Mr. Jason Pelton
Project Manager
New York State Department of Environmental Conservation
Remedial Bureau D
625 Broadway
Albany, New York 12233-7015

Arcadis of New York, Inc.
Two Huntington Quadrangle
Suite 1S10
Melville
New York 11747
Tel 631 249 7600
Fax 631 249 7610
www.arcadis.com

ENVIRONMENT

Subject:
Results of First Quarter 2019 System Operation and Monitoring,
Bethpage Park Groundwater Containment System (BPGWCS),
Operable Unit 3 (Former Grumman Settling Ponds),
Bethpage, New York, NYSDEC Site #1-30-003A.

Date:
May 31, 2019

Contact:
Christopher Engler

Phone:
315 409 6579

Email:
christopher.engler@arcadis.com

Our ref:
NYNG2019.32TM.RPTI4

Dear Jason:

Enclosed is one electronic PDF copy of the first quarter results of the OU3 BPGWCS operation and monitoring, preformed in accordance with the NYSDEC-approved OU3 Groundwater IRM OM&M Manual (Arcadis 2009) and the NYSDEC-approved Sampling and Analysis Plan (SAP; Arcadis 2009). As we have transitioned to electronic submittals (via PDF) in line with NYSDEC's paper reduction program, hard copies of the report can be provided on request.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Arcadis of New York, Inc.

Christopher Engler, PE
New York PE-069748
Vice President

Copies:
Edward Hannon, Northrop Grumman Corporation
Donald Hesler, NYSDEC
Steven Karpinski, NYS Dept. of Health
John Lovejoy, Nassau County Dept. of Health
Carol Stein, USEPA
Carlo San Giovanni, Arcadis
Public Repository
File

Enclosures:

TABLES

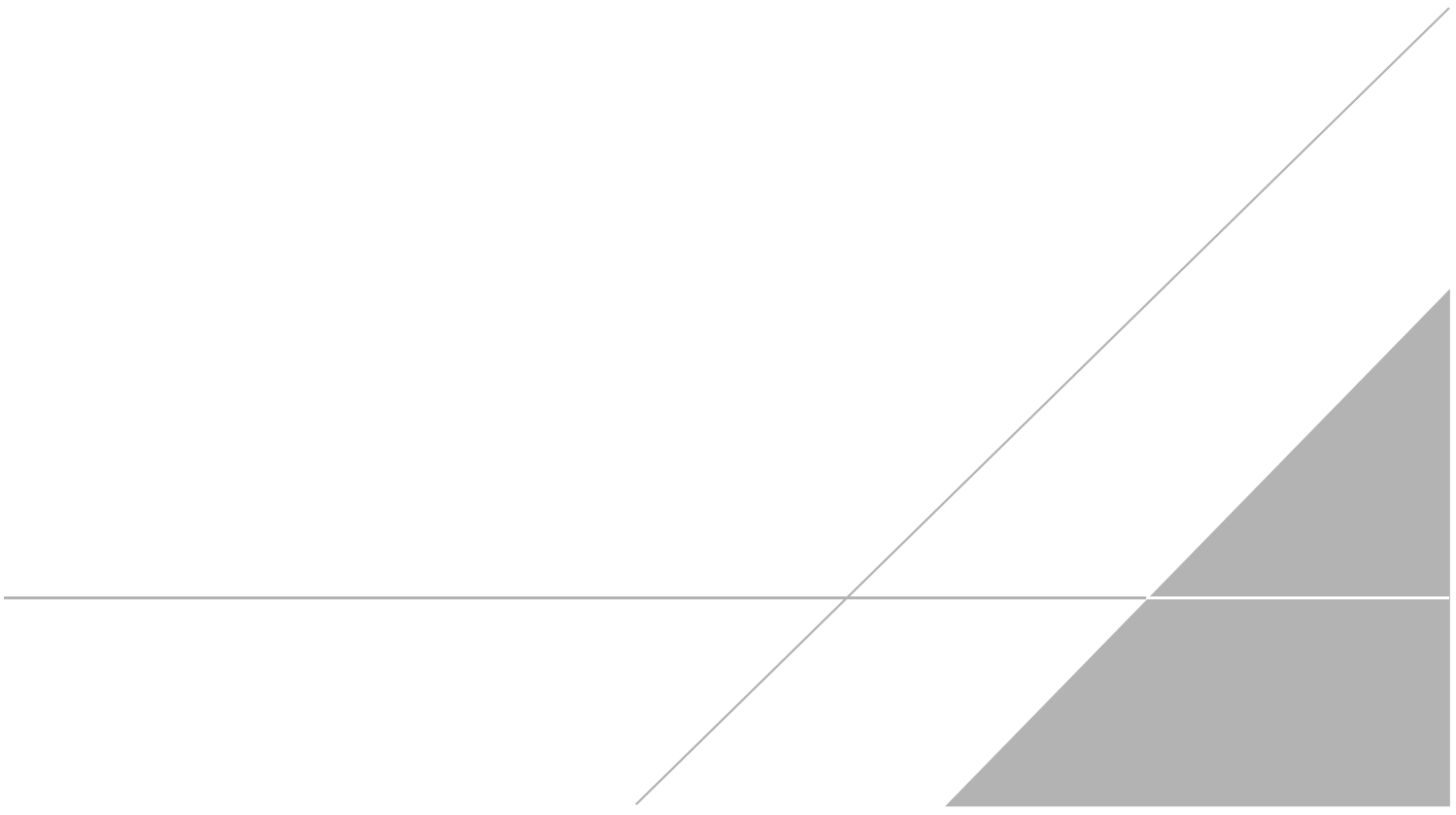


Table 1
Operational Summary
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

ARCADIS Design & Consultancy for natural and built assets

MONTH	DAY																													Days Operational [1]
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
2009 Total																																160
2010 Total																																352
2011 Total																																351
2012 Total																																353
2013 Total																																354
2014 Total																																349
2015 Total																																348
2016 Total																																351
2017 Total																																354
2018 total																																348
Jan 2019	(2)																(3)					(4)										30
Feb 2019																																28
Mar 2019																																31
1Q 2019																																89
TOTAL																																**3409**

Legend:

Indicates system online the majority or all of the day.
Indicates system operated with reduced flow rates.
Indicates system off-line the majority or all of the day.

Abbreviations, Notes, and Units on last page.

Table 1
Operational Summary
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Notes:

1. Days the system was operational for the majority of the day are counted as one day.

First Quarter 2019

2. RW-2 pump failed on December 20, 2018 and system was brought back online operating at a reduced flowrate.
3. RW-2 pump failed and system was brought back online operating at a reduced flowrate.
4. System shutdown by site operator to accommodate replacement of valves and fittings.

Abbreviations/Units:

1Q	First Quarter
RW	Recovery Well

Table 2
Summary of Influent Water Sample Analytical Results
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

ARCADIS Design & Consultancy for natural and built assets

Compound	04/04/18 (µg/L)	08/07/18 (µg/L)	11/08/18 (µg/L)	03/01/19 (µg/L)
Project VOCs				
1,1,1 - Trichloroethane	< 0.50	< 1.0	< 1.0	< 1.0
1,1 - Dichloroethane	< 1.0	< 1.0	< 1.0	< 1.0
1,2 - Dichloroethane	< 1.0	< 1.0	< 1.0	< 1.0
1,1 - Dichloroethene	< 0.50	< 1.0	< 1.0	< 1.0
Tetrachloroethene	< 0.50	< 1.0	< 1.0	< 1.0
Trichloroethene	**2.9**	**2.6**	**2.6**	**3.1**
Vinyl Chloride	**6.3**	**2.7**	**1.9**	**2.7**
cis 1,2-Dichloroethene	**7.5**	**5.3**	**6.8**	**7.9**
trans 1,2-Dichloroethene	< 0.50	< 1.0	< 1.0	< 1.0
Benzene	< 0.50	< 0.50	< 0.50	< 0.50
Toluene	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	< 1.0	< 1.0	< 1.0	< 1.0
m,p-Xylene	< 1.0	< 1.0	< 1.0	< 1.0
Subtotal Project VOCs	**16.7**	**10.6**	**11.3**	**13.7**
Non-Project VOCs				
1,1,2,2-Tetrachloroethane	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2-Trichloroethane	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Butanone	< 5.0	< 5.0	--	--
2-Butanone	< 10	< 10	< 10	< 10
4-Methyl-2-Pentanone	< 5.0	< 5.0	< 5.0	< 5.0
Acetone	< 10	< 10	< 10	< 10
Bromodichloromethane	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	< 2.0	< 2.0	< 2.0	< 2.0
Carbon Disulfide	< 2.0	< 2.0	< 2.0	< 2.0
Carbon Tetrachloride	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene	< 1.0	< 1.0	< 1.0	< 1.0
Chlorodibromomethane	< 1.0	< 1.0	< 1.0	< 1.0
Chlorodifluoromethane (Freon 22)	< 5.0	< 5.0	--	< 5.0
Chloroethane	< 1.0	< 1.0	< 1.0	< 1.0
Chloroform	**0.54**	< 1.0	< 1.0	< 1.0
Chloromethane	< 1.0	< 1.0	< 1.0	< 1.0
cis-1,3-Dichloropropene	< 1.0	< 1.0	< 1.0	< 1.0

Abbreviations, Notes, Qualifiers, and Units on last page.

Table 2
Summary of Influent Water Sample Analytical Results
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

ARCADIS Design & Consultancy for natural and built assets

Compound	04/04/18 (µg/L)	08/07/18 (µg/L)	11/08/18 (µg/L)	03/01/19 (µg/L)
Non-Project VOCs				
Dichlorodifluoromethane (Freon 12)	< 2.0	< 2.0	--	< 2.0
Dichloromethane	< 0.50	< 2.0	< 2.0	< 2.0
Ethylbenzene	< 1.0	< 1.0	< 1.0	< 1.0
Methyl N-Butyl Ketone	< 5.0	< 5.0	< 5.0	< 5.0
Methyl Tert-Butyl Ether	< 1.0	< 1.0	--	< 1.0
Styrene (Monomer)	< 1.0	< 1.0	< 1.0	< 1.0
trans-1,3-Dichloropropene	< 1.0	< 1.0	< 1.0	< 1.0
Trichlorofluoromethane (Freon 11)	< 2.0	< 2.0	--	< 2.0
Trichlorotrifluoroethane (Freon 113)	< 0.50	< 5.0	< 5.0	< 5.0
1-Chloro-1,1-difluoroethane (Freon 142b)	< 5.0	< 5.0	--	--
Subtotal Non-Project VOCs	**0.54**	0	0	0
Total VOCs[1]	**17**	**11**	**11**	**14**
1,4-Dioxane[2]	**1.08**	**0.52**	**0.59**	**0.8**
Compound	**04/04/18 (µg/L)**	**08/07/18 (µg/L)**	**11/08/18 (µg/L)**	**03/01/19 (µg/L)**
Inorganics				
Dissolved Cadmium	--	< 3.0	--	--
Total Cadmium	--	< 3.0	--	--
Dissolved Chromium	--	**10.2**	--	--
Total Chromium	--	**10.5**	--	--
Dissolved Iron	--	**108**	--	**204**
Total Iron	--	**166**	--	--
Total Manganese	--	--	--	**47.7**
pH[3]	5.7	5.8	5.7	5.5

Abbreviations, Notes, Qualifiers, and Units:

-- Not Analyzed
USEPA United States Environmental Protection Agency
VOC Volatile Organic Compound

1. "Total VOCs" represents the sum of individual concentrations of the compounds detected. The values used in calculations referenced in this report have been rounded to the nearest whole number.

2. Samples collected prior to July 11, 2018 were analyzed for 1,4-Dioxane using USEPA Method 522-SIM. After July, 2018 1,4-Dioxane analysis is performed using USEPA Method 8270D-SIM-CLLE.

3. Influent pH samples collected and measured in the field by Arcadis personnel on the dates listed using a field calibrated pH/conductivity meter. pH units are standard units.

2.9 Bold value indicates a detection.
<0.50 Compound not detected at or above the laboratory quantification limit.
J Result is estimated.
µg/L micrograms per liter

Table 3
Summary of Effluent Water Sample Analytical Results
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

ARCADIS Design & Consultancy for natural and built assets

Compound	Discharge Limit[1] (µg/L)	04/04/18 (µg/L)	05/11/18 (µg/L)	06/07/18 (µg/L)	07/11/18 (µg/L)	08/07/18 (µg/L)	09/05/18 (µg/L)	10/10/18 (µg/L)	11/08/18 (µg/L)	12/06/18 (µg/L)	01/10/19 (µg/L)	02/05/19 (µg/L)	03/01/19 (µg/L)
Project VOCs													
1,1,1-Trichloroethane	5[2]	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 1.0	< 0.50	<0.50	<0.50	<0.50
1,1-Dichloroethene	5[2]	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 1.0	< 0.50	<0.50	<0.50	<0.50
Tetrachloroethene	5[2]	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 1.0	< 0.50	<0.50	<0.50	<0.50
Trichloroethene	5[2]	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 1.0	< 0.50	<0.50	<0.50	<0.50
Vinyl Chloride	5[2]	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 1.0	< 0.50	<0.50	<0.50	<0.50
cis 1,2-Dichloroethene	5[2]	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 1.0	< 0.50	<0.50	<0.50	<0.50
trans 1,2-Dichloroethene	5[2]	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 1.0	< 0.50	<0.50	<0.50	<0.50
Subtotal Project VOCs		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Compound	Discharge Limit[1] (µg/L)	04/04/18 (µg/L)	05/11/18 (µg/L)	06/07/18 (µg/L)	07/11/18 (µg/L)	08/07/18 (µg/L)	09/05/18 (µg/L)	10/10/18 (µg/L)	11/08/18 (µg/L)	12/06/18 (µg/L)	01/10/19 (µg/L)	02/05/19 (µg/L)	03/01/19 (µg/L)
Non-Project VOCs													
Chloroform	5[2]	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 1.0	< 0.50	<0.50	<0.50	<0.50
Dichloromethane	5[2]	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 1.0	< 0.50	<0.50	<0.50	<0.50
Trichlorotrifluoroethane (Freon 113)	5[2]	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 2.0	< 0.50	<0.50	<0.50	<0.50
Subtotal Non-Project VOCs		0	0	0	0	0	0	0	0	0	0	0	0
Total VOCs[3]		0	0	0	0	0	0	0	0	0	0	0	0
Treatment Efficiency[4]		> 99.9%	> 99.9%	> 99.9%	> 99.9%	> 99.9%	> 99.9%	> 99.9%	> 99.9%	> 99.9%	> 99.9%	> 99.9%	> 99.9%

Compound	Discharge Limit[1] (µg/L)	04/04/18 (µg/L)	05/11/18 (µg/L)	06/07/18 (µg/L)	07/11/18 (µg/L)	08/07/18 (µg/L)	09/05/18 (µg/L)	10/10/18 (µg/L)	11/08/18 (µg/L)	12/06/18 (µg/L)	01/10/19 (µg/L)	02/05/19 (µg/L)	03/01/19 (µg/L)
Inorganics													
Dissolved Cadmium	5	< 3.0	--	--	--	< 3.0	--	--	--	--	--	--	--
Total Cadmium	5	< 3.0	--	--	--	< 3.0	--	--	--	--	--	--	--
Dissolved Chromium	50	< 10	--	--	--	< 10	--	--	--	--	--	--	--
Total Chromium	50	< 10	--	--	--	< 10	--	--	--	--	--	--	--
Dissolved Iron	600	**172**	**158**	< 100	**141**	< 100	--	--	--	--	--	--	--
Total Iron	600	**218**	**106**	< 100	**168**	**138 J**	< 100	**145**	**142**	**144**	**120**	**179**	**204**
Total Mercury	250	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	--	--	--	--	--	--	--
Total Manganese	600	--	--	--	--	**50.2**	**46.2**	**47.3**	**50.6**	**48.8**	**52.4**	**51.2**	**47.7**
Nitrate and Nitrite	10,000	**2,800**	**2,800**	**2,900**	**2,500**	**2,800**	**2,900**	**2,600**	**2,600**	**2,800**	**2,700**	**2,800**	**2,500**
Toal Kjeldahl Nitrogen	10,000	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 200	< 201	**450**
Total Nitrogen	10,000	**2,800**	**2,800**	**2,900**	**2,500**	**2,800**	**2,900**	**2,600**	**2,600**	**2.8**	**2,700**	**2,800**	**3,000**
1,4-Dioxane[5]	NE	**0.997**	**0.984**	**0.646**	**0.71**	**0.52**	**0.45**	**0.57**	**0.49**	**0.78**	**0.73**	**1.10**	**0.76**
pH[6]	5.5-8.5	6.6	6.9	7.0	6.5	7.0	6.5	6.5	6.8	6.8	6.9	7.0	6.6

Abbreviations, Notes, Qualifers, and Units on last page.

Table 3
Summary of Effluent Water Sample Analytical Results
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

ARCADIS Design & Consultancy for natural and built assets

Abbreviations, Notes, Qualifiers, and Units:

--	Not Analyzed
NE	Not Established
NYSDEC	New York State Department of Environmental Conservation
SPDES	State Pollutant Discharge Elimination System
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1. Discharge limits per the interim SPDES equivalency program or Division of Water Technical and Operational Guidance Series (TOGS 1.1.1) Quality Standards and Guidance Values and Groundwater Effluent Limitations, if the compound is not part of the SPDES Permit Equivalency.

2. As of September 2017, the 10 SPDES VOCs discharge limits are per Site Number 1-30-003A Operable Unit 3 SPDES Permit Equivalency.

3. "Total VOCs" represents the sum of individual concentrations of compounds detected. The values used in calculations referenced in this report have been rounded to the nearest whole

4. Treatment efficiency was calculated by dividing the difference between the influent and effluent total VOC concentrations by the influent total VOC concentration.

5. Samples collected prior to July 11, 2018 were analyzed for 1,4-Dioxane using USEPA Method 522-SIM. Samples collected are analyzed for 1,4-Dioxane using USEPA Method 8270D-SIM-CLLE.

6. Effluent pH measured on site using a handheld pH meter. pH units are standard units.

120	Bold value indicates a detection.
< 0.50	Compound not detected above the laboratory quantification limit.
J	Result is estimated.
µg/L	micrograms per liter

Table 4
Influent Vapor Sample Analytical Results
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

ARCADIS Design & Consultancy for natural and built assets

Compound[1]	04/05/18 (µg/m^3)	08/07/18 (µg/m^3)	11/08/18 (µg/m^3)	03/01/19 (µg/m^3)
Project VOCs				
1,1,1 - Trichloroethane	**0.87**	**0.71**	**0.76**	**0.76**
1,1 - Dichloroethane	**4.9**	**3.8**	**3.6**	**6.9**
1,2 - Dichloroethane	**0.45 J**	< 0.65	< 0.65	< 0.65
1,1 - Dichloroethene	**1.7**	**1.2**	**1.2**	**1.9**
Tetrachloroethene	**3.0**	**2.9**	**4.1**	**2.8**
Trichloroethene	**73.1**	**53.7**	**45**	**54**
Vinyl Chloride	**81.8**	**47.8**	**29.1**	**52.7**
cis 1,2-Dichloroethene	**137**	**99.5**	**120**	**165**
trans 1,2-Dichloroethene	**0.44 J**	< 0.63	< 0.63	**0.52 J**
Benzene	**0.61**	**0.77**	**0.64**	**0.93**
Toluene	**3.6**	**0.64**	**0.41 J**	**0.87**
o-Xylene	**0.74**	< 0.69	< 0.69	**0.69**
m,p-Xylene	**1.1**	< 0.69	< 0.69	**0.74**
Subtotal Project VOCs	**309**	**211**	**205**	**289**
Non-Project VOCs				
1,1,2,2-Tetrachloroethane	< 0.55	< 0.55	< 0.55	< 0.55
1,1,2-Trichloroethane	< 0.44	< 0.44	< 0.44	< 0.44
1,2-Dichloropropane	**0.45 J**	< 0.74	< 0.74	< 0.74
1,3-Butadiene	< 0.35	< 0.35	< 0.35	< 0.35
2-Butanone	**4.7**	**0.86**	**0.74**	**0.47**
4-Methyl-2-Pentanone	< 0.66	< 0.66	< 0.66	< 0.66
Acetone	**22**	**7.6**	**5.2**	**4.8**
Bromodichloromethane	< 0.54	< 0.54	< 0.54	< 0.54
Bromoform	< 0.33	< 0.33	< 0.33	< 0.33
Bromomethane	< 0.62	< 0.62	< 0.62	< 0.62
Carbon Disulfide	**7.5**	< 0.50	< 0.50	< 0.50
Carbon Tetrachloride	**0.62**	**0.59**	**0.48**	**0.42**
Chlorobenzene	< 0.74	< 0.74	< 0.74	< 0.74
Chlorodibromomethane	< 0.68	< 0.68	< 0.68	< 0.68
Chlorodifluoromethane (Freon 22)	**14**	**15**	**12**	**8.1**
Chloroethane	< 0.42	< 0.42	< 0.42	< 0.42
Chloroform	**11**	**8.8**	**7.8**	**6.3**
Chloromethane	**1.2**	**1.8**	**1.3**	**1.5**
cis-1,3-Dichloropropene	< 0.73	< 0.73	< 0.73	< 0.73
Dichlorodifluoromethane (Freon 12)	**2.5**	**2.4**	**2.4**	**1.9**
Dichloromethane	< 0.56	**2.8**	< 0.56	0.63
Ethylbenzene	**1.1**	< 0.69	< 0.69	< 0.69
Methyl N-Butyl Ketone	< 0.65	< 0.65	< 0.65	< 0.65
Methyl Tert-Butyl Ether	**0.43 J**	< 0.58	**0.47 J**	**0.50 J**
Styrene (Monomer)	< 0.68	< 0.68	< 0.68	< 0.68
trans-1,3-Dichloropropene	< 0.73	< 0.73	< 0.73	< 0.73
Trichlorofluoromethane (Freon 11)	**1.9**	**1.7**	**1.9**	**1.1**
Trichlorotrifluoroethane (Freon 113)	**2.1**	**2.3**	**2.1**	**1.8**
1-Chloro-1,1-difluoroethane (Freon 142b)	< 0.66	**0.45 J**	< 0.66	< 0.66
Subtotal Non-Project VOCs	**70**	**44**	**34**	**28**
Total VOCs[2]	**379**	**255**	**239**	**317**

Abbreviations, Notes, Qualifiers, and Units on last page.

Table 4
Influent Vapor Sample Analytical Results
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Abbreviations, Notes, Qualifiers, and Units:

ELAP	Environmental Laboratory Approval Program
NYSDOH	New York State Department of Health
OM&M	Operation, Maintenance, and Monitoring
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1. Vapor samples collected by Arcadis on the dates shown and submitted to a NYSDOH ELAP certified laboratory for VOC analyses per Modified USEPA Method TO-15. A VOC analyte list is provided in the DRAFT Bethpage Park Groundwater Containment System OM&M Manual (Arcadis 2016). Influent samples were collected at Vapor Sampling Port-1 (VSP-1); refer to Figure 3 of this OM&M Report for the location of VSP-1.

2. "Total VOCs" represents the sum of individual concentrations of compounds detected. The values used in calculations referenced in this report have been rounded to the nearest whole number.

0.87	Bold value indicates a detection.
< 0.65	Compound not detected above the laboratory quantification limit.
J	Result is estimated.
µg/m^3	micrograms per cubic meter

Table 5
Summary of Effluent Vapor Sample Analytical Results
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Compound[1]	04/05/18 (µg/m^3)	08/07/18 (µg/m^3)	11/08/18 (µg/m^3)	03/01/19 (µg/m^3)
Project VOCs				
1,1,1 - Trichloroethane	**0.60**	**0.50**	< 0.44	**0.65**
1,1 - Dichloroethane	**4.5**	**3.0**	**3.7**	**6.5**
1,2 - Dichloroethane	**0.36 J**	< 0.65	< 0.65	< 0.65
1,1 - Dichloroethene	**1.3**	**0.79**	**0.99**	**1.6**
Tetrachloroethene	**1.7**	**1.3**	**1.8**	**1.9**
Trichloroethene	**32**	**16**	**19**	**30**
Vinyl Chloride	**51.1**	**14.0**	**14.0**	**34.5**
cis 1,2-Dichloroethene	**100**	**43.2**	**67.4**	**114**
trans 1,2-Dichloroethene	< 0.63	< 0.63	< 0.63	< 0.63
Benzene	**1.1**	**1.7**	< 0.51	**1.0**
Toluene	**5.7**	**5.3**	**1.5**	**2.8**
o-Xylene	**0.34 J**	**0.34 J**	< 0.69	**0.69**
m,p-Xylene	**0.69**	**0.56 J**	< 0.69	**1.0**
Subtotal Project VOCs	**199**	**87**	**109**	**195**
Non-Project VOCs				
1,1,2,2-Tetrachloroethane	< 0.55	< 0.55	< 0.55	< 0.55
1,1,2-Trichloroethane	< 0.44	< 0.44	< 0.44	< 0.44
1,2-Dichloropropane	< 0.74	< 0.74	< 0.74	< 0.74
1,3-Butadiene	< 0.35	< 0.35	< 0.35	< 0.35
2-Butanone	**5.6**	**43.1**	**20**	**14**
4-Methyl-2-Pentanone	< 0.66	< 0.66	< 0.66	< 0.66
Acetone	**23**	**238**	**122**	**96.4**
Bromodichloromethane	< 0.54	< 0.54	< 0.54	< 0.54
Bromoform	< 0.33	< 0.33	< 0.33	< 0.33
Bromomethane	< 0.62	< 0.62	< 0.62	< 0.62
Carbon Disulfide	< 0.50	**0.26 J**	< 0.50	< 0.50
Carbon Tetrachloride	**0.45**	**0.46**	< 0.20	**0.33**
Chlorobenzene	< 0.74	< 0.74	< 0.74	**0.97**
Chlorodibromomethane	< 0.68	< 0.68	< 0.68	< 0.68
Chlorodifluoromethane (Freon 22)	< 0.56	**11**	**11**	**8.8**
Chloroethane	< 0.42	< 0.42	< 0.42	< 0.42
Chloroform	**13**	**9.3**	**10.0**	**10**
Chloromethane	**1.1**	**2.3**	**0.97**	**1.5**
cis-1,3-Dichloropropene	< 0.73	< 0.73	< 0.73	< 0.73
Dichlorodifluoromethane (Freon 12)	**2.5**	**2.3**	**2.5**	**2.1**
Dichloromethane	< 0.56	**1.3**	< 0.56	**0.66**
Ethylbenzene	**0.43 J**	< 0.69	< 0.69	< 0.69
Methyl N-Butyl Ketone	< 0.65	< 0.65	< 0.65	< 0.65
Methyl Tert-Butyl Ether	< 0.58	< 0.58	**0.29 J**	**0.36 J**
Styrene (Monomer)	< 0.68	< 0.68	< 0.68	< 0.68
trans-1,3-Dichloropropene	< 0.73	< 0.73	< 0.73	< 0.73
Trichlorofluoromethane (Freon 11)	**1.9**	**2.1**	**1.8**	**1.3**
Trichlorotrifluoroethane (Freon 113)	**2.3**	**2.1**	**2.3**	**2.5**
1-Chloro-1,1-difluoroethane (Freon 142b)	< 0.66	**0.36 J**	< 0.66	< 0.66
Subtotal Non-Project VOCs	**50**	**313**	**171**	**139**
Total VOCs[2]	**250**	**399**	**280**	**334**

Abbreviations, Notes, Qualifiers, and Units on last page.

Table 5
Summary of Effluent Vapor Sample Analytical Results
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Abbreviations, Notes, Qualifiers, and Units:

ELAP	Environmental Laboratory Approval Program
NYSDOH	New York State Department of Health
OM&M	Operation, Maintenance, and Monitoring
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1. Vapor samples collected by Arcadis on the dates shown and submitted to a NYSDOH ELAP certified laboratory for VOC analyses per Modified USEPA Method TO-15. A VOC analyte list is provided in the DRAFT Bethpage Park Groundwater Containment System OM&M Manual (Arcadis 2016). Effluent samples were collected at Vapor Sampling Port-5 (VSP-5); refer to Figure 3 of this OM&M Report for the location of VSP-5.

0.60	Bold value indicates a detection.
< 0.65	Compound not detected above the laboratory quantification limit.
J	Result is estimated.
µg/m^3	micrograms per cubic meter

Table 6
Summary of Effluent Vapor Tentatively Identified Compounds
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Compound[1,2,3]	04/05/18 (ppbv)	08/07/18 (ppbv)	11/08/18 (ppbv)	03/01/19 (ppbv)
Tentatively Identified Compounds				
2-Ethyl-1-hexanol	ND	ND	ND	**1.1 JN**
2-Methyl-1,3-Dioxolane	ND	**5.6 JN**	ND	ND
2-Phenyl-2-propanol	ND	**5.5 JN**	ND	**1.6 JN**
3-Methyl-Furan	ND	**2.6 JN**	ND	ND
Acetophenone	ND	**8.0 JN**	ND	**1.3 JN**
alkane	ND	ND	ND	**7.9 J**
alkane	ND	ND	ND	**4.4 J**
Carbon Dioxide	ND	**210 JNB**	**16 JNB**	**170 JNB**
Dimethyl ether	**290 JNB**	ND	ND	ND
Ethanol	ND	**2.6 JN**	ND	ND
Isopropylbenzene	**19 JN**	**16 JN**	ND	**3.3 JN**
Unknown	ND	**1.5 J**	ND	ND
Total VOC TICs	**19 J**	**41.8 J**	0	**19.6 J**

Abbreviations, Notes, Qualifiers, and Units:

ECU	Emission Control Unit
ELAP	Environmental Laboratory Approval Program
NYSDOH	New York State Department of Health
OM&M	Operation, Maintenance, and Monitoring
TIC	Tentatively Identified Compound
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1. Vapor samples collected by Arcadis on the dates shown and submitted to a NYSDOH ELAP certified laboratory for VOC analyses per Modified USEPA Method TO-15. A VOC analyte list is provided in the DRAFT Bethpage Park Groundwater Containment System OM&M Manual (Arcadis 2016). Effluent samples were collected at Vapor Sampling Port-5 (VSP-5); refer to Figure 3 of this OM&M Report for the location of VSP-5.

2. The ECUs were placed in a parallel configuration on 3/1/2018 to test for performance gain.

3. VSP-5 sample location moved to location parallel ECUs near effluent stack.

290	Bold value indicates a detection.
ND	TIC were not detected.
B	TIC was detected in the associated field blank.
J	Result is estimated.
N	Indicates presumptive evidence of a compound.
ppbv	parts per billion by volume

Table 7
Summary of System Parameters
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Date [1]	Water Flow Rates						Water Pressures					Air Flow Rate [2]	Air Pressures [5]					Air Temp. [5]
	Remedial Well [2]				Combined Influent [3]	Effluent [2,7]	Remedial Well Effluent [2,4]				Effluent [5]	Effluent	ECU Influents				Effluent	Effluent
	RW-1	RW-2	RW-3	RW-4			RW-1	RW-2	RW-3	RW-4			GAC-501	GAC-502	PPZ-601	PPZ-602		
	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(gpm)	(psi)	(psi)	(psi)	(psi)	(psi)	(scfm)	(iwc)	(iwc)	(iwc)	(iwc)	(iwc)	(^{o}R)
04/04/18	30.4	88.5	59.7	29.8	208	239	55	6	51	55	23	1,522	0.5	0.0	0.0	0.0	0.0	532
05/11/18	30.1	80.4	76.0	30.3	217	219	54	6	7	54	20	1,888	0.0	0.0	0.0	0.0	0.0	531
06/07/18	30.1	60.0	75.6	30.0	196	201	54	5	6	55	13	1,859	0.0	0.0	0.0	0.0	0.0	535
07/11/18	30.2	95.5	81.5	30.7	238	241	52	8 [(9)]	32 [(9)]	53	15	1,817	0.0	0.0	0.0	0.0	0.0	545
08/07/18	30.7	77.8	80.7	30.7	220	227	53	6 [(9)]	32 [(9)]	54	15	1,827	0.0	0.0	0.0	0.0	0.0	540
09/05/18	30.6	62.7	81.0	30.9	205	208	53	5 [(9)]	35 [(9)]	53	9	1,841	0.0	0.0	0.0	0.0	0.0	542
10/10/18	30.7	77.8	80.7	30.7	220	227	53	66	33	54	14	1,827	0.0	0.0	0.0	0.0	0.0	540
11/08/18	30.9	70.6	80.8	30.8	213	229	53	12	32	54	19	1,789	0.0	0.0	0.0	0.0	0.0	538
12/06/18	31.3	60.5	80.5	30.3	203	213	53	10	32	55	15	1,720	0.0	0.0	0.0	0.0	0.0	535
01/10/19	30.4	69.8	80.2	30.7	211	221	54	6	33	54	12	1,581	0.0	0.0	0.0	0.0	0.0	530
02/05/19	30.9	75.6	76.0	30.7	213	223	54	67	47	55	14	1,607	0.0	0.0	0.0	0.0	0.0	535
03/01/19	30.5	75.0	75.9	30.3	212	220	55	30	47	56	12	1,695	0.0	0.0	0.0	0.0	0.0	528

Abbreviations, Notes, and Units on last page.

Table 7
Summary of System Parameters
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Abbreviations, Notes, and Units:

ECU	Emission Control Unit
GAC	Granular Activated Carbon
HMI	Human-Machine Interface
PPZ	Potassium Permanganate-impregnated Zeolite
RW	Remedial Well
SCADA	Supervisory Control and Data Acquisition
Temp	Temperature

1. Operational data collected by Arcadis on days noted. Parameters listed were typically recorded during compliance monitoring events. Data in this table correspond to approximately the past year of system operation.
2. Instantaneous parameters obtained from the SCADA HMI: Water Flow Rate, Water Pressure, Air Flow Rate.
3. Combined influent water-flow rate is the sum of individual well flow rates via the SCADA System.
4. Remedial Well effluent pressure readings measured at the influent manifold within the treatment system building.
5. Instantaneous values recorded from field-mounted instruments during weekly site visits.
6. RW-2 flow rate was increased on 2/15/2018 to test for performance and life cycle gains and was adjusted in the end of September 2018 to design flow rate of 75 gpm.
7. Effluent system pressure and flow rate are variable and will not coincide with influent flowrates due to discharge pump operating on variable speed drive.

gpm	gallons per minute
iwc	inches of water column
psi	pounds per square inch
^{o}R	degrees Rankine
scfm	standard cubic feet per minute

Table 8
Summary of Groundwater Recovered, VOC Mass Recovered, and VOC Mass Recovery Rates
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Operating Period [1]	Volume of Groundwater Recovered (x1,000 gal) [2]					VOC Mass Recovered (lbs) [3]															VOC Mass Recovery Rate (lbs/day) [4]													
						Total VOCs [5]					Project VOCs [6]					Non-Project VOCs [7]					Total VOCs [5]					Project VOCs [6]					Non-Project VOCs [7]				
	RW-1	RW-2	RW-3	RW-4	Total	RW-1	RW-2	RW-3	RW-4	Total	RW-1	RW-2	RW-3	RW-4	Total	RW-1	RW-2	RW-3	RW-4	Total	RW-1	RW-2	RW-3	RW-4	Total	RW-1	RW-2	RW-3	RW-4	Total	RW-1	RW-2	RW-3	RW-4	Total
System Pilot Test, Shakedown and Startup Totals [8]	137	270	251	150	808	NA	NA	NA	NA	1.1	NA	NA	NA	NA	1.0	NA	NA	NA	NA	0.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2010 Totals	15,726	35,127	38,160	15,689	104,702	0.56	172	412	89	672	0.56	171	28	0.10	200	< 0.01	0.17	383	89	469	< 0.01	0.46	1.1	0.24	1.8	< 0.01	0.46	0.075	< 0.01	0.54	< 0.01	< 0.01	1.0	0.24	1.3
2011 Totals	15,218	36,570	37,682	15,196	104,666	0.36	167	271	78	516	0.36	167	35	0.090	203	< 0.01	1.1	236	78	314	< 0.01	0.45	0.73	0.21	1.4	< 0.01	0.45	0.095	< 0.01	0.55	< 0.01	< 0.01	0.64	0.21	0.85
2012 Totals	15,260	35,178	36,111	15,336	101,885	0.28	114	113	40	267	0.25	113	12	0.39	126	< 0.01	1.5	101	40	141	< 0.01	0.31	0.31	0.11	0.73	< 0.01	0.31	0.032	< 0.01	0.35	< 0.01	< 0.01	0.28	0.11	0.39
2013 Totals	15,968	37,514	36,622	16,036	106,140	0.14	111	41	18	171	0.14	110	4.3	0.36	113	< 0.01	1.6	37	18	57	< 0.01	0.30	0.11	0.050	0.47	< 0.01	0.30	0.012	< 0.01	0.31	< 0.01	< 0.01	0.10	0.049	0.16
2014 Totals	15,690	33,222	31,199	15,691	95,802	0.063	67	9.9	8.1	85	0.063	65	2.0	0.20	67	< 0.01	1.5	8.1	7.9	17	< 0.01	0.19	0.028	0.023	0.24	< 0.01	0.18	< 0.01	< 0.01	0.19	< 0.01	< 0.01	0.023	0.022	0.047
2015 Totals	15,859	38,082	34,961	14,755	103,657	0.028	47	7.1	4.5	57	0.021	45	1.5	0.20	45	<0.01	1.7	5.6	4.2	12	<0.01	0.13	0.019	0.012	0.16	<0.01	0.12	<0.01	<0.01	0.12	<0.01	<0.01	0.015	0.012	0.032
2016 Totals	15,826	34,539	39,349	15,826	105,540	<0.01	38	3.2	2.2	44	<0.01	37	1.4	0.20	39	<0.01	1.5	1.7	2.0	5.2	<0.01	0.10	<0.01	<0.01	0.12	<0.01	0.10	<0.01	<0.01	0.11	<0.01	<0.01	<0.01	<0.01	0.014
2017 Totals	16,005	31,600	37,614	15,965	101,184	< 0.01	13	2.2	1.2	17	< 0.01	13	1.1	0.16	14	< 0.01	0.56	1.1	1.1	2.7	< 0.01	0.037	< 0.01	< 0.01	0.046	< 0.01	0.035	< 0.01	< 0.01	0.038	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2018 Totals	15,145	37,712	32,473	14,917	100,247	< 0.01	13.71	0.90	0.56	15.2	< 0.01	13.5	0.70	< 0.01	14.2	< 0.01	0.27	0.19	0.52	0.97	< 0.01	0.038	< 0.01	< 0.01	0.042	< 0.01	0.037	< 0.01	< 0.01	0.039	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
October 2018 through December 2018 Totals																																			
01/01/19 - 02/01/19	1,322	1,656	3,433	1,319	7,730	< 0.01	0.76	0.12	< 0.01	0.88	< 0.01	0.8	0.094	< 0.01	0.85	< 0.01	< 0.01	0.022	< 0.01	0.022	< 0.01	0.025	< 0.01	< 0.01	0.028	< 0.01	0.025	< 0.01	< 0.01	0.028	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
02/01/19 - 03/01/19	1,231	3,013	3,031	1,206	8,481	< 0.01	1.4	0.10	< 0.01	1.5	< 0.01	1.4	0.083	< 0.01	1.5	< 0.01	< 0.01	0.019	< 0.01	0.019	< 0.01	0.049	< 0.01	< 0.01	0.053	< 0.01	0.049	< 0.01	< 0.01	0.052	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
03/01/19 - 04/01/19	1,318	2,789	3,264	1,305	8,675	< 0.01	1.3	0.11	< 0.01	1.4	< 0.01	1.3	0.090	< 0.01	1.4	< 0.01	< 0.01	0.021	< 0.01	0.021	< 0.01	0.041	< 0.01	< 0.01	0.045	< 0.01	0.041	< 0.01	< 0.01	0.044	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Subtotal Jan - Mar 2019 [9]	3,870	7,458	9,727	3,830	24,885	< 0.01	3.4	0.33	< 0.01	3.8	< 0.01	3.4	0.27	< 0.01	3.7	< 0.01	< 0.01	0.062	< 0.01	0.062	< 0.01	0.038	< 0.01	< 0.01	0.042	< 0.01	0.038	< 0.01	< 0.01	0.041	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2019 Totals	3,870	7,458	9,727	3,830	24,885	< 0.01	3.4	0.33	<0.01	3.8	< 0.01	3.4	0.27	< 0.01	3.7	< 0.01	< 0.01	0.06	< 0.01	0.062	< 0.01	0.038	< 0.01	< 0.01	0.042	< 0.01	0.038	< 0.01	< 0.01	0.041	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total [10]	151,296	341,109	350,594	149,965	992,965	2	1,022	914	256	2,191	2	1,010	105	2	1,119	< 0.01	10	809	254	1,066	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Abbreviations, Notes, Qualifiers, and Units:

NA Not Applicable
VOC Volatile Organic Compound.

1. Represents operating period between consecutive monitoring events.
2. Volume of groundwater recovered is based on individual local well totalized flow readings. Listed value is the difference between totalized flow values recorded between consecutive monitoring events. The total groundwater recovered during a given operating period is the sum of the individual well flow totals. Values shown are rounded to the nearest gallon, but should only be considered accurate to two significant figures to account for error associated with field measurements.
3. Mass recovered per well was calculated by multiplying the Total VOC concentration from the most recent sampling event by the number of gallons extracted during the reporting period. The total amount recovered during a given operating period is the sum of masses recovered from each of the individual wells. Values less than ten pounds are presented using two significant figures and values greater than ten pounds have been rounded to the nearest whole number; however, these values should only be considered accurate to two significant figures to account for error associated with field measurements and analytical data.
4. Mass recovery rates were calculated by dividing the total mass recovered for each well and for the system by the number of days in the respective operating period. Values are presented using two significant figures.
5. "Total VOCs" represents the sum of individual concentrations of the VOCs detected.
6. "Project VOCs" represents the sum of individual compound concentrations of 1,1,1-trichloroethane; 1,1-dichloroethane; 1,2-dichloroethane; 1,1-dichloroethene; tetrachloroethene; trichloroethelyene; vinyl chloride; cis-1,2-dichloroethene; trans-1,2-dichloroethene; benzene; toluene; and xylenes-o,m, p.
7. "Non-Project VOCs" represents the difference between Total VOCs and Project VOCs.
8. Values based on operational data recorded prior to system startup on July 21, 2009.
9. The volume of groundwater recovered and mass recovered calculations represent the operational period between January 1, 2019 and April 1, 2019.
10. "Total" refers to the amounts removed by the Operable Unit 3 Bethpage Park Groundwater Containment System.

< Less than

gal Gallons
lbs Pounds
lbs/day Pounds per day

Table 9
Summary of Air Quality Impact Analysis
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Toxic Air Contaminant	VSP-05 Vapor Effluent (µg/m^3)	Emission Rate[1]			Scaled Impact - Hourly[2] (µg/m^3)	Scaled Impact - Annual[2] (µg/m^3)	SGC[3] (µg/m^3)	AGC[3] (µg/m^3)	% of SGC	% of AGC
	3/1/2019	lb/yr	lb/hr	g/s						
Project VOCs										
1,1,1-Trichloroethane	0.65	0.04	4.12E-06	5.19E-07	1.64E-03	5.01E-05	9,000	5.00E+03	0.0%	0.0%
1,1-Dichloroethane	6.5	0.36	4.12E-05	5.2E-06	1.6E-02	5.0E-04	--	0.63	--	0.1%
1,1-Dichloroethene	1.6	0.09	1.01E-05	1.28E-06	4.03E-03	1.2E-04	--	200	--	0.0%
Benzene	1.0	0.06	6.34E-06	8.0E-07	2.5E-03	7.7E-05	1,300	0.13	0.0%	0.1%
cis-1,2-Dichloroethene	114	6.33	7.22E-04	9.1E-05	2.9E-01	8.8E-03	--	63	--	0.0%
Tetrachloroethene	1.9	0.11	1.20E-05	1.5E-06	4.8E-03	1.5E-04	300	4	0.0%	0.0%
Toluene	2.8	0.16	1.77E-05	2.2E-06	7.0E-03	2.2E-04	37,000	5,000	0.0%	0.0%
Trichloroethene	30	1.66	1.90E-04	2.4E-05	7.6E-02	2.3E-03	20	0.20	0.4%	1.2%
Vinyl Chloride	34.5	1.91	2.19E-04	2.8E-05	8.7E-02	2.7E-03	180,000	0.11	0.0%	2.4%
Xylene-O	0.69	0.02	2.15E-06	2.71E-07	8.56E-04	2.6E-05	22,000	100	0.0%	0.0%
Xylenes - M,P	1.0	0.03	3.55E-06	4.5E-07	1.4E-03	4.3E-05	22,000	100	0.0%	0.0%
Non-Project VOCs										
2-Butanone	14	0.78	8.87E-05	1.1E-05	3.5E-02	1.1E-03	13,000	5,000	0.0%	0.0%
Acetone	96.4	5.35	6.11E-04	7.7E-05	2.4E-01	7.4E-03	180,000	30,000	0.0%	0.0%
Carbon Tetrachloride	0.33	0.02	2.09E-06	2.63E-07	8.31E-04	2.54E-05	1900	1.7E-01	0.0%	0.0%
Chlorobenzene	0.97	0.05	6.15E-06	7.74E-07	2.44E-03	7.47E-05	--	60	--	0.0%
Chlorodifluoromethane (Freon 22)	8.8	0.49	5.58E-05	7.0E-06	2.2E-02	6.8E-04	--	50,000	--	0.0%
Chloroform	10	0.55	6.34E-05	8.0E-06	2.5E-02	7.7E-04	150	15	0.0%	0.0%
Chloromethane	1.5	0.08	9.50E-06	1.2E-06	3.8E-03	1.2E-04	22,000	90	0.0%	0.0%
Dichlorodifluoromethane (Freon 12)	2.1	0.12	1.33E-05	1.7E-06	5.3E-03	1.6E-04	--	12,000	--	0.0%
Dichloromethane	0.66	0.04	4.18E-06	5.3E-07	1.7E-03	5.1E-05	14,000	60	0.0%	0.0%
Methyl-Tert-Butylether	0.36	0.02	2.28E-06	2.87E-07	9.06E-04	2.8E-05	--	3.8	--	0.0%
Trichlorofluoromethane (Freon 11)	1.3	0.07	8.24E-06	1.0E-06	3.3E-03	1.0E-04	9,000	5,000	0.0%	0.0%
Trichlorotrifluoroethane (Freon 113)	2.5	0.14	1.58E-05	2.0E-06	6.3E-03	1.9E-04	960,000	180,000	0.0%	0.0%

Abbreviations, Notes, and Units on last page.

Table 9
Summary of Air Quality Impact Analysis
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Abbreviations, Notes, and Units:

AGC	Annual Guideline Concentration
CAS#	Chemical Abstracts Service Registry Number
DAR-1	Division of Air Resources-1
--	None Specified
NYSDEC	New York State Department of Environmental Conservation
SGC	Short-term Guideline Concentration
VSP	Vapor Sampling Point

1. Emission rate calculated based on VSP-05 effluent concentration and a daily average exit air flow rate of 1,695 ft^3/min for 3/01/2019.
   1,1,1-Trichloroethane (lb/hr) = TCE [µg/m^3] x Air Flow Rate [ft^3/min] x (1 m^3/35.3147 ft^3) x (60 min/hr) x (0.000001 g/1 µg) x (0.0022 lb/g)
   lb/yr = lb/hr x 8,760 hrs/yr
   g/s = lb/hr x hr/3,600 sec x 453.59 g/lb
2. Ambient impact based on AERMOD modeling using normalized rate of 1 g/s is scaled to the actual emission rate of the pollutant. Modeling was performed using the representative meteorological data from the nearest station (Brookhaven/Farmingdale) for the years 2011 through 2015. The maximum impact from all the years was used for the calculations.
   Scaled hourly impact (µg/m^3) = AERMOD predicted hourly ambient impact at 1 g/s ([µg/m^3]/[g/s]) x Actual emission rate (g/s)
   Scaled annual impact (µg/m^3) = AERMOD predicted annual ambient impact at 1 g/s ([µg/m^3]/[g/s]) x Actual emission rate (g/s)

AERMOD Normalized Ambient Impact at 1 g/s	
Hourly ([µg/m^3]/[g/s])	Annual ([µg/m^3]/[g/s])
3,153.03	96.49

3. Short-term and annual guideline concentrations specified in the NYSDEC DAR-1 AGC/SGC tables revised August 10, 2016.
4. Compounds not detected above the laboratory reporting limit are excluded from the air quality impact analysis summary.

cfm	cubic feet per minute
g/s	grams per second
lb/hr	pounds per hour
lb/yr	pounds per year
µg/m^3	micrograms per cubic meter

Table 10
Summary of Remedial Well Groundwater Sample Analytical Results - VOCs
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Compound[1] (µg/L)	Sample Location: Sample Date: NYSDEC SCGs	RW-1 4/4/2018	RW-1 8/7/2018	RW-1 11/8/2018	RW-1 3/1/2019	RW-2 4/4/2018	RW-2 8/7/2018	RW-2 11/8/2018	RW-2 3/1/2019	RW-3 4/4/2018	RW-3 8/7/2018	RW-3 11/8/2018	RW-3 3/1/2019	RW-4 4/4/2018	RW-4 8/7/2018	RW-4 11/8/2018	RW-4 3/1/2019
Project VOCs																	
1,1,1-Trichloroethane	5	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	5	< 1.0	< 1.0	< 1.0	< 1.0	**0.65 J**	< 1.0	< 1.0	**1.1**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	0.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethene	5	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0
Tetrachloroethene	5	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0	**0.33 J**	< 1.0	< 1.0	< 1.0
Trichloroethylene	5	< 0.50	< 1.0	< 1.0	< 1.0	**8.9**	**7.8**	**8.2**	**9.9**	**1.3**	**1.5**	**1.6**	**2.1**	**0.30 J**	< 1.0	< 1.0	< 1.0
Vinyl Chloride	2	< 0.50	< 1.0	< 1.0	< 1.0	**20.5**	**11.8**	**7.6**	**10.7**	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0
cis-1,2-dichloroethene	5	< 0.50	< 1.0	< 1.0	< 1.0	**25.8**	**18.5**	**26.6**	**33.4**	**0.92**	**1.4**	**1.0**	**1.2**	< 0.50	< 1.0	< 1.0	< 1.0
trans-1,2-dichloroethene	5	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0	< 0.50	< 1.0	< 1.0	< 1.0
Benzene	1	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Toluene	5	< 1.0	< 1.0	< 1.0	< 1.0	**0.41 J**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Xylene-o	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Xylenes-m,p	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Subtotal Project VOCs		0	0	0	0.0	**56.26**	**38.1**	**42.4**	**55.1**	**2.22**	**2.9**	**2.6**	**3.3**	**0.63**	0	0	0
Non-Project VOCs																	
1,1,2,2-Tetrachloroethane	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2-Trichloroethane	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,3-Butadiene	0.5	< 5.0	< 5.0	< 5.0	NA	< 5.0	< 5.0	< 5.0	NA	< 5.0	< 5.0	< 5.0	NA	< 5.0	< 5.0	< 5.0	NA
2-Butanone	NE	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
4-methyl-2-pentanone	50	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Acetone	NE	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Bromodichloromethane	50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform	50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane	5	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Carbon Disulfide	60	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Carbon tetrachloride	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorodibromomethane	50	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorodifluoromethane (Freon 22)	NE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	**5.6**	**5.9**	**3.8**	**3.4 J**
Chloroethane	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroform	7	< 0.50	< 1.0	< 1.0	< 1.0	**1.0**	**0.75 J**	**0.51 J**	< 1.0	**0.77**	**0.68 J**	**0.73 J**	**0.76 J**	< 0.50	< 1.0	< 1.0	< 1.0
Chloromethane	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis-1,3-dichloropropene	0.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dichlorodifluoromethane (Freon 12)	5	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Dichloromethane	5	< 0.50	< 2.0	< 2.0	< 2.0	< 0.50	< 2.0	< 2.0	< 2.0	< 0.50	< 2.0	< 2.0	< 2.0	< 0.50	< 2.0	< 2.0	< 2.0
Ethylbenzene	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methyl N-Butyl Ketone	50	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Methyl tert-Butyl Ether	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
trans-1,3-dichloropropene	0.4	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichlorofluoromethane (Freon 11)	5	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Trichlorotrifluoroethane (Freon 113)	5	< 0.50	< 5.0	< 5.0	< 5.0	< 0.50	< 5.0	< 5.0	< 5.0	< 0.50	< 5.0	< 5.0	< 5.0	< 0.50	< 5.0	< 5.0	< 5.0
1-Chloro-1,1-difluoroethane (Freon 142b)	NE	< 5.0	< 5.0	NA	NA	< 5.0	< 5.0	NA	NA	< 5.0	< 5.0	NA	NA	< 5.0	< 5.0	NA	NA
Subtotal Non-Project VOCs		0	0	0	0	**1.0**	**0.75**	**0.51**	**0**	**0.77**	**0.68**	**0.73**	**0.76**	**5.6**	**5.9**	0	**3.4**
Total VOCs[2]		0	0	0	0	**57.26**	**38.85**	**42.91**	**55**	**2.99**	**3.58**	**3.33**	**4.1**	**6.23**	**5.90**	0	**3.4**
1,4-Dioxane[3]		**0.750**	**0.43**	**0.46**	**0.42**	**1.76**	**0.82**	**0.87**	**2.2**	**0.512**	**0.33**	**0.29**	**0.41**	**0.223**	**0.15 J**	**0.13 J**	**0.21 J**

Notes and abbreviations on last page.

Table 10
Summary of Remedial Well Groundwater Sample Analytical Results - VOCs
Bethpage Park Groundwater Containment System
Operable Unit 3 (Former Grumman Settling Ponds)
Bethpage, New York

Abbreviations, Notes, Qualifiers, and Units:

ASP	Analytical Services Protocol
ELAP	Environmental Laboratory Approval Program
NA	Not Analyzed
NE	Not Established
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OLM	Ozone Limited Method
OM&M	Operation, Maintenance, and Monitoring
SCGs	Standards, Criteria, and Guidance values
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

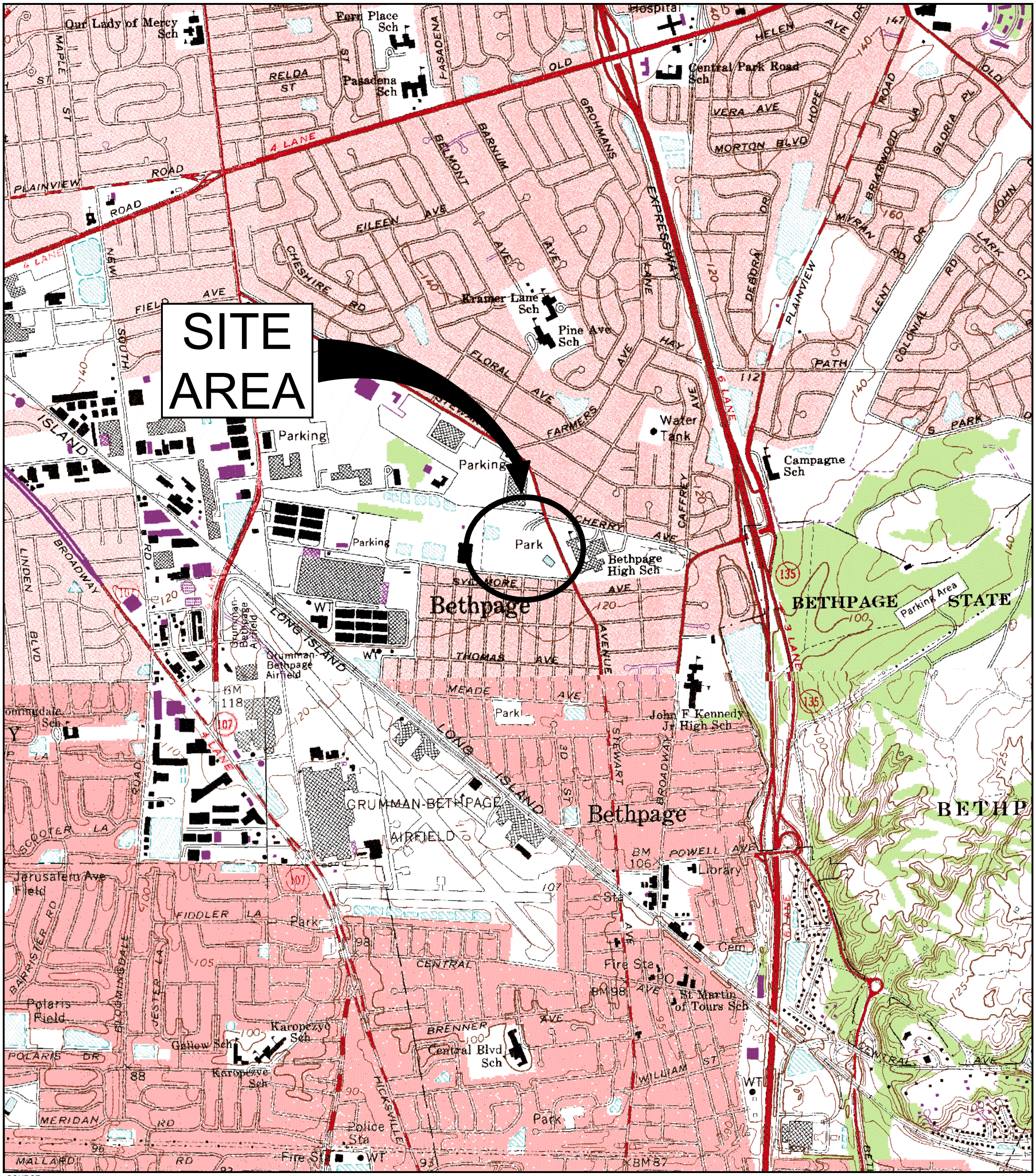
1. Water samples collected by Arcadis on the dates shown and submitted to a NYSDOH ELAP certified laboratory for VOC analyses per NYSDEC ASP 2005, Method OLM 4.3 (prior to September 1, 2014) and per EPA Method 8260C (after September 1, 2014). Results validated following protocols specified in Sampling and Analysis Plan in the DRAFT Bethpage Park Groundwater Containment System OM&M Manual (Arcadis 2016). See previous quarterly reports for historical analytical results.

2. "Total VOCs" represents the sum of individual concentrations of the VOCs detected.

3. Samples collected prior to July 11, 2018 were analyzed for 1,4-Dioxane using USEPA Method 522-SIM. Samples collected after are analyzed for 1,4-Dioxane using USEPA Method 8270D-SIM-CLLE.

	Bold cell outline indicates an exceedance of an SCG
8.9	Bold data indicates a detection
< 1.0	Compound not detected above its laboratory quantification limit
J	Compound detected below its reporting limit; value is estimated
µg/L	micrograms per liter

FIGURES



SOURCE:
USGS 7.5 MIN. AMITYVILLE QUADRANGLE, AMITYVILLE, N.Y., 1994, FREEPORT QUADRANGLE, FREEPORT, N.Y., 1994, HICKSVILLE QUADRANGLE, HICKSVILLE, N.Y., 1967, PHOTOREVISED 1979, HUNTINGTON, N.Y., 1967, PHOTOREVISED 1979

0 2000' 4000'

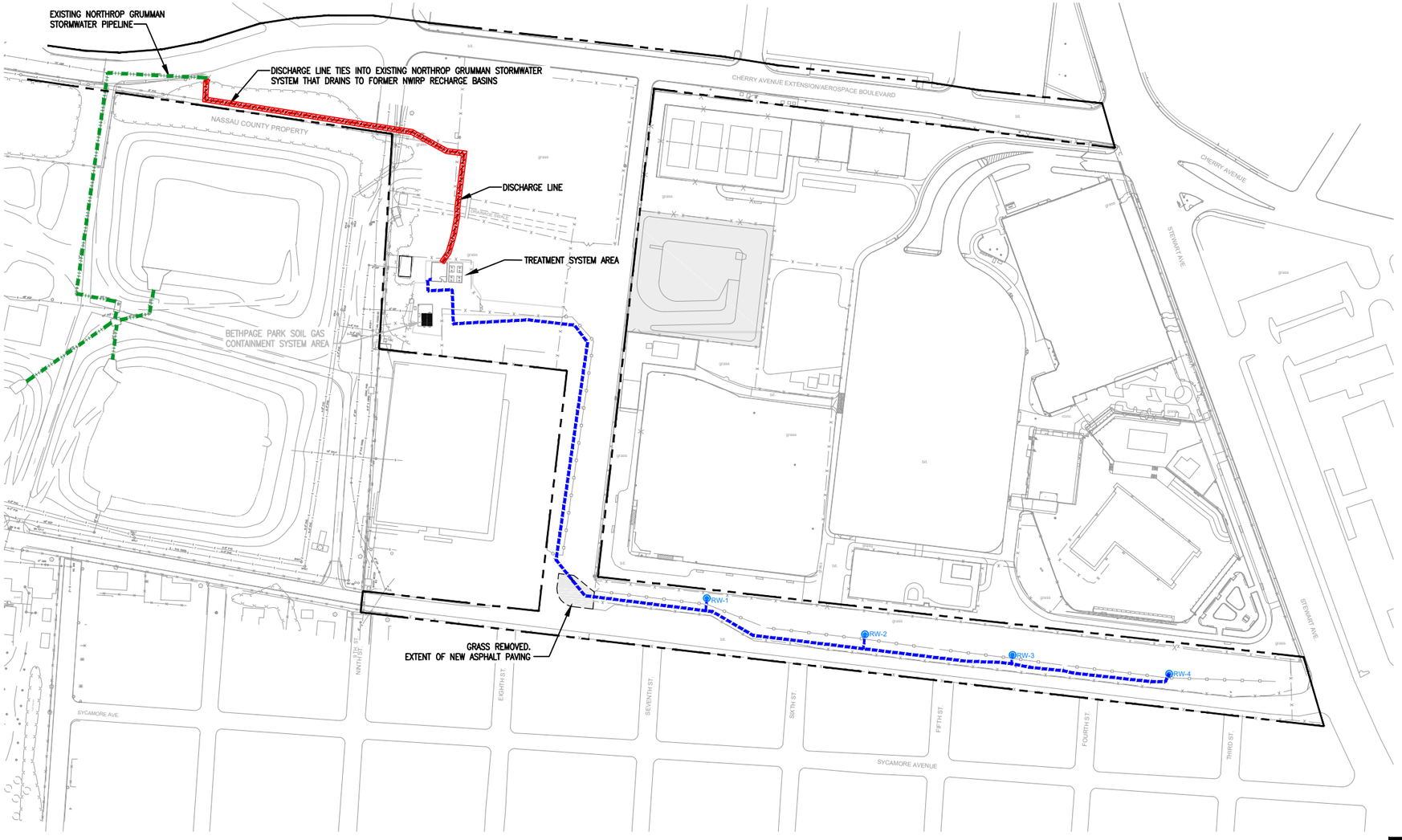
SCALE IN FEET

BETHPAGE PARK GROUNDWATER CONTAINMENT SYSTEM
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

SITE LOCATION

ARCADIS Design & Consultancy for natural and built assets

FIGURE 1



LEGEND:

- NORTHROP GRUMMAN PROPERTY LINE
- FENCE
- bit. BITUMINOUS PAVEMENT
- INFLUENT PIPELINE AND ELECTRICAL CONDUITS
- EFFLUENT PIPELINE
- EXISTING NORTHROP GRUMMAN STORMWATER PIPELINE
- RW-4 REMEDIAL WELL
- NWIRP NAVAL WEAPONS INDUSTRIAL RESERVE PLANT (NOW OWNED BY NASSAU COUNTY)

0 200' 400'

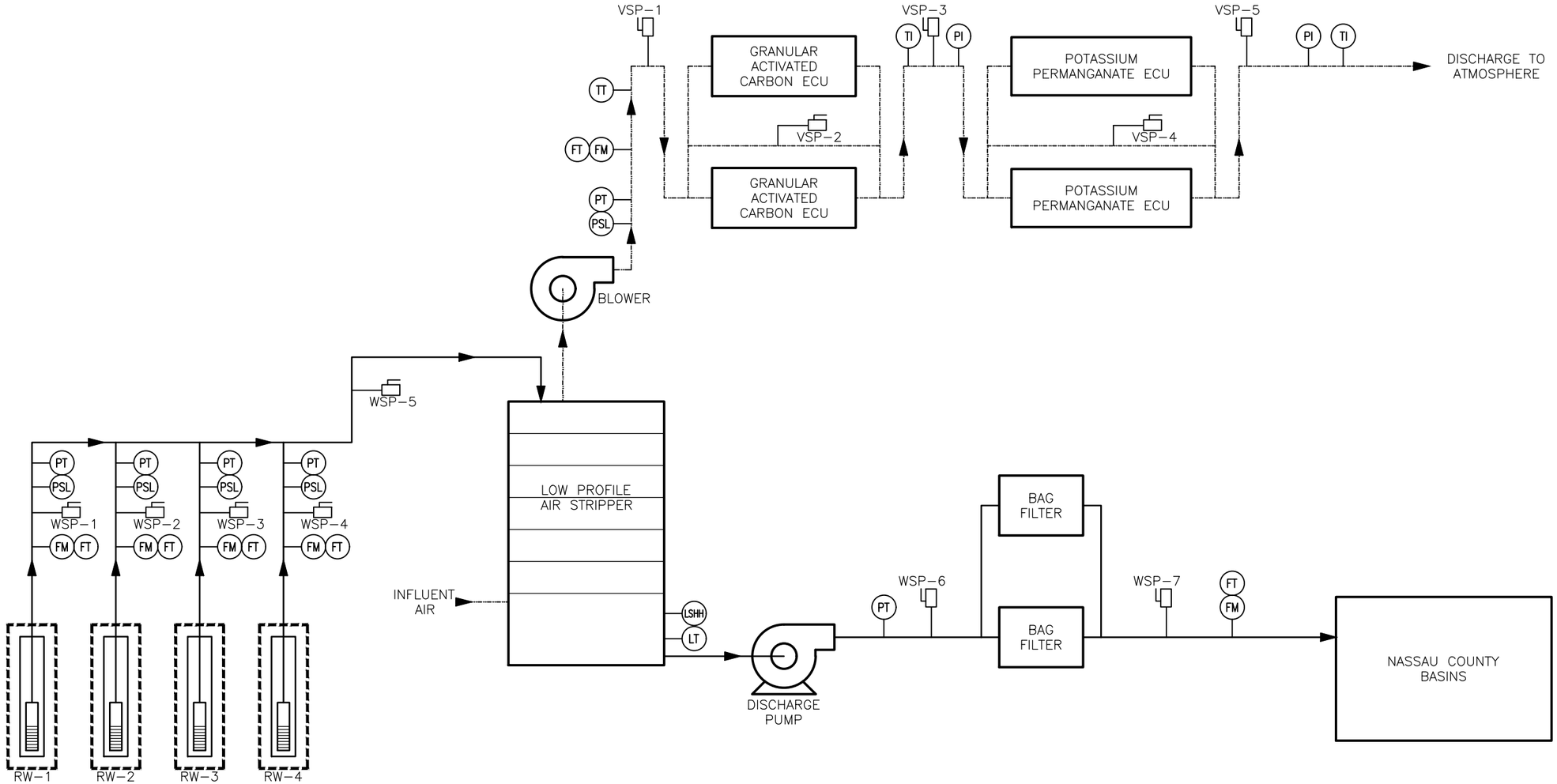
SCALE IN FEET

BETHPAGE PARK GROUNDWATER CONTAINMENT SYSTEM
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

SITE AND GROUNDWATER CONTAINMENT SYSTEM

ARCADIS Design & Consultancy for natural and built assets

FIGURE 2



LEGEND:

- PROCESS WATER
- PROCESS AIR
- FM — INSTRUMENT
- SAMPLE PORT
- FLOW DIRECTION
- FM FLOW METER
- FT FLOW RATE TRANSMITTER
- PSL PRESSURE VACUUM LOW
- PT PRESSURE TRANSMITTER
- PI PRESSURE INDICATOR
- LSHH LEVEL SWITCH HIGH HIGH
- LT LEVEL TRANSMITTER
- TT TEMPERATURE TRANSMITTER
- TI TEMPERATURE INDICATOR
- WSP WATER SAMPLE PORT
- VSP VAPOR SAMPLE PORT
- ECU EMISSION CONTROL UNIT

BETHPAGE PARK GROUNDWATER CONTAINMENT SYSTEM
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

GROUNDWATER TREATMENT SYSTEM PROCESS SCHEMATIC AND MONITORING LOCATIONS

ARCADIS Design & Consultancy for natural and built assets

FIGURE 3

EXPLANATION:

- NORTHROP GRUMMAN PROPERTY LINE
- FENCE
- BASIN
- bit. BITUMINOUS PAVEMENT
- MW-200-1 MONITORING WELL
- RW-2 REMEDIAL WELL
- PZ-2C PIEZOMETER

NOTES:

1. MONITORING WELLS, REMEDIAL WELLS, AND PIEZOMETERS SURVEYED TO NORTH AMERICAN DATUM (NAD) 83.
2. PARK FEATURES SHOWN WERE PRESENT PRIOR TO TOWN OF OYSTER BAY REDEVELOPMENT IN 2005.

0 100' 200'

APPROXIMATE SCALE IN FEET

BETHPAGE PARK GROUNDWATER CONTAINMENT SYSTEM
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

GROUNDWATER MONITORING NETWORK SITE PLAN

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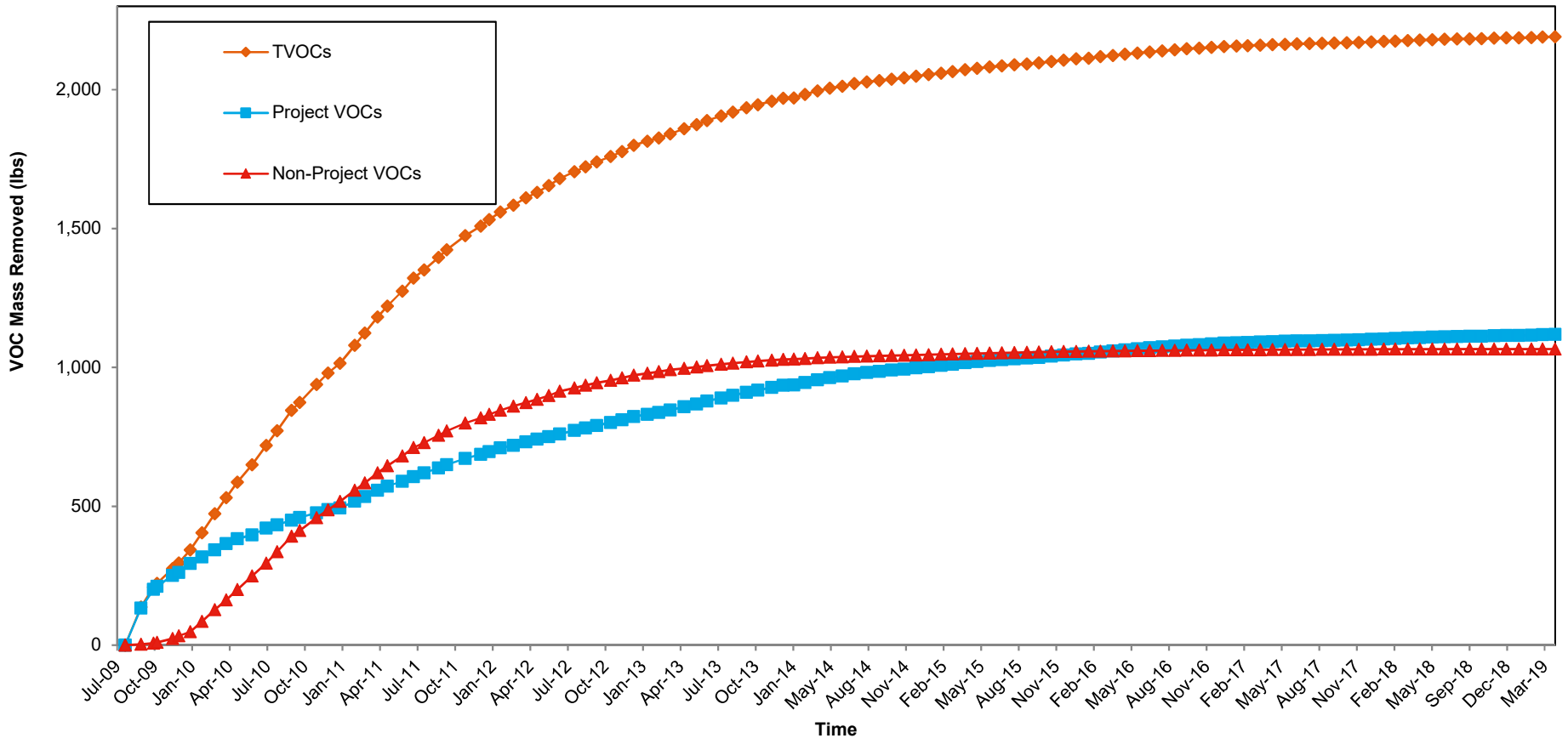
FIGURE 4



Abbreviations, Notes, and Units:

VOC = Volatile Organic Compound
TVOCs = Total VOCs detected

Project VOCs = sum of 1,1,1-trichloroethane; 1,1-dichloroethane; 1,2-dichloroethane; 1,1-dichloroethene; tetrachloroethene; trichloroethene; vinyl chloride; cis-1,2-dichloroethene; trans-1,2-dichloroethene; benzene; toluene; and total xylenes.
Non-Project VOCs = sum of VOCs that are not Project VOCs.

lbs = pounds

BETHPAGE PARK GROUNDWATER CONTAINMENT SYSTEM
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

CUMULATIVE TOTAL, PROJECT, AND NON-PROJECT VOC MASS REMOVED

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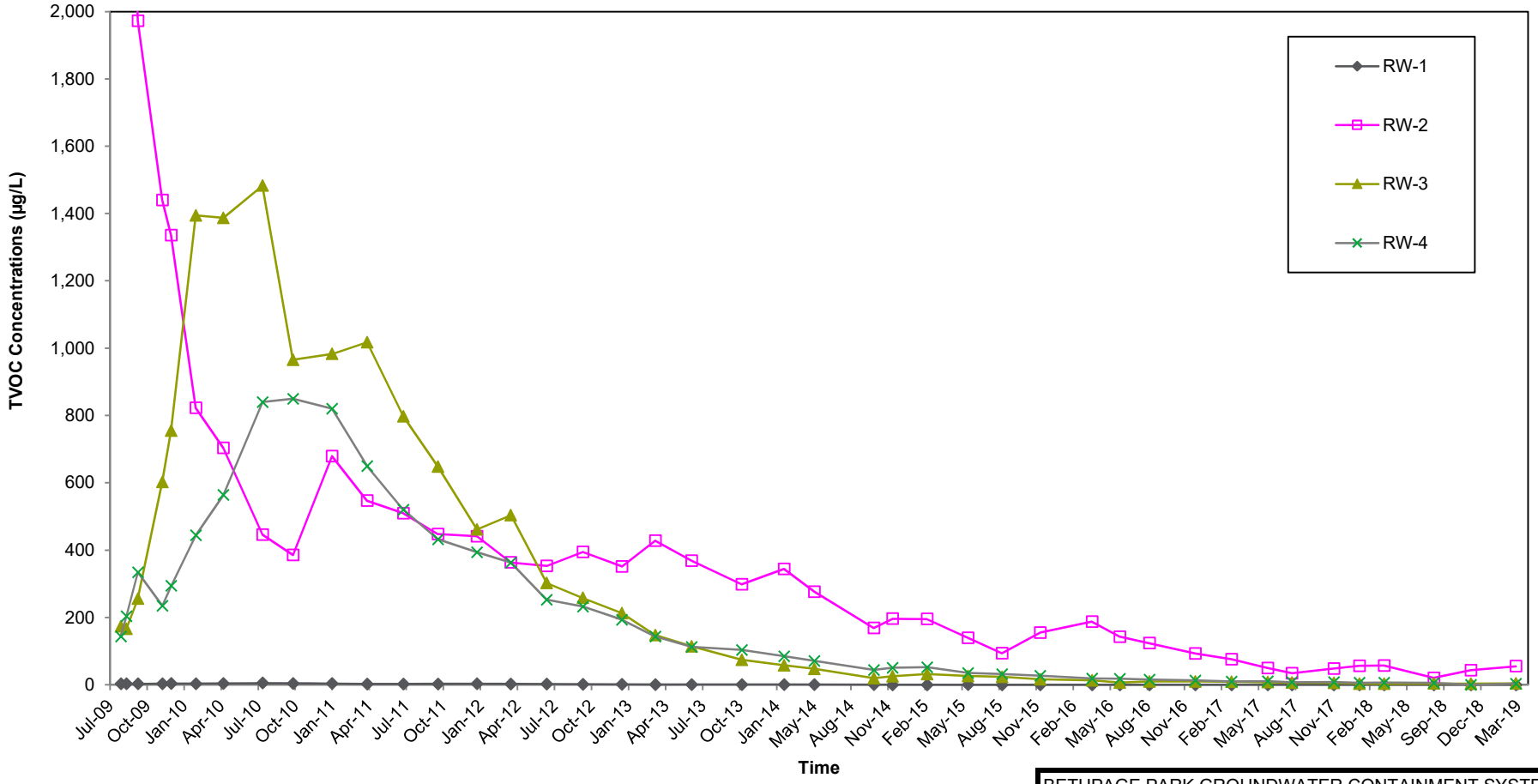
FIGURE
5

G:\APROJECT\Northrop Grumman Bethpage\OU3.2 Groundwater Containment System\11 Draft Reports-Presentations\Reports\2019 Q1\Tables\Q1_Table 2-8.xlsxFigure 5 TVOC Mass Graph



Abbreviations, Notes, and Units:

VOC = Volatile Organic Compound
TVOCs = Total VOCs detected

1. Results prior to September 10, 2009 are not shown to improve figure clarity. The TVOC concentrations are greater than 2,000 µg/L. See previous reports for full data set.

µg/L = micrograms per liter

BETHPAGE PARK GROUNDWATER CONTAINMENT SYSTEM
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

REMEDIAL WELL TOTAL VOC CONCENTRATIONS

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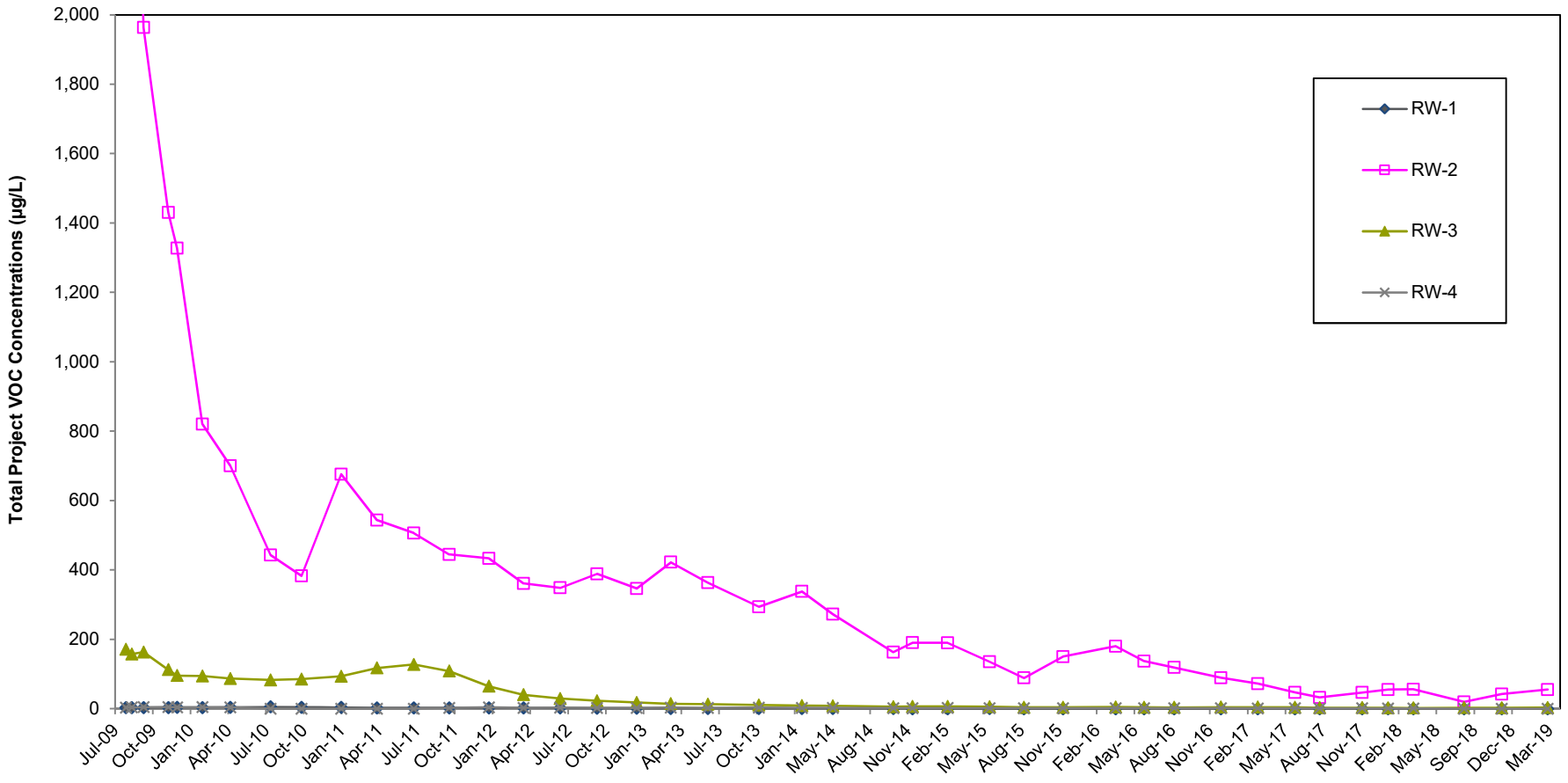
FIGURE
6A



Abbreviations, Notes, and Units:

VOC = Volatile Organic Compound
TVOCs = Total VOCs detected

Project VOCs = sum of 1,1,1-trichloroethane; 1,1-dichloroethane; 1,2-dichloroethane; 1,1-dichloroethene; tetrachloroethene; trichloroethene; vinyl chloride; cis-1,2-dichloroethene; trans-1,2-dichloroethene; benzene; toluene; and total xylenes.

1. Results prior to September 10, 2009 are not shown to improve figure clarity. Total Project VOC concentrations are greater than 2,000 µg/L. See previous reports for full data set.

µg/L = micrograms per liter

BETHPAGE PARK GROUNDWATER CONTAINMENT SYSTEM
OPERABLE UNIT 3
(FORMER GRUMMAN SETTLING PONDS)
BETHPAGE, NEW YORK

REMEDIAL WELL PROJECT VOC CONCENTRATIONS

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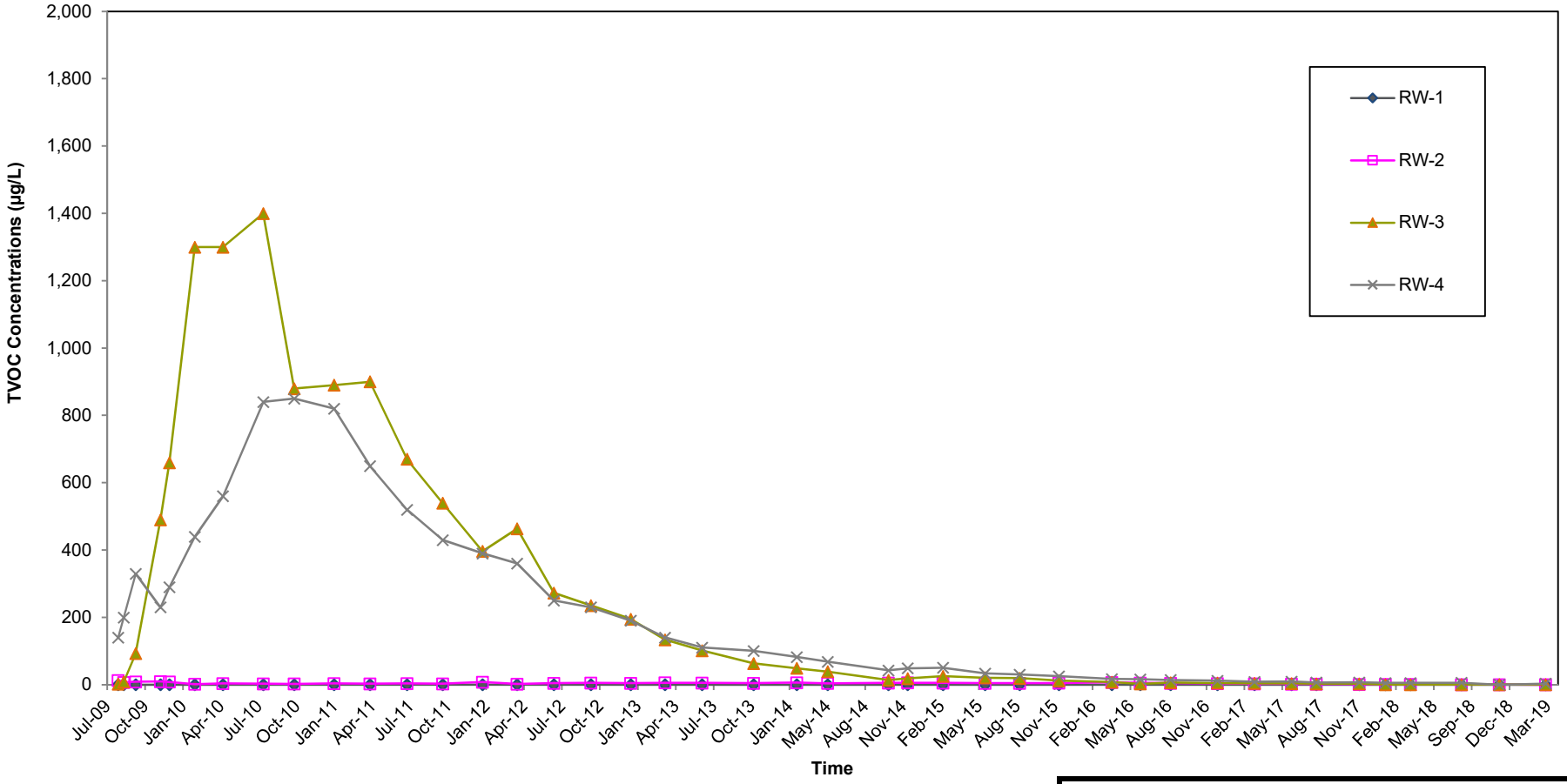
FIGURE
6B

G:\APROJECT\Northrop Grumman Bethpage\OU3.2 Groundwater Containment System\11 Draft Reports-Presentations\Reports\2019 Q1\Tables\Q1_Table 2-8.xlsxFigure 6B RW Project VOC



Abbreviations, Notes, and Units:

VOC = Volatile Organic Compound
TVOCs = Total VOCs detected.

Non-Project VOCs = sum of TVOCs that are not Project VOCs.

µg/L = micrograms per liter

BETHPAGE PARK GROUNDWATER CONTAINMENT SYSTEM
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REMEDIAL WELL NON-PROJECT VOC CONCENTRATIONS

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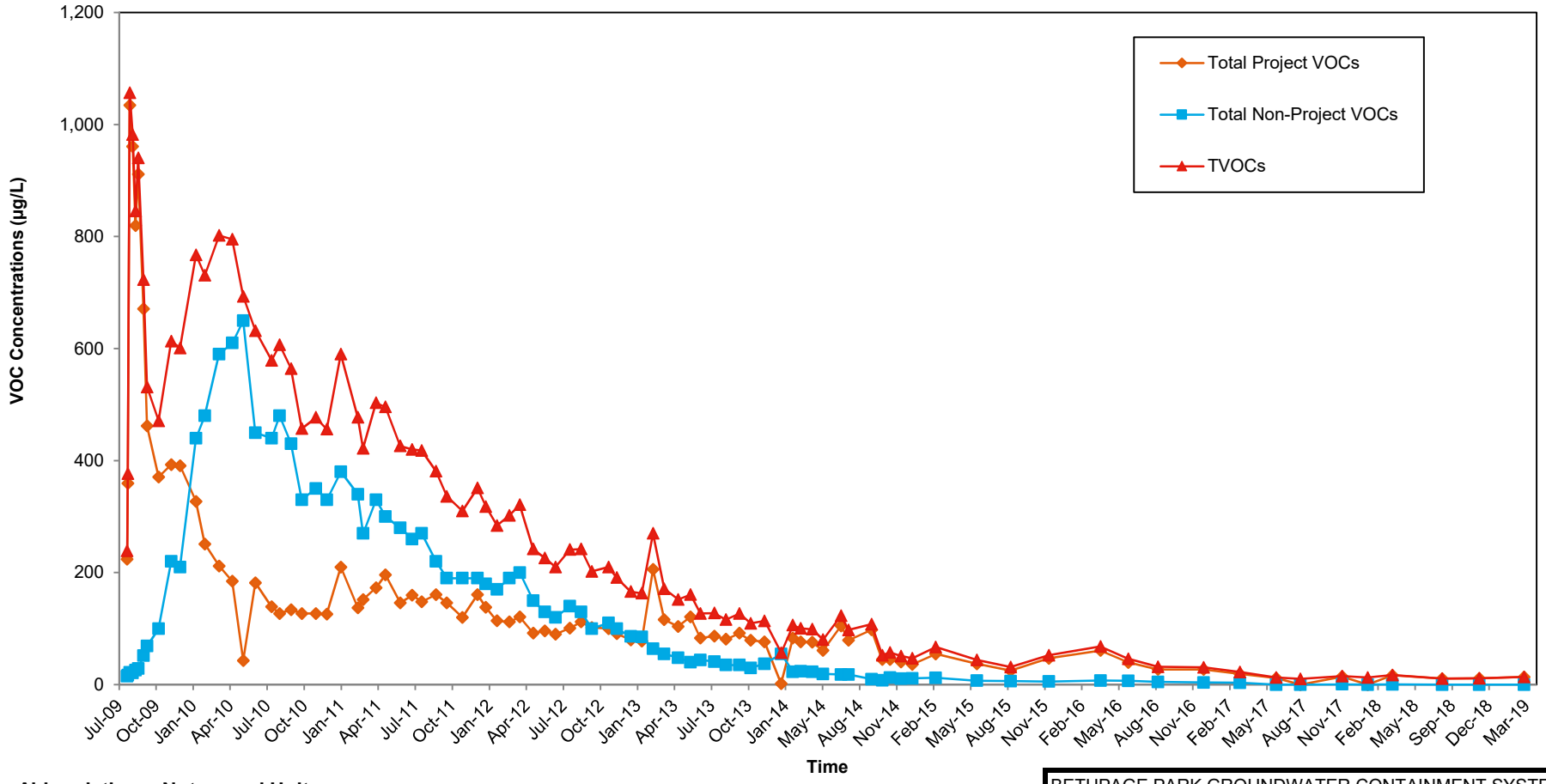
FIGURE
6C

G:\APROJECT\Northrop Grumman Bethpage\OU3.2 Groundwater Containment System\11 Draft Reports-Presentations\Reports\2019 Q1\Tables\Q1_Table 2-8.xlsxFigure 6C RW Non-Proj VOC



Abbreviations, Notes, and Units:

VOC = Volatile Organic Compound
TVOCs = Total VOCs detected.

Project VOCs = sum of 1,1,1-trichloroethane; 1,1-dichloroethane; 1,2-dichloroethane; 1,1-dichloroethene; tetrachloroethene; trichloroethene; vinyl chloride; cis-1,2-dichloroethene; trans-1,2-dichloroethene; benzene; toluene; and total xylenes.

Non-Project VOCs = sum of VOCs that are not Project VOCs.

µg/L = micrograms per liter

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INFLUENT TOTAL, PROJECT AND NON-PROJECT VOC CONCENTRATIONS

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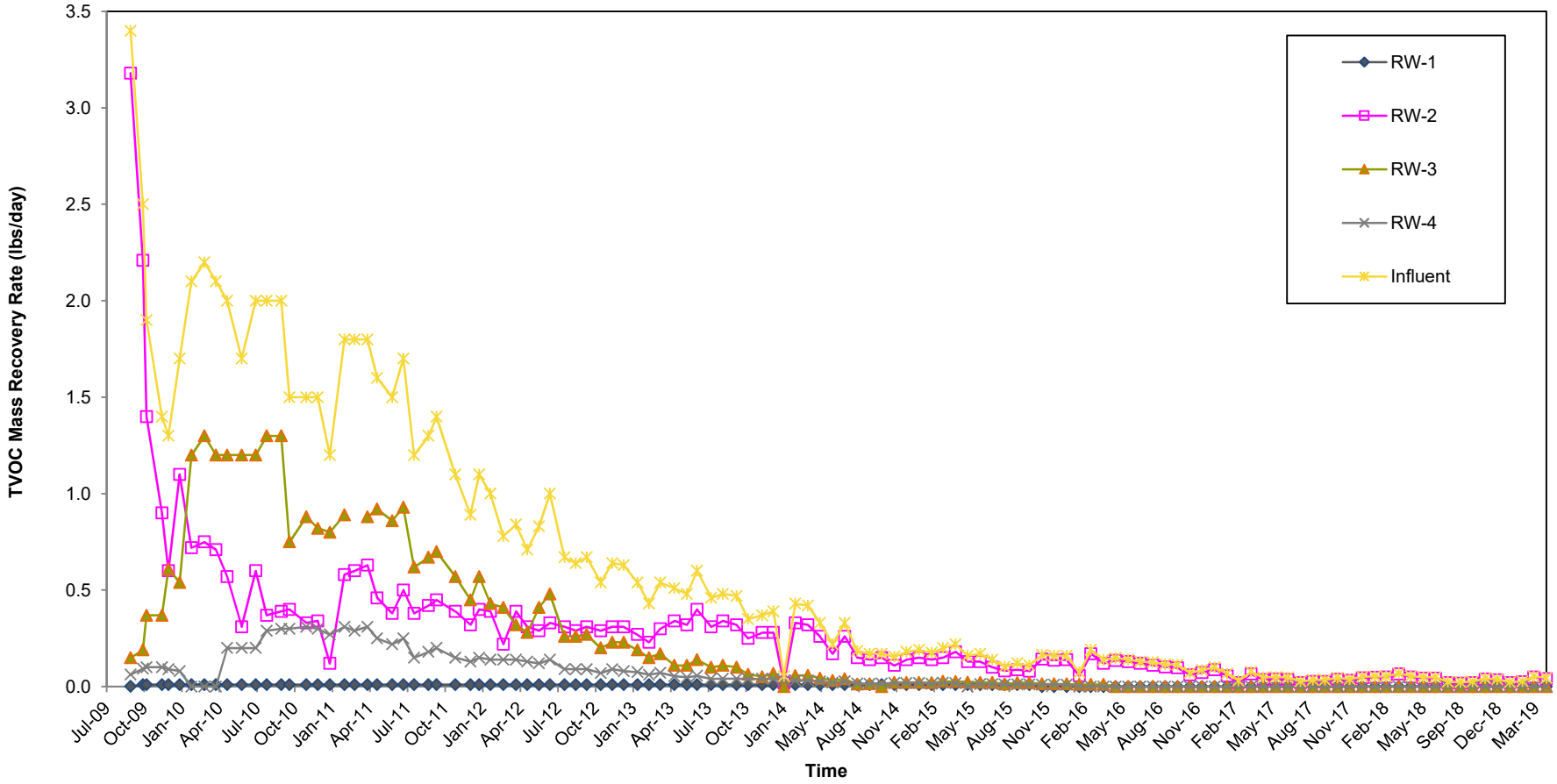
FIGURE
7

G:\APROJECT\Northrop Grumman Bethpage\OU3.2 Groundwater Containment System\11 Draft Reports-Presentations\Reports\2019 Q1\Tables\Q1_Table 2-8.xlsxFigure 7 Comb. Inf. VOC Conc.



Abbreviation, Notes, and Units:

VOC = Volatile Organic Compound
TVOCs = Total VOCs detected

lbs/day = pounds per day

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TOTAL VOC MASS RECOVERY RATES

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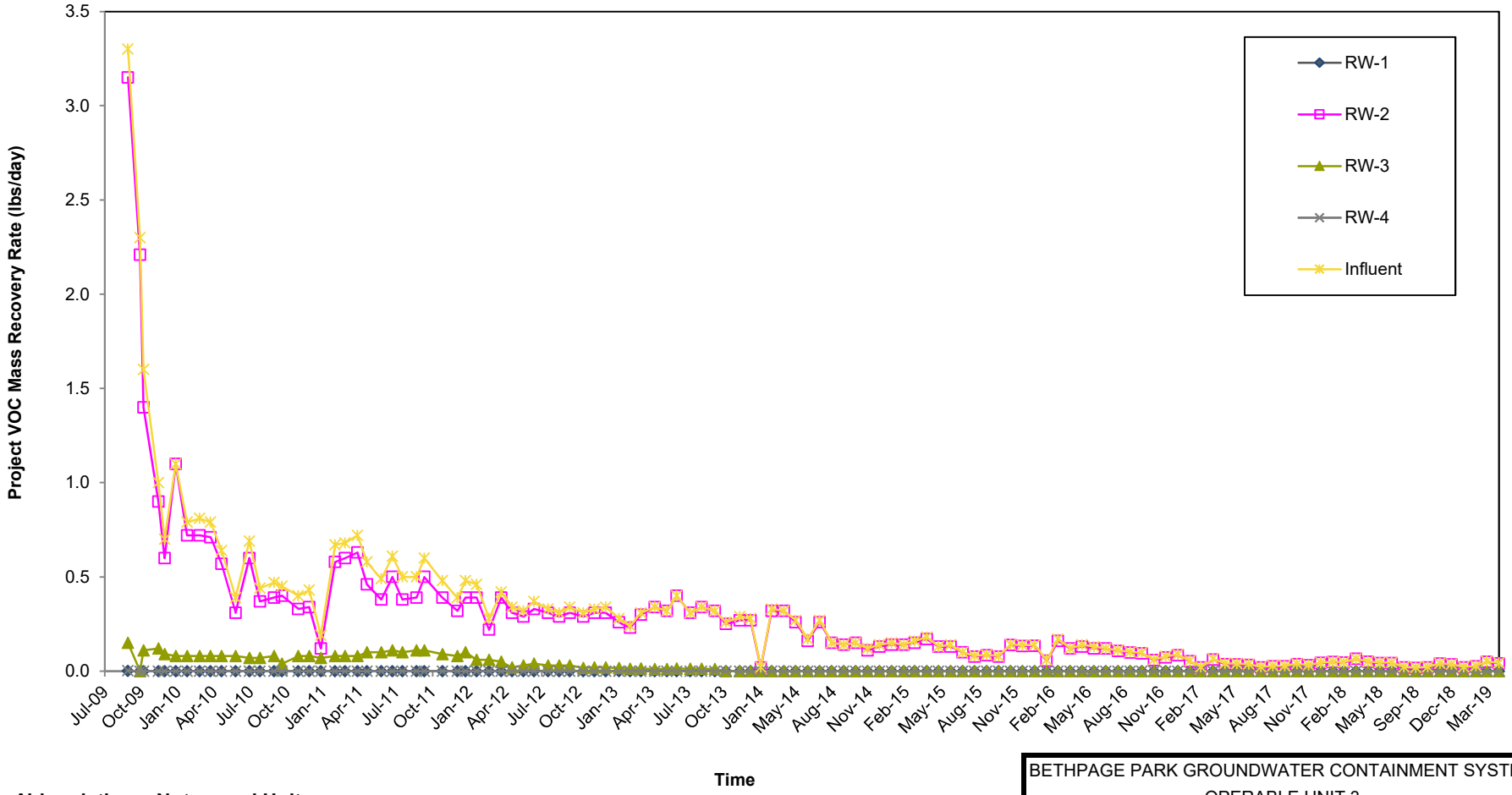
FIGURE
8A

G:\APROJECT\Northrop Grumman Bethpage\OU3.2 Groundwater Containment System\11 Draft Reports-Presentations\Reports\2019 Q1\Tables\Q1_Table 2-8.xlsxFigure 8A VOC Recovery Rates



Abbreviations, Notes, and Units:

VOC = Volatile Organic Compound

Project VOCs = Sum of 1,1,1-trichloroethane; 1,1-dichloroethane; 1,2-dichloroethane; 1,1-dichloroethene; tetrachloroethene; trichloroethene; vinyl chloride; cis-1,2-dichloroethene; trans-1,2-dichloroethene; benzene; toluene; and total xylenes

lbs/day = pounds per day

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PROJECT VOC MASS RECOVERY RATES

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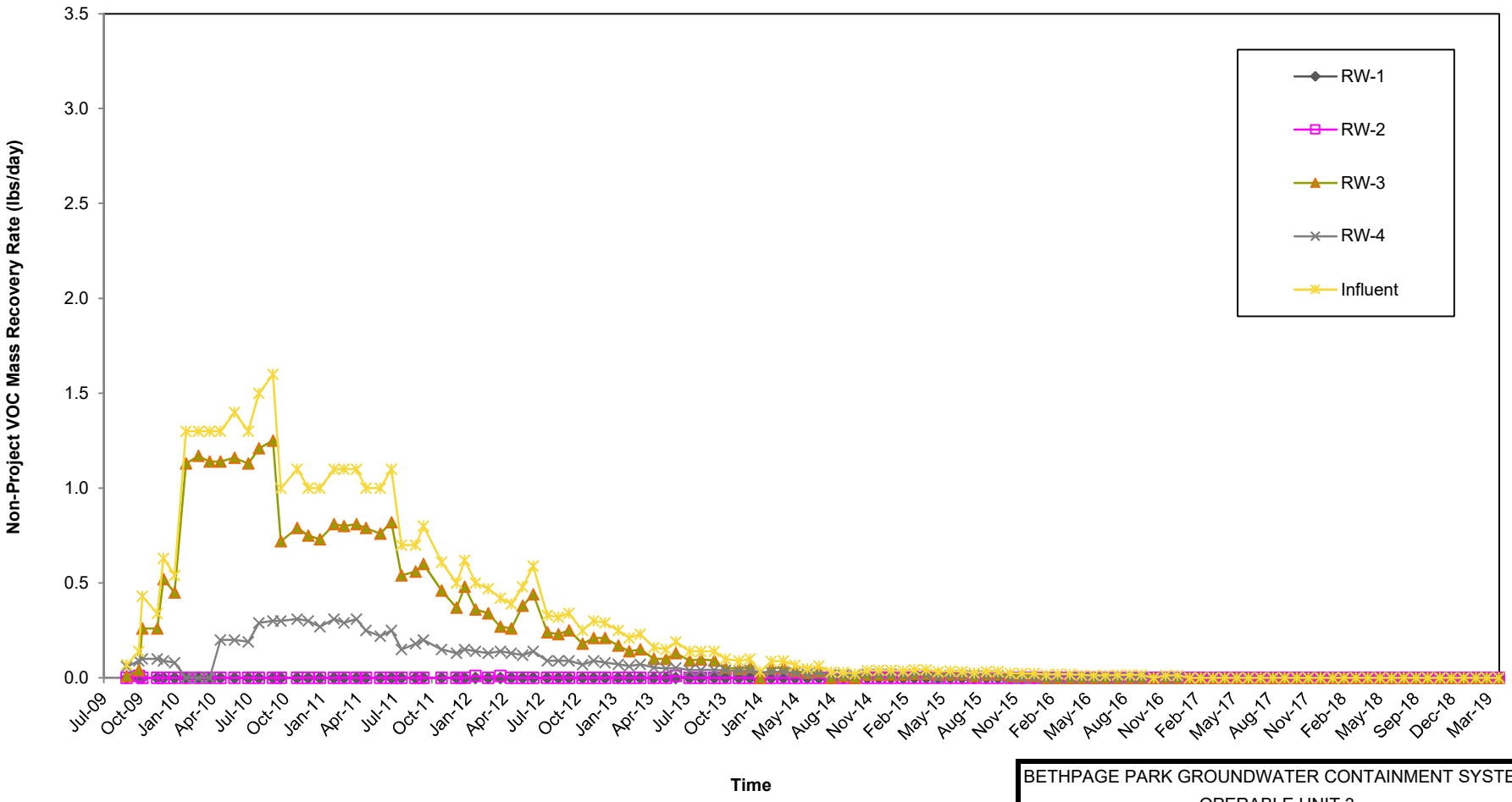
FIGURE
8B

G:\APROJECT\Northrop Grumman Bethpage\OU3.2 Groundwater Containment System\11 Draft Reports-Presentations\Reports\2019 Q1\Tables\Q1_Table 2-8.xlsxFigure 8B VOC Recovery Rates



Abbreviations, Notes, and Units:

VOC = Volatile Organic Compound

Non-Project VOCs = sum of VOCs that are not Project VOCs.

lbs/day = pounds per day

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NON-PROJECT VOC MASS RECOVERY RATES

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FIGURE
8C