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ENVIRONMENT

Subject:

2017 Third Quarter Operation, Maintenance and Monitoring Report,
Operable Unit 2, Northrop Grumman Systems Corporation and Naval Weapons Industrial Reserve Plant (NWIRP) Sites, Bethpage, New York.
(NYSDEC Site #s 1-30-003A and B)

Date:
November 30, 2017

Contact:
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Our ref:
NY001496.0216.RPTI4
NY001496.0416.NAVI4

Dear Jason:

On behalf of Northrop Grumman Systems Corporation (Northrop Grumman), Arcadis is providing the NYSDEC with the 2017 Third Quarter Operation, Maintenance and Monitoring Report (Report). This Report was prepared to document the operation, maintenance and monitoring (OM&M) activities conducted for the on-site portion of the Operable Unit 2 (OU2) groundwater remedy and the results of ongoing volatile organic compound (VOC) and inorganic monitoring in groundwater to meet the remedial objectives set forth in the March 2001 OU2 Record of Decision (ROD).

Table 1 summarizes OU2 remedial system performance operational data and water balance. Tables 2 and 3 provide the analytical results for remedial system water and vapor samples for this period, respectively. Tables 4A and 4B provide the air modeling inputs and outputs and resulting analyses, based on quarterly vapor samples collected from the Tower 96 and Tower 102 systems, respectively, for this period. Table 5 provides a summary of percent mass removal of TCE from first quarter 2016 through third quarter 2017. Table 6 provides the validated analytical results of groundwater monitoring for this period. Figures 1 through 3 show the Locations of Wells and Onsite Groundwater Remedy, ONCT Groundwater Extraction and Treatment System Site Plan, and the ONCT Groundwater Extraction and Treatment System Schematic, respectively.

Please contact us if you have any questions or comments.

Sincerely,

Arcadis of New York, Inc.

David E. Stern
Senior Hydrogeologist

Christopher Engler, P.E. 069748
Engineer of Record

Copies:

Ed Hannon – Northrop Grumman
Walter Parish – NYSDEC Region 1
Donald Hesler – NYSDEC
Steven Scharf – NYSDEC
Steven Karpinski – New York State Department of Health
John Lovejoy - NCDOH
Lora Fly – NAVFAC Midlant Environmental
David Brayack – TetraTech NUS, Inc.
Roger Smith – Glenn Springs Holdings, Inc.
Manfred Bohms – Steel Equities
Mike Negrelli – USEPA
Lorenzo Thantu – USEPA
Matthew Russo – Town of Oyster Bay
Stan Carey – Massapequa Water District
Richard Kern – New York American Water
Frank Koch – South Farmingdale Water District
John Reinhardt – Town of Hempstead Water District
Michael Boufis – Bethpage Water District
Janet Steiniger – Bethpage Public Library (Public Repository)
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TABLES

Table 1
Operational Summary for the On-Site Portion of the OU2 Groundwater Remedy, Third Quarter 2017[1]
Operable Unit 2, Northrop Grumman Systems Corporation,
Bethpage, New York

	Quarterly Flow Rates (gpm)		Quarterly Flow Volumes (MG)			Quarterly VOC Concentrations (µg/L)		VOC Mass Removed (lbs) [7]	
	Design [2]	Average [3,4]	Design [2]	Actual [3,4]	% of Design	TCE [5]	TVOC [5,6]	Quarterly	Cumulative
Influent Groundwater									
Well 1 [11]	800	811	104.8	106.0	101%	603	634	562	45,398
Well 3R [11]	700	711	91.7	93.0	101%	365	412	320	90,267
Well 17 [11,12]	1,000	811	131.0	106.0	81%	105	135	120	52,907
Well 18 [11,12]	600	528	78.6	69.0	88%	45	67	39	6,331
Well 19 [11,12]	700	582	91.7	76.0	83%	118	144	92	8,304
Total [13]	**3,800**	**3,443**	**498**	**450**	**90%**	**--**	**--**	**1,133**	**203,207**
Effluent Groundwater [8]									
Calpine	100 - 400	342	--	44.8	--	--	--	--	--
OXY Biosparge [10]	2 - 42	0	--	0	--	--	--	--	--
West Recharge Basins	1,112 - 1,455	1,793	--	235.0	--	--	0.0	--	--
South Recharge Basins [12]	2,231	1,297	292.4	170.0	58%	--	1.3	--	--
Total [14]	**--**	**3,432**	**--**	**450**	**--**				
Additional Flow to South Recharge Basins									
Storm Water Runoff Contributing to South Recharge Basins Flow Volume [14]	--	--	--	18.1	--	--	--	--	--
Total Flow Volume to South Recharge Basins [12,14,15]			**292**	**188**	**64%**				

Treatment Efficiencies [9]	
Tower 96 System:	>99.9%
Tower 102 System:	>99.9%

Notes and abbreviations on last page.

Notes and Abbreviations:

(1) Quarterly reporting period: July 03, 2017 through October 02, 2017.
(2) "Design" flow rates were determined for the five remedial wells and for the South Recharge Basins based on computer modeling (ARCADIS G&M, Inc. 2003c, modified in April 2005). Flow rates for Calpine, OXY Biosparge and West Recharge Basins are typical flow rates and are provided for reader information. "Design" flow volumes represent the volume of water that should be pumped/discharged during the reporting period and is calculated by multiplying the design rate by the reporting period duration.
(3) "Average" flow rates for the remedial wells represent the average actual pumping rates when the pumps are operational and do not take into account the time that a well is not operational. During this quarterly reporting period, the remedial wells operated for the following percentage of the time: Well 1 (99.8%), Well 3R (99.9%), Well 17 (99.7%), Well 18 (99.8%), and Well 19 (99.6%). "Actual" volumes are determined via totalized values computed by SCADA using the instantaneous flow rates transmitted from local flow meters .
(4) "Average" flow rates for the system discharges represent the average flow rate during the entire reporting period and are determined by dividing the total flow during the reporting period by the reporting period duration. The Calpine and South Recharge Basins flow volumes are determined via totalized values computed by SCADA using the instantaneous flow rates transmitted from local flow meters . The West Recharge Basin flow is calculated by subtracting the cumulative flow to the other discharges from the total influent flow. Actual flow to the recharge basins is greater, as shown, because storm water combines with the plant effluent prior to discharge to the recharge basins.
(5) The TCE and TVOC concentrations for the remedial wells are from the quarterly sampling event performed during this reporting period on September 12, 2017 (Table 2).
(6) The TVOC concentration for the two sets of recharge basins are their respective average monthly SPDES concentration for the current quarter.
(7) TVOC mass removed for the reporting period is calculated by multiplying the TVOC concentration from the quarterly sampling event and the quantity of water pumped during the reporting period.
(8) There are four discharges for the effluent groundwater: South Recharge Basins, West Recharge Basins, Calpine and OXY Biosparge system. Treated water is continuously discharged to the south and west recharge basins, and is available "on-demand" to both the Calpine Power Plant (Calpine) for use as make-up water, and the biosparge remediation system operated by Occidental Chemical (OXY Biosparge).
(9) Treatment System Efficiencies are calculated by dividing the difference between the remedial well flow weighted influent and effluent TVOC concentrations by the remedial well flow weighted influent concentration.
(10) Occidental Chemical has not reported any water usage for the OXY Biosparge system since May 2016.
(11) The downtime during Third Quarter 2017 was minor and due to typical operation and maintenance. See Note 12 for detail on reduced per cent design flow values.
(12) As reported in an email to the NYSDEC dated September 29, 2017, during the third quarter the pumping rates were adjusted at Wells 17 through 19 to accommodate draining the western most of the South Basins for a comprehensive basin scraping and rehabilitation work. Rainfall events would dictate the increase or decreases in pumping needed to maintain draining of the western most of the South Basins. Average pumping rates are shown above.
(13) Total pumpage/recharge rates are accurate to ±15% due to limitations in metering. Flow meter calibration was completed on September 29, 2016.
(14) Storm Water Runoff Volume is calculated by multiplying the adjusted tributary area and NOAA precipitation data for the reporting periods. The adjusted tributary area is tributary area that is adjusted by the runoff coefficient to exclude the infiltration volume from the total rainfall volume. The tributary area, runoff coefficient, and adjusted tributary area are from Dvirka and Bartilucci Consulting Engineers' Storm Water Permit Evaluation Report (January, 28, 2010). The NOAA precipitation data are calculated as a sum of NOAA daily precipitation data for the reporting period. NOAA precipitation data are retrieved from Station GHCND:USW00054787 - FARMINGDALE REPUBLIC AIRPORT, NY US.
(15) Total Flow Volume to South Recharge Basins is estimated as a sum of flow volumes contributed from the Effluent Groundwater to South Recharge Basins and from Storm Water Runoff to South Recharge Basins.

--	not applicable	SCADA	Supervisory Controls and Data Acquisition
µg/L	micrograms per liter	SPDES	State Pollution Discharge Elimination System
gpm	gallons per minute	TCE	trichloroethene
lbs	pounds	TVOC	total volatile organic compounds
MG	million gallons	VOC	volatile organic compounds
NOAA	National Oceanic and Atmospheric Administration		

Table 2
Concentrations of Constituents in Remedial Wells and Treatment System Effluents, Second Quarter 2017, Operable Unit 2, Northrop Grumman Systems Corporation, Bethpage, New York

Constituents (units in µg/L)	Location ID:	WELL 1	WELL 3R	96 EFFLUENT
	Sample ID:	WELL 1	WELL 3R	T96 EFFLUENT
	Sample Date:	9/12/2017	9/12/2017	9/12/2017
Volatile Organic Compounds (VOCs)(1)				
1,1,1-Trichloroethane		< 4.0	**0.68 J**	< 1.0
1,1,2,2-Tetrachloroethane		< 4.0	< 1.0	< 1.0
1,1,2-Trichloroethane		< 4.0	< 1.0	< 1.0
1,1-Dichloroethane		< 4.0	**1.5**	< 1.0
1,1-Dichloroethene		< 4.0	**4.1**	< 1.0
1,2-Dichloroethane		< 4.0	< 1.0	< 1.0
1,2-Dichloropropane		**4.4**	< 1.0	< 1.0
2-Butanone (MEK)		< 4.0	< 1.0	< 1.0
2-Hexanone (MBK)		< 2.0	< 5.0	< 5.0
4-methyl-2-pentanone (MIK)		< 2.0	< 5.0	< 5.0
Acetone		< 4.0	< 1.0	< 1.0
Benzene		< 2.0	< 0.5	< 0.5
Bromodichloromethane		< 4.0	< 1.0	< 1.0
Bromoform		< 4.0	< 1.0	< 1.0
Bromomethane		< 8.0	< 2.0	< 2.0
Carbon Disulfide		< 8.0	< 2.0	< 2.0
Carbon Tetrachloride		< 4.0	< 1.0	< 1.0
Chlorobenzene		< 4.0	< 1.0	< 1.0
Chloroethane		< 4.0	< 1.0	< 1.0
Chloroform		< 4.0	< 1.0	< 1.0
Chloromethane		< 4.0	< 1.0	< 1.0
cis-1,2-Dichloroethene		**4.9**	**4.3**	< 1.0
cis-1,3-Dichloropropene		< 4.0	< 1.0	< 1.0
Dibromochloromethane		< 4.0	< 1.0	< 1.0
Ethylbenzene		< 4.0	< 1.0	< 1.0
Methylene Chloride		< 8.0	< 2.0	< 2.0
Styrene		< 4.0	< 1.0	< 1.0
Tetrachloroethene		**21.7**	**30.5**	< 1.0
Toluene		< 4.0	< 1.0	< 1.0
trans-1,2-Dichloroethene		< 4.0	< 1.0	< 1.0
trans-1,3-Dichloropropene		< 4.0	< 1.0	< 1.0
Trichloroethylene		**603**	**365**	< 1.0
Trichlorotrifluoroethane (Freon 113)		< 2.0	**3.5 J**	< 5.0
Vinyl Chloride		< 4.0	**2.7**	< 1.0
Xylene-o		< 4.0	< 1.0	< 1.0
Xylene-m,p		< 4.0	< 1.0	< 1.0
Total VOCs(3)		**630.0**	**410**	0
1,4-Dioxane(1,4)		**9.35**	**14.9**	**12.2**

Notes and abbreviations on last page.

Table 2
Concentrations of Constituents in Remedial Wells and Treatment System Effluents, Second Quarter 2017, Operable Unit 2, Northrop Grumman Systems Corporation, Bethpage, New York

Constituents (units in µg/L)	Location ID: / Sample ID: / Sample Date:	WELL 17 / WELL 17 / 9/12/2017	Well 17 / REP-091217-MG-1 / 9/12/2017	WELL 18 / WELL 18 / 9/12/2017	WELL 19 / WELL 19 / 9/12/2017	102 EFFLUENT / T102 EFFLUENT / 9/12/2017
Volatile Organic Compounds (VOCs)[1]						
1,1,1-Trichloroethane		**0.25 J**	**0.27 J**	**0.42 J**	**0.28 J**	< 1.0
1,1,2,2-Tetrachloroethane		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2-Trichloroethane		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane		**0.86 J**	**0.85 J**	**1.2**	**0.66 J**	< 1.0
1,1-Dichloroethene		**1.7**	**1.7**	**3.1**	**1.4**	< 1.0
1,2-Dichloroethane		< 1.0	< 1.0	< 1.0	**0.3 J**	< 1.0
1,2-Dichloropropane		**0.27 J**	**0.24 J**	< 1.0	< 1.0	< 1.0
2-Butanone (MEK)		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Hexanone (MBK)		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
4-methyl-2-pentanone (MIK)		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Acetone		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzene		< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Bromodichloromethane		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromoform		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Bromomethane		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Carbon Disulfide		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Carbon Tetrachloride		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorobenzene		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroform		< 1.0	< 1.0	< 1.0	**0.4 J**	< 1.0
Chloromethane		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
cis-1,2-Dichloroethene		**2.8**	**2.9**	**2.7**	**16.5**	< 1.0
cis-1,3-Dichloropropene		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibromochloromethane		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methylene Chloride		< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Styrene		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tetrachloroethene		**21.6**	**21.4**	**13.8**	**6.7**	< 1.0
Toluene		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
trans-1,2-Dichloroethene		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
trans-1,3-Dichloropropene		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene		**105**	**104**	**44.5**	**118**	< 1.0
Trichlorotrifluoroethane (Freon 113)		**2.8 J**	**2.9 J**	**1.2 J**	< 5.0	< 5.0
Vinyl Chloride		< 1.0	< 1.0	2.7	< 1.0	< 1.0
Xylene-o		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Xylene-m,p		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total VOCs[3]		**140**	**130**	**67**	**140**	0
1,4-Dioxane[1,4]		8.51	8.21	7.44	5.53	7.02

Notes and abbreviations on last page.

Notes and Abbreviations:

(1)	VOC samples analyzed using USEPA Method 8260C. 1,4-Dioxane samples analyzed using USEPA Method 522 SIM.
(2)	Results for the program are validated at 20% frequency, per protocols specified in OU2 Groundwater Monitoring Plan (Arcadis 2016).
(3)	Total VOC results rounded to two significant figures.
(4)	1,4-Dioxane sample collected on October 12, 2017.
1.6	Bold value indicates the constituent was detected at or above its reporting limit.
< 5.0	Compound is not detected above its laboratory quantification limit .
µg/L	micrograms per liter
J	Constituent value is estimated
OU2	Operable Unit 2
REP	blind replicate sample
SIM	selective ion monitoring
VOC	volatile organic compound
USEPA	United Stated Environmental Protection Agency

Table 3
Vapor Sample Analytical Results for Treatment Systems, Third Quarter 2017, Northrop Grumman Systems Corporation, Operable Unit 2, Bethpage, New York(3)

Constituents (Units in µg/m³) Location ID: / Sample ID: / Date:	96 INFLUENT T96 INFLUENT 9/19/2017	96 MIDTRAIN T96 MIDTRAIN 9/19/2017	96 SUP MIDTRAIN T96 SUP MIDTRAIN 9/19/2017	96 EFFLUENT T96 EFFLUENT 9/19/2017	102 INFLUENT T102 INFLUENT 10/17/2017	102 EFFLUENT T102 EFFLUENT 10/17/2017
Volatile Organic Compounds (VOCs)						
1,1,1-Trichloroethane	< 22	< 16	< 11	< 16	**23**	**0.60**
1,1,2,2-Tetrachloroethane	< 27	< 21	< 14	< 21	< 0.69	< 0.69
1,1,2-Trichloroethane	<22	< 16	< 11	< 16	**1.50**	< 0.55
1,1-Dichloroethane	**40.9**	**33**	**28**	**38**	**53.4**	**19**
1,1-Dichloroethylene	**99.5**	**88.8**	**78.1**	**99.1**	**115**	**103**
1,2-Dichloroethane	< 32	< 24	< 16	< 24	**4.0**	< 0.81
1,2-Dichloropropane	**88.7**	**31**	**27**	**26 J**	**5.5**	< 0.92
Benzene	< 26	< 19	< 13	< 19	**0.61 J**	< 0.64
Bromodichloromethane	< 27	< 20	< 13	< 20	< 0.67	< 0.67
Bromoform	< 17	< 12	< 8.3	< 12	< 0.41	< 0.41
Bromomethane	< 31	< 23	< 16	< 23	< 0.78	< 0.78
Carbon disulfide	< 25	< 18	< 12	< 18	< 0.62	< 0.62
Carbon tetrachloride	< 10	< 7.5	< 5.0	< 7.5	**4.8**	< 0.25
Chlorobenzene	< 37	< 27	< 18	< 27	< 0.92	< 0.92
Chloroethane	< 21	< 16	< 11	< 16	< 0.53	< 0.53
Chloroform	< 39	< 29	< 20	< 29	**18**	**3.2**
Chloromethane	< 17	< 12	< 8.3	< 12	**0.78**	**0.81**
cis-1,2-Dichloroethene	--	--	--	--	**396**	**39**
cis-1,3-Dichloropropene	< 36	< 27	< 18	< 27	< 0.91	< 0.91
Dibromochloromethane	< 34	< 26	< 17	< 26	< 0.85	< 0.85
Ethylbenzene	< 35	< 26	< 17	< 26	< 0.87	< 0.87
Methylene chloride	< 28	< 20	< 14	< 20	**1.0**	**9.4**
Styrene	< 34	< 25	< 17	< 25	< 0.85	< 0.85
Tetrachloroethylene	**667**	**138**	**8.8**	< 8.1	**395**	**4.3**
Toluene	< 30	< 22	**17**	**38.4**	< 0.75	< 0.75
trans-1,2-Dichloroethene	--	--	--	--	**3.7**	**0.59 J**
trans-1,3-Dichloropropene	< 36	< 27	< 18	< 27	< 0.91	< 0.91
Trichloroethylene	**12100**	**6610**	**3670**	**6130**	**3990**	**40**
Trichlorotrifluoroethane (Freon 113)	**121**	**85.1**	**75**	**102**	**113**	**22**
Vinyl chloride	**49.6**	**50.4**	**48.1**	**67.7**	**0.28**	**0.28**
Xylene-o	< 35	< 26	< 17	< 26	< 0.87	< 0.87
Xylenes - m,p	< 35	< 26	< 17	< 26	< 0.87	< 0.87
Total VOCs(2),(5)	**13,167**	**7,036**	**3,952**	**6,501 (4)**	**5,126**	**242**

Notes and abbreviations on last page.

Notes and Abbreviations:

(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.

(2) "Total VOCs" represents the sum of individual concentrations of compounds detected rounded to the nearest whole number.

(3) Tower 102 Vapor samples delayed due to system maintenance and air sampling equipment failures.

(4) "Total 1,2-Dichloroethene" compound inadvertently reported for T102 Influent and T102 Effluent samples this Quarter. The result of the compound, 400 ug/m^3 and 39.3 ug/m^3, respectively were not added to the "Total VOCs". Cis-1,2-Dichloroethene and trans-1,2-Dichloroethene has been added to the constituents list as of October 2017.

(5) TVOC Tower 96 Efflent concentration under further review. In parallel, Northrop Grumman is scheduling a carbon changeout during the 4th Quarter.

--	Not analyzed
$\mu g/m^3$	micrograms per cubic meter
J	Compound detected below its reporting limit; value is estimated.
NYSDOH	New York State Department of Health
SUP	Supplemental
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound

Table 4A
Summary of AERMOD Air Quality Impact Analysis
Tower 96 Treatment System, Operable Unit 2,
Northrop Grumman Systems Corporation,
Bethpage, New York

Constituent	CAS#	T96 Effluent (ug/m^3)	Emission Rate[1]			Scaled Impact - Hourly [2] (ug/m^3)	Scaled Impact - Annual [2] (ug/m^3)	SGC [3] (ug/m^3)	AGC[3] (ug/m^3)	%SGC	% AGC
		9/19/2017	lb/yr	lb/hr	g/s						
1,1 - Dichloroethane	00075-34-3	**38**	6.22	7.10E-04	8.94E-05	1.32E-02	3.88E-04	NS	6.30E-01	--	0.1%
1,1 - Dichloroethylene	00075-35-4	**99.1**	16.21	1.85E-03	2.3E-04	3.5E-02	1.0E-03	NS	6.30E-01	--	0.2%
Trichloroethylene	00079-01-6	**6130**	1002.68	1.14E-01	1.4E-02	2.1E+00	6.3E-02	20	2.0E-01	10.7%	31.3%
Vinyl Chloride	00075-01-4	**67.7**	11.07	1.26E-03	1.6E-04	2.4E-02	6.9E-04	180000	1.1E-01	0.0%	0.6%
Toluene	00108-88-3	**38.4**	6.28	7.17E-04	9.0E-05	1.3E-02	3.9E-04	37000	5000	0.0%	0.0%
1,2-Dichloropropane	00078-87-5	**26**	4.25	4.85E-04	6.1E-05	9.1E-03	2.7E-04	NS	4	--	0.0%
Trichlorotrifluoroethane (Freon 113)	00076-13-1	**102**	16.68	1.90E-03	2.4E-04	3.6E-02	1.0E-03	960000	180000	0.0%	0.0%

Notes and abbreviations on last page.

Table 4A
Summary of AERMOD Air Quality Impact Analysis
Tower 96 Treatment System, Operable Unit 2,
Northrop Grumman Systems Corporation,
Bethpage, New York

Notes and Abbreviations:

(1) Emission rate calculated based on effluent concentration and a stack air flow rate of 4,951 cfm. The stack air flow rate (in acfm) is taken from the actual stack air flow rate on the day of sampling. Effluent temperature used in the model was 96°F from direct read in-line gauge.

Trichloroethene (lb/hr) = TCE [ug/m$^{3]}$ x Air Flow Rate [ft^3/min] x (1 m^3/35 ft^3) x (60 min/hr) x (0.000001 g/1 ug) x (0.0022 lb/g)

lb/yr = lb/hr x 8,760 hrs/yr

g/s = lb/hr x 1 hr/3,600 sec x 453.59 g/1 lb

(2) Ambient impact based on AERMOD modeling using noramalized 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 (Farmingdale, NY) for the years 2011 through 2015, and a stack which is 55 feet high and 20 inches in diameter. The maximum impact from all the years was used for the calculations.

Scaled hourly impact (ug/m^3) = AERMOD predicted hourly ambient impact at 1 g/s ([ug/m^3]/[g/s]) x Actual emission rate (g/s)

Scaled annual impact (ug/m^3) = AERMOD predicted annual ambient impact at 1 g/s ([ug/m^3]/[g/s]) x Actual emission rate (g/s)

AERMOD Normalized Ambient Impact at 1 g/s	
Hourly ([ug/m^3]/[g/s])	Annual ([ug/m^3]/[g/s])
148.05	4.35

(3) Short-term and annual guideline concentrations for air toxic pollutants specified in the NYSDEC DAR-1 AGC/SGC tables revised August 10, 2016.

(4) The receptor height corresponds to the average inhalation level.

µg/m^3	micrograms per cubic meter
lb/yr	pounds per year
lb/hr	pounds per hour
g/s	grams per second
26	bold value indicates a detection
AGC	annual guideline concentration
SGC	short-term guideline concentration
acfm	actual cubic feet per minute
CAS #	Chemical Abstracts Service Registry Number
DAR-1	Division of Air Resources-1
NS	none specified
NYSDEC	New York State Department of Environmental Conservation

Table 4B
Summary of AERMOD Air Quality Impact Analysis
Tower 102 Treatment System, Operable Unit 2,
Northrop Grumman Systems Corporation,
Bethpage, New York

Constituent	CAS#	T102 Effluent (ug/m^3)	Emission Rate[1]			Scaled Impact -Hourly[2] (ug/m^3)	Scaled Impact -Annual[2] (ug/m^3)	SGC[3] (ug/m^3)	AGC[3] (ug/m^3)	%SGC	% AGC
		10/17/2017	lb/yr	lb/hr	g/s						
1,1,1 - Trichloroethane	00071-55-6	**0.6**	0.15	1.73E-05	2.18E-06	7.62E-04	4.99E-06	9000	5000	0.0%	0.0%
1,1 - Dichloroethane	00075-34-3	**19**	4.81	5.49E-04	6.9E-05	2.4E-02	1.6E-04	NS	6.3E-01	--	0.0%
1,1 - Dichloroethene	00075-35-4	**103**	26.06	2.98E-03	3.7E-04	1.3E-01	8.6E-04	NS	200	--	0.0%
Tetrachloroethene	00127-18-4	**4.3**	1.09	1.24E-04	1.6E-05	5.5E-03	3.6E-05	300	4.0	0.0%	0.0%
Trichloroethene	00079-01-6	**40**	10.12	1.16E-03	1.5E-04	5.1E-02	3.3E-04	20	2.0E-01	0.3%	0.2%
Vinyl Chloride	00075-01-4	**0.28**	0.07	8.09E-06	1.0E-06	3.6E-04	2.3E-06	180000	1.1E-01	0.0%	0.0%
cis 1,2-Dichloroethene	00156-59-2	**39**	9.87	1.13E-03	1.4E-04	5.0E-02	3.2E-04	NS	6.3E+01	--	0.0%
trans 1,2-Dichloroethene	00156-60-5	**0.59**	0.15	1.70E-05	2.1E-06	7.5E-04	4.9E-06	NS	6.3E+01	--	0.0%
Chloroform	00067-66-3	**3.2**	0.81	9.24E-05	1.2E-05	4.1E-03	2.7E-05	150	14.7	0.0%	0.0%
Chloromethane	00074-87-3	**0.81**	0.20	2.34E-05	2.9E-06	1.0E-03	6.7E-06	22000	90	0.0%	0.0%
Dichloromethane	00075-09-2	**9.4**	2.38	2.72E-04	3.4E-05	1.2E-02	7.8E-05	14000	60	0.0%	0.0%
Trichlorotrifluoroethane (Freon 113)	00076-13-1	**22**	5.57	6.35E-04	8.0E-05	2.8E-02	1.8E-04	960000	180000	0.0%	0.0%

Notes and abbreviations on last page.

Table 4B
Summary of AERMOD Air Quality Impact Analysis
Tower 102 Treatment System, Operable Unit 2,
Northrop Grumman Systems Corporation,
Bethpage, New York

Notes and Abbreviations:

(1) Emission rate calculated based on effluent concentration and a stack air flow rate of 7,659 cfm. The stack air flow rate (in acfm) is taken from the actual stack air flow rate on the day of sampling. Effluent temperature used in the model was 71°F from direct read in-line gauge.

Trichloroethene (lb/hr) = TCE [ug/m^{3}] x Air Flow Rate [ft^{3}/min] x (1 m^{3}/35 ft^{3}) x (60 min/hr) x (0.000001 g/1 ug) x (0.0022 lb/g)

lb/yr = lb/hr x 8,760 hrs/yr

g/s = lb/hr x 1 hr/3,600 sec x 453.59 g/1 lb

(2) Ambient impact based on AERMOD modeling using noramalized 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 (Farmingdale, NY) for the years 2011 through 2015, and a stack which is 69.52 feet high and 24 inches in diameter. The maximum impact from all the years was used for the calculations.

Scaled hourly impact (ug/m^{3}) = AERMOD predicted hourly ambient impact at 1 g/s ([ug/m^{3}]/[g/s]) x Actual emission rate (g/s)

Scaled annual impact (ug/m^{3}) = AERMOD predicted annual ambient impact at 1 g/s ([ug/m^{3}]/[g/s]) x Actual emission rate (g/s)

AERMOD Normalized Ambient Impact at 1 g/s	
Hourly ([ug/m^{3}]/[g/s])	Annual ([ug/m^{3}]/[g/s])
348.85	2.29

(3) Short-term and annual guideline concentrations for air toxic pollutants specified in the NYSDEC DAR-1 AGC/SGC tables revised August 10, 2016.

(4) The receptor height corresponds to the average inhalation level.

°F	degrees Fahrenheit
μg/m^{3}	micrograms per cubic meter
acfm	actual cubic feet per minute
ft^{3} /min of cfm	cubic feet per minute
g/s	grams per second
lb/hr	pounds per hour
lb/yr	pounds per year
9.4	bold value indicates a detection
AGC	annual guideline concentration
CAS #	Chemical Abstracts Service Registry Number
DAR-1	Division of Air Resources-1
NS	none specified

Table 5
Summary of TCE Mass Removal, Tower 96 Treatment System, Third Quarter 2017, Northrop Grumman Systems Corporation, Operable Unit 2, Bethpage, New York(1,2,3)

ARCADIS Design & Consultancy for natural and built assets

Date		TCE Concentration (µg/m³)				TCE Mass Emission(5)	Percent of Allowable TCE Emissions(6)	Percent Mass Removal		
		T96 INFLUENT	T96 MIDTRAIN	T96 SUP MIDTRAIN	T96 EFFLUENT(7)	(lbs)	Rolling	T96 MIDTRAIN	T96 SUP MIDTRAIN	T96 EFFLUENT
3/14/2016		24,892	4,311	NS	50	0.6	3.4%	82.7%	NA	99.8%
5/12/2016		25,539	7,455	NS	49	0.6	3.3%	70.8%	NA	99.8%
8/17/2016		24,787	4,232	NS	34	0.5	2.3%	82.9%	NA	99.9%
12/22/2016		29,031	4,018	NS	161	2.3	2.2%	86.2%	NA	99.4%
2/14/2017	(2)	24,300	NS	142	42	0.8	2.2%	NA	99.4%	99.8%
3/21/2017		23,800	NS	2,580	1,280	20	6.0%	NA	89.2%	94.6%
4/14/2017	(3)	18,200	NS	NS	16,600	184	42.8%	NA	NA	8.8%
5/11/2017	(7)	21,600	4,800	NS	4,800	55	53.7%	77.8%	NA	77.8%
6/27/2017	(4,8)	19,700	4,030	NS	591	13	56.1%	79.5%	NA	97.0%
7/18/2017		NS	NS	NS	3,360	30	62.0%	NA	NA	NA
8/18/2017	(9)	NS	NS	NS	4,745	66	75.1%	NA	NA	NA
9/19/2017		12,100	6,610	3,670	6,130	87	92.4%	45.4%	69.7%	49.3%

Notes and Abbreviations:

(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.
(2) System transitioned from a regenerative VPGAC to once-through VPGAC (Supplemental Bed 1) system with PPZ polishing bed (Supplemental Bed 2) on 1/26/2017. Northrop Grumman performed pilot testing on this operational modification as discussed with NYSDEC on January 26, 2017.
(3) PPZ media was removed from the Supplemental Bed 2 on 3/23/2017 by OXY and was left empty.
(4) A carbon change out was performed in Supplemental Bed 1 and new carbon was placed in the previously empty Supplemental Bed 2 on May 18, 2017.
(5) TCE Mass Emission calculated based on the exhaust air flow rate on the day of sampling and the period of time since the preceding day of sampling.
TCE (lb) = TCE Concentration [µg/m³] x Days x Flow Rate [ft³/min] x (1 m³/35 ft³) x (60 min/hr) x (24 hr/day) x (0.000001 g/1 ug) x (0.0022 lb/g)
(6) Percent of allowable TCE emissions to date is a time-weighted annual rolling average based on the 500 lb/year emission limit specified in the CRR-NY 212-2.2 Table 2. High Toxicity Air Contaminant List, revised April 1, 2017.
(7) For calculation purposes, the T96 MIDTRAIN concentration was used for the T96 Effluent result for May 11, 2017 as the T96 Effluent sample results were validated and rejected based on the use of non-dedicated sample collection fittings.
(8) T96 Influent sample collected on 6/30/2017.
(9) Sampling not conducted in August, the average of July and September effluent data and actual average air flow rate for the time period were used for estimated calculations for August 18, 2017.

italics dates of pilot test using once through carbon treatment operation.
µg/m³ micrograms per cubic meter
lbs pounds
CRR-NY Codes, Rules and Regulations of the State of New York
ELAP Environmental Laboratory Approval Program
NA not applicable
NS not sampled
NYSDOH New York State Department of Health
PPZ potassium permanganate coated zeolite
SUP supplemental
TCE trichloroethylene
USEPA United States Environmental Protection Agency
VOC volatile organic compound
VPGAC vapor phase granular activated carbon

Table 6.
Concentrations of Volatile Organic Compounds
and 1,4-Dioxane in Monitoring Wells [1]
BPOW 2-1, BPOW 2-2 and BPOW 2-3, Third Quarter 2017
Operable Unit 2 (Groundwater),
Bethpage, New York

CONSTITUENT Units (ug/L)	Sample ID: Date:	BPOW 2-1 BPOW 2-1 9/12/2017	BPOW 2-2 BPOW 2-2 9/12/2017	BPOW 2-3 BPOW 2-3 9/20/2017
Volatile Organic Compounds (VOCs) [2,3]				
1,1,1-Trichloroethane		< 0.50	< 0.50	< 0.50 J
1,1,2,2-Tetrachloroethane		< 0.50	< 0.50	< 0.50 J
1,1,2-trichloro-1,2,2-trifluroethane		< 1.0	< 1.0	< 1.0
1,1,2-Trichloroethane		< 0.50	< 0.50	< 0.50 J
1,1-Dichloroethane		< 0.50	< 0.50	< 0.50
1,1-Dichloroethene		< 0.50	< 0.50	< 0.50 J
1,2-Dichloroethane		< 0.50	< 0.50	< 0.50
1,2-Dichloropropane		< 0.50	< 0.50	< 0.50 J
2-Butanone (MEK)		< 5.0	< 5.0	< 5.0
2-Hexanone		< 2.0	< 2.0	< 2.0
4-methyl-2-pentanone (MIK)		< 2.0	< 2.0	< 2.0
Acetone		< 5.0	< 5.0	< 5.0
Benzene		< 0.50	< 0.50	< 0.50 J
Bromodichloromethane		< 0.50	< 0.50	< 0.50 J
Bromoform		< 0.50	< 0.50	< 0.50
Bromomethane		< 0.50	< 0.50	< 0.50
Carbon Disulfide		< 0.50	< 0.50	< 0.50
Carbon tetrachloride		< 0.50	< 0.50	< 0.50
Chlorobenzene		< 0.50	< 0.50	< 0.50 J
Chloroethane		< 0.50	< 0.50	< 0.50
Chloroform		< 0.50	< 0.50	< 0.50 J
Chloromethane		< 0.50	< 0.50	< 0.50
cis-1,2-dichloroethene		< 0.50	< 0.50	< 0.50 J
cis-1,3-dichloropropene		< 0.50	< 0.50	< 0.50 J
Dibromochloromethane		< 0.50	< 0.50	< 0.50
Ethylbenzene		< 0.50	< 0.50	< 0.50 J
Methylene Chloride		< 0.50	< 0.50	< 0.50 J
Styrene		< 0.50	< 0.50	< 0.50
Tetrachloroethene		< 0.50	< 0.50	< 0.50
Toluene		< 0.50	< 0.50	< 0.50 J
trans-1,2-dichloroethene		< 0.50	< 0.50	< 0.50 J
trans-1,3-dichloropropene		< 0.50	< 0.50	< 0.50 J
Trichloroethylene		< 0.50	< 0.50	< 0.50 J
Vinyl Chloride		< 0.50	< 0.50	< 0.50
Xylene-o		< 0.50	< 0.50	< 0.50
Xylenes - m,p		< 0.50	< 0.50	< 0.50
Total VOCs [4]		0	0	0
1,4-Dioxane [2,3]		**1.38**	**0.293**	**3.98**

See last page for Notes and Abbreviations.

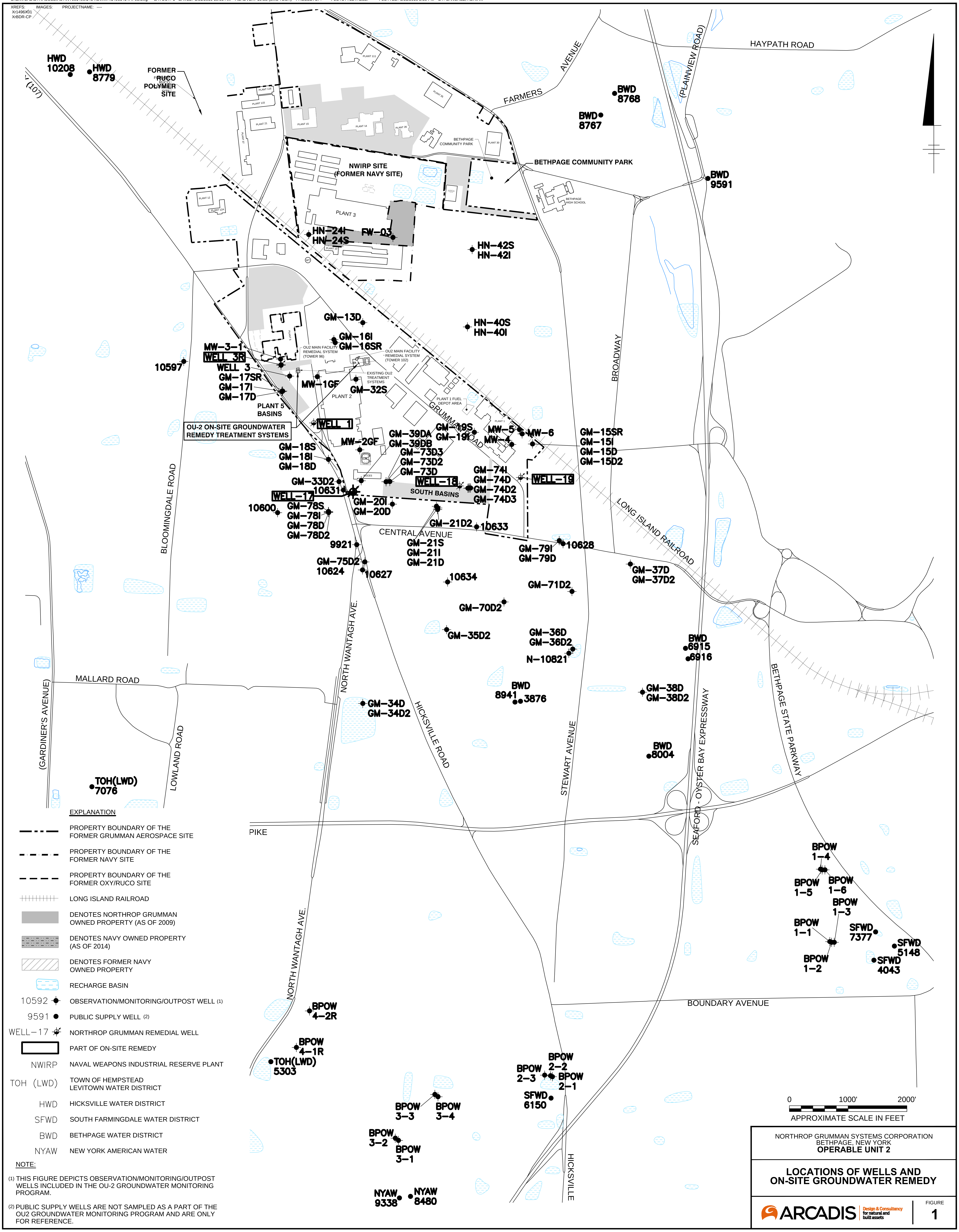
Table 6.
Concentrations of Volatile Organic Compounds and 1,4-Dioxane in Monitoring Wells (1)
BPOW 2-1, BPOW 2-2 and BPOW 2-3, Third Quarter 2017
Operable Unit 2 (Groundwater),
Bethpage, New York

Notes and Abbreviations:

(1)	These outpost wells have been recently repurposed for use as plume monitoring wells per the June 2015 Groundwater Monitoring Plan Addendum (ARCADIS of New York, Inc., 2015) as conditionally approved by the NYSDEC (August 25, 2015). Therefore, TVOC trigger levels that may have been previously established are no longer shown
(2)	Samples were analyzed for VOCs using USEPA Method 524.2; samples were analyzed for 1,4-Dioxane using USEPA Method 522
(3)	Results for the program are validated at 20% frequency, per protocols specified in OU2 Groundwater Monitoring Plan (Arcadis 2016)
(4)	Total VOCs are rounded to two significant figures
0.333	Bold value indicates constituent detected at or above its reporting limit
J	Constituent value is estimated.
TVOCs	Total Volatile Organic Compounds
VOC	Volatile Organic Compounds
µg/L	micrograms per liter
<0.5	Compound not detected above its laboratory quantification limit.

FIGURES

CITY:(Reqd) DIV/GROUP:(Reqd) DB:(Reqd) LD:(Opt) PIC:(Opt) PM:(Reqd) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\SYRACUSE\ACT\NY001496\1414\GWM\4\14961414\4F01.dwg LAYOUT: 1 SAVED: 3/31/2016 10:05 AM ACADVER: 19.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ---- PLOTTED: 3/31/2016 2:50 PM BY: SANCHEZ, ADRIAN
XREFS: IMAGES: PROJECTNAME: ----
X/1496X01
X/BDR-CP



EXPLANATION

(dash-dot line)	PROPERTY BOUNDARY OF THE FORMER GRUMMAN AEROSPACE SITE
(dash-dot-dot line)	PROPERTY BOUNDARY OF THE FORMER NAVY SITE
(dashed line)	PROPERTY BOUNDARY OF THE FORMER OXY/RUCO SITE
(hatched line)	LONG ISLAND RAILROAD
(grey fill)	DENOTES NORTHROP GRUMMAN OWNED PROPERTY (AS OF 2009)
(dotted grey fill)	DENOTES NAVY OWNED PROPERTY (AS OF 2014)
(hatched fill)	DENOTES FORMER NAVY OWNED PROPERTY
(blue fill)	RECHARGE BASIN
10592	OBSERVATION/MONITORING/OUTPOST WELL (1)
9591	PUBLIC SUPPLY WELL (2)
WELL-17	NORTHROP GRUMMAN REMEDIAL WELL
(box)	PART OF ON-SITE REMEDY
NWIRP	NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
TOH (LWD)	TOWN OF HEMPSTEAD LEVITOWN WATER DISTRICT
HWD	HICKSVILLE WATER DISTRICT
SFWD	SOUTH FARMINGDALE WATER DISTRICT
BWD	BETHPAGE WATER DISTRICT
NYAW	NEW YORK AMERICAN WATER

NOTE:

(1) THIS FIGURE DEPICTS OBSERVATION/MONITORING/OUTPOST WELLS INCLUDED IN THE OU-2 GROUNDWATER MONITORING PROGRAM.

(2) PUBLIC SUPPLY WELLS ARE NOT SAMPLED AS A PART OF THE OU2 GROUNDWATER MONITORING PROGRAM AND ARE ONLY FOR REFERENCE.

NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE, NEW YORK
OPERABLE UNIT 2

LOCATIONS OF WELLS AND ON-SITE GROUNDWATER REMEDY

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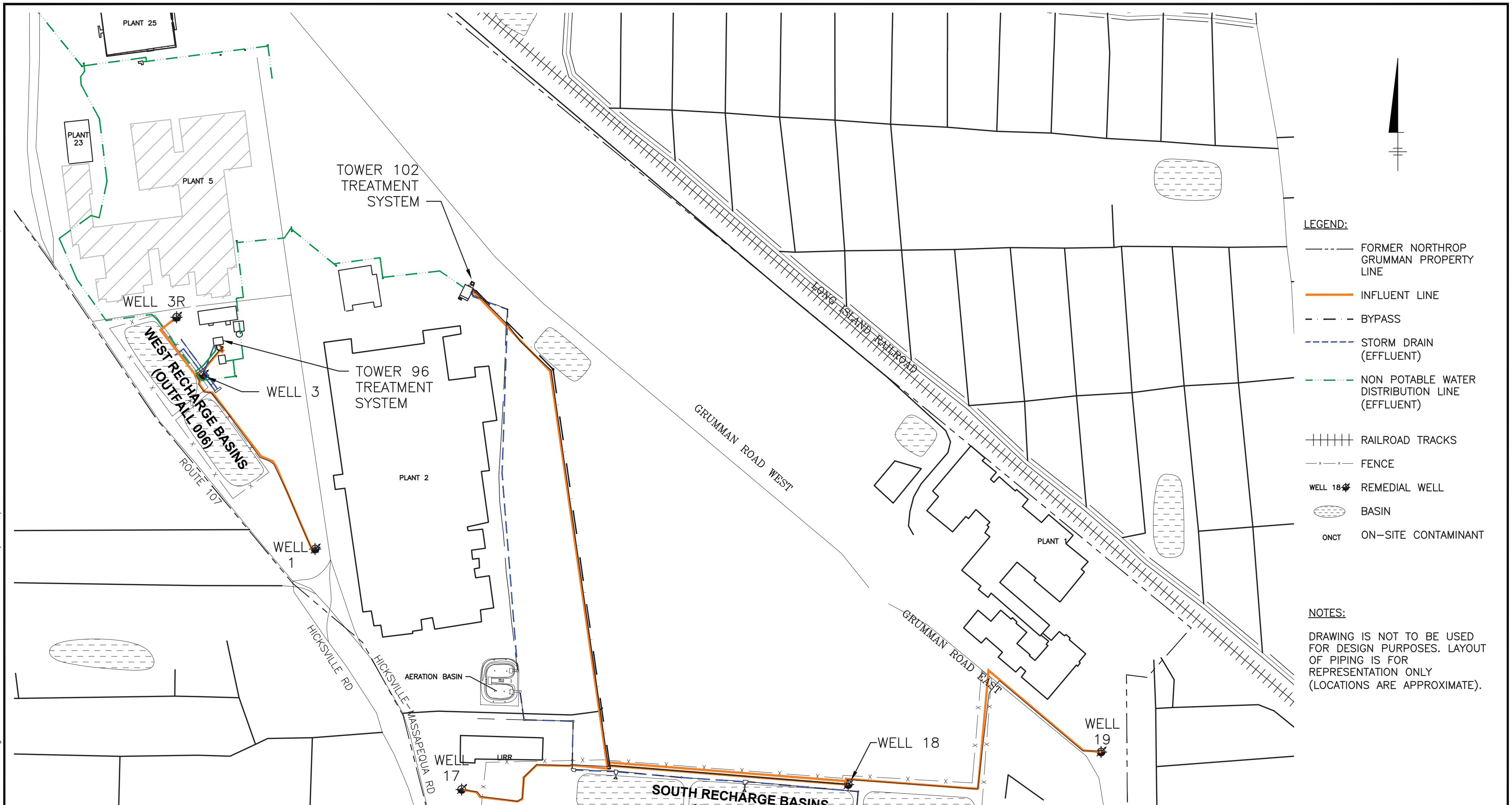
FIGURE
1



NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE, NEW YORK
OPERABLE UNIT 2

ONCT GROUNDWATER EXTRACTION AND TREATMENT SYSTEM SITE PLAN

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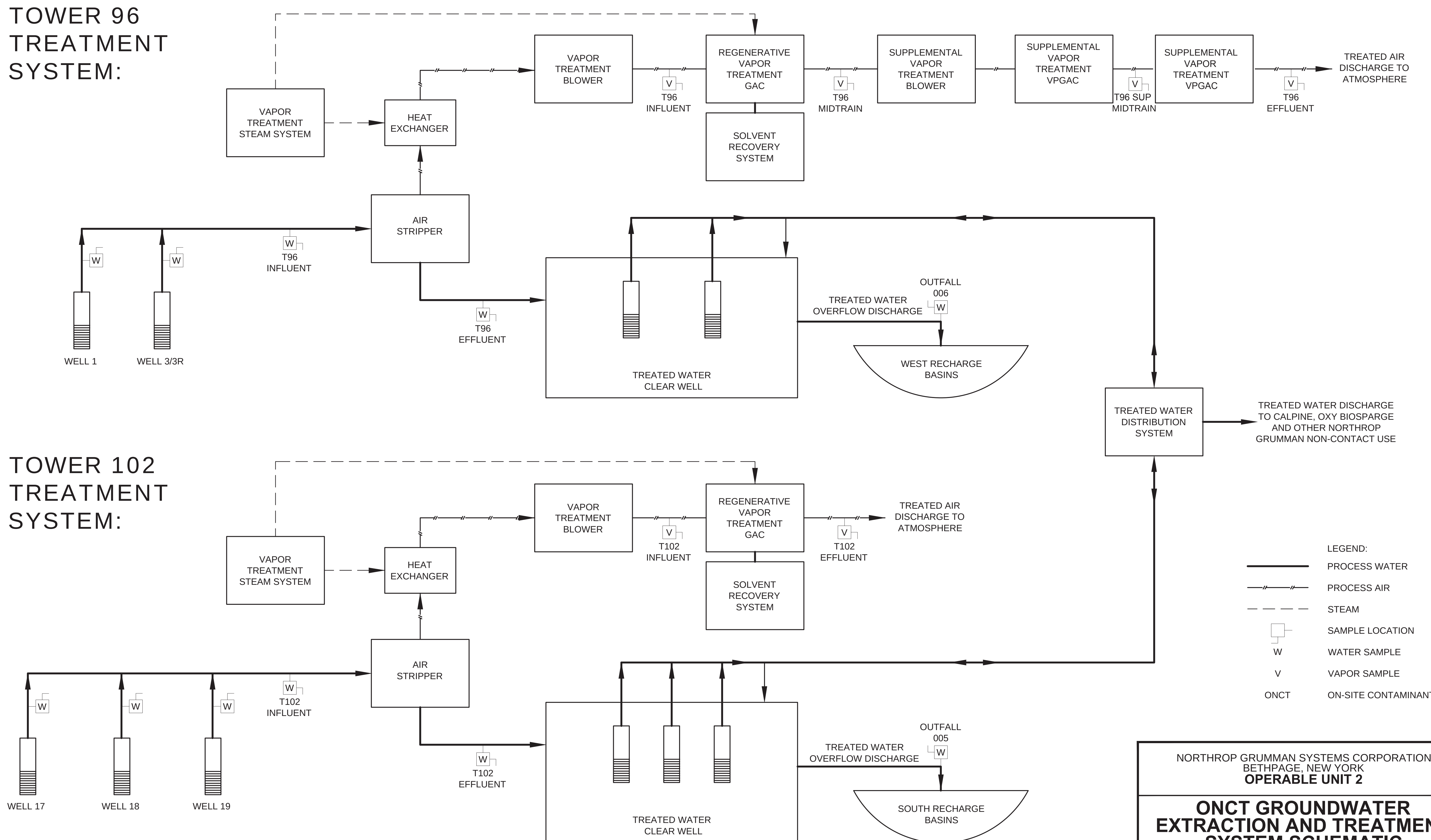
FIGURE
2



NORTHROP GRUMMAN SYSTEMS CORPORATION
BETHPAGE, NEW YORK
OPERABLE UNIT 2

ONCT GROUNDWATER EXTRACTION AND TREATMENT SYSTEM SCHEMATIC

ARCADIS Design & Consultancy for natural and built assets

FIGURE
3