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1. Executive summary

Introduction

In 2010, IBM Corporate Citizenship launched the Smarter Cities Challenge® to help 100 cities around the world over three years become smarter through grants of IBM talent. These cities have made great progress on the road to becoming more instrumented, interconnected and intelligent (see www.smartercitieschallenge.org).

Suffolk County, New York, US, was one of 16 cities awarded an IBM Smarter Cities Challenge grant in 2014 as part of ongoing citizenship efforts by IBM to build a Smarter Planet®. In June 2014, a team of six IBM experts spent three weeks in the county working with stakeholders to help solve key challenges as identified by County Executive Steven Bellone.

Nitrogen pollution presents a significant risk to Suffolk County's water quality and is impacting surrounding bays, marshes and rivers. The main source of this nitrogen pollution is domestic properties with on-site treatment systems for waste, such as cesspools and septic systems.

The challenge

The County has noted a decline in the quality of Long Island's surface water as evidenced by brown and red tides, reduced levels of shellfish and marsh pannes. Excessive contaminants in the water bodies, particularly nitrogen, are responsible for this degradation, with 69% of this nitrogen production coming from the septic systems of individual properties. Other sources include agriculture, residential fertilizers and sewage treatment plants.

This contamination can potentially have a significant impact on not only the quality of life for residents and visitors to Suffolk County, but also the economy on the island. This could result in major economic challenges for the County, leading to reduced industry, reduced coastal resiliency, restrictions on development and lower house prices plus a negative impact on tourism. The County has placed a potential value on this of approximately \$2.3 billion, with fishing contributing \$900 million, use of beaches \$670 million and boating \$760 million.

The key challenge is to make recommendations that address the County's nitrogen problem and account for the following factors:

- Lack of funding and resources
- Different challenges across the County's various geographies
- Multiple stakeholders with conflicting objectives
- A fragmented structure and management system across the county that limit the County's ability to take action
- Lack of water quality awareness and understanding among citizens and visitors
- Lack of overall information management strategy to support decision making and the long-term management of nitrogen reduction in the county
- Lack of integrated water and wastewater management strategy
- Lengthy timescales for water quality restoration
- Efforts to manage water quality that must be sustained over a long period of time

Findings and recommendations

During its three-week visit, the Smarter Cities Challenge team conducted a series of interviews and workshops with more than 90 stakeholders representing 38 organizations. The team focused on addressing excessive nitrogen loads in the County's water supply. With so many interrelated challenges, this issue could not be solved in isolation. Instead, it required collaboration, coordination and alignment to achieve a sustainable solution.

The people of Suffolk County clearly prioritize the quality of their water and have a passion for addressing and resolving this issue. Residents, businesses and visitors alike value water and the central role it plays in their quality of life on the island, but they need help developing and implementing a plan to improve and protect water quality. For instance, a common misconception is that failing septic systems are the cause of nitrogen pollution when, in fact, on-site septic systems are not designed to remove nitrogen in the first place.

The County and other stakeholders have conducted a significant amount of work to identify the cause of contamination and potential tactics to resolve the problem. However, one of the team's key findings was that this work is not always done in a coordinated manner and at times lacks common objectives or goals. This results in potentially conflicting findings and inadequate management of (or planning for) certain phases of the water cycle. While there is a significant quantity of relevant data across the county, it is distributed across many organizations and is available in various forms. The absence of an overarching strategy for data structure, usage and storage makes it even more difficult for the County to uncover insights and inform actions.

To help Suffolk County achieve a successful platform for integrated water management, the team identified 11 recommendations in four key areas:

1. Blueprint for the future

Suffolk County should establish a long-term Water Resource Plan with a set of target outcomes and a baseline that will inform future decisions on change. This plan should build on existing planning, but the format should become a “living template” that is used regularly within a governance process for water management for the island. The plan should outline the architecture for water management and drive core programs to improve water management and quality. Our recommended initial programs focus on solutions to reduce nitrogen pollution for the properties within Suffolk County currently on cesspools or septic systems, as well as improving the control and management of waste treatment within the existing 193 sewage treatment plants (STPs).

2. Execution

Execution recommendations support the blueprint and focus on establishing a means of sharing and managing data across the entire water cycle, from rivers and streams to water treatment plants and agriculture to aquifers and oceans. This will help ensure that different organizations involved in water management will maintain ownership and security of data and enable sharing of information to support decision making and progress in monitoring water quality. A core principle of integrated water management is to plan and manage water and wastewater in a cohesive manner to ensure the full water cycle is regulated (see Appendix F). The team also recommends a process for compliance management to ensure that processes are followed and improvements are identified on an ongoing basis.

3. Engagement

Water is at the heart of Suffolk County, and its quality directly impacts the lifestyle, health and economy of the County's 1.5 million residents, as well as its five million annual visitors. The Engagement recommendations focus on helping residents and visitors understand the role they play in managing and improving water quality, motivating them to take action.

4. Enablers

Improving the County's water quality and implementing a sustainable solution could take several years. These final recommendations focus on funding the necessary efforts, while ensuring that the processes and organizational structure will be able to meet future needs and continue to support county-wide integrated water management.

Conclusion

Water quality impacts not only the ecological aspects of Suffolk County but also the lifestyle, economy and health of its residents and visitors. Current levels of nitrogen and other pollutants in local bodies of water are the result of water infrastructure and septic systems that evolved over many years with no overall plan. If Suffolk County wants to continue to grow its economy, attract tourists and deliver a high quality of life for its residents, it must tackle water management with common goals, shared information and an integrated approach to managing water and wastewater services.



2. Introduction

A. The Smarter Cities Challenge

By 2050, cities will be home to more than two-thirds of the world's population. Cities wield more economic power and have access to more advanced technological capabilities than ever before. However, they are struggling with a wide range of challenges that threaten the sustainability of their core support and governance systems, including transportation, water, energy, communications, healthcare and social services.

Meanwhile, trillions of digital devices, connected through the Internet, are producing tremendous amounts of data. All of this information — from the flow of markets to the pulse of societies — can be turned into knowledge, because we now have the computational power and advanced analytics to make sense of it. With this knowledge, cities could reduce costs, cut waste and improve efficiency, productivity and quality of life for their citizens. In the face of the mammoth challenges of economic crisis and increased demand for services, ample opportunities still exist for the development of innovative solutions.

In November 2008, IBM initiated a discussion on how the planet is becoming “smarter.” By this it meant that intelligence is becoming infused into the systems and processes that make the world work — into things no one would recognize as computers: cars, appliances, roadways, power grids, clothes and even natural systems, such as agriculture and waterways. By creating more instrumented, interconnected and intelligent systems, citizens and policymakers can harvest new trends and insights from data, providing the basis for more informed decisions.

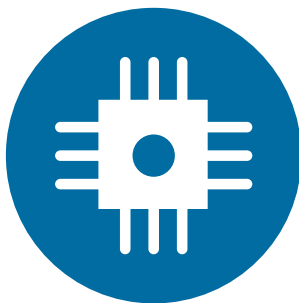
A Smarter City uses technology to transform its core systems and optimize finite resources. Since cities grapple on a daily basis with the interaction of water, transportation, energy, public safety and many other systems, IBM is committed to a vision of Smarter Cities® as a vital component of building a Smarter Planet. At the highest levels of maturity, a Smarter City is a knowledge-based system that provides real-time insights to stakeholders and enables decision makers to manage the city's subsystems proactively. Effective information management is at the heart of this capability, and integration and analytics are the key enablers.

Intelligence is being infused into the way the world works.

As IBM aligns its citizenship efforts with the goal of building a Smarter Planet, it realizes that city leaders around the world face increasing economic and societal pressures. Given the growing demand for services, they have to deliver new solutions ever more rapidly.

With this in mind, IBM Corporate Citizenship has launched the Smarter Cities Challenge to help 100 cities around the world over a three-year period become smarter through grants of IBM talent. Suffolk County, New York, was selected through a competitive process and awarded a Smarter Cities Challenge grant in 2014.

During a three-week period in June 2014, a team of six IBM experts worked in Suffolk County to deliver recommendations around key issues for County Executive Steven Bellone.



Instrumented

We can measure, sense and see the condition of practically everything.



Interconnected

People, systems and objects can communicate and interact with each other in entirely new ways.



Intelligent

We can analyze and derive insight from large and diverse sources of information to predict and respond better to change.

Figure 1: Instrumented, interconnected, intelligent

B. The challenge

The County has recognized a decline in the island's surface water quality, as evidenced by an increase in brown and red tides, reduced levels of shellfish and marsh pannes. The cause of this decline is excessive contaminants in the ground and surface water bodies, particularly nitrogen. The majority (69%) of this nitrogen comes from cesspools and septic systems on individual properties. Other sources include agriculture, lawn fertilizer and outputs from sewage treatment plants.

This contamination may result in economic challenges for the County, including reduced industry, reduced coastal resiliency, restrictions on new development and a negative impact on tourism.

The key challenge is to make recommendations that address the County's nitrogen problem and account for the following factors:

- Lack of funding and resources
- Different challenges across the County's various geographies
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- A fragmented structure and management system across the county that limit the County's ability to take action
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- Efforts to manage water quality that must be sustained over a long period of time

3. Findings, context and roadmap of recommendations

A. Findings and context

Based on its three-week visit, the IBM team made the following observations with key supporting points:

- Today's current operating model, which includes multiple organizations, does not address the full water cycle:
 - It lacks long-term network planning and coordinated water and wastewater handling solutions across the entire water cycle, which are necessary to achieve a balanced approach to water quality.
 - There is no regular testing, monitoring or management of septic system maintenance.
 - There is no agreement on required metrics to manage water quality, such as total nitrogen load.
 - There is limited or no coordination across different organizations on similar programs of work.
- Levels of infrastructure monitoring and understanding, particularly for individual households, cannot support or sustain the improvement of water quality:
 - Staff shortages and limited cross-training result in the postponement of preventive maintenance activities to handle emergencies and other reactive work.
 - New technologies and regulations may require additional resources or different skills.
 - Current housing options do not meet the needs of changing demographics and are particularly lacking for young professionals.
- After potential federal and state funding, there is still a US\$7 billion gap for wastewater treatment upgrades in Suffolk County (based on Suffolk County Department of Economic Development and Planning cost estimates for septic system upgrades and changes).
- Residents and businesses value water quality but do not understand how they influence it or know what they can do to improve and protect it:
 - Citizens with individual septic solutions generally take action on maintenance only when there is an issue with the septic system.
 - The County lacks a common way to quantify the economic impact that poor water quality has on Suffolk County.
 - Many citizens do not recognize the relationship between their water use and overall water quality; many do not know that their water comes from an aquifer below their homes.
- Lack of coordination across organizations prevents collective and deliberate action:
 - Diffused responsibilities, varying objectives and lack of agreement limit how and when to engage the public.
 - There is no common measure or goal for the amount of nitrogen loading that is acceptable.
 - Interested stakeholders do not meet on a regular basis to discuss water issues.
- Suffolk County recognizes cesspools and septic tanks as the primary contributor of the nitrogen load in the water:
 - There are 360,000 individual properties with an on-site cesspool or septic system.
 - These technologies are not designed to remove nitrogen.
- Current Department of Health Services codes for septic solutions do not address nitrogen reduction needs:
 - Alternative approaches and innovative technologies are not encouraged enough due to a lack of information, resources and incentives, as well as failed previous trials.
- The County lacks an overall data strategy:
 - Relevant data is fragmented and owned by different stakeholders in different formats.
 - There is no single electronic registry or repository that tracks cesspools and septic systems in Suffolk County.

During the three-week visit, the IBM team referenced a number of documents to consolidate its understanding of the issues and support its conclusions. The core documents are identified in Appendix C (see references 4, 8, 9, 18 and 19).

B. Roadmap of recommendations

Based on these findings, the IBM team recommends that Suffolk County develop an Integrated Water Management model. The model should address the granularity and variety of nitrogen sources, the several paths by which nitrogen reaches the water, the limited options of reduction treatment for on-site septic systems and the limited feasibility of new sewers in the county. The County also must consider the multiple interrelated factors that influence water quality in Suffolk County. This comprehensive plan should be resilient enough to absorb and mitigate the impact of factors that are outside the County's control (including federal and state grants, tax revenues, regulations and weather events). The team established multiple action plans to give the County a full scope of considerations it must take into account when approaching nitrogen reduction in water.

The deployment of the Integrated Water Management model is supported by 11 distinct recommendations across four elements: Blueprint for the future, Execution, Engagement and Enablers (see Figure 2).

Blueprint for the future includes three recommendations: the creation of the robust Water Resource Plan, the consolidation of the STP network and the definition of the right technologies for areas where sewers are not a feasible option in the Water Resource Plan.

The Execution of these recommendations covers the full set of available solutions for wastewater disposal. Based on data analytics, the County will be able to identify the most appropriate and cost-effective geographies to serve with new sewers, where to extend existing sewers, which STPs require a capacity increase, locations to install small clusters and which septic/treatment technologies should be installed where sewers are not feasible.

Within this comprehensive model, it is recommended that Suffolk County consolidate existing STPs under the same governance and operations to improve wastewater treatment. The priority is to focus on those plants that have high levels of nitrogen load or are within areas nominated as a priority for sewer construction or extension. Blueprint adoption and implementation is closely connected to the other three elements of the Integrated Water Management model. In fact, the Blueprint can be effective only when it is supported by Execution and Engagement.

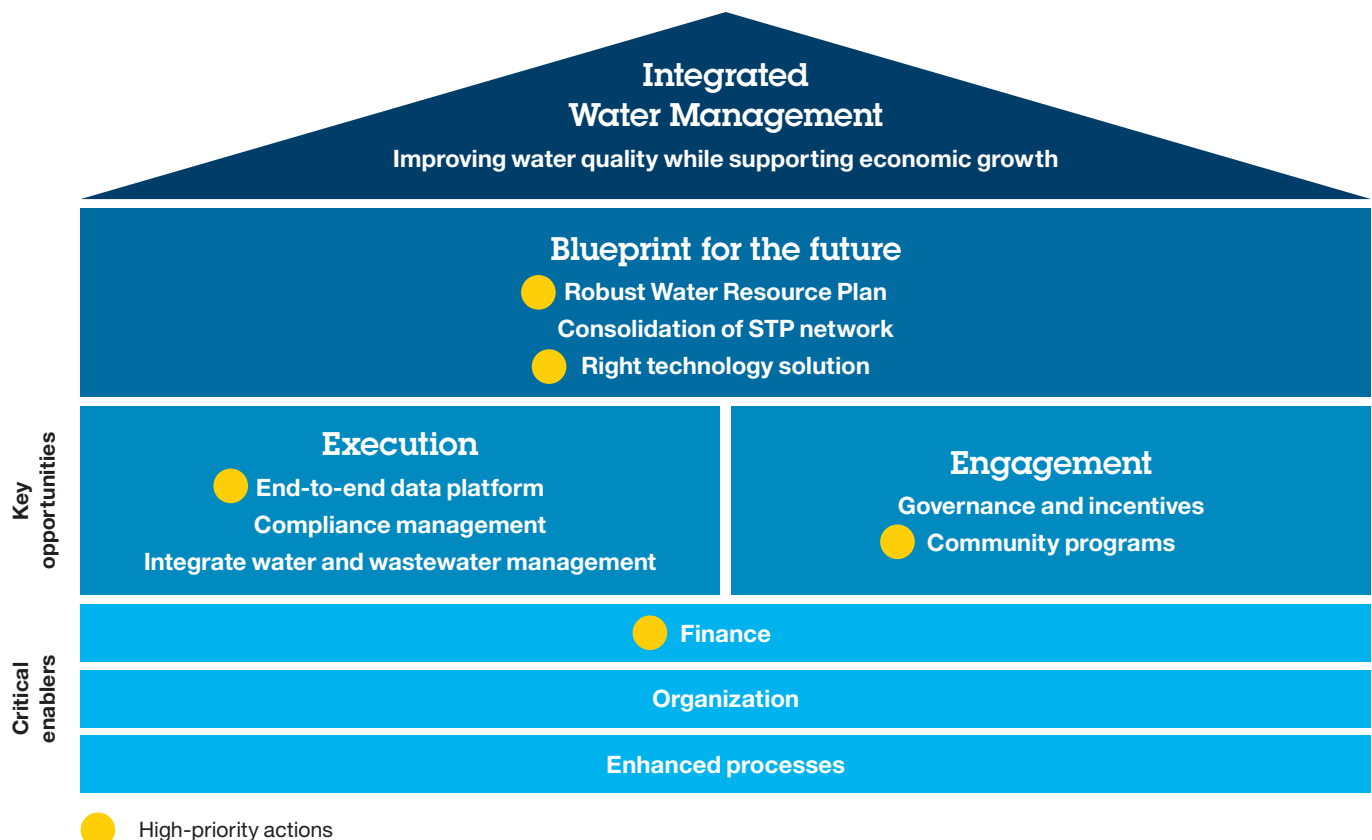


Figure 2: Overview of recommendations, with yellow circles indicating high-priority actions

Critical to the overall success of Integrated Water Management is the implementation of an end-to-end data model, which enforces a common language and is a central source of information for decision makers. The number of stakeholders and the difference in their current data structures is the main inhibitor to data-driven management. The implementation of such a model will provide the data necessary to execute the County's water quality mission and responsibilities in a more effective manner. Compliance management is important for the County to ensure all key processes in the water cycle are monitored, assessed and executed in a way that allows nitrogen reduction goals to be met. Another recommendation is to consolidate water authority and wastewater management activities. There are several examples of improved effectiveness in such a combined operation mode, including the optimization of back-office processes, such as invoicing, procurement and laboratory testing. The consolidation will allow the County to manage the water cycle in an integrated fashion, with potential new opportunities to harmonize water fees and increase revenues for managing wastewater.

In order to achieve the overall plan, the County must address the three key enablers of finance, organization and process. The first enabler of finance is particularly challenging because the funding must be ongoing. Funding all the components, which are much more granular than the 11 recommendations themselves, is a complex puzzle of grants, bonds, fees and savings at several different levels (federal, state, county, municipal and so on). Planning, application, prioritization and monitoring for all must be meticulously controlled. It is recommended that the County appoint a financial team to specifically address the funding of the overall Water Resource Plan execution. This team should have strong leadership, high accountability to the County Executive and a clear understanding of the Water Resource Plan, along with the ability to coordinate funding and expenses.

The organization must be redesigned to support the recommended changes in management oversight of the water cycle. The inclusion of additional STPs, the release of the revised Sanitary Code, the expansion of some responsibilities and the creation of more robust compliance require a more senior and skilled workforce. This may mean an increase of resources and a potential shift in careers generated by new opportunities in the full water cycle.

Finally, it was noted that several processes within County operations should be reviewed for inefficiency or duplication of efforts. The County should consider implementing a continuous improvement process, employing "lean" principles to help improve customer responsiveness and potentially free up valuable resources to be employed in new areas.

Although implementation of most of the recommendations will be led by County staff, a successful outcome requires the participation of the communities, people and organizations of greater Suffolk County. Under the topic of Engagement, two recommendations are made to address this participation. The first is governance and incentives, for which the goal is to define methods to encourage homeowners to become active participants in the Water Resource Plan, primarily by upgrading their on-site septic systems. The definition of appropriate and affordable incentives, supported by financial plans, will increase the success of the County in achieving its upgrade goals.

Remediating all 360,000 individual septic and cesspool installations will require awareness and self-initiation of action from the residents and communities owning these systems. It is recommended that Suffolk County undertake significant engagement activities to encourage residents and visitors to contribute to the solution for excess nitrogen. Engagement programs should offer a broad spectrum of initiatives to increase awareness, achieve an appropriate and distributed level of understanding and obtain adequate commitment. Those initiatives should directly link the value of water quality to daily life. For example, the adoption of such programs as the Blue Flag (see reference 5 in Appendix C) will make the impact of individual behaviors on the surrounding area immediately visible.

Such engagement is vital to this program. In order for the County to achieve its water quality goals, the people must be sufficiently committed to act.

This recommended program is highly ambitious and comprehensive. To build momentum and demonstrate near-term progress, the following high-priority activities must begin as soon as possible:

- Establish common nitrogen load allocation goals
- Create a comprehensive water resource management plan
- Launch a Blue Flag pilot
- Develop an on-site/cluster systems inventory
- Release Sanitary Code updates to support new on-site wastewater management options
- Establish a financing plan to accompany the Water Resource Plan
- Identify priority data sources to integrate into a common water management platform

These actions are reflected in a summary roadmap (see Figure 3). A roadmap of all recommended actions is available in Appendix I.

In order to provide the County with initial guidance for planning purposes, order-of-magnitude cost figures have been estimated for each recommendation. These costs have been estimated in ranges and classified as high (up to \$30 million), medium (up to \$10 million) and low (up to \$1 million). The County has previously estimated total infrastructure costs for septic system upgrades to be approximately \$8 billion, which is not included in our cost estimates.

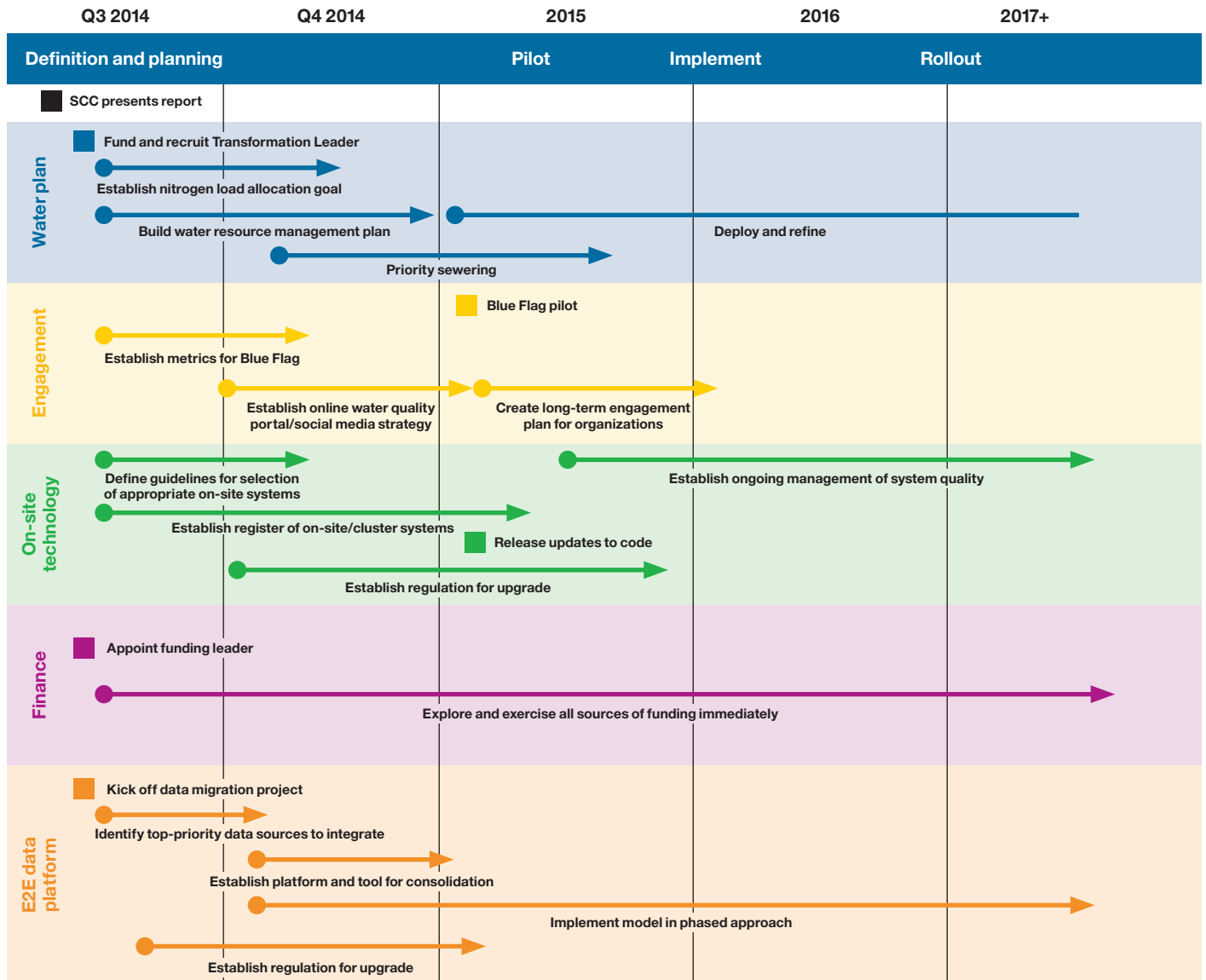


Figure 3: Roadmap of high-priority actions

4. Recommendations

The following paragraphs detail the 11 recommendations for Suffolk County, highlighting the scope, key milestones and stakeholders for each. The recommendations described have been developed based on the information covered within the three week period. The owners identified will need to plan the implementation of these recommendations in the context of the overall priorities and budget for Suffolk County.

Recommendation 1: Finalize and deploy a robust and integrated Water Resource Plan

The recognized problem of high nitrogen loads in ground and surface water cannot be addressed in isolation. All contributing elements (households, industry and agriculture) must be considered in an integrated manner (see Figure 4), with the numerous interactions among the components of the water cycle taken into account. Such an integrated approach is not yet implemented in Suffolk County, mainly due to the multiple stakeholders and the variety of needs involved.

There is a need for an integrated water resource management plan supported by clearly identified sponsors and sustained by a related organization. Suffolk County must identify responsibility for water management across the island, and the plan must take into account all contributing or mitigating elements impacting the water resources of Suffolk County. The high diversity of situations in sub-watershed geographies necessitates specific approaches for individual areas, which must be considered in the plan. In addition, the plan should consider future scenarios, such as population growth, water body levels and flows, to help ensure that actions and plans taken today support the long-term outcomes desired for water quality and overall county development.

The proposed Water Resource Plan must serve as a master plan that will help decide the most appropriate scenarios, trigger their translation into action plans and follow up on their impacts. It is important that this plan can be used on a regular basis and is easily maintained to support decision making on water management. In this way, the plan can steer actions and support decisions to help reduce total nitrogen loads on water bodies. Consequently, this will translate into better quality of life and suitable economic development.

The team's proposal is to build the plan incrementally, based on the existing comprehensive plan (see reference 21 in Appendix C), while engaging its use and making outcomes visible at the earliest stage possible. This will help to foster plan acceptance and hasten the development of the surrounding governance structure.

An integrated approach to planning and managing water bodies is being established in many other countries and cities, and this work may help inform Suffolk County during the development of its plan. Examples can be found in Appendix C (see references 20, 23, 25, 26, 29, 30, 33, 34, 35 and 36).

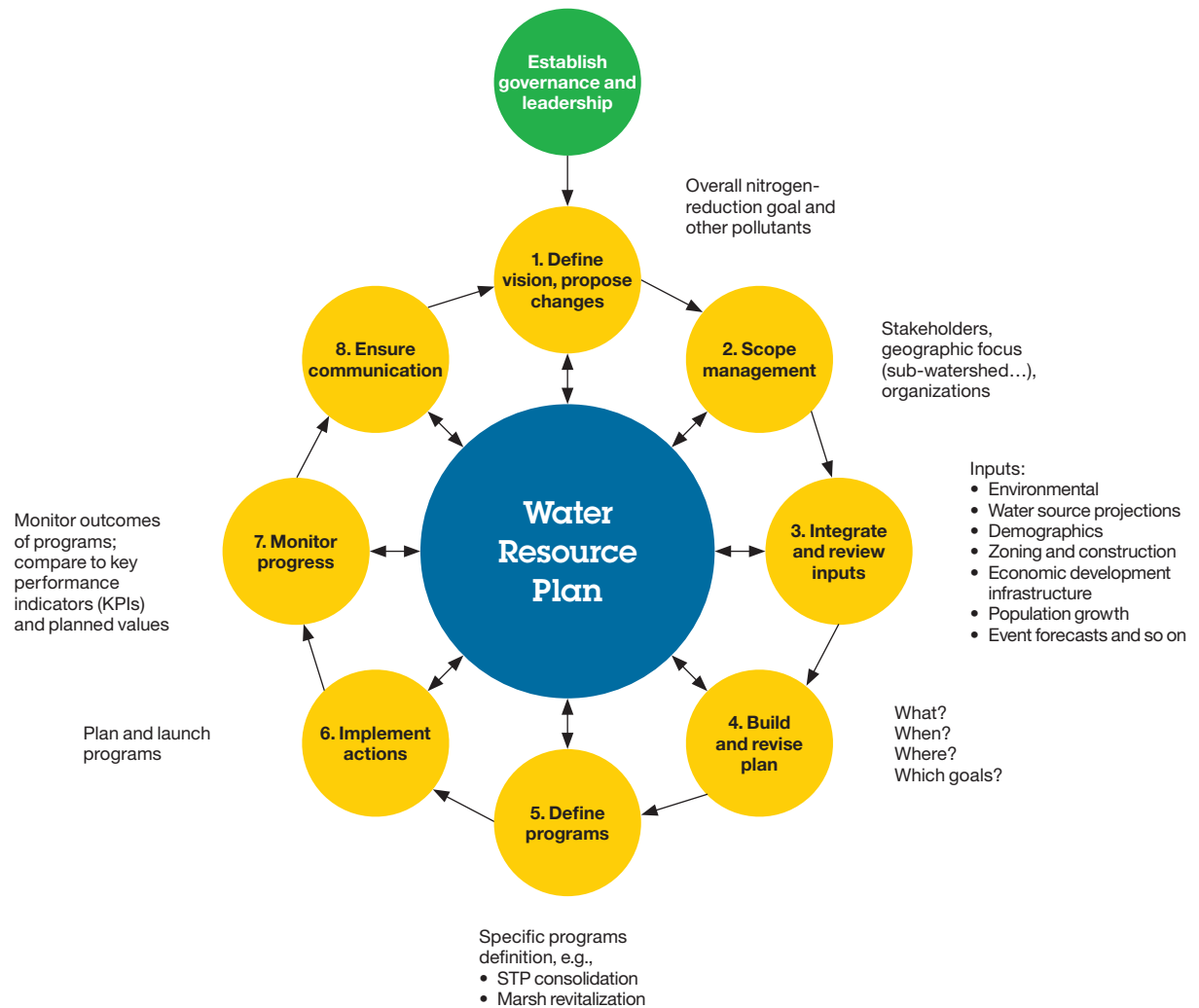


Figure 4: An incremental plan with specific sponsors and immediate outcomes will foster acceptance

Recommendation 1: Finalize and deploy a robust and integrated Water Resource Plan

The County should finalize and deploy an integrated Water Resource Plan supported by clearly identified sponsors and sustained by a related project organization.

Scope and expected outcomes

Scope

Develop a master plan for water management that will be used as a framework to support decisions related to agreed-upon outcomes for water quality and related activities.

To achieve desired results, the plan should do the following:

- Provide a vision and overview regarding agreed-upon goals (what the future will look like)
- Offer a common view of the current situation as well as future developments and scenarios
- Contain tools for supporting operational decision making
- Trigger, monitor and integrate specific programs and action plans
- Ensure and streamline related monitoring and communication

Expected outcomes

Developing a master plan for water management and related activities will help to ensure the following outcomes:

- Common goals are defined and an agreed-upon strategy is defined to reach these goals
- All areas of the water cycle are efficiently managed and integrated, including water supply, storm water runoff, wastewater treatment, water production, industrial and agricultural water use and surface and groundwater
- Adequate solutions are developed and implemented that consider local conditions and future development needs

Cost of inaction

The costs of inaction are a lack of plan information, resulting in uncoordinated actions, wasted efforts, duplicated tasks and redundant investments. Key nitrogen reduction goals may be missed without properly synthesizing a full range of actions.

Proposed owner and stakeholders	Suggested resources needed
<p>Owner: Suffolk County Department of Health Services supported by the Department of Economic Development and Planning</p> <p>Stakeholders:</p> <ul style="list-style-type: none"> • All County agencies • Suffolk County Water Authority (SCWA) and other water authorities • STP operations operated both privately and by the County • Towns, villages and hamlets • Nonprofits • Businesses and trade associations • State agencies, such as the New York State Department of Environmental Conservation (NYSDEC) • Federal agencies • Universities 	<ul style="list-style-type: none"> • An external vendor to provide guidance and knowledge transfer to the Suffolk County Department of Economic Development and Planning • Part-time input from other departments and stakeholders during the joint planning phase • A dedicated team to maintain, update, communicate and coordinate efforts according to the plan <p>Cost estimate: Medium</p>

Recommendation 1: Finalize and deploy a robust and integrated Water Resource Plan (continued)

Dependencies	Key milestones, activities and timeframe
<p>This recommendation requires the consolidation of the STP network (described in Recommendation 2), as well the establishment of a framework to visualize, monitor and manage water quality (see Recommendation 4).</p>	<p>Short term (up to 6 months):</p> <ul style="list-style-type: none"> • Develop initial plan • Establish governance and leadership • Set preliminary goals for nitrogen load allocation • Build resource management plan • Define and launch initial programs <p>Long term (1 - 5 years):</p> <ul style="list-style-type: none"> • Implement program • Launch actions • Measure progress • Manage integrated management resource plan
Priority	
High	

Recommendation 2: Operate the sewage treatment plant network under the control of the Suffolk County Department of Public Works

There are currently 193 sewage treatment plants (STPs) within Suffolk County, of which 23 are operated by the Suffolk County Department of Public Works (SCDPW), including the Bergen Point plant, which accounts for approximately 51% of total STP volume. The STP Report for 2013 (see reference 11 in Appendix C) states that by the end of 2014, all County STPs will be treating for nitrogen reduction. However, 61 plants have been identified as “high risk,” a consequence of producing average nitrogen levels in excess of the 10 mg/L target. The recommendation is to include all 193 STPs under the management of SCDPW. This may mean that private operators continue to operate certain STPs under the management of the SCDPW.

Recommendation 2: Operate the STP network under the control of the SCDPW

The County should manage all 193 public and private STPs under the authority of the SCDPW to facilitate the smooth transformation of operations that support a reduction in nitrogen loads. Although the SCDPW will have overall control, there may be instances in which private operators continue execution of operations at the individual plant level.

Operational transfer will be prioritized based upon STP location (proximity to potential areas for new or extended sewers feeding the STP) as well as the plant's history for producing high levels of nitrogen.

Scope and expected outcomes

Scope

To achieve the desired results, the County should take the following actions:

- Transfer operational control of privately run STPs to the SCDPW, covering all 193 plants
- Maintain Suffolk County Department of Health Services (SCDHS) risk-based approach to monitoring STP output

Expected outcomes

Moving STPs under the direction of the SCDPW will help to ensure the benefits listed below:

- Consistent operation, management and monitoring of STPs
- Network optimization and improved overall performance in nitrogen reduction efforts
- Increased revenue and the opportunity to achieve parity on charges for wastewater services across the county
- Waste collection cost uniformity across the county, reducing transport and logistical costs for waste disposal while optimizing waste management capacity
- More focused efforts for addressing areas with high levels of nitrogen

Costs of inaction

The costs of inaction include the continued operation of STPs releasing unacceptable nitrogen levels. Without proper maintenance and oversight, these plants will continue to worsen nitrogen pollution, ultimately undermining economic development and tourism.

Proposed owner and stakeholders	Suggested resources needed
<p>Owner: Head of SCDPW</p> <p>Stakeholders: Commissioner of the Department of Health Services, private STP operators, civil services and unions</p>	<ul style="list-style-type: none"> • Program management and transition planning • Teams to manage new plant operations <p>Cost estimate: High</p>
Dependencies	Key milestones, activities and timeframe
<p>This recommendation requires the establishment of a Water Resource Plan (see Recommendation 1) and will impact the consolidation of water and wastewater operations (see Recommendation 3).</p> <p>A workforce model and practices also must be designed to meet future needs (see Recommendation 9). Potential solutions for decentralized wastewater treatment (see Recommendation 11) also will influence the consolidation of STP operations.</p>	<ul style="list-style-type: none"> • Confirm criteria, priority and control of transfer (Month 1) • Develop high-level transition plans aligned to the overall resource plan and place identified resources (Months 2 - 3) • Define STP management and operational approach based on service levels (Months 3 - 9) • Schedule service management meetings with privately run STPs (Months 4 - 12) • Transfer initial tranche of STPs to new network (Months 4 - 24) • Manage ongoing program for STP transfer (Year 2 onward)
Priority	
Medium	

Recommendation 3: Integrate water and wastewater operations

A number of businesses provide drinking water to Suffolk County, with the Suffolk County Water Authority (SCWA) serving 72 percent of the population (see reference 15 in Appendix C). These water companies operate independently from wastewater services, as well as from one another. Such separation may cause investment decisions to be made in a localized manner without full consideration of overall county needs or the water cycle. In addition, this situation causes a number of support services to be duplicated, including sampling, lab services, customer contact centers and billing.

As part of the Water Resource Plan, bringing water and wastewater services together will allow a more integrated view for management across the county, which may result in a more effective investment portfolio. The combined operations also bring alignment on water consumption and the related level of service requirements for wastewater.

The recommendation is to first assess the feasibility and business case for consolidation, followed by the definition of a future operating model for water and wastewater management across the county. A diagram in Appendix G outlines the core operational and customer cycles for a combined water and wastewater company. Highlighted on the diagram are some best practices that should inform the design and help optimize these services for Suffolk County.

The County should consolidate its water and wastewater management processes through the integration of the SCWA with the 193 STPs currently in operation. This will entail developing a business case and target operating model for the combined water and wastewater services, which may present savings and process improvement opportunities.

This recommendation does not include multiple water providers for approximately 30 percent of the population. Including these companies may be worth considering at a later stage.

Scope

To achieve the desired results, the County should do the following:

- Integrate the operations, billing and support services of the SCWA and SCDPW for water and wastewater services
- Integrate the operations and support services of the transferred STPs as they are on-boarded (see Recommendation 2)

Expected outcomes

Consolidating water and wastewater operations will provide Suffolk County with the following benefits:

- An integrated view for effective management of the total water cycle
- Tighter orchestration between water management and Department of Health Services regulation
- Network optimization through the elimination of redundant activities and fewer repeat visits to specific sites
- Increased savings and synergies through the integration of key support services, such as sampling, laboratory services, call centers, control centers and management structures
- New revenue opportunities and funding options in addition to water-specific fees
- Uniform pricing for water and wastewater services for a majority of Suffolk County citizens
- Improved management of storm water runoff

Costs of inaction

Continuing to operate water and wastewater operations separately will result in more duplication of services and operations, often within the same facility. In addition, investment decisions about capital construction and refurbishment will not be aligned and may not cover the full water cycle.

Recommendation 3: Integrate water and wastewater operations (continued)

Proposed owner and stakeholders	Suggested resources needed
<p>Owners:</p> <ul style="list-style-type: none"> • Commissioner of SCDPW • Commissioner of SCWA <p>Stakeholders: Commissioner of the Department of Health Services</p>	<p>Support from transition teams, human resources teams, business representatives and department heads</p> <p>Cost estimate: Medium</p>
Dependencies	Key milestones, activities and timeframe
<p>Integrating water and wastewater operations depends on the success of the following recommendations:</p> <ul style="list-style-type: none"> • Recommendation 1: Finalize and deploy a robust and integrated Water Resource Plan • Recommendation 9: Develop workforce model and practices to meet future needs <p>Integrating water and wastewater operations will impact the following recommendations:</p> <ul style="list-style-type: none"> • Recommendation 2: Operate the STP network under the control of the SCDPW • Recommendation 10: Adapt the business processes in the SCDPW and the SCDHS to meet expanded integrated water management responsibilities 	<ul style="list-style-type: none"> • Define business case and identify synergies (2 months) • Determine the target operating model to combine water and wastewater services (4 months) • Establish an implementation plan and budget (3 - 4 weeks) • Agree on working patterns and structures with unions (6 - 9 months) • Transition and consolidation of shared services (6 - 9 months) • Transition and implementation of combined operation (9 months with stabilization of operations for an additional 6 - 12 months)
Priority	
Low	

Recommendation 4: Establish a framework to visualize, monitor and manage water quality

The County currently faces a number of data-related challenges:

- Fragmented data owned by different stakeholders in different formats
- Lack of a unified electronic registry/repository that tracks cesspools and septic systems
- No management or uniform reporting for wastewater disposal companies, such as sludge collectors/haulers
- Data collaboration and data sharing among stakeholders is limited and cumbersome
- Little or no data exchange between the County and towns/villages
- Large amounts of data are paper-based and difficult to collect
- Electronic data may be outdated, inaccurate or missing, including the following examples:
 - Inaccuracies exist in manhole data post-IMI-study
 - As-built sewer plans are missing or inaccurate
 - Sewer permits before Merlin 2013 are all on paper
 - No inventories exist for pumping stations that connect to the sewer main
- Freedom of Information Law (FOIL) requests are necessary in some cases to share data among stakeholders
- Household information is limited
- Data is not standardized, and there is no integration layer
- Limited data sharing is currently done via email, PDF, Excel spreadsheets and .csv files
- Data analysis and data reporting are often performed by running custom SQL queries
- Shortage of IT professionals
- IT/software/systems knowledge for certain applications resides with a single person
- Perceived reluctance from some stakeholders to use common systems for particular functions, making data sharing more difficult:
 - GIS systems: Esri vs. MapInfo
 - Operator10 vs. Oper32
 - iFIX used by District 3 vs. Genesis used by the other districts
- Proliferation of data sources created by in-house applications
- Lack of an overall strategic approach to IT
- High reliance on non-production databases, such as MS Access
- Disaster recovery (D/R) approach is based on backups
- No high-availability architecture for IT
- The County's preference is to have open data access for external users
- For some software systems, the County relies on niche software vendors

The team recommends that Suffolk County consolidate its IT into a pool of shared resources that can serve all agencies across the county and create an integrated data platform. This will lead to the rationalization of software licenses, data sources and applications, as well as lead to greater levels of openness, data sharing and collaboration among the different stakeholders. The County is currently using a federated approach to IT that results in a fragmented IT organization in which knowledge sits with individuals instead of in a resource pool of IT specialties, such as GIS, web design and development, data architecting and administration, system administration and many others.

Suffolk County should create a single, non-federated IT organization with computer science professionals to carry out the full software development lifecycle as well as data management for all County agencies. A single integrated data platform will allow the County to easily share its data with other County agencies and external stakeholders, such as towns, research organizations, universities and nonprofits. The data platform can incorporate information owned by other stakeholders, such as zoning data, and it can serve as the repository for data that the County does not currently have but needs, such as a cesspool/septic system registry. Examples of similar data integration platforms are highlighted in Appendix C (see references 1, 2, 27, 28, 31, 32 and 38).

Finally, a disaster recovery program and high-availability architecture are recommended.

Recommendation 4: Establish a framework to visualize, monitor and manage water quality

The County should create a centralized data integration platform to establish a “single source of truth” that is accessible to all stakeholders, promoting collaboration and data sharing.

Scope and expected outcomes

Scope

To achieve desired results, the County should do the following:

- Implement this recommendation in phases
- Start by creating a common information model with a few data sources and add incrementally as the model is enriched
- Create mechanisms (SOA, API management, MDM or data federation) to enable access (interagency and citizen-facing) to the data in the new common information model
- Clean and modify applications that use consolidated data sources per the new common information model
- Migrate existing citizen-facing applications to the newly created data integration platform
- Consolidate the County’s currently scattered IT teams into a single IT department that can service all County organizations and departments and act as the owner of the data integration platform
- Digitize existing information and data on key information sets
- Implement a high-availability architecture for the centralized data integration platform
- Define and implement a more robust approach to disaster recovery

Expected outcomes

This recommendation should result in the following outcomes:

- Every stakeholder will have access to current status and insights, enabling them to remain informed and drive decisions and investments that need to be made
- Relevant stakeholders can share water-related information, including the nitrogen loading model, overall water resource management and total maximum daily load (TMDL) across the platform
- Different stakeholders will have information tailored to their requirements to help them take the right actions
- A centralized data integration platform used across the County will make data readily available
- Reduced risk of limiting the management of an application or data set to a single skilled individual
- Reduced risk of data loss
- Operational cost reduction for infrastructure and licenses

Costs of inaction

The result of inaction would be the continued use of fragmented and isolated data owned by different stakeholders across different organizations, making it difficult for anyone to get a single view of the information. In addition, software license cost savings — from multiple GIS systems, databases, operations systems and asset management systems — would not be realized. The County would continue to create one-off applications that require their own databases and fragment the data even more.

Inaction will hinder the modernization of applications and data management systems, compromising County efforts to improve nitrogen pollution levels. The County would continue to use MS Access, a non-production database, and would also continue to store paper-based network and infrastructure information in a single location. Limited disaster recovery planning would continue to present an unacceptable business/operations risk. The County would continue to run the risk of poor availability of IT applications through ongoing use of non-production databases and multiple applications.

Recommendation 4: Establish a framework to visualize, monitor and manage water quality (continued)

Proposed owner and stakeholders	Suggested resources needed
<p>Owner: Deputy County Executive — Operations</p> <p>Stakeholders:</p> <ul style="list-style-type: none"> • All County agencies • SCWA and other water authorities • STP operations — private, County • Towns, villages, hamlets • Nonprofits • Businesses and trade associations • State agencies, such as NYSDEC • Federal government agencies • Universities 	<ul style="list-style-type: none"> • Consolidated IT department • SCDHS • SCDPW • Towns • SCWA • State agencies (such as NYSDEC) • STP operators <p>Cost estimate: Medium</p>
Dependencies	Key milestones, activities and timeframe
<p>Fulfilling this recommendation is dependent on the County completing the following recommendation:</p> <ul style="list-style-type: none"> • Recommendation 1: Finalize and deploy a robust and integrated Water Resource Plan 	<p>Short term:</p> <ul style="list-style-type: none"> • Creation of a unified County IT department (3 months) • Identify initial priority data sources and confirm data ownership and governance (Weeks 2 - 4) • Define information model for pilot sources, for example, select two or three data sources owned by SCDHS to start consolidating a common information model (Weeks 2 - 4) • Implement subset of common information model (Week 5) • Establish a platform and tools to consolidate and share initial models (Weeks 6 - 11) • Enable access to this model subset (Weeks 8 - 10) • Migrate application(s) that use(s) this subset of the model (Weeks 11 - 14) • Identify next set of data sources and models and implement (Weeks 10 - 20) <p>Long term:</p> <ul style="list-style-type: none"> • IT department to chair and continue work to complete the creation of a common information model (all stakeholders involved) (1 year) • Continue work to migrate applications (ongoing) • Enable mobility for applications (ongoing) • Consolidate all distributed County data centers into one, including Hauppauge and Yaphank (1 year) • Develop a resilient D/R strategy (1 year) • Define overall data governance and measurement objectives
Priority	
High	

Recommendation 5: Establish governance to enable the installation of appropriate technology and to motivate responsible behavior

This recommendation addresses three key issues for Suffolk County's governance structure. Local residents in Suffolk County must upgrade their on-site cesspool or septic systems, as these systems do not treat nitrogen, a main pollutant of the water bodies on Long Island. In addition, the majority of residents use their cesspools or septic systems to manage general domestic wastewater, some of which may not be compliant with the Suffolk County Department of Health Services Sanitary Code. Finally, the current Sanitary Code does not encourage or allow residents to upgrade their cesspools or septic systems.

Suffolk County cannot proactively address water quality issues with the current governance structure in place. By permitting new technology, the County will enable local residents to upgrade septic systems to treat nitrogen, helping to improve water quality and quality of life in Suffolk County. Education of the public, proactive and regular septic system checks and quicker permit approval processes will encourage the variety of stakeholders to upgrade their systems.

The governance structure needs to not only allow for new technology but also must establish a system for enforcement and compliance across the county. Currently, Suffolk County does not regularly check or monitor the performance of cesspools and septic systems. Effective public communication, as well as a governed operational regime that includes monitoring and checks, may make residents more likely to maintain their septic systems. The EPA guidelines for management of decentralized septic solutions should be taken into consideration in the definition of this governance structure (see Appendix H).

As Suffolk County combats the harmful effects of nitrogen pollution, an established and enforceable governance structure must begin to manage and monitor pollution reduction progress across the county.

Recommendation 5: Establish governance to enable the installation of appropriate technology and to motivate responsible behavior

Suffolk County should create a governance structure for updated wastewater management systems in individual residences to improve sanitation and minimize nitrate loads in the groundwater. New septic technologies that reduce localized nitrogen levels can help improve water quality, resulting in better quality of life and economic development. The County should encourage citizens to upgrade their septic solution infrastructure.

Scope and expected outcomes

Scope

To achieve desired results, the County should take the following actions:

- Create a governance structure for updating the Suffolk County Department of Health Services Sanitary Code to allow for new and improved technologies
- Launch the pilot program for septic system technology that treats nitrogen and allow homeowners to test new technology
- Communicate alternative system options to citizens and private operators in a timely manner
- Educate citizens about nitrogen in lawn fertilizers and incentivize the use of organic or nitrate-free fertilizer and other acceptable products
- Facilitate removal and upgrade of cesspools across the county through public education and awareness
- Require point-of-sale certifications for residences to upgrade septic solutions and designate homes as "nitrogen free"
- Expedite permit approval process by the Department of Health Services to allow builders, towns, individuals and estate agents to upgrade or install new on-site septic systems that treat nitrogen

Expected outcomes

By following this recommendation, the County should experience the following:

- Decreased number of cesspools in Suffolk County
- Increased number of upgraded septic solutions in Suffolk County that help reduce nitrogen
- Decreased amount and concentration of nitrogen in water bodies in the county
- Expanded public awareness of the impacts of individual septic systems on collective water quality
- Quicker approvals of permits for advanced septic systems or other adapted wastewater treatment technology
- Reduced impact on nitrogen levels from domestic fertilizer
- Septic solutions will no longer be a reason to restrict development of towns and villages in Suffolk County

Recommendation 5: Establish governance to enable the installation of appropriate technology and to motivate responsible behavior (continued)
Scope and expected outcomes (continued)
Costs of inaction

Inaction will perpetuate water contamination from individual septic tanks and cesspools. Residents will remain unaware of the impact of their systems, and County staff will be unable to monitor, evaluate and correct issues with water contamination in an effective and efficient manner. With a lack of maintenance, more septic solutions will begin to fail over time, causing higher operational costs for households and increased health risks from untreated sewage.

Proposed owner and stakeholders	Suggested resources needed
<p>Owner: Commissioner of the Department of Health Services</p> <p>Stakeholders:</p> <ul style="list-style-type: none"> • Department of Economic Development and Planning • Individual residents • Septic system manufacturers • Septic system installers/operators • Towns/communities 	<ul style="list-style-type: none"> • County team to operate transition and manage governance • Communications initiative to raise citizen awareness • County legislature representatives • Owner from Department of Health Services • Representatives from private operators/installers <p>Cost estimate: Low</p>
Dependencies	Key milestones, activities and timeframe
<p>Establishing a successful governance depends on the following recommendations:</p> <ul style="list-style-type: none"> • Recommendation 4: Establish a framework to visualize, monitor and manage water quality • Recommendation 10: Adapt the business processes in the SCDPW and the SCDHS to meet expanded integrated water management responsibilities • Recommendation 11: Establish a framework for decentralized wastewater handling solutions 	<p>Short term:</p> <ul style="list-style-type: none"> • Complete application for the Sewer Repair Program for pilot septic system upgrades to receive funding (30 days) • Select pilot technology system and initial pilot residents to install new systems (90 days) • Update DHS Sanitary Code to eliminate outdated technologies in Suffolk County (6 months) • Construct a governance structure for monitoring, enforcing and incentivizing citizens to upgrade their wastewater treatment or contribute to county-wide investment (6 months) • Update process for assessment and authorization of new technologies for treatment of nitrogen to include in DHS Sanitary Code (Year 1) • Implement governance structure for monitoring, enforcing and incentivizing citizens to upgrade their wastewater treatment or contribute to county-wide investment (Year 1) <p>Long term:</p> <ul style="list-style-type: none"> • Incentivize citizens to upgrade septic systems with denitrification (Years 1 - 2)
Priority	
Medium	

Recommendation 6: Excite communities to embrace the solutions for improving water quality

Local citizens, governments and organizations understand the fundamental value of water but have yet to create a streamlined and all-encompassing civic engagement strategy to address water quality. Citizens do not yet relate water usage with water and wastewater quality. Suffolk County must engage communities and visitors to embrace local resources for water quality improvements, reaching across diffused interests and uniting them to take action.

To engage citizens, Suffolk County should establish positive reinforcement, such as the global Blue Flag program (see references 3 and 5 in Appendix C), to highlight water quality and safety standards. Beaches and marinas with Blue Flag distinctions have higher attendance and contribute to a thriving tourism industry that benefits local economic development.

Suffolk County also must improve public awareness of water quality, specifically around water usage and its impact on the environment. Social media and online portals provide easy opportunities for citizens, visitors and stakeholders to engage with one another on water quality (see references 1, 2, 6, 7, 10 and 39).

Twitter, Facebook and smartphone apps like Creek Watch and WaterQuality (see Appendix C) provide stakeholders with a place to learn and provide information on water quality. Users can upload photos of issues, check Blue Flag beach conditions and learn about county-wide or local initiatives on water quality. Giving stakeholders the tools to take action is a necessary first step in addressing declining water quality in Suffolk County.

As media platforms spur interest and engagement, Suffolk County must create a cohesive and all-encompassing strategy for public awareness. Continued town hall meetings, as County Executive Steven Bellone has previously held, draw input from stakeholders and provide a structure for engagement. Education and workshops, in which students learn about the water cycle and how to manage wastewater, can engage the community and educate the next generation of water quality stewards in Suffolk County. Focused activities that benefit the local community tend to receive more support, making the towns and villages a pivotal part of the engagement strategy.

Ultimately, citizens' desire to act, in conjunction with a proactive and clear strategy from Suffolk County, can spur collective action in the community and begin to address water quality in a comprehensive way.

Recommendation 6: Excite communities to embrace the solutions for improving water quality

Suffolk County must motivate the various stakeholders and community members to embrace water quality improvements by clearly identifying the importance and benefits these improvements deliver at the local level. The County must explain the value of water across political, social and environmental lines to improve civic engagement and local economic development.

Scope and expected outcomes

Scope

To achieve desired results, the County should perform the following actions:

- Establish positive reinforcement by adopting the Blue Flag approach, or a similar program, to create clean, safe and environmentally friendly beaches and coastal areas as well as make visitors associate closed attractions with poor water quality
- Provide easily accessible information on water quality through online and social media outlets for public knowledge and use
- Engage the public and other stakeholders via social media to help provide information on pollution incidents or risks
- Communicate the economic value of water to the public and translate this understanding into action
- Develop a long-term plan for improved water quality with collective action opportunities for local residents
- Promote civic buy-in from local organizations with regular town hall meetings regarding water quality
- Link sustainable economic development with the inherent value of water to motivate citizens to contribute socially and financially
- Target schools and public buildings to educate children about water usage and pollution as well as the role they play in protecting water quality

Expected outcomes

This recommendation should result in the following outcomes:

- Established water quality and safety standards for beaches with Blue Flag distinctions
- Increased access to information on water quality for residents and visitors
- Improved awareness of beach closures and contaminations
- Shared financial information on the economic impact of clean water throughout Suffolk County, including its effect on sales and tourism and pollution-related expenses
- Cleaner beaches with fewer algae blooms, less prevalent red and brown tides and reduced nitrogen levels
- Increased civic engagement, meetings and volunteer opportunities for citizens to express concerns and share insights related to water quality

Recommendation 6: Excite communities to embrace the solutions for improving water quality (continued)

Scope and expected outcomes (continued)

Costs of inaction

Economic development, specifically development of tourism and water-related industries, will continue to suffer from deteriorating water quality if the County does not act on this recommendation. Citizens will remain unaware of their role as stewards of water quality in Suffolk County and will, therefore, take no action to improve water quality.

Proposed owner and stakeholders	Suggested resources needed
<p>Owner: Suffolk County Department of Economic Development and Planning</p> <p>Stakeholders:</p> <ul style="list-style-type: none"> • Suffolk County Department of Health Services • Long Island Chambers of Commerce • Towns and villages • Long Island Commission for Aquifer Protection • Business owners • Suffolk County Department of Public Works • Nonprofits 	<ul style="list-style-type: none"> • Incremental funding for the establishment and monitoring of the Blue Flag system • Social media expansion • Portal for easy access to information • Town hall meetings with citizen groups for input and feedback • Advocacy and promotion team • Additional resources to monitor and follow new guidelines <p>Cost estimate: Low</p>
Dependencies	Key milestones, activities and timeframe
<p>Engaging the community in water quality issues hinges on the completion of the following:</p> <ul style="list-style-type: none"> • Recommendation 4: Establish a framework to visualize, monitor and manage water quality 	<p>Short term:</p> <ul style="list-style-type: none"> • Establish metrics, based on Blue Flag criteria, to evaluate safety and environmental quality of beaches and waterways (90 days) • Design and establish a structure for social media use with clear guidelines and goals on how it will help the County manage nitrogen pollution and establish a plan for two-way use of information (4 months) • Publish water quality levels and information online via a portal or social media, as well as on-site with positive reinforcement (6 months) • Establish programs for local school children on water quality education (6 months) • Engage and work with towns regarding application for Blue Flag (6 months) <p>Long term:</p> <ul style="list-style-type: none"> • Update and monitor beach and waterway cleanliness and provide information to the public (Year 1) • Create a long-term engagement plan for organizations to excite individual residents and visitors about water quality protection (Years 1 - 3) • Establish checkpoints and engagement days to reignite dedication to improved water quality (Year 3 and ongoing)

Priority

High

Recommendation 7: Create a structure to drive compliance

With its diverse group of stakeholders and distinct and complicated processes, Suffolk County must ensure citizens and stakeholders comply with the governance established in the Water Resource Plan (see Recommendation 1).

This recommendation defines the appropriate level of control for compliance, showing how and when to keep citizens and organizations accountable. EPA guidelines on the management of decentralized solutions also should be considered (see Appendix H).

Initially, Suffolk County should gather input from key stakeholders involved in protecting water quality. The newly established compliance team should compare stakeholder processes, metrics and milestones to relevant KPIs from the Water Resource Plan.

Suffolk County should define a governance model and approach to manage and adapt the monitoring framework through the different phases of implementation.

Recommendation 7: Create a structure to drive compliance

Suffolk County and vested stakeholders should establish a compliance framework for managing and monitoring key milestones set out in the Water Resource Plan (see Recommendation 1). This includes defining roles and responsibilities to monitor and control key processes and targets to achieve clean water.

Scope and expected outcomes

Scope

To achieve desired results, the County should establish the following roles and responsibilities:

- Suffolk County Department of Health Services
 - Monitor septic system upgrade programs and share progress
 - Perform sample testing, share results in real time and enforce recovery plans when necessary
- Suffolk County Department of Public Works
 - Hold regular governance meetings to discuss STP operations, ensure they meet compliance standards and identify action if needed
 - Monitor operating volumes in STPs and analyze the sample testing of wastewater before and after treatment, driving recovery plans when necessary
 - Monitor source waste location and quality and identify follow-up actions for locations with high levels of nitrogen or septic system failure
- Suffolk County Water Authority
 - Perform sample testing, share results and create timely alerts for critical situations
 - Share records for water sources, locations and volumes
- Towns and villages:
 - Link zoning with the Water Resource Plan and the compliance measures

Expected outcomes

Creating a structure to drive compliance should result in the following:

- Increased stakeholder awareness of issues, such as failing STPs or deficient septic systems
- A cross-functional dashboard with compliance and progress statuses for system upgrades
- A recovery plan for system failures, in place and at the ready
- Adoption of a relevant, recommended EPA management model

Costs of inaction

Without compliance, an established governance structure cannot improve water quality. Lack of monitoring and enforcement prevents Suffolk County from proactively addressing issues with STPs or on-site septic systems, an issue that will continue if the County does not take action.

Recommendation 7: Create a structure to drive compliance (continued)	
Proposed owner and stakeholders	Suggested resources needed
<p>Owner: Suffolk County Department of Health Services</p> <p>Stakeholders:</p> <ul style="list-style-type: none"> • Water authorities • Suffolk County Department of Public Works • US Environmental Protection Agency 	<ul style="list-style-type: none"> • New role for ownership of these processes • Data framework • Transition coordination • Assurance role for the County <p>Cost estimate: Low</p>
Dependencies	Key milestones, activities and timeframe
<p>Establishing a structure to drive compliance depends on the County's ability to fulfill the following recommendations:</p> <ul style="list-style-type: none"> • Recommendation 1: Finalize and deploy a robust and integrated Water Resource Plan • Recommendation 4: Establish a framework to visualize, monitor and manage water quality • Recommendation 5: Establish governance to enable the installation of appropriate technology and to motivate responsible behavior 	<p>Short term:</p> <ul style="list-style-type: none"> • Form an interdisciplinary meeting between owner and stakeholders to outline a plan of action and discuss key themes (Week 1 and ongoing) • Confirm initial priority measures for compliance and align with Recommendation 4 focus areas (Weeks 2 - 10) • Develop supporting materials (Weeks 7 - 8) • Execution (Week 13) • Measurement (Week 16 and ongoing) <p>Long term:</p> <p>Annually review the critical KPIs, validate compliance processes and modify them as appropriate, based on water quality status, new pollution/water quality factors and improvement of processes</p>
Priority status	
Medium	

Recommendation 8: Continue to develop a funding mechanism

Funding is a pressing issue for the County as it works to solve its nitrogen challenges. We recommend appointing a financial team with strong leadership to generate a funding plan specifically for wastewater management goals.

Suffolk County's Water Resource Plan calls for a multitude of actions that vary in nature and scale, balancing complex needs across the county. Each of these projects, both short- and long-term, will require significant investment. Some recommendations will produce additional revenue, like the consolidation of the STP network. Others, including the Suffolk County Water Authority and wastewater management consolidation and organizational changes, will result in savings. The financial team should coordinate all funding actions, grant applications and bond issuance (see references 16 and 22 in Appendix C). The team must direct resulting revenue and operational savings toward the execution of the Water Resource Plan.

Funding is directly connected to federal, state and county regulations and is not always guaranteed. For this reason, the County should establish a global view of grant applications (to-do, pending, granted, rejected), other funding actions and statuses (such as bonds), new revenue, water fees and expected savings. With this framework in place, the County can plan, prioritize and/or redirect available funding as well as drive the execution of individual projects based on a comprehensive view. Suffolk County may find the Smarter Cities Financing Guide from the Smarter Cities Council useful in identifying various funding options for municipalities (see reference 24 in Appendix C).

Recommendation 8: Continue to develop a funding mechanism

Suffolk County's estimated cost of additional sewers and septic system upgrades is US \$8 billion and requires an extensive, long-term approach to finance the entire plan. To get started, the County should construct a complete financial picture of spending along with a timeline and funding options.

Scope and expected outcomes

Scope

To achieve desired results, the County should take the following actions:

- Explore existing and applicable grants at the state and federal level
- Evaluate existing taxes/funding that can be redirected toward water quality issues
- Consider the following options for revenue generation:
 - County loans (including the option to place the repayment responsibility with the homeowners)
 - Adjustments to sales, tourist, property, toll road and vice taxes
 - Wastewater management fee, potentially determined by water consumption for waste services
 - Water consumption —based fee
 - Fees from citizens for their wastewater services managed by the County following the integration of privately operated STPs
 - Leverage efficiencies in the overall water management processes, including testing, invoicing and chemical purchase
- Align the priority and timing of septic system upgrades or sewer extension deployments with the availability of confirmed funding and the priorities defined in the Water Resource Plan
- Define a set of affordable incentives, based on priority, to help ensure earlier upgrades

Expected outcomes

Developing an approach to managing the funding mechanism should result in the following advantages:

- A clear understanding of funding availability within a five-year timeframe, enabling execution and implementation in the very near term
- Generating new revenue sources
- Establishing a regional funding model
- Effective reduction of nitrogen pollution

Costs of inaction

Without a funding mechanism and an approach to managing it, integrated water management efforts will fail and communities will lack the awareness they need to make investments in improving water quality.

Recommendation 8: Continue to develop a funding mechanism (continued)	
Proposed owner and stakeholders	Suggested resources needed
<p>Sponsor: The County Executive</p> <p>Owner: Finance</p> <p>Stakeholders:</p> <ul style="list-style-type: none"> County legislators Federal and state legislators Suffolk County water authorities and local communities 	<ul style="list-style-type: none"> Financial leadership Legislators <p>Cost estimate: Medium</p>
Dependencies	Key milestones, activities and timeframe
<p>Successful management of the funding mechanism depends upon the County's strong partnership with federal and state governments, as well as the existing management of bonds. The recommendation also depends on the completion of the following recommendations:</p> <ul style="list-style-type: none"> Recommendation 1: Finalize and deploy a robust and integrated Water Resource Plan Recommendation 2: Operate the STP network under the control of the SCDPW Recommendation 11: Establish a framework for decentralized wastewater handling solutions 	<p>Short term:</p> <ul style="list-style-type: none"> Appoint a financial lead Engage all the stakeholders Agree on priorities Implement a funding plan and contingencies to deliver the following: <ul style="list-style-type: none"> Proactive application and securing of grants Development of new revenue sources Mechanism for progress tracking <p>Long term:</p> <ul style="list-style-type: none"> Ongoing management and tracking of the funding structure over a multi-year roadmap to monitor the following: <ul style="list-style-type: none"> Bond repayments Distribution of the savings/benefits Collection of revenue
Priority status	
High	

Recommendation 9: Develop workforce model and practices to meet future needs

Suffolk County must adjust its resource model with the appropriate number and type of resources for present and future needs. Currently, staffing concerns in the Department of Health Services and the Department of Public Works limit Suffolk County's ability to manage water effectively (see reference 14 in Appendix C).

First, open positions and staffing shortages limit the County's proactive maintenance capabilities and effective infrastructure management. Specialized job roles limit flexibility and staff transfers across organizational borders, impacting retention rates.

Finally, an aging workforce and limited new hires with the necessary skills will prevent Suffolk County from effectively planning, managing and monitoring water-related quality improvements.

Suffolk County must establish a succession plan to recruit new employees with the most critical necessary skills.

If Suffolk County allows advanced on-site septic systems (see Recommendation 6) with consolidated governance structures, skill demand in the county will increase significantly.

Ultimately, Suffolk County must build a vigorous and proactive staffing plan to service customers effectively, perform proactive asset maintenance and maintain a workforce with high levels of organizational knowledge.

Recommendation 9: Develop workforce model and practices to meet future needs

The County should update its staffing plan and workforce practices to proactively manage and prepare for changing requirements.

Scope and expected outcomes

Scope

The proposed plans for updating standards, code and management oversight of on-site septic and cluster systems will drive increased workload for the Suffolk County Department of Health Services. The recommendation to consolidate the STP network will potentially drive increased needs for the Suffolk County Department of Public Works. A proactive organizational strategy and staffing plan will help prepare the County to handle the anticipated increase in workload while delivering a higher level of service to constituents.

To achieve desired results, the County requires the following:

- Fast and effective wastewater permit process, especially for new technologies
- Proactive monitoring and maintenance of expanded wastewater network
- Efficient and accurate data gathering, as well as skills to enable data sharing
- Distribution of key skills across several employees, preventing isolated capabilities in the organization, which can be risky
- Career path development to ensure roles within the organization can attract and retain skilled staff

Expected outcomes

With a future-focused workforce model, the County should benefit from the following:

- Improved response times to requests for new on-site permits/variances
- More complete and accurate water quality data
- Reduced overtime costs and optimized labor costs
- Improved workforce retention rates
- Business resilience and continuity for critical skills

Costs of inaction

The result of inaction would be critical skill gaps for operational roles, duplicated waste activities and data management, extended turnaround times for on-site and cluster system permits and potential widespread events due to the lack of critical maintenance and monitoring prioritization.

Recommendation 9: Develop workforce model and practices to meet future needs (continued)	
Proposed owner and stakeholders	Suggested resources needed
<p>Owners:</p> <ul style="list-style-type: none"> • Commissioner of the Department of Public Works • Commissioner of the Department Health Services <p>Stakeholders:</p> <ul style="list-style-type: none"> • Civil service organization • Union representatives • County finance 	<ul style="list-style-type: none"> • Workload planner/staffing leader • Managers of relevant departments • Advocacy by County leadership team • Representation from human resources (HR) <p>Cost estimate: High</p>
Dependencies	Key milestones, activities and timeframe
<p>Implementing a new workforce model depends on the successful completion of the following recommendations:</p> <ul style="list-style-type: none"> • Recommendation 2: Operate the STP network under the control of the SCDPW • Recommendation 4: Establish a framework to visualize, monitor and manage water quality • Recommendation 5: Establish governance to enable the installation of appropriate technology and to motivate responsible behavior • Recommendation 11: Establish a framework for decentralized wastewater handling solutions <p>This recommendation will be impacted by the following implementation:</p> <ul style="list-style-type: none"> • Recommendation 3: Integrate water and wastewater operations 	<p>Short term:</p> <ul style="list-style-type: none"> • Identify staffing plan owner and form an interdisciplinary team of owner and stakeholders to outline plan of action (Month 1) • Map workflow processes, determine demand-side and supply-side inputs (such as expected volume of permits, testing, retention levels, expected retirements, skill levels) (Months 2 - 3) • Build gap analysis of skill demand vs. supply (Month 4) • Define and implement communications plan with staff (Month 7 and ongoing) • Develop strategy for supply of needed skills, consider retention strategies and work process redesign (Months 5 - 6) • Develop succession plan for key positions and demand for new roles (Month 6) • Gain financial support for staffing as necessary (Months 6 - 7) • Execute staffing plan (Months 7 - 12) <ul style="list-style-type: none"> – Deploy training program to keep current staff up-to-date and ready for transitioning into new roles – Work with union representatives to staff new positions – Work with HR to confirm and approve new role descriptions as well as recruitment/deployment plans and processes <p>Long term:</p> <ul style="list-style-type: none"> • Establish regular reassessment (suggest annually) of one- to three-year resource plan (Year 1 and ongoing) • Deploy work process redesign program to reduce process burden and improve responsiveness to customers (Years 1 - 2) • Work with civil service and union representatives to develop apprenticeship programs to meet demand (Ongoing) • Establish strategic relationships with local schools to foster recruitment into the field (Ongoing)
Priority	
Medium	

Recommendation 10: Adapt the business processes in the Suffolk County Department of Public Works and the Suffolk County Department of Health Services to meet expanded integrated water management responsibilities

Consolidation of water cycle management will require continuous process improvement in the Suffolk County Department of Public Works (SCDPW) and the Suffolk County Department of Health Services (SCDHS). Suffolk County has an opportunity to reduce functional duplications between departments and agencies, eliminating unnecessary events, such as multiple visits to a single residence to draw well and pool samples.

Citizens and various stakeholders believe inefficient processes and duplicate responsibilities will continue to slow permit processing times and agency responsiveness. With improved operational efficiencies, Suffolk County departments can absorb the anticipated workload associated with increased management involvement in the overall water cycle.

Recommendation 10: Adapt the business processes in the SCDPW and the SCDHS to meet expanded integrated water management responsibilities

Suffolk County must prepare for increased wastewater treatment volumes by expanding the scope of responsibility and control of the Department of Public Works and Department of Health Services. To do that, the County should improve its operational processes and prepare its organizations and businesses for additional responsibilities using end-to-end management systems.

Scope and expected outcomes

Scope

- To achieve desired results, the County requires the following:
- Increased responsiveness to customer needs through waste reduction and cost savings
 - Defined goals and metrics across networks and functions
 - Expanded access to data, readiness to integrate and effective data use
 - Use of economies of scale, such as integrated purchasing, operations, billing and waste disposal

Expected outcomes

- Improving processes to help the Department of Public Works and Department of Health Services meet an expanded scope of responsibilities should help the County achieve the following:
- Process alignment with defined outcomes and goals for improved water quality
 - Improved service levels with more responsive processes
 - Eliminated areas of duplication and wasted effort

Costs of inaction

The County's inaction would result in lost opportunities for cost reduction and efficiency improvements. The County would continue to invest time and money into duplicate efforts and would not be able to measure progress because of continued data fragmentation.

Recommendation 10: Adapt the business processes in the SCDPW and the SCDHS to meet expanded integrated water management responsibilities (continued)

Proposed owner and stakeholders	Suggested resources needed
<p>Owners:</p> <ul style="list-style-type: none"> • Commissioner of the Department of Public Works • Commissioner of the Department of Health Services <p>Stakeholders:</p> <ul style="list-style-type: none"> • County leadership • Line operators and managers • County finance 	<ul style="list-style-type: none"> • Process optimization program manager • Managers, line leaders and operators • Advocacy by County leadership team <p>Cost estimate: Medium</p>
Dependencies	Key milestones, activities and timeframe
None	<p>Short term:</p> <ul style="list-style-type: none"> • Identify program owner and form an interdisciplinary team of owners and stakeholders to outline plan of action (Month 1) • Determine client value metrics and common goals (Months 2 - 3) • Identify process owners and change agents to prioritize and lead improvement initiatives (Months 2 - 4) • Conduct value stream mapping workshops and determine areas of duplication and waste (Months 3 - 6) • Create action plans to eliminate pain points and duplicate work (Month 6) • Execute action plans (Months 7 - 12) • Measure improvements (Month 13 and ongoing) <p>Long term:</p> <p>Establish regular continuous improvement process discipline (Years 1 - 3)</p>
Priority status	
Medium	

Recommendation 11: Establish a framework for decentralized wastewater handling solutions

The Water Resource Plan will define which areas of the county are sewered. In non-sewered areas, the most appropriate on-site wastewater handling method — decentralized wastewater handling — must be defined separately. In Suffolk County, the on-site legacy methods are cesspools and septic systems connected to leaching pools, which do not remove nitrogen. In addition, these methods are generally poorly maintained and have limited follow-up programs in place.

There are different needs in different areas of the county, so selecting the appropriate technology will be specific to a particular property and location (see references 13 and 17 in Appendix C). Citizens should be able to select their on-site wastewater treatment method from a range of possible solutions (see references 12 and 37 in Appendix C). But even the best on-site solution requires correct operation and maintenance to meet performance requirements for waste treatment and nitrogen reduction.

Therefore, a framework is necessary to monitor and manage compliance to ensure that decentralized wastewater treatment systems are meeting operational requirements. The framework should consider control and certification intervention not only at installation but also at other points in the system's lifecycle, such as transfer of ownership, house development/renovation and upgrade.

- This recommendation addresses the needs for the following:
- Improved support for the selection of adequate technology within a broad range of possibilities
 - Enhanced follow-up processes to improve existing decentralized wastewater handling facilities throughout the entire lifecycle
 - Improved data gathering and performance monitoring of on-site waste disposal facilities
 - Increased nitrogen-removing wastewater handling solutions across the county

Recommendation 11: Establish a framework for decentralized wastewater handling solutions

Finalize and implement a framework for the selection, deployment and management of appropriate local wastewater handling solutions for both individual and cluster systems.

Scope and expected outcomes

Scope

- To achieve desired results, the County should perform the following actions:
- Provide access to a broader set of adequate technology solutions
 - Encourage innovative solutions for wastewater handling
 - Set up a framework for the operation and maintenance of decentralized systems
 - Set up a framework for the permitting and monitoring of decentralized systems, encouraging an upgrade to nitrogen-removing solutions
 - Promote the consideration of cluster systems in situations where it makes sense, considering economies of scale for better operations

Expected outcomes

- With a framework for decentralized wastewater handling solutions, the County can expect to experience the following advantages:
- An accessible and available knowledge base for decentralized water treatment possibilities
 - Improved solution selection (on-site or cluster) for each property
 - A consistent prioritization strategy to determine timing for solution implementation
 - An established approach to ensure ongoing management and monitoring of wastewater treatment solutions
 - An overall plan that determines what solutions to implement and when, aligning with the overall resource management plan
 - Smooth and simple data gathering at all stages of the decentralized system's lifecycle

Costs of inaction

If the County does not establish this framework, it will continue to implement solutions that do not treat nitrogen and will have no visibility of on-site treatment facilities. This will impede the identification and upgrade of poorly operated systems, and the overall nitrogen load will continue to increase.

Recommendation 11: Establish a framework for decentralized wastewater handling solutions (continued)	
Proposed owner and stakeholders	Suggested resources needed
<p>Owner: Department of Health Services</p> <p>Stakeholders:</p> <ul style="list-style-type: none"> Academic institutions (for research/innovation) Private service companies and treatment facility operators Towns and villages Department of Public Works 	<ul style="list-style-type: none"> Department of Public Works to assess technologies Universities and wastewater treatment companies to expand innovation and continue research on cluster systems <p>Cost estimate:</p> <ul style="list-style-type: none"> Develop framework: Medium Implement infrastructure changes (as estimated by Suffolk County): High
Dependencies	Key milestones, activities and timeframe
<p>The successful development and implementation of this framework is contingent on the following recommendations:</p> <ul style="list-style-type: none"> Recommendation 1: Finalize and deploy a robust and integrated Water Resource Plan <p>This recommendation will impact the following:</p> <ul style="list-style-type: none"> Recommendation 3: Integrate water and wastewater operations Recommendation 5: Establish governance to enable the installation of appropriate technology and to motivate responsible behavior Recommendation 6: Excite communities to embrace the solutions for improving water quality Recommendation 7: Create a structure to drive compliance 	<p>Short term:</p> <ul style="list-style-type: none"> Gather knowledge and provide information regarding on-site and cluster systems (3 - 4 months) Define guidelines for the selection of appropriate on-site and cluster technology (2 months) Establish governance and a shareable mechanism: <ul style="list-style-type: none"> Establish a register of on-site/cluster systems with self-register capabilities (6 months) Provide guidelines and training information for private operators (3 - 4 months) Require certification and inspection for ongoing quality management of on-site solutions (Month 9 and ongoing) Establish an inspection record information system for on-site and cluster systems (1 month and ongoing) Establish regulations to ensure the implementation or upgrade of on-site treatment systems during renovation or when property ownership changes (2 months and ongoing) <p>Long term:</p> <ul style="list-style-type: none"> Establish a “Low-N certified” label for properties that meet nitrogen reduction standards (Year 1 and ongoing) Define the framework and create a toolkit to help select technology for small cluster/grouping of properties, considering cost-benefit analysis and known environmental impact (6 months, starting Year 2)
Priority status	
High	

5. Conclusion

Water quality in Suffolk County, NY — Long Island's largest county — has a fundamental impact on the quality of life of the County's citizens. Long Island is the second most visited tourist destination in the state of New York, and it relies on water to attract these visitors. Water is critical to local economic development, recreation and industry. As water quality deteriorates and pollution in the local waterways becomes more apparent, Suffolk County has many compelling reasons to address water quality issues immediately. Suffolk County's rich agricultural and seafood history highlights the value of environmental conservation and waterway protection in the region.

Suffolk County faces many challenges that impede water quality improvement:

- A weak economy and limited funding
- A fragmented network of stakeholders
- Outdated standards for septic tank solutions
- Aging infrastructure
- Decentralized land use and zoning
- A geographically diverse land mass with varying challenges
- An outdated governance structure
- Constrained resources for monitoring and permitting
- Numerous data repositories
- A declining population
- High local property taxes
- Concerned residents

As Suffolk County begins to address its water quality challenges, it understands that a comprehensive water resource strategy with actionable and measurable goals, along with support from a diverse group of stakeholders, is the key to success. This report identifies a number of recommendations that together will help Suffolk County transform its water quality now and in the future. The following are key elements that will help the County drive this change:

- An integrated approach to water and wastewater management
- A more proactive and data-driven stakeholder action plan
- A secure funding base
- Engaged communities

The IBM team created an actionable roadmap that enables Suffolk County to take an incremental approach to solving its water quality issues. Each milestone provides necessary actions, key stakeholders and desired outcomes to help Suffolk County become the "gold standard" in managing water contamination from nitrogen pollution. The desire for improvement and change is apparent, as Suffolk County has taken the necessary first step of addressing the importance of water for its community, its economy and its future. Suffolk County, with its passion for change and its commitment to improvement, can position itself as a Smarter County to revitalize its local economy and reclaim its water.



6. Appendix

A. Acknowledgments

Individuals interviewed:

The following is a list of the individuals we met with during our engagement with Suffolk County. We would like to thank them for their contributions and valuable insight.

Name	Title	Organization
Mark Lesko	Executive Director	Accelerate Long Island
Thomas Gallagher	Director of Sales & Operations	Aparo, Sanitary & Environmental Services
David L. Berg	Associate LEED Accredited Professional	Cameron Engineering & Associates, LLP
Mark Wagner, C.E.P.	Partner, LEED Accredited Professional	Cameron Engineering & Associates, LLP
Marianne Garvin	President & CEO	CDC of Long Island
Joel Moser	Adjunct Professor of International & Public Affairs at Columbia University	Columbia University
Lorne Brousseau	GIS & Stormwater Manager, Marine Program	Cornell University, Cooperative Extension of Suffolk County
Frank Castelli	Environmental Projects Coordinator — Water Quality Improvement	Suffolk County Department of Economic Development and Planning
Barry S. Paul	Deputy Commissioner	Department of Health Services
Larry Stipp	Office Systems Analyst III	Department of Health Services, Division of Environmental Quality
Walter J. Hilbert	Chief Principal Public Health Engineer	Department of Health Services, Division of Environmental Quality, Office of Wastewater Management
Kristina Heinemann	Agriculture and Decentralized Wastewater Treatment Coordinator, Watershed Management Branch	US Environmental Protection Agency (EPA), Region II
Robert Riekert	Deputy Director	Huntington
Margo Myles, AICP	Senior Environmental Analyst, Coordinator of Open Space Conservation	Huntington
Jen L. Jordon-Sweet	Research Staff Member, Silicon Technology, Research Division	IBM NSLS 725A/X20, Brookhaven National Laboratory
Damon McMullen	Trustee, Commissioner of Police, Commissioner Wastewater Treatment System	Incorporated Village of Northport
Cara Longworth	Executive Director	Long Island Regional Planning Council
Mitchell H. Pally	CEO	Long Island Builders Institute
Tony Leung	New York State (NYS) Department of Environmental Conservation (DEC)	NYSDEC
Julie Nace	Peconic Estuary Program Coordination NYSDEC, Bureau of Marine Resources	NYSDEC
Glynis M. Berry	Director	Peconic Green Growth
Marshall Brown	Founder	Save the Great South Bay
Alison Branco, Ph.D.	Marine Biologist	Suffolk County Department of Health Services, Office of Ecology Peconic Estuary Program
Joseph M. Fusillo, P.E.	Director of Water Quality and Laboratory Services	Sidney B. Bowne & Son, LLP
Swaroop Puchalapalli, P.E.		Sidney B. Bowne & Son, LLP

Name	Title	Organization
Harold Walker	SBU/CE	Stony Brook University
Christopher Gobler	SBU/SOMAS	Stony Brook University
Larry Swanson	SBU/SOMAS	Stony Brook University
Minghua Zhing	SBU/SOMAS	Stony Brook University
Robert Wilson	SBU/SOMAS	Stony Brook University
David L. Calone	Chairman	Suffolk County Planning Commission
John C. Donovan	Chief Engineer	Suffolk County Department of Public Works, Division of Sanitation Engineering
Steven Bellone	County Executive	Suffolk County
Camilo Salazar, M.S.C.	Environmental Analyst	Suffolk County Department of Economic Development and Planning, Division of Water Quality
Cynthia DiStefano	Director of Classification	Suffolk County Department of Civil Service
Dorian Dale	Director of Sustainability, Chief Recovery Officer	Suffolk County Department of Economic Development and Planning
Sarah Lansdale	AI/CP, Director of Planning	Suffolk County Department of Economic Development and Planning
Walter Dawydiak, Jr. P.E., J.D.	Director	Suffolk County Department of Health Services, Division of Environmental Quality
Eric Rotondi	Legislative Aide, Office of Presiding Officer DuWayne Gregory	Suffolk County
John M. Kennedy, Jr.	Legislator, District 12	Suffolk County
Jay Schneiderman	Legislator, District 2	Suffolk County
Sarah Anker	Legislator, District 6	Suffolk County
Robert Trotta	Legislator, District 13	Suffolk County
Steve Stern	Legislator, District 16	Suffolk County
William R. Spencer	Legislator, District 18	Suffolk County
Al Krupski	Legislator, District 1	Suffolk County
Robert Calarco	Legislator, District 7	Suffolk County
Kara Hahn	Legislator, District 5	Suffolk County
Monica Martinez	Legislator, District 9	Suffolk County
Ben Wright, P.E.	Principal Engineer	Suffolk County Department of Public Works, Division of Sanitation Engineering
R. Boris Rukovets, P.E.	Public Works Special Project Supervisor	Suffolk County Department of Public Works, Division of Sanitation Engineering
Pamela Donovan	Staff to Sarah Anker, Legislator, District 6	Suffolk County
Dominick Ninivaggi	Superintendent	Suffolk County Department of Public Works
Colleen Capece	Special Projects Coordinator	Suffolk County Office of Budget and Management
Edward Lyons		Suffolk County
Carl Lind	Cartographer	Suffolk County
Kate Oheim	Assistant Cartographer	Suffolk County
Neil Ralph	District 3 Bergen Plant Senior Instrumentation Technician	Suffolk County
Jonathan Schneider	Deputy County Executive	Suffolk County

Name	Title	Organization
Samuel Chu	Chief of Operations and Commissioner of Labor	Suffolk County
Joanne Minieri	Deputy County Executive and Commissioner of Economic Development and Planning	Suffolk County
Vanessa Baird Streeter	Director of Communications	Suffolk County
Connie R. Corso	Budget Director	Suffolk County Executive Office
Robert M. Lipp	Director of Budget Review, Budget Review Office, Suffolk County Legislator	Suffolk County Legislature
Christine M. Lasher	Assistant Laboratory Director	Suffolk County Water Authority
Timothy Kilcommons, P.E.	Chief Engineer, Department of Public Works, Division of Sanitation Engineering	Suffolk County Water Authority
Larry Kulick, C.P.A.	Chief Financial Officer	Suffolk County Water Authority
Jeffry Szabo	Chief Executive Officer	Suffolk County Water Authority
Joseph Pokerny P.E.	Deputy CEO for Operations	Suffolk County Water Authority
Paul Kuzman	Director of Production Control	Suffolk County Water Authority
Karen A. Randazzo	Director of Water Quality and Laboratory Services	Suffolk County Water Authority
Carrie Meek Gallagher	LEED Green Associate, Chief Sustainability Office	Suffolk County Water Authority
Michael G. Mullowney	Systems Analyst	Suffolk County Water Authority
Amy C. Engel	Executive Director	Sustainable Long Island
Stuart R. Lowrie	Conservation Finance & Policy Advisor	The Nature Conservancy
Stephen Lloyd	Conservation Information Manager	The Nature Conservancy
Elizabeth C. Smith	Environmental Economist	The Nature Conservancy
Chris Clapp	Marine Specialist	The Nature Conservancy
Carl LoBue	Scientist	The Nature Conservancy
Andrew Manitt	Research Coordinator	The Sustainability Institute, Molloy College
Tim Carden	Managing Director	The PFM Group
Richard Groh	Chief Environmental Analyst, Dept. of Environmental Control	Town of Babylon
Jeanmarie Buffet	Senior Environmental Analyst	Town of Babylon
Anthony Graves	Principal Environmental Analyst, Division of Environmental Protection	Town of Brookhaven
Edward P. Romaine	Supervisor	Town of Brookhaven
Thomas Talmage, P.E.	Town Engineer	Town of East Hampton
Larry Cantwell	Town Supervisor	Town of East Hampton
Philip C. Ingerman	Director of Intergovernmental Relations, Office of Supervisor Frank P. Petrone	Town of Huntington
Joseph Cline, P.E.	Director, Dept. of Engineering	Town of Huntington
Eric M. Hofmeister	Deputy Supervisor	Town of Islip
Jefferson V. Murphree, AICP	Town Building and Planning Administrator	Town of Riverhead
Stephanie Hurd	Senior Environmental Analyst, Dept. of Environment & Waterways	Town of Smithtown
Allyson Murray	Director	Peconic Green Growth
Kyle Collins	Dept. of Land Management	Town of Southampton

Name	Title	Organization
Jennifer Garvey	Deputy Chief of Staff Officer of the Supervisor	Town of Southampton
Anna Throne-Holst	Supervisor	Town of Southampton
Mark Terry	Principal Planner, LRWP Coordinator	Town of Southold
Michael Collins	Professional Engineer, Office of the Engineer	Town of Southold
Maureen A. Tooke	Decentralized Wastewater Mgmt. Program/SepticSmart	US EPA Office of Wastewater Management – Idaho Operations Office
Kyle Strober	Long Island Regional Director	US Senator Charles Schumer's Office
Debbie Tinnirello	Long Island Regional Director	US Senator Kirsten Gillibrand's Office
Kevin P. Walsh	Managing Director, Long Island Operations	VHB Engineering, Surveying and Landscape Architecture
Tawaun Weber	Assistant Director	Vision Long Island
Elisabeth Muehlemann		Vision Long Island
Conrad Teller	Mayor	Westhampton Beach
Peter Scully	Regional Director	NYS Department of Environmental Conservation
Adrienne Esposito	Executive Director	Citizens Campaign for the Environment
Scott Martella		NYS Office of Governor Andrew Cuomo
Joshua Slaughter	Legislative Aide	representing Kate Browning, Legislator
Ann Golob	Long Island Index Project	Rauch Foundation
Steven Romalewski	Director	CUNY Mapping Service, Center for Urban Research

Organizations represented:

We spoke with individuals who represented the following organizations and stakeholders in Suffolk County and its surrounding areas. Each contributor was extremely knowledgeable, passionate and engaged in the water quality issues of Suffolk County, NY.

Accelerate Long Island	Brookhaven National Laboratory	Save the Great South Bay
Aparg, Sanitary and Environmental Services	Incorporated Village of Northport	SCDHS – Office of Ecology Peconic Estuary Program Suffolk County
Cameron Engineering and Associates, LLP	Long Island Regional Planning Council	Sidney B. Bowne and Son, LLP
CDC of Long Island	Long Island Builders Institute	Suffolk County
Columbia University	Sustainable Long Island	Town of Brookhavenw
Come!! University, Cooperative Extension of Suffolk County	The Nature Conservancy	Town of East Hampton
Suffolk County Department of Environment and Energy	The Sustainability Institute, Molloy College	Town of Huntington
Suffolk County Department of Public Works	Town of Babylon	Town of Islip
Suffolk County Executive Office	VHB Engineering, Surveying and Landscape Architecture	Town of Riverhead
Suffolk County Legislature	Vision Long Island	Town of Smithtown
Suffolk County Water Authority	Westhampton Beach	Town of Southampton
Environmental Protection Agency (EPA) Region II	Peconic Green Growth	Town of Southold
Suffolk County Department of Health Services	New York State Department of Environmental Conservation	Stony Brook University
Public Financial Management, Inc.		

B. Team biographies



Jan Bowen
Executive Partner and Water
Industry Leader
IBM UK (Bristol)

Bowen has more than 20 years of experience working within supply chain management and operations, focusing on realizing performance improvement across both geographic and organizational boundaries. She has worked in a variety of industries spanning automotive, aerospace and defense, chemicals and petroleum and more recently utilities. Her leadership has driven significant improvement-focused projects that address not only the change in business process and organization but also the associated enabling technologies. Bowen's experience within the utilities industry has involved the design and implementation of work and asset management solutions for water and wastewater companies. She recently led a project in which IBM helped establish a new national water utility in the Republic of Ireland.



Kelly Clifton
Strategy and Analytics Consultant
IBM North America (Charlotte)

Clifton's work focuses on business strategy and transformation services for external clients. She has acted as a consultant for large industrial clients and has extensive experience with innovative business opportunities within IBM, such as cloud, mobile, social and analytics. She assists with business development opportunities and research for the Smarter Cities Center of Excellence and IBM Smarter Water. Clifton has worked in local government reorganization and urban planning in the Commonwealth of Virginia. While in graduate school, she consulted for a multinational company in North Carolina, providing effective social media strategies to improve business-to-business marketing. Clifton holds a BA from the University of Virginia in government and history and an MA in management from Wake Forest University.



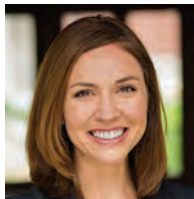
Antonio Nasuto
Director of Operations and Sales
Transformation for Central and
Eastern Europe
IBM (Prague)

Nasuto has more than 25 years of IBM experience, and most recently he led the integration of Sales Management Support into the global CRM model. Previously, he held several management roles in Sales and Business Operations, leading Global Technology Services CoE, Europe Sales Reporting CoE and Sales Management Support CoE in Bratislava. Nasuto has successfully managed global teams' transformation, integration and sales support. Prior to his international assignment, Nasuto specialized in services and was responsible for such clients as Exxon, Generali, Telecomitalia and many more.



Vincent Mottier
Application Innovation Services
Managing Consultant
IBM (Zurich)

Currently, Mottier's work focuses on Smarter Water™, enterprise asset management and business process analysis and design projects for transportation and water/wastewater utilities companies. He has 12 years of experience in the IT and telecommunications industries — with positions that span market research, product management and corporate strategy — combined with more than eight years working for renowned water research institutions on topics like wastewater treatment, runoff water handling and information management and data modeling for urban water management. Mottier holds a PhD and a Master's degree in environmental engineering from the Swiss Federal Institute of Technology, as well as an MS in hydrology from the University of Montpellier, France.



Allison McFadden

**Director of Integrated Supply Chain,
Business Integration and Transformation
IBM North America (Raleigh)**

McFadden has 15 years of experience in supply chain management, operations and business process transformation, during which she has focused on global and cross-functional team leadership. She has led large-scale projects for multiple product lines within IBM, including the launch of IBM systems software manufacturing in Dublin, Ireland. After this successful launch, McFadden served as the senior leader of the Dublin Software Center where she was responsible for the manufacturing and fulfillment of all IBM software products for the European and Growth Market regions. She has also led significant transformation projects for the IBM hardware division, the most recent of which was recognized as a finalist for both the Institute of Supply Chain Management and Supply Chain Council awards for excellence in supply chain. Her current responsibilities include developing strategic direction for the IBM Integrated Supply Chain and partnering with business services to provide supply chain talent and assets to clients. She holds a BS in industrial engineering from Purdue University and an MBA from Duke University.



Cesar Saavedra

**Worldwide Software Systems and
Data Management Consultant
IBM North America (Orlando)**

Saavedra has 24 years of IT experience, focusing primarily on architecting, implementing, testing, integrating and maintaining software and data systems. He holds BS and MS degrees in computer science from the University of Kansas, as well as an MBA from the University of Florida. Saavedra has experience in a variety of industries and sectors, including airlines, city and federal government, energy, telecommunications, retail, logistics, semiconductor manufacturing and many others. Currently, he is part of the IBM Worldwide WebSphere Competitive Team and works with sales teams around the world advising on IBM competitors in a variety of areas, including integration, BPM, SOA, API management, databases and the Internet of Things. Before joining IBM, Saavedra worked at Oracle, TIBCO, Lucent Technologies and AT&T Bell Laboratories. He is TOGAF certified.

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Figure 5: A BeachLive view gives the public access to information about water quality at public beaches and other factors that may affect beach use



Figure 6: A detailed BeachLive view about a particular beach's status

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Figure 7: A view of Splash, a site where the public can learn about the quality of water at public beaches in the Republic of Ireland

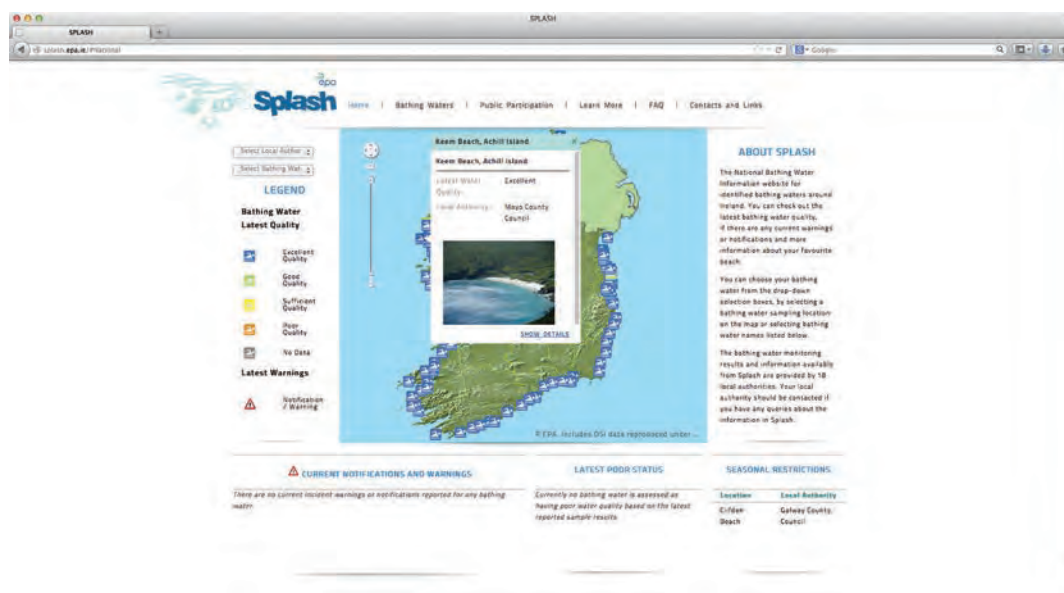


Figure 8: Splash view displaying details about a particular beach

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 - 16 Hurricane Sandy Coastal Resiliency Competitive Grants Program Mitigation Funds. Suffolk County. Environmental Projects Coordinator.
 - 17 "Request for Expressed Interest in: A Demonstration of Innovative Alternative On-site Wastewater Treatment Systems in Suffolk County." Issued April 14 2014. www.suffolkcountyny.gov/Portals/0/planning/general/RFEI-WQ-I-AWSS.pdf
- Submissions reviewed the following companies:
- AK Industries and AK/HA Mfg. LLC
 - Orenco Systems
 - Biogard Inc.
 - Busse, Green Technologies Inc.
 - Norweco
- 18 Suffolk County Atlas. Suffolk County Department of Economic Development and Planning.
 - 19 Suffolk County Save Open Space Bond Act Workforce Housing Transfer of Development Right Implementation Plan. February 2005. Suffolk County Department of Planning. February 2005. www.suffolkcountyny.gov/Portals/0/planning/Publications/SOS_DevRights022005.pdf
 - 20 "Guidance for Establishing Successful Responsible Management Entities." Water Environment Research Foundation. <http://ww2.werf.org/AM/CustomSource/Downloads/uGetExecutiveSummary.cfm?FILE=DEC5R06.pdf&ContentFileID=14491>

- 21 Comprehensive Water Resources Management Plan. Suffolk County. www.suffolkcountyny.gov/Departments/HealthServices/EnvironmentalQuality/WaterResources/ComprehensiveWaterResourcesManagementPlan.aspx
- 22 "Adopted Operating Budget, Narrative and Appropriations, County of Suffolk, NY." Volume No. 1. 2013. www.suffolkcountyny.gov/Portals/0/countyexecutive/Budgets/2013adoptedoperatingbudget.pdf
- 23 Give Water a Hand. "Success Stories." University of Wisconsin, Environmental Resources Center. Accessed June 20, 2014. <http://erc.cals.wisc.edu/gwah/success-stories>
- 24 "Smart Cities Financing Guide." Smart Cities Council. Accessed June 20, 2014. <http://smartcitiescouncil.com/resources/smart-cities-financing-guide>
- 25 Wills, R. "Panel recommends more consolidation of sewer and wastewater systems in Allegheny County." TribLIVE News. March 15, 2013. Accessed June 20, 2014. <http://triblive.com/news/adminpage/3667302-74/allegheny-alcosan-federal#axzz37d4GfVI>
- 26 The Water Agencies. Public Institutions of the Ministry for Sustainable Development. France. Accessed June 17, 2014. www.lesagencesdeleau.fr/en/les-agences-de-leau/les-six-agences-de-leau-francaises/
- 27 Digital Delta. Accessed June 19, 2014. www.digitaledelta.nl/en
- 28 "Digital Delta transforms Dutch water system using Big Data." IBM Smarter Cities. YouTube video. Accessed June 18, 2014. www.youtube.com/watch?v=O8gsNsgFYBo

The water agencies in France are public institutions of the Ministry for Sustainable Development. Their primary objective is to help reduce pollution and protect water resources and aquatic environments. The six water agencies employ some 1,800 employees who are organized around the catchment management of river basin districts. They fulfill their duties within the framework of multi-year action programs.

The Digital Delta project brings together the Dutch Ministry of Water, the Delfland local water authorities, the University of Delft, IBM and other organizations. The project focuses on the provisioning of unlimited and readily accessible water and climate services. One of the key objectives is to integrate and open up water-related data from more than 100 ongoing projects, making it available to organizations, scientists and businesses involved in water management.

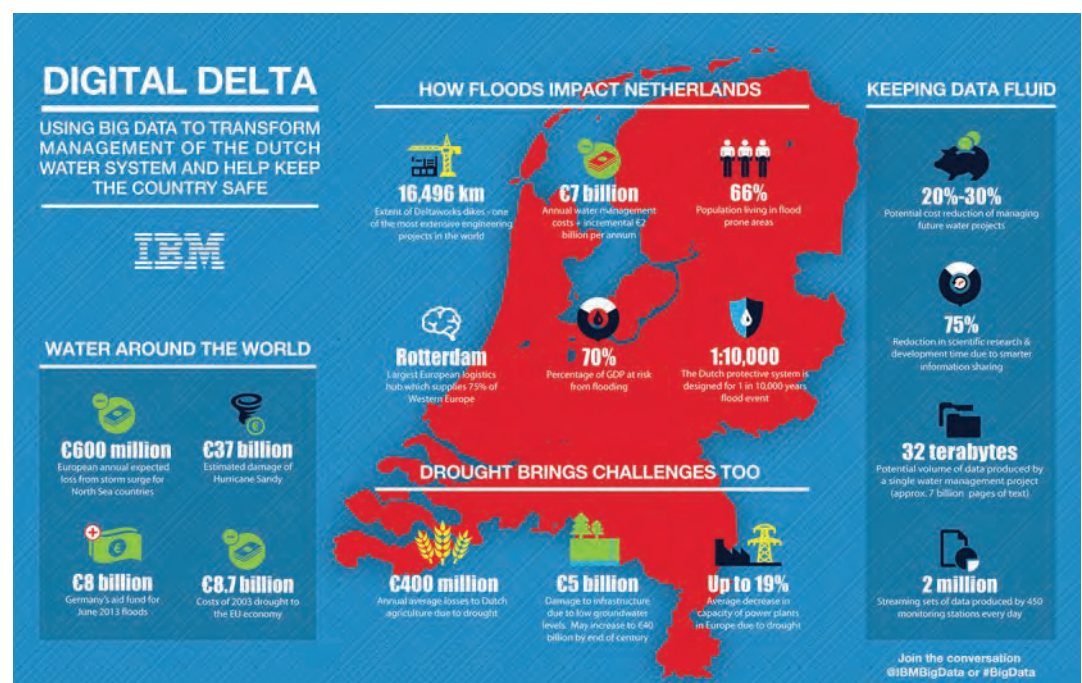


Figure 9: The Digital Delta approach

29 "Watershed Scale Platform for Research, Development, Testing & Demonstration of Water Technologies and Services." Southern Ontario Water Consortium. Accessed June 18, 2014. <http://sowc.ca>

30 "The Southern Ontario Water Consortium (SOWC). A major force in international water expertise." Ontario Business Report. Accessed June 20, 2014. www.mri.gov.on.ca/obr/2012/07/the-southern-ontario-water-consortium-sowc

The Southern Ontario Water Consortium uses a data integration and management platform for near real-time watershed monitoring and watershed management. The platform synthesizes numerous information sources and formats within the framework of the Grand River Watershed (CA). The data integration platform supports water management professionals and researchers to develop efficient tools to predict floods, protect the water supply sources and forecast the impact of growth and urbanization on vital ecosystems.

31 Singer, N. "Mission Control, Built for Cities. IBM Takes 'Smarter Cities' Concept to Rio de Janeiro." *The New York Times*. March 3, 2012. Accessed June 18, 2014. www.nytimes.com/2012/03/04/business/ibm-takes-smarter-cities-concept-to-rio-de-janeiro.html?pagewanted=all&_r=0

32 "Sheltering a City with Data, the Rio de Janeiro Story." Accessed June 19, 2014. www.youtube.com/watch?v=DFMppW9zUxY

33 "Watershed Management: Guiding Principles for Integrated Management of Water in Switzerland." Federal Office for the Environment (FOEN). Swiss Confederation. 2011. Accessed June 19, 2014. www.bafu.admin.ch/publikationen/publikation/01576/index.html?lang=en

The referenced document provides an overview on how integrated watershed management is addressed in Switzerland. Water resources, water bodies and water infrastructure conditions are monitored. The information is used to evaluate actions' effectiveness, to help enhance system awareness and detect challenges early.

34 "Handbook for Developing Watershed Plans to Restore and Protect our Waters." United States Environmental Protection Agency. Accessed June 20, 2014. http://water.epa.gov/polwaste/nps/handbook_index.cfm

35 "Integrated Water Resources Management (IWRM)." United Nations Department of Economic and Social Affairs (UNDESA). Accessed June 20, 2014. www.un.org/waterforlifedecade/iwrn.shtml

36 "Constructed Wetlands." United States Environmental Protection Agency. Accessed June 20, 2014. <http://water.epa.gov/type/wetlands/restore/cwetlands.cfm>

37 "Mix or NoMix? A Closer Look at Urine Source Separation." *Eawag News*. Eawag: Swiss Federal Institute of Aquatic Science and Technology. March 2007. Accessed June 20, 2014. www.eawag.ch/medien/publ/eanews/archiv/news_63/index_EN

38 "SmartBay." Marine Institute, Ireland. Accessed June 20, 2014. www.smartbay.ie

39 Managing Our Water. "Namoi Catchment Management Authority." New South Wales Government. Accessed June 20, 2014. www.namoi.cma.nsw.gov.au/42.html?4



Figure 10: The Rio de Janeiro operation center integrates data from the city's public agencies to improve response to events, such as floods and landslides

D. Component Business Model

IBM uses a tool called a Component Business Model (CBM), which sets out a range of components for which an organization requires capability. It helps to provide a framework for an organization to assess current capability levels and future needs against proposed changes or future events. It can be used to help understand the gaps and define priority actions to build capabilities within the organization. It is commonly used in conjunction with a maturity matrix, which is a set of qualitative statements against key criteria, to help an organization assess its capabilities against accepted best practices.

Our CBM comprises five vertical silos that represent the key areas we believe are vital to water/wastewater management in Suffolk County:

1. Engagement and customer management
2. Water sourcing, distribution and treatment
3. Wastewater/recycling strategy
4. Resiliency and environmental management
5. Manage business

Within these silos, the different functions fall into one of three categories:

- **Direct** — These activities set direction and strategy
- **Control** — Actions that manage or monitor performance
- **Execute** — Transactional activities performed in execution of processes

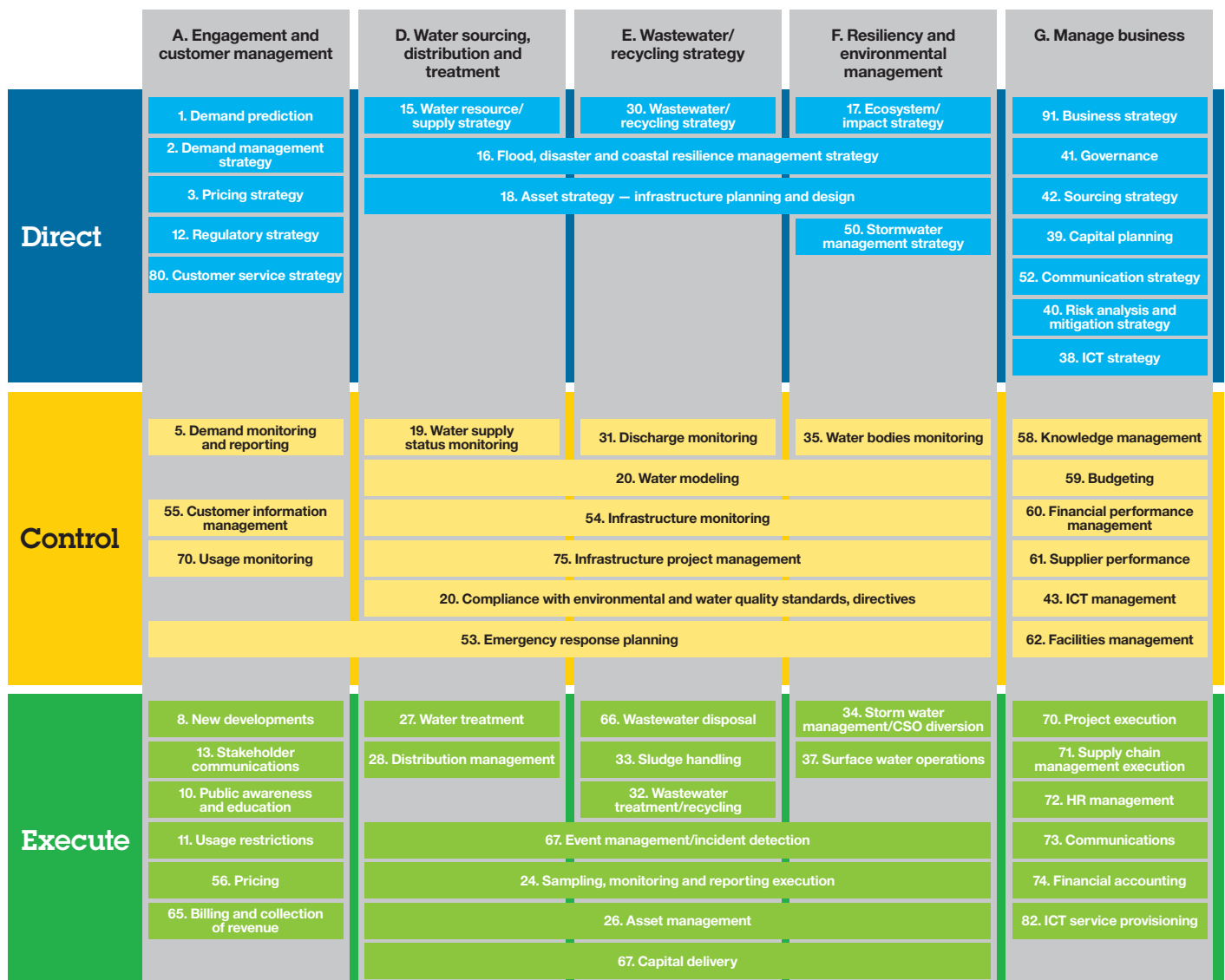


Figure 11: Our approach

Summary of the maturity matrix

A maturity matrix is a set of qualitative statements for defined criteria to assess a capability against known best practices. The statements describe different levels of maturity for organizations to help them understand current maturity levels and define objectives for improvement. A maturity matrix is a tool that helps organizations identify where change is necessary and aligns thinking on where to focus improvement.

The maturity matrix for Suffolk County highlights the County's six focal areas for water and wastewater management:

1. Water and wastewater resource planning
2. Infrastructure and asset management
3. Monitoring and meeting regulatory requirements
4. Customer/stakeholder management and engagement
5. Finance, planning and management
6. Governance and compliance

Suffolk County can use the following maturity matrices to gain a slightly more detailed perspective on how their water/wastewater management approach measures up. By benchmarking its maturity on the matrix, the County can begin to understand where it needs to prioritize and focus resources to improve water quality.

Criteria	Level 1	Level 2	Level 3	Level 4	Level 5
Water and wastewater resource planning	<ul style="list-style-type: none"> Local or informal approach to planning not consistent Lack of information on water systems and water cycle No current management and progression plans 	<ul style="list-style-type: none"> Formation of plans for resources shared across districts/town boundaries Limited alignment of career progression and performance management to future demand plans Inconsistent and incomplete information in multiple systems 	<ul style="list-style-type: none"> Common and integrated plan for complete water cycle Recognition of the importance of high-quality information Plans for job rotation and cross skilling in place Clear strategy on what technology is needed where for on-site wastewater and water treatment. 	<ul style="list-style-type: none"> Complete inventory of data, common format and shared information Documented decision criteria and repeatable process to update investment plans and budgets Job rotation and cross skilling fully aligned to future resource plans 	<ul style="list-style-type: none"> Use of analytical techniques to capacity plan all resource types for future use, with investment planning and funding aligned Career progression and skills planning aligned to future demand Clear goals and measures in place for water evaluation
Infrastructure and asset management	<ul style="list-style-type: none"> Inconsistent and incomplete asset information in multiple systems (including paper-based data) Maintenance and service decisions are reactive, not proactive Wasted effort on accessing reporting; processes localized 	<ul style="list-style-type: none"> Recognition within the organization of the importance of high-quality and timely asset information to support strategy Approach for specification, tracking, inventory and event history of assets under development Initial ideas of proactive/preventative asset maintenance plans 	<ul style="list-style-type: none"> Single integrated view of asset specification, location, history and inventory developed Proactive/preventative maintenance schedules established Mechanisms in place to ensure collaboration and share learning between engineering and operations (for example, treatment and distribution) Mobile working and optimization of field work 	<ul style="list-style-type: none"> Preventative maintenance schedules based on up-to-date and fact-based performance data Asset specifications regularly reviewed and challenged to drive service and cost improvements Mobile working with data capture at source Standardized data dictionaries and information repositories 	<ul style="list-style-type: none"> Use of simulation tools to support asset investment decisions Information available across organizations through end-to-end visibility County can readily access data on asset trends, such as repair histories and so on Proactive event management with full County view of infrastructure

Figure 12: Maturity matrix: Details

Criteria	Level 1	Level 2	Level 3	Level 4	Level 5
Monitoring and meeting regulatory requirements	<ul style="list-style-type: none"> Limited/no monitoring of treatment facilities or natural systems — core mandatory only Basic legislative compliance understood and achieved No comprehensive and systematic reporting on quality Informal discussions with regulators held — usually reactive Treatment status is largely behind the fact, based on manual reading of the wastewater treatment process(s) 	<ul style="list-style-type: none"> Performance metrics around compliance and quality agreed across all functions but not fully monitored or enforced Regulatory management seen as core competence The agency gets regular data from treatment operations, supported by manual sampling 	<ul style="list-style-type: none"> Collaboration between central compliance teams and wider organization established Performance metrics around compliance and quality agreed with all stakeholders and residents Data model analysis associated KPIs defined and in use County has target for nitrogen load 	<ul style="list-style-type: none"> Link training, leadership, values and performance metrics to establish and maintain a continuous improvement culture Quality program defining all stakeholder requirements through information collaboration Policies on customer revenue, environment and assets integrated and aligned Collaboration among stakeholders for sampling and analysis 	<ul style="list-style-type: none"> Compliance and quality levels optimized with nearly real-time data Influential, highly coordinated regulatory and stakeholder management County tracks all wastewater/waste treatments activities, using automated sensors Single, integrated platform sharing relevant information to applicable stakeholders
Customer/stakeholder management and engagement	<ul style="list-style-type: none"> County does not have a consolidated view of key stakeholders and interaction history Limited awareness of how water quality can be addressed in the community Limited communication from County — only on specific issues 	<ul style="list-style-type: none"> Discussions started with wider groups of stakeholders around collective action for water quality County and key stakeholders provide some information available online, but not a complete picture, for addressing water quality Feedback systematically acted on by County 	<ul style="list-style-type: none"> Understanding individual stakeholder positions on water quality and use these to drive engagement Route customer feedback to process owners to drive continuous improvement County has some water quality priorities with some actions started to support and execute against these 	<ul style="list-style-type: none"> Collaborative planning with key stakeholders to further optimize impact and motivation Robust and centralized networks of key stakeholders to proactively leverage organizational strengths Proactive use of social media and other collaboration platforms to capture water quality information and share 	<ul style="list-style-type: none"> Proactive communications to citizens regarding incidents and water quality issues Water-centric culture, citizens “live” the values and are empowered to “go the extra mile” Maximum use of stakeholders to engage and educate the public in an orchestrated and strategic way

Figure 12: Maturity matrix: Details (continued)

Criteria	Level 1	Level 2	Level 3	Level 4	Level 5
Finance, planning and management	<ul style="list-style-type: none"> • Planning and budgeting processes are separate, with minimal coordination • Manual compilation and validation of data for reporting • Pricing for water and wastewater does not link to usage • No structured approach to identify funding 	<ul style="list-style-type: none"> • Planning and budgeting processes are separate, with moderate coordination • Some manual corrections/control in financial planning and data usage for decision making • County has some view of capital project priorities, but these are not fully informed 	<ul style="list-style-type: none"> • Some alignment of planning and budgeting with strategic, long-term direction • Contains financial and non-financial data • Pricing for water links to usage; wastewater is not included in same billing system • Addresses priority projects for investment on a reactive basis • Basic KPIs in place 	<ul style="list-style-type: none"> • Planning and budgeting aligned to strategize together for the long term • Key investment milestones are built into plans and budgets, with various options for funding streams and resource needs in place • Proactive management and diversified funding streams 	<ul style="list-style-type: none"> • Planning and budgeting are web based, and processes are fully integrated reporting tools • Optimized pricing model that allows County to explore pricing and project scenarios • Pricing for water and wastewater directly linked to usage in the same billing system – parity across population
Governance and compliance	<ul style="list-style-type: none"> • Compliance reporting is manual • County stakeholders do not as a rule collaborate with water agencies • Enforcement of water quality regulation violations does not exist • Local regulations do not allow for innovative and new technologies to improve wastewater treatment processes • Informal and reactive discussions at the state level 	<ul style="list-style-type: none"> • Delay in identifying compliance events, with moderate risk of legal or cost implications • Some exceptions given for new technology but after tedious application process • Enforcement for water quality regulation violations exists but is not regularly performed • Local initiatives to drive improvements in water quality and water use • Compliance management seen as core competence 	<ul style="list-style-type: none"> • County shares compliance data between departments and water agencies • New technology permits issued in a timely manner • User's consumption is not fully customized or tied to wastewater treatment • Regular enforcement of treatment systems compliance occurs • Common understanding forming of how state, County and local entities work together 	<ul style="list-style-type: none"> • An integrated view aligning financial, environmental and societal factors linked to citizen compliance for wastewater • County allows pilots for new and advanced technologies for wastewater • Enforcement and public awareness are linked and communicated regularly to citizens • Consistent levels of quality across County with systematic sharing • Informal collaboration between state, County and towns on compliance 	<ul style="list-style-type: none"> • County manages enforcement by a predetermined schedule • County prioritizes key areas for enforcement and system upgrade • Stakeholders share data related to water quality compliance — two way sharing • Pull from communities to identify initiatives for improving water quality • Aligned and working closely at state level on common goals and compliance issues

Figure 12: Maturity matrix: Details (continued)

E. Estimates

The team estimated order of magnitude implementation costs for each of its 11 recommendations to Suffolk County. We categorized these implementations as low, medium and high. Low costs are under US \$1 million, medium costs are up to US \$10 million and high costs are up to US \$30 million. These estimates are designed to help the County support its planning activities.

Recommendation description	Estimated cost of implementation	Potential benefit/revenue
1. Finalize and deploy a robust and integrated Water Resource Plan	< \$10 m	
2. Operate the sewage treatment plant network under the control of the Department of Public Works	< \$30 m	Revenue ~ \$50 m
3. Integrate water and wastewater operations	< \$10 m	Lab consolidation
4. Establish a framework to visualize, monitor and manage water quality	< \$10 m	Savings in licenses, application support
5. Establish governance to enable the installation of appropriate technology and to motivate responsible behavior	< \$1 m	
6. Excite communities to embrace the solutions for improving water quality	< \$1 m	
7. Create a structure to drive compliance	< \$1 m	
8. Continue to develop a funding mechanism	< \$10 m	
9. Develop workforce model and practices to meet future needs	< \$30 m	
10. Adapt the business processes in the Department of Public Works and the Department of Health Service to meet expanded integrated water management responsibilities	< \$10 m	Process savings
11. Establish a framework for decentralized wastewater handling solutions	< \$10 m	

Figure 13: Estimate of costs and potential benefits: Order of magnitude

F. The water cycle

We strongly recommend that Suffolk County consider the full water cycle in its future planning and management of water quality to help ensure an integrated approach. The water cycle is the full cycle of water, from precipitation through water treatment, distribution, use, collection, wastewater treatment and return to the source (see Figure 14).

We included a set of statements as suggestions for key objectives and outcomes that Suffolk County may want to adopt as a set of outcomes for an integrated approach to water and wastewater management.

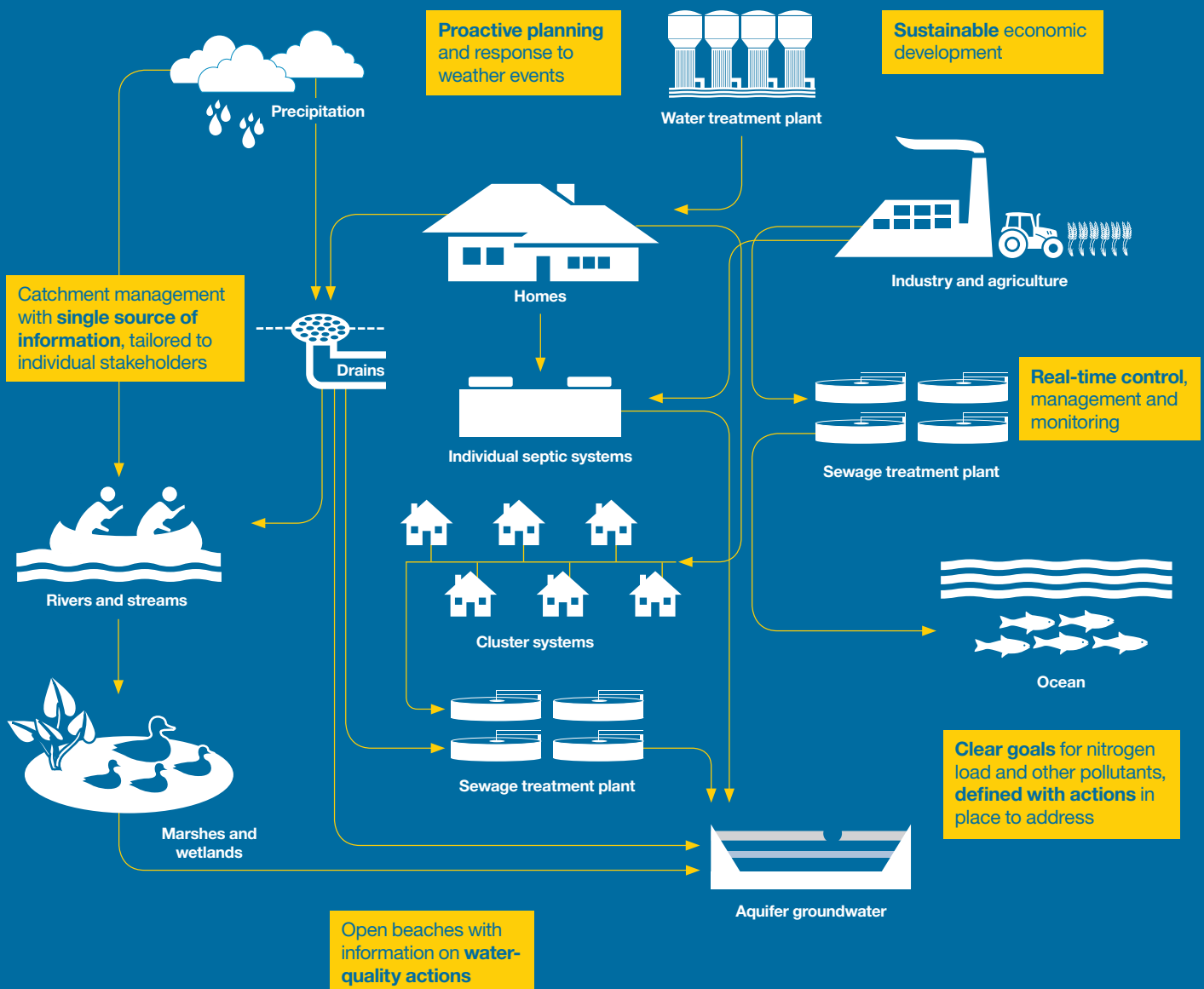
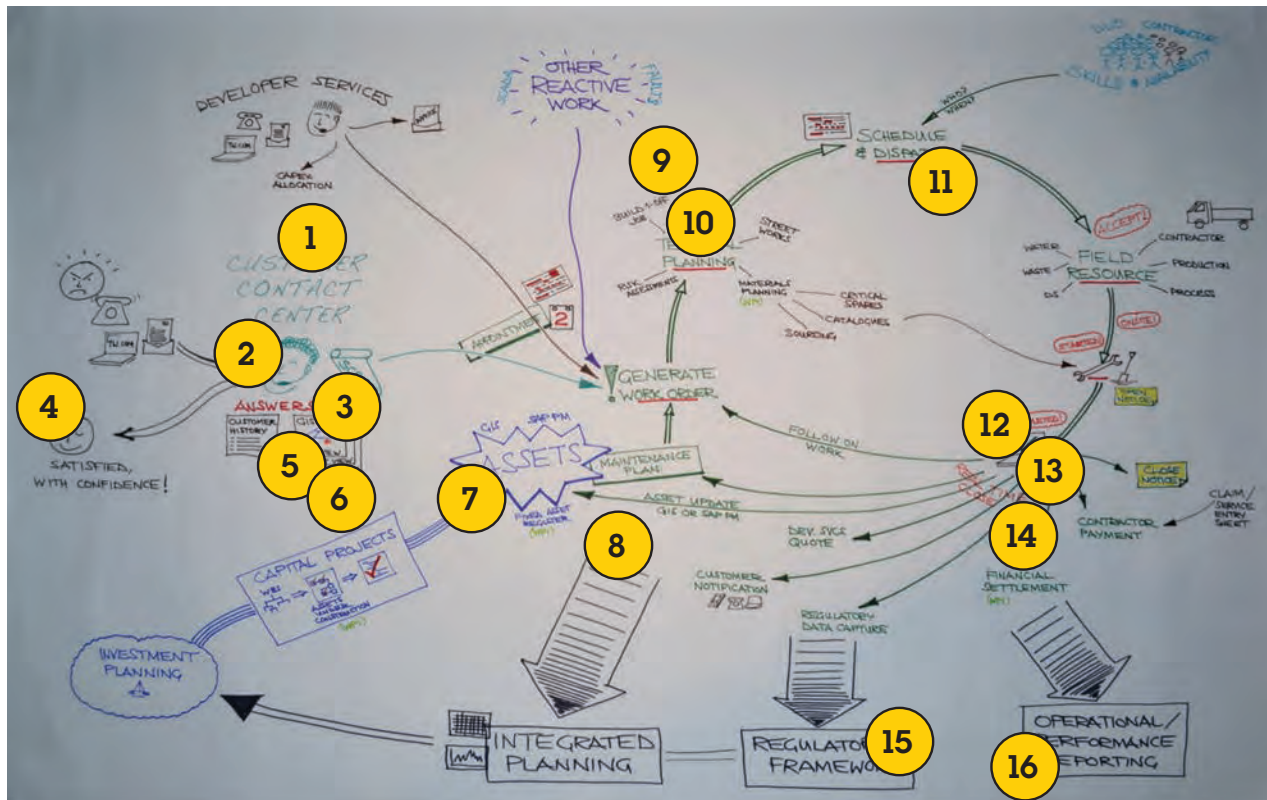


Figure 14: The water cycle with key objectives and outcomes from an integrated approach



1. Booking appointments during the call based on the schedule
2. Structured scripts to improve the customer experience
3. Automation of penalty payments
4. Customer correspondence visible to agents
5. Real-time visibility of events and work for the contact
6. Integrated planning solution for waste process
7. Commissioning and depreciation of assets at an equipment level
8. Process-centric asset hierarchy integrated to fixed asset register
9. Using attachments via web services to help manage
10. Technical planning workbench provides an integrated solution to plan work in line with customer need, permitting, notices and availability of resource
11. Scheduling solution for sampling
12. Fully integrated purchase to pay for contract work
13. Mobile GIS and GPS integration data capture at source
14. Real-time visibility of work order status and data captured
15. Performance and monitoring framework
16. Daily dashboard to help drive performance

Figure 16: Best practices for managing water and wastewater services

H. Assessment of EPA management models for Suffolk County

Suffolk County should consider applying the EPA Management Model methodology for oversight of its decentralized wastewater treatment systems. In order to apply any of the models, it is critical that Suffolk County establish an inventory of on-site and cluster systems. For simplicity and efficiency, we recommend Suffolk County pursue one county-wide model described in the EPA Management Model Summary Assessment table below. The County should pursue Model 3 for its short-term goals. For cluster systems, we recommend Model 4 as a long-term goal. Program features that Suffolk County must develop to advance along the maturity curve are in red text.

Table 1: Summary of management models	Typical applications	Program description	Comments
	MODEL 1 – Homeowner awareness model		
	<ul style="list-style-type: none"> Areas of low environmental sensitivity where sites are suitable for conventional on-site systems. 	<ul style="list-style-type: none"> Systems properly sited and constructed based on prescribed criteria. Owners made aware of maintenance needs through reminders. Inventory of all systems. 	As a baseline for implementing any EPA management model, Suffolk County should prioritize creating an inventory of all on-site systems in the county.
	MODEL 2 – Maintenance contract model		
	<ul style="list-style-type: none"> Areas of low to moderate environmental sensitivity where sites are marginally suitable for conventional on-site systems due to small lots, shallow soils or low-permeability soils. Small clustered systems. 	<ul style="list-style-type: none"> Systems properly sited and constructed. More complex treatment options, including mechanical components or small clusters of homes. Requires service contracts to be maintained. Inventory of all systems. Service contract tracking system. 	This model is not recommended for Suffolk County.
	MODEL 3 – Operating permit model		
	<ul style="list-style-type: none"> Areas of moderate environmental sensitivity, such as wellhead or source water protection zones, shellfish growing waters or bathing/water contact recreation. Systems treating high-strength wastes or large-capacity systems. 	<ul style="list-style-type: none"> Establishes system performance and monitoring requirements. Allows engineered designs but may provide prescriptive designs for specific receiving environments. Regulatory oversight by issuing renewable operating permits that may be revoked for noncompliance. Inventory of all systems. Tracking system for operating permit and compliance monitoring. Minimum for large capacity systems. 	Model 3 is a recommended near-term model for Suffolk County. Tracking of performance and monitoring mechanisms must be developed in order to manage under this model.
	MODEL 4 – Responsible management entity (RME) operation and maintenance model		
	<ul style="list-style-type: none"> Areas of moderate to high environmental sensitivity where reliable and sustainable system operation and maintenance (O&M) is required, e.g., sole source aquifers, wellhead or source water protection zones, critical aquatic habitats or outstanding value resource waters. Clustered systems. 	<ul style="list-style-type: none"> Establishes system performance and monitoring requirements. Professional O&M services through RME (either public or private). Provides regulatory oversight by issuing operating or NPDES permits directly to the RME. (System ownership remains with the property owner.) Inventory of all systems. Tracking system for operating permit and compliance monitoring. 	Model 4 is a recommended target model for Suffolk County. Robust inventory, performance requirements and monitoring mechanisms must be established. Once this baseline has been established, Suffolk County can consider defining an RME model to operate and maintain on-site systems.
	MODEL 5 – Responsible management entity (RME) ownership model		
	<ul style="list-style-type: none"> Areas of greatest environmental sensitivity where reliable management is required. Includes sole source aquifers, wellhead or source water protection zones, critical aquatic habitats or outstanding value resource waters. Preferred management program for clustered systems serving multiple properties under different ownership (e.g., subdivisions). 	<ul style="list-style-type: none"> Establishes system performance and monitoring requirements. Professional management of all aspects of decentralized systems through public/private RMEs that own or manage individual systems. Qualified, trained owners and licensed professional owners/operators. Provides regulatory oversight by issuing operating or NPDES permit. Inventory of all systems. Tracking system for operating permit and compliance monitoring. 	Model 5 is at the upper end of the maturity curve and may be assessed at a future date. A cost-benefit analysis should be conducted to understand if the cost of training and implementation for the entire population would support the benefit for the additional requirements of this model.

I. Roadmap of recommendations

The team defined key milestones and estimated timescales for each of the recommendations. We have not accounted for wider County timescales or initiatives in preparing this roadmap should more time be necessary. The intent of this roadmap is to provide input for the County's overall planning to develop an integrated plan.

#	Recommendation	Pr.	Owner/sponsor	Key milestones and action	2H 2014						Year 1		Year 2	Year 3	Year 3-5
					Q3 2014			Q4 2014			1H 2015	2H 2015	2016	2017	2018 — beyond
					1	2	3	4	5	6					
1	Finalize and deploy a robust and integrated Water Resource Plan	1	Department of Economic Development and Planning	Fund and recruit transformation leader Establish goal for nitrogen load allocation Identify and agree other pollutant goals Build water resource plan Define plan's governance Define maintenance to keep the plan on track Deploy plan; launch actions and measure progress											
4	Establish a framework to visualize, monitor and manage water quality	1	Deputy County Executive — Operations	Establish a new integrated IT Team Kick off data migration project Identify top priority data sources to integrate Implement model in phased approach Establish platform and tool for consolidation Enable access to integrated model Migrate applications Define overall data governance and objectives Continued integration of common information model Develop resilient disaster recovery strategy Consolidate distributed County data centers Enable mobility											
6	Excite communities to embrace the solutions for improving water quality	1	Department of Economic Development and Planning	Establish metrics for Blue Flag Establish online water quality portal/social media strategy Provide data on beach environment/Blue Flag status to public Create long-term engagement plan for organizations											
8	Continue to develop funding mechanism	1	Deputy County Executive — Finance	Appoint funding leader Explore and exercise all sources of funding immediately — ongoing until goals attained Establish ongoing management and tracking to targets of the funding structure											
11	Establish a framework for decentralized wastewater handling solutions	1	Department of Health Services	Gather knowledge/provide information re: decentralized systems Define guideline for selection of appropriate on-site and cluster technology Establish a register of onsite/cluster Provide guidelines and training information for private operators Certification and inspection for ongoing management of quality and operation Establish inspection record information systems Establish a regulation ensuring the implementation or upgrade of onsite treatment when renovation/ownership changes Establish Low N Certified for properties Definition of long-term technology and innovation											

#	Recommendation	Pr.	Owner/sponsor	Key milestones and action	2H 2014						Year 1		Year 2	Year 3	Year 3-5
					Q3 2014			Q4 2014			1H 2015	2H 2015	2016	2017	2018 - beyond
					1	2	3	4	5	6					
2	Operate the STP network under the control of the SCDPW	2	Head of DPW	Develop criteria and priority for transfer											
				Define approach to management and control of STPs											
				High priority STPs transferred											
				Service meetings in place with privately run STPs											
				2nd tranche priority plants transferred											
3	Integrate water and wastewater operations	4	Head of DPW and Head of SCWA	Develop business case											
				Define target operating model											
				Information plan/budget defined											
				Agree with unions on working structures											
				Transition and consolidation of shared services											
5	Establish governance to enable the installation of appropriate technology and to motivate responsible behavior	3	Director of the Department of Health Services	Transition and implementation of combined operations											
				Apply for septic repair program for pilot septic systems											
				Select pilot technology system and residents to install new systems											
				Communication strategy											
				Construct governance structure to monitor, enforce											
7	Create a structure to drive compliance	3	Suffolk County Department of Health Services	Update DHS Sanitation Code for new tech											
				Continue incentive programs for upgraded septic											
				Kick off compliance task force											
				Confirm initial high-priority measures for compliance (align w/4)											
9	Develop workforce model and practices to meet future needs	2	Director of the Department of Public Works and Director of the Department of Health Services	Measurement											
				Execution of compliance											
				Annually review critical KPIs, validate and modify as appropriate											
				Map workflow processes, determine inputs											
10	Adapt the business processes in the SCDPW and the SCHHS to meet expanded integrated water management responsibilities	3	Director of the Department of Public Works and Director of the Department of Health Services	Gap analysis											
				Develop strategy for supply of skills											
				Succession planning											
				Gain financial support											
				Execute staffing plan											



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