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October 18, 2018

Richard C. Dreher, President
The Dreher Group
166 Nassau Street, 2nd Floor
Princeton, NJ 08542

Re: Geotechnical Services - Stormwater Testing
Proposed Retail Development
Block 436, Lot 11.01
City of Linden, Union County, New Jersey
MC Project No. 15002372A

Dear Mr. Dreher:

In accordance with our agreement, Maser Consulting is pleased to present the results of a stormwater testing program performed at the referenced project site. The purpose of this study was to evaluate subsurface conditions and perform permeability testing at a proposed stormwater management (SWM) basin location in accordance with the New Jersey Stormwater Best Management Practices Manual (BMP). Our findings are presented in the following sections of this report. This report is intended to supplement a study previously performed by Maser Consulting, the results of which were presented in our report dated July 18, 2017.

Introduction

The following plans were used as the basis for the subsurface exploration program and preparation of this report:

- A grading plan entitled “Preliminary and Final Major Site Plan for Linden Edgar, LLC” prepared by Maser Consulting P.A. and dated December 17, 2017; last revised July 23, 2018.
- “ALTA/NPS Land Title Survey” prepared by Maser Consulting P.A. and dated March 27, 2017.

The plans indicate the property boundaries, existing site conditions, existing topographic information, conceptual site layout, and proposed grading information.

Since the time of our previous report, a new SWM has been proposed in the southwestern portion of the site and partially situated within the existing grass area and existing gas station area. Based on the referenced grading plan, the existing ground surface within the proposed SWM basin area generally slopes down from west to east with surface grades ranging from Elevation (EL) ± 16.5 feet to EL ± 18.0 feet. We understand that the proposed SWM basin will be constructed as a bioretention basin established at EL ± 11.0 feet with an undrain established at EL ± 8.08 feet.



Two (2) test pit explorations (TP-101 and TP-102) were performed within the proposed SWM basin location. The test pits were advanced using a Kobelco 135SR Excavator to depths ranging from approximately ± 8.0 to ± 18.0 feet below the ground surface (BGS) to visually classify and log the subsurface soils, evaluate groundwater conditions, and collect samples for laboratory tube permeameter testing.

A representative from Maser Consulting's Geotechnical Department observed the test pit excavations. Soils encountered were classified in the field in accordance with N.J.A.C. 7:9A, Subchapter 5.3, Terminology Required for Soil Logs. Individual profile logs of the explorations are attached to this report. Representative soil samples of strata encountered were collected and returned to Maser Consulting's Red Bank laboratory facilities for further evaluation and analyses. Details pertaining to the subsurface conditions encountered are presented on the Test Pit Logs attached to this report. The ground surface elevations reported on the logs were estimated from the referenced site plan and should be considered approximate. The locations of the explorations performed for this program are shown on attached Figure 1 – Exploration Location Plan.

A ± 5 -inch layer of asphalt was encountered at the ground surface of TP-101. Topsoil was encountered at the surface of TP-102 at a depth of ± 4 inches.

A layer of existing fill was observed below the asphalt or topsoil, where encountered, and extended to the surface of natural soils at depths ranging from ± 3.4 feet to ± 6.7 feet BGS. The existing fill consisted of predominantly sandy clay loam with occasional debris (brick fragments, asphalt fragments, plastic fragments, and clay pipe fragments).

Natural soils were encountered below the existing fill and extended to the completion depths. Natural soils consisted of predominantly silty clay loam, with seems of sandy clay loam to loam, with gravel contents ranging up to 25%, cobble contents ranging up to 10%, and boulder contents ranging up to 5%.

Static groundwater and evidence of seasonal high groundwater (SHGW) was not encountered in the test pits performed for this project. However, very slight seepage in the test pit sidewalls were observed in Test Pits TP-101 and TP-102 at depths ranging from ± 8.5 to ± 18.0 feet BGS (EL $-0.5 \pm$ feet to EL $8.5 \pm$ feet). The observed seeps were very slow and, in our opinion, related to a recent precipitation event relative to our field work. It should also be noted that soil staining was observed in TP-102 but occurred directly below a layer of fill and likely not indicative of SHGW. Please refer to the Test Pit Logs for additional details. It should be noted that perched water conditions can develop locally within existing granular soils above the less permeable layers. Fluctuations in groundwater levels can occur due to several factors, including variations in precipitation, seasonal changes, and site development activities, which can alter surface water drainage paths.



Groundwater levels are subject to seasonal variations, as well as manmade influences. Furthermore, the perched groundwater conditions observed during the field exploration could become more widespread during prolonged wet periods or immediately following precipitation events. If more specific information regarding seasonal variations is required, we recommend installing temporary groundwater observation pipes with a monitoring program and/or performing additional explorations in areas of question.

TABLE 1 GROUNDWATER/SHGW SUMMARY					
Exploration	Approximate G.S. Elev. (Ft.)	Groundwater Observed		Estimated SHGW	
		Depth (Ft.)	Elevation (Ft.)	Depth (Ft.)	Elevation (Ft.)
TP-101	17.0	NE	-	>18.0	-1.0
TP-102	16.5	NE	-	>16.5	0.0

Notes: All depths and elevations are approximate. NE=Not Encountered. N/A=Not Applicable

In accordance with the requirements set forth in the NJ BMP manual, Maser Consulting performed permeability testing within the most hydraulically restrictive soil zone below the basin bottom elevation (up to a maximum of 8 feet below the proposed basin bottom elevation), as determined in the field based on visual characteristics of the soil.

The testing consisted of 4 Tube Permeameter Tests (A and B samples at test pits TP-101 and TP-102), performed in accordance with New Jersey Administrative Code (N.J.A.C.) 7:9A-6.2 and BMP-E requirements. The tube samples were collected by inserting the sample tube into the ground and retrieving the tube by excavating the surrounding soils. Samples were transported to our Red Bank, New Jersey laboratory for testing. The results of the tube permeameter testing are summarized in Table 2. Please refer to the attached individual test data sheets for details.



TABLE 2 TEST SUMMARY					
Exploration Number	Approx. G.S. Elev.	Test Depth (EL)	Sample	Tested Infiltration Rate (In./Hr.)	Soil Permeability Class
TP-101	17.0'	9.0' (8.0')	A	0.47	K1
			B	0.72	K2
TP-102	16.5'	8.5' (8.0')	A	0.00	K0
			B	0.00	K0

All depths and elevations are approximate.

Limitations and Additional Considerations

This program has been performed in accordance with generally accepted engineering practice and any applicable design standards as referenced herein. This report and all supporting documentation have been prepared exclusively for the use of The Dreher Group pursuant to the Agreement between Maser Consulting P.A. and The Dreher Group. All provisions set forth in the Agreement and the General Terms and Conditions attached thereto are incorporated herein by reference. No warranty, express or implied, is made herein.


The findings, conclusions, and recommendations contained in this report are based on data revealed by limited exploration and testing of the subsurface at the referenced project site. The explorations indicate subsurface conditions only at the specific locations and times explored, and only within the depths penetrated.

Stormwater management systems should be designed, constructed, and maintained in accordance with all applicable regulatory agencies, including but not limited to the BMP and associated DEP requirements, to preserve functionality over the service life of the systems. The systems should be constructed under the observation of the geotechnical engineer to evaluate compliance with such regulations and confirm the engineering properties of the subsoils encountered at the detention system locations are consistent with those encountered during this program.




Geotechnical Services-Stormwater Testing
Proposed Retail Development
City of Linden, NJ
October 18, 2018

We trust this letter provides the information you require at this time. Should you have any questions or require additional information, please contact this office.



John C. Walton, P.E.
Principal Associate

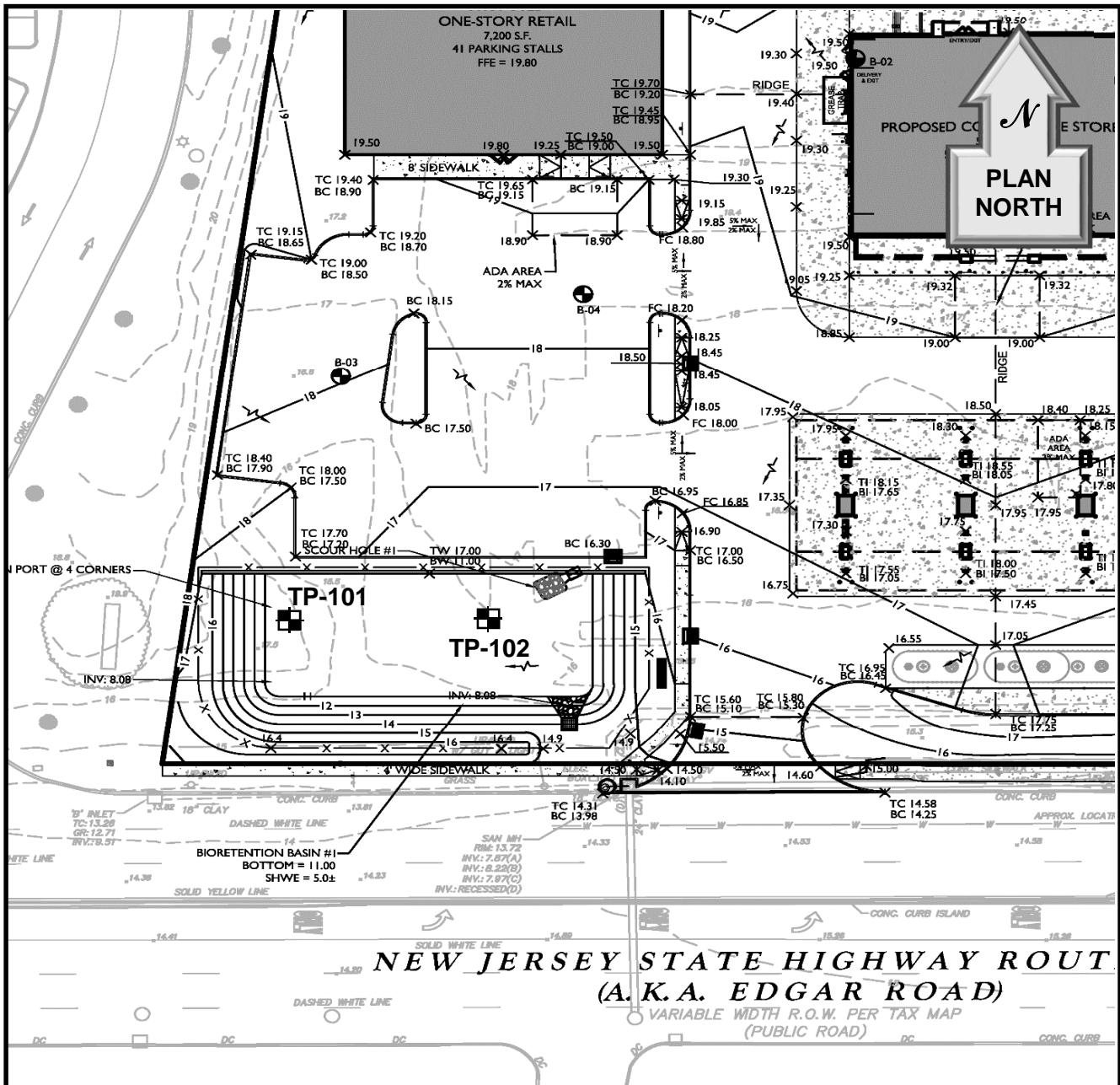
Sincerely,
MASER CONSULTING P.A.

Matthew J. Church
Project Engineer

MJC/jcw

Attachments

Cc: Michael Gallagher, P.E. (Maser)

Enclosures: Exploration Location Plan, Test Pit Logs, Infiltration Data



LEGEND:

TP-101



INDICATES THE NUMBER AND APPROXIMATE LOCATIONS OF TEST PITS PERFORMED FOR THIS PROGRAM

NOTES:

- 1.) *BASE PLAN OBTAINED FROM "PRELIMINARY AND FINAL MAJOR SITE PLAN FOR LINDEN EDGAR, LLC.", PREPARED BY MASER CONSULTING, P.A. DATED DECEMBER 12, 2017; LAST REVISED JULY 23, 2018.
- 2.) THIS DRAWING IS PART OF MASER CONSULTING, P.A. GEOTECHNICAL REPORT (PROJECT NO. 15002372A) DATED OCTOBER, 2018 AND SHOULD ONLY BE USED IN CONJUNCTION WITH THE REPORT.



Title:	EXPLORATION LOCATION PLAN		
Project:	PROPOSED WAWA LOT11.1, BLOCK 436 CITY OF LINDEN, UNION COUNTY, NEW JERSEY		
Drawn By:	*	Checked By:	MC
Scale:	N.T.S.	Date:	10/08/18
Project No.:	15002372A		Figure No.:
			1

TEST PIT No. TP-101

DATE EXCAVATED: 9/21/18

SURFACE ELEVATION: 17.0'±

Project: Dreher Linden

EXCAVATED BY: Chris

Location: Linden City, Union County, NJ

EQUIPMENT USED: Kobelco 135 SR

Job Number: 15002372A

INSPECTED BY: Austin Young

DEPTH (ft)	DEPTH (in)	DESCRIPTION	REMARKS
0	3	5" of Asphalt Concrete.	5"
	6	(2.5YR 4/2) Weak Red Sandy Loam. Clear Smooth.	
	9	Granular, Friable. 65% Gravel. (Fill, Moist).	15"
	12	(5YR 4/2) Dark Reddish Gray Loam. Clear Smooth.	
	24	Subangular-Blocky to Massive, Very-Firm. 85% Gravel.	
	36	(Fill, Moist).	15"
	48		
5	60	(5YR 4/3) Reddish Brown Sandy Clay Loam. Clear Wavy.	
	72	Subangular-Blocky, Friable. 45% Gravel. (Fill, Moist).	75"
	84		
	96	(2.5YR 5/2) Weak Red Sandy Loam. Clear Wavy.	
	108	Subangular-Blocky, Friable. (Moist).	110"
10	120		
	132		
	144		
	156	(2.5YR 4/4) Reddish Brown Sandy Clay Loam.	
	168	Subangular-Blocky, Friable to Firm. 25% Gravel,	
15	180	10% Cobble, 5% Boulder. Seams of Sandy Loam to Loam.	
	192	Clay Content Increases & Silt Content Decreases with Depth.	
	204	(Moist).	
	216		
	228	END OF TEST PIT	
	240	AT 216 INCHES	
		OCCASIONAL SEEPAGE AT 9'-18' IN SAND SEAMS	

GROUNDWATER: DEPTH (ft.) DATE

First Encountered ▽ N.E. 9/21/18

At Completion (0 hrs.) ▼ N.E. 9/21/18

After Completion (>24 hrs.) ▼ _____

ESTIMATED DEPTH TO SEASONAL HIGH GROUNDWATER: NE

TEST PIT No. TP-101

TEST PIT No. TP-102

DATE EXCAVATED: 9/21/18
SURFACE ELEVATION: 16.5'±

Project: Dreher Linden
Location: Linden City, Union County, NJ
Job Number: 15002372A

EXCAVATED BY: Chris
EQUIPMENT USED: Kobelco 135 SR
INSPECTED BY: Austin Young

DEPTH (ft)	DEPTH (in)	DESCRIPTION	REMARKS
0	3	(2.5YR 3/3) Dark Reddish Brown Silty Clay Loam.	
	6	Clear Smooth. Granular, Friable. 10% Gravel.	
	9	(Topsoil, Moist).	4"
	12		
	24	(5YR 5/6) Yellowish Red Loam to Silty Clay Loam.	
	36	Clear Wavy. Platy to Subangular-Blocky, Extremely-Firm.	
	48	40% Gravel, 15% Cobble. Brick Fragments, Asphalt Millings, Plastic. (Fill, Moist).	41"
5	60	(10YR 4/2) Dark Grayish Brown Silty Clay Loam.	
	72	Clear Wavy. Prismatic to Subangular-Blocky, Firm.	
	84	10% Gravel. Buried Topsoil. (7.5YR 5/6) Strong Brown	
	96	Many Course Distinct Soil Staining. (Moist).	63"
	108		
10	120	(2.5YR 5/6) Red Silty Clay Loam. Subangular-Blocky, Firm.	
	132	(2.5 YR 4/4) Reddish Brown Sandy Loam to	
	144	Sandy Clay Loam Seams.	
	156	Seam Layers Hold Water with Depth. (Moist).	
	168		
15	180		
	192		
	204		
	216	END OF TEST PIT	
	228	AT 198 INCHES	
20	240	SOME SEEPAGE AT 102 INCHES	

GROUNDWATER: DEPTH (ft.) DATE

First Encountered ☒ N.E. 9/21/18

At Completion (0 hrs.) ☒ N.E. 9/21/18

After Completion (>24 hrs.) ☒ _____

ESTIMATED DEPTH TO SEASONAL HIGH GROUNDWATER: NE

TEST PIT No. TP-102

TUBE PERMEAMETER TEST DATA

Project Name: Dreher Linden Rt. 1 & Park Ave. Project Number: 15002372A
Block: 436 Municipality: Linden
Lot: 11.1 County: Union
Test Number: 1 Date Collected: 9/21/2018
Material Tested: TP-101 Replicate: A
Depth of Sample: 108 Inches Sample Type: Undisturbed
Stand Pipe: Not Used

1. **Sample Dimensions** Radius = 2.54 cm
Length = 3.38 in

2. **Measurements** Tube Weight = 356.82 g
Total Weight = 738.3 g
tube #: X-11 Soil Weight = 381.48 g

Volume = Length * 2.54 cm/inch * π * Radius²
Volume = 173.66

Bulk Density = Soil Weight / Volume
Bulk Density = 2.20

Height of Water Level above Rim of Test Basin (inches)

At beginning of interval: 3.63 H₁
At end of interval: 3.38 H₂

3. **Test Data**

	Time Begin, T ₁	Time End, T ₂	Test Length (min)	Δ Height (in)
a.	0:00	0:30	30	0.250
b.	0:00	0:31	31	0.250
c.	0:00	0:31	31	0.250
d.	0:00	0:31	31	0.250
		av =	30.75	0.250

4. **Permeability Calculation** $K \text{ (in/hr)} = 60 \text{ min/hr} * r^2/R^2 * L \text{ (in)}/T \text{ (min)} * \ln(H_1/H_2)$

K = 0.47 in/hr = Soil Permeability Class K1

5. Any Defects in Sample: No

6. I hereby certify that the information on Form 3b of this application is true and accurate. I am aware that falsification of data is a violation of the water pollution Control Act (NJSA 59:10A-1 et seq.) and is subject to penalties as prescribed in NJAC 7:14-8.

Signature of Professional Engineer

John Walton

License #GE47253

TUBE PERMEAMETER TEST DATA

Project Name: Dreher Linden Rt. 1 & Park Ave. Project Number: 15002372A
Block: 436 Municipality: Linden
Lot: 11.1 County: Union
Test Number: 1 Date Collected: 9/21/2018
Material Tested: TP-101 Replicate: B
Depth of Sample: 108 Inches Sample Type: Undisturbed
Stand Pipe: Not Used

1. **Sample Dimensions** Radius = 2.54 cm
Length = 3.25 in

2. **Measurements** Tube Weight = 359.69 g
Total Weight = 723.73 g
tube #: 1002 Soil Weight = 364.04 g

Volume = Length * 2.54 cm/inch * π * Radius²
Volume = 167.23

Bulk Density = Soil Weight / Volume
Bulk Density = 2.18

Height of Water Level above Rim of Test Basin (inches)

At beginning of interval: 3.50 H₁
At end of interval: 3.13 H₂

3. **Test Data**

	Time Begin, T ₁	Time End, T ₂	Test Length (min)	Δ Height (in)
a.	0:00	0:30	30	0.375
b.	0:00	0:30	31	0.375
c.	0:00	0:30	30	0.375
d.	0:00	0:30	31	0.375
		av =	30.5	0.375

4. **Permeability Calculation** $K \text{ (in/hr)} = 60 \text{ min/hr} * r^2/R^2 * L \text{ (in)}/T \text{ (min)} * \ln(H_1/H_2)$

K = 0.72 in/hr = Soil Permeability Class K2

5. Any Defects in Sample: No

6. I hereby certify that the information on Form 3b of this application is true and accurate. I am aware that falsification of data is a violation of the water pollution Control Act (NJSA 59:10A-1 et seq.) and is subject to penalties as prescribed in NJAC 7:14-8.

Signature of Professional Engineer

John Walton

License #GE47253

TUBE PERMEAMETER TEST DATA

Project Name:	Dreher Linden Rt. 1 & Park Ave.	Project Number:	15002372A
Block:	436	Municipality:	Linden
Lot:	11.1	County:	Union
Test Number:	1	Date Collected:	9/21/2018
Material Tested:	TP-102	Replicate:	A
Depth of Sample:	102 Inches	Sample Type:	Undisturbed
		Stand Pipe:	Not Used

1. **Sample Dimensions** Radius = 2.54 cm
Length = 3.38 in

2. **Measurements** Tube Weight = 371.04 g
Total Weight = 696.66 g
tube #: DD-14 Soil Weight = 325.62 g

Volume = Length * 2.54 cm/inch * π * Radius²
Volume = 173.66

Bulk Density = Soil Weight / Volume
Bulk Density = 1.88

Height of Water Level above Rim of Test Basin (inches)

At beginning of interval: 3.63 H₁
At end of interval: 3.50 H₂

3. **Test Data**

	<u>Time Begin,</u>	T ₁	<u>Time End,</u>	T ₂	<u>Test Length</u> (min)	<u>Δ Height</u> (in)
a.	0:00		2:00		120	0.125
b.	0:00		2:00		120	0.125
c.	0:00		2:00		120	0.125
d.	0:00		2:00		120	0.125
				av =	120	0.125

4. **Permeability Calculation** $K \text{ (in/hr)} = 60 \text{ min/hr} * r^2/R^2 * L \text{ (in)}/T \text{ (min)} * \ln(H_1/H_2)$

K = 0.06 in/hr = Soil Permeability Class K0

5. Any Defects in Sample: No

6. I hereby certify that the information on Form 3b of this application is true and accurate. I am aware that falsification of data is a violation of the water pollution Control Act (NJSA 59:10A-1 et seq.) and is subject to penalties as prescribed in NJAC 7:14-8.

Signature of Professional Engineer

John Walton

License #GE47253

TUBE PERMEAMETER TEST DATA

Project Name: Dreher Linden Rt. 1 & Park Ave. Project Number: 15002372A
Block: 436 Municipality: Linden
Lot: 11.1 County: Union
Test Number: 1 Date Collected: 9/21/2018
Material Tested: TP-102 Replicate: B
Depth of Sample: 102 Inches Sample Type: Undisturbed
Stand Pipe: Not Used

1. **Sample Dimensions** Radius = 2.54 cm
Length = 3.25 in

2. **Measurements** Tube Weight = 368.93 g
Total Weight = 718.53 g
tube #: BB-14 Soil Weight = 349.6 g

Volume = Length * 2.54 cm/inch * π * Radius²
Volume = 167.23

Bulk Density = Soil Weight / Volume
Bulk Density = 2.09

Height of Water Level above Rim of Test Basin (inches)

At beginning of interval: 3.50 H₁
At end of interval: 3.50 H₂

3. **Test Data**

	Time Begin, T ₁	Time End, T ₂	Test Length (min)	Δ Height (in)
a.	0:00	2:00	120	0.000
b.	0:00	2:00	120	0.000
c.	0:00	2:00	120	0.000
d.	0:00	2:00	120	0.000
		av =	120	0.000

4. **Permeability Calculation** $K \text{ (in/hr)} = 60 \text{ min/hr} * r^2/R^2 * L \text{ (in)}/T \text{ (min)} * \ln (H_1/H_2)$

K = 0.00 in/hr = Soil Permeability Class K0

5. Any Defects in Sample: No

6. I hereby certify that the information on Form 3b of this application is true and accurate. I am aware that falsification of data is a violation of the water pollution Control Act (NJSA 59:10A-1 et seq.) and is subject to penalties as prescribed in NJAC 7:14-8.

Signature of Professional Engineer

John Walton

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