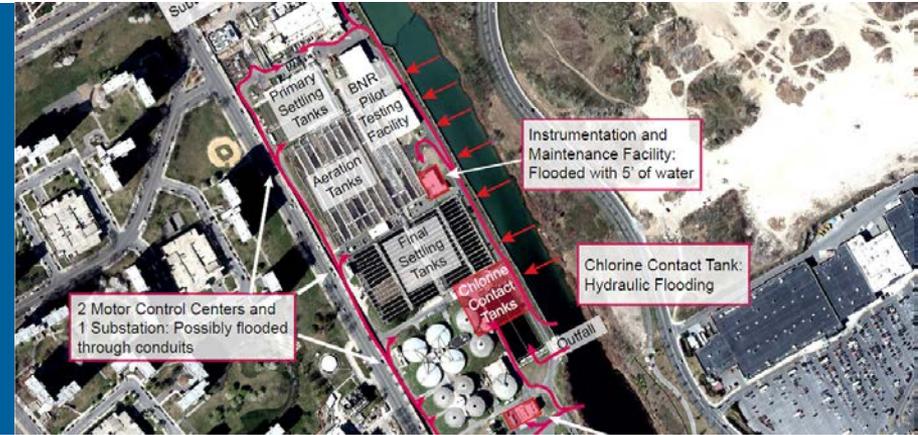




TOWARD A MORE RESILIENT WASTEWATER TREATMENT INFRASTRUCTURE AND OPERATIONS



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RESILIENCY OF WATER RESOURCE RECOVERY FACILITIES (WRRFs)

- As described by the National Infrastructure Advisory Council (2009), “the effectiveness of a resilient infrastructure depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event”.
- WRRFs are critical part of the water infrastructure



CURRENT FRAMEWORK FOR RESILIENCY AT WWTPs' INFRASTRUCTURES



- Current framework fundamentally sounds good, but not adequate to achieve the level of resilience needed
- Mitigation strategies usually reduce the impact of power loss to 1-33% degradation in operations for short term power outage

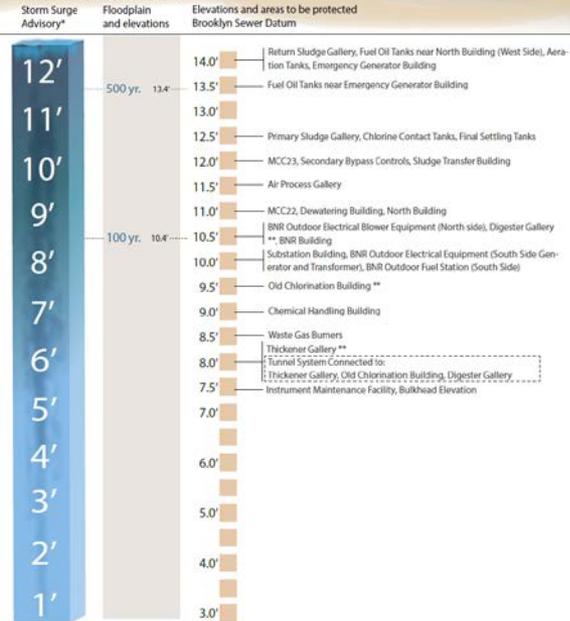
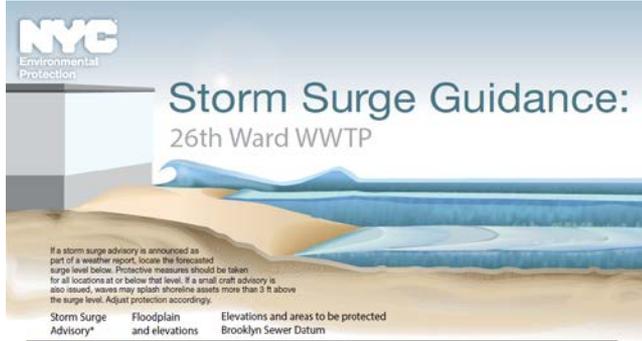
CURRENT FRAMEWORK FOR RESILIENCY AT WRRFs' INFRASTRUCTURES

Emergency response and mitigation implementation plans:

- Barriers around key assets (e.g. sandbags, water-proof doors, flood walls)
- Waterproof, elevate, relocate, cap, seal or upgrade equipment, instrumentation and buildings
- Emergency generators, fuels to generators, portable equipment and spare parts and equipment, control systems
- Bolted down chemical tanks
- Critical equipment needed to perform basic (primary) treatment at the plant
- Dewatering and temporary pumping, major equipment replacement and repair



NYC WASTEWATER RESILIENCY PLAN



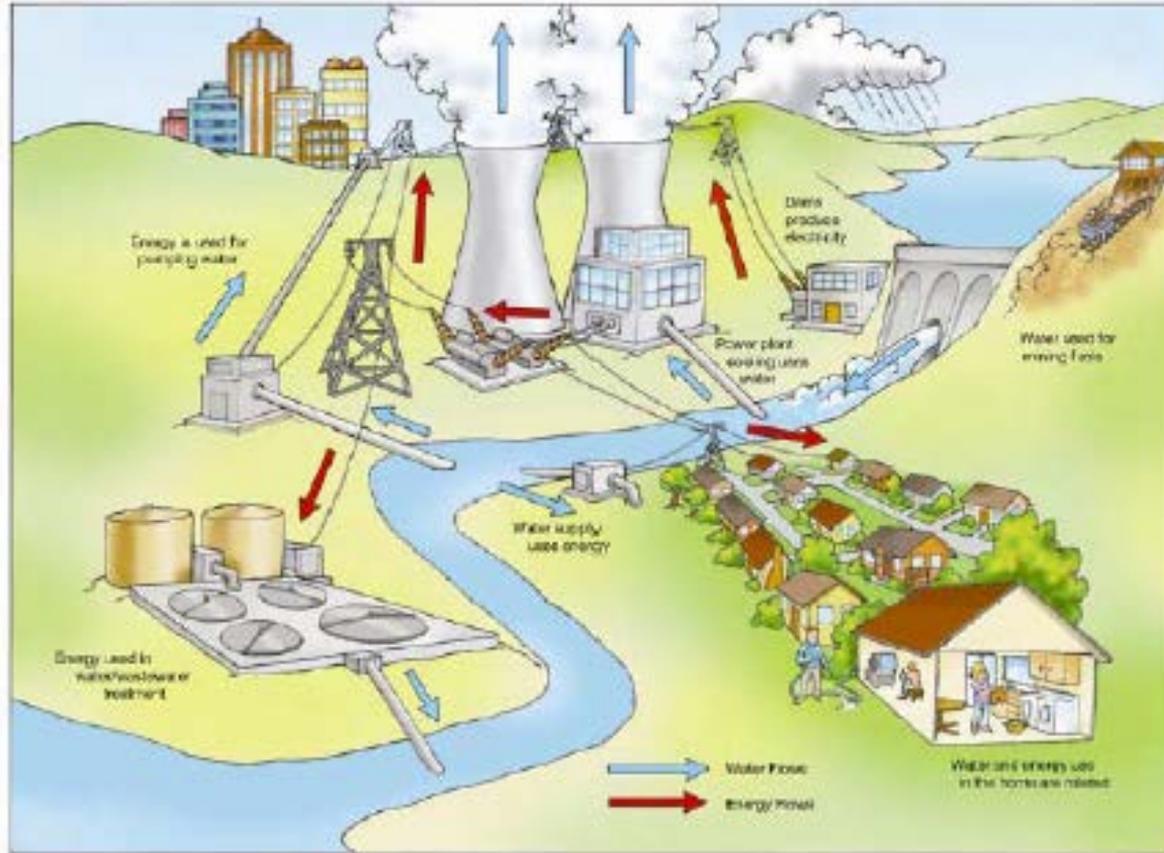
Location	Recommended Protective Measure
Air Process Gallery	Sandbag
BNR Building	No Action Required
Chemical Building	No Action Required
Chlorination Building (Old)	Flood Proof Equipment and Construct Barrier
Chlorine Oil Contact Tanks	Elevate Equipment
Dewatering Building	Sandbag
Final Settling Tanks	No Action Required
Sludge Thickener Gallery	Construct Barrier
Primary Sludge Gallery	Flood Proof Equipment and Construct Barrier
Dewatering Building	Sandbag

26th WARD WWTP



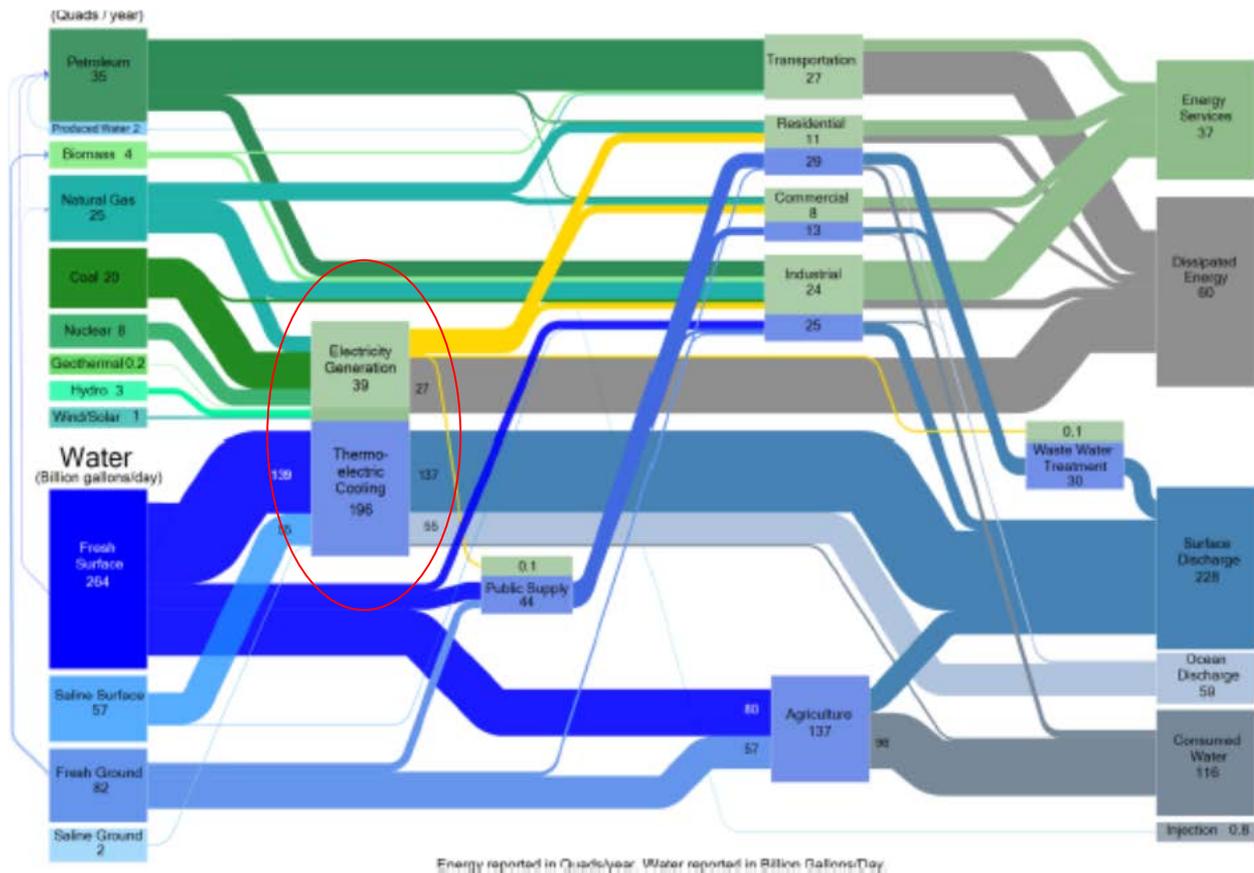
*Storm surge added to Mean Higher High Water at Sandy Hook as of 2012, which is 1.77 ft Brooklyn Sewer Datum. Sea level is expected to rise up to 30 inches by 2050. This storm surge advisory is for current conditions.
**One of the multiple flood pathways into the tunnel system. To avoid tunnels, waves of offshore are protected.

WATER-ENERGY-ENVIRONMENT



Source: The Water-Energy Nexus: Challenges and Opportunities, DOE Report (2014)

WATER-ENERGY NEXUS



Source: The Water-Energy Nexus: Challenges and Opportunities, DOE Report (2014)

2-4%
of total U.S. energy use is consumed by water and wastewater systems
(That's as much as 187.4 million MWh per year)*

More than 40x the power generated by the Hoover Dam in a year!

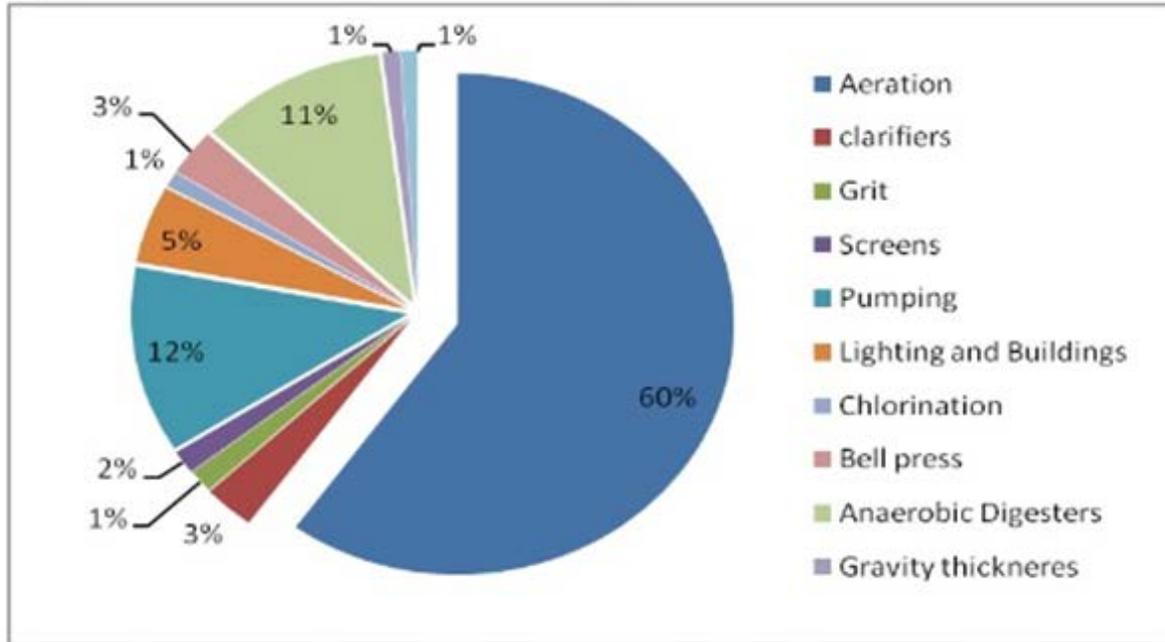
How much water is needed to extract and produce electricity?

More than 4x the amount of water used by all U.S. residences.

Courtesy of US Water Alliance

WATER-ENERGY NEXUS

Energy Distribution within a WWTP



TREATMENT FACILITIES DEPENDENCIES

WATER TREATMENT FACILITY DEPENDENCIES

Since January 2011, DHS has conducted 134 ECIP surveys of water treatment facilities, collecting data on the facilities' dependencies and resilience. The data show the following dependencies for those water treatment facilities in Figure 1.

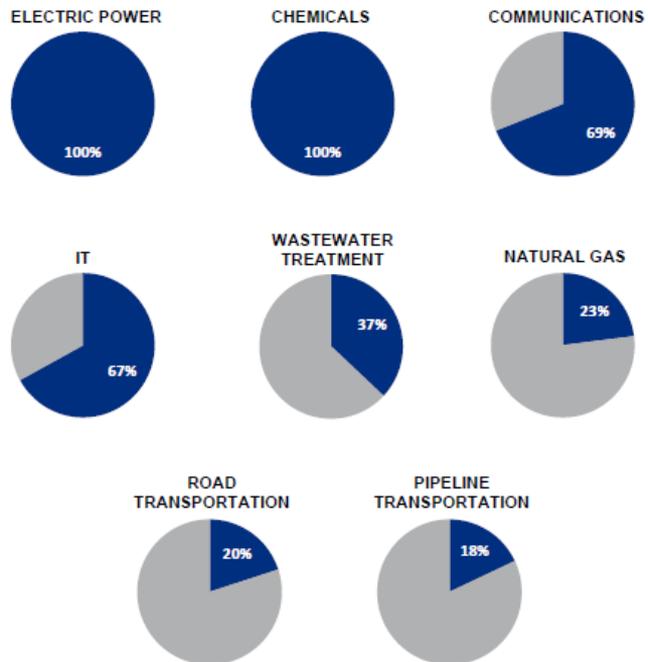


FIGURE 1.—Percent of Assessed Water Treatment Facilities Dependent upon Other Utilities (Courtesy of DHS and Argonne National Laboratory).

WASTEWATER TREATMENT FACILITY DEPENDENCIES

Since January 2011, DHS has conducted 96 ECIP assessments of wastewater treatment facilities, collecting data on the facilities' dependencies and resilience. The data show the following dependencies for those wastewater treatment facilities in Figure 2.

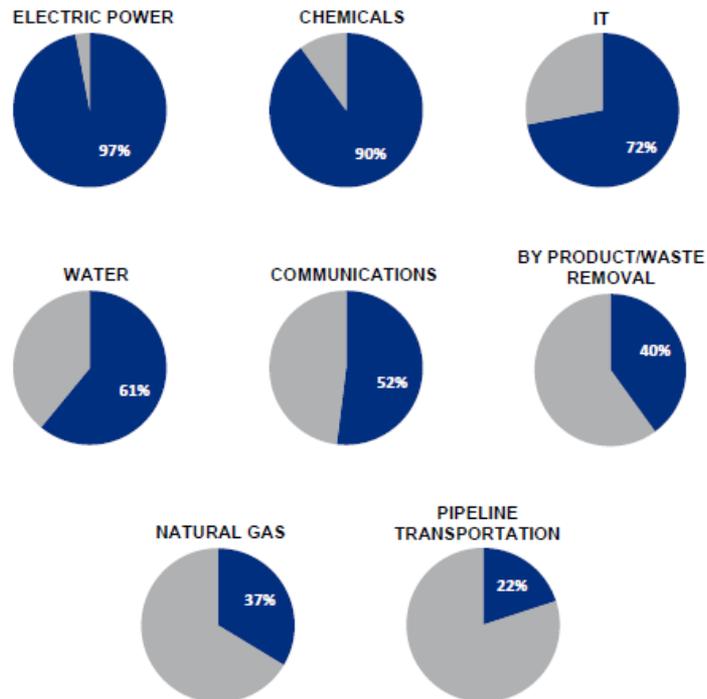
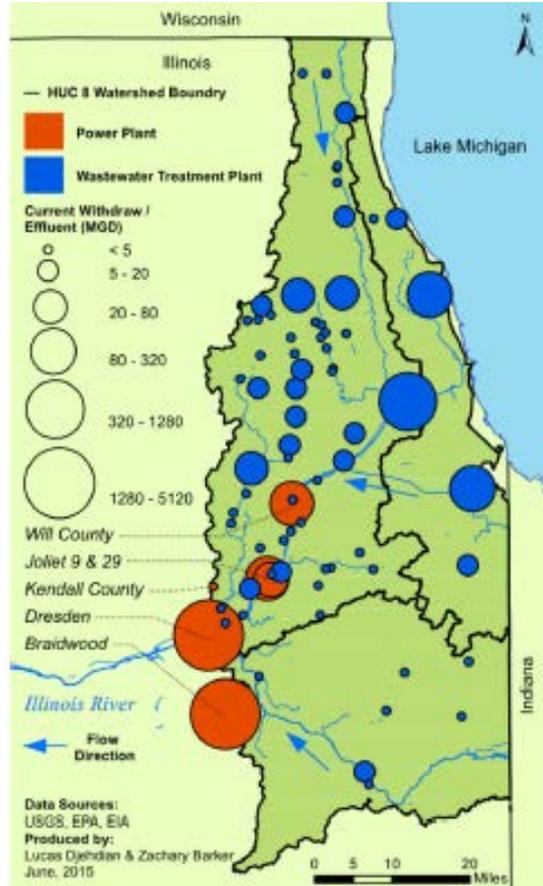


FIGURE 2.—Percent of Assessed Wastewater Treatment Facilities Dependent upon Other Utilities (Courtesy of DHS and Argonne National Laboratory).

NEED FOR DEVELOPMENT OF INTEGRATED MITIGATION PLANS



- Greater Chicago Area includes 72 wastewater treatment plants and six power plants (2 coal, 3 nuclear and 1 natural gas).
- 1,600 million gallons of wastewater treated per day
- 5,116 million gallons of water withdrawal per day

Courtesy of Barker and Stillwell, 2016 (Env. Sci Tech, 50: 5379-5388)

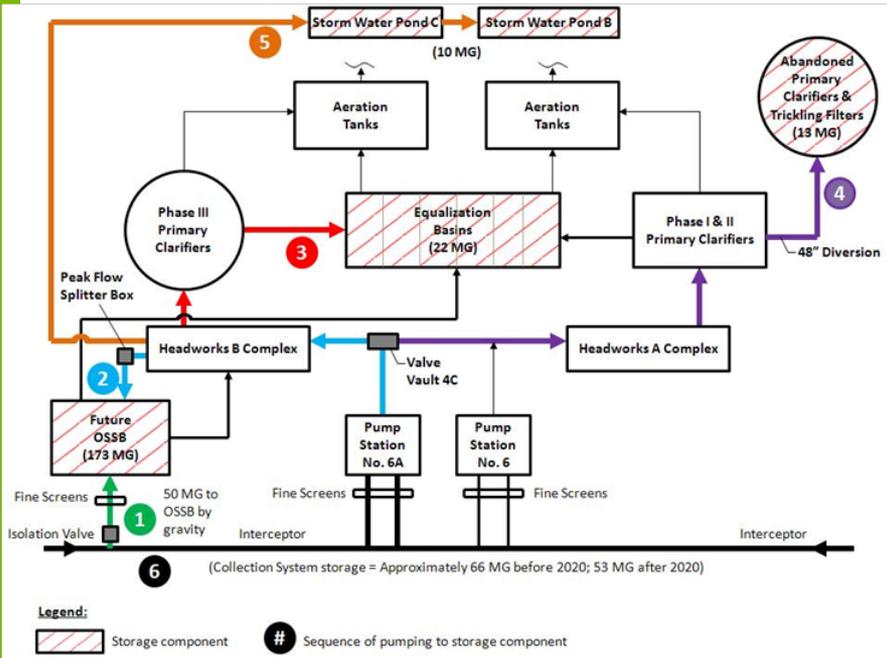
- Most of the Chicago area rivers are dominated with effluent of these wastewater treatment plants.

WASTEWATER TREATMENT-ENVIRONMENT

- Discharge to sensitive water bodies, e.g. Florida Everglades
- Effluent dominated receiving waters, e.g. Chicago River
- Meeting discharge permit
- Required water quality and quantity to minimize negative impact on public health
 - Hurricane Katrina: EPA gave the City of New Orleans a 60-day deadline to restore both primary and secondary wastewater treatment.
- Hazards associated with the release of chemicals used WRRFs into the environment and public health
 - Chemical name, volume, concentration and form
- Hazards associated with interruption of operations at WRRFs
 - Anaerobic digesters



POWER LOSS SCENARIO PLANNING – STORAGE AND EMERGENCY GENERATOR PLANS



- Provide storage in the plant, collection systems, and emergency storage basins
- Generator power for pumping
- Extended power (more than 24 hours) loss results in loss of biological treatment capacity
- Longer term power loss (more than 3 days) needs long term planning and infrastructure upgrades

INTEGRATED MASTER PLANNING INCLUDING RISK ASSESSMENT AND RESILIENCY

- WRRFs conduct master plan for facilities upgrade including equipment/technology upgrades, future regulatory requirements, operational cost improvements, and operational ease
- Include risk assessment due to both natural and unnatural risks to WRRFs
- Periodic update of the risk/vulnerability assessment/mitigation plan
- Infrastructure upgrades to include integrated risk mitigation plan
- Include renewable energy sources for alternative power supplies

THANK YOU

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