HOW THE

Birmingham Water Works Implemented the **J100 (RAMCAP®) Standard**

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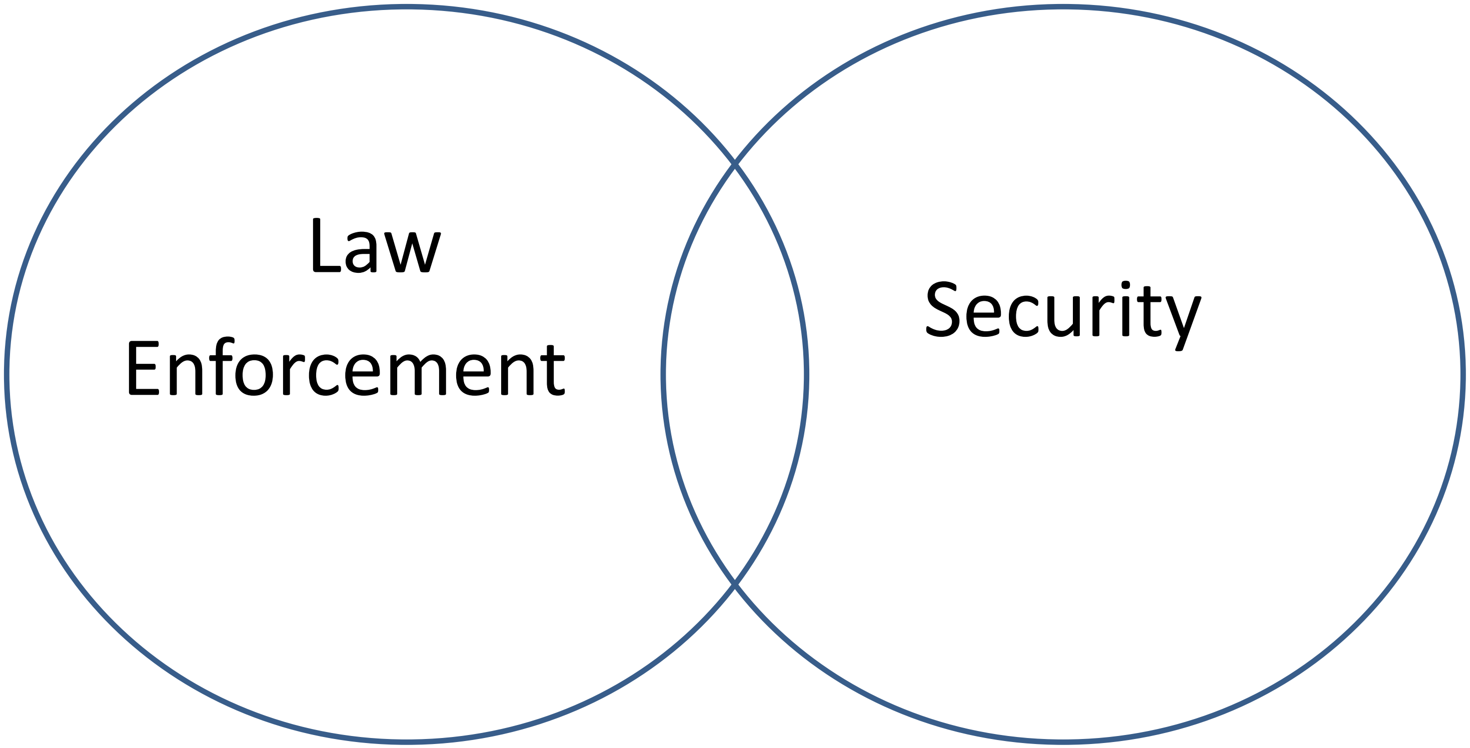
SECURITY

Imagi

Security vs. Law Enforcement



Primary Role of Security - to **Prevent** and **Deter**

Imagine the result

What's to Come

Introductory Remarks

Assets and Malevolent Threats

All-Hazards Approach

Risk Reduction

Context

Section 2013 of the America's Water Infrastructure Act of 2018 (AWIA requires community water system's that serve more than 3,300 people to complete a risk and resilience assessment and develop an emergency response plan.

Important Dates

	Risk and Resilience Assessment	***Emergency Response Plan***
Serving >100,000 People	*March 31, 2020*	*September 30, 2020*
Serving 50,000 to 99,999 People	*December 31, 2020*	*June 30, 2021*
Serving 3,301 to 49,999 People	*June 30, 2021*	*December 30, 2021*

Risk Analysis and Management for Critical Asset Protection – RAMCAP®

ANSI/ASME-ITI/AWWA-J100 : a voluntary, consensus-based standard to support utilities becoming more ***secure*** *and* ***resilient***

AWWA and ASME-ITI developed the J100 standard in response to recent natural disasters and it was intended to help water and wastewater utilities identify potential threats to U.S. water infrastructure and prepare for or mitigate damage

In-short, it focuses on an "all hazards" approach.

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Risk Analysis and Management for Critical Asset Protection

J100 differentiates itself from previous RAM-W^{SM} methodology by providing guidance for calculating:

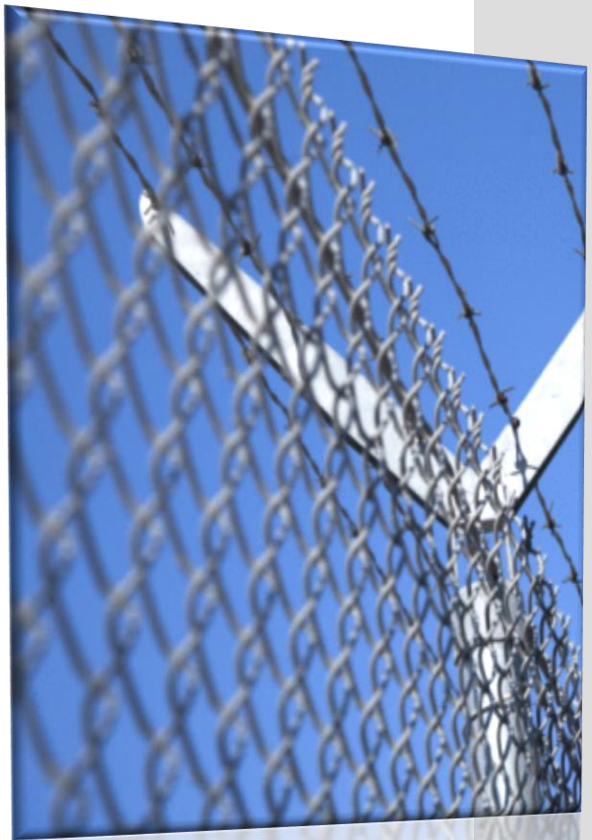
The Probability of Attack

The Probability of Occurrence of natural hazard

Asset and utility resilience

What Was Covered

The BWWB Vulnerability Assessment update included a review of each of the elements identified below:



- Raw water pipes and facilities
- Physical barriers
- Water collection and treatment
- Water storage and distribution facilities
- Use, storage & handling of various chemicals
- Operation and maintenance of the system

What Else is Covered

Computer Systems

- Data Center
- Laboratory Information Management System
- Financial and Billing Systems
- Filter Plant Distributed Control Systems
- Remote site SCADA RTU panel PLCs
- Raw water PLCs

Introductory Remarks

The Players

BWWB Core Security Task Force

Responsible for completing the vulnerability assessment and recommending improvements

Knowledge and experience included

- **Water Purification**
- **Pumping**
- **SCADA/ IT**
- **Security**
- **Engineering & Project management**
- **Electrical System Experts**
- **Financial Systems**

Imagine the result

Assets and Malevolent Threats

The Process *(workshop-based approach)*

The Task Force met to complete tasks required by RAM-W^{SM} and to incorporate elements of J100

WORKSHOPS

- Facility Prioritization
- Critical Asset Identification
- Threat Assessment
- Consequence Assessment
- Risk Analysis - RAM-W^{SM} & J100
- Risk Reduction Alternatives

Imagine the result

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Facility Prioritization Workshop

- Identified facilities requiring ***particular attention*** when searching for critical assets.
- Helped prioritize proposed ***risk reduction ideas***

BWWB Mission Objectives

Maintaining Fire and Sanitary Water Supply

Maintaining Potable Water Supply

Supporting Critical Customers

Specific Aspects of Each Facility Considered

Capacity

Water Quality

Geographic Extent

Critical Customers

Maintaining Pressure

Critical Asset Workshop

- Identified "***Single Points of Failure***" within the water system *(assets without which BWWB cannot meet objectives)*
- *Identified* ***Critical Assets*** of the system that warranted the ***highest level of attention***

Critical Asset Workshop

Risk Equation Applied to Each Critical Asset

$$R = (T) \times (V) \times (C)$$

R: Asset Risk Value

T: Probability of Threat (Ranges from 0-1)

V: Vulnerability to Threat (Ranges from 0-1)

C: Consequence of Occurrence ($)

Imagine the result

Threat Assessment Workshop

- BWWB Core Security Task Force stepped through a simulated terrorist cell attack on the BWWB based on their collective knowledge of the system.

Worst Case Scenarios

Adversary pathways

Examined for each High Priority facility

All-Hazards Approach

Threat Assessment Workshop

Additional threats will be taken into account under J100: Natural Hazards

Tornado

Flood

Earthquake

Hurricane

All-Hazards Approach

Consequence Assessment Workshop

The loss of a critical asset was evaluated in terms of the following measures of consequence, as defined in J100

- Economic Loss
- Community impact

- Number of injuries
- Deaths

Imagine the result

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Risk Analysis Workshop *RAM-W*

Risk Analysis Workshop

RAM-W[SM] Methodology

Imagine the result

- Calculated the relative risk associated with each of our critical assets
- Established a risk mitigation target
- Risk values were calculated using the RAM-W[SM] equation $R = P_A \times (1-P_E) \times C$.
- Risk values are asset-specific: calculation was performed for each critical asset developed.
- **RAM-W Methodology: P_A equal to 1.0 *in every case*.**
- P_E appear as high (0.9), high/medium (0.7), medium (0.5), or low (0.1), as applicable.

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All-Hazards Approach

Risk Analysis Workshop *J100 Methodology*

Imagine the result

- **J100 Risk Analysis assumes that the likelihood of an attack is not equal to 1**.
- J100 Risk Analysis allows calculation of a Proxy Measure to calculate the likelihood of an adversarial attack on a *specific metro region* and asset by placing metro regions in Tiers.
- Birmingham : Tier 7 after review of Appendix F of the J100 Document.
- Guidance for consequence and vulnerability given in Appendix B.

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Risk Analysis Workshop *J100 Methodology*

RISK ANALYSIS: Natural Hazards

- Appendix G of the J100, takes into account Natural Hazard risks for each
- Used elements of J100 to measure BWWB risk of potential natural hazards for the following
  - Tornadoes
  - Earthquakes
  - Floods
  - Hurricanes

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Tornadoes

Tornado Hazard measures risk

Statewide Data & County Data*

Strong Violent Tornadoes (EF2-EF5)

Hazard risk analysis

(*http://www.awwa.org/standardj100)

Imagine the result

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Tornadoes

Risk calculation consisted of five components

1 **Annual Probability** *(state/county calculation)*

2 **Planning Horizon** *(20 years)*

3 **Probability** (Annual Probability x Planning Horizon)

4 **Vulnerability** EF2-EF5, given number set equal to 1

5 **Consequence** **$**

Risk (Probability x Vulnerability x Consequence)

Imagine the result

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Tornadoes

Tornado hazard risk calculation:

$$R_T = P_T \times V_T \times C_T$$

R_T =Risk associated with a Tornado
P_T = Probability of a Tornado
(Probability X 20 Year Planning Horizon)
V_T = Vulnerability to Tornado (assumed to be 1)
C_T = Consequence of a Tornado

Earthquakes

Imagine the result

- Hazard risk analysis
  US Geographical Survey website data
  (http://eqint.cr.usgs.gov/eqprob/2002/index.php)

- Risk for each critical asset for Earthquakes of different sizes:
  - > 5.0, ≤ 6.0
  - > 6.0, ≤ 6.5
  - > 6.5, < 7.0

  Given data in Appendix G of J100.

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Earthquakes

Imagine the result

Risk calculation consisted of eight components

1. Time Interval
2. Probability of a 5.0 to 6.0 Earthquake
3. Vulnerability to a 5.0 to 6.0 Earthquake
4. Probability of 6.0 to 6.5 Earthquake
5. Vulnerability to a 6.0 to 6.5 Earthquake
6. Probability of 6.5 to 7.0 Earthquake
7. Vulnerability to a 6.5 to 7.0 Earthquake
8. Consequence $

Risk
∑(Probability x Vulnerability) *x Consequence

*for each class of earthquake

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Earthquakes

Imagine the result

Earthquake hazard risk calculation:

$$R_E = \sum(P_E \times V_E \times C_E)$$

R_E=sum of risks associated with each size of earthquake
P_E = Probability of size of each earthquake
(Probability X 20 Year Planning Horizon)
V_E = Vulnerability to Earthquake of each size
C_E = Consequence of an Earthquake

*for each class of earthquake

Floods

- Highly dependent on location of structures and equipment within system.
- J100 references the use of FEMA Flood Insurance Rate Maps (FIRMs)
- Flood Zone maps were analyzed to determine facilities that fall within the High Risk areas.
- BWWB determined that only one facility fell within the high risk area.

Floods

Imagine the result

Flood hazard risk calculation:

$$\mathbf{R_F = P_F \times C_F}$$

R_F = Risk associated with a Flood

P_F = Probability of a Flood
(0.01/year X 20 Year Planning Horizon)

C_F = Consequence of a Flood

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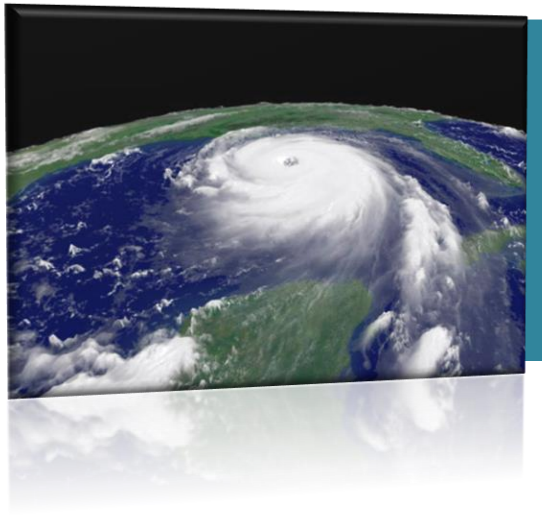
Hurricanes



- The Hurricane hazard measures all Category One Hurricanes and greater on the Saffir-Simpson scale.
- After review of the National Hurricane Center Risk Analysis Program for the return period of hurricanes it was determined that the Birmingham metro regional structures are not susceptible specifically to Hurricane damage.
- Damage would be form other related threats (floods and tornadoes)

Risk Reduction Alternatives Workshop

Imagine the result

Approach

- Developed a list of potential risk reduction ideas
- Considered Intrusion alarms, access control devices, and surveillance cameras
- Looked at standby-power generators
- Looked at conversion from gaseous chlorine to hypochlorite for disinfection
- Updated our Emergency Response Plan to reflect "All Hazards" approach

Risk Reduction Alternatives Workshop

- Looked at installing retaining wall/levee for flood prone area
- Looked at redundant power feeds for plants
- Looked at determining fault line designation near critical assets

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Risk Reduction Alternatives Workshop

Imagine the result

Next steps

- Developed a list of general and site specific risk reduction ideas to present to key decision makers
- Evaluated the ideas and formulate a plan for improving the overall security and natural hazard risk reduction of our utility
- Items will be addressed in the Capital Improvement Plan budgeting process and in Emergency Response training.

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J100 (RAMCAP®) Standard

Q&A

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