ASTRO ELECTROPLATING
GROUNDWATER REMEDIATION

Former Astro Electroplating Site
170 Central Avenue
Farmingdale, NY 11735

GROUNDWATER CONDITIONS REPORT

Prepared for:

Astro Electroplating Inc.
171 4th Avenue
Bay Shore, NY 11706

Prepared by:

AMC Engineering
18-36 42nd Street
Astoria, NY 11105
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Fax: (516) 706-3214

October 11, 2018

1.0 INTRODUCTION

AMC Engineering PLLC (AMC) has been retained by Astro Electroplating Inc. (Astro) to perform a groundwater conditions investigation for the former Astro Electroplating site located at 170 Central Avenue in Farmingdale, NY. The purpose of this investigation is to establish average groundwater depths and to determine the direction and magnitude of groundwater velocity at the site. The site location is included on the Site Plan in **Attachment 1**.

1.1 Hydrology and Geology

The project is located approximately 2.8 miles west of the Wyandanch Spring Lake and the Carlls River. There are no other open water bodies or conveyances in the vicinity of the subject site area.

The topography of the Site and surrounding area was reviewed from the United States Geological Survey (USGS) 7.5-minute series topographic map for the Huntington, NY Quadrangle (**Attachment 2**), which indicates that the Site has a topographic elevation range of approximately 100 feet above mean sea level (amsl). The Site is relatively flat. However, the topographic gradient in the surrounding vicinity gently slopes downward to the south all the way to the Great South Bay.

According to the USGS Ground Water Atlas of the United States, New York region (1995) and the USGS Hydrogeologic Framework of Long Island, New York, the site is situated within the Coastal Plain physiographic province. The Coastal Plain physiographic province is characterized by layers of Cretaceous age sediments (primarily clay, sand, and gravel) overlying igneous and metamorphic rocks that crop out in Connecticut. The surface of these rocks slopes to the southeast, and the overlying Coastal Plain sediments slope and thicken in the same direction. Quaternary glacial deposits (primarily outwash sand and gravel) cover the Coastal Plain sediments on Long Island to depths of as much as 600 feet. In the area of the site, bedrock is present at a depth of approximately 1,050 feet below grade and is overlain by the Lloyd Aquifer, Raritan Confining Unit, Magothy Aquifer, Jameco Aquifer and the Upper Glacial Aquifer.

Previous subsurface investigations for this Site has determined that the soil properties at the saturated zone are silty sand. This information was used to approximate the hydraulic conductivity and porosity of the soil at the saturated zone.

2.0 GROUNDWATER MONITORING TEST

AMC mobilized on July 13, 2018 to perform the groundwater level monitoring test at the Site. The test involved the installation of In-Situ Level Troll 700 data loggers in observation wells MW-2A, MW-7 and MW-10 to collect depth-to-water (DTW) data in 1-minute intervals. Additionally, manual depth-to-water readings of the monitoring wells were taken at the start of the test using a Solinst 101 P7 Water Level Meter to establish relative groundwater elevation.

After 3 hours of the test, the final DTW readings were recorded and the data loggers were removed. The wells were surveyed and the relative elevations and distance between each well were noted. The location of the monitoring wells are shown on the Site Plan in **Attachment 1**.

The results of this investigation yielded results that differed from previously established groundwater flow conditions on Long Island. In order to verify the results, AMC mobilized onsite a second time on September 24, 2018 to re-survey the wells and establish relative groundwater elevations. At this time, MW-7 was covered by a parked car and therefore MW-6 was surveyed in its place.

3.0 DATA INTERPRETATION AND CONCLUSIONS

Relative survey information, depth to water readings, and calculated groundwater elevations are shown in **Table 1** below for both investigation dates. The relative groundwater elevations established at the beginning of each test were used as a benchmark to establish groundwater elevation from the data obtained from the Level Troll 700 data loggers. Data obtained from the data loggers is illustrated in **Graph 1**, **Graph 2** and **Graph 3** for each monitoring well. The average depth to water values were obtained using the average water depth observed with the data loggers. Groundwater elevations are compared in **Graph 4**.

Table 1
Calculated Groundwater Elevation

Well No.	Well Diameter (in)	Total Well Depth (ft)	Survey Reading (ft)	Casing Elevation (ft)	DTW 7/13/2018	DTW 9/24/2018	GW ELV 9/24/2018
MW2A	2	47.5	**4.95**	**95.05**	**39.93**	**40.13**	**54.92**
MW10B	2	60.6	**5.54**	**94.46**	**-**	**39.90**	**54.56**
MW10C	1	45.35	**5.68**	**94.32**	**38.84**	**39.76**	**54.56**
MW6A	2	69.35	**6.56**	**93.44**	**-**	**39.07**	**54.37**
MW6B	1	58.78	**6.56**	**93.44**	**-**	**39.02**	**54.42**
MW6C	1	46.49	**6.56**	**93.44**	**-**	**39.03**	**54.41**
MW7	1	-	**6.56**	**93.44**	**39.68**	**39.03**	**54.41**

Groundwater velocity and direction can be calculated between two wells by using Darcy's law with the following equation:

$$v = \frac{K * \frac{dh}{dl}}{\rho}$$

V= Groundwater velocity
K= Hydraulic Conductivity
Dh= Difference in head
Dl= Distance between wells
P= porosity

The following assumptions are made when applying this equation:

a. The hydraulic conductivity and hydraulic gradient across the Site are constant.
b. The aquifer is homogeneous, isotropic, and of infinite aerial extent (no boundaries).

Assuming the soil at the saturated zone across the Site is silty sand, the approximate range of hydraulic conductivity is between 3.0 feet/day to 0.152 feet/day. The horizontal component of groundwater velocity is determined by applying the Darcy equation between MW-10 and MW-6, and the vertical component of velocity is determined by applying the Darcy equation between MW-10 and MW-2A. Adding the two groundwater velocity vectors yielded a magnitude of 6.9112 feet/year flowing in general Southern direction (57.5355° East of South).

Considering that the release of contaminants occurred in year 1967, the plume is anticipated to have moved around 350 feet in the South-Southeast direction. The direction and approximate location of the groundwater plume is indicated in the attached Plume Spread Map in **Attachment 3**.

The calculations used for determining the hydraulic conductivity are provided in **Attachment 4**.

GRAPHS

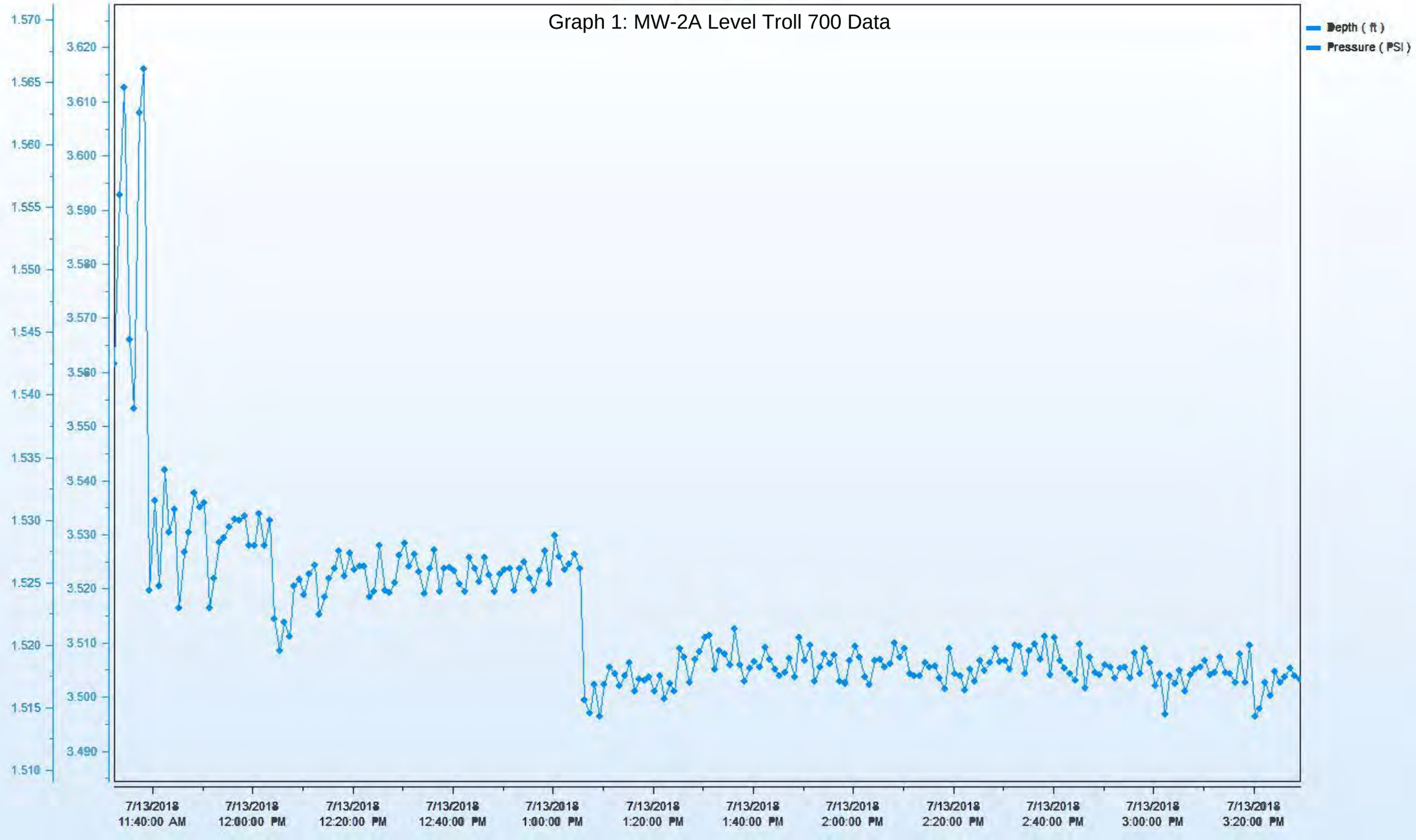
Graph 1	In-Situ Level Troll Data for MW-2A
Graph 2	In-Situ Level Troll Data for MW-7
Graph 3	In-Situ Level Troll Data for MW-10
Graph 4	Monitoring Well Groundwater Elevation

ATTACHMENTS

Attachment 1	Site Plan
Attachment 2	USGS 7.5-minute Topographic Map (Huntington, NY Quadrangle)
Attachment 3	Plume Spread Map
Attachment 4	Groundwater Velocity Calculations

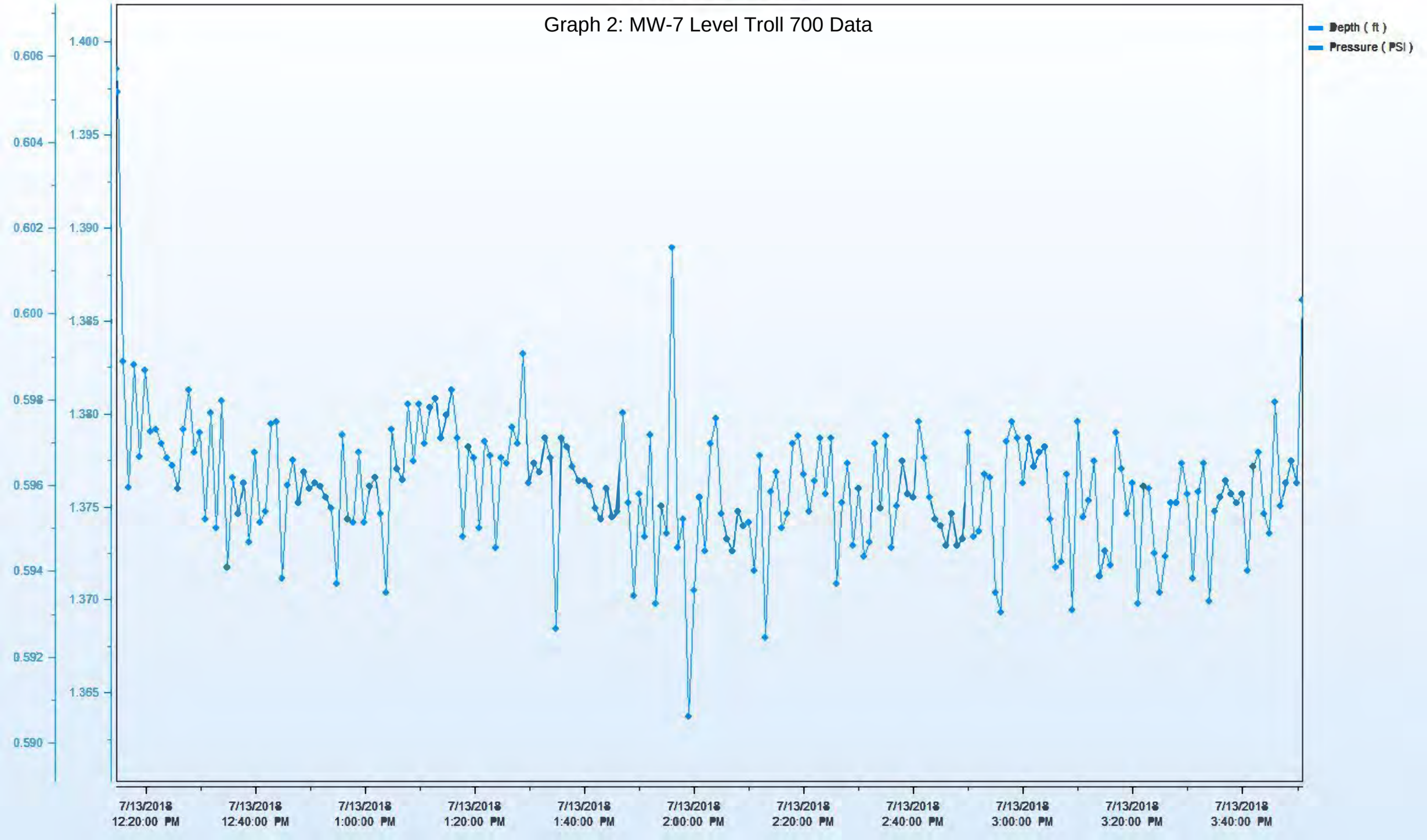
Astro - Farmingdale

Graph 1: MW-2A Level Troll 700 Data



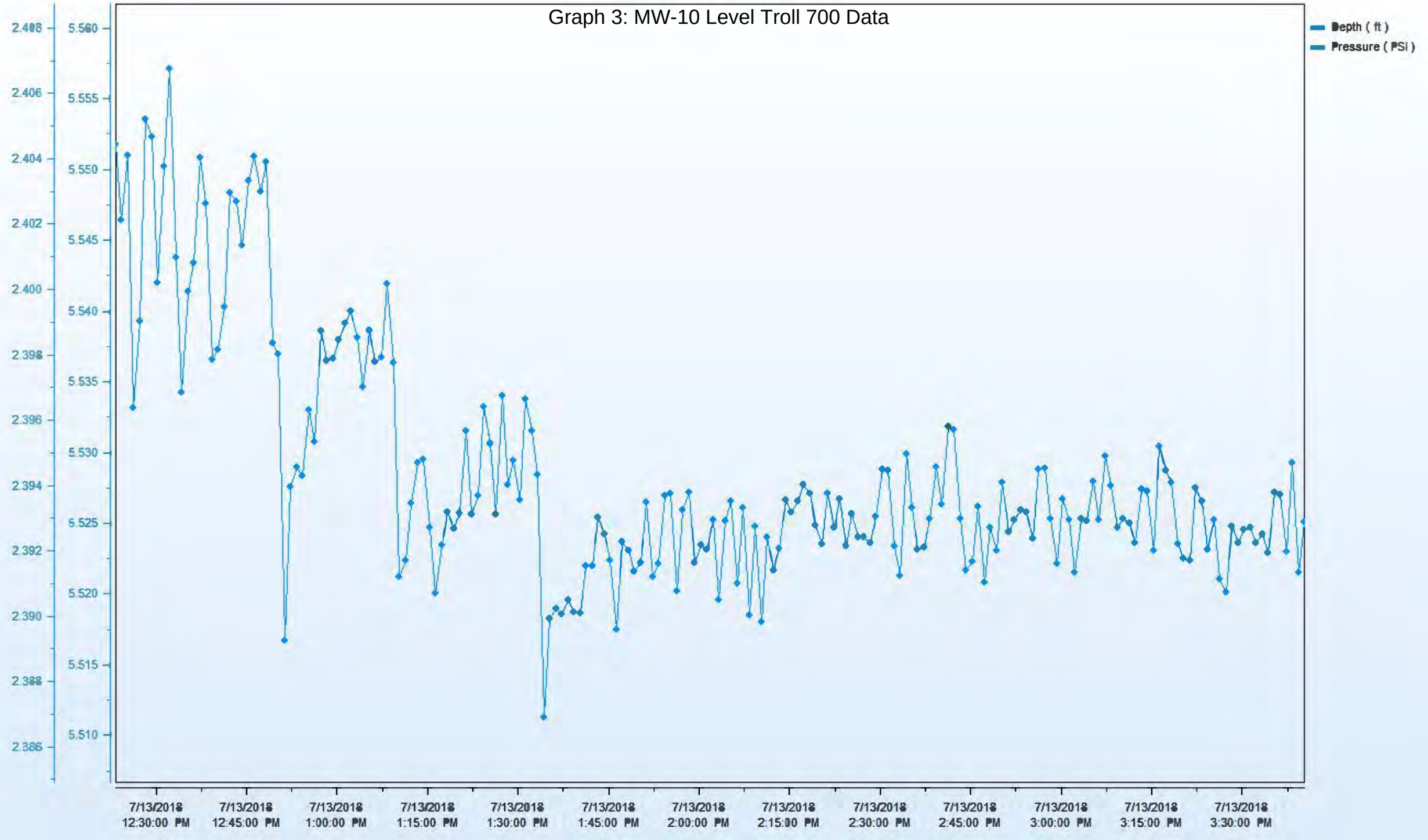
Astro - Farmingdale

Graph 2: MW-7 Level Troll 700 Data

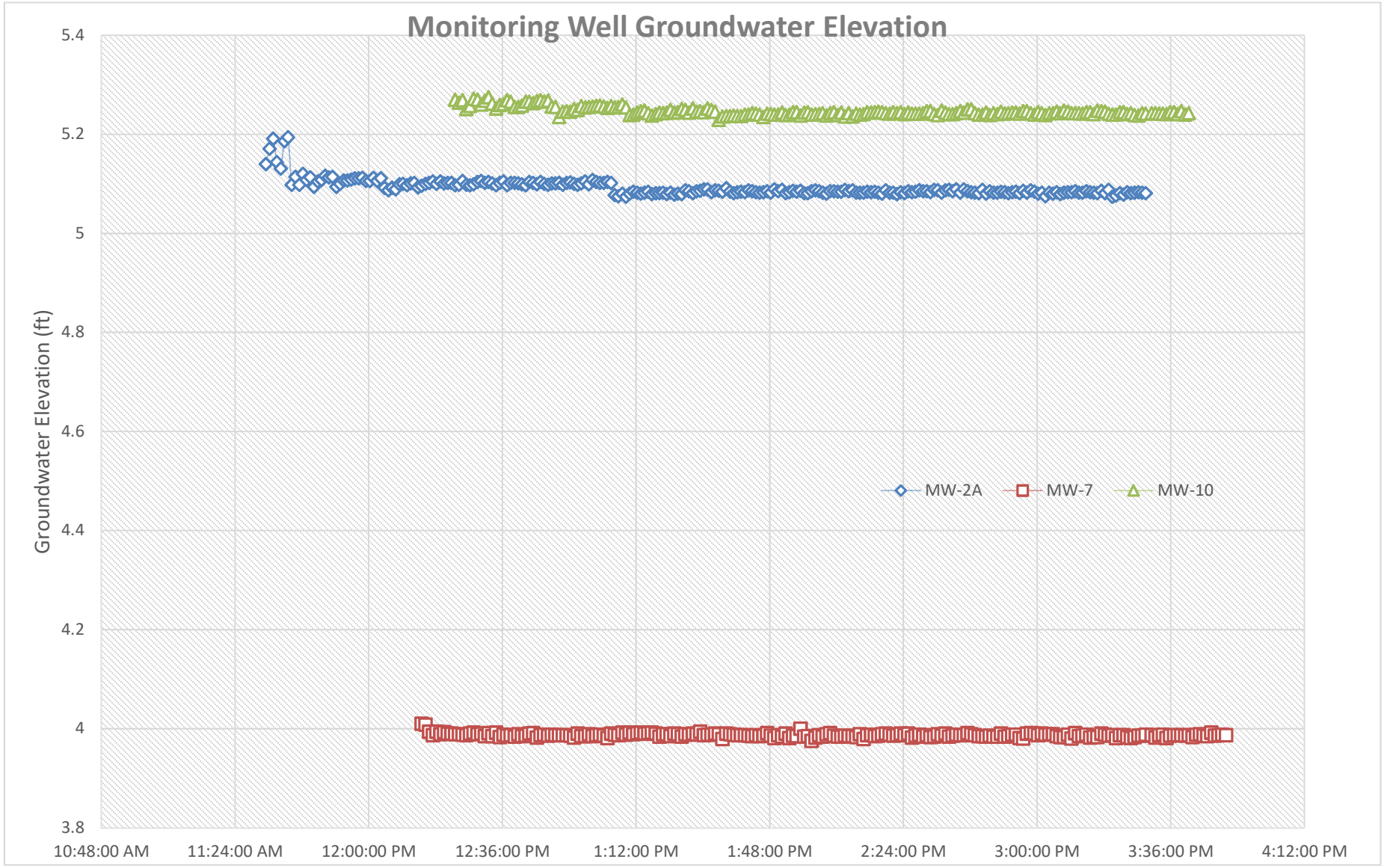


Astro - Farmingdale

Graph 3: MW-10 Level Troll 700 Data



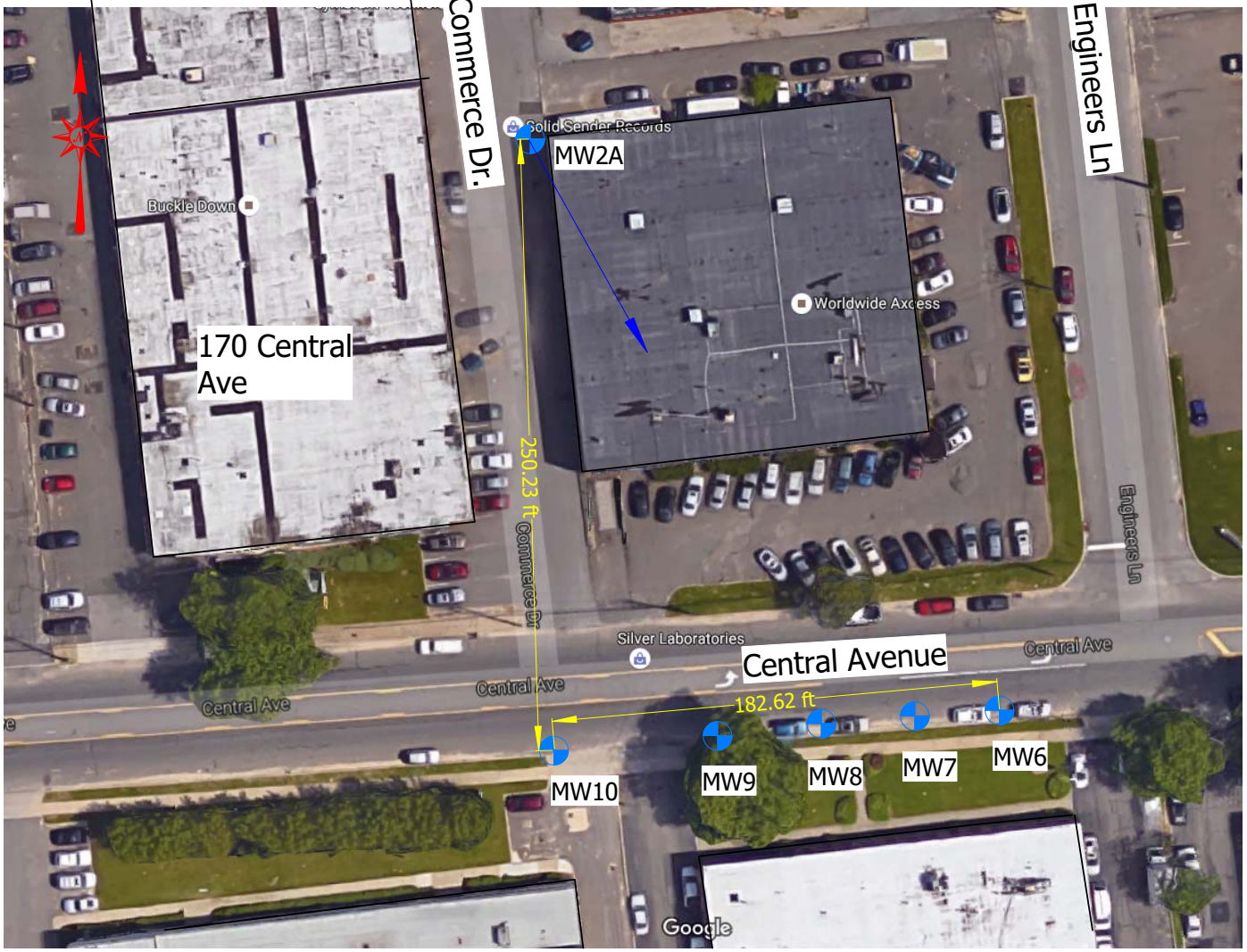
Graph 4

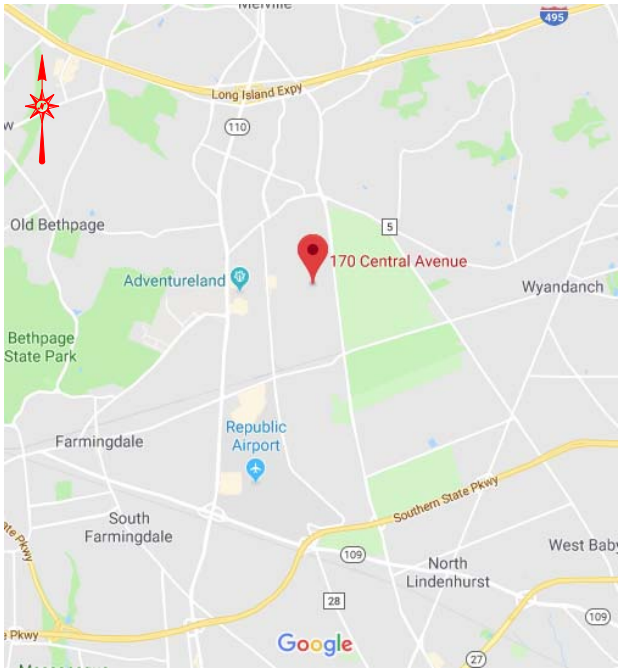

Monitoring Well Groundwater Elevation
Groundwater Elevation (ft)
5.4
5.2
5
4.8
4.6
4.4
4.2
4
3.8
10:48:00 AM
11:24:00 AM
12:00:00 PM
12:36:00 PM
1:12:00 PM
1:48:00 PM
2:24:00 PM
3:00:00 PM
3:36:00 PM
4:12:00 PM
MW-2A
MW-7
MW-10

ATTACHMENTS

ATTACHMENT 1

Site Plan





KEY MAP

LEGEND

- MONITORING WELL
- GROUNDWATER DIRECTION

Well No.	Well Diameter (in)	Total Well Depth (ft)	Survey Reading (ft)	Casing Elevation (ft)	DTW 7/13/2018	DTW 9/24/2018	GW ELV 9/24/2018
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PROJECT: ASTRO Electroplating Inc.
170 Central Avenue
Farmingdale, NY 11735

TITLE: Site Plan

DATE: Sep 26, 2018

DRAWING BY: ZM

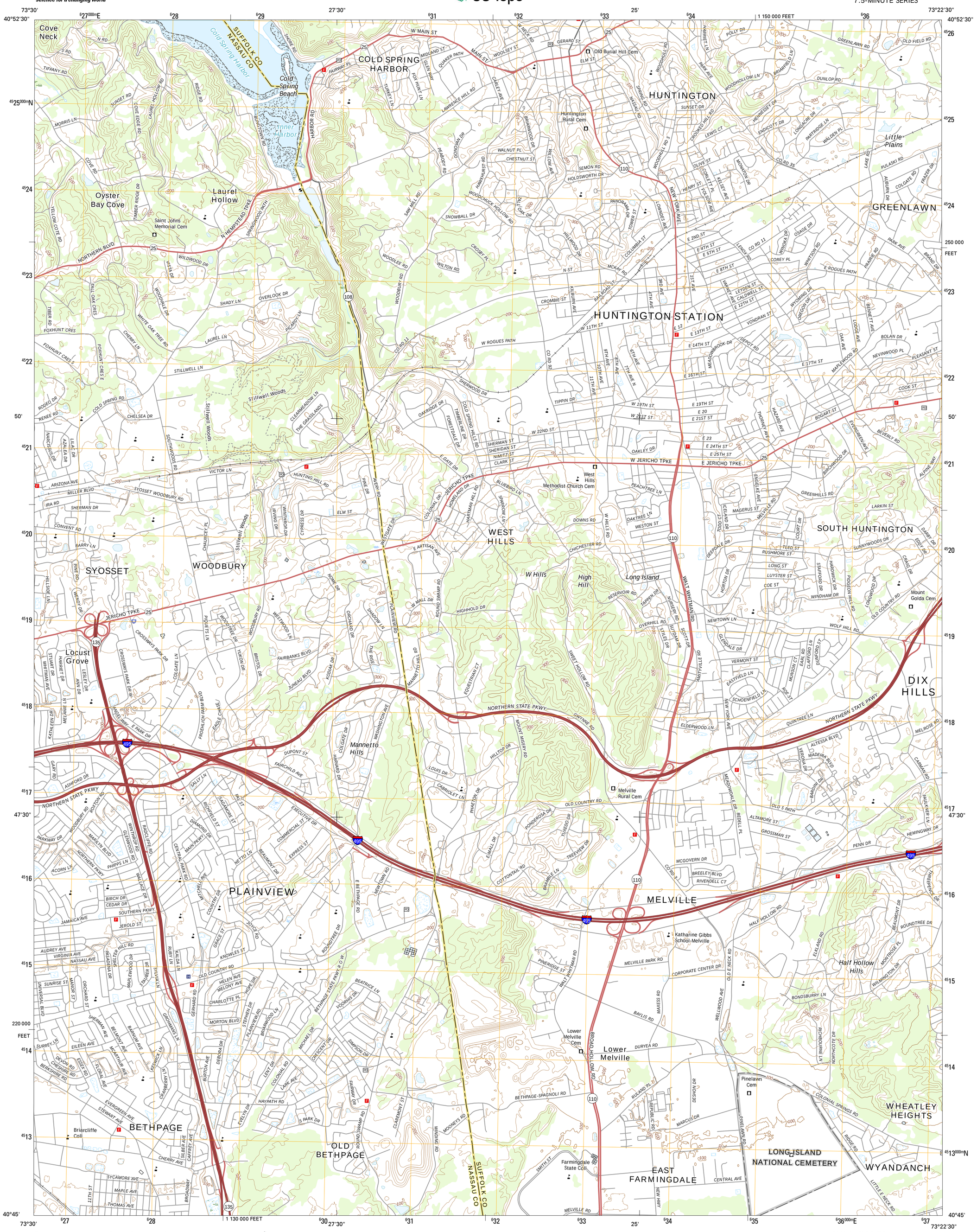
ATTACHMENT 2

Topographic Map

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

HUNTINGTON QUADRANGLE
NEW YORK
7.5-MINUTE SERIES

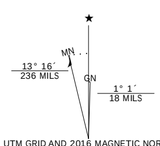


Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 18T
10 000-foot ticks: New York Coordinate System of 1983 (long island zone)

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, June 2013
Roads..... U.S. Census Bureau, 2015 - 2016
Names.....GNIS, 2016
Hydrography.....National Hydrography Dataset, 2013
Contours.....National Elevation Dataset, 2015
Boundaries.....Multiple sources; see metadata file 1972 - 2016

Wetlands.....FWS National Wetlands Inventory 1977 - 2014



UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000-m Square ID
XL
Grid Zone Designation
18T

SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2
1000 500 0 METERS 1000 2000
1 0.5 0 1
MILES
1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
FEET

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

QUADRANGLE LOCATION

ROAD CLASSIFICATION

Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

1	2	3
4		5
6	7	8

1 Bayville
2 Lloyd Harbor
3 Northport
4 Hicksville
5 Greenlawn
6 Freeport
7 Amityville
8 Bay Shore West

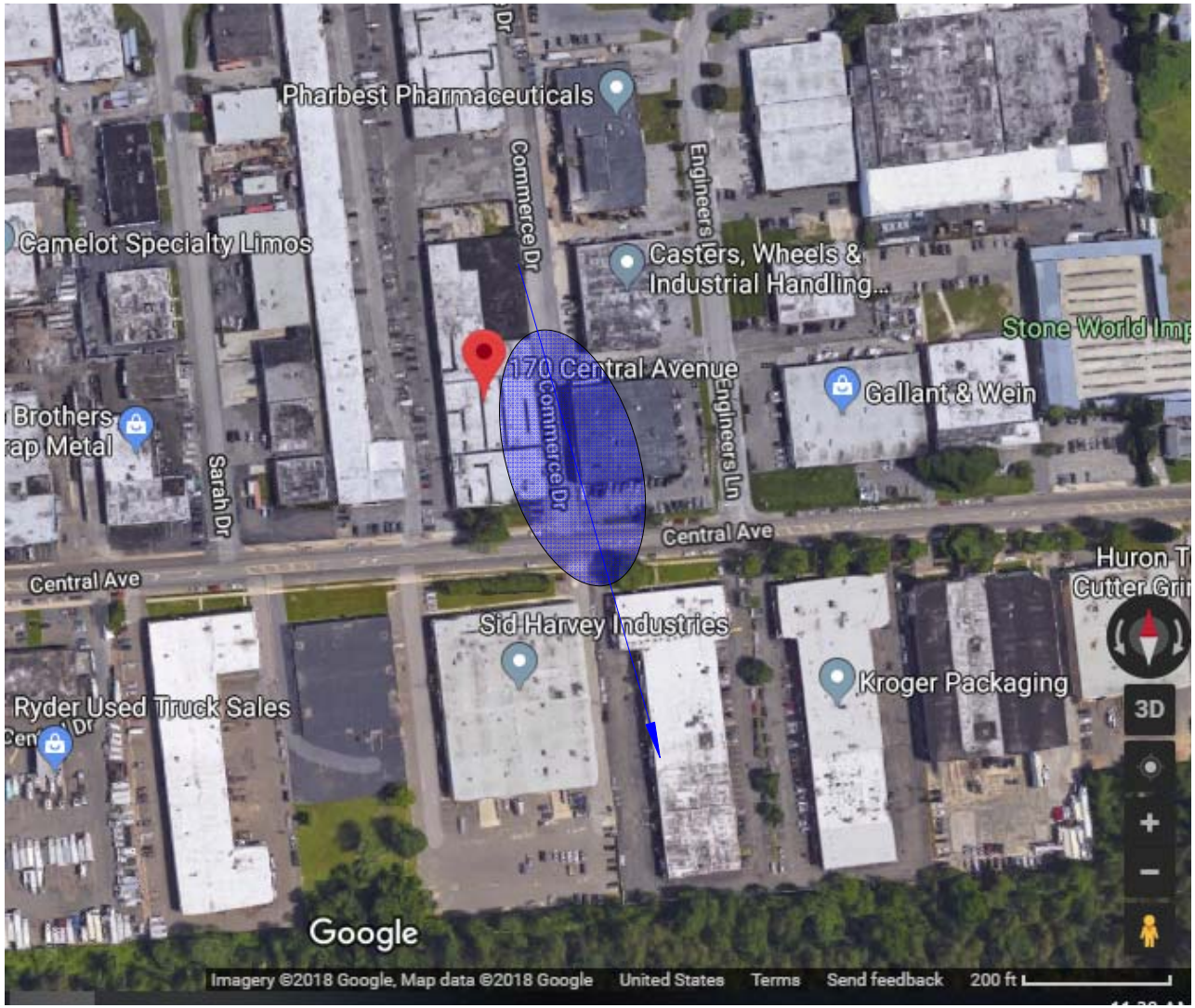
ADJOINING QUADRANGLES

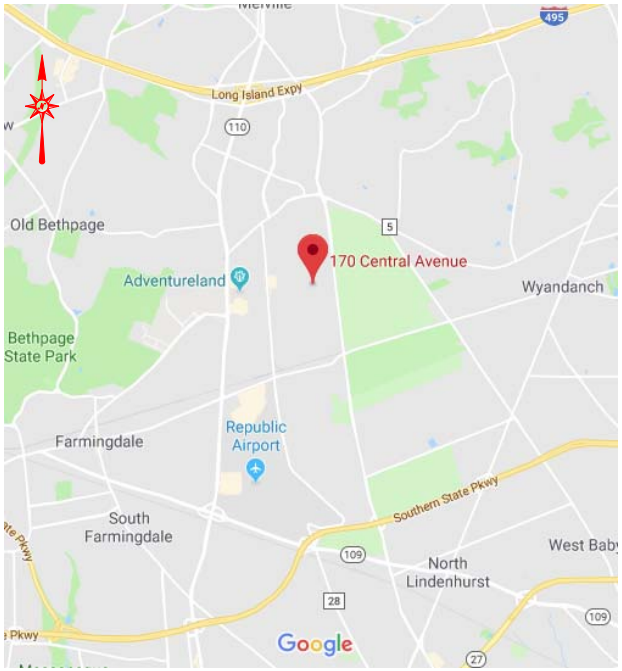
HUNTINGTON, NY
2016

NSN 7643016396793
NGA REF NO. USGS24K21527

APPENDIX 3

Plume Spread Map





KEY MAP

LEGEND

GROUNDWATER PLUME
GROUNDWATER DIRECTION

Release Year:	**1967**	
Plume spread rate:	**6.9**	**Feet/year**
Distance traveled:	**352.4718**	**Feet**

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PROJECT: ASTRO Electroplating Inc.
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TITLE: Plume Spread

DATE: Oct 11, 2018

DRAWING BY: ZM

APPENDIX 4

Groundwater Velocity Calculations

Groundwater Velocity Calculations

Reference: Construction Dewatering & Groundwater Control (2007) J. Patrick Powers - John Wiley & Sons

Former Astro Electroplating: 170 Central Avenue, Farmingdale, NY: 7/19/2018 & 9/24/2018

Horizontal Velocity (MW10-MW6) E+5.44°N

Darcy's Law for velocity $v = \frac{K * \frac{dh}{dl}}{\rho}$

		Max.		Min.	
K	Hydraulic conductivity	10.000	M/DAY	0.500	M/DAY
K	Hydraulic conductivity	3.049	FT/DAY	0.152	FT/DAY
dh	Difference in head	0.15	FT	0.15	FT
dl	Distance	180	FT	180	FT
p	porosity	0.25		0.4	
degrees North of East		5.44			
Convert degrees to Rads		0.09			
	V_1=	**0.01**	**FT/DAY**	**0.000**	**FT/DAY**
	V_1=	**3.7**	**FT/YEAR**	**0.116**	**FT/YEAR**
	V_{1x}=	**3.693**	**FT/YEAR**		
	V_{1y}=	**0.352**	**FT/YEAR**		

Vertical Velocity (MW10-MW2A) S+2.23°W

Darcy's Law for velocity $v = \frac{K * \frac{dh}{dl}}{\rho}$

		Max.		Min.	
K	Hydraulic conductivity	10.000	M/DAY	0.500	M/DAY
K	Hydraulic conductivity	3.049	FT/DAY	0.152	FT/DAY
dh	Difference in head	0.36	FT	0.36	FT
dl	Distance	248	FT	248	FT
p	porosity	0.25		0.4	
degrees west of south		2.23			
Convert degrees to Rads		0.0389208			
	V_2=	**0.02**	**FT/DAY**	**0.001**	**FT/DAY**
	V_2=	**6.5**	**FT/YEAR**	**0.202**	**FT/YEAR**
	V_{2x}=	**-0.251**	**FT/YEAR**		
	V_{2y}=	**-6.457**	**FT/YEAR**		

Net Groundwater Velocity Vector

Vx=V1x+V2x=	**3.441**	**FT/YEAR**		
Vx=V1y+V2y=	**-6.105**	**FT/YEAR**		
Calculated GW Velocity=	**7.0080**	**FT/YEAR**	**0.22**	**FT/YEAR**
	29.409184	**°E of S**		**°E of S**