TOWN OF MEDWAY
DEPARTMENT OF PUBLIC SERVICES
INTEGRATED WATER RESOURCES MANAGEMENT PLAN
MEDWAY, MASSACHUSETTS
KLEINFELDER PROJECT #20110090.003A

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DRAFT

A Report Prepared for:

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TOWN OF MEDWAY
DEPARTMENT OF PUBLIC SERVICES
DRAFT INTEGRATED WATER RESOURCES MANAGEMENT PLAN
MEDWAY, MASSACHUSETTS

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Executive Summary

This Integrated Water Resources Management Plan (IWRMP) for the Town of Medway, Massachusetts is formulated in response to the needs of the Town and designed to protect the environmental resources both within Medway and within the broader region surrounding the Town. The purpose is to provide a plan to meet the Town's water resources needs, establishing a sustainable approach that responds to today's challenges while supporting future growth and development. To fully realize the potential of integrated solutions to Medway's water resource challenges, local interactions amongst the water resources systems must be understood.

As with most municipalities, Medway's public infrastructure needs continue to grow and create competing demands for limited Town resources. The Department of Public Services (DPS) operates and maintains the Town's domestic water system, wastewater collection system, and stormwater system. Each of these systems requires continual management and improvement to meet the changing needs of the Town while maintaining compliance with various state and federal regulations. This IWRMP documents existing conditions within these three municipal infrastructure systems, identifies and prioritizes system needs to support community goals, and presents a management plan that meets system needs within a sustainable operational framework to proactively manage Town infrastructure now and into the future.

Regulatory Drivers

Medway's DPS operates and maintains municipal infrastructure systems that are subject to local, state and federal regulations. These regulations contribute to the definition of "need" insofar as operating standards and regulatory compliance represent a minimum threshold of investment. The primary permits and associated operating regulations under which the Town manages water resource infrastructures include:

- Water Management Act (WMA) Permit (potable water)
- Municipal separate storm sewer system (MS4) National Pollution Discharge Elimination System (NPDES) General Permit (stormwater)
- Charles River Pollution Control District (CRPCD) NPDES Permit (wastewater Co-Permittee)

Goals/Strategies

The IWRMP continues the Town's efforts to achieve goals established in the 2009 Master Plan, as well as goals specifically tied to the performance of the water resources systems. These include:

1. Improve and protect water quality and quantity.
2. Protect water supply sources through local land use mechanisms.
3. Implement comprehensive water conservation measures, including leak detection, metering, conservation-oriented water rates, drought contingency plans, and public education.
4. Take an active role in maintaining and/or increasing Medway's allocated capacity at the CRPCD.
5. Mitigate environmental impacts of stormwater-driven water quality impairments through local and regional implementation of best management practices (BMPs), both structural and non-structural.
6. Establish an implementation plan for long term sustainability that is affordable, effective and achievable.
7. Improve Town processes to eliminate barriers and streamline effective management of water resources.

This IWRMP includes the following implementation strategies for needed improvements to the water resources systems:

- Support operations and maintenance (O&M) efforts of the DPS, including funding annual infrastructure management needs such as I/I removal, leak detection, catch basin cleaning and street sweeping.
- Modify local site design or development standards to encourage creative approaches to water resources management, including incorporating low impact development, green infrastructure, and enhanced water conservation, where appropriate.
- Engage the public in understanding the water resources systems to encourage voluntary behaviors that improve conservation efforts, manage wastewater flows and improve stormwater runoff quality.

Public Participation

The Town solicited and encouraged public participation in the IWRMP effort through three primary sources:

1. Public Communication – Through execution of a detailed Communication Plan (outlined in Section 2.2) the Town provided an overview of the IWRMP process and regular updates on the planning process. Outreach through a variety of media was critical to successfully reach residents and business owners.
2. Citizens Advisory Task Force (CATF) Representation – The CATF was initiated to invite knowledgeable stakeholders and partners, who in turn act as an extension of the public. Each participant provided insight into the key issues that concerned their constituents and brought updates on the IWRMP process back to the broader stakeholders whom they represented.
3. Public Participation – Through scheduled presentations, the public reviewed the details of the draft IWRMP and provided feedback for incorporation into the final IWRMP.

The details of the public participation process through the IWRMP development is described in Chapter 2.

Built and Natural Environment

Medway's water resources systems interact with both the built and natural environment in a variety of ways. Most of the Town (60.7%) is zoned residential, which contributes to a high demand on municipal water and wastewater services, as well as contributing stormwater runoff . The Town's buildout analysis shows that over 2000 new homes and more that 4.1 million square feet of commercial and industrial space would contribute to increased water demands. While the Town currently has a moratorium on sewer extensions, supporting this future development is in the best interest of the Town, however careful planning is needed to minimize impacts on the environment. Population growth projections allow for planning for future needs. The Town benefits from a variety of natural resources, including the Charles River and a robust groundwater supply, however continued protection of these resources is required for long term sustainability.

Water Resources Systems and Needs

The DPS manages the three municipal water resources systems: wastewater, domestic water and stormwater. The wastewater system was first developed in 1977 and serves the central and southern areas of Town. Wastewater is transported to the Charles River Pollution Control District, of which Medway is a co-permittee. Medway contributes approximately 0.8 million gallons per day to the treatment plant, currently using approximately 83% of its allocated capacity. As such, the Town has suspended the extension of the sewer system through a moratorium, although residents located along the current sewer alignment can connect as their capacity is reserved through betterment previously assessed. Infiltration and inflow represent extraneous flows in some portions of the system, contributing to reduced wet weather capacity and inflating the wastewater discharge to the plant. The remaining portion of the Town utilizes on-site wastewater management systems (septic), although there are many challenges related to the suitability of soils within the Town. A summary of the wastewater needs discussed in Chapter 7 are summarized below:

Table ES-1: Wastewater Needs

Near Term Needs	Address I/I	Managing wastewater flows to the CRPCD requires identification and removal of extraneous flows from the wastewater collection system.
	Improve Sewer System Operations	Support I/I mitigation and identify structural defects in aging infrastructure.
	Install permanent flow meters	Provide actual measured flows to CRPCD and remove the uncertainty of calculating flow contributions based on assumptions.
	Improve record keeping of septic failures	Allow septic data to be queried real-time and provide the Board of Health more reliable information.
	Provide public education for septic owners	Help homeowners
	Purchase Available Wastewater Capacity at CRPCD from Franklin	Allow the Town to continue with planned development and provide sustainable wastewater collection into the future. Allow the Town to lift the sewer moratorium.
Long Term Needs	Limited Sewer Extensions	Connect failed septic systems to the collection system if capacity becomes available.

Medway is facing an ongoing challenge as it nears its allocated capacity for wastewater treatment at the CRPCD. Planned developments will push the Town past its capacity in the next 15 years, which limits future development potential in Town, as well as the opportunity to extend sewers to current septic users.

The domestic drinking water system is supplied through groundwater wells with an annual maximum raw water withdrawal limit of 0.92 MGD on an average basis. Regular treatment is provided for the domestic water system to control naturally occurring iron and manganese, as well as to provide corrosion control, disinfection and fluoridation. Ongoing challenges with treatment at the Oakland Street well have limited its use, and effectively reduced the available water supply for the Town. While the DPS is still able to meet the daily water demand, long term stability of the supply depends on reinstating the full capacity of the groundwater wells through additional treatment. In addition, with population projected to increase, this effort is especially critical to support growth within Town. The water system is also at risk if the largest supply well, Populatic, were to be taken offline for repairs or emergency. The lack of redundancy and limited intermunicipal water system connections further threaten the system. In addition, reducing the volume of unaccounted for water (UAW) can help to offset supply limitation. A summary of the drinking water needs discussed in Chapter 7 are summarized below:

Table ES-2: Drinking Water Needs

Near Term Needs	Resiliency and Redundancy; System Capacity	Currently, extended periods of high demand cannot be satisfied without the Populatic Well or a source of emergency supply. Sources of emergency supply, equipment and protocols are not well established. Water treatment improvement / expansion is needed to supply near and long-term demand. The Town is close to exceeding its supply.
	Reducing UAW; Increasing WMA Permit Limit	UAW has exceeded the State Performance Standard in all seven of the last reporting periods. This needs to be addressed so that Medway can request an increase in its WMA Permit to withdraw water.
	Improving Documentation	Better documentation procedures are needed to project Medway's drinking water demands and measure system performance more accurately.
Long Term Needs	Infrastructure Improvements	Updates to the Town's hydraulic model can help inform strategic decisions regarding the appropriate phasing of infrastructure replacement projects.
	Promoting Conservation	Reducing demand through conservation efforts can reduce stress on the drinking water system infrastructure.
	Managing Demand from Future Developments	The Town currently does not have a water use review policy to determine if the domestic water system can accommodate the needs of proposed developments.
	Increasing System Capacity	The Town can use the Oakland Street well more regularly if the well's water is treated for Iron and Manganese.
	Increasing WMA Permitted Volume	Projections show demand exceeding the WMA authorized withdrawal limit in most scenarios by 2025.
	Evaluate Reclaimed/Grey Water for Industrial and Agricultural Use	Reclaimed water is used directly in non-potable applications such as irrigation.

	Evaluate Reclaimed Water from CRPCD for Indirect Potable Reuse	Reclaimed water from CRPCD is used to recharge the underlying aquifer, indirectly supplying the Town's GW Wells.

Medway's drinking water supply is at immediate risk due to a lack of redundancy and reliability. Challenges with water quality continue to drive the Town's infrastructure priorities, and distribution system upgrades are overdue. Management of unaccounted for water through leak and break detection is critical to meeting demand and allowing for future growth.

The stormwater system serves to provide drainage throughout the Town, discharging into the various water bodies, including the Charles River. The MS4 NPDES permit governs the quality of these discharges and drives most of the needs for the stormwater system. While flooding related to insufficient capacity and beaver dam construction does occur, the DPS efforts focus on mapping of the stormwater system, as well as sampling. Further regulatory driven activities are needed as the new permit is enacted.

Table ES-3: Stormwater Needs

Regulatory Requirements	Reduce TMDLs in Charles River	Develop and implement Phosphorus Control Plan
	MS4 Permit Compliance	Town must continue with the activities outline in the MS4 permit including public education and involvement, their IDDE program, construction site stormwater runoff management, stormwater management in development, and housekeeping/O&M procedures.
Near Term Needs	Address Localized Flooding	The Town should address the hydraulic inadequacies in stormwater drainage system
	Manage Impervious Cover of Proposed Developments	Impervious coverage from commercial development may contribute to increased stormwater runoff
	Promote Public Education and Engagement	Proper education of the public may help to address residential stormwater issues and develop support for future programs
Long Term Needs	Promote Stormwater Capture and Infiltration	Stormwater runoff from future development may contribute to drainage/flooding issues; Groundwater infiltration will support existing streams and drinking water supply
	Improve Town's Stormwater Inspection and Maintenance Procedures	Town must address the inconsistencies in rules and regulations related to managing stormwater assets and BMPs

Regulatory requirements drive most of the Town's stormwater system needs, however overall site development and public education are critical to protect this system as the Town continues to grow. Managing water quantity and quality are equally important.

Evaluation of Alternatives

Using an integrated planning model, called Stella (see Chapter 8), the IWRMP analyzed the Town's water resources system needs to identify alternatives that had the greatest impact on each system individually as well as on multiple systems. These results informed the final plan which sought to prioritize alternatives and recommendations based on their impacts, the needs of the Town and the criticality of implementation. In terms of criticality, recommendations are broken-down into three categories:

- High Priority - represents activities that require the Town's immediate attention in the first few years of the IWRMP implementation plan. These recommendations may be required by permits, critical needs for the water resource systems, or influential towards the implementation of future recommendations.
- Medium Priority – reflects some of the ongoing and proposed activities that that the Town undertakes to maintain and/or improve the water resource systems. This includes assessments of system performance, targeted system infrastructure rehabilitation and improvements, yearly system maintenance, and the implementation of tools to assist with system management.
- Low Priority – less critical activities that will help to optimize system performance and/or management. These recommendations provide support to other IWRMP recommendations and are spread throughout the first 10 years of the implementation plan.

Integrated Water Resources Management Plan (IWRMP)

Medway's IWRMP provides a long-term (20-year) plan which prioritizes needs from the three water resources systems: wastewater, domestic water, stormwater. This plan provides a roadmap for the DPS to manage its resources in an integrated manner, by tackling the most critical issues through solutions that provide multiple benefits throughout the systems. This approach provides a thoughtful approach to allow for long term sustainability of the systems, as well as cost-effective alternatives. The recommended implementation plan for the IWRMP is shown in Table ES-4 through ES-7. Tables ES-4 and ES-5 document the Town's existing programs which will continue under the IWRMP. Medway has already begun to implement this IWRMP, including making changes to its operations and maintenance efforts to identify and reduce unaccounted for water, as well as initiating capital projects. In addition, the MS4 program has previously been planned with the implementation of the new permit in 2018. Many of the programs identified as high and medium priorities have been initiated by the Town and are included herein to further support the good work that is already underway.

This plan requires targeted spending early in the implementation period to address critical weaknesses, specifically in the water supply system. Roughly 66% of the IWRMP total cost is associated with improvements to the drinking water system. As the Town continues to implement this long-term plan, there are various sources of funding for the components of the IWRMP that include those from within Medway (such as taxes, betterments and bonds), those from state and federal agencies (such as the State Revolving Fund (SRF) and other grants/loans) and those from private parties.

The Town will continue to use this IWRMP framework as a planning tool, creating a living document for its infrastructure needs. As new studies and projects are identified, they will be included in the plan. As such, the later years of this 20-year plan will continue to be modified, especially as the Town completes its upcoming Water System Master Plan update, and other studies which will further inform capital needs. Changes in State or Federal regulations, or environmental conditions may also initiate new projects for inclusion in the IWRMP.

Table ES-4: IWRMP Current Spending Implementation Plan Years 0-10 (2018 Dollars)

	Water Resource	Current Program	Current Estimated Value	Y0 2019	Y1 2020	Y2 2021	Y3 2022	Y4 2023	Y5 2024	Y6 2025	Y7 2026	Y8 2027	Y9 2028	Y10 2029
High	SW	MS4 Program Implementation	$4,856,000	$468,500	$444,500	$405,500	$424,000	$412,500	$480,000	$455,500	$415,500	$435,000	$423,000	$492,000
		Subtotal High Priority Cost:	**$ 4,856,000**	***$468,500***	***$444,500***	***$405,500***	***$424,000***	***$412,500***	***$480,000***	***$455,500***	***$415,500***	***$435,000***	***$423,000***	***$492,000***
Medium Priority	WW	Permanent Sewer System Metering	$247,000	$27,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000
	WW	SSES Investigations and Rehabilitation	$1,000,000		$200,000		$200,000		$200,000		$200,000		$200,000	
	WW	Temporary Sewer System Metering	$50,000	$50,000										
	DW	Unaccounted for Water Activities	$110,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
	DW	Update Town-wide Drinking Water Hydraulic Model	$50,000	$50,000										
	DW	Annual Water Distribution System Maintenance	$1,100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000
	DW	Highland and Lovering Tank Painting/Cleaning	$1,000,000				$500,000					$500,000		
	DW	Indoor and Outdoor Water Conservation	$165,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
	ALL	Public Education and Engagement	$11,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
		Subtotal Medium Priority Cost:	***$3,722,000***	***$126,000***	***$348,000***	***$148,000***	***$848,000***	***$148,000***	***$348,000***	***$148,000***	***$348,000***	***$648,000***	***$148,000***	***$348,000***
		Total IWRMP Current Spending Years 0-10 Cost:	**$8,578,000**	**$594,500**	**$792,500**	**$553,500**	**$1,272,000**	**$560,500**	**$828,000**	**$603,500**	**$763,500**	**$1,083,000**	**$771,000**	**$640,000**

Table ES-5: IWRMP Current Spending Implementation Plan Years 11-20 (2018 Dollars)

	Water Resource	Current Program	Current Estimated Value	Y11 2030	Y12 2031	Y13 2032	Y14 2033	Y15 2034	Y16 2035	Y17 2036	Y18 2037	Y19 2038	Y20 2039
High	SW	MS4 Program Implementation	$4,609,000	$467,000	$426,000	$446,000	$433,000	$504,000	$478,500	$436,500	$457,000	$444,000	$517,000
		Subtotal High Priority Cost:	***$4,609,000***	***$467,000***	***$426,000***	***$446,000***	***$433,000***	***$504,000***	***$478,500***	***$436,500***	***$457,000***	***$444,000***	***$517,000***
Medium Priority	WW	Permanent Sewer System Metering	$220,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000
	WW	SSES Investigations and Rehabilitation	$1,000,000	$200,000		$200,000		$200,000		$200,000		$200,000	
	WW	Temporary Sewer System Metering	$50,000	$50,000									
	DW	Unaccounted for Water Activities	$100,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
	DW	Update Town-wide Drinking Water Hydraulic Model	$50,000	$50,000									
	DW	Annual Water Distribution System Maintenance	$1,000,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000
	DW	Highland and Lovering Tank Painting/Cleaning	$1,000,000				$500,000					$500,000	
	DW	Indoor and Outdoor Water Conservation	$150,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
	ALL	Public Education and Engagement	$20,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
		Subtotal Medium Priority Cost:	***$3,590,000***	***$448,000***	***$148,000***	***$348,000***	***$648,000***	***$348,000***	***$148,000***	***$348,000***	***$148,000***	***$848,000***	***$148,000***
		Total IWRMP Current Spending Years 11-20 Cost:	**$8,199,000**	**$915,000**	**$574,000**	**$794,000**	**$1,081,000**	**$852,000**	**$626,500**	**$784,500**	**$605,000**	**$1,292,000**	**$665,000**

Note:

- High, medium and low priorities represent relative importance of projects with respect to meeting regulations, maintaining operation of the water resources systems, and providing long-term service.

Table ES-6: IWRMP Implementation Plan Years 0-10 (2018 Dollars)

	Water Resource	Recommendation	Opinion of Probable Cost	Y0 2019	Y1 2020	Y2 2021	Y3 2022	Y4 2023	Y5 2024	Y6 2025	Y7 2026	Y8 2027	Y9 2028	Y10 2029
High Priority	WW	Purchase Available Wastewater Capacity at CRPCD	$950,000	$950,000										
	DW	Drinking Water Quality - Treatment Improvements	$15,000,000	$1,000,000	$6,000,000	$3,000,000	$3,000,000	$2,000,000						
	DW	Drinking Water Supply Capacity Redundancy/Reliability	$2,191,000		$467,000		$1,347,000	$377,000						
	DW	Update Emergency Drinking Water Supply Plan	$65,000			$65,000								
	DW	Pursue WMA Permit Withdrawal Limit Increase	$15,000			$15,000								
		Subtotal High Priority Cost:	***$18,221,000***	***$1,950,000***	***$6,467,000***	***$3,065,000***	***$4,347,000***	***$2,377,000***	***$0***	***$0***	***$0***	***$0***	***$0***	***$0***
Medium Priority	DW	Water Distribution System Improvements	$9,915,000	$2,990,000	$2,425,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000
	SW	Drainage Improvements	$320,000					$320,000						
	SW	Stormwater Structural BMPs	$137,500							$33,500	$46,000		$52,000	
	SW	Stormwater Infiltration Analysis	$24,000								$6,000	$6,000	$6,000	$6,000
	ALL	Asset Management Program	$475,000	$75,000	$75,000	$75,000	$75,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
		Subtotal Medium Priority Cost:	***$10,871,500***	***$3,065,000***	***$2,500,000***	***$575,000***	***$575,000***	***$845,000***	***$525,000***	***$558,500***	***$577,000***	***$531,000***	***$583,000***	***$531,000***
Low Priority	WW	Purchase CCTV Equipment to Support WW Operations	$150,000					$150,000						
	WW	Limited Sewer Extensions[1]	$920,000									$175,000	$350,000	$400,000
	DW	Redevelop Water Supply Impact Mitigation Fee	$20,000			$10,000	$10,000							
	SW	Promote Impervious Cover Management	$50,000					$30,000	$20,000					
	ALL	Review Interdepartmental Workflow for Development	N/A											
		Subtotal Low Priority Cost:	***$1,140,000***	***$0***	***$0***	***$10,000***	***$10,000***	***$180,000***	***$20,000***	***$0***	***$0***	***$175,000***	***$350,000***	***$400,000***
		Total Opinion of Probable IWRMP Cost:	**$30,232,500**	**$5,015,000**	**$8,967,000**	**$3,650,000**	**$4,932,000**	**$3,402,000**	**$545,000**	**$558,500**	**$577,000**	**$706,000**	**$933,000**	**$931,000**

Table ES-7: IWRMP Implementation Plan Years 11-20 (2018 Dollars)

	Water Resource	Recommendation	Opinion of Probable Cost	Y11 2030	Y12 2031	Y13 2032	Y14 2033	Y15 2034	Y16 2035	Y17 2036	Y18 2037	Y19 2038	Y20 2039
Medium	DW	Water Distribution System Improvements	$5,000,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000
	SW	Install Stormwater Structural BMPs	$60,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
	ALL	Asset Management Program	$250,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
		Subtotal Medium Priority Cost:	**$5,256,000**	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***
		Total Opinion of Probable IWRMP Cost:	**$5,256,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**

Notes:

- High, medium and low priorities represent relative importance of projects with respect to meeting regulations, maintaining operation of the water resources systems, and providing long-term service.
- IWRMP projections include current projects and programs identified within the planning period. Additional projects are expected to be identified as the Town implements its Asset Management program and updates its Water Master Plan. Changes to State and Federal regulations, environmental conditions as well as local development and growth may also drive additional spending not currently part of this plan.

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[1] Sewer extension costs may be offset through betterment assessments. Costs represented herein do not include betterment offsets.

1. Introduction

This Integrated Water Resources Management Plan (IWRMP) for the Town of Medway, Massachusetts is formulated in response to the needs of the Town and designed to protect the environmental resources both within Medway and within the broader region surrounding the Town. The purpose is to provide a plan to meet the Town's water resources needs, establishing a sustainable approach that responds to today's challenges while supporting future growth and development. By integrating the water, wastewater and stormwater needs into a single management plan, this IWRMP encompasses a holistic evaluation of the water resources systems while presenting a thoughtful plan for the future. The IWRMP references the Environmental Protection Agency's (EPA's) *Integrated Municipal Stormwater and Wastewater Planning Approach Framework* (Integrated Planning Framework) as guidance in the development of the plan presented herein. The plan's scope is also in conformance with Massachusetts Department of Environmental Protection (MassDEP) informal guidance on the development of IWRMPs under the Massachusetts Water Policy and guide to Water Resources Management Planning.

EPA's Integrated Planning Framework is a regulatory construct. Manmade infrastructure (sewer, storm, potable water) disrupt natural water resources hydrology and ecology in significant ways, and yet they are indispensable. Regulatory programs have evolved in tandem with our recognition of the environmental impacts of our urban development, but generally have done so in isolated silos of jurisdiction. The Integrated Planning Framework is a relatively new regulatory paradigm. It allows infrastructure operators to invest in their infrastructure in a manner that achieves broad-based goals of water quality improvement and protection, while elevating the highest risk/reward infrastructure improvements over compliance tasks with fewer quantitative benefits. This is a recognition that our water resource systems are inter-related, and a failure in one may manifest in another (e.g. collapsed sewer pipe resulting in an SSO that drains to a catch basin and discharges to the river). Conversely, an investment in one system may have benefits for another (e.g. construction of a stormwater infiltration basin for phosphorus removal that contributes to aquifer health and potable well sustainability). To fully realize the potential of integrated solutions to Medway's water resource challenges, these interactions locally must be understood.

1.1 Organization of the Report

This IWRMP summarizes the integrated planning efforts and documents the existing conditions of the domestic wastewater, water and stormwater systems. The report is divided into the following sections:

Executive Summary: This section provides a high-level summary of the IWRMP process, outlines the needs of the water resources systems and presents the final recommendations and implementation plan.

Chapter 1 - Introduction: This section describes the context of the IWRMP, including regulatory and local drivers for the integrated planning effort. Related planning documents are summarized, as well as an overview of the program goals and strategy.

Chapter 2 – Public Participation: This section outlines the effort to engage stakeholders in the IWRMP process, including seeking feedback to drive the direction of the plan.

Chapter 3 – Built and Natural Environment: This section summarizes the built and natural environment within the Town of Medway. These existing conditions provide the basis for the identification of system needs.

Chapter 4 - Existing Wastewater System: This section provides a detailed summary of the existing wastewater system, including the Charles River Pollution Control District (CRPCD), wastewater system performance, reference to regulatory drivers and operational considerations. A summary of prior relevant studies on the wastewater system is also included.

Chapter 5 - Existing Domestic Water System: This section provides a detailed summary of the existing domestic water system, including the public water supply and distribution system as well as private water supplies. The section describes the historical system performance, regulatory drivers and operational considerations.

Chapter 6 - Existing Stormwater System: This section provides a detailed summary of the existing stormwater system, including the system performance and a discussion of the regulatory drivers. This section also references operational considerations and funding.

Chapter 7 – Needs Assessment: This section documents the assessment of system needs for the wastewater, water and stormwater systems within the Town of Medway and presents conclusions.

Chapter 8 – Development and Screening of Alternatives: This section describes the development of alternative improvements in response to the needs identified in Chapter 7, along with the details of the screening process.

Chapter 9 – Integrated Water Resources Management Plan: This section includes detailed descriptions of the recommended capital and non-capital projects (e.g. policy or administrative strategies), including engineer's estimate of probable construction cost. This section also describes the implementation plan for the recommended projects, including a discussion of the funding mechanisms and strategies for implementation.

1.2 Program Background and Development

As with most municipalities, Medway's public infrastructure needs continue to grow and create competing demands for limited Town resources. The Department of Public Services (DPS) operates and maintains the Town's domestic water system, wastewater collection system, and municipal separate storm sewer system (MS4). Each of these systems requires continual management and improvement to meet the changing needs of the Town while maintaining compliance with various state and federal regulations. This IWRMP documents existing conditions within these three municipal infrastructure systems, identifies and prioritizes system needs to support community goals, and presents a management plan that meets system needs within a sustainable operational framework to proactively manage Town infrastructure now and into the future.

The development of the IWRMP included two phases:

- Phase I focused on advancing the Town's understanding of, and compliance with, the requirements mandated through the National Pollutant Discharge Elimination System (NPDES) MS4 General Permit under which the MS4 system is regulated. At project initiation the Town was operating under a General Permit issued in 2003. Although originally anticipated to expire in 2008, the permit was administratively continued while several new Draft General Permits were published by the U.S. Environmental Protection Agency (US EPA). During this period, the Town utilized Phase I of the IWRMP to accomplish outstanding compliance activities and enhance program elements. Phase I also initiated the public outreach process through implementation of a Citizens Advisory Task Force (CATF) and IWRMP Task Force. These outreach efforts are described in detail in Chapter 2. Work products from Phase I efforts included:

  - Illicit Discharge Detection and Elimination Plan, 2014
  - Municipal Services Operations and Maintenance Plan, 2014
  - Town-wide Stormwater System Map, 2014

- Phase II of the IWRMP continued the integrated planning process, incorporating the drinking water and wastewater systems. This phase included development of the written IWRMP and associated activities outlined herein, including:
  - Documentation of the Town's built and natural environment;
  - Completion of a Town growth and buildout analysis – including water supply and wastewater collection projections;
  - Completion of a needs assessment for water and wastewater systems, incorporating stormwater system needs identified through Phase I;
  - Evaluation of alternatives to address needs; and,
  - Development of the integrated plan, including an implementation plan.

1.2.1 Regulatory Considerations

Medway's DPS operates and maintains municipal infrastructure systems that are subject to local, state and federal regulations. These regulations contribute to the definition of "need" insofar as operating standards and regulatory compliance represent a minimum threshold of investment. Changing regulations introduce new challenges to the management of the Town's municipal water resources infrastructure. The primary permits and associated operating regulations under which the Town manages water resource infrastructures include:

- Water Management Act (WMA) Permit (potable water)
- MS4 National Pollution Discharge Elimination System (NPDES) General Permit (stormwater)
- Charles River Pollution Control District (CRPCD) NPDES Permit (wastewater Co-Permittee)

1.2.2 Past Reports and Studies

The Town has invested in other town-wide planning reports recently that support this IWRMP and are referenced throughout the plan as they relate to identifying needs and solutions. These reports include:

- Town of Medway Master Plan, 2009
- Open Space and Recreation Plan (OSRP), 2009
- Zoning Bylaw and Map, 2017

The Town of Medway has also completed several reports which include components that identify and address water resource needs within the Town. Grant projects and development-specific studies undertaken from 2013-2016 also support the development of this IWRMP, including the Exelon Power Water Supply and Demand Assessment, 2015. These reports include:

- Haley and Ward, 1999, *Sewer Master Plan*
- Haley and Ward, 2012, June 2011, *Chicken Brook Interceptor Sewer Inspections*
- Haley and Ward, 2017, *Water System Integrity Report*
- Kleinfelder, 2013, *Illicit Discharge Detection & Elimination Program Plan, Town of Medway*
- Kleinfelder, 2014, *Unaccounted for Water Compliance Plan, Town of Medway*
- Kleinfelder, 2014, *Water Management Act Grant Report: Town of Medway Water Audit Report; Top 10 Industrial /Commercial / Institutional Water Audit Report*
- Kleinfelder, 2015, *Town of Medway Sustainable Water Management Initiative FY15 Grant – District Metering & Water Loss Memorandum*
- Kleinfelder, 2015, *Water Supply & Demand Assessment in Relation to Exelon Power 'West Medway II' Project*
- Kleinfelder, 2016, *Town of Medway Stormwater Utility Feasibility & Draft Implementation Framework*
- Weston and Sampson, 2010, *Water System Master Plan*

In addition, the MassDEP has completed multiple Total Maximum Daily Load (TMDL) studies for the Charles River Basin which have implications for the Town's stormwater management obligations. A 2007 study focused on a TMDL for the Lower Charles River and addressed nutrients, noxious aquatic plants, and water clarity impairments. The 2007 TMDL Study indicated that "regular occurrences of severe algal blooms during the summer months reduce water clarity and contribute to anoxic bottom waters that do not support aquatic life". A separate 2011 TMDL Study for the Upper/Middle Charles River indicated:

> "Both water quality monitoring data and visual evidence demonstrate that the Upper/Middle Charles is significantly impaired from excessive nutrients with excessive algae blooms and large extents of aquatic plant growth."

As a community within the Charles River basin, Medway is subject to certain pollutant reductions required under the respective TMDLs, including:

- Final Pathogen TMDL for the Charles River Watershed, CN 156.0, 2007
- Final Total Maximum Daily Load for Nutrients in the Lower Charles River Basin, Massachusetts, CN 301.0, 2007
- Total Maximum Daily Load for Nutrients in the Upper/Middle Charles River, Massachusetts, CN 272.0, 2011

1.3 Program Goals and Implementation Strategies

The 2009 Master Plan listed four major goals for the Town's water and sewer infrastructure which provided an important context for this IWRMP. These goals all remain relevant to the current planning effort, as they have been validated through several other recent planning reports listed above, as well as through the IWRMP public participation process:

8. Improve and protect water quality and quantity.
9. Protect water supply sources through local land use mechanisms.
10. Implement comprehensive water conservation measures, including leak detection, metering, conservation-oriented water rates, drought contingency plans, and public education.
11. Take an active role in maintaining and/or increasing Medway's allocated capacity at the CRPCD.

In addition to the above goals, this IWRMP also seeks to achieve the following:

12. Mitigate environmental impacts of stormwater-driven water quality impairments through local and regional implementation of best management practices (BMPs), both structural and non-structural.
13. Establish an implementation plan for long term sustainability that is affordable, effective and achievable.
14. Improve Town processes to eliminate barriers and streamline effective management of water resources.

This IWRMP includes the following implementation strategies for needed improvements to the water resources systems:

- Support operations and maintenance (O&M) efforts of the DPS, including funding annual infrastructure management needs such as I/I removal, leak detection, catch basin cleaning and street sweeping.
- Modify local site design or development standards to encourage creative approaches to water resources management, including incorporating low impact development, green infrastructure, and enhanced water conservation, where appropriate.
- Engage the public in understanding the water resources systems to encourage voluntary behaviors that improve conservation efforts, manage wastewater flows and improve stormwater runoff quality.

2. Public Participation

As described in the EPA's Integrated Planning Framework, Medway's IWRMP sought to implement "a process which opens and maintains channels of communication with relevant community stakeholders in order to give full consideration of the views of others in the planning process and during implementation of the plan." This Chapter outlines the IWRMP's public participation process, including the engagement of a targeted stakeholder group and a summary of feedback received on the specific elements of the plan.

2.1 Public Participation Plan and Efforts

The Town solicited and encouraged public participation in the IWRMP effort through three primary sources:

4. Public Communication – Through execution of a detailed Communication Plan (outlined in Section 2.2) the Town provided an overview of the IWRMP process and regular updates on the planning process. Outreach through a variety of media was critical to successfully reach residents and business owners.
5. Citizens Advisory Task Force (CATF) Representation – The CATF was initiated to invite knowledgeable stakeholders and partners, who in turn act as an extension of the public. Each participant provided insight into the key issues that concerned their constituents and brought updates on the IWRMP process back to the broader stakeholders whom they represented.
6. Public Participation – Through scheduled presentations, the public reviewed the details of the draft IWRMP and provided feedback for incorporation into the final IWRMP.

2.2 Communication Plan

The Town implemented a communication plan to provide regular updates on the planning process. The Town utilized the DPS website as the medium for communicating with the public. Additional communication was accomplished through distribution of brochures and display of posters. The communication plan for the IWRMP was tailored to also incorporate educational messaging required under the MS4 permit. Implementation of the IWRMP communication plan accomplished the milestones as shown in Table 2-1:

Table 2-1: Communication Plan

Communication Milestone	Summary of Communication
Issue Press Release	✓ Solicited participants for Citizens Advisory Task Force
Publish in local newspaper	✓ Newspaper article about Sustainable Water Management Initiative Grant and IWRMP, Milford Daily News
Distribute IWRMP Brochures	✓ IWRMP Introduction ▪ Summarized the IWMRP and provided information on local water resources. ▪ Introduced total maximum daily loads (TMDLs) and impact on Medway. ✓ Yard Waste Recycling & Composting ▪ Distributed at Recycling Center.
Present IWRMP Poster	✓ Described IWRMP process and objectives ✓ Displayed at Medway Pride Day
Webpage Update #1: Establish dedicated IWRMP website	✓ https://www.townofmedway.org/department-public-services/dps-water-sewer/pages/integrated-water-resources-management-program ✓ Provide overview of the IWRMP process including summary of program goals and expected outcomes. ✓ Introduce IWRMP Task Force. ✓ Outline schedule for IWRMP development and public participation opportunities ✓ Reference IWRMP brochure (see Appendix A)
Webpage Update #2: "What are Medway's Local Water Resources?"	✓ Provide a summary of local water resources to provide basis for public education. ✓ Describe local surface waters and role in environmental and flood protection. ✓ Summarize role of groundwater in domestic water supply. ✓ Provide statistics on Town's water infrastructure – water, sewer and drain.
Webpage Update #3: "How are Our Water Resources Connected?"	✓ Outline the water cycle. ✓ Describe how day to day activities impact local water resources.
Webpage Update #4: "How Can You Help? Simple Steps You Can Take To Help Protect Medway's Water Resources!"	✓ Provide tips for homeowners and businesses to reduce contaminants in the environment that impact water resources. ✓ Provide references for water conservation recommendations. ✓ Encourage participation in Town's rain barrel program.
Webpage Update #5: Water system challenges and solutions	✓ Summarize results of water system needs assessment and present initial solutions.
IWRMP Update #6: Wastewater system challenges and solutions	✓ Summarize results of wastewater system needs assessment and present initial solutions.
IWRMP Update #7: Stormwater system challenges and solutions	✓ Summarize results of stormwater system needs assessment and present initial solutions.
IWRMP Update #8: Draft IWRMP	✓ Outline Draft IWRMP.

Communication with the public will continue throughout implementation of the IWRMP as projects are initiated and completed.

2.3 Stakeholder and Partner Outreach

Engaging with local stakeholders and partners is critical to the success of the IWRMP. The Town engaged stakeholders through the establishment of a CATF. The CATF allowed participants to engage in the details of the IWRMP process and products, providing insight and real-time feedback. CATF participants provided cross-sectional representation of the Town through elected and appointed positions, as well as citizens at large. The goal of the CATF was to provide reciprocal learning. CATF members are considered ambassadors to the public, sharing what they learn through participation with residents and stakeholders. They are also project participants, sharing knowledge and local experience to contribute to the process.

The development and engagement of the CATF is summarized in Table 2-2. Meeting summaries of all CATF meetings are included in Appendix A.

Table 2-2: Summary of Citizens Advisory Task Force Events

Date	Activity	Summary
August 13, 2012	Press release announcing IWRMP. Invitation to participate	Official formation of CATF
December 8, 2012	Letter invitation to participate on IWRMP CATF	CATF Invitees: • Medway Town Administrator • Planning & Economic Development Committee • Town Planner • Water/Sewer Board • DPS Director and Deputy Director • 495 MetroWest Partnership • Medway Business Council • CRPCD Executive Director • Citizen • Members of the press • Legislative delegates
January 24, 2013	Phase I CATF Meeting #1 held at Town Hall	Meeting agenda: • Overview of IWRMP • Phase I Scope • CATF Role • IWRMP Objectives • Public Outreach Plan

Date	Activity	Summary
April 25, 2013	SWMI Grant Stormwater Utility Workshop 1	Meeting agenda: • Introduction to Stormwater Funding • National and Regional Perspectives • Medway Stormwater Program and Future Priorities • Stormwater Utility Implementation Approaches
May 29, 2013	SWMI Grant Stormwater Utility Workshop 2	Meeting agenda: • Discussion of / update on IWRMP Phase 1.
June 28, 2017	Phase II CATF Update Meeting #1 held at Town Hall	Meeting agenda: • Project Purpose/Background • Update on Needs Assessment ○ Drinking Water ○ Wastewater ○ Stormwater • MS4 Notice of Intent
November 16, 2017	Phase II CATF Update Meeting #2 held at Town Hall	Meeting agenda: • Project Overview/Status • Integrated Systems • System Needs / Projections / Alternatives ○ Drinking Water ○ Wastewater ○ Stormwater • Decision Model Development
January 10, 2017	Phase II CATF Update Meeting #3 held at DPS Office	Meeting agenda: • Project Overview/Status • Evaluation of Scenarios • Decision Model Results • Feedback and Selection of Preferred Scenario
April 17, 2018	Phase II CATF Update Meeting #4 held at DPS Office	Presentation of Draft IWRMP

2.4 Public Participation

In addition to the stakeholder and partner outreach events noted above, the Draft IWRMP was presented publicly to the Board of Selectmen on XXXXX.

This presentation included a summary of the IWRMP process which allowed the public to understand the level of effort that went into developing the plan. The group reviewed the recommended alternatives and provided feedback on the direction of the plan, including the priority projects.

2.5 Public Input and Conclusions

[Feedback on draft IWRMP]

3. Built and Natural Environment

This chapter summarizes Medway's built and natural environment and how they influence management of water resources infrastructure within the Town. The built environment discussion outlines land use and zoning, as well as an analysis of Town buildout potential using the Town's 2009 Master Plan for reference. Understanding population growth and the economy is critical to developing a sustainable long-term plan. The discussion of the natural environment addresses existing conditions related to water resources, supply and quality. Understanding the influence of local geology, floodplains, climate and species habitat provides a holistic evaluation of the unique challenges that Medway faces.

3.1 Built Environment

Medway's roots are agricultural, and the Town's rural character is still visible in the open fields, low density residential development, and historic architecture. The primarily farming economy was eventually augmented by large-scale industrial development fueled by mills on the Charles River, Chicken Brook, and Hopping Brook. This industrial economy drove a housing boom. Early residential areas were clustered along the Charles River near Village Street. After the mills closed and major highways were constructed nearby, Medway became a predominantly residential community. Newer commercial development is focused along Route 109 in commercial plazas.

3.1.1 Land Use and Zoning

Medway encompasses a total land area of 11.6 square miles, with the majority representing residential land use. Land use (existing and future) is a critical factor in infrastructure planning. For example, among other things land use generates data related to:

- Potable water demand (consumption) which differs greatly between residential, agricultural and industrial users;
- Wastewater generation (discharges) in volume and effluent characteristics;
- Potential pollutant load export to receiving waters through stormwater run-off.

Zoning similarly directly impacts water resource planning. It dictates allowable land uses within specific geographies, and the density to which that land use can be developed. Consequently, the IWRMP evaluated current land uses and estimated future conditions based on "build-out" potential under existing zoning. This analysis informed the future needs evaluation.

Approximately 1.2 square miles (or 10%) of the total land area in Medway is impervious surface, which includes roads, sidewalks, and parking areas. Percent of impervious area correlates strongly with water quality impacts from stormwater discharge, and flooding related to increased rate and volume of run-off. A summary of the land use classification of the Town is presented in Table 3-1. This table also includes undeveloped parcels zoned as either residential or commercial/industrial.

Table 3-1: Assessor's Office Land Use Classification[2]

Land Use	Percent of Total	Sq. Mi.
Residential	60.7	7.04
Undeveloped Residential	9.2	1.07
Commercial/Industrial	12.1	1.40
Undeveloped Commercial/Industrial	0.5	0.06
Chapter 61, 61A, 61B	4.7	0.55
Government & Tax Exempt	12.8	1.48

Medway is divided into 14 zoning districts, each with a required minimum lot size, as summarized in Table 3-2. The majority of Medway is zoned Agricultural Residential and Village Residential, as shown in Figure 3-1.

Table 3-2: Medway's Zoning Districts

District	District Type	Minimum Lot Size (SF)
Residential	AR-I - Agricultural Residential I	44,000
	AR-II - Agricultural Residential II	22,500
	VR - Village Residential	22,500
Nonresidential	CB - Central Business	10,000
	VC - Village Commercial	10,000
	C-V - Commercial V	20,000
	BI - Business/ Industrial	20,000
	I-I - Industrial I	20,000
	I-II - Industrial II	20,000
	I-III - Industrial III	40,000
Overlay	Flood Plain District	N/A

[2] Data obtained from Medway's 2009 Master Plan (Medway, 2009).

District	District Type	Minimum Lot Size (SF)
	Adaptive Use Overlay District	N/A
	Groundwater Protection District	N/A
	Multifamily Overlay District	N/A

The Town of Medway adopted the “Zoning Bylaw of the Town of Medway Massachusetts” (Zoning Bylaw) in 1951 and amended it most recently in May 2017. The Zoning Bylaw sets requirements for usage, setback, frontage and minimum lot sizes for development, and maximum height and lot coverage.

The Zoning Bylaw includes four overlay districts, as follows:

I. The ***Flood Plain District*** is defined by the 100-year floodplain as depicted on the Flood Insurance Rate Maps (FIRM) for Medway and further defined by the Norfolk County Flood Insurance Study (FIS), which went into effect July 17, 2012. It is intended to:
   - prevent public emergencies resulting from water quality contamination and pollution,
   - avoid loss of utility services,
   - eliminate costs of responding to and cleaning up flooding, and
   - reduce damage to public and private property resulting from flooding waters.

II. The ***Adaptive Use Overlay District*** is intended to:
   - promote economic development and preserve community character by encouraging conversion of existing residential buildings in certain older neighborhoods to limited business and mixed uses

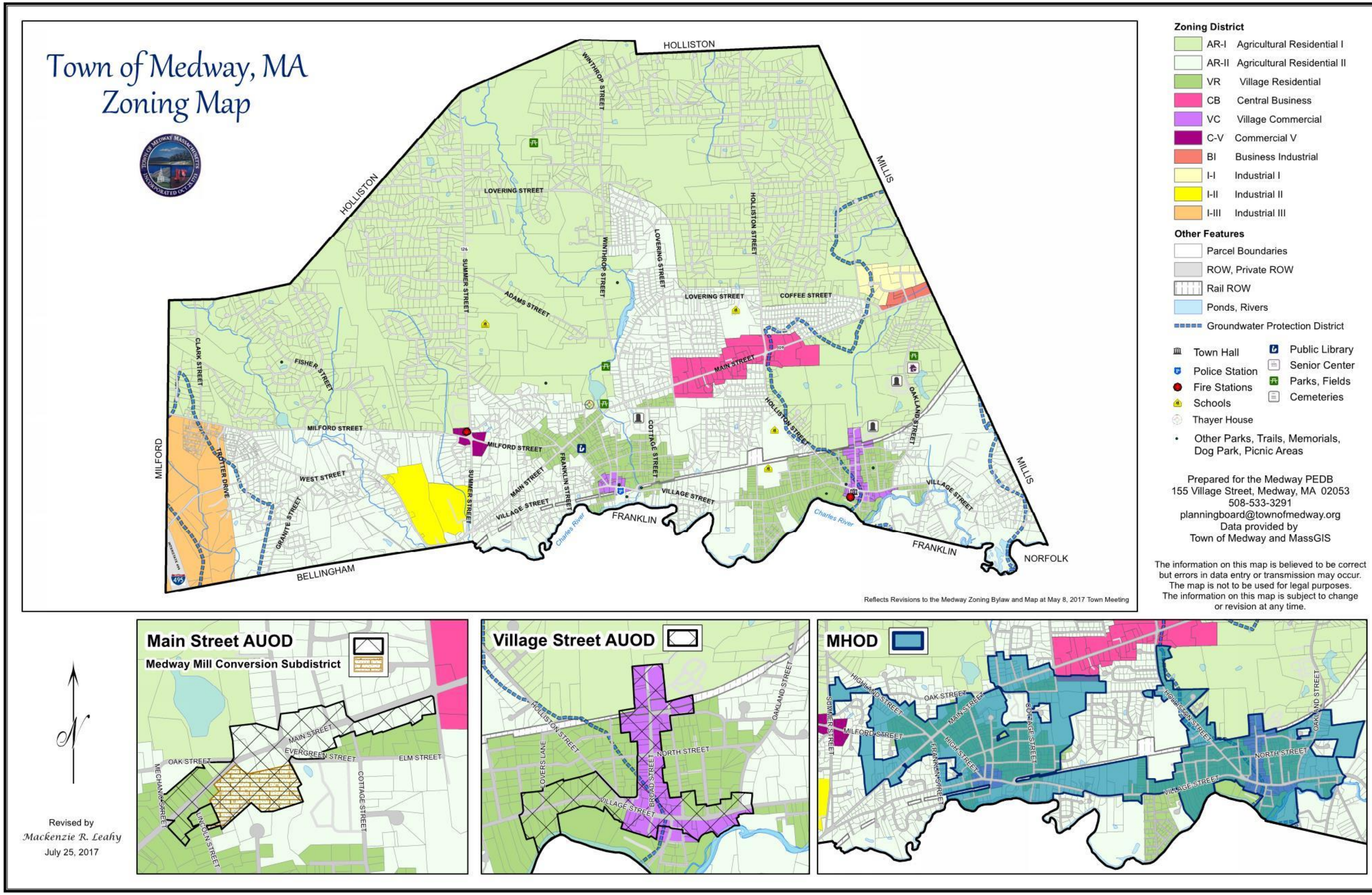

Figure 3-1: Town of Medway Zoning Map, 2017

III. The ***Groundwater Protection District*** is intended to:

- protect the MassDEP designated Zone II recharge areas to ensure an adequate quantity and quality of drinking water for Medway residents, institutions, and businesses and
- preserve and protect existing and potential sources of drinking water supplies.

IV. ***The Multifamily Overlay District*** establishes a special permit option to allow for the development of Multifamily Dwellings or Apartment Houses and Multifamily Developments. It is intended to:

- promote pedestrian oriented development, and
- increase the number of affordable housing units.

3.1.2 Buildout Analysis

The IWRMP utilizes the Town's buildout analysis is to document the development potential in Medway based on existing zoning, and consequently what the demands of such build-out might require in terms of infrastructure and services. As noted above, approximately 9.7% of the Town (2,097 acres) within the Town are currently undeveloped buildable land. The Town of Medway utilized a buildout analysis developed by the Metropolitan Area Planning Commission (MAPC) in 2000, with supplemental analysis completed in 2001 by the Executive Office of Environmental Affairs (EOEA). This buildout analysis included the following key findings:

- Projected that build out in Medway would include approximately 2057 new homes and more than 4.1 million square feet of commercial and industrial space based on zoning and environmental land constraint issues,
- Determined that at full buildout population of the Town would be approximately 18,106 people based on current zoning regulations, and
- Estimated that residential and commercial development buildout would increase water demand from about 1,148,397 gallons per day (gpd) in 2000 to 1,883,430 gpd at build out, representing an increase of 60%.

The 2009 Master Plan concluded that Medway's buildout (18,106 people) would be reached around 2040 based on population trends and building permit data. Buildout analyses are theoretical and are useful for establishing demand parameters. However, buildout timeframes (i.e. achieving full buildout) are highly variable and dependent on many outside factors. The figures cited are used as a demand benchmark but not for project population projections and implementation schedule purposes.

The Town Master Plan acknowledges that residential development “tends to place significant demand on municipal resources and infrastructure without providing much return in the form of property taxes collected.” Therefore, the Master Plan concluded that rezoning land from agricultural / residential to commercial / industrial should be considered, since “commercial and industrial land districts generate more tax revenue than they cost in services provided.” Several new developments have been either permitted or proposed in recent years. New planned development is discussed in Section 7.

3.1.3 Population

Based on data from the 2009 Master Plan, Medway experienced slow growth in the 1970’s and large jumps in population in the 1980’s and the 1990’s. The population has flattened in the 2000’s, as shown in Table 3-3.

Table 3-3: Historic Population (Source: US Census)

Year	Population	Absolute Change	Average Annual Change (%)
1970	7,938	-	-
1980	8,447	509	0.62%
1990	9,931	1,484	1.63%
2000	12,448	2,517	2.28%
2005	12,764	316	0.50%
2010	12,752	-8	-0.02%
2015	13,226[3]	474	0.73%

3.1.3.1 Population Growth Projections

To develop a comprehensive plan for Medway’s water resources, the IWRMP evaluated the potential for population growth. These population projections represent realistic growth considerations, whereas the buildout analysis noted above considered the full buildout potential, which is a theoretical scenario. Several data sources are available for development of population growth projections, including:

- UMass Donahue Institute’s Population Estimation Program (UMDI)
- Massachusetts Department of Transportation (Mass DOT)

[3] Source: 2015 United States Population Estimate

Table 3-4 shows projected populations from the UMDI Main Projection Series, which analyzes recent regional trends to estimate future populations.

Table 3-4: UMDI Population Projections

Year	Population	Absolute Change	Average Annual Change (%)
2020	13,146	-80[4]	-0.12%
2025	13,312	166	0.25%
2030	13,502	190	0.28%
2035	13,526	24	0.04%

Population projections from the two sources noted above, as well as population measured by the U.S. Census are displayed in Figure 3-2.

As shown in Figure 3-2, the UMDI projection consistently provides a higher estimate than Mass DOT projections. While the estimates differ from one another by approximately 6%, looking to multiple sources for population estimates can be useful in providing an upper and lower limit for anticipated population growth. Both population projections predict a population decrease from current census estimates for the year 2020 and differ by approximately 6% for the final 2035 population estimate.

[4] As measured from the 2015 United States Census population estimate

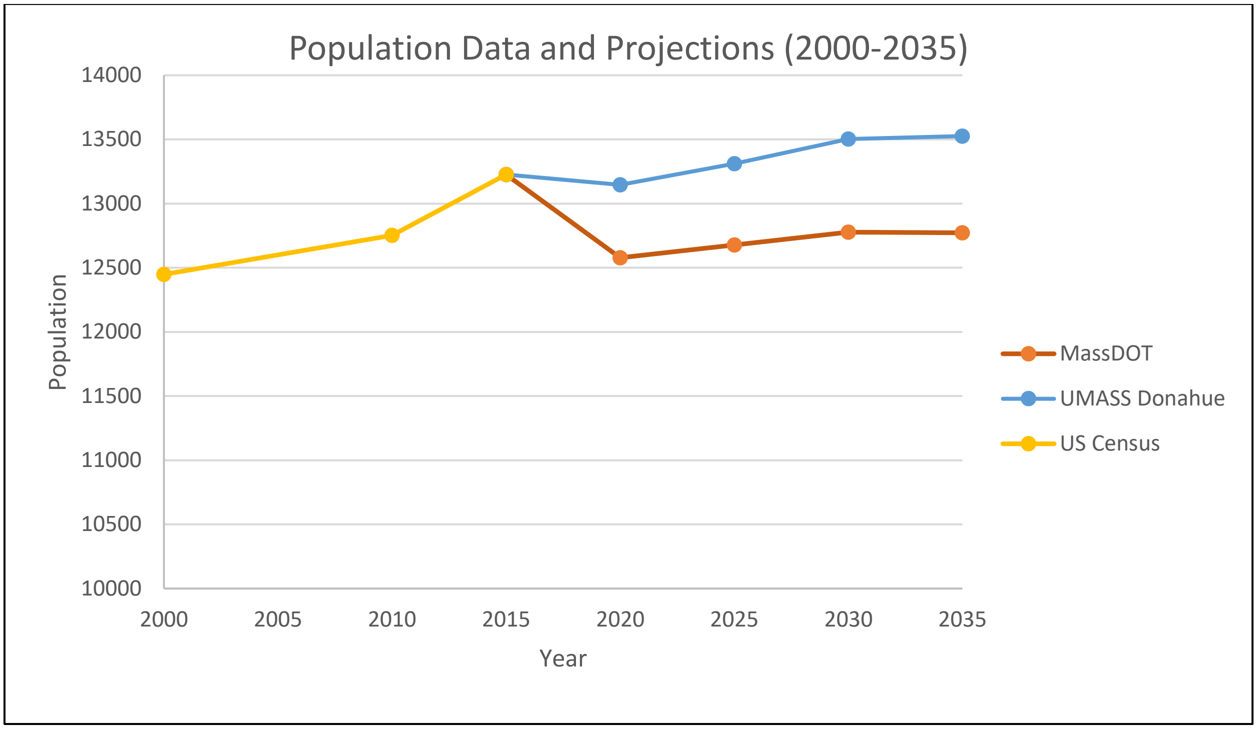

Figure 3-2: Medway's Population Data and Projections (2000 – 2035)

3.2 Natural Environment

3.2.1 Climate

The Town of Medway maintains a weather station (ID: KMAMEDWA10) located on Village Street West at 200 feet above sea level. The station records temperature, humidity, dew point, precipitation, pressure, and wind speed and direction every five minutes.

The average daily high temperatures in January and July are 37 F and 84 F, respectively. Normal rainfall averages 48.75 inches annually, and the average annual total snowfall is 42.8 inches. The mean number of days with precipitation is 80. The average wind speed varies from 5.6 miles per hour (mph) in the windier part of the year (November 2 to April 27) to 4.0 miles per hour (mph) during the calmer time of the year (April 27 to November 2).

3.2.2 Geology and Hydrogeology

Medway's surficial geology is largely a result of glacial activity that occurred most recently about 10,000 to 20,000 years ago. The four surficial deposits near Lake Medfield are: alluvial deposits, swamp deposits, Populatic Pond deposits, and Medway deposits. Alluvial deposits consisting of sand, silt, and minor gravel are found in flood plains along the northern boundary of the Charles

River. Swamp deposits consist of sand, silt, clay, and organic materials. The Populatic Pond deposits and Medway deposits, which run along the northern and southern side of the Charles River, consist of varying amounts of sand and gravel.

Deposits of sand and gravel typically have higher permeabilities than bedrock and till and may yield large quantities of water. The high and medium yield overburden aquifers in Medway that supply the Town's four wells are located within the Charles River Basin and are hydraulically connected to the Charles River and its tributaries, ponds, and wetlands, as shown in Figure 3-3. Surficial geologic deposits in Medway are underlain by Quincy Granite. This rock unit consists of dark gray to dark green, alkaline granite containing riebeckite and aegirine. The Quincy Granite unit is surrounded to the north, east, and west by Biotite Granite and Dedham Granite rock units. Further south in Bellingham it is bordered by the Bellingham Conglomerate.

3.2.3 Soils

Most of the soils in Medway are fine sandy loams as listed in Table 3-5 and shown in Figure 3-3.

Table 3-5: Soils in Medway

Soil Category	Soil Name
Sandy loam	Canton Merrimack Paxton Ridgebury Scituate Woodbridge Hinckley
Loamy sand	Deerfield
Silt loam	Rippowam Raynham

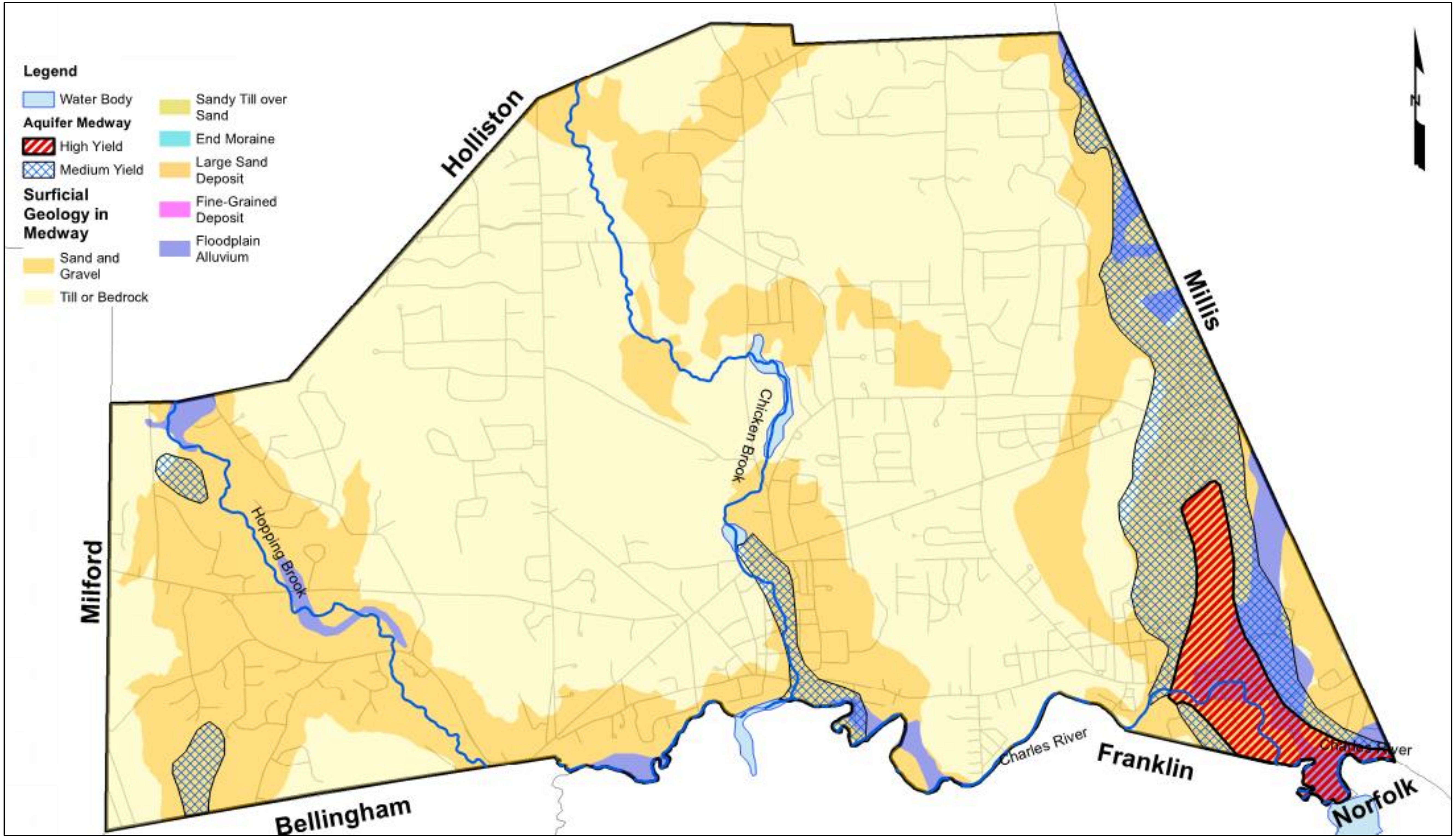

Figure 3-3: Surficial Geology and Aquifers

3.2.4 Topography and Depth to Groundwater

The terrain ranges in elevation from 135 to 370 feet above mean sea level. Figure 3-4 shows the USGS Topographic quadrangle map for Medway. Depth to groundwater was estimated using the Natural Resources Conservation Service Soil Classifications. Each soil is assigned a range for "depth to high water table". The midpoint of the range was assumed to be the depth to groundwater. Estimated depth to groundwater in Medway ranges from 1.4 feet to 5.3 feet below grade.

3.2.5 Water Resources

Medway's natural water resources consist of surface waters (rivers, brooks, ponds, and wetlands) and groundwater. All of Medway lies entirely within the Charles River Basin and the Charles River forms about two-thirds of the Town's southern boundary with Franklin. Other important waterways are Chicken Brook and Hopping Brook. Chicken Brook flows through the center of Town, from Holliston in the north to the Charles River in the south. Chicken Brook frequently runs dry during the warmer months. Hopping Brook flows from Milford in the northwest to the Charles River in the south. A portion of Hopping Brook is protected by town-owned and Army Corps of Engineers land on its borders. In the East, Medway shares the Great Black Swamp with Millis. There are also several ponds throughout Medway, with Park Pond and Milk Pond along the Chicken Brook. The major streams, rivers ponds and watersheds are shown on Figure 3-5.

3.2.5.1 Flood Plains

Medway has three major types of flood hazard zones as identified on the Norfolk County Flood Insurance Rate Map (FIRM) issued by the Federal Emergency Management Agency (FEMA) and shown on Figure 3-5:

Zone A represents an area that will be inundated by a 100-year storm (a storm event with a one percent annual probability of occurrence) for which no Base Flood Elevations have been determined. Medway has three small Zone A areas:

- between Village Street and Forest Road, along an abandoned railroad bed,
- near the northern part of Hopping Brook, and
- along the small brook near the intersection of Route 109 and Holliston Street.

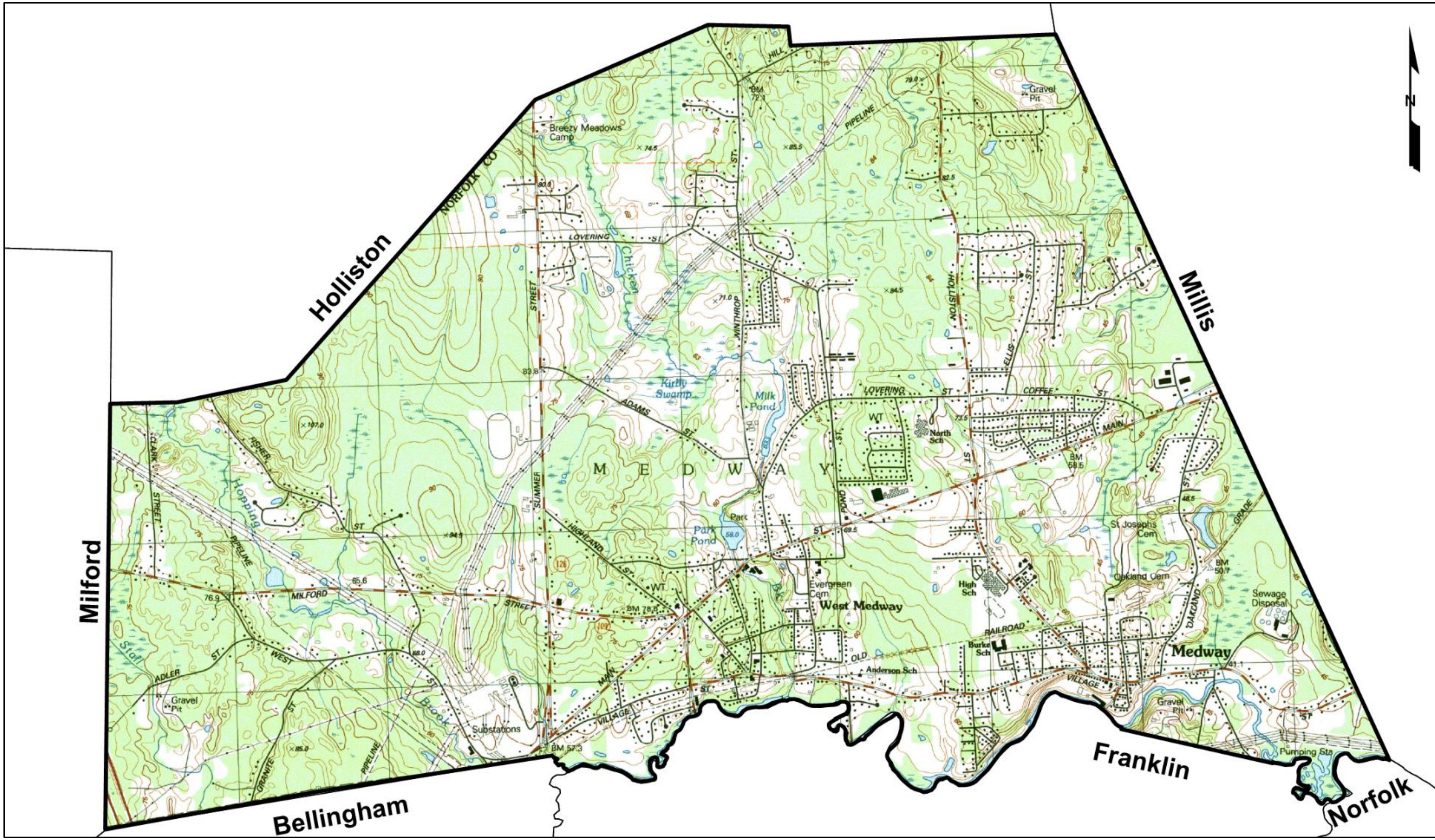

Figure 3-4: USGS Quadrangle Map

Zone AE represents an area that will be inundated by a 100-year storm for which Base Flood Elevations have been determined. Medway has one Zone AE area that closely follows most of Hopping Brook, Chicken Brook, the Charles River, and the small brook near the intersection of Route 109 and Holliston Street.

Zone X500 can represent one of the following:

- an area that will be inundated by a 500-year storm (a storm event with a 0.2 percent annual probability of occurrence),
- an area inundated by 100-year storm with average depths of less than one foot or with drainage areas less than one square mile, or

an area protected by levees from 100-year storm flooding. Zone X500 is the most common zone in Medway. X500 zones border the AE zones along Hopping Brook, Chicken Brook, the Charles River, and the small brook near the Route 109 and Holliston Street intersection. Other X500 zones include an area near Hopping Brook around Route 109, and the areas surrounding the AE zone near Park Pond and Milk Pond.

3.2.5.2 Wetlands

Wetlands are prevalent throughout the Town, as seen on Figure 3-5. Most of the wetlands are deciduous forested wetlands. There are several wetland areas in Town that are within floodplain Zone X500, including an area west of Clark Street, two areas near Stall Brook at the Milford and Bellingham borders, the area around Summer Hill Road, the wetlands at the end of the brook near the Highland Street and Park Street intersection, four areas in the Black Swamp, an area of wetlands on Route 126 near Pheasant Run Road and two patches of wetlands along the brook that offshoots eastwardly from Milk Pond.

3.2.5.3 Water Supply Protection

The Town provides drinking water to residents and businesses from four local groundwater supply wells installed in sand and gravel aquifer deposits (Figure 3-5). All four wells are located within the Charles River Basin in the Bogastow Brook sub-basin and the Charles Chicken Brook to Stop River sub-basin. Based on Medway's 2009 Master Plan, the Town owns or controls approximately 66 acres of land to protect the public water supply. In addition, as discussed in Section 3.1.1, the Town has a Groundwater Protection Overlay District intended to protect Zone II recharge areas. The Town's water supply wells are discussed further in Section 5.1.

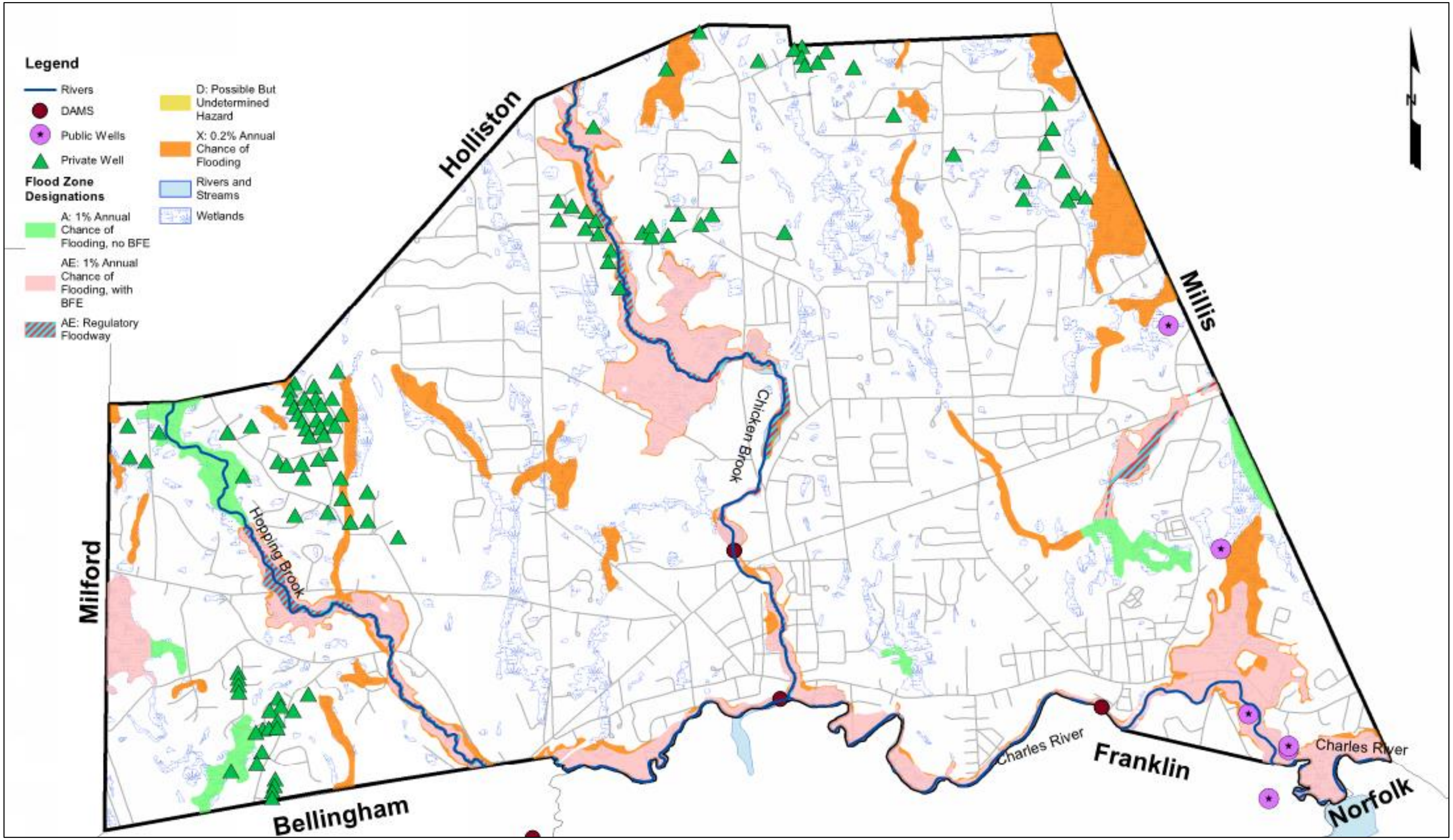

Figure 3-5: Water Resources and Wetlands

3.2.5.4 Dams

The Choate Pond Dam was constructed along Chicken Brook in 1827, creating Choate Pond. This is the only dam owned by the Town of Medway. This earthen dam was originally constructed to power a box board mill, but now serves recreational purposes. The Choate Pond dam does not have an emergency spillway and is classified as a "significant hazard potential" by DCR, which requires a Phase I inspection every five years. The last inspection was performed in 2016. The Town is in the process of constructing a splash pad and wooden pavilion at Choate Park.

Historical mills located along the Charles River utilized dams between Medway and Franklin to control water for industrial use. The Sanford Mill Dam and West Medway Dam are currently still in place along the Charles River. These dams are both privately owned, and the latest records available from the Charles River Watershed Association list the Sanford Mill Dam as a significant hazard and the West Medway dam as a low hazard. In addition to man-made dams, a variety of beaver dams are also present throughout Medway which contribute to localized flooding.

3.2.5.5 Surface Water Quality and Impairments

Medway is one of thirty-five communities associated with the Charles River Watershed. The watershed is comprised of approximately 308 square miles of land along the 80-mile-long Charles River stretching from Echo Lake in Hopkinton, MA to the Boston Harbor. Medway resides entirely within the watershed near the upstream end of the Charles River, which establishes most of the town's southern border. Several water bodies in Medway have been determined to be impaired for various pollutants. Table 3-6 presents Medway's water bodies and their associated pollution impairments.

From a regulatory perspective, when a water body is impaired to the point that it can no longer support its designated uses, a mechanism known as the "Total Maximum Daily Load" (TMDL) is put into place. This legally enforceable mechanism sets specific mass load allocations (typically based on a total annual load) for the pollutant causing the impairment to all permitted point sources discharging to the tributary waterways. As noted in Section 1.2.2, Medway is required to comply with final TMDLs for bacteria (pathogens) and nutrients in the Charles River.

Table 3-6: Impaired Waters, Town of Medway MA

Water Body	Segment ID	Impairment Category[b]		Impairments		Approved TMDL (EPA#)	
		2014	2016	2014	2016	2014	2016
Charles River	MA72-04	5	5	(Other flow regime alterations[b])			
				Chlordane in Fish Tissue			
				DDT in Fish Tissue			
				E. coli		32366	
				Fishes Bioassessments			
				Mercury in Fish Tissue			
Charles River	MA72-05	5	5	(Non-Native Aquatic Plants[b])			
				Aquatic Macroinvertebrate Bioassessments			
				Chlordane in Fish Tissue			
				DDT in Fish Tissue			
				Dissolved oxygen saturation		40317	
				Excess algal growth		40317	
				Mercury in Fish Tissue			
				Nutrient / eutrophication		40317	
				Dissolved oxygen		40317	
				Total phosphorus		40317	
				Turbidity		40317	
Chicken Brook	MA72-34	2	5		E. coli		
Hopping Brook	MA72-35	2	5		E. coli		
Lake Winthrop	MA72140	5	5	(Non-Native Aquatic Plants[b])			
				2,3,7,8-Tetrachlorodibenzo-p-dioxin (only)			
				Aquatic Plants (Macrophytes)		40319	
Populatic Pond	MA72096	5	5	Chlordane in Fish Tissue			
				DDT in Fish Tissue			
				Dissolved oxygen saturation		40319	
				Excess algal growth		40319	
				Mercury in Fish Tissue		33880	
				Nutrient / eutrophication		40319	
				Dissolved oxygen		40319	

[an] Impairment Category Definitions:

1 – Unimpaired and not threatened for all designated uses

2 – Unimpaired for some uses and not assessed for others

3 – Insufficient information to make assessments for any uses

4 – Impaired or threatened for one or more uses, but not requiring a TMDL calculation

5 – Impaired or threatened for one or more uses and requiring a TMDL

[b] TMDL not required (Non-pollutant)

The information presented is based on the Massachusetts Division of Watershed Management Final 2014 Integrated List of Waters and the Proposed 2016 List of Integrated Waters.

In 2007, MassDEP issued a Pathogen TMDL Report for the Charles River Watershed to address fecal coliform bacterial impairment, as required by section 303(d) of the Clean Water Act. Fecal coliform bacteria are found in the intestinal tract of warm-blooded animals and their presence in surface waters is an indication of fecal contamination which threatens public health. The Surface Water Quality Standards for the Commonwealth of Massachusetts are described in 314 CMR 4.00. Under 314 CMR 4.00, all waters within Medway are either designated as Class B (Charles River), or undesignated, and therefore default to the Class B designation. For Class B waters (i.e. for all waters within Medway) the water quality standards require that fecal coliform bacteria shall not exceed a geometric mean of 200 colonies per 100 ml in any representative set of samples, nor shall more than ten percent of the samples exceed 400 colonies per 100 ml. The 2007 Charles River TMDL specifies the 200 colonies and 400 colonies per 100 ml standards as the means to achieving the waste load reduction of 96.4% required by the TMDL. The requirements for meeting the bacteria TMDL are incorporated into the 2016 MS4 Permit which is discussed in Section 6.4.

A separate 2007 TMDL covers nutrients in the Lower Charles River Basin, and in 2011, the Final Nutrients TMDL for the Upper/Middle Charles River Basin was issued. The TMDLs identify phosphorus as the pollutant of concern. Excess phosphorus can contribute to harmful algae blooms which damage ecosystems and can be a public health concern. Sources of phosphorus include leaf litter, sediment, and household products like detergents and fertilizers. The requirements for meeting the phosphorus TMDL requirements are incorporated into the MS4 General Permit, which is discussed in Section 6.4.

3.2.6 Wildlife Habitat and Endangered Species

There are five Core Habitat areas and two Critical Natural Landscapes (CNL) that fall partially in Medway, based on the Natural Heritage and Endangered Species Program (NHESP) BioMap, as shown on Figure 3-6. Core Habitats are the most viable habitats for rare plants and/or animals or exemplary natural communities. Resource areas and buffer zones in these habitats are within the jurisdiction of the local conservation commission under the Massachusetts Wetlands Protection Act Regulations (310 CMR 10). The Core Habitats and Critical Natural Landscapes include:

- Core 1198/CNL 608: A 171-acre Core Habitat/331-acre CNL featuring Aquatic Core and a Species of Conservation Concern – Four-toed Salamander. The Core Habitat and CNL stretches into the Town of Franklin.

- Core 1272: Located in the northwest corner of the Town. A 154-acre Core Habitat featuring a Species of Conservation Concern – Spotted Turtle. The Core Habitat stretches into the Town of Holliston.
- Core 1274: Located in the northwest corner of the Town. A 134-acre Core Habitat featuring a Species of Conservation Concern – Spotted Turtle. The Core Habitat stretches into the Town of Milford.
- Core 1315: Located in the northwest corner of the Town. A 418-acre Core Habitat featuring Species of Conservation Concern – Four-toed Salamander and Spotted Turtle. The Core Habitat stretches into the Town of Holliston.
- Core 1337/CNL 672: Located in the northeast corner of the Town. An 833-acre Core Habitat/1,220-acre CNL featuring Aquatic Core, Wetland Core, and a Species of Conservation Concern. – Spatterdock Darner. The Core Habitat stretches into the Town of Millis.

In addition, there are three species listed by the Massachusetts Endangered Species Act.

Table 3-7: Medway Rare and Endangered Species

Scientific Name	Common Name	Taxonomic Class	State Rank	Most recent Observation
Notropis Bifrenatus	Bridle Shiner	Fish	Special Concern	1969
Terrapene Carolina	Eastern Box Turtle	Reptile	Special Concern	Historic
Linum Medium Var Texanium	Rigid Flax	Vascular Plant	Threatened	1902

There is also one area designated as Priority Habitats of Rare Species (PH) under the Massachusetts Endangered Species Act (321 CMR 10), based on NHESP records (Figure 3-6). This habitat includes:

- PH 938 is in the southeast corner of the Town. This priority habitat also overlaps with Franklin and Bellingham.

Figure 3-6 also shows mapped Certified Vernal Pools, which are protected by wetlands regulations, along with Potential Vernal Pools (which are not).

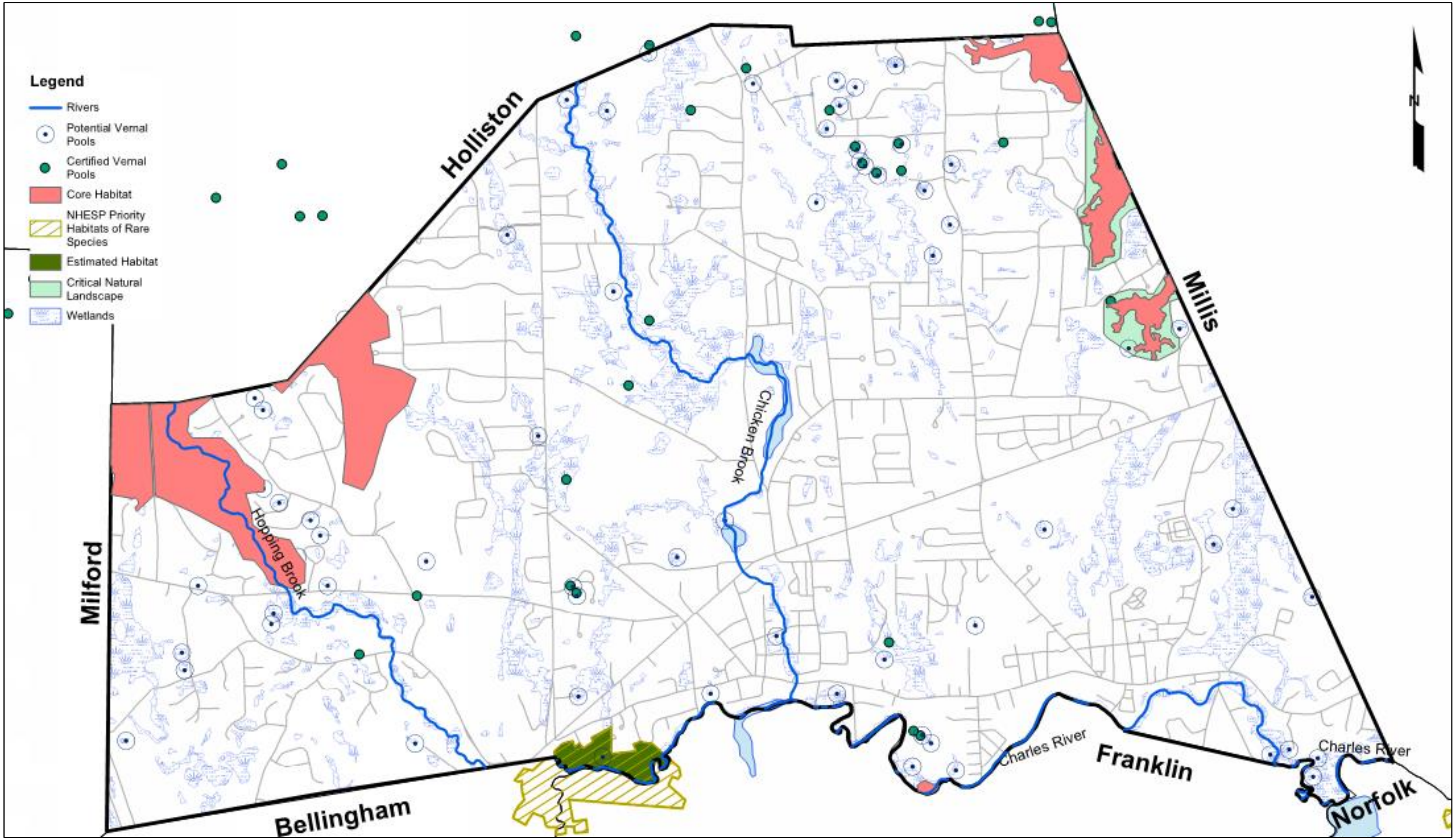

Figure 3-6: Habitat and Endangered Species

3.2.7 Hazardous Waste Sites

Three sites within Medway are listed on the MassDEP Chapter 21E Sites master list, which tracks locations of hazardous material and oil spills. While these locations represent some hazardous material exposure to the environment, they do not necessarily signify a definite contamination risk to water resources in the Town. These sites include:

- Tier I – Medway Oil and Propane, 37 Broad Street
- Tier II– Main Street Shell, 86 Main Street
- Tier 1D – No location listed, 8 Populatic Street

4. Existing Wastewater System

4.1 Wastewater Collection System

The Town of Medway owns and operates a municipal sanitary sewer system first developed in 1977. It presently serves the central and southern areas of the Town, with a section extending along Summer Street to the northern portion of Town; which accounts for approximately 65-percent of the community. The remaining 35-percent of the Town has on-site wastewater disposal systems (septic systems).

Medway's wastewater collection system consists of:

- Approximately 55 miles of gravity sewer pipes, ranging in diameter from 6 to 54 inches. Most of the system is polyvinyl chloride (PVC) pipe – a distribution of pipe materials and corresponding lengths are listed in Table 4-1.
- Two (2) major interceptors: 1) the 24-in diameter Oakland Street Interceptor and 2) the 24- to 54-inch diameter Chicken Brook Interceptor. Both interceptors collect and convey the wastewater to the Charles River Pollution Control District (CRPCD) facility.
- Approximately 1,385 sewer manholes.
- One (1) wastewater submersible pumping station, with duplex pumps.
- Approximately 2,645 linear feet of force main, mostly 6-inch in diameter.

Table 4-1: Wastewater Collection System Gravity Sewer Information

Pipe Material	Length (feet)	Percent of Sewer System
Ductile Iron (DI)	1,300	<1%
Polyvinyl Chloride (PVC)	206,800	70%
Reinforced Concrete (RCP)	23,900	8%
Unknown (UNK)	60,300	21%
Total Gravity Sewer	**292,300**	

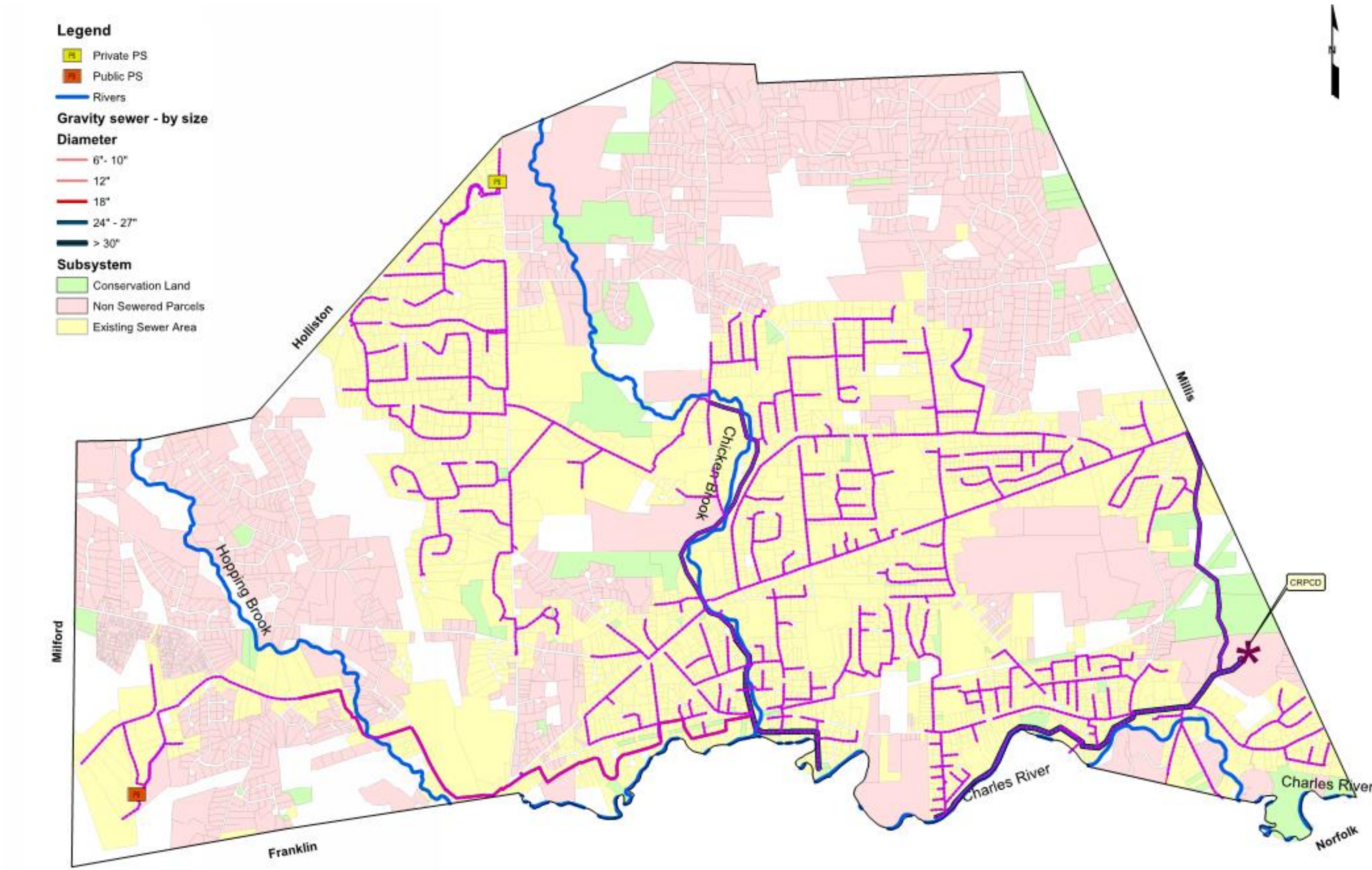

Figure 4-1: Wastewater Collection System in Medway, MA

4.1.1 Past Studies

As mentioned in Section 1.2.2, the Town completed several reports that identify and address needs within the wastewater collection system. The outstanding recommendations from these reports are summarized below:

- Sewer Master Plan (1999):
  The 1999 Master Plan recommended approximately 136,000 linear feet of sewer extensions across seven districts. There are currently four (4) districts with outstanding sewer extensions per the recommendations of the plan as shown in Table 4-2.

Table 4-2: Medway Sewer Extensions

DISTRICT	RECOMMENDED SEWER EXTENSION	CURRENT STATUS
Medway Center	1,350 lf	Completed
East Village	1,700 lf	Completed
Main Street	23,500 lf	*Outstanding*
Black Swamp	11,400 lf	*Outstanding*
Chicken Brook	27,200 lf	*Outstanding*
West Medway	31,860 lf	*Outstanding*
Hoping Brook	39,600 lf	Partially Completed

- Chicken Brook I/I Study (2011):
  The 2011 evaluation of the Chicken Brook interceptor recommended the rehabilitation of 26 manholes and seven pipeline segments. In addition to rehabilitation, the study recommended routine CCTV and individual I/I investigations of each subareas.

4.2 Charles River Pollution Control District (CRPCD)

The Towns of Medway and Franklin established the CRPCD in 1973 with the construction of a 4.54 MGD regional wastewater treatment facility. The CRPCD wastewater treatment plant (WWTP) is physically located in Medway, at 66 Village Street, and now receives wastewater from the Towns of Franklin, Medway, Millis, Bellingham, and septage from the Towns of Norfolk, Wrentham, Dover, Sharon, Holliston, Weston and Sherborn. The CRPCD WWTP was expanded in 1999 to increase the capacity to 5.7 MGD. The last major upgrade, aimed at extending the useful life of the plant, was completed in 2016 and included improving phosphorus removal, replacing the disinfection system and extending the life of the facility for an additional 20 years.

The CRPCD WWTP provides tertiary wastewater treatment prior to discharge into the Charles River. The EPA and MassDEP have jointly issued a NPDES permit that regulates the discharge.

Each town is assigned an allocated capacity, which was established by Franklin and Medway relinquishing a portion of their allocated capacity over the years based on each Town's estimation of their future wastewater demands. The current allocated capacity and 2016 average daily flows for each Town is presented in Table 4-3. Medway has the second largest allocation in the regional wastewater treatment facility, behind Franklin. Currently, Medway is approaching its limit, using 82 percent of its allocated capacity in 2016.

Table 4-3: CRPCD Wastewater Flow vs Capacity

Town	Allocated Capacity Average Daily Flow (MGD)	2016 Average Daily Flow (MGD)	Percent Used (%)
Bellingham	0.377	0.253	68
Franklin	3.642	2.415	66
Medway	0.955	0.779	82
Millis	0.628	0.356	57
Norfolk, Wrentham, Dover, Sherborn	0.100		
Total:	**5.7**	**3.803**	68

Flow meters measure wastewater flows to the CRPCD for each town. Medway's contribution is determined by totaling the flows measured at the Chicken Brook Interceptor, the difference between the flows measured at the Black Swamp Interceptor and Millis' flow from Route 109, and the unmetered connections. Flows from the Chicken Brook Interceptor are metered right before the collection system crosses beneath the Charles River at the southern Town boundary. Flows from the Black Swamp Interceptor are measured just after Medway and Millis' flow combine just south of Route 109 by Oakland Street and the Town boundary. Further detail on system configuration is provided in Section 4.3. Medway typically contributes approximately 20 percent of the flow at the CRPCD WWTP.

4.3 System Performance

This section summarizes the performance of the Town's wastewater system.

4.3.1 Existing Flows

As noted above, the CRPCD estimates Medway's wastewater flow using the flow meter on the Chicken Brook Interceptor, which records the flows west of Holliston Street, and a per property calculation from the eastern portion of the Town (approx. 550 properties). This estimate is based on subtracting out other Town's metered flow, and applying the total flow among the unmetered properties, resulting in a representative average of 295 gpd per property[5]. Figure 4-2 depicts the distribution of metered and unmetered wastewater flows.

From 2014 to 2016, Medway's' estimated average daily flow (ADF) at CRPCD was 0.788 MGD – 83% of the Town's allocated capacity - with a maximum average daily flow of 1.36 MGD (Figure 4-3). The max peak flow of 1.99 MGD was registered in March 2014.

To curtail the increased flows to the CRPCD, the Town of Medway passed a moratorium on new sewer extensions in March 2015. While the moratorium excludes new sewer extensions, new connections are permitted provided that the property abuts an existing sewer.

There are approximately 150 homes located on properties that abut the existing sewer system which do not currently discharge to sewer, but rather to on-site septic systems. These properties have been assessed betterments in the past related to the sewer construction, which grants them the right to request connection to the Town's wastewater system regardless of the sewer moratorium. Discharge from these properties are thus included as "reserved capacity" within the Medway wastewater system. The total reserved capacity is approximately 42,000 gpd (i.e. 280 gpd x 150 homes[6]). Activating this reserved capacity would increase Medway's contribution towards their allocated capacity at CRPCD from 83% to 87%. Figure 4-3 depicts the Town's average daily flows and reserved capacity against the allocated capacity at CRPCD.

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[5] The total flow from this vicinity is applied to the contributing properties as a per property average, however the total flow also includes extraneous flow that may enter the system through defects in the collection system in this vicinity. This estimate is not intended to suggest that the properties discharge those flows.

[6] Estimate is based on TR-16 guidance of 70 gpd per capita and an average of 4 persons per household (70 x 4 = 280 gpd)

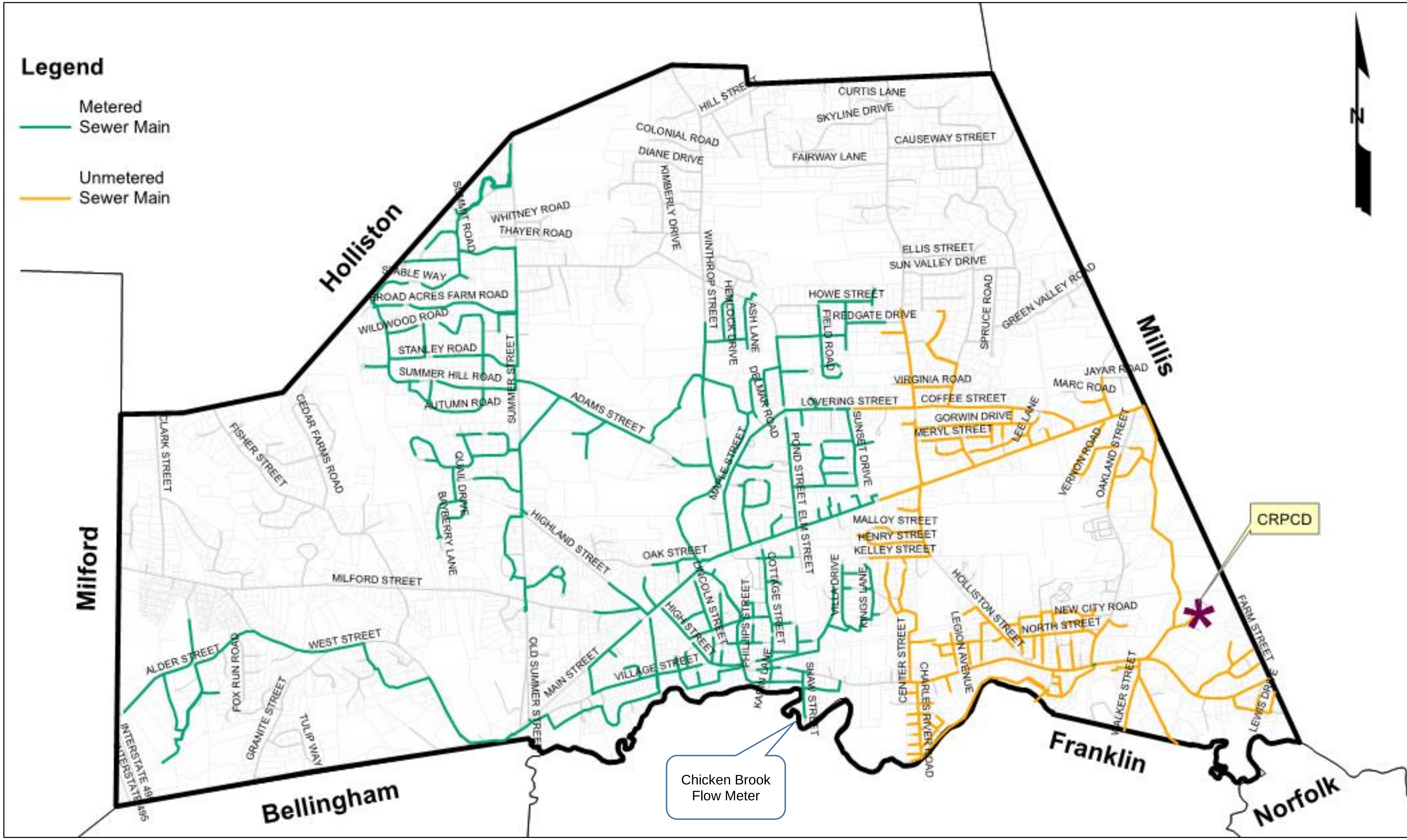

Figure 4-2: Metered and Unmetered Wastewater Flow

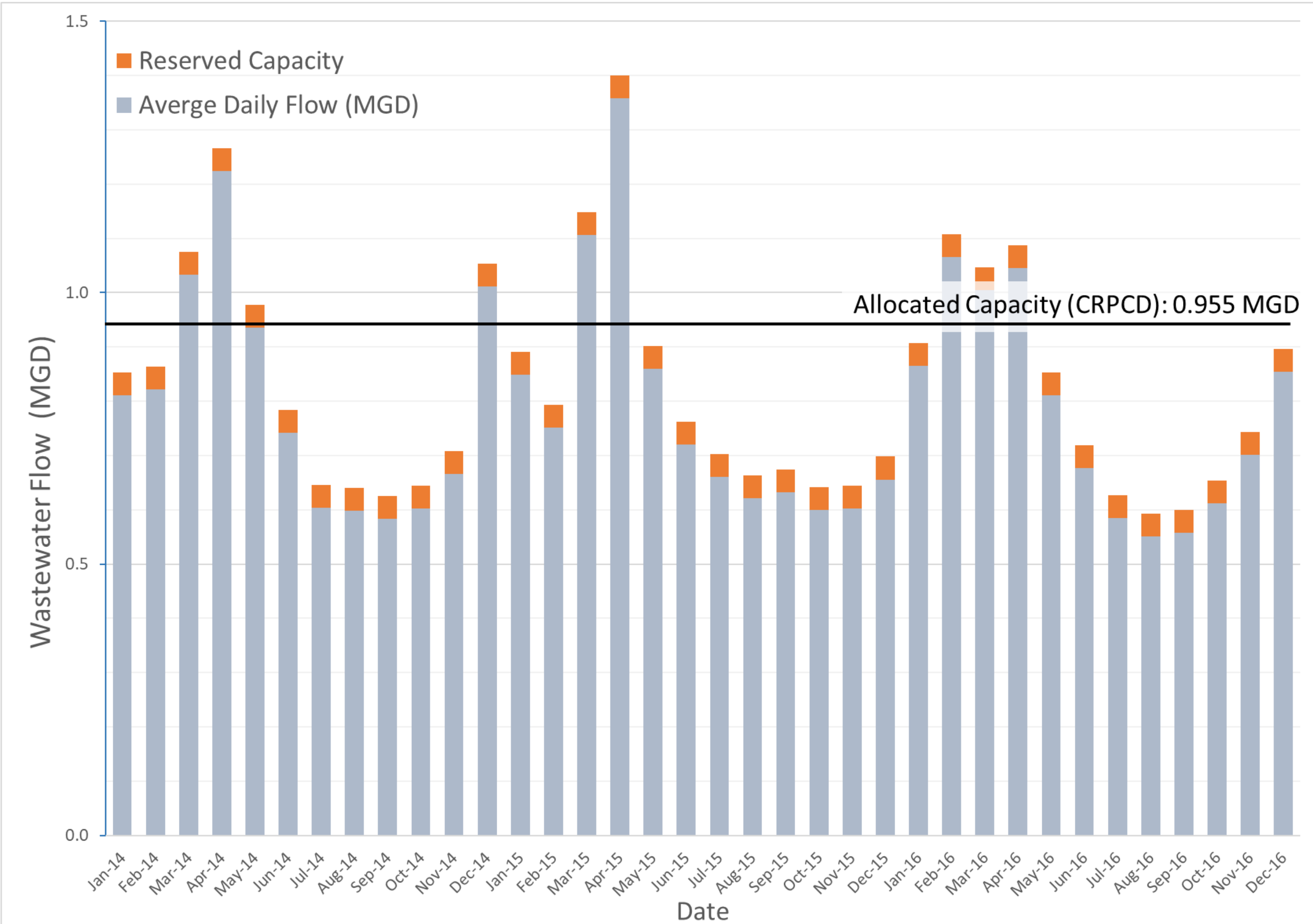

Figure 4-3: Wastewater Flows vs. CRPCD Capacity

Categorizing the type of wastewater flow can inform seasonal variations and their impacts on the Town's wastewater collection system. Figure 4-3 shows that during the spring months, the flows recorded at CRPCD increases; likely due to extraneous flows (infiltration and inflow) entering the system. Extraneous flow is flow entering the collections system through structural defects in the infrastructure during high-ground water months (infiltration), rainfall entering the system via sump pumps (inflow), or storm drain infrastructure inadvertently connected to wastewater collection system (cross-connection). Flow to the CRPCD consequently drops during the summer months when the groundwater is lower, and thus less extraneous flow is entering the system.

4.3.2 Hydraulic Capacity

Despite approaching its allocated capacity at the CRPCD, Medway's wastewater system does not typically exhibit problems related to hydraulic capacity. Medway has experienced two sanitary sewer overflows (SSOs) in the past five years, as detailed in Table 4-4.

Table 4-4: Sanitary Sewer Overflow History

SSO date	Location	Volume released	Cause of release
6/22/2014	34 Coffee Street	100 gallons	Sewer system blockage - roots
6/22/2014	4 Douglas Road	100 gallons	Sewer system blockage - roots

Both SSOs occurred because of roots entering the wastewater system and causing blockages. The DPS proactively manages the wastewater system through inspections and maintenance to minimize the risk of SSOs and has not experienced an SSO since.

4.3.3 Infiltration and Inflow (I/I)

Through the capital improvements budget, Medway appropriates $140,000 per year to investigate sources of infiltration and inflow, and to repair any identified deficiencies. This budget is supplemented, as needed, by the operations budget and the sewer enterprise fund.

In 2013 the Town conducted an Infiltration and Inflow Study focused on the Chicken Brook interceptor to identify segments in need of further investigation and/or repair. The study consisted of detailed inspection of 40 sewer manholes as well as the cleaning and closed-circuit television (CCTV) inspection of 8,276 linear feet of the interceptor sewer. This investigation identified approximately 50,000 GPD of active infiltration in 19 of the 31 segments of the interceptor. Most leaks were located at the joints of the reinforced concrete pipe (RCP) or at service lateral taps. As of this report publication date, the Town has addressed the noted deficiencies in the Chicken Brook Interceptor. In 2015, during high groundwater season, the Town inspected 42,422 linear feet of sewer and identified approximately 63,400 GPD of infiltration in sewer subareas 2 and 3 (Figure 4-4). Pipe defects accounted for most of the infiltration, while manhole defects accounted for the rest.

As part of the IWRMP, the DPS undertook a town-wide metering program to assist in prioritizing needs within the wastewater system. The Technical Memorandum summarizing this effort is included as Appendix B, while a summary of the finding is included below:

- Fifteen meters were installed for an eight-week period recoding wastewater flows in 15-min intervals. DEP guidelines recommend flow metering during the spring month, to capture high ground water as well as the rainy season. However, to keep with the greater IWRMP schedule, the flow metering was conducted between October and December

2017. Conducting the flow metering off-season allows us to make broad generalization as to which subarea requires additional investigation.

- Per the I/I analysis, Subarea 8 exhibits the highest infiltration rate (more than DEP's 4,000 gpd/in-mi) as well as the second highest inflow rate.
- The metered flow from subareas 4 and cumulative 9[7] indicate minor infiltration influence while the cumulative subarea 9 also indicates inflow influence in the recorded flow.
- Flow rates from the meters in subarea 7 and 13 were heavily influenced by the incoming flow from Millis and therefore difficult to parse out without 15-min flow records from the neighboring community.
- Similarly, the meter data from Subarea 11 and 12 is unreliable due to potential calibration issues compounded by the incoming flows from Franklin.

[7] Flow observed in subarea 9, without deducting the flow from contributing subareas (subareas 1, 1A, 2, 3, 5, 8, 14)

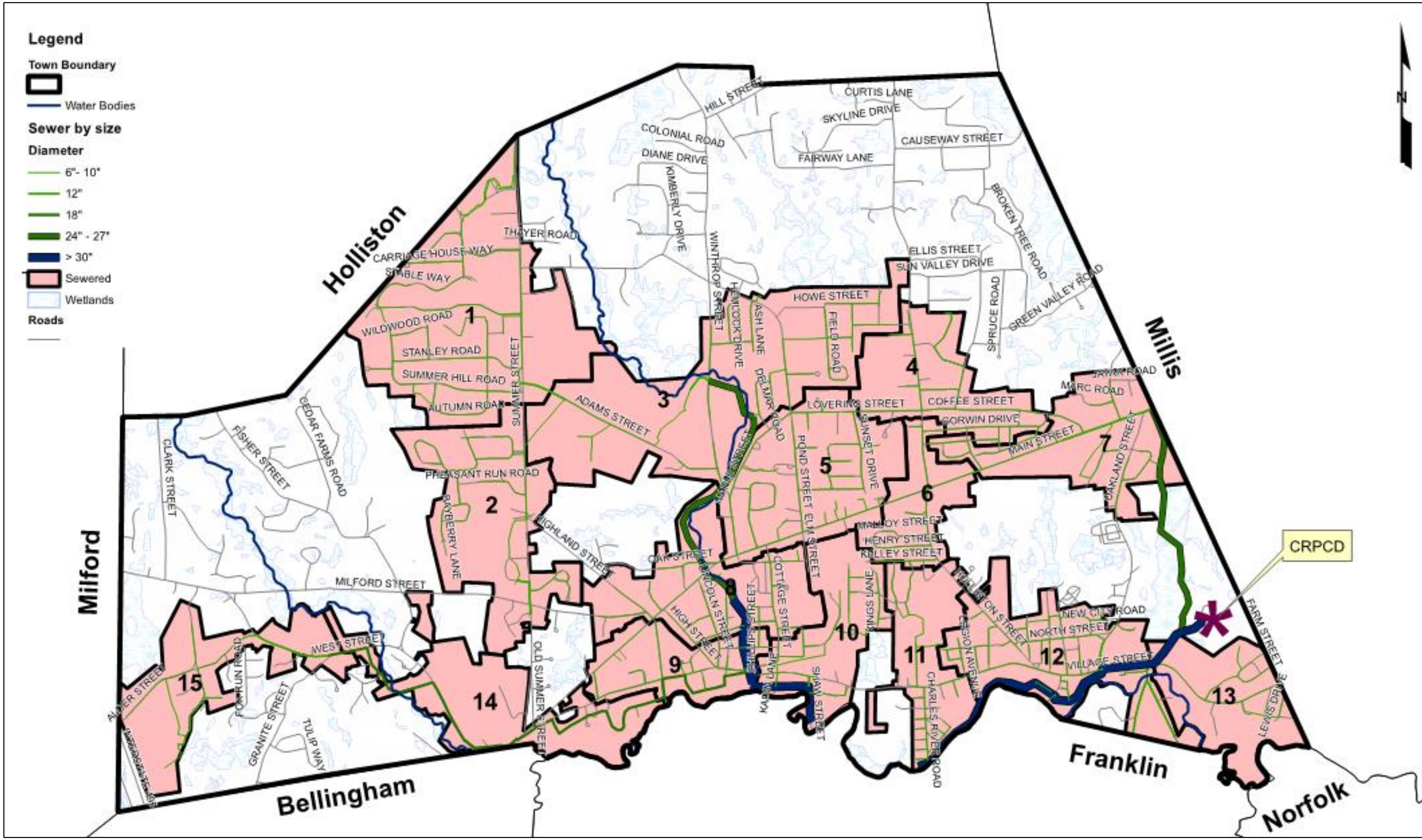

Figure 4-4: Sewer Subareas

4.4 Wastewater System Operations and Maintenance

The Town of Medway has implemented several preventative maintenance programs for the wastewater collection system, which include:

- *Cleaning, Inspection, and Maintenance Program:* Through this program the Town performs manhole inspections. Field crews take complete inventory of each manhole, take pictures to document defects, and record the information into the PeopleForm system. This information is then used to schedule maintenance and repairs.
- *Fats, Oil, and Grease (FOG) Program:* Through this program, the Town:
  - Disseminates educational information for commercial/ industrial facilities and residents to prevent fat, oil, grease, and grease-like products from forming obstructions in the network and causing sewer overflows,
  - Performs annual inspections and periodic sewer cleaning, specifically on sewers that service or are downstream of food service establishments.
- *Root Control Program:* Through this program the Town targets sewer pipelines with known root intrusion. Root intrusions are reported and recorded in the work order system. Reports of root intrusion are generated by contractors, by DPW personnel during CCTV inspections or by DPW personnel after responding to a sewer blockage call. Treatment for root control typically involves mechanical cutting of the roots.

Additionally, the Town of Medway performs regular maintenance on the force mains as well as weekly inspections of their pump station. In addition, the Town proactively tests the back-up generators on a monthly and bi-annual schedule.

4.4.1 Wastewater Collection System Improvements

A large percentage of the Town's more recent improvements or extensions were the result of new residential development. Over the past seven years, Millstone Village, Applegate Road, Neelon Lane, Summer Valley, and Broad Acres developments resulted in sewer extensions prior to the moratorium. Commercial expansions required construction of several new manhole structures (e.g. Cumberland Farms and John's Auto) and service has been extended as well to the commercial marijuana growing facility on Marc Road.

4.4.2 Rules and Regulations

Since 1970, the Medway Water and Sewer Department has established rules and regulations for the use of the wastewater collection system. The current sewer regulations were adopted in 1994 and include guidelines for the following:

- service connections,
- pumping stations,
- construction methods,
- material specifications,
- enforcement of proper design,
- user rates and fines, and
- regulations governing discharge to the CRPCD treatment facility.

4.4.3 Rates

The Town of Medway has three tiers of sewer rates, as shown in Table 4-5, based on water-use volume and customer classifications. Sewer service is billed quarterly along with the water bills.

Table 4-5: Medway's FY18 Sewer Rates

	Sewer Rates		
	Tier 1 (0-2000 cubic feet)	**Tier 2** (2,001 - 3,500 cubic feet)	**Tier 3** (>3501 cubic feet)
Residential	$5.88	$6.66	$8.81
Commercial	$5.88	$7.57	$9.91

4.5 On-Site Wastewater Management Systems

There are approximately 1,500 residences within the Town of Medway that utilize on-site wastewater disposal systems, as of 2017. This comprises just over 30 percent of the properties in Town. Most of these subsurface disposal systems consist of conventional septic systems. A conventional septic system consists of four main components that receive the wastewater from the building. The first is the septic tank, which allows the heavier solids and the lighter scum to be separated from the effluent. The second is the distribution chamber, which serves to direct flow evenly to the leaching field. The third is the leaching field, which may consist of a single bed, or two or more trenches, and serves to distribute septic tank effluent to the surrounding soil. The fourth component is the soil between the leaching field and the groundwater. It is this soil that provides much of the treatment for a conventional on-site system. Title 5 septic systems may also include a reserve leaching area for use if the primary leaching area fails. Conventional septic systems have a life-span of 20-30 years and typically require annual pump-out. Systems nearing the end of their functional life tend to require more frequent pump-outs.

4.5.1 Site Suitability

The Soil Survey for Norfolk County, Massachusetts (Northern Part), 1981, prepared cooperatively by the United States Department of Agriculture Soil Conservation District and the Massachusetts Agricultural Experiment Station can be used to help classify the top three to four feet of soil, which is instrumental in supporting the septic drain field. The soil survey classifies each soil based upon its limitation for use in subsurface wastewater disposal as slight, moderate or severe. As shown in Table 4-6, most of the Town's soil can be classified as severe, resulting in unfavorable conditions for septic systems. However, representatives from the Medway Board of Health have indicated that soil conditions are often observed to be better in the field than reference materials suggest.

Table 4-6: Soil Survey Classification

Classification	Definition of Classification	Reasons for Classification	Percentage of Town
Severe	Soil properties or site features so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required	Slow percolation, wetness, large stones, and slope.	92%
Moderate	Soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design	Large stones and slope	4%
Slight	Soils are generally favorable for the specified use and limitations are minor and easily overcome		2%
Unassigned		Typically fill material that is not native to the area	2%

4.5.2 Regulatory

Title 5 of the State Environmental Code serves to provide comprehensive standards with the goal of protecting public health and the environment in all communities of the Commonwealth where the use of on-site wastewater management systems is required. Title 5 prescribes the way subsurface sewage disposal systems should be located, designed, constructed, and inspected based on accepted standards and methods for the design, construction, maintenance, and repair of on-site systems under a wide range of conditions common to the Commonwealth.

The Medway Board of Health Code of Regulations governs the use of subsurface sewage disposal systems in Town. The Board of Health regulations adopted Title 5 of the State Environmental Code (310 CMR 15.00) as the local regulation, with superseding additions. Where full compliance to Title 5 is not feasible, the Board of Health can issue local upgrade approvals for existing systems. The purpose of the upgrade approval is to "allow for both the best feasible upgrade within the borders of the lot, and have the least effect on public health, safety and the environment" by "varying to the least degree necessary" from the regulations. The regulations outline several basic requirements that may not be varied by the local approving authority. If one or more of these requirements cannot be met in an upgrade, the owner shall apply to the DEP for a groundwater discharge permit, apply for the use of a tight tank, apply for a variance, or abandon the system. The owner may also construct an approved innovative/alternative technology system to meet the requirements.

4.5.3 Operations and Maintenance

The Town does not maintain an on-going, mandatory subsurface disposal system maintenance or inspection program. Per the Town's regulations, the Board of Health collects pump-out slips from service contractors. However, the Board of Health does not currently have a digital or automated way to track and/or identify failed systems within the Town. Septic system inspections are performed by the Health Department when there has been a complaint, or to comply with Title 5, which requires inspection of residential septic systems "at or within two years prior to the time of transfer of title of the facility served by the system", and if there is a change in facility use or modification to the design flow. A septic system is considered failing if it requires a pump out five or more times in one year. The IWRMP process found that many septic facilities in Town are not meeting their design intent, resulting in excessive pump outs or complete failure. This need is discussed further in Section 7.

5. Existing Domestic Water System

5.1 Public Water Supply

The Town's public drinking water supply is drawn entirely from the Charles River Basin through four gravel packed groundwater wells located in the eastern/southeastern portion of Town as shown in Figure 5-1 and described in Table 5-1. The wells are in two separate sub-basins within the Charles River Basin (Bogastow Brook sub-basin and Charles Chicken Brook to Stop River sub-basin). The two sub-basins are categorized under the WMA Regulations (310 CMR 36.00) as Groundwater Withdrawal Categories 4 and 5. These classifications require Medway to:

- Minimize existing negative withdrawal impacts to the greatest extent feasible
- Prioritize conservation and water loss reduction

Table 5-1: Groundwater Wells Summary

Well No./ Name	Charles River Subbasin Name & Subbasin ID #	Groundwater Withdrawal Category	Year Built	Screen Diameter (in)	Depth (ft)	Pump (hp)	TDH (ft)
1 - Water St/ Populatic	Charles Chicken Brook, #21162	5	1943 (Deepened 2000)	24	61	40	295
2 -Oakland Street	Bogastow Brook, #21132	4	1964	24	59	60	265
3 -Village Street	Charles Chicken Brook, #21162	5	1976 (Replaced 2008)	18	86	60	292
4 -Industrial Road	Bogastow Brook, #21132	4	2008	24	86	60	300

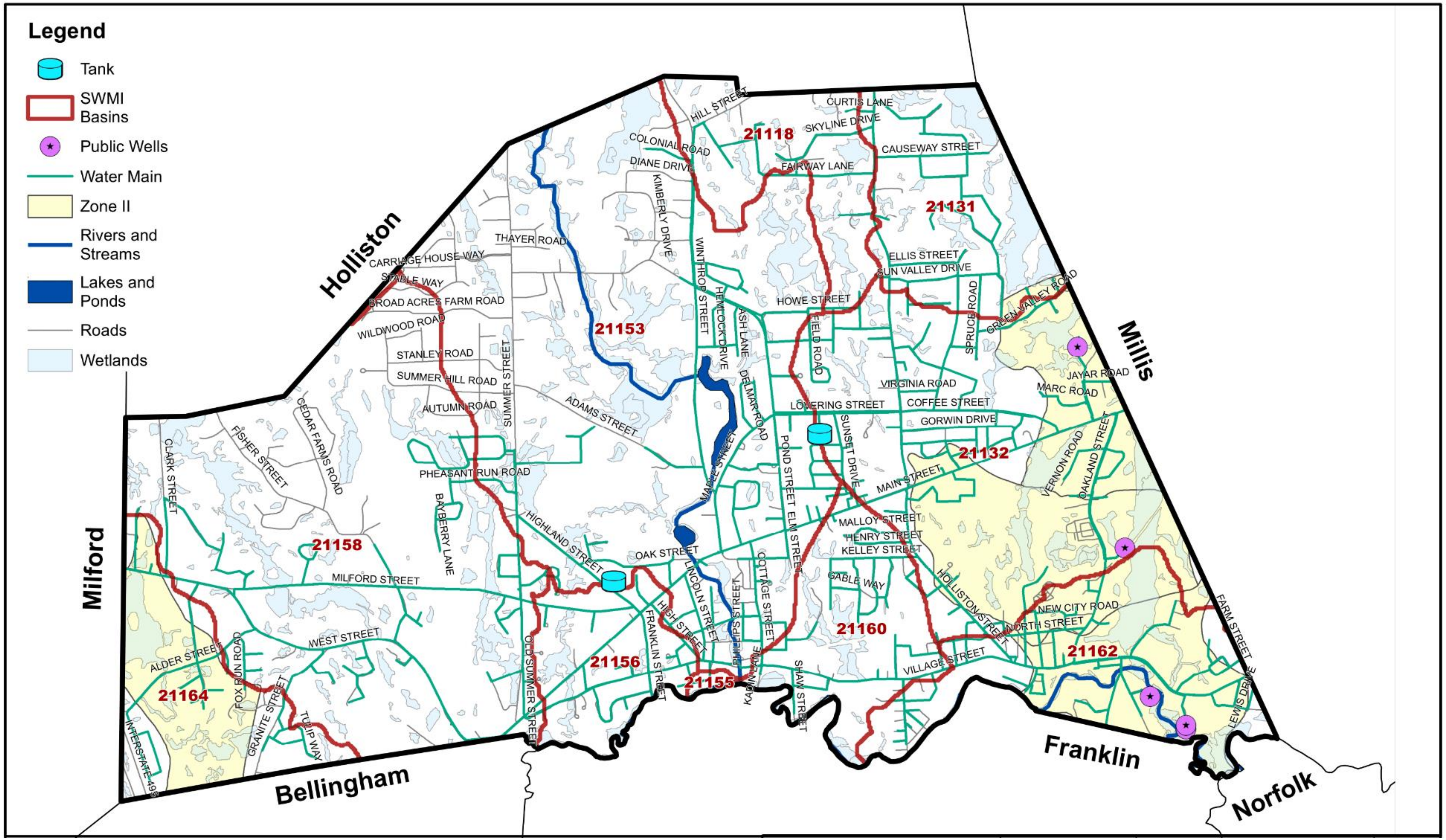

Figure 5-1: Town of Medway Drinking Water Supply/Distribution System

5.1.1 Water Withdrawal Limits

Medway currently has a WMA Permit with an annual maximum raw water withdrawal limit of 0.92 MGD on an average daily basis (335.8 MG annually). In 2019, the authorized volume will increase to 0.94 MGD (343.1 MG annually) and in 2024 it will increase to 1.00 MGD (365 MG annually). The 1.00 MGD limit includes a 5% buffer designed to accommodate uncertainty in growth projections used in setting the limit and/or to accommodate the water demand of a community that has not achieved water use performance standards but demonstrates meeting functional equivalence requirements (discussed further in the Water Needs Assessment in 7.2.7).

The Town has discretion to pump their four groundwater wells in any combination to meet demands, provided two requirements from the Town's WMA Permit are met:

- Average daily withdrawal from all four wells combined is less than or equal to the maximum authorized annual withdrawal (currently 0.92 MGD) over the course of a calendar year; and
- No groundwater sources are pumped above their safe yields (shown in Table 5-2) at any time.

A safe yield represents the maximum daily withdrawal that can be made at an individual groundwater source. This safe yield is set by the WMA Permit to ensure that neither the well nor the aquifer contributing to the well are ever overstressed. The sum of all the safe yields is the maximum total daily withdrawal available to the Town should it need to meet atypical peak or emergency demands (i.e. firefighting) on a short-term basis. The safe yields for each groundwater source are presented in Table 5-2. It is also important to note that anytime the Town pumps above the permitted average daily withdrawal limit, enough corresponding days where pumping is below the average will be necessary to ensure that the current annual average limit of 0.92 MGD is met. Actual well yields depend on operational considerations and current well conditions, which can be described by the Maximum Daily Output (MDO) and Reliable Daily Output (RDO):

- MDO is the supply volume pumped at full capacity for an assumed 24 hour run time.
- RDO is the supply volume pumped under normal conditions for an assumed run time of 16 hours per day.

Although these are not regulatory parameters, it is important to evaluate the MDO and the RDO of the wells in relation to current and projected future demands when evaluating supply adequacy.

Table 5-2: Source Safe Yield and Available Water Supply

Source Name	Design Capacity (MGD)	WMA Permit Maximum Daily Withdrawal (MGD)	Available Withdrawal (MGD)	
			Current Maximum Daily Output (MDO)	Current Reliable Daily Output (RDO)
Populatic Street Well	0.86	0.87	0.612	0.408
Oakland Street Well	0.59	0.59	0.396	0.264
Village Street Well	1.01	0.66	0.576	0.336
Industrial Road Well	0.66	0.475	0.324	0.207
Total	**3.12**	**2.60**	**1.908**	**1.215**

As can be seen in Table 5-2, the original design capacity and the authorized maximum withdrawal are both significantly higher than the actual current well performance (both MDO and RDO). This limitation in supply capacity is discussed in Section 7.2.

5.1.2 Water Supply Treatment and Limitations

Medway's water supply requires regular treatment prior to distribution to the public. The Town utilizes the following treatment processes for its drinking water supply.

Table 5-3: Drinking Water Treatment Processes in Medway, MA

Treatment	Technology/Chemical
Corrosion Control	Lime, polyphosphate
Disinfection	Sodium hypochlorite
Fluoridation	Sodium fluoride
Iron & Manganese Control	Sequestration with polyorthophosphate

The Town currently uses sequestration, by adding polyorthophosphate to groundwater at the well head, to control potential aesthetic problems caused by iron and manganese. MassDEP guidelines allow sequestering of iron and manganese if their combined levels are below 1.0 mg/L. The polyphosphate also enhances the corrosion control program. The use of sequestering is effective and permitted for the Populatic Street, Village Street, and Industrial Road wells.

Sequestration is not effective for the Oakland well since the iron and manganese levels are regularly in excess of 1.0 mg/L.

Iron and manganese are currently listed by the U.S. EPA and MassDEP as secondary contaminants. Secondary contaminants are regulated based on aesthetics such as color and odor rather than toxicity and adverse health effects like primary contaminants. The MassDEP publishes a list of Secondary Maximum Contaminant Levels (SMCLs) for secondary contaminants. The SMCL for iron is 0.3 mg/L and the SMCL for manganese is 0.05 mg/L. Additionally the MassDEP suggests that infants less than one year of age should not be fed formula made with water having an excess of 0.3 mg/L of manganese for extended periods of time. The Oakland Street well regularly exceeds the SMCL for both iron and manganese. As such, the Oakland Street Well is currently only used for short term spikes in demand or as necessary if another well is taken offline for repairs. Additionally, the Village Street Well frequently contains manganese above the action level for infants and at times has exceeded 1 mg/L. While levels of iron and manganese at the Populatic Street Well are at or below the SMCL, continued heavy reliance and increased pumping rates at this well could increase iron and manganese concentrations. The Industrial Park Well does not exhibit iron or manganese concentrations above the SMCLs. MassDEP has recommended that Medway begin to evaluate ways to reduce levels of iron and manganese in the public drinking water (Haley & Ward 2017).

The Town's long-term capital plan includes the construction of a water treatment facility to remove iron and manganese. Once this facility is constructed, the Oakland Street Well could be utilized to likely supply up to 0.26 MGD, assuming a recommended operational run time of 16 hours per day. This additional supply volume would increase the ability of the system to meet demands if any of the other wells needed to be taken offline for an extended period.

5.1.3 Private Water Supply

In addition to the public water supply, the Town of Medway issues permits for private wells through the Board of Health. A total of 51 irrigation wells have been permitted, along with 385 private drinking water wells throughout five well districts. 77% of all private wells are in the northwestern portion of Town. Given the estimated population served by the municipal system, approximately 28% of residents receive water from private supply wells. If the public water supply were to be extended to all private well users, it would add approximately 0.25 MGD of additional demand.

5.1.4 Intermunicipal Water System Connections

Medway has several potential emergency interconnections with neighboring communities: Bellingham, Franklin, Millis, and Milford (Milford Water Company). However, the Town reports that only the connection with Milford has been used (and is hydraulically able) to provide water to Medway. Furthermore, although interconnections exist between the systems, there are no formal agreements, operational triggers, or emergency equipment in place for the use of the interconnections. Milford Water Company also has challenges with supply availability and should not be relied on as the sole emergency source for Medway. Hydraulic and water quality compatibility is currently unknown and would need to be analyzed for each connection to determine the feasibility and equipment required for reliable emergency water transfers between the communities. This was evaluated conceptually for a Millis interconnection (Kleinfelder, Exelon Millis study, 2016), and the most favorable location recommended was at Village Street but would require construction of a pressure booster station

5.2 Water Distribution System

Medway's water distribution system includes 75 miles of water mains ranging from 6-inch to 12-inch in diameter, excluding service pipes, and 577 hydrants. Table 5-4 provides a summary of the water distribution system.

Table 5-4: Distribution System Pipe Sizes

Pipe Diameter	Total Length (miles)	Percentage of System
< 6"	2	3%
6"	20	26%
8"	38	48%
10"	4	5%
12"	14	18%

Most of the distribution system is comprised of 8-inch distribution mains, with 12-inch water mains providing transmission throughout the Town. More than a quarter of the system is 6-inch or smaller mains. Smaller mains may not be able to provide adequate fire flow, depending on the system pressures. Best practice is to replace 6-inch water mains with 8-inch or greater, depending on fire flow needs. Conversely, installing a main that is too large can result in stagnant water. The Weston & Sampson 2010 Water System Master Plan identifies several areas as having fire flow deficiencies. The Town has made progress in replacing water mains that do not provide adequate fire flow, however, further upgrades are still required.

The original water system was constructed circa 1911 using unlined cast iron pipes. Around 1930, the Town began installing cement lined cast iron to protect the interior pipe wall from corrosion. The Town continues to monitor pipes which exhibit leaks and breaks for consideration for replacement. Modern pipe materials utilize ductile iron or polyvinyl chloride (PVC).

5.2.1 Water Distribution Storage

The distribution system consists of a single pressure zone with two tanks providing storage, as shown in Figure 5-1:

- Highland Street Tank – standpipe originally constructed in 1911, was fully replaced in 2011 with a new 0.8 MG welded steel tank, and
- Lovering Street Tank - standpipe constructed in 1964, is a 1.8 MG welded steel tank.

These tanks require regular cleaning and maintenance to sustain their structural integrity and protect water quality.

5.2.2 Past Studies

Medway has completed several studies of the domestic water system in recent years, including:

Water System Master Plan, 2010

Weston & Sampson concluded in the 2010 Water System Master Plan that the Town's transmission system needed to be strengthened. The single transmission main to service the Town creates vulnerability due to lack of redundancy, several areas had fire flow deficiencies, and the Highland Street Tank needed rehabilitation. The Water System Master Plan also recommended a multi-year construction improvement program including transmission main improvements in Highland Street, Holliston Street, Main Street, Village Street and West Street; various water main replacements to improve fire flow capacities and replace older small diameter unlined mains; abandonment of parallel mains, and the construction of a new tank at the site of the Highland Street Tank. Since the time of the report Medway has fully replaced the Highland Street tank and completed several of the recommended transmission main improvements.

Exelon Supply Adequacy Study, 2015

In 2015, Kleinfelder completed a study of the feasibility of providing potable water to supply an expansion of the Exelon Power facility in West Medway. The study examined the adequacy of Medway's system to meet the water demand of the proposed facility as well as potential solutions to address any limitations of the water system. The study found that Medway's current water supply was not adequate to meet near-term demands or future demands of the Exelon facility. Kleinfelder recommended that Medway continue to implement conservation efforts to minimize groundwater withdrawals, apply for a new WMA Permit with an increased withdrawal volume, supplement supply with routine well cleaning and redevelopment, and fund projects such as the installation of a satellite well and construction of a water treatment facility.

Water System Integrity Report, 2017

In 2017, Haley and Ward, Inc. evaluated treatment options for the Town to address the elevated levels of iron and manganese entering the distribution system from certain supply wells. The report analyzed solutions including new groundwater sources, individual treatment at the well locations, and a centralized treatment facility. The Water System Integrity Report concluded that the most cost-effective approach to solve the water quality issue would be to construct a centralized water treatment facility at the Populatic Well location.

5.3 Water Consumption

The public water distribution system serves 3,610 service accounts[8], 3,366 of which are residential accounts. Based on the 2010 census average household size of 2.84 people, this equates to a service population of nearly 9,600 people, or approximately 72%[9] of the Town's population. Table 5-5 provides a summary of historic water consumption for Medway based on data provided in the MassDEP Public Water Supply Annual Statistical Reports (ASR).

Table 5-5: Medway Historic Water Usage, Annual

Year	Total Annual Finished Water Pumped (gallons)
2012	362,427,000
2013	391,007,000
2014	408,951,000
2015	303,174,000
2016	287,526,000

The Town experienced a significant increase from 2012-2014 which can be attributed to a leak in the system. In 2014, during an inspection and sampling program within the stormwater system,

[8] According to the Town's Annual Statistical Report (ASR) submitted to the Department of Environmental Protection (MassDEP) for Reporting Year 2016.

[9] The 2016 ASR Medway incorrectly reported serving 100% of the population, resulting in an underestimated value for residential water usage of approximately 37 residential gallons per capita per day (RGPCD).

Medway found that water discharging from a stormwater outfall during dry weather had chlorine levels similar to the Town's drinking water chlorine levels. This inspection led to identification of a 0.237 MGD leak from a drinking water main. Pumping data for 2015 shown in Table 5-5 demonstrates the impact of fixing this leak. Overall water demand has decreased further in recent years, attributed in part to conservation efforts.

Water consumption is classified into six different categories. These categories include the following:

- Residential – Water used in residential dwellings for drinking, bathing, sanitation and outdoor use.
- Commercial/Business – Water used in retail business, restaurants, and service garages.
- Residential Institutional – Water used in group residential facilities, such as nursing homes.
- Agricultural/Industrial – Water used in manufacturing process plants or in irrigation uses.
- Municipal – Water used in municipal buildings such as Town Hall and public schools. Also includes Confidently Estimated Municipal Use (CEMU).
- Unaccounted-For Water (UAW) – Unmetered water, used in hydrant flushing, firefighting, water main leaks and inaccurate meters. Ninety-nine percent of the water services in Medway are metered, including the Town's municipal buildings.

Table 5-6 summarizes the approximate percentage of finished water, used by various consumer types during the 2016 reporting year.

Table 5-6: Water Usage by Consumer Type, 2016 ASR

Consumer Type	Approx. Usage as Percentage of Pumped Finished Water (%)
Residential	63
Commercial/Business	5.5
Residential Institution	4
Agricultural/Industrial	3
UAW	17
Municipal	7.5

The details of water consumption by each consumer type is examined further below. During the 2014 reporting year, Medway's reported metered residential volume was significantly larger than the average reported volume. Similarly, the other metered use categories are all substantially lower than average reported volumes. It is believed that a reporting or metering error occurred during 2014 and that values shown are not representative of actual use patterns. As such, 2014 metered volumes are presented in the tables below but are not included in the calculation of averages.

5.3.1 Residential

Residential water consumption is directly related to the service population, outdoor water use and how much water each person consumes. Medway implements an outdoor water ban that is in effect from May 1 through September 30. In-ground irrigation systems are prohibited at all times. Outside watering of all types is not permitted between the hours of 9am and 5pm. Hand watering is permitted on an odd-even basis. Residential water use is typically examined by residential gallons per capita per day (RGPCD), which provides insight into how residents consume water. MassDEP has established a statewide performance standard of 65 RGPCD. The calculation of this statistic is highly dependent on population estimates. Using MassDEP's method to calculate the service population, Medway's historical average daily residential water consumption is presented in Table 5-7.

Table 5-7: Medway Historic Residential Water Usage

Year	Residential Metered Water Usage (gpd)	Percent of Total Water Use	Per Capita Consumption (RGPCD)
2012	516,312	52%	56
2013	563,612	53%	60
*2014**	*689,139*	*62%*	*73*
2015	509,209	61%	54
2016	496,509	63%	52
Average	521,411	56%	55.5

*Reporting error

Residential water use makes up most of Medway's consumption, averaging approximately 56 percent of the total water use from 2012 through 2016, excluding 2014. As shown above, Medway's residential water consumption has consistently met the MassDEP performance standard of 65 RGPCD, except for the 2014 reporting year which is presumed to be an error as is described above.

5.3.2 Commercial/Business

Commercial water consumption is dependent on the number and types of businesses within Medway. For the 2016 reporting year, Medway reported 152 commercial service connections. Medway's historical average daily commercial water consumption is presented in Table 5-8.

Table 5-8: Medway Historic Commercial Water Usage

Year	Commercial Metered Water Usage (gpd)	Percent of Total Water Use
2012	41,682	4.2%
2013	56,772	5.3%
*2014**	*6,099*	*0.5%*
2015	41,336	5.0%
2016	43,579	5.5%
Average	45,842	5.0%

*Reporting error

5.3.3 Residential Institutional

Residential institutional use accounts for water used in housing facilities such as nursing homes. Medway has reported having a total of 17 residential institutional service connections for each of the last five reporting years. Medway's historical average daily residential institutional water consumption is presented in Table 5-9.

Table 5-9: Medway Historic Residential Institutional Water Usage

Year	Residential Institutional Metered Water Usage (gpd)	Percent of Total Water Use
2012	46,436	4.7%
2013	38,608	3.6%
*2014**	*4,366*	*0.4%*
2015	32,306	3.9%
2016	30,084	3.8%
Average	36,859	4.0%

*Reporting error

5.3.4 Agricultural/Industrial

Agricultural and Industrial uses are reported separately in the ASR. However, Medway consistently reports less than 1 MG of agricultural water use on an annual basis. This includes water used to grow food, raise animals, or run a garden center. For the purposes of this report agricultural and industrial uses are treated as a single category. Medway's historical average daily agricultural and industrial water consumption is presented in Table 5-10.

Table 5-10: Medway Historic Agricultural/Industrial Water Usage

Year	Agricultural/Industrial Metered Water Usage (gpd)	Percent of Total Water Use
2012	20,450	2.1%
2013	31,470	2.9%
*2014**	*3,930*	*0.4%*
2015	25,615	3.1%
2016	24,789	3.1%
Average	25,581	2.8%

As with the previous usage categories, Medway reported the 2014 agricultural and industrial consumption volume to be much lower than the other years shown, however, no significant decrease in the number of agricultural and industrial accounts was documented. Excluding the 2014 value, Medway's agricultural and industrial users consume about 25,581 gpd on average, which is approximately 2.8% of the total water demand.

5.3.5 Municipal

Within the ASR, metered municipal uses and CEMU are reported separately. However, in this section of the report the volumes are summed to analyze Medway's total municipal use. Medway's historical average daily municipal use is presented in Table 5-11.

Table 5-11: Medway Historic Municipal Water Usage

Year	Municipal Water Usage (gpd)	Percent of Total Water Use
2012	80,553	8.1%
2013	99,341	9.3%
*2014**	*278,061*	*25%*
2015	62,215	7.5%
2016	57,063	7.2%

Over the last five reporting periods, Medway's municipal use has averaged approximately 8.0% of the total Town water consumption. In 2014, Medway reported a large spike in municipal use. This was due to Medway reporting a large volume of water lost as the result of a large, long-term water main break as part of their CEMU volume. This value is not considered representative of Medway's annual municipal use and is not included in the average use value presented above.

5.3.6 Unaccounted-for Water

Unaccounted-for water (UAW) is determined by comparing the total volume of water pumped into the distribution system (i.e. metered at the source) with the actual amount of water delivered to customers (i.e. metered for each account). MassDEP has established a statewide performance standard of 10% every year. UAW data for years 2012 through 2016 is presented in Table 5-12 and shown in Figure 5-2.

Table 5-12: Medway Historic Unaccounted for Water

Year	Unaccounted for Water (gpd)	Percent of Total Water Use
2012	204,145	29.0%
2013	281,449	26.3%
2014	278,061	12.4%
2015	158,904	19.3%
2016	135,616	17.2%

As shown in Table 5-12 and below in Figure 5-2, UAW has exceeded the performance standard of 10% in each of the last five reporting periods, averaging approximately 21% over that period. However, Medway has been making progress towards reducing UAW in recent years as the Town continues to address the problem by:

- implementing a full meter replacement program from 2010 to 2012,
- reviewing large meters for potential downsizing,
- replacing several older unlined cast iron water mains,
- calibrating the Town's four source meters annually,
- performing more frequent leak detection surveys.

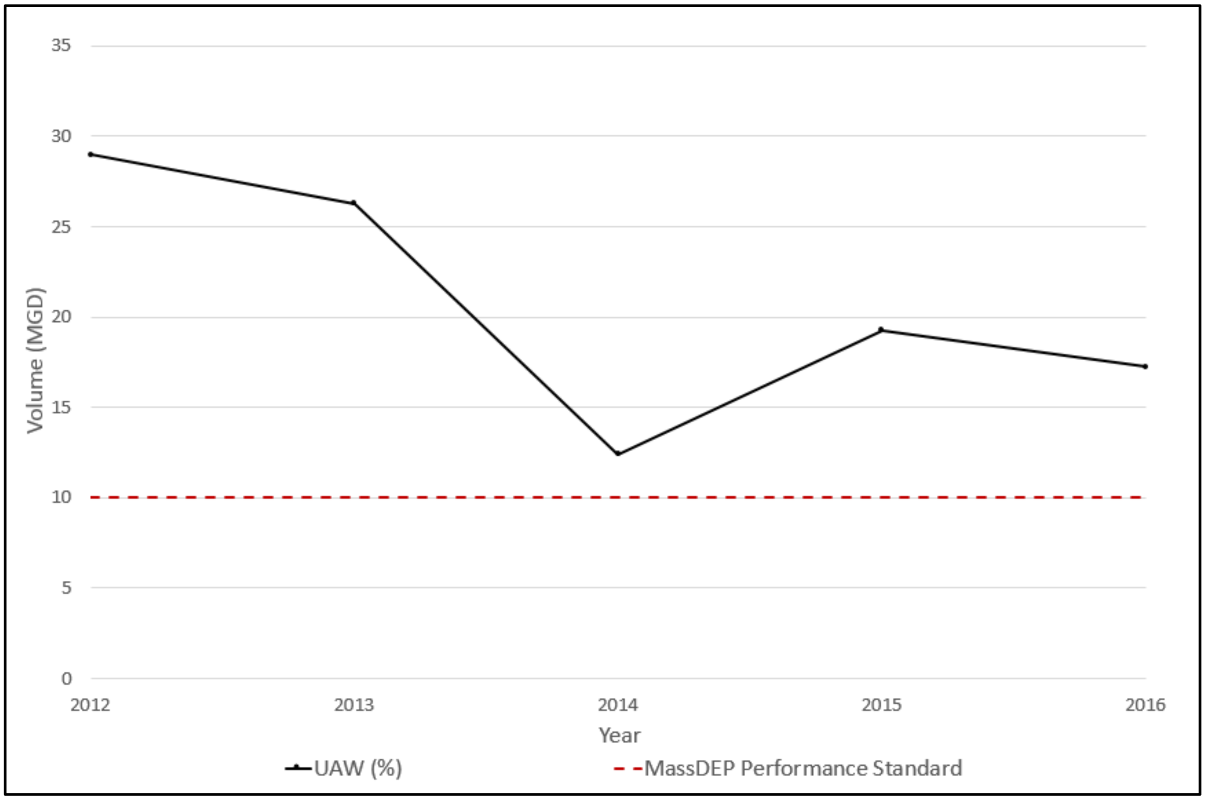

Figure 5-2: Unaccounted for Water 2012-2016

In 2011, a leak detection survey identified five (5) leaks that accounted for 0.05 MGD (18.25 MGY) of UAW. All leaks were repaired at the time of the leak detection survey. A follow-up leak detection survey in 2014 identified a total loss of 0.52 MGD from six (6) leaks. Two of the major leaks, an estimated 0.50 MGD, were found to be from water mains. Following repairs, the Town later revised the estimated volume lost from the water main breaks to be approximately 0.25 MGD. All leaks and water main breaks were repaired following the leak detection survey. The most recent leak detection survey was completed in December of 2017 and identified a total of eight (8) leaks totaling approximately 0.12 MGD in losses. All 8 of the leaks were detected on residential service lines, three of the leaks were repaired by the leak detection contractor at the time of the survey and the remainder were repaired by the Town shortly thereafter.

Ongoing efforts to reduce UAW were recommended in a letter to the Town in November 2014, by Kleinfelder. In addition, Medway has a Town-wide UAW Compliance Plan, which it is working on implementing.

5.3.7 Average Daily Demand

Average Daily Demand (ADD) is calculated by dividing the total annual water consumption by 365 to get the volume of water consumed on an average daily basis. Medway's ADD for the last five reporting periods is shown in Figure 5-3.

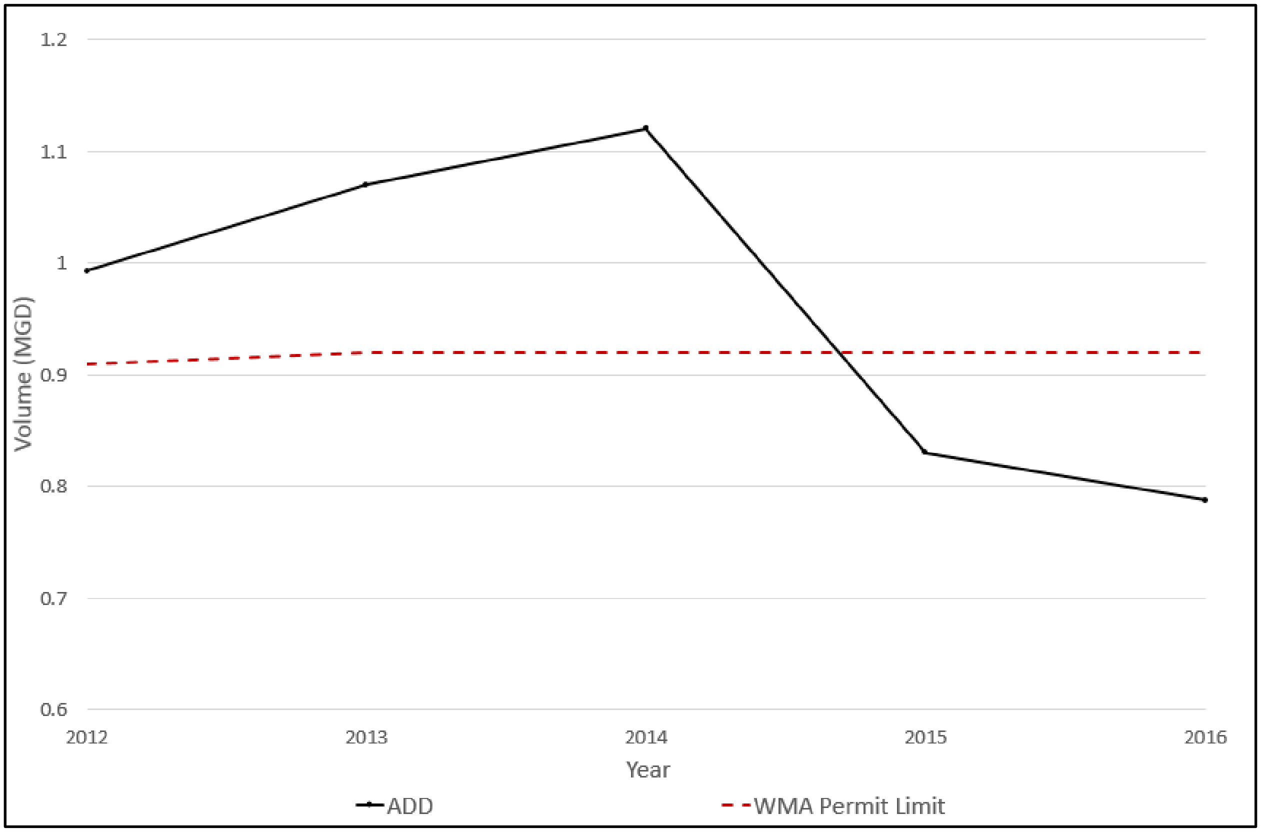

Figure 5-3: Average Daily Demand 2012-2016

As shown above, Medway's ADD exceeded their WMA permitted withdrawal volume in three of the last five reporting periods. However, recently Medway has been able to reduce their ADD below the WMA permitted withdrawal limit of 0.92 MGD. The sharp reduction in ADD observed between the 2014 and 2015 reporting years is attributed to the repair of large water main leaks as discussed in the previous section.

5.3.8 Maximum Daily Demand

Maximum Daily Demand (MDD) is reported as the largest volume supplied during the reporting year for a single 24-hour period. Medway's MDD data for the last five reporting periods is shown below in Figure 5-4. As shown in Table 5-2, Medway's WMA permit defines a safe yield for each of its four sources. The sum of these values is the maximum daily withdrawal allowed by their WMA permit. However, Medway's supply wells are not currently capable of producing near this volume, as discussed in Section 7.

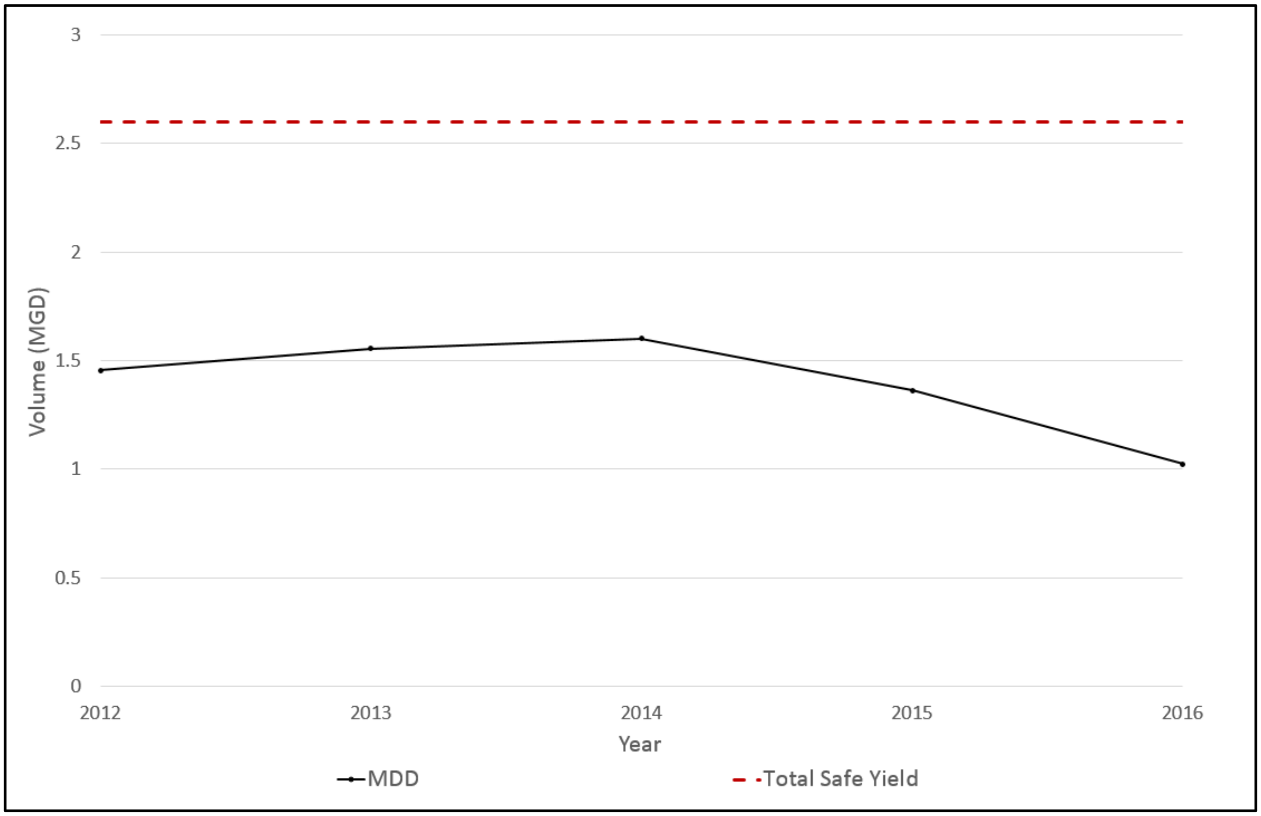

Figure 5-4: Maximum Daily Demand 2012-2016

Medway has experienced a recent decline in MDD that coincides with the decline in ADD. This decline can be attributed, in part, to the large leak repairs performed in 2014. Typically, the MDD of a distribution system is approximately 1.5 times the ADD. In the most recent reporting year Medway's MDD was only 1.3 times the ADD. This is an indication that water bans and other conservation measures may be successfully contributing to demand conservation during dry summer months.

5.3.9 Peak Hour Demand

Peak hour demand is defined as the maximum amount of water used in a 60-minute period and typically occurs within the 24-hour MDD period. Typically, peak hour demands are satisfied through distribution storage, rather than from supply sources. Peak hour demand is not required to be reported on the ASR. The Weston & Sampson 2010 Water System Master Plan uses the ratio of 1.5 times MDD to estimate peak hour demand. Figure 5-5 applies this ratio to Medway's most recent MDD data to estimate peak hour demand.

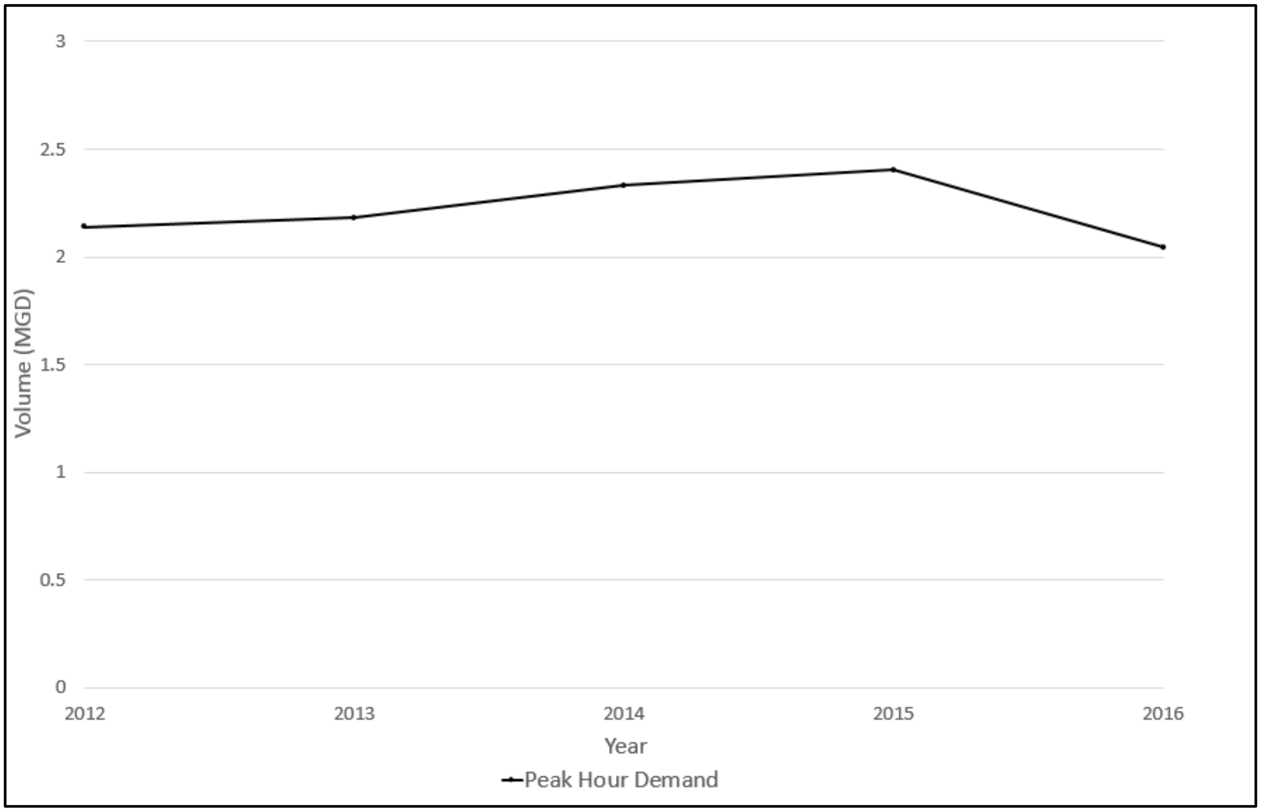

Figure 5-5: Estimated Peak Hour Demand 2012-2016

5.4 Water System Operations and Maintenance

The Town of Medway Water Department is responsible for maintaining the drinking water distribution system and its various components. Recently, the Water & Sewer Commission has undertaken numerous capital improvement projects aimed at increasing system performance and resiliency. The improvement projects consisted of:

- replacement of all water meters,
- construction of a new storage tank at the Highland Street location, and
- replacement of several older unlined mains on Main, Village, West, Highland, Adams, and Winthrop Streets.

In addition to completing capital improvement projects the Water Department performs operations and maintenance activities. These activities include but are not limited to:

- daily manual monitoring of the treatment processes,

- monitoring and maintenance associated with the SCADA system,
- leak detection,
- routine hydrant flushing, and
- response to service calls regarding water quality concerns and leaks.

5.4.1 Bylaws

The Medway Water & Sewer Division Rules and Regulations were last revised in April 2017 and are available on-line. Article IV describes general water regulations while Article V describes construction standards. In addition, The Town has the authority under Section 5 of the bylaws to:

- restrict water use,
- declare mandatory water bans,
- restrict outdoor watering to odd/even days based on property address,
- restrict outdoor watering to periods of low demand,
- restrict outdoor watering completely,
- prohibit the filling of swimming pool, and
- prohibit the use of automatic sprinklers as part of a declaration of a State of Water Supply Conservation. Section 5a of the Town bylaws lists additional regulations regarding automatic sprinkler systems within the Town of Medway.

5.4.2 Water Conservation

Public education is a key factor in water conservation. The Medway Water Department publishes water conservation information on the Town's website, in the Water System Annual Quality Report, and in customer's water bills. In August 2013, the Town started mailing water bills on a quarterly basis to replace the previous semi-annual combined water, sewer, and trash bill. Frequent water billing typically helps to conserve water by making consumers aware of their most recent water use. Recommendations have been made in the past to consider a monthly water billing system to assist customers in tracking their water use, especially during the high peak summer months. Having only recently implemented quarterly billing, the Town does not intend to switch to monthly billing at this time.

The Town has recently implemented a software change that will allow customers to view monthly water use through an online account. The Town hopes that this effort will raise awareness among customers like the awareness projected by a monthly billing cycle. Medway has worked diligently to conserve the drinking water supply. In accordance with their WMA Permit, the Town has imposed outside water use restrictions in times of drought. In addition, the Town has a Low Flow Water Fixture Kit program that allows water users to order free showerheads, aerators, and toilet leak detection dye tablets once per quarter.

5.4.3 Water Rates

As shown in Table 5-13, the Town of Medway has three tiers of water rates based on water use volume for each of their three customer classifications. Medway's current rate schedule was approved in June 2017. This tiered billing structure provides customers with an additional financial incentive to conserve water by offering lower rates for accounts which consume the least.

Table 5-13: Medway's FY18 Water Rates

	Water Rates		
	Tier 1 (0-2,000 cf)	Tier 2 (2,001-3,500 cf)	Tier 3 (>3501 cf)
Residential	$7.17	$8.63	$10.87
Commercial	$7.62	$9.74	$11.75
Irrigation	$10.47	$13.78	$16.99

6. Existing Stormwater System

Stormwater is an integral water resource asset in Medway. Through infiltration of pervious surfaces, it contributes to recharge of local aquifers from which groundwater is withdrawn and contributes to base flow of rivers and streams. Proper management of stormwater also protects water quality and thereby allows primary and secondary contract recreation in receiving water bodies. This chapter will describe the municipal stormwater drainage system.

The Town of Medway's stormwater management program includes the operation and maintenance of, and improvements to, the municipal stormwater drainage system. The stormwater system collects surface runoff from rainfall events and snowmelt and conveys that runoff to receiving waterbodies. Historically, the primary (if not only) purpose of a municipal drainage system was flood protection/mitigation and public health and safety. The stormwater system, however, also promotes other aspects of the natural water cycle, such as rainwater storage and groundwater infiltration. The water quality impacts from stormwater runoff, storage, and infiltration to the receiving waterbody and quantity have become a primary concern of environmental regulators and activists. Through the NPDES regulatory program under the Clean Water Act, the EPA regulates stormwater discharges from municipal separate storm sewer systems (MS4s). The Town is currently a permittee under the revised 2016 MS4 Permit (2016 Permit), effective July 1, 2018, which replaced the previous 2003 MS4 Permit and its subsequent revisions and updates. Section 6.4 presents a detailed review of the MS4 Permit requirements.

6.1 Surface Waters

As presented in Section 3, the eleven sub-basins in Medway are associated with eight waterbodies: Black Swamp Brook, Charles River, Chicken Brook, Hopping Brook, Stall Brook, an unnamed tributary to Bogastow Brook, and two unnamed tributaries to Lake Winthrop. Stormwater runoff within these watershed sub-basins has a direct impact on the water quality of these waterbodies. The waters of the United States are defined by 40 CFR 230.3(s), and may be paraphrased as the inter- and intrastate waterbodies, tidal flats, and adjacent wetlands that may be used for commerce, recreation and as habitat for flora and fauna. Some of these waterbodies in Medway suffer from water quality impairments (see Section 6.4 for more details). These impairments may hinder commerce and recreation, or potentially impact public health and the environment. The MS4 program requires that the community evaluate their municipally owned and operated stormwater system to identify impacts their management of the system may have on local waterbodies and mitigate those impacts to the maximum extent practicable.

6.2 Municipal Stormwater Infrastructure

Stormwater in Medway is captured and conveyed to its local waterbodies by “grey” stormwater infrastructure such as catch basins, manholes, pipes and outfalls, as well as” green” stormwater components such as overland channels, ditches, and swales. Drainage pipes vary in size from about 6 to 48 inches in diameter, and typical pipe materials include reinforced concrete (RC), vitrified clay (VC), polyvinylchloride (PVC), and ductile iron (DI). The stormwater manholes are typically 4-foot diameter precast concrete structures. The overall drainage system for which the Town is legally responsible under their MS4 permit includes other elements such as town-owned stormwater treatment structures and interconnections with other MS4s.

The inventory and mapping of Medway’s stormwater collection system is part of their 2016 MS4 Permit requirements. The Town continues to document the extent of its stormwater collection system through field investigations and record research. As part of illicit discharge detection and elimination (IDDE) investigations of 2015 under Phase I of the IWRMP, Kleinfelder used the Town’s record drawings to plot all initially known outfalls in the Medway stormwater system. An outfall which is jurisdictional under the Clean Water Act (and as such the MS4 permit) as defined by 40 CFR 122.2 and 122.26(b)(9), is “any discernible, confined and discrete conveyance” where an MS4 discharges to waters of the United States. This does not include open conveyances between MS4s or closed conduits used to convey waterways. As of the summer of 2017, the Town had identified 425 stormwater outfalls[10]. The Town maps additional outfalls as they are discovered and classifies them as jurisdictional or non-jurisdictional outfalls with respect to the MS4 Permit. The categorization of stormwater outfalls following the 2015 and 2017 inspections is shown in Table 6-1. The Town has also identified and located 2,122 catch basins through their field investigations[11]. By date of this report publication, the Town’s staff consider the inventory of stormwater outfall and catch basins to be about 95% complete.

[10] Source: PeopleGIS, accessed Summer 2017
[11] Source: PeopleGIS, accessed Summer 2017

Table 6-1. Categorization of Stormwater Outfalls

	2015	2017
Total Stormwater Outfalls in Medway	276	425
MS4 or suspected MS4 Outfalls	222	319
Non- MS4 Outfalls	54	106

The Town created a geographic information system (GIS)-based set of maps depicting Medway's stormwater system infrastructure. These GIS maps contain the updated 2017 set of stormwater outfalls and catch basins. Further efforts have advanced the existing stormwater manholes and pipes inventory in GIS using record plans and hand sketched drawings from the Town. Approximately 20% of the stormwater pipes and manholes, primarily around the downtown/commercial areas, have been incorporated into these Town-wide GIS maps. The Town continues to document the existing stormwater network making updates to the GIS maps as needed. The Town's GIS database also includes information on the streams and waterbodies to which Medway's MS4 discharge, and the initial delineation of catchments based on the 2015 inventory of outfalls. The database does not yet contain information about the Town's green infrastructure components, MS4 interconnections, or Town-owned stormwater treatment structures/BMPs.

6.3 System Performance

During the outfall inventory work of 2015, field crews performed assessments of the stormwater outfalls. Outfalls in the downtown/commercial areas of Medway were prioritized for inspection, as illicit discharges were more likely to exist in these older areas of Town. The crews documented the condition of the outfalls and their immediate vicinity. These outfalls varied in size from 6-inch pipes to 5-foot by 5-foot culverts and encompassed a variety of pipe materials and shapes. Outfall material types included the typical RC, VC, PVC and DI pipes but other outfalls were found made of corrugated metal (CM), high-density polyethylene (HDPE), and even stone. The investigated stormwater outfalls were found to be in generally good condition.

From the inspection work of 2015, the Town identified 17 outfalls which had active flow during dry weather. Of those locations, 8 outfalls were considered "Problem" outfalls. A problem outfall is identified under the 2016 MS4 Permit as locations "with known or suspected contributions of illicit discharges". Figure 6-1 depicts all of Medway's stormwater outfalls.

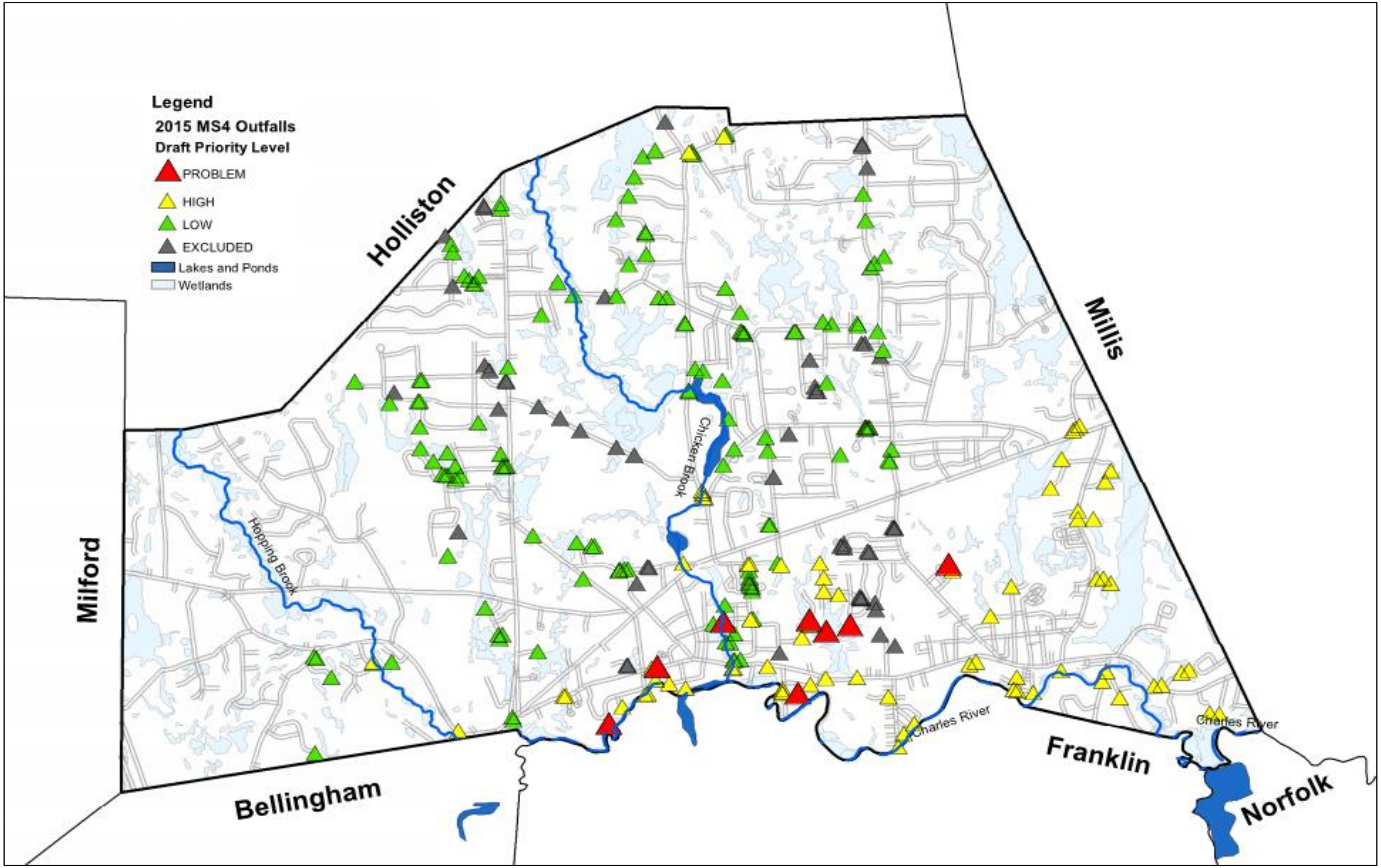

Figure 6-1: Stormwater Outfalls

6.4 Regulatory

6.4.1 NPDES MS4 Permit

The NPDES MS4 General Permit allows permittees to discharge stormwater in compliance with the Clean Water Act, as amended (33 U.S.C. § 1251 et seq) and the Massachusetts Clean Water Act, as amended (M.G.L. Chap. 21§§ 26-53), provided that the permit conditions are met. This permitting mechanism is designed to prevent stormwater runoff from conveying harmful pollutants into local surface waters. Medway's MS4 is considered a Small MS4. According to 40 CFR § 122.26 (b)(8) and (b)(16), a Small MS4 is defined as "a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains)" that services a population of less than 100,000. A Small MS4 must be owned or operated by a State or local public body and built to collect or convey storm water. A Small MS4 must neither be a combined sewer nor part of a public treatment works.

A timeline of important changes related to the MS4 Permit is presented below.

- **2003:** The Environmental Protection Agency (EPA) issues the first Massachusetts MS4 General Permit (the 2003 Permit), which regulates stormwater discharges from small municipal separate storm sewer systems in Massachusetts.
- **2008:** The 2003 Permit is set to expire but is administratively continued and remains in effect until a new permit becomes effective.
- **2010:** EPA issues the Draft North Coastal Small MS4 General Permit for public comment; it is applicable to 84 communities, including Medway.
- **2014:** EPA issues the 2014 Draft MS4 General Permit for public comment.
- **2016:** EPA issues the 2016 Final MS4 General Permit (2016 Permit), which incorporates modifications to the 2014 Draft MS4 General Permit and will replace the 2003 Permit. The 2016 Permit has an effective date of July 1, 2017.
- **May 26, 2017:** the Massachusetts Coalition for Water Resources Stewardship (MCWRS) sends a letter to the EPA requesting that the effective date of the 2016 Permit be postponed. Their letter outlined issues with the 2016 Permit related to the total maximum daily load (TMDL) reduction requirements and standards to reduce stormwater pollutant loading to the "maximum extent practicable" (MEP).
- **June 2017:** EPA voluntarily accepts to postpone the effective date of the 2016 Permit by 12 months.

- **July 1, 2018:** new effective date of the 2016 Permit.

Apart from the administrative rule-making process, multiple entities appealed the General Permit in federal court. These entities represented both the regulated community seeking relief from some permit conditions as well as stakeholder groups (primarily environmental advocacy non-governmental organizations) seeking stricter provisions. EPA issued the administrative stay, in part, with the expectation that the appeal process would be completed within the year, which is not the case. The 2016 Permit, therefore, is now in effect prior to resolution of the federal suit. Medway is moving forward with required program tasks assuming milestone deadlines established in the Permit are in force. The 2016 Permit includes two components:

- requirements to reduce pollutants to the “maximum extent practicable” (MEP),
- “water quality-based effluent limitations” (WQBEL), - which incorporates requirements for discharges to certain impaired waters that have established TMDLs” as well as Water Quality Limited Water Bodies (impaired water bodies for which a TMDL is not yet established)

General requirements of the 2016 Permit under the MEP obligation are typically referred to as Minimum Control Measures (MCMs) and include:

MCM 1: Public education and outreach;
MCM 2: Public involvement and participation;
MCM 3: Illicit discharge detection and elimination (IDDE) program;
MCM 4: Construction site stormwater runoff control;
MCM 5: Stormwater management in new development and redevelopment (post construction stormwater management); and
MCM 6: Good housekeeping and pollution prevention for permittee owned operations.

MCMs 3 and 6 are prescriptive and include specific tasks, reports, programs, and investigations that are extensive and potentially costly. MCM 5 addresses development standards and establishes a more stringent requirement than current Massachusetts stormwater standards with respect to on-site stormwater management. Specifically, municipalities must require retention on site of the runoff volume equivalent to one inch multiplied by the post-construction impervious area, or inclusion of structural controls with design capacity to capture and treat a comparable volume of stormwater for pollutant reduction prior to discharge to the MS4.

The WQBEL requirement "includes provisions to ensure that discharges from the MS4 do not cause or contribute to an exceedance of water quality standards." A summary of Medway's impaired water bodies and associated TMDLs was provided in Section 3.2.5.5. The 2007 Charles River Bacteria TMDL specifies the 200 colonies and 400 colonies per 100 ml standards as the means to achieving the waste load reduction of 96.4% required by the TMDL. The requirements for meeting the bacteria TMDL are incorporated into Appendix F of the 2016 MS4 Permit. These requirements include enhanced public education messaging, and IDDE prioritization of catchments draining to the Charles.

The 2011 Charles River Upper/Middle Basin Phosphorus TMDL requirements for Medway are incorporated into the 2016 MS4 Permit, Appendix F. Medway must reduce its phosphorus loading by 30 percent. Phosphorus reductions must be achieved in accordance with a Phosphorus Control Plan (PCP) to be developed within five years after the effective date of the 2016 Permit (by July 1, 2023). An iterative and phased approach is required whereby a Phase 1 plan is executed between years 5 and 10 while a Phase 2 plan is developed. The permit presents in significant detail what elements must be addressed in the PCP and the schedule by which certain elements must be completed.

Actions to comply with approved TMDL requirements to reduce phosphorus loading in the Charles River Watershed represent a considerable effort for the Town. Compliance would require implementation of structural controls carrying significant capital costs. The EPA's authority under the Clean Water Act to require this level of control and reduction is the primary basis of the appeal currently under way. In the meantime, the Town is addressing permit obligations and developing a Stormwater Management Plan in compliance with the permit.

6.4.2 Bylaws

The Town of Medway has adopted a Stormwater Management Bylaw (Bylaw), as Article 26 of its General Bylaws (Revised August 2007). In partial fulfillment of the obligations of the Town under the Clean Water Act (33 U.S.C. 1251 & seq.) (the "Act") and under the Town's MS4 Stormwater Permit, the Town of Medway established a comprehensive regulation of discharge to the Town's MS4.The purpose and intent of this Bylaw is to:

- Protect the waters of the U.S. as defined in the Act and implementing regulations from uncontrolled discharges of stormwater or discharges of contaminated water which have a negative impact on the receiving waters by changing the physical, biological and chemical composition of the water resulting in an unhealthy environment for aquatic organisms, wildlife and people.

- Reduce discharges of contaminated water into the MS4 and resultant discharges from the MS4 into waters of the U.S. and improve surface water quality.
- Permit and manage reasonable access to the MS4 to facilitate proper drainage.
- Assure that the Town can continue to fairly and responsibly protect the public health, safety and welfare.

The Stormwater Management Bylaw was amended in 2017 with the specific purpose of meeting requirements of the 2016 MS4 Permit as well as local standards and objectives with respect to operation of the system.

6.5 Operations and Maintenance

As part of the MCM 6 of the MS4 Permit, the Town of Medway adopted pollution prevention and good housekeeping controls. These ensure that Town operations and activities conducted at Town-owned facilities do not contribute to stormwater and groundwater pollution. The Town had many practices already in place prior to the preparation of their Municipal Services Operations & Maintenance Manual (drafted January 2014) in conformance with the Draft MS4 Permit. This document serves to record, formalize, and enhance existing best practices to meet permit requirements to reduce stormwater pollution "to the maximum extent practicable." The document will need to be updated somewhat to comply with the new Final MS4 Permit.

The Town's IDDE Program is evaluated on a continuous basis, and at the end of each MS4 Permit Annual Reporting cycle. To date, Medway has been implementing IDDE under the requirements of the 2003 MS4 Permit, using the guidance of the December 2008 EPA New England Illicit Discharge Detection & Elimination Protocol. As part of the process of preparing for the 2016 Permit, Medway's existing IDDE protocols were reviewed and modified where necessary to comply with the requirements of the 2016 Permit.

Town staff continue to follow the procedures laid out in the IDDE plan, which outlines the approach to completing the stormwater system's infrastructure inspection and documentation. The Town also has record documents, in the form of as-builts, field notes and hand sketches, depicting storm drainage information for various streets across the town. These records are used in conjunction with field investigation data to develop and update the Town's stormwater infrastructure system.

6.6 Funding

Stormwater related activities are funded through the Medway DPS' annual budget. There are no dedicated stormwater fees to support stormwater activities. As shown in Table 6-2, other sources of available funding for stormwater activities include grants and loans such as those from the Massachusetts Grants and Financial Assistance: Watersheds & Water Quality website.

Table 6-2: Available Funding for Stormwater Activities

Grant	Description
Section 319 Nonpoint Source Competitive Grant (This grant program is authorized under Section 319 of the federal Clean Water Act)	This grant is for projects that implement measures that address the prevention, control, and abatement of major source(s) of nonpoint source (NPS) pollution within a watershed/subwatershed. The project must contain an appropriate method for evaluating the project results and must address activities that are identified in the Massachusetts NPS Management Plan. To be eligible to receive funding, a 40% non-federal match is required from the grantee.
Section 604b Water Quality Management Planning Grant (This grant program is authorized under the federal Clean Water Act Section 604(b))	This grant is for water quality assessment and management planning activities by planning agencies, councils of governments, conservation districts, counties, cities and towns, and other public planning agencies and interstate agencies. No local match is required.
Stormwater MS4 Municipal Assistance Grant	This grant was established to aid groups of municipalities engaged in coordinated partnerships that emphasize resource sharing in meeting the requirements of the 2003 or the 2016 Small MS4 General Permits.
Mass Clean Water Trust Asset Management Grant Program	This program funds the establishment of Stormwater Utility Plans as well as asset management activities that can support stormwater infrastructure inspection, condition assessment and documentation and prioritization as well as software, hardware, and training.

7. Needs Assessment

This Chapter summarizes the results of the needs assessment for each system to understand the limitations and priorities for future investments.

7.1 Wastewater System Needs Assessment

The wastewater portion of the needs analysis serves to:

- Document needed improvements within the sewered portion of the Town based on subareas with similar physical characteristics.
- Project future capacity needs at the CRPCD to establish long term sustainability for the collection system.
- Outline priorities for I/I investigations and mitigation.
- Define unsewered study areas with similar physical characteristics.
- Identify “need” areas where, cumulatively, on-site wastewater disposal systems may:
    - cause a risk to public health,
    - create a potential risk to natural and water resources, and/or
    - create a significant financial burden for property owners.

7.1.1 Sewered Area Needs

7.1.1.1 Flow Metering

Currently, the Town has one permanent flow meter along the Chicken Brook Interceptor (CBI) that measures a portion the wastewater generated (Section 4.3.1). CRPCD calculates Medway’s contribution to the treatment plant through a calculation of unmetered flow as well as the data from the CBI meter. The Town is interested in installing additional meters to corroborate the wastewater flows estimated by CRPCD, which are used as basis for their invoices, as well as to better quantify extraneous flows within the system. The Town would benefit from installing additional meters:

- Between MH 11-8 and MH 11-6 on Charles River Rd. This meter would capture flow from subareas tributary to Subarea 11 in addition to flow from Franklin.
- Between MH 12-27 and MH 12-3 on Village St. This meter would capture flow from subareas tributary to Subarea 12 in addition to flow from Franklin.
- Between MH 13-1 and MH 13-2 on Village St. This meter would capture flow from subareas tributary to Subarea 13 in addition to flow from Millis.

In addition to three new meters, the Town will need to work with Millis to upgrade the flow meter located on Village Street, near the town boundary to quantify flow in 15-minute intervals.

7.1.1.2 Projected Flows

Wastewater flows are projected to increase as population within the Town increases, current residents connect to the system, or land uses change. As referenced in Section 3.1.3.1, the population may fluctuate between 13,146 and 13,526 between 2020 and 2035; less than a 2% increase from the current population of 13,259.

In addition to population growth, wastewater flows will increase as septic users within the sewer district connect to the collection system and as planned development is completed. The collection system and planned developments are shown on Figure 7-2. Per the Town's Planning Department, there is over 150,000 gpd in new connections projected that stem from developments such as: Timbercrest, Millstone Village, Willows/Salmon and Medway Green, amongst others. Based on these factors, wastewater flows will likely increase from an ADF of 790,000 to 970,900 by 2035. Wastewater projections are shown in Table 7-1: Wastewater Projections

Table 7-1: Wastewater Projections

Type of Flow	Current	2020	2025	2030	2035
Flow to CRPCD	790,000	783,300	793,200	804,500	805,900
Known Development *(Source: Planning Department)*	0	17,000	85,000	119,000	165,000
Planned Projected Flow	**790,000**	**800,300**	**878,200**	**923,500**	**970,900**

7.1.1.3 CRPCD Capacity

To meet future demands, the Town needs additional capacity at CRPCD. If property owners who had previously been assessed a sewer betterment elect to connect to the sewer system, thus utilizing the reserved capacity and the anticipated developments are completed, it would exceed Medway's allocated capacity at CRPCD. Current projections predict that the Town will exceed its allocated capacity by 2030 and come within 3% of their capacity by 2025 as shown on Figure 7-1. The above projections assume the sewer moratorium remains in place, however Medway may reach its allocated capacity before 2030 if the sewer moratorium is lifted. Obtaining additional capacity at CRPCD will provide the Town with a stable platform for economic development and strategic planning.

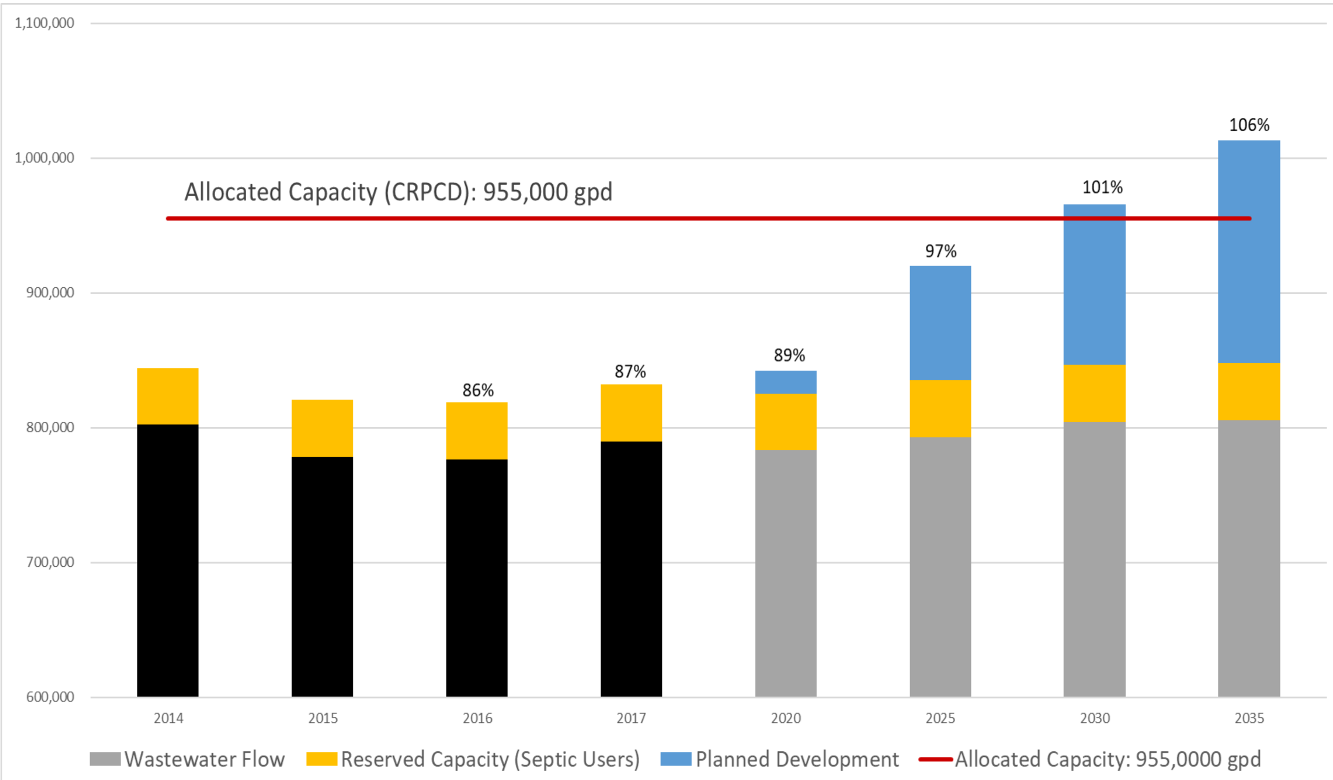

Figure 7-1: Wastewater Projections vs. CRPCD Capacity

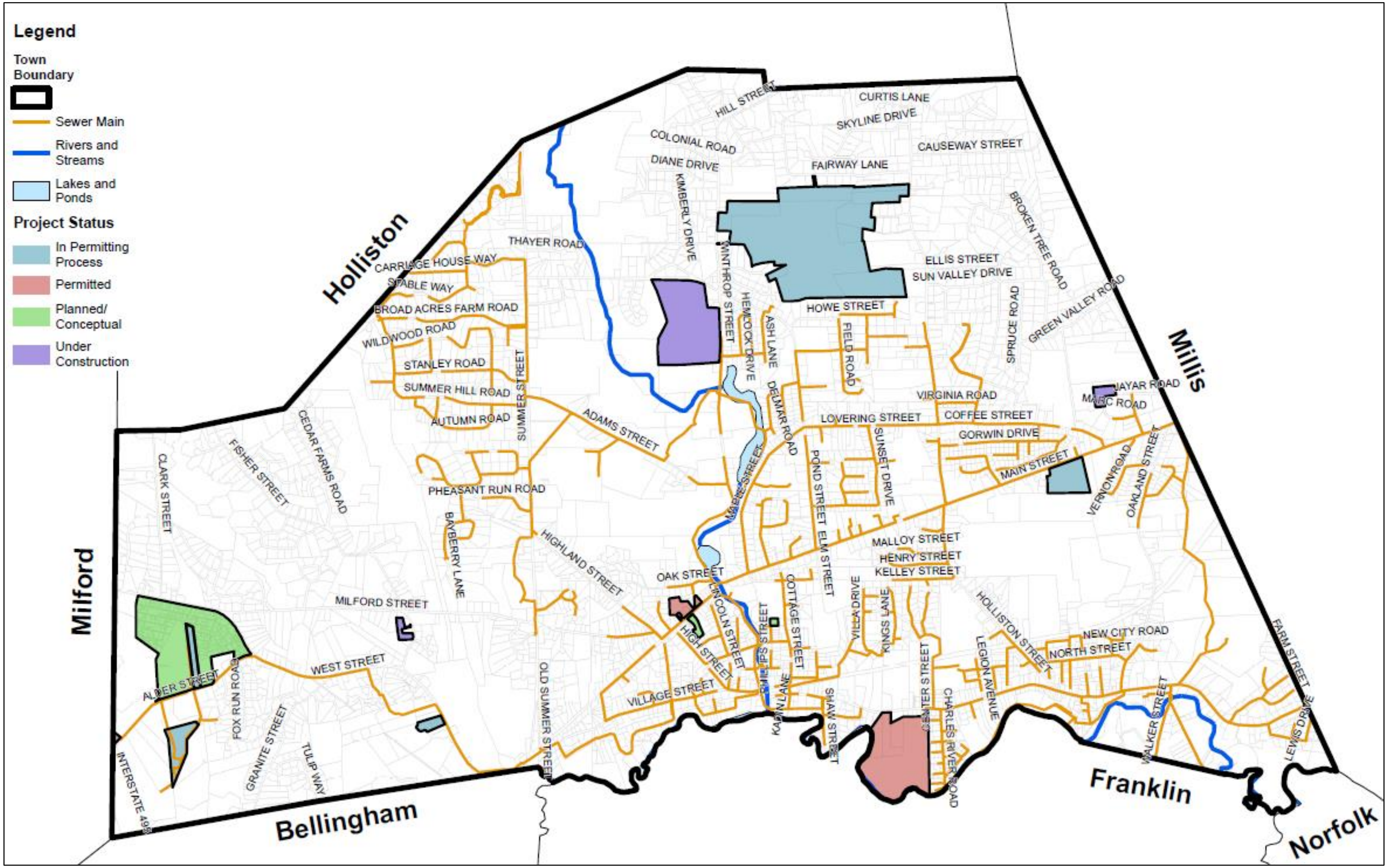

Figure 7-2: Planned Development (Source: Medway Planning Department, 2018)

7.1.1.4 Infiltration and Inflow

Removing excessive infiltration and inflow (I/I) from the wastewater collection system is a priority for most communities. However, for Medway this need is paramount as the Town approaches the limit of their allotted capacity at CRPCD. Removing I/I from the collection system will help provide a buffer between the allocated capacity and the Town's average daily flow. The Town's flows are heavily impacted by seasonal fluctuations, an indication of extraneous flow entering the wastewater collection system.

As outlined in the Infiltration and Inflow Technical Memorandum (Appendix B), subareas 8 and 9 (cumulative) have high infiltration and inflow contributions as evidenced by the 100% increase between minimum and peak flows. Recommendations for further I/I investigations include:

- Subareas 8 and 9: Smoke testing, flow isolation, CCTV
- Subareas 7, 11, 12, and 13: Flow isolation

Follow up investigations through a sanitary sewer evaluation survey (SSES) will help to inform rehabilitation needs to address infiltration and further actions required to address inflow in the most susceptible subareas.

7.1.1.5 Sewer Operations

Routine inspections help the DPS stay ahead of potential issues, such as structural defects. As aging infrastructure deteriorates, routine inspections also allows the DPSs to identify defects that contribute to the ongoing I/I issue. Routine inspections also help identify "trouble" areas that may require more frequent cleaning due to fat, oil and grease or other contributing factors. Current inspections have not identified corrosion or hydrogen sulfide-related issues downstream of the pump station. However, the Town is interested in implementing a systematic CCTV inspection program which will track the information the collected in a database and develop an asset management program to assist with preventive maintenance. Asset management programs allow communities to be proactive in their operations, as opposed to reacting to issues. This approach will allow the Town to plan for expenditures.

7.1.2 Unsewered Area Needs

Through the IWRMP process, the Town recognized that the prevalence of septic failures is high. The Board of Health currently maintains a GIS database with partial information regarding septic systems. The GIS database tracks the latest inspection date and its result, but it does not track the nature of the failure. Not all failing septic systems are indicative of unfavorable soils or high ground water. A septic system may be failing because it is old, or because of improper maintenance (i.e. residents are disposing of fat, oils, or grease). The GIS database shows that 69 septic systems (9%) have failed and are currently being replaced, repaired, or have been repaired since inspection. The prevalence of failed systems based on the GIS database is shown in Figure 7-3.

The current dataset does not provide adequate information to infer trends with respect to cause of failures. In addition, high property turn-over in Town may trigger more system inspections and may skew the data to show disproportionately high septic system failure rates.

7.1.2.1 Record Keeping

The Medway Board of Health maintains a physical file for each property in Town that has had a new septic system installed since 1965, which equates to hundreds of files. While they have a digital database (GIS) to track the latest inspection, the database provides little to no additional information. The Town needs an electronic repository that would document the age of the system (installation date), design criteria (soil permeability, ground water elevation, soil type, etc.), history of pump-outs, and history of replacements/repairs. A comprehensive database would allow for better management of the septic failures and would help track systems receiving frequent pump-outs.

7.1.2.2 Public Education

Improperly disposing of fats, oils and grease can be detrimental to a septic system and lead to frequent pump-outs. Frequent septic system pump-outs classify a system as failing despite the underlying capacity of the system to perform in the absence of those wastes. Public education is a powerful tool for preserving the efficiency and operating capacity of the septic system.

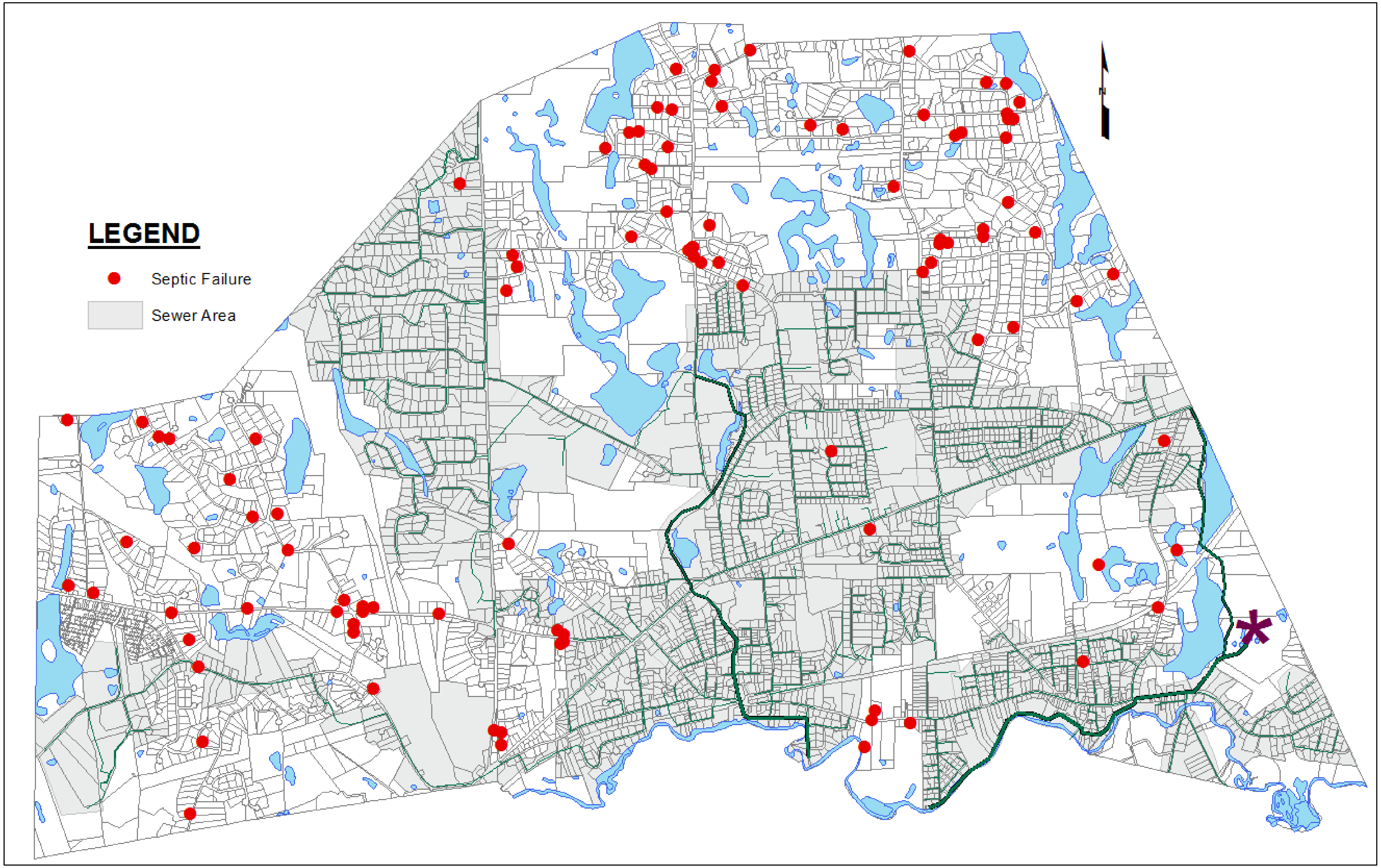

Figure 7-3: Septic System Failures

7.1.2.3 Targeted Sewer Extensions

The Town currently prohibits extension of the wastewater collection system to new users through the sewer moratorium due to noted capacity issues for discharge to the CRPCD, outside of those with reserved capacity (previously paid betterments). The prevalence of septic failures may be better managed by the recommendations outlined in the previous sections. Over time, if the Town can secure additional treatment capacity, and thus lift the sewer moratorium, sewer extensions should be considered in targeted areas to eliminate septic failures and protect the environment.

7.1.3 Summary of Wastewater Needs

Medway is facing an ongoing challenge with limited wastewater treatment capacity at the CRPCD which limits development potential in Town, as well as the potential to extend sewers to current septic users. Immediate efforts to increase the treatment capacity may include purchasing additional capacity and targeted efforts to identify and remove extraneous flow from the system. Continuing support of the DPS's operational efforts is critical to maintaining the existing system and managing needs going forward. The summary of the Town's short-term and long-term wastewater needs is outlined in Table 7-2.

Table 7-2: Wastewater Needs

Near Term Needs	Address I/I	Managing wastewater flows to the CRPCD requires identification and removal of extraneous flows from the wastewater collection system.
	Improve Sewer System Operations	Support I/I mitigation and identify structural defects in aging infrastructure.
	Install permanent flow meters	Provide actual measured flows to CRPCD and remove the uncertainty of calculating flow contributions based on assumptions.
	Improve record keeping of septic failures	Allow septic data to be queried real-time and provide the Board of Health more reliable information.
	Provide public education for septic owners	Help homeowners
	Purchase Available Wastewater Capacity at CRPCD from Franklin	Allow the Town to continue with planned development and provide sustainable wastewater collection into the future. Allow the Town to lift the sewer moratorium.
Long Term Needs	Limited Sewer Extensions	Connect failed septic systems to the collection system if capacity becomes available.

7.2 Domestic Water System Needs

The Town of Medway is facing a variety of challenges with respect to its drinking water supply and distribution system. The 2009 Master Plan identified three goals which have been carried into this IWRMP and help to drive the needs analysis:

1. Improve and protect water quality and quantity.
2. Protect water supply sources through local land use mechanisms.
3. Implement comprehensive water conservation measures, including leak detection, metering, conservation-oriented water rates, drought contingency plans, and public education.

In reviewing these goals, as well as the current state of the domestic water system, the needs analysis presented in this section includes:

- Planning for future growth,
- Increasing system resiliency and redundancy,
- Increasing system capacity,
- Providing additional water treatment,
- Managing water demand resulting from new development,
- Increasing the WMA authorized withdrawal volume,
- Promoting water conservation,
- Supporting groundwater recharge,
- Improving distribution system infrastructure,
- Reducing unaccounted for water (UAW), and
- Improving documentation procedures.

7.2.1 Existing Limits on Water Supply

In reviewing water supply in relation to future demand projections, it is important to recognize the limits of the water supply, including regulatory, physical, water quality and risk limitations:

Regulatory:

- Through its WMA permit, the Town has a maximum daily withdrawal of 2.60 MGD. However, they must not exceed a daily average of 0.92 MGD (on an annualized basis).
- In 2019, the authorized daily withdrawal volume will increase to 0.94 MGD and in 2024 it will increase to 1.00 MGD.

Physical:

- The maximum daily output (MDO) of Medway's supply wells is 1.91 MGD, which is the maximum flow that the wells can sustain for a 24-hour run time for each well. The MDO is not a sustainable supply limit.
- The reliable daily output (RDO) of the wells is 1.22 MGD, which is based on flow for a 16-hour run time each well can sustain. This supply represents the reliable supply limit with respect to the physical components of the wells and pumps.

Quality:

- The presence of naturally occurring iron and manganese in the groundwater requires the Town to treat the water supply at each well, as noted in Section 5.1.2. However, currently the Oakland Street well water quality is so poor that sequestration is not a viable treatment alternative, and the well is rarely used. This effectively limits the RDO and MDO of the water supply.

Risk:

- The Populatic well represents the Town's largest and most reliable water supply well, supplying almost half of the Town's water each year. For that reason, this well also represents the greatest risk to the water supply if the well were to become unusable due to water quality, equipment failure or any other unforeseen reason.

7.2.2 Supply Needs for Current and Future Demands

Section 5.3 outlined Medway's historical water consumption from 2012 to 2016, including a breakdown by customer type to describe the nature of water use in Town. This discussion also presented graphics showing the change in average and maximum day demands over the same period. This data was used as a baseline from which to project future demand trends which the Town must plan to meet. This analysis also helps to inform the priority of the needs that are identified. The historical water demands shown in Table 7-3 were represented graphically in Figure 5-4 and Figure 5-5 and are included herein as the basis for analyzing future demands.

Table 7-3: Medway Historic Water Demands

Year	Average Day Demand (ADD), MGD	Maximum Day Demand (MDD), MGD
2012	0.99	1.45
2013	1.07	1.56

2014	1.12	1.60
2015	0.83	1.36
2016	0.79	1.02

The following resources were used to project population:

- UMass Donahue Institute's Population Estimation Program (UMDI)
- Massachusetts Department of Transportation (Mass DOT)

Using these population projections, the IWRMP evaluated alternative demand scenarios using the Massachusetts Water Resources Commission's "Policy for Developing Water Needs Forecasts for Public Water Suppliers and Communities and Methodology for Implementation" document as a basis for demand projections.

Residential water use is the largest single use category in Medway. Residential customers in Medway currently consume an average of approximately 56% of the water that enters the distribution system. Alternative scenarios were developed using various RGPCD values to evaluate the priority of residential demand management activities. The second biggest water use category in the Town is UAW. Over the last five years Medway has lost an average of approximately 21% of the water entering the distribution system to unknown, non-revenue sources. In the most recent reporting year Medway's UAW was 17.2%. Alternative scenarios were developed using Medway's current UAW value, as well as increased and decreased UAW values to evaluate the priority of UAW reduction as it relates to Medway's ability to meet future demand. The alternative demand scenarios evaluated are presented below in Table 7-4.

Table 7-4: Demand Projection Scenarios

Scenario	Population Projection	Year	Population	Residential Use (RGPCD)	UAW (%)
-		2016	13259	52	17
1	UDMI	2020	13146	49	10%
		2025	13312		
		2030	13502		
		2035	13526		
2	UDMI	2020	13146	52	17%
		2025	13312		
		2030	13502		
		2035	13526		
3	UDMI	2020	13146	65	20%
		2025	13312		
		2030	13502		

		2035	13526		
4	UDMI	2020	13146	52	14%
		2025	13312		
		2030	13502		
		2035	13526		
1A	Mass DOT	2020	12578	49	10%
		2025	12678		
		2030	12778		
		2035	12771		
2A	Mass DOT	2020	12578	52	17%
		2025	12678		
		2030	12778		
		2035	12771		
3A	Mass DOT	2020	12578	65	20%
		2025	12678		
		2030	12778		
		2035	12771		
4A	Mass DOT	2020	12578	52	14%
		2025	12678		
		2030	12778		
		2035	12771		

The projected future ADD for each scenario is shown below in Figure 7-4 and the projected future MDD is shown on Figure 7-5. Projections are presented through 2035 for each scenario. Horizontal lines are shown on the projection graphs to represent the theoretical supply volume under various operational conditions as follows:

- Since the RDO is the reliable volume Medway could withdraw daily, all RDO values are presented on the ADD projection graph. Similarly, since the MDO is the theoretical maximum volume that Medway could obtain during times of peak demand, all MDO values are shown on the MDD projection graph. The projections reference historic data tabulated from Medway's ASRs and future development information provided by the Town. In general, several scenarios suggest that Medway could have trouble meeting both ADD and MDD with its current supply as early as the year 2020.
- RDO; MDO – Represents the theoretical output volume if Medway were to operate all wells for 16 or 24 hours a day, respectively, and is shown as the red line on the projection graphs.
- RDO; MDO Without Oakland Street Well – The yellow lines represent the production capacity of Medway's supply wells in the absence of supply from the Oakland Street well. These volumes are representative of Medway's current operations since the Oakland Street well cannot be used in any significant capacity due to water quality concerns.

- RDO; MDO Without Populatic – The purple lines represent Medway's production capacity if the Populatic Street well were to be taken offline. This is shown to illustrate Medway's level of dependence on the Populatic Street Well.
- RDO; MDO Without Populatic & Oakland – The orange lines are shown to represent the production capacity of the system if both the Oakland Street well and the Populatic Street well were unavailable. This is a worst-case scenario but is representative of Medway's current supply capabilities if the Populatic Street well went offline, as no significant supply is available from the Oakland Street well due to poor water quality.

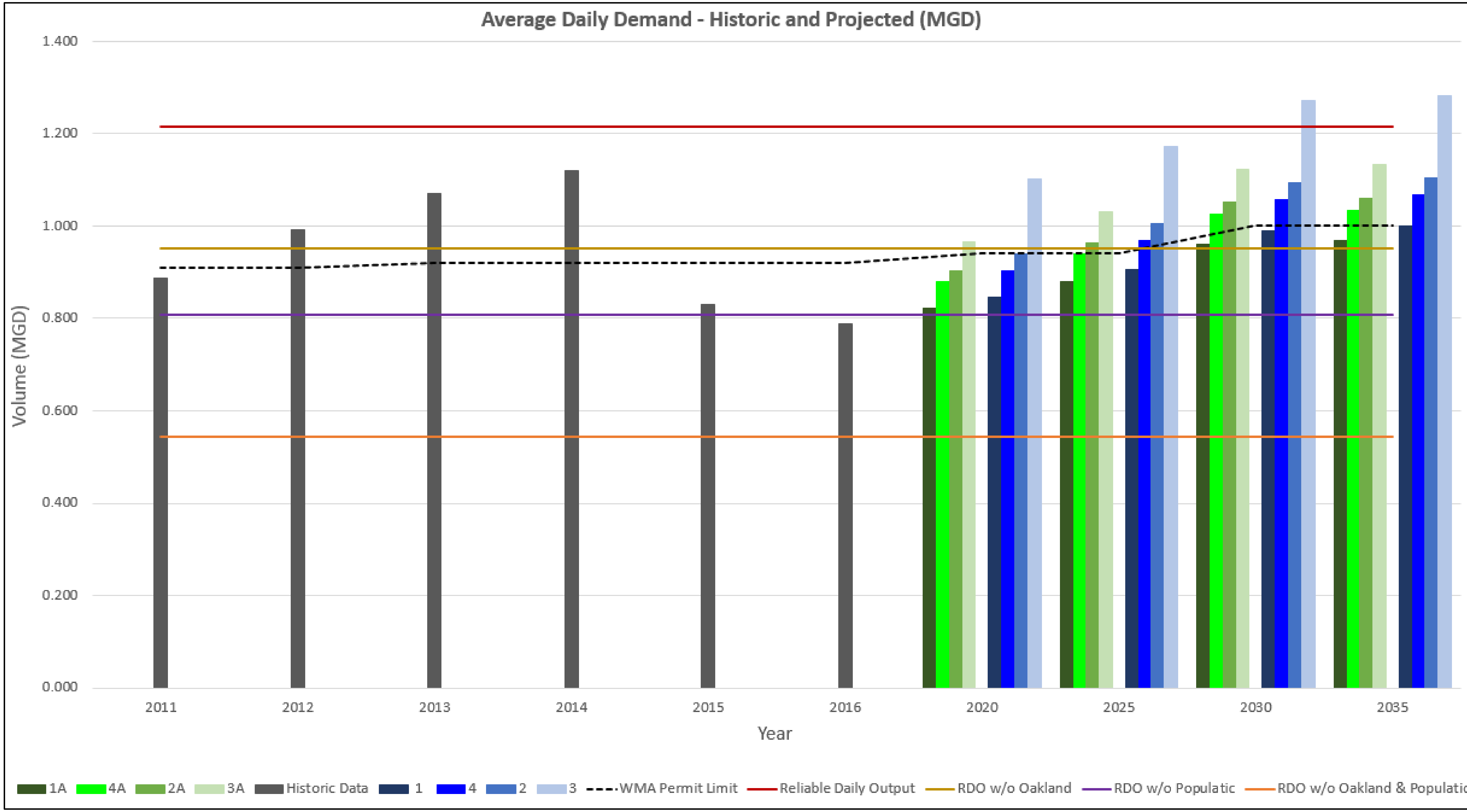

Figure 7-4: Average Daily Demand, Historic and Projected

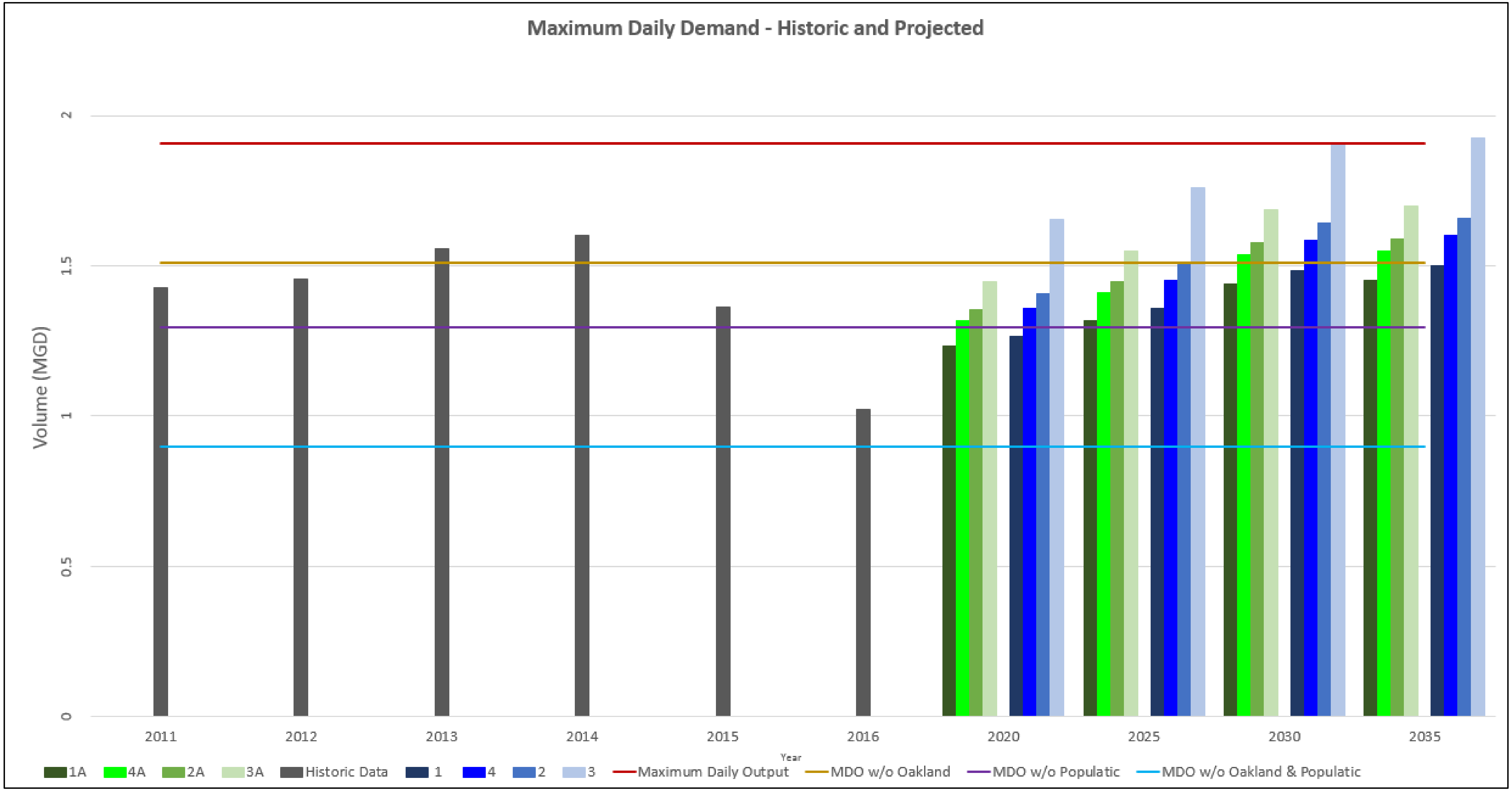

Figure 7-5. Maximum Daily Historic and Projected Demand

7.2.2.1 Redundancy

While the demand projections show that the system can meet the ADD and MDD of most scenarios in the near term, even without the Oakland Street well, the Town depends heavily on the Populatic Street well to meet that demand. On average, over the last five years the Populatic Street well has provided 47% of the Town's annual water supply. If DPS needs to take the Populatic Street well offline for repairs or if the well becomes contaminated and the Oakland Street well cannot be pumped due to water quality concerns, the Town would experience an immediate supply deficit of 0.25 MGD during average demand and 0.13 MGD during peak demand based on the 2016 ADD and MDD values. Projections show that this deficit could grow to as much as 0.74 MGD by the year 2020 under Scenario 3. Additionally, the MDO of the remaining two supply wells would not be able to meet the projected ADD for 50% of the scenarios by the year 2020. Even if the remaining two wells were operated 24 hours a day they would not produce enough water to satisfy the average demand. As shown on the graphs above, all eight scenarios predict that Medway will face a significant immediate supply deficit during average and peak demand if the Oakland Street well cannot contribute significant volume due to water quality issues and the Populatic Street well was taken offline.

Even if the Oakland Street well could be used to supplement supply, all demand projections show that Medway's ADD is projected to exceed the RDO of the system without the Populatic Street well by 2020 and that Medway's MDD is predicted to exceed the MDO of the system without the Populatic Street well by 2025. For this reason, installation of a satellite well at the Populatic Street location should be of high priority to improve the redundancy of the system and guard against the supply deficit that would occur if the well needed to be taken offline.

7.2.2.2 Resiliency

As shown on the graphs above, all eight scenarios predict that Medway will face an immediate supply deficit during average and peak demand if the Oakland Street well cannot contribute significant volume due to water quality issues and the Populatic Street well was taken offline. The reliance on the Populatic Street well to meet system demands, the fact that the Oakland Street well cannot be pumped for long periods of time due to water quality, and the lack of supply redundancy, suggests that an immediate need of Medway's drinking water system is to update the emergency drinking water supply plan and make infrastructure and operational improvements as necessary in order to increase the system's resiliency to short term supply shortages through use of emergency interconnections with neighboring towns.

7.2.2.3 Increasing System Production Capacity

By the year 2030 all projections suggest that Medway will experience a supply deficit in relation to ADD if supplemental capacity cannot be obtained through the Oakland Street well or another source. Similarly, six of the eight projections suggest a deficit in relation to MDD in the absence of supply from Oakland Street. Medway also currently has several permitted and proposed developments estimated to increase system demand by approximately 0.19 MGD by 2035. To accommodate future development and population increase, the Town needs to prioritize increasing the capacity of the drinking water system. The highest priority for increasing the system capacity should be to provide treatment to the Oakland Street well since the source is already existing. According to the projection data presented in Figure 7-4 and Figure 7-5, with the additional supply from Oakland Street Medway will be able to meet demand through 2035 under all scenarios except Scenario 3. The Town can also increase their system capacity by increasing the frequency of well maintenance to maximize well capacities however more frequent well maintenance alone is not likely to provide enough additional supply to meet Medway's future demands and should not be considered an alternative to the expansion of Medway's treatment capabilities.

7.2.2.4 Managing Demand from Future Development

As discussed above, Medway has several currently planned developments expected to come online by the year 2035 which are included in these projections. The Town currently does not have a development approval process that considers limitations on water demand from proposed developments. Any additional development within Medway will increase the system demand above the numbers projected in this report. As such, Medway should prioritize the modification of the existing water supply impact mitigation fee and require a water demand analysis as part of the Planning Board approval process to determine if the distribution system can adequately supply any future developments.

7.2.3 Increasing WMA Authorized Withdrawal Volume

Even in the absence of system capacity and redundancy concerns, Medway is currently operating close to its WMA permit limit and has exceeded the permitted withdrawal volume in three of the last six reporting years. Medway's WMA Permit limit is presented on Figure 7-4. By 2025, six of the demand scenarios predict that Medway's ADD will exceed the authorized withdrawal limit. Six scenarios suggest that by 2030 the ADD will exceed Medway's' baseline volume, which is set at 0.99 MGD. Only two scenarios predict that Medway may be able to operate within it's currently permitted limit through 2035 and those would require the Town to reduce UAW to 10% or less. If Medway cannot significantly reduce UAW, the Town will need to prioritize applying for a new WMA Permit to ensure continued compliance with MassDEP regulations. It should also be noted that any volume withdrawn over the baseline volume of 0.99 MGD would require mitigation in accordance with MassDEP mitigation planning requirements.

7.2.4 Reducing UAW and Promoting Conservation

As discussed above, the only demand scenarios that predict that Medway will be able to stay within its authorized withdrawal limit are scenarios 1 and 1A. These scenarios are projected using the statewide standard of 10% UAW as well as a 5% reduction on Medway's 2016 RGPCD value. These two scenarios show that if Medway was able to reduce its UAW value to 10% or less and reduce residential usage by 5%, then the Town could meet typical and peak demand volumes further into the future without exceeding the authorized volume in their current WMA permit.

Over the last five years, Medway's reported UAW has averaged 20.8 percent, more than double the statewide standard of 10 percent; with a maximum reported value of 29.0 percent. During the 2016 reporting year Medway reported a UAW of 17.2 percent. If Medway can reduce the UAW to the State Performance Standard of 10 percent or lower, then the Town could:

- potentially accommodate all current and future development without making other significant capital improvements to the drinking water distribution system and
- could provide as much as 20 MG of additional water to be supplied to customers.

The Town should prioritize the reduction of the UAW prior to assessing the need for an increased authorized withdrawal volume through their WMA Permit. It is in the best interest of the Town to generate revenue from as much of the withdrawn water as possible and prevent its loss through non-revenue sources. The Town can reduce UAW through water main replacement projects, more effective and frequent leak detection procedures, and better documentation of unmetered municipal uses.

7.2.5 Improving Documentation Procedures

Reliable input data is important in generating water use projections and gauging improvements in system performance. Over the last seven years the Town has reported significant fluctuations in the population served, the RGCPD, and the UAW, suggesting that documentation of the variables used to calculate these values have been inconsistent.

As shown on Figure 7-6, the reported population served by the Town's system has varied from 8,756 residents in 2013 to 13,259 residents in 2016, which represents a 66 percent increase. This increase in not representative of actual fluctuations in the number of Medway residents serviced by the distribution system. These inaccurate fluctuations in reported service population result in large fluctuations in the reported RGPCD as shown on Figure 7-7. While more accurate reporting is not likely to impact the total volume of water consumed, it should be a priority if Medway wants to be able to measure the effectiveness of future demand management programs.

Values reported in Medway's ASRs show significant variation in UAW over the last seven reporting years. While UAW is a calculated value based mostly on metered volumes, poor or inconsistent documentation of confidently estimated municipal uses (CEMU) are likely contributing to the large fluctuation in UAW that is reported. The Town has reported an exceedance of the State Performance Standard in all the last 7 reporting periods. Reported UAW values for the last seven years are shown on Figure 7-8. Some of the values shown are adjusted to correct obvious reporting errors.

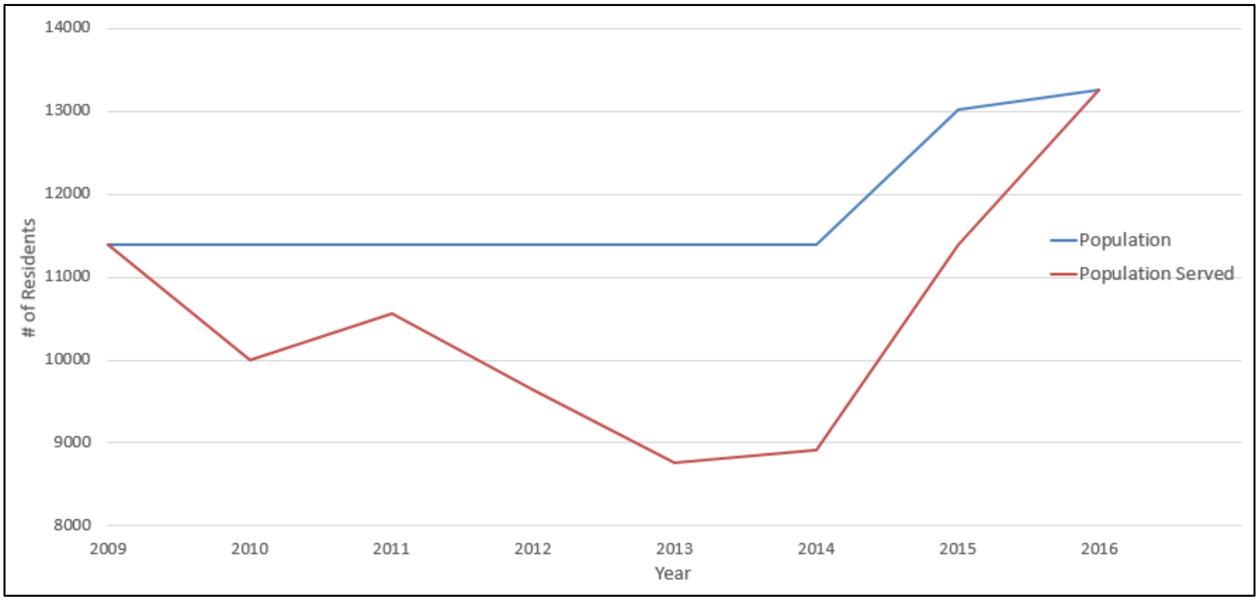

Figure 7-6: Reported Total Population and Population Served (2009-2016)

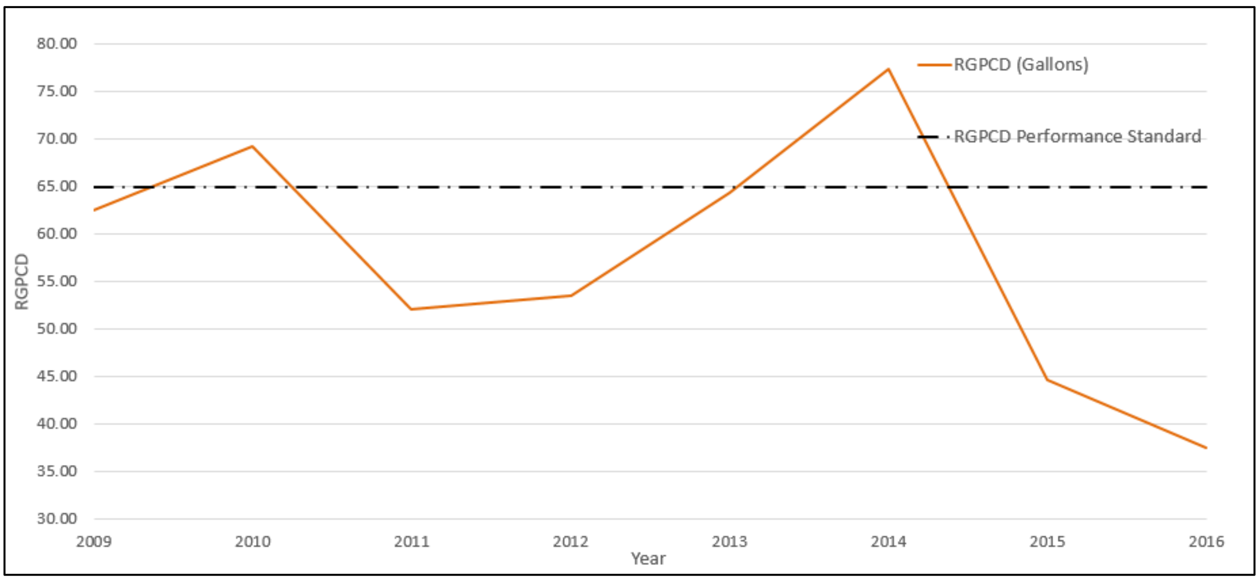

Figure 7-7: Reported RGPCD (2009-2016)

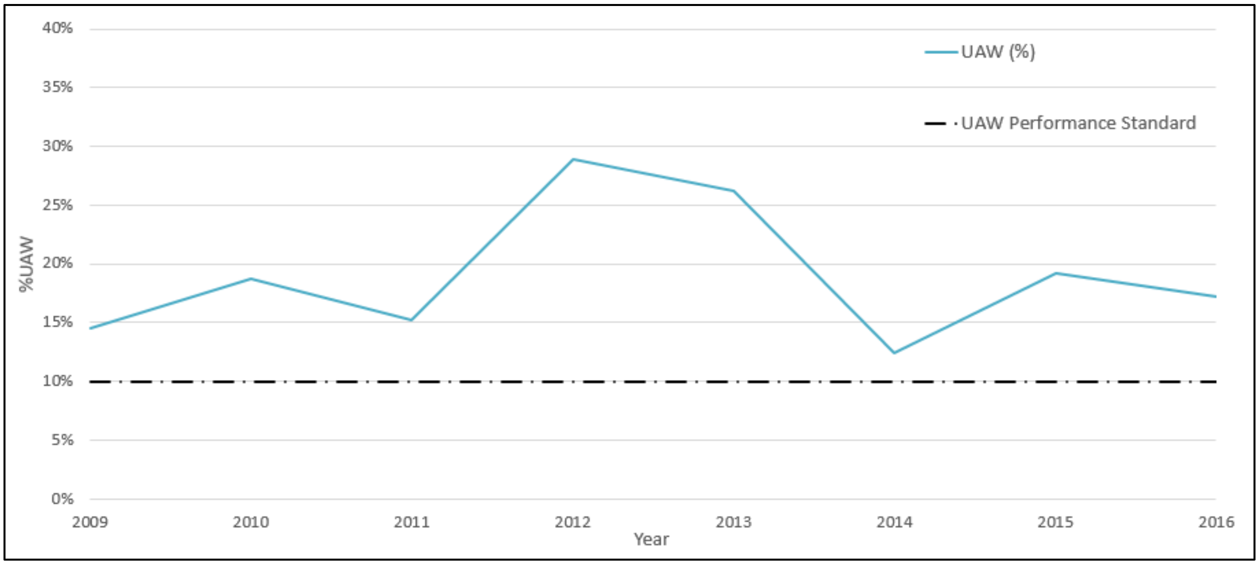

Figure 7-8: Reported UAW (2009-2016)

7.2.6 Improvements to Distribution System Infrastructure

In addition to the needs developed through analysis of the demand projection presented in Figure 7-4 and Figure 7-5, Medway has a number of basic infrastructure needs that are not directly tied to the Town's current or future demand volume.

The Town currently maintains a hydraulic model of their drinking water distribution system; however, no system-wide hydraulic analysis has been performed since 2010. It is an industry best practice to perform a system-wide hydraulic analysis to identify future infrastructure improvements that can impact Medway system performance once every ten years. Consequently, such an analysis should be conducted by 2020. This will allow the Town to identify problem areas such as low or excessive pressure, inadequate fire flow availability, and excessive water age that would need to be addressed with capital improvements.

7.2.7 Reclaimed Water Reuse Potential

As part of IWRMP, the Town wanted to evaluate the potential for reusing wastewater to support long term water supply sustainability. Currently the CRPCD discharges to the Charles River, where the water is carried downstream to the ocean. Water reuse alternatives would keep some of that water locally in Medway. There are two potential water reuse options for consideration: reclamation of water discharged from the CRPCD for indirect potable use (supplement groundwater) and reclaimed (or grey) water reuse for agricultural or industrial use.

- Indirect Potable Use - In this option, processed CRPCD effluent would be used to recharge the groundwater basin to supplement the potable water supply. Groundwater recharge could be accomplished by percolating CRPCD effluent into the groundwater through percolation ponds, which would require sufficient available land, or through injection wells. Additional treatment of the Plant's effluent may be required to support this reuse option.
- Agricultural or Industrial Use – In this option, processed CRPCD effluent and/or captured rainwater could be used to supply non-potable water for agricultural irrigation or industrial manufacturing needs. This option would also involve the construction of a separate reclaimed water infrastructure network including distribution pipes and tanks.

While both options represent sustainable water recycling potential for the Town which could support the water supply long term, they both require extensive planning and design considerations. Indirect potable reuse would need to be reviewed with MassDEP to determine regulatory viability. This option would also require planning and modeling of the groundwater to ensure the correct residence time in the aquifer, as well as a capital investment to build the infrastructure to support groundwater recharge. Grey water reuse would also need additional consideration to determine the market (agriculture or industrial users) that might be interested in non-potable water supply. Absent a separate infrastructure system, this grey water could be supplied at the CRPCD, but would need to be trucked to the end user.

Both water reuse alternatives remain viable, however the need to support the water supply does not appear to be dire enough at this time to support the investments needed to pursue either option. The Town continues to support more traditional improvements to the water supply, as discussed herein, that could support its needs into the future. These reuse alternatives can remain as long-term solutions to be revisited later.

7.2.8 Summary of Domestic Water Needs

Medway's current and future drinking water needs center around increasing the production capacity by increasing treatment capabilities, reducing demand by lowering UAW, and increasing supply redundancy and resiliency. Some of the needs described previously are high priority because they can provide immediate and measurable benefits to the Town. Medway should address these high priority needs in the near term, as shown in Table 7-5

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Table 7-5: Drinking Water Needs

Near Term Needs	Resiliency and Redundancy; System Capacity	Currently, extended periods of high demand cannot be satisfied without the Populatic Well or a source of emergency supply. Sources of emergency supply, equipment and protocols are not well established. Water treatment improvement / expansion is needed to supply near and long-term demand. The Town is close to exceeding its supply.
	Reducing UAW; Increasing WMA Permit Limit	UAW has exceeded the State Performance Standard in all seven of the last reporting periods. This needs to be addressed so that Medway can request an increase in its WMA Permit to withdraw water.
	Improving Documentation	Better documentation procedures are needed to project Medway's drinking water demands and measure system performance more accurately.
Long Term Needs	Infrastructure Improvements	Updates to the Town's hydraulic model can help inform strategic decisions regarding the appropriate phasing of infrastructure replacement projects.
	Promoting Conservation	Reducing demand through conservation efforts can reduce stress on the drinking water system infrastructure.
	Managing Demand from Future Developments	The Town currently does not have a water use review policy to determine if the domestic water system can accommodate the needs of proposed developments.
	Increasing System Capacity	The Town can use the Oakland Street well more regularly if the well's water is treated for Iron and Manganese.
	Increasing WMA Permitted Volume	Projections show demand exceeding the WMA authorized withdrawal limit in most scenarios by 2025.

	Evaluate Reclaimed/Grey Water for Industrial and Agricultural Use	Reclaimed water is used directly in non-potable applications such as irrigation.
	Evaluate Reclaimed Water from CRPCD for Indirect Potable Reuse	Reclaimed water from CRPCD is used to recharge the underlying aquifer, indirectly supplying the Town's GW Wells.

7.3 Stormwater System Needs Assessment

The stormwater portion of the needs analysis serves to:

- identify water quality needs that affect surface waters,
- document regulatory needs for compliance with the MS4 Program,
- assess the remaining efforts needed to document the existing stormwater system,
- identify the drainage problem areas throughout the Town, and
- review the operation and maintenance procedures related to addressing stormwater runoff issues.

The needs assessment described in this section provides the basis for a water quality improvement plan related to the municipal stormwater system in conformance with the MS4 General Permit guidelines and provides the framework for proactive system maintenance. The goal of these investigation programs and planning activities is the protection of public health, Medway properties and water quality in Medway's receiving waterbodies.

7.3.1 Water Quality Needs

Stormwater runoff within the Town discharges to one of several receiving waterbodies. MassDEP evaluates the water quality of these receiving waters periodically for impairment for microbial and nutrient related contamination and other pollutants. Currently the Charles River exhibits impairment due to Phosphorus and E. Coli. Phosphorus loading to the Charles River is regulated through a TMDL requirement. As such, the Town continues to work to identify TMDL contributions and develop measures to reduce their Phosphorus loading over time. Additionally, MassDEP's Proposed 2016 List of Integrated Waters identifies an impairment status pending for Chicken and Hopping Brooks with both indicated as being contaminated with E. Coli.

DPS has already begun an illicit discharge detection and elimination (IDDE) through which sources of E. Coli contamination may be identified. The IDDE program includes a full assessment of the Town's stormwater outfalls, including mapping, inspection, and catchment characterization.

To meet Medway's TMDL reduction requirements, the Town will need to develop and implement a Phosphorus Control Plan (PCP) in accordance with the MS4 Permit. Work under this effort will involve identifying the nutrient loading caused by the runoff from properties in Medway that are considered generating sites. During the IWRMP development, Kleinfelder performed the primary analysis below to identify potential generating sites within Medway's high priority stormwater outfall catchment areas. The results of this analysis are included in Appendix C.

As part of the PCP, the Town will have to assess these properties in further detail to determine the most suitable Best Management Practice (BMP) that may be utilized for each site. BMP information is available from the Massachusetts Stormwater Handbook Volume 2, Chapter 2. The assessment of each property should also consider the following BMP attributes:

- component type,
- BMP size,
- surface applicability,
- maintenance,
- treatment type,
- recharge,
- treatment removal, and
- cost.

7.3.2 MS4 Program Permit Compliance Needs

The MS4 Permit is a 5-year term which renews and is intended to build upon successes of the prior term. Over the first five-year permit term, the Town must focus on several tasks including: implementing a very targeted stormwater public education and outreach program, updating the stormwater infrastructure system's GIS data, continuing an ongoing stormwater outfall inspection and sampling program, completing the delineation, prioritization, and inspection of high priority outfall catchment areas.

Over the subsequent MS4 permit term (Years 5 – 10), in addition to the above ongoing tasks, the Town will need to complete Phase 1 of a Phosphorus Control Plan, including the installation of structural controls sufficient to demonstrate achieving 25% of its TMDL phosphorus reduction requirement for the Charles River by 2028. Medway will then be required to implement Phase 2 of the PCP by Year 15 (2033) demonstrating 50% of its phosphorus reduction achieved and 100% of its P reduction achieved (Phase 3) by Year 20 (2038).

Table 7-6 outlines the MS4 compliance needs based on the 6 MCMs established in the 2016 MS4 Permit.

Table 7-6: Minimum Control Measure Needs

Minimum Control Measure	Needs
Public Education & Outreach	The 2016 MS4 Permit requires the education of both public and private entities about the impact they have I the MS4 system. Information may be disseminated through direct mailings, brochures/pamphlets, newspaper articles, message boards, public service announcements, public events/festivals, the local town website, and online news publications.
Public Involvement and Participation	On-going and continuous public involvement and participation is required under the 2016 MS4 Permit. The public participation effort initiated through the IWRMP will need to continue to ensure engagement.
Illicit Discharge Detection and Elimination (IDDE) Program	The *MS4 Permit Regulatory Update on Illicit Discharge and Elimination Program (IDDE)* memorandum by Kleinfelder, and included in Appendix C, summarizes the necessary updates to the current IDDE Plan to meet the 2016 MS4 Permit requirements. The Town should incorporate these updates to bring the IDDE Plan into compliance with the new 2016 MS4 Permit.
Construction Site Stormwater Runoff Control	The Town will continue to utilize their legal authority to inspect and enforce the implementation of best management practices by site developers to mitigation construction stormwater runoff pollution. This will require the continued support of the Town’s erosion and sediment control and waste control measures.
Stormwater Management in New Development and Redevelopment	Continued support of the Town’s guidelines for site development review, the implementation of green infrastructure/LID design considerations, and site stormwater runoff control BMPs will enable the Town to meet the requirements of the 2016 MS4 Permit. The Town should also

	consider targeting properties with the intent of possibly reducing impervious cover, which may also benefit stormwater runoff pollution control.
Good Housekeeping and Pollution Prevention	Under the 2016 MS4 Permit, the Town is responsible for implementing an operations and maintenance program to prevent or reduce stormwater runoff pollution that may impact the water quality of local water bodies. As development within the Town continues, the careful development and detailed review of stormwater pollution prevention plans (SWPPP) will be necessary to maintain sediment transport and mitigate site erosion from site activities operations. The SWPPPs should conform to the requirements outlined in the 2016 MS4 Permit. The Town will be required to update their O&M procedures to comply with the requirements of the 2016 MS4 Permit. Along with the development of SWPPPs, the updated O&M efforts will help improve procedures related to catch basin cleaning, street sweeping, road salt utilization, and the inspection and maintenance of existing Town-owned stormwater structural BMPs.

7.3.2.1 Stormwater System Mapping

The 2016 MS4 Permit has additional mapping requirements beyond that of the previous 2003 MS4 Permit. Certain elements are to be completed within two years of the 2016 MS4 Permit effective date (7/1/2018), while other items are to be accomplished within a ten-year timeframe. Table 7-7 lists those requirements.

Table 7-7: 2016 MS4 Permit Mapping Requirements

From MS4 Permit Effective Date	The system map should be updated to include:	Medway Map Status
Within 2 Years	Outfalls and receiving waters (required by MS4-2003 permit)	Y
	Open channel conveyances (swales, ditches, etc.)	N
	Interconnections with other MS4s and other storm sewer systems	N

From MS4 Permit Effective Date	The system map should be updated to include:	Medway Map Status
	Municipally-owned stormwater treatment structures (e.g., detention and retention basins, infiltration systems, bioretention areas, water quality swales, gross particle separators, oil/water separators, or other proprietary systems)	N
	Waterbodies identified by name and indication of all use impairments as identified on the most recent EPA approved Massachusetts Integrated List of waters report pursuant to Clean Water Act section 303(d) and 305(b)	Y
	Initial catchment delineations. Any available system data and topographic information may be used to produce initial catchment delineations. For this permit, a catchment is the area that drains to an individual outfall or interconnection.	Preliminary for 2015 High Priority Outfalls
Within 10 Years	Outfall spatial location (latitude and longitude with a minimum accuracy of +/-30 feet)	Y
	Pipes	N
	Manholes	N
	Catch basins	Y
Within 10 Years	Refined catchment delineations. Catchment delineations shall be updated to reflect information collected during catchment investigations	N
	Municipal sanitary sewer system (if available)	Y
	Municipal combined sewer system (if applicable).	N/A

7.3.3 Drainage (Hydraulic) Improvement Needs

Flooding due to stormwater runoff is another ongoing concern for Medway's stormwater system. The Town monitors approximately 26 locations (as depicted on Figure 7-9) for issues related to area drainage and/or flooding during heavy rain periods. The flooding may be caused by catch basin backups, low topography areas with inadequate drainage, beaver dams on private property or at culverts, inadequate pipe sizing in the infrastructure network or by an increase in the conveyance of overland flow due to impervious land development. The Town should continue to perform routine inspections of their stormwater collection system to identify maintenance issues (such as sedimentation within catch basins) especially in areas prone to frequent flooding. Design and development standards can help mitigate water quality and quantity impacts to the community. Low-lying areas and those downgradient of steep slopes may be most susceptible to flooding caused by stormwater runoff.

The two dams along the Charles River and Medway's southern border are used to control the flow of water reaching the downstream reaches of the Charles River. The Town should coordinate with the management of these dams to ensure flooding is not exacerbated by dam operations both within Medway and downstream along the Charles River.

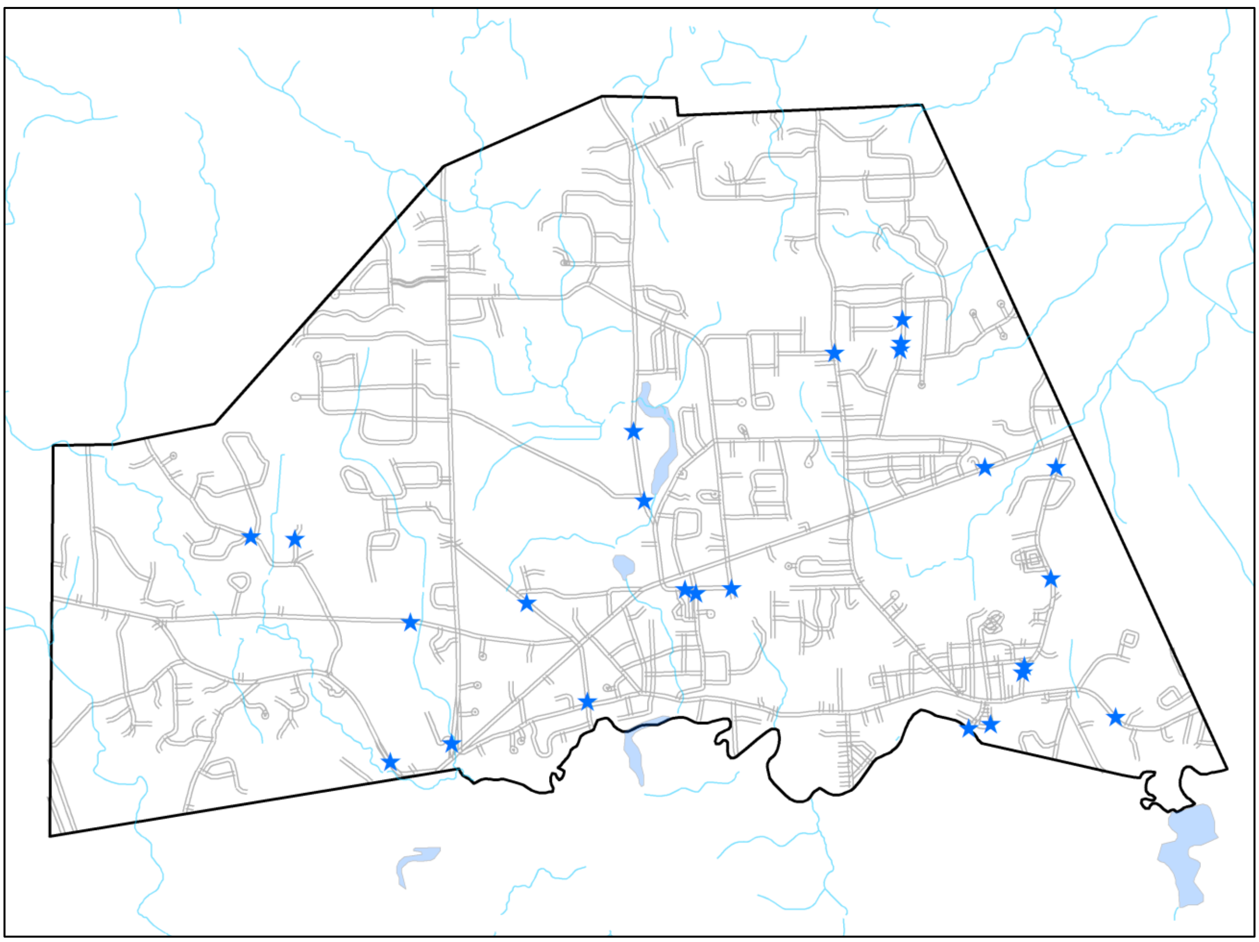

Figure 7-9: Medway Problem Drainage Areas

Drainage Operation and Maintenance

The Town has documented stormwater O&M related drainage issues including those shown in Table 7-8.

Table 7-8: Stormwater Drainage Issues

Issue	Description
Beaver dams blocking streams within cross-country easements	There is beaver activity currently throughout the town of Medway. Periodically that causes issues with culverts while other times they create beaver dams along a cross-country stream on private property. DPS staff does not have the authority to perform maintenance in these private areas and the authority to address these matters lies with the Conservation Commission.
Inspection and maintenance of privately-owned stormwater BMPs	Residents and Town staff have made complaints about the aesthetics and performance of privately-managed stormwater basins. DPS staff does not believe these basins are being inspected or maintained properly. Without proper maintenance, these basins may contribute to drainage and flooding issue on neighboring properties and roadways.

7.3.4 Summary of Stormwater Needs

Regulatory requirements drive most of the Town's stormwater system needs, however overall site development and public education are critical to protect this system as the Town continues to grow. Managing water quantity and quality are equally important, as shown in Table 7-9.

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Table 7-9: Stormwater Needs

Regulatory Requirements	Reduce TMDLs in Charles River	Develop and implement Phosphorus Control Plan
	MS4 Permit Compliance	Town must continue with the activities outline in the MS4 permit including public education and involvement, their IDDE program, construction site stormwater runoff management, stormwater management in development, and housekeeping/O&M procedures.

Near Term Needs	Address Localized Flooding	The Town should address the hydraulic inadequacies in stormwater drainage system
	Manage Impervious Cover of Proposed Developments	Impervious coverage from commercial development may contribute to increased stormwater runoff
	Promote Public Education and Engagement	Proper education of the public may help to address residential stormwater issues and develop support for future programs
Long Term Needs	Promote Stormwater Capture and Infiltration	Stormwater runoff from future development may contribute to drainage/flooding issues; Groundwater infiltration will support existing streams and drinking water supply
	Improve Town's Stormwater Inspection and Maintenance Procedures	Town must address the inconsistencies in rules and regulations related to managing stormwater assets and BMPs

8. Identification and Screening of Alternatives

To prioritize the implementation of the needs presented in Chapter 7, the IWRMP included an analysis of the interactions between each system to determine where the Town's investments would be most cost effective. This analysis recognizes that an investment in one system may provide a consequential benefit to another, therefore an analysis of interactions and tradeoffs between all three systems allows Town decision makers to evaluate the full value or risk of any given alternative and compare alternative investments using equivalent metrics. This provides a basis for the Town to justify its capital expenditures and O&M priorities based on a comprehensive understanding of the benefits and tradeoffs associated with the alternatives. Further, this analysis allows the IWRMP to identify:

1. How are the stormwater, wastewater, and drinking water systems connected?
2. What interconnections/relationships are the most impactful?
3. How would various investments or policies ("alternatives") affect the systems, either through benefits or risks?
4. How could multiple alternatives be combined to address Medway's issues most effectively?

8.1 System Interconnections

To understand how the needs presented in Chapter 7 may affect multiple systems, it is important to understand the basic connectivity between the systems. The basic interconnections between Medway's systems are illustrated conceptually in Figure 8-1 and described below.

- **Wastewater and Drinking Water:** Drinking water demand affects the supply and distribution system in Medway, but it also affects the volume of wastewater that enters the system. Approximately 85 percent of the water consumed in Medway is disposed of through the Town's wastewater collection and treatment system. With Medway currently projected to exceed their permitted wastewater volume at the CRPCD WWTP, understanding this relationship is important, as it helps focus attention on the causes of future water and wastewater stress, and not just isolated solutions. It also helps stakeholders understand that alternatives such as water conservation and recycled water have broader benefits across the Town than just the single sectors with which they are normally associated.
- **Wastewater and Stormwater:** Stormwater is primarily influenced by precipitation and land use, and stormwater issues are often regulated and managed with policies and infrastructure aimed specifically at these factors. Stormwater can contribute to capacity issues at the wastewater treatment facility. Inflow and infiltration into the collection system pipes represents a connectivity between the two systems and can lead to SSOs as well as decreasing available wastewater capacity and unnecessarily treating extraneous flows.

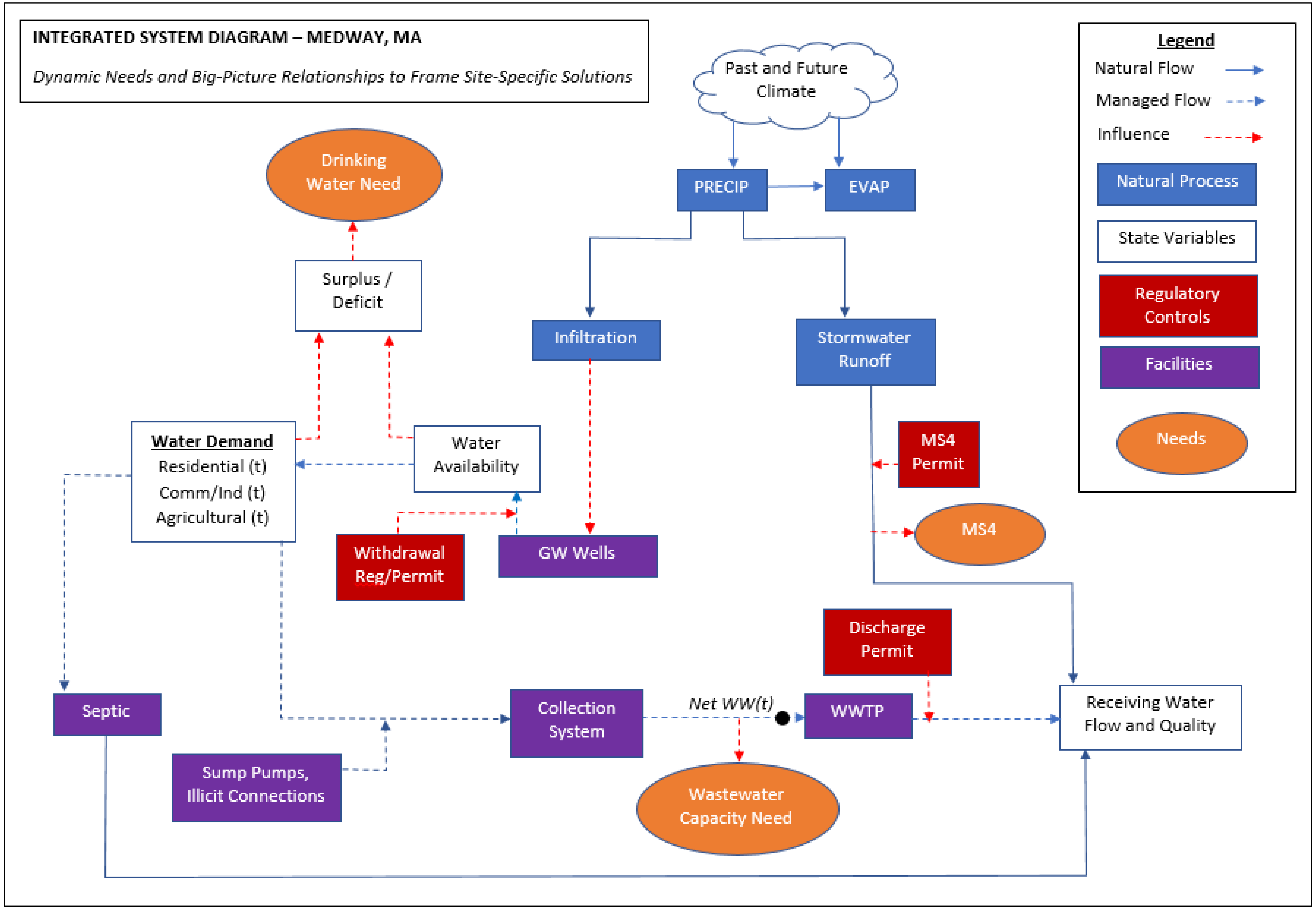

Figure 8-1: Medway Water System Interconnections

- **Stormwater and Drinking Water:** Precipitation results in both runoff and infiltration into the ground which replenishes the aquifer that supplies Medway's wells. Seasonal depletion of the aquifer generally leads the Town to reallocate its demand to different wells (e.g. the Oakland Well), and this may be sub-optimal for water quality reasons. Promoting more infiltration of stormwater into the ground could help reduce dependence on wells with poorer water quality.

Understanding the connectivity between systems informs how various alternatives could serve the Town strategically, by benefitting more than one sector. This IWRMP aims to prioritize investments based on strategic value (solving the most important problems with solutions with broad benefits), affordability, and consensus-backing of decision makers on why each decision is made.

8.2 Alternatives

An alternative is a strategic policy, capital project, or maintenance program to improve water resource and infrastructure conditions, ultimately working towards addressing the Town's needs as identified in Chapter 7. Alternatives for addressing the issues in each system were chosen with the understanding that their primary impact would be for the related system, but that secondary impacts may be evidenced for other systems as well. Figure 8-2 illustrates the ways in which these strategic alternatives (conceptually shown at a planning level) would interact with the three connected systems. Some of these secondary impacts may be beneficial, and others may be detrimental.

For example, water conservation is identified as an alternative primarily because it can help reduce water demand and stress on the Town's wells and aquifer supply. However, tracing impacts through the integrated diagram shown in Figure 8-2, shows that alternatives can affect other systems as well.

Table 8-1 identifies the primary system targeted by each strategic alternative, and the secondary systems that could either benefit or experience negative consequences.

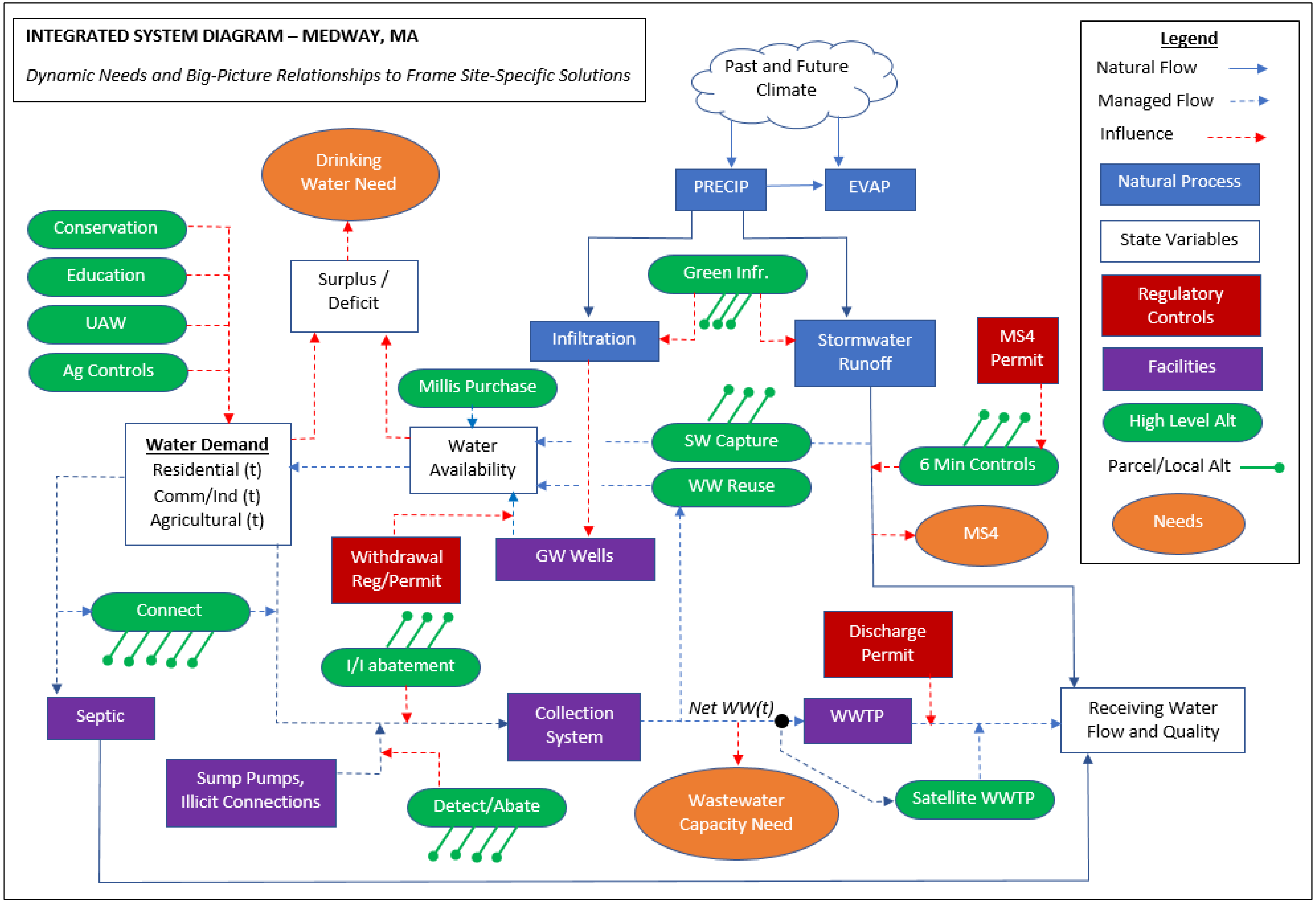

Figure 8-2: Medway Water Resources System Interconnections with Strategic Alternatives

Table 8-1: Impacts of Alternatives Throughout Medway's Water Systems

Alternative	Total DW Demand	Available DW Supply	Well Utilization	WW Flow to CRPCD	WW Discharge to River	Change in Septic Flow	SW Discharge to River
Manage Impervious Area		✓ (secondary)		✓ (secondary)	✓ (secondary)		✓ (primary)
Increased Green Infrastructure		✓ (secondary)		✓ (secondary)	✓ (secondary)		✓ (primary)
Increased Stormwater Capture			✓ (secondary)				✓ (primary)
Reducing I/I of the Waste Water System				✓ (primary)	✓ (primary)		✓ (secondary)
Septic to Sewer Conversion				✓ (primary)	✓ (primary)	✓ (primary)	
Reclaimed Water for Non-Potable Use	✓ (secondary)	✓ (secondary)	✓ (secondary)		✓ (primary)		
Reclaimed Water for Indirect Potable Use		✓ (secondary)			✓ (primary)		
Well Supply Redundancy			✓ (primary)				
Indoor Conservation	✓ (primary)	✓ (primary)	✓ (primary)	✓ (secondary)	✓ (secondary)		
Outdoor Conservation	✓ (primary)	✓ (primary)	✓ (primary)				✓ (secondary)
Unaccounted for Water	✓ (primary)	✓ (primary)	✓ (primary)	✓ (secondary)	✓ (secondary)		

✓ (primary): Primary Impact

✓ (secondary): Secondary Impact

8.3 Integrated Modeling of Alternatives

The analysis of interactions and tradeoffs between the three systems required the development of a simple tool that would be used to dynamically illustrate system connectivity. A commonly employed software packaged called STELLA was used to develop an integrated system model. STELLA enables planners to "draw" interconnected systems and then simulate the flow of water into, through, and out of each water resource system. It also allows for transfers of water between the various systems in the model using rules and logic input by the user to govern such flows.

An integrated model is a dynamic assessment of a system that simplifies complex problems to inform decisions. For Medway, it is useful to explore how water system interactions could change in the future under different climate conditions and because of the strategic alternatives.

8.3.1 Overview of STELLA and its Application in Medway

The integrated model chosen for the Medway systems was STELLA, a dynamic systems simulation tool for studying the behavior of interconnected systems and the decisions that affect them. STELLA stands for "Systems Thinking, Experimental Learning Laboratory with Animation." Effectively, STELLA helps to visualize and understand the performance of interconnected systems in a "big picture" platform by allowing for experimentation with different alternatives and groupings of alternatives. It helps to demonstrate which alternatives offer the broadest benefits, so that these can be factored into the long-term plan, be evaluated for cost, and ultimately for the value they bring to the Town.

8.3.2 Inputs

The STELLA model also allows for examination of the performance of alternatives over different hydrologic conditions. It is populated with data representing a historic dry year, a historic wet year, and a historic average year, all regarding total precipitation. The model does not rely on any specific year from the historical record, but composites the historical statistics into percentiles, such that the dry year comprises the 10th percentile of rain for each month over the period of record, the wet year comprises the 90th percentile, and the average year comprises the 50th percentile. In other words, the rainfall for January in the representative dry year is computed as the 10th percentile of all other records for the month of January, and so on. In addition to precipitation data the following data sources are described in earlier sections of the report and are used as inputs for the STELLA Model:

- Population projections – UMass Donahue Institute & Mass DOT
- Water demand through 2035 – Developed using ASR data and the Massachusetts Water Resources Commission's "Policy for Developing Water Needs Forecasts for Public Water Suppliers and Communities and Methodology for Implementation"
- Septic systems – GIS Data
- Wastewater flows – CRPCD Data
- Impervious areas – GIS Data

Figure 8-3 and Figure 8-4 illustrate the STELLA model for Medway. The double arrows represent flowing water, and the single-line red arrows represent a mathematical or logical dependence of one element on another.

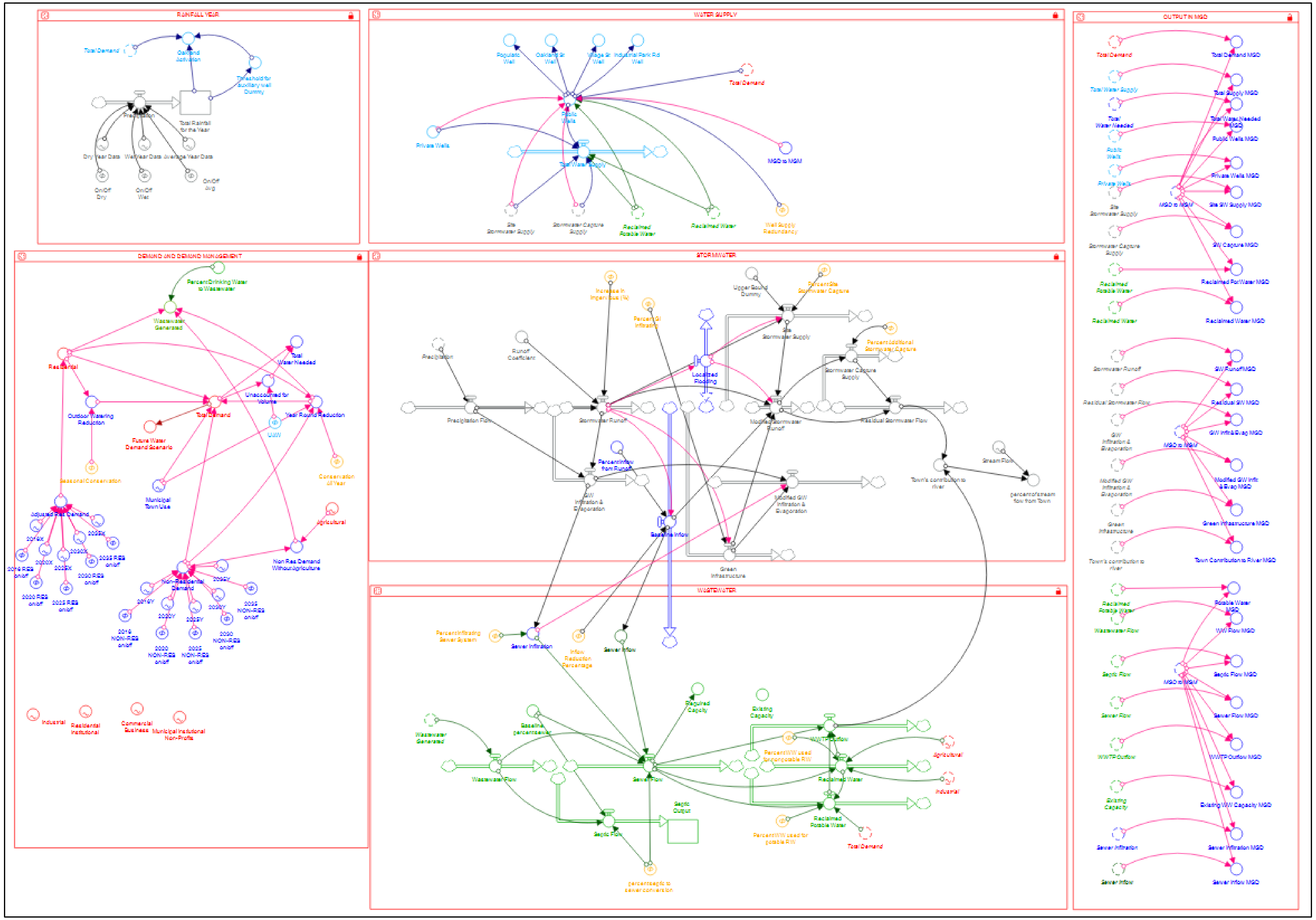

Figure 8-3: STELLA Model Layout for Medway's Integrated System

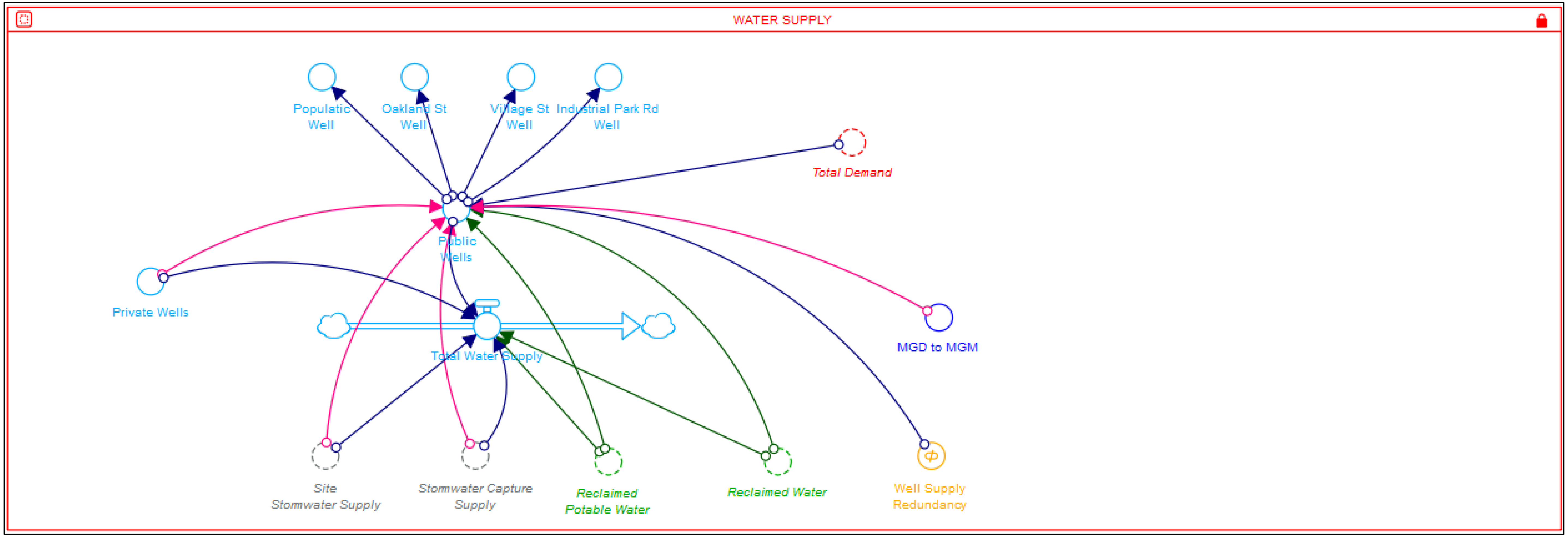

Figure 8-4: STELLA Model Layout for Medway's Drinking Water System

8.3.3 Validation

Integrated models rely on known relationships and data, and it is important to demonstrate that this information provides an appropriate baseline for existing conditions and reasonable sensitivity to changes in conditions. The two foundational aspects of the Medway model were checked for reasonable representation of current conditions to validate the model: Current drinking water demand, and the flow of wastewater into the treatment plant over a range of climate conditions. The validation first examined future demand projections, beginning from the current year. Figure 8-5 shows that the current demand aligns well with 2016 demand levels as reported on ASR.

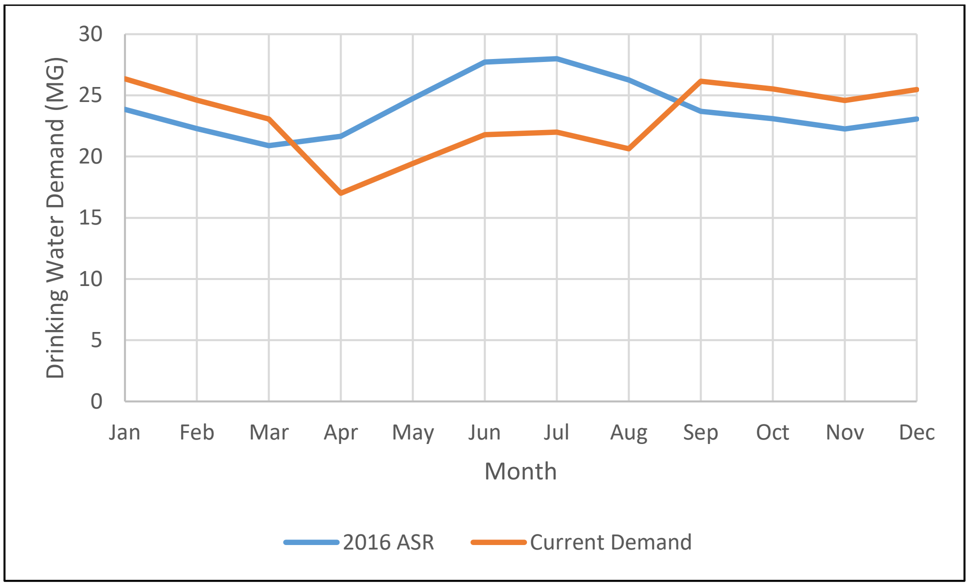

Figure 8-5: Drinking Water Demand Projections and Current Demand Level

The validation then evaluated the model's ability to represent the dependence of wastewater flow into the WWTP as a function of precipitation. Recent records shown in Figure 8-7 suggest that total average flow into the treatment facility ranges from approximately 0.8 MGD to approximately 1.3 MGD during the wettest year. Presumably, this is a fair representation of Inflow and Infiltration (I/I) into the system. This observed relationship was used to calibrate a percentage of Stormwater that enters the collection system monthly. That percentage is then applied in the model to the amount of monthly precipitation that falls.

To test this theory, and to calibrate the percentage, the model was run for current conditions and no alternatives activated for all three representative climate conditions: dry year, average year, and wet year. Figure 8-7 demonstrates that the model accurately reflects the trend in Figure 8-6. In dry years, the average wastewater flow is approximately 0.8 MGD, in wet years it is approximately 1.3 MGD. This validates the model's ability to represent the influence of stormwater on wastewater volume, and by extension, the normal level of sanitary flow in the system, which is assumed to equal approximately 85% of residential and commercial drinking water demand.

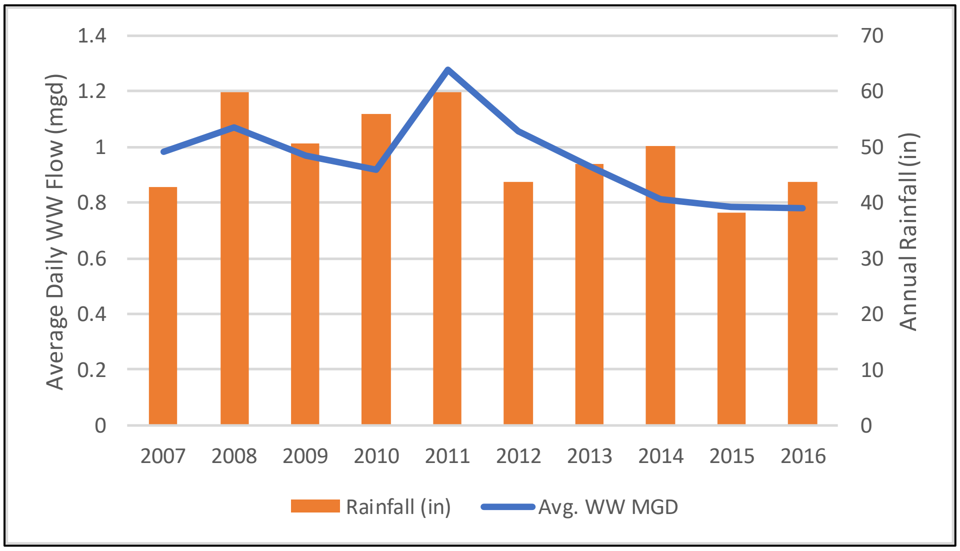

Figure 8-6: Precipitation vs. Total Flow into CRPCD

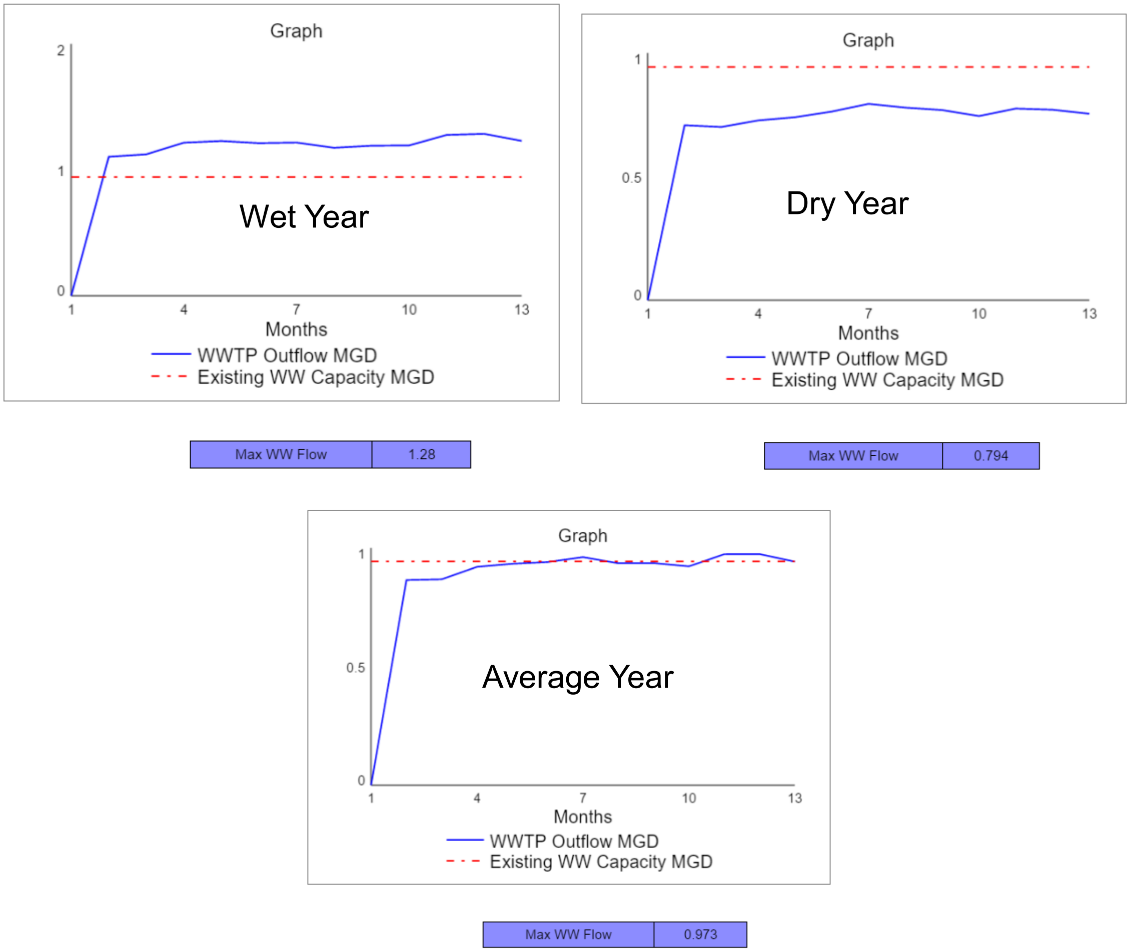

Figure 8-7: Model Validation for Stormwater Influence on Flow to CRPCD

These validation tests give us confidence that the water demand, the sanitary wastewater generation, and the total influence of stormwater on the collection system is well represented in this model, such that the simulation of improvements would yield meaningful information to decision makers.

8.3.4 Evaluating Individual Alternatives

The model provides useful information on the primary and secondary impacts of individual alternatives, as well as groupings of alternatives. For individual alternatives, it helps to understand whether they affect one primary system, more than one system, and if all the effects are beneficial. Figure 8-8 illustrates this method of screening using three different alternatives as examples. Using a variety of metrics across the three systems, the alternatives are evaluated to understand impacts. Then are grouped as individual alternatives that work well together across the Town's water systems.

Each of the three examples illustrates a different type of response. First, year-round conservation could help reduce both water demand and resultant wastewater flow, therefore having a positive impact on two of the Town's systems. Second, reduction of inflow and infiltration could significantly reduce the amount of flow into the wastewater treatment facility. However, this would result in additional stormwater flowing into the river. While this represents an important tradeoff, the net benefit may still be positive, depending on the relative importance of reducing wastewater treatment capacity and reducing stormwater runoff. Third, applications of Green Infrastructure will likely help reduce stormwater discharge to the river but may not have a clear impact on drinking water or the collection system unless the projects are placed in areas of known inflow to the collection system.

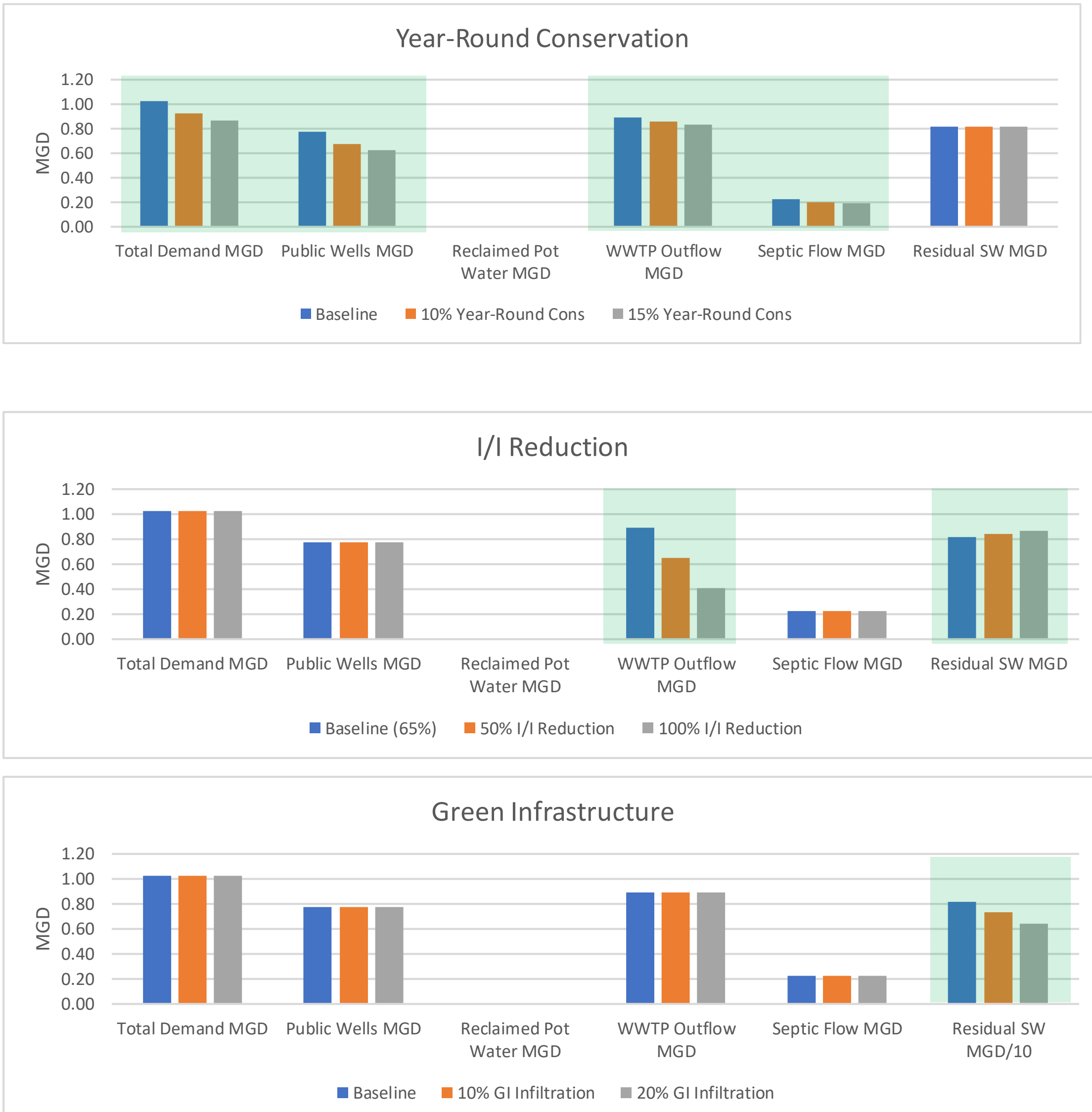

Figure 8-8: Screening Results for Three Model Alternatives

8.4 Evaluating Scenarios

Once the potential impacts of individual alternatives were better understood, they were grouped into "scenarios" for further experimentation. Each scenario was designed to combine related alternatives to address a specific goal, on the theory that this will illuminate alternatives that can satisfy multiple objectives. The alternatives that demonstrated the broadest effectiveness individually and in combination with others were combined into a "hybrid" grouping, which became the basis of recommendations presented in Chapter 9.

The initial scenarios were not intended to represent complete solutions on their own, since they are focused primarily on one objective. Scenarios represent extremes in the system to display what areas need the most attention and what alternatives have the largest effect on the system. For this step, the groupings are hypothetical, aimed at educating us to better combine the highest performing alternatives into a meaningful recommendation in the next step.

The different scenarios to help educate us on how well the alternatives work together (or do not):

- Maximize Water Resource Systems Investment: Helps us understand what a result could be with an unlimited budget and if all the problems were addressed fully.
- Minimize Water Resource Systems Investment: Helps us understand what alternatives could achieve the bare minimum of what needs to be done.
- Drinking Water Investment: Solely focuses on resolving all the drinking water issues within the system.
- Stormwater (MS4) Investment: Solely focuses on resolving all the stormwater issues within the system.
- Wastewater Investment: Solely focuses on resolving all the wastewater issues within the system.
- Water Reuse: Focuses on the alternatives that will allow water reuse.

The results of the scenarios were tabulated using metrics for all three sectors. Figure 8-9 presents the findings.

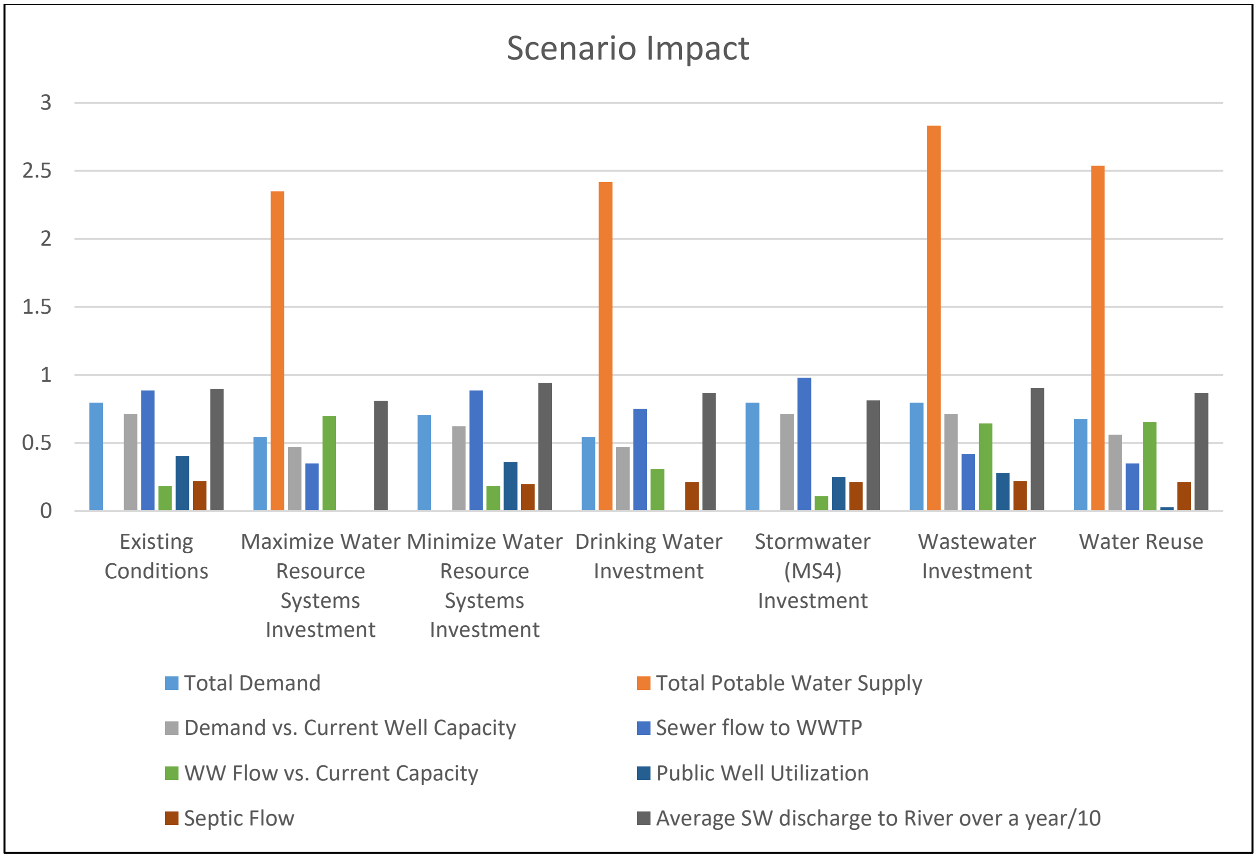

Figure 8-9: Model Scenario Results

8.5 Results

The model results for the scenarios presented above allowed us to see what alternatives had broad impacts on the water resource systems, and which had more modest impacts. A summary of the relative impacts is provided below:

- Large Impact on the System
  - Inflow Reduction
  - Septic to Sewer Conversion
  - Indoor/Outdoor Conservation
  - Reduction of unaccounted for water
- Mild Impact on the System
  - Increase/Reduction in Impervious Area
  - Reclaimed water for non-potable use or indirect potable use
  - Well Supply Redundancy
- Little to No Impact on the System
  - Increased green infrastructure
  - Increased stormwater capture

Utilizing the results of the integrated modeling effort, the IWRMP presented in Chapter 9 seeks to prioritize alternatives and recommendations that have demonstrated the greatest impact on the Town's water resources systems.

9. Integrated Water Resources Management Plan

9.1 Overview

This IWRMP has documented the existing built and natural environment, as well as the current, wastewater management, drinking water supply, and stormwater management systems in the Town of Medway. The existing conditions chapters inventoried the Town's infrastructure and management systems and the needs analysis chapters assessed the adequacy of those systems to meet the Town's goals. The alternatives analysis assessed and prioritized available options that could potentially meet the Town's water resources needs, allowing for a better understanding of the influence of each alternative. Each of the water resources alternatives represents its own set of costs, impacts, and benefits.

The goal of the Integrated Water Resources Management Plan presented in this Chapter is to document the final recommendations and to create a cost-effective integrated approach to water resources management that meets the most goals of the Town, produces the highest environmental benefit, and creates the least environmental impact.

As noted previously, the Town undertook this IWRMP effort with the goal of understanding the breadth and depth of needs throughout water resource systems. Developing an organized plan to address current needs and plan for the future allows the Town to stay proactive in its management of its finite water resources while also being fiscally responsible in its future planning.

9.2 Integrated Plan

The project recommendations of the IWRMP have been prioritized based on the outcome of the hybrid decision modeling scenario. A 20-year Implementation Plan with phased costs and schedule is then presented in Section 9.4.

It is important to note that the Town will continue to use this IWRMP framework as a planning tool, creating a living document for its infrastructure needs. As new studies and projects are identified, they will be included in the plan. As such, the later years of this 20-year plan will continue to be modified, especially as the Town completes its upcoming Water System Master Plan update and implements an Asset Management program and other studies which will further inform capital needs. Changes in State or Federal regulations, or environmental conditions may also initiate new projects for inclusion in the IWRMP.

9.2.1 Overall Recommendations

The following recommendations span all DPS functions and touch on each of the water resources systems.

- Develop Asset Management Program

  The Town should implement an Asset Management (AM) program to support all efforts related to the IWRMP. The 20-year plan should include yearly AM activities to optimize maintenance and streamline planning efforts for all three water resource systems.

- Continue Public Education and Engagement

  The Town should continue to promote public education and engagement with regards to water resources. Programs and activities related to this recommendation may include:

  - Educational quizzes tied to free water resource product giveaways.
  - Quarterly town meetings/presentations focused on water resource topics.
  - Social media engagement for alerts/information related to water resource activities and initiatives.
  - Coordination with schools to further incorporate water resource education into student curricula.

- Review Interdepartmental Workflow for Development

  The Town staff have expressed interest in updating their workflow procedure related to the way the Town manages proposed development plans. Different Town departments are involved in various ways related to the review and approval process of development plans. The 2008 Development Guide Handbook provides a procedural workflow for development plan reviews and identifies the responsible departments for various steps in the process. This workflow may be outdated. Therefore, Kleinfelder recommends that the Town update their interdepartmental workflow procedures by 2022 to reflect current practices and protocols.

- Annual IWRMP Program Assessment

  The recommendations presented herein and scheduled in the implementation plan should be evaluated on an annual basis to reaffirm alignment with the Town's short term and long-term goals, as well as incorporate new information gathered through investigations and assessments. Periodic evaluation of water demands, wastewater flows and population should also be calibrated against the assumptions included herein.

9.2.2 Wastewater System Recommendations

- Purchase Available Wastewater Capacity at CRPCD

  Wastewater flows from Medway are close to exceeding the Town's allocated capacity at the CRPCD. To accommodate the current wastewater flows and future demand projections, the Town should consider purchasing up to an additional 300,000 gallons per day of capacity at the CRPCD. The cost of purchasing the additional capacity is unknown at this time but could be as much as $10/gallon. The Town should prioritize this recommendation to increase the wastewater capacity within the first 2 years of the IWRMP.

- Install Permanent Sewer System Metering

  By 2020, the Town should install and maintain three (3) wastewater flow meters to help quantify and verify flow contributions in areas of the town where CRPCD metering is incomplete. These permanent meters will not replace the periodic system wide metering that should be performed every 10 years.

- Perform Sewer System Evaluation Survey (SSES) Investigations and Rehabilitation

  The Town may increase its available wastewater capacity and reduce wastewater treatment cost by removing sources of infiltration and inflow (I/I) into the Medway sewer system. After installing temporary flow meters in 13 locations, Kleinfelder performed an I/I analysis on the flow metering data collected and identified three locations to install permanent flow meters. The Town should also perform follow-up investigations to identify specific sources of I/I into the wastewater system. This recommendation reflects a reoccurring activity through the 20-year IWRMP.

- Purchase CCTV Equipment to Support WW Operations

  To support ongoing maintenance of the wastewater system, the DPS can perform certain sewer system inspection activities in-house. These interests align with the goals outlined in the Town's Wastewater Collection System Operations and Maintenance Plan. To support the ongoing I/I work and any future Asset Management (AM) related work, Kleinfelder recommends the Town purchase a utility van equipped with CCTV inspection equipment to perform pipeline inspections on the Medway sewer system. This equipment should include CCTV crawler cameras suitable for pipes 6-inch through 54-inch in size, the CCTV inspection launching apparatus, and computer software to collect data and document the condition of the sewer pipes in accordance with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) standards.

- Perform Temporary Sewer System Metering

  The Town should continue to perform a periodic town-wide temporary metering of the entire wastewater system to evaluate flows in the subsystem areas and identify areas of focus for future SSES work. The IWRMP includes a town-wide metering program that will occur every 10 years with the most recently metering completed in 2017.

9.2.3 Drinking Water System Recommendations

- Implement Drinking Water Treatment Improvements

  The Town's Oakland Street well is infrequently placed into production due to its water quality issues related to iron and manganese. To address increasing water quality concerns at the four town wells (including Oakland Street), the Town should invest in a phased approach to establish a more centralized drinking water treatment plant. This will help to provide more effective and consistent water treatment to the Town's residents and help to improve the public's opinion of Medway's drinking water.

- Implement Drinking Water Supply Redundancy

  The Town's drinking water distribution system relies on the Populatic Street well to help produce a reliable daily output (RDO) sufficient to meet the Town's drinking water demand. Without the Populatic Well, the RDO from all remaining wells might not support water consumption above 0.79 MGD (which reflects the 2016 daily water demand). To maintain a sufficient RDO and accommodate a scenario where the Populatic Well may be taken offline, the Town should install a redundant well at the Populatic site. This recommendation also includes a phased approach to installing redundant water supply wells at the Populatic, Oakland and Village Street well sites. The goal of this alternative is to provide an additional well at one of the current well locations to improve the redundancy of the system. Given the criticality of the well supply situation, the Town should prioritize implementing this recommendation.

- Update Emergency Drinking Water Supply Plan and Establish Interconnections

The Town's water system is not resilient. Formal agreements are not in place between Medway and its neighboring towns with which it has emergency interconnections. The Town staff believe that the interconnection with Milford may be the only emergency connection that can hydraulically supply water to Medway, but it too has capacity limitations. Medway needs to formally establish additional interconnections. Medway has an existing emergency response plan, but detailed standard operating procedures are lacking. Kleinfelder recommends that the Town:

- Investigate hydraulic and infrastructure and equipment needs for each interconnection.
- Draft standard operating procedures (SOPs) for each emergency interconnection that should include the connection's physical characteristics, any potential water quality impacts, the conditions under which the connection will be utilized, and the prioritization of that connection.
- Establish agreements with neighboring towns for each emergency interconnection, with priority given towards establishing agreements with Millis and with Milford.

The Town's existing emergency response plan should be updated to incorporate the items mentioned above.

- Continue with Unaccounted for Water Activities

The Town is concerned that current efforts in managing unaccounted for water (UAW) have produced varying results. The UAW in Medway was 17% as of 2016. While the UAW percentage may fluctuate from year-to-year due to the age of the distribution network, the lack of proper UAW management measures will eventually result in the increase in UAW. If Medway can reduce the UAW to the State Performance Standard of 10 percent or lower, then the Town could:

- potentially accommodate all current and future development without making other significant capital improvements to the drinking water distribution system and
- could provide as much as 20 MG of additional water to be supplied to customers.

The Town should prioritize the reduction of the UAW prior to assessing the need for an increased authorized withdrawal volume through their WMA Permit. It is in the best interest of the Town to generate revenue from as much of the withdrawn water as possible and prevent its loss through non-revenue sources. The Town can reduce the UAW through water main replacement projects, more effective and frequent leak detection procedures, and better documentation of unmetered municipal uses. Currently, the Town allocates about $10,000 to $12,000 to support UAW efforts.

The Town should continue to promote the management of UAW and even consider enhancing their UAW management activities. This enhancement may include:

- Purchasing and implementation of a new digital correlating logger system. The Town should prioritize deployment of the correlating loggers in areas of high concern identified through the Town's leak database.
- Performing replacement of residential water meters on a systemwide scale.
- Working with Town departments to improve the tracking of unmetered water usage in activities such as vehicle servicing and washing.

The benefits of this recommendation include:

- reducing the volume of water being withdrawn from the Medway groundwater supply.
- decreasing the likelihood that the Town's daily drinking water demand will exceed its WMA permitted withdrawal limit and similarly reducing the urgency for an increase to the WMA limit.
- allowing Medway to progress towards meeting MassDEP statewide UAW Standards.
- helping to demonstrate a functionally equivalent compliance by adhering to their UAW Compliance Plan (which will be necessary for a WMA Permit limit increase).
- providing a financial benefit to the Town by decreasing the amount of non-revenue water that is pumped from the groundwater wells.

- Update Town-wide Drinking Water Hydraulic Model

The last system-wide hydraulic analysis of the drinking water distribution system was performed in 2010. The Town should perform a hydraulic assessment on the drinking water system to update their model every 5 to 10 years starting no later than 2020. The results of the hydraulic model analysis will become the basis for the water system improvements performed over the course of the 20-year IWRMP.

- Implement Water Distribution System Improvements

An updated hydraulic model will supplement the Town's efforts in identifying deficiencies in the water distribution system (e.g. fire flow and pressure deficiencies system looping, etc.). The Town should develop capital improvement projects to address those deficiencies in the distribution system. The Town staff envisioned performing these system improvements as part of the ongoing distribution system operations and maintenance program. The implementation of these system improvements should begin in 2021, following the hydraulic system analysis.

- Continue with Annual Water System Maintenance

  Major failures in Medway's drinking water distribution system may result in the Town's inability to provide drinking water to its residents. The Town should continue their efforts to maintain the existing drinking water infrastructure especially with respect to performing:

  - maintenance on the four drinking water supply wells to meet production demand levels,
  - a phased uni-directional hydrant flushing program in the distribution system to improve the in-system drinking water quality, and
  - annual inspections of the Highland Street and Lovering Street water storage tanks.

  This recommendation is important not only to meet future daily water demand projections but also to promote the longevity and quality of the drinking water system.

- Perform Highland and Lovering Tank Painting and Cleaning

  The Highland and Lovering Street water storage tanks are critical assets in Medway's drinking water system. The Town should continue its efforts to maintain these critical water infrastructure assets by performing routine cleaning and maintenance every 10 years starting with the Lovering Tank in 2023 and Highland Tank in 2027.

- Continue to support Indoor Water Conservation

  Kleinfelder recommends that the Town continue and enhance their indoor water conservation measures including the following:

  - Provide water saving devices (dye tablets, aerators, low-flow showerheads, toilet displacement bags, etc.) to residents at no charge. The Town should increase the public knowledge of device availability and promote use by demonstrating the potential savings to customers.
  - The Town should also provide a chart within customer's water bills (or by other means) showing their water use in comparison to households of a similar size. This recommendation will aim to increase awareness among large volume users and promote conservation.

- Continue to support Outdoor Water Conservation

  Kleinfelder recommends that the Town continue and enhance their outdoor water conservation measures including the following:

  - Restrict non-essential outdoor water use to 2 days/week.
  - Continue with rain barrel give away/price reduction program.
  - Consider implementing a bylaw under severe/catastrophic conditions to restrict private well water usage.
  - Continue to promote public events and develop educational materials around water conservation for residents

- Redevelop Water Supply Impact Mitigation Fee

  The Town has a water system access fee based on the size of service used to connect to the existing drinking water distribution system. Kleinfelder recommends evaluating the manner in which the Town could modify this fee to better reflect the actual demand that a new development connection would place on the drinking water system supply.

- Pursue WMA Permit Withdrawal Limit Increase

  Demand projections for water usage shows that the Town will exceed its WMA Permit withdrawal limit by as early as 2023. Kleinfelder recommends that the Town commence the regulatory process to update their WMA Permit and increase the withdrawal limit. The predictions show that water demand will exceed 1.07 MGD by 2035. Therefore, the Town should consider requesting to increase the withdrawal limit to at least 1.1 MGD to accommodate future growth in demand.

9.2.4 Stormwater System Recommendations

- Continue MS4 Program Implementation

  The Town should continue its efforts to comply with the 2016 Municipal Separate Storm Sewer System (MS4) Permit requirements which became effective on July 1, 2018. The IWRMP incorporates the provisions laid out in the MS4 Permit for the first five years. The Town should also continue to monitor the ongoing litigation related to the MS4 Permit to understand and prepare for any future changes to the permit's requirements.

- Perform Drainage Improvements

The Town should address the local flooding issues caused by hydraulic restrictions in the stormwater infrastructure system. To accomplish this, the Town should perform the following:

  - Analyze the existing list of areas with flooding issues and problematic drainage to identify which issues are caused by hydraulic restrictions.
  - Design remedial solutions to address the hydraulic inefficiencies.
  - Monitor the post construction performance of the remedial solution.

The Town Staff have identified 25 locations where there are catch basin/drainage problem areas, see Section 7.3.3. As time goes on, Kleinfelder anticipates that the Town will incorporate additional areas with stormwater drainage related issues. The IWRMP assumes that the Town will continue to address stormwater drainage issue on a yearly basis.

- Install Stormwater Structural BMPs

The analysis presented in Appendix C indicates several locations where the Town could identify locations for implementing stormwater structural BMPs to address stormwater runoff. These BMPS would also promote improved stormwater quality to meet future requirements for the Charles River TMDL Phosphorus Control Plan under the MS4 Permit.

- Perform Stormwater Infiltration Analysis for Town-Owned Properties

The Town should perform studies to identify town-owned parcels where impervious pavement can be reduced or disconnected from the MS4 to promote stormwater infiltration and groundwater recharge. Targeted sites should include public schools and municipal properties with large parking lots.

- Promote Impervious Cover Reduction

The Town should review its development policies and make improvements to the components that regulate the impervious cover of developments. This recommendation aims to more effectively manage the existing and potential stormwater runoff related issues (both in terms of quantity and quality). This is also an element of MS4 compliance. Kleinfelder performed a preliminary analysis of the Town's development policies and recommends that the Town consider the following:

- Reducing the maximum impervious coverage percentage for the commercial zoning districts from 80% to 60% in the zoning bylaws. This change in the maximum percentage aligns with the standards set in communities like Medway.
- Setting the maximum impervious coverage percentage for the Village Commercial zoning district at 70%.
- Reviewing the development requirements for the Central Business zoning district to manage the potential stormwater runoff related issues from the area. The district's parcels are situated in a localized high point in Medway. The impervious cover from development in this area may produce problematic stormwater runoff when coupled with the slopes of the terrain.

9.3 Assessment of IWRMP Impacts and Benefits

The project and activity recommendations of the IWRMP were reviewed in relation to impacts and benefits on public health and safety and on the environment. The implementation of the IWRMP will primarily have benefits to Medway's environment and public health and safety. Some projects will require construction, although most of the construction activity is expected to take place on existing developed or cleared land. Many projects consist of planning, operation and maintenance and policy implementation which will either be neutral or beneficial to the environment and public health and safety. The impacts and benefits of each recommendation is summarized below on Table 9-1 and discussed in Sections 9.4.1 and 9.4.2.

9.3.1 Environmental Impacts and MEPA Thresholds

For environmental impact, the regulations of 301 CMR 11.03 of the Massachusetts Environmental Policy Act (MEPA) were reviewed. The MEPA thresholds of impact for likely IWRMP projects were reviewed. In general, many of the projects are either neutral or beneficial to the environment. None of them are expected to trigger the requirement for submittal of an Environmental Impact Report (EIR). However, several projects relating to water system improvements will trigger the need for filing an Environmental Notification Form (ENF). The following provides a summary of the anticipated environmental impacts and potential MEPA requirements.

Land:

- There may be town-owned parcels that are converted for stormwater management related construction and activities (such as the construction of stormwater structural BMPs). There will be town-owned parcels which are already utilized for drinking water supply and treatment that are utilized for the construction of the drinking water treatment improvements. Impact from construction activities will be mitigated through stormwater pollution prevention plans. However, these activities are not expected to be large enough to trigger MEPA thresholds for impacts to land

State-listed Endangered or Threatened Species:

- The MEPA thresholds for impacts to state-listed endangered or threatened species are not expected to be triggered by the activities of the IWRMP.

Table 9-1: Summary of Potential Environmental and Public Health or Safety Impact and Benefits

System	Recommendation	Project Type	Potential Environmental Impact	Potential Public Health or Safety Impact	MEPA EIR or ENF Required?	Expected Project Mitigation if Required
ALL	Re-evaluate IWRMP Annually	Planning/Mgmt.	neutral	neutral	No	
ALL	Develop Asset Management Program	Planning/Mgmt.	neutral	neutral	No	
ALL	Continue with Public Education and Engagement	Planning/Mgmt.	promotes citizen understanding of impacts of their actions on environment	promotes citizen understanding of impacts of their actions on environment	No	
ALL	Review Interdepartmental Workflow for Development	Planning/Mgmt.	neutral	neutral	No	
WW	Purchase Available Wastewater Capacity at CRPCD	Policy	neutral	neutral	ENF required for increased discharge of 100,000 gpd	Town will need to demonstrate that wastewater system has been optimized to justify capacity purchase.
WW	Install Permanent Sewer System Metering	O&M	neutral	neutral	No	
WW	Perform SSES Investigations and Rehabilitation	O&M	promotes proper system operation	promotes proper system operation	No	
WW	Purchase CCTV Equipment to Support WW Operations	O&M	promotes proper system operation	promotes proper system operation	No	
WW	Perform Temporary Sewer System Metering	O&M	neutral	neutral	No	
WW	Consider Limited Sewer Extensions	Capital	reduce failed septic releases	reduce failed septic releases	ENF if expands flow by 10% or if 5+miles long or if 1/2 mile cross-country	Assuming construction is performed in existing roadways, mitigation is unlikely to be required.
DW	Implement Drinking Water Treatment Improvements	Capital	neutral	promote compliance with health advisories	ENF likely for expansion of existing treatment plant by 10% or 1MGD or construction of new plant of 1+MGD	Unlikely to be required. Town's water strategic plan is to construct centralized treatment for all wells at the Populatic site. It is expected that treatment facility will be built on existing cleared land.
DW	Implement Drinking Water Supply Redundancy	Capital	neutral	public safety enhancement	ENF required for new withdrawal of 100,000 gpd or more	Mitigation will be incorporated into the Water Management Act permit amendment process. This could include offsetting withdrawals by I/I removal, demand reduction, environmentally beneficial projects, etc.
DW	Update Emergency Drinking Water Supplies	Planning/Mgmt.	neutral	public safety enhancement	No	
DW	Continue with Unaccounted for Water Activities	O&M	reduces demand on aquifers	neutral	No	
DW	Update Town-wide Drinking Water Hydraulic Model	Planning/Mgmt.	neutral	improved understanding of system performance	No	
DW	Implement Water Distribution System Improvements	Capital	neutral	can reduce incidence of main breaks and other disruptions	No	

System	Recommendation	Project Type	Potential Environmental Impact	Potential Public Health or Safety Impact	MEPA EIR or ENF Required?	Expected Project Mitigation if Required
DW	Continue with Annual Water System Maintenance	O&M	promote system functioning possible demand reduction	promotes proper system operation; enhances water quality	No	
DW	Perform Highland and Lovering Tank Painting and Cleaning	O&M	neutral	promotes proper system operation; enhances water quality	No	
DW	Continue with Indoor and Outdoor Water Conservation	Policy	reduces demand on aquifers	reduced demand means poorer quality wells need not be put in service	No	
DW	Redevelop Water Supply Impact Mitigation Fee	Policy	neutral	neutral	No	
DW	Pursue a WMA Permit Withdrawal Limit Increase	Policy	neutral - state regulations and policy promote environmental protection as a precursor to approval	improved ability to meet future demand	ENF required for new withdrawal of 100,000 gpd or more	Mitigation will be incorporated into the Water Management Act permit amendment process. This could include offsetting withdrawals by I/I removal, demand reduction, environmentally beneficial projects, etc.
SW	Continue with MS4 Program Implementation	Planning/Mgmt.	MS4 Program designed to improve surface water quality	improved surface water quality is protective of public health and safety	No	
SW	Perform Drainage Improvements	Capital	Specific improvements are not yet identified. If properly designed, permitted and constructed, environmental impact should be minor and/or temporary.	Improved drainage and reduced flooding are protective of public health and safety.	Unlikely to be required.	Improvement projects are likely to be small and consist of culvert replacements. Potential impacts include wetlands or land impacts.
SW	Install Stormwater Structural BMPs	Capital	Assuming locations are chosen in previously disturbed areas and properly designed, permitted and constructed, environmental impact should be minor and/or temporary while water quality benefit will be positive	improved surface water quality is protective of public health and safety	Unlikely to be required.	Projects are likely to be small and avoid wetlands, rare species habitat and conservation land. Potential impacts include wetlands or land impacts.
SW	Perform Stormwater Infiltration Analysis - Town Owned Properties	Planning/Mgmt.	neutral - potentially beneficial to recharge aquifers if appropriate solutions are implemented	promotion of infiltration could potentially reduce flash flooding	No	
SW	Promote Impervious Cover Reduction	Policy	neutral - potentially beneficial to recharge aquifers if appropriate solutions are implemented	reduction of impervious cover could potentially reduce flash flooding	No	

Legend:

neutral
positive
negative

Wetlands, Waterways and Tidelands:

If improvements require alterations of existing wetlands greater than 5,000 square feet (for example, for the construction of stormwater structural BMPs), then the ENF filing requirement would be triggered. Mitigation would likely consist of wetland replication on a 1:1 basis.

Drinking Water:

- The MEPA thresholds for impacts to drinking water supply will be met or exceeded by the activities of the IWRMP and require filing of an ENF (at a minimum).
- The IWRMP includes a recommendation to increase the WMA Permit withdrawal limit by over 100,000 gpd and to construct a centralized water treatment facility which will likely exceed 1 MGD; both of which trigger the MEPA ENF requirement.
- Mitigation will be consistent with the SWMI Guidance and Policy for Minimization and Mitigation.

Wastewater:

- The MEPA thresholds for impacts to wastewater will be met or exceeded by the activities of the IWRMP and require filing of an ENF.
- The plan includes a recommendation to increase Medway's allocated capacity at the CRPCD by up to 300,000 gpd to accommodate future flow projections. This capacity may be purchased from Franklin and does not require additional upgrades at the plant. However, the ENF requirement is triggered by an expansion in discharge of 100,000 gpd or greater.

Transportation:

- The MEPA thresholds for impacts to transportation are not expected to be triggered by the activities of the IWRMP.

Energy, Air Quality, Solid and Hazardous Waste:

- The MEPA thresholds for impacts to energy, to air quality, and to solid and hazardous waste are not expected to be triggered by the activities of the IWRMP.

Historical and Archeological Resources:

- The MEPA thresholds for impacts to historical and archeological resources are not expected to be triggered by the activities of the IWRMP.

9.3.2 Benefits of the Integrated Plan

One key aspect in the development of this IWRMP was the focus on the integrative and interactive nature of the plan recommendations. The interaction between the three water resource systems can be seen through the water cycle. Kleinfelder leveraged these intersystem relationships to maximize the benefits achieved through the IWRMP recommendations. Beyond the direct benefits that each recommendation provides on a local level, there are regional benefits that may be seen beyond the town boundary of Medway. Namely, the water resources of the neighboring communities are interconnected with Medway's water resource systems. For example,

- Medway's emergency interconnections with the drinking water systems of neighboring communities serves to supply those communities with water in time of need. The upgrades to the drinking water supply and treatment quality to improve Medway's own resiliency may benefit the neighboring communities requiring emergency supply via these interconnections.
- As previously mentioned, Medway is situated near the headwaters of the Charles River which is one of the most significant water resource assets in the Commonwealth. The stormwater runoff flows through Medway's MS4 and ultimately to the Charles River. The improvements to stormwater runoff quality will benefit the local Medway receiving waters and the waters downstream along the Charles River. As a participant in the recently completed Upper Charles River Regional Stormwater Finance Feasibility Study, Medway has demonstrated willingness to address water quality related issues on an efficient watershed basis with neighboring communities.
- The regional efforts to comply with the MS4 permit and improve water quality within the Charles River Watershed will benefit from intermunicipal collaboration and discussion. By leveraging resources and sharing knowledge between communities, Upper Charles Towns may qualify for grants and additional assistance to reduce the cost of implementing their respective MS4 programs.
- The CRPCD is a regional wastewater treatment facility that receives flows form several communities surrounding Medway. The recommendations to control and improve I/I will reduce the amount of treated wastewater at the CRPCD and minimize Medway's impact to the CRPCD's overall capacity and cost.

9.4 Implementation Plan

The Implementation Plan is provided to assist the Town in prioritizing the recommendations of the IWRMP, forecasting the anticipated cost of these recommendations and leveraging the influence of each recommendation to maximize their benefits to the water resource systems as identified through the Hybrid Scenario. The implementation of each recommendation may be based on several factors including the criticality of the recommendation, its benefits on the water resource system, funding cost for the recommendation, and preferred reoccurrence of the recommended activity.

In terms of criticality, recommendations are broken-down into three categories:

- High Priority - represents activities that require the Town's immediate attention in the first few years of the IWRMP implementation plan. These recommendations may be required by permits, critical needs for the water resource systems, or influential towards the implementation of future recommendations.
- Medium Priority – reflects some of the ongoing and proposed activates that that the Town undertakes to maintain and/or improvements the water resource systems. This includes assessments of system performance, targeted system infrastructure rehabilitation and improvements, yearly system maintenance, and the implementation of tools to assist with system management.
- Low Priority – less critical activities that will help to optimize system performance and/or management. These recommendations provide support to other IWRMP recommendations and are spread throughout the first 10 years of the implementation plan.

The recommended implementation plan for the IWRMP is shown in Tables 9-2 through 9-5. Tables 9-2 and 9-3 document the Town's existing programs which will continue under the IWRMP. Medway has already begun to implement this IWRMP, including making changes to its operations and maintenance efforts to identify and reduce unaccounted for water, as well as initiating capital projects. In addition, the MS4 program has previously been planned with the implementation of the new permit in 2018. Between years 0-4, high priority capital investments averaging roughly $3.5 million each year will help to address the critical needs of the water resource systems including wastewater capacity and drinking water quality and supply. In years 4-10, the plan shifts the focus of investments towards medium priority water and stormwater system improvements. Over the course of the 20-year plan, over $1 million each year will be spent towards maintaining and improving the water resource systems. Also, over the course of this plans the Town can expect to spend $400,000 to $500,000 on the stormwater MS4 permit program. In year 5, the stormwater MS4 program may experience significant increases in cost depending on the outcome of ongoing litigations involving the water quality/TMDL reduction aspects of the permit requirements.

Table 9-2: IWRMP Current Spending Implementation Plan Years 11-20 (2018 Dollars)

	Water Resource	Current Program	Current Estimated Value	Y0 2019	Y1 2020	Y2 2021	Y3 2022	Y4 2023	Y5 2024	Y6 2025	Y7 2026	Y8 2027	Y9 2028	Y10 2029
High	SW	MS4 Program Implementation	$4,856,000	$468,500	$444,500	$405,500	$424,000	$412,500	$480,000	$455,500	$415,500	$435,000	$423,000	$492,000
		Subtotal High Priority Cost:	**$ 4,856,000**	***$468,500***	***$444,500***	***$405,500***	***$424,000***	***$412,500***	***$480,000***	***$455,500***	***$415,500***	***$435,000***	***$423,000***	***$492,000***
Medium Priority	WW	Permanent Sewer System Metering	$247,000	$27,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000
	WW	SSES Investigations and Rehabilitation	$1,000,000		$200,000		$200,000		$200,000		$200,000		$200,000	
	WW	Temporary Sewer System Metering	$50,000	$50,000										
	DW	Unaccounted for Water Activities	$110,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
	DW	Update Town-wide Drinking Water Hydraulic Model	$50,000	$50,000										
	DW	Annual Water Distribution System Maintenance	$1,100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000
	DW	Highland and Lovering Tank Painting/Cleaning	$1,000,000				$500,000					$500,000		
	DW	Indoor and Outdoor Water Conservation	$165,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
	ALL	Public Education and Engagement	$11,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
		Subtotal Medium Priority Cost:	***$3,722,000***	***$126,000***	***$348,000***	***$148,000***	***$848,000***	***$148,000***	***$348,000***	***$148,000***	***$348,000***	***$648,000***	***$148,000***	***$348,000***
		Total IWRMP Current Spending Years 0-10 Cost:	**$8,578,000**	**$594,500**	**$792,500**	**$553,500**	**$1,272,000**	**$560,500**	**$828,000**	**$603,500**	**$763,500**	**$1,083,000**	**$771,000**	**$640,000**

Table 9-3: IWRMP Current Spending Implementation Plan Years 11-20 (2018 Dollars)

	Water Resource	Current Program	Current Estimated Value	Y11 2030	Y12 2031	Y13 2032	Y14 2033	Y15 2034	Y16 2035	Y17 2036	Y18 2037	Y19 2038	Y20 2039
High	SW	MS4 Program Implementation	$4,609,000	$467,000	$426,000	$446,000	$433,000	$504,000	$478,500	$436,500	$457,000	$444,000	$517,000
		Subtotal High Priority Cost:	***$4,609,000***	***$467,000***	***$426,000***	***$446,000***	***$433,000***	***$504,000***	***$478,500***	***$436,500***	***$457,000***	***$444,000***	***$517,000***
Medium Priority	WW	Permanent Sewer System Metering	$220,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000	$22,000
	WW	SSES Investigations and Rehabilitation	$1,000,000	$200,000		$200,000		$200,000		$200,000		$200,000	
	WW	Temporary Sewer System Metering	$50,000	$50,000									
	DW	Unaccounted for Water Activities	$100,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
	DW	Update Town-wide Drinking Water Hydraulic Model	$50,000	$50,000									
	DW	Annual Water Distribution System Maintenance	$1,000,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000
	DW	Highland and Lovering Tank Painting/Cleaning	$1,000,000				$500,000					$500,000	
	DW	Indoor and Outdoor Water Conservation	$150,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
	ALL	Public Education and Engagement	$20,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000
		Subtotal Medium Priority Cost:	***$3,590,000***	***$448,000***	***$148,000***	***$348,000***	***$648,000***	***$348,000***	***$148,000***	***$348,000***	***$148,000***	***$848,000***	***$148,000***
		Total IWRMP Current Spending Years 11-20 Cost:	**$8,199,000**	**$915,000**	**$574,000**	**$794,000**	**$1,081,000**	**$852,000**	**$626,500**	**$784,500**	**$605,000**	**$1,292,000**	**$665,000**

Note:

- High, medium and low priorities represent relative importance of projects with respect to meeting regulations, maintaining operation of the water resources systems, and providing long-term service.

Table 9-4: IWRMP Implementation Plan Years 0-10 (2018 Dollars)

	Water Resource	Recommendation	Opinion of Probable Cost	Y0 2019	Y1 2020	Y2 2021	Y3 2022	Y4 2023	Y5 2024	Y6 2025	Y7 2026	Y8 2027	Y9 2028	Y10 2029
High Priority	WW	Purchase Available Wastewater Capacity at CRPCD	$950,000	$950,000										
	DW	Drinking Water Quality - Treatment Improvements	$15,000,000	$1,000,000	$6,000,000	$3,000,000	$3,000,000	$2,000,000						
	DW	Drinking Water Supply Capacity Redundancy/Reliability	$2,191,000		$467,000		$1,347,000	$377,000						
	DW	Update Emergency Drinking Water Supply Plan	$65,000			$65,000								
	DW	Pursue WMA Permit Withdrawal Limit Increase	$15,000			$15,000								
		Subtotal High Priority Cost:	***$18,221,000***	***$1,950,000***	***$6,467,000***	***$3,065,000***	***$4,347,000***	***$2,377,000***	***$0***	***$0***	***$0***	***$0***	***$0***	***$0***
Medium Priority	DW	Water Distribution System Improvements	$9,915,000	$2,990,000	$2,425,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000
	SW	Drainage Improvements	$320,000					$320,000						
	SW	Stormwater Structural BMPs	$137,500							$33,500	$46,000		$52,000	
	SW	Stormwater Infiltration Analysis	$24,000								$6,000	$6,000	$6,000	$6,000
	ALL	Asset Management Program	$475,000	$75,000	$75,000	$75,000	$75,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
		Subtotal Medium Priority Cost:	***$10,871,500***	***$3,065,000***	***$2,500,000***	***$575,000***	***$575,000***	***$845,000***	***$525,000***	***$558,500***	***$577,000***	***$531,000***	***$583,000***	***$531,000***
Low Priority	WW	Purchase CCTV Equipment to Support WW Operations	$150,000					$150,000						
	WW	Limited Sewer Extensions[12]	$920,000									$175,000	$350,000	$400,000
	DW	Redevelop Water Supply Impact Mitigation Fee	$20,000			$10,000	$10,000							
	SW	Promote Impervious Cover Management	$50,000					$30,000	$20,000					
	ALL	Review Interdepartmental Workflow for Development	N/A											
		Subtotal Low Priority Cost:	***$1,140,000***	***$0***	***$0***	***$10,000***	***$10,000***	***$180,000***	***$20,000***	***$0***	***$0***	***$175,000***	***$350,000***	***$400,000***
		Total Opinion of Probable IWRMP Cost:	**$30,232,500**	**$5,015,000**	**$8,967,000**	**$3,650,000**	**$4,932,000**	**$3,402,000**	**$545,000**	**$558,500**	**$577,000**	**$706,000**	**$933,000**	**$931,000**

Table 9-5: IWRMP Implementation Plan Years 11-20 (2018 Dollars)

	Water Resource	Recommendation	Opinion of Probable Cost	Y11 2030	Y12 2031	Y13 2032	Y14 2033	Y15 2034	Y16 2035	Y17 2036	Y18 2037	Y19 2038	Y20 2039
Medium	DW	Water Distribution System Improvements	$5,000,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000
	SW	Install Stormwater Structural BMPs	$60,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000	$6,000
	ALL	Asset Management Program	$250,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000
		Subtotal Medium Priority Cost:	**$5,256,000**	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***	***$531,000***
		Total Opinion of Probable IWRMP Cost:	**$5,256,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**	**$531,000**

Notes:

- High, medium and low priorities represent relative importance of projects with respect to meeting regulations, maintaining operation of the water resources systems, and providing long-term service.
- IWRMP projections include current projects and programs identified within the planning period. Additional projects are expected to be identified as the Town implements its Asset Management program and updates its Water Master Plan. Changes to State and Federal regulations, environmental conditions as well as local development and growth may also drive additional spending not currently part of this plan.

[12] Sewer extension costs may be offset through betterment assessments. Costs represented herein do not include betterment offsets.

9.5 Financial Constraints

The IWRMP outlines multiple recommendations for the Town to implement, each entailing a different cost. The careful evaluation of the Town's financial structure and the impact of these recommended cost is an important step towards the successful implementation of the IWRMP.

There are various sources of funding for the components of the IWRMP that include those from within Medway (such as taxes, betterments and bonds), those from state and federal agencies (such as the State Revolving Fund (SRF) and other grants/loans) and those from private parties. The available funding sources are discussed in Section 6.6, and they include a mixture of grants, loans and general funds from the Town.

Roughly 66% of the IWRMP total cost is associated with improvements to the drinking water system. Grants and loans may not be enough to fund these drinking water efforts. Therefore, the Town may have to leverage in-house capital resources and review the revenue generating structure of their drinking water servicing fees. Also, efforts to fund the drinking water recommendations should not overshadow the importance of the other water resource recommendations.

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APPENDIX A

IWRMP Brochure & Task Force Meeting Summaries

Help Protect Your Watershed

The Town of Medway is located within the Charles River Watershed. This means that all surface water and groundwater in Town, including that from your property, flows to the Charles River. Therefore, how you care for your property can affect both water quality and water supply.

Photo by Mark Wilcox

What are your Local Water Resources?

Surface Water
The Charles River forms two thirds of Medway's southern border with Franklin. Like Choate Pond, many of Medway's surface waters provide important wildlife habitat and popular recreational areas for residents. Wetland areas throughout Town also provide essential flood protection.

Groundwater
Medway residents receive their water supply from ground water sources. The Town's four supply wells draw their water from the underground sand and gravel aquifer of the Charles River basin.

How Are Our Water Resources Connected?

With a little help from the water cycle, our actions have a direct impact on surface waters and ground water sources.

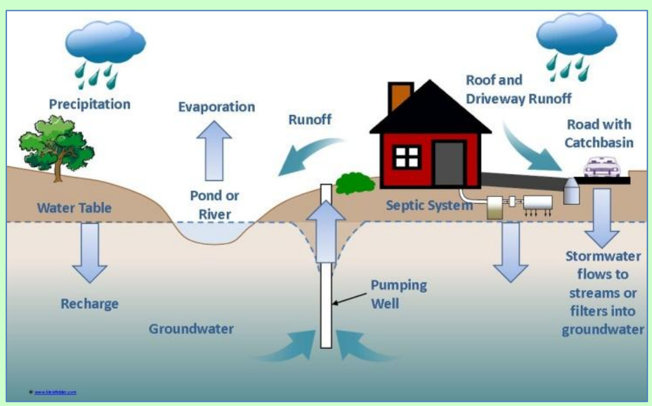
- Excess chemicals applied to lawns, oil and debris found on paved surfaces, and even animal waste become sources of pollution when they are carried to receiving waters or infiltrated into the ground by stormwater.

- Extra pumping of groundwater in the summer to supply water for lawns and gardens lowers the level of the water table and can dry up streams.

- A failing septic system can release bacteria and nutrients into the water cycle, contaminating nearby surface waters and ground water.

- Stormwater and ground water can enter aging sanitary sewer infrastructure, overloading it and potentially resulting in overflows to the environment.

- Aging or undersized drainage pipes can fail during storm events and cause local flooding.



How Can You Help?

Get Involved
Participate in cleanup activities in your neighborhood, the annual Medway Clean Sweep & the annual Medway Pride Day.

Watch for Notices about IWRMP upcoming meetings.

Steps You Can Take to Help Protect Medway's Water Resources

- Limit the use of pesticides and fertilizers – use natural or organic lawn care methods

- Compost your yard waste

- Have your septic tank pumped and system inspected regularly

- Practice Water Conservation

- Never dump anything down storm drains or in streams & take unwanted household chemicals to hazardous-waste collection centers

- Direct downspouts away from paved surfaces

- Pick up after your pet

- Use low-phosphate or phosphate-free detergents

What are TMDLs and do They Impact Medway?

Under the Clean Water Act (CWA) states are required to identify impaired waters. These are waters where existing pollution controls are not enough to meet or maintain water quality standards. Once impaired waters are identified, each state must develop a "Total Maximum Daily Load" (TMDL) for the types of discharges polluting the impaired waters. A TMDL determines how much of a pollutant can be put into a body of water before it has harmful effects.

Two TMDLs have been finalized for the Charles River Basin; these include the Final TMDL for Nutrients in the Upper/Middle Charles River and the Final Pathogen TMDL for the Charles River Watershed. Both apply to the area of Charles River located in Medway.

In development of its Integrated Water Resources Management Program, as well as through updates to its Stormwater Management Program, Medway is working towards complying with TMDL requirements and reducing the Town's contribution of pollutants to the Charles River.

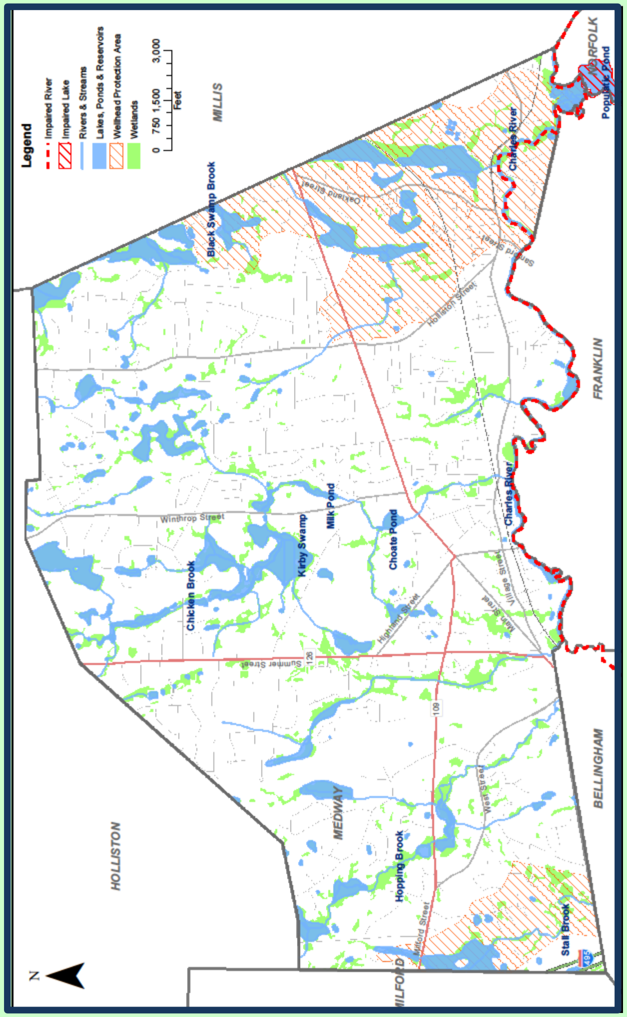
In order to view more detailed information about TMDLs or to view the TMDLs developed for the Charles River Watershed please visit: http://www.mass.gov/dep/water/resources/tmdls.htm .

KLEINFELDER
Bright People. Right Solutions.

For more details, regarding the Town's IWRMP please contact the Department of Public Services.

Contact Information

DPS Main Office
Town Hall
155 Village Street, 2nd Floor
Medway, MA 02053
508-533-3275



Town of Medway

Integrated Water Resources Management Program (IWRMP)

The purpose of the IWRMP is to look at all of Medway's water resources holistically and determine how to manage Medway's drinking water, wastewater, stormwater and surface water needs in a balanced way that protects the environment and allows for sustainable growth.

Town Of Medway, MA

Department of Public Services

Environmental Services

www.townofmedway.org

"A Green Community"

Integrated Water Resources Management

The purpose of the Integrated Water Resources Management Program (IWRMP) is to look at all of Medway's water resources holistically and determine how to manage Medway's drinking water, wastewater, stormwater and surface water needs in a balanced way that protects the environment and allows for sustainable growth.

Protecting Medway's Water for the Future

What are your Local Water Resources?

Choate Pond

Surface Water

All of Medway is located within the Charles River Basin. The Charles River forms $^{2}/_{3}$ of Medway's southern border with Franklin. Like Choate Pond, many of Medway's surface waters provide important wildlife habitat and popular recreational areas for residents. Wetland areas throughout Town also provide essential flood protection.

Groundwater

Medway residents receive their water supply from ground water sources. The Town's four supply wells draw their water from the underground sand and gravel aquifer of the Charles River basin.

Highland Street Water Tank

How Can You Help?

Get Involved!

Participate in neighborhood cleanups and the annual Medway Clean Sweep & Pride Day events.

Watch for notices about IWRMP upcoming meetings.

Charles River

Choate Park

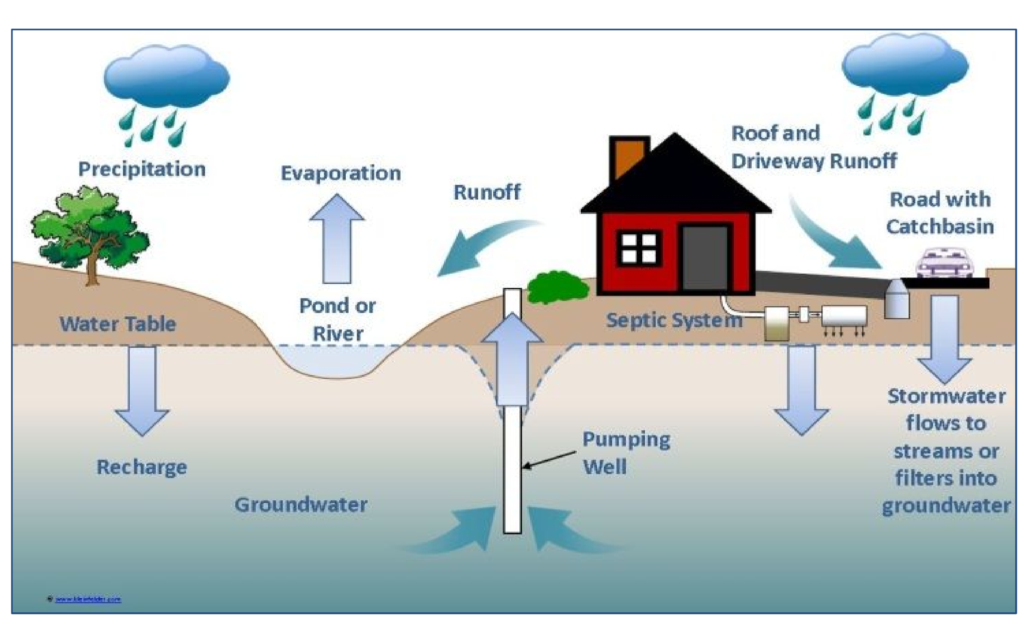
Choate Pond

Simple Steps You Can Take to Help Protect Medway's Water Resources!

- ✓ *Limit the use of pesticides and fertilizers containing phosphorus – use natural or organic lawn care methods*
- ✓ *Compost your yard waste*
- ✓ *Have your septic tank pumped and system inspected regularly*
- ✓ *Practice Water Conservation*
- ✓ *Never dump anything down storm drains or in streams & take unwanted household chemicals to hazardous-waste collection centers*
- ✓ *Direct downspouts away from paved surfaces*
- ✓ *Pick up after your pet*
- ✓ *Use low-phosphate or phosphate-free detergents*

How are Our Water Resources Connected?

Through the elements of the water cycle, our actions have a direct impact on surface waters and ground water sources.

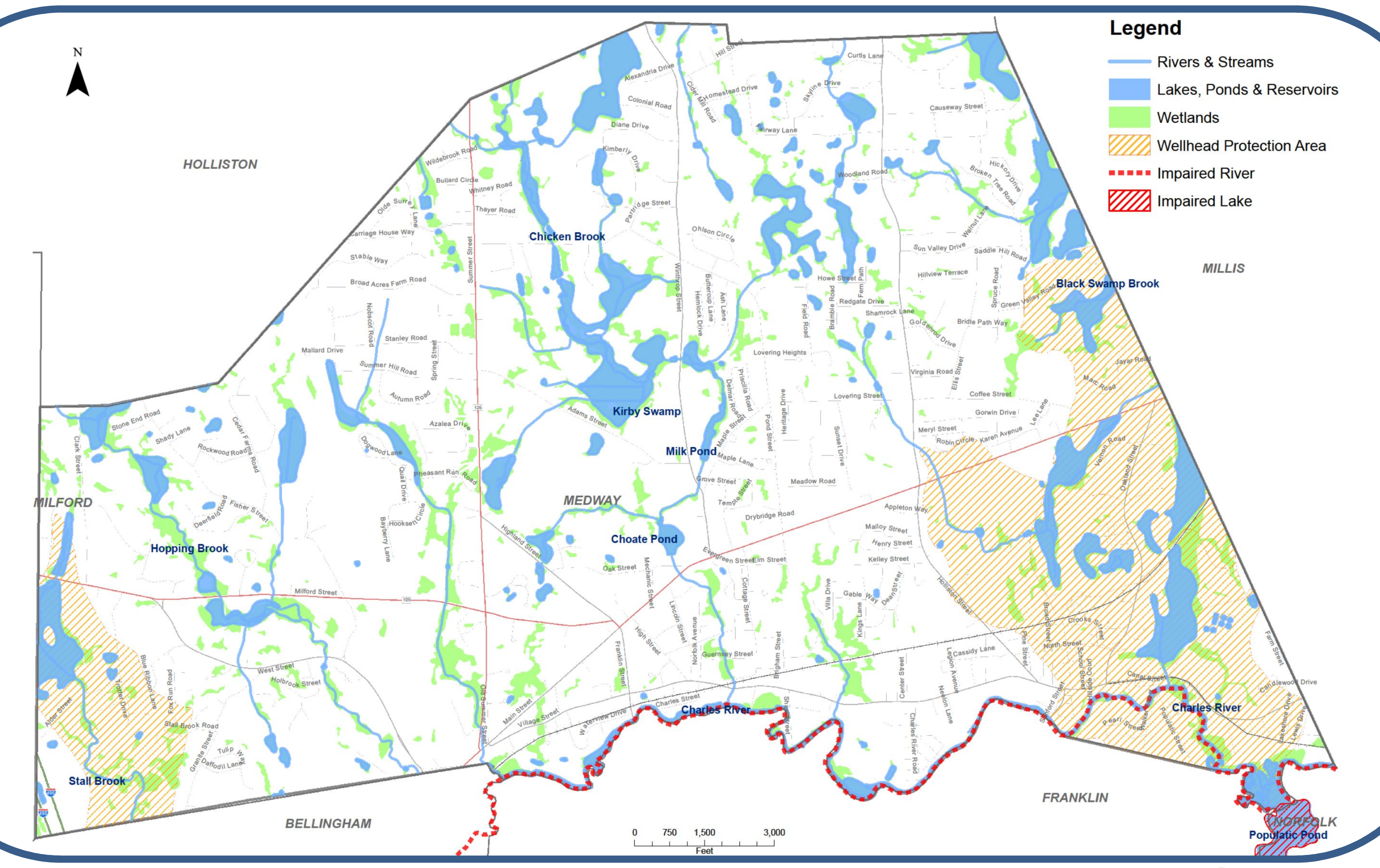


~ *Excess chemicals applied to lawns, oil and debris found on paved surfaces, and even animal waste become sources of pollution when they are carried to receiving waters or infiltrated into the ground by stormwater.*

~ *Extra pumping of groundwater in the summer to supply water for lawns and gardens lowers the level of the water table and can dry up streams.*

~ *A failing septic system can release bacteria and nutrients into the water cycle, contaminating nearby surface waters and ground water.*

~ *Stormwater and ground water can enter aging sanitary sewer infrastructure, overloading it and potentially resulting in sanitary sewer overflows to the environment.*



For more information about Medway's Water Resources Management contact the Department of Public Services at 508-533-3275 or visit our website at www.townofmedway.org

KLEINFELDER

MEMORANDUM

TO: Meeting Attendees (via email):
Dennis Crowley, John Foresto: Medway Board of Selectmen (BOS)
Ted Kenney, Leo O'Rourke: Medway Water and Sewer Commission
Allison Potter, Medway Assistant Town Administrator
David D'Amico, Medway Department of Public Services (DPS), Director
Barry Smith, Medway DPS, Deputy Director
Susan Affleck-Childs, Medway Town Planner
Carol Pratt, Medway Finance Director
Beth Hallal, Medway Health Agent
Bridget Graziano, Medway Conservation Agent
Stephanie Mercandetti, Medway Community & Economic Development Director
Mary Becotte, Medway Communications Director
Jillian Rossini, Medway DPS Intern
Liz Taglieri, Director, Charles River Pollution Control District (CRPCD)
Ryan Arego, Legislative Aid to Rep. Jeffrey Roy, 10th Norfolk District

FROM: Kleinfelder Attendees: Kirsten Ryan, Laura Nolan, Betsy Frederick, Kasha Richardson, Jenna Diamond

DATE : July 31, 2017

SUBJECT: **Meeting Notes, Integrated Water Resources Management Plan Task Force Meeting, June 28, 2017.**

CC: Town of Medway: Michael Boynton, Town Adminstrator; Doug Downey, Citizen, Andy Rodenheiser, Planning Board.

Kleinfelder: Cecilia Carrion-Carmona, Jonnas Jacques

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1. Introduction

The meeting was opened by Mr. David D'Amico who welcomed participants and outlined purpose and value of the event. These planning efforts described below are taking place as the Town is seeing new development pressures which require water and sewer service – and the Town is coming up against their capacity to deliver that service.

The Kleinfelder Team provided a background on the integrated planning process and benefits, along with summary of status of previous work, described current (and evolving) regulatory context, and introduced areas for discussion at this workshop. Primary objectives include

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progress updates on drinking, wastewater and stormwater needs assessment with emphasis on soliciting comment and/or confirmation from attendees regarding findings. The second part of the workshop is focused on National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Notice of Intent (NOI) discussion and conceptual development. Major discussion points are summarized below, with **action items in bold**.

2. Needs Assessment

Kleinfelder presented a summary of the Needs Assessment task results for drinking water, wastewater, and stormwater. The presentation slides are provided in Attachment 1.

2.1. Drinking Water Needs

Kirsten Ryan (Kleinfelder) presented a summary of existing conditions and needs based on prior planning studies conducted to date. Major needs areas are 1) lack of supply redundancy, 2) lack of supply capacity to meet projected future demands (1.0 vs 1.09 MGD as average day demand), 3) increasing levels of iron and manganese and 4) high unaccounted-for water (15+%). The Town's current demand (~0.8 MGD) is also very close to its water withdrawal permit limit of 0.92 MGD. Requesting an increase in the permit limit will require mitigation of the volume through recharge or other projects.

Prior studies found no feasible options in Town for new source due to the Town hydrogeology. Restoring current wells or adding a satellite well at the Populatic well site are the best options. New source would take years, cost in millions. There are also challenges with existing land use and regulations (Zone II stormwater and Title 5 regulations). Satellite well adjacent to an existing well would take ~1 year or less; cost order of magnitude less.

Water needs group discussion points:

- Projections include some proposed development projects (Timbercrest, Millstone, Willows). **Others not included on this list to be added to the analysis.**
- D. Crowley indicated there is strong urgency for addressing both the water supply and quality issues. Complaints about brown water is a hot-button issue for the public and should be addressed proactively. Leak detection should be prioritized. Action on the capacity issue should begin within 6 – 12 months.
- D. D'Amico & B. Smith indicated that Haley & Ward is doing a study for satellite well; treatment options. The Board of Selectmen will be asked to act upon recommendations in October.
- D. Crowley expressed urgency and asked if a meeting with MassDEP should take place now.
    - o D. DAmico indicated the need to get unaccounted for water (UAW) to 10% or less to allow permit process to get underway.
    - o K. Ryan said that MassDEP will work with you on options prior to reaching 10% and pointed out that Kleinfelder had developed a UAW Compliance Plan for Medway. If followed, this demonstrates best efforts to meeting the 10%.

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  - D. D’Amico said that a town-wide leak detection survey was just completed; and a 50 gpm leak recently found and repaired; based on general awareness around the issue due to news cycle has resulted in better reporting from the public.
- B. Graziano asked about irrigation wells- How much withdrawal is associated with these and do they impact the aquifer? Currently no ban; do we know how much volume this represents?
  - B. Hallal stated that the Board of Health has a record of permitted wells. They are not typically located in Zone IIs of the town wells.
- D. Crowley indicated a desire to address drinking water quality proactively and asked if wells should be treated individually or centrally?
  - D. D’Amico stated that Oakland well has been source of much of the problem; iron causes discoloration, well is used only it if they have to. Uni-directional flushing program for the pipes has resolved the problem of build-up in the pipes but filtering the raw water at must be the long-term solution. Flushing program started five years ago and has been effective. Haley & Ward will have a report on treatment evaluation in October.
  - K. Ryan cautioned against planning to construct treatment based solely on existing conditions at only selected wells. Many systems of similar age in eastern MA are experiencing sudden jumps in iron, manganese (Holliston, Wareham, are only 2 such examples). Medway’s wells are all relatively close in the eastern part of Town. Treatment alternatives evaluation should consider investing in a central plant with expandable volume.
- T. Kenney stated that there is some misunderstanding with water customers as to whether this is health problem or not – it is not a health issue, it is an aesthetics issue (at current levels of Fe, Mn).
  - B. Smith indicated that every well gets maintenance every year.
- Team brainstorming alternative ideas included: possibly pumping CRPCD discharge to watershed/uplands for recharge; purchase of water from Millis (DPS not in favor due to booster and chemistry issues; D. Crowley not in favor).

2.2. *Wastewater Needs*

Laura Nolan (Kleinfelder) presented the wastewater needs analysis and results (see attached presentation). The needs assessment addresses sewered and non-sewered areas differently.

2.2.1. Sewered Areas

There are data gaps in the assessment of sewered area needs as the town is only partially metered. A significant percentage of the community is not metered and flow is consequently estimated for volume/cost purposes. Infiltration / inflow removal and maintenance has been happening but the full extent of the problem is unknown and therefore efforts cannot be prioritized.

L. Taglieri was asked if CRPCD sees significant infiltration or inflow, and if the cost of treating this water is cheaper. All flow to the plant is treated in the same way and to the same quality; there is no “discount” related to the quality of the flow (i.e. diluted flow) to the plant.

General discussion was led by Laura Nolan regarding use of flow meters for measuring overall system flows. Currently only 60% of the flow to the CRPCD is metered through permanent meters which provides 15-min flow data. The remaining flow from Medway to the plant is estimated by CRPCD. The current, permanent meter of flow to CRPCD does not provide details into inflow or infiltration (I/I) contributions in specific parts of town, and does not capture a large portion of the flow. The group discussed exploring installation of a new, permanent meter which could capture the remaining 40% of the flow to the CRPCD.

Discussion then moved to temporary metering program for Infiltration/Inflow identification. Industry practice regarding protocols for standard I/I investigations was described by L. Nolan. Temporary meters could be used throughout the town to evaluate the infiltration and inflow entering the system.

- D. Crowley inquired about cost per meter of the I/I program.
- L. Nolan said about $6,000 per meter for rental, data collection, data analysis and reporting. I/I investigations involve a progressive approach based on cost-effectiveness of reducing I/I to the plant. The number of flow meters is dependent on the size of the system. The program would typically focus on installing one flow meter per 20,000 linear feet of sewer.
- D. D'Amico indicated the I/I program has the added benefit of determining the flow rates in the unmetered areas.
- S. Affleck and L. O'Rourke asked about installing a permanent meter to capture the 40% unmetered
- L. Nolan noted that the temporary meters could be used to validate the estimation that CRPCD uses for the unmetered area. At that point the Town could decide to have a permanent meter installed to provide more accurate monitoring of flow.

Flow metering is not within the IWRMP scope of work. At the request of DPS, **Kleinfelder will prepare a proposal for metering for DPS review.**

Potential alternatives to be considered by KLF in the next IWRMP Tasks include: Public education related to fats, oils, grease (FOG) and illicit connections, private inflow; prioritized I/I investigation and rehabilitation, town-wide metering, and condition assessment via CCTV inspection.

2.2.2. Un-Sewered Areas

L. Nolan continued the presentation, moving on to non-sewered area assessment and data sources and ranking method. Attendees posed questions regarding data sources, specifically regarding septic system performance (e.g. pump-outs). B. Hallal clarified that septage haulers are required to report to Board of Health (BOH) and CRPCD to maintain license to operate. The Health Department keeps paper records, which Kleinfelder has reviewed.

B. Hallal indicated that perr BOH septic failures must be fixed within two years of failure, which is typically not determined until property is to be sold. Cause of failures is variable, and is not always due to soil conditions, but could be lack of maintenance. Title V regulation changes dating to 1995 that address water table elevation requirements have had an impact as well. B. Hallal noted that based on her experience, the NRCS soils survey for the area is not necessarily accurate. **Kleinfelder will follow up with B. Hallal to determine if better information is available**. BOH believes a shared system is a potential option when considering alternatives to meet the wastewater needs. **This will be considered by KLF in the evaluation phase.**

Wide-spread failure of systems in a neighborhood is typically an indicator of wastewater management "need" regardless of available solutions. (Town of Millis Farm Street was provided as an example of entire neighborhood in failure.) The issue of septic systems in relation to wells was discussed.

- D. D'Amico asked if Medway pursues a new well, must they oust the septic systems?
  - B. Hallal stated that would not be legal.
  - K. Ryan clarified that for a new Town well, no septic systems would be allowed within the Zone I (400-ft radius) but allowed in the Zone II.
  - L. O'Rourke mentioned that septic systems have the benefit of recharging the groundwater and asked about feasibility to do a large septic system for the entire neighborhood rather than individual systems.
  - D. Crowley stated that it would be cost prohibitive to extend sewer, and an unfair burden on sewer rate payers.
  - S. Affleck stated that decentralized treatment should be allowed by local permits / regs and/or require it as an evaluation option. This IWRMP process is timely as the Town is updating Town Master Plan over the next 2 years.

The group had a brief discussion about whether poor/failing septic should be sewer ratepayers responsibility (i.e. extend sewer to solve private problem). Consideration included sewer overlay district by-laws (local or legislated) and whether this should be part of discussion during currently on-going update to Master Plan. The question was raised whether the town is legally obligated to reserve capacity for areas subject to betterment, and the answer provided was yes. **Kleinfelder will consider this in refining the evaluation.**
D. Crowley asked about this issue in relation to the obligation for the TimberCrest 40B development. D.D'Amico replied that Timbercrest is exempt from sewer moratorium due to 40B. Cannot have a satellite system.

2.3. Stormwater Needs Assessment

Laura Nolan of Kleinfelder presented results of the Stormwater Needs Assessment to date (see attached presentation). The primary needs include 1) maintenance, 2) water quality improvements, 3) public education and 4) mapping / inventory of infrastructure location and condition.

The Town has a good understanding of stormwater maintenance need, including location of "drainage trouble spots" where maintenance of catch basins and culverts can precede known storm events. Kleinfelder has delineated stormwater catchments per the MS4 regulation, although based on current DPW program, new outfalls are routinely found during infrastructure work. Based on current GIS mapping and DPW's records, there are approximately 20 new outfalls to be integrated into mapping. These might not be shown on the prior maps if they are not under the MS4 program.

Kleinfelder provided some background regarding number of MS4 outfalls and status. There are currently 220 known MS4-jurisdictional outfalls and approximately 278 total with dry weather flow was detected in 8 of the outfalls inspected so far, and suspected illicit discharges in 2 of those 8. Approximately 2/3 of total number of outfalls have been inspected to date.

DPS staff indicated that Choate Pond is an area of focus for desired improvements. During discussion of next steps for stormwater alternative evaluation, Planning Board personnel asked about private property with easements. DPS replied that the Town may have access to easements, but there are many that are simply unknown or unidentified. Regarding opportunities for retrofitting structural infiltration BMPs, the Town will review opportunities where there are large town owned properties scheduled for repaving.

At the end of discussion, B. Graziano asked about problem catch basins near industry on E. Main Street. A business has been moving soil which has made its way to the catch basins; these need protection per Town regulation. Sedimentation of catch basins is a general problem.

Regarding town legal mechanisms, both new and re-development can be regulated for stormwater management under current by-law. DPS added that connection to drainage is negotiable and is case-by-case. Medway Block, for example, wanted to connect to drain the way they always have. DPS told them they need to meet the water quality standard. They are now going to build a culvert.

At this point attendees discussed different approaches to addressing stormwater issues. D. Crowley representing BOS expressed the opinion that it is not fair to single out properties for enhanced protections based off of location of problem outfalls. DPS stated that everyone will ultimately be required to meet the local by-law obligations but that it is during the development or re-development process where greatest leverage is applied to property owners.

3. MS4 Program and Notice of Intent Discussion

Betsy Frederick from Kleinfelder presented an overview of the MS4 stormwater permit program (see attached presentation) and the group transitioned from a discussion about stormwater needs to a discussion of the MS4 permit and Notice of Intent (NOI) requirements. During this discussion attendees asked if it is guaranteed that the permit is going to be required. For clarification, Kleinfelder reminded the Town that there is currently a permit in place and it will remain in effect until the new permit is finalized after the current legal appeal. Several of the permit terms, particularly as they relate to water quality based effluent limitations, are likely to change. Many of the elements of the 6 Minimum Control Measures will remain essentially unchanged. Virtually all of the work conducted in Phase 1 of the IWRMP was to address areas of non-compliance under the 2003 MS4 permit still in effect.

Attendees requested clarification around distinction between the IWRMP contract and the MS4 permit program. While elements of the MS4 program will be completed under the IWRMP (mapping under Phase I, preparation of an NOI and a stormwater management plan), completion of the IWRMP does not address 100% compliance under the MS4 program. The Town has been provided some cost estimates from Kleinfelder for operational, administrative and capital costs to achieve and maintain MS4 compliance. Much of that is related to operational enhancements such as increased street sweeping and catch basin clean-out, as well as catchment investigations for illicit discharges. All of these estimates will have to be re-visited after the legal appeals for the 2016 final permit have been concluded. Currently EPA has postponed effective date of the 2016 permit to July 1, 2018.

General discussion ensued regarding whether/how political environment might impact the permit or even EPA in general. Kleinfelder responded that even in the event of near term implications, a new federal administration or the advent of state primacy for the NPDES program are the more likely factors that should influence planning.

Attendees turned to the task of addressing NOI requirements. Process for the NOI is for local determination of program goals, and public notice of the program. There is unlikely to be significant engagement with EPA regarding specifics of the goals so long as they are in general accordance with the permit requirements.

The group brainstormed areas of possible action regarding Minimum Control Measures (MCM) 1 and 2: Public Education and Public Participation.

Possible actions included:

- Addressing bacteria through robust outreach to dog owners – would have to be both on-line and in person since licenses can be obtained on-line.
- Looking at opportunities to address grass clipping disposal with landscapers or developers seeking permits.
- Speaking with local business council for partnering opportunities
- Working with Town Director of Communications for coordinated media effort.
- "Trout in the Classroom" program involving water quality – already in place in schools
- High School has a club (confirm with Jill) that may also volunteer support
- Medway cable access can be a resource for Q&A or other forum. Kent Scott (ex-Planning Board) was suggested as a moderator for such a program.
- The Garney Dog Park was proposed for a location-specific outreach effort to dog owners.
- King Fido's Fair was proposed as an event-specific outreach effort (also dog oriented).
- Trash bill is the most widely disseminated "utility" bill (more homes than water users); Curbside Calendar publication was discussed, but seems already "over-subscribed" when it comes to additional information. (As an aside, over 50% of homes claimed they had not received their recycling sticker included with the publication, so apparently people do not read it very carefully.)
- "Municipal Matters" monthly digital newsletter was proposed as good candidate for providing news. People must sign up for it pro-actively, and Town can monitor who actually opens (and then presumably reads) the newsletter. Currently has a 60 – 70% "open" rate.

- Proposed web site for viewing water bills could potentially include "pop-up" information on stormwater.
- Choate Park was considered a good location-specific opportunity for plaques or other recreationally-inspired message boards.
- Electronic message boards are controlled by DPW and rotating messages can be programmed.
- Stormwater information could be added to "story book" kiosks (needs further explanation).
- Boardwalk over local wetlands could include kiosk information as well.
- Senior Centers will likely require face-to-face meetings.
- Facebook has been an active area of growth– the Medway page has tripled followers in recent past.
- Local op-ed opportunities in newspapers is an attractive option.
- Medway Community Farm may be a willing partner – they work with elementary school kids.
- Restaurants involved with FOG program (fats, oil and grease) may be willing partners as well.
- Industrial messages can be more specific and geared to local concerns – e.g. metal roofs are prohibited in Zone II's and this message about metals can go to industrial parcels.

Kleinfelder will be facilitating further discussions with Task Force (or sub-set thereof) to develop a Draft NOI. An email poll will be sent to schedule the next meeting.
The meeting adjourned approximately 3:30 p.m.

Subsequent to the meeting, an updated MS4 recommended schedule (showing 7/1/18 effective date) was requested. Kleinfelder has prepared this and provided it as an attachment to this document.

4. Next Steps

IWRMP:

- Kleinfelder will refine and complete the Needs Assessment considering the discussion points and action items above and prepare a Technical Memorandum documenting the results.
- Kleinfelder will proceed with the Alternatives Evaluation IWRMP tasks and meet again with the Task Force in the Fall to share results and preliminary recommendations. Feedback from that second meeting will help guide the selection of alternatives for more detailed assessment in Task 5 (Conceptual design and cost development).

MS4:

- Kleinfelder will incorporate the results of the above discussion into a draft NOI document and schedule a meeting to continue the process of the NOI development discussions.

Attachments:

- Meeting Power Point presentation
- Sign –in Attendees Sheet
- Medway MS4 Program recommended schedule

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MEETING SUMMARY

Integrated Water Resources Management Plan Task Force Meeting

Date: November 28, 2017

Attendees: Susan Affleck-Childs, Medway Town Planner
Ryan Arego, Legislative Aid to Rep. Jeffrey Roy, 10^{th} Norfolk District
David D'Amico, Medway Department of Public Services (DPS), Director
Doug Downey, Citizen
John Foresto: Medway Board of Selectmen (BOS)
Bridget Graziano, Medway Conservation Agent
Ted Kenney: Medway Water and Sewer Commission
Laura Nolan, Kleinfelder Project Manager
Allison Potter, Medway Assistant Town Administrator
Kasha Richardson, Kleinfelder Project Engineer
Kirsten Ryan, Kleinfelder Client Account Manager
Barry Smith, Medway DPS, Deputy Director
Liz Taglieri, Director, Charles River Pollution Control District (CRPCD)

CC: Michael Boynton, Town Administrator;
Andy Rodenheiser, Planning Board

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1. Introduction

The meeting was opened by Laura Nolan (Kleinfelder) who welcomed the participants and outlined the objectives of the event. Meeting participants introduced themselves.

2. Project Overview/ Status

The Kleinfelder Team provided a brief overview of integrated planning process and benefits, along with a summary of the status of the project. Primary objectives for the meeting included introducing the project decision model with emphasis on soliciting comments and/or confirmation from attendees regarding the model inputs and alternatives. Major discussion points are summarized below, with **action items in bold**.

3. Integrated Systems Group Exercise

Kleinfelder conducted a group exercise, asking participants to comment on everything they thought about when they think about water. This included water, wastewater, and stormwater systems. Participants were asked to comment on how they interact, how they are managed, and

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what are the funding sources and stakeholders. The posters with notes from the exercise are provided in Attachment 2.

Group exercise discussion points:

- John indicated that the cost-benefit of both operating expenses and capital expenses of alternatives (i.e. reclaimed water) should be determined.
- Dave indicated there are areas of the Town that are not serviced by sewer, and the main concern is septic system failures. The Town doesn't have the luxury of gravity sewer mains due to both topography (force main/ pump stations would be required in some areas) and capacity concerns at the CRCPD.
- Stephanie asked if green infrastructure could be utilized, including planting trees, installing rain gardens. This would have a stormwater benefit and add to the aesthetic of the Town.
- Dave indicated the Town needs to talk to planning board about the stormwater standards.
- Bridget said that there is some green infrastructure along Route 109 and at the Merrimack building.
    - There are concerns about runoff from private properties (businesses) to the MS4.
    - Need to make sure stormwater basins are in compliance (both public and private)
- Dave stated corporations are supposed to have a stormwater management plan, but they don't follow it
- Suzy indicated retention basins are used as dumping grounds
- Bridget said that a big issue is the lack of education concerning stormwater management.
- Ted indicated that there is sufficient water supply and quality, but the Town needs adequate water aesthetic.
- Suzy asked if grey water be could be utilized.
- John said that the Town's water policies have to appeal to stakeholders, which currently have no interest.
    - Many Medway residents will only drink bottled water.
- Ted emphasized education is how to gain interest.
- Dave said that public schools do not have an interest in incorporating water management into the curriculum
- Barry indicated the CRWA is also a stakeholder that needs buy-in
- John said Medway needs loans from the State, as other towns are affected by Medway water systems.
- Suzy stated that the Town can't turn down development projects with insufficient water supply as the reason
    - Dave: indicated it is possible if you prove your case
- Dave said the Town has 4 wells, but there is a concern if one becomes unusable. The Town is looking at installing a satellite well.
    - 24 Stable Way is the location of the tank
- Suzy stated the Town should look into banning irrigation wells.
- Dave indicated the Town has approved the Parks Project which has a splash pad
    - Ted stated that this sends a mixed message. People feel entitled to water.
- Doug said that schools and Route 109 are hot topics on Medway's media sources. If the Town were to add Route 109 to the title on the main website with information about water system, it could reach more people.

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- Public outreach will not be effective on the water/sewer website.
- Bridget suggested the Town could add a link to the article redirecting to the water/sewer website.
- Suzy said we should utilize Facebook as a means to inform the public. The Town has 2800 followers.
- Ted agreed that the Town can leverage social media.
- Ryan suggests the Town works with school clubs to make the Town green.

4. System Needs, Projection, and Alternatives

Kirsten Ryan (Kleinfelder) presented a summary of future population projections and the potential strain this could cause on both Medway's drinking water supply and wastewater treatment capacity.

4.1 Drinking Water Needs

The Town Planning Board has approved projects without taking into account the addition water supply and wastewater treatment capacity concerns. The Town also has a higher than average percent of unaccounted for water. With current unaccounted for water percentage and the projected increase in supply due to population increase, the Town will run out of reliable water supply by 2020. If the Town needed to take its largest well offline, providing adequate supply could become an issue by 2018.

- John said The Town needs to act now to build a well. It will take a long time to get approval for a well. Conservation isn't a dependable alternative. Water is also necessary for fire safety concerns
- Ted agreed that a new well is inevitable. He asked if the industrial bottle lots been accounted for in terms of water use?
    - Doug replied that there isn't a lot of industrial water use in upcoming development. There are some restaurants, motels, and workforce housing

4.2 Wastewater Needs

Known developments and properties that have access to sewer but currently use septic systems are permitted to connect to the sewer system. The Town will reach its permitted capacity by 2020 with these new connections to sewer, and the Town has already gone above its allocated capacity in previous years.

- John indicated that Franklin is willing to sell their wastewater treatment capacity now, but may not be willing to later on. The Town needs to act now.
    - He asked what are the legal implications of not having capacity for developers? We have a sewer moratorium – no extensions.
- Dave indicated the Town does not use MassSave for water

4.3 Stormwater Needs

There are areas in the Town that have been identified as drainage problem areas, which could affect public health if they occur within a Zone I or Zone II. The Town has 10% impervious cover and around 3,120 MG of runoff per year. There are water quality concerns at the outfalls

- Look into flood skimming and aquifer recharge as an alternative.

The Kleinfelder team presented some examples of needs for each of the three water systems and identified potential alternatives.

System alternatives discussion points:

Drinking Water:

- There are drinking water interconnections with neighboring communities, but no formal agreement. Milford is the only town we can get emergency water from without using a pump.
- There is an issue with Fe/ Mn blending
- Doug asked how successful are water use rebate programs
  - Dave indicated they are good if promoted. He thinks they are helping
- Dave said the SR2S meters were replaced in 2010-2012
  - Ted indicated the town is not aware of any issues.

Wastewater:

- The BOH has loans for septic replacement. $200K has lasted 3-4 years. Seems like a good program and will be evaluated if it should be refunded again in this tech memo
- Wastewater was a combined system until the 1970s.

Stormwater

- Suzy emphasized the Town needs more focus on inspection/ maintenance of detention basins, both Town and private.
- Bridget/Suzy indicated the Town needs to enforce the bylaw. There is private discharge to the public system

5. Decision Model Development

Laura provided an overview of Kleinfelder's plan to use a decision model (STELLA decision modeling software) to help determine the direction of the IWRMP. She described the inputs of the model and then followed with asking the participants what alternatives they would like to see in the IWRMP, and what types of alternative would not be preferred.

Decision Model Discussion Points:

- John indicated the speed of implementation for drinking water alternatives will be discussed Monday (11/20). We have an "out" on the wastewater side through purchasing capacity
- Ted said that tactical decisions short-term solutions will be made based on strategy, we don't have 20 years to wait.
- Dave indicated he wanted to see the following alternatives menus:
  - Do nothing

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- Full speed
- Timing

- Barry said he wanted to look at deferred cost.
- Suzy asked if soft implementation should be assumed
  - Dave said we should assess benefits of soft implementation
  - John said this should be on the list of things to be done.
- Bridget indicated the Town needs education in public schools. It is a long-term solution
- John indicated that if the Town can purchase more capacity, the consultants shouldn't spend time on the wastewater side.
  - Allison agreed that drinking water is a better investment.
- Dave said that DPS doesn't benefit from stormwater management. We should set up a meeting with MassDEP to hear their thoughts regarding the IWRMP. For stormwater, we are already limited on how much we can pump out anyway.
- John indicated that there are easy regulations/ planning/ permitting that could help us later on.
- Bridget said the Town already requires rain barrels, dry well, or other infiltration requirements for new buildings. The Town could expand policies to include retrofits. The current policy already includes existing houses with additions. The Town could add a restriction on development based on stormwater capacity. The Town could create incentives i.e. washing machines. Rain barrels are $60 ech subsidized.
- Stephanie agrees. She said that rain barrels would also help with water culture. They help residents to understand the quantity of water being managed.
- John stated cost is not an issue for the satellite well. A new well or a satellite wastewater treatment facility would be cost prohibitive. It would cost $7M to repair the Village Street Well.
- Dave asked how can the Town incorporate rate increases over time. What is the affordability?
- **Dave to provide water rate impacts**
- Bridget said people should know the costs will go up if conservation doesn't happen. They should be informed before rates skyrocket.
  - Education – DPS needs to publicize.
- **Kleinfelder to provide a list of planned runs of model for reaction/ feedback.**

6. Next Steps

Run Decision Model:

- Kleinfelder will gather input from Town to identify preferred alternatives for further development,
- Kleinfelder will schedule a third workshop in January

Conceptual Design of Alternatives:

- Kleinfelder will evaluate the cost of the preferred alternatives after feedback at the January meeting

Draft Implementation Plan:

- Kleinfelder will review the implementation schedule and costs for the preferred alternative.
- A fourth workshop will be Scheduled for April
- The complete draft of the IWRMP will be provided ahead of the workshop.

Attachments:

- Meeting Power Point presentation
- Meeting poster notes

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Medway's Integrated Water Resources Management Plan

IWRMP Update Workshop

IWRMP Task Force
Medway Town Hall
November 16, 2017

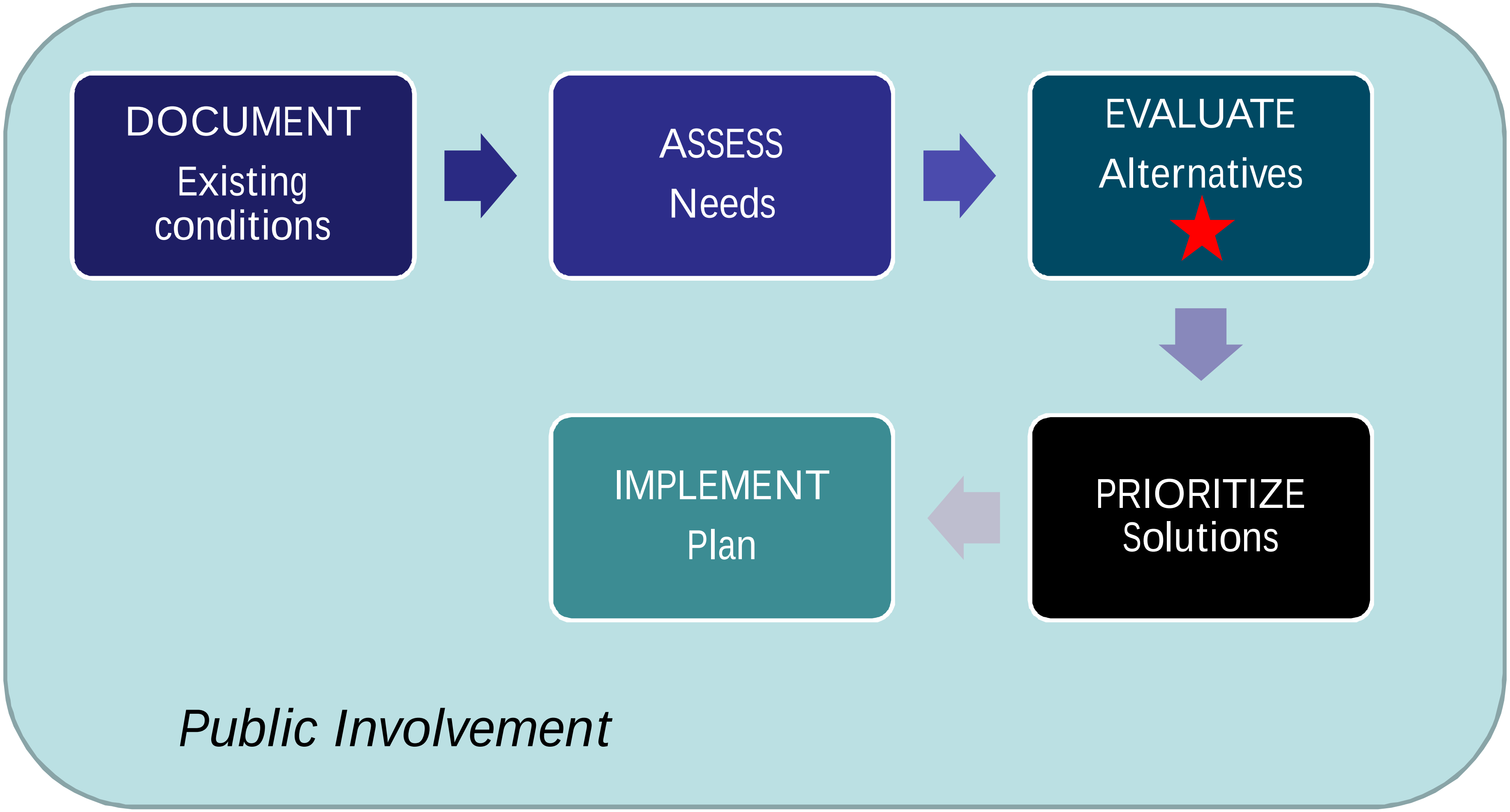
KLEINFELDER
Bright People. Right Solutions.

TOWN OF MEDWAY MASSACHUSETTS
INCORPORATED OCT. 25, 1713

Agenda

1. Introductions, Meeting Objectives
2. Project Overview/Status
3. Integrated Systems Group Exercise
4. System Needs, Projections and Alternatives
    i. Drinking Water
    ii. Wastewater
    iii. Stormwater
5. Decision Model Development
6. Next Steps

Integrated Water Resources Planning Process



IWRMP Phase II

- ☑Document Existing Conditions
- ☑Identify Needs
- ☑Identify Alternatives to Address Needs
- ❖Evaluate Alternatives and Select Preferred Solutions
- ❑Conceptual Design
- ❑Develop IWRMP (in progress)
- ❑Develop Implementation Schedule

Integrated Water Resources Systems

Water

Stormwater

Wastewater

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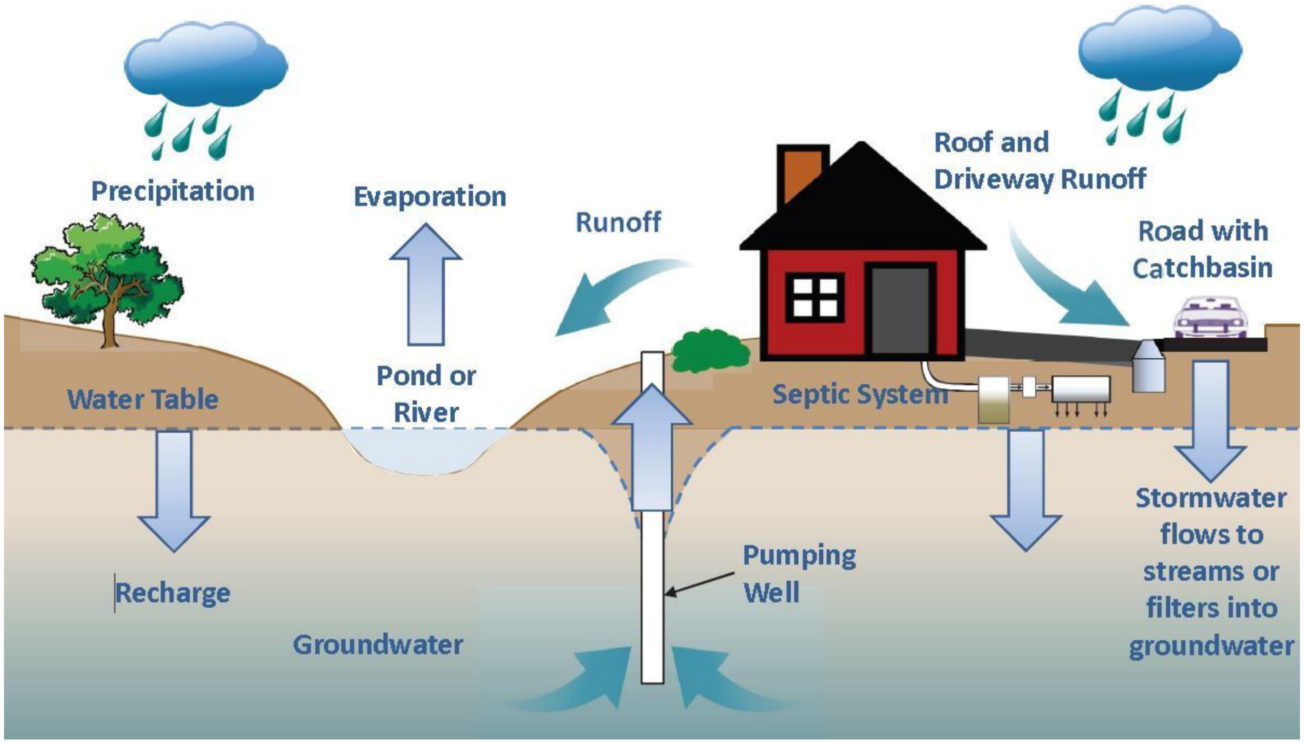
How do we integrate the analysis?

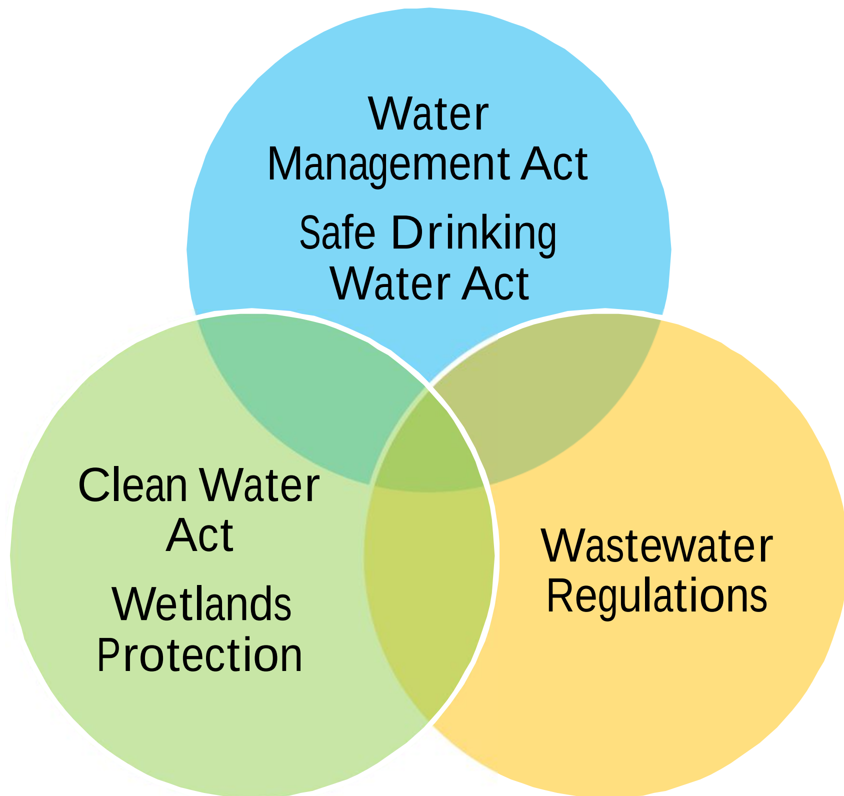
- Develop Decision Model
  - Simulate interactions between systems
  - Provide quantitative assessment of alternatives
  - Determine which alternatives will be most effective
  - Allow for focused design effort on selected alternatives

Why Integrated Water Resources Planning?



Water resources and infrastructure are all interconnected !

Regulatory Context & Integrated Planning



Water resources and infrastructure ***regulations*** *overlap*

Medway's Water Resources Challenges

Water bans in effect as drought continues

Medway: State executive OKs Exelon expansion Milford Daily News
With **Medway** unable to provide the average of 95,000 gallons of **water** the plant will need per day, Exelon has been in talks with neighboring Millis to ...

WATER SUPPLY & DEMAND ASSESSMENT IN RELATION TO EXELON POWER 'WEST MEDWAY II' PROJECT

Storm water permit, and huge expense, may be incoming

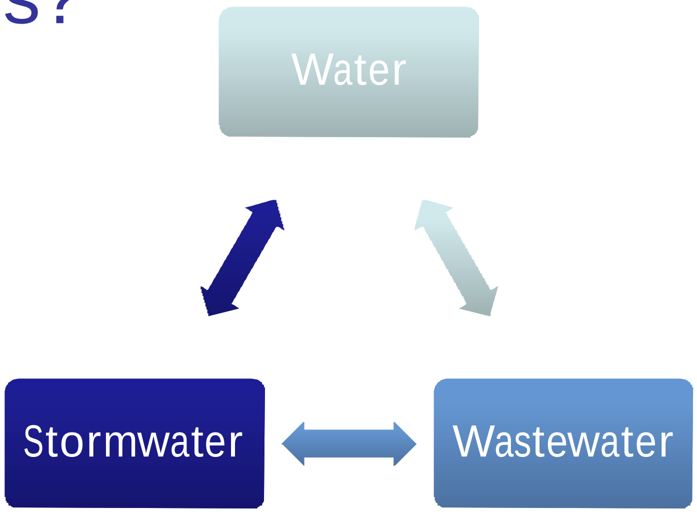
Water: a costly commodity in MetroWest

Like Bellingham, Medway's water is pumped out of the ground, which brings naturally occurring high levels of iron and manganese.

Medway crews repond to three water main breaks

Group Exercise

- What do these systems mean to you?
- How do they interact?
- What are the drivers for managing them?
- Who are the stakeholders?
- What are the funding sources?



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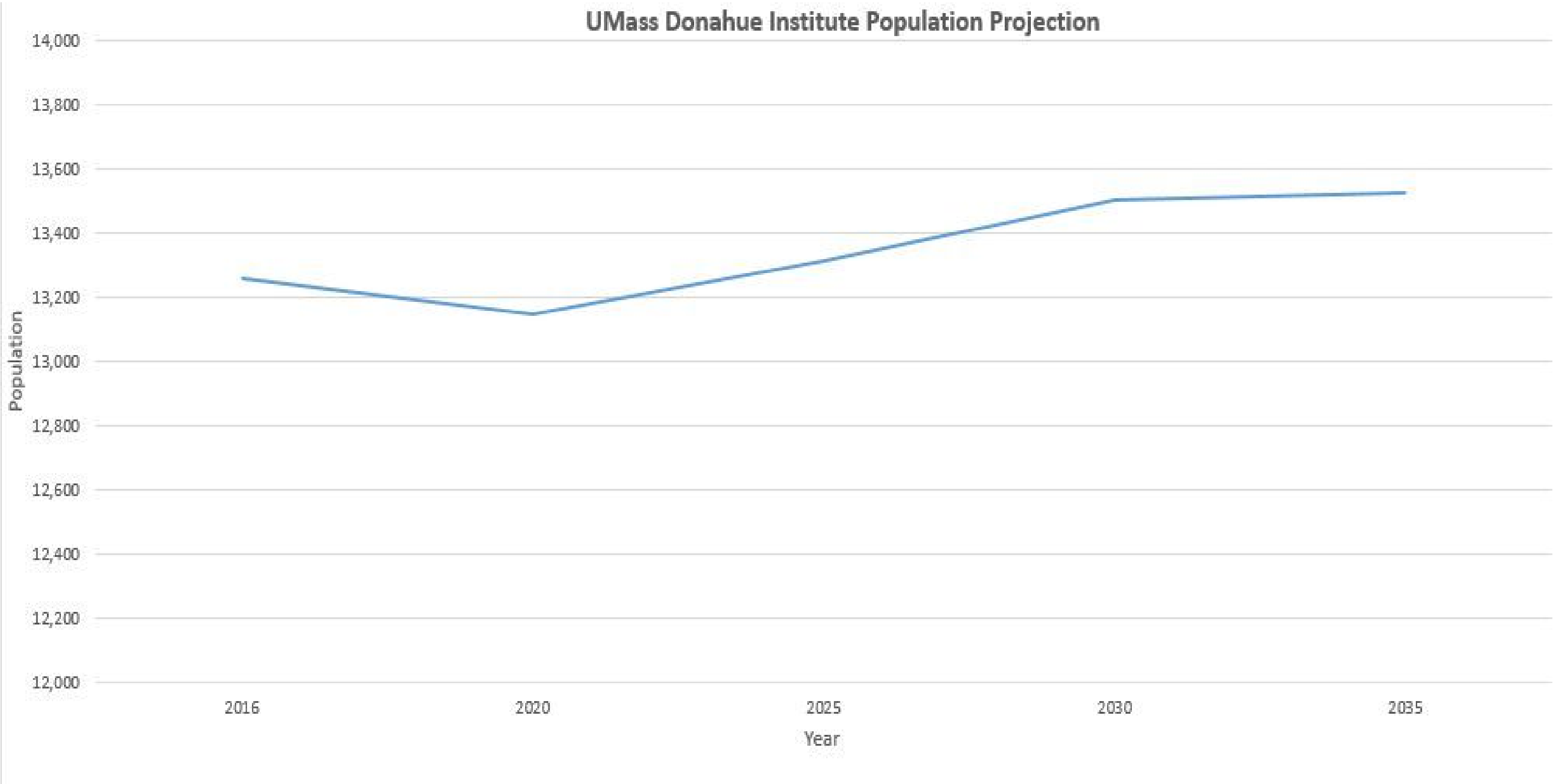
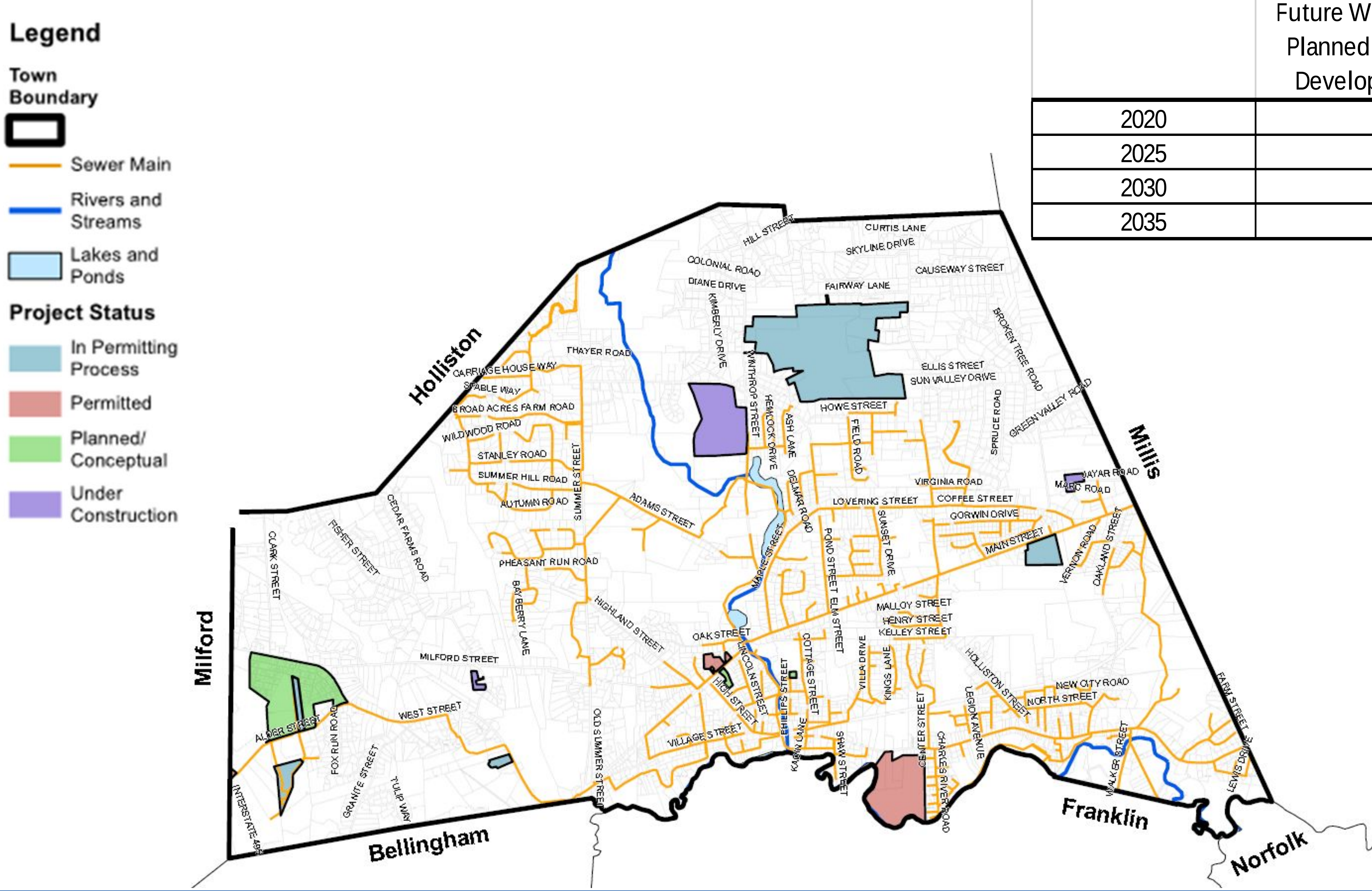
System Needs, Projections and Alternatives

Population Growth



- 1.26% Growth from 2020 to 2025
- 1.48% Growth from 2025 to 2030

Upcoming Development Projects



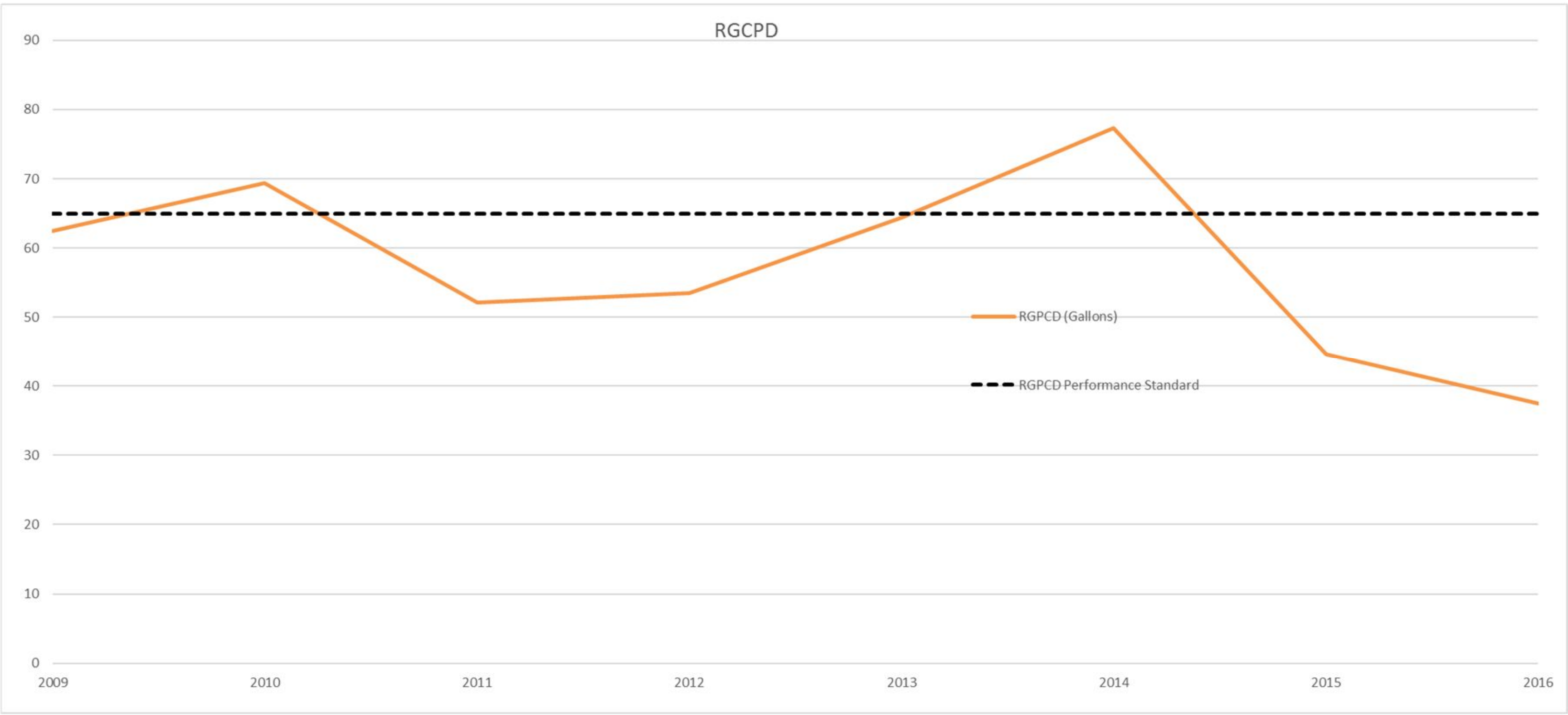
	Future Water Demand, Planned & Permitted Development (gpd)
2020	84,700
2025	185,900
2030	197,600
2035	251,700

Average Water Use by Customer Type

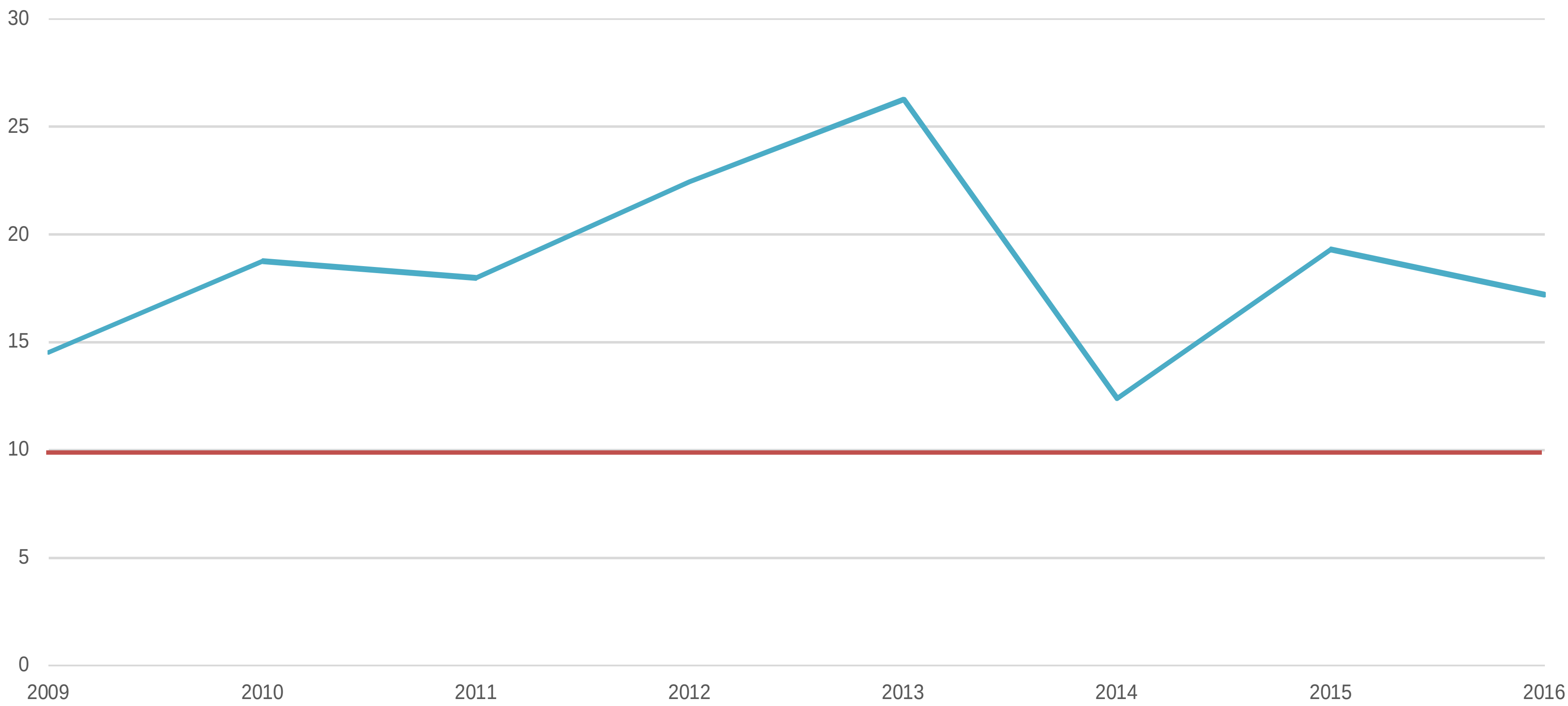
	Avg Annual Use (MG)	Percent of Townwide Use
Residential	215.846	87%
Residential Institutional	8.670	4%
Commercial Business	12.737	5%
Agricultural	0.337	0%
Industrial	5.991	2%
Municipal/Institutional/Non-Profits	3.331	1%
Other	0.525	0%
Total	247.436	100%

Source: ASR Data, 2009-2016

Residential Water Usage, Historic

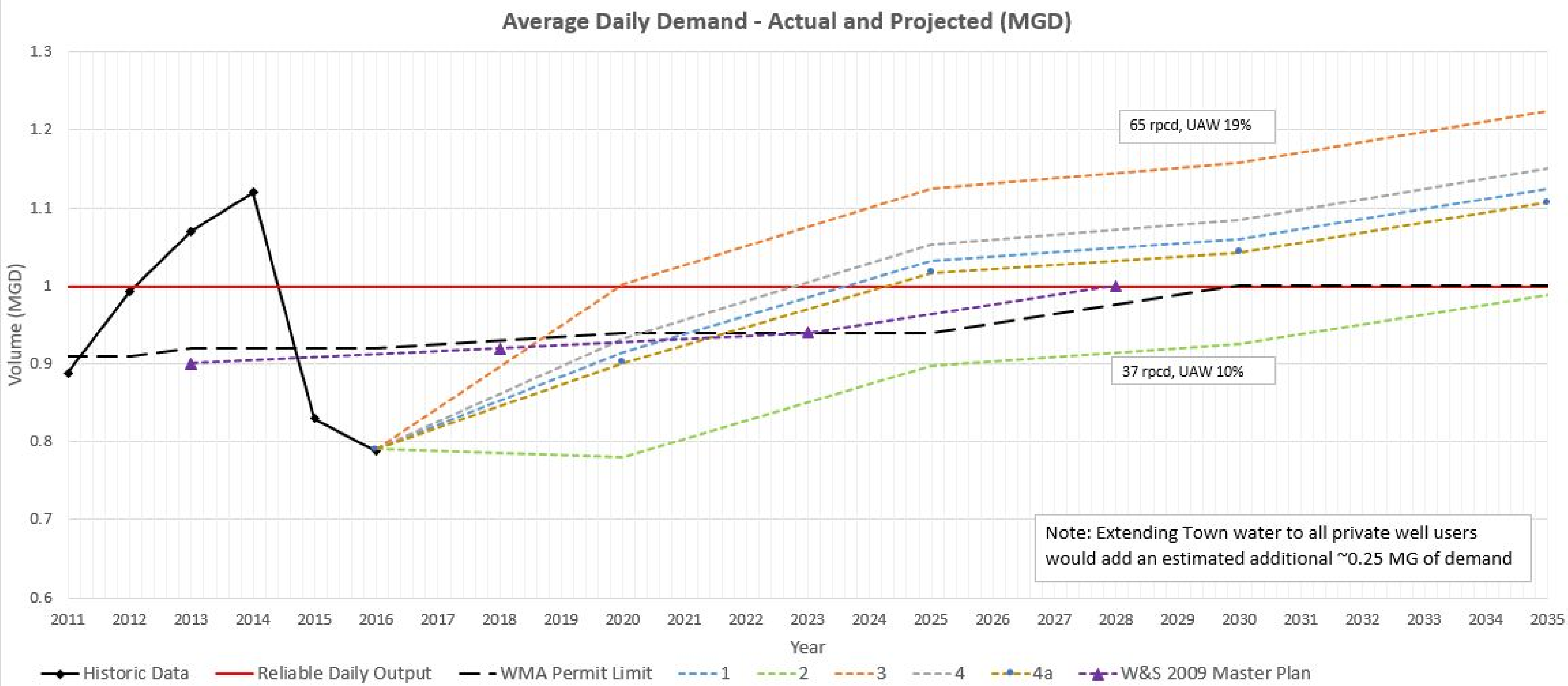


Unaccounted for Water (UAW, % of total)



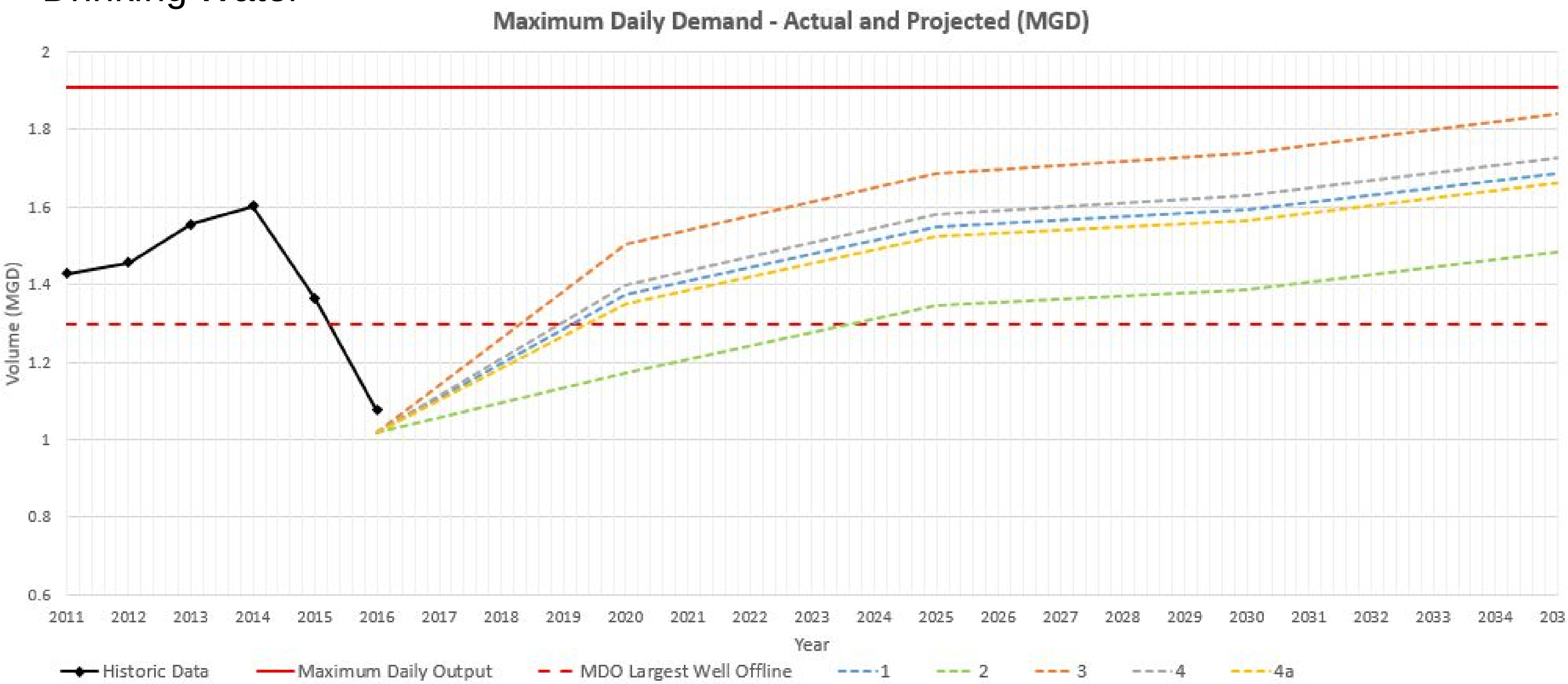
MassDEP requirement: 10% UAW

Drinking Water



Scenario	Description
1	Future residential water Use at current (2016) rate and UAW at current (2016) value
2	Future residential water use at current (2016) rate and UAW at 10%
3	Future residential water use at 65 gpcd and UAW 2011-2016 avg. value
4	Future residential water use at 65 GPCD and UAW at 10% (Umass Donahue Population)
4a	Future residential water use at 65 GPCD and UAW at 10% (MassDOT Population)

Drinking Water



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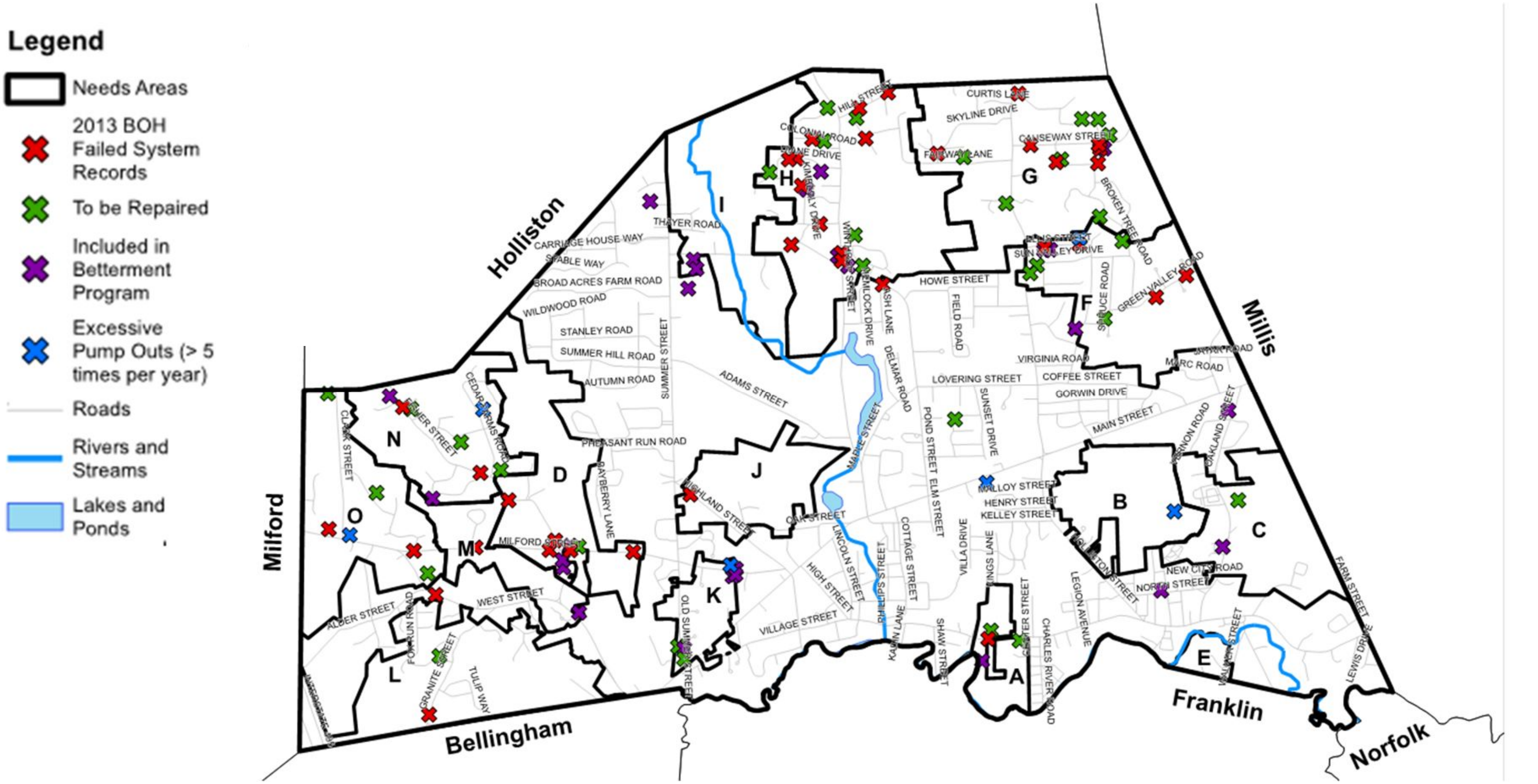
4	Future residential water use at 65 GPCD and UAW at 10% (Umass Donahue Population)
4a	Future residential water use at 65 GPCD and UAW at 10% (MassDOT Population)

Groundwater Sources

	Avg Annual Pumping (MG)	Percent of Total Water Supply
Populatic/Water Street GP Well	154.640	44%
Oakland Street GP Well	24.680	7%
Village Street Replacement Well	111.926	32%
Industrial Park Road Well	58.290	17%
Total	349.535	100%

Source: ASR Data, 2009-2016

Septic System Failures

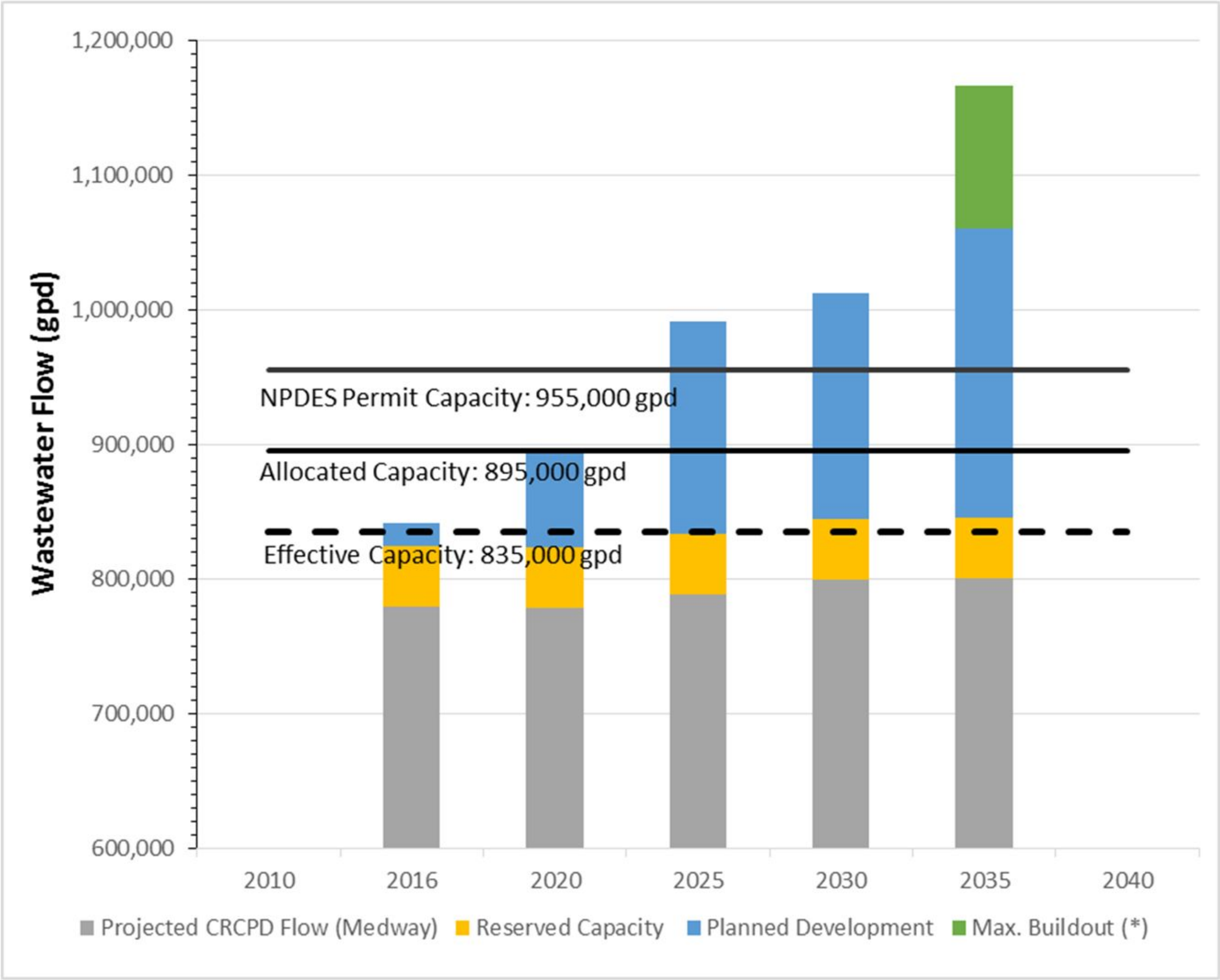


CRPCD Limits - Medway

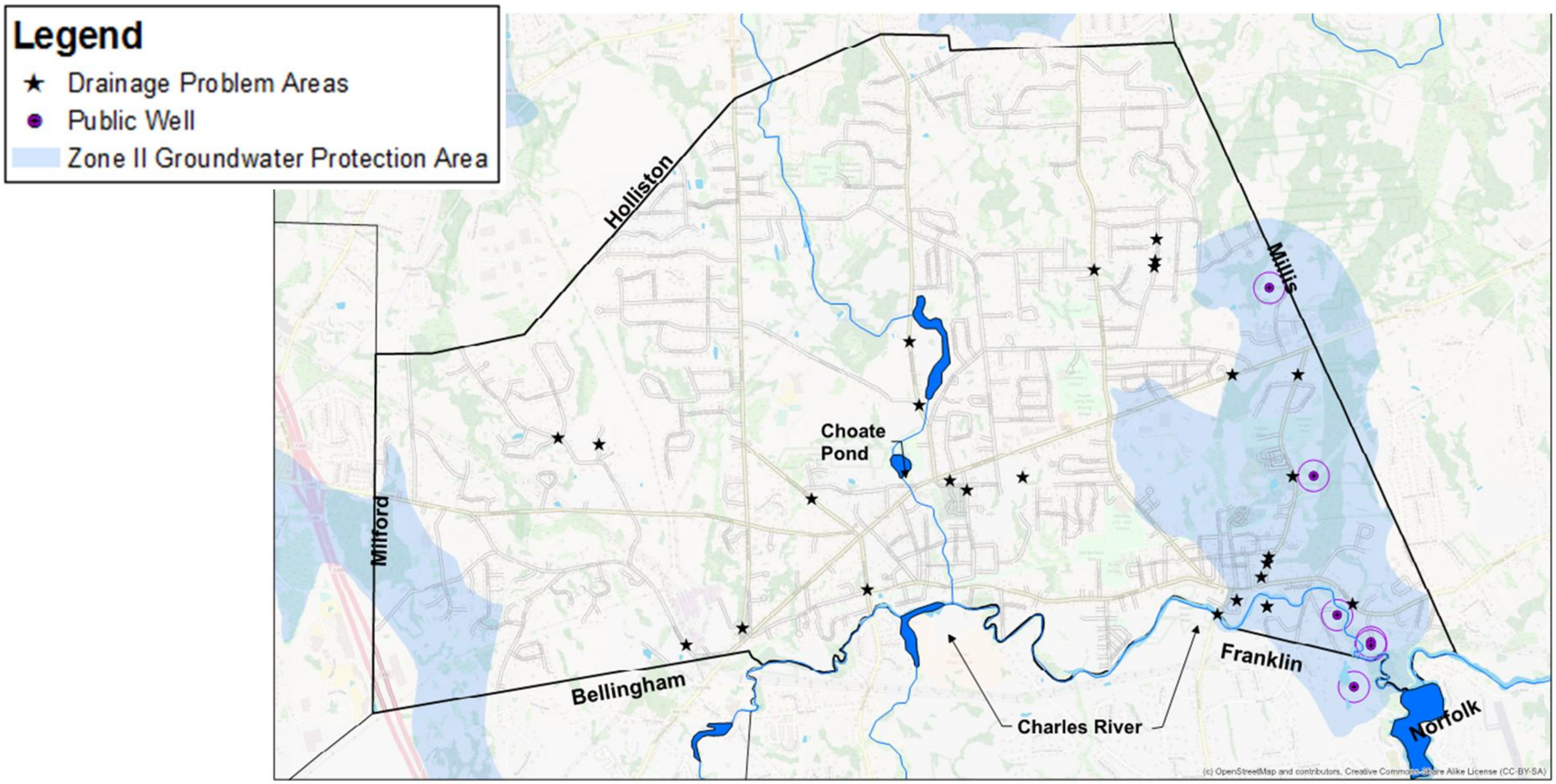
- Permit Capacity: 955,000 gpd
- Capacity Allocation: 895,000 gpd
- Effective Capacity: 835,000 gpd

Type of Flow	Current	2020	2025	2030	2035
Flow to CRPCD *(per Umass Donahue projections)*	779,000	778,600	788,300	799,400	800,800
Reserved Capacity *(Septic Users in Sewered Area)*	45,000	45,000	45,000	45,000	45,000
Known Development *(Source: Planning Department)*	17,000	72,000	158,000	168,000	214,000
Projected Flow	841,000	895,600	991,300	1,012,400	1,059,800

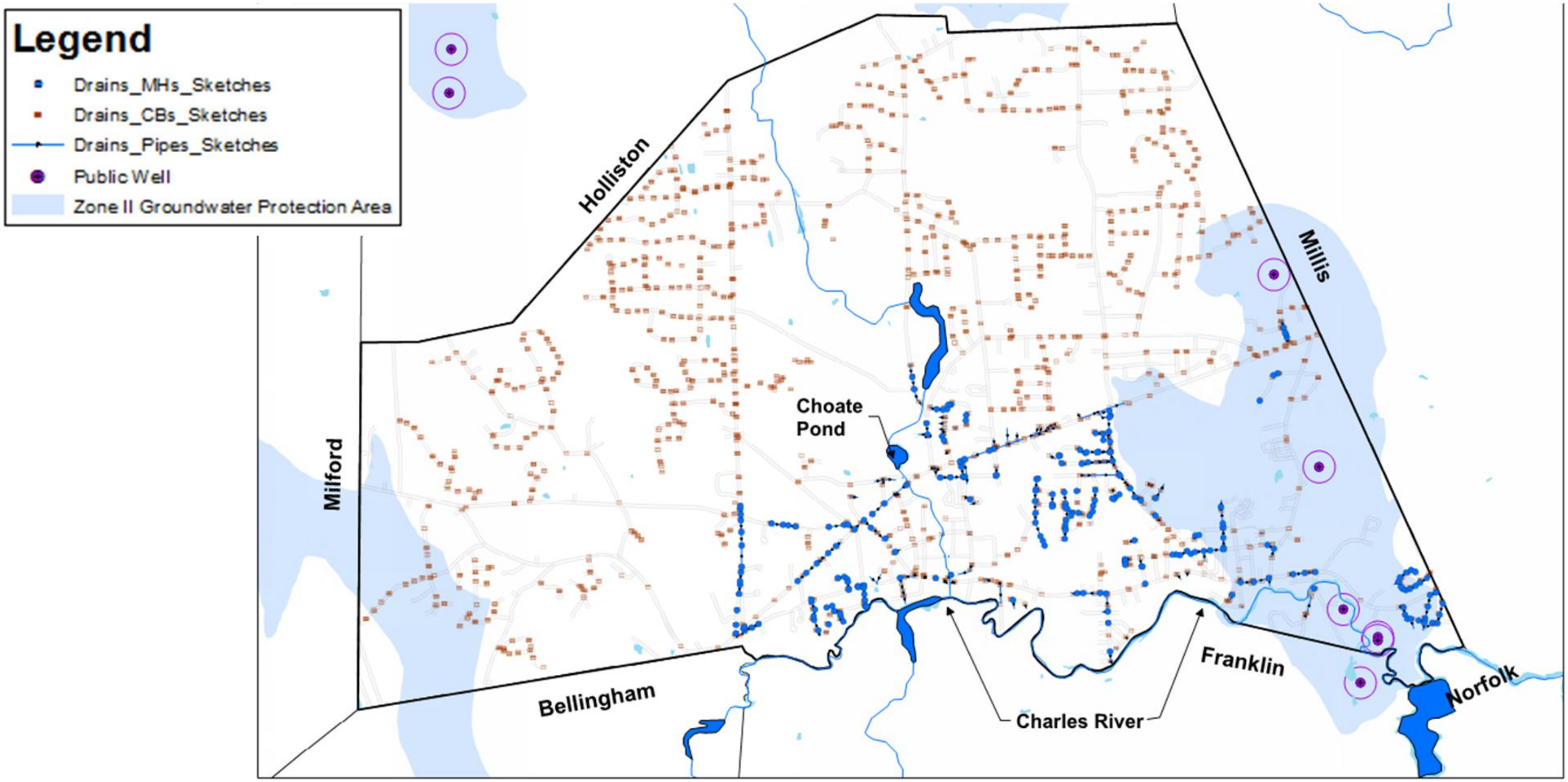
Wastewater Projections



Stormwater: Maintenance Areas



Stormwater: Mapping Needs



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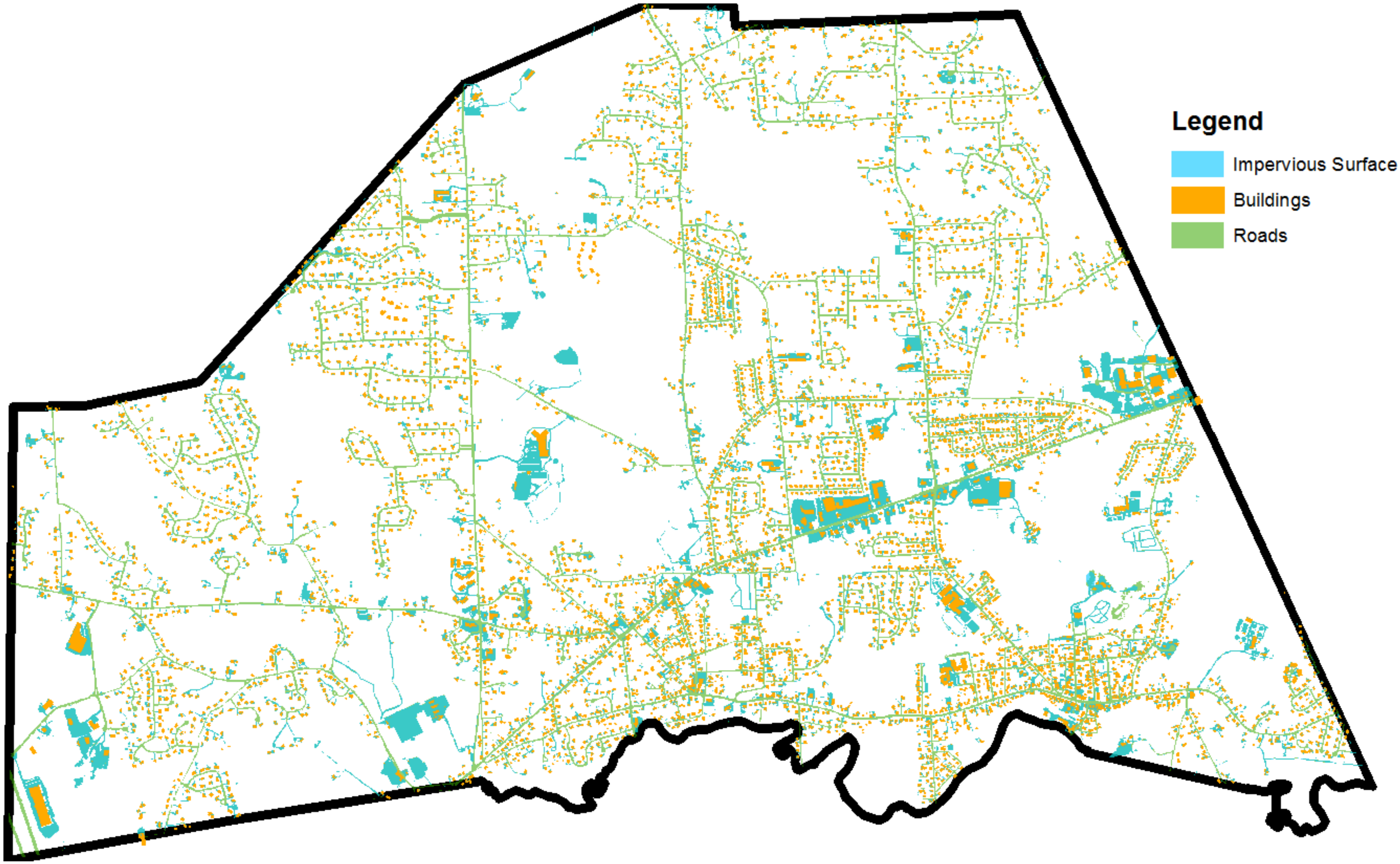

Stormwater: Runoff Impacts

- 10% of Town Area = Impervious Cover
- Average Annual Rainfall: 41.1”
- Runoff: ~3,120 MG/year

- Water Quality Discharges at Outfalls

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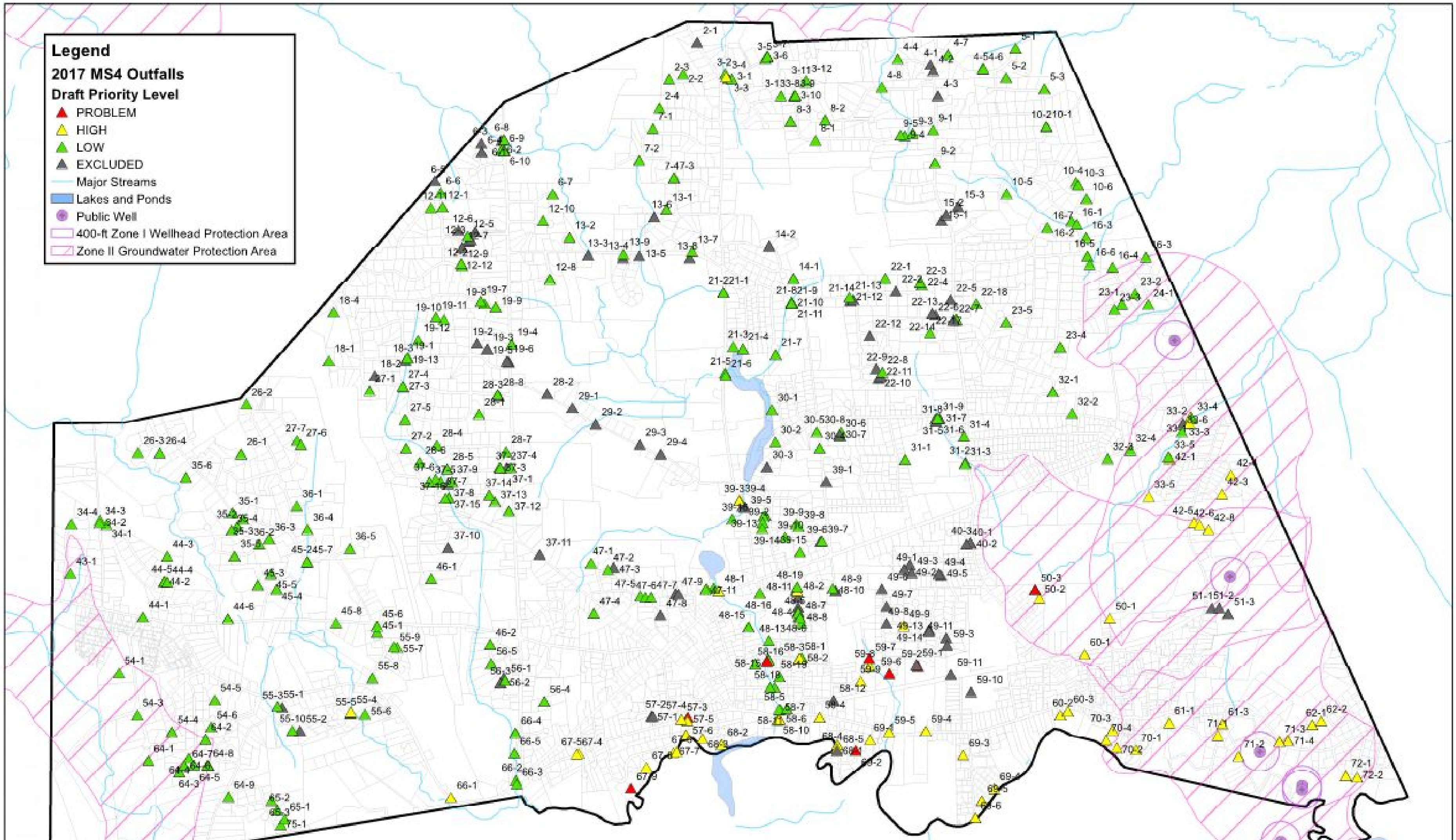


Medway Stormwater Outfall 2017 Inventory - 425 Total

Drinking Water

Needs	Solutions
Lack of well supply capacity	• annual well rehabilitation program to restore lost capacity; increase resiliency
Lack of well redundancy	• Satellite wells • Replacement wells / wellfield

Unlikely to meet max daily demand with largest source offline
 	
Within 2-5 years, may be unable to meet average day demand
	• Emergency purchase agreement with Millis
	• Alternative water sources
	  • New supply well
	  • Stormwater capture
	  • Wastewater Reuse

Drinking Water

Needs	Solutions
Future supply deficit projected	Continue / enhance demand management • Conservation education/outreach • Fixture retrofits • Rebates • Water ban
New regulatory constraints (WMA) • Offsets required for higher withdrawal authorization	Consult with DEP on new WMA Permit application; identify credits
Iron & manganese levels requiring treatment	Construct treatment facility
Un-accounted for water (UAW) >10%	• Meter testing / replacement program • Continue Annual Leak detection • Water main replacement as recommended in 2010 Master Plan

Wastewater

Needs	Alternatives
Data Gaps (flow metering)	• Permanent meter to confirm flow to CRPCD
CRPCD discharge limits	• Sewer moratorium • Infiltration/Inflow (I/I) Removal o Flow Metering* o Illicit Connections o Private Inflow Sources o CCTV Inspection o Manhole Sealing o Cured in Place Pipelining (CIPP)
Support Planned Buildout	• Sewer Extensions • I/I Removal • Increase discharge limit at CRPCD

Wastewater

Needs	Solutions
Septic systems failures • Physical limitations- High groundwater, extensive wetlands; poorly drained soils. • Protect Water Supply Sources	• Decentralized Treatment System • Sewer Extensions • Septic Needs Support Funds
Ongoing Maintenance • Fats, Oils, Grease (FOG) • Root Removal • System Condition Assessment • Pump Station Operation	• Support DPS Operations • CCTV Inspection of full system
Public Education	• FOG • Illicit Connections • Private Inflow Sources

Stormwater

Needs	Solutions
Localized Flooding • Low Topography • Sedimentation • Blocked Catch Basins • Beaver Activity	• Implement Green Infrastructure • Address development standards • Support maintenance
Mapping of System • GIS mapping of drain system • Delineate Catchments	• Map Drain System in Problem and High Concern Catchments
Water Quality Monitoring at Outfalls • Dry Weather Flow • Water Quality Sampling	• Support DPS Operations • MS4 Funding

Stormwater

Needs	Solutions
Maintenance • Good Housekeeping • Catch Basin Cleaning • Street Sweeping	• Support DPS Operations • MS4 Funding
Public Education	• Ongoing education programs
Water Quality Improvements	• 6 Minimum Controls • BMPs

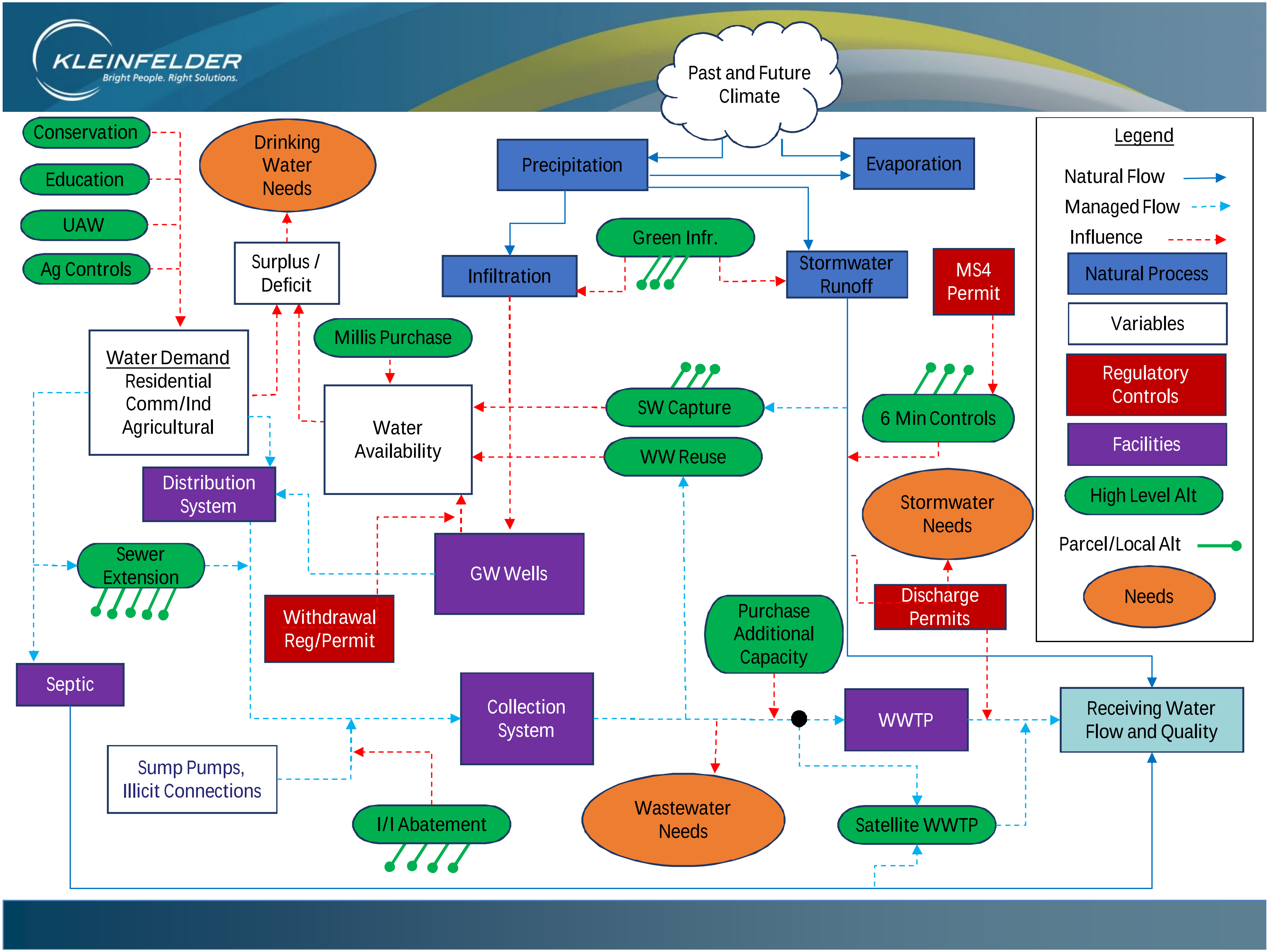
Decision Model Development

- How do we decide which alternatives will be best for the Town?
  - Technically feasible
  - Cost effective
  - Acceptable
  - Multi-benefit solutions

Decision Model

- Simulate dynamic interactions between systems:
  - Rainfall ↓, Groundwater ↓
  - Impervious Cover ↑, Runoff ↑
  - Population ↑, Water Demand ↑, Wastewater ↑
  - Limits: permits, water availability, capacity
  - Tradeoffs: resources, quality

- Goal: quantify the tradeoffs and sensitivities as a guide for decision making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Past and Future Climate
Precipitation
Evaporation
Conservation
Education
UAW
Ag Controls
Drinking Water Needs
Surplus / Deficit
Infiltration
Green Infr.
Stormwater Runoff
MS4 Permit
Water Demand
Residential
Comm/Ind
Agricultural
Millis Purchase
Water Availability
SW Capture
WW Reuse
6 Min Controls
Distribution System
Stormwater Needs
Sewer Extension
GW Wells
Withdrawal Reg/Permit
Discharge Permits
Purchase Additional Capacity
Septic
Collection System
WWTP
Receiving Water Flow and Quality
Sump Pumps, Illicit Connections
Wastewater Needs
I/I Abatement
Satellite WWTP
Legend
Natural Flow
Managed Flow
Influence
Natural Process
Variables
Regulatory Controls
Facilities
High Level Alt
Parcel/Local Alt
Needs

Model Inputs

- Historical and Projected:
  - Water demands
  - Wastewater flow
  - Precipitation
  - Management options
    - UAW identification
    - I/I removal
    - Treatment

Alternatives

- These are your decisions….
  - Which ones would be preferred?
  - Which would not be preferred?
  - What might be missing?

Next Steps Summary

Next Steps

- Run Decision Model (Nov-Dec)
  - Identify preferred alternatives for further development
  - Workshop in January
- Conceptual Design of Alternatives (Jan-Feb)
  - Evaluate Costs
- Draft Implementation Plan (Feb-Mar)
  - Review implementation schedule and costs
  - Workshop and Public Meeting in April
- Complete Draft IWRMP (April)

Integrated Water Resources Management Plan

Thank you for your time!

DEP

Operating/Capital Expenses

Future budget planning

Recycled water

Lack of service - wastewater/water
↳ future plans?

Septic Failures

Manage Stormwater -> green infrastructure

Planning Board -> Approvals

Groundwater protection

$

Public outreach/education

DPS/Private owned BMPs

Loss of water supply well -> resiliency

Conservation - enforcement?

UAW

Private wells regulate?

cross department education?

Integrated Decisions

WWTF → Reclaim? → irrigation, recharge

extend sewer? → P.S. needed? (all gravity) centralized WWTP?

capacity? now? later?

LID

stormwater → infiltration incentivized?

public awareness – Public wells

Stormwater – private structures
- not following the
- awareness?
- enforcement ✓ education

WATER – supply / quality / fire protection

Treatment

Stakeholders → selling the solutions

how to reach busy people

Regulators

CRWA → Developers

supply available?

Funding – State

wetland impacts

Education → Drought

getting public's attention → via hot button project (eg 109) daily update

Medway's Integrated Water Resources Management Plan

Progress Update & Needs Assessment Workshop

IWRMP Task Force, Medway Town Hall, June 28, 2017

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TOWN OF MEDWAY MASSACHUSETTS
INCORPORATED OCT. 25, 1713

Introductions, Objectives

Part 1: 9:30-11:30AM: IWRMP Update

- Present Needs Assessment Method; Findings
- Obtain feedback

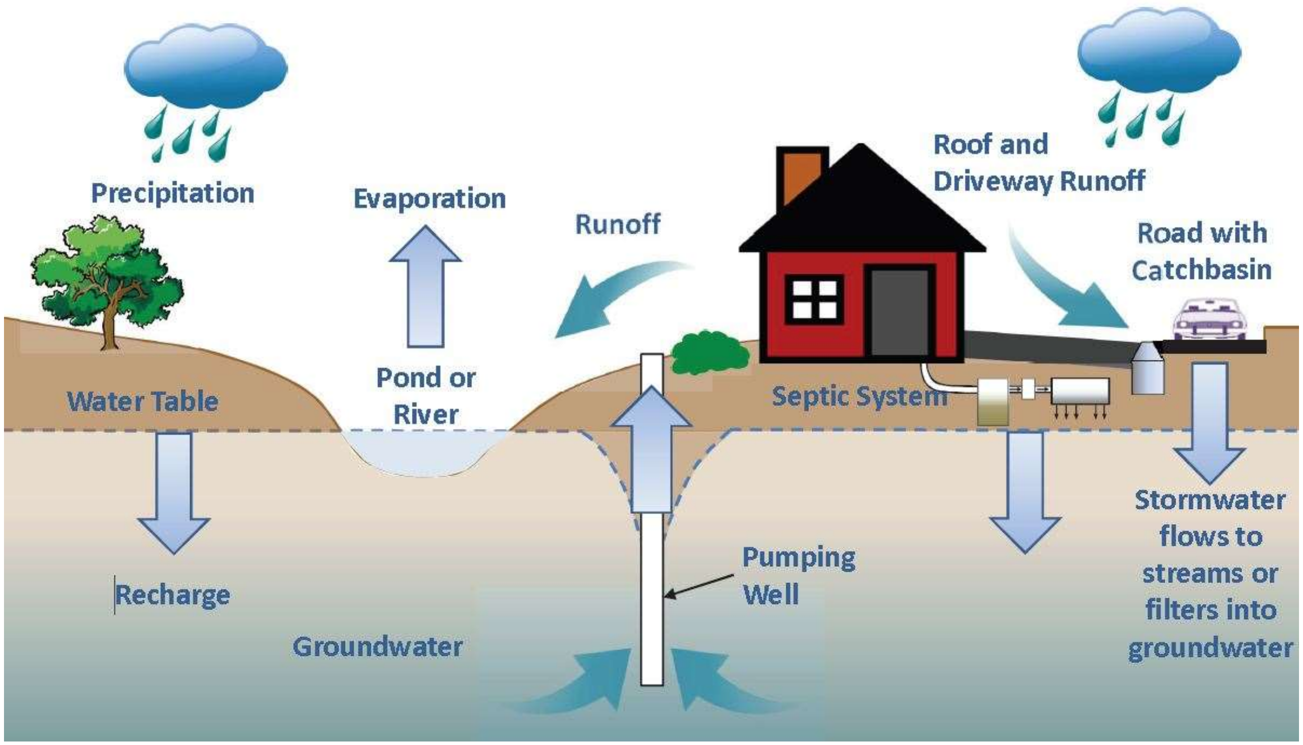
Part 2: 1:00-3:30PM: MS4 Notice of Intent Working Session

- Provide Update
- MCM 1- Public Education Program Development

IWRMP Update / Needs Assessment Agenda

1. Introductions, Meeting Objectives
2. Integrated Planning Purpose / Benefits
3. Regulatory Context
4. IWRMP Scope and Status
5. Existing Conditions & Needs Analysis:
   i. Drinking Water
   ii. Wastewater
   iii. Stormwater
6. Next Steps

Why Integrated Water Resources Planning?



Water resources and infrastructure are all interconnected !

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**WATER SUPPLY & DEMAND ASSESSMENT
IN RELATION TO
EXELON POWER 'WEST MEDWAY II' PROJECT**

Water: a costly commodity in MetroWest

Like Bellingham, Medway's water is pumped out of the ground, which brings naturally occurring high levels of iron and manganese.

Medway crews repond to three water main breaks

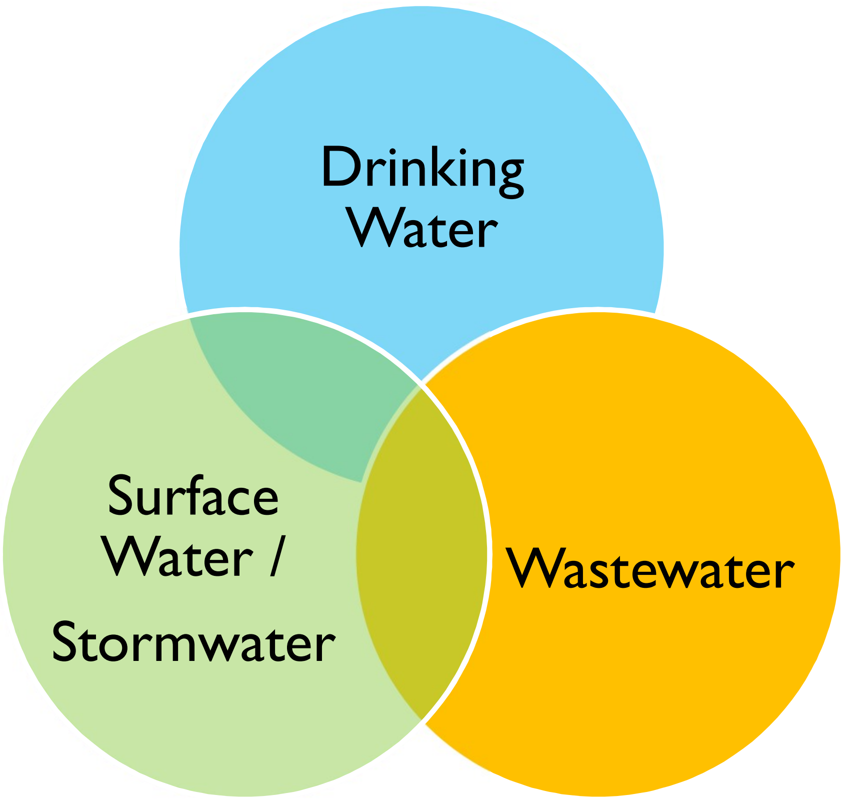
Medway losing 100,000 gallons of water a day

By Zachary Comeau, Daily News Staff

Why Integrated Water Resources Planning?

- *Pressure on aging infrastructure*
- *Pressure on available land*
- *Competition for limited resources*

What is Integrated Water Resources Planning?

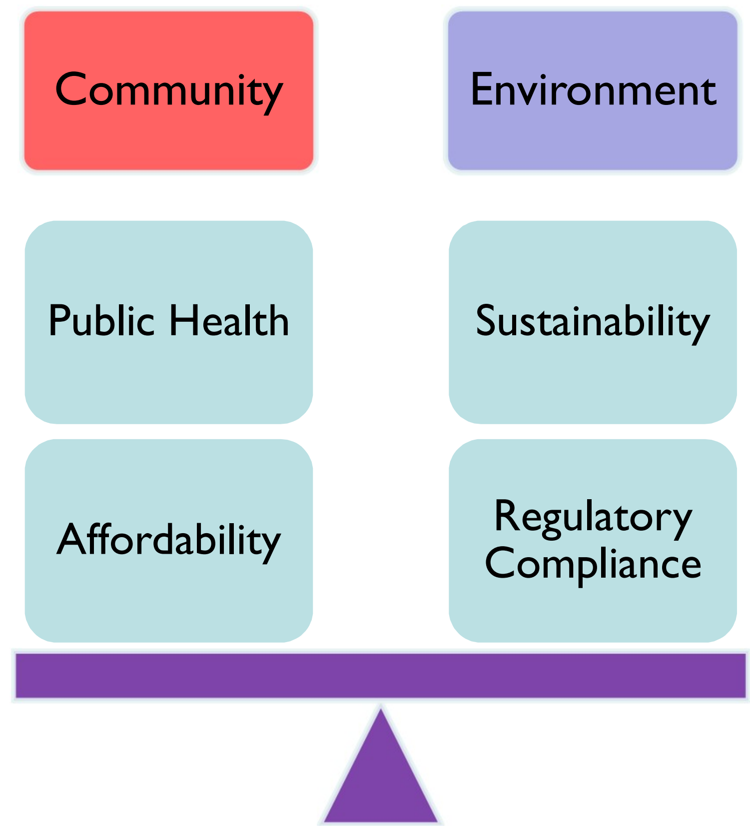


- What Resources exist?
- What condition are they in?
- What requirements must be met?
- What are the needs & priorities of the community?
- How can they be balanced and sequenced?
- What is our short & long term plan?

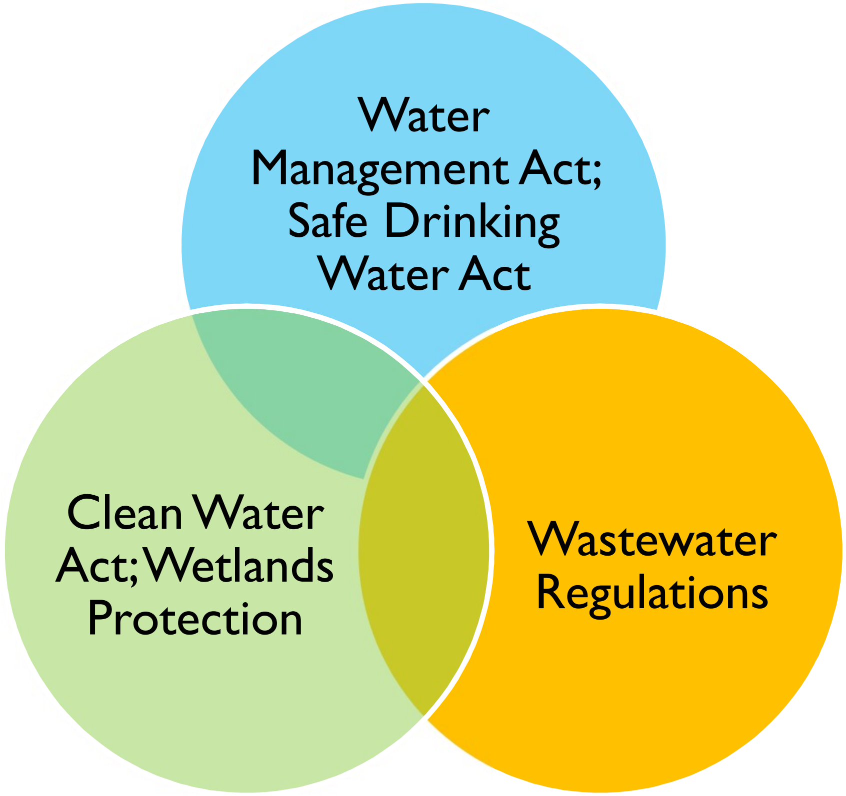
What is Integrated Water Resources Planning?

“evaluates alternative means for addressing current and future wastewater, drinking water, and stormwater needs and identifies the most economical and environmentally appropriate means of meeting those needs”

- MassDEP



Regulatory Context & Integrated Water Resources Planning



Water resources and infrastructure <u>regulations</u> overlap !

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Benefits of Integrated Water Resources Planning

- Needs identified
- Solutions prioritized

- Proactive vs reactive
- Proceeding holistically provides efficiency
- Increase access to funding; regulatory leverage

- *Medway well-positioned to balance growth with environmental / fiscal sustainability while maintaining regulatory compliance*

Medway IWRMP History & *Regulatory Changes**

2013
IWRMP Phase I in progress

**New WMA regs in development*

Grant #1 - evaluates Water Management Permit options

**New Mn health advisory for water*

2014
January: IWRMP phase I completed

**EPA issues new Draft MA MS4 Permit*

**DEP issues new WMA and Sewer regs*

2015
IWRMP on hold pending final MS4 Permit

Grant #2: water loss study

Exelon Demand Assessment

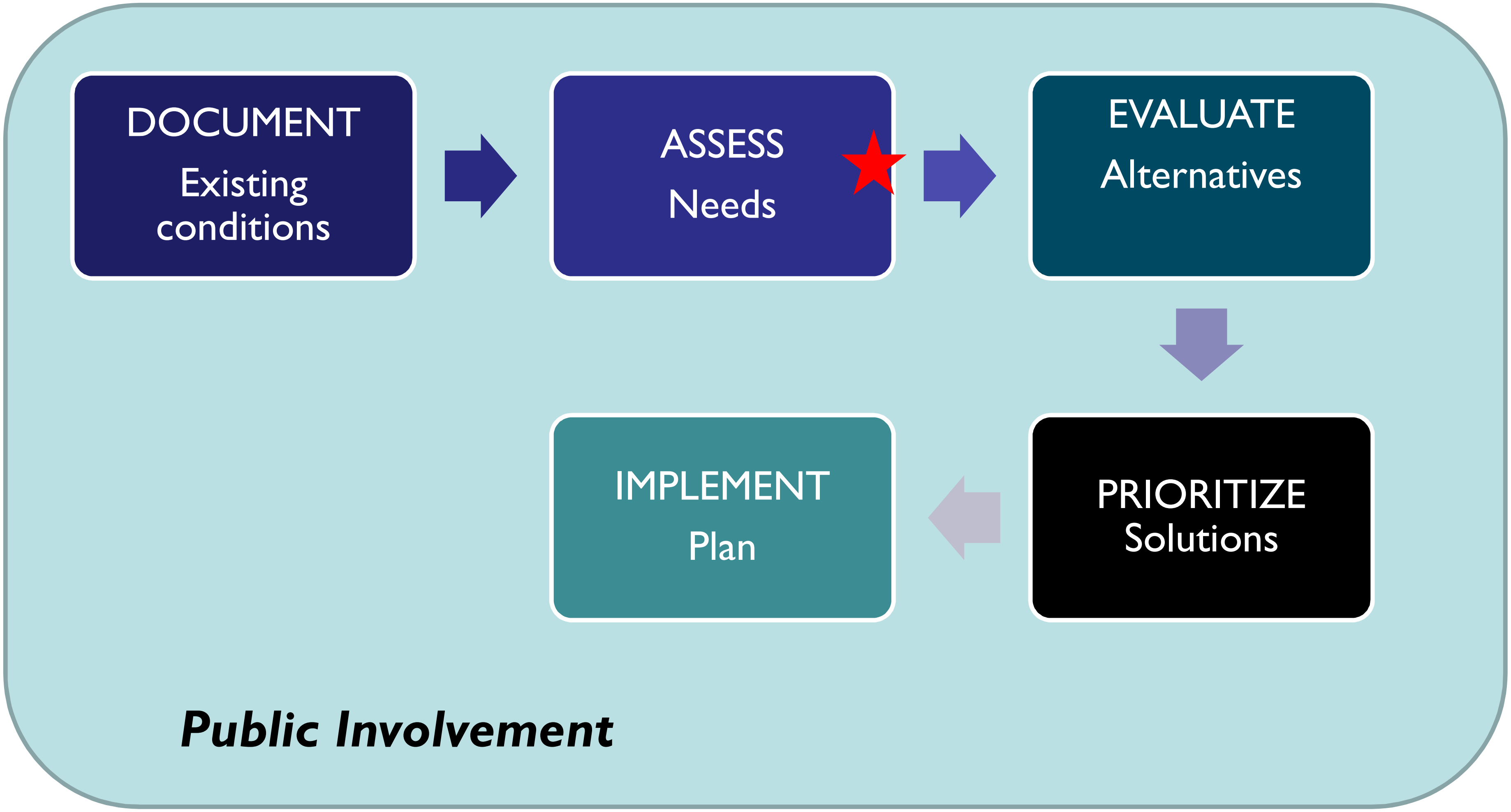
2016
Grant #3: Stormwater Funding study

**April: EPA issues Final MS4 Permit*

Effective date 7/1/17

December 2016 – Medway authorizes Kleinfelder to proceed with the remainder of IWRMP process

Integrated Water Resources Planning Process



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IWRMP Phase I / Phase II

Phase I:

Focus on MS4 Compliance Tasks

Begin Documenting Stormwater Existing Conditions

- ☑Advisory Task Force convened (that's you!)
- ☑Stormwater Educational Outreach Materials
- ☑GIS Outfall Compilation & Stormwater Map
- ☑Priority Outfall Inspection & GPS Location
- ☑Illicit Discharge Detection & Elimination Plan
- ☑Municipal Good Housekeeping Manual

IWRMP Phase II Tasks; Scope, Schedule

		6/27/2017		FY17			FY18			FY18			FY18			FY18		
IWRMP TASKS		% Complete	TASK	Q4			Q1			Q2			Q3			Q4		
		38%		A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Task Force (*); Public Meetings (X)	DW / WW / STORM	50%	1			*			X*		*					X*		
Existing / Future Conditions	DRINKING WATER	95%	2															
	WASTEWATER	75%																
	STORMWATER	75%																
Needs Assessment	DW / WW / STORM	75%																
Evaluate Alternatives	DW / WW / STORM	0%	3															
ID Technologies / Sites	WW/ SW		3															
Screening & Recommendation	WW		4															
Evaluate Options; Conceptual Design & Cost	DW / WW / STORM		5															
Plan Development	DW / WW / STORM	25%	6															

Drinking Water

IWRMP Needs Assessment

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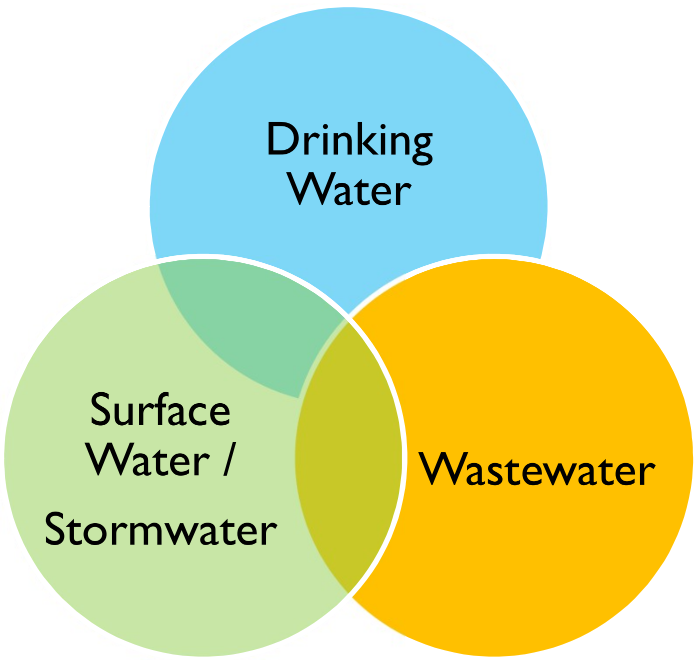
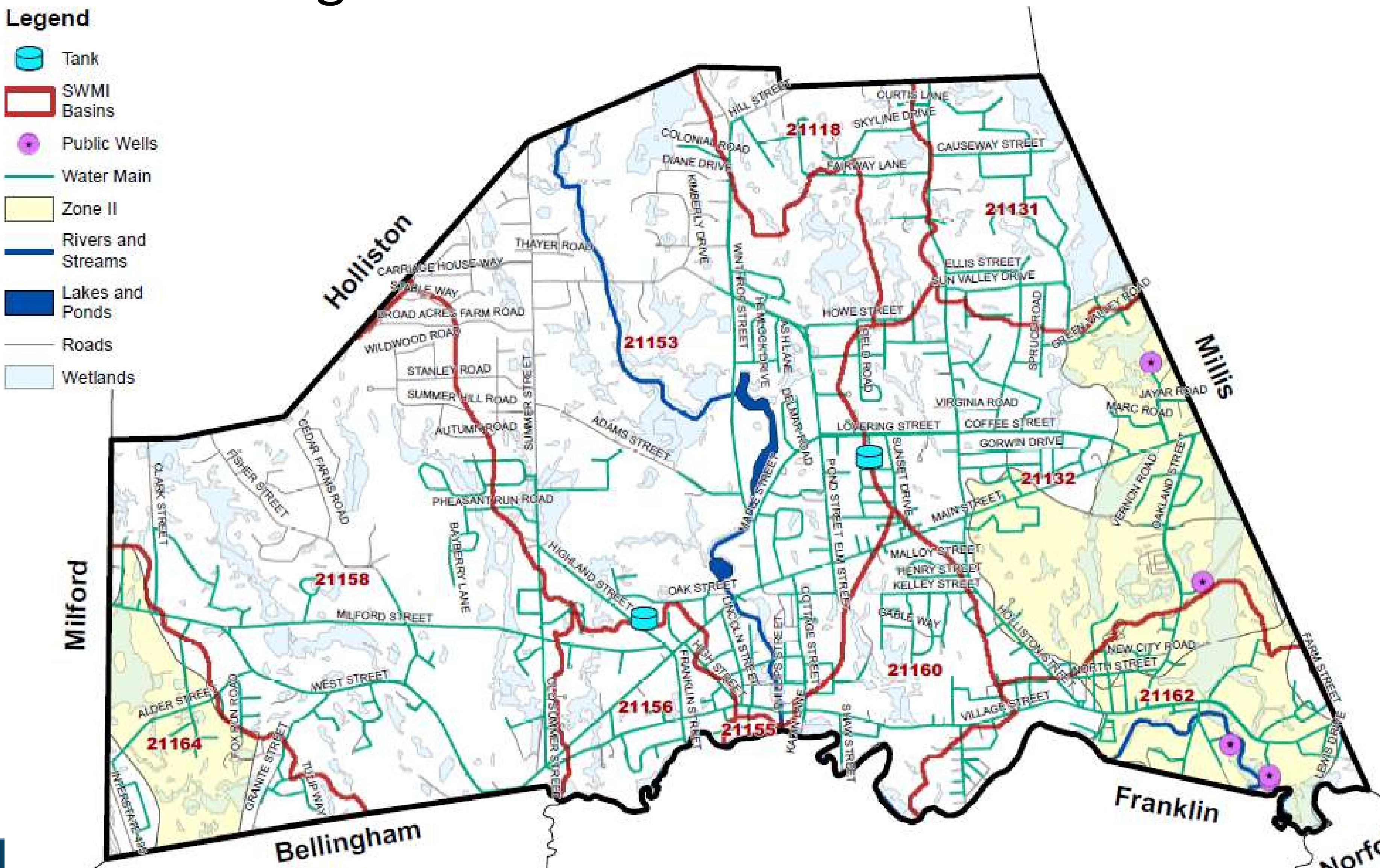
Integrated Planning: Drinking Water



Drinking Water Resources



Needs Assessment: Drinking Water

Information Sources

- DPS Records & Staff knowledge
- 2010 Water Master Plan (W&S)
- Groundwater exploration summary (H&W)
- 2013 Water Management Study (KLF)
- 2014 Water Loss evaluation (KLF)
- 2015 Exelon Demand Study (KLF)

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Needs Assessment: Drinking Water

- Lack of well supply capacity
- Lack of well redundancy
- Demands increasing
- Un-accounted for water (~15%)
  - Aging water mains; leaks
  - Unmetered connections?
- Iron & manganese levels requiring treatment

Source: Exelon Water Supply Study, 2015, KLF

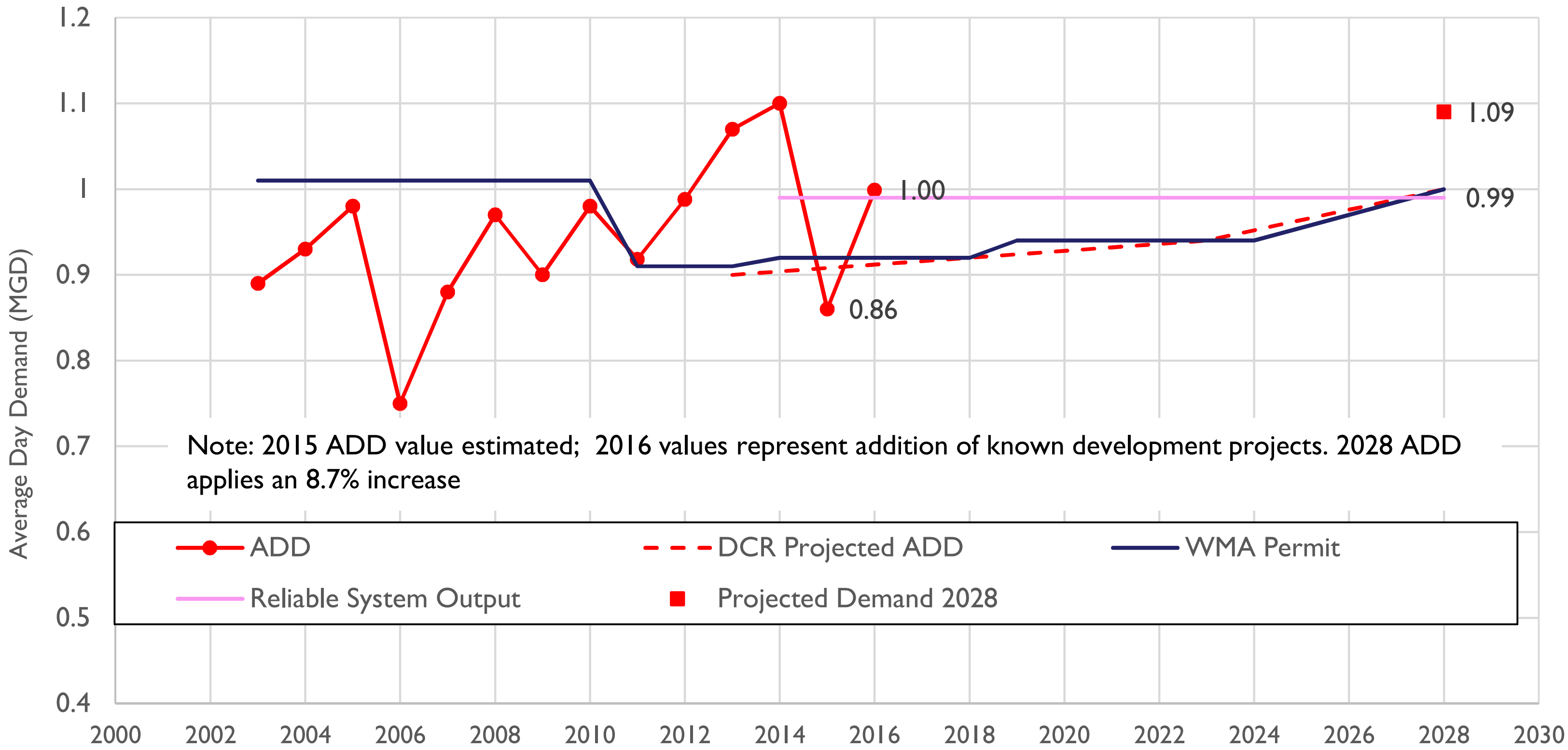
Needs Assessment: Drinking Water

- Unable to meet max daily demand with largest source offline
- Barely able to meet current average day demand
- Significant future supply deficit projected

- New regulatory constraints (WMA)
- Offsets required for higher withdrawal authorization

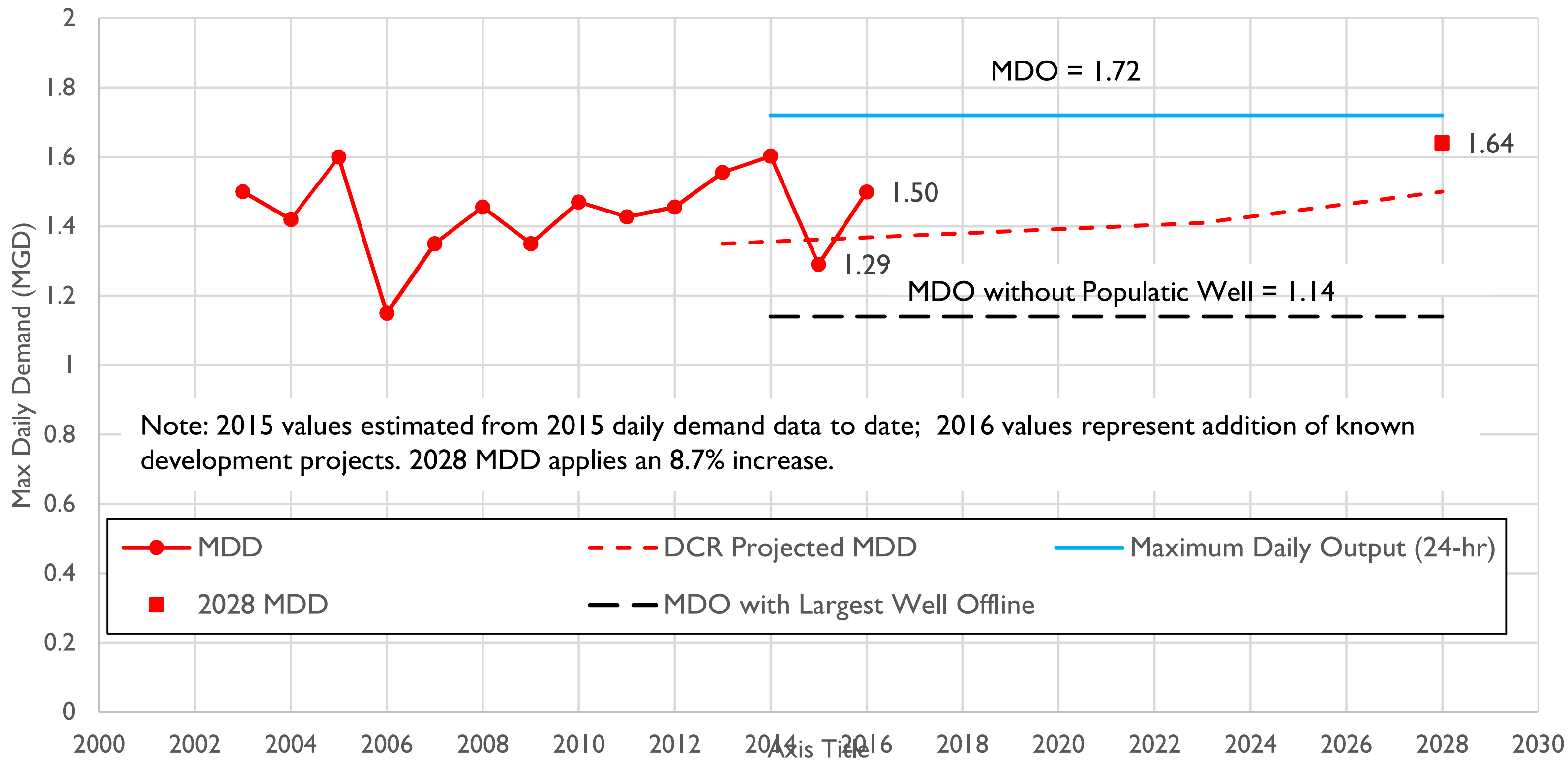
Source: Exelon Water Supply Study, 2015, KLF

Needs Assessment: Drinking Water - ADD



Source: Exelon Water Supply Study, 2015, KLF

Needs Assessment: Drinking Water - MDD



Source: Exelon Water Supply Study, 2015, KLF

Recommendations : Drinking Water

Continue / Ongoing

- Continue / enhance demand mgmt.; water loss reduction programs
  - UAW (Water loss) Compliance Plan:
    - meter testing / replacement program
    - Annual Leak detection
    - Conservation education/outreach
    - Fixture retrofits
    - Rebates
    - Water ban

Source: Exelon Water Supply Study, 2015, KLF

Recommendations : Drinking Water

Near Term

- Implement annual well rehabilitation program to restore lost capacity; increase resiliency (1/yr)
- Consult with DEP on new WMA Permit application; identify credits
- Satellite well exploratory study
- Evaluate water purchase from Millis
- Water treatment facility alternatives study

Source: Exelon Water Supply Study, 2015, KLF

Recommendations : Drinking Water

Mid – Longer Term:

- Construct satellite well at Populatic
- Construct treatment facility to provide approx. 1.8 MGD total of treated supply
- Emergency purchase agreement with Millis
- Water main replacement as recommended in 2010 Master Plan

Source: Exelon Water Supply Study, 2015, KLF

Drinking Water

Discussion on Priorities / Next Steps

Wastewater

IWRMP Needs Assessment

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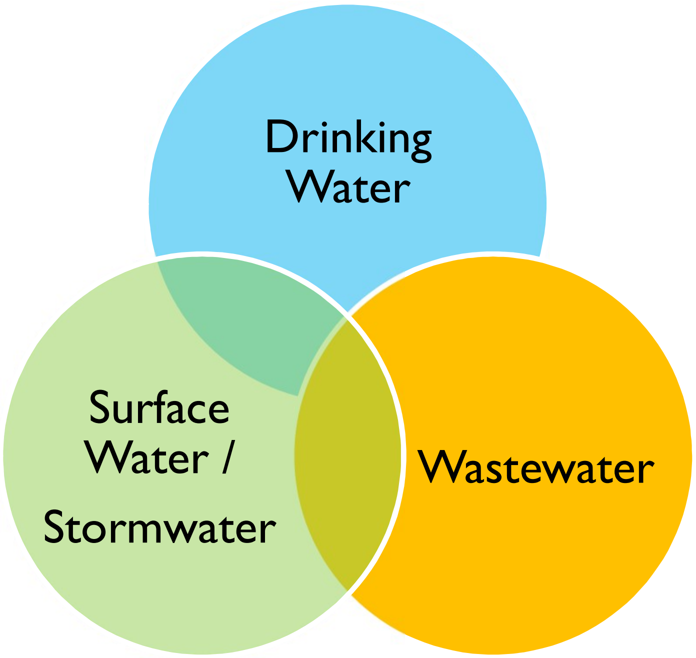
Integrated Planning: Wastewater

- Sanitary Sewer Overflows (SSOs)
- Illicit Connections
- Septic Discharge
- Water Resource Protection:
  - Recreational Waters
  - Zone II Protection Areas



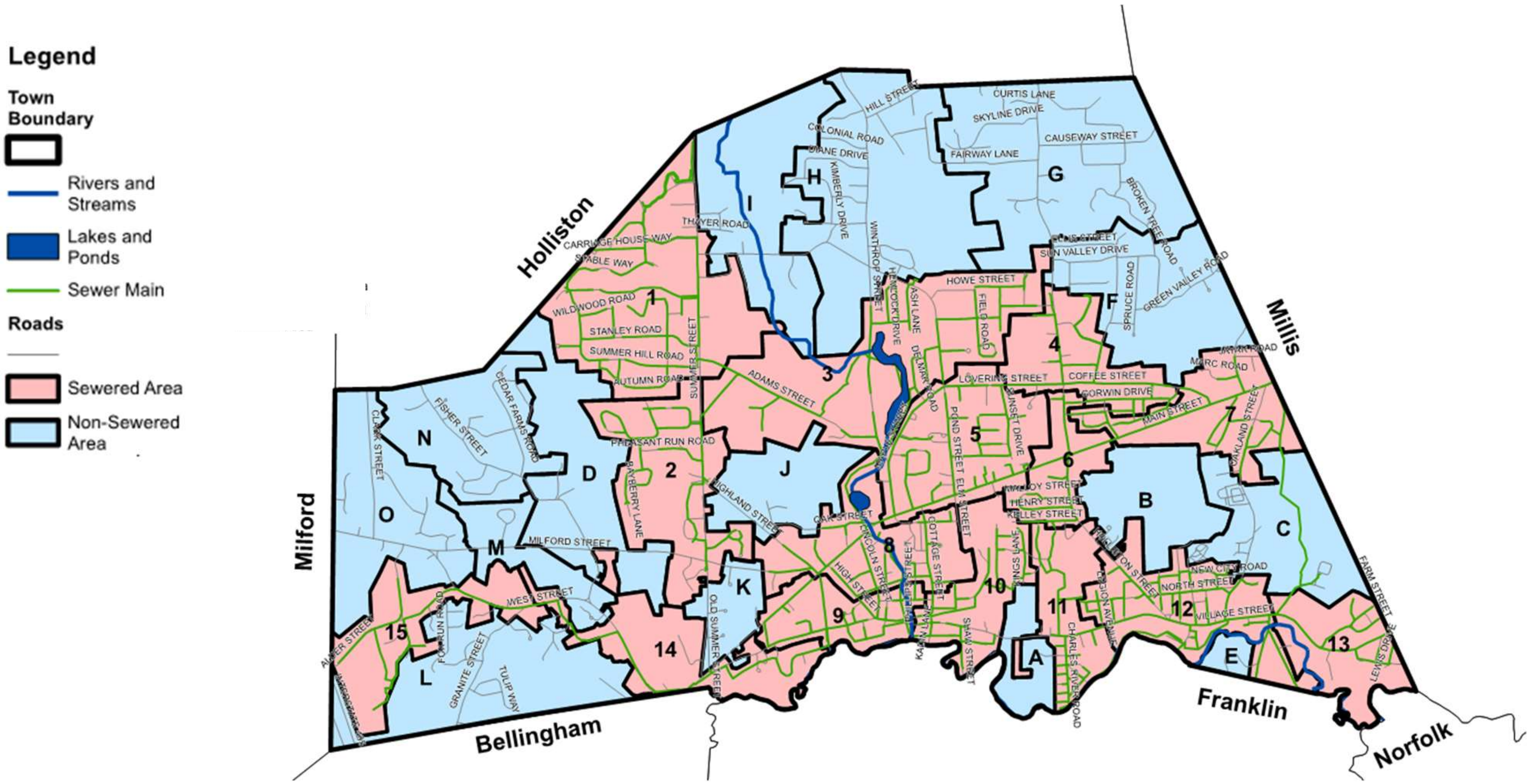
Wastewater System Challenges

- Wastewater regulations
- CRPCD disposal costs
- CRPCD discharge limits
- Sewer moratorium
- Increasing development pressure on permit limits & land
- Septic systems failing in unsewered areas
- Physical limitations- High groundwater, extensive wetlands; poorly drained soils.

Wastewater Needs Assessment – Data Sources

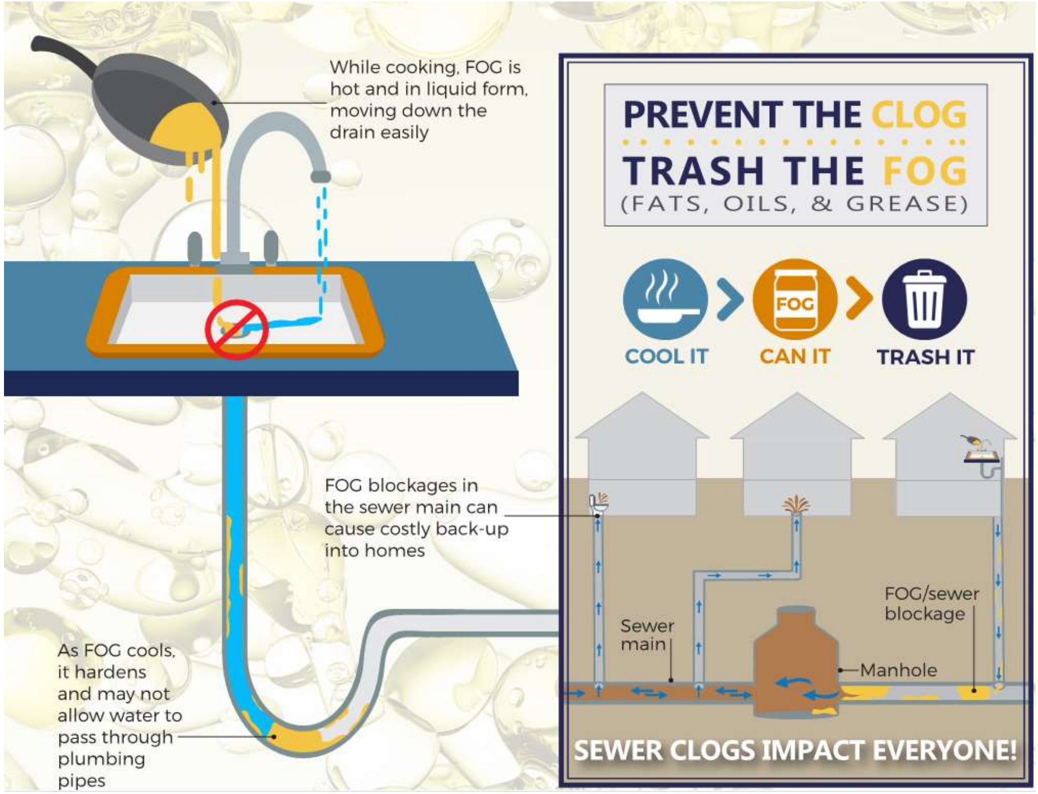
- Past I/I study reports
- CRPCD flow estimates
- DPS interviews
- GIS layers
- Board of Health records
- Interviews with Planning; Economic Development

Identification of Needs: Sewered Areas



Sewered Area Needs

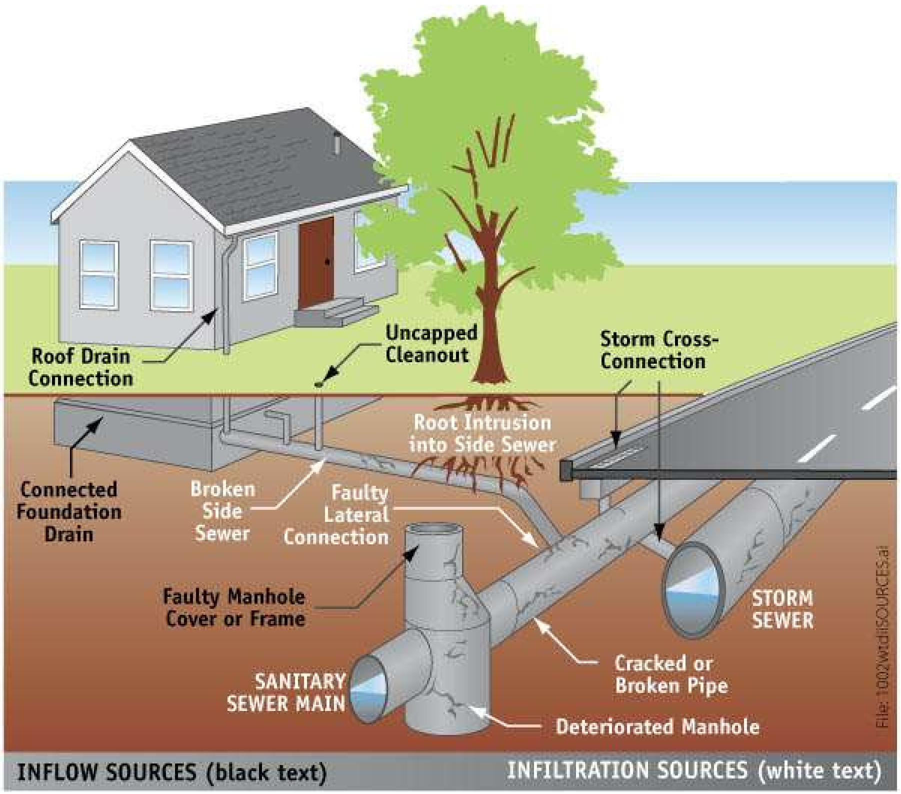
- Maintenance Needs:
  - Fats, Oils, Grease (FOG)
  - Root Removal
  - Pump Station Operation
- Buildout Needs
  - Subdivision
  - Unclaimed Capacity (Betterments)



Source: City of Cambridge

Sewered Area Needs

- Infiltration/Inflow (I/I) Removal
  - Ongoing Investigation Program
  - Metering
  - CCTV Inspection
  - Manhole Sealing
  - Cured in Place Pipelining (CIPP)



Source: King County

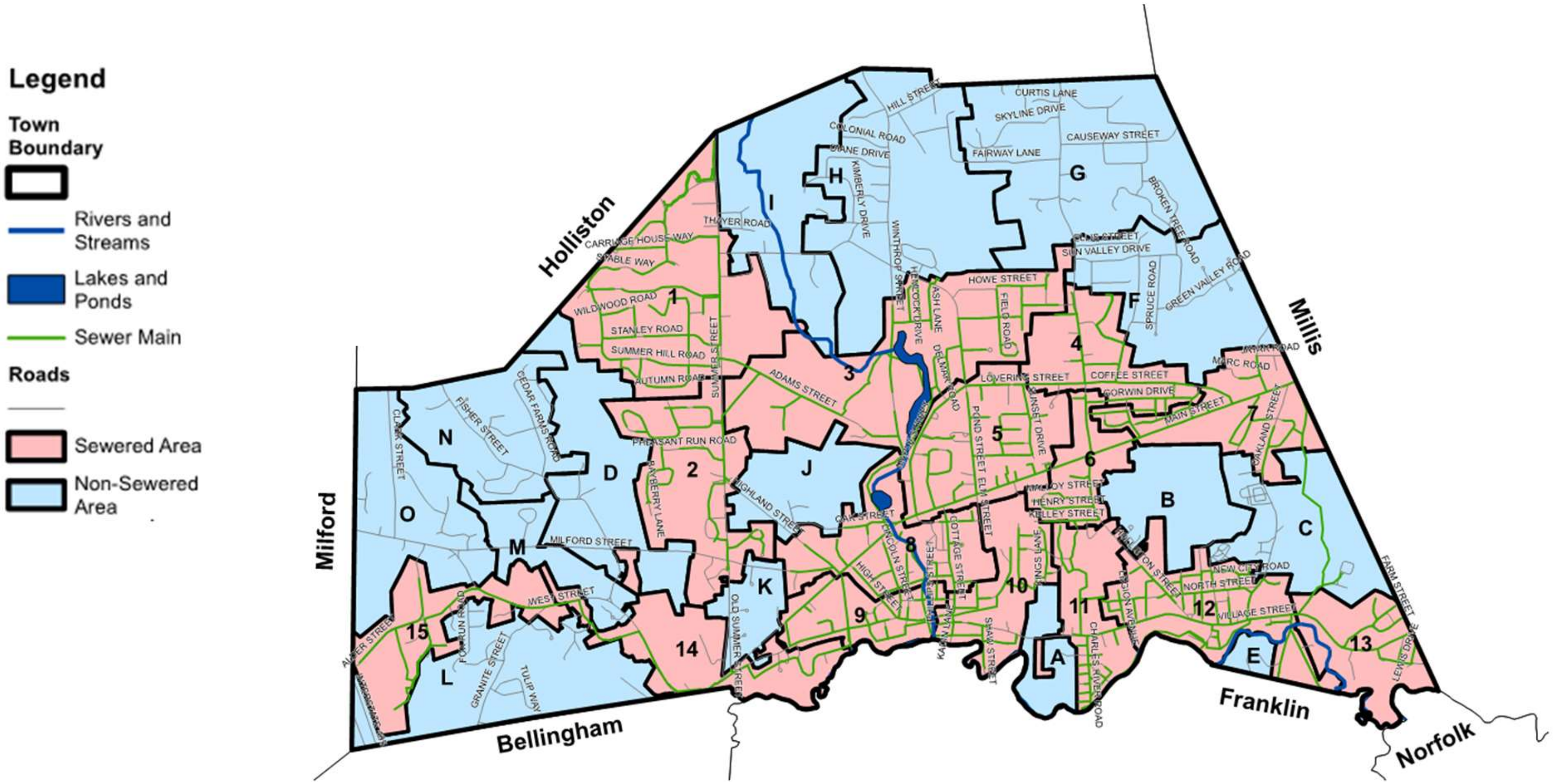
Sewered Area: Data Gaps

- Town-wide metering
  - Partial Metering at CRPCD
  - Temporary meters to identify I/I
  - Permanent meter to confirm flow to CRPCD
- System Condition Assessment
  - CCTV Inspection of full system
  - Partial inspection completed as part of I/I

Sewered Area Alternative Evaluation (Next Steps)

- Public Education
  - FOG
  - Illicit Connections
  - Private Inflow Sources
- Continue I/I Investigations and Rehabilitation
  - Town-wide metering program
- Condition Assessment

Identification of Needs: Unsewered Areas



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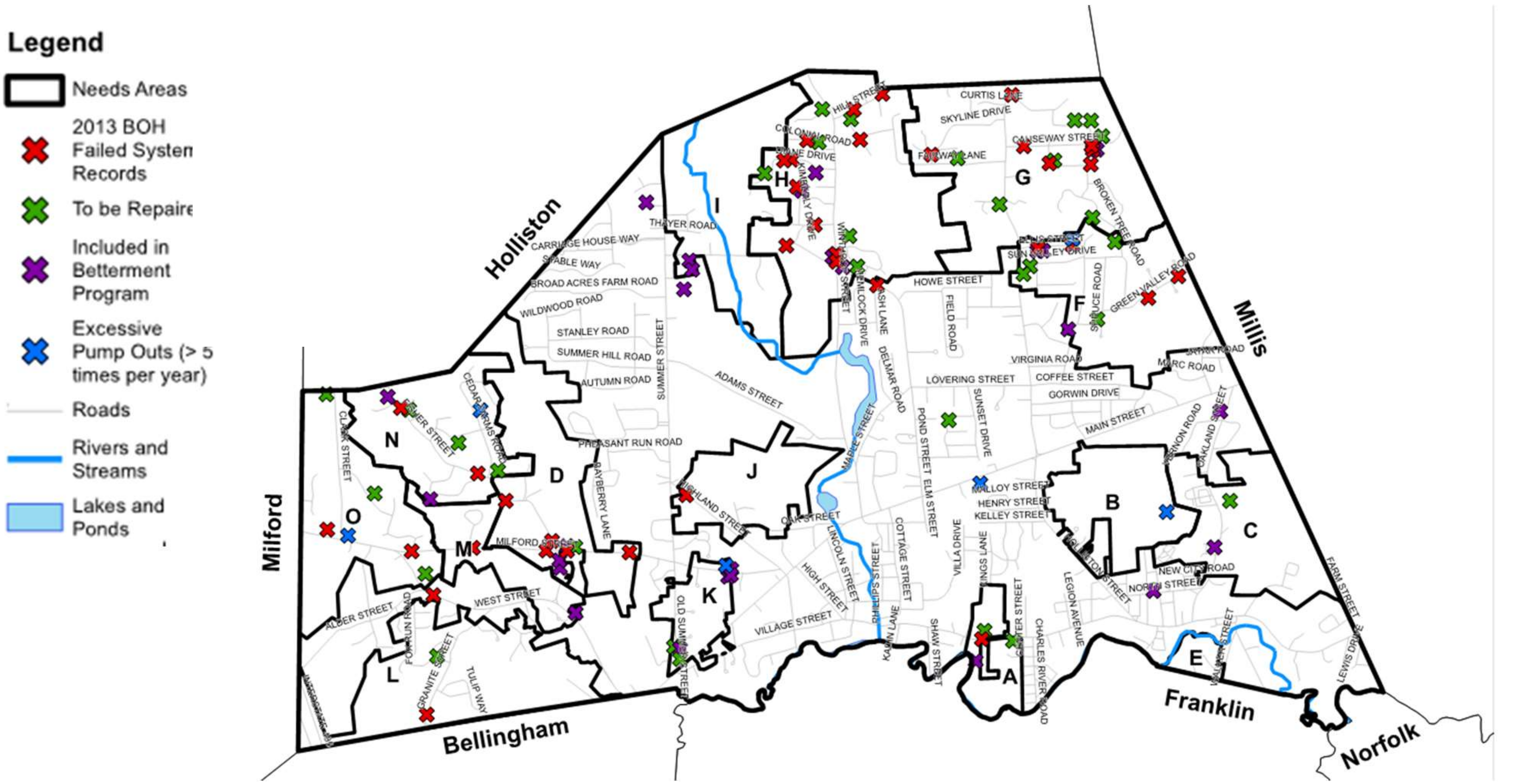
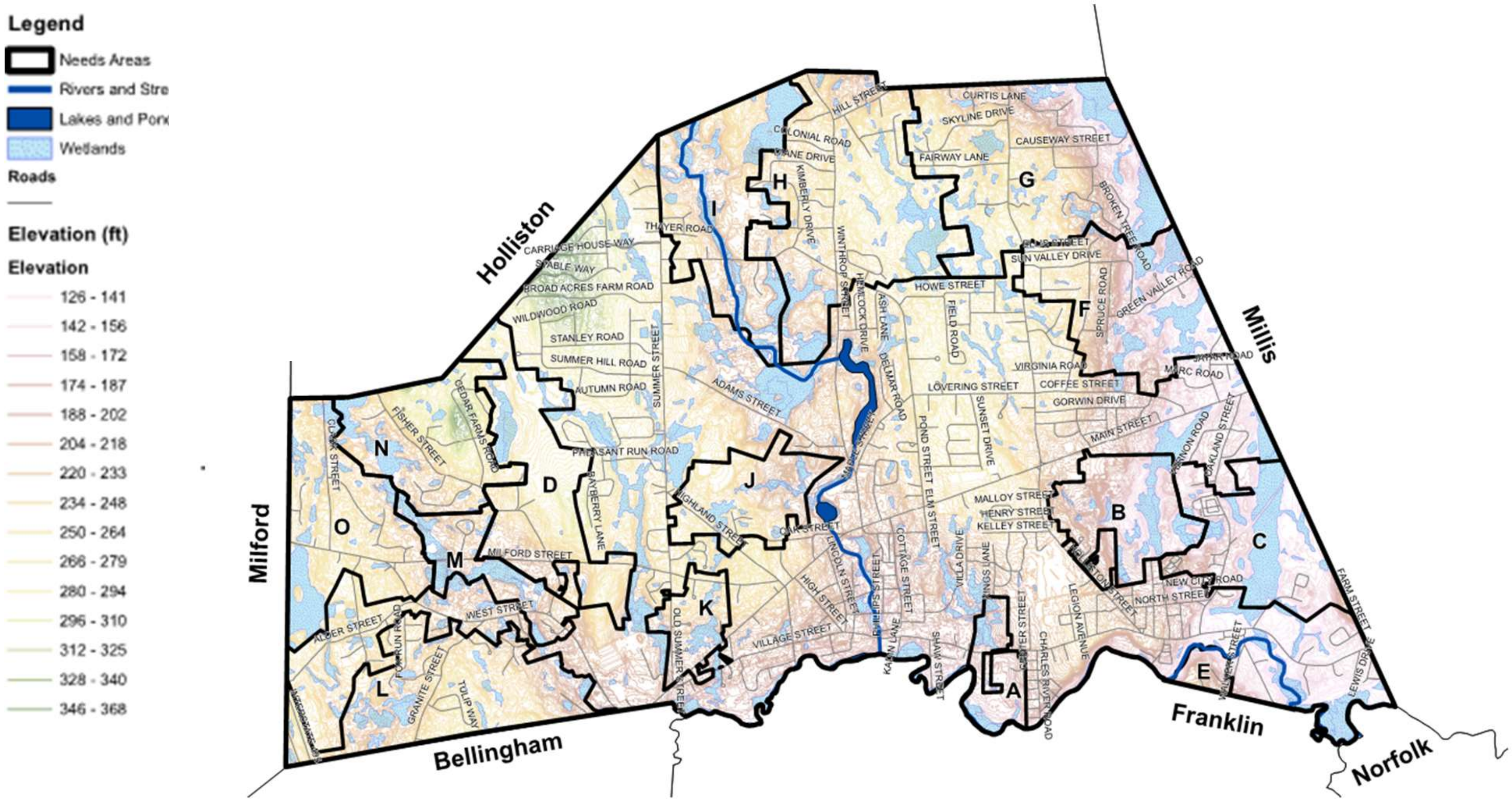
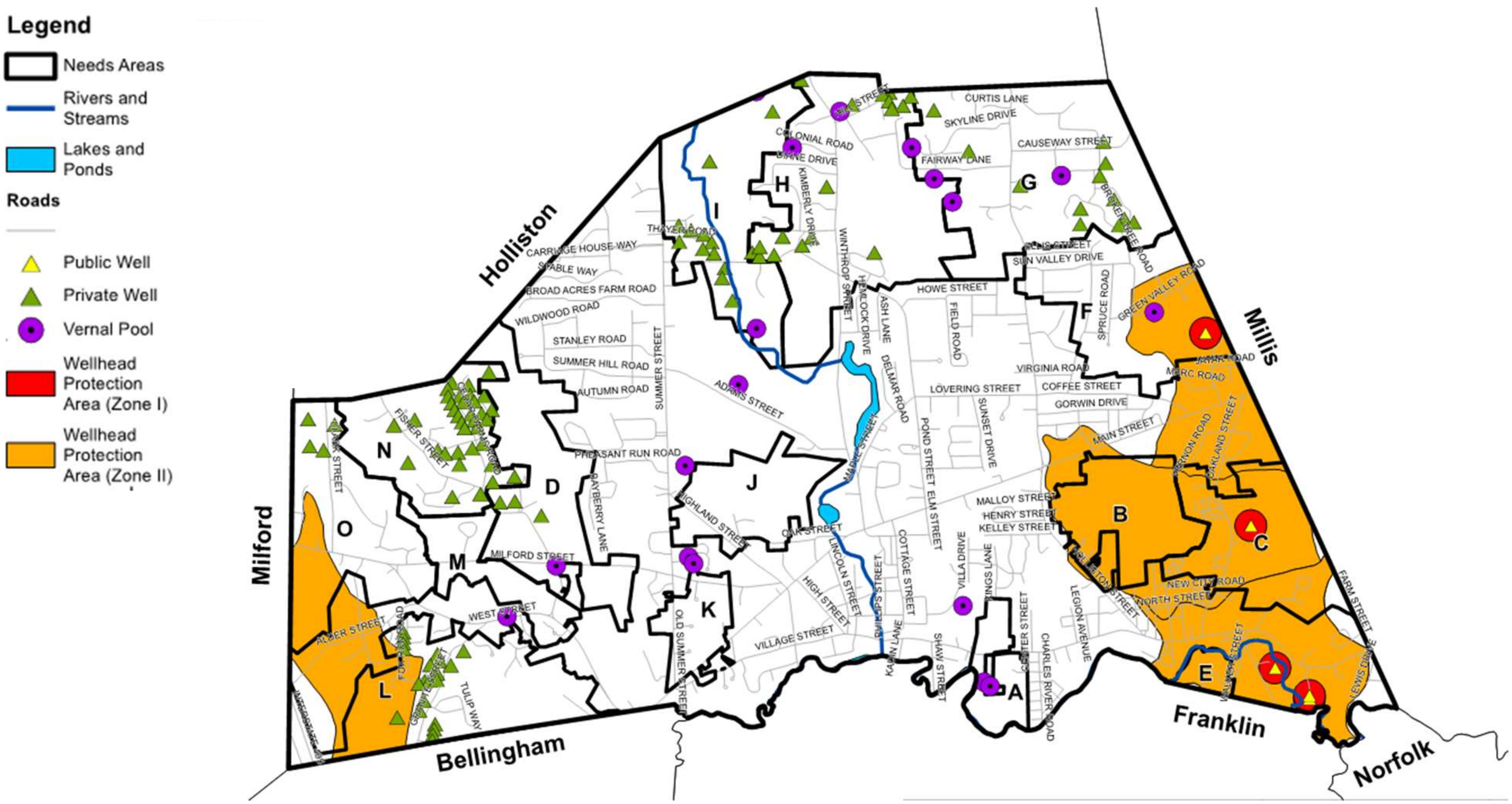
Septic System Failures



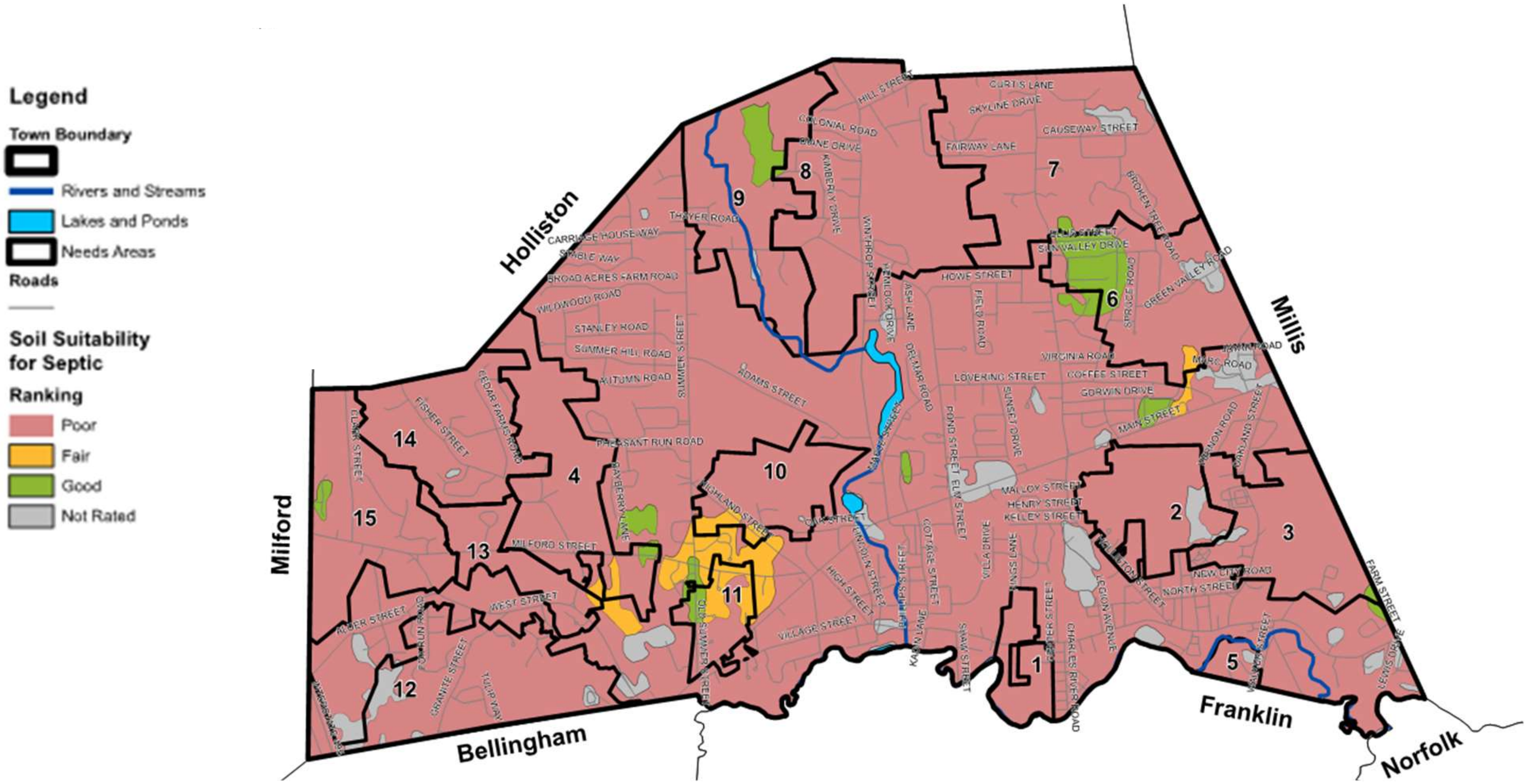
Depth to Groundwater



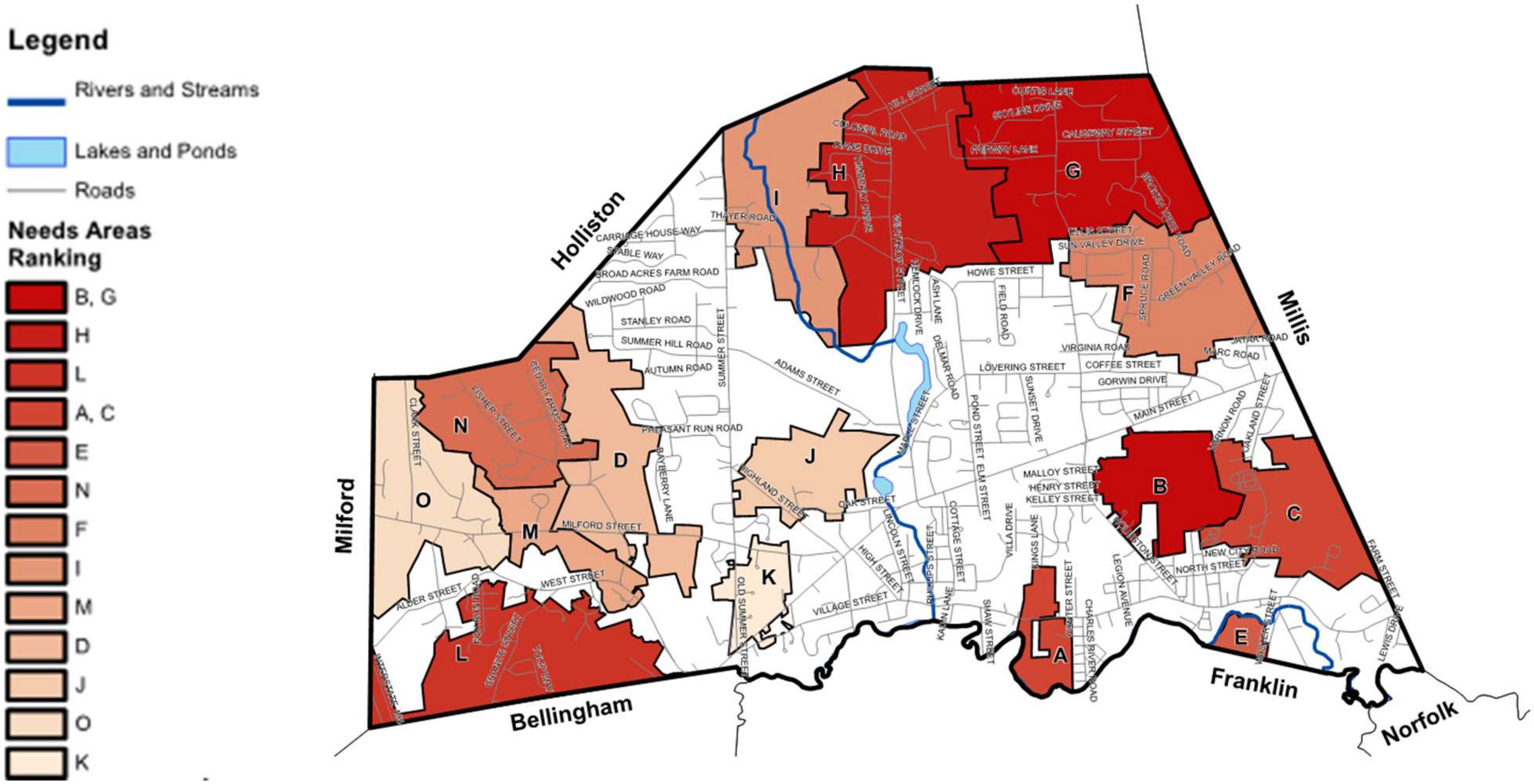
Protected Waters



Soil Suitability for Septic Tank Absorption Field



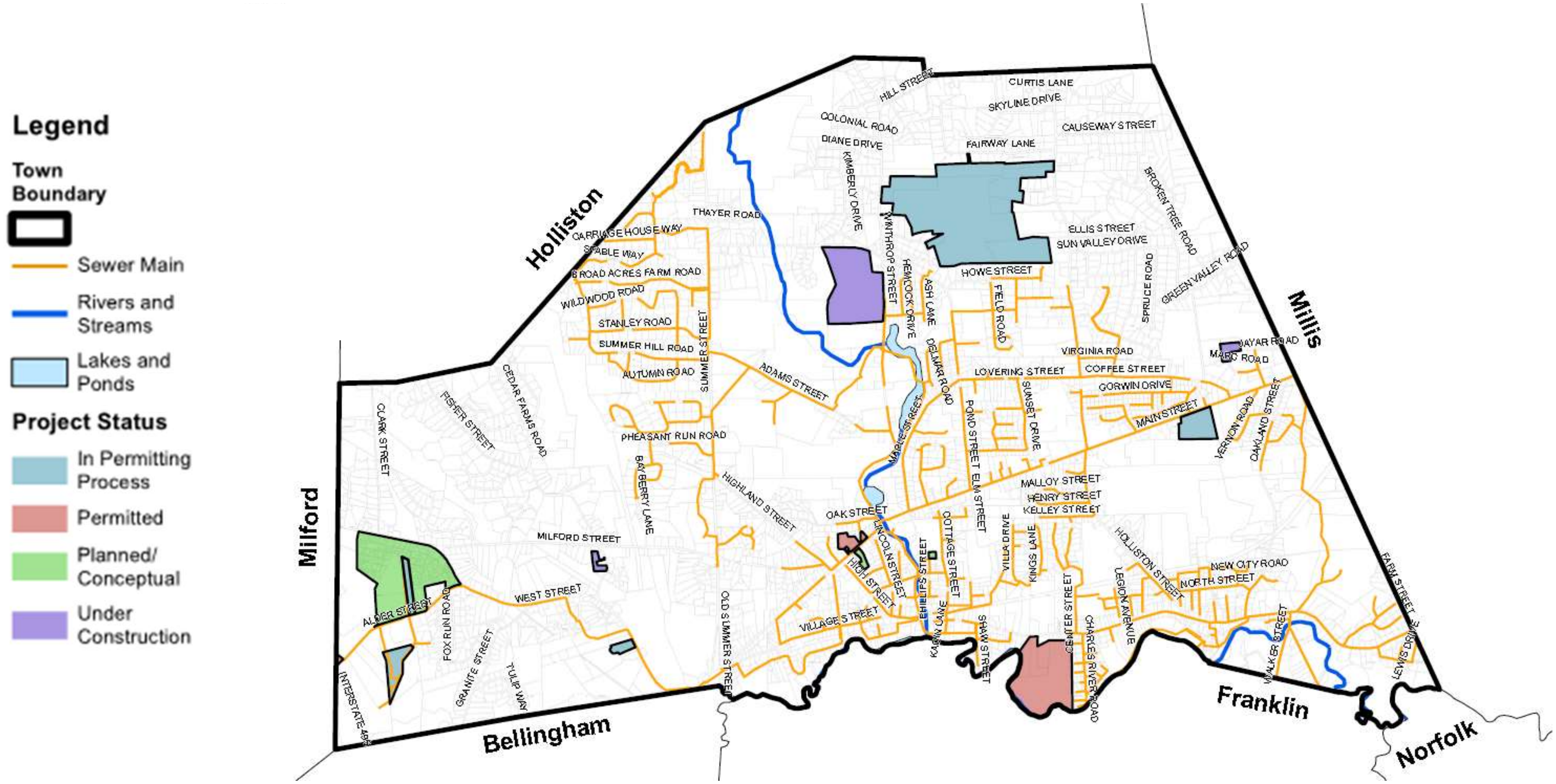
Unsewered Area Needs Ranking



Summary of Unsewered Area Needs Analysis

Needs Area	Failures and Pump-Outs	Soil Suitability for Septic	Depth to Groundwater	Private Wells	Wetlands	Vernal Pools	Zone IIs	***Total***	**Ranking**
A	2	10	8	0	6	6	0	*32*	**6**
B	0	10	8	0	9	0	10	*37*	**2**
C	1	10	10	0	1	0	10	*32*	**6**
D	4	9	0	2	0	2	0	*17*	**12**
E	0	10	7	0	4	0	10	*31*	**7**
F	5	3	8	0	5	2	4	*27*	**9**
G	7	10	4	2	4	10	0	*37*	**2**
H	10	10	1	3	8	4	0	*36*	**3**
I	1	7	3	9	2	4	0	*26*	**10**
J	0	8	2	0	4	2	0	*16*	**13**
K	2	0	3	0	2	2	0	*9*	**15**
L	1	10	2	6	10	2	2	*33*	**4**
M	1	10	4	0	3	0	0	*18*	**11**
N	4	10	0	10	6	0	0	*30*	**8**
O	3	9	1	0	0	0	2	*15*	**14**

Upcoming Development Projects



Unsewered Area Needs

- Decentralized Treatment System
  - Improve Water Quality
  - Promote Groundwater Recharge
- Septic Needs Support Funds
- Sewer Extensions
  - Protect Water Supply Sources

Source: EPA

Unsewered Area Alternative Evaluation (Next Steps)

- Decentralized Treatment Evaluation
  - High Needs Areas
  - Town-Owned Property
  - Suitable Soils

- Evaluate Sewer Extension Options
  - Create Capacity
  - Prioritize Drinking Water Protection

Stormwater

IWRMP Needs Assessment

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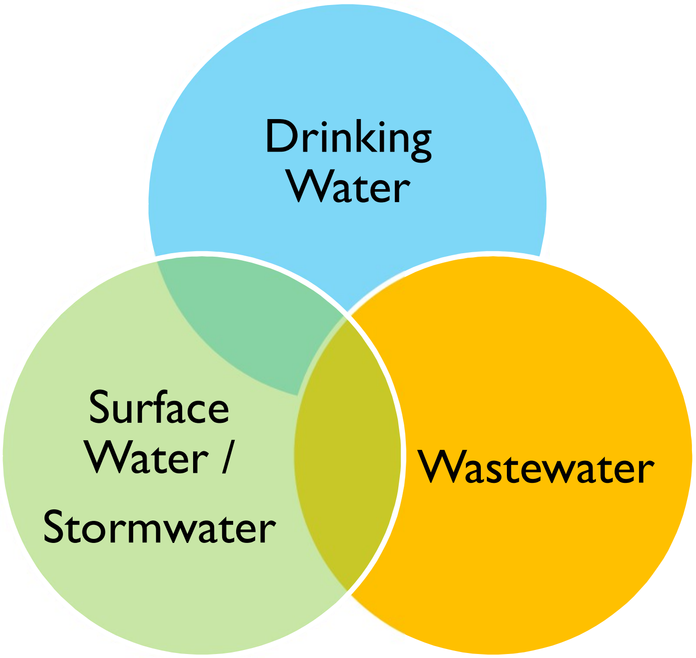
Integrated Planning: Stormwater

- Illicit Connections
- Inflow Sources (Flooding)
- Infiltration of Contaminated Water
- Drought Impacts
- Water Resource Protection:
  - Recreational Waters
  - Zone II Protection Areas



Stormwater Needs Assessment – Data Sources

- Phase I Task results
- Stormwater Funding Grant Workshops
- DPS interviews
- Results of outfall inspections
- GIS layers
- Drainage hand sketches; record drawings

Stormwater System: Maintenance (Hydraulic) Needs

- Localized Flooding
  - Low Topography
  - Sedimentation
  - Blocked Catch Basins
  - Beaver Activity
- Mapping of System
  - Delineate Catchments

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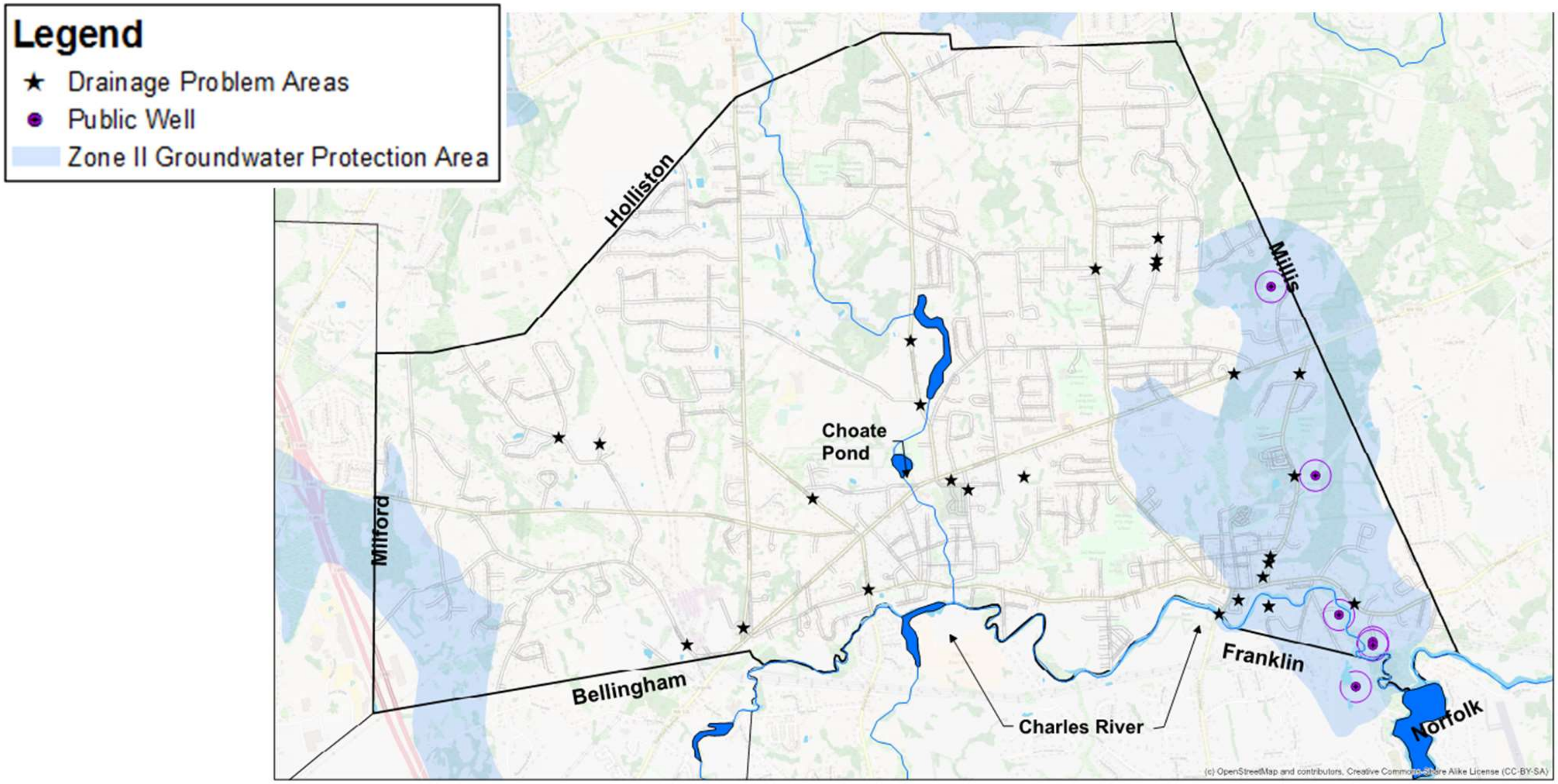
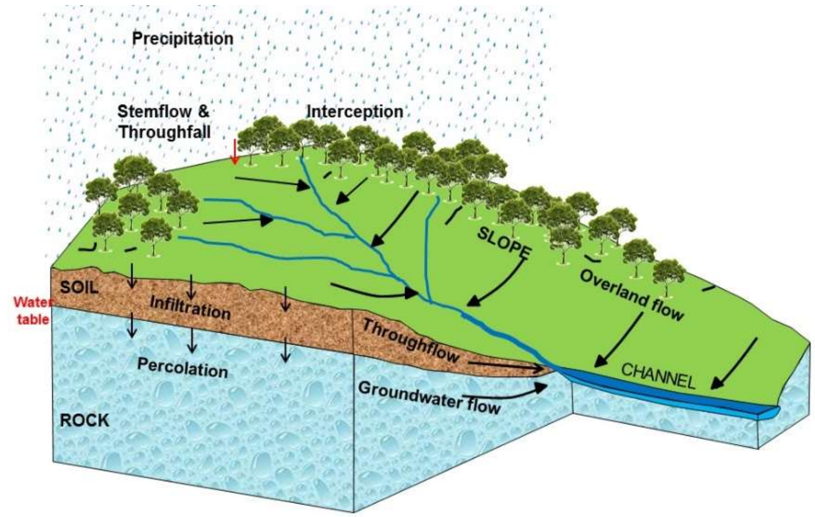
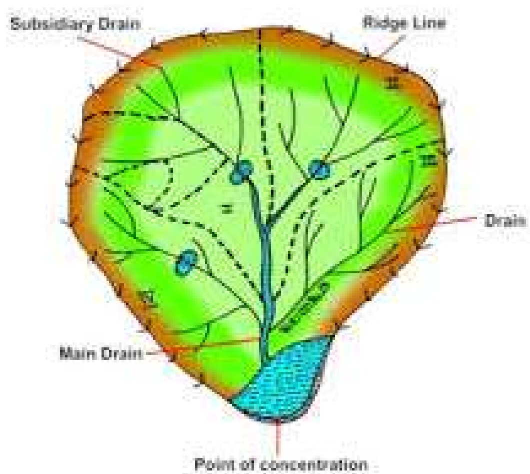
Stormwater System: Maintenance Needs



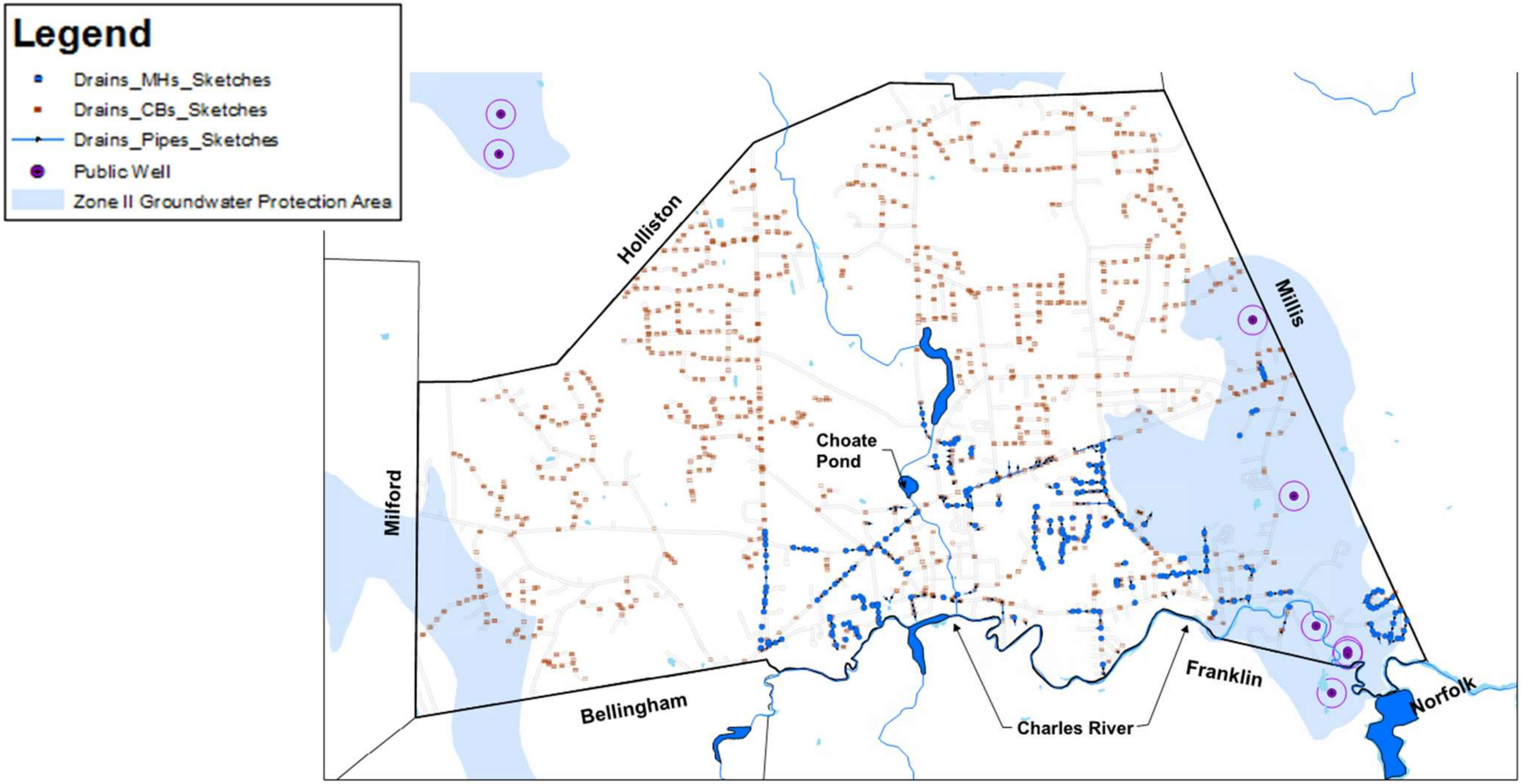
Stormwater Mapping Needs

- Delineate Catchments
  - 278 Mapped Outfalls
  - Drain System Approx. 20-25% Complete





Stormwater Mapping Needs



Stormwater System: Water Quality Needs

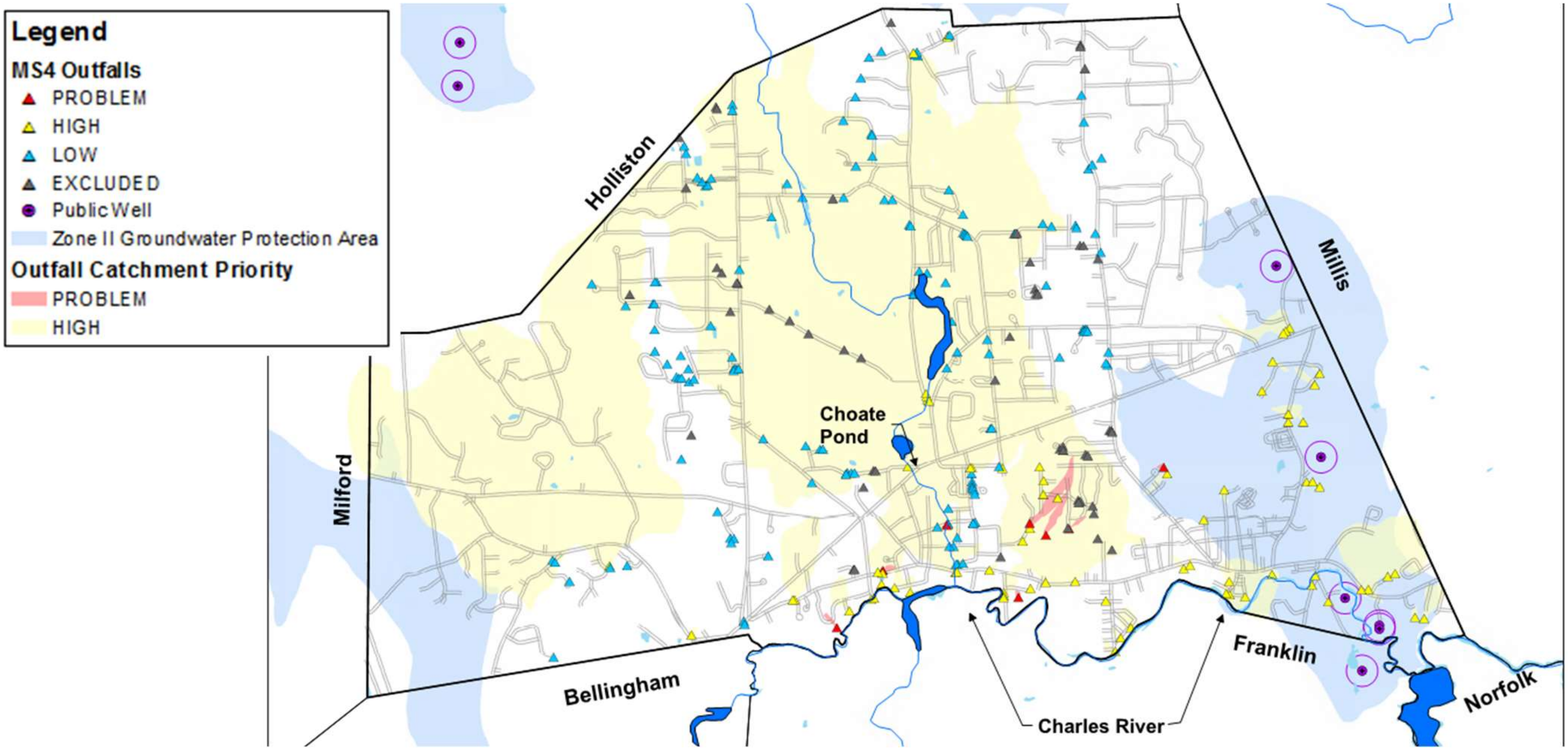
- 278 Outfalls
- Runoff Collects Contaminants from Catchment Area
- Water Quality Monitoring at Outfalls
  - Dry Weather Flow
  - Water Quality Sampling

Water Quality Sampling

- Samples are being analyzed for
  - Ammonia
  - Chlorine
  - Conductivity
  - Salinity
  - E. coli or enterococcus
  - Surfactants
  - Temperature
  - Pollutants of concern

What you don't want in the water bodies!

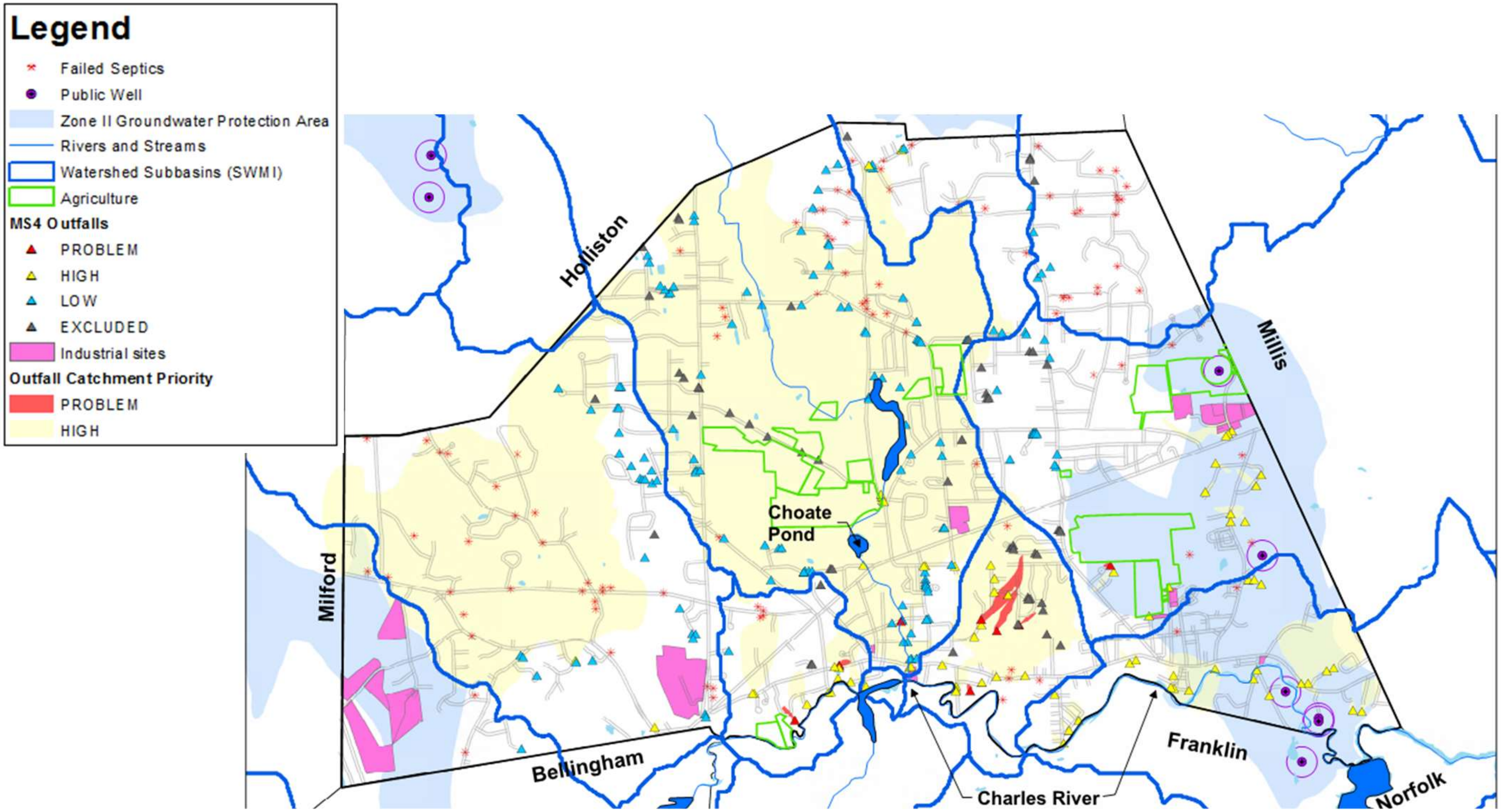
Identification of High Need Catchments (Water Quality)



Water Quality Factors for Catchments

- Watershed/Catchment:
  - **Watershed Impaired Status**
  - **Outfall Direct Discharge**
  - Outfall Density
  - Age of Surrounding Development
  - **Older Industrial Operations (40+ years)**
  - Aging/Failing Sewers
  - **Density of Failed or Converted Septic Tanks**
  - Long Reaches of Culverted Streams
- Public Health:
  - **Drinking Water Supplies**
  - **Public Beaches**
  - **Recreational Areas**
- Suspected Illicit Discharge:
  - **Results of Dry Weather Inspections**
  - Reports/Complaints

Water Quality Priorities Map

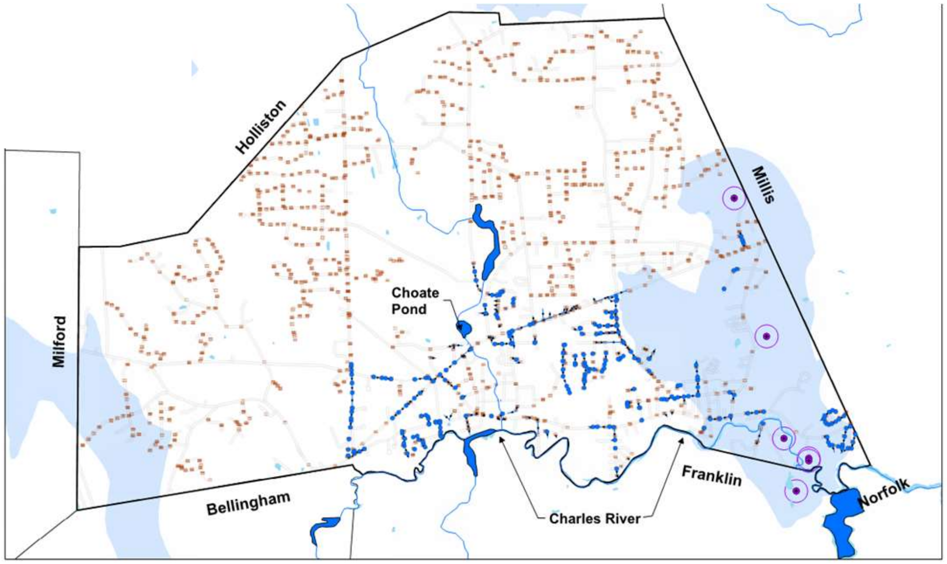


Stormwater Needs Summary

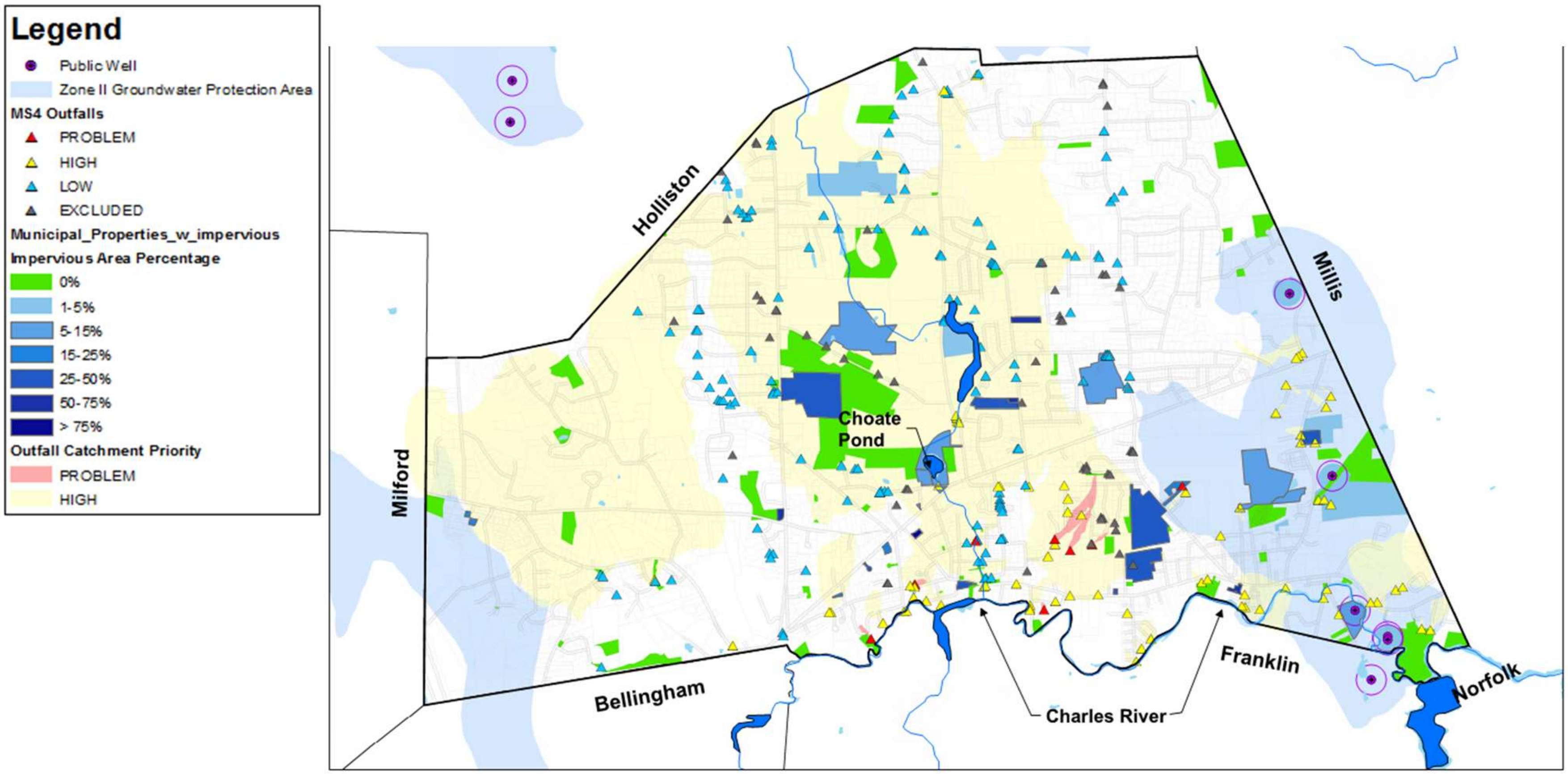
- Maintenance (Good Housekeeping)
  - Catch Basin Cleaning
  - Street Sweeping
- Water Quality Solutions
- Public Education (ongoing)
- GIS Mapping of Drain System

Stormwater System: Data Gaps

- Drain System Mapping
  - Currently 20-25%
  - Identify potential for cross connections



Town Owned Properties for BMP Evaluation

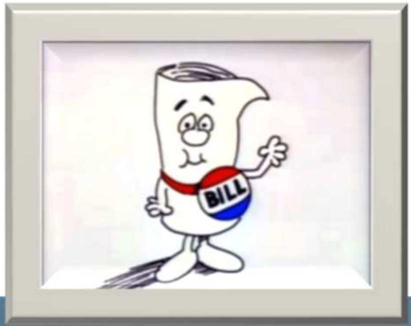


Stormwater Alternative Evaluation (Next Steps)

- Consider Structural Best Management Practices (BMPs) on Town owned parcels
  - Choate Pond
- Map Drain System in Problem and High Concern Catchments
- Identify Improvements

Regulatory Framework – Medway's New Bylaw

- Local By-Law: Article XXVI – Stormwater Management and Land Disturbance
  - Addresses all of the regulatory enforcement provisions required under NPDES MS4 General Permit: Illicit Discharges, Construction Phase Management and Post-Construction Phase Management
  - Has integrated new requirements of the 2017 MS4 GP (e.g. retain 1" of run-off volume and 90% of TSS)



…and about that MS4 General Permit

- EPA has reportedly agreed to “stay” the effective date of the Permit pending legal appeal
- This is an administrative action – not part of the legal process
- Original MA Petitioners’ appeal was related to WQBEL and meeting water quality standards; broader action also appeals the MEP standard (6 MCMs)

Next Steps Summary

MEETING SUMMARY

Integrated Water Resources Management Plan
Task Force Meeting

Date: January 10, 2018

Attendees: Ryan Arego, Legislative Aid to Rep. Jeffrey Roy, 10th Norfolk District
Dennis Crowley, Medway Board of Selectmen (BOS)
David D'Amico, Medway Department of Public Services (DPS), Director
John Foresto: Medway Board of Selectmen (BOS)
Jenna Diamond, Kleinfelder Project Engineer
Bridget Graziano, Medway Conservation Agent
Ted Kenney: Medway Water and Sewer Commission
Laura Nolan, Kleinfelder Project Manager
Leo O'Rourke, Medway Water
Allison Potter, Medway Assistant Town Administrator
Kirsten Ryan, Kleinfelder Client Account Manager
Barry Smith, Medway DPS, Deputy Director
Jessica Strunkin, 495 Medway Partnership
Liz Taglieri, Director, Charles River Pollution Control District (CRPCD)
Kirk Westphal, Kleinfelder Senior Principal Professional

CC: Michael Boynton, Town Administrator;
Andy Rodenheiser, Planning Board
Barry Zides, Medway Water & Sewer Commission

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1. Introduction

The meeting was opened by Laura Nolan (Kleinfelder) who welcomed the participants and outlined the objectives of the event. Meeting participants introduced themselves.

2. Project Overview/ Status

The Kleinfelder Team provided a brief overview of the integrated planning process and benefits, along with a summary of the status of the project. Primary objectives for the meeting included introducing the project decision model with emphasis on soliciting comments and/or confirmation from attendees regarding the model outputs and solutions. Major discussion points are summarized below. The powerpoint presentation is included as an attachment to this meeting summary.

3. STELLA Model Configuration

Kirk Westphal (Kleinfelder) explained the significance behind STELLA, a decision based model. The idea of the model is to simulate the dynamic relationship between the various systems in the town: stormwater, wastewater, and drinking water. The model shows what factors influence the systems the most. STELLA captures all the flows within the system and displays how they come together.

The decision based model acts as a centralized tool to help support informed decision-making. It illustrates primary and secondary benefits and impacts of management and investment decisions across the three water sectors (water, wastewater, and stormwater). STELLA allows all three systems to be analyzed at the same time in order to illustrate multiple benefits of certain water management alternatives, tradeoffs resulting from some alternatives, and the combined performance of different groupings of alternatives.

STELLA is an application that is widely used throughout the United States for integrated planning, and has a long history of success in informing stakeholders and decision makers as they seek to make value-based decisions. The model calibration process and outputs were presented; demonstrating calibration sufficient for project purposes.

4. Scenario Review

Laura discussed the various scenarios that Kleinfelder has examined using the STELLA model. Each scenario includes a variety of alternatives as outlined in Slides 11 through 19. The scenarios are not yet intended to represent recommended solutions – rather, they are formulated to help test the alternatives in various groupings to discern those that offer broad value and benefits from those that are more limited.

- Scenario 1: Existing Conditions: Models current conditions and acts as the baseline for the different scenarios.
- Scenario 2: Maximize Water Resource System Investment. This scenario includes all alternatives.
- Scenario 3: Minimize Water Resource System Investment. This scenario addresses the alternatives with minimum costs by focusing on administrative changes or relatively inexpensive solutions.
- Scenario 4: Drinking Water Investment. Focuses on drinking water alternatives only.
- Scenario 5: Stormwater (MS4) Investment. Focuses on stormwater alternatives only.
- Scenario 6: Wastewater Investment. Focuses on wastewater alternatives only.
- Scenario 7: Water Independence. Focuses on water reuse from CRPCD to supplement the water supply system.
- Scenario 8: Hybrid/Optimization. This scenario represents the Town's preference and goals for water resources systems investment. This has not been formulated at this time,

but will be formulated following this meeting using results of the model to date as well as the feedback from this discussion.

The purpose of the meeting is to develop Scenario 8, based on needs the Town deems most critical. The Selectmen expressed concern in forming Scenario 8 without understanding costs. The group discussed that the preferred Scenario will be formulated by incorporating the known directions/needs of the Town. Kleinfelder will develop cost estimates for each possible hybrid scenario and draft scope of work. A draft of the preferred solution will be presented for discussion in April. The Town would be able to provide feedback and make adjustments before the plan is finalized.

5. Solutions Medway Already Enforces or Will Enforce

The group discussed the status/approach to alternatives that are already in place. Currently, the town relies on customers to initiate water conservation efforts. They have discussed banning outdoor water use. They have already limited outdoor water use during droughts, but could do more if needed. This action could meet with public resistance, but could be a real solution to address future water availability concerns. It is one of the things that regulatory agencies look for as part of a sound integrated plan.

Barry Smith (DPS) stated that a new program is being implemented next month that allows residents to see their water usage online, which may help with conservation.

Regarding sewer extensions to areas with high septic failures, it is cost prohibitive to extend the sewer to the whole Town. The Town may consider extending the sewer to localized areas with septic failure, which may be part of the preferred Scenario. Extending the sewer to accommodate current septic users would increase the wastewater flow. Current flows are close to the Medway's treatment capacity so additional considerations would be required if sewer extensions are considered.

The group discussed other options for handling the ongoing septic failures. The Town is open to the idea of installing a large septic tank (decentralized system) to connect several houses with failed septic close together. This alternative may not be feasible, however given the poor soil and groundwater conditions. Addressing the septic problem may require regular pump outs and continuing to educate the public about appropriate septic management.

The group discussed whether encouraging residents to construct private wells would be feasible to reduce water demands. Private wells would not change the wastewater flow to the plant. Private wells would reduce the demand on the municipal system, however the wells would still draw from the same aquifer and reduce Town revenue. Stephanie stated that the aquifer only has a certain amount of water, and adding more wells would just add more straws coming out of the aquifer. However; it was noted that private wells are deeper than public wells and some private residents may not get water from Medway's aquifer, but a deeper bedrock aquifer one. Private wells also reduce the Town's control over water usage.

The group discussed the potential to examine water reuse as a way to reduce potable water demand. There may be some customers who would purchase treated wastewater for use in watering and industrial uses. Dave mentioned the upcoming construction on Village Street and Holliston Street to replace water mains. The Town could add a 6" PVC to the street while doing construction that could be used to transport recycled water in the future. Gray water is expensive to distribute. The gray water could be used to water public parks. Another idea would be to construct a filling station customers could purchase recycled water, or the Town could explore injecting the treated water into the aquifer to replenish groundwater supplies. Dave mentioned they could lay the pipe in the short term and implement the use of gray water in the future. Consideration of this alternative would require approval from DEP to reuse wastewater as well as to reduce discharges to the Charles River. Kleinfelder will contact DEP to explore feasibility and constraints. At this point, it is considered to be a long-term alternative for which infrastructure might best be developed on an opportunistic basis.

6. Hybrid/Optimization Scenario

The hybrid Scenario will reflect the Town's priorities and preferred solutions. It will need to incorporate the political and fiscal realities in addition to technical feasibility. It should be formulated using alternatives with the greatest affordable value, and should help inform decision makers of the positive and negative consequences (benefits and tradeoffs) of each decision.

Water quantity and water quality are critical areas that Medway wants to address.

It was noted that over the years, the incoming revenue has decreased due to conservation.

To increase conservation, the Town would like to provide more education to residents.

The Town would like to focus on cost effective alternatives and would like to see both short and long term solutions included in the plan.

Additional important points discussed:

- UAW is about 18% currently in Medway. The goal is to get to 10% to be in better standing when applying for permits and new wells.
- Water demand is closing in on well capacity. Within 2 to 3 years the Town would need additional capacity if nothing else is done to offset demand.
- Well redundancy is necessary.
- The model indicates that if the Town was able to significantly reduce on unaccounted for water, they could potentially defer the need for new water supply infrastructure and/or agreements.

The group discussed short term and long-term goals for the preferred Scenario, as outlined in the attached table. Consensus was that the long term plan should encompass a 20-year planning horizon:

- Short term goals
    - Reduce infiltration and Inflow
    - Examine unaccounted for water
    - Improve Town-wide Conservation

- Green Infrastructure: Implement policy changes to require new developments to build with Green Infrastructure in mind.
- Continue to examine unaccounted for water reduction
  - Leak detection
  - Metering
- Well Supply Redundancy:
  - Agreements with two different towns are in existence. Milford has a connection that is already set up to feed Medway water. Franklin, Millis, and Bellingham also have possible connections. Bellingham has hydrant to hydrant, and could connect a pipe to ensure flow.
  - Town would like to use Oakland well more, additional work is needed to make the well more effective and improve water quality.
- Stormwater capture
  - Improve rain barrel campaign. Low cost if they pass a quiz that will help with public education. Rain barrel is a small seed that can raise awareness. Encourage as policy of the town.
- Wastewater Capacity
  - Increasing permit limit is being discussed now to set the Town up for the future. Dialog with Franklin has started for buying capacity at the CRPCD from Franklin.
- Septic Failures;
  - Possibly extend sewer to the failed septic clusters located near the sewer.
- Asset Management
  - Town is interested in managing costs and preparing for future expenditures. Kleinfelder is experienced with the DEP grant program that can fund planning efforts.
- Green Infrastructure: Even if benefits may be limited, a small but visible project in a central location, well publicized, and even inviting as a place to walk or rest, could help raise awareness and affect the public's overall water ethic. Potentially construct something small on Town property– example of rain garden in front of Millis Town Hall.

- Long term goals
  - Continuation of indoor and outdoor conservation.
  - Continuation of managing unaccounted for water to a goal of 10% and reducing infiltration sources into sewer system.
  - Reduce inflow sources into the sewer system
  - Improve sewer system operations
  - Address localized flooding
  - Implementation of rain barrels
  - Have an emergency water supply from a neighboring town
  - Improve well production
  - Increase permit limits
  - Provide water treatment
  - Increase infiltration
    - Green Infrastructure
  - Stormwater capture
    - BMPS

- Rain gardens
  - MS4 Enforcement
    - Education

7. Next Steps

Laura noted that Kleinfelder will explore the hybrid Scenario 8 further using the feedback received at this meeting. The team will develop conceptual cost estimates for each scenario. The draft plan will be presented to Selectmen and then the public in April. Feedback from these meetings will be incorporated into the final plan. Kirsten will work with Allison on Public Outreach messaging activities.

Attachments:

- Meeting Power Point presentation
- Hybrid scenario notes
- Sign in sheet

Medway's Integrated Water Resources Management Plan

IWRMP Update Workshop

IWRMP Task Force
Medway DPS
January 10, 2018

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TOWN OF MEDWAY MASSACHUSETTS
INCORPORATED OCT. 25, 1713

Agenda

1. Introductions
2. Project Overview/Status
3. Evaluation of Scenarios
4. Decision Model Results
5. Feedback and Selection of Preferred Scenario
6. Next Steps
   - Fine-Tuning
   - Conceptual Designs

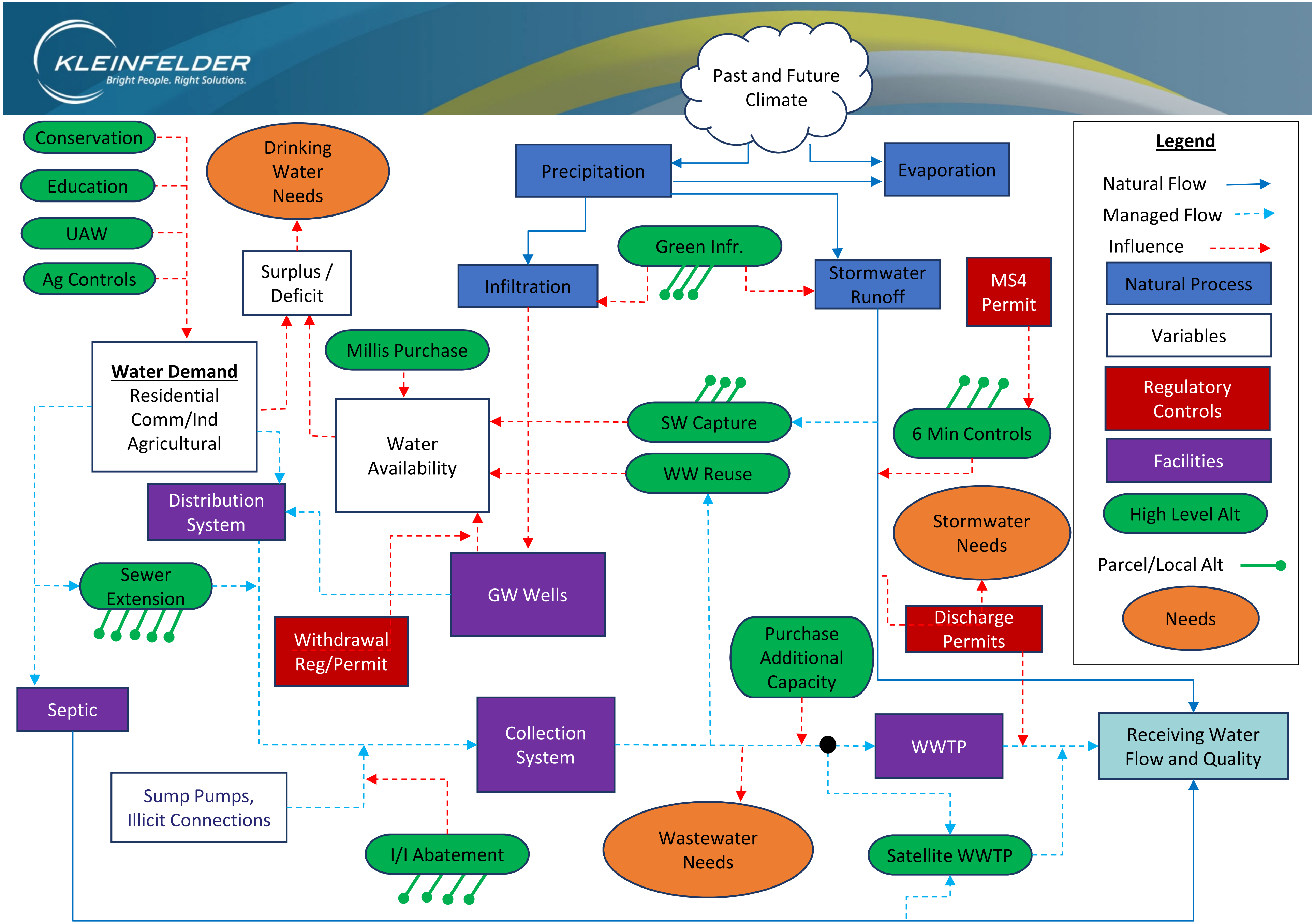
IWRMP Phase II

- ☑Document Existing Conditions
- ☑Identify Needs
- ☑Identify Alternatives to Address Needs
- ❖Evaluate Alternatives and Select Preferred Solutions
- ❑Conceptual Design
- ❑Develop IWRMP (in progress)
- ❑Develop Implementation Schedule

Decision Model

- Simulate dynamic interactions between systems:
  - Rainfall ↓, Groundwater ↓
  - Impervious Cover ↑, Runoff ↑
  - Population ↑, Water Demand ↑, Wastewater ↑
  - Limits: permits, water availability, capacity
  - Tradeoffs: resources, quality

- Goal: quantify the tradeoffs and sensitivities as a guide for decision making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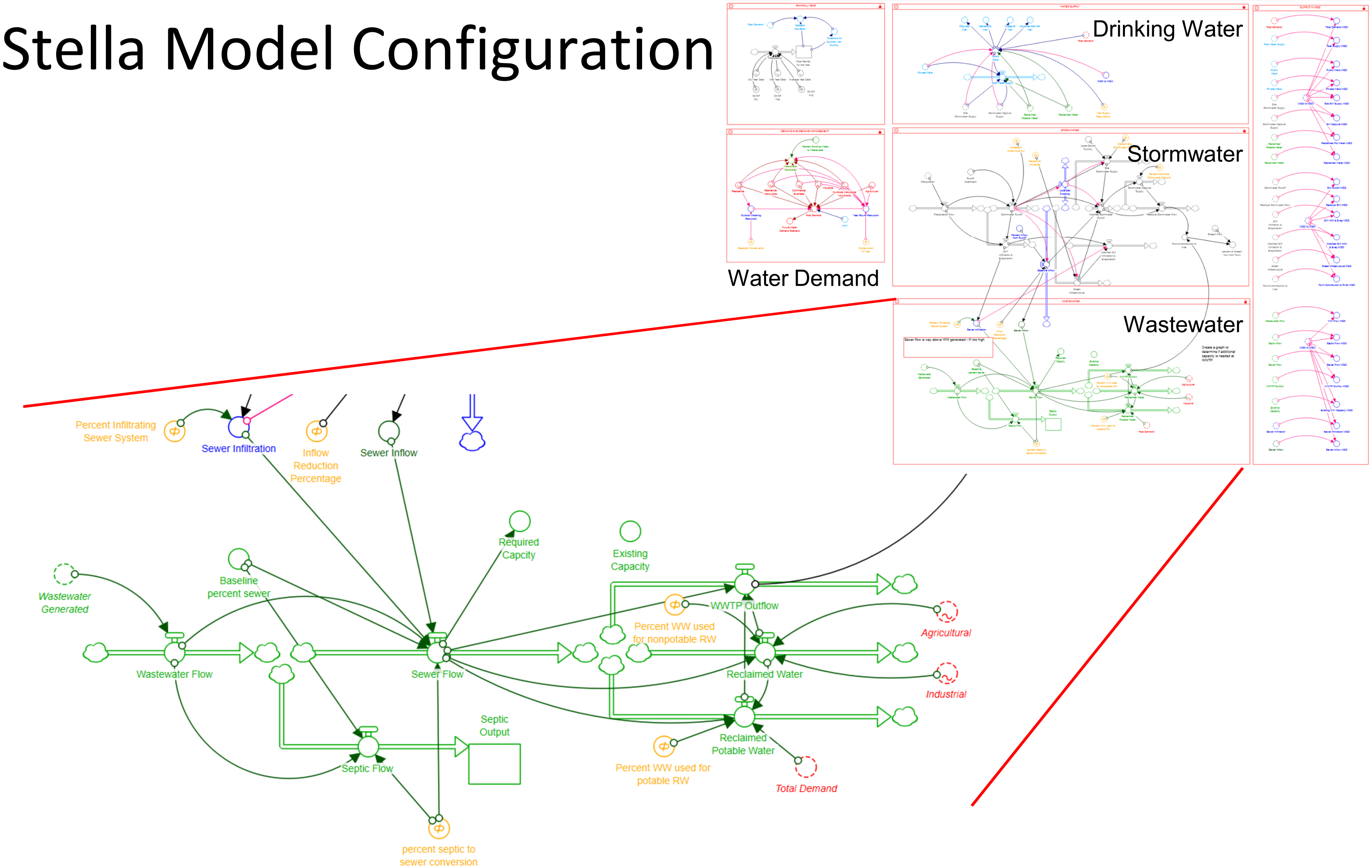
Past and Future Climate
Conservation
Education
UAW
Ag Controls
Drinking Water Needs
Surplus / Deficit
Precipitation
Evaporation
Infiltration
Green Infr.
Stormwater Runoff
MS4 Permit
Water Demand
Residential
Comm/Ind
Agricultural
Millis Purchase
Water Availability
SW Capture
WW Reuse
6 Min Controls
Distribution System
Stormwater Needs
Sewer Extension
GW Wells
Withdrawal Reg/Permit
Discharge Permits
Purchase Additional Capacity
Septic
Collection System
WWTP
Receiving Water Flow and Quality
Sump Pumps, Illicit Connections
I/I Abatement
Wastewater Needs
Satellite WWTP
Legend
Natural Flow
Managed Flow
Influence
Natural Process
Variables
Regulatory Controls
Facilities
High Level Alt
Parcel/Local Alt
Needs

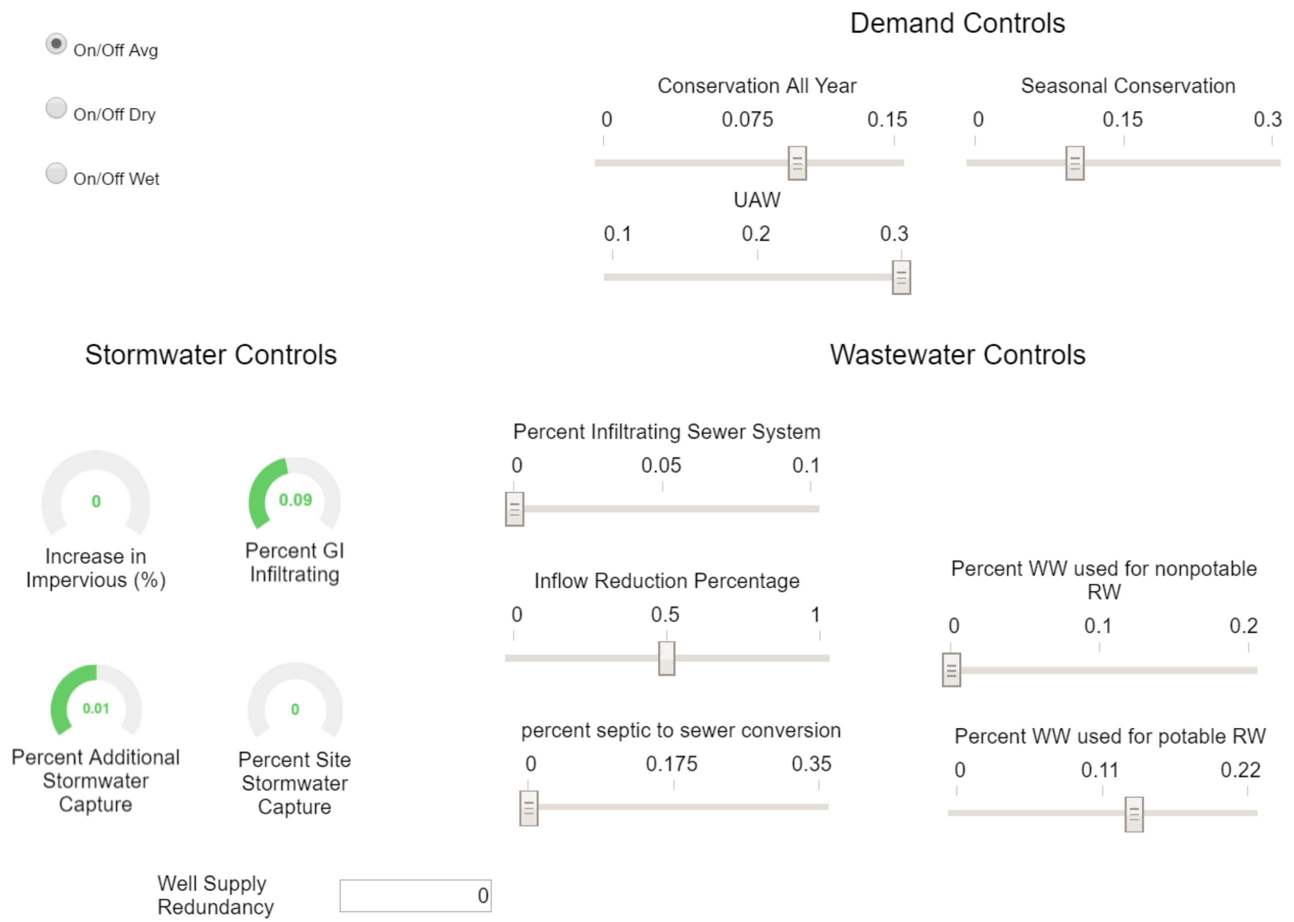
Model Parameters

- Management Alternatives: Simulated change from today's conditions
- Monthly Variability
- Precipitation: Dry/Average/Wet Years
- Calibration/Verification
  - Recent Water Supply Data (2011-2016)
  - 2007-2017 Wastewater Flows

Stella Model Configuration

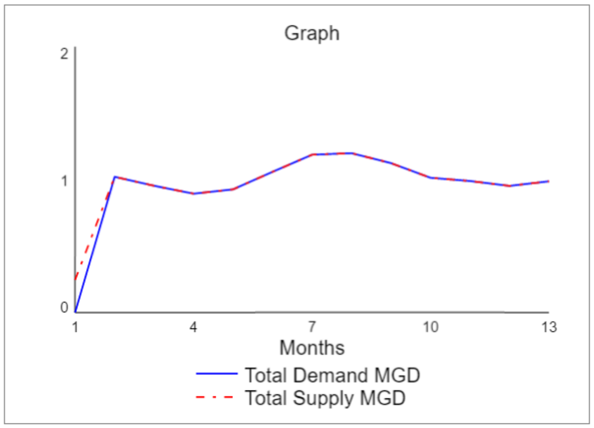


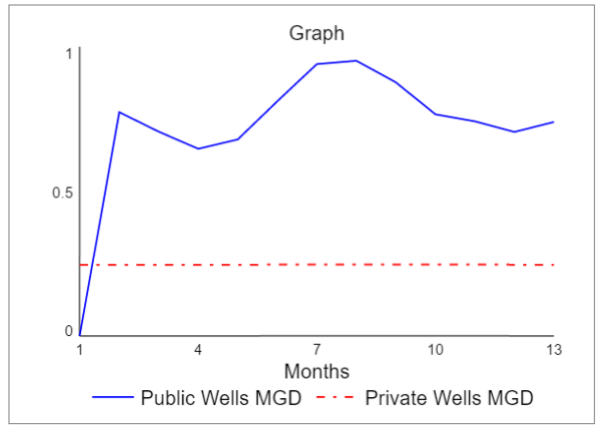
Decision Model Management Variables

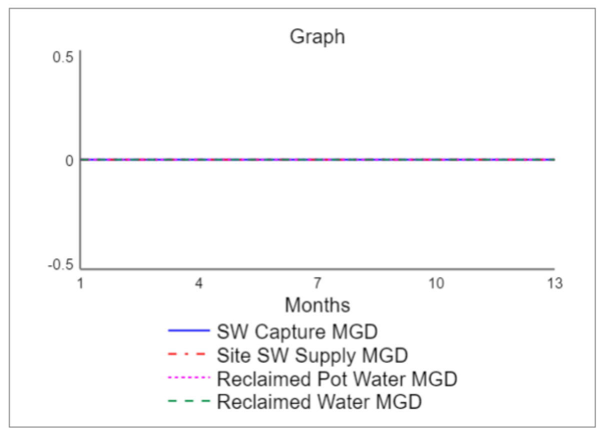


Decision Model – Sample Output

WATER SUPPLY OUTPUT



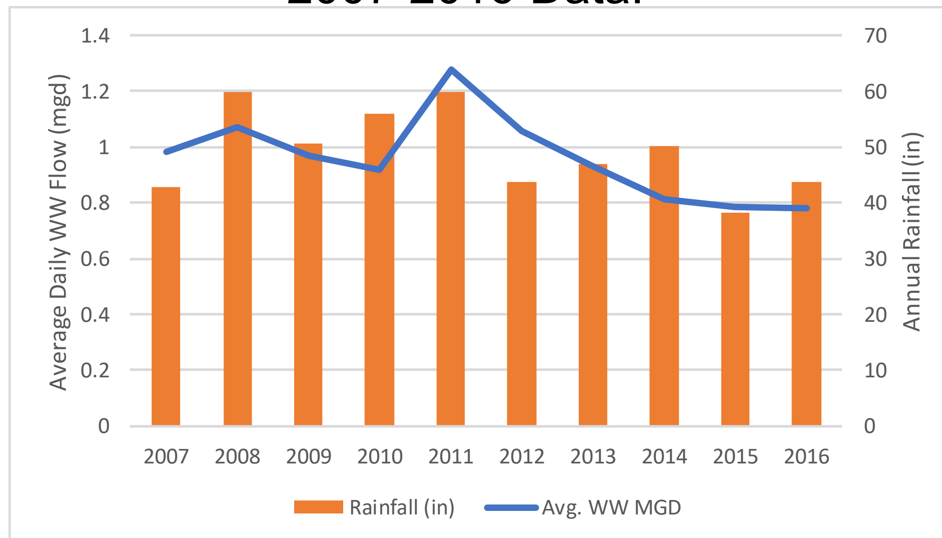




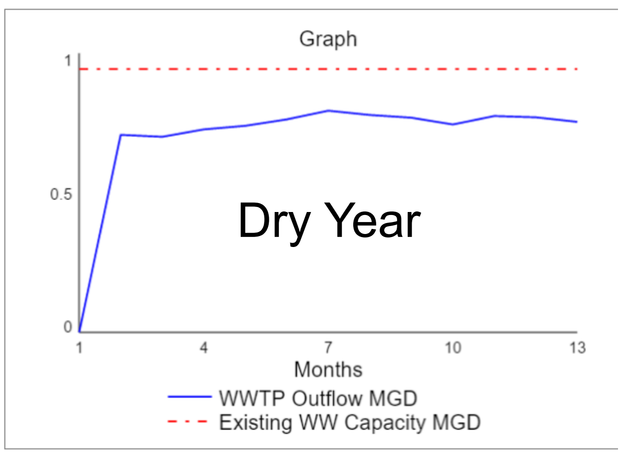
Draft Results

Decision Model
WW Calibration

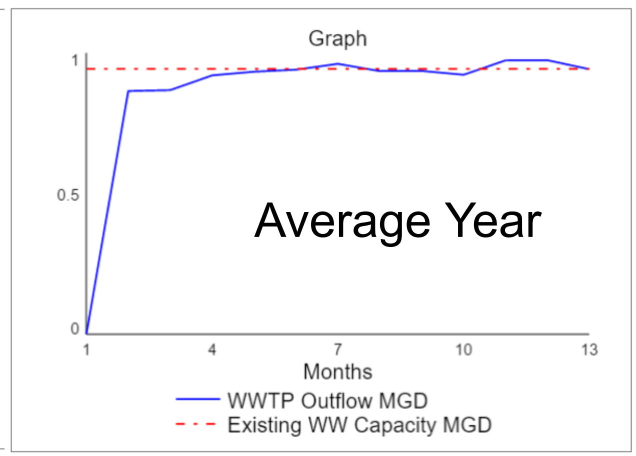
2007-2016 Data:



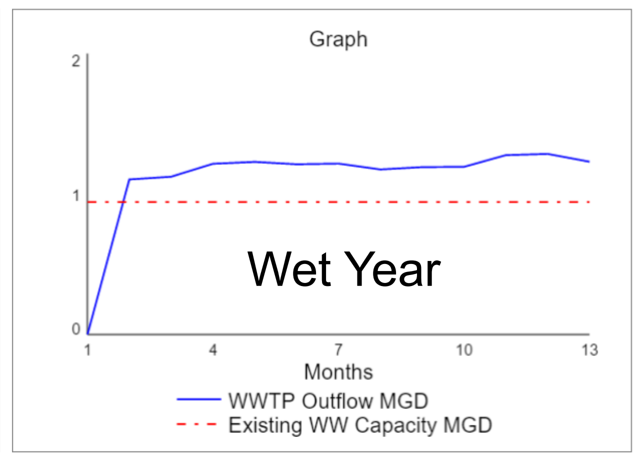
Simulation Results:



Max WW Flow	0.794



Max WW Flow	0.973



Max WW Flow	1.28

Draft Results

Scenario Summary

Scenario 1: Maintain Existing Conditions	Baseline conditions
Scenario 2: Maximize Water Resource Systems Investment	Address all alternatives and implement to maximum influence
Scenario 3: Minimize Water Resource Systems Investment	Minimize plan cost, focus on administrative/inexpensive alternatives.
Scenario 4: Drinking Water Investment	Focus on water system only
Scenario 5: Stormwater (MS4) Investment	Focus on stormwater system only
Scenario 6: Wastewater Investment	Focus on wastewater system only
Scenario 7: Water Independence	Focus on water reuse from CRPCD
Scenario 8: Hybrid/Optimized	Town preferred alternatives

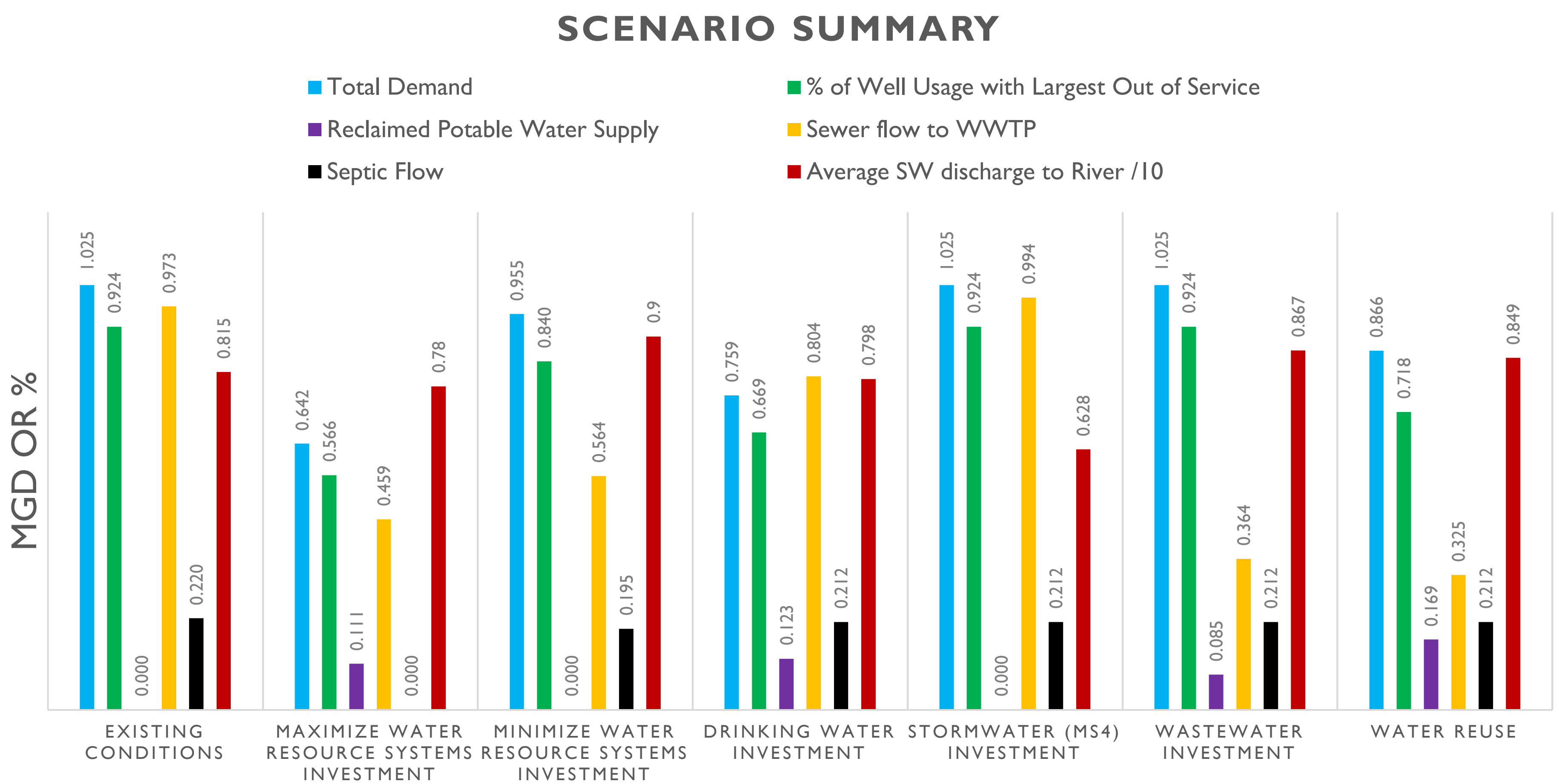
Water Resources Management Activities	Scenario 1 Maintain Existing Conditions	Scenario 2 Maximize Water Resource Systems Investment	Scenario 3 Minimize Water Resource Systems Investment	Scenario 4 Drinking Water Investment	Scenario 5 Stormwater (MS4) Investment	Scenario 6 Wastewater Investment	Scenario 7 Water Independence	Scenario 8 Hybrid/ Optimized
Indoor water conservation	✓	+	+	+	✓	✓	✓	✓
Outdoor water conservation	✓	+	+	+	✓	✓	✓	✓
Manage unaccounted for water	✓	+	✓	+	✓	✓	+	✓
Reduce infiltration sources into sewer system	✓	+	✓	✓	✓	+	+	✓
Reduce inflow sources into sewer system	✓	+	✓	✓	✓	+	+	✓
Improve sewer system operations	✓	+	✓	✓	✓	+	+	✓
Address localized flooding	✓	+	✓	✓	+	✓	+	✓
On-site stormwater capture (rain barrels)	✓	+	+	✓	+	✓	+	✓
Availability of emergency water supply from neighboring town (to accommodate largest source offline -Populatic)	×	✓	×	✓	×	×	×	
Provide redundant well	×	✓	×	✓	×	×	×	
Improve well production/increase permit limits	×	✓	✓	✓	×	×	×	

Water Resources Management Activities	Scenario 1 Maintain Existing Conditions	Scenario 2 Maximize Water Resource Systems Investment	Scenario 3 Minimize Water Resource Systems Investment	Scenario 4 Drinking Water Investment	Scenario 5 Stormwater (MS4) Investment	Scenario 6 Wastewater Investment	Scenario 7 Water Reuse	Scenario 8 Hybrid/ Optimized
Improve well production/increase permit limits	×	✓	✓	✓	×	×	×	
Water treatment	×	✓	×	✓	×	×	✓	
Manage future development water demands	×	✓	✓	✓	×		×	
Manage impervious cover for new developments	×	✓	✓	×	✓	×	×	
Increase infiltration through Green Infrastructure	×	✓	×	×	✓	✓	×	
Town-wide stormwater capture (BMPs, rain gardens)	×	✓	×	×	✓	×	✓	
Improve MS4 enforcement	×	✓	✓	×	✓	×	×	
Manage water quality through grey infrastructure	×	✓	×	×	✓	✓	✓	
Manage septic failures	×	✓	✓	×	×	✓	✓	
Septic to sewer conversion through sewer extension	×	✓	✓	×	×	✓	✓	
Availability of treatment capacity at CRPCD	×	✓	✓	×	×	✓	✓	
Evaluate grey water for industrial and agricultural use	×	✓	×	×	×	✓	✓	
Evaluate indirect potable reuse (treat wastewater for groundwater injection)	×	✓	×	×	×	×	✓	

Water Resources Management Activities	Scenario 1 Maintain Existing Conditions	Scenario 2 Maximize Water Resource Systems Investment	Scenario 3 Minimize Water Resource Systems Investment	Scenario 4 Drinking Water Investment	Scenario 5 Stormwater (MS4) Investment	Scenario 6 Wastewater Investment	Scenario 7 Water Reuse/Water Independence	Scenario 8 Hybrid/ Optimized
Indoor water conservation	-	+15%	+5%	+15%	✓	×	×	✓
Outdoor water conservation	-	+30%	+5%	+30%	✓	×	×	✓
Manage unaccounted for water	-	+10%	+	+	+	+	+	✓
Reduce infiltration sources into sewer system	-	+100%	+5%	✓	✓	+100%	+71%	✓
Reduce inflow sources into sewer system	-	+10%	+5%	✓	✓	+10%	+3%	✓
Improve sewer system operations	-	✓	✓	✓	✓	✓	✓	✓
Address localized flooding	-	✓	✓	✓	✓	✓	✓	✓
On-site stormwater capture (rain barrels)	-	+2%	+1%	+2%	+2%	✓	+2%	✓
Availability of emergency water supply from neighboring town (to accommodate largest source offline -Populatic)	×	✓	×	✓	×	×	×	
Provide redundant well	×	✓	×	✓	×	×	×	
Improve well production/increase permit limits	×	✓	✓	✓	×	×	×	

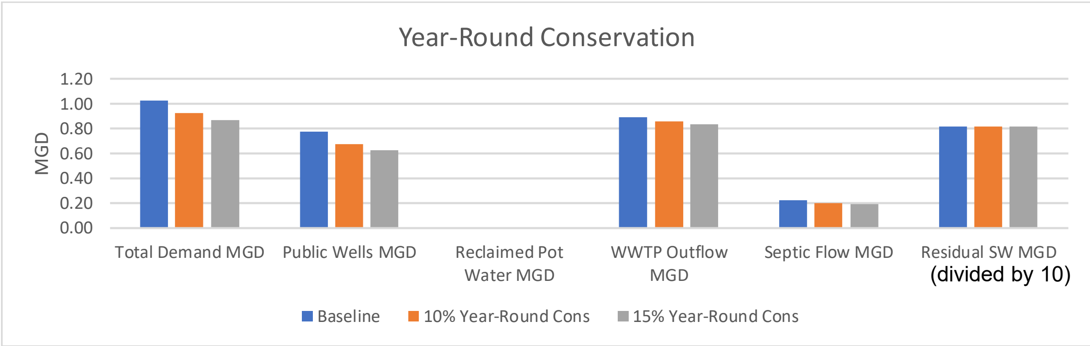
Water Resources Management Activities	Scenario 1 Maintain Existing Conditions	Scenario 2 Maximize Water Resource Systems Investment	Scenario 3 Minimize Water Resource Systems Investment	Scenario 4 Drinking Water Investment	Scenario 5 Stormwater (MS4) Investment	Scenario 6 Wastewater Investment	Scenario 7 Water Reuse	Scenario 8 Hybrid/ Optimized
Improve well production/increase permit limits	✗	✓	✓	✓	✗	✗	✗	
Water treatment	✗	✓	✗	✓	✗	✗	✓	
Manage future development water demands	✗	✓	✓	✓	✗		✗	
Manage impervious cover for new developments	✗	**-15%**	**-5%**	✗	**0%**	✗	✗	
Increase infiltration through Green Infrastructure	✗	**20%**	✗	✗	**20%**	✓	✗	
Town-wide stormwater capture (BMPs, rain gardens)	✗	**2%**	✗	✗	**2%**	✗	**2%**	
Improve MS4 enforcement	✗	✓	✓	✗	✓	✗	✗	
Manage water quality through grey infrastructure	✗	✓	✗	✗	✓	✓	✓	
Manage septic failures	✗	✓	✓	✗	✗	✓	✓	
Septic to sewer conversion through sewer extension	✗	**100%**	**12%**	✗	✗	✓	✓	
Availability of treatment capacity at CRPCD	✗	✓	✓	✗	✗	✓	**0.04%**	
Evaluate grey water for industrial and agricultural use	✗	**20%**	✗	✗	✗	**20%**	**20%**	
Evaluate indirect potable reuse (treat wastewater for groundwater injection)	✗	**22%**	✗	✗	✗	**22%**	**22%**	

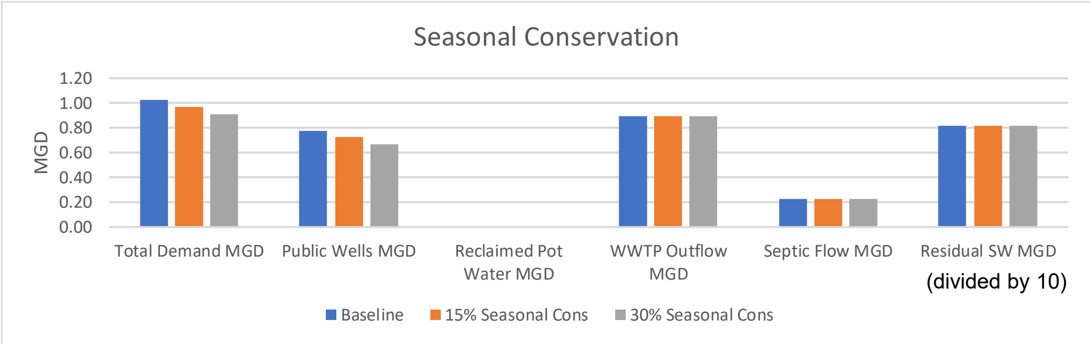
Scenario Tradeoffs

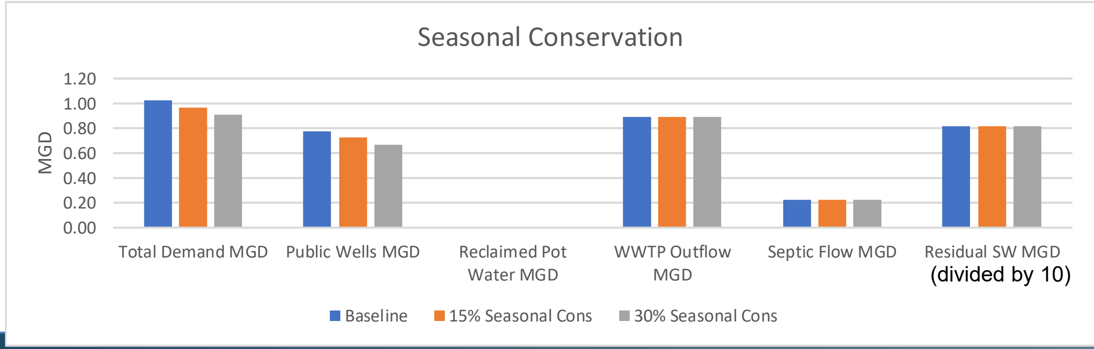


Draft Results

Key Drinking Water Alternatives

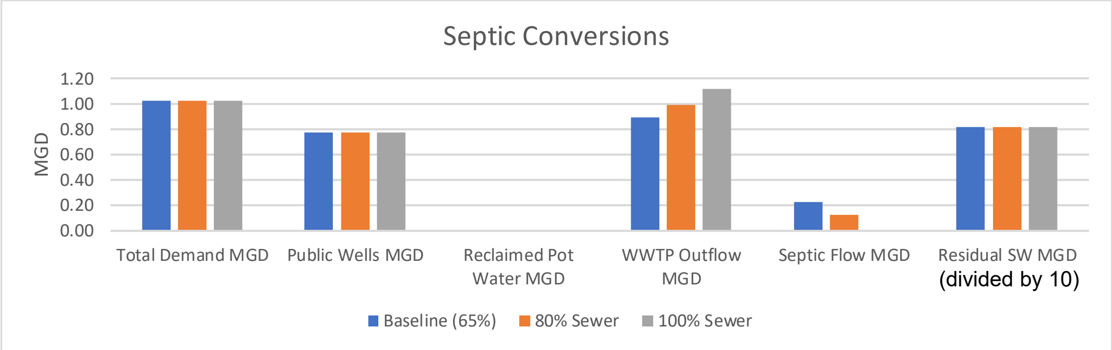


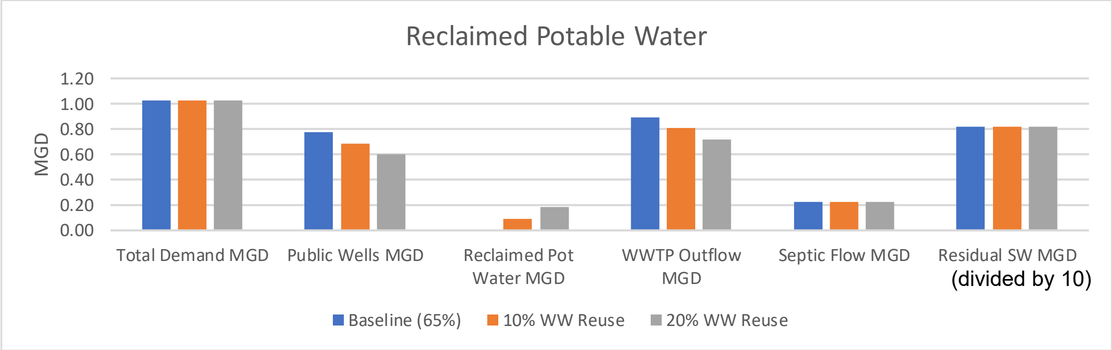


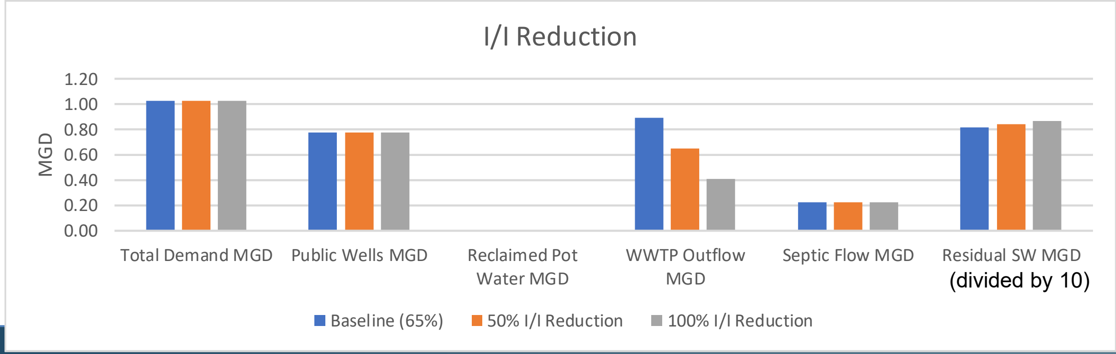


Draft Results

Key Wastewater Alternatives

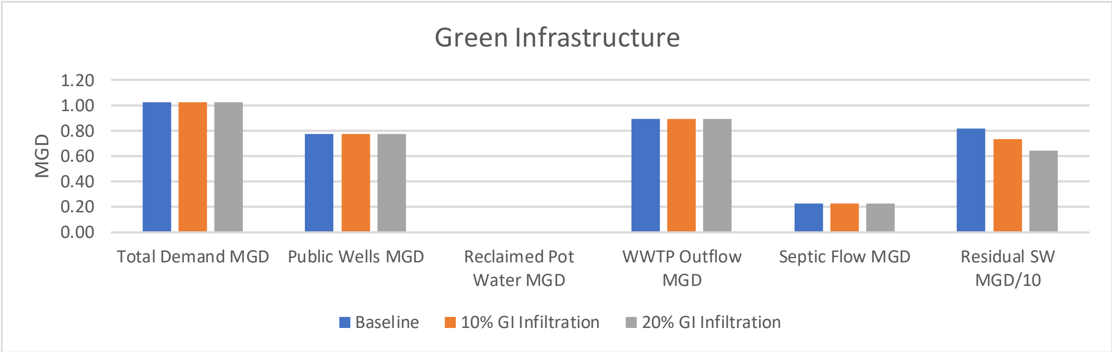






Draft Results

Key Stormwater Alternatives



Draft Results

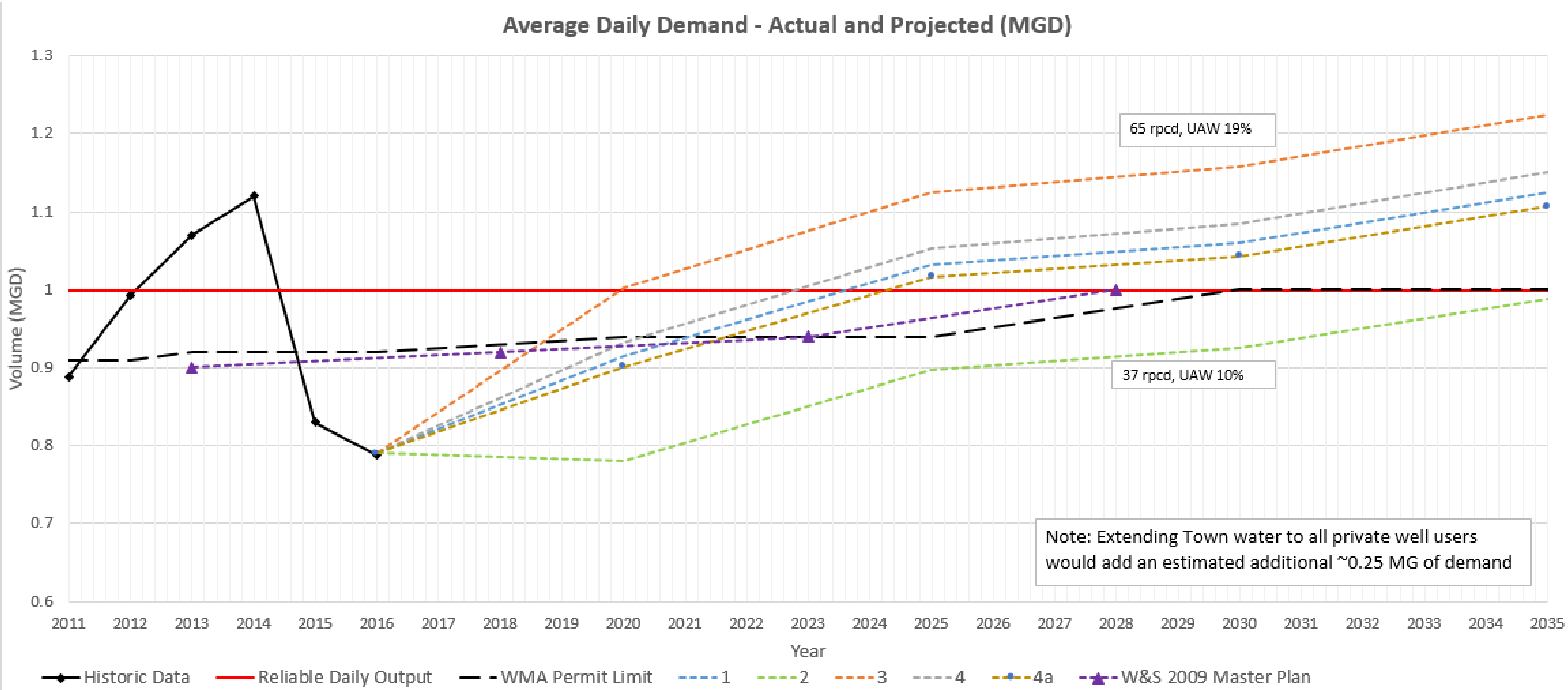
Influence of Alternatives

Cost ↑

Green Infrastructure	Water Reuse	Sewer Extension UAW
Stormwater Management	Well Supply Redundancy	I/I removal
Site Stormwater Capture	Manage Impervious Cover	Conservation

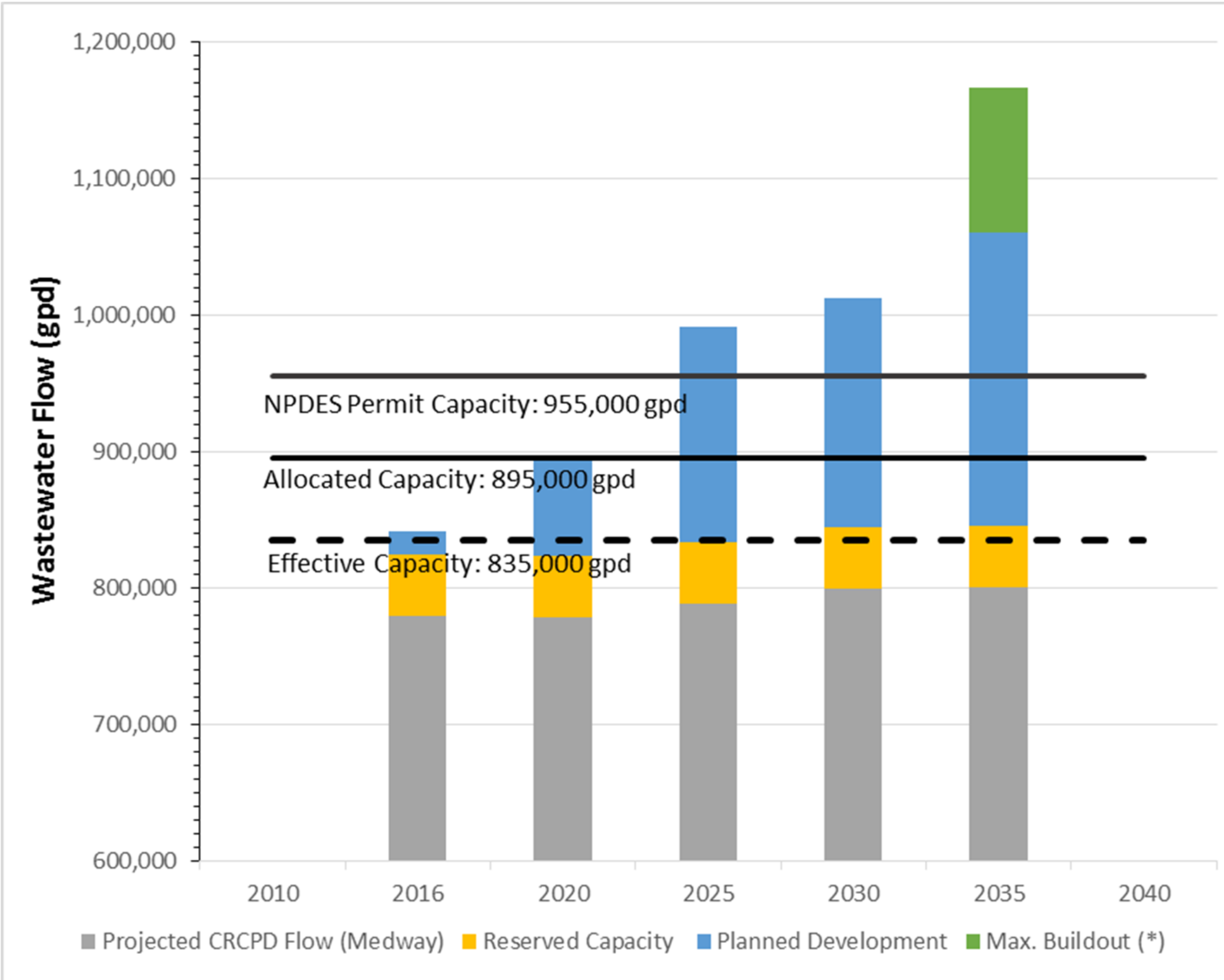
Influence →

Drinking Water



Scenario	Description
1	Future residential water Use at current (2016) rate and UAW at current (2016) value
2	Future residential water use at current (2016) rate and UAW at 10%
3	Future residential water use at 65 gpcd and UAW 2011-2016 avg. value
4	Future residential water use at 65 GPCD and UAW at 10% (Umass Donahue Population)
4a	Future residential water use at 65 GPCD and UAW at 10% (MassDOT Population)

Wastewater Projections



What Other Questions Should We Address?

Next Steps Summary

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Next Steps

- Conceptual Design of Alternatives (Jan-Feb)
  - Evaluate Costs
- Draft Implementation Plan (Feb-Mar)
  - Review implementation schedule and costs
  - Workshop and Public Meeting in April
- Complete Draft IWRMP (April)

Integrated Water Resources Management Plan

Thank you for your time!

Reference Slides – from Fall Meeting

Drinking Water

Needs	Solutions
Lack of well supply capacity	• annual well rehabilitation program to restore lost capacity; increase resiliency
Lack of well redundancy	• Satellite wells • Replacement wells / wellfield

Unlikely to meet max daily demand with largest source offline
 	
Within 2-5 years, may be unable to meet average day demand
	• Emergency purchase agreement with Millis
	• Alternative water sources
	  • New supply well
	  • Stormwater capture
	  • Wastewater Reuse

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Drinking Water

Needs	Solutions
Future supply deficit projected	Continue / enhance demand management • Conservation education/outreach • Fixture retrofits • Rebates • Water ban
New regulatory constraints (WMA) • Offsets required for higher withdrawal authorization	Consult with DEP on new WMA Permit application; identify credits
Iron & manganese levels requiring treatment	Construct treatment facility
Un-accounted for water (UAW) >10%	• Meter testing / replacement program • Continue Annual Leak detection • Water main replacement as recommended in 2010 Master Plan

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Wastewater

Needs	Alternatives
Data Gaps (flow metering)	• Permanent meter to confirm flow to CRPCD
CRPCD discharge limits	• Sewer moratorium • Infiltration/Inflow (I/I) Removal o Flow Metering* o Illicit Connections o Private Inflow Sources o CCTV Inspection o Manhole Sealing o Cured in Place Pipelining (CIPP)
Support Planned Buildout	• Sewer Extensions • I/I Removal • Increase discharge limit at CRPCD

Wastewater

Needs	Solutions
Septic systems failures • Physical limitations- High groundwater, extensive wetlands; poorly drained soils. • Protect Water Supply Sources	• Decentralized Treatment System • Sewer Extensions • Septic Needs Support Funds
Ongoing Maintenance • Fats, Oils, Grease (FOG) • Root Removal • System Condition Assessment • Pump Station Operation	• Support DPS Operations • CCTV Inspection of full system
Public Education	• FOG • Illicit Connections • Private Inflow Sources

Stormwater

Needs	Solutions
Localized Flooding • Low Topography • Sedimentation • Blocked Catch Basins • Beaver Activity	• Implement Green Infrastructure • Address development standards • Support maintenance
Mapping of System • GIS mapping of drain system • Delineate Catchments	• Map Drain System in Problem and High Concern Catchments
Water Quality Monitoring at Outfalls • Dry Weather Flow • Water Quality Sampling	• Support DPS Operations • MS4 Funding

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Stormwater

Needs	Solutions
Maintenance • Good Housekeeping • Catch Basin Cleaning • Street Sweeping	• Support DPS Operations • MS4 Funding
Public Education	• Ongoing education programs
Water Quality Improvements	• 6 Minimum Controls • BMPs

MEETING SUMMARY

Integrated Water Resources Management Plan
Task Force Meeting

Date: April 17, 2018

Attendees:
Susan Affleck-Childs, Medway Planning and Economic Development Board
Stephanie Carlisle, Medway Department of Public Services (DPS)
Dennis Crowley, Medway Board of Selectmen (BOS)
David D'Amico, Medway DPS, Director
John Foresto: Medway Board of Selectmen
Bridget Graziano, Medway Conservation Agent
Jonnas Jacques, Kleinfelder Project Engineer
Ted Kenney: Medway Water and Sewer Commission
Laura Nolan, Kleinfelder Project Manager
Allison Potter, Medway Assistant Town Administrator
Kirsten Ryan, Kleinfelder Client Account Manager
Barry Smith, Medway DPS, Deputy Director
Jessica Strunkin, 495 Medway Partnership
Barry Zides, Medway Water & Sewer Commission

CC:
Ryan Arego, Legislative Aide to Rep. Jeffrey Roy, 10th Norfolk District Michael Boynton, Town Administrator
Andy Rodenheiser, Planning Board
Leo O'Rourke, Medway Water & Sewer Commission
Liz Taglieri, Director, Charles River Pollution Control District (CRPCD)

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1. Introduction

The meeting was opened by Laura Nolan (Kleinfelder) who welcomed the participants and outlined the objectives of the meeting. Meeting participants introduced themselves.

2. Project Status Update

(Slides 2-3) Laura Nolan provided a brief update on the IWRMP project status identifying the steps completed since the January 2018 Task Force meeting. These steps included evaluating the IWRMP alternatives and developing the preferred solutions/ recommendations. The primary objective for the meeting included introducing the IWRMP draft project recommendations, their costs, and the proposed implementation schedule with an emphasis on soliciting comments and/or confirmation from attendees regarding the cost and implementation scheduling. The Kleinfelder Team also requested comments and feedback on how the draft IWRMP would be presented during the BOS and Public meetings. Major discussion points are summarized below. The PowerPoint presentation is included as an attachment to this meeting summary.

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3. STELLA Model, Influence of Alternatives, and IWRMP Scenarios Review

(Slides 4-8) Laura Nolan summarized the development of the STELLA decision model and its use in identifying the more influential alternatives in terms of their cost and impact on the Town's water resources. The more influential alternatives included Conservation, UnAccounted for Water (UAW), Infiltration/Inflow (I/I) Removal and Well Supply Redundancy. Laura also summarized the various IWRMP scenarios that captured the benefits and trade-offs of grouping the IWRMP alternative in different ways.

(Bottom of Slide 8) Laura then discussed how the water reuse alternative lead to the evaluation of water reclamation and grey water reuse options for the Town. The Kleinfelder Team determined that these water reuse options were too expensive and not practical for the Town to undertake at this time. The IWRMP will outline the conditions under which it would be a more practical for the Town to engage either water reuse option.

4. Drinking Water Capacity vs Demand Projections

(Slide 9) Laura discussed the development of the drinking water demand projections with the group. Two models were referenced for population projections: UMass Donahue Institute (UMDI) and MassDOT. The UMDI population projection is an aggressive model for determining population growth and it was used to set the upper bound for the population projections. The MassDOT model projections are more reserved than the UMDI and was therefore used to set the lower bound for the population projections. Both models indicate an initial decrease in population growth which may reflect the regional trend of residents moving away from suburban areas and towards the more urban city centers.

(Slide 9) The 2016 residential water usage in Medway averaged about 52 gallons per capita per day (GPCD). This value reflects the actual water usage from the portion of the residential population connected to the public water system in Medway. UAW in the Town during 2016 was 17% of the total pumped water supply. These values for residential water usage and UAW increased to 54 GPCD and 22% respectively during 2017. However, the 2016 values were used in the drinking water demand projections to establish the existing conditions.

(Slides 10-11) Kleinfelder developed various scenarios projecting future water demand through 2035 in Medway. These scenarios were developed using each population projection model assuming different levels of residential water use (49-65 GPCD) and assuming the Town achieves different levels of UAW (10-20%). The scenarios established the upper and lower bound for the water demand projections assuming the Town's minimum and maximum investment, respectively, in water conservation measures related to residential water use and UAW. A hybrid scenario was also developed for each population model which assumes the Town maintains the current residential water usage at 52 GPCD and assumes the Town achieves a realistic UAW of 14%.

(Slides 12-16) A series of graphs were presented that depicted the Town's water supply production capacity versus the average daily water demand based on historic data from 2011 and the projected data through 2035. The reliable daily output (RDO) of all four wells used in production at full capacity is about 1.2 million gallons per day (MGD). Kirsten Ryan (Kleinfelder) noted that the RDO reflects the theoretical maximum output from the wells operating at full capacity, which is similar to the typical daily production during the summertime peak water demand periods. Since the water quality of the Oakland well is not reliable, the RDO of sufficient water quality from the remaining three wells is about 0.95 MGD. If the Town's main well (Populatic) were to go offline and the decision was made to use the Oakland well, the RDO of diminished water quality would be about 0.81 MGD which is slightly below the current average daily water demand. This identifies a high priority need to have a redundant well at the Populatic site because the Town could not meet its current water demand if the current Populatic well were to go offline. If both the Populatic and Oakland wells were not used for production, the Town could only produce a RDO of about 0.54 MGD. The graphs also depict the WMA Permit withdrawal limit which increases from about 0.91 MGD in 2011 to 1.0 MGD by 2035.

(Slides 17-22) The future water demand based on UMDI and MassDOT hybrid scenarios were also plotted on the graphs. This showed that using the UMDI model, the projected demand would exceed the currently average daily RDO (all wells except for Oakland) and the WMA Permit withdrawal limit in 2023. This also showed that using the MassDOT model, the projected demand would exceed the currently average daily RDO and the WMA Permit withdrawal limit in 2025. Given these projects, the Town will have to consider increasing the WMA Permit withdrawal limit and installing treatment measures to utilize the Oakland well by 2023.

Since UAW is unlikely to drop to 14% in a short period of time, another scenario reviewed the future water demand projections assuming the 2016 residential water usage (52 GPCD) and the 2016 UAW (17%) with the UMDI and MassDOT population models. This scenario indicated that the Town would have to consider increasing the WMA Permit withdrawal limit by 2020 and installing treatment measures to utilize the Oakland well by 2021. Given the increase in the 2017 values for residential water use (54 GPCD) and UAW (22%), the Town should strongly consider pursuing a WMA Permit increase and installing treatment at Oakland as the first actions of the IWRMP 20-year plan.

5. Wastewater Capacity vs Demand Projections

(Slide 23) Laura then presented a graphic depicting the wastewater capacity versus demand projections in gallon per day (GPD). On the graph, a horizontal line portrayed
Permitted Capacity (955,000 GPD). This represents Medway's maximum available treatment capacity at the CRPCD. *[During the meeting the graphic also showed allocated and effective capacity limits, however upon further discussion with CRPCD those limits were removed from the graphic.]*

The graph also portrayed the existing and future wastewater flows. The 2017 wastewater flow is approximately 880,000 GPD. The Town should also consider the reserved capacity which is set aside for the septic users whose properties received a betterment from local sewer line installations. The Town must allow these septic users to connect the public wastewater system if they decide to abandon their septic systems. This reserved capacity of potential wastewater flow totals to about 45,000 GPD. Also included in the graph are the wastewater flow contributions from future planned developments. The wastewater flow from developments is projected to increase based on available information on when various developments achieved full build-out status. Developments that have already received planning board approval would cause the Town to exceed its treatment capacity in the future. This illustrates a high priority need for the Town to increase their capacity at the CRPCD. It is understood that the Town is currently negotiating an increase to their wastewater capacity at the CRPCD.

6. IWRMP Implementation Chart and Cost Schedule Graph

(Slides 24-26) Laura discussed the development of the draft IWRMP recommendations, which aimed to supplement the current efforts of the DPS and present addition project considerations to address town-wide water resource needs. Funding opportunities by way of grants or the state revolving fund (SRF) are available to the various components of the IWRMP recommendations.

The Draft IWRMP Implementation Chart depicting the various plan recommendations separated the IWRMP operations and maintenance (O&M) related components from the capital improvement projects. The recommendations were also grouped by their water resource category (wastewater (WW), drinking water (DW), stormwater (SW), and overall (ALL)).

Operations and Maintenance Recommendations

- WW: Install and Maintain 2 Permanent Flow Meters
    - The Town should wastewater flow install meters to help quantify and verify flow contributions in areas of the town where CRPCD metering is incomplete.
- WW: Sewer System Evaluation Survey (SSES) Investigations and Rehabilitation
    - The Town should perform follow-up investigations to the recent I/I metering done as part of the IWRMP development to identify sources of I/I into the wastewater system.
- WW: Purchase CCTV Equipment to Support WW Operations
    - The DPS has shown interest in performing certain sewer system inspection activities in-house over time. This will support ongoing I/I and Asset Management (AM) related work.
- DW: Annual Water System Maintenance
    - The Town should continue ongoing maintenance work on wells, recommended uni-directional hydrant flushing, and annual inspection of the two water storage tanks.
- DW: Indoor/Outdoor Water Conservation Activities
    - The Town should continue their public education efforts along with other activities to conserve water throughout the 20-year plan.
- DW: Update Emergency Drinking Water Supply Plan
    - The Town has an emergency response plan. However, agreements are not in place between Medway and its neighboring towns with which it has an interconnection. It was noted by Barry Smith (DPS) that the interconnection with Milford may be the only emergency connection that can hydraulically supply water to Medway. Other interconnections would require a booster pump or another measure to supply water into Medway. This plan would include recommendations for prioritizing interconnection use during emergencies and establish agreements.
- DW: Ongoing UAW Management Activities
    - The importance of managing UAW was previously identified in the water demand projection discussion. Currently the town allocates about $10-12k to support UAW effort. Dennis Crowley (BOS) raised a concern that the efforts for UAW were not

yielding to lower results for UAW (noting that the UAW increased from 17% to 22% from 2016 to 2017). Barry Smith indicated that previously high UAW results were attributed to water main breaks that have subsequently been repaired. He also mentioned that due to the age of the water distribution system, UAW could be expected to fluctuate year to year. Without managing UAW, the non-revenue water being pumped and treated could only be expected to increase. Kirsten indicated that a UAW of 20% contributes to about $50,000 of revenue lost. Therefore, it is a high priority for the Town to continue and even enhance their UAW activities.

- DW: Enhance Water Impact Fee
  - The Town has a water system access fee based on the size of service used to connect to the system. This recommendation would evaluate the manner in which the Town could modify this fee to better reflect the actual demand that a new development connection would place on the water system supply.
- DW: Highland and Lovering Tank Painting and Cleaning
  - The Town should continue its efforts to maintain the critical water infrastructure assets.
- SW: MS4 Program Implementation and Education
  - The Town should continue its efforts to comply with the 2016 Municipal Separate Storm Sewer System (MS4) Permit requirements which becomes effective on July 1, 2018.
- ALL: Asset Management Updates
  - This reflects the ongoing support of the AM program though the 20-year plan discussed under capital improvements.

<u>Capital Improvements Recommendations</u>

- WW: Purchase WW Treatment Capacity
  - To accommodate the current wastewater flows and future demand projections, the Town should consider purchasing up to an additional 300,000 gallons per day of capacity at the CRPCD. The cost of purchasing the additional capacity is unknown at this time but could be as much as $10/gallon.
- WW: Limited Sewer Extensions
  - When wastewater flow capacity becomes available, the Town should consider extending the sewer system in limited areas to accommodate resident with septic systems in failure mode.
- WW: Town-wide Sewer System Metering
  - Periodically the Town should perform a temporary metering of the entire wastewater system to evaluate flow in the subsystem areas and identify areas of focus for future SSES work. The IWRMP included a town-wide metering program.
- DW: Drinking Water Treatment Improvements (Design/Construction)
  - This reflects the Haley and Ward water treatment improvement recommendations. This is a high priority item for the Town to consider in order to bring the Oakland well into compliance with their water quality standards.
- DW: Drinking Water Supply Redundancy (Design/Construction)
  - This reflects the Haley and Ward redundant well supply improvements recommendations. This is a high priority item for the Town to consider to reliably meet their current and future water demand projections.

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- DW: Update Town-wide Drinking Water Hydraulic Model
  - The last system-wide hydraulic analysis of the drinking water distribution system was performed in 2010. The Town should perform a hydraulic assessment on the drinking water system to update their model every 10 years starting in 2020.
- DW: Construct Water System Improvements
  - An updated model may help to supplement the Town's efforts in identifying deficiencies in the drinking water distribution system (fire flow, looping, etc.). The Town should develop capital projects to address those deficiencies in the system. The group considered identifying this recommendation as an O&M item.
- SW: Drainage Improvements to Address Localized Flooding
  - The Town should address the local flooding issues caused by hydraulic restrictions in the stormwater infrastructure system.
- SW: Manage Impervious Cover
  - The Town should review its development policies to identify areas where improvements can be made to the stormwater components of the development policies.
- SW: Structural BMPs to Manage Stormwater Quality
  - There are several locations identified in the IWRMP report where the Town should consider implementing stormwater structural BMPs to address stormwater runoff and promote improved stormwater quality.
- SW: Town Property Stormwater Infiltration Analysis
  - The should perform studies to identify town-owned parcel where impervious pavement can be discontinued to promote stormwater infiltration and groundwater recharge.
- ALL: Asset Management Program

7. Next Steps

The group discussed concluding the meeting early before discussing the cost of each IWRMP recommendation. Dennis requested time to meet with the Water and Sewer Commissioners and the DPS staff to discuss the impacts of the IWRMP implementation cost schedule. Dave D'Amico (DPS) indicated that the impacts from the first 3 years of the IWRMP implementation cost schedule were considered in the recently proposed water and sewer rate fee structure.

The group decided to postpone the draft IWRMP presentations meetings to the BOS and Public until the implementation schedule is finalized. The group discussed delaying the submission date of the draft IWRMP. At this time the Kleinfelder team will plan to submit the draft IWRMP to the Town for review in June 2018.

Attachments:

- Meeting PowerPoint presentation
- Sign in sheet

Medway's Integrated Water Resources Management Plan

Draft IWRMP Presentation

IWRMP Task Force
Medway DPS
April 17, 2018

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TOWN OF MEDWAY MASSACHUSETTS
INCORPORATED OCT. 25, 1713

Agenda

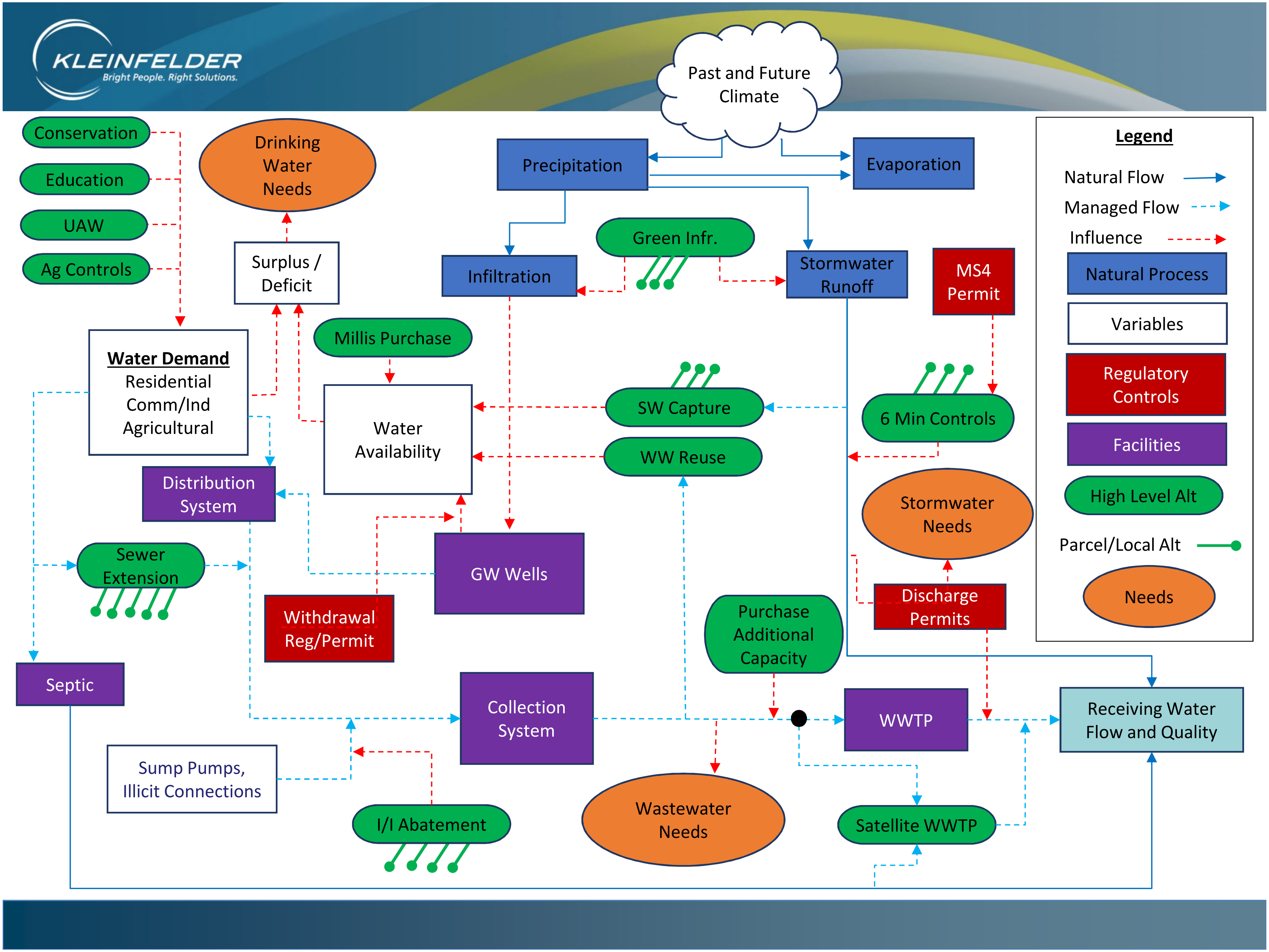
1. Introductions
2. Project Overview/Status
3. Presentation of Draft IWRMP
4. Feedback on Messaging for BOS
5. Feedback on Messaging for Public
6. Next Steps

IWRMP Phase II

- ☑Document Existing Conditions
- ☑Identify Needs
- ☑Identify Alternatives to Address Needs
- ☑Evaluate Alternatives and Select Preferred Solutions
- ☑Conceptual Design
- ❖Develop IWRMP (in progress)
- ❖Develop Implementation Schedule

Decision Model

- Simulate dynamic interactions between systems:
  - Rainfall ↓, Groundwater ↓
  - Impervious Cover ↑, Runoff ↑
  - Population ↑, Water Demand ↑, Wastewater ↑
  - Limits: permits, water availability, capacity
  - Tradeoffs: resources, quality
- Goal: quantify the tradeoffs and sensitivities as a guide for decision making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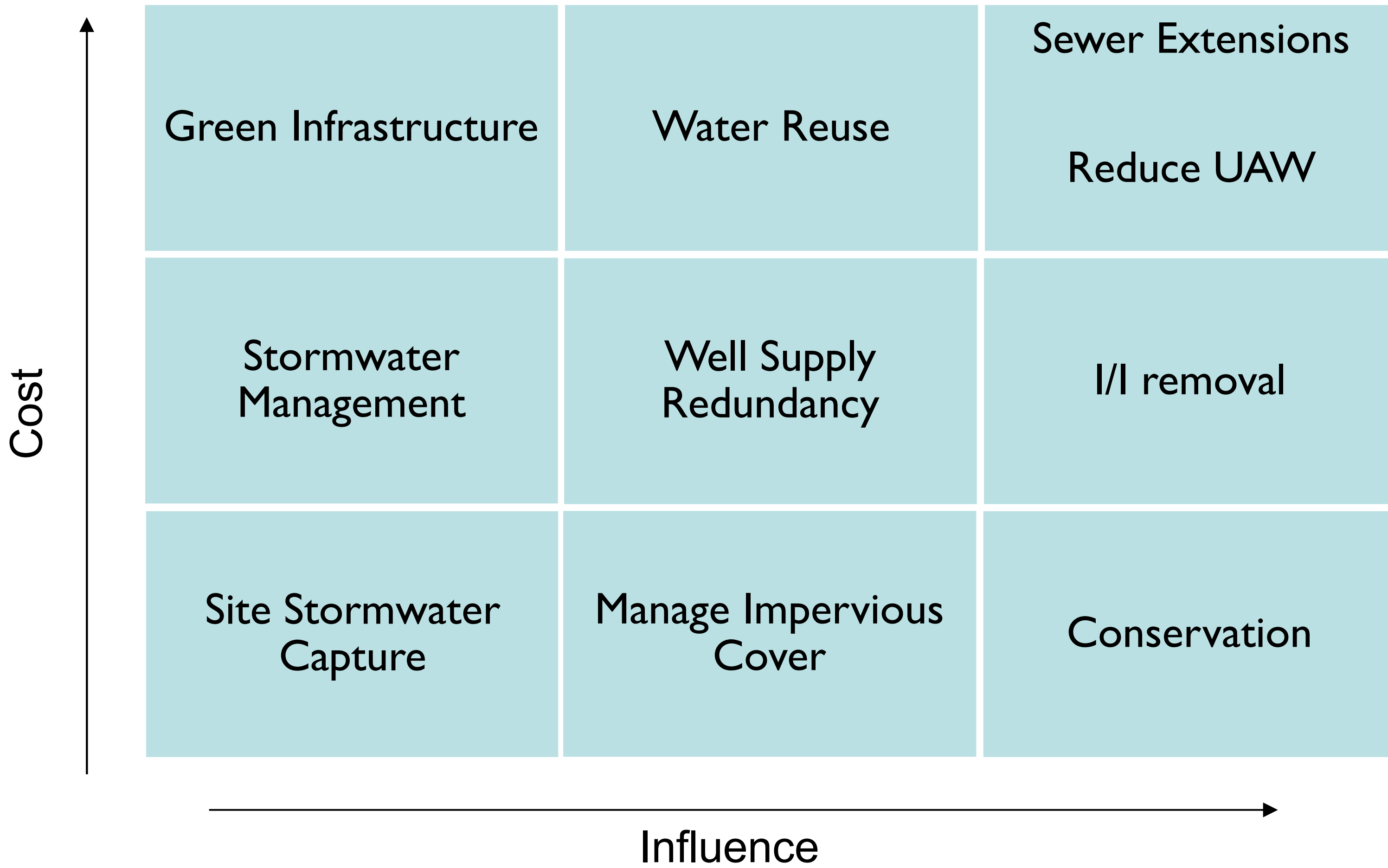
Past and Future Climate
Conservation
Education
UAW
Ag Controls
Drinking Water Needs
Surplus / Deficit
Precipitation
Evaporation
Infiltration
Green Infr.
Stormwater Runoff
MS4 Permit
Water Demand
Residential
Comm/Ind
Agricultural
Millis Purchase
Water Availability
SW Capture
WW Reuse
6 Min Controls
Distribution System
Stormwater Needs
Sewer Extension
GW Wells
Withdrawal Reg/Permit
Discharge Permits
Purchase Additional Capacity
Septic
Collection System
WWTP
Receiving Water Flow and Quality
Sump Pumps, Illicit Connections
I/I Abatement
Wastewater Needs
Satellite WWTP
Legend
Natural Flow
Managed Flow
Influence
Natural Process
Variables
Regulatory Controls
Facilities
High Level Alt
Parcel/Local Alt
Needs

Influence of Alternatives



	Water Resources Management Activities	Scenario 1 Maintain Existing Conditions	Scenario 2 Maximize Water Resource Systems Investment	Scenario 3 Minimize Water Resource Systems Investment	Scenario 4 Drinking Water Investment	Scenario 5 Stormwater (MS4) Investment	Scenario 6 Wastewater Investment	Scenario 7 Water Independence	Scenario 8: Hybrid **Short Term Action**	Scenario 8: Hybrid **Long Term Action**
Drinking Water	Indoor water conservation	✓	+	+	+	✓	✓	✓	✓	✓
Drinking Water	Outdoor water conservation	✓	+	+	+	✓	✓	✓	+	+
Drinking Water	Manage unaccounted for water	✓	+	✓	+	✓	✓	+	+	+
Wastewater	Reduce infiltration into sewer system	✓	+	✓	✓	✓	+	+	✓	✓
Wastewater	Reduce inflow into sewer system	✓	+	✓	✓	✓	+	+	✓	+
Wastewater	Sewer system operations	✓	+	✓	✓	✓	+	+	✓	+
Stormwater	Address localized flooding	✓	+	✓	✓	+	✓	+	✓	✓
Stormwater	On-site stormwater capture (rain barrels)	✓	+	+	✓	+	✓	+	✓	✓
Drinking Water	Emergency water connections	×	✓	×	✓	×	×	×	✓	
Drinking Water	Construct redundant well	×	✓	×	✓	×	×	×	✓	
Drinking Water	Improve well production	×	✓	✓	✓	×	×	×	✓	✓

✓= Included in Scenario, += Increase Existing Investment, ×= Not Included in Scenario

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		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6	Scenario 7	Scenario 8: Hybrid	
	Water Resources Management Activities	Maintain Existing Conditions	Maximize Water Resource Systems Investment	Minimize Water Resource Systems Investment	Drinking Water Investment	Stormwater (MS4) Investment	Wastewater Investment	Water Reuse	**Short Term Action**	**Long Term Action**
Drinking Water	Increase WMA permit limits	×	✓	✓	✓	×	×	×		✓
	Water treatment	×	✓	×	✓	×	×	✓	+	✓
	Manage future development water demands	×	✓	✓	✓	×		×	✓	
Stormwater	Manage impervious cover for new developments	×	✓	✓	×	✓	×	×	✓	
	Increase infiltration through Green Infrastructure	×	✓	×	×	✓	✓	×		✓
	Town-wide stormwater capture (BMPs, rain gardens)	×	✓	×	×	✓	×	✓		✓
	Improve MS4 enforcement (education)	×	✓	✓	×	✓	×	×	+	✓
	Manage water quality through grey infrastructure	×	✓	×	×	✓	✓	✓		✓
Wastewater	Sewer extension	×	✓	✓	×	×	✓	✓		✓
	Purchase available additional capacity at CRPCD	×	✓	✓	×	×	✓	✓	✓	
	Evaluate grey water for industrial and agricultural use	×	✓	×	×	×	✓	✓		
	Evaluate indirect potable reuse (treat wastewater for groundwater injection)	×	✓	×	×	×	×	✓		

✓= Included in Scenario, += Increase Existing Investment, ×= Not Included in Scenario, ?= Scope to be determined

Projections

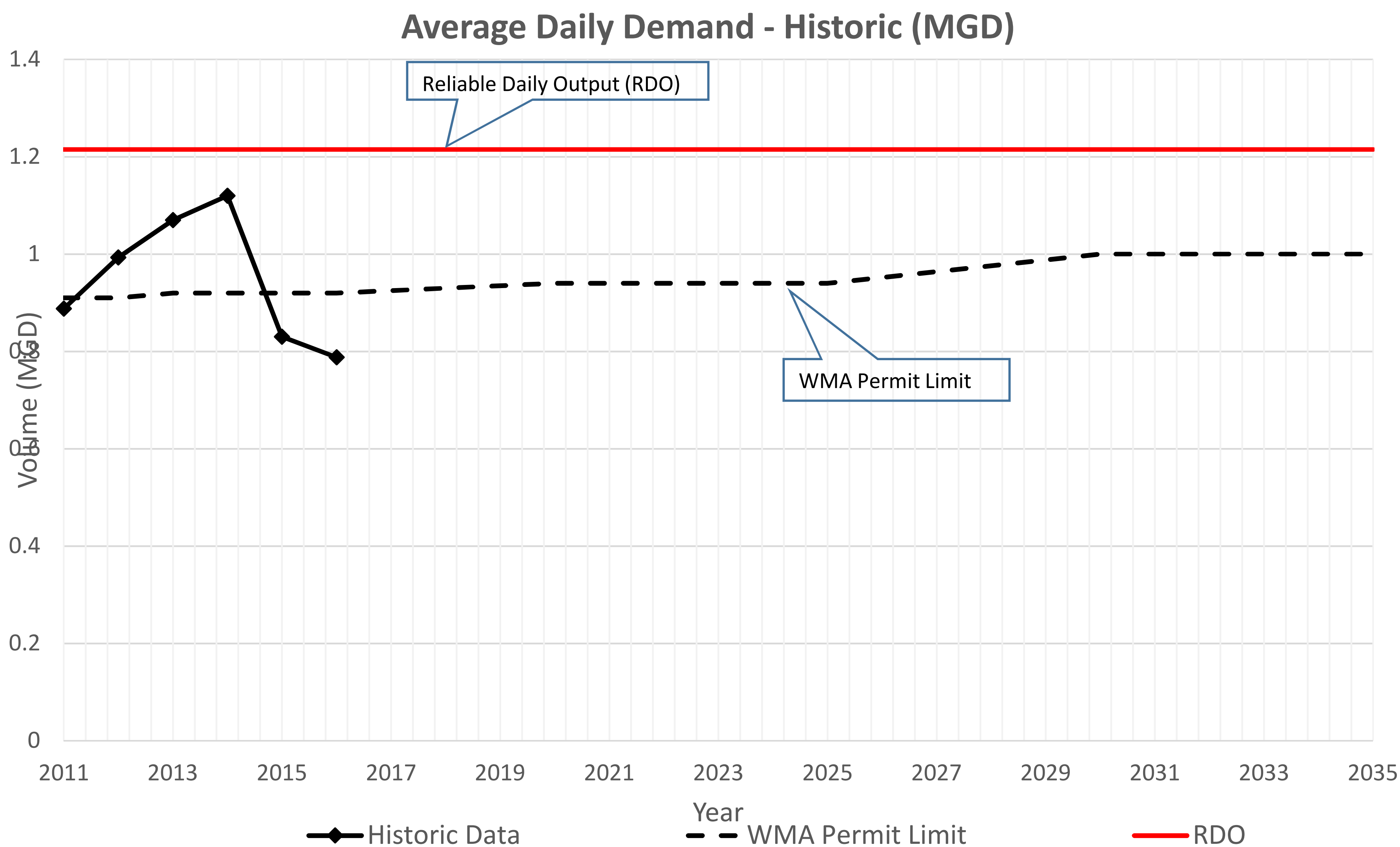
- Population
  - UMass Donahue Institute (UMDI) – Upper Bound
  - MassDOT – Lower Bound
- Residential Water Use
  - 2016: 52 gal/capita/day
- Unaccounted for Water
  - 2016: 17%

Drinking Water Projections

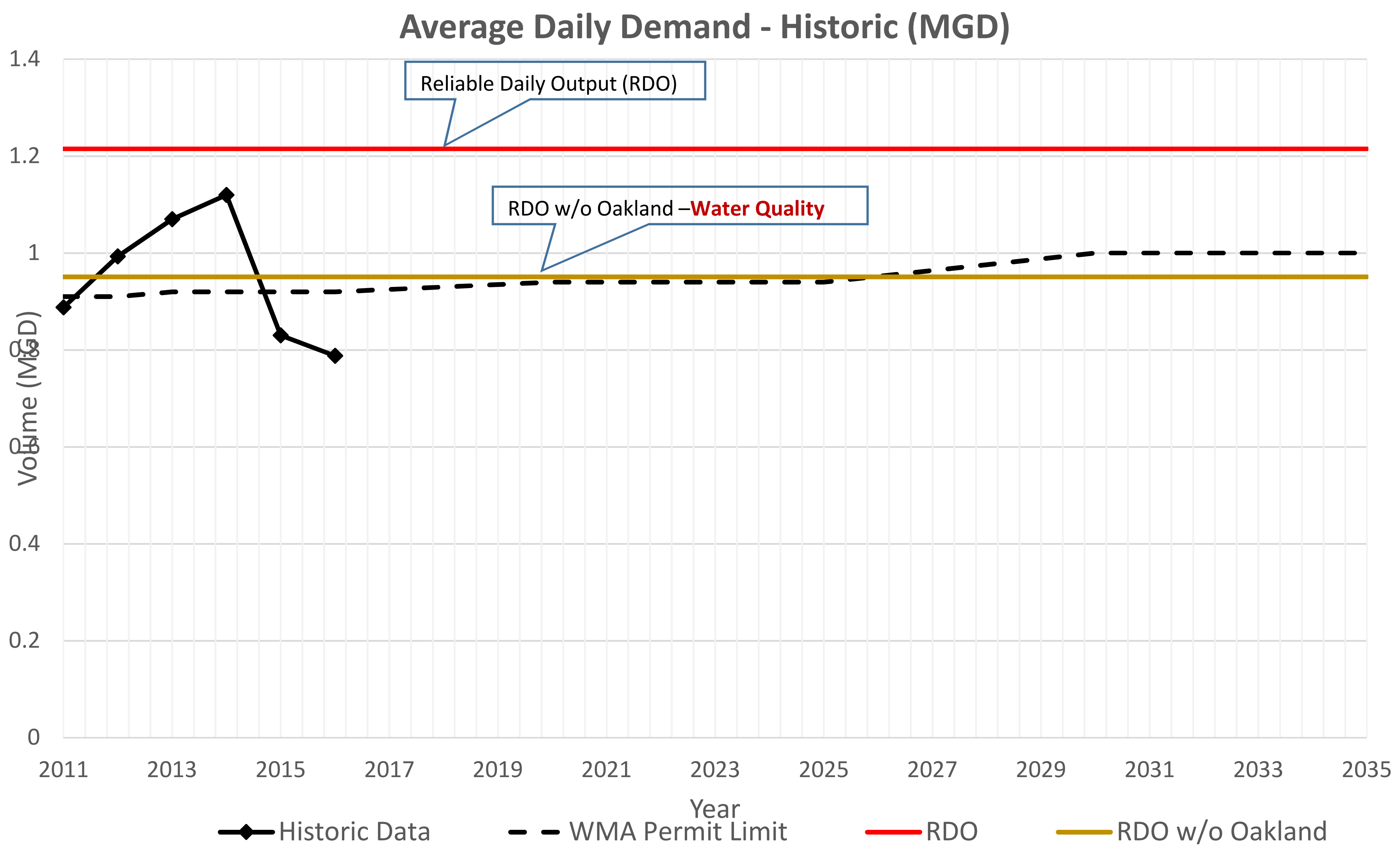
Scenario	Description	Population Projection	Year	Population	Residential Use (RGPCD)	UAW (%)
-	Baseline		2016	13259	52	17
1	Maximum Investment	UMDI	2020	13146	49	10%
			2025	13312		
			2030	13502		
			2035	13526		
2	Existing Conditions	UMDI	2020	13146	52	17%
			2025	13312		
			2030	13502		
			2035	13526		
3	Minimum Investment	UMDI	2020	13146	65	20%
			2025	13312		
			2030	13502		
			2035	13526		
4	Hybrid Scenario	UMDI	2020	13146	52	14%
			2025	13312		
			2030	13502		
			2035	13526		

Drinking Water Projections

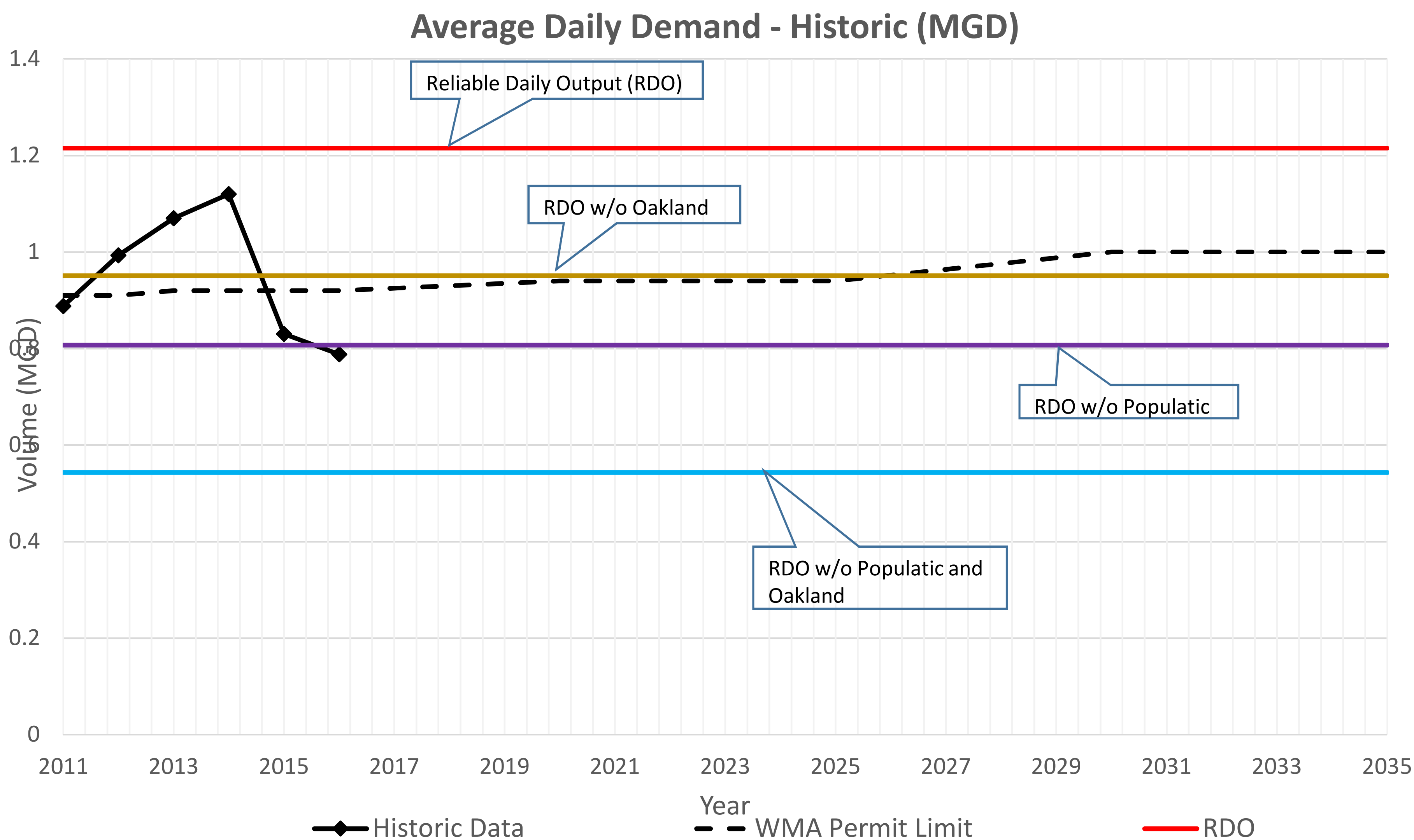
Scenario	Description	Population Projection	Year	Population	Residential Use (RGPCD)	UAW (%)
-	Baseline		2016	13259	52	17
1A	Maximum Investment	MassDOT	2020	12578	49	10%
			2025	12678		
			2030	12778		
			2035	12771		
2A	Existing Conditions	MassDOT	2020	12578	52	17%
			2025	12678		
			2030	12778		
			2035	12771		
3A	Minimum Investment	MassDOT	2020	12578	65	20%
			2025	12678		
			2030	12778		
			2035	12771		
4A	Hybrid Scenario	MassDOT	2020	12578	52	14%
			2025	12678		
			2030	12778		
			2035	12771		



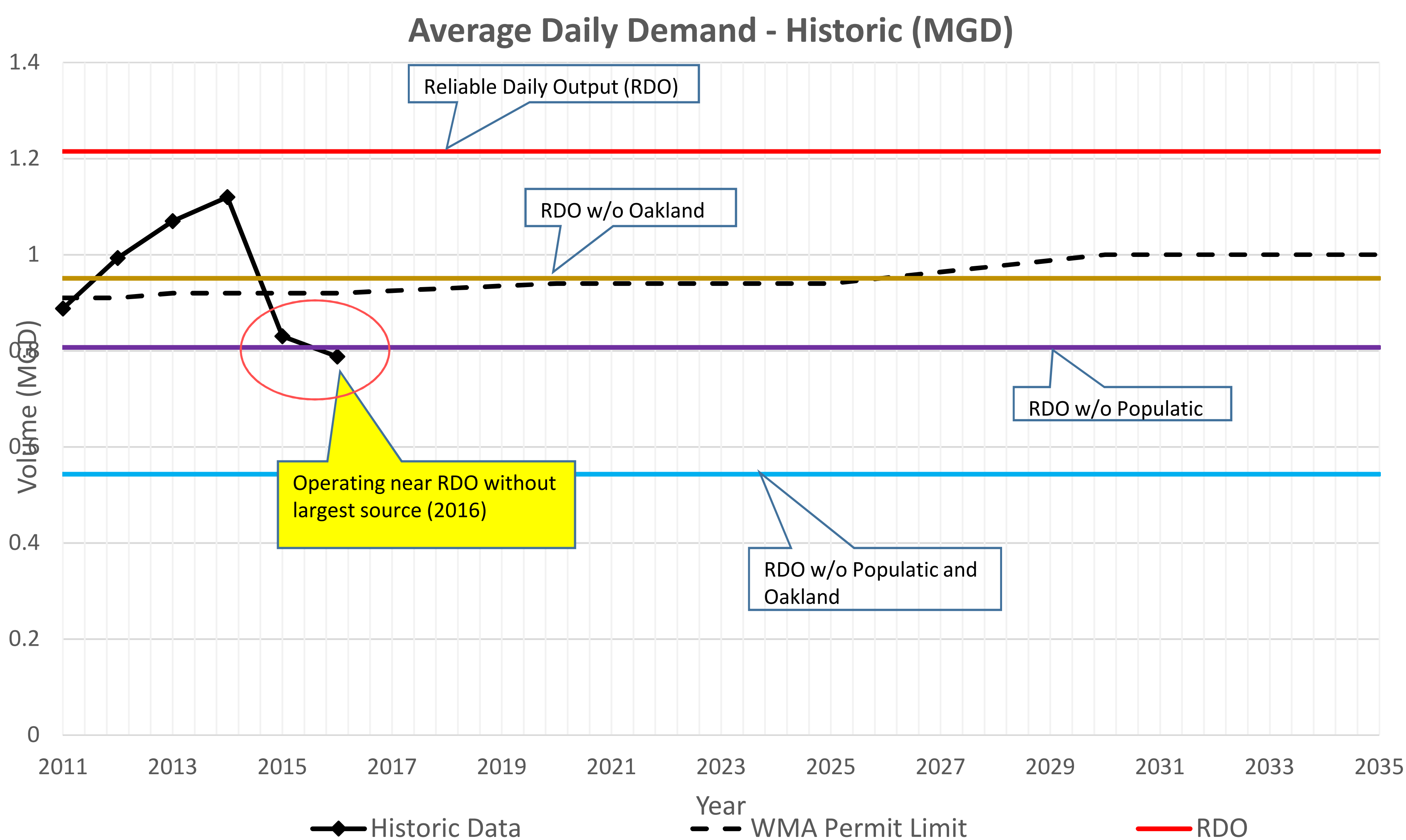
Average Daily Demand - Historic (MGD)
Reliable Daily Output (RDO)
WMA Permit Limit
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Volume (MGD)
2011
2013
2015
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
Year
Historic Data
WMA Permit Limit
RDO



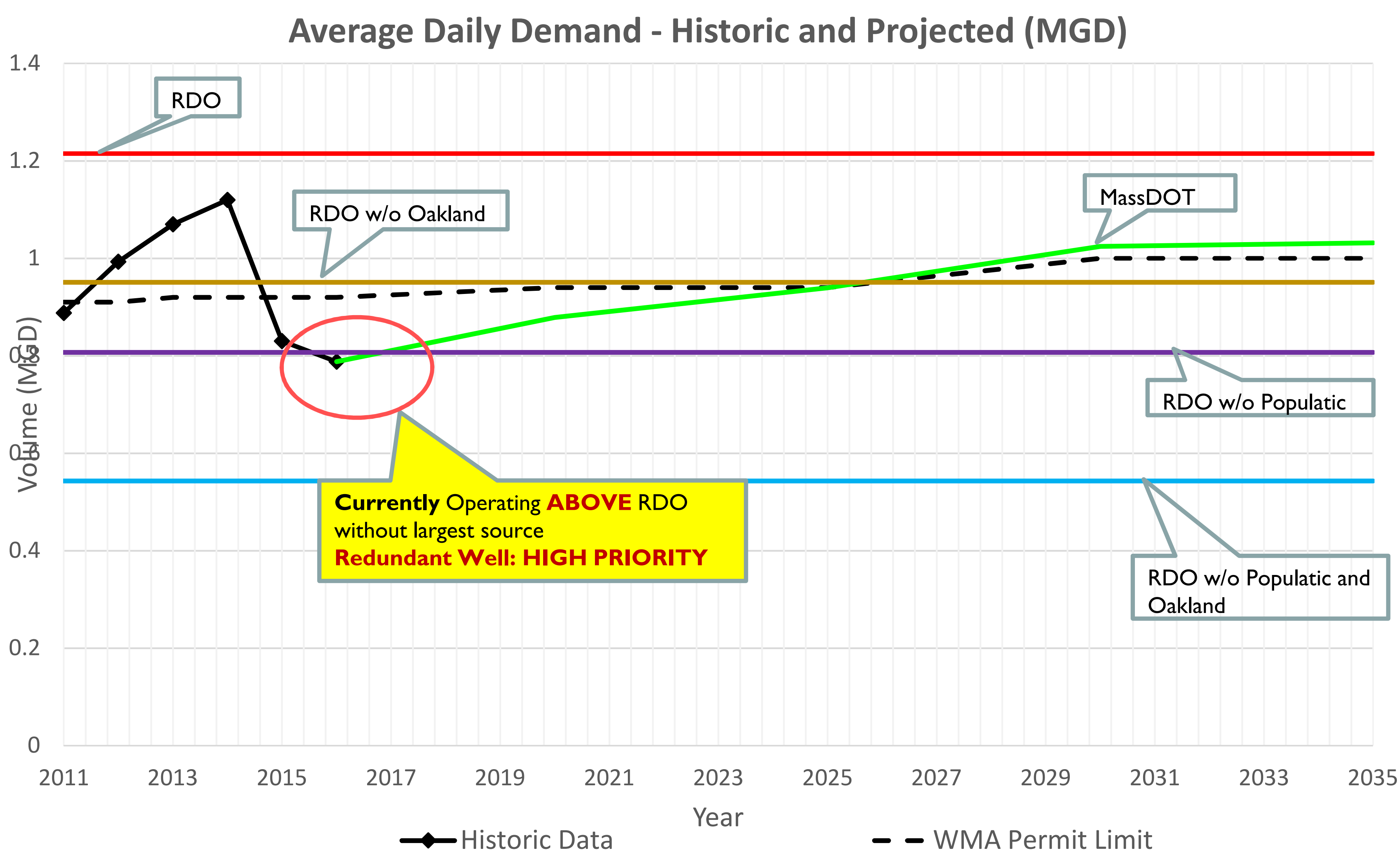
Average Daily Demand - Historic (MGD)
Reliable Daily Output (RDO)
RDO w/o Oakland –Water Quality
Volume (MGD)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2011
2013
2015
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
Year
Historic Data
WMA Permit Limit
RDO
RDO w/o Oakland

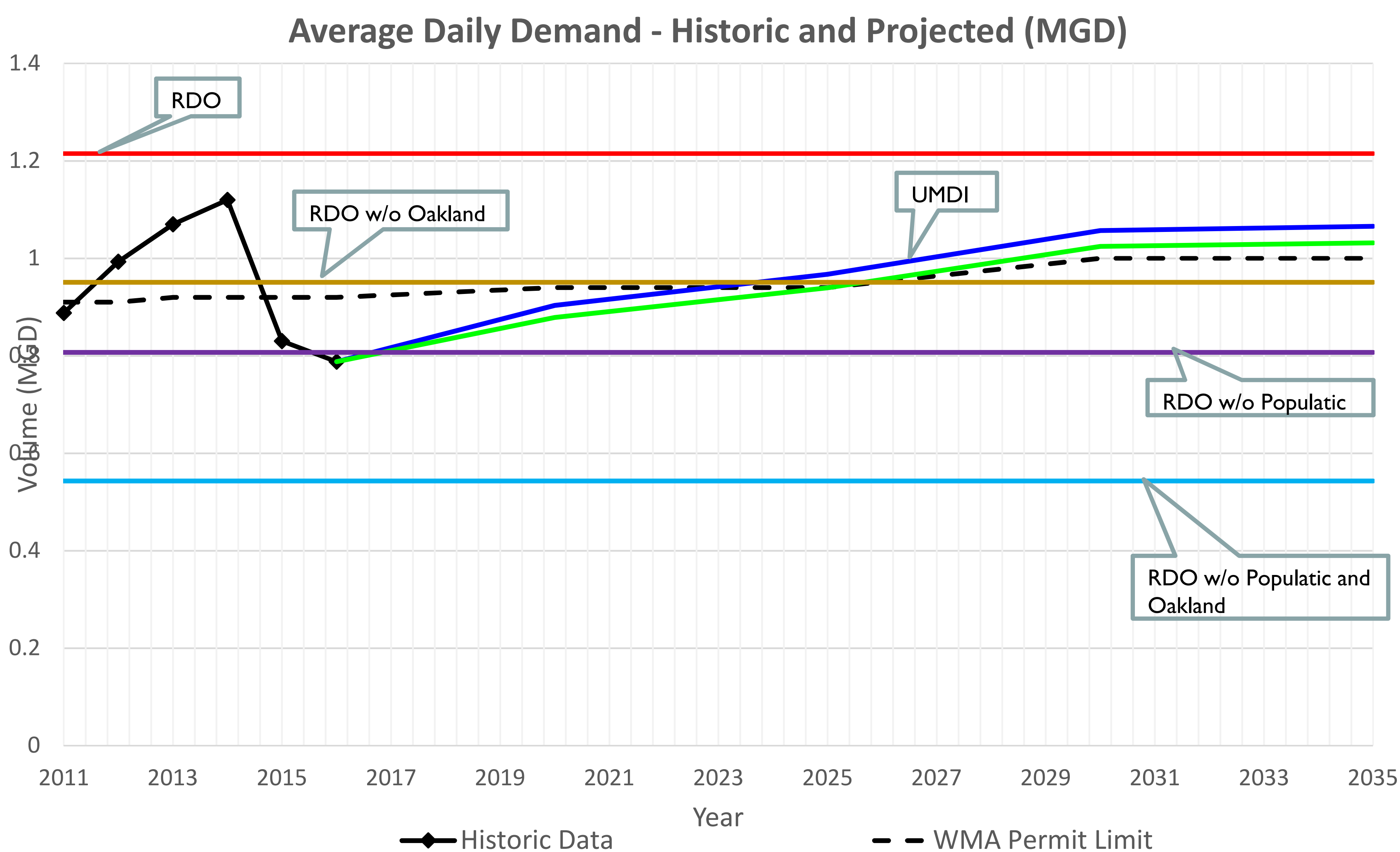


Average Daily Demand - Historic (MGD)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Volume (MGD)
Reliable Daily Output (RDO)
RDO w/o Oakland
RDO w/o Populatic
RDO w/o Populatic and Oakland
2011
2013
2015
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
Year
Historic Data
WMA Permit Limit
RDO

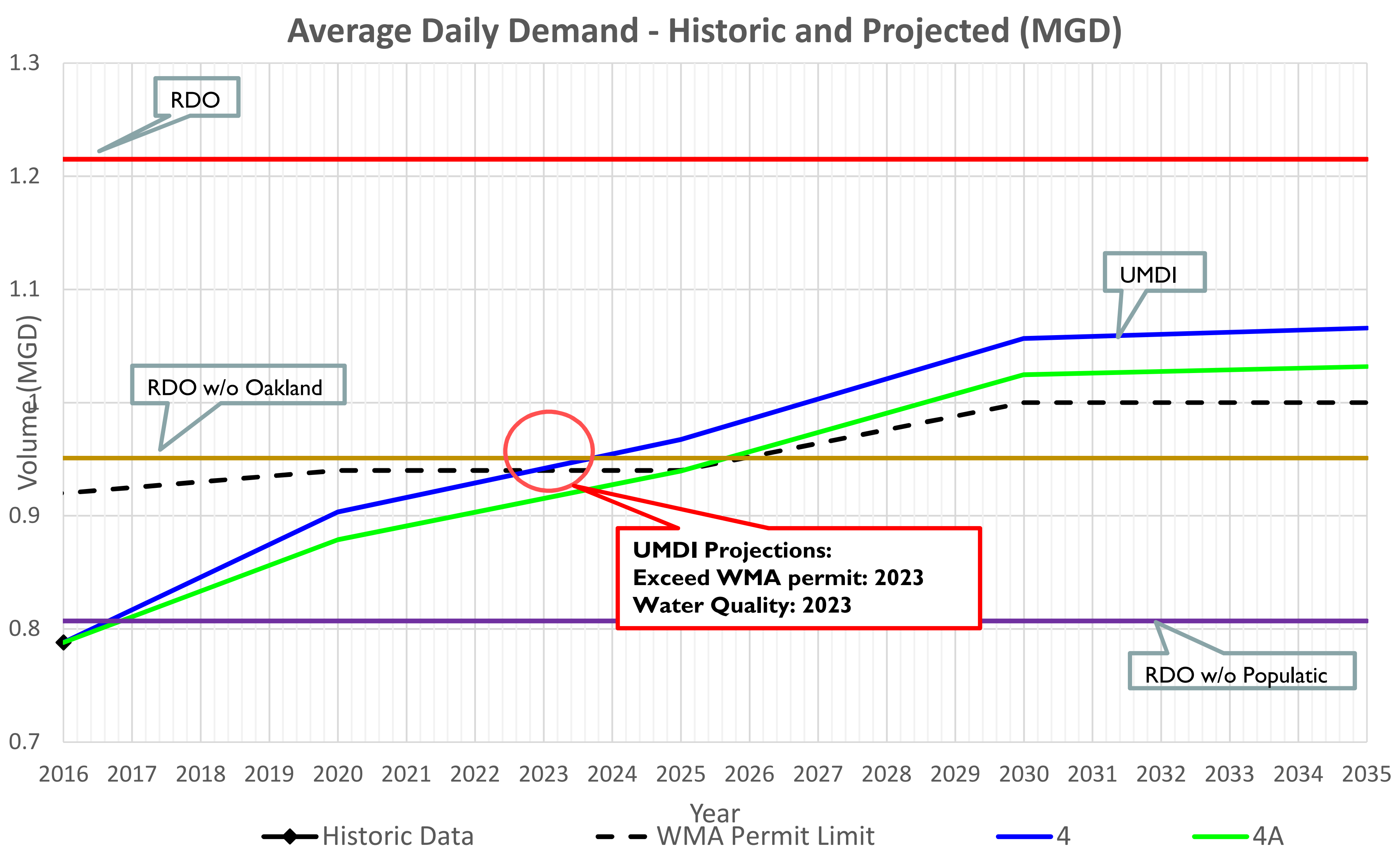


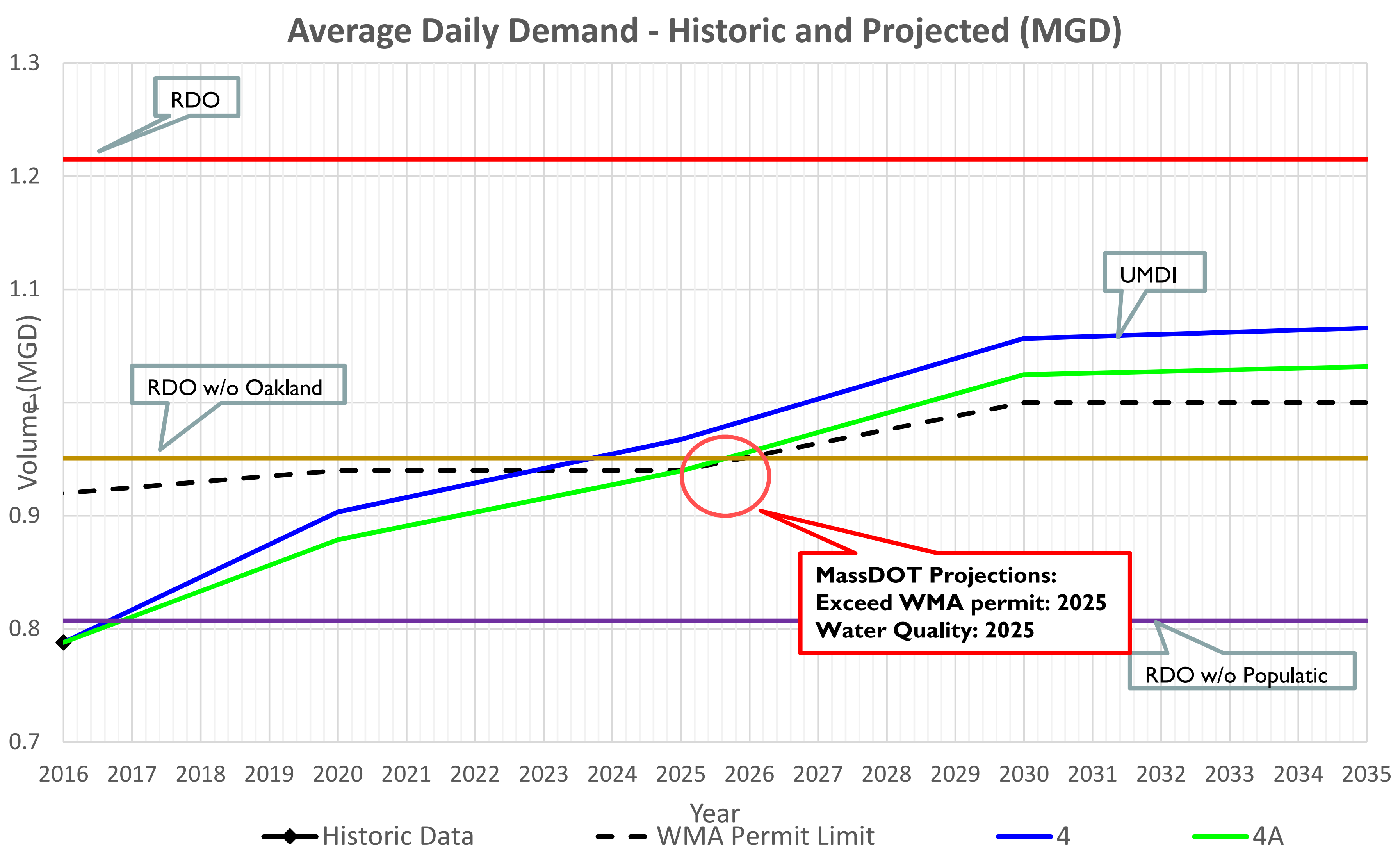
Average Daily Demand - Historic (MGD)
Reliable Daily Output (RDO)
RDO w/o Oakland
RDO w/o Populatic
Operating near RDO without largest source (2016)
RDO w/o Populatic and Oakland
Volume (MGD)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2011
2013
2015
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
Year
Historic Data
WMA Permit Limit
RDO


Average Daily Demand - Historic and Projected (MGD)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Volume (MGD)
RDO
RDO w/o Oakland
MassDOT
RDO w/o Populatic
RDO w/o Populatic and Oakland
Currently Operating ABOVE RDO without largest source
Redundant Well: HIGH PRIORITY
2011
2013
2015
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
Year
Historic Data
WMA Permit Limit



Average Daily Demand - Historic and Projected (MGD)
1.4
1.2
1
0.8
0.6
0.4
0.2
0
Volume (MGD)
2011
2013
2015
2017
2019
2021
2023
2025
2027
2029
2031
2033
2035
Year
RDO
RDO w/o Oakland
UMDI
RDO w/o Populatic
RDO w/o Populatic and Oakland
Historic Data
WMA Permit Limit

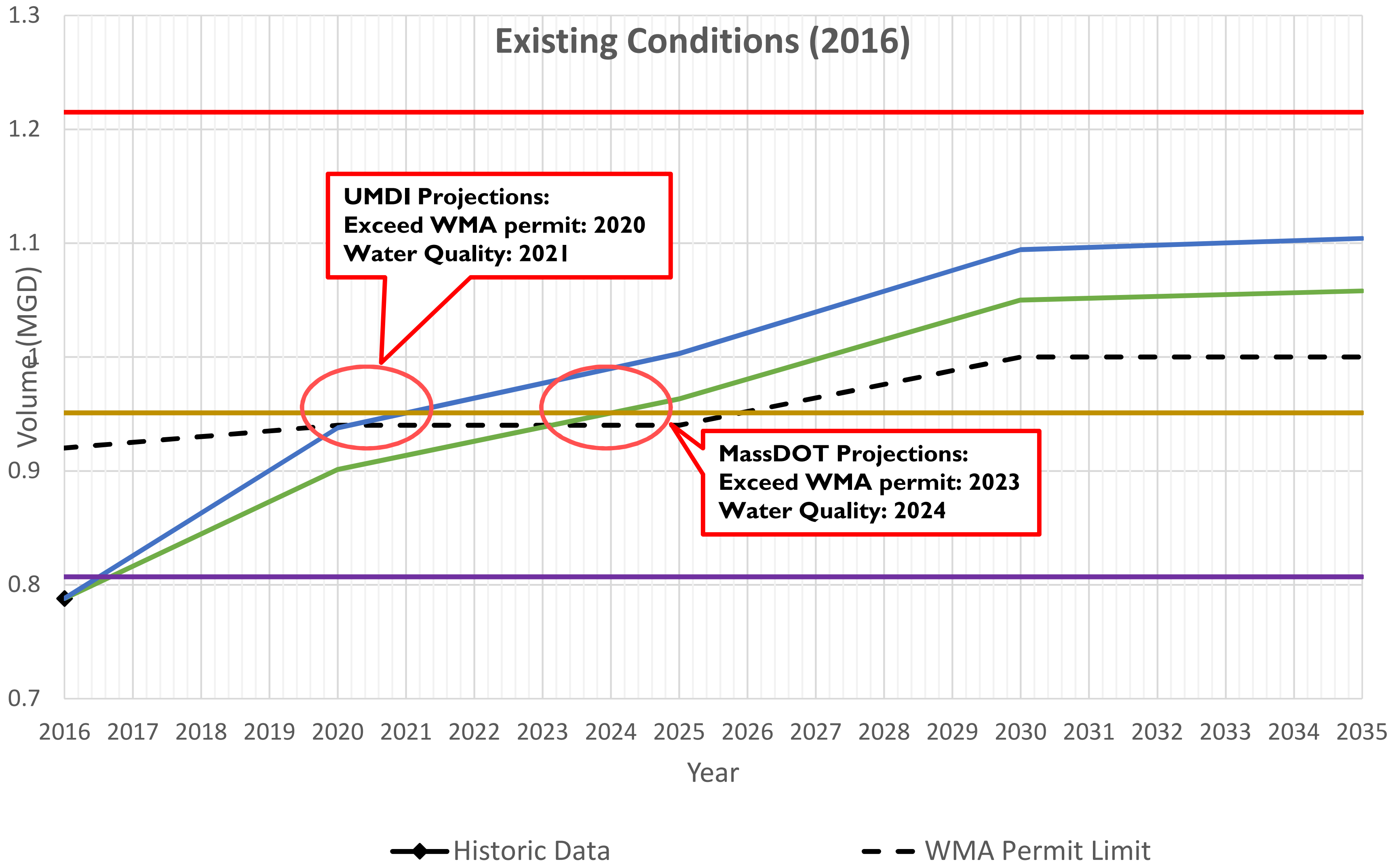

Average Daily Demand - Historic and Projected (MGD)
1.3
1.2
1.1
1
0.9
0.8
0.7
Volume (MGD)
RDO
UMDI
RDO w/o Oakland
UMDI Projections:
Exceed WMA permit: 2023
Water Quality: 2023
RDO w/o Populatic
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035
Year
Historic Data
WMA Permit Limit
4
4A



Average Daily Demand - Historic and Projected (MGD)
1.3
1.2
1.1
1
0.9
0.8
0.7
Volume (MGD)
RDO
UMDI
RDO w/o Oakland
MassDOT Projections:
Exceed WMA permit: 2025
Water Quality: 2025
RDO w/o Populatic
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
Year
Historic Data
WMA Permit Limit
4
4A

Takeaways

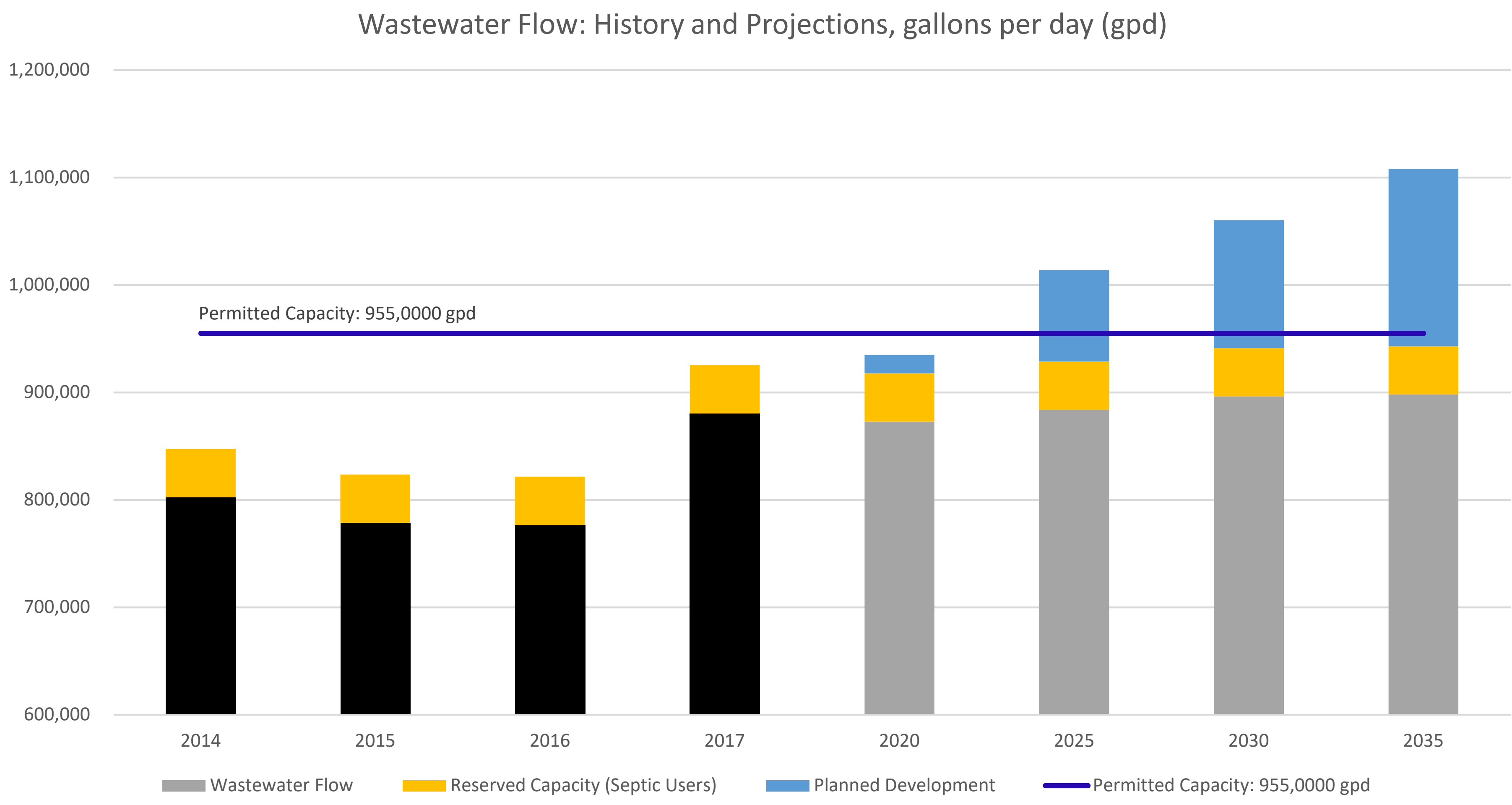
- Scenario Parameters:
  - 52 GPCD
  - 14% UAW (down from 17% in 2016)
- Redundant Well: High Priority
- WMA Permit increase: 2023 (earliest)
- Treatment at Oakland: 2023 (earliest)


Existing Conditions (2016)
UMDI Projections:
Exceed WMA permit: 2020
Water Quality: 2021
MassDOT Projections:
Exceed WMA permit: 2023
Water Quality: 2024
Volume (MGD)
1.3
1.2
1.1
1
0.9
0.8
0.7
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035
Year
Historic Data
WMA Permit Limit

Takeaways

- Scenario Parameters:
  - 52 GPCD
  - 17% UAW (22% in 2017)
- Redundant Well: High Priority
- WMA Permit increase: 2020 (earliest)
- Treatment at Oakland: 2021 (earliest)

- WMA permit increase: need to demonstrate effort to reduce UAW (functional equivalence)



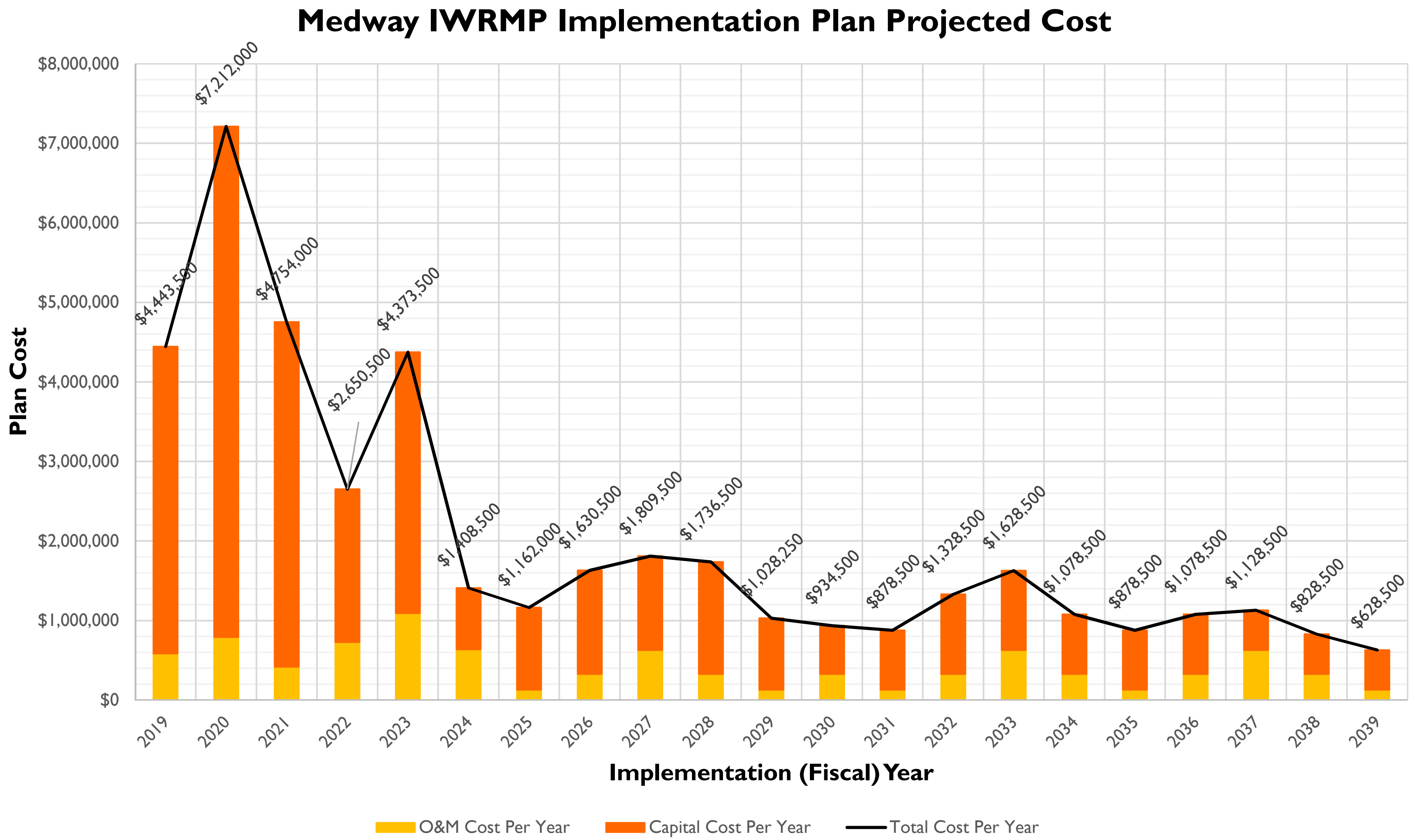
Wastewater Flow: History and Projections, gallons per day (gpd)
1,200,000
1,100,000
1,000,000
900,000
800,000
700,000
600,000
Permitted Capacity: 955,0000 gpd
2014
2015
2016
2017
2020
2025
2030
2035
Wastewater Flow
Reserved Capacity (Septic Users)
Planned Development
Permitted Capacity: 955,0000 gpd

Proposed Draft IWRMP

- Plan complements current DPS budgets/efforts
- Some efforts are one time, others annual
- Grant opportunities available
- More detail in first five years
  - Projected out to 20 years
  - Specific capital expenditures unknown for years 10-20

Proposed Draft IWRMP Implementation Chart

		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Operations and Maintenance	Install and Maintain 2 Permanent Flow Meters																					
	SSES Investigations and Rehabilitation																					
	CCTV Equipment to Support WW Operations																					
	Annual Water System Maintenance																					
	Indoor/Outdoor Water Conservation Activities																					
	Update Emergency Drinking Water Supply Plan																					
	Ongoing UAW Management Activities																					
	Enhance Water Impact Fee																					
	Lovering Tank Painting and Cleaning																					
	Highland Tank Cleaning																					
	MS4 Program Implementation and Education						?	?	?	?	?	?										
	Asset Management Updates																					
Capital Improvements	Purchase WW Treatment Capacity																					
	Limited Sewer Extensions														?			?			?	
	Town-wide Sewer System Metering																					
	Drinking Water Treatment Improvements - Design																					
	Drinking Water Treatment Improvements - Const.																					
	Drinking Water Supply Redundancy - Design																					
	Drinking Water Supply Redundancy - Construction																					
	Update Town-wide Drinking Water Hydraulic Model																					
	Construct Water System Improvements																					
	Drainage Improvements to Address Localized Flooding										?					?						
	Manage Impervious Cover																					
	Structural BMPs to Manage Stormwater Quality																					
	Town Property Stormwater Infiltration Analysis															?				?		
	Asset Management Program																					



Medway IWRMP Implementation Plan Projected Cost
Plan Cost
$8,000,000
$7,000,000
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$0
$4,443,500
$7,212,000
$4,754,000
$2,650,500
$4,373,500
$1,408,500
$1,162,000
$1,630,500
$1,809,500
$1,736,500
$1,028,250
$934,500
$878,500
$1,328,500
$1,628,500
$1,078,500
$878,500
$1,078,500
$1,128,500
$828,500
$628,500
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
Implementation (Fiscal) Year
O&M Cost Per Year
Capital Cost Per Year
Total Cost Per Year

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Proposed Draft IWRMP – O&M

IMPLEMENTATION YEARS 1-3	FY 2019	FY 2020 (Y1)	FY 2021 (Y2)	FY 2022 (Y3)
Install and Maintain 2 Permanent Flow Meters [A]		$16,000	$6,000	$6,000
SSES Investigations and Rehabilitation*		$200,000		$200,000
Update Emergency Drinking Water Supply Plan* [G]		$65,000		
Enhance Ongoing UAW Management Activities* [A, G]		$3,500	$7,500	$100,000
Annual Water System Maintenance – Wells, Flushing, Tanks* [A]	$82,500	$82,500	$82,500	$82,500
Indoor/Outdoor Water Conservation Activities* [A, G]	$15,000	$15,000	$15,000	$15,000
Enhance Existing Water Impact Fee*			$10,000	$10,000
MS4 Program Implementation and Education* [G, P]	$488,000	$411,000	$297,000	$315,000
O&M Cost Per Year:	***$585,500***	***$793,000***	***$418,000***	***$728,500***

A – Includes Annual Cost
G – Grant Funding Available
P – Budget Follows Permit Period
S – SRF Funding Available
* – Current Town Effort

Proposed Draft IWRMP - Capital

IMPLEMENTATION YEARS 1-3	**FY 2019**	**FY 2020 (Y1)**	**FY 2021 (Y2)**	**FY 2022 (Y3)**
Purchase WW Treatment Capacity (up to 300,000 gpd)	$2-3M			
Drinking Water Treatment Improvements - Design [S]	$170,000	$1,608,000	$732,000	
Drinking Water Treatment Improvements - Construction [S]	$688,000	$4,219,000	$3,029,000	
Drinking Water Supply Redundancy - Design [S]		$101,000		$226,000
Drinking Water Supply Redundancy - Construction [S]		$366,000		$1,121,000
Update Town-wide Drinking Water Hydraulic Model		$50,000		
Water Distribution System Improvements [A, S]			$500,000	$500,000
Develop Asset Management Program [G]		$75,000	$75,000	$75,000
Capital Cost Per Year:	***$3,858,000***	***$6,419,000***	***$4,336,000***	***$1,922,000***
Total Cost Per Year:	**$4,443,500**	**$7,212,000**	**$4,754,000**	**$2,650,500**

A – Includes Annual Cost
G – Grant Funding Available
P – Budget Follows Permit Period
S – SRF Funding Available
* – Current Town Effort

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Proposed Draft IWRMP

IMPLEMENTATION YEARS 4-6	**FY 2023 (Y4)**	**FY 2024 (Y5)**	**FY 2025 (Y6)**
Maintain 2 Permanent Flow Meters [A]	$6,000	$6,000	$6,000
Purchase CCTV Equipment to Support WW Operations	$150,000		
SSES Investigations and Rehabilitation*		$200,000	
Annual Water System Maintenance – Wells, Flushing, Tanks* [A]	$82,500	$82,500	$82,500
Indoor/Outdoor Water Conservation Activities* [A, G]	$15,000	$15,000	$15,000
Lovering Water Tank Painting and Cleaning*	$500,000		
MS4 Program Implementation and Education* [G, P]	$315,000	$310,000	?
Asset Management Updates [G]	$25,000	$25,000	$25,000
O&M Cost Per Year:	***$1,093,500***	***$638,500***	***$128,500***

A – Includes Annual Cost
G – Grant Funding Available
P – Budget Follows Permit Period
S – SRF Funding Available
* – Current Town Effort

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Proposed Draft IWRMP

IMPLEMENTATION YEARS 4-6	**FY 2023 (Y4)**	**FY 2024 (Y5)**	**FY 2025 (Y6)**
Drinking Water Treatment Improvements - Design [S]	$389,000		
Drinking Water Treatment Improvements - Construction [S]	$1,664,000		
Drinking Water Supply Redundancy - Design [S]	$94,000		
Drinking Water Supply Redundancy - Construction [S]	$283,000		
Water Distribution System Improvements [A, S]	$500,000	$750,000	$1,000,000
Structural BMPs to Manage Stormwater Quality [G]			$33,500
Drainage Improvements to Address Localized Flooding [S]	$320,000		
Manage Impervious Cover - Policy	$30,000	$20,000	
Capital Cost Per Year:	***$3,280,000***	***$770,000***	***$1,033,500***
Total Cost Per Year:	**$4,373,500**	**$1,408,500**	**$1,162,000**

A – Includes Annual Cost
G – Grant Funding Available
P – Budget Follows Permit Period
S – SRF Funding Available
* – Current Town Effort

IMPLEMENTATION YEARS 7-10	FY 2026 (Y7)	FY 2027 (Y8)	FY 2028 (Y9)	FY 2029 (Y10)
Maintain 2 Permanent Flow Meters [A]	$6,000	$6,000	$6,000	$6,000
SSES Investigations and Rehabilitation*	$200,000		$200,000	
Annual Water System Maintenance – Wells, Flushing, Tanks* [A]	$82,500	$82,500	$82,500	$82,500
Indoor/Outdoor Water Conservations Activities* [A, G]	$15,000	$15,000	$15,000	$15,000
Highland Tank Cleaning*		$500,000		
Asset Management Implementation [G]	$25,000	$25,000	$25,000	$25,000
O&M Cost Per Year:	***$328,500***	***$628,500***	***$328,500***	***$128,500***
Limited Sewer Extensions		$175,000	$350,000	$393,750
Water Distribution System Improvements [A, S]	$1,250,000	$1,000,000	$1,000,000	$500,000
Structural BMPs to Manage Stormwater Quality [G]	$46,000		$52,000	
Town Property Stormwater Infiltration Analysis [G]	$6,000	$6,000	$6,000	$6,000
Capital Cost Per Year:	***$1,302,000***	***$1,175,000***	***$1,402,000***	***$899,750***
Total Cost Per Year:	**$1,630,500**	**$1,809,500**	**$1,736,500**	**$1,028,250**

A – Includes Annual Cost
G – Grant Funding Available
P – Budget Follows Permit Period
S – SRF Funding Available
* – Current Town Effort

IMPLEMENTATION YEARS 11-15	**FY 2030 (Y11)**	**FY 2031 (Y12)**	**FY 2032 (Y13)**	**FY 2033 (Y14)**	**FY 2034 (Y15)**
Maintain 2 Permanent Flow Meters [A]	$6,000	$6,000	$6,000	$6,000	$6,000
SSES Investigations and Rehabilitation*	$200,000		$200,000		$200,000
Annual Water System Maintenance* [A]	$82,500	$82,500	$82,500	$82,500	$82,500
Indoor/Outdoor Water Conservation* [A, G]	$15,000	$15,000	$15,000	$15,000	$15,000
Lovering Water Tank Painting and Cleaning				$500,000	
Asset Management Updates [G]	$25,000	$25,000	$25,000	$25,000	$25,000
O&M Cost Per Year:	***$328,500***	***$128,500***	***$328,500***	***$628,500***	***$328,500***
Town-wide Sewer System Metering [G]	$50,000				
Update Town-wide Drinking Water Hydraulic Model [G]	$50,000				
Water Distribution System Improvements [A, S]	$500,000	$750,000	$1,000,000	$1,000,000	$750,000
Structural BMPs Analysis [G]	$6,000				
Capital Cost Per Year:	***$606,000***	***$750,000***	***$1,000,000***	***$1,000,000***	***$750,000***
Total Cost Per Year:	**$934,500**	**$878,500**	**$1,328,500**	**$1,628,500**	**$1,078,500**

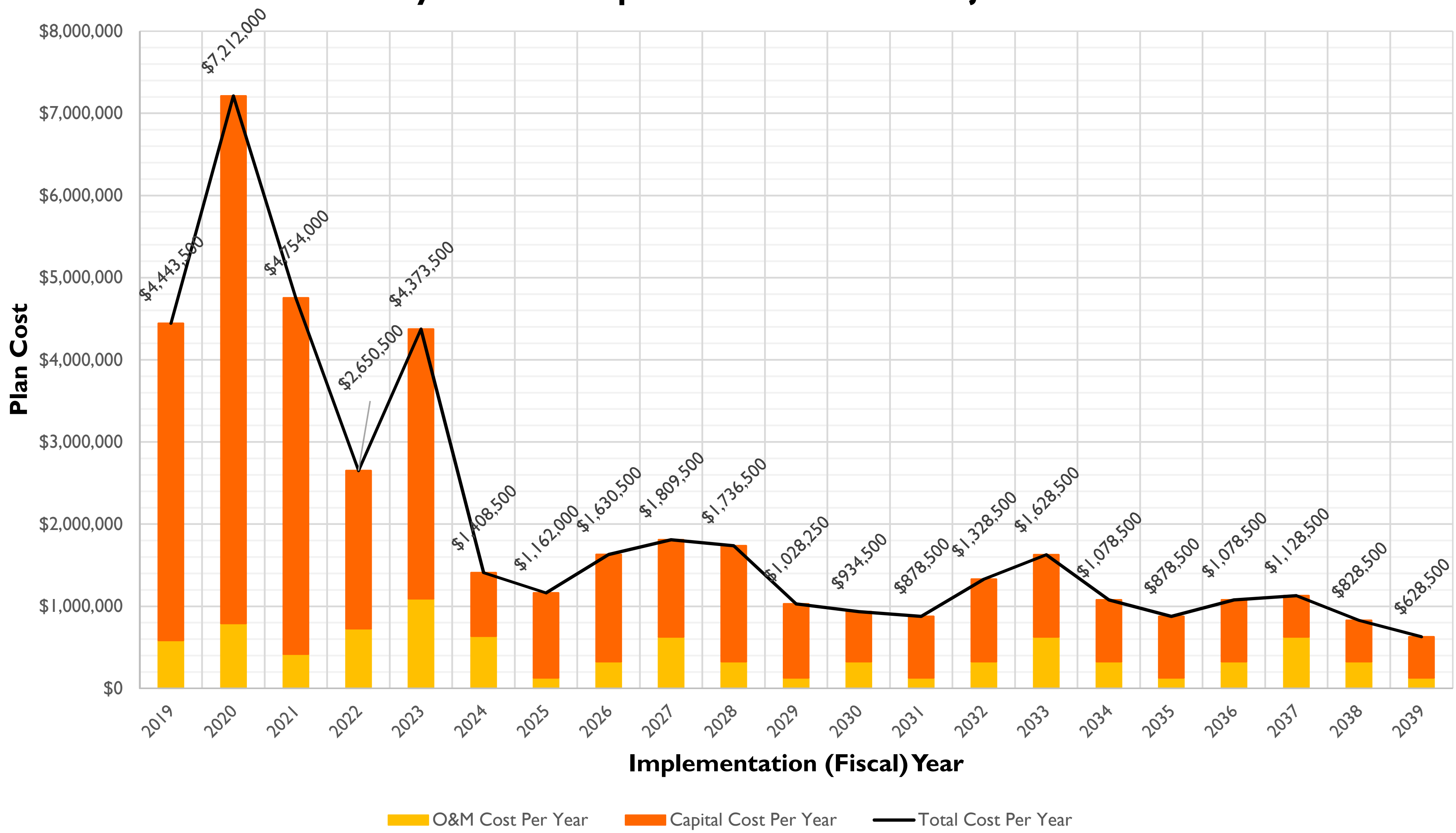
A – Includes Annual Cost
G – Grant Funding Available
P – Budget Follows Permit Period
S – SRF Funding Available
* – Current Town Effort

IMPLEMENTATION YEARS 16-20	FY 2035 (Y16)	FY 2036 (Y17)	FY 2037 (Y18)	FY 2038 (Y19)	FY 2039 (Y20)
Maintain 2 Permanent Flow Meters [A]	$6,000	$6,000	$6,000	$6,000	$6,000
SSES Investigations and Rehabilitation*		$200,000		$200,000	
Annual Water System Maintenance* [A]	$82,500	$82,500	$82,500	$82,500	$82,500
Indoor/Outdoor Water Conservation* [A, G]			$500,000		
Highland Water Tank Cleaning*	$15,000	$15,000	$15,000	$15,000	$15,000
Asset Management Updates [G]	$25,000	$25,000	$25,000	$25,000	$25,000
O&M Cost Per Year:	***$128,500***	***$328,500***	***$628,500***	***$328,500***	***$128,500***
Water Distribution System Improvements [A, S]	$750,000	$750,000	$500,000	$500,000	$500,000
Capital Cost Per Year:	***$750,000***	***$750,000***	***$500,000***	***$500,000***	***$500,000***
Total Cost Per Year:	**$878,500**	**$1,078,500**	**$1,128,500**	**$828,500**	**$628,500**

A – Includes Annual Cost
G – Grant Funding Available
P – Budget Follows Permit Period
S – SRF Funding Available
* – Current Town Effort

KLEINFELDER
Bright People. Right Solutions.

Medway IWRMP Implementation Plan Projected Cost



How to Present Plan

- Board of Selectmen
  - Focus on implementation plan
  - Discuss water and wastewater projections
- Public
  - More background information
  - Water and wastewater projections
  - Big picture spending

Next Steps Summary

Next Steps

- Incorporate Task Force Feedback
- Present Draft to Selectmen
- Present to Public
- DPS Review of Draft IWRMP
- Submit Draft IWRMP to DEP (June)

Integrated Water Resources Management Plan

Thank you for your time!

APPENDIX B

Flow Metering Assessment Technical Memorandum

MEMORANDUM

TO: David D’Amico, DPS Director, Town of Medway

FROM: Adria Fichter and Cecilia Carmona, Kleinfelder

DATE : August 21, 2018

SUBJECT: DRAFT Medway Flow Metering Assessment

CC: Laura Nolan and Kirsten Ryan, Kleinfelder

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1 INTRODUCTION

The purpose of this technical memorandum is to document the results of a flow metering program undertaken by the Town of Medway’s Department of Public Services (DPS). Through the development of an Integrated Water Resources Management Plan (IWRMP), the Town determined that metering the entire system was necessary to document the needs of the wastewater collection system and allow for long term planning for wastewater needs. This I/I analysis includes a summary and analysis of the flow metering results to identify excessive I/I sources within the collection system in accordance with MassDEP’s request for municipalities to submit an I/I analysis (314 CMR 12.04(2)). This technical memorandum provides a summary of past and current I/I investigations, analysis and removal work completed through various system-wide programs.

1.1 EXISTING WASTEWATER SYSTEM

Medway’s wastewater collection system was first developed in 1977, and presently serves the central and southern areas of Town, with sections extending to the northern portion of Town, as shown in Figure 1-1. The Town owns and operates the separate municipal wastewater system, which serves approximately 65 percent of the community. The remaining 35 percent has standard, on-site wastewater disposal systems, often referred to as septic systems. Flow from the wastewater system generally flows to the southeast, ultimately discharging at the Charles River Pollution Control District (CRPCD) wastewater treatment plant.

As shown in Figure 1-1, Medway’s wastewater collection system consists of:

- Approximately 55 miles of gravity sewer pipes, ranging in diameter from 6 to 54 inches.

- Approximately 1,385 sewer manholes.
- One (1) wastewater submersible pumping station that uses duplex pumps to move wastewater from gravity sewers in low lying areas to gravity sewers in higher areas.
- 2,644 linear feet of force main, 6-inch diameter, to convey wastewater from the pump station to downstream gravity sewer.
- Two (2) major interceptors that collect and convey wastewater to the Charles River Pollution Control District (CRPCD) wastewater treatment plant (WWTP): the 24-inch diameter Oakland Street interceptor and the 24-inch to 54-inch diameter Chicken Brook interceptor.

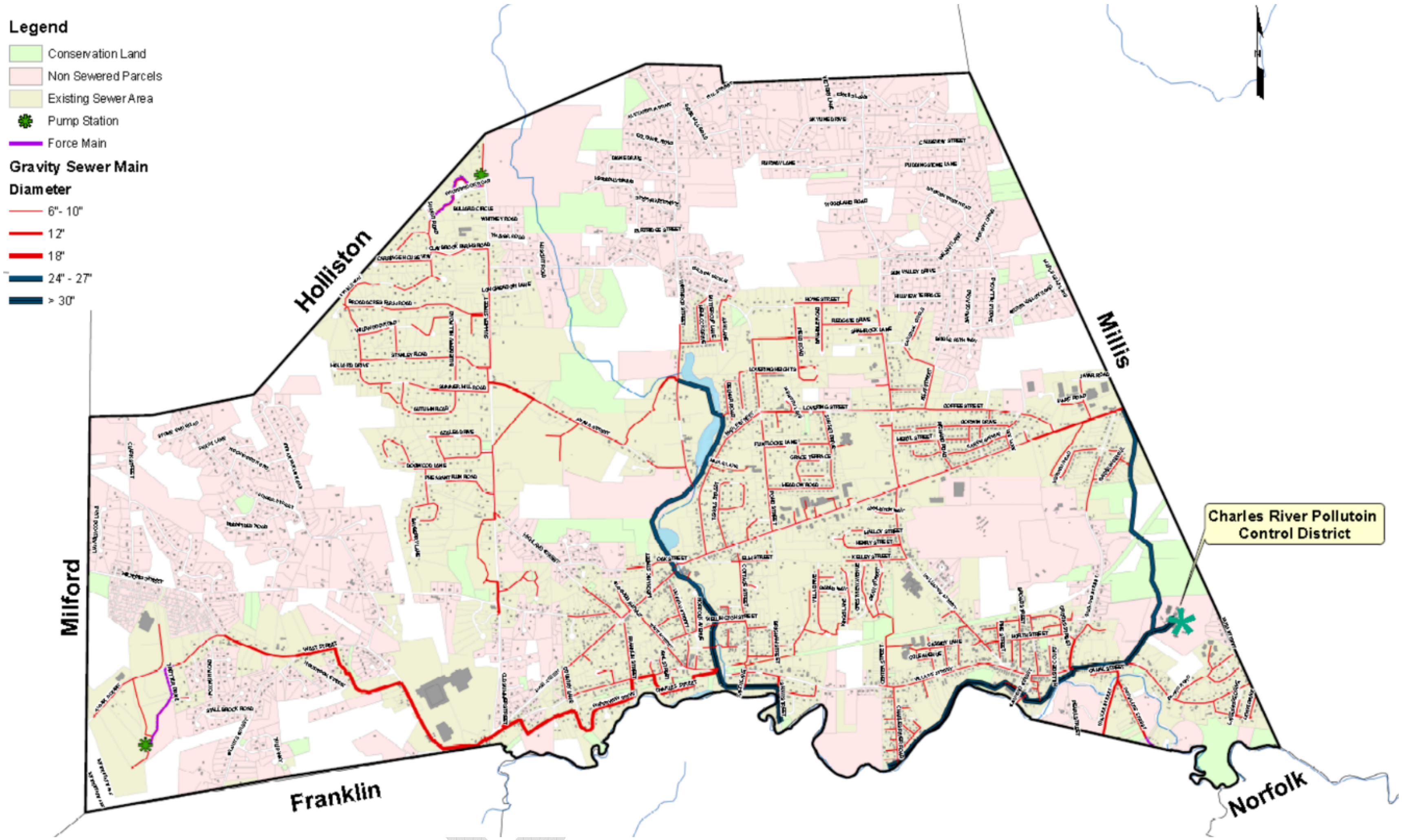

Figure 1-1 Wastewater Collection System in Medway, MA

1.2 PERMANENT FLOW METER

Most of the wastewater flow from Medway is measured by the CRPCD. Flow meters at the WWTP measure influent wastewater flow, and Medway's contribution is determined by subtracting the total flow discharging to the CRCPD WWTP from the metered flows from neighboring communities. Flow from the Oakland Street interceptor currently discharges to the CRPCD WWTP unmetered and is estimated by the CRPCD. Medway typically contributes 17 percent of the flow to the CRPCD WWTP. In the past three (3) years, the maximum daily flow was 1.41 MGD and the average flow was 0.79 MGD.

1.3 FLOW METER PROGRAM

For documenting infiltration and inflow within the collection system, Kleinfelder, Inc. (Kleinfelder) developed a flow metering program that included fifteen (15) flow meters for a period of eight (8) weeks, from October 12th to December 7th, 2017. The location of the flow meters is shown in Figure 1-2. While this metering period did not coincide with the typical spring, high groundwater, period the timing of the metering program was needed to support the IWRMP effort. As such, the I/I analysis presented herein represents an initial evaluation of the Town's I/I potential, with recommendations included in Section 3 to be incorporated into the IWRMP.

1.3.1 Rainfall Monitoring

The flow metering effort also included installation of two (2) rain gauges at the Trotter Sewer Pump Station and at the Water Department. The location of the flow meters and rain gauges is shown in Figure 1-2.

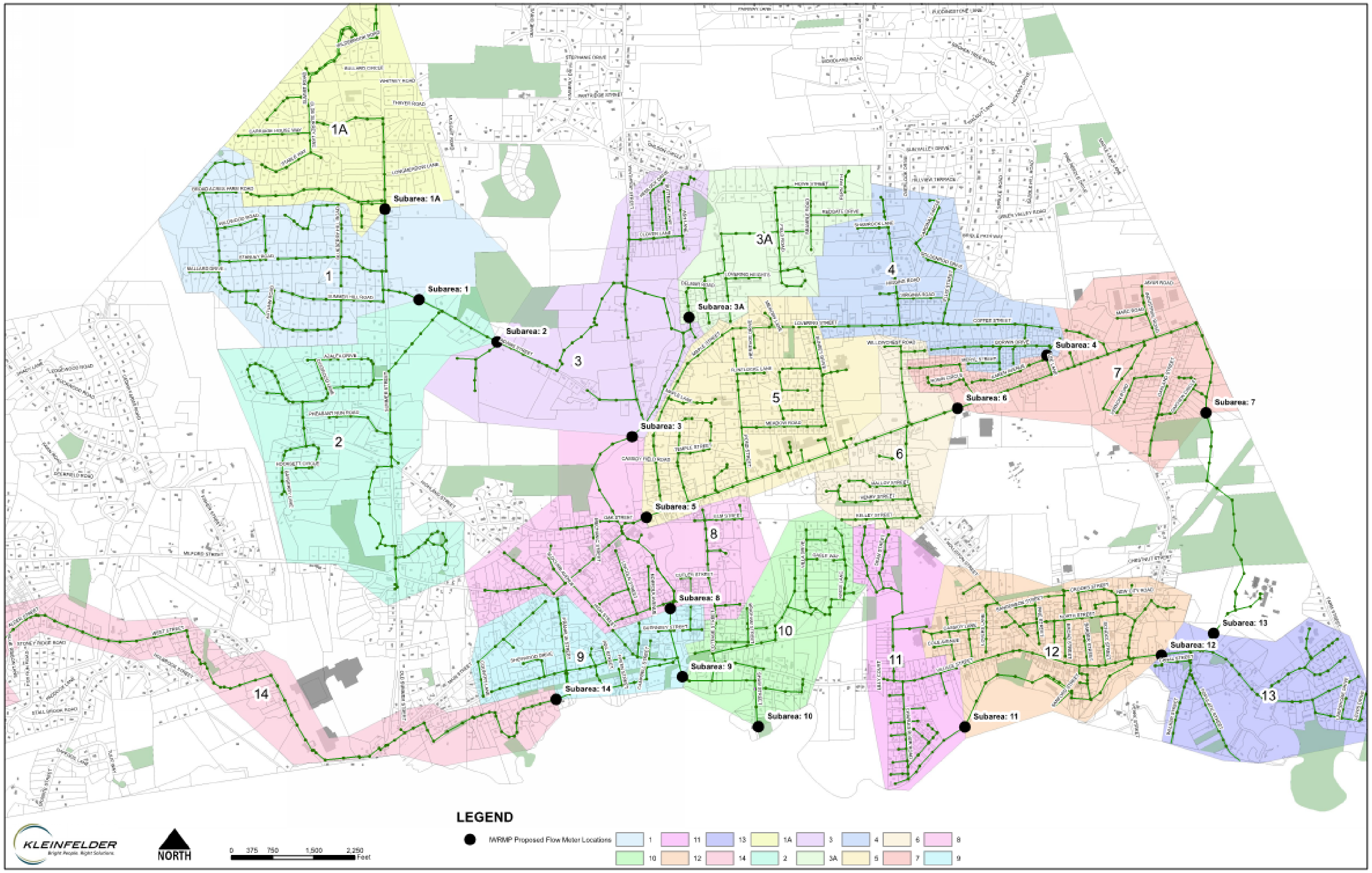

Figure 1-2 Rain Gauge Locations and Flow Meter Areas

1.4 FLOW SCHEMATIC

Each of the flow meter locations was selected to capture a specific subarea, the portion of the sewer system upstream of the monitoring manhole. Schematically, Figure 1-3 shows the relationship of the subareas. Flow to the CRPCD from Medway also includes flow from neighboring towns, Franklin and Millis. Contributing flow from these towns into each subarea is indicated in the schematic below.

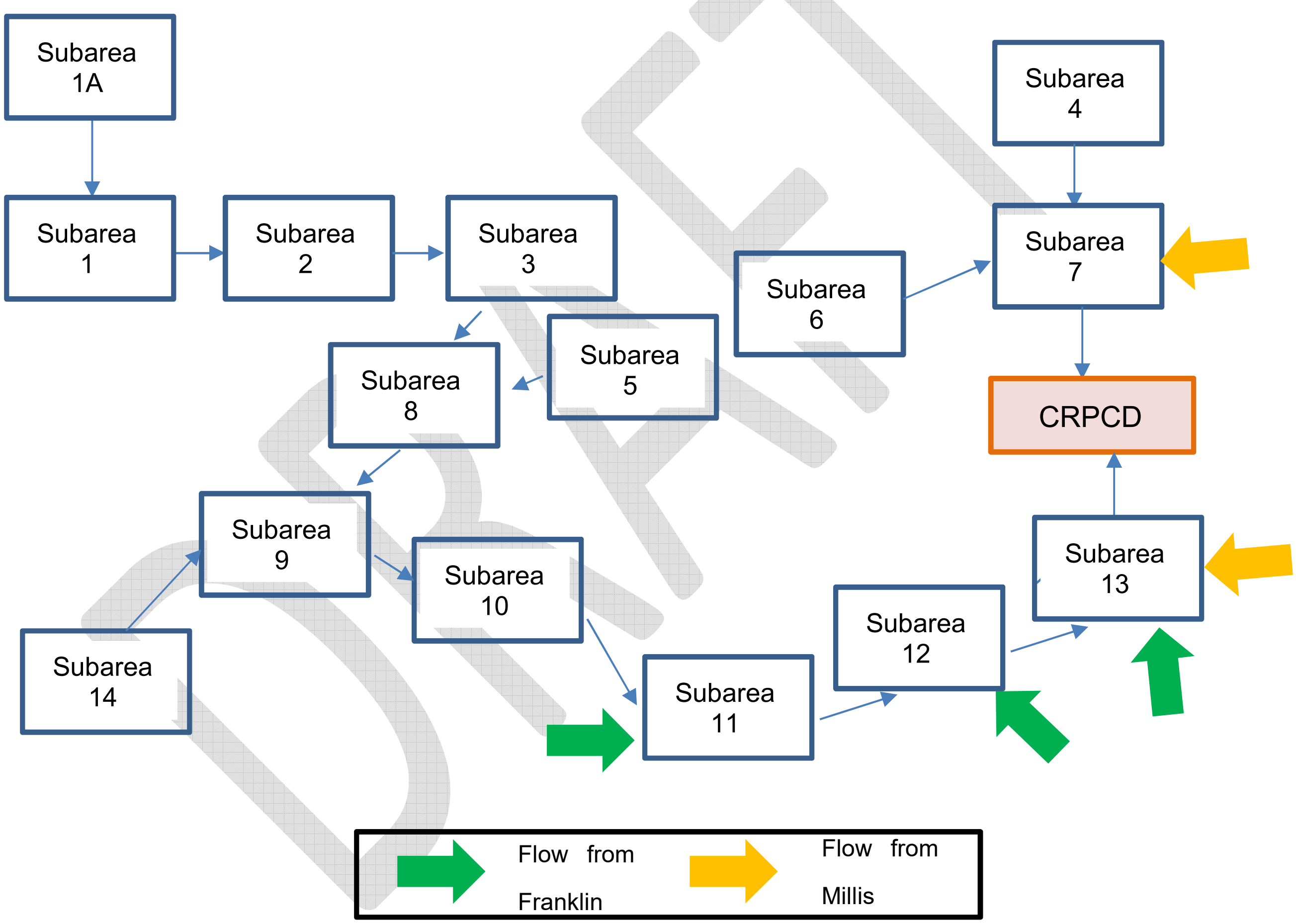

Figure 1-3 Flow Meter Schematic

1.5 GROUNDWATER MONITORING

Kleinfelder obtained groundwater data from the most proximate USGS groundwater monitoring point in Norfolk (USGS 420545071174001 MA-NNW 27 Norfolk, MA). The analysis included a review of average groundwater levels from September 2001 through June 2017 to identify the extent of seasonal variability in groundwater. Figure 1-4 presents the monthly average groundwater levels during the fifteen (15) years of historical record, with bars representing the standard deviations in the groundwater level data. The seasonal variability indicates that the groundwater levels during the temporary flow monitoring period from October to December is approximately 0.4 feet lower than the average spring (April-June) groundwater levels. The selection of this metering period was dependent on the IWRMP schedule, which required the needs analysis to be completed by December 2017. The metering period selected was not during the ideal period for I/I analyses as prescribed by MassDEP, therefore the I/I analysis and conclusions below discuss the limitations of this data.

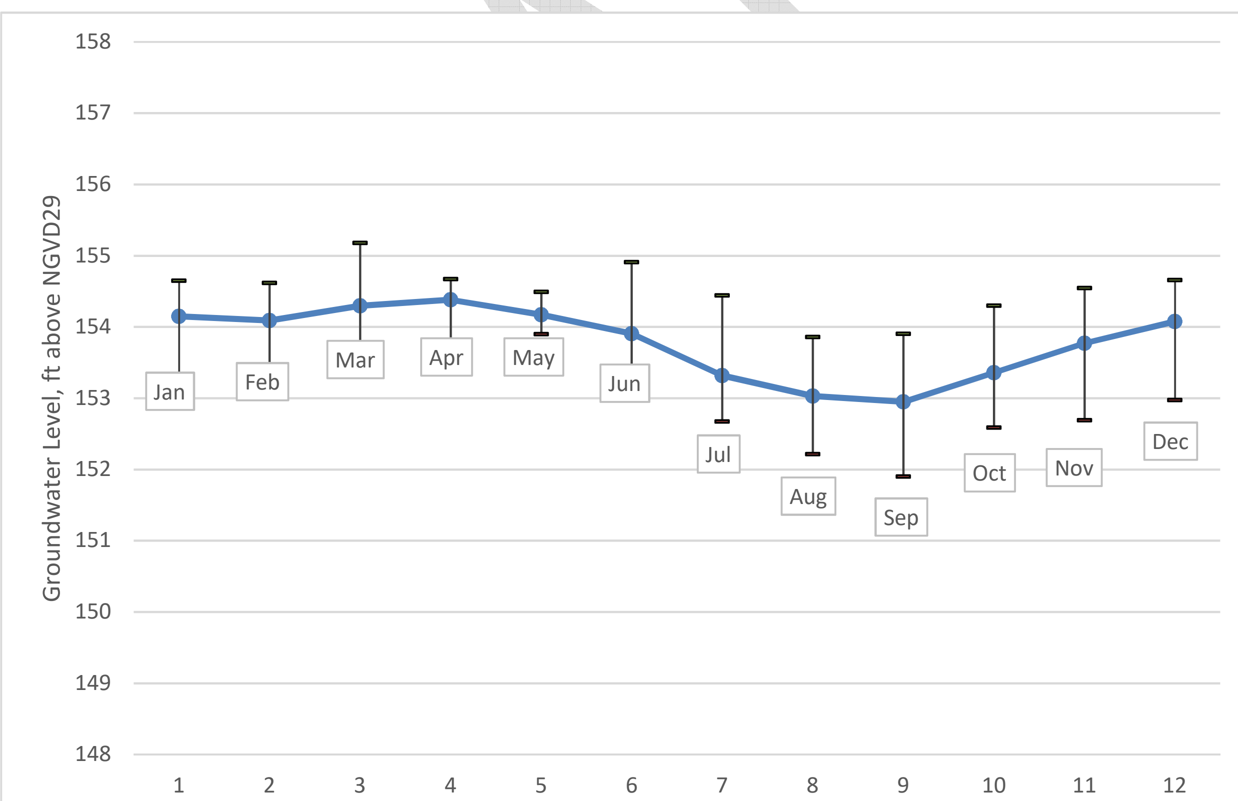

Figure 1-4 Monthly Average Groundwater Levels, September 2001 - June 2017

2 INFILTRATION AND INFLOW ANALYSIS

This section provides a summary of the estimated I/I within the collection system. The analysis references MassDEP's *Guidelines for Performing Infiltration/Inflow Analyses and Sewer System Evaluation Surveys (Guidelines)*.

2.1 INFILTRATION ANALYSIS

Infiltration is extraneous water that enters a sewer system from the ground from leaks in the system from defective pipes, pipe joints, connections, or manholes. Groundwater infiltration occurs where components of the sewer lie at or beneath the groundwater table elevation. Infiltration typically appears as a nearly constant source of flow in the collection system that slowly changes over time with the natural levels of groundwater. Larger volumes of infiltration are anticipated in the spring when groundwater levels are high and smaller volumes are anticipated in the summer. Rainfall-Induced infiltration (RII) is a short-term increase in infiltration which is the direct result of storm events and enters the collection system through the same infrastructure defects as groundwater infiltration. Since RII occurs with storm events, it is difficult to differentiate this type of infiltration from inflow and is categorized as a portion of delayed inflow. Inflow will be discussed later in this technical memorandum.

2.1.1 Minimum Infiltration and Sanitary Flow

Calculation of the nighttime minimum flow is the first step in determining the infiltration rates for each subarea. Infiltration rates were estimated for the metered areas based on flow data from a series of dry-weather days during the hours of midnight to 5:00 AM. Using rain gauge data, the team identified four (4) representative dry weather days to estimate dry weather infiltration as presented in Table 2-1.

Table 2-1 Dry Weather Dates

Dry Weather Days
Wednesday, October 18, 2017
Thursday, October 19, 2017
Friday, October 20, 2017
Saturday, October 21, 2017

Kleinfelder calculated the average dry weather flow (DWF) for each of the flow meter areas in accordance with MassDEP Guidelines. During the nighttime, there is usually very little sanitary flow in the system as most of the Town is residential and most users are sleeping during this time.

Sanitary flow is defined in the MassDEP Guidelines as the component of wastewater which includes domestic, commercial, institutional, and industrial sewage, and specifically excludes infiltration and inflow. For each subarea, nighttime minimum flows were analyzed to determine an appropriate portion of the flow that can be attributed to infiltration versus sanitary flow. In most cases, the meters recorded very low flows with some periodic spikes in flow. These spikes can be attributed to residential usage rather than infiltration, which tended to increase the average nighttime minimum flow. These nighttime spikes varied between subareas, and thusly the percentage of nighttime flow assumed to be infiltration varied as well between 20 and 90 percent depending on the size of the subarea. Remaining flow is assumed to be sanitary flow. Sanitary flow is estimated by subtracting the minimum infiltration from metered wastewater flow during dry weather.

Infiltration rates presented below represent average nighttime flows during this dry weather period. The average sanitary flow for each subarea represents the typical daily sanitary flow. It is important to note that subareas 7 and 13 include flow contributions from Millis. Millis flows are recorded by the CRPCD and reported in daily flow rates. Millis daily flows, measured in gallons per day (gpd), provides a representation of the total flow contributed to the CRPCD, however it does not provide accurate insight into the flow characteristics throughout the day. As such, nighttime minimum flows for Subarea 7 and 13 cannot be analyzed to review the infiltration contribution. Additional study is recommended in this subarea, including nighttime flow isolation to estimate nighttime flow contributions from Millis.

Furthermore, subarea 9 includes flow from subareas 1A, 1, 2, 3, 5, 8, and 14. The flow in gallons per minute (gpm) measured in subarea 9 is too low to account for the contributions from all of the aforementioned subareas. The results from subarea 9 directly impact the results in subareas 10, 11, 12, and 13. Therefore, additional flow metering and investigation is required in at least subareas 9, 10, 11, and 12 to calculate both the infiltration and the inflow rates for these subareas.

Table 2-2 below summarizes the infiltration rates for subareas with sufficient data.

Table 2-2 Dry Weather Infiltration and Sanitary Flow, by Subarea

Subarea	Minimum Infiltration Estimate (gpm)	Average Sanitary Flow (gpm)
1	4.5	30.0
1A	0.04	5.0
2	8.1	33.1
3	4.9	40.3
4	13.7	23.8
5	5.8	22.9
6	1.4	12.8
8	94.1	163.1
9*	158	103.4
10*	64.6	212.7
14	0.7	3.1

*The values calculated for subareas 9 and 10 are cumulative infiltration rates for the entire system up until and including the respective subarea.

2.1.2 Validation of Minimum Infiltration

As noted previously, metering wastewater flow during the fall does not capture peak infiltration which typically coincides with periods of high groundwater in the spring. Groundwater levels during the metering period (October-December 2017) were lower in general than the average groundwater levels documented by the USGS at the groundwater monitoring site in Norfolk as shown in Figure 2-1.

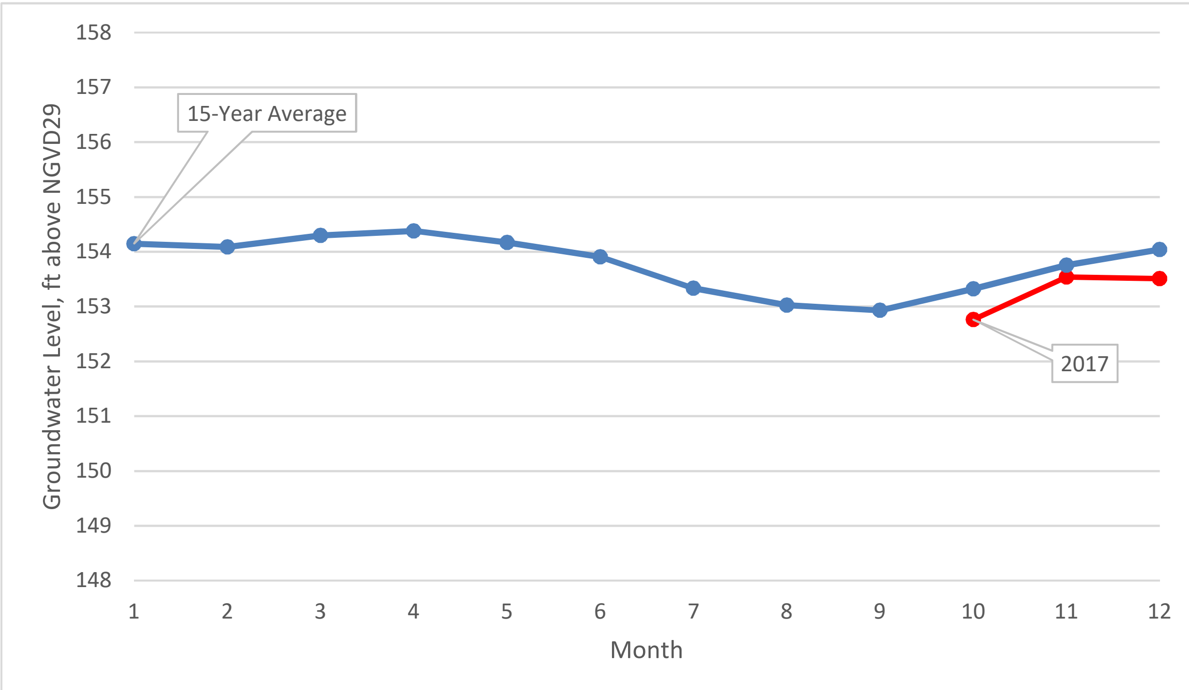

Figure 2-1 Metering Period Groundwater Levels in Relation to Monthly Average

Therefore, the infiltration analysis must account for the groundwater conditions in two (2) ways:

1. Documentation of infiltration rates from dry periods early in the metering period can be considered to represent minimum infiltration values. Groundwater levels documented in October 2017 were lower than the summertime average groundwater level from the 15-year groundwater history.
2. Since groundwater levels during this time are lower than the annual peak groundwater levels, which typically occur in April, the discussion in Section 2.1.3 presents adjustments to the estimated infiltration rates to estimate peak infiltration rates.

To this end, the results of the minimum infiltration analysis are included in Table 2-3. Again, both Subarea 7 and 13 are excluded from this analysis due to the lack of precision in the flow data from Millis. Subareas 11 and 12 are also excluded due to inconsistent flow rates.

Table 2-3 Minimum Infiltration Analysis

Subarea	Minimum Infiltration Estimate (gpm)	Average Sanitary Flow (gpm)	Minimum Infiltration Rate gpd/idm
1	4.52	30.05	210
1A	0.05	5.03	10
2	8.09	33.07	360
3	4.88	40.26	380
4	13.74	23.77	730
5	5.82	22.89	220
6	1.44	12.79	130
7	N/A		
8	94.08	163.11	2680
9*	158	103.36	790
10*	64.57	212.67	290
13	N/A		
14	0.7	3.12	20

2.1.3 Peak Infiltration

As noted, the flow metering period did not coincide with periods of peak groundwater, therefore infiltration rates noted above do not represent peak infiltration rates. To determine estimates of peak infiltration, this analysis included a review of historical wastewater flows to the CRPCD from Medway to determine the seasonal variability in flows. Figure 2-2 shows the 4-year average for wastewater flow to the CRPCD, as well as the 4-year average for each month. Daily flow from 2017 is also graphed for reference.

Flows documented for 2017 were generally higher than the 4-year rolling average. Historically, wastewater flows in April (1.213 MGD) are double the October flows (0.615 MGD). While this graph also includes inflow, it is conservative to assume that infiltration rates documented in October typically represent approximately half of the peak infiltration rates. Therefore Table 2-4 has been updated below to represent peak infiltration rates using a peaking factor of 2.

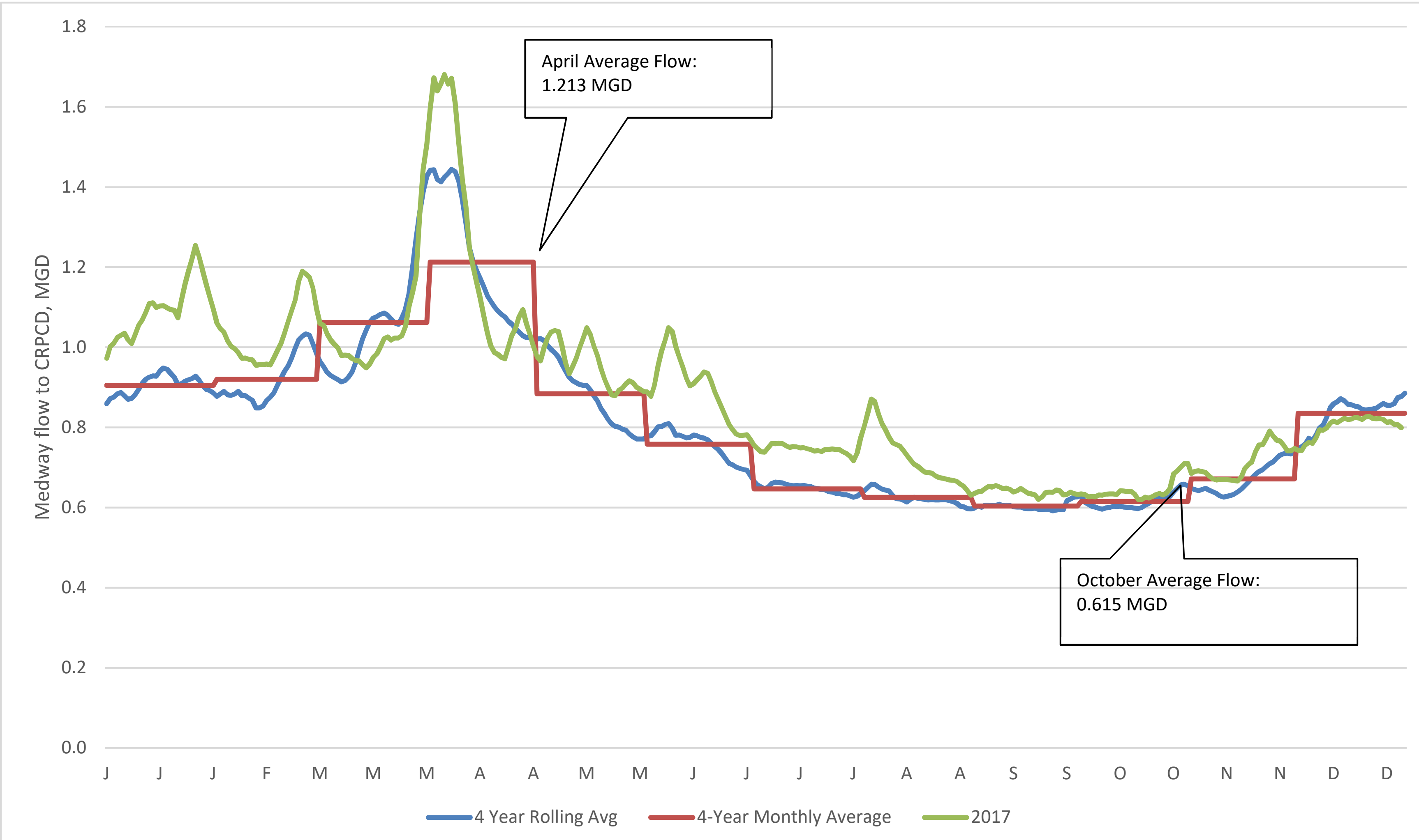

Figure 2-2 Four Year Rolling and Monthly average of Medway's Wastewater Flow to CRPCD

Table 2-4 Peak Infiltration Summary

Subarea	Minimum Infiltration Estimate (gpm)	Peak Infiltration Estimate (gpm)	Total inch-dia-mile	Peak gpd/idm
1	4.52	9.03	32.39	410
1A	0.05	0.09	24.83	10
2	8.09	16.17	32.7	720
3	4.88	9.75	18.68	760
4	13.74	27.48	27.33	1450
5	5.82	11.64	39.3	430
6	1.44	2.87	16.57	250
7	N/A			
8	94.08	188.16	50.62	5,360
9*	158	316	290.64	1,570
10*	64.57	129.13	327.88	640
11				
12				
13	N/A			
14	0.7	1.39	55.75	40

2.1.4 Infiltration Analysis

MassDEP defines the following thresholds for categorizing infiltration within the collection system.

Low – Less than 2,000 gpd/in-diam-mile
Medium – Between 2,000 and 4,000 gpd/in-diam-mile
High – Greater than 4,000 gpd/in-diam-mile

A peak infiltration rate of 4,000 gpd/in-diam-mile is typically used as the threshold for which it is cost effective to pursue infiltration mitigation through follow up investigations work and system rehabilitation. As shown in Figure 2-3 **Subarea Infiltration Estimate Summary**, infiltration rates in subareas 1, 1A, 2, 3, 4, 5, 6, and 14, are considered low by MassDEP guidelines. Subarea 8 is above the high infiltration threshold and the infiltration rates calculated in other subareas, at approximately 5,360 gpd/in-diam-mile.

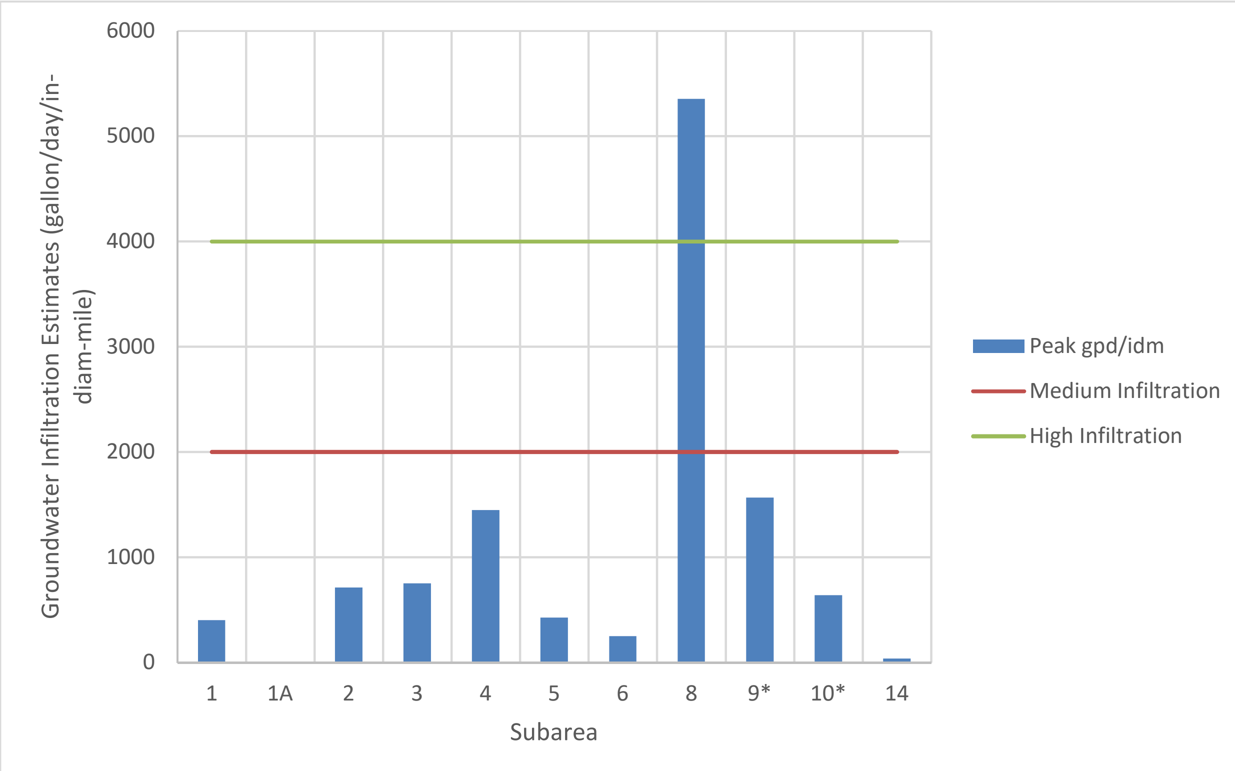

Figure 2-3 Subarea Infiltration Estimate Summary

Subsequent subareas, 9, 10, 11, 12, and 13, exhibit discrepancies between the flow values recorded during the study and the summation of flows leading to that subarea. Infiltration rates for subareas 9 and 10 were calculated for the entirety of the system leading to that subarea. This does not provide the same precision as analyzing each subarea separately, but instead could illustrate subareas where additional flow metering and analysis is required. By not isolating each subarea, inconsistencies within the data are compounded.

When analyzing the flow observed in subarea 9, without deducting the flow from contributing subareas (subareas 1, 1A, 2, 3, 5, 8, 14), the cumulative peak infiltration rate for subarea 9 was calculated as approximately 1,570 gpd/in-diam-mile. The cumulative infiltration rate calculated for Subarea 9 represent the average infiltration rate for these combined subareas and allows to dissipate the high rates evidenced in subarea 8. Similarly, when the cumulative peak infiltration rate is calculated using the observed flow in subarea 10, it was approximately 640 gpd/in-diam-mile.

2.2 INFLOW ASSESSMENT

Inflow is an element of wastewater flow largely influenced by precipitation. Inflow stems from sources such as sump pumps, roof leaders, foundation and surface drains, and cross connections with the storm-sewer system. Inflow is calculated as the area between the storm event hydrograph and the calculated average daily sanitary flow. Since inflow is largely dependent on storm events, it is expected to be nearly zero during prolonged dry-weather. Inflow is characterized into two different components, direct and indirect inflow. Direct inflow quickly influences the sewer system and therefore the storm event hydrograph, through direct connections from structures such as catch basins, roof leaders, and manholes. Significant direct connections can quickly increase wastewater flow causing a spike during storm events and put increased stress on the sewer system.

Indirect inflow, due to indirect connections to the sewer system, such as from sump pumps, foundation drains, and cross-connections between the storm and sewer systems, is apparent in the storm event hydrograph after a delay from the start of the storm and after direct inflow. The influence of indirect inflow is largely apparent after the storm event has ended and is expected to gradually decrease to approximately zero. It is difficult to isolate rainfall induced infiltration (RII) from indirect inflow, and therefore, the indirect inflow volume is assumed to include it.

2.2.1 Wet Weather Events

During the eight (8) week flow metering analysis, there were seven (7) low-intensity, short-duration rainfall events. The rain events are described in **Table 2-5**, below. Additional intermittent rain events were recorded during the flow metering period but did not generate significant rainfall.

Table 2-5 Observed Wet-Weather Events

Start	End	Duration	Total Rainfall	Average Intensity	Peak Intensity
10/25/2017 21:30	10/26/2017 5:30	8:00	0.44 in	0.01 in/hr	0.03 in/hr
10/29/2017 19:00	10/30/2017 3:45	8:45	3.11 in	0.09 in/hr	0.29 in/hr
11/13/2017 12:30	11/13/2017 16:45	4:15	0.16 in	0.01 in/hr	0.01 in/hr
11/16/2017 12:15	11/16/2017 14:45	2:30	0.36 in	0.03 in/hr	0.09 in/hr
11/19/2017 4:15	11/19/2017 8:45	4:30	0.40 in	0.02 in/hr	0.08 in/hr
11/22/2017 7:30	11/22/2017 16:00	8:30	0.81 in	0.02 in/hr	0.06 in/hr
12/5/2017 22:30	12/6/2017 6:00	7:30	0.70 in	0.02 in/hr	0.11 in/hr

As described previously, the flow metering program was completed during dry weather. According to MassDEP recommendations, inflow should be calculated using storm events with an intensity of at least 0.2 inches per hour that last at least six hours. During the metering analysis, only one 15-minute observation was greater than or equal to the 0.2 inch per hour recommended intensity, and it was recorded on 10/30/2017 at 3:00 AM. This peak intensity also coincided with the rain event with the largest total rainfall and it lasted approximately nine (9) hours. Therefore, the storm event observed on October 29th and October 30th, was selected for the inflow analysis. However, it should be noted that there was a rain event three (3) days prior to this selected storm, and there is the possibility that indirect inflow, or RII initially affected the hydrograph of this storm event.

The selected storm event is shown below in Figure 2-4.

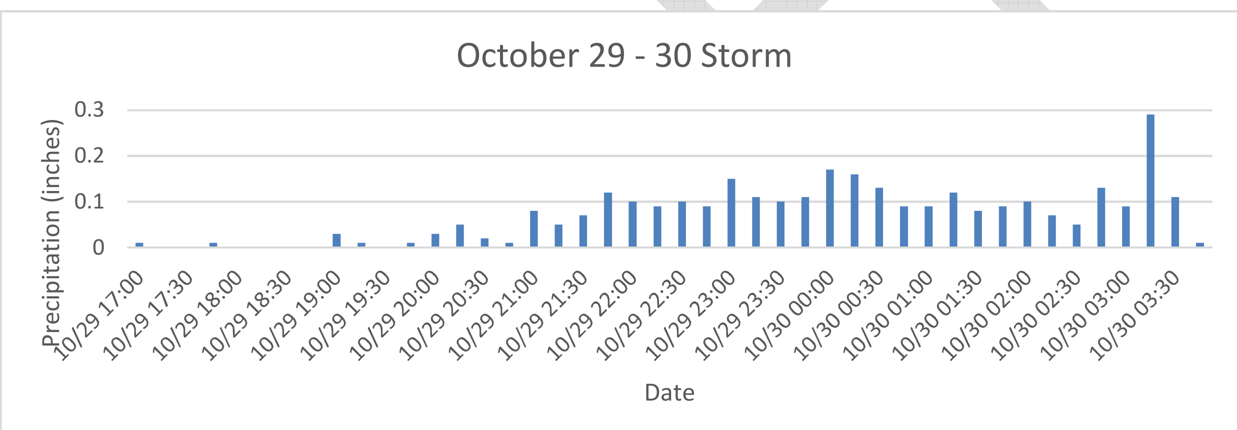

Figure 2-4 Selected Inflow Rain Event - October 29th - 30th

Direct and indirect inflow volumes were calculated for each of the subareas. These volumes are calculated by subtracting the average daily sanitary curve from the storm event hydrograph and are summarized Table 2-6.

Table 2-6 Direct and Indirect Inflow Volumes

Subarea	Total in-dia-mi	Storm Event October 29th-30th		
		Direct Inflow Volume	Indirect Inflow Volume	Total Inflow Volume
1	32.38	7,080	8,050	15,130
1A	24.83	28,770	17,480	46,240
2	32.69	9,720	700	10,420
3	18.67	35,770	27,810	63,580
4	27.33	12,700	8,360	21,060
5	39.29	11,000	1,380	12,370
6	16.57	660	900	1,550
7	N/A			
8	50.62	77,730	3,450	81,180
9*	290.64	90,830	97,480	188,300
10*	327.88	3,290	34,330	37,620
11				
12				
13	N/A			
14	55.74	650	6,980	7,620

Because RII is difficult to distinguish from indirect inflow, it is assumed to be included in inflow volumes, and due to the relatively dry period during the flow metering, it is likely that these inflow estimations are low.

Inflow volumes were calculated from the storm event hydrograph as well as the estimated daily sanitary curve. Inflow is observed when the storm event hydrograph diverges from the daily curve, both at the beginning of the storm event and after the storm has passed. In many of the subareas, the flows measured, do not align with an average daily curve, and thusly, the transition between direct and indirect inflow is unclear as well as the conclusion of direct inflow. The influence of rainfall on inflow is not as clear. This may be due to the relatively small rain events that occurred. The following hydrograph was used to estimate the inflow volume for Subarea 1, with similar hydrographs included in the Appendix for the remaining subareas .

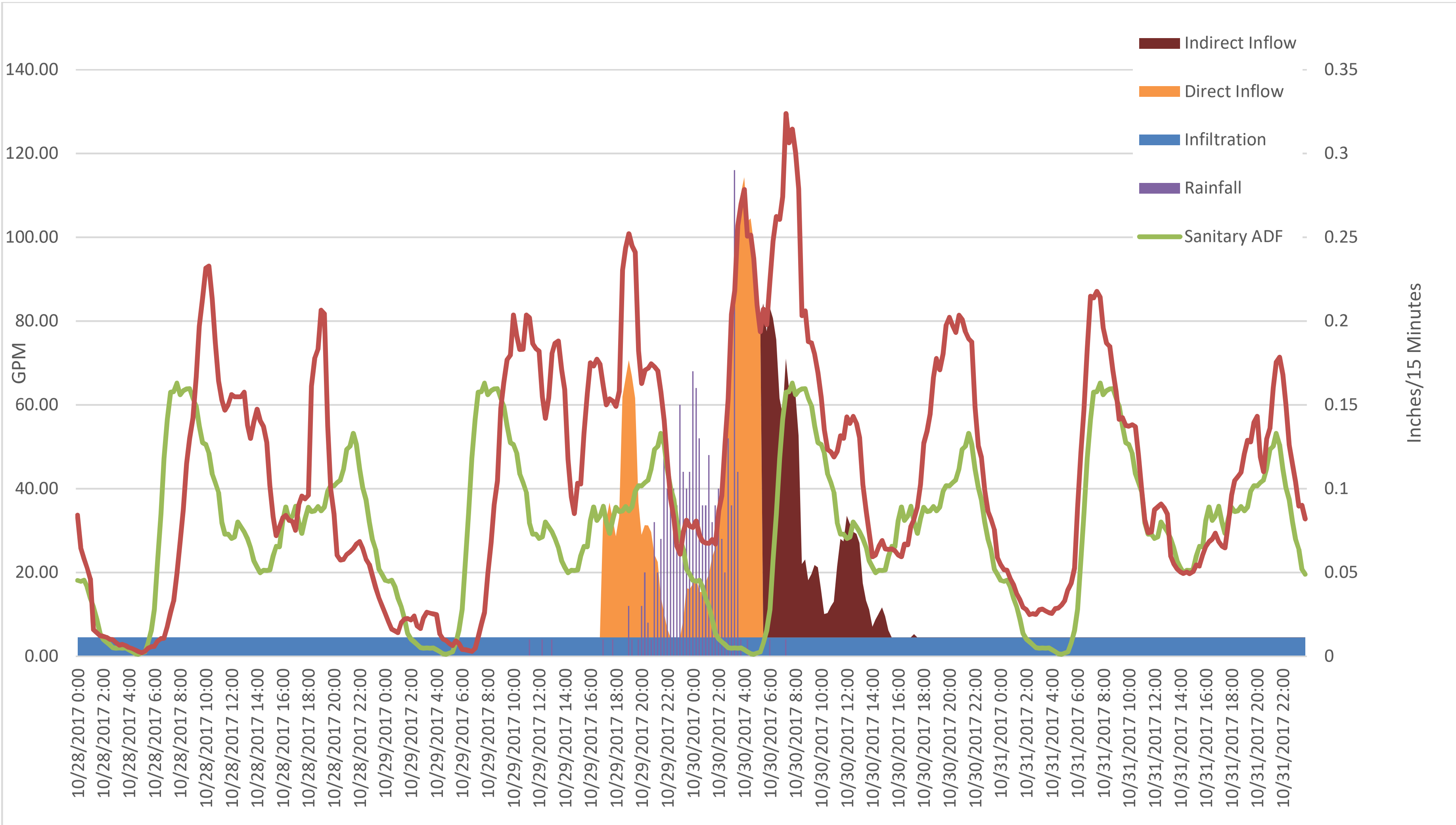

Figure 2-5 Subarea 1 Rain Event Hydrograph

The total inflow volume in gallons was determined for the October 29th – 30th rain event, which was 3.11 inches of rain. To determine the relationship between inches of rainfall and inflow volume in gallons, the 1-year 6-hour and the 5-year 24-hour design storms for Boston, 1.72 inches, and 4.64 inches respectively were plotted graphically. These storms were selected according to MassDEP guidelines. The following graphs graphically estimate the volume of inflow expected for the selected design storms.

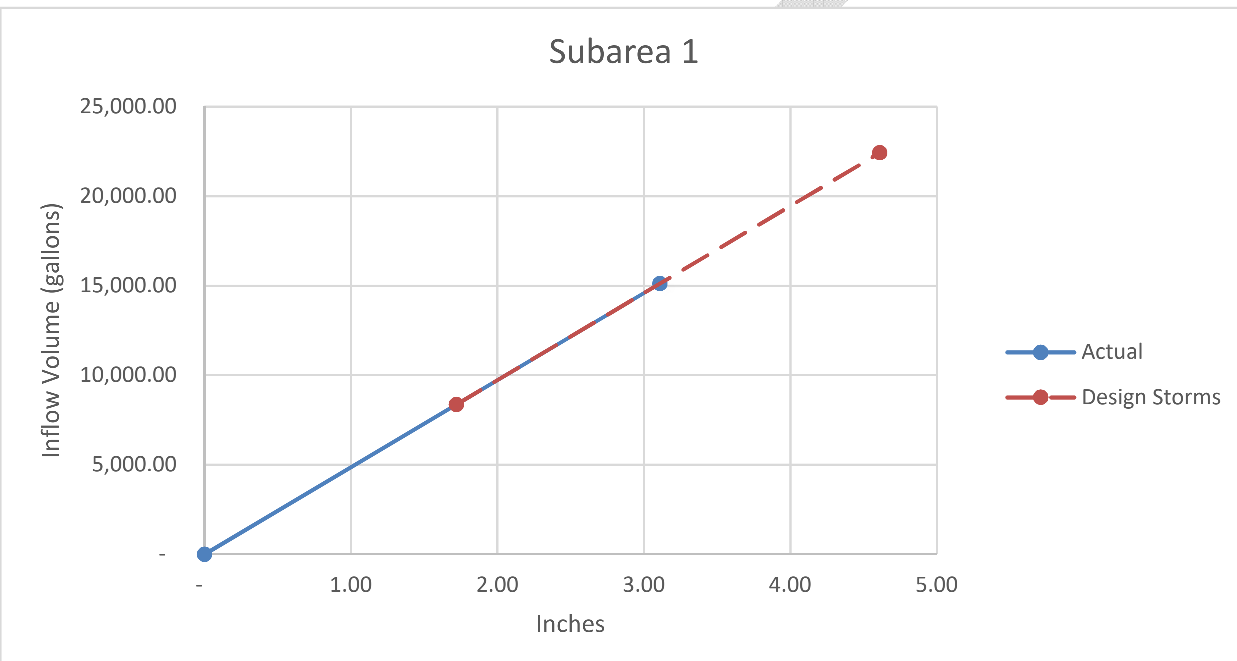

Figure 2-6 Estimated Inflow Subarea 1

Based on this extrapolation, the inflow volume for Subarea 1 can be determined for both design storms. This process was replicated for all subareas and the estimated inflow volume for each is summarized in Table 2-7, below.

Table 2-7 Inflow Summary

Subarea	In-dia-mi	Storm Event October 29th-30th			1-Yr 6-hour Design Storm	5-Year 24-hour Storm	% of Total Inflow
		Direct Inflow Volume	Indirect Inflow Volume	Total Inflow Volume	Total Inflow Volume	Total Inflow Volume	
1	32.38	7,080	8,050	15,130	8,370	22,420	6%
1A	24.83	28,770	17,480	46,240	25,580	68,550	18%
2	32.69	9,720	700	10,420	5,760	15,440	4%
3	18.67	35,770	27,810	63,580	35,160	94,240	25%
4	27.33	12,700	8,360	21,060	11,650	31,210	8%
5	39.29	11,000	1,380	12,370	6,850	18,340	5%
6	16.57	660	900	1,550	860	2,300	1%
7	N/A						
8	50.62	77,730	3,450	81,180	44,900	120,330	31%
9*	290.64	90,830	97,480	188,300	104,140	243,400	
10*	327.88	3,290	34,330	37,620	20,810	48,620	
11							
12							
13	N/A						
14	55.75	650	6,980	7,620	4,220	9,850	3%

According to MassDEP, when the inflow in a subarea is greater than 80% of the total inflow, inflow removal should be investigated. Subareas 1A, 3, and 8 were 18%, 25%, and 31% respectively, but do not necessarily indicate the need for inflow removal.

3 RECOMMENDATIONS

3.1 INFILTRATION

Based only on the calculated infiltration rates, Subareas 8 and 9 exhibit high infiltration rates according to MassDEP guidelines, and as compared to the rest of the analyzed system. This high infiltration rate suggests that it may be cost-effective for Medway to pursue infiltration removal in at least Subarea 8.

Isolated flow information was not calculated for Subareas 7 and 13 due to the influence of flows from Millis. Millis flow data is only available in daily totals, which makes it impossible to calculate fluctuations in flows throughout the day. As such, nighttime minimum infiltration rates cannot be calculated.

Specific recommendations for characterizing and mitigating infiltration in Medway include:

- Additional investigations into infiltration potential in Subarea 8 and 9, through targeted smoke testing, flow isolation and CCTV as needed. These additional efforts will inform the Town's next steps for mitigating infiltration in this Subarea.
- Flow isolation in Subareas 7, 11, 12, and 13.
- Discuss replacement of Millis flow meters to allow for continuous daily metering (15-min increments). After these meters are replaced, re-meter Subareas 7 and 13 and subtract out Millis flow contributions to determine infiltration contributions from Medway. Additional investigations and mitigation efforts will be informed after such analysis is complete.

3.2 INFLOW

The inflow values calculated for subareas 1, 1A, 2, 3, 4, 5, 6, 8, and 14, are all significantly below MassDEP guidelines for investigating inflow removal. However, this is only a measure of the inflow up until Subarea 8. It's possible that these subareas represent a larger portion of the total inflow to the CRPCD when inflow for the remaining subareas is calculated.

Without a clear understanding of the infiltration rate in subareas 7, 9, 10, 11, 12, and 13, it is difficult to calculate a valid inflow volume for those subareas. Inflow volumes were estimated for subareas 9 and 10, using the cumulative flows and infiltration rates calculated in section 2. However, this is not a precise estimation, and based on inflow values from the preceding areas, these estimations of inflow were low. Additional flow metering data from these subareas is necessary to accurately quantify the inflow in these areas. Follow up investigations through a sanitary sewer evaluation survey (SSES) will help to inform rehabilitation needs to address infiltration and further actions required to address inflow in the most susceptible subareas.

APPENDIX C

Preliminary Outfall Catchment Delineation Analysis

As outlined in the MS4 Permit, a catchment is the total area that drains to an individual outfall or interconnection. The purpose of delineating MS4 catchments under the MS4 Permit is to define contributing areas for investigation of potential sources of illicit discharges and to identify and prioritize areas for future monitoring and field investigations. As such, a catchment delineation is a critical IDDE planning and investigation tool. Catchments for the 2015 inventory of stormwater outfalls were delineated during Phase I of the IWRMP. The process to delineate the stormwater outfall catchment areas utilize 2-foot topographic contours from MassGIS as the governing parameter, and, where available, mapped drainage infrastructure to adjust delineations.

This approach was conservative because it included areas that contribute overland flow, in addition to piped stormwater, towards the outfall location. In some cases, this may help identify non-point sources of pollution to receiving waters, such as waterfowl or pet waste in parks - which can be addressed in other portions of the MS4 Permit required elements (e.g. Education and Public Participation).

Catchment area boundaries define the drainage break lines associated with rainfall runoff. The delineated boundaries run perpendicular to contours and encapsulate the area where surface runoff would drain towards the outfall. The presumption under this approach is that inlets along the runoff path (e.g. catch basins) convey flow to the outfall which is the regulated point source. The catchments from the 2015 outfall delineations shown in

Figure 1: Medway Outfall Catchments and SWMI Subbasin

. These delineations will need to be refined as Medway continues to update its drainage GIS mapping to include catch basins and drain pipe. New catchment delineations should be produced for the 2017 inventory of outfalls and as additional outfalls are discovered by Town staff.

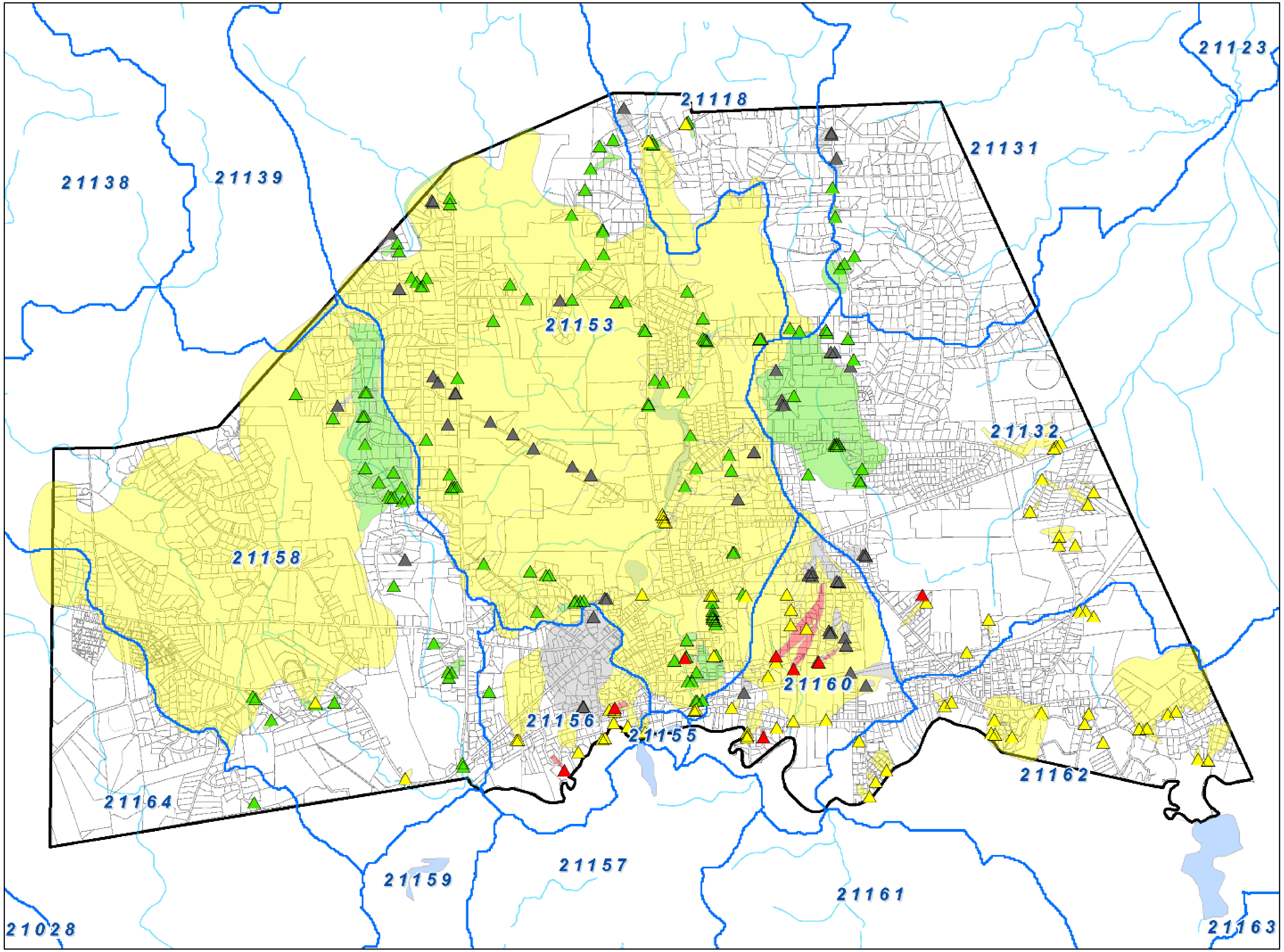

Figure 1: Medway Outfall Catchments and SWMI Subbasin

Outfall Catchment Prioritization

The process of ranking the delineated outfall catchment areas is based on criteria taken from the MS4 Permit. The purpose of the ranking exercise is to prioritize the field investigation of all outfalls and their contributing catchments throughout the Town's MS4. Over a period of 10 years, the Town is obligated to investigate and confirm the condition of the system as it relates to illicit connections or non-stormwater discharges introduced into, and discharging from, the MS4. In the process, they will be obtaining and integrating important condition data on related MS4 assets that will contribute to capital and operational investment decision-making going forward.

The MS4 Permit, Part 2.3.4.7.c, specifies the following criteria that must be considered (although not all may apply) when prioritizing catchments for the IDDE Program:

- Result of dry weather inspections
- Dry weather receiving water quality
- Number of complaints or reports
- Watershed impaired status
- Outfall direct discharge
- Density of generating sites
- Outfall density
- Age of surrounding development, older industrial operations, and aging and failing sewers
- Density of failed or converted septic tanks
- Long stretches of culverted streams

The 2015 inventory of stormwater outfalls was analyzed to prioritize catchments. **Error! Reference source not found.** presents the 2015 Outfall Catchment Prioritization Matrix highlighting the criteria above and the associated scoring system.

As part of the analysis, each catchment was ranked according to the ranking criteria for outfalls. An assigned weighting factor for each criterion reflected how influential the criterion was towards discovering an illicit discharge and how detrimental the criterion was to the public health of the community. The criteria with more significant weighting factors included: Results of Dry Weather Inspections, Watershed Impaired Status, Reports and Complaints, Outfall Direct Discharge, Older Industrial Operations (40+ years), and Density of Failed or Converted Septic Systems. The overall ranking score calculation involved multiplying the sum of the criterion's score by its weight.

Table 1: 2015 Outfall Catchment Prioritization Matrix

Outfall Inspection Criteria	Score						
	Blank	0	1	2	3	4	5
Results of Dry Weather Inspections	Not inspected yet		No flow or indicators	Light flow or indicators	Moderate to heavy flow w/o indicators	Light flow with indicators	Moderate to heavy flow with indicators
Dry Weather Receiving Water Quality (number of incidents)	No data	0	1	2	>= 3		
Number of Reports and Complaints		None		Some	Frequent		
Watershed impaired Status			Not impaired	Impaired exotic or proposed	Impaired		
Outfall Direct Discharge		Indirect discharge to not impaired	Direct discharge to not impaired	Indirect discharge to impaired	Direct discharge to impaired		
Density of Generating Sites			baseline default, 0	0	2-4	4	
Outfall Density			Low	Medium	High		
Age of Surrounding Development (number of buildings within 100 ft. of outfall)		None	< 20-year-old	2 to 20 40-year-old	40+ year-old		
Older Industrial Operations (40+ years) within 100 ft. of outfall		None	< 20-year-old	2 to 20 40-year-old	40+ year-old		
Aging/Failing Sewers (within 100 ft. of outfall)		None	< 20-year-old	2 to 20 40-year-old	40+ year-old		
Density of Failed or Converted Septic Tanks (within 100 ft. of the outfall)		None	<= 1	1-2	3-4	>= 5	
Long Reaches of Culverted Streams			Low	Medium	High		

A total of 276 catchments were evaluated in the 2015 Outfall Catchment Priority Ranking Matrix. Based on this ranking system, a maximum score of 138 was possible. The priority ranking was broken into four categories in accordance with the MS4 Permit, as shown in Table 2.

Table 2: Outfall Catchment Priority Ranking Summary

Rank (Risk)	Description	Score Range	Quantity
PROBLEM	Known or suspected illicit discharge based on existing information	Any	8
HIGH PRIORITY	High potential for illicit discharge / High Priority for Investigation	41 - 138	75
LOW PRIORITY	Low potential for illicit discharge / Low Priority for Investigation	0 - 40	139
EXCLUDED	No potential for illicit discharges	Any	54

Problem Catchments

Problem catchments are catchments with known or suspected illicit discharges. Town staff identified eight (8) outfalls with dry weather flow during field inspections from 2013 to 2015. Two of these outfalls had screening samples which indicated potential illicit discharges . The Town implemented follow up actions in response to the two outfalls with potential illicit discharges. None of the outfalls identified subsequent to the 2015 inventory have been classified as “Problem” on the basis of observable ‘known or suspected’ illicit discharges. This designation is essentially a binary exercise and it is either “problem” or not upon finding the outfall. Other category designations rely upon a scoring system (described above). Only the outfalls dating from the 2015 inventory were scored and the descriptions below apply only to the original 276 outfalls.

High Priority Catchments

High Priority catchments are catchments that have outfalls not classified as Problem or Excluded outfalls and whose priority ranking score was 41 or greater. Also, any outfall discharging to an area of concern to public health due to the proximity of public beaches, recreational areas, drinking water supplies or shellfish beds is classified as High Priority. There are 75 High Priority catchments in Medway among the original 276 identified.

Low Priority Catchments

Low Priority catchments are catchments whose outfalls are not classified as Problem or Excluded outfalls and whose priority ranking score was 40 or less. There are 139 Low Priority catchments in Medway among the original 276 identified.

Excluded Catchments

Excluded catchments are catchments whose outfalls have no potential for illicit discharges. This categorization is limited to roadway drainage, drainage for athletic fields/parks, or cross-country drainage alignments in undeveloped areas. There are 54 Excluded catchments in Medway among the original 276 identified.

High Priority Catchment Evaluation

Approximately 25 percent of the 2015 outfall catchments in Medway are categorized as High Priority. The evaluation of these catchments, performed as part of the IWRMP, looked at the parcels within each high priority catchment area.

For this evaluation, the analysis identified the following parcel characteristics:

- General Information – including corresponding catchment ID and parcel address.
- Parcel Type – Residential, Municipal, Pasture, Manufacturing, etc., based on Medway's 2016 GIS town-wide parcel information.
- Land Use – based on MassGIS 2013 regional land usage information for the Town of Medway.
- Parcel Size (in square meters) – based on MassGIS 2013 town parcel GIS information for the Town of Medway.
- Assessment of Pervious Pavement – qualitative review based on Google Earth orthoimagery (municipal parcels based on GIS numeric calculations)
- Table 3 below, presents the analysis of these Medway parcel and the high priority catchments. Results of this analysis may support the development of the PCP.

Table 3: Outfall Catchment Parcel Analysis

Outfall ID	Parcel Address	Parcel Type	Land Use	Parcel Size (m^2)	Pavement Percentage
58-10	0 Adams St	Pasture	Non-Forested Wetland	170421	Low
58-10	0 Oak St	Municipal	Participation Recreation	75127	10%
59-5	0 R Center	Vacant	Forest; Residential	10064	0%
51-1	0 Village St	Municipal	Forest	26773	0%
48-11, 48-12	1 Mahan Cr	Municipal	Residential; Commercial	2863	64%
48-11, 48-12, 58-10	1 Maple Lane	Municipal	Residential; Commercial	29706	37%
33-1, 33-3	1 Marc Rd	Manufacturing	Industrial	3350	High
3-4	10 Cedar Mill Rd		Residential; Forest	4114	
55-4	10 Trotter Drive	Research and Development facility	Industrial	45713	Medium
49-6, 59-8	107 Main St	Gasoline Service Station	Commercial; Residential; Forested	3319.9	Medium
57-3	11 Awl St	Manufacturing	Industrial	4423	Medium
	112 Main St				
48-9, 58-1	115-A Main St	Car Wash Facilities	Commercial	3047	High
58-10	116 Summer St	Mixed Use	Non-Forested Wetland; Pasture; Forest	201226	Low
	117 Main St				
48-9, 48-11, 48-12, 58-1	120 Main St	Manufacturing	Residential; Commercial	30909	High
59-5	13 R Dean St	Vacant	Forest	8378	0%
61-1	136 Village St	Auto Repair Facility	Commercial	1546	Medium
67-9	14 Waterview Dr.	Municipal	Residential; Non-Forested Wetland	4815.759	Medium
58-10	148 Lovering St	Mixed Use	Pasture	55122	Low
66-1	15 West St	Auto Repair Facility	Commercial; Powerline Utility	25589	High
58-10	155 Lovering St	Mixed Use	Residential	43049	Medium
61-1, 70-3, 70-4, 68-2	155 Village St	Municipal	Commercial; Institutional Forest; Residential	4945	72%
58-10	157 Lovering St	Mixed Use	Forested Wetland; Pasture	41168	Low
59-5	16 Cassidy Ln	Municipal (education)	Institutional; Participation Recreation	58586	34.60%
	163 Main St				
58-10	165 Main St	Office Building	Industrial; Non-Forested Wetland	33549	Medium
48-1, 58-10	17 Priscilla Rd	Truck Crops	Forested Wetland; Pasture	22834	Low
58-10	2 B Oak St	Municipal	Transitional	13611	9.90%
3-4	2 Hill St		Residential; Forest	4091	
72-1	2 R Cynthia Cir	Municipal	Residential	110213	Low
60-2, 60-3	203 R Village Street	Municipal	Residential; Forest	22020	72%
48-1, 58-10	25 R Adams St	Pasture	Forest	24758	Low

Outfall ID	Parcel Address	Parcel Type	Land Use	Parcel Size (m^2)	Pavement Percentage
48-1, 58-10	25 Winthrop St	Pasture	Pasture; Forest	236872	Low
33-1, 33-3	3 Industrial Park Rd	Auto Repair Facility, Research and Development Facility	Industrial	3237	High
58-7	305 Village St	Tanks holding fuel and oil products for retail	Commercial; Forest	701.68	Low
33-3	35 Coffee St	Mixed Use	Forested	22265	Low
	37 broad St				
58-10	38 Winthrop St	Mixed Use	Pasture	119103	Low
33-1	4 Industrial Park Rd	Manufacturing	Industrial	5385	High
71-4	41 R Village St	Municipal	Residential	37266	4.80%
33-1, 33-3	7 Industrial Park Rd	Manufacturing	Industrial	20011	High
48-1, 58-10	70 Lovering St	Housing Authority	Residential	11549	62%
50-1	42 Broad St	Manufacturing	Industrial	7963	High
50-1	43 Broad St	Pasture	Pasture	1472	Low
51-1, 51-3	44 Oakland St	Municipal	Forest; Forested Wetland	165271	0.07%
50-1	45 Broad St	Pasture	Pasture	2247	Low
48-1, 58-10	82 Lovering St	Field Crops	Pasture	82082	Low
49-6, 49-7, 59-5	85 Main St	Auto Repair Facility	Commercial	8198.6	Medium
58-10	88 Summer St	Municipal	Institutional; Participation Recreation	147303	33%
49-7	89 Main St	Commercial	Commercial	4662	High
3-6	9 Hill St	Residential; Agriculture	Forest; Industrial	34177.6	Low
33-1	9 Industrial Park Rd	Manufacturing	Industrial	8005	Medium
59-5	45 Holliston St	Municipal (education)	Institutional; Participation Recreation	116827	34%
50-1	46 Broad St	Municipal	Waste Disposal; Forest	124965	High
48-1, 58-10	74 Lovering St	Field Crops	Residential	2680	Low
55-4	76 Milford St	Residential; Agriculture	Pasture; Industrial	54647	Low
58-10	8 Wards Ln	Municipal	Cropland; Participation Recreational; Non-Forested Wetland	161737	3.70%
67-4	5 Country Lane	Municipal		1334	18%
48-1, 58-10	50 Winthrop St	Municipal	Cropland; Forest	67822	0.90%
58-10	51 Winthrop St	Mixed Use	Non-Forested Wetland; Pasture; Forest	33132	Low
58-10	53 R Winthrop St	Pasture	Non-Forested Wetland	24232	Low
58-10	54 Adams St	Municipal	Non-Forested Wetland; Pasture; Forest	15445	9%
33-1	6 Industrial Park Rd	Manufacturing	Industrial	17032	Medium
50-1	64 R Holliston St	Pasture	Non-Forested Wetland; Pasture; Forest	340781	Low
71-3	66 Village St	Utility authority: electric, light, sewer, water	Waste Disposal; Forest	180395	High
55-4	69 Milford St	Gas Pressure control Stations	Forest; Industrial	13923	High