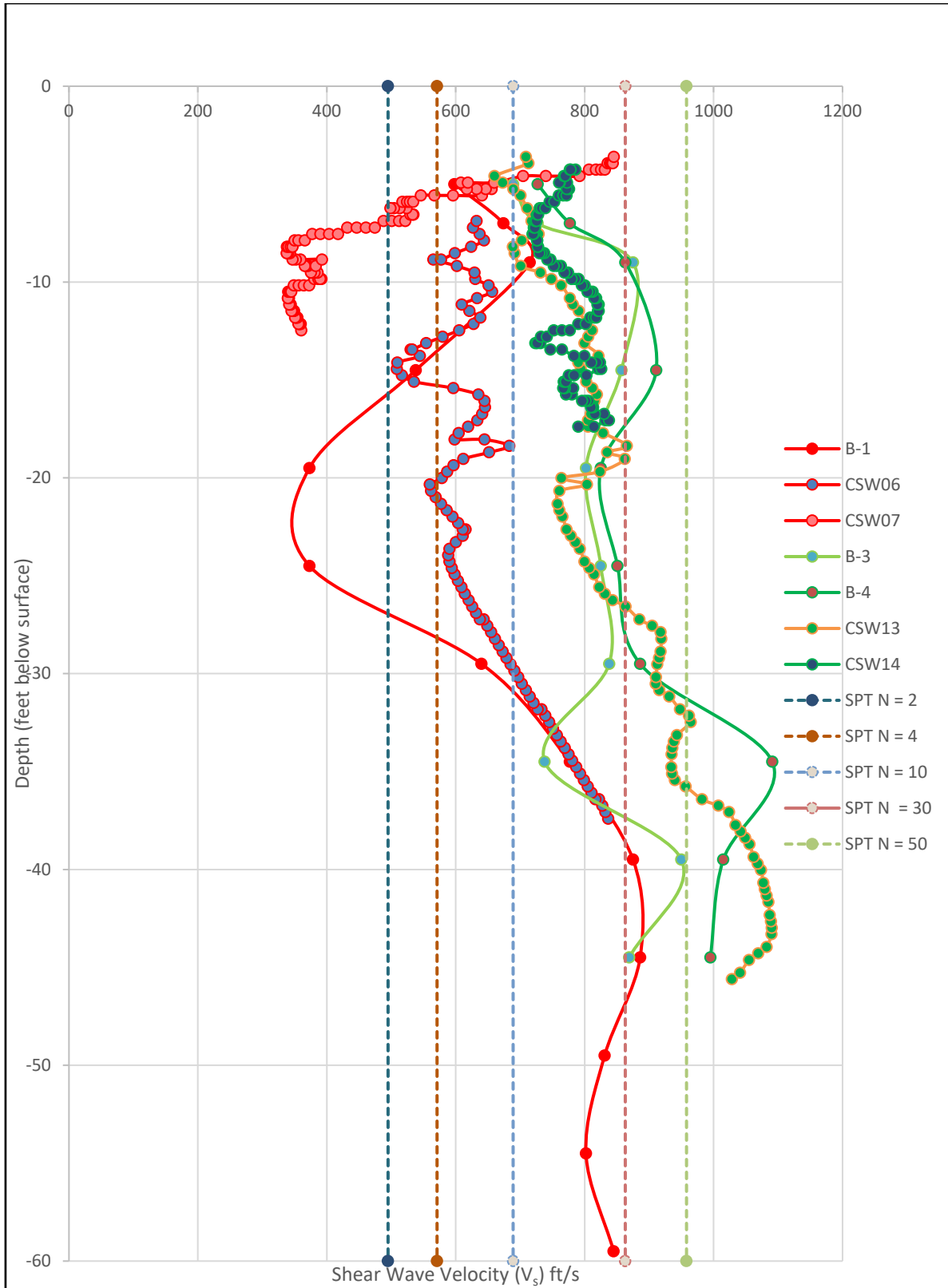


Figure 2 Shear Wave Velocity vs. Depth (Pre- and Post-Treatment)

ATTACHMENT A
ACSW Test & SPT Boring Locations

ATTACHMENT B

SPT Boring Logs

ACSW Plots of v_s against Depth

ATTACHMENT C
GBA Guidelines
Standard Terms and Conditions

INTEGRITY DRILLING & GEOPHYSICAL SERVICES, LLC - STANDARD TERMS AND CONDITIONS

1) **ENTIRE AGREEMENT.** Upon authorization by the CLIENT and commencement of performance hereunder, these terms and Integrity Drilling & Geophysical Services, LLC's (IDGSL's) Proposal constitute the entire agreement between the parties concerning its subject matter. Any changes or additional conditions proposed by CLIENT are hereby rejected, unless expressly stated in this Agreement or incorporated by a change order.

2) **CHANGES.** Upon receipt of notice from CLIENT of a change in the scope of the work hereunder, IDGSL will promptly notify the CLIENT if there is an impact on the schedule, price or terms of the Agreement. Thereafter, an estimate of any impact on the Agreement will be prepared and submitted to the CLIENT. The parties agree to promptly negotiate and implement changes to the Agreement. CLIENT acknowledges and agrees that its use of any purchase order or other form to procure services is solely for administrative purposes and in no event shall IDGSL be bound to any terms and conditions on such form regardless of reference to or signature. CLIENT shall endeavor to reference this Agreement on any purchase order (or any other form), but CLIENT's failure to do so shall not operate to modify this Agreement.

3) **SITE INFORMATION AND ACCESS.** The CLIENT shall make available to IDGSL all relevant information and documents under his control regarding past, present and proposed conditions of the site. The information shall include, but not be limited to, plot plans, topographic surveys, hydrologic data and previous soil and geologic data including borings, field or laboratory tests and written reports. The CLIENT shall immediately transmit to IDGSL any new information that becomes available or any change in plans. The CLIENT shall also ensure uninterrupted site access for IDGSL throughout performance of this Agreement.

4) **PERMITS AND UTILITIES.** Unless otherwise stated in the Proposal, the CLIENT shall apply for and obtain all required permits and licenses and shall make all necessary arrangements for right of entry to provide IDGSL access to the site for all equipment and personnel at no charge to IDGSL. The CLIENT shall also provide IDGSL with the location of all underground utilities and structures in the exploration area. IDGSL is not responsible for location or identification of utilities.

5) **PAYMENT AND SUSPENSION.** Unless otherwise stated in the Proposal, invoices will be submitted by IDGSL either at the completion of the work or on a monthly basis and will be due and payable on the invoice date. Invoices not paid within thirty (30) days of the invoice date shall be subject to a late fee of one and one-half percent (1.5%) per month computed at 31 days from the date of invoice. In addition, any collection fees, legal fees, court costs, and other related expenses incurred by IDGSL in the collection of delinquent invoice amounts shall be paid by CLIENT. **IN THE EVENT CLIENT DISPUTES ALL OR PART OF AN INVOICE, CLIENT MUST ADVISE IDGSL IN WRITING WITHIN FIFTEEN (15) DAYS FROM INVOICE DATE. UNDISPUTED PORTIONS ARE SUBJECT TO PAYMENT WITHIN THIRTY (30) DAYS.** IDGSL may suspend performance of services under this Agreement if: 1) CLIENT fails to make payment in accordance with the terms hereof, 2) CLIENT becomes insolvent, enters bankruptcy, receivership, or other like proceeding (voluntary or involuntary) or makes an assignment for the benefit of creditors, or 3) IDGSL reasonably believes that CLIENT will be unable to pay IDGSL in accordance with the terms hereof and notifies CLIENT in writing prior to such suspension of services. If any such suspension causes an increase in the time required for IDGSL's performance, the performance schedule and/or period for performance shall be extended for a period of time equal to the suspension period.

6) **OWNERSHIP RIGHTS.** Any documents produced by IDGSL shall be the sole property of IDGSL. At the request and expense of the CLIENT, IDGSL shall provide the CLIENT with copies of any or all drawings, specifications and other documents prepared by IDGSL.

7) **STANDARD OF CARE.** In the performance of professional services, IDGSL will use that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession practicing in the same or similar localities. No warranty, either express or implied, is made or intended by this Agreement or by furnishing oral or written reports of the findings. IDGSL is to be liable only for damage proximately caused by the negligence of IDGSL. The CLIENT recognizes that subsurface conditions may vary from those encountered at the location where borings, surveys or explorations are made by IDGSL and that the data, interpretations and recommendation of IDGSL are based solely on the information available to him. IDGSL will not be responsible for the interpretation by others of the information developed.

8) **INSURANCE.** IDGSL will maintain insurance for this Agreement in the following types: 1) Comprehensive General Liability (CGL) insurance; 2) Professional Liability Coverage; and 3) Contractors Pollution Liability.

9) **ENVIRONMENTAL LIABILITY.** Because CLIENT owns and/or operates the site where work is being performed, CLIENT has and shall retain all responsibility and liability associated with the environmental conditions at the site. Unless specifically identified in IDGSL's Proposal, CLIENT'S responsibility and liability includes the handling and disposal of any samples or hazardous materials generated on the site as a result of IDGSL's performance hereunder.

10) **CONSEQUENTIAL DAMAGES.** IDGSL shall NOT be responsible for any consequential, incidental or indirect damages.

11) **LIMITATION OF LIABILITY.** *Notwithstanding any other provision of this Agreement, the total liability of IDGSL, its officers, directors and employees for liabilities, claims, judgments, demands and causes of action arising under or related to this Agreement, whether based in contract or tort, shall be limited to the total compensation actually paid to IDGSL for the services hereunder or \$50,000, whichever is less. All claims by CLIENT shall be deemed relinquished unless filed within one (1) year after substantial completion of the services hereunder.*

12) **DISPUTES.** Any dispute arising hereunder shall first be resolved by taking the following steps, where a successive step is taken if the issue is not resolved at the preceding step: 1) by the technical and contractual personnel for each party performing this Agreement, 2) by executive management of each party, 3) by mediation or 4) through the court system of the jurisdiction of the IDGSL office that entered into this Agreement. CLIENT hereby waives the right to trial by jury for any disputes arising out of this Agreement. Except as otherwise provided herein, each party shall be responsible for its own legal costs and attorneys' fees.

13) **AUTHORIZATION TO SIGN.** The person signing this Agreement warrants that he has authority to sign as, or on behalf of, the CLIENT for whom or for whose benefit IDGSL's services are rendered. If such a person does not have such authority, he agrees that he is personally liable for all breaches of this Agreement, and that in any such action against him for breach of such warranty, reasonable attorneys'

Symmes Road Lift Station, Riverview, FL
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fees and legal costs shall be included in a judgment rendered.

14) ASSIGNMENT. Neither party may delegate, assign, sublet or transfer his duties or interest in this Agreement without the written consent of the other party.

15) CHOICE OF LAWS. This Agreement shall be governed by the laws of the state of Florida.

16) FORCE MAJEURE. Should performance of services by IDGSL be affected by causes beyond its reasonable control, including but not limited to: acts of God; acts of a legislative, administrative or judicial entity; acts of contractors other than contractors engaged by IDGSL; fires; floods; labor disturbances; unusually severe weather and/or an epidemic; then CLIENT will grant IDGSL a time extension and the parties will negotiate an equitable adjustment to the price of any affected services, where appropriate.

17) FIELD REPRESENTATION. Unless otherwise expressly agreed in writing, IDGSL shall not be responsible for the safety or direction of the means and methods at the CLIENT's site of contractors or their employees or agents that are not hired by IDGSL, and the presence of IDGSL at the CLIENT's site will not relieve the contractor of its responsibilities for performing the work in accordance with applicable regulations, or in accordance with project plans and specifications. If necessary, CLIENT will advise any contractors that IDGSL's services are so limited. IDGSL will not assume the role of "prime contractor", "principal contractor", "constructor", "controlling employer", or their equivalents unless the scope of such services are expressly agreed in writing.

18) TERMINATION. This Agreement may be terminated by either party upon ten (10) days written notice to the other. In the event of a termination, Client shall pay for all reasonable charges for work performed and demobilization by IDGSL to date of notice of termination. The limitation of liability and indemnity obligations of this Agreement shall be binding notwithstanding any termination of this Agreement.