



Homeland Security
Review
Of
Small Public Water Systems

“Plant D”



Funded by the
Midwest Technology Assistance Center
Illinois State Water Survey
Champaign, Illinois

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SOUTHERN ILLINOIS UNIVERSITY EDWARDSVILLE

**Homeland Security Review
of
Small Public Water Systems**

“Plant D”

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Disclaimer

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Table of Contents

Executive Summary.....i

Section 1 Introduction, Need and Methodology

1.1 Introduction and Need.....1-1
1.2 Personnel.....1-1
1.3 Methodology.....1-1
1.4 Risk Assessment.....1-3
1.5 Summary of Distribution System “Plant D”.....1-4

Section 2 Findings of Field Evaluations

2.1 Results of Interviews with System Manager (Day #1).....2-2
2.2 Results of Questionnaire Completed by System Manager (Day #1).....2-5
2.3 Results of Questionnaire Completed by System Manager (Day #1).....2-13
2.4 Results if in-depth discussion with System Manger (Day 2) Part 1.....2-17
2.5 Results if in-depth discussion with System Manger (Day 2) Part 2.....2-19
2.6 Results if in-depth discussion with System Manger (Day 2) Part 3.....2-25

Section 3 Distribution System Interruption Scenarios

3.1 Introduction
3.2 Distribution System Interruption Scenario # 1
3.2.1 Completed Security Incident Report Form for Scenario #1
3.2.2 Site Characterization Form for Scenario #1
3.2.3 Public Health Response Action Worksheet fro Scenario #1
3.3 Distribution System Interruption Scenario # 2
3.3.1 Completed Security Incident Report Form for Scenario #2
3.3.2 Site Characterization Form for Scenario #2
3.3.3 Public Health Response Action Worksheet fro Scenario #2

Section 4 Summary, Recommendations and Conclusions

4.1 Summary.....4-1
4.2 Water System Interruption Scenarios.....4-3
4.3 Recommendations to the System Manager.....4-3
4.4 Conclusions.....4-5

Executive Summary

In response to the terrorist attack on September 11, 2001, the Federal Department of Homeland Security required all water systems to perform a vulnerability assessment (VA) and submit it to U. S. EPA and prepare or update their emergency response plan (ERP).

The VA process up to this point had been a self-assessment by the individual water systems. A third party appraisal of the VA process was considered the most effective method to evaluate the implementation of the measures identified by the VA. ERTC evaluated the VA and ERP process on the “Plant D” water system, which would be representative of small water distribution systems throughout the state.

Three ERTC personnel performed the evaluation of the VA and ERP at “Plant D” (a distribution system) during December of 2005. The evaluation was performed in three parts: initial visit; follow-up visit; and the system manager’s response to the two water system interruption scenarios. To assess the VAs and ERPs at the water system, ERTC developed an evaluation method based upon protocol developed by the U.S. EPA, the Kansas Department of Health and Environment (KDHE), and the National Rural Water Association (NRWA). Using a risk assessment method modified from the KDHE method, ERTC evaluated existing deterrents in the water system while at the same time determining which elements of the system are at greatest risk.

The element presenting the highest risk to the continuing supply of safe and reliable water was the lack of an alternate electrical power supply. The water system does not have a backup power supply to operate its pumps, chlorine generation and injection system, in its three pump houses.

The water system manager was provided with two water system interruption scenarios to address. The first scenario presents the manager with an incident of accidental contamination of the water system with agricultural chemicals. The second scenario is an act of a terrorist introducing a biological contaminant into the water system. This was a cognitive exercise designed to make the manager dust-off his ERP and use it to complete the *incident report forms* and *worksheets* provided to them by ERTC. The second benefit of working through the exercise was that the manager would realize the value of updating and upgrading his ERP and VA.

ERTC made twelve recommendations to the water system, the most important being the acquisition of an alternative power source to operate the pump houses.

It is our conclusion that “Plant D” is a very well managed water distribution system. It has a Cross Connection Control Program (CCCP) that is up to date and well documented. The water system has done a very good job of using its limited manpower and resources to help create and upgrade deterrents to intentional and/or unintentional situations that may lead to contamination of the public water supply.

The VA and ERP prepared by the water system were adequate and met all the requirements. However, during the evaluation of the VA, the ERTC staff found a few inadequacies. It was also

evident that few, if any, of the security issues identified in the VA have been addressed. It is our opinion that after the original VA was prepared and forwarded to U.S. EPA, it was then placed into a file cabinet and not looked at again until a day or two before the ERTC visit. This is typical human behavior, for the manager to use all of his work time addressing the daily responsibilities of running the water system, while placing the VA out-of-site and out-of-mind. To alleviate the potential problem with the out-of-site-out-of-mind VA, it is recommended that some type of periodic update of the VA be performed by all of the subject water systems.

Section 1

Introduction, Need and Methodology

1.1 Introduction and Need

In response to the terrorist attack on September 11, 2001, the Federal Department of Homeland Security required water systems to perform a vulnerability assessment (VA) and prepare or update their emergency response plan (ERP). The VA was required to be completed and submitted to U. S. Environmental Protection Agency by June of 2004, and the ERPs were to have been certified as updated to incorporate findings of the VA by the end of the same year.

The need to evaluate the effectiveness of the VA and the implementation of the security measures was realized in discussions between the Midwest Technical Assistance Center (MTAC) at the Illinois State Water Survey in Champaign, Illinois and the Environmental Resources Training Center (ERTC) at Southern Illinois University Edwardsville. The evaluations would be targeted at the small water systems serving populations of 10,000 and less.

The VA process up to this point had been a self-assessment by the individual water systems. A third party appraisal of the VA process was deemed the most effective method to evaluate the implementation of the measures identified by the VA. ERTC entered into an agreement with MTAC to evaluate the VA and ERP process in four water systems that would be representative of small water systems throughout the state.

1.2 Personnel

The evaluation team consisted of three of the ERTC staff members. The staff performing the evaluations was:

Barb Woods holds an Illinois Class A Water Operator License and has 18 years of experience in water plant operations. Kim Bateman holds a class C/D water operator license and an IEPA Cross connection Control Inspector license. He also has over 20 years of experience in water and wastewater operations. Paul Shetley holds an Illinois Class C/D Water Operator License, and has over 20 years of water quality experience including six years as manager of a water distribution system.

1.3 Methodology

It is not practical or possible to evaluate every water system in the state of Illinois. Therefore, MTAC and ERTC agreed to evaluate one water system from each of the following four categories: (1) groundwater treatment, (2) surface water treatment, (3) distribution system, and (4) a system that treats and buys water wholesale. The water system evaluated in this document is a distribution system, hereafter referred to as "Plant D".

To be able to evaluate the water systems, ERTC compiled and developed an evaluation protocol that was applicable to each type of system. The protocol was used to compare and contrast the VA prepared by the water system to the security issues found during the ERTC visits to the

facility. The security issues evaluated would be each water system's physical assets (buildings, vehicles, tanks, pumps, water mains, valves, and hydrants), IT assets (computer systems and SCADA systems), and cross connection controls.

The protocol utilized to evaluate the water systems was based upon the U.S. EPA *Emergency Response Protocol Toolbox*, the *Simplified Vulnerability Assessment Tool for Drinking Water* designed by the Kansas Department of Health and Environment (KDHE) and the National Rural Water Association (NRWA) *Security Vulnerability Self-Assessment Guide for Small Drinking Water Systems*. The ERTC staff employed a three-step procedure to evaluate each water system, which consisted of three one-half day, visits to the system.

Day 1 Initial site visit to the water system was used to explain the evaluation procedures to the manager of the system. The VA prepared by the system was reviewed and its contents discussed with the manager. System manager was interviewed regarding security systems and cross connection control programs. The system manager was also asked to complete a questionnaire evaluating the VA and security measures at his facility.

Day 2 After review of the data collected during the initial site visit, the ERTC personnel prepared additional questions tailored to the specific security issues observed. The ERTC survey team returned to the water system to ask the manager specific questions related to his water system.

Day 3 The manager of each system was asked to address two "water system interruption scenarios" that were prepared by the ERTC staff. The manager completed the questionnaires associated with each of the two scenarios.

During each site visit, the ERTC evaluation team reviewed the potential for intentional and unintentional contamination or interruption of the water supply. Intentional contamination of the water supply would include:

- a. Vandalism
- b. Terrorism
- c. Sabotage

Unintentional contamination or interruption of the water supply would include:

- a. Water main break
- b. Cross connection event
- c. Drop in water pressure
- d. Malfunction of chlorine feed system
- e. Contamination of the source of water
- f. Tornadoes
- g. Floods
- h. Earthquakes

1.4 Risk Assessment Methodology

The risk evaluation method presented below was modified from the KDHE *Simplified Vulnerability Assessment Tool for Drinking Water*. This method was chosen because it places a numeric value to the risk of each element of the water system.

Risk:

The individual components of risk (R), the probability of an asset being at risk (P), the consequences to the supply of water if the threat to a asset is carried out (C), and the effectiveness of any deterrents that would mitigate the threat (E) are expressed in the equation below. The risk is simply the product of the components P, C, and E:

$$R = P \times C \times E$$

It should be emphasized that R represents relative risk. The goal of risk management should be to balance risk across the water system’s highest-ranking asset. By modifying the deterrent for each asset at risk, a greater effectiveness of control is asserted toward each system’s protection of potable water quality.

Factors for P, E, and C

Probability of this asset being at risk (P)

Low 1
to
High 5

Effectiveness of Deterrents (E)

Highly Effective 1
to
Ineffective 5

Consequence of Action (C)

Normal supply of safe water – all demands met	1
Adequate supply of safe water – all <i>emergency</i> demands met	2
Inadequate supply of safe water – parts of the system without water	3
No supply of safe water – only contaminated water available for fire fighting and sanitary needs	4
No water available – system shut down	5

Example 1 Master Meter

P = 1 C = 3 E = 1 R = 3 N/A

Comments: By convenience store

Explanation for this asset:

P = because of this asset’s location, it was considered a low probability

C = occurrence at this asset would eliminate water service to many customers

E = well lighted, high traffic area, with security camera

R = 3 is considered a relatively low risk

Example 2 Storage Tanks

P = 5	C = 3	E = 5	R = 75	N/A
-------	-------	-------	--------	-----

Comments: Elevated Tank

Explanation for this asset:

P = because of this assets remote location, it was considered a high probability

C = occurrence at this asset would eliminate service to many customers

E = no security measures, no effective deterrents in place

R = 75 is considered a very high risk

1.5 Summary of Distribution System “Plant D”

Plant D is a distribution system that purchases its water from a large wholesale supplier. It has been supplying water to its customers for approximately 30 years, and gains from 40 to 50 new customers a year. The manager of the water system completed the VA and submitted it to the EPA in June of 2004, as required by the regulations. He also updated the system’s ERP and submitted the certificate of completion to EPA in the fall of 2004. A SCADA (supervisor control and data acquisition) system was installed in 2003 at two pump houses and one controlling water tower. The water system has continued to expand its SCADA system, with plans to have the all of the system monitored within the next few years. A summary of the Plant D system is provided below.

1. Two 500,000 gallon ground storage vessels
2. Four 750 gpm high service pumps
3. Two 250 gpm booster pumps
4. Four elevated storage towers
5. 100 miles of distribution main ranging from 2 to 12 inches
6. 2500 customers
7. One office building
8. One maintenance building
9. Seven employees
10. Chlorine solution generated onsite using a MIOX system
11. Two potential interconnects
 - a. Interconnect #A
 - b. Interconnect #B
 - c. Two vaults
12. One Hot Box, backflow prevention assembly enclosure (customer owned)
13. Fire Hydrants
14. Meters
15. Computer System
16. SCADA monitoring 50% of system

Section 2

Findings of Field Evaluations

2.1 Results of Interview with System Manager (Day #1)

For the following nineteen items, ERTC assigned a value from 1 to 5 for the factors P,C, and E.

Note: An explanation of the factors used in completing the risk equations is presented again for the convenience of the reader. Modified from: *Simplified Vulnerability Assessment Tool for Drinking Water* (KDHE) as explained in Section 1.

P = probability of occurrence at this asset

C = consequences to the supply of water if the threat to this asset is carried out

E = the effectiveness of any deterrents that would mitigate the threat

R = individual components of risk

N/A = does not apply, put a X

1. Master Meter #1 _____

P = 1 C = 3 E = 1 R = 3 N/A

Comments:
By convenience store

2. Master Meter #2 _____

P = 1 C = 2 E = 3 R = 6 N/A

Comments:
Rural setting

3. Buildings _____

P = 1 C = 1 E = 1 R = 1 N/A

Comments:

4. Chemicals and Storage _____

P = 1 C = 1 E = 1 R = 1 N/A

Comments:

5. Storage Tanks _____

(Elevated)
P = 1 C = 3 E = 1 R = 3 N/A
(Ground)
P = 1 C = 3 E = 1 R = 3 N/A

Comments:
Elevated and Ground

6. Primary Power_____

P = 3	C = 3	E = 5	R = 45	N/A
-------	-------	-------	--------	-----

Comments:

7. Pumps_____

P = 3	C = 3	E = 4	R = 36	N/A
-------	-------	-------	--------	-----

Comments:

8. Pipes_____

Above ground:				
P = 1	C = 3	E = 1	R = 3	N/A
Below ground:				
P = 3	C = 3	E = 1	R = 9	N/A

Comments:
Above and below ground

9. Valves_____

Above ground:				
P = 1	C = 3	E = 1	R = 3	N/A
Below ground:				
P = 1	C = 3	E = 3	R = 9	N/A

Comments:
Above and below ground

10. Hydrants, flush_____

P = 3	C = 2	E = 4	R = 24	N/A
-------	-------	-------	--------	-----

Comments:

11. Other vulnerable points_____

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Comments:

12. Computers_____

P = 1	C = 1	E = 2	R = 2	N/A
-------	-------	-------	-------	-----

Comments:

13. Files_____

P = 1	C = 1	E = 2	R = 2	N/A
-------	-------	-------	-------	-----

Comments:

14. Transportation, work vehicles_____

P = 1	C = 1	E = 3	R = 3	N/A
-------	-------	-------	-------	-----

Comments:

15. Telephones_____

P = 1	C = 1	E = 1	R = 1	N/A
-------	-------	-------	-------	-----

Comments:

16. Cell phones_____

P = 1	C = 1	E = 1	R = 1	N/A
-------	-------	-------	-------	-----

Comments:

17. Radio_____

P = 1	C = 1	E = 1	R = 1	N/A
-------	-------	-------	-------	-----

Comments:

18. SCADA system_____

P = 1	C = 3	E = 1	R = 3	N/A
-------	-------	-------	-------	-----

Comments:

19. Schools_____

P = 1	C = 1	E = 1	R = 1	N/A
-------	-------	-------	-------	-----

Comments:

2.2 Results of Questionnaire Completed by System Manager (Day #1)

(Questionnaire based upon *Security Vulnerability Self-Assessment Guide for Small Water Systems*, NRW)

1. Is access to the critical components of the water system (i.e., a part of the physical infrastructure of the system that is essential for water flow and/or water quality) restricted to authorized personnel only.

Yes [x] No []
N/A []

Action Needed/Taken
“contract work overseen by administrators”

2. Are facilities fenced, including well houses and pump pits, and are locked where appropriate.

Yes [x] No []
N/A []

Action Needed/Taken

3. Are your doors, windows, and other points of entry such as tank and roof hatches and vents kept closed and locked.

Yes [x] No []
N/A []

Action Needed/Taken

4. Is there external lighting around critical components of your water system.

Yes No

N/A

Action Needed/Taken
“Critical areas are lighted “

5. Are warning signs (tampering, unauthorized access, etc.) posted on all critical components of your water system. For example, well houses and storage tanks.

Yes No

N/A

Action Needed/ Taken
Out of site, out of mind
Why advertise to public

6. Do you patrol and inspect your source intake, buildings, storage tanks, equipment, and other critical components.

Yes No

N/A

Action Needed/Taken

7. Is the area around the critical components of your water system free of objects that may be used for breaking and entering?

Yes No

N/A

Action Needed/Taken
Critical components are free
of objects

8. Are the entry points to your water system easily seen?

Yes No

N/A

Action Needed/Taken
All except tank #3, it is setting
in a wooded area that is somewhat
secluded

9. Do you have an alarm system that will detect unauthorized entry or attempted entry at critical components?

Yes No

N/A

Action Needed/Taken
50% SCADA monitored
office and maintenance shed
audible alarm,
neighborhood calls into sheriff

10. Do you have a key control and accountability policy for all locked water system facilities?

Yes No

N/A

Action Needed/Taken
Personnel only

11. Are your wellheads sealed properly?

Yes No

N/A

Action Needed/Taken

12. Are well vents and caps screened and securely attached?

Yes No

N/A

Action Needed/Taken

13. Are observation/test and abandoned wells properly secured to prevent tampering?

Yes No

N/A

Action Needed/Taken

14. Is your surface water source secured with fences or gates. Do water system personnel visit the source?

Yes No

N/A

Action Needed/Taken

15. Are deliveries of chemical and other supplies made in the presence of water system personnel?

Yes No

N/A

Action Needed/Taken Call before delivery is made

16. Have you discussed with your supplier(s) procedures to ensure the security of their products?

Yes No

N/A

Action Needed/Taken
Salt purchase only

17. Are chemicals, particularly those that are potentially hazardous or flammable, properly stored in a secure area?

Yes No

N/A

Action Needed/Taken

18. Do you monitor raw and treated water so that you can detect changes in water quality?

Yes No

N/A

Action Needed/Taken
On top of required sampling
Other measures are completed
as needed

19. Are tank ladders, access hatches, and entry points secured?

Yes No

N/A

Action Needed/Taken

20. Are vents and overflow pipes properly protected with screens and/or grates?

Yes No

N/A

Action Needed/Taken

21. Can you isolate the storage tank from the rest of the system?

Yes No

N/A

Action Needed/Taken

22. Do you control the use of all hydrants and valves?

Yes No

N/A

Action Needed/Taken

23. Does your system monitor for, and maintain, positive pressure?

Yes No

N/A

Action Needed/Taken

24. Are your personnel issued photo-identification?

Yes No

N/A

Action Needed/Taken
Looking into possibility of
Requiring photos

25. When terminating employment, do you require employees to turn in photo IDs, keys, access codes, and other security-related items?

Yes No

N/A

Action Needed/Taken

26. Do you use uniforms and vehicles with your water system prominently displayed?

Yes No

N/A

Action Needed/Taken

27. Have water system personnel been advised to report security vulnerability concerns and to report suspicious activity.

Yes No

N/A

Action Needed/Taken

28. Are vehicles locked and secured at all times.

Yes No

N/A

Action Needed/Taken
When necessary

29. Are maps, records, and other information stored in a secure location.

Yes No

N/A

Action Needed/Taken

30. Are copies of records, maps, and other sensitive information labeled confidential, and are all copies controlled and returned to the water system.

Yes No

N/A

Action Needed/Taken

31. Is there information on the Web that can be used to disrupt your system or help induce a contaminant into your water system?

Yes No

N/A

Action Needed/Taken

2.3 Results of Questionnaire Completed by the System Manager (Day #1)

(Questions developed by ERTC)

1. Do all of your distribution system meters have backflow prevention protection?

Yes No

Dual checks

N/A

Action Needed/Taken

2. Are your three (4) water storage vessels inspected periodically for:

Water quality

Proper operation

Vandalism

N/A

Action Needed/Taken

In addition, every 3-5 years engineers inspect tanks for paint, damage, and repair needed

3. Do you have some form of validation process for entering the water storage vessels?

Yes No

N/A

Action Needed/Taken

Personnel notifies office when working in storage tanks

4. Of your 2,500 water customers, how would they be categorized.

a. high hazard a. ___ "a few" _____

b. low hazard b. ___ "mostly" _____

c. what factors are used to determine a difference between high hazard and low hazard

N/A

Action Needed/Taken

By reviewing CCR, Also knowing what the water will be used for

5. Are materials located at your maintenance building protected from:

- a. vandalism [x]
- b. theft [x]
- c. weather [x]
- d. terrorism [x]

N/A []

Action Needed/Taken
Equipment inside shed
Pipe outside is not

6. How would you classify your water distribution system operators and employees?

- 1. Class A [x]
- 2. Class B []
- 3. Class C/D [x]
- 4. Office workers [x]

N/A []

Action Needed/Taken
Maintenance personnel are
Certified operators
Exceptions ; laborer

7. Do you incorporate the process of seasonal staffers with your billing?

Yes [] No [x]

N/A []

Action Needed/Taken

8. What type of backflow prevention do you require on lawn sprinkler systems?

RPZ [x]
Other []

N/A []

Action Needed/Taken

9. Does the District do its own water main taps?

Yes No

N/A

Action Needed/Taken

10. Does fire hydrant flushing incorporate other departments or people?

a. fire department

N/A

Action Needed/Taken

11. Are flush hydrants kept locked up?

Yes No

N/A

Action Needed/Taken

12. Is your computer software protected from outside intruders?

Yes No

N/A

Action Needed/Taken

13. Are passwords and virus protection periodically upgraded?

Yes No

N/A

Action Needed/Taken

14. Is there computer software for the backflow prevention program?

Yes No

N/A

Action Needed/Taken

15. Are all truck drivers that deliver chemicals to your plant properly checked out for correct identification, to include contents of truck?

Yes No

N/A

Action Needed/Taken

16. Are all residential above ground potable water sources protected and locked.
Example: Farmer has a "Hot Box" enclosure for his RPZ backflow prevention assembly?

Yes No

N/A

Action Needed/Taken

2.4 Results of in-depth discussion with System Manager (Day 2) Part 1

The checklist items 1-7 presented below include distribution system assets taken from the *Security Vulnerability Self-Assessment Guide for Small Water Systems* (NRWA).

1. Are facilities that house backflow prevention assemblies locked or resistant to tampering?

Yes No

N/A

Action Needed/Taken

2. Are warning signs (tampering, unauthorized access, etc.) posted on all critical components of your water system. (For example, Hot Box /backflow prevention outside enclosure)?

Yes No

N/A

Action Needed/Taken

We believe that advertising to the general public where our critical components are is not wise.

Out of site, out of mind.

3. Do you patrol and inspect your outside backflow prevention assembly enclosures?

Yes No

N/A

Action Needed/Taken

Daily

4. Is the area around the critical components of your outside backflow prevention assembly enclosure free of objects that may be used for breaking and entering?

Yes No

N/A

Action Needed/Taken

5. Are the entry points to your outside backflow prevention assembly easily seen? Can someone hide close to your outside backflow prevention enclosure and not be seen?

Yes No

N/A

Action Needed/Taken
Both,
One is in an urban setting
One is in a rural setting

6. Do you have a video camera or alarm system that will detect unauthorized entry or attempted entry at your outside backflow prevention enclosures?

Yes No

N/A

Action Needed/Taken
Both,
Entry alarm through the SCADA

7. Do you have a neighborhood watch program for your water system.

Yes No

N/A

Action Needed/Taken

2.5 Results of in-depth discussion with System Manager (Day 2) Part #2

The checklist items 1-21 were developed by ERTC from the Illinois Environmental Protection Agency (IEPA) Title 35 regulations.

1. Do you have a Cross Connection Control Program?

Yes No

N/A

Action Needed/Taken

2. Do you have a Cross Connection Control Program ordinance approved by the IEPA?

Yes No

N/A

Action Needed/Taken

3. What type of program do you have?

- a. isolation
- b. containment
- c. total protection

N/A

Action Needed/Taken Cisterns and wells isolated from Potable water system Dual check valves required on every service

4. Is your distribution system current with its requirement of biannual system surveying?

Yes No

N/A

Action Needed/Taken

5. How is the process of question number (4) carried out?

- Phone
- Mail
- Personal Visit

N/A

Action Needed/Taken
Ongoing, as people move in or new service line is installed a customer survey is conducted and put on file

6. Is a physical inspection required if the received survey is not completely filled out?

- Yes No

N/A

Action Needed/Taken

7. If a physical inspection is required, who is required to do the inspection?

- a. water operator
- b. plumber
- c. water operator/CCCDI
- d. plumber/CCCDI

N/A

Action Needed/Taken
IDPH, Plumbing inspector

8. Does your ordinance require a physical test of all testable backflow prevention assemblies upon installation and annually there after?

- Yes No

N/A

Action Needed/Taken

9. Do you require all backflow prevention testers (CCCDI) to be listed with your distribution department before work is done?

Yes No

N/A

Action Needed/Taken

10. Does your program have a policy requiring disconnection of the service if the backflow prevention assembly is not annually tested?

Yes No

N/A

Action Needed/Taken

11. Does your program have a policy that also requires a fee for reconnection of the service?

Yes No

N/A

Action needed/Taken

12. Does your Cross Connection Control Program have a set procedure for all new connections to the distribution system or change of ownership?

Yes No

N/A

Action Needed/Taken

13. Does your program take into account other sources of water that might be introduced during a fire situation?

Yes No

N/A

Action Needed/Taken

14. Does your program take into account that rural water system residents often have private well systems?

Yes No

N/A

Action Needed/Taken

15. Does your program take into account that water system customers may have lawn irrigation systems?

Yes No

N/A

Action Needed/Taken

16. Do you require any person who will be working in your distribution system to be acknowledged or permitted?

Yes No

N/A

Action Needed/Taken Licensed plumber on Permit and/or onsite
--

17. Does your Cross Connection Control program interact with other distribution system programs?
- a. valve location and exercise Yes No
- b. hydrant flushing, swabbing/pigging Yes No

N/A

Action Needed/Taken

18. In case of a loss of pressure or contamination, are your operators trained in proper sampling techniques and location.
- Yes No

N/A

Action Needed/Taken

19. Is proper notification of service connection customers completely understood by your distribution system employees?
- Yes No

N/A

Action Needed/Taken

20. Does your distribution system ERP take into account all measures needed?
- Yes No

N/A

Action Needed/Taken

21. Do you facilitate real time exercises regarding distribution system interruption or pressure loss due to intentional or unintentional situations?

Yes No

N/A

Action Needed/Taken

2.6 Results of in-depth discussion with System Manager (Day 2) Part 3

The risk evaluation method was modified from the KDHE Simplified *Vulnerability Assessment Tool for Drinking Water* as explained in Section 1.

For the following 22 items, ERTC assigned a value from 1 to 5 for the factors P,C, and E.

Note: An explanation of the factors used in completing the risk equations is presented again for the convenience of the reader.

P = probability of occurrence at this asset

C = consequences to the supply of water if the threat to this asset is carried out

E = the effectiveness of any deterrents that would mitigate the threat

R = individual components of risk

N/A = does not apply, put a X

1. Private wells

P = 1 C = 1 E = 1	R = 1	N/A
Action Needed/Taken		

2. Lawn irrigation systems

P = 1 C = 1 E = 1	R = 1	N/A
Action Needed/Taken		

3. Outside yard hydrants

P = 1 C = 1 E = 1	R = 1	N/A
Action Needed/Taken		

4. Outside personal fire hydrants

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

5. Fire trucks

P = 3	C = 3	E = 3	R = 27	N/A
-------	-------	-------	--------	-----

Action Needed/Taken

6. Internal Program Conflicts

a. distribution system hydrant flushing

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

b. collections system line flushing

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

c. cleaning out collection system vac. trucks

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

7. Auxiliary water system
a. bulk water station

P = 5	C = 1	E = 1	R = 5	N/A
-------	-------	-------	-------	-----

Action Needed/Taken

8. Residential home water softener

P = 4	C = 1	E = 1	R = 4	N/A
-------	-------	-------	-------	-----

Action Needed/Taken

9. Sewer rodding

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

10. Filling swimming pool---winter chemicals, stagnate water

P = 5	C = 1	E = 1	R = 5	N/A
-------	-------	-------	-------	-----

Action Needed/Taken

11. Feeding chlorine at plant

P = 1	C = 1	E = 1	R = 1	N/A
-------	-------	-------	-------	-----

Action Needed/Taken

12. Feeding other types of plant chemicals, etc.

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

13. Air gaps, are they installed correctly

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken Yes, they are installed correctly
--

14. Atmospheric Vacuum Breaker (AVB), are they installed correctly

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken Yes, they are installed correctly
--

15. Hydrant program,
a. are RPZ required and tested before hydrant is used

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

- b. are hydrants designated/permitted

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

16. Hot Boxes, outside enclosures for backflow prevention assemblies

- a. are the kept locked

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

17. Any pits or vaults, assemblies have test cocks or relief valves which can create a potential point of entry for contaminants

P = 1	C = 4	E = 1	R = 4	N/A
-------	-------	-------	-------	-----

Action Needed/Taken Master Meter

18. Any outside backflow prevention assembly enclosures without freeze protection

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

- a. any outside backflow prevention assemblies with landscape or poor drainage issues

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

19. RPZ assembly and its relationship to a drain

- a. flooding due to undersized drain, potential contamination

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

- b. alarm system for backflow prevention assembly discharge

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

- c. Is flooding alarm connected to a SCADA, caller ID

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

20. Fertilizer Plant Connections to Water

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

21. Water main breaks, unaccounted for water

P =	C =	E =	R =	N/A x
-----	-----	-----	-----	-------

Action Needed/Taken

22. Fire or Flush hydrants hit by vehicles

P = 1	C = 1	E = 1	R = 1	N/A
-------	-------	-------	-------	-----

Action Needed/Taken

Section 3

Distribution System Interruption Scenarios

3.1 Introduction

To further test the effectiveness of the water system's ERP, its manager was asked to address two distribution system interruption scenarios. The first scenario presents the manager with an incident of accidental contamination of the water system with agricultural chemicals. The second scenario is an act of a terrorist introducing a biological contaminant into the water system. This was a cognitive exercise designed to make the manager dust-off his ERP and use it to complete the *incident report forms* and *worksheets* provided to them by ERTC. The second benefit of working through the exercise was that the manager would realize the value of updating and upgrading his ERP and VA.

For each scenario, the manager was asked to complete two forms and a worksheet taken from the USEPA *Emergency Response Toolbox, Planning For and Responding to Drinking Water Contamination Threats and Incidents*. The forms and worksheets completed by the water system manager for each scenario, are listed below along with their corresponding section numbers where they can be found in the EPA document.

Security Incident Report Form, Section 2.4 of USEPA *Emergency Response Toolbox*

Site Characterization Report Form, Section 3.6 of USEPA *Emergency Response Toolbox*

Public Health Response Action Worksheet, Section 5.4 of USEPA *Emergency Response Toolbox*

The organization of Section 3 of this report is as follows:

Section 3.2 Presentation of Scenario #1 and response by the water system personnel

Section 3.2.1 Security Incident Report Form for Scenario #1 completed by the system manager

Section 3.2.2 Site Characterization Report Form for Scenario #1 completed by the system manager

Section 3.2.3 Public Health Response Action Worksheet for Scenario #1 completed by the system manager

Section 3.3 Presentation of Scenario #2 and response by the water system personnel

Section 3.3.1 Security Incident Report Form for Scenario #2 completed by the system manager

Section 3.3.2 Site Characterization Report Form for Scenario #2 completed by the system manager

Section 3.3.3 Public Health Response Action Worksheet for Scenario #2 completed by the system manager

3.2 Distribution System Interruption Scenario #1

Condition:

*Unintentional contamination of a portion of the distribution system.
(To complete this task, use attached report forms and action worksheet)*

Scenario:

**A storm occurs and power to your high service pumps is lost.
At the same time that power is lost, a car hits a flushing hydrant.**

Due to storage in your water tower, system pressure is maintained for short period. As time passes, system pressure drops below 20 psi.

While this occurs, chemicals from a fertilizer plant backflow into the distribution system.

Chemicals in the system are:

- a. alachlor
- b. atrazine

Using your ERP, explain the steps needed to restore power, fix the flush hydrant, remove the chemicals from your distribution system and notify the public.

C = 3 P = 5 E = 5 R = 75 N/A

Action Needed / Taken	(Completed by Water System Manager)
1.	System wide boil order issued by way of radio, TV, hand delivery, phone, doorknockers, and by word of mouth
2.	Assuming there is a generator, begin emergency operating plan, to get the high service pumps up and running to re-pressurize the distribution system.
3.	Dispatch the maintenance crew for repairs to the damaged flush hydrant
4.	Issue a Do Not Drink order by way of media, word of mouth, phone, doorknockers.
5.	Contact fertilizer plant to verify any sudden loss of product and if so what product is missing. Get MSDS sheets for the possible missing product.
6.	Once missing product is verified by fertilizer plant, notify IEPA of situation.
7.	Try to isolate the effected area, either by shutting down valves in the distribution system or by flushing water in a one-way direction.
8.	Contact bottling plants for drinking water source for those affected.
9.	Begin sampling upstream and down stream for chemical analysis from the area calling in the unusual odor.
10.	Once samples are normal and upon the approval of the IEPA, remove the DO NOT Drink order.

3.2.1 Completed Security Incident Report Form for Scenario #1
(Transcribed from forms completed by the System Operator)

3.2.2 Site Characterization Report Form for Scenario #1
(Transcribed from forms completed by the System Operator)

3.2.3 Public Health Response Action Worksheet for Scenario #1
(Transcribed from forms completed by the System Operator)

3.3 Distribution System Interruption Scenario #2

Condition:

Intentional contamination of a portion of the distribution system.

(To complete this task, use attached report forms and action worksheet)

Scenario:

A saboteur rents a farmhouse.

The individual then removes the dual check from the house meter yoke. The individual then takes two, 55-gallon barrels of biological material, and using two small PD pumps, injects the contents into your distribution system.

Biological contaminants injected into the system are:

- a. pseudomonas bacteria
- b. fecal coliform bacteria

He then leaves the farmhouse.

Several days later, a number of people on the same line become ill.

Using your ERP, explain what needs to be done in order to reduce the possibility of more people getting ill. How other distribution service customers will be notified. Finally, explain what needs to be done to reconcile this problem.

C = 2	P = 3	E = 3	R = 18	N/A
C = 4	P = 5	E = 5	R = 100	N/A

Action Needed / Taken (Completed by Water System Manager)

1. Increase chlorine levels to at least 2.0 mg/l free chlorine residual in the distribution system.
2. Notify residences of the possible contamination and issue a Do Not Drink order until further notice. Contact residences by means of doorknockers, house-to-house notification, word of mouth, and the media. (When contacting the media, give a press release stating public input as to any suspicious activities noted in what area, and possible dates; this might bring the person(s) out in the open or at least make them move out of the area).
3. Contact IEPA, IDPH; contact local lab for use of sampling, around the clock monitoring, Sheriffs Office, and Water Bottling plants (for drinking water to be made available to residences affected).
4. Sampling at affected homes including upstream and down stream
5. Begin heavy flushing to ensure a positive route for contaminants to exit the distribution system.
6. Continue monitoring samples every 24 hours until no positive are shown for at least two consecutive samples 24 hours apart.
7. Upon IEPA approval, remove the Do Not Drink order and resume normal operation.

3.3.1 Completed Security Incident Report Form for Scenario #2
(Transcribed from forms completed by the System Operator)

3.3.2 Site Characterization Report Form for Scenario #2
(Transcribed from forms completed by the System Operator)

3.3.3 Public Health Response Action Worksheet for Scenario #2
(Transcribed from forms completed by the System Operator)

Section 4

SUMMARY, RECOMMENDATIONS, and CONCLUSIONS

4.1 Summary

Three ERTC personnel performed the evaluation of the VA and ERP at “Plant D” during December of 2005. The evaluation was performed in three parts: initial visit; follow-up visit; and the system manager’s response to the two water system interruption scenarios. To assess the VAs and ERPs at the water system, ERTC developed an evaluation method based upon protocol developed by the U.S. EPA, the Kansas Department of Health and Environment (KDHE), and the National Rural Water Association (NRWA). Using a risk assessment method modified from the KDHE method, allowed ERTC to evaluate existing deterrents in the water system while at the same time determining which elements of the system are at greatest risk.

All areas of the system were evaluated for risk. Using the evaluation results, ERTC ranked specific elements of the system with the highest risk, based upon their numeric risk value. The water system management should make it the highest priority to work toward reducing the risk to the element with the high-risk values. The elements of the water system with the highest risk values are ranked and presented below:

1. Electrical Power (45)
2. Fire Truck Connection to Hydrants (27)
3. Flush Hydrants (24)

ERTC also used general questions from the Section 1 of the NRWA Vulnerability Self-Assessment for Small Water Systems to further review the areas of greatest concern related to protection of the potable water supply. Areas in the distribution system that had already been protected in a positive manner were also noted. Listed below are the portions of the system that should be considered for upgrade.

1. The water system does not have a backup power supply to operate any of its three pump houses creating a risk value of 45. This value is relatively high because all equipment in the pump houses is powered by electricity. Electrical powered equipment at each pump house includes the pumps, chlorine generation system, and chlorination injection pumps, which are necessary for the safe and proper operation of the water system.
2. Allowing fire trucks free access to fire hydrants creates a risk value of 27. The value is relatively high due to the potential risks associated with the possibility of chemical (fire retardants and foaming agents) and biological (bacteria) contaminants being present in fire truck tanks. There is also a potential for the fire truck pumps to exceed the capacity of the water flow in the distribution mains, resulting in a vacuum that could create a backflow condition with the potential for contamination of the potable water supply. This risk is an inherent problem with the use of potable water in firefighting.

3. Flush hydrants are located at water main termination points creates a risk value of 24. The value is relatively high because of the remote locations of the hydrants.
4. Fifty percent of the “Plant D” system is monitored by SCADA. The system manager stated that as his budget allows he will be continuing to upgrade and expand his SCADA system. The ERTC staff agrees that any additional on-line monitoring through the SCADA system would be beneficial, especially when considering the size of the system.
5. The management of the water system believes that the posting of warning signs would attract vandals and curiosity seekers to who might try to enter the secure zones. The ERTC staff believes that the signage could be a deterrent if posted in the proper places.
6. The management of the system recognizes the need for all personnel working in their system to be easily identified. They plan to remedy this situation in the near future by issuing photo IDs.
7. The management of “Plant D” recognizes that certain matters related to the water distribution system are proprietary. There are no plans to supply information on a website that would compromise the security of the potable water system.
8. The pipe storage yard is not secured by any fence or other deterrent. The pipe storage yard is accessible to vehicular and pedestrian traffic.
9. Dual check valves on all the meter installations are a very strong deterrent to the potential for either intentional or unintentional contamination of the distribution system. The installation of the dual check valves at all meter settings was performed by the water system over ten years ago. This action is evident of a pro-active and forward thinking management.
10. Periodic inspections of the water towers and ground storage tanks should be scheduled as a significant deterrent to intentional/unintentional threat to the water quality of the system.
11. High hazard areas in the distribution system should always take a high priority by way of periodic review. It only takes a small amount of certain chemicals to create a very big problem in the potable water system.
12. Seasonal bill stuffers in the water bills should be considered as a method of informing the customer of possible unintentional system contamination through cross connection violations. Spring is an opportune time of year, since people are active out of doors filling swimming pools and using hand held chemical spray bottles.
13. Computer Software might be considered for your annual backflow prevention assembly testing requirements. These programs are now capable of doing a variety of other duties such as scheduling water quality monitoring, hydrant flushing, flow testing, and valve exercising.

4.2 Water System Interruption Scenarios

The water system manager was provided with two water system interruption scenarios to address. The first scenario presents the manager with an incident of accidental contamination of the water system with agricultural chemicals. The second scenario is an act of a terrorist introducing a biological contaminant into the water system. This was a cognitive exercise designed to make the manager dust-off his ERP and use it to complete the *incident report forms* and *worksheets* provided to them by ERTC. The second benefit of working through the exercise was that the manager would realize the value of updating and upgrading his ERP and VA

In an interview subsequent to the completion of the system interruption scenario *incident report forms* and *worksheets*, he stated that exercise was very worthwhile and made him realize the value of maintaining a current VA and ERP.

4.3 Recommendations to the System Manager

The following recommendations have been compiled by the ERTC evaluation staff to aid the water system manager in upgrading his facility to avoid possible contamination of the potable water supply. The review committee also noted elements of the water system that had already been protected. The recommendations are based on the evaluation of the VA prepared by the water system using the NRWA Vulnerability Self-Assessment Guidelines. The Kansas Department of Health and Environment (Bureau of Water) *Simplified Vulnerability Assessment Tool for Drinking Water* was used as a tool to evaluate the VA.

1. Backup Power Supply:
The installation of a backup power supply is recommended to ensure an uninterrupted supply of safe, reliable drinking water.
2. Fire Trucks:
Allowing fire trucks free access to fire hydrants is a relatively high risk. The potential risks are associated with the possibility of fire retardants and contaminated water being present in fire truck tanks. There is also a potential for the fire truck pumps to exceed the capacity of the water flow in the distribution mains, resulting in a vacuum that could create a backflow condition with the potential for contamination of the potable water supply. It is recommended that water system personnel be present when fire trucks are using water from hydrants.
3. Warning Signs:
Warning and *Do Not Enter* signs should be posted at secure areas such as pumphouses and storage tanks.

4. **System Visibility:**
Any element of the water system located in a rural setting is at a relatively high risk. If possible, brush and trees should be removed from the site to make it more visible to the neighbors, local traffic, and law enforcement officials.
5. **Pipe Storage Yard Security:**
Securing the pipe storage yard with a fence that would restrict access to authorized personnel is recommended. There is a high potential for the pipe in currently unsecured storage area to be tampered with, causing damage and contamination of the water supply.
6. **Intruder Alert:**
“Plant D” is not manned and monitored on 24 hour a day basis, providing an opportunity for intruders during off-duty hours. The three pump houses have intruder alarms that have not been connected to the SCADA system. It is recommended that the intruder alarms be connected to the SCADA system and the automatic dialer to alert the on-call staff when unauthorized personnel enter the buildings.
7. **SCADA System Upgrade:**
It is highly recommended that the water system continue with its planned upgrade and expansion of its SCADA system. The utilization of a SCADA system is the most efficient method to monitor a large water distribution system.
8. **Cross Connection Control Program:**
The water system uses isolation and containment (dual check valves on all the meter installations) as part of their Cross Connection Control Program. This is a very reliable method of providing redundant protection of the potable water system. It is recommended that the water system continue with its current CCC program
9. **Back Flow Device Inspection:**
A physical inspection of back flow prevention devices such as RPZs and dual check valves should be required by the water system.
10. **Back Flow Device Inspection**
A licensed plumber who is also a certified Cross Connection Control Device Inspector (CCCDI) should perform all inspections of backflow devices.
11. **List of Registered Contractors:**
It is recommended that all people who will be working in the distribution system register with the water system in some manner. A list of CCCDI professionals should be kept at the office and provided to water customers who are in need of their services.
12. **Lawn Irrigation System:**
The water system should continue to ensure that all customers with a lawn irrigation system install and maintain the required back flow device such as RPZs and dual check valves.

4.4 Conclusions

It is our conclusion that “Plant D” is a very well managed water distribution system. It has a Cross Connection Control Program (CCCP) that is up to date and well documented. The ERTC evaluation team has made a few recommendations to improve the CCCP.

The water system has done a very good job of using its limited manpower and resources to help create and upgrade deterrents to intentional and/or unintentional situations that may lead to contamination of the public water supply. However, ERTC recommends a few upgrades to the security system along with continuing the planned upgrade of the SCADA system. Also strongly recommended is the installation of a backup power supply to operate the pumps during the inevitable electrical outage.

The VA and ERP prepared by the water system were adequate and met all the requirements. However, there were a few discrepancies found between the VA prepared by the water system and the one prepared by ERTC evaluation staff. It was evident that few, if any, of the security issues identified in the VA have been addressed. It is our belief that after the original VA was prepared and forwarded to U.S. EPA, a copy was placed into a file cabinet and not looked at again until a day or two before the ERTC visit. This is typical human behavior, for the manager who uses all of his work time addressing the daily responsibilities of running the water system, while placing the VA out-of-site and out-of-mind. To alleviate the problem of the out-of-site-out-of-mind VA, it is recommended that all of the subject water systems perform some type of periodic update of the VA.

References:

Emergency Response Protocol Toolbox

U.S. Environmental Protection Agency

www.epa.gov/safewater/watersecurity/pubs/rptb_response_guidelines.pdf

Simplified Vulnerability Assessment Tool for Drinking Water

Kansas Department of Health and Environment.

www.kdheks.gov/water/security.html

[Click on KDHE Simplified Vulnerability Analysis](#)

Security Vulnerability Self-Assessment Guide for Small Drinking Water Systems

National Rural Water Association

www.ilrwa.org

[Click on Security, then click on Water Vulnerability Assessment](#)

Title 35, Environmental Protection, Rules and Regulations of the State of Illinois

Subtitle F: Public Water Supplies

Chapter I: Pollution Control Board

Section 607.104 Cross Connection

Chapter II: Environmental Protection Agency

Section 653.801 Cross Connection Control Program

Section 653.802 Specified Conditions and Installation Procedures

Section 653.803 Cross Connection Control Devices

Section 653.804 Heat Exchange Cross Connections

Section 653.805 Fire Protection

Illinois Pollution Control Board/Illinois Environmental Protection Agency

www.ipcb.state.il.us/SLR/IPCB and [IEPA Environmental Regulations - Title 35.asp](#)