



The Moorings Condominiums  
Building 6

374 - 388 Moorings Cove Drive  
Tarpon Springs, FL 34689  
B.A.S.I.C. File No.: B2020-018

March 17th, 2021



## FINAL REPORT



**Bay Area Sinkhole Investigation & Civil Engineering**

2601 E. 7th Avenue, Tampa, FL 33605  
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To: The Moorings Condominiums Association  
Attn: Karen Cleary, President  
450 Moorings Cove Drive  
Tarpon Springs, FL 34689

Date: 03/17/2021  
Project # B2020-018

Subject: Injection Pin Pile, Compaction and Chemical Grouting  
The Moorings Condominiums | Building 6  
374 – 388 Moorings Cove Drive, Tarpon Springs, FL 34689

Dear Ms. Cleary,

We have reviewed a Structural Damage Evaluation and Subsidence Investigation report by SDII Global, (SDII), dated May 4<sup>th</sup>, 2018, a Geologic/Geotechnical Testing and Evaluation report by Applied Engineering & Geosciences (AEG), dated September 21<sup>st</sup>, 2018, a Sinkhole Loss Determination report by Structural Engineering and Inspections, Inc, (SEI), dated November 28<sup>th</sup>, 2018, a Peer Review report by SDII Global, (SDII), dated January 11<sup>th</sup>, 2019, a Neutral Evaluation report by Andreyev Engineering, Inc., (AEI), dated March 16<sup>th</sup>, 2020 and field work and engineering design performed by B.A.S.I.C. Engineering.

Based on the aforementioned reports, you have asked us to recommend and monitor a remediation program. B.A.S.I.C. Engineering recommended utilizing a combination of injection pin piles, compaction grouting and chemical grouting points. We have provided you with a Site Plan indicating the location of the injection pin piles, compaction grout and chemical grouting points and their estimated depths of installation. However, we were unable to accurately predict the amount of grout that would be required prior to actual field installation.

Injection Pin Piles are recommended in similar situations whereby the property requires lifting or other foundation support in addition to sealing off the limestone interface to prevent future sinkhole activity from occurring. The installation of the Injection Pin Piles is a process whereby high carbon steel pilings are hydraulically driven into the ground until a predetermined pressure reading is attained, or refusal occurs where lifting of the structure takes place. The Injection Pin Piles are then grouted through a patented process allowing grout to be pumped directly at the limestone interface.

In addition to the installation of the Injection Pin Piles, a high slump pressure grouting program is recommended as a means of sealing deep openings into underlying cavernous zones, fill in void zones, consolidate/densify the loose soils, prevent downward migration of soil particles and also to provide greater lateral stability to the steel pilings. A 4-6 inch slump grout is recommended by B.A.S.I.C. Engineering so that it may be accurately pumped below the structure and it may flow through the grout holes and densify soil voids with greatest efficiency.

Compaction grouting is the injection of grout into the soil to improve bearing capacity. This is accomplished by using a very viscous (low-mobility), aggregate under high pressure to form grout bulbs, which displace and densify the surrounding soils in a controlled manner through an injection pipe. The upward component of force causing heaving at the surface during compaction grouting usually limits the degree which soil can be compacted, making compaction grouting ineffective for stabilizing upper level soils (approximately the top 15 feet). Therefore, in order to stabilize the uppermost subsurface soils, chemical grouting has also been recommended.

Chemical grouting is a process whereupon a polyurethane grout is injected to fill void spaces and improve the strength of granular soils. Chemical grout behaves like a fluid but reacts with an agent and water and within sixty seconds forms a solid, expanding to compact the soils similarly to standard compaction grouting but in a more controlled manner.

## **MONITORING**

As requested, we have completed the monitoring of the subsurface injection pin piles, compaction grouting and chemical grouting operations as conducted by Helicon Foundation Repair Systems, Inc., (Helicon). This work was completed utilizing the TMG Injection Pier System, Compaction Grouting and Chemical Grouting. The remediation was started on January 12<sup>th</sup>, 2021 and completed on March 12<sup>th</sup>, 2021. A technician from our firm was present during the remediation operations to monitor operations and perform applicable grout slump tests.

Helicon installed a total of 65 injection pin piles around the property as per our site plan recommendations, as shown in figure 6a. Due to the site conditions, one (1) point was omitted from our original recommendations. (Injection Pin Pile Number 64). The depths of installation ranged from a low of 5 feet to a high of 56 feet below grade. Each pin pile was hydraulically driven into the soil until enough pressure was reached for refusal. The hydraulic gauge reading (psi) was recorded for each injection pin pile along with the installed depth (Figure 6b). The contractor then accepted delivery of a 1500-psi pressure grout from Pasco Ready Mix. The grout was a high slump 4-6 inch pressure grout. A grout gun was connected to each of the 65 injection pin piles pumped by Helicon, utilizing a TK-40 pump. The grout was pumped until a pressure gauge reading of up to 400-psi was reached on the in-line gauge. The amount of grout pumped for each injection pin pile was recorded (Figure 6b). A total of 73.8 cubic yards of grout was pumped in various quantities through 65 injection pin piles points.

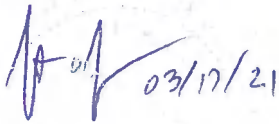
Helicon then staked the compaction grout point locations as shown in Figure 6d in accordance with B.A.S.I.C. Engineering's recommendations. Angled compaction grout points were installed to refusal (hard limestone bedrock) at depths ranging from 32 to 41 feet below existing grade. A total of 379 feet of grout casing was installed at the 10 compaction grout points. After the grout casing was installed, a TK-40 pump was used to inject a mixture of cement, fly ash, sand, water, and other admixtures into the loose soils and voids in the limestone and overlying sand strata. Pumping continued until a grout pressure of 200 to 400 psi was achieved (over that required to initiate grout take) or lifting of the structure was observed (via a surveyor's level). The grout casing was then extracted upward four to five feet and pumping resumed. A total of 65.8 cubic yards of grout was pumped in various quantities through 10 compaction grout points on the subject property, ranging from a minimum of 1.66 cubic yards on point #5 to a maximum of 11.94 cubic yards on point #7.

Lastly, a total of 1,133.8 lbs. of chemical grout was injected through 12 chemical grout points by Helicon as shown in Figures 6e. Angled points were pumped at depth ranges between 12', 10', 8', 6', 4' and 2 feet below ground surface until lift of the slab/ground refusal was achieved.

It is our opinion that the injection pin piles, compaction grout and chemical grout were installed in accordance with industry standards and are an effective method to fill voids, cracks, fractures and cavities and to stabilize granular material, thus improving the physical properties of soil and rock at The Moorings Condominiums | Building #6. The proven technology utilized by the pier manufacturer and the ability to solve foundation settlement problems using a combination of injection pin piles, compaction grout and chemical grout, has demonstrated success without additional settlement. This report is not a guarantee that sinkhole activity will not continue to exist at the subject property but rather a summary and certification of the work completed by Helicon Foundation Repair Systems, Inc.

We thank you for the opportunity to provide the services to you on this project. We trust that the information provided in this letter is satisfactory. Should you have any questions, or require additional assistance, please do not hesitate to call.

Sincerely,



Justin D. James, P.E.  
Florida P.E. # 60886  
C.O.A. # 25869  
Attachments

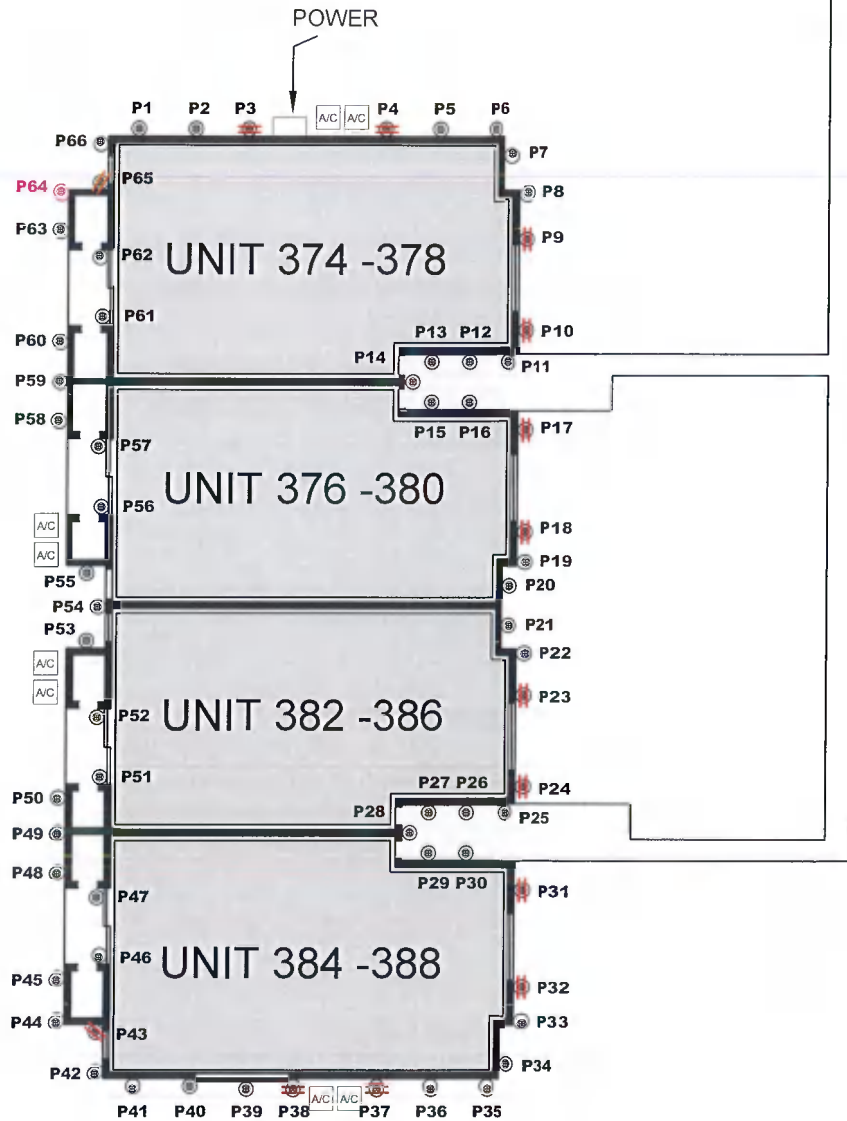


# TECHNICAL NOTES:

- ⊗ - INJECTION PIN PILE
- ⊗ - SPREADER BEAM
- ⊗ - POINTS OMITTED
- SEE FIGURE 6c FOR PIN PILE DETAIL
- NOT FOR PERMITTING



TWO STORY  
WOOD FRAME  
BUILDING #6



Approximate Scale  
1" = 20'



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374-388 MOORINGS COVE DRIVE, TARPON SPRINGS, FL 34689  
PINELLAS COUNTY

CONSTRUCTION INJECTION PLAN

FIGURE NO.: 6a

FILE NO.: B2020-018

DATE: 03/17/2021

CHECKED BY: JJ

# TECHNICAL NOTES:

## - INJECTION PIN PILE SUMMARY POINTS

Points #	PSI	Depth (ft)	Strokes	Actual Grout (cy)
1	2600	33.0	115	2.29
2	2800	29.0	240	4.36
3	2900	35.0	4	0.07
4	2800	28.0	135	2.45
5	2700	25.0	3	0.05
6	2800	25.0	39	0.71
7	2700	29.0	22	0.40
8	2600	27.0	3	0.05
9	2600	28.0	45	0.82
10	2600	33.0	23	0.42
11	2800	31.0	28	0.51
12	2500	25.0	44	0.84
13	2800	32.0	65	1.26
14	2600	31.0	2	0.04
15	2700	33.0	98	1.90
16	2700	30.0	127	2.46
17	2500	38.0	95	1.84
18	2600	32.0	2	0.04
19	2300	31.0	56	1.08
20	2700	32.0	121	2.33
21	2700	27.0	17	0.31
22	2400	32.0	116	2.09
23	2700	41.0	49	0.88
24	2400	19.0	13	0.23
25	2800	34.0	2	0.04
26	2700	29.0	36	0.65
27	2600	33.0	10	0.18
28	2600	32.0	101	1.80
29	2800	29.0	104	1.86
30	2700	41.0	254	4.57
31	2500	25.0	116	2.09
32	2700	20.0	140	2.52
33	2600	42.0	3	0.05

Points #	PSI	Depth (ft)	Strokes	Actual Grout (cy)
34	2600	46.0	3	0.06
35	2500	29.0	254	4.77
36	2500	30.0	135	2.54
37	2700	56.0	139	2.59
38	2800	40.0	158	2.94
39	2700	30.0	84	1.56
40	2700	36.0	8	0.15
41	2700	30.0	2	0.04
42	2400	45.0	144	2.68
43	2500	29.0	81	1.43
44	2500	33.0	47	0.83
45	2600	36.0	105	1.86
46	2700	40.0	141	2.49
47	2700	43.0	5	0.08
48	2600	25.0	50	0.82
49	2500	26.0	3	0.05
50	2400	27.0	2	0.03
51	2600	25.0	31	0.51
52	2600	28.0	81	1.33
53	2300	5.0	5	0.08
54	2700	22.0	35	0.58
55	2300	5.0	2	0.03
56	2500	25.0	2	0.04
57	2700	28.0	70	1.15
58	2400	28.0	5	0.08
59	2500	28.0	2	0.03
60	2400	28.0	60	0.99
61	2700	29.0	56	0.92
62	2800	41.0	12	0.20
63	2200	18.0	6	0.10
64	-	-	-	-
65	2300	5.0	2	0.03
66	2500	30.0	100	1.64
<b>TOTALS:</b>		<b>1957.0</b>	<b>4058</b>	<b>73.8</b>



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INJECTION PIN PILE SUMMARY POINTS

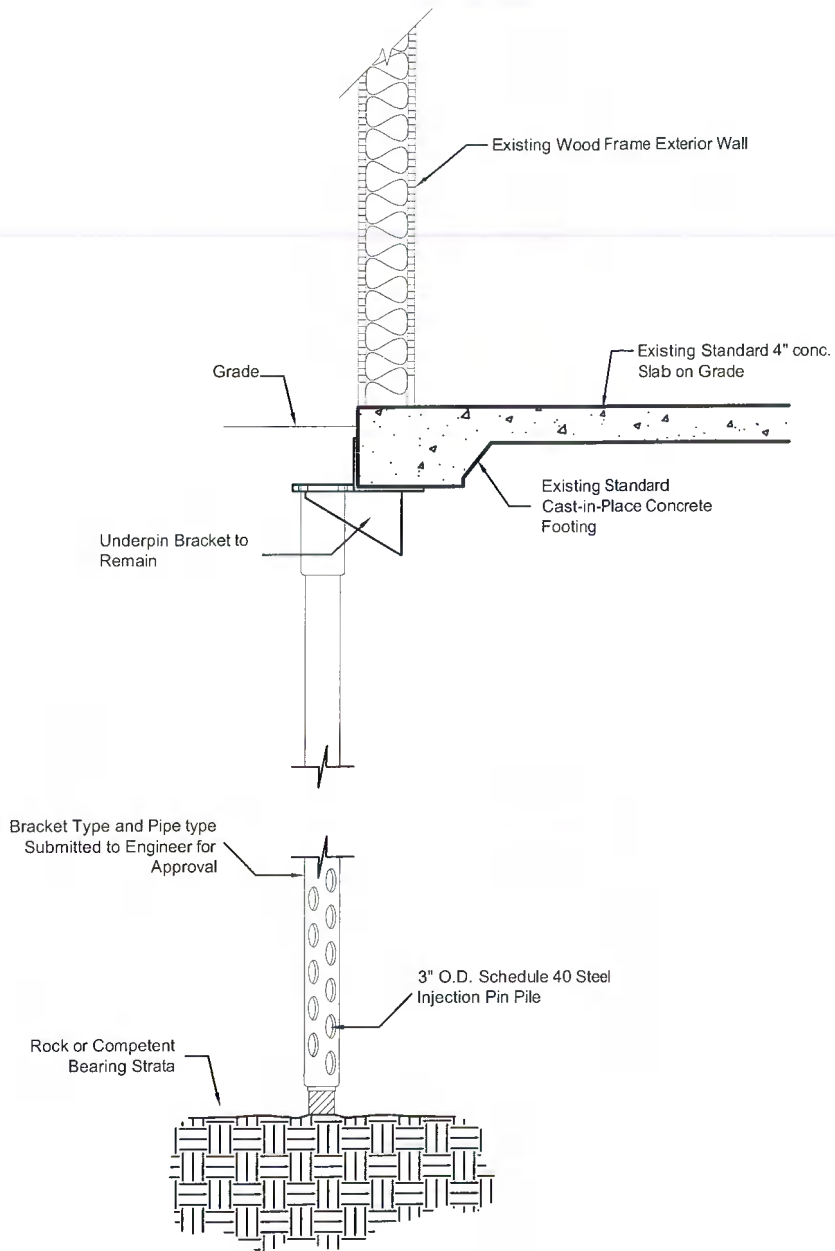
FIGURE NO.: 6b

FILE NO.: B2020-018

DATE: 03/17/2021

CHECKED BY: JJ

Wood Frame on Spread Footer:  
Injection Pin Pile Detail  
(Not for Permitting)



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INJECTION PIN PILE DETAIL PLAN

FIGURE NO.: 6c

FILE NO.: B2020-018

DATE: 03/17/2021

CHECKED BY: JJ

# TECHNICAL NOTES:

- INSTALLED POINTS DEPTH: 32' - 41'

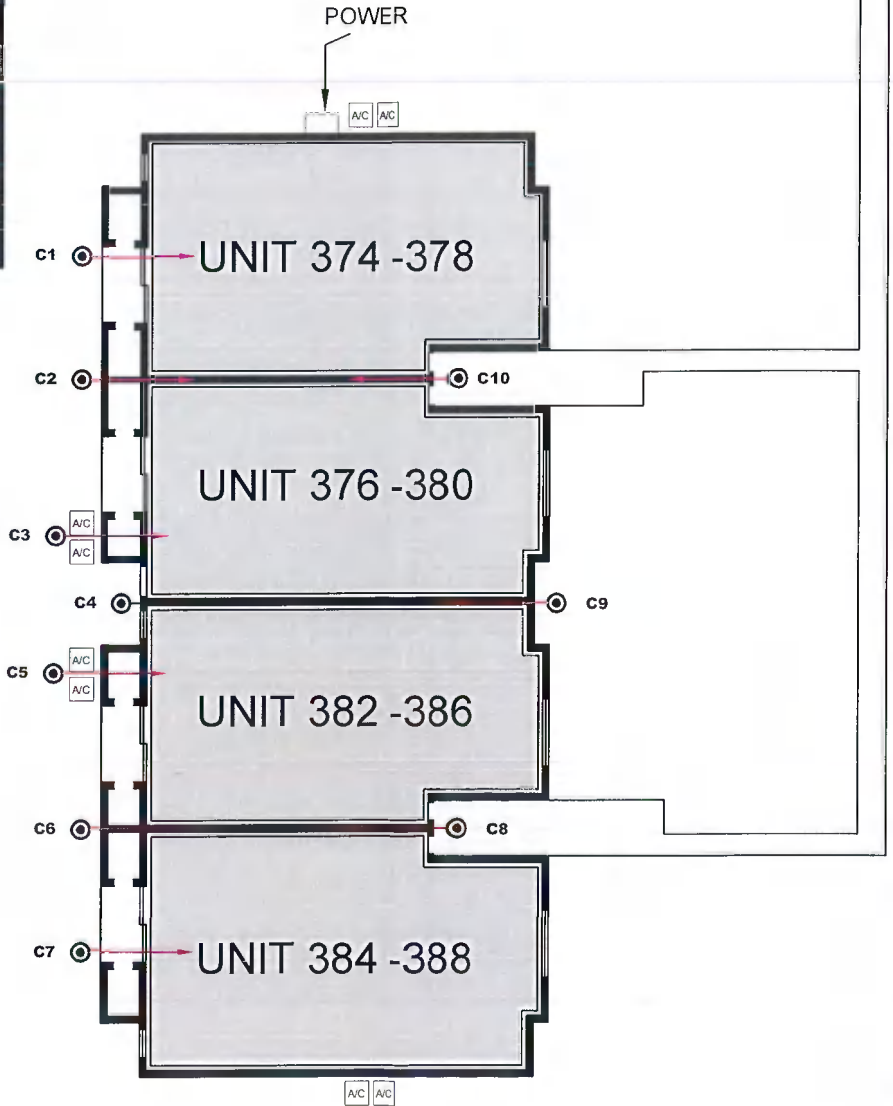
← ⊙ - ANGLED COMPACTION GROUT POINTS

- NOT FOR PERMITTING

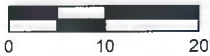


Points #	Depth (ft)	Strokes	Actual Grout (cy)
1	32	453	8.46
2	37	378	7.15
3	38	89	1.67
4	39	214	4.02
5	39	94	1.66
6	39	526	9.79
7	38	622	11.94
8	41	400	7.12
9	39	311	5.61
10	37	438	8.42
<b>Total:</b>	<b>379</b>	<b>Total:</b>	<b>65.8</b>

TWO STORY  
WOOD FRAME  
BUILDING #6



Approximate Scale  
1" = 20'



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COMPACTION GROUT PLAN

FIGURE NO.: 6d

FILE NO.: B2020-018

DATE: 03/17/2021

CHECKED BY: JJ



# TECHNICAL NOTES:

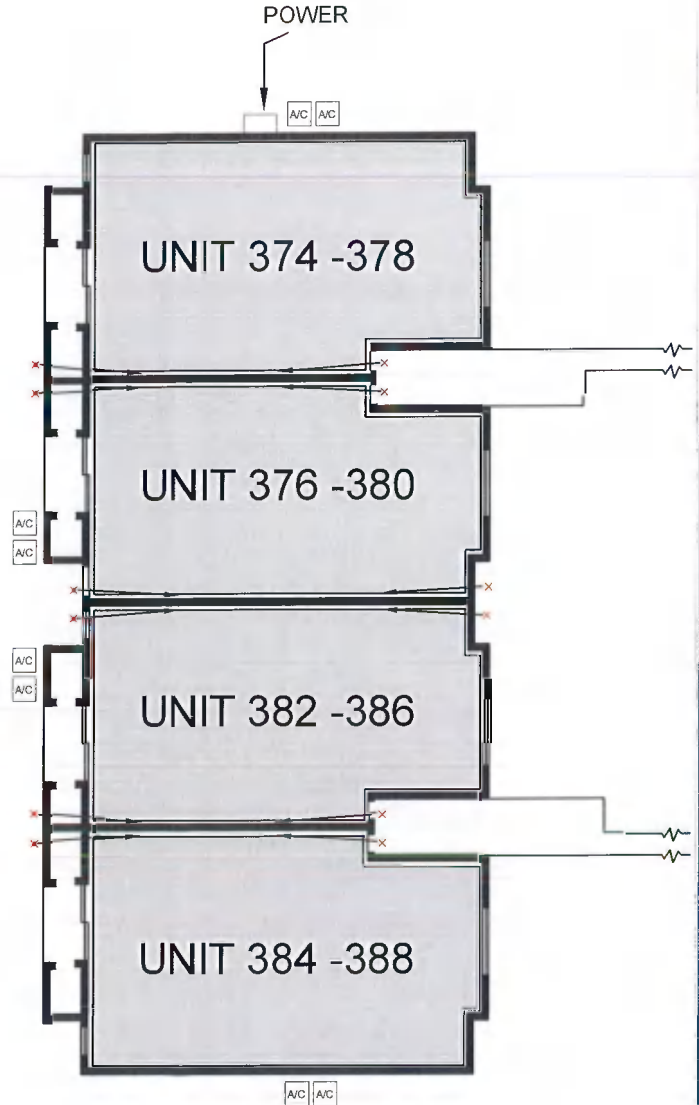
- INSTALLED DEPTH: 12', 10', 8', 6', 4' & 2' BGS
- ✗ - INSTALLED EXTERIOR CHEMICAL GROUT POINTS = 12
- INSTALLED EXTERIOR CHEMICAL GROUT QUANTITY = 1,133.8 LBS
- NOT FOR PERMITTING

## TWO STORY WOOD FRAME BUILDING #6



Point #s	Depth (ft)	PSI	Lbs.
1	12	1200	41.5
	10	-	-
	8	-	-
	6	1200	15.1
	4	1200	7.0
2	2	1200	2.8
	12	1200	26.7
	10	-	-
	8	-	-
	6	1200	11.6
3	4	-	-
	2	-	-
	12	1200	50.0
	10	1200	29.9
	8	1200	20.1
4	6	1200	15.1
	4	1200	7.0
	2	1200	2.8
	12	1200	50.0
	10	1200	29.9
5	8	1200	20.1
	6	1200	15.1
	4	1200	7.0
	2	1200	2.8
	12	1200	50.0
6	10	1200	26.7
	8	1200	-
	6	1200	12.7
	4	1200	-
	2	1200	-
7	12	1200	38.7
	10	-	-
	8	-	-
	6	1200	15.1
	4	1200	1.4
2	-	-	

Point #s	Depth (ft)	PSI	Lbs.
7	12	1200	50.0
	10	1200	16.2
	8	-	-
	6	1200	15.1
	4	1200	7.0
8	2	1200	2.8
	12	1200	50.0
	10	1200	29.9
	8	1200	20.1
	6	1200	15.1
9	4	1200	7.0
	2	1200	2.8
	12	1200	50.0
	10	1200	29.9
	8	1200	20.1
10	6	1200	13.0
	4	-	-
	2	-	-
	12	1200	50.0
	10	1200	29.9
11	8	1200	17.2
	6	1200	10.2
	4	-	-
	2	-	-
	12	1200	50.0
12	10	1200	27.1
	8	-	-
	6	1200	15.1
	4	1200	7.0
	2	1200	2.8
12	12	1200	50.0
	10	1200	21.5
	8	-	-
	6	1200	15.1
	4	1200	7.0
2	1200	2.8	
<b>Total:</b>			<b>1133.8</b>



Approximate Scale  
1" = 20'



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CHEMICAL GROUT PLAN

FIGURE NO.: 6e

FILE NO.: B2020-018

DATE: 03/17/2021

CHECKED BY: JJ