TRIP REPORT

Date: October 25, 2016

To: Tim Dunaway, P.E.

From: Scott Anderson, Hydrogeologist

Subject: Summary of Soil Infiltration Tests
Mt. Union Station
Sunoco PPP
Shirley Township, Huntingdon County, Pennsylvania

This trip report provides results of soil infiltration tests that were completed at the Mt. Union Station located in Shirley Township, Huntingdon County, Pennsylvania as part of the Pennsylvania Pipeline Project (PPP) for Sunoco Logistics L.P.

1.0 PURPOSE

This report presents the field data and results of double-ring soil infiltration tests conducted to support stormwater management system design. Two deep tests (IT-A and IT-B) were performed at the property. Test locations are listed by coordinates in World Geodetic System 84 (WGS 84) latitude and longitude format in Table 1, and locations are also illustrated on a figure attached to this report.

2.0 FIELD ACTIVITIES

The infiltration tests were conducted by Kevin Schwab and Mark Mengel of Tetra Tech, Inc., on October 3, 2016. The test locations were positioned in the field using a handheld, WAAS-enabled GPS unit. Table 1 provides the coordinates of the test locations. IT-A and IT-B were located in a flat hay field.

The infiltration tests were performed in accordance with the procedure specified in the 2006 Pennsylvania Stormwater Best Management Practices (BMP) Manual. Double-ring tests were performed. The double-ring test locations were prepared for test locations with the assistance of a mini-excavator, with care taken to minimize disturbance of the soil surface to be tested. The double-ring infiltrometers that were used for testing consisted of 10-inch and 6-inch diameter sections of steel casing. After digging to the target depth, the test surface was leveled, and any loose soil or fallen vegetation was removed. The rings were driven a minimum of 2 inches into the soil. At IT-A, initially, the rings were not seated completely due to the presence of rocks. However, during the pre-soak, the rings achieved proper sealing as evidenced by decreased water drop and water loss during the final 30 minutes of the pre-soak. Since water level drop was observed to decrease, a 30-minute test was performed (even though over 2 inches of water level drop was observed in the last 30 minutes). Infiltration test depths are provided on Table 1.

Test locations were pre-soaked for 1 hour. The tests were then conducted with measurements at 30-minute intervals, based on the observed water level drops during the second half of the presoak period. Presoak and test information was recorded on infiltration test sheets; copies of the test sheets are attached to this report.

During the testing, the weather was overcast and mild, and no precipitation was observed during the tests. No rain for a period of 24 hours prior to testing was noted.

In addition, test pits were machine-excavated for each testing location to characterize the soil, determine the depth to bedrock, if encountered, and inspect for evidence of a seasonal high water table. The test pits were identified with the corresponding infiltration test name. The test pits were completed to approximately two feet below the target infiltration test depth. Descriptions of the soil from the test pits were recorded by a Tetra Tech geologist on field logs, which were based on the example form in the BMP manual. Copies of the field soil logs are attached to this report.

3.0 RESULTS

3.1 SOILS DESCRIPTION

Soils encountered consisted of thin (approximately a foot thick) brown to dark yellowish brown topsoil/surface loam overlying reddish-yellow, brown, and dark gray silt and clay, with weathered parent material (siltstone, sandstone, and shale fragments) noted in the bottom horizons (silt and clay horizons) of the test pits. Munsell color classifications for each horizon are provided on attached soil logs. Thin grass roots were encountered in the topsoil/surface soils. Soils were noted to be moist during the excavation activities. Soil mottling was observed below 30 inches depth in both test pits. Seasonal high groundwater was not observed in either test pit. Additionally, bedrock was not encountered. Table 1 summarizes the depths of the infiltration tests (test pits completed approximately 2 feet deeper than infiltration test depths).

The soils were not noted to be wet during the excavation activities and generally exhibited an increasing degree of degradation of parent material with depth. Mottling was noted below 30 inches in both test pits in variable brown silts and clays. Since seasonally high groundwater was not encountered, the mottling observed is not likely due to the unconfined water table. Rather, the mottling observed is likely a consequence of a seasonal perched zone or slow infiltration of increased precipitation events through the finer grained soils.

According to United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey[1] data, the soil types for the test locations are mapped as Beddington channery silt loam (BeB), 3 to 8 percent slopes.

[1] http://websoilsurvey.nrcs.usda.gov/. Accessed October 25, 2016.

3.2 INFILTRATION TEST RESULTS

Table 1 summarizes the infiltration rates (inches per hour) calculated from the test data. Infiltration rates presented in Table 1 were calculated from the averaged water level drop of the last four (stabilized) readings measured in the inner ring. The tests exhibited light to moderate infiltration rates, utilizing a 30-minute test cycle.

In consideration of the infiltration rates for design purposes, a safety factor of 3 is assumed based on the significant presence of silts and clays at the test depths. The geometric mean of IT-A and IT-B is 2.4 inches per hour. With application of the safety factor of 3, the resultant recommended rate is 0.8 inches per hour.

TABLE 1
Summary of Infiltration Test Results and Work Locations
Mt. Union Station

Location (IT-#)	Location Data[1]		Test Depth (inches)	Infiltration Test Result (inches per hour)
	LATITUDE WGS 84	LONGITUDE WGS 84		
A	40.344647	-77.864839	72	3.34
B	40.344694	-77.865111	72	1.66

Note

[1] Field coordinates

ATTACHMENTS

SITE FIGURE

Figure 1

Infiltration Testing Locations
Mount Union Station
Soil Type: Beddington Channery Silt Loam (BeB)
Huntington County

INFILTRATION TEST DATA SHEETS

INFILTRATION TEST DATA SHEET

Tetra Tech, Inc.

PROJECT NAME: MOUNT UNION
PROJECT NUMBER: 112IC05958
TEST AREA ID: IT-A closest to road
PERSONNEL: MM

TEST METHOD: (Double Ring Infiltrometer) Percolation ~~Single Ring Infiltrometer~~

Location Coordinates or Description:

INNER RING INSIDE DIAMETER/HEIGHT: 6/10
OUTER RING INSIDE DIAMETER/HEIGHT: 10/10

PERCOLATION HOLE DIAMETER: NA (If performing an open hole perc test)

DATE(s): 10/3/16

Distance from the bottom of the inner ring/hole to measuring point (minimum water column of 6-8 inches): 7"

MEASURING POINT: (Ring Rim) Indicator Mark

DEPTH OF TEST: 6'

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE, INNER RING (liters)	REMARKS
1530	0	-------	4.2 L	1540 down 4" added 2.1 L
1600	30	3 10/16	2.0 L	
1630	60	2 7/16	1.3 L	Rings installed on top of Rock. NOT seating completely.
1630	0	-------	4.2	
1700	30	1 9/16	1.0L	
1730	60	1 11/16	1.1 L	
1800	90	1 11/16	1.0 L	
1830	120	1 11/16	-	END OF TEST

INFILTRATION TEST DATA SHEET

Tetra Tech, Inc.

PROJECT NAME: Mount Union
PROJECT NUMBER: 112IC05958
TEST AREA ID: IT-B Furthest from road
PERSONNEL: KAS

TEST METHOD: (Double Ring Infiltrometer) Percolation
Single Ring Infiltrometer

Location Coordinates or Description:

INNER RING INSIDE DIAMETER/HEIGHT: 6/10
OUTER RING INSIDE DIAMETER/HEIGHT: 10/10

PERCOLATION HOLE DIAMETER: _____ (If performing an open hole perc test)

DATE(s): 10/3/16

Distance from the bottom of the inner ring/hole to measuring point (minimum water column of 6-8 inches): 8"

MEASURING POINT: (Ring Rim) Indicator Mark

DEPTH OF TEST: 6'

TIME	ELAPSED TIME SINCE START OF TEST (minutes)	WATER LEVEL DROP, INNER RING OR PERCOLATION HOLE (inches)	VOLUME OF WATER ADDED AT EACH CYCLE, INNER RING (liters)	REMARKS
PRESOAK DATA				
1610	0	———	4.2 L	
1640	30	14/16	.5L	
1710	60	1 0/16	.55L	
TEST DATA				
1710	0	———		
1740	30	14/16	.5 L	
1810	60	14/16	.5L	
1840	90	13/16	.5L	
1910	120	12/16	.45 L	

Sunoco - Mount Union Station		Test Loc. IT-A (6')	10/3/2016	
Time	Elapsed Time (minutes)	Water Level Drop (in)	Volume of Water Added (L)	
1630	0	0.00	0	
1700	30	1.63	1	
1730	60	1.69	1.1	
1800	90	1.69	1	
1830	120	1.69	NA	Infiltration Rate
				Average Stabilized Rate (in/hr)
				3.34

Sunoco - Mount Union Station		Test Loc. IT-B (6')	10/3/2016	
Time	Elapsed Time (minutes)	Water Level Drop (in)	Volume of Water Added (L)	
1710	0	0.00	0	
1740	30	0.875	0.5	
1810	60	0.875	0.5	
1840	90	0.813	0.5	
1910	120	0.750	0.45	Infiltration Rate
				Average Stabilized Rate (in/hr)
				1.66

SOIL LOGS

TETRA TECH

Soil Log

Tested By: KAS **Project:** Mt. Union **Project No.:** 112IC05958

Test Pit: IT - A **Date:** 10/3/16 **Elevation:** **Equipment Used:** mini-ex

Geology: flat ag field **Soil Type:** silt and clay **Land Use:** Hay field **Weather:** partly cloudy

Additional Comments

Horizon	Upper Boundary	Lower Boundary	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Color	Color Patterns	Pores, Roots, Rock Structure	Depth to Bedrock	Depth to Water	Comments
A	0	30 cm	loam	fine granular	10YR 4/3	even				
B	30	~~78~~ cm	silt clay	med angular blocky	7.5YR 5/6	even				hard
B2	78	125 cm	clay	SAA	7.5YR 4/6 & 5/6	60% mottled <10%	10% siltstones channers			hard
B3	125	160 cm	silt clay	platty	7.5YR 4/3 & 5/2	50% mottled 50%	15% siltstones channers	semi degraded		med
BC	160	140 cm	clay	fine-med subangular	7.5YR 4/4 & 5/3	70% mottled 30%	10% siltstones 10% shales	degrading		soft
CB	140	235 cm	clay trace silt	med subangular blocky	7.5YR 3/2 & 4/3 & 5/6	33% mottled 33%	25% siltstones & shale degrading			soft

Horizon:	USDA Definition	Soil Textural Class	Boundary	Notes:
O	Organic debris	Use ternary diagram from US Department of Agriculture Soil Conservation Service	Use depth and classification Classification as Follows: Abrupt	
A	Dark colored, mixed mineral organic matter			
B	Maximum accumulation of silicate clay minerals		Clear	
C	Weathered parent material		Gradual	
R	Layer of consolidated rock beneath the soil		Diffuse	

Table based on: Sample soil log located on page 12 of the Pennsylvania Stormwater Best Management Practices Manual
USDA Definitions located from: http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/?cid=nrcs142p2_054308

3/2
4/3
5/6

TETRA TECH

Soil Log

Tested By: LAS **Project:** Mt. Union **Project No.:** 112IC05958

Test Pit: TT-B **Date:** 10/3/16 **Elevation:** **Equipment Used:** mini-ex

Geology: flat ag field **Soil Type:** silt and clay **Land Use:** Hay field **Weather:** partly cloudy

Additional Comments

Horizon	Upper Boundary	Lower Boundary	Soil Textural Class	Type, Size, Coarse Fragments, etc.	Soil Color	Color Patterns	Pores, Roots, Rock Structure	Depth to Bedrock	Depth to Water	Comments
A	0	28	silt loam	fine granular	10YR 4/4	even	few small roots			
B	28	80	silt clay	fine - med sub angular	7.5YR 6/6	even				
B2	80	110	clay	fine - med sub angular - angular	7.5YR 5/4 7.5YR 5/2	80% mottled 20%				
B3	110	155	silt clay	fine - med sub angular blocky	7.5YR 4/3 7.5YR 5/6	70% mottles 30%	5% degrading siltstones & shales			
BC	155	200	clay trace silt	SAA	7.5YR 3/1 7.5YR 5/4	60% mottles 40%	30% degrading silt/sandstones & shales			
CB	200	245	silt clay	SAA	7.5YR 4/3 7.5YR 5/2	50% mottles 50%	45% siltstones and shales of various stages of degredation			still has some rock structure

Horizon:	USDA Definition	Soil Textural Class	Boundary	Notes:
O	Organic debris	Use ternary diagram from US Department of Agriculture Soil Conservation Service	Use depth and classification	
A	Dark colored, mixed mineral organic matter		Classification as Follows: Abrupt	
B	Maximum accumulation of silicate clay minerals		Clear	
C	Weathered parent material		Gradual	
R	Layer of consolidated rock beneath the soil		Diffuse	

Table based on: Sample soil log located on page 12 of the Pennsylvania Stormwater Best Management Practices Manual
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