TATA & HOWARD

September 18, 2017

Mr. Thomas Holder, Director
Department of Public Works
Town of Wayland
41 Cochituate Road
Wayland, MA 01778

Subject: Technical Memorandum
Water Meters and Advanced Metering Infrastructure Evaluation
T&H No. 4328

Dear Mr. Holder:

In accordance with our agreement, Tata & Howard is pleased to present one (1) electronic copy and (8) hardcopies of this Technical Memorandum for the evaluation of water meters and advanced metering infrastructure (AMI) systems for the Town of Wayland's water distribution system. The purpose of this evaluation is to provide a comparison of different AMI technologies to provide the Board of Public Works with information to aid in the future selection of a new metering system. The evaluation will review the Town's existing metering system and compare both traditional fixed network and cellular network AMI system features and functionality. An estimate of current annual revenue loss due to meter age will be approximated. Implementation of the new AMI system including procurement, proposal evaluation criteria, installation, and public education strategies will be reviewed. Finally, the evaluation will compare the initial capital costs and 20-year life cycle cost of each AMI technology based on budgetary values collected from meter and AMI vendors. Recommendations at the conclusion of this technical memo will summarize our findings for meter and AMI technology to best suit the needs of the Town.

1.0 Existing Metering System

The Town of Wayland spans an area of approximately 15.9 square miles. The Town's Department of Public Works (DPW) provides water service to nearly 100 percent of the Town's population. Currently, the water system has 5,057 metered water accounts. The Town also has approximately 102 wastewater accounts which are billed based on registered consumption through the water meter. All metering infrastructure including residential meters, touchpads, endpoints, data collectors, and handheld devices are owned and maintained by the Wayland DPW. The term endpoint refers to the device that communicates with a water meter and transmits data via radio frequency to the AMI system infrastructure. Commercial meters and associated equipment are purchased,

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tested, and maintained by the water customer. The Town's water meters range in size from 5/8-inch to 4-inch. A variety of different water meter manufacturers and models are currently used to meter water usage throughout the system, including Sensus SR, SRII, iPERL, OMNI, and compound meters, as well as Badger compound and electromagnetic meters. Table No. 1-1 shows the quantity and percentage of meter manufacturers and models in the Wayland system.

Table No. 1-1
Existing Meter Manufacturer and Model Summary

Meter Manufacturer	Meter Model	Quantity	Percentage
Sensus	SR	287	6%
Sensus	SRII	3,233	64%
Sensus	iPERL	1,482	29%
Sensus	OMNI	44	<1%
Sensus	Compound	6	<1%
Badger	Compound	4	<1%
Badger	Electromagnetic Meter	1	<1%
Totals		**5,057**	**100%**

In Wayland, approximately 64 percent of the metering system is made up of Sensus SRII water meters. The Town began installing SRIIs in the late 1990s for all 5/8-inch to 1-inch meter applications. In 2002, the Town switched to the Sensus SR water meter for 3/4-inch and 1-inch meter applications due to customer complaints of meter noise. The Town standardized on replacing 5/8-inch meters with 3/4-inch meters during this time so 5/8-inch meter replacements were no longer installed. In 2008, the Sensus iPERL meter was introduced to the Town and has exclusively been the meter installed for all 3/4-inch and 1-inch meter applications to date. Table No. 1-2 provides a summary of all meters, 5/8-inch through 4-inch, by age for the entire system based on the installation year. Approximately 63 percent of the Town's meters have been in service for over 15 years. In accordance with AWWA Manual M6, a planned meter replacement program can be implemented over a given number of years, e.g., 10 percent of the meters each year over 10 years or 20 percent per year over five years, so that all replaced meters in the system will consistently be an efficient, modern design.

Table No. 1-3 summarizes the quantity of meters by size in the existing system. The 5/8-inch water meters make up approximately 57 percent of the total meters followed by 3/4-inch meters at 33 percent. Together, the 5/8-inch and 3/4-inch residential water meters account for the majority of the meters in the system, approximately 90 percent.

Table No. 1-2
Existing Meter Age Summary

Age (years)	Quantity	Percentage
>20	6	<1%
16-20	3,193	63%
11-15	219	4%
6-10	730	14%
0-5	909	18%
Totals	**5,057**	**100%**

Table No. 1-3
Existing Meter Size Summary

Meter Size	Quantity	Percentage
5/8-inch	2,902	57%
3/4-inch	1,631	33%
1-inch	442	9%
1.5-inch	38	<1%
2-inch	40	<1%
3-inch	3	<1%
4-inch	1	<1%
Totals	**5,057**	**100%**

The Town of Wayland's DPW includes one trained meter reading employee that rotates through six (6) different routes. Route 6 is the only route with connections to the municipal sewer but not all water customers along this route have a wastewater connection. Most water customers are billed semi-annually, however, some commercial users are billed on a quarterly schedule. Approximately 90 percent of the meters are read by Sensus touchpads by using a handheld meter reading device and physically contacting the touchpad located outside each customer's building.

The Town currently has Sensus RadioRead MXU endpoints installed on the exterior of the building on the remaining 10 percent of the metered accounts in the system. These meters are read by handheld devices that can obtain radio read data when in close proximity to the endpoint connected to a water meter. The Town's meter reading staff will carry this handheld device while walking the routes collecting meter readings. Meter reading data is uploaded into the existing Sensus meter reading software used by the Town which communicates with the Town's billing system, VADAR. The meter reading information is transferred into the VADAR billing system which is then used to generate bills to send to customers. The Town's current water rate structure is shown below in Table No. 1-4.

Table No. 1-4
FY18 Water Rates

Tier	Volume of Water (100 cubic feet)	Water Rates (per 100 cubic feet)
1	0 - 15	$5.36
2	15 – 30	$7.00
3	30 – 80	$8.09
4	>80	$13.51

In Wayland, a customer's registered water usage is used to produce bills for both water and sewer. As previously mentioned, The Town has approximately 102 wastewater accounts located along Boston Post Road. The Town's sewer rates are shown in Table No. 1-5.

Table No. 1-5
FY18 Sewer Rates

Rate Tiers	Annual Sewer Rates	Quarterly Sewer Rates
Capacity Rate	$2.79	$0.70
Flow Rate	$1.97	$0.49
Penalty Rate	$5.91	$1.48

The total quarterly sewer charge is derived by a combination of the following equations and rates shown in Table No. 1-5:

Average Flow = Recent Read (gallons) - Previous Read (gallons) / Days in quarter
Capacity Cost = Capacity Assigned to Account (gpd) x Quarterly Capacity Sewer Rate
Flow Cost = Minimum of Capacity x 50% or Average flow (gpd) x Quarterly Flow Rate
Penalty Cost = Maximum of Zero or Average Flow (gpd) – 50% of Capacity Assigned to Account (gpd) x Quarterly Penalty Rate
Quarterly Charge = The sum of Capacity, Flow, and Penalty Costs

2.0 Advanced Metering Infrastructure (AMI)

Advanced metering infrastructure (AMI) systems provide a technology which automatically collects water metering data and transfers that data to a central location for analysis and billing purposes. This system operates similarly to a traditional automated meter reading (AMR) system, however, it provides more sophisticated data collection,

analysis, and alarms than an AMR system and typically provides a two-way communication link between the Town's meter reading software and the metering endpoints. An AMI system has the ability to not only send and receive real-time water usage readings from each customer without physically reading the meter but can also receive and act on instructions and program changes sent from the Town through the meter reading software to the endpoint. AMI systems can operate and send meter reading data via radio frequency through fixed network infrastructure, cellular infrastructure, fiber optics, or other available backhaul methods.

The typical components of an AMI system include the water meters, battery powered endpoints connected to the water meters which transmit meter reading data to a collector or series of collectors, and collectors which receive, store, and transmit meter reading data to a network control computer (NCC). The meter reading software installed on the Town's computer is used to analyze meter reading data and transfer the data to the Town's billing system. AMI systems allow for improved meter reading efficiency, reduced data handling errors, fewer estimated bills, and eliminate the need for accessing the customer's property to read a water meter unless a radio transmission error occurs. Furthermore, with an AMI system the Town has the ability to institute more frequent billings which can expedite receivables for the Town and provide more frequent and more manageable bills for customers.

The following are typical features and capabilities of an AMI system through the endpoint, meter reading software, or a combination of the two working together:

- Two-way communication between the endpoint and meter reading software
- Remotely read meters, including on demand meter readings
- Integration with billing system for automatic bill generation
- More frequent billings due to simplified and more efficient meter reading process
- Reduced number of estimated bills
- Warnings for high, low, or zero flows customized by water meter size or specific customer usage patterns
- Customer-side leak detection and continuous usage
- Meter tampering alarm
- Backflow alarm
- Endpoint low battery warning
- Interval read data logging for determining usage trends and patterns
- Improved customer service with more analytical tools and water consumption history available to Town office personnel
- Customer portal for customers to access limited data as permitted by the Town which can reduce customer service calls
- Additional tools and data for public education purposes and conservation promotion and enforcement
- Improve unaccounted-for-water (UAW) analysis through time synchronization of master meters and consumer meters
- Minimize administrative time and human error in manually entering meter reading data

- Network for implementation of future distribution system technologies, including remote customer shutoffs for failure to pay bills or due to severe leak detection

Based on the goals and noted priorities of the Town for the new meter reading technology, AMI systems evaluated in this memorandum include fixed network and cellular based networks. A fixed network uses stationary data collectors mounted within Town, owned and maintained by the Town, to receive, store, and transfer data to and from the meter and endpoint. A cellular network operates similarly to a fixed network, however, it does not require the installation of data collectors specifically for the AMI network. Endpoints use existing cellular infrastructure that is owned and maintained by a cellular company as the backhaul method for receiving and transmitting data to and from the meter and endpoint. Most fixed network and cellular based networks can provide the typical features and capabilities noted above for an AMI system.

Billing Improvements

Implementing an AMI system allows the Town to remotely read water meters and bill water and sewer customers on an efficient, routine and continuous cycle. The Town can obtain on demand meter readings as necessary through the AMI system. With more accurate and daily meter readings collected through the AMI network, the Town can bill their customers more frequently and reduce the number of inaccurate bills. More frequent billings will expedite receivables for the Town and provide more manageable bills for customers. The meter and AMI implementation program provides the Town with an opportunity to update customer account information to improve how bills are generated and mailed to customers. Transfer files are set up by the billing system vendor and meter readings are automatically transferred from the AMI software to the billing system similar to the Town's current data transfer procedures, minimizing manual entry of meter readings and decreasing the potential for data transfer errors.

Customer Service

AMI systems store historical water usage data for each meter account for a finite period of time. When a customer notifies the Town about a discrepancy, such as a high water bill, the Town will have the ability to quickly pull up a usage profile and graph of the customer's account and provide a breakdown of water usage throughout the billing period, including hourly interval data. The Town will be able to determine if a high volume of water was used during a certain time period or on a certain day to assist the customer in understanding when the water was used. This tool will be valuable to the Town in providing customers with immediate information to explain the reasoning behind a higher than normal water bill.

Hourly interval data collected through the AMI system will allow the Town to detect leaks on the customer side of the water meter. Leaks can be detected by a continuous flow of water measured by the meter register throughout the day, even during hours when demands are typically zero. Additional flags in the AMI software can be generated upon high daily consumption, low daily consumption, or zero flow detections for an extended

period of time. Identifying customer leaks and significant flow pattern changes will improve customer relations with the Wayland DPW, enhance customer confidence in the DPW's management of the water system and billing practices, and at the same time promote the conservation of water.

Additional warnings that can be flagged in the AMI software include tamper alarms for when registers are disconnected and alter how the water meter records consumption and backflow alarms that indicate water is traveling through the water meter and register in the reverse direction. If backflow occurs for an extended duration or routinely, the meter installation should be inspected by Town personnel to check if the meter seal has been cut or if tampering has occurred.

Although the new AMI system will improve meter reading procedures and billing efficiency, the additional data and software available to Town personnel will require their efforts be redirected to managing the new information and reports generated. Town personnel will need to routinely review data and the reports generated in the AMI software and take the appropriate actions when water usage alarms are flagged in the software to realize the true benefits of the AMI system. Customers may contact the Water Department in an attempt to obtain additional water usage data after the AMI system is implemented.

Fixed Network and Cellular Network AMI Comparison

A traditional fixed network AMI system requires the use of endpoints at each meter location to transmit information to data collectors that are strategically located throughout the Town. Propagation studies are conducted prior to installation of the system by the system vendor to determine the location and quantity of data collectors needed to communicate with all meters throughout the system. These data collectors are typically mounted to water storage tanks, utility poles, buildings or other infrastructure that is located at high elevations with the ability to access an external power source. Utilizing water storage tanks and Town owned buildings is preferred to avoid rental costs for space on a utility pole or on a structure not owned by the Town. Some systems offer solar powered data collectors which would eliminate the need for an external power source, but due to the criticality of keeping the collectors in operation at all times, an external power source is often used. After data is collected, it is transmitted to the NCC located at the DPW where the data can be analyzed using the manufacturer's meter reading software, and meter reading data can be transferred by account into the Town's billing system.

A cellular network AMI system provides all of the benefits of a fixed network without the need for new data collector infrastructure. Data collection and transfer in a cellular network is achieved wirelessly through existing infrastructure already installed by a cellular network provider. The Town pays a contractual fee(s) to the service provider based on the number of accounts, and all maintenance required to keep the system in operation is the responsibility of the cellular service provider. Cellular network AMI systems provide a full coverage network capable of reading water meters in any area with cellular reception. Similar to a fixed network, data is collected from the meter and

endpoint and transmitted to a NCC located at the DPW where data can be analyzed using the manufacturer's meter reading AMI software, and meter reading data can be transferred by account into the Town's billing system.

Both fixed network and cellular AMI systems will meet the goals and priorities of the Town for its meter replacement program. As mentioned above, there are numerous benefits to implementing a fixed network or cellular AMI technology. Table No. 2-1 provides technology specific advantages and disadvantages for a fixed network compared to a cellular network AMI system.

Table No. 2-1
Fixed Network and Cellular Network AMI Comparison

AMI System	Advantages	Disadvantages
Fixed Network	• Lower annual O&M costs • Lower cost endpoints • Endpoints have 10-year full and 20-year pro-rated warranty • Repeaters can be installed to enhance network and capture readings in areas with intermittent coverage	• Network infrastructure has to be constructed prior to meter and endpoint deployment • All network hardware owned by the Town • Maintenance contracts and hardware management plan is necessary to maintain network • Rental fees if mounting collectors on private structures • Routine IT support required
Cellular Network	• Cellular infrastructure is owned and maintained by the service provider • Faster deployments since cellular infrastructure already installed • Infrastructure management and maintenance plan is not necessary	• Higher annual O&M costs due to monthly fees for cellular service contracts • Replacement of all cellular endpoints after 10 years due to limited battery life and expected technology changes • Higher cost cellular endpoints • If areas in Town exist with zero cellular service, mobile read collection using a handheld will be necessary since cellular network will not be enhanced

3.0 Water Meter Accuracy and Revenue Loss

Water Meter Accuracy Degradation

Water meters are mechanical devices and will begin to work less efficiently over time losing accuracy. As a meter loses accuracy, it will under register the flows through the meter. Some water consumed by the customer is not registered by the water meter resulting in unaccounted for or non-revenue water. Factors that contribute to meter inaccuracy include water quality, low or high flow rates, buildup of materials from the water in the distribution system, and general wearing of mechanical components within the meter. To determine if a meter is operating within accuracy standards, the meter must be tested. Testing of water meters is costly and not always routine practice for a utility, particularly for small residential meters where replacement costs may be less expensive than the labor fees for a testing company.

Utilities tend to replace meters based on age rather than based on their accuracy. Normal life expectancy of water meters varies from 7-15 years according to *Chapter 11 – Capacity Development and Standard Operation Procedures* in the Massachusetts Department of Environmental Protection's (MassDEP) *Guidelines for Public Water Systems*. Utilities tend to focus on the accuracy of larger meters because these meters are typically installed at locations that have high water usage. The large meters have more mechanical parts as well which makes them more vulnerable to wear and inaccurate registration of flows. Small inaccuracies at meter accounts that use a large volume of water can result in significant revenue loss for the Town. Periodic testing of water meters can be a beneficial practice for water utilities. Meters that are found to be outside of the AWWA accuracy standards or more stringent manufacturer accuracy limits should be repaired or replaced. Table No. 3-1 shows the AWWA recommended testing frequency for water meters.

Table No. 3-1
AWWA Recommended Testing Frequency

Meter Size (inches)	Type	Frequency (Years)
5/8-3/4	Positive Displacement	10
1-2	Positive Displacement	5
≥3	Compound/Turbine/Fire	1

It is also important that water meters are accurately sized for the specific customer based on typical water usage, minimum and maximum flow rates, and the volume percentage of water registered that falls into certain flow ranges. Data logging an existing water meter can be used to assist in the selection of an appropriately sized water meter. AWWA M22 Sizing Water Service Lines and Meters Manual provides guidance on appropriately sizing water meters for a particular customer. Meters not sized appropriately becomes a significant concern when there are several large meters that exist in facilities that have

changed owners or water demands over time. A large meter could be installed in a location that no longer has a high water demand, and a significant portion of the flow through the meter could be at a low flow rate that the large meter does not accurately measure, which would result in revenue losses for the Town.

Meters not sized appropriately is not a major concern in Wayland with only two meters greater than 2-inch in the system. However, during the meter replacement program, the existing one 3-inch and one 4-inch meters should be reviewed to confirm the meter sizing is appropriate for the water usage patterns at these facilities. Due to the low flow accuracy capabilities of modern water meters, the Town of Wayland has standardized on a 3/4-inch water meter as their minimum size for typical residential accounts. Standardizing on a 3/4-inch residential meter allows for greater accuracy on high flows that could be high enough to cause accuracy drop-off when registered by a typical 5/8-inch water meter. The low flow accuracy capability of newer 3/4-inch water meters is similar to that of a 5/8-inch water meter and missing some water registration through a 3/4-inch water meter at low flows is not a concern.

Consumption and Revenue Loss

A study in the Journal of the AWWA determined water meter accuracy based on statistical sampling of water meter age and material. Meter accuracy degraded by 0.3 to 0.5 percent each year in service based on the results of the study. Based on the estimated meter inaccuracies using the AWWA study, annual revenue loss due to unregistered flow for water billings is shown in Table No. 3-2. A meter accuracy degradation of 0.3 percent per year was used in this analysis as a conservative value to estimate revenue loss in Wayland. The total registered volume of finished water, as reported in the Town's 2016 Annual Statistical Report (ASR), was divided by the total number of meter accounts to estimate and evenly distribute the recorded volume of water consumption between all accounts. The unrecorded consumption per meter was determined by using this estimated water usage per meter multiplied by the corresponding meter deficiency based on the age of the water meter. Meter deficiency is equal to the yearly degradation of 0.3 percent multiplied by the age of the meter in years. The sum of the unrecorded consumption for each meter as shown in Table No. 3-2 provides a total annual unrecorded consumption. The age and quantity of meters included in Table No. 3-2 were based on data tables provided by the Wayland DPW.

Based on the water rates shown in Table No. 1-4, a Residential Tier 2 fee of $7.00 per 100 cubic feet was used as a conservative value to estimate the revenue loss. The estimated volume of unrecorded water being lost through under registering water meters in Wayland is approximately 22.6 million gallons per year, approximately 4.4 percent of the Town's yearly water usage according to the 2016 ASR. The total revenue loss due to under registering meters is estimated to be approximately $212,000 annually. Approximately $180,000 of this revenue loss is attributed to meters with greater than 15 years of service life. This annual revenue loss is a conservative value estimated purposely not to inflate the approximate revenue loss by the Town. The actual revenue loss may be higher depending on the rate structure Tier in which each customer's usage

falls into. Implementing a meter replacement program will reduce unregistered flow and minimize revenue loss caused by old, inaccurate water meters. The approximate revenue loss for wastewater billings due to under registering water meters was calculated and determined to be less than $1,000, and therefore, considered negligible for the analysis included in this technical memorandum.

Table No. 3-2
Estimated Annual Revenue Loss from Unrecorded Consumption

Meter Age (Years)	Quantity	Estimated Accuracy	Unrecorded Consumption Per Meter (Gallons)	Unrecorded Consumption Subtotal (Gallons)	Revenue Loss per Meter	Revenue Loss Subtotal
0	30	100.00%	0	0	0	0
1	105	99.70%	308	32,378	$2.89	$303
2	126	99.40%	617	77,708	$5.77	$727
3	130	99.10%	925	120,262	$8.66	$1,125
4	152	98.80%	1,233	187,486	$11.54	$1,754
5	366	98.50%	1,542	564,307	$14.43	$5,281
6	512	98.20%	1,850	947,296	$17.31	$8,864
7	41	97.90%	2,159	88,501	$20.20	$828
8	63	97.60%	2,467	155,416	$23.08	$1,454
9	66	97.30%	2,775	183,169	$25.97	$1,714
10	48	97.00%	3,084	148,015	$28.86	$1,385
11	39	96.70%	3,392	132,288	$31.74	$1,238
12	48	96.40%	3,700	177,618	$34.63	$1,662
13	58	96.10%	4,009	232,507	$37.51	$2,176
14	28	95.80%	4,317	120,879	$40.40	$1,131
15	46	95.50%	4,625	212,772	$43.28	$1,991
16	35	95.20%	4,934	172,684	$46.17	$1,616
17	69	94.90%	5,242	361,712	$49.05	$3,385
18	75	94.60%	5,551	416,292	$51.94	$3,896
19	1,074	94.30%	5,859	6,292,489	$54.83	$58,883
>20	1,946	94.00%	6,167	12,001,552	$57.71	$112,307
Total	**5,057**			**22,625,331**		**$211,720**

Abatement Policy

The Town's existing meter reading software and VADAR billing system do not automatically identify and flag inaccurate meter readings or bills that may result from atypical water usage by a customer. The Billing Department has to manually review meter readings to catch a reading which may be above or below normal water usage for each customer. Although the Water Department does not estimate meter readings or bills, the Town offers an abatement policy for customers who identify a problem with their water bill. The abatement policy is posted on the Water Department website. The

policy requires customers to check for leaking toilets, leaking irrigation systems, and to make sure that their water meter is not running while all taps are turned off. If the customer has identified the problem then they must write a letter to the Department of Public Works and attend a subsequent hearing. If an abatement is granted, then the customer chooses if they would like a reimbursement check or a monetary credit applied to their account for future bills. Based on reports provided by the Billing Department, the Town approved total annual abatements ranging from $125,000 to $430,000 between FY13 and FY16.

Abatements result in annual revenue losses for the Town. Based on the Town's policy for abatements, some of the historical abatements are justified. However, some abatements may be due to the lack of a meter reading software that can collect, store, and be used confidently to present water usage data to the customers to prove the consumption is accurate. With the implementation of an AMI network, the software and system tools available will allow the Billing Department to catch inaccurate meter readings prior to an incorrect bill being generated, reducing the number of abatements. With the new AMI software, the Billing Department will be able to view and explain to customers when specific water usage occurred, and customers will be deterred from requesting abatements unless absolutely justified.

4.0 Project Implementation

Procurement Options

The method for procuring a meter and AMI system can be achieved through various processes. The first method of procurement is a public invitation for bid (IFB) which involves generating specifications for a meter and AMI system and issuing bid documents to interested parties for the supply and installation of the meters and AMI system. Upon receipt of all bids the Town would award the contract to the lowest responsive bidder.

The second option for procurement is a criteria based proposal process for the supply of water meters and endpoints and the supply and installation of the AMI system. A request for proposals (RFP) is generated to identify the required and preferred features for the meters and AMI system. The RFP is issued to interested parties, and after receipt of separate technical and price proposals, the Town reviews and selects the most advantageous system based on a combined analysis of the predetermined technical evaluation criteria for the technical proposal and the costs included in the price proposal. The most advantageous proposal is not necessarily the bidder with the lowest price proposal. Typically, the systems that are determined to be the most advantageous will be asked to give a presentation of their system to the Town to demonstrate the advantages of their products and answer any remaining questions.

With the second option, after procurement of the meters and AMI system through an RFP process, installation of the water meters and endpoints can be completed by Town personnel or installation services can be procured through a public IFB process where the

responsive installation contractor with the lowest bid price is awarded the contract. The Town is currently considering the attributes of installing the water meters and associated endpoints using Town personnel compared to outsourcing installation services to an experienced contractor.

The recommended procurement method for the Town is to use a criteria based RFP process to allow the Town to select a meter and AMI system that will best fit the needs and preferences of the Town, not based solely on price as with an IFB. Utilizing a public IFB would not allow the Town to select the most advantageous system based on the technical evaluation criteria, but instead would require the Town to award the contract to the responsive bidder with the lowest bid price that meets the requirements defined in the specifications. Following procurement of the water meters and endpoints, the Town can use its own personnel for installation or outsource installation services to a contractor. If outsourcing installation services, a separate IFB shall be issued to solicit bids and award the installation contract to the responsive installation contractor with the lowest bid price.

The specifications and requirements set forth in the RFP would govern where responsibility lies for the supply contractor and the installation contractor or the Town if it chooses to complete installations using Town personnel. The supply contractor would be responsible for supplying all water meters, endpoints, and AMI infrastructure required for a fully functioning metering network. In addition, the supply contractor would be responsible for installing, testing, and troubleshooting the furnished AMI network equipment and software, not including the endpoints. The installation contractor or the Town would be responsible for properly installing and programming water meters and endpoints to communicate through the fixed or cellular network. A technical support item and training item would be included in the RFP requiring the supply contractor to provide technical assistance and training to all installation contractor or Town personnel who will be installing the meters and endpoints.

RFP Evaluation Criteria

The Town has provided Tata & Howard with a list of evaluation criteria for the new meter and AMI system. The criteria are based on features that the Town considers most important to have in a water meter and AMI system. These and other criteria will be grouped into certain categories in the evaluation criteria used to compare and score the technical proposals submitted under the RFP. A technical proposal will be scored Highly Advantageous, Advantageous, Not Advantageous, or Unacceptable for each category included in the evaluation criteria based on the system's technical capabilities presented in the proposal. Certain categories in the evaluation criteria will be considered more important and the scoring in these categories will be weighted differently than other less important categories. Proposers submitting overall Highly Advantageous or Advantageous proposals will be asked to demonstrate their systems to the Town. The Town's high priority criteria are summarized below.

- Remote meter reading capabilities
- Two-way network communication

- Simple reading process allows the Town to bill quarterly and/or monthly
- Detect water leaks timely and reduce water loss
- Collect hourly interval meter readings
- Detect unauthorized usage during water bans or restrictions
- Alarms to detect abnormal water usage
- System provides appropriate data security
- 20-year battery life for the endpoint and battery failure detection
- Tamper alarms
- On-demand meter reading
- Backflow notification
- Brass meter body
- Minimize service calls
- Long expected equipment life
- Vendor meets certain minimum requirements
- Implementation can be done using a phased installation program
- Basic installations allow for installations by contractor or Town personnel
- Compatibility with existing VADAR billing system
- Customer portal available and online payment options available
- Individual account summary report capabilities
- Network coverage capable of reading all customer meters
- Propagation study must identify and address any trouble areas and vendor shall identify equipment required to adequately read all meters
- Ability to set read intervals and frequency in which meter readings are collected
- Minimum 30-day storage of data in meter and/or endpoint
- User friendly analytic AMI software
- Upgradable programs for future technology advancements

Installation Options

Installation of water meters and endpoints using Town personnel would save the Town money on installation costs. Massachusetts prevailing wage rates for meter installers used by an installation contractor are approximately $70 per hour. Using Town personnel would allow the Town more scheduling flexibility for completing the program. Assuming approximately six installations in a day, two staff members dedicated to the installation of meters and endpoints working five full days per week for 42 weeks in a year could replace approximately 2,520 meters per year and complete the replacement program within two years. In addition to the dedicated installers, additional resources would be required to assist with project management, scheduling of appointments, and coordination and data handling.

The installation of water meters and endpoints could also be awarded to an installation contractor by public bid. After the procurement contract for meter and AMI materials is awarded, a separate IFB could be issued and awarded to the lowest responsive bidder. Contract services would expedite the completion of the meter replacement program and ensure that adequate resources are assigned to the work without unexpected interruptions.

Instances come up throughout the year where Town personnel may be required to complete additional tasks which may slow the installation progress. An installation contractor would likely be given one year to complete the meter replacement program. This would also allow the Town personnel to remain focused on the other daily tasks required to maintain the water system.

If the Town elects to complete the meter and endpoint installations using its own personnel, some contractors will still offer its services for appointment scheduling and project planning. The appointment scheduling, call backs, cancellations, and rescheduling can become a burden on Town personnel while trying to manage normal Town business. Installation contractors have developed software programs to aid in scheduling customer appointments and tracking installer schedules. This can be beneficial to the Town during a meter replacement program.

Billing System Coordination

The new AMI system software will be required to communicate, receive, and transfer data with the Town's existing VADAR billing software. The RFP will require the vendor to provide references where their system was able to interface with the Town's existing billing software. The vendor will be required to carry all costs associated with configuring the necessary transfer files for communication of meter readings, event flags, and account data between the two systems. Contact information for the Town's billing system representative should be identified in the RFP so that the proposers have an adequate opportunity to review the needed transfer files with the billing system vendor to understand the work and fees required to integrate the systems prior to providing a proposal cost. The billing system vendor will often be the party that develops the transfer files so the proposer will have to include appropriate costs for the billing system vendor in its proposal.

It will be the responsibility of the installation contractor or the Town, if using its own personnel to install water meters and endpoints, to collect and record accurate information from the installation to update the existing account information within the VADAR billing system. The AMI system supplier often depends on the data collected by the Town as well to update the account information in its AMI software. It is critical for the same information to be added to the billing system and the AMI software in order for these two systems to properly communicate and transfer data. A second transfer file known as a mass meter data transfer file is often generated by the billing system vendor to take the data for several installations in an excel or .csv file and replace the account information in the billing system. The mass meter data transfer file eliminates the potential for human error and data to be added incorrectly into the billing system. If a new meter number is entered incorrectly into the billing system and entered correctly in the AMI software, then the meter numbers will be different in each system, and the two systems will not be able to communicate if the process uses the meter number to transfer data between the systems.

Regardless of the Town completing installations or if an installation contractor is hired, there will be a period of time where two reading systems will be in operation, the existing Sensus reading system and the new AMI software. A procedure will need to be developed for collecting meter readings using the correct methods and for entering the meter readings into the appropriate meter reading software. Coordination with the meter and AMI system supplier will be necessary to simplify the transition period and avoid billing confusion.

Depending on the complexity of the bill generation process which will need to be reviewed with the Town's billing system vendor prior to the meter replacement program, final bills for the old meter can be issued to the customer upon replacement of an existing water meter or can be incorporated with a partial bill based on the new water meter on the customer's normal billing cycle.

Public Education and Customer Service

It is always important with implementation of a new metering project to keep the public well informed and educated on the basis for the project, timeframe, system features, and replacement coordination. Since the customers are funding the project, it is imperative to keep the community involved with the progress.

A public education/outreach program should be implemented to address both the public and the Town's governing authorities who review and approve the project funding and financing. A governmental authority outreach program should be structured to discuss the following topics:

- Financial Data
  - Estimated capital and yearly O&M costs
  - Procurement, funding, and financing options
  - Billing frequency, revenue changes, and expected payback periods
- Anticipated Schedule
  - Funding and financing timeframe
  - Procurement of meters and AMI system
  - Installation and implementation
- Impact to rate payers

The general public should be involved in the design and planning process to a point. A general public education/outreach program should be structured to discuss the following topics:

- Address any concerns with health effects of AMI system with information furnished by the meter and AMI system supplier
- Reasons for the meter system upgrade and associated benefits
  - Fair and equitable water bills
  - Benefits of increased billing frequency
  - Enhanced customer service
  - Customer informational portal
- Impacts of the project and how customers can assist with progress

  - Scheduling procedures and customers are expected to be responsive
  - Meter installation time: 20 minutes to 1 hour
  - Home entry is required to replace the water meter and connect the endpoint
  - Keep the space around the water meters accessible
  - Customer to address plumbing issues on water service prior to meter installation
  - Endpoints will be mounted on the building exterior
  - Tampering with water meters or endpoints is prohibited, is easily detected through the AMI system, and customers who tamper with equipment will be penalized appropriately
- Commercial and Industrial appointments can be scheduled during off hours to minimize impact to daily business operations
- Data transfer is secure and no private account information is transmitted
- Create a website and forum to provide routine information, frequently asked questions (FAQs), and updates throughout the project and to provide customers a medium to ask questions to the Town

In transitioning from design to procurement and then to project implementation, the presented information should transition from conceptual facts to notification of the planned installation process. This should be conveyed using multiple forms of media prior to the start of the program so that water users have a clear understanding of what to expect. The following are suggested methods of information distribution from the Town to the customers:

- Bill stuffers
- Informational mailings
- Information included in Consumer Confidence Reports
- Door hangers
- Phone calls
- Advertising at Town Hall
- Television broadcast
- Newspaper articles
- Public service announcements
- Town website posts
- Social media

Each route will be notified that meter installations are beginning in their area and they should be advised to schedule an appointment with the Town in advance. Typically, three letters can be mailed to customers with a two week period between letters. Each follow up letter can include language that stresses the importance of the meter replacement program more than the previous letter with the last letter identifying it is the Final Notice. Those who do not call to schedule an appointment should be contacted directly to schedule an appointment. It is important to stress that this replacement program is necessary and the customer participation is mandatory.

Although a majority of water customers will be cooperative in the meter replacement program, there will be some customers who do not respond or refuse to allow the Town to replace the water meter. The Town should develop a policy for those unwilling to participate in the meter replacement program. Such policy may include a fee, estimated bill, or shutting off the water service after all reasonable attempts to contact the customer have failed. It is important to adequately inform the customer of the penalties of noncooperation prior to taking action. In addition, the Town should review all of its existing documented polices, ordinances, and regulations prior to proceeding with the meter replacement program to confirm an existing policy will not conflict with the goals of the meter replacement project or inhibit the Town from ultimately gaining access to the meters for replacement.

5.0 Project Costs and Payback Period

Project Capital Cost Comparison

Water meter and AMI system vendors provided preliminary budgetary costs for their traditional fixed and cellular two-way AMI systems. The budgetary costs were evaluated to produce a conservative cost estimate for each AMI system technology. Table No. 5-1 summarizes the budgetary supply costs for new water meters and endpoints and the supply and installation costs for a fixed network. The First Year O&M costs associated with the fixed network cost estimate include backhaul charges, service agreements, hosting charges, customer portal charges, data collector and handheld maintenance, and technical support/training. The estimated supply cost for a fixed network AMI system is approximately $1,717,000.

Table No. 5-2 summarizes the budgetary supply costs for new water meters and endpoints and the supply and installation costs for a cellular AMI system. The First Year O&M Costs for the cellular system include cellular service agreements which are estimated at $0.89 per account per month. The estimated supply cost for the cellular AMI system is approximately $1,696,000.

According to Tables No. 5-1 and 5-2 the initial costs for a fixed network system are slightly higher than that of a cellular system due to the infrastructure required to implement a private radio frequency network. Cellular infrastructure is existing and is owned and maintained by the cellular service provider. Monthly service fees are applied per account in a cellular system. The initial capital cost of an AMI system only represents a portion of the system cost over time, and a 20-year life cycle cost analysis has to be factored into the evaluation to provide a true representation of the system cost over the expected life of a meter and AMI system. A 20-year life cycle cost comparison between the fixed network and cellular AMI systems is presented later in this technical memorandum to better compare AMI system costs.

Table No. 5-1
Estimated Water Meters and Fixed Network AMI System Supply Cost

Item Description	Quantity	Units	Unit Price	Total
3/4-inch Positive Displacement Water Meter	4,533	Ea.	$140	$634,620
1-inch Positive Displacement Water Meter	442	Ea.	$220	$97,240
1 1/2-inch Positive Displacement Water Meter	38	Ea.	$450	$17,100
2-inch Positive Displacement Water Meter	40	Ea.	$600	$24,000
3-inch, Compound Water Meter	3	Ea.	$2,000	$6,000
4-inch, Compound Water Meter	1	Ea.	$3,100	$3,100
			Water Meter Subtotal:	$782,060
Fixed Network Endpoint	5,057	Ea.	$110	$556,270
Handheld Unit	2	Ea.	$5,000	$10,000
AMI System Hardware and Software, Installation and System Engagement Fees	1	L.S.	$100,000	$100,000
First Year O&M Costs, Including Training and Technical Support	1	L.S.	$20,000	$20,000
			Complete System Subtotal:	$1,468,330
			Construction Contingency (10%):	$146,800
			Engineering and Construction Administration:	$102,000
			Total Estimated Cost:	$1,717,130

Table No. 5-2
Estimated Water Meters and Cellular Network AMI System Supply Cost

Item Description	Quantity	Units	Unit Price	Total
3/4-inch Positive Displacement Water Meter	4,533	Ea.	$140	$634,620
1-inch, Positive Displacement Water Meter	442	Ea.	$220	$97,240
1 1/2-inch, Positive Displacement Water Meter	38	Ea.	$450	$17,100
2-inch, Positive Displacement Water Meter	40	Ea.	$600	$24,000
3-inch, Compound Water Meter	3	Ea.	$2,000	$6,000
4-inch, Compound Water Meter	1	Ea.	$3,100	$3,100
			Water Meter Subtotal:	$782,060
Cellular Endpoint	5,057	Ea.	$120	$606,840
Handheld Unit	N/A			
AMI System Software and Engagement Fees	1	L.S.	$5,500	$5,500
First Year O&M Costs, Including Training and Tech Support	1	L.S.	$55,000	$55,000
			Complete System Subtotal:	$1,449,400
			Construction Contingency (10%):	$145,000
			Engineering and Construction Administration:	$102,000
			Total Estimated Cost:	$1,696,400

Meter Installation Cost Analysis

Should the Town elect to install meters using Town personnel, it is recommended that an additional office administrator is hired for the two-year duration of the meter installation program. This staff member will take on the responsibility of scheduling appointments and coordinating with the Town's designated meter installers. This will allow the existing office staff to assist with the meter replacement program, but still manage current day to day operations. An assumed full-time salary of $40,000 per year (approximately $20.00 per hour) plus an additional 40 percent per year for fringe benefits totaling $112,000 over the two-year installation period is used in this evaluation as an estimated cost for the additional Town administration staff during the meter installation program if completed using Town personnel.

The Town also has the option to retain the services of a meter installation contractor to substantially complete the meter replacement program over a one-year duration. This would take the burden of coordination and the majority of the labor efforts off Town staff. Table No. 5-3 shows a breakdown of estimated meter installation costs for an installation contractor.

In determining the unit prices for meter installations, it was assumed that 2.5 percent of meters in the system will require a Non-Standard (NS) Type 1 installation which may involve additional items such as new tail pieces, small fittings, and additional labor. It was also assumed that 2.5 percent of meters will require a NS Type 2 installation that may require new valves or a meter setter to relocate the water meter away from a wall or corner. An additional 50 hours was budgeted for NS Type 3 installations for more extensive plumbing work beyond NS Type 1 and NS Type 2 installations using the MA prevailing wage rate for a licensed plumber marked up by 35 percent for labor markups, overhead, and profit. Five percent of the installation cost subtotal was added for contractor mobilization, and an additional 15 percent was included for engineering and contingency.

The estimated meter installation cost for an installation contractor to complete the meter replacement program for the Wayland system is approximately $661,000 as shown in Table No. 5-3.

Table No. 5-3
Estimated Water Meter and Endpoint Installation Contract Costs

Item Description	Quantity	Units	Unit Price	Total
Install 3/4-inch Water Meter and Endpoint	4,533	Ea.	$103	$468,000
Install 1-inch Water Meter and Endpoint	442	Ea.	$123	$54,500
Install 1 1/2-inch Water Meter and Endpoint	38	Ea.	$205	$7,800
Install 2-inch Water Meter and Endpoint	40	Ea.	$255	$10,200
Install 3-inch Water Meter and Endpoint	3	Ea.	$500	$1,500
Install 4-inch Water Meter and Endpoint	1	Ea.	$750	$750
Additional Labor (NS Type 3 Installs)	50	Hrs.	$95	$4,750
			Subtotal:	$547,500
			Mobilization (5%):	$27,400
			Engineering and Contingency (15%):	$86,200
			Total Estimated Installation Cost:	$661,100

20-year Life Cycle Cost Analysis

The estimated project costs presented in Table No. 5-1 and Table No. 5-2 provide a budgetary value for initial capital costs required to procure materials and implement an AMI system. Although it is an effective way to compare different systems of similar

technology, when comparing different technologies such as a fixed network and a cellular network, it is beneficial to compare the 20-year life cycle costs for each system. A life cycle analysis takes into consideration the service life of system infrastructure as well as recurring annual fees such as data plans, technical support, software upgrades, and rental fees.

The 20-year life cycle costs were analyzed for four different AMI technology and meter installation scenarios. The scenarios include two AMI technology options, fixed network and cellular network AMI, and two means for meter and endpoint installation, including meters and endpoints installed by Town personnel or instead by an installation contractor.

The two scenarios involving meter installation by Town personnel assume a two-year installation period with an additional full-time staff member with a salary plus benefits cost of $56,000 per year. The Town will not recover the full amount of revenue loss presented in this memorandum from unregistered water use until the end of year two if installation is completed by Town personnel over a two year period. The scenarios with meters being installed by an installation contractor are assumed to be completed in one year. In these scenarios, the Town will recover the revenue loss from unregistered water use after the first year.

The estimated initial capital cost of each system includes procurement and installation of water meters, registers, endpoints, AMI system hardware and software, first year O&M costs, engineering (design, bidding, and construction administration), and contingency. First Year O&M Costs include data backhaul charges, service/hosting agreements, customer portal charge, collector and handheld maintenance, technical support, and system training.

The annual fees associated with the 20-year life cycle cost of a fixed network AMI system are similar to the first year O&M costs, but with annual three percent increases due to inflation. The three percent increase will account for inflation on maintenance agreements, licensing fees, power rates, and communication fees. Starting at Year 6 an additional hardware and software maintenance/replacement cost is included to account for expected replacements and upgrades due to technology updates after the initial five year guarantee period. This yearly hardware and software maintenance cost is increased annually by three percent. Fixed network AMI system infrastructure maintenance, upgrades, and replacement costs are included in the annual user fees under a service agreement provided by the vendor to provide a full 20-year service life for the fixed network AMI option.

The cellular network 20-year life cycle cost is estimated using a flat annual rate. This annual rate accounts for an assumed service agreement charge of $0.89 per account per month for the ten year guarantee period. Cellular AMI vendors will guarantee the technology and functionality of the cellular endpoints for ten years with these systems and will replace a failed endpoint or upgrade to newer cellular endpoints if technology advancements require the endpoints to be updated in order to function properly. However, after ten years, the guarantee will expire and a system-wide replacement of

endpoint may be necessary at this time or soon after to keep up with new cellular technology advancements. The costs for this system-wide endpoint replacement are included after Year 10 in the life cycle costs for the cellular AMI options. Results of the 20-year life cycle cost analyses are factored into the payback period analysis shown in Table No. 5-4.

Payback Period

The project payback period for water meters with a fixed network or cellular AMI system is based on a combination of several factors. The factors contributing to the payback period include the initial capital cost of the system, meter installation costs, yearly revenue recovery by replacing under registering water meters, annual O&M costs, and equipment replacement costs at certain stages of the 20-year life cycle. A summary of the payback period for each AMI system and installation method is shown in Table No. 5-4.

Table No. 5-4
Summary of Water Meter and AMI System Payback Period

Improvement Option	Initial Capital Cost	Payback Period
Scenario No. 1: Fixed Network AMI System w/ meters installed by Town Personnel	$1,829,000	9.5 years
Scenario No. 2: Fixed Network AMI System w/ meters installed by Installation Contractor	$2,378,000	12.5 years
Scenario No. 3: Cellular Network AMI System w/ meters installed by the Town	$1,808,000	15 years
Scenario No. 4: Cellular Network AMI System w/ meters installed by Contractor	$2,357,000	17.5 years

1. The initial capital cost for Scenarios No. 1 and No. 3 include $112,000 for installation for hiring an additional Town Administrator to assist with appointment scheduling and project coordination.
2. The initial capital cost for Scenarios No. 2 and No. 4 include $661,000 for installation for the services of an installation contractor to install water meters and endpoints and manage the replacement program.

As shown in Table No. 5-4, the lowest initial capital costs are for systems that are installed by the Town. After considering the expected yearly O&M costs and future hardware/software replacements costs in the life cycle cost analysis, the systems with the fastest payback period are fixed network AMI systems due to the high yearly O&M costs associated with cellular service agreements which are charged per account in the system. Although the initial payback would nearly occur at Year 11 for Scenario No. 3 (Cellular AMI installed by Town personnel), the project cost increases significantly for the cellular AMI options at Year 11 due to the potential cost for the deployment of a complete cellular endpoint replacement program for all accounts. This additional cost delays the payback period significantly by approximately four to five years for cellular AMI options.

A factor that was not taken into consideration due to its difficulty to quantify as a monetary gain is the time savings for meter reading and billing which would further reduce the payback period of all four scenarios. Another factor that impacts the payback period making it longer is the fact the Town has been proactive in beginning to replace some of its older water meters on a yearly basis. For example, there are more than 1,600 water meters in the system that are less than ten years old. If these meters had not been recently replaced, the revenue loss in Table No. 3-2 would have been significantly higher resulting in faster payback period than those shown in Table No. 5-4. The Town could also consider not replacing all of these newer meters and only install a new endpoint connected to each meter, which in turn would reduce the capital costs presented in Table No. 5-1 and Table No. 5-2 and also result in a reduction in the payback period assuming these meters will remain accurate for another ten years.

6.0 Conclusions

Implementation Schedule

The implementation schedule will be dependent on the appropriation of funds for the procurement of the water meters, endpoints, and AMI network. If funding is available as of July 2018 (FY19), procurement contracts could be signed soon after this date starting the expected one or two year installation process if completed by an installation contractor or Town personnel, respectively. The meter and AMI replacement program could be completed by July 2019 if completed by an installation contractor and July 2020 if completed by Town personnel.

The RFP will solicit proposals for meters and an AMI system for a minimum two-year agreement to allow for the purchase of equipment at the proposal price for the term of the agreement. Depending on the Town's funding and storage space for meters and endpoints, all hardware and equipment required to implement the system could be purchased in full at the beginning of the project or at any point over the course of the two year agreement. Coordination with the supply vendor will be necessary to confirm meters and endpoints can be produced to meet the needs of the Town's installation schedule.

Meter and AMI Recommendations

As previously mentioned, AWWA recommends replacement of small water meter, less than 2-inch every 15 years. Upon review of the existing meter ages for the Town of Wayland, more than 63 percent of customer meters have been in service in excess of 15 years. The age of existing meters suggests that there may be under-registering water meters not capturing approximately 4.4 percent of the Town's annual water usage per the 2016 Annual Statistical Report. The total annual estimated revenue loss due to under registering water meters is $212,000. If action is not taken to replace the Town's water meters, the amount of unbilled water usage will continue to increase.

Budgetary capital costs for the supply of water meters, endpoints, and the supply and installation of a fixed network or cellular AMI are similar at approximately $1,700,000. The capital costs include the procurement of equipment, engineering costs for design, bidding, and construction administration, and contingency. However, the annual service contract costs associated with a cellular AMI will increase the 20-year life cycle cost and therefore extend the payback period compared to the implementation of a fixed network AMI.

Upon review of the Town's existing metering system and billing process, Tata & Howard recommends the following improvements:

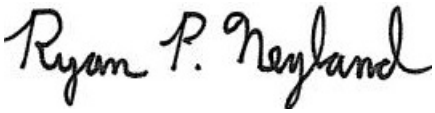
1. Replace, at a minimum, all water meters with a service life greater than 15 years. It is our understanding that the Town prefers to upgrade all meters in the system at the same time it procures and installs the new AMI network. All 5/8-inch residential water meters being replaced shall be upsized to 3/4-inch water meters per Town standardization.
2. Replace the existing water meter reading system with either a traditional fixed network AMI system or a cellular network AMI system. Both AMI options will meet the goals and major priorities of the Town as presented in this memorandum.
3. Utilize an evaluation criteria based RFP process to procure water meters and endpoints and to furnish and install the AMI system.
4. Implement a phased meter and endpoint replacement program with designated Town personnel or an installation contractor. If using Town personnel, employ sufficient internal and external support to successfully implement and manage the replacement program. A phased program will allow for a more flexible installation schedule, which can be beneficial to the Town if using its own personnel to manage meter installations with other normal job activities. Proper planning and organization will be imperative for the Town to successfully manage and complete the meter replacement program using its own staff.
5. Resolve any outstanding issues within the billing system or upgrade to a new billing system prior to the commencement of the meter replacement program. Outstanding billing system issues will cause confusion during the phased implementation period.
6. Review the options for a mass meter transfer file with the billing system provider to confirm an application is available to automatically transfer data collected in the field into the billing system to prevent the need for manual data entry, save time, and eliminate human error in data transfer.
7. Conduct public and governmental education and outreach programs.

During the course of this technical evaluation, the undersigned served as Project Manager, Ms. Patricia L. Kelliher served as Project Engineer, Mr. Dustin J. Lacombe served as Assistant Project Engineer, Ms. Amanda K. Cavaliere provided technical reviews, and Mr. Paul B. Howard, P.E. served as Project Officer.

At this time, we wish to express our continued appreciation to the Town for their participation in this evaluation and for their help in collecting information and data. We appreciate the opportunity to assist the Town on this important project.

Sincerely,

TATA & HOWARD, INC.



Ryan P. Neyland, P.E.
Project Manager