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MEMORANDUM

TO: Jan Reitsma, Town Manager

CC: Dave Komiega, Plant Manager
Doug Hankins, Wright-Pierce
Tom Simbro, Wright-Pierce

FROM: Jon Himlan

DATE: April 19, 2016

RE: Response to Wright-Pierce Value Engineering Report

The memorandum provides Woodard & Curran's (W&C) response to the Wright Pierce (W-P) Draft Value Engineering (VE) Report that we received on April 11, 2016. As an overview, we found the VE to be a beneficial effort and think that a good amount of the W-P comments will add value and can be incorporated into the design project.

The VE Report describes that the W-P scope was not to perform a detailed engineering on each item, but to present concepts for W&C to review and determine which of the presented ideas warrant further consideration or engineering analysis. W&C has performed this initial review and the purpose of this memorandum is primarily to describe which of the concepts presented in the VE warrant further evaluation. To that end, we have organized our response as follows:

- General comments and questions we have on the report;
- Items that are represented in the VE Report to potentially have a significant cost impact on the project;
- Items that have a modest cost impact that should be evaluated further through the design; and
- Items that have a modest cost impact that we recommend be excluded from further evaluation.

We have also attached a version of the summary table (Table 3-1) in the VE report with a column we added that summarizes which items we recommend for further evaluation as we proceed with the final design.

General Comments and Questions on the Report

1. Executive Summary – pages ES-1 through ES-3: there are several statements about project cost and schedule that we understand to be a summary of the VE items 1 through 4 that pertain to W&C's cost estimate for the construction general conditions. These statements are as follows:

   "*…estimated project costs are $1.5 to $2.0 million short of the true project cost.*"

   "…estimated project cost may not reflect the true construction cost given the project scale, site constraints, (i.e. proximity to adjacent structures and utilities, limited space for contractor laydown area, field trailers and site access) and construction sequencing requirements."

   "…a 12 month construction schedule which is not feasible give the size of the project and limited space…A 24 month construction schedule is more appropriate"

"…estimated construction costs do not reflect inflationary costs."

W&C Comment: We agree that a 12-month construction period may be optimistic and that it may be more prudent to plan for an 18 to 24 month duration. However, our calculations find that the cost impact is significantly less than what W-P has presented. A more detailed description of our evaluation on this issue is described further under "Items with the Potential for Significant Cost Impact," Items 1 through 4. To make the report clearer, we propose that W-P consider revising the costs presented in the Executive Summary and Results Sections.

2. Executive Summary – Operations Building – page ES-4: includes the following statement related to the use of existing versus constructing new building space on site: "*While we agree with the design engineers desire to separate administration and laboratory spaces from wastewater processing spaces. It is our opinion that consideration should be given to repurposing the Operations Building to service as the new Solids Handling Building and relocate the administration and laboratory facilities to a new building constructed on site*."

   W&C Comment: We do not fully agree with this statement, however, in conjunction with Item 4 below, we are evaluating alternative approaches for construction of sludge handling improvements that allow expanded use of the existing Operations Building.

3. Executive Summary – Activated Sludge Process – page ES-5: includes the statement related to the proposed biological reactors: "*Wright-Pierce's calculations indicate that a volume reduction of these tanks can be achieved without sacrificing effluent quality or treatment performance...Potentially a total construction savings of $1.3 million could be ascertained*."

   W&C Comment: We note that further on in the results section of the VE report, W-P is not specifically recommending that the reactor volume be decreased, rather they are simply recommending that W&C verify our calculations. We have verified our calculations and have provided the results of that effort below in "Items with the Potential for Significant Cost Impact," under the Item 15. As described, we have determined that the reactor volume should not be decreased. Therefore, to make the report clearer, we propose that W-P consider removing the above statement from the Executive Summary.

4. Executive Summary - Sludge Handling Building – page ES-6: the statement is made; "*Wright-Pierce recommends that the design team consider alternative methods to construct the solids handling building*."

   W&C Comment: We agree with this recommendation and are considering an alternate method as further described under "Items with the Potential for Significant Cost Impact," Items 21, 22 and 24.

5. Introduction – page 1-3: the statement, "…*given the scope of the Value Engineering Analysis, our goal was to identify and evaluate the feasibility of the presented ideas. However, a detailed engineering review of each alternative's feasibility was not undertaken. It is recommended that the design engineering team (W&C) review the alternatives presented and determine which of the presented ideas warrant further consideration or engineering analysis*."

   W&C Comment: Similar to W-P's statement and because no detailed engineering data or quantitative information is presented in the VE report, W&C's design scope and budget is not sufficient to develop detailed engineering data on every idea W-P has presented. As W-P recommends, we have reviewed the W-P concepts and described within this memorandum which ones we think warrant further consideration.

6. Summary of Results - Table 3-1: each item is check marked as being in the category of either "recommended, consider, or rejected."

   W&C Comment: It is not clear in the Report, but we interpret the differentiation between "recommended" and "consider" is that for items with the category of "consider," W-P has a lower level of confidence that further analysis will find that the item actually results in cost savings.

7. Summary of Results – page 3-4: the statement, "*Each worksheet includes… a brief narrative comparing the original and alternative design concept, supporting calculations and sketches and an opinion of potential cost savings*."

   W&C Comment: There are no supporting calculations provided with any of the worksheets. Therefore, we recommend that this sentence should be edited with "supporting calculations" removed.

Items with the Potential for Significant Cost Impact

The following are items that are represented in the VE Report to potentially have a significant cost impact on the project. We think that these items are important for further discussion with the Town, but we have determined that not all of them have a significant impact on the project cost.

- Items 1 through 4 - General Conditions: WP states that they estimate the project to be $1.8M higher in cost than the W&C estimate because of the construction duration and associated cost for temporary construction facilities, laydown and sequencing, and inflation of labor and material rates. No supporting cost data is provided in the VE Report, however, additional information was provided to W&C by W-P via email on March 23, 2016. In this email, W-P indicated that to determine the $1.8M, they took W&C's general conditions cost estimate and doubled it and applied a 3% annual inflation rate to W&C's construction cost estimate.

W&C responses to Items 1 through 4 are as follows:

- General Conditions/Duration:
  We reviewed the construction duration and agree that 12 months may be optimistic and that it may be more prudent to anticipate 18 to 24 months for a duration. A key aspect of holding to the 12 month duration was to align with the RIDEM consent order schedule[1]. Regardless, we believe that this cost impact is overestimated by W-P because not all general conditions costs are time dependent. We have recalculated our cost estimate and it resulted in a $280,000 increase to overall construction cost as opposed to the W-P projected $625,000.

- Temporary Construction Facilities, Site Laydown and Construction Sequencing:
  The cost impacts of construction sequencing and temporary facilities were considered by W&C during the preparation of the 30% design construction cost estimate. At the current level of design, there was not enough information to develop a detailed estimate of the costs that might be incurred by a contractor for these items. At the 30% level of design, we carry the costs for undefined items such as sequencing and additional laydown area in the higher contingency (20%) that is implemented at this stage of design. As the design advances and sequencing

[1] The Draft Facilities Plan Amendment Report, dated May 2, 2014, prepared by Woodard & Curran and submitted to RIDEM included a construction schedule of 18 months. In June 2014, as a result of a budget crisis, the Town negotiated with RIDEM for an extension of the Consent Agreement schedule. As part of that negotiation, the construction schedule was reduced.

plans are refined, we will add those costs and reduce the contingency with the net effect of the overall cost remaining near the same.

In addition, through this review, we identified that there are Town- owned parcels (parking lots, etc.) that are located adjacent or very near to the site on Water Street that if they could be made available to the Contractor, it would reduce the cost to the project.

- Cost Inflation:
  As noted in the VE report, the 30% design cost estimate is in 2016 dollars. We do not use inflation rates on our preliminary cost estimates, because they are already conservative relative to the cost of labor and materials quantities. It is our position that adding inflation costs would over-inflate the estimate.

  Furthermore, we find the VE estimate of inflation to be overstated. Based on the widely use Engineering News Record (ENR) Construction Cost Index (CCI) the construction inflation rate over the past two years has been approximately 2%. In addition, the inflation rate should only be applied to labor, materials, subcontracts, and equipment rental which only make up 60% of the total construction cost (W-P applied a 3% inflation rate to the entire construction cost). Applying the 2% inflation rate to the appropriate cost components results in an amount of $390,000. As previously described, this level of cost (2%) is already accounted for in the contingency and conservative nature of the 30% design cost estimate.

- Item 15 – Nutrient Removal Process Design: W-P states that they used a relatively generic model that indicated the proposed reactor tank volume could potentially be reduced. As a result they recommended that W&C review our process model to verify the required size for the activated sludge process.

  To address this item, we have reviewed and verified that the proposed reactor tank volume is appropriate and confirmed that further analysis is not warranted. We also note that during the Facilities Plan and 30% design, W&C performed extensive analysis of existing process data, calculations and modeling to size the proposed reactor volume. Through our analysis, we found that the yield (mass of sludge produced per mass of pollutant consumed) experienced in Warren is higher than typical default values used in commercially available process models. However, the yield value measured and used for design for the Warren plant is within the range of values we have seen for many similar plants that we have evaluated. Although the VE report does not contain specific information on the model inputs and output that W-P used, we suspect that the default parameters W-P used in their model, such as yield, did not reflect wastewater characteristics experienced at the Warren plant that results in the discrepancy in their determination of required reactor volume.

- Items 21, 22 and 24 - Sludge Handling Building Redesign: the VE states that significant excavation for the proposed sludge handling building will be challenging due to subsurface soil and groundwater conditions. The VE further recommends considering redistributing the proposed Sludge Handling Building functions to existing infrastructure onsite to reduce the amount of excavation needed. W&C agrees with W-P that there may be an opportunity to reduce the excavation volume for the sludge handling building, and we have identified a variation on that approach. Our alternative approach accomplishes the fundamental goal of reducing the amount of excavation as well as new building construction but protects the physical environment of the Operations Building that is a key feature identified by operations staff. We recommend developing our concept further through the detailed design. The basis for our variation on the redistribution scenario proposed by W-P is as follows:

- W-P recommends a new independent chemical building located above the chlorine contact tank (CCT). We see a level of risk in placing chemicals above the CCT because if there were a chemical leak that made its way through the secondary containment, it would have a direct path to flow out to the Warren River. In addition, there may be structural challenges in utilizing the CCT as a base foundation for a building.

  As an alternate to the W-P scenario, W&C believes that the basic goal of minimizing excavation can be achieved by locating some of the chemicals in the Operations Building and some chemicals in a new slab-on-grade chemical storage facility that is constructed as part of the new reactor structure. Locating the chemicals in the Operations Building will require locating the new switchgear and motor control centers on the second floor of the building.

- W-P recommends constructing the gravity thickeners (GTs), sludge transfer pumps, and scum tank within the existing sludge handling building foundation. We do not see this as feasible for the following reasons:

  - The geotechnical program found a layer of peat in close vicinity to the existing sludge storage building making it doubtful the existing foundation and subsoils will be adequate to support the new structures. Installing piles through the existing foundation and peat layer to support the new structures is one means of potentially overcoming this but results in a complicated structural configuration. We believe the difficulty in constructing this scenario will add cost rather than decreasing it.

  - Removing the interior partition walls of the existing foundation to accommodate the new structures is likely to decrease its bearing capacity.

  - The sludge transfer pumps require a footprint of 20 feet by 28 feet, or 560 square feet. The available area for the sludge transfer pumps under the W-P scenario is only 160 square feet.

  As an alternate to the W-P scenario, W&C believes that the basic goal of minimizing excavation can be achieved by locating the sludge transfer pumps in the Operations Building basement. Under our alternate concept, the new GTs, thickened sludge tank and scum tank would be located between the Operations Building and the Chlorine Contact Tank. This alternate scenario would significantly decrease the size of the new sludge handling structure and the associated excavation volume.

- W-P recommends installing the rotary drum thickener (RDT) on the second floor of the Operations Building. This recommendation is contrary to a fundamental design parameter which is to remove sludge processing operations from the Operations Building. This parameter was strongly stated by the operations staff and W&C agrees with it because sludge handling generates hydrogen sulfide which is odorous, corrosive and a health hazard. Evidence of hydrogen sulfide corrosion is apparent in the severe corrosion observed on all metal equipment and material in the operations building basement. In addition, the production of hydrogen sulfide is not compatible with the function of the upper floors as personnel and laboratory space. Furthermore, per the National Fire Protection Association (NFPA) 820 document, the solids handling activities makes the operations building a classified space and therefore any electrical equipment needs to be explosion proof.

  The W&C alternate scenario includes RDT installation in a building located above the new thickened sludge and scum tanks. This new structure would have a footprint which is significantly smaller than the Sludge Handling Building footprint in the 30% design and would

incorporate housing sludge pumps in the Operations Building. This approach reduces new construction cost, increases use of the existing Operations Building without compromising the inside air quality for staff and equipment longevity.

Items with Modest Cost Impact Recommended for Further Evaluation

The VE items with a modest cost impact that we agree should be evaluated further through the design are described in the attached table.

Items with Modest Cost Impact Recommended for Exclusion from Further Evaluation

The following describes the VE items with a modest cost impact that W&C recommends are excluded from further evaluation.

- Item 5 – Screenings Building Above Grit Tank: This alternative was explored during the 30% design. When considering the need for the storage portion of the building we found it to be more cost effective to construct the building as slab on grade rather than above the headworks structure. The W-P analysis indicates that the storage function could be accomplished in a separate wood framed shed that has no frost wall foundation. We disagree with this conclusion because the wood framed shed is less likely to meet the 20-year design life requirements for the project and would not fit in with the aesthetics of the WWTF.

- Item 7 – Influent Screening Opening Size: Influent screening is an important preliminary treatment step to protect downstream equipment. Having a ¼ -inch screen versus a ½ inch screen has the benefit of a higher level of removal resulting in less maintenance and wear and tear on downstream equipment. The basis for the W-P recommendation is a manufacturer-provided screenings capture graph from one particular manufacturer and indicates an estimated screenings quantity of 13 cubic feet per million gallons. Our original design basis of 2 cubic feet per million gallons was also from manufacturer-provided data indicating that the quantities from these discrete sources can vary significantly. For an independent data point, we referred to the Water Environment Federation (WEF), Manual of Practice (MOP) No. 8, "Design of Municipal Wastewater Treatment Plants." On page 11-7 of MOP 8 is a figure showing screening quantities for fine screens. It indicates a screening capture rate of 7 cubic feet per million gallons. At that rate, the volume of screenings would be approximately 3 to 4 cubic yards per week. An 8-cubic yard dumpster would fit within the screenings building and would provide approximately 2-weeks of screening storage. Therefore, we recommend keeping the screen size at ¼-inch to maintain the level of protection and utilize a larger dumpster container at a negligible impact on the overall project cost.

- Item 10 – Direct Discharge Septage: Septage is typically high in organic loading and is anaerobic. The current configuration of the septage receiving to the night soil tank allows this loading to be slowly introduced to the WWTF. Direct discharge will put a slug loading of organics, nutrients and low pH into the process which is not accounted for in the current design and may cause process upsets, odors, foaming and negatively impact total nitrogen removal which is a primary reason for this upgrade. In addition, direct discharge is counter to TR-16 which recommends flow equalization of septage receiving.

- Item 11 – Consider Separate Electric Room (Primary Sludge Pump Station): The basis for the W-P recommendation is to protect the electrical equipment from fumes generated below and to allow a reduced ventilation rate resulting in the remainder of the pump station becoming a classified area. Reducing the ventilation rate will necessitate that all the pump and blower motors (total of seven) are explosion proof. Therefore, we concluded that this would add cost.

- Item 14 – Review Air Ventilation Rates: It does not appear that there is a cost benefit analysis to support the recommendation. It is our experience that declassifying areas with ventilation rates of 6 air changes per hour is more cost effective than providing explosion proof equipment because the area becomes classified. In our opinion, it is also safer for operators if the areas are provided with the higher ventilation rate.

- Item 25 – Alternative Gravity Thickener Tank Material: Per the discussion on Item 22, it is not cost effective to construct the gravity thickeners (GTs) within the footprint of the existing sludge handling building foundation. Therefore the GT tanks will need to be buried and epoxy coated steel in a buried application would be subject to corrosion. This would necessitate either a shorter design life or a costly cathodic protection system.

- Item 31 – Hydronic Piping: It is our opinion that the approach of testing and selectively replacing the piping will not be cost effective. Pressure testing the piping may work, but in our experience there is a risk that it will weaken the joints. This would result in numerous leaks upon commissioning the new equipment and result in change orders. In addition this evaluation of the existing piping is labor intensive and could result in added cost.

- Item 37 – Storage Building: Refer to Item 5.

Attachment: Table of Summary of Items Recommended for Further Evaluation (based on VE Report Table 3-1)

TABLE 3-1
WARREN, RI WWTF UPGRADE (30% DESIGN)
VALUE ENGINEERING ANALYSIS

Item No.	Item Title/Description	Cost Implications			Preliminary Evaluator			W&C Response
		VE Estimate of Capital Cost Savings	VE Estimate of Operational Costs Savings	VE Estimate of Life Cycle Cost Savings	Recommended	Consider	Rejected	
	General Conditions							
1	Construction Period	($626,000)	N/A	N/A	X			
2	Temporary Construction Facilities	($100,000)	N/A	N/A	X			
3	Construction Sequencing	($100,000)	N/A	N/A	X			
4	Project Inflationary Costs	($1,000,000)	N/A	N/A	X			Exclude
		($1,826,000)						
	Headworks							
5	Screenings Building Above Grit Tank	$120,000	N/A	N/A	X			Exclude
6	Eliminate new influent mechanical screens, wash press and Building	$400,000	Not Estimated	Not Estimated		X		Exclude
7	Influent Screening opening size	Not Estimated	$5,000/yr	Not Estimated	X			Exclude
8	Grit Aeration - reduction of aeration volume	Not Estimated	Not Estimated	Not Estimated	X			Evaluate Further
	Primary Clarifiers							
9	Submersible chopper pump for scum...instead of mixers and pumps	$120,000	Not Estimated	Not Estimated		X		Evaluate Further

TABLE 3-1
WARREN, RI WWTF UPGRADE (30% DESIGN)
VALUE ENGINEERING ANALYSIS

Item No.	Item Title/Description	Cost Implications			Preliminary Evaluator			W&C Response
		VE Estimate of Capital Cost Savings	VE Estimate of Operational Costs Savings	VE Estimate of Life Cycle Cost Savings	Recommended	Consider	Rejected	
10	Septage Tank/night soil tank - Do we need to have vs direct discharge	Not Estimated	Not Estimated	Not Estimated		X		Exclude
11	Consider separate electrical room	($5,000)	Not Estimated	Not Estimated	X			Exclude
	Intermediate Pump Station							
12	Dry pit pump vs nonclog vertical - higher efficiency	N/A	Not Estimated	Not Estimated		X		Exclude
13	Pump size versus pump cycling - jockey pump	($60,000)	Not Estimated	Not Estimated		X		Evaluate Further
14	Review air ventilation rates	N/A	Not Estimated	Not Estimated		X		Exclude
	Aeration Tanks							
15	Nutrient Removal Process Design	$1,330,000	Not Estimated	Not Estimated		X		Exclude
16	Mixer Aerator Design and Configuration	$275,000	Not Estimated	Not Estimated	X			Evaluate Further
17	Nutrient Removal Process Alternative	N/A	N/A	N/A			X	Not Applicable
18	Aeration Tank Configuration/Dimensions - Excavation issues	N/A	N/A	N/A			X	Not Applicable

TABLE 3-1
WARREN, RI WWTF UPGRADE (30% DESIGN)
VALUE ENGINEERING ANALYSIS

Item No.	Item Title/Description	Cost Implications			Preliminary Evaluator			W&C Response
		VE Estimate of Capital Cost Savings	VE Estimate of Operational Costs Savings	VE Estimate of Life Cycle Cost Savings	Recommended	Consider	Rejected	
	Secondary Clarifier							
19	Consider suction tube vs Spiral blade	Not Estimated	Not Estimated	Not Estimated		X		Evaluate Further
	Chlorine contact tanks							
20	Disinfection and Dechlorination Instrumentation	$50,000	Not Estimated	Not Estimated	X			Evaluate Further
21	New independent Chemical Building	See Item No. 22 and 24				X		Exclude
	Solids Handling Building							
22	Solids Handling Building Redesign	$750,000	Not Estimated	Not Estimated	X			Evaluate Further
23	Single gravity thickener unit versus two units	Not Estimated	Not Estimated	Not Estimated		X	X	Not Applicable
24	Install Rotary Drum thickener in ex. Admin building	See Item #22	Not Estimated	Not Estimated	X			Exclude
25	Alternative Gravity Thickener Tank Material	$100,000	Not Estimated	Not Estimated		X		Exclude
26	Use Group Classification	N/A	N/A	N/A	X			Evaluate Further
27	Chemical Storage - fire Protection	$11,100	N/A	N/A	X			Evaluate Further
	Admin Building							
28	Reuse existing thickened sludge storage tank	See Item No. 22 and 24				X		Exclude

TABLE 3-1
WARREN, RI WWTF UPGRADE (30% DESIGN)
VALUE ENGINEERING ANALYSIS

Item No.	Item Title/Description	Cost Implications			Preliminary Evaluator			W&C Response
		VE Estimate of Capital Cost Savings	VE Estimate of Operational Costs Savings	VE Estimate of Life Cycle Cost Savings	Recommended	Consider	Rejected	
29	New exterior thickened storage tank on west side of Admin with pumps in lower level of	See Item No. 22 and 24				X		Evaluate Further
30	New Electrical room needs outside swing doors and second egress	($5,000)	Not Estimated	Not Estimated	X			Evaluate Further
31	Mechanical - Hydronic Piping	$260,000	Not Estimated	Not Estimated	X			Exclude
32	Mechanical - Energy Recovery	($60,000)	$23,500/yr	Not Estimated		X		Evaluate Further
33	Fiber Optic Cable Replacement	$28,700	$1200/yr	Not Estimated		X		Evaluate Further
	Generator							
34	Relocation to opposite side of site	$0	Not Estimated	Not Estimated	X			Exclude
	Cost Estimate							
35	Review excavation and dewatering cost estimate	Not Estimated	Not Estimated	Not Estimated		X		See Item 22
36	Demolition costs	Not Estimated	Not Estimated	Not Estimated		X		See Item 22
37	Storage Building	$70,000	Not Estimated	Not Estimated	X			Exclude