Course 4 - Risk and Resilience Management – Module 4

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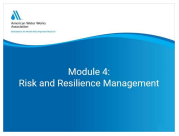
1.1 Risk and Resilience Management



Notes:

This is Module 4, Risk and Resilience Management, the final module in Course 3 on Risk and Resilience Management of Water and Wastewater Systems.

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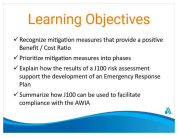
1.2 Learning Objectives



Notes:

These are the learningobjectives for this module. After successfully completing this module, course participants will be able to:

- Recognize mitigation measures that provide a positive Benefit / Cost Ratio
- Prioritize mitigation measures into phases
- Explain how the results of a J100 risk assessment support the development of an Emergency Response Plan
- Summarize how J100 can be used to facilitate compliance with the AWIA

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1.3 Risk and Resilience Management

Notes:

In this module, we will talk about the Risk and Resilience Managementstep and discussthe following topics:

- The steps in the Risk and Resilience process
- Example mitigation measures, and
- How to calculate Gross Benefit, Net Benefit, and Benefit / Cost Ratio

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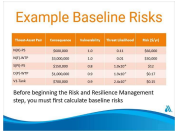
1.4 Example Baseline Risks



Notes:

Before you can perform Risk and Resilience Management, you must first calculate baseline risk. This is a reminderof baseline risk calculations we discussedin Module 3 for the following threat-assetpairs:

- Hurricane impacting a PumpStation
- Flood impacting a Water TreatmentPlant
- Process Sabotage by an Insiderimpacting a PumpStation
- Proximity hazard, in the form of an upstream chemicaltank farm, impacting a Water Treatment Plant
- A Vehicle bomb impacting a finished watertank

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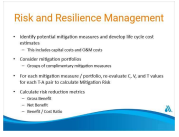
1.5 Risk and Resilience Management



Notes:

This is the Risk and Resilience Management process.

- First you identify potential mitigation measures foryour T-A pairs thatcould reduce risk and develop life cycle cost estimates. This includes capital costs and O&M costs.
- Often we simultaneously considergroups of complimentary mitigation measuresand refer to them as mitigation portfolios.
- Then assume you have implemented the mitigation portfolio and re-evaluate C, V, and T values for each T-A pair to calculate Risk values after mitigation
- The Risk values after implementation of the mitigation portfolio will hopefully be less than the Baseline Risk
- Then you calculate the risk reduction metrics
  - Gross Benefit
  - Net Benefit
  - Benefit / CostRatio
- We will talk more about the risk reduction metrics in a few minutes

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1.6 Example Mitigation Measures

Example Mitigation Measures

- Fences and barriers
- Cameras
- Lighting
- Electronic entry control
- Intrusion detection
- Network firewalls
- Security SOPs
- Security personnel
- Improved policies and procedures
- Preparedness plans
- Training and exercises

Notes:

These are some example mitigation measures. There are many, many others that could be considered, but this gives you a general idea. Remember many of these security measures are discussed in G430.

The examples in this slide include things like:

- Fences and barriers
- Cameras
- Lighting
- Electronic entry control
- Intrusion detection
- Network Firewall
- Security Standard Operating Procedures
- Security personnel
- Improved policies and procedures
- Preparedness plans, and
- Training and exercises

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1.7 Benefit Evaluation Metrics

Benefit Evaluation Metrics

Total Gross Benefit = Baseline Risk – Mitigation Risk

Net Benefit = Total Gross Benefit – Mitigation Cost

Net Benefit / Cost Ratio = Net Benefit / Mitigation Cost

- Give priority to mitigation measures that have the highest Net Benefit, lives saved, and injuries avoided
- Use Benefit/Cost ratio as "the breaker" between options with very similar levels of Net Benefits
- A Benefit/Cost ratio greater than 1.0 means there is a return on the investment made in the mitigation measure (higher is better)

Notes:

This slide shows how to calculate the benefit evaluation metrics:

- Total Gross Benefit = Baseline Risk - Mitigation Risk
- Net Benefit = Total Gross Benefit - Mitigation Cost
- Net Benefit / Cost Ratio = Net Benefit / Mitigation Cost

These are calculated for each mitigation measure / portfolio.

In order to achieve the greatest return on investment for your mitigation dollars, you should give priority to mitigation measures that have the highest Net Benefit, lives saved, and injuries avoided

The Benefit/Cost ratio should be used as a "tie-breaker" between options with very similar levels of Net Benefits. A Benefit/Cost ratio greater than 1.0 means there is a return on the investment made in the mitigation measure (higher is better)

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1.8 Example Benefit Calculations

Example Benefit Calculations

- Potential contamination of an elevated water tank
- The Baseline Risk of this T-A pair is assumed to be $100,000

Notes:

Now we will go through an example of benefit calculations. The threat-asset pair being evaluated is potential contamination of a water storage tank and we will assume the Baseline Risk is $100,000.

Photo Source - https://slideplayer.com/slide/7223008/

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1.9 Example Mitigation Portfolio

Example Mitigation Portfolio

- Mitigation portfolio costs $15,000
  - Construct fence with warning signs
  - Install ladder guard
  - Improve lighting
  - Perform random security patrols
- Consequence remains unchanged, Vulnerability is reduced, Threat Likelihood decreases
- Mitigation Risk is $5,000

Notes:

We are going to evaluate the risk reduction metrics of this mitigation portfolio:

- Construct a fence with warning signs
- Install a ladder guard
- Improve lighting, and
- Perform random security patrols

We'll assume the cost of this portfolio is $15,000.

When you re-evaluate C, V, and T, you determine that:

Consequence remains unchanged because the mitigation measures in this portfolio would not change the outcome / consequences if the event is successful,

Vulnerability is reduced because the adversary is more likely to be detected / stopped and therefore less likely to be successful, and

Threat Likelihood decreases because the adversary will likely choose a softer target.

As a result, we'll assume the revised risk of the T-A pair is $5,000.

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1.10 Example Calculations

Example Calculations

Total Gross Benefit Baseline Risk – Mitigation Risk $100,000 - $5,000 = **$95,000**	**Given values:** Baseline Risk = $100,000 Mitigation Risk = $5,000 Mitigation Cost = $15,000
Net Benefit Total Gross Benefit – Mitigation Cost $95,000 - $15,000 = **$80,000**	
Net Benefit / Cost Ratio Net Benefit / Mitigation Cost $80,000 / $15,000 = **5.3**	

Notes:

Now we will calculate Total Gross Benefit, Net Benefit, and Benefit / Cost Ratio.

On the previous slides, we were told that Baseline Risk = $100,000; Risk after implementing the mitigation portfolio = $5,000; and the cost of implementing the mitigation portfolio = $15,000.

Total Gross Benefit is calculated by taking the Baseline Risk ($100,000) and subtracting the Mitigation Risk ($5,000), resulting in the Total Gross Benefit = $95,000.

The Net Benefit equals the Total Gross Benefit ($95,000) and subtracting the Mitigation Cost ($15,000), resulting in the Net Benefit = $80,000.

The Net Benefit/Cost Ratio is calculated by dividing the Net Benefit ($80,000) by the Mitigation Cost ($15,000), resulting in a Net Benefit/Cost Ratio of 5.3.

As you can see, the mitigation portfolio evaluated in this example provides a high Net Benefit of $80,000 and a very favorable Net Benefit / Cost Ratio of 5.3. Remember, a Net Benefit / Cost Ratio of greater than 1.0 indicates a positive return on investment associated with implementing the mitigation options.

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1.11 Risk / Resilience Workshop

Risk / Resilience Workshop with Stakeholders

- Discuss and achieve consensus on risk / resilience management recommendations
- Strike a balance between the financial resources needed and the willingness of the utility to accept risk
- Manage expectations
- Take ownership of the results

Notes:

Once you have evaluated risk reduction and resilience improvement measures for all of your threat-asset pairs, it is recommended that you conduct a Risk & Resilience Workshop with stakeholders. In the workshop you should discuss and achieve consensus on risk / resilience management recommendations

No utility has enough money to implement every mitigation recommendation, so it is necessary to strike a balance between the financial resources needed to address risks and the willingness of the utility to accept some degree of risk

If you are a consultant helping a utility with this workshop, remember this is not YOUR risk assessment, it is the UTILITY's risk assessment, and it is important for the utility stakeholders to take ownership of the results.

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***1.12 Which mitigationportfolio would be preferred?*(Multiple Choice, 10 points, 3 attempts permitted)**

Correct	Choice
	Net Benefit of $50,000 and B/C ratio of 0.3
	Net Benefit of $25,000 and B/C ratio of 3.5
X	Net Benefit of $50,000 and B/C ratio of 1.0
	Net Benefit of $5,000 and B/C ratio of 1.5

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response. Please reference slide 7.

Notes: Now let's check your understanding of the benefit evaluation metrics used to select favorable mitigation portfolios.

Correct answer: c

a) Incorrect - The Net Benefit of $50,000 is good, but the B/C ratio of 0.3 is poor

b) Incorrect - The and B/C ratio of 3.5 is good but the Net Benefit of $25,000 is less than other options

c) Correct - Net Benefit of $50,000 and B/C ratio of 1.0 are the best combination of metrics

d) Incorrect - The B/C ratio of 1.5 is pretty good, but the Net Benefit of $5,000 is less than other options

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1.13 Prioritizing Implementation of Mitigation Measures

Notes:

Most utilities will not have enough money to implement all selected mitigation measures at one time, so you should prioritize the implementation into phases. Here are some criteria you should consider when setting priorities:

- Enhanced policies and procedures, which have low cost but will create an improved culture of security and preparedness
- Projects that provide dual benefits by improving operational efficiency as well as decreasing risk
- Projects that replace existing systems that are ineffective or that are reaching end-of-life

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1.14 Prioritizing Implementation of Mitigation Measures

Notes:

Here are some additional prioritization criteria you should consider:

- Projects that reduce the risk of multiple T-A pairs or reduce the vulnerability of a T-A pair to zero
- Projects that provide layered defense in depth by detecting / protecting outer layers prior to inner layers
- And, of course, Professional judgment

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1.15 Example Prioritization of

Notes:

The next few slides present examples of how you might potentially prioritize mitigation projects into short, mid, and long-term buckets

Short-term measures yield high benefits and should be implemented as soon as possible. These may include:

- Cybersecurity measures
- Updating policies, procedures, and design standards
- Conducting training and exercises, and
- Developing mutual aid agreements

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1.16 Example Prioritization of

Notes:

Mid-term projects may possibly be implemented in the next 1 to 5 years, and could include:

- High impact / low cost capital projects
- Integrating security and preparedness into new construction and major renovations, and
- Replacing/ upgrading security technologies that have reached end-of-life

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1.17 Example Prioritization of

Notes:

Long-term measures may be ones that you implement beyond 5 years. These may include:

- Expensive capital projects that may require grant funding
- Projects requiring a long lead time for planning and design, and
- Projects associated with the Capital Improvement Program (CIP) that are scheduled beyond 5 years

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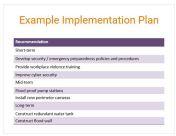
1.18 Example Implementation Plan



Notes:

This table is a simplified example of what a prioritized implementation plan may look like. You could also have columns for:

- CIP identification number
- Expected date of implementation
- Justification
- And who is responsible for tracking and implementing the project

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***1.19 Activity* (Multiple Response, 10 points, 3 attempts permitted)**

Correct	Choice
X	Require stronger computer passwords
X	Developing security design standards
X	Conduct tabletop exercises
X	Update the access control policy
	Install in-line chlorine residual sensors at City Hall, the local hospital, and the local high school
	Build a dam that creates an alternate water source
	Repair dilapidated fences around three elevated storage tanks

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response. The correct answers are: Require stronger computer passwords, developing security design standards, conduct tabletop exercises, update the access control policy. Please review slides 15.

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***1.20 Activity* (Multiple Response, 10 points, 3 attempts permitted)**

Correct	Choice
	Construct a fivemilelevee to protect a water treatment plant and create an area for an amusement park and several tourist attractions to be constructed
X	Repair dilapidated fences around three elevated storage tanks
X	Replace surveillance cameras at the raw water intake with improved technology
	Update the access control policy
X	Install in-line chlorine residual sensors at City Hall, the local hospital, and the local high school
X	Add intrusion detection during an ongoing pump station upgrade
	Require stronger computer passwords

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response. The correct answers are: repair dilapidated fences around three elevated storage tanks, replace surveillance cameras at the raw water intake with improved technology, add intrusion detection during an ongoing pump station upgrade, install in-line chlorine residual sensors at City Hall, the local hospital, and the local high school. Please review slides 16.

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***1.21 Activity* (Multiple Response, 10 points, 3 attempts permitted)**

Correct	Choice
X	Construct a fivemilelevee to protect a water treatment plant and create an area for an amusement park and several tourist attractions to be constructed
	Repair dilapidated fences around three elevated storage tanks
X	Build a dam that creates an alternate water source
	Update the access control policy
X	Relocate largepump station located in the 100 year floodplain, construct a new water treatment plant with advanced security features to serve a growing area
X	Construct a new water treatment plant with advanced security features to serve a growing area
	Require stronger computer passwords

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response. The correct answers are: Relocate a large pump station located in the 100 year floodplain, construct a new water treatment plant with advanced security features to serve a growing area, Construct a fivemilelevee to protect a water treatment plant and create an area for an amusement park and several tourist attractions to be constructed, build a dam that creates an alternate water source. Please review slides 17.

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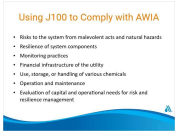
1.22 Using J100 to Comply with AWIA



Notes:

Rememberone of the objectives of this course was to explain how J100 can be used to facilitate compliance with the AWIA. This slide reminds us of some of the things that the Act says must be included in a risk and resilience assessment. We have already talked about each of these in previous modules, but let's talk a little more about:

- Evaluation of capital and operational needs for risk and resilience management

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1.23 Capital and Operational Needs for Risk and Resilience Management

Notes:

J100 results can help define capital and operational needs in the following ways:

- Risk and Resilience Management calculations yield life cycle cost estimates for individual mitigation measures and mitigation portfolios
- The grouping of mitigation measures to create portfolios helps to form projects
- J100 results help integrate security and preparedness into CIP planning, and
- Prioritizing projects for phased implementation helps utilities understand budget needs in out years.

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1.24 Integrating Risk Mitigation into the Capital Improvement Plan

Notes:

Here are some things to consider when you are trying to Integrate Risk Mitigation into the Capital Improvement Plan:

- Start by establishing a culture of security and preparedness that sets expectations for capital improvement planning
- Integrate risk and resilience features into all new construction and major renovations
- To do this you should create design standards that can be provided to design engineers and contractors, and lastly
- Consider architectural features such as Crime Prevention Through Environmental Design that provide passive security improvements

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1.25 Integrating Risk Mitigation into the Capital Improvement Plan

Notes:

Here are some additional things to consider when you are trying to Integrate Risk Mitigation into the Capital Improvement Plan:

- Acknowledge positive risk and resilience aspects of projects already in the CIP
- Train CIP project managers to identify and preserve risk and resilience features
- Don't allow "value engineering" or last minute re-designs to eliminate redundancies or reverse intended benefits

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1.26 Knowledge Check

(Multiple Choice, 10 points, 3 attempts permitted)

Correct	Choice
	Risk and Resilience Management calculations
	Life cycle cost estimates
	Grouping of measures to create mitigation portfolios
	Prioritizing projects for phased implementation
X	All of the above

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response. All of the above is most correct.

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1.27 Using an RRA to Support Development of an ERP

Notes:

Remember, one of the objectives of this course was to explain how the results of an RRA can inform the development of an Emergency Response Plan. This graphic helps to illustrate this concept:

- The RRA helps identify and prioritize risks to the utility
- Identified risks provide an understanding of potential mission impacts
- These mission impacts help define emergency response needs
- And the emergency response needs help inform the development of the Emergency Response Plan

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1.28 Using an RRA to Support Development of an ERP

Notes:

So here are some ways that J100 results can inform the development of an ERP

- Obviously the RRA can help define and prioritize risks
- It can help characterize dependencies
- It can help quantify operational impacts, and
- It can help identify cost-effective mitigation strategies

The AWIA states that the RRA should drive the strategies, actions, and procedures in the ERP. All of the things mentioned above can inform the development of an ERP

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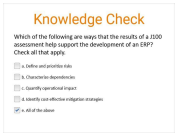
1.29 Which of the following are ways that the results of a J100 assessment help support the development of an ERP? Check all that apply.

(Multiple Response, 10 points, 3 attempts permitted)



Correct	Choice
	a. Define and prioritize risks
	b. Characterize dependencies
	c. Quantify operational impact
	d. Identify cost-effective mitigation strategies
X	e. All of the above

Feedback when correct:

That's right! You selected the correct response.

Feedback when incorrect:

You did not select the correct response.

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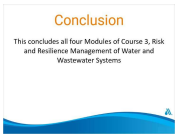
1.30 Conclusion



Notes:

This concludes all four Modules of Course 3, Risk and Resilience Management of Water and Wastewater Systems

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1.32 Closing

Notes:

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