Five Centennial Drive
Peabody, MA 01960-7985
tel: 978-532-1900 fax: 978-977-0100
www.westonandsampson.com

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Town of Middletown, Rhode Island
W&S Job No. 2150091

September 16, 2015

Mr. Warren Hall, PE, PLS
Town Engineer
Town of Middletown
350 East Main Road
Middletown, RI 02842

Re: East Side Water Line Expansion Letter Report

Dear Mr. Hall,

Weston & Sampson has completed the agreed scope of services for the engineering review of a water distribution system modification, for the proposed East Side Water Line extension in the Town of Middletown, Rhode Island (Town).

The purpose of this evaluation was to determine how water age and water pressure would be impacted within the proposed water main extension. Three (3) alternative water main extension designs were obtained from the Town. A computer based hydraulic model was developed and used to evaluate how water age and water pressure will be affected within the area of the proposed extension. In addition to the distribution system analysis, cost estimates for the construction of the three proposed design alternatives were developed.

BACKGROUND

Approximately fourteen (14) private residential wells within this area of town were tested for water quality in December 2014 and January 2015. The test results indicated that the wells had nitrate concentrations above the Environmental Protection Agency's (EPA) maximum containment level (MCL) of 10 mg/L. The Town of Middletown proposed to extend the existing public water distribution system to this area of town as a solution. However, the City of Newport Department of Utilities (NDU), who owns and operates the existing water distribution system, has the following concerns with the proposed pipeline extension:

- Low demand and dead ends/lack of water main looping may create water quality issues and high water age.
- This area of Middletown is served by NDU's high service system and areas of low ground elevation within the proposed water system expansion may result in high water pressures.

The Town created three water main extension alternatives, with the intention to limit long dead-end mains, and asked Weston & Sampson to provide hydraulic modeling services for the three (3) alternatives to address the NDU's concerns. The Town provided quantity take-offs with approximate linear footage of water main, maximum number of potential new customers, and approximate number of new fire hydrants for the three different alternatives. These quantities were used in providing cost estimates for construction of the each option.

SERVICE AREA & MODEL DEVELOPMENT

Bentley WaterCAD® version 08.11.05.61 hydraulic modeling software, was used to model the impact of the proposed water main extension alternatives on the existing distribution system. General plans showing the location of proposed water mains provided by the Town and GIS databases were used to both locate the existing and proposed water mains and develop the hydraulic model. For this evaluation the model included the existing Goularte Lane water storage tank, existing water mains from the tank to the connection points of the proposed extensions, and the location of the proposed water mains. A map of the three (3) proposed scenarios showing the key locations used for the model analysis can be found in Figure 1 attached.

DEMAND DEVELOPMENT

Average day demands for the hydraulic model were calculated using historical water consumption and water service tie-in data provided by the Town for a previous distribution system expansion project. Modeling with an average day demand scenario represented typical water usage and calculated the average water age. Also, utilizing the data provided by the Town, we were able to calculate the potential number of customers who might tie into the proposed water main expansion. The data shows that for previous projects, approximately 33% of potential customers opted to connect to the expanded distribution system.

Three different demand scenarios were developed to analyze the effects of both demands and demand distribution for the proposed expansion. Based on the historical consumption data from the Town, we assumed that each potential customer will use an average of 135 gallons per day (gpd). For all demand scenarios, the Silveria School was accounted for as a potential customer. Based on information provided by the Town, the school's demand was set to 700 gpd. Below are explanations of the three demand scenarios along with Table 1, which shows the assumed number of customers who will tie into the new water main and the estimated water demands used in the hydraulic model.

SENARIO 1 – Contaminated Wells Greater than MCL
For this scenario, water demands were included in the model only for homes with wells that had a nitrate sample reading of 10 mg/L or greater. The demand data was assigned to the appropriate junctions in the model within the proposed expansion area based on the location of each particular home.

SENARIO 2 – All Contaminated Wells
This scenario included water demands in the model for all sampled homes with wells that recorded a nitrate reading greater than 0 mg/L. The demand data was assigned to the appropriate junctions in the model within the proposed expansion area based on the location of each home.

SENARIO 3 – Contaminated Wells Greater than 10 mg/L and 33% of Potential Customers
This scenario included the demands from Scenario 1 (wells with nitrate sample readings of 10 mg/L or greater) and 33% of the remaining potential customers in the proposed expansion area.

TABLE 1
Estimated Average Water Demands

Demand Scenario	Assumed No. of Customers	Average Demand (gpd)
1	15	2,590
2	57	8,260
3	81	11,500

It should be noted that the demands shown in Table 1 are to be used for planning purposes and are estimated based on historical consumption data from a past project with similar type homes in the area.

MODELING RESULTS

The model was run under the three different demand scenarios for each of the three proposed water main extensions. The three extensions are known as the Wyatt Loop, Wyndham Loop, and Third Beach Loop. Each of these water main loops has one or two connection points to the existing system. Table 2 lists the location of the connection point(s) for each proposed loop. The connection point(s) and proposed loops can be seen in Figure 1 attached.

TABLE 2
Water Main Extension Connection Points

Loop	Connection Points
Wyatt	Wyatt Road @ Berkeley Avenue Green End Avenue @ Berkeley Avenue
Wyndham	End of Wyndham Hill Road Green End Avenue @ Berkeley Avenue
Third Beach	Green End Avenue @ Berkeley Avenue

Elevations were assigned to the nodes in the model based on GIS contours provided by the Town. SCADA data provided by the NDU was utilized to create a tank level pattern for the Goularte Lane tank. The hydraulic model was then used to find water pressure ranges at each node within the proposed extension area.

The water pressure was found to range from 60 psi to 121 psi in the proposed extension area. Knowing that NDU had concerns about high water pressure, we modeled different pressure reducing valve (PRV) scenarios, which all yielded similar water age results due to the limited demand in the proposed expansion area. We felt it was best to install one PRV in the expanded service area and have several houses with static pressures above 80 psi than to install multiple PRVs and have many houses with static pressures less than 35 psi. Therefore, since the area with the lowest elevation (intersection of Porter Road and Russett Avenue) reached pressures of 121 psi, an 8-inch pressure reducing valve (PRV) was placed in Wapping Road, between Peckham Lane and Baldwin Road. The PRV was set at 51 psi in order to make sure pressures at the intersection of Porter Road and Russett Avenue did not exceed 80 psi.

Through the use of the hydraulic model we were able to calculate the increase in water age for the proposed distribution system expansion. Water age is affected by two key components: water demand and demand distribution. The water age data in Table's 3 and 4 represents the increase in water age from the connection points to the two sample sites. Sample Site 1 represents the farthest point of proposed water main extension (intersection of Porter Road and Russett Avenue) from the existing system. This site is also the lowest elevation in the proposed water main extension. Sample Site 2 is located at the end of Peckham Lane. This site represents where the potential largest user, the Silveria School, is located.

TABLE 3
Sample Site 1 Estimated Water Age Increase

	Water Age Increase (days)		
Demand Scenario	**Wyatt**	**Wyndham**	**Third Beach**
1	>85	78	76
2	19	16	16
3	22	19	19

TABLE 4
Sample Site 2 Estimated Water Age Increase

	Water Age Increase (days)		
Demand Scenario	**Wyatt**	**Wyndham**	**Third Beach**
1	25	23	23
2	13	12	12
3	11	10	10

Scenario 1 placed a small demand on the distribution system and the demand was spread out to multiple areas throughout the proposed expansion loops. Therefore, the water age shows the largest increase from the connection points to the far end of the proposed system.

Scenario 2 showed drastic improvements to the water age impacts when compared to Scenario 1. This demand set was highly concentrated to the areas where contaminated well sites were found. While the demand was more than Scenario 1 the key driver for the lower water age increase across the proposed system was the demand concentration. The majority of the demands in this scenario are located at the far end of the expanded distribution system. This helps pull water through the system minimizing the increase in water age.

Scenario 3 helps prove that demand concentration is the key driver concerning water age throughout the proposed distribution system. This scenario has the largest demand but also has the greatest distribution throughout the proposed expansion area. Since the demands were distributed more throughout the system than in Scenario 2, the water age was greater for the majority of the proposed expansion area.

It should be noted that through the hydraulic modeling data we found that due to the demand concentration, the proposed mains east of Peckham Lane had significantly greater water age than the water mains west of Peckham Lane. There is a large demand at the Silveria School located at the end of Peckham Lane that helps keep the water age low in this area. We found that the water age, on average, is a week younger at Sample Site 2 than it is at Sample Site 1.

However during the summer when the demand decreases at the Silveria School, we expect the average water age to increase by approximately one week at Sample Site 2. This is solely based on the decrease in demand. Sample Site 1 will see an average increase of 0.5 days due to the drop in demand at the Silveria School.

COST ESTIMATE

Weston & Sampson has prepared cost estimates for the three existing water main extension alternatives based on quantities for water main linear footage, fire hydrants, and potential water service connections provided by the Town. The cost estimates take into account the use of processed gravel for backfilling, installation of trench pavement within all water main trenches, fifteen percent (15%) construction contingency, and an additional twenty percent (20%) for engineering costs. Table 5 shows the totals for the cost estimates of the three different loops. Attached are cost estimates for each of the three alternative loops. These cost estimates show the individual quantities and unit prices for the items described above.

TABLE 5
Proposed Loop Construction Cost Estimates

Loop	Estimated Cost
Wyatt	$5,718,000
Wyndham	$4,549,000
Third Beach Road	$4,658,000

CONCLUSIONS

The results obtained after running the hydraulic model indicate that there is not much difference in the water age increase between the three different proposed water loops. The only factor that is significantly different between the loop scenarios is construction cost. The Wyndham and Third Beach Road loops are similar in cost and are the less expensive alternatives compared to the Wyatt Loop. The Wyatt Loop is more expensive due to the amount of water main installed in Wyatt Road and Mitchell's Lane. However, the Wyndham Loop requires water main to be installed in an easement in private property and the Third Beach Road Loop has a single feed to the proposed expansion area. For the Third Beach Loop, if a water main break occurs in Green End Avenue, between Berkeley Avenue and Third Beach Road, all of the expanded distribution system will lose water.

The water age increase for each proposed loop is approximately the same for the specific demand scenarios. The two factors that impacted water age were the water demand and the concentration of the demand. For the purpose of this evaluation, Scenario 2 has a more concentrated demand set than Scenario's 1 and 3. Even though Scenario 3 had higher demands than Scenario 2, the demands were

more dispersed throughout the proposed expansion area.

Through the hydraulic analysis, we have found that the increase in water age for the proposed expansion is highly dependent on water demand but more importantly the distribution of the demand. To have the greatest impact on reducing water age in the expanded system, a large number of residents in a concentrated area near the end of the system will need to tie into the expanded system. To accurately determine the effect of the expanded system on water age, an exact number of residents who plan on connecting to the new system should be known.

We appreciate the opportunity to assist the Town in this matter. Please contact Kevin Carter or me at 978-532-1900 should you have any questions or require further support.

Very truly yours,

WESTON & SAMPSON ENGINEERS, INC.

Michael D. Warner, PE
Project Manager

Attachments: Figure 1: Wyatt Loop
Figure 2: Third Beach Loop
Figure 3: Wyndham Loop
Draft Engineers Cost Estimate

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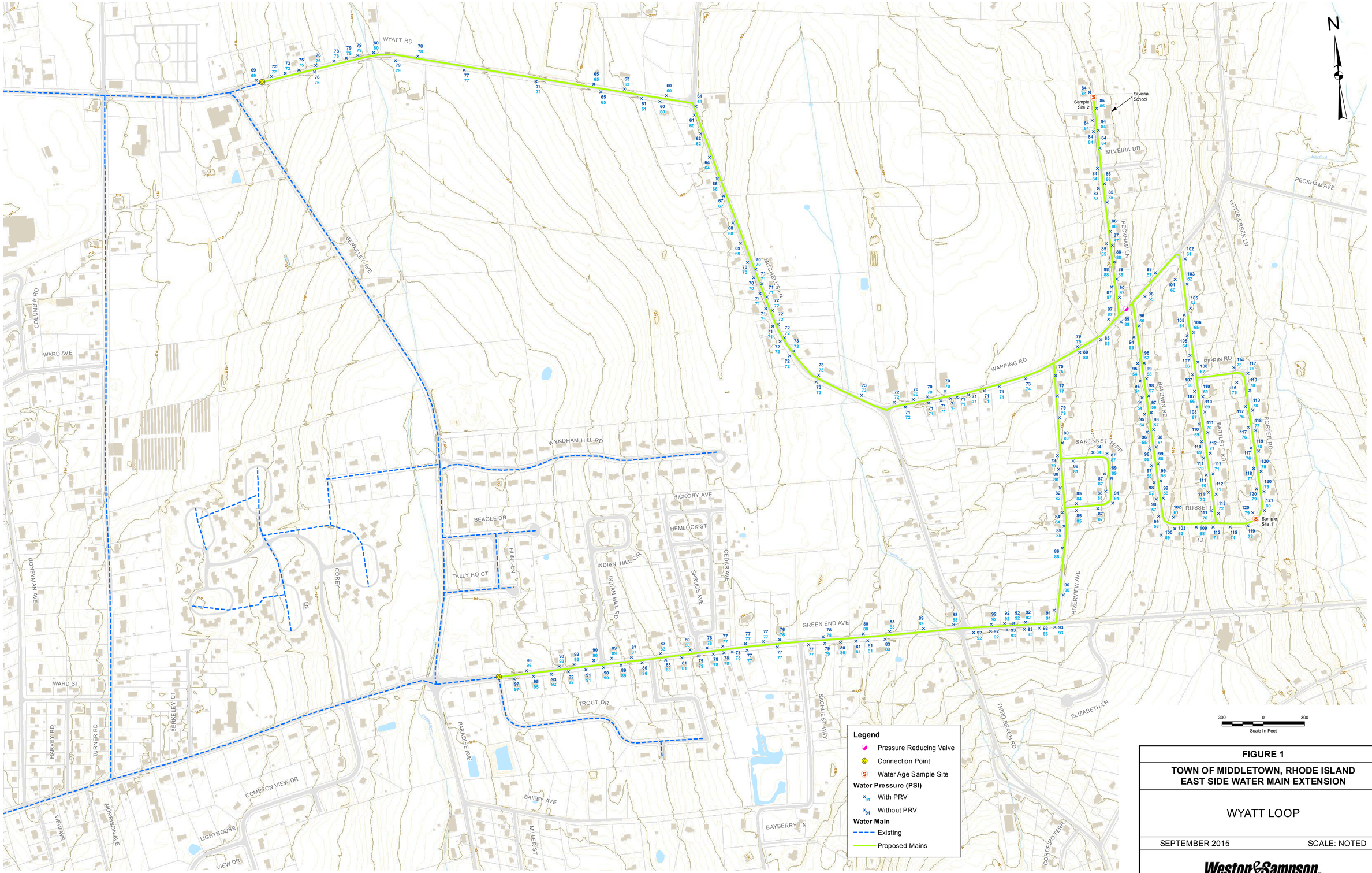

FIGURE 1

TOWN OF MIDDLETOWN, RHODE ISLAND
EAST SIDE WATER MAIN EXTENSION

WYATT LOOP

SEPTEMBER 2015 SCALE: NOTED

Weston&Sampson

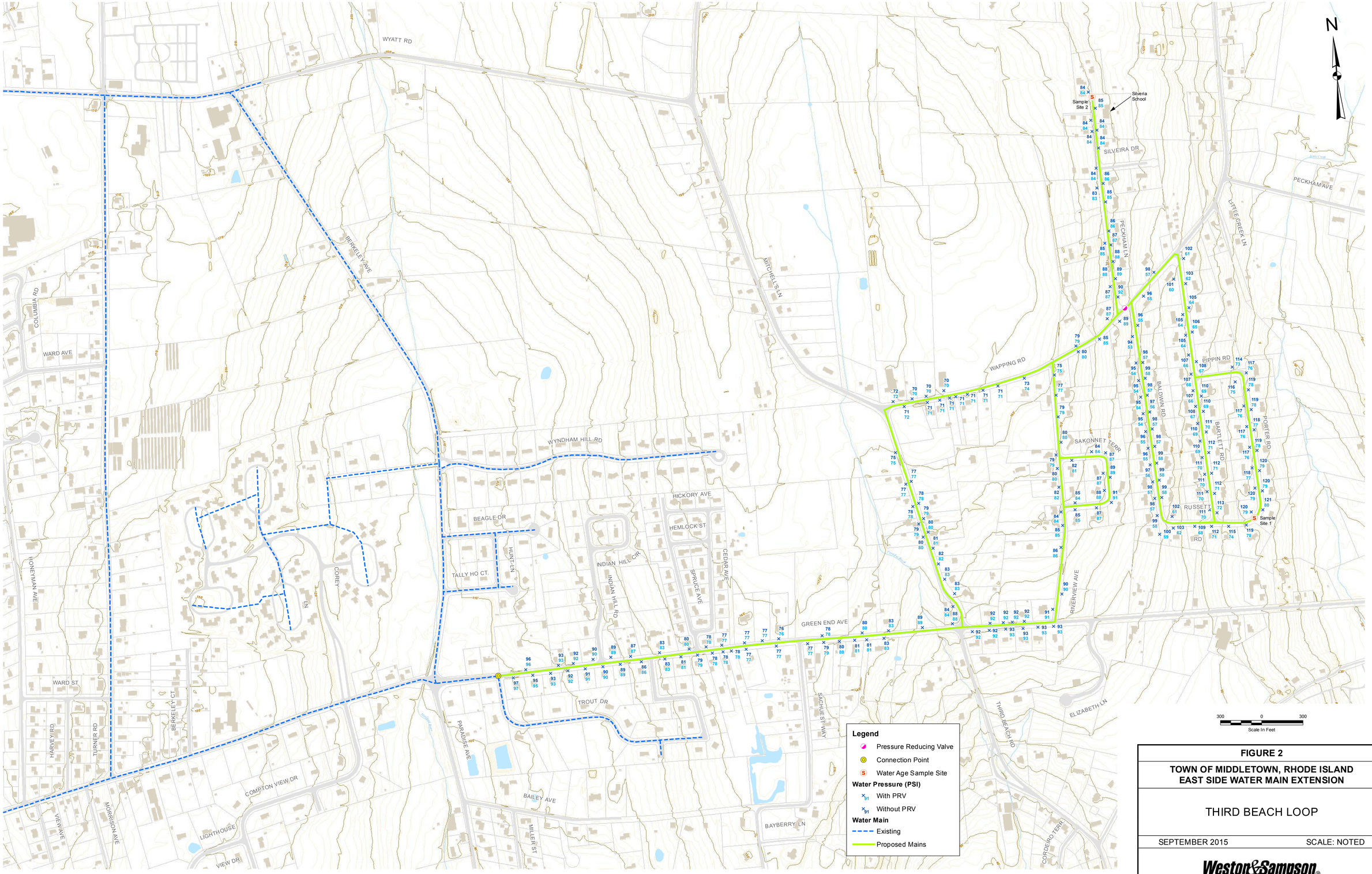

FIGURE 2

TOWN OF MIDDLETOWN, RHODE ISLAND
EAST SIDE WATER MAIN EXTENSION

THIRD BEACH LOOP

SEPTEMBER 2015 SCALE: NOTED

Weston&Sampson

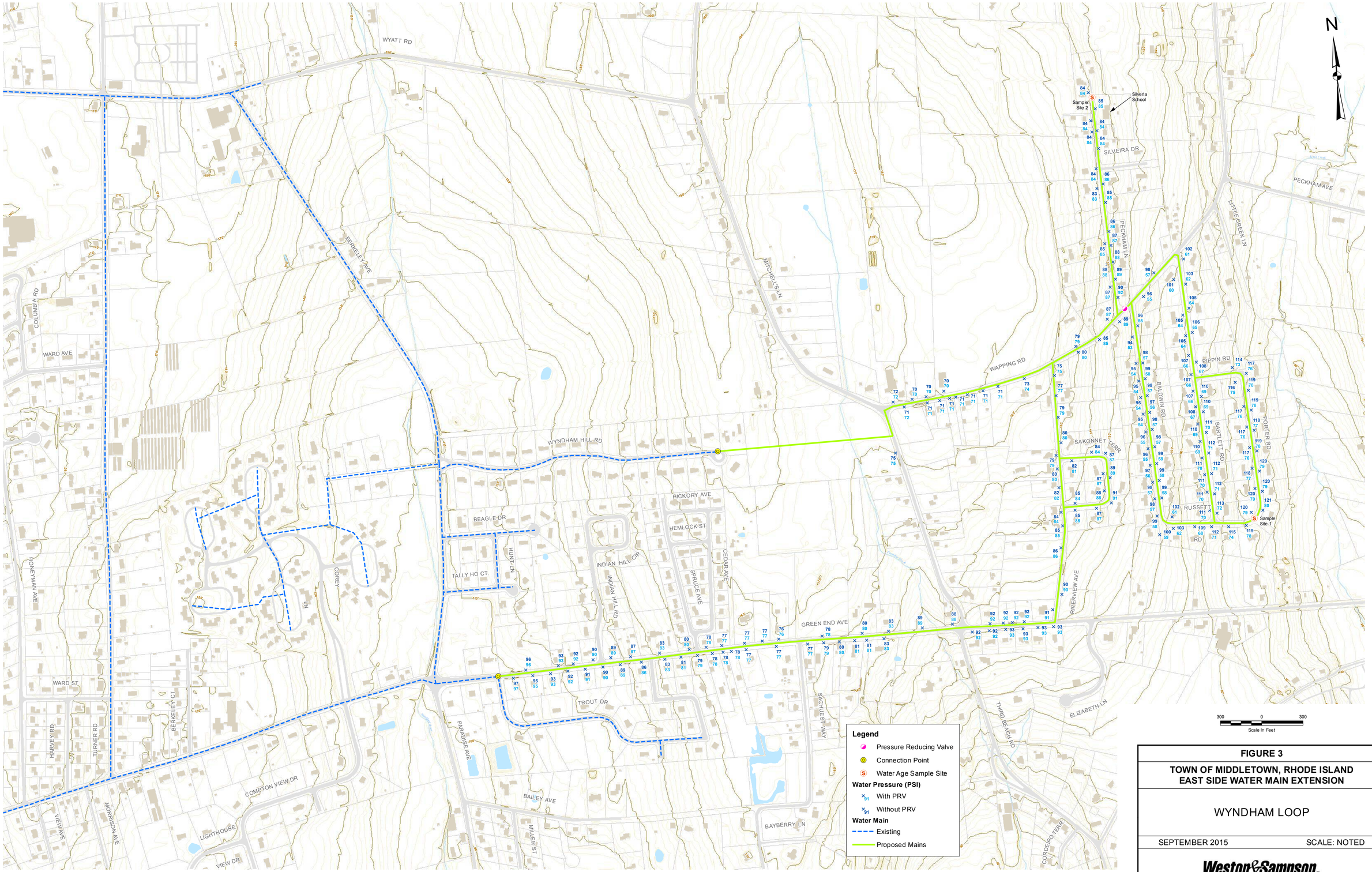

FIGURE 3

TOWN OF MIDDLETOWN, RHODE ISLAND
EAST SIDE WATER MAIN EXTENSION

WYNDHAM LOOP

SEPTEMBER 2015 SCALE: NOTED

Weston&Sampson

Town of Middletown, Rhode Island
East Side Water Line
Draft Engineers Cost Estimate
July 2015

Weston & Sampson Engineers Inc.
Peabody, MA
2150091

		Wyatt Loop		Wyndham Loop		Third Beach Loop	
Item	**Unit Price**	**Quantity**	**Cost**	**Quantity**	**Cost**	**Quantity**	**Cost**
8-inch Ductile Iron Water Main, per linear foot	$100.00	23,026	$2,302,600.00	18,287	$1,828,700.00	18,562	$1,856,200.00
Service Connections, per install*	$1,900.00	197	$374,300.00	165	$313,500.00	180	$342,000.00
Hydrants, per hydrant	$4,000.00	41	$164,000.00	30	$120,000.00	32	$128,000.00
Pavement, per linear foot	$25.00	23,026	$575,650.00	18,287	$457,175.00	18,562	$464,050.00
Processed Gravel, per cubic yard	$40.00	20,468	$818,702.22	16,255	$650,204.44	16,500	$659,982.22
	Subtotal		*$4,235,252.22*		*$3,369,579.44*		*$3,450,232.22*
	Construction Contingency (15%)		$635,287.83		$505,436.92		$517,534.83
	Engineering Costs (20%)		$847,050.44		$673,915.89		$690,046.44
	Total Cost		*$5,717,590.50*		*$4,548,932.25*		*$4,657,813.50*
	Total Cost (Rounded)		**$5,718,000.00**		**$4,549,000.00**		**$4,658,000.00**

*Service connections include the installation cost for the corporation stop, curb stop and copper piping

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