WATER RESILIENCE STUDY

FINAL REPORT AND RECOMMENDATIONS

NATIONAL INFRASTRUCTURE ADVISORY COUNCIL (NIAC)

QUARTERLY BUSINESS MEETING

JUNE 24, 2016

Jack Baylis, President and CEO, The Baylis Group, LLC, *Chair*

Albert J. Edmonds, Chairman and CEO, Edmonds Enterprises Services; CEO, Logistics Applications, Inc.

Margaret E. Grayson, President-Commercial Sector, Consulting Services Group, LLC

James J. Murren, Chairman and CEO, MGM Resorts International

Joan McDonald, Principal, JMM Strategic Solutions

Beverly Scott, Ph. D., CEO, Beverly Scott Associates, LLC

AGENDA

- Study Overview
- Findings
- Recommendations
- Call to Action
- Questions

WORKING GROUP MEMBERS

- **Jack Baylis**, President and CEO, The Baylis Group, LLC, *Chair*
- **Albert J. Edmonds**, Chairman and CEO, Enterprise Services; CEO, Logistics Applications, Inc.
- **Margaret E. Grayson**, President-Commercial Sector, Consulting Services Group, LLC
- **James J. Murren**, Chairman and CEO, MGM Resorts International
- **Joan McDonald**, Principal, JMM Strategic Solutions
- **Beverly Scott**, Ph.D., CEO, Beverly Scott Associates, LLC

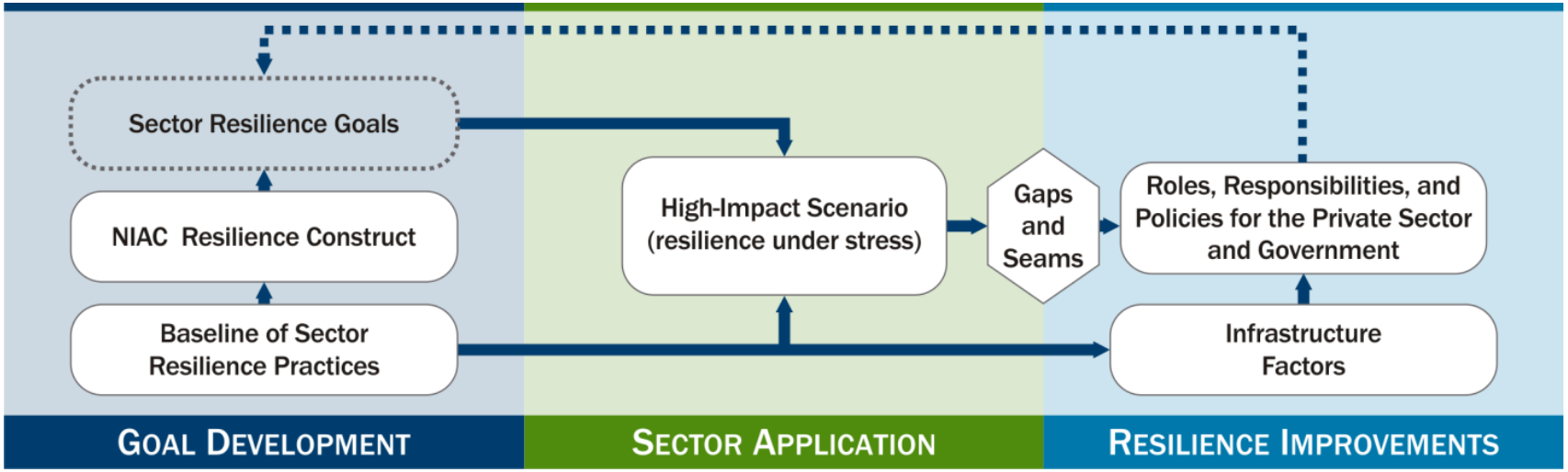
STUDY CHARGE

Apply the NIAC-recommended framework for establishing resilience goals (developed in the 2010 study*) to the Water Sector in order to:

- Assess security and resilience in the Water Sector
- Uncover key water resilience issues
- Identify potential opportunities to address them

**Framework for Establishing Critical Infrastructure Resilience Goals (NIAC 2010)*

FRAMEWORK FOR ESTABLISHING RESILIENCE GOALS

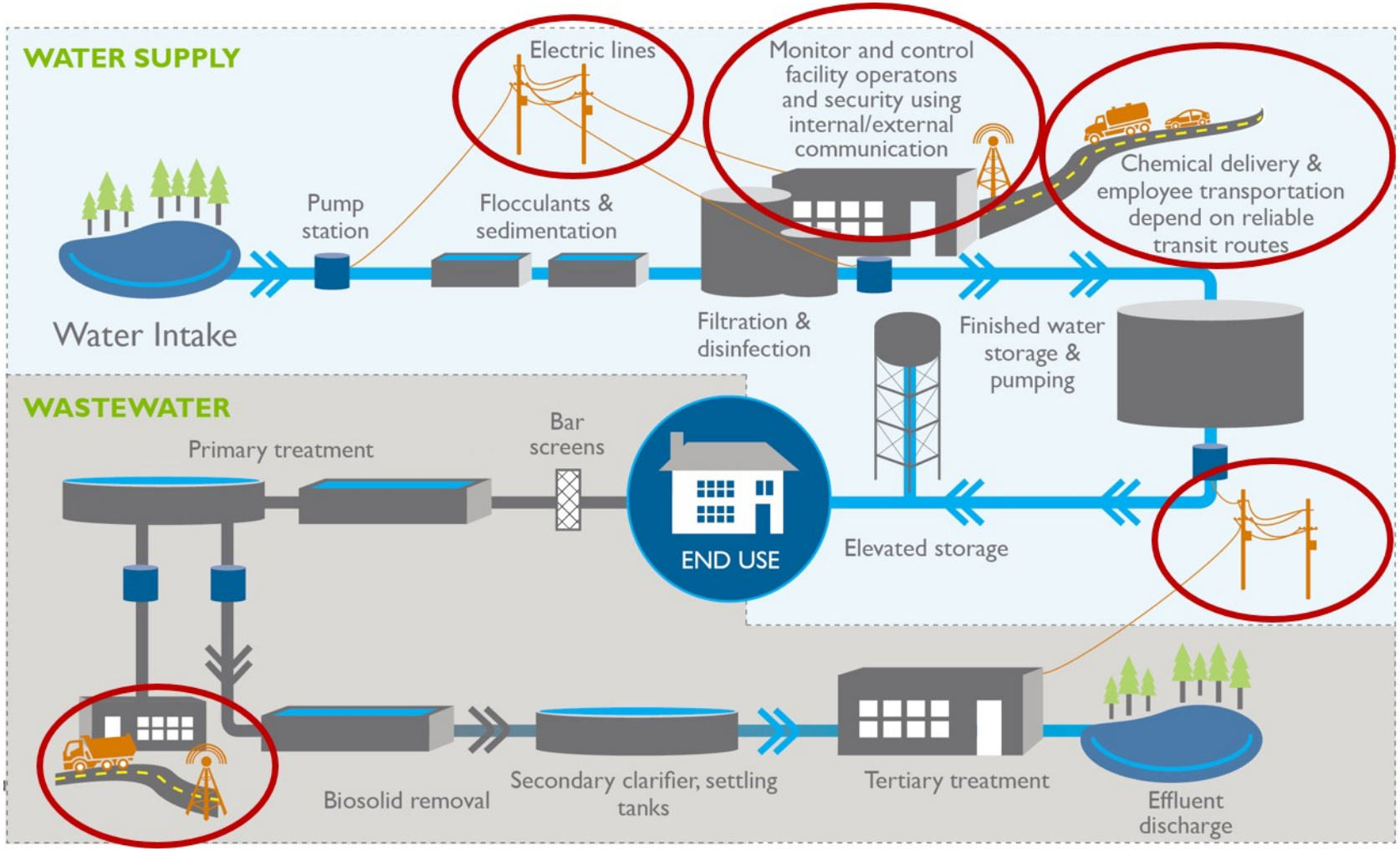


- Establish a baseline of current practices
- Describe and organize practices using the NIAC Resilience Construct
- Set prospective sector goals implied by practices

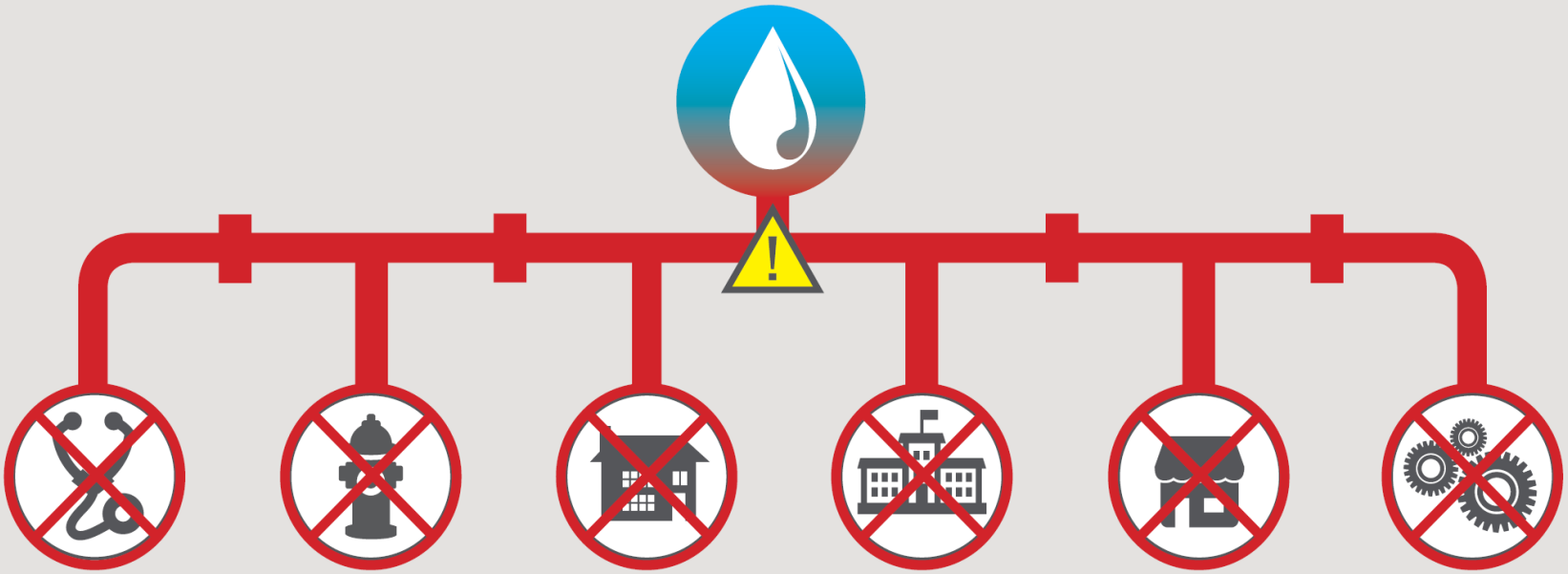
- Assess sector resilience using a high-impact event (beyond design limits)
- Identify gaps and seams in response

- Clarify sector roles and responsibilities and infrastructure factors that affect resources
- Modify sector resilience goals based on lessons learned

CRITICAL WATER SECTOR DEPENDENCIES



IMPACTS OF WATER SERVICE DISRUPTION



Critical health services threatened as hospitals are forced to close.

Limited or no water available for fire suppression

People are forced to evacuate homes due to loss of water for drinking and sanitation.

Schools, offices, and government headquarters are shut down resulting in limited services and decreased productivity.

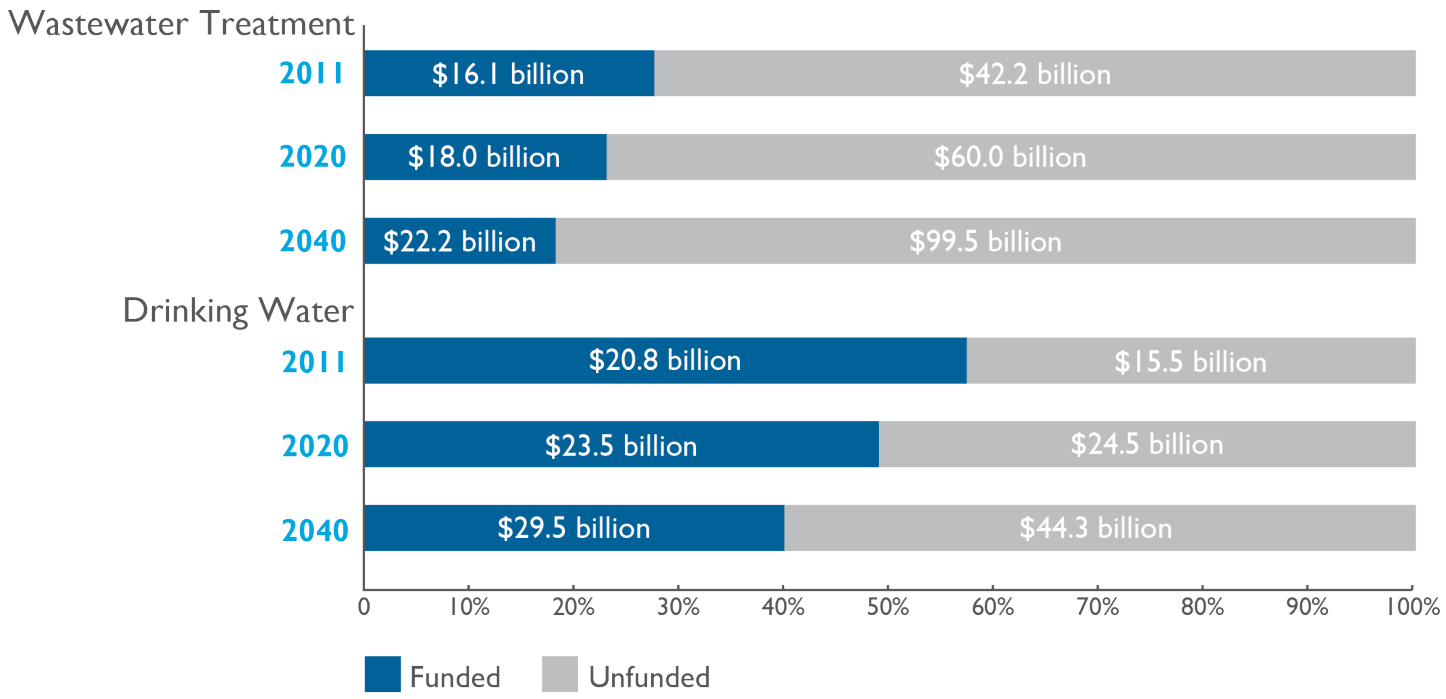
Stores, restaurants, and other businesses are forced to close, causing lost revenue that impacts local economies.

Loss of water for cooling and other processes **curtails manufacturing and commercial operations.**

UNDERINVESTMENT IN WATER INFRASTRUCTURE

Expected Wastewater Treatment and Drinking Water Infrastructure Needs and Investments in the U.S., 2011, 2020, and 2040

(billions of 2010 dollars)



Source: American Society of Civil Engineers, Failure to Act, 2011

WATER INFRASTRUCTURE CHALLENGES

FINDINGS

FINDINGS

1. Poor Understanding of the Criticality of the Water Sector
   - Water is not given appropriately high priority as a critical lifeline sector by public officials and dependent sectors during disaster planning, prevention, and response.
2. Inadequate Valuation of Water Services
   - Water services are often undervalued and taken for granted because they are typically highly reliable, inexpensive, and hidden from view.
3. Wide Disparity of Capabilities and Resources
   - Technical capabilities and resources vary widely among water utilities. Smaller utilities in particular often lack the qualified staff, tools, technical expertise, and reliable information needed to manage new risks.

FINDINGS

4. Significant Underinvestment in Water Sector Resilience
   - There is significant, chronic underinvestment in water infrastructure and resilience due in part to widespread public ownership and a reluctance to raise rates.
5. Fragmented and Weak Federal Support for Water Resilience
   - Resilience has not been substantially integrated into the actions of Federal agencies, and resilient outcomes are not part of Federal guidance and resources.
6. Regional Collaboration Not Broadly Applied
   - Limited regional coordination across jurisdictions and water systems leads to inefficient, siloed decision-making that can hamper resilience.

RECOMMENDATIONS

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1. Analyze and map the complex risk of major water disruptions and develop mitigations.
2. Fortify Water Sector response and recovery capabilities.
3. Increase Federal funding, investment, and incentives to improve water infrastructure resilience.
4. Increase technical and financial resources and expertise available to the Water Sector.
5. Strengthen Federal leadership, coordination, and support for Water Sector resilience.

RECOMMENDATION 1: ANALYZE AND MAP COMPLEX RISKS OF MAJOR WATER DISRUPTIONS AND DEVELOP MITIGATIONS

Specific actions

1.1 Conduct **joint tabletop exercises**, across jurisdictions and interdependent sectors, to test the resilience of water infrastructure during major incidents, such as cyberattacks and large-scale power outages.

1.2 Identify **existing user-friendly models** that would help emergency managers and planners better understand systems and interdependencies at the metropolitan and regional level, and work with water associations on outreach and distribution so models can be more broadly applied across the sector.

1.3 Identify analytic tools, guidelines, and checklists for assessing cross-sector and cyber vulnerabilities to be part of a **series of pilot projects** at selected sites across the Water Sector.

1.4 Identify analytic tools, guidance for mitigation, and associated best practices (including those from other sectors) to **provide water utilities with the actionable information** they need to make planning and capital investment decisions.

RECOMMENDATION 2: FORTIFY WATER SECTOR RESPONSE AND RECOVERY CAPABILITIES

Specific Actions:

2.1 Create a **government-industry playbook for managing extreme events** that clearly defines the roles and responsibilities of agencies and utilities to help sustain operations during a severe event and help prioritize activities, such as providing fuel for emergency generators and re-supply of crucial chemicals.

2.2 Consolidate emergency response roles and responsibilities for water into a **single Emergency Support Function** within the Annex to the National Response Framework.

2.3 Increase funding to **expand the successful mutual aid program**—Water/Wastewater Agency Response Network (WARN)—to facilitate regional collaboration of events that extend across jurisdictions.

RECOMMENDATION 3: INCREASE FEDERAL FUNDING, INVESTMENT, AND INCENTIVES TO IMPROVE WATER INFRASTRUCTURE RESILIENCE (1)

Specific actions:

3.1 Create a **Federal financial assistance program** to reduce the financial burden on low-income communities from water rate increases. To launch the program, implement a pilot with 5 water utilities within 12 months.

3.2 Create a **disaster deductible** for allocating Stafford Act funding to incentivize communities to make investments to increase resilience.

3.3 Identify and **promote innovative financing options** that fast track and streamline investments in water infrastructure resilience, including public-private partnerships and century bonds, new or expanded use of the State Revolving Funds, or new ways to leverage other Federal grant programs.

RECOMMENDATION 3: INCREASE FEDERAL FUNDING, INVESTMENT, AND INCENTIVES TO IMPROVE WATER INFRASTRUCTURE RESILIENCE (2)

Specific actions:

3.4 Develop **cost-share pilot projects** with water utilities to speed adoption of better, more cost-effective approaches for service delivery by reducing the risk of implementation.

3.5 To catalyze economic development, **encourage smart, sustainable, and resilient systems; and create job opportunities and inclusion at the local level** that will build public awareness and support for infrastructure investment. Require the heads of all Federal departments and agencies responsible for critical infrastructure investment to:

- Report annually to the OMB all **current and planned department/agency investments** in critical infrastructure for which they have oversight;
- Design innovative programs and approaches that **create job opportunities and local community benefits** using Federal infrastructure investments; and
- Establish **multiyear goals and performance milestones** for critical infrastructure investments and include them in department/agency strategic plans.

RECOMMENDATION 4: INCREASE TECHNICAL AND FINANCIAL RESOURCES AND EXPERTISE AVAILABLE TO THE WATER SECTOR

Specific actions:

4.1 **Create a network of land grant universities** to build localized technical capabilities, services, and expertise for water utilities that can be leveraged with private funding, and help train the next-generation workforce.

4.2 Direct funding to water associations to **increase outreach efforts** of financial tools and life cycle assessment models that help utilities justify necessary infrastructure investments and support improved asset management practices.

4.3 **Expand cyber resources, expertise, and workforce training** for the Water Sector. This should include sharing best security practices and applications through outreach and leveraging existing programs, such as the Protective Security Advisor's cybersecurity initiative.

RECOMMENDATION 5: STRENGTHEN FEDERAL LEADERSHIP, COORDINATION, AND SUPPORT FOR WATER SECTOR RESILIENCE

Specific actions:

5.1 Establish a temporary high-level Federal coordinating body to **proactively lead collaboration** across Federal, State, and local government and the Water Sector.

5.2 **Identify barriers to resilience and rapid recovery** in existing Federal laws and regulations through analysis. Recommend statutory reforms that would promote resilient activities, encourage innovation, and provide flexibility in regulatory compliance during emergency situations.

5.3 **Initiate a national public outreach campaign** to increase awareness about the importance of water services.

5.4 **Convene a national public-private philanthropic leadership forum** with representatives from business, government, community advocates, education, labor, and philanthropic organizations to determine the best approaches for leveraging Federal infrastructure investments to increase economic opportunities and build public support for Water Sector investment.

CALL TO ACTION

- Building and sustaining a resilient water infrastructure must be a top national priority.
- We must generate strong public interest, support, and the political will to reinvigorate crumbling infrastructures.
- New investments in smart, sustainable, resilient infrastructure must be used as a catalyst for job creation, economic competitiveness, and an equitable and shared prosperity.
- Strengthening the security and resilience of our critical infrastructure exceeds the capabilities of any one company, sector, or government agency. Water associations, NGOs, academia, and the private sector—particularly CEOs—must all be engaged and committed to progress.

QUESTIONS?

APPENDIX: BACKGROUND INFORMATION

INFORMATION AND DATA SOURCES

- **70+ interviews** with subject matter experts, infrastructure owners and operators; national leaders; academics; and Federal, State, and local government representatives
- Research and analysis of nearly **300 sources** (reports, studies, videos, news articles, testimonies, and policy directives)
- Study Group report including its findings and conclusions and case study disruption scenarios
  - 16-member group representing public utilities, State and municipal government agencies, academia, private sector companies, and national laboratories
- Council member experience and expertise

FINDING #1: POOR UNDERSTANDING OF THE CRITICALITY OF THE WATER SECTOR

Water is not given appropriately high priority as a critical lifeline sector by public officials and dependent sectors during disaster planning, prevention, and response.

1.1 Under the National Response Framework, water responsibilities are distributed across four Emergency Support Functions (ESFs) and multiple Federal agencies. This can result in water being excluded from unified command or interagency coordination, and can create confusion during response and recovery efforts that can impede water service recovery during disasters.

1.2 Water and wastewater utilities rely on electricity for operations, fuel for backup power and transportation, and chemicals for water treatment. While these dependencies are known to operators and emergency personnel, it is more difficult to track the changing risks within the interdependent sectors that supply critical products and services. These dependencies and the associated risks are often not sufficiently addressed in practices, such as business continuity or response planning along supply chains or across dependent sectors.

FINDING #2: INADEQUATE VALUATION OF WATER SERVICES

Water services are often undervalued and taken for granted because they are typically highly reliable, inexpensive, and hidden from view.

2.1 A significant portion of the infrastructure includes underground pipes and other assets that are invisible to the public eye. This location can mask the need for significant repairs, replacements, and upgrades as the infrastructure ages. Public perception of water infrastructure condition may not match the backlog of needed maintenance on many systems.

2.2 There are very few high-profile examples of major water infrastructure failures. As a result, weak public understanding and recognition of the critical nature of water services makes it difficult for public officials and decision-makers to justify the time and money required to make repairs following an incident, as well as fund key infrastructure improvements.

2.3 It is difficult for public officials to gain support to increase rates or allocate public funds for short- and long-term water infrastructure projects, particularly if disadvantaged or low-income populations would be harmed by rising water prices.

2.4 Investments in resilience can produce order-of-magnitude savings compared to expenditures for emergency response and repair.

FINDING #3: WIDE DISPARITY OF CAPABILITIES AND RESOURCES

Technical capabilities and resources vary widely among water utilities. Smaller utilities in particular often lack the qualified staff, tools, technical expertise, and reliable information needed to manage new risks.

3.1 As water utilities—particularly those that are under-resourced—balance day-to-day operations with long-term risk-management decisions, they may lack the capabilities to adapt to a range of uncertain threats, such as extreme weather events and rising sea levels. Water utility planners lack reliable projections, guidelines, or design standards from Federal agencies that would enable them to design, build, and maintain resilient infrastructure.

3.2 The increasing prevalence of cyber intrusions challenge business-as-usual practices for nearly all utilities. Strong cybersecurity awareness and practices among utility personnel are often limited. The number of available Water Sector cyber experts is insufficient for current needs, and utilities are constrained in their ability to offer competitive hiring packages to attract top cybersecurity experts.

3.3 It is difficult to maintain, recruit, and train qualified personnel due to specialized job requirements and competition for skilled workers, leading to a loss of institutional knowledge and skills. Many utilities are unable to invest in enough engineering resources to assess existing and future infrastructure needs.

3.4 The technology, knowledge, and tools to promote resilience exist, but awareness of their availability and adoption does not appear to be spread widely throughout the sector, and knowledge transfer lags.

3.5 Water and wastewater utilities are diverse in the advancement of their operations—some are developing and implementing leading-edge practices, while others lack the information, expertise, and tools to do so.

FINDING #4: SIGNIFICANT UNDERINVESTMENT IN WATER SECTOR RESILIENCE

There is significant, chronic underinvestment in water infrastructure and resilience due in part to widespread public ownership and a reluctance to raise rates.

4.1 Public resources are often available for immediate short-term needs, such as emergency response, but historic patterns of inadequate investment have delayed needed maintenance and inhibited long-term improvement projects. This has created frequently distressed conditions that threaten reliable operations outside of emergency events.

4.2 Publicly owned utilities often use bonds to fund construction and rely on rate increases to recoup costs. The requirements for additional Federal or State funding to support an infrastructure project, such as State Revolving Funds, can make it difficult to access or use these sources.

4.3 The challenge of maintaining affordability for all customers, including low-income or at-risk customers, can make it difficult for some water and wastewater systems to implement full cost-of-service pricing.

4.4 Some publicly owned utilities do not adequately invest in pre-disaster mitigations because they believe that the Federal Government will provide significant resources to repair their system in the wake of a major disaster.

FINDING #5: FRAGMENTED AND WEAK FEDERAL SUPPORT FOR WATER RESILIENCE

Resilience has not been substantially integrated into the actions of Federal agencies, and resilient outcomes are not part of Federal guidance and resources.

5.1 Some Federal regulations inhibit utilities from taking steps to improve resilience or build in redundancy, such as building and operating cost-effective power generation or allowing for different water quality standards to be met during an emergency.

FINDING #6: REGIONAL COLLABORATION NOT BROADLY APPLIED

Limited regional coordination across jurisdictions and water systems leads to inefficient, siloed decision-making that can hamper resilience.

6.1 The lack of a broadly accepted framework for regional goals, resource-sharing criteria, and performance metrics hinders the development of a shared approach to disruption. The framework should apply to all phases of resilience, not just response.

6.2 Water disruptions primarily affect local communities, but can have a significant impact on local and regional lifeline sectors. Insufficient attention is given to the risk and impact of a large-scale national disruption.

6.3 The sector has made in-roads in this area through WARN. The interstate, volunteer-based network provides mutual aid between member utilities following a disaster to aid in expedited restoration of services.

RECOMMENDATION #1: ANALYZE AND MAP COMPLEX RISKS OF MAJOR WATER DISRUPTIONS AND DEVELOP MITIGATIONS

Specific actions

1.1 DHS NPPD—in coordination with DOE, EPA, DOT, HHS, SLTTGCC, and Federal and State partners—should conduct joint tabletop exercises, across jurisdictions and interdependent sectors, to test the resilience of water infrastructure during major incidents, such as cyberattacks and large-scale power outages. The joint exercise should be conducted within 12 months of the release of this report.

1.2 The Federal Government should identify existing user-friendly models that would help emergency managers and planners better understand systems and interdependencies at the metropolitan and regional level. The evaluation should identify best practices and data needed to improve existing models. The Federal agencies best positioned to improve and distribute models should work with the water associations on outreach and distribution of the models and best practices so they can be applied more broadly across the sector.

1.3 Within one year, the Federal Government—in partnership with the Water Sector—should identify analytic tools, guidelines, and checklists for assessing cross-sector and cyber vulnerabilities to be part of a series of pilot projects at selected sites across water infrastructure. The pilots should leverage existing tools and guidance, and the results of the pilot should be used to encourage the application of successful tools and best practices more broadly across the sector by providing decision-makers with the evidence and data they need to justify investments.

1.4 The Federal Government, working with the Water Sector, should identify analytic tools (including those for assessment of cross-sector vulnerabilities and dependencies), guidance for mitigation, and associated best practices (including those from other sectors) to provide water utilities with the actionable information they need to prepare for emerging threats and risks, particularly as they make decisions related to planning and capital investments (e.g., hardening assets, protecting or building facilities).

RECOMMENDATION#2: FORTIFY WATER SECTOR RESPONSE AND RECOVERY CAPABILITIES

Specific Actions:

2.1 The NSC working with the major water associations and relevant Federal agencies should create a government-industry playbook for managing extreme events. The playbook, which could be modeled after the Electricity Subsector Coordinating Council Playbook, should clearly define the roles and responsibilities of agencies and utilities to help sustain operations during a severe event and help prioritize activities, such as providing fuel for emergency generators and re-supply of crucial chemicals.

2.2 The Secretary of Homeland Security should direct the administrator of FEMA to consolidate emergency response roles and responsibilities for water into a single ESF within the Annex to the National Response Framework. This would improve coordination and reduce confusion, improve information sharing and communication, and alleviate over-taxing of resources within the Water Sector.

2.3 EPA should increase funding to expand the successful mutual aid program, WARN, to facilitate regional collaboration of events that extend across jurisdictions and reinforce the program as a successful model for addressing the full spectrum of resilience and physical and cyber asset challenges.

RECOMMENDATION #3: INCREASE FEDERAL FUNDING, INVESTMENT, AND INCENTIVES TO IMPROVE WATER INFRASTRUCTURE RESILIENCE (1/2)

Specific actions:

3.1 EPA, under existing or newly established authorities, should work with HHS to create a Federal financial assistance program (similar to LIHEAP) to reduce the financial burden on low-income communities from water rate increases and allow communities to make necessary infrastructure investments and set rates that reflect the true cost of providing services. To launch the financial assistance program, EPA should work with the major water associations to implement a pilot with five water utilities within 12 months of this report's release.

3.2 Create a disaster deductible for allocating Stafford Act funding to incentivize communities to make investments to increase resilience. The NSC, DHS, and FEMA should develop resilience criteria that takes into account the multiple factors that can affect investment by water utilities and recognizes utilities that provide mutual aid and support. Mitigation and resilience actions would be credited toward a region's deductible. If they do not take certain steps, in the event of a disaster, there would be a certain amount of covered assistance that they would be responsible for paying.

3.3 Identify and promote innovative financing options that fast track and streamline investments in water infrastructure resilience, including public-private partnerships and century bonds; new or expanded use of the State Revolving Funds, as recommended by the Environmental Financial Advisory Board; or new ways to leverage other Federal grant programs, such as those available through HUD, USDA, DOE, and FEMA. EPA's Water Infrastructure and Resiliency Finance Center appears well-positioned to lead this effort and can also conduct the necessary outreach, share best practices, provide technical assistance, and serve as a clearinghouse for effective mechanisms.

RECOMMENDATION #3: INCREASE FEDERAL FUNDING, INVESTMENT, AND INCENTIVES TO IMPROVE WATER INFRASTRUCTURE RESILIENCE (2/2)

Specific actions:

3.4 DHS S&T's Office of Resilience should reduce the risk of implementing innovative technology and funding mechanisms by developing cost-share pilot projects with water utilities to speed adoption of better and more cost-effective approaches to service delivery. Successful demonstrations should include an evaluation of whether the mechanism is applicable to other sectors.

3.5 Federal critical infrastructure investment should be repositioned to catalyze economic development; encourage smart, sustainable, and resilient systems; and create job opportunities and inclusion at the local level that will build public awareness and support for infrastructure investment. To achieve this, the President, through OMB and in coordination with the NSC should direct the heads of all Federal departments and agencies responsible for critical infrastructure investment, as identified in PPD-21, to:

- Identify and report annually to OMB all current and planned department/agency investments in critical infrastructure for which they have oversight;
- Design innovative programs and approaches that create job opportunities and local community benefits using Federal infrastructure investments; and
- Establish multiyear goals and performance milestones for critical infrastructure investments and include them in department/agency strategic plans.

RECOMMENDATION #4: INCREASE TECHNICAL AND FINANCIAL RESOURCES AND EXPERTISE AVAILABLE TO THE WATER SECTOR

Specific actions:

4.1 Create a network of land grant universities to build localized technical capabilities, services, and expertise for water utilities that can be leveraged with private funding, and help train the next-generation workforce. The initial program should start with 10 geographically dispersed universities that meet certain criteria, such as access to State funding, existing subject matter expertise, applicability to selected research topics, and their location.

4.2 The Secretary of Homeland Security should direct funding to water associations to increase outreach efforts of financial tools and life-cycle assessment models that help utilities justify infrastructure investments and support improved asset management practices.

4.3 NSC and DHS should expand cyber resources, expertise, and workforce training for the Water Sector. This should include sharing best security practices and applications through outreach and leveraging existing programs, such as the Protective Security Advisor's cybersecurity initiative.

RECOMMENDATION #5: STRENGTHEN FEDERAL LEADERSHIP, COORDINATION, AND SUPPORT FOR WATER SECTOR RESILIENCE

Specific actions:

5.1 Establish a temporary high-level Federal coordinating body led by DHS—with senior-level representatives from major agencies that have a role in water—to proactively lead collaboration across Federal, State, and local government and the Water Sector, with particular emphasis on extreme and national-level events. To avoid creating another level of bureaucracy, the coordinating body should be limited to two years.

5.2 The focus on water at the Federal level has traditionally been on clean water (EPA), control of water resources (USACE), and emergency response (FEMA), with little emphasis on proactive resilience and security. One of the first tasks of the Federal coordinating body should be to identify barriers to resilience and rapid recovery in existing Federal laws and regulations through analysis.

- The review should result in recommendations for statutory reforms that could be made to promote resilient activities, encourage innovation, and provide flexibility in regulatory compliance during emergency situations.
- The review should also ensure that rules do not overlap or overrule each other.

RECOMMENDATION #5: STRENGTHEN FEDERAL LEADERSHIP, COORDINATION, AND SUPPORT FOR WATER SECTOR RESILIENCE

Specific actions:

5.3 The Federal coordinating body, working with national water associations and the WSCC and GCC, should initiate a national public outreach campaign to increase awareness about the importance of water services.

5.4 Within one year of issuance of this report, the NSC, in coordination with the Council of Economic Advisors, should convene a national public-private philanthropic leadership forum with representatives from business, government, community advocates, education, labor, and philanthropic organizations to determine the best approaches for leveraging Federal infrastructure investments to increase economic opportunities and build public support for Water Sector investment.