CITY OF NEWARK
Mayor Ras J. Baraka

Department of Water and Sewer Utilities **A City We Can All Believe In**

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November 8, 2018

Mr. Joseph J. Mattle, Supervisor
NJDEP – Bureau of Water System Engineering
401 East State Street
PO Box 420
Trenton, New Jersey 08625-0420

Subject: Newark Water Department – PWSID: NJ 0714001
Pequannock WTP – Draft Corrosion Control Review and Recommendations Letter
No. LCR 180001 - Response to DEP Comments dated October 26, 2018

Dear Mr. Mattle:

The City of Newark (Newark) hereby responds to the comments and questions noted in your letter dated October 26, 2018 on the Corrosion Control Review and Recommendation Report.

Wanaque Gradient

1. *The Draft Report only includes a corrosion control evaluation for Newark's Pequannock Gradient. A CCT review and recommendations report is required to be conducted for Newark's Wanaque Gradient. The evaluation of the Wanaque Gradient must include sequential sampling along with determining if a pipe scale study is required. In addition, Newark must evaluate whether elevated lead levels in the Wanaque Gradient can be attributed to the influence of Pequannock Gradient water leaking through division gates. A schedule for completion of this task shall be submitted.*

   Response:

   As presented in Section 2 of the draft report, "Pequannock WTP Corrosion Control Review and Recommendation" dated October 10, 2018, the lead sampling compliance data shows

that, if evaluated separately from the Pequannock service area, the Wanaque Gradient would have been in compliance from 2002 to the first half of 2018 with 90th percentile values ranging from 0.0 to 11.2 µg/L as presented in Table 2-3. In comparison, the 90th percentile values for the Pequannock Gradient ranged between 9.5 and 36.0 µg/L over that same period as presented in Table 2-1. Because the City of Newark water system is regulated as one system (i.e. combined Pequannock/Wanaque), the Lead Action Level exceedances in 2017 and 2018 apply to the entire City. However, based on the data, it is the lead levels in the Pequannock Gradient that are triggering the exceedances and not the Wanaque Gradient.

Based on the lead compliance sampling data and the work done to-date, it appears that the current CCT for the Wanaque Gradient is sufficient at reducing lead levels in the drinking water to below the standards and no modifications to the CCT on the Wanaque Gradient are recommended at this time. However, as a whole, the entire City of Newark is not currently meeting the Lead Action Level due to the Pequannock/Wanaque combined monitoring and 90th percentile calculation and, therefore, a CCT review is triggered. A separate technical memorandum will be provided with a more detailed evaluation of the CCT in the Wanaque Gradient including sequential sampling, pipe scales, and an evaluation on blending with the Pequannock Gradient.

Regarding blending, an initial evaluation has been performed to review the blending between the Pequannock and Wanaque Gradients. Based on a review of the water quality parameters (WQPs) for the City of Newark from July 2016 to present, it is likely that a blending zone exists at the interface between the Wanaque service area and the Pequannock service area. This was determined based on comparing silica, orthophosphate and alkalinity values of the two water systems. An analysis of the WQP data is provided in a table in Attachment 1 and three maps in Attachment 2 which show the locations of the WQPs, as well as, the lead sampling results from the three most recent sampling rounds. The approximate areas with "likely" blending of Pequannock water into Wanaque are shown in red on the maps. The approximate areas that "potentially" experience blending are shown in yellow on the maps.

Although blending is occurring, it does not appear that this has impacted the effectiveness of the Wanaque CCT. To confirm this, the following studies are proposed:

- Sequential sampling and pipe scale analysis of a home with a lead service line (LSL) in the Wanaque service area that is "likely" blending with Pequannock water
- Sequential sampling and pipe scale analysis of a home with a LSL in the Wanaque service area that is "potentially" blending with Pequannock water
- Sequential sampling and pipe scale analysis of a home with a LSL in the Wanaque service area that does not experience blending with Pequannock water

The blending is likely a result of occasional opening of the pressure regulating valves to allow the higher gradient water to supply Wanaque during emergency events such as water main breaks and fires. It is also possible that a gate was open at the time of the sampling. Regardless, the best solution for a consistent CCT across Pequannock and Wanaque is to dose orthophosphate in Pequannock so that any blending with Wanaque will not dilute Wanaque's orthophosphate concentration in the blended areas.

A CCT memorandum for Wanaque will be provided by January 15, 2019. If the scale analysis is not complete by that date, a supplemental memorandum will be provided once the scale analysis is received.

2. *The primary recommendation in the Draft Report for achieving optimized CCT is the addition of an orthophosphate chemical feed system. However, the Draft Report also shows that the pH in Pequannock Gradient is highly variable. Newark's pH must be stabilized and become reliable before implementing any form of optimal corrosion control as pH influences other corrosion control related parameters such as buffer capacity, alkalinity and Oxidation Reduction Potential (ORP).*

    - *The Draft Report does not evaluate or make any specific recommendation to address buffer capacity. Buffer capacity is a measure of the water's resistance to changes in pH, which depends on the water's alkalinity and Dissolved Inorganic Carbons (DIC) values. Newark's raw water alkalinity is low, and variable as indicated in the trend graphs. Low alkalinity is directly related to pH control stability, which impacts the water's buffering capacity. Therefore, Newark must demonstrate how it plans to address the pH variability or demonstrate how current alkalinity/DIC levels are acceptab1e.*

    - *If the upgraded lime feed system is being utilized to optimize pH, Newark must demonstrate that the lime feed system can accommodate the addition of phosphoric acid and/or orthophosphate for corrosion control.*

    - *Newark had advised that the fluctuating pH levels were due to operational issues as opposed to a buffering capacity issue. If the issues were or are based on operational issues, then Newark must explain those operational issues and how those operational issues will be resolved.*

    - *Pre-chlorination with chlorine gas lowers pH. Newark must address why this treatment step continues to be utilized or explain how and when the process will be discontinued and what, if any pre-oxidation process will be installed in its place.*

<u>Response:</u>

The alkalinity for the Pequannock delivered water ranges between 10 and 35 mg/L as $CaCO_3$ with an average of approximately 22 mg/L as $CaCO_3$ and the DIC is approximately 8.5

mg/L as $CaCO_3$. Based on CDM Smith's experience with other water systems, alkalinity and DIC levels in this range are sufficient to maintain consistent pH.

The 2016 EPA Optimal Corrosion Control Treatment Guidance Manual states that the optimal pH range for orthophosphate is 7.2 to 7.8 which will be the target pH range for Newark. Buffering intensity is more greatly influenced by pH than alkalinity. For example, waters with pH values between 8.0 and 8.5 and low DIC have low buffer intensity and, as a result, have greater variability in pH within the distribution system. Waters outside of this pH range (including the optimal pH range for orthophosphate of 7.2 to 7.8), even with low DIC, will have higher buffer intensity and should exhibit less variability in pH in the distribution system. Figure 1 shows the impact of pH and alkalinity on buffer intensity for the Pequannock finished water, including the future addition of orthophosphate.

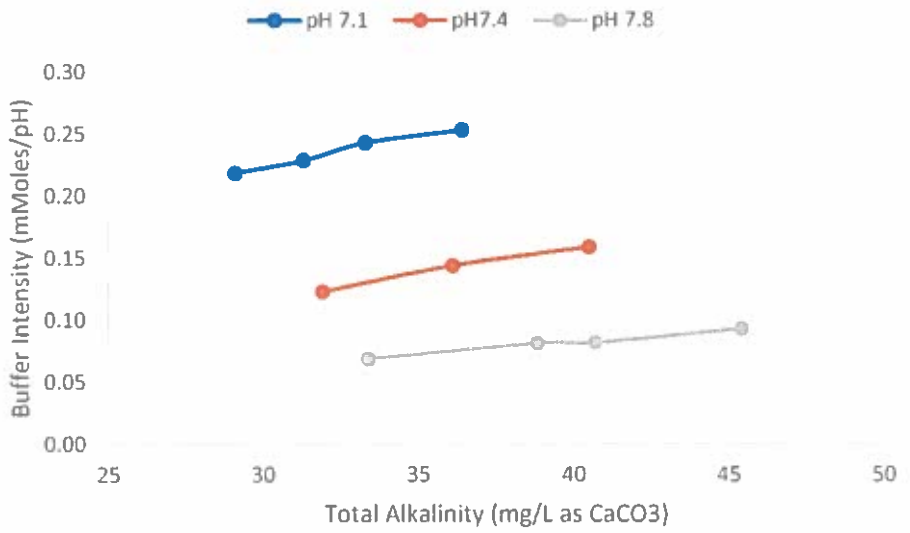

Figure 1 – Buffer Intensity as a Function of Alkalinity and pH

The fluctuations in pH experienced at the plant and across the system over the last few years are likely a result of operational issues at the Pequannock WTP rather than buffering capacity. This is evident from the historic daily, or even hourly, fluctuations experienced in pH at the Pequannock WTP POE, while the pH across the distribution system on a given day is fairly consistent. This can be seen from comparing the pH values from the Pequannock Gradient's WQPs on a given date. As shown in Figure 2, the pH range is fairly consistent across the large distribution system area.

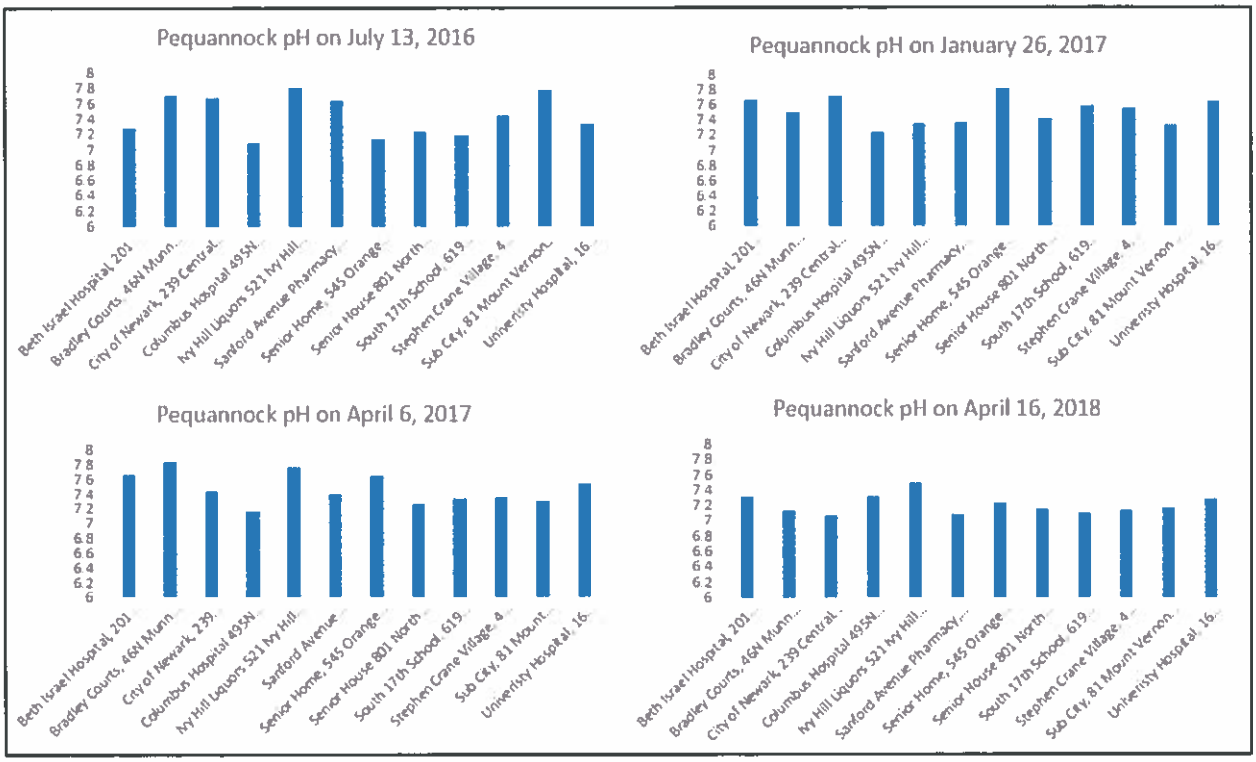

Figure 2 – Pequannock pH Values from WQPs

The operational issues with the lime system are in the process of being addressed. The following modifications are currently being performed:

- The lime feed system could only feed enough lime to support a finished water pH of 7.0 to 7.2 or approximately 900 pounds per day (lb/day) out of each of the Pequannock WTP's two lime feed systems. The feeder gear ratio has been modified and now the system can feed approximately 1500 lb/ day per system.

- When hydrated lime in the storage hopper bridged it would subsequently fall directly in the feed tank and overfeed lime thus contributing to finished water pH fluctuations. This condition was assessed and it was determined that the lime feed systems were installed without rotary airlocks which would stop this from happening. This modification to the system has been designed and the airlocks are being fabricated and should be installed within 90 days.

- The lime feed tanks were installed without drain lines to waste. When overfeeding in the hopper was occurring, there was no place to send the high pH water except to the finished water. Drain lines to waste have now been installed thereby eliminating these increases and further stabilizing finished water pH.

- Underfeeding due to undersized feed lines caused drops in pH. These feed lines have now been upsized giving the plant improved control of pH.

The lime system should be able to dose at a rate of 1500 lb/day out of each of the two lime systems. During the loop study, it will be determined if additional lime is needed in order to discontinue the use of sodium silicate and whether or not the lime system can provide enough chemical to adjust pH to the optimal range for orthophosphate.

As noted, chlorine gas lowers pH while sodium hypochlorite raises pH. In addition, orthophosphate lowers pH. With each chemical change, the lime will need to adjust to compensate for the impacts to pH resulting from the chemical modifications/additions. This will be closely monitored during the loop study and full scale implementation of the chemical changes.

3. *While any adjustments are implemented to stabilize the pH in the Pequannock Gradient, simultaneous compliance must be maintained with all other applicable rules (e.g. EPA's Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules, Surface Water Treatment Rules).*

Response:

It is acknowledged that any modifications made to the treatment process or water quality parameters for the Pequannock Gradient will need to maintain simultaneous compliance with other applicable rules.

4. *Newark's existing filter performance must be evaluated.*

Response:

The filters at the Pequannock WTP were evaluated under the CTA report in 2016. An RFP for filter upgrades is expected to be issued by Newark shortly.

5. *Iron and manganese potentially located within Newark's distribution mains must be evaluated to determine their impact on Newark's CCT.*

Response:

The Pequannock WTP effluent does not contain high iron and manganese. However, even trace levels of metals can build up over time and collect in the distribution system. To prevent dirty water resulting from orthophosphate reacting with iron and manganese in the distribution system, the flushing program will be implemented prior to dosing the orthophosphate.

6. *Adequate chlorine residual within the distribution system must be maintained.*

- *Distribution disinfectant residual levels should be examined closely. Decreasing pH in a distribution system can lead to unstable and low disinfection residuals, as seen in the data provided thus far. Low disinfectant residual levels could lead to microbially-induced corrosion, which could be contributing to lead releases into the drinking water.*

Response:

It is noted that disinfectant residual in the distribution system will be closely monitored and maintained during any treatment modification. It is not anticipated that the pH would decrease with the addition of orthophosphate as the dose of the pH adjustment chemical(s) will be adjusted to compensate for any pH reduction caused by the orthophosphate.

7. *Consecutive system impacts*

- *Newark must evaluate current and potential impacts, including changes to the CCT inhibitor and pH adjustment, to the Pequannock Water Department which is located upstream of the proposed orthophosphate injection location.*

- *Address how any changes to the corrosion control process impacts Newark's remaining consecutive systems {Belleville Water Department, Bloomfield Water Department and City of Elizabeth (Liberty Water Company c/o NJ American Water)}.*

- *For the evaluation of the above consecutive systems, Newark shall refer to the Department's Source Water Changes and Treatment Modifications Guidance available at https://www.state.n.j.us/dep/watersupply/pdf/change-source-treatment-guidance.pdf*

Response:

Newark will review the proposed changes to the CCT inhibitor and pH adjustment with the Pequannock Water Department prior to implementation. The need for a satellite orthophosphate feed system will be evaluated and discussed with the Pequannock Water Department.

Newark's consecutive systems are anticipated to benefit from the changes being proposed to the CCT in the Pequannock source of supply. The following indicates the impact to each system:

- Belleville Water Department – will transition from sodium silicate to orthophosphate simultaneously with Newark. The transition will be coordinated to encourage Belleville to flush the mains prior to the transition to remove residuals in the pipe and during the transition to help passivate the system. If the dose of orthophosphate from Newark is diluted, a satellite feed system for Belleville may be recommended.

- Bloomfield Water Department – will transition from sodium silicate to orthophosphate simultaneously with Newark. The transition will be coordinated to encourage Bloomfield to flush the mains prior to the transition to remove residuals in the pipe and during the transition to help passivate the system . If the dose of orthophosphate from Newark is diluted, a satellite feed system for Bloomfield may be recommended.

- City of Elizabeth (c/o New Jersey American Water – Liberty) – already doses orthophosphate, which is currently supplied from the Wanaque source. The CCT proposed at the Pequannock supply will not have an impact on the City of Elizabeth system.

- Nutley Township – will transition from sodium silicate to orthophosphate simultaneously with Newark. The transition will be coordinated to encourage Nutley to flush the mains prior to the transition to remove residuals in the pipe and during the transition to help passivate the system. If the dose of orthophosphate from Newark is diluted, a satellite feed system for Nutley may be recommended.

- All other interconnections with Newark are either on the Wanaque Gradient or used on an emergency basis only. Most of the systems with emergency interconnections with Newark utilize an orthophosphate chemical for corrosion control. With the addition of orthophosphate at the Pequannock WTP, the orthophosphate residual concentration in these systems will be more consistent when purchasing water from Newark.

- The areas experiencing blending between the Pequannock and Wanaque Gradients will benefit from a more stable orthophosphate residual coming from both the Pequannock and Wanaque Gradients.

Each consecutive system will be notified of the treatment changes at Newark prior to implementation and documentation of the notification will be provided to NJDEP. Newark will work with the systems to establish a sampling plan and, after two consecutive monitoring periods, new or modified WQPs.

Based on the responses herein with the understanding that some responses require additional follow-up, the City of Newark requests NJDEP's authorization to proceed with the recommendation of adding orthophosphate into the distribution system of the Pequannock Gradient at the Valley Road Rechlorination Station. The use of orthophosphate will be tested in a proposed pipe loop study in advance of a full scale implementation.

A Bureau of Water System Engineering permit application for temporary treatment will be provided for a review of the technical aspects of the chemical feed system.

If further information is required, please contact me.

Sincerely,

Kareem Adeem
Assistant Director
Department of Water and Sewer Utilities
City of Newark

cc: L. Ofori, BWSE – Engineering
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D. Smith, CDM Smith
C. Rego, CDM Smith
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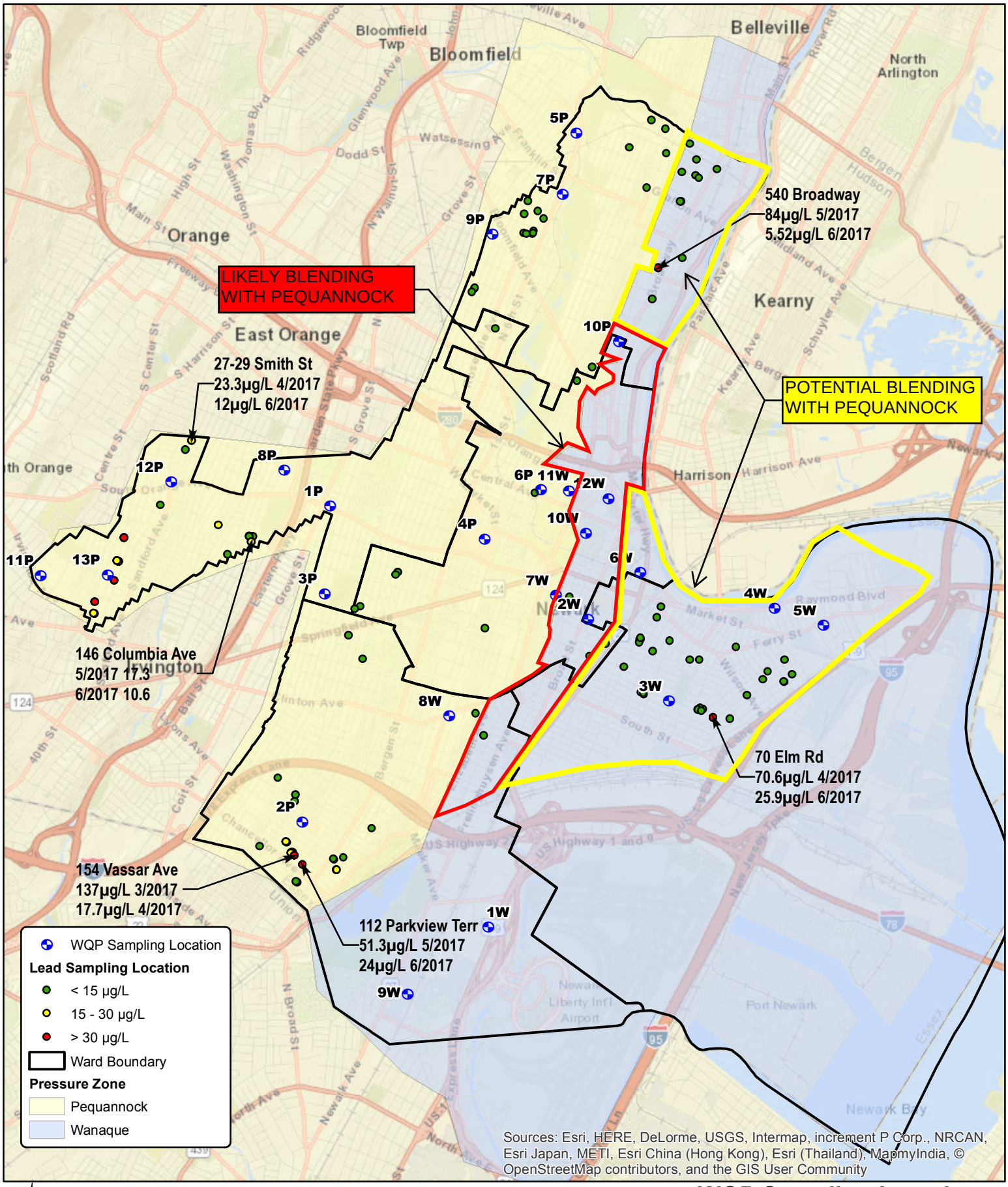
Attachment 1 - Pequannock and Wanaque WQP Results (July 2016 - September 2018)

Sample ID	WQP Sampling Locations	pH			Alkalinity (mg/L as CaCO3)			Orthophosphate (PO4)			Silica (mg/L as Silica)		
		min	average	max	min	average	max	min	average	max	min	average	max
Pequannock													
TH	Sample House, PWTP	6.35	7.10	7.94	14.30	25.76	42.05	0.00	0.03	0.33	4.88	7.78	12.00
VR	Montclair Recholrination Stn. 782 Valley Road	6.29	7.23	7.79	20.50	29.90	43.25	0.00	0.01	0.30	3.78	5.96	9.48
1P	Senior Home, 545 Orange Street	7.15	7.43	7.82	23.60	29.16	37.20	0.00	0.00	0.00	4.29	6.55	8.80
2P	Beth Israel Hospital, 201 Lyons Avenue	6.76	7.52	8.15	23.00	29.34	37.70	0.00	0.00	0.00	4.06	6.19	7.60
3P	South 17th School, 619 South 17th Street	6.69	7.32	7.70	23.30	29.17	36.40	0.00	0.00	0.00	4.23	6.40	8.03
4P	Univeristy Hospital, 16 Bergen Street	6.85	7.30	7.65	24.00	29.04	35.00	0.00	0.00	0.00	4.05	5.97	7.75
5P	Stephen Crane Village, 4 Steven Crane Plaza	6.91	7.55	8.46	23.10	32.88	40.00	0.00	0.00	0.00	4.11	5.74	8.05
6P	City of Newark, 239 Central Avenue	6.89	7.38	7.72	23.10	30.41	42.40	0.00	0.00	0.00	4.20	6.22	8.18
7P	Senior House 801 North 6th Street	7.05	7.32	7.64	21.40	29.18	34.00	0.00	0.00	0.00	4.37	6.36	8.34
8P	Bradley Courts, 46N Munn Avenue	6.89	7.51	7.83	21.40	29.12	35.00	0.00	0.00	0.00	4.07	5.98	7.90
9P	Columbus Hospital 495N 13th Street	6.87	7.25	7.72	22.00	29.16	35.70	0.00	0.00	0.00	4.01	6.37	8.09
10P	Brodway House, 298 Broadway	7.15	7.32	7.62	21.80	28.52	34.70	0.00	0.00	0.00	4.56	6.49	8.19
11P	Ivy Hill Liquors 521 Ivy Hill Plaza	7.01	7.69	8.73	22.70	30.51	36.70	0.00	0.00	0.00	4.54	5.86	8.03
12P	Sanford Avenue Pharmacy, 1041 South Orange Avenue	6.72	7.37	7.75	21.50	32.36	59.30	0.00	0.00	0.00	4.12	5.96	8.00
13P	Sub City, 81 Mount Vernon Place	6.75	7.58	8.37	23.00	30.87	41.30	0.00	0.00	0.00	4.01	5.81	8.01
Wanaque													
BR	Belleville Reservoir	7.07	7.58	8.61	31.50	42.58	60.70	0.00	1.46	2.47	0.64	2.56	8.40
1W	Holiday Inn, 450 Route 1 & 9 South	7.34	7.79	8.30	31.80	41.06	50.30	0.11	1.40	2.37	1.24	2.58	5.29
2W	Newark City Hall, 930 Broad Street	7.08	7.42	7.67	23.00	31.93	38.00	0.00	0.10	0.72	4.44	5.60	7.52
3W	Glamour's Salon, 251 Oliver Street	7.02	7.49	7.97	25.70	33.59	38.20	0.29	0.64	1.34	3.14	4.58	6.47
4W	River Bank Auto Repairs, 638 Raymond Blvd	6.96	7.44	7.88	26.50	33.48	40.40	0.31	0.45	0.64	3.57	4.80	6.55
5W	Hawkins School, 9 Hawkins Street	6.90	7.39	7.95	25.30	33.09	38.20	0.00	0.37	0.67	3.50	4.65	6.91
6W	Seton Hall Law School, 1109 Raymond Blvd	6.99	7.59	8.13	27.00	32.38	38.20	0.00	0.42	0.68	3.19	4.96	6.22
7W	Newark Health Service, 94 William Street	7.05	7.43	7.84	24.30	31.38	37.00	0.00	0.10	0.62	3.95	5.78	7.58
8W	Firehouse, 360 Clinton Avenue	6.88	7.49	7.77	24.50	31.79	36.70	0.00	0.17	1.39	3.70	5.69	7.98
9W	Associated Humane Society, 124 Evergreen Avenue	7.09	7.61	8.20	21.30	41.17	51.60	0.00	0.69	1.47	1.37	3.20	6.41
10W	Rutgers University, 190 Univeristy Avenue	6.86	7.36	7.65	23.60	30.58	38.20	0.00	0.36	2.02	4.50	5.89	7.77
11W	Senior Citizen Home, 9 Summit Street	7.11	7.38	7.92	23.30	30.60	38.40	0.00	0.05	0.24	4.45	5.77	6.97
12W	Newark Library, 5 Washington Avenue	7.15	7.48	7.80	24.00	31.71	38.20	0.00	0.10	0.32	4.35	5.57	6.76

Legend

Likely Blending with Pequannock
Potential Blending with Pequannock



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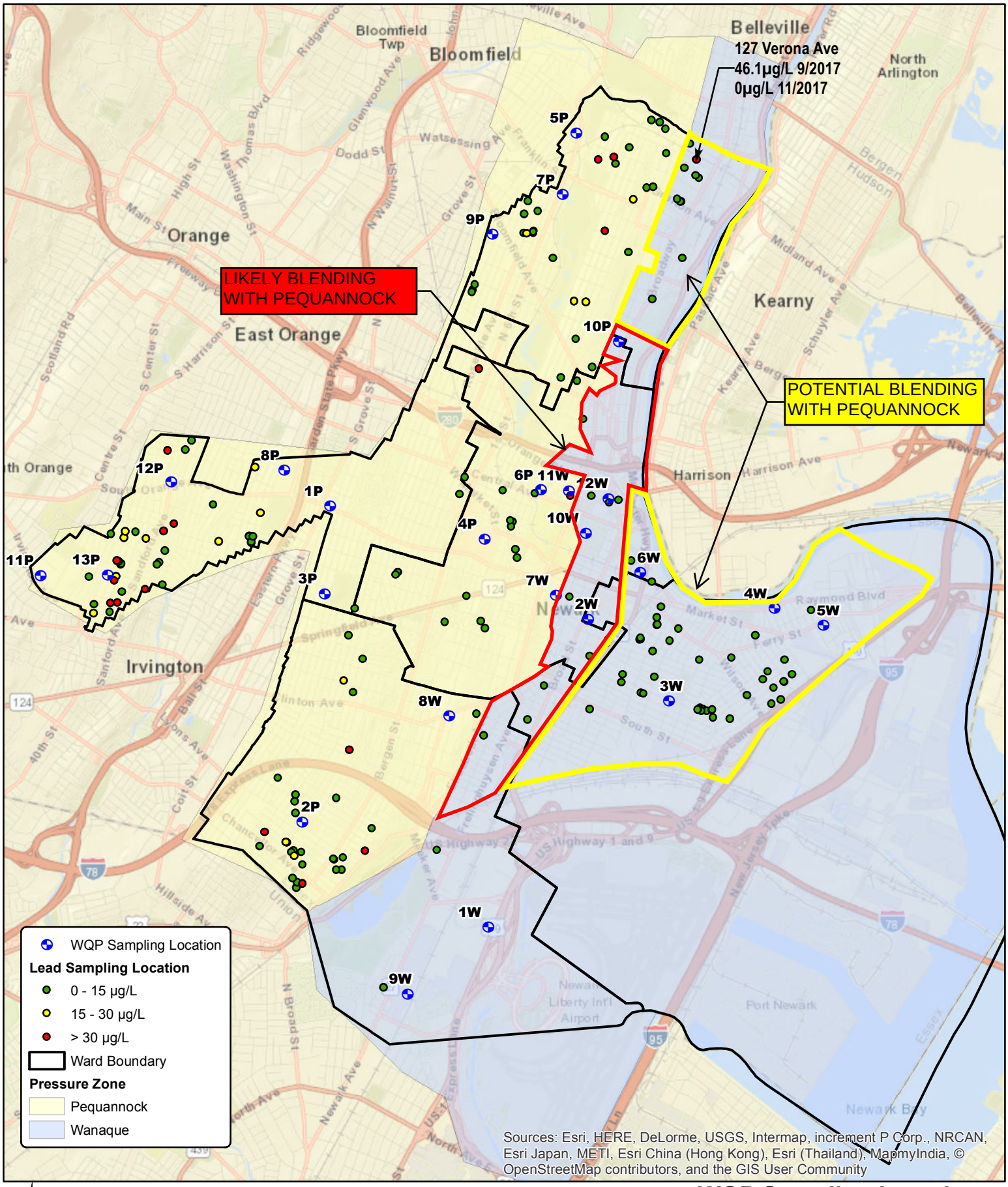
Miles

WQP Sampling Locations (1st Half 2017)

City of Newark Corrosion Control Project

CDM Smith



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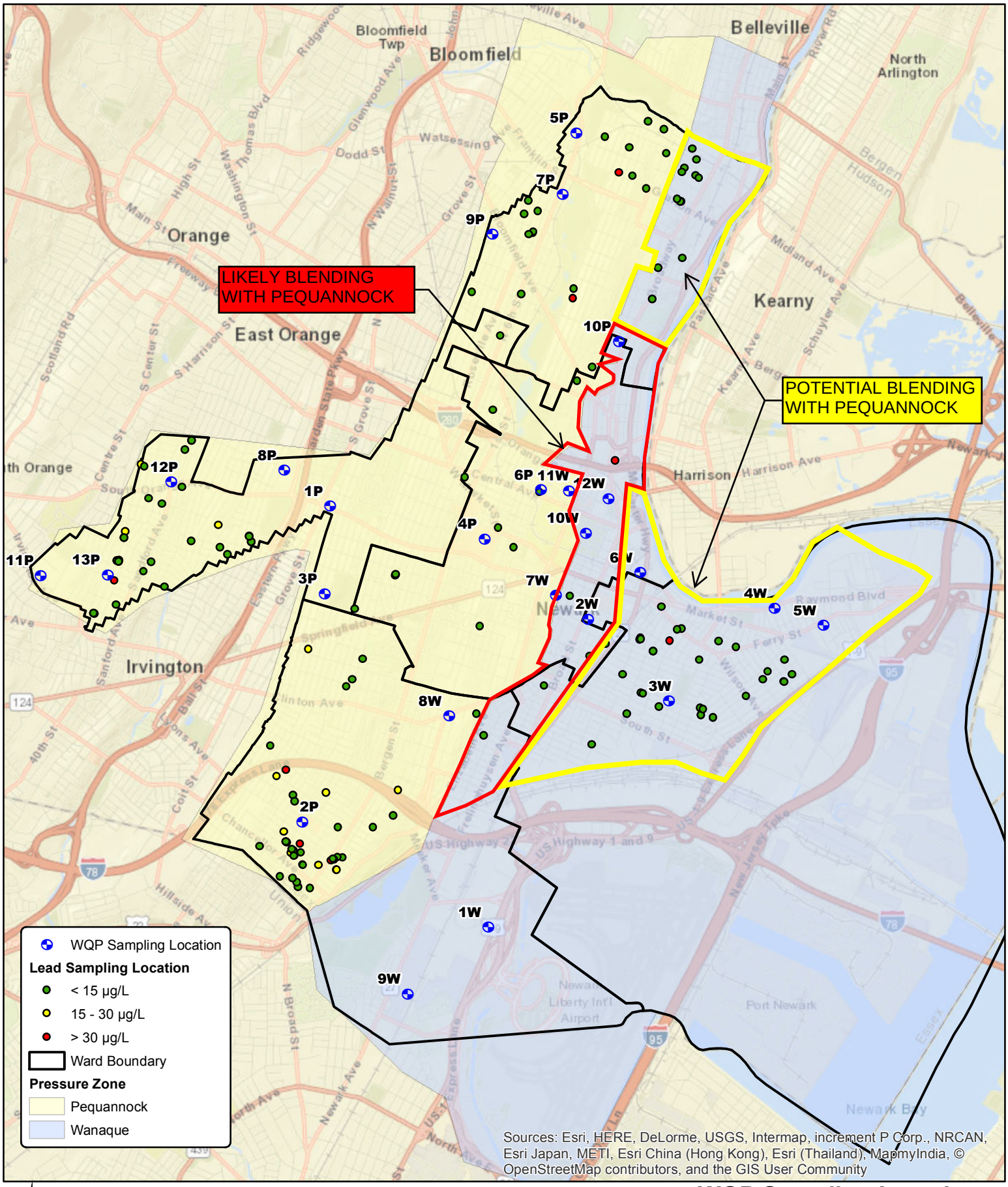
WQP Sampling Locations (2nd Half 2017)

City of Newark Corrosion Control Project

CDM Smith



WQP Sampling Locations (1st Half 2018)

City of Newark Corrosion Control Project

CDM Smith