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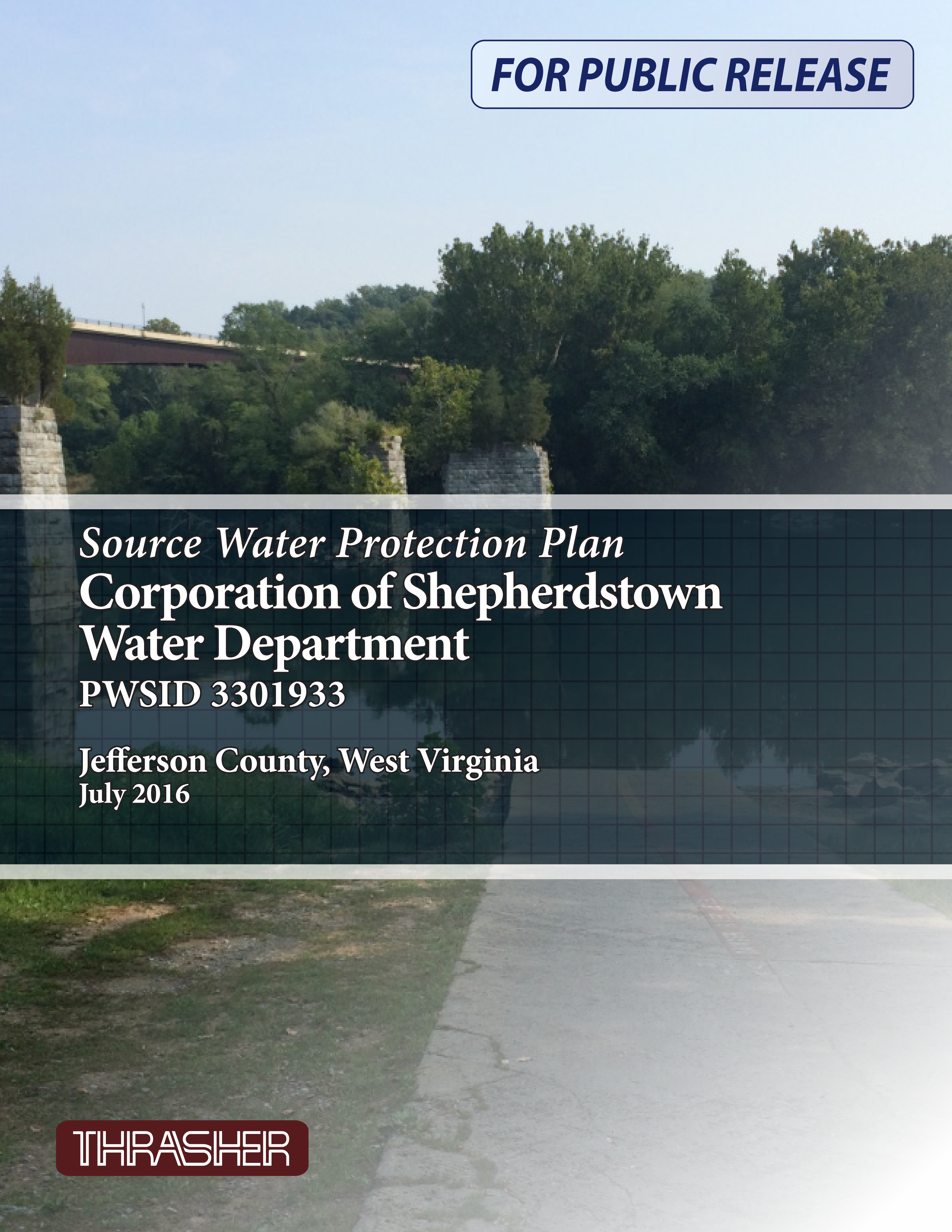

Source Water Protection Plan

Corporation of Shepherdstown Water Department

PWSID 3301933

Jefferson County, West Virginia

July 2016

THRASHER

SOURCE WATER PROTECTION PLAN
FOR THE
CORPORATION OF SHEPHERDSTOWN
PWSID No. WV3301933

Prepared By:

Project Engineer

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I certify the information in this Source Water Protection Plan is complete and accurate to the best of my knowledge.

Authorizing Signatory:

Frank Welch ______________________ 6/28/2016 ______

Frank Welch
Public Works Director

Date

____
Date of Submission

Funding By:

Office of Environmental Health Services
West Virginia Department of Health and Human Resources

THRASHER PROJECT No. 101-010-1046.805

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EXECUTIVE SUMMARY

The Corporation of Shepherdstown Water Department (Shepherdstown) has developed this Source Water Assessment and Protection (SWAP) Program to assess, preserve, and protect the raw water source used to for their Public drinking Water Supply System (PWSS) and to provide long term availability of an abundant supply of safe water in sufficient quantity for present and future citizens of Shepherdstown and surrounding areas of Jefferson County, West Virginia.

This water system treats water to meet federal and state drinking water standards, conventional treatment does not fully eradicate all potential contaminants but conventional methods are often very expensive. This SWAPP describes Shepherdstown's efforts and proposals to protect its source of drinking water in accordance with Safe Drinking Water Act (SDWA) standards and all code changes specific to PWSS's utilizing surface water sources or surface water influenced groundwater sources.

Under the amended and new codes, each existing public water utility using surface water or ground water influenced by surface water as a source must have completed or updated a source water protection plan by July 1, 2016, and must continue to update their plan every three years. New plans are also required when there is a significant change in the Potential Sources of Significant Contamination (PSSC) within the Zone of Critical Concern (ZCC). The code also requires that public water utilities include details regarding PSSCs, protection measures, system capacities, contingency plans, and communication plans.

Shepherdstown's water treatment facility obtains surface water from the Potomac River for treatment. The plant has a treatment capacity of 1,000,000 gallons per day (GPD) and pumps approximately fourteen (14) hours per day producing an average of 636,400 GPD. Shepherdstown maintains two (2) elevated treated water storage tanks totaling 1,400,000 gallons and does not retain any raw water storage. Currently, the water system is experiencing 37% unaccounted for water and water lost from main leaks; however, the utility is conducting leak detection and making necessary repairs to reduce unaccounted for water. Shepherdstown currently does not have a generator, consequently the utility does not operate during power outages.

The primary requirements for Shepherdstown's PWSS SWAPP are as follows:

- Delineate of the Source Water Protection area, based on a five hour travel time to the intake,
- Develop and inventory the confidential, local and regional potential contamination sources,
- Determine of the PWSS's susceptibility to contamination,
- Make the assessment available to the public in the form of management strategies, education, and outreach strategies and
- Organize a protection team involving public stakeholders, such as representatives from emergency services, local health department, etc.
- Develop a contingency plan, identifying options available to the utility to detect and react to short and/or long term water interruption, or incidents of spill or contamination

PURPOSE

The goal of the West Virginia Bureau for Public Health (WV BPH) source water assessment and protection (SWAP) program is to prevent degradation of source waters which may preclude present and future uses of drinking water supplies to provide safe water in sufficient quantity to users. The most efficient way to accomplish this goal is to encourage and oversee source water protection on a local level. Every aspect of source water protection is best addressed by engaging local stakeholders.

The intent of this document is to describe what Shepherdstown has done, is currently doing, and plans to do to protect its source of drinking water. Although this water system treats the water to meet federal and state drinking water standards, conventional treatment does not fully eradicate all potential contaminants, and treatment that goes beyond conventional methods is often very expensive. By completing this plan, Shepherdstown acknowledges that implementing measures to prevent contamination can be a relatively economical way to help ensure the safety of the drinking water.

What are the benefits of preparing a Source Water Protection Plan?

- Fulfills the requirement for public water utilities to complete or update their source water protection plan.
- Identifies and prioritizes potential threats to the source of drinking water; and establishes strategies to minimize the threats.
- Plans for emergency responses to incidents that compromise the water supply by contamination or depletion, including how the public, state, and local agencies will be informed.
- Plans for future expansion and development, including establishing secondary sources of water.

- Ensures conditions to provide the safest and highest quality drinking water to customers at the lowest possible cost.
- Provides more opportunities for funding to improve infrastructure, purchase land in the protection area, and other improvements to the intake or source water protection areas.

BACKGROUND: WV Source Water Assessment and Protection Program

Since 1974, the federal Safe Drinking Water Act (SDWA) has set minimum standards on the construction, operation, and quality of water provided by public water systems. In 1986, Congress amended the SDWA. A portion of those amendments was designed to protect the source water contribution areas around groundwater supply wells. This program eventually became known as the Wellhead Protection Program (WHPP). The purpose of the WHPP is to prevent pollution of the source water supplying the wells.

The Safe Drinking Water Act Amendments of 1996 expanded the concept of wellhead protection to include surface water sources under the umbrella term of "Source Water Protection". The amendments encourage states to establish SWAP programs to protect all public drinking water supplies. As part of this initiative, states must explain how protection areas for each public water system will be delineated, how potential contaminant sources will be inventoried, and how susceptibility ratings will be established.

In 1999, the WVBPH published the West Virginia Source Water Assessment and Protection Program, which was endorsed by the United States Environmental Protection Agency. Over the next few years, WVBPH staff completed an assessment (i.e., delineation, inventory and susceptibility analysis) for all of West Virginia's public water systems. Each public water system was sent a copy of its assessment report. Information regarding assessment reports for Shepherdstown can be found in **Table 1**.

STATE REGULATORY REQUIREMENTS

On June 6, 2014, §16.1.2 and §16.1.9a of the Code of West Virginia (1931) was reenacted and amended by adding three new sections designated §16.1.9c, §16.1.9d and §16.1.9e. The changes to the code outline specific requirements for public water utilities that draw water from a surface water source or a groundwater source influenced by surface water.

Under the amended and new codes, each existing public water utility using surface water or ground water influenced by surface water as a source must have completed or updated a source water protection plan by July 1, 2016, and must continue to update the plan every three years. Existing source water protection plans have been developed for many public water utilities in the past. If available, these plans were reviewed and considered in the development of this updated plan. Any new water system established after July 1, 2016 must submit a source water protection plan before they begin operation. A new plan is also required when there is a significant change in the Potential Sources of Significant Contamination (PSSC) within the Zone of Critical Concern (ZCC).

The code also requires that public water utilities include details regarding PSSCs, protection measures, system capacities, contingency plans, and communication plans. Before a plan can be approved, the local health department and public will be invited to contribute information for consideration. In some instances, public water utilities may be asked to conduct independent studies of the source water protection area and specific threats to gain additional information.

SYSTEM INFORMATION

The Shepherdstown Water Department is classified as a state regulated public utility and operates a public water system serving the Corporation of Shepherdstown and surrounding areas of Jefferson County, West Virginia. A public water system is defined as:

> *"Any water supply or system which regularly supplies or offers to supply water for human consumption through pipes or other constructed conveyance, if serving at least an average of twenty-five individuals per day for at least sixty days per year, or which has at least fifteen service connections, and shall include:*
>
> *i. Any collection, treatment, storage and distribution facilities under the control of the owner or operator of the system and used primarily in connection with the system*
>
> *ii. Any collection or pretreatment storage facilities not under such control which are used primarily in connection with the system."*

A public water utility is defined as, "any public water system which is regulated by the West Virginia Public Service Commission."

For purposes of this source water protection plan, public water systems are also referred to as public water utilities. Information on the population served by this utility is presented in **Table 1** on the following page.

Table 1. System Information

<table>
<tr><td>Administrative office location:</td><td colspan="3">104 North King Street
Shepherdstown, WV 25443</td></tr>
<tr><td>Is the system a public utility, according to the Public Service Commission rule?</td><td colspan="3">Public Utility
Municipality</td></tr>
<tr><td>Date of Most Recent Source Water Assessment Report:</td><td colspan="3">November 2004</td></tr>
<tr><td>Date of Most Recent Source Water Protection Plan:</td><td colspan="3">February 2011</td></tr>
<tr><td rowspan="2">Population served directly:</td><td colspan="2">Customers</td><td>Total Population</td></tr>
<tr><td colspan="2">Residential 1,493
Commercial 134
Industrial
Public Authorities 45
Total 1,672</td><td>4,000</td></tr>
<tr><td rowspan="2">Bulk Water Purchaser Systems:</td><td>System Name</td><td>PWSID Number</td><td>Population</td></tr>
<tr><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Total Population Served by the Utility:</td><td colspan="3">4,000</td></tr>
<tr><td>Does the utility have multiple source water protection areas (SWPAs)?</td><td colspan="3">Yes</td></tr>
<tr><td>How many SWPAs does the utility have?</td><td colspan="3">2</td></tr>
</table>

WATER TREATMENT AND STORAGE

As required, Shepherdstown has assessed their system (e.g., treatment capacity, storage capacity, unaccounted for water, contingency plans) to evaluate their ability to provide drinking water and protect public health.

Table 2 contains information on the water treatment methods and capacity of the utility. Information about the surface water sources from which Shepherdstown draws water can be found in **Table 3**. If the utility draws water from any groundwater sources to blend with the surface water, the information about these ground water sources can be found in **Table 4**.

Table 2. Water Treatment Information

Water Treatment Process (List in order)	Raw Water Intake ↓ Aeration ↓ Ferric, Hydrogen Peroxide & DelPac ↓ Flash Mixing ↓ Flocculation ↓ Sedimentation ↓ Mixed Media Filters ↓ Chlorination & Fluoridation ↓ Clear Well ↓ High Service Pumps ↓ Distribution System
Current Treatment Capacity (GPD)	1,000,000
Current Average Production (GPD)	636,400
Maximum Quantity Treated and Produced (GPD)	1,117,400
Minimum Quantity Treated and Produced (GPD)	269,900
Average Hours of Operation in One Day	14
Maximum Hours of Operation in One Day	24
Minimum Hours of Operation in One Day	6
Number of Storage Tanks Maintained	2
Total Gallons of Treated Water Storage (gal.)	1,400,000
Total Gallons of Raw Water Storage (gal.)	0

Table 3. Surface Water Sources

Intake Name	SDWIS #	Local Name	Describe Intake	Name of Water Source	Date Constructed/ Modified	Frequency of Use (Primary/ Backup/ Emergency)	Activity Status (Active/ Inactive)
River Intake	IN001	N/A	Perforated pipe (16”) which gravity flows through screen into raw water pump station.	Potomac River	1974 *(C)* 2004 *(M)*	Primary	Active
Town Run	IN002	Town Run		Town Run		Backup	Active

Table 4. Ground Water Sources

Does the utility blend with groundwater?	No

(C) – Constructed
(M) - Modified

DELINIATIONS

For surface water systems, delineation is the process used to identify and map the drainage basin that supplies water to a surface water intake. This area is generally referred to as the Source Water Protection Area (SWPA). All surface waters are susceptible to contamination because they are exposed at the surface and lack a protective barrier from contamination. Accidental spills, releases, sudden precipitation events that result in overland runoff, or storm sewer discharges can allow pollutants to readily enter the source water and potentially contaminate the drinking water at the intake. The SWPA for surface water is distinguished as a Watershed Delineation Area (WSDA) for planning purposes; and the Zone of Peripheral Concern (ZPC) and Zone of Critical Concern (ZCC) are defined for regulatory purposes.

The WSDA includes the entire watershed area upstream of the intake to the boundary of the State of West Virginia border or a topographic boundary. The ZCC for a public surface water supply is a corridor along streams within the watershed that warrants more detailed scrutiny due to its proximity to the surface water intake and the intake's susceptibility to potential contaminants within that corridor. The ZCC is determined using a mathematical model that accounts for stream flows, gradient and area topography. The limits of the ZCC are based on a five-hour time-of-travel of water in the streams to the water intake, plus an additional one-quarter mile below the water intake. The width of the ZCC is 1,000 feet measured horizontally from each bank of the principal stream and five hundred feet measured horizontally from each bank of the tributaries draining into the principal stream. Ohio River ZCC delineations are based on ORSANCO guidance and extend 25 miles above the intake and one-quarter mile below the intake. The Ohio River ZCC delineations include 1,320 feet (one-quarter mile) measured from the bank of the main stem of the Ohio River and 500 feet on tributary.

The ZPC for a public surface water supply source and for a public surface water influenced groundwater supply source is a corridor along streams within a watershed that warrants scrutiny due to its proximity to the surface water intake and the intake's susceptibility to potential contaminants within that corridor. The ZPC is determined using a mathematical model that accounts for stream flows, gradient and area topography. The length of the zone of peripheral concern is based on an additional five-hour time-of-travel of water in the streams beyond the perimeter of the ZCC, which creates a protection zone of ten hours above the water intake. The width of the zone of peripheral concern is 1,000 feet measured horizontally from each bank of the principal stream and 500 feet measured horizontally from each bank of the tributaries draining into the principal stream.

For groundwater supplies there are two types of SWPA delineations: 1) wellhead delineations and 2) conjunctive delineations, which are developed for supplies identified as groundwater under the direct influence of surface water. A wellhead protection area is determined to be the area contributing to the recharge of the groundwater source (well or spring), within a five year time of travel. A conjunctive delineation combines a wellhead protection area for the hydrogeological recharge and a connected surface area contributing to the wellhead.

Information and maps of the WSDA, ZCC, ZPC and Wellhead Protection Area for this public water supply were provided to the utility and are attached to this report. See **Appendix A**. Other information about the WSDA is shown in **Table 5**.

Table 5. Watershed Delineation

Size of WSDA (mi.^{2})	5,956
River Watershed Name (8-digit HUC)	South Branch Potomac (02070001) North Branch Potomac (02070002) Cacapon-Town (02070003) Conococheague-Opequon (02070004)
Size of Zone of Critical Concern (ac.)	5,484
Size of Zone of Peripheral Concern (ac.)	13,765

Additionally, the Instate Commission on the Potomac River Basin utilizes Emergency River Spill Model (ERSM) to estimate the movement of spills along the Potomac River. The model was developed based on dye studies conducted by the U.S. Geological Survey. More information regarding the ERSM is included in **Appendix D**. Information is also available at *www.potomacriver.org*.

PROTECTION TEAM

One important step in preparing a source water protection plan is to organize a source water protection team who will help develop and implement the plan. The legislative rule requires that water utilities make every effort to inform and engage the public, local government, local emergency planners, the local health department and affected residents at all levels of the development of the protection plan. The West Virginia Bureau for Public Health (WVBPH) recommends that the water utility invite representatives from these organizations to join the protection team, which will ensure that they are given an opportunity to contribute in all aspects of source water protection plan development. Public water utilities should document their efforts to engage representatives and provide an explanation if any local stakeholder is unable to participate. In addition, other local stakeholders may be invited to participate on the team or contribute information to be considered. These individuals may be emergency response personnel, local decision makers, business and industry representatives, those who own land in the protection area, and additional concerned citizens.

The administrative contact for Shepherdstown is responsible for assembling the protection team and ensuring that members are provided the opportunity to contribute to the development of the plan. The acting members of the protection team are listed in **Table 6**.

The role of the protection team members will be to contribute information to the development of the source water protection plan, review draft plans, and make recommendations to ensure accuracy and completeness, and when possible, contribute to implementation and maintenance of the protection plan. The protection team members are chosen as trusted representatives of the community served by the water utility and may be designated to access confidential data that contains details about the local PSSCs. The input of the protection team will be carefully considered by the water utility when making final decisions relative to the documentation and implementation of the source water protection plan.

Shepherdstown will be responsible for updating their Source Water Protection Plan and rely upon input from the protection team and the public to better inform their decisions. To find out how you can become involved as a participant or contributor, visit the utility website or call the utility phone number, which are provided in **Table 6**.

Table 6. Protection Team

Name	Representing	Title	Phone Number	Email
Jerry Bock	Shepherdstown Water	Board Member	304-283-8338	jerrybock@comcast.net
Monica Whyte	West Virginia Bureau for Public Health	Environmental Resource Specialist Iii	304-725-9453	Monica.a.whyte@wv.gov
Lori Robertson	Corporation of Shepherdstown	Recorder	540-336-4737	Lahraven@comcast.net
Amy Boyd	Shepherdstown	Town Clerk	304-876-2398	clerk@shepherdstown.us
Frank Welch	Shepherdstown	Public Works Director	304-876-2394	Fwelch@shepherdstown.us
Charles "Woody" Coe III	Shepherdstown	Chief Water Operator	304-876-2394	ccoe@shepherdstown.us
Jim Auxer	Corporation of Shepherdstown			
Date of first protection Team Meeting		April 26, 2016		
Efforts to engage local stakeholders and explain absence of required stakeholders:		Shepherdstown Water participated in the Safe Water for West Virginia forum hosted by the West Virginia Rivers Coalition on May 12, 2016. John Brady, Shepherdstown Water and Sewer Board member, was also invited to participate on the protection team, but was unable to attend the April 26 protection team meeting.		

POTENTIAL SIGNIFICANT SOURCES OF CONTAMINATION

This Source Water Protection Plan provides a complete and comprehensive list of the Potential Sources of Significant Contamination (PSSCs) contained within the Source Water Protection Area (SWPA), based on information obtained from the West Virginia Department of Environmental Protection (WVDEP), the WVBPH, and the West Virginia Division of Homeland Security and Emergency Management (WVDHSEM). Additionally, consultants completed a review of aerial imagery and sought information from the protection team to identify PSSCs not contained in the databases provided by the agencies listed above and to confirm the accuracy of these databases. A facility or activity is listed as a PSSC if it has the potential to release a contaminant that could impact a nearby public water supply. It does not necessarily indicate that a release has occurred.

WVBPH provided a database of PSSCs located in the Shepherdstown SWPA. These data are organized into two types, SWAP PSSCs and Regulated Data. SWAP PSSCs are those that have been collected and verified by the WVBPH SWAP program during previous field investigations to form source water assessment reports and source water protection plans. Regulated PSSCs are derived from federal and state regulated databases, and may include data from WVDEP, US Environmental Protection Agency, WVDHSEM, and from out of state data sources. A list of PSSCs found in WVBPH databases can be found in **Appendix A**.

Confidentiality of PSSCs

A list of the PSSCs contained within the ZCC should be included in source water protection plans. However, the exact location, characteristics, and approximate quantities of contaminants shall only be made known to one or more designees of the public water utility and maintained in a confidential manner. In the event of a chemical spill, release, or other related emergency, information pertaining to the contaminant shall be immediately disseminated to any emergency responders reporting to the site. The designees for Shepherdstown are identified in the communication planning section of the Source Water Protection Plan.

PSSC data from some agencies, such as WVDHSEM and WVDEP, may be restricted due to the sensitive nature of the data. Locational data will be provided to the public water utility. However, to obtain specific details regarding contaminants, such as information included in Tier II reports, water utilities should contact the local emergency planning commission (LEPC) or agencies, directly. To obtain specific details regarding contaminants, water utilities should contact the local emergency planning commission (LEPC) or agencies directly. While the maps and lists of the PSSCs and regulated sites are to be maintained in a confidential manner, these data are provided in **Appendix A** for internal review and planning uses only.

Local and Regional PSSCs

For the purposes of this Source Water Protection Plan, local PSSCs are those that are identified by the water utility and local stakeholders that were not included in the PSSCs lists distributed by the WVBPH and other agencies. There are two reasons why local PSSCs may be identified. First, it is possible that threats exist from unregulated sources or land uses that have not already been inventoried and do not appear in regulated databases. A PSSC inventory should identify all contaminant sources and land uses in the delineated ZCC, therefore, each public water utility should investigate their protection areas for local PSSCs. Local PSSCs are also identified when a public water utility expands their PSSC inventory efforts to include the Zone of Peripheral Concern (ZPC) or Watershed Delineation Area (WSDA). Utilities may consider collaborating with upstream communities to identify and manage regional PSSCs.

When conducting local and regional PSSC inventories, utilities should consider that some sources may be obvious like above ground storage tanks, landfills, livestock confinement areas, highway or railroad right of ways, and sewage treatment facilities. Others are harder to locate like abandoned cesspools, underground tanks, French drains, dry wells, or old dumps and mines.

Information on any new or updated PSSCs identified by Shepherdstown that do not already appear in datasets from the WVBPH can be found in **Table 7**.

Shepherdstown PSSCs

Shepherdstown and consultants reviewed intake locations and the delineated ZCCs for both the primary intake on the Potomac River and the secondary intake on Town Run to verify the existence of PSSCs provided by the WVBPH and identify new PSSCs. Additionally, a number of facilities that were included in WVBPH databases were no longer in operation; these have been removed from the PSSC list included in Appendix A so that attention can be focused on those facilities that currently have the potential to contaminate source water. Information gathered from permit files and from interviews with protection team members was used to determine which facilities are currently operational. A survey of facilities documented in WVBPH provided databases located in areas outside of the ZCC was completed to ensure that any facilities with a high risk of contaminating the source water do not exist outside of the ZCC but within a close enough proximity that contamination could occur.

WVBPH guidance documentation was utilized to prioritize sources based on WVBPH risk ratings. In general, the Shepherdstown Water primary and back up ZCCs contain few facilities with high risk scores. The PSSCs with highest risk scores include a potential confined animal feeding operation, facilities with aboveground storage tanks, Cress Creek Golf Club, sludge and septic disposal from the Potomac Portable Restrooms and Septic company, and mercury pick up at the Rockenbaugh Site (RCRA facility). The specific nature of activities at each of these facilities is not clear; the water department should communicate with each to establish a more precise understanding of the risk posed by each.

295 residences were identified within the Potomac River ZCC and 56 residences were identified within the Town Run ZCC in areas not served by public sewer lines. These are assumed to have septic systems. While the relative risk of an individual septic system is low, due to the large number of septic systems in the area, these collectively should be considered as a potential for contamination.

Table 7. Locally Identified Potential Significant Sources of Contamination

Potomac River

PSSC No.	Map Code	Site Name	Site Description	Comments
A-3	A-3	Dale Price Farm	This is a potential confined animal feeding operation. There appears to be a large poultry house onsite.	Potential contaminants include livestock sewage wastes; nitrates; phosphates; chloride; chemical sprays and dips for controlling insect, bacterial, viral, and fungal pests on livestock; coliform and non-coliform bacteria; and viruses. BPH risk: 4.9.
A-7	A-7	Unknown agricultural facility	This is an agricultural facility that contains a tree farm and additional row crops.	Potential contaminants include pesticides, fertilizer, gasoline, and motor oils from chemical applicators. BPH Risk: 3.2.
C-58	C-58-2	Shepherd University buildings	Two large Shepherd University buildings were identified here that are located just outside of the public sewer boundary.	Potential contaminants include solvents, pesticides, acids, alkalis, waste oils, machinery/vehicle servicing wastes, gasoline and heating oil from storage tanks, and general building wastes. BPH Risk: 1.1.
C-58	C-58-3	Shepherd University buildings	One Shepherd University building that is located outside the public sewer service boundary was identified at this location.	Potential contaminants include solvents, pesticides, acids, alkalis, waste oils, machinery/vehicle servicing wastes, gasoline and heating oil from storage tanks, and general building wastes. BPH Risk: 1.1.
C-58	C-58-4	Shepherd University buildings	One Shepherd University building that is located outside the public sewer service boundary was identified at this location.	Potential contaminants include solvents, pesticides, acids, alkalis, waste oils, machinery/vehicle servicing wastes, gasoline and heating oil from storage tanks, and general building wastes. BPH Risk: 1.1.
C-1	C-1-1	Unknown	A facility with potential aboveground storage tanks present was identified at this location.	Aboveground storage tanks may contain large quantities of potentially hazardous chemicals that can leak into surface waterways if not properly maintained. The contents of the tanks at this location are unknown and should be investigated. BPH Risk: 6.8.

Table 7. Locally Identified Potential Significant Sources of Contamination (*Continued*)

PSSC No.	Map Code	Site Name	Site Description	Comments
C-1	C-1-2	Unknown	Potential aboveground storage tanks	The contents of the tanks at this location are unknown and should be investigated. BPH Risk: 6.8.
C-25	C-25	Junkyard	Junkyard	Oils, antifreeze, and other automobile fluids may leak from the used automobiles and contaminate the source waters if not cleaned up and disposed of properly. BPH risk: 3.4.
C-23	C-23-1	Historic gas station	Historic gas station	Potential contaminants include petroleum hydrocarbons, metals, and volatile organic compounds. BPH Risk: 3.0.
A-22	Not labeled individually	Agricultural land uses	17 characterized as agricultural. Including pastures, small crop plots, hay fields, greenhouses, and farms with some farm animals.	• Pesticides and other chemicals used for farm operations • Disposal of animal waste or burying dead livestock Increased nutrient load from these sources in surface water may result in algal growth. Algal presence may result in taste and odor issues. If stressed some algae also releases toxic chemicals that could cause a threat to human health
R-4	Not labeled individually	Residential septic system	295 total residences located outside of the area served by the public sewer system were identified. It is assumed that each has a septic system.	Common household products include household cleaners, oven cleaners, drain cleaners, toilet cleaners, disinfectants, metal polishes, jewelry cleaners, shoe polishes, synthetic detergents, bleach, laundry soil and stain removers, spot removers and dry cleaning fluid, solvents, lye or caustic soda, household pesticides, photochemicals, printing ink, and other common products. Wall and furniture treatments include paints, varnishes, stains, dyes, wood preservatives (creosote), paint and lacquer thinners, paint and varnish removers and de-glossers, paintbrush cleaners, and floor and furniture strippers. Mechanical repair and other maintenance products include automotive wastes, waste oils, diesel fuel, kerosene, #2 heating oil, grease, degreasers for driveways and garages, metal degreasers, asphalt and roofing tar, tar removers, lubricants, rust proofers, car wash detergents, car waxes and polishes, rock salt, and refrigerants. BPH risk: 2.3

Table 7. Locally Identified Potential Significant Sources of Contamination (*Continued*)

Town Run

PSSC No.	Map Code	Site Name	Site Description	Comments
C-3	C-3	Cool Green Auto & Tire	This is an auto shop on E. Washington Street.	Potential contaminants include waste oils, solvents, acids, paints, automotive wastes, and miscellaneous oils. BPH risk: 2.7.
C-25	C-25	John Thompson	Junk yard	Oils, antifreeze, and other automobile fluids may leak from the used automobiles and contaminate the source waters if not cleaned up and disposed of properly. BPH risk: 3.4.
M-5	M-5-2	Water Treatment Plant	Drinking Water Treatment Plant	Possibly related to the NOAA water treatment facility (PSSC number M-5 in SWAP PSSC table). Disinfection byproducts are a potential contaminant source. BPH Risk: 1.5.
C-23	C-23-2	Historic gas station/Sustainable Resources	Historic Gas Station that is now the site of Sustainable Resources, a natural resource management company.	Potential contaminants include petroleum hydrocarbons, metals, and volatile organic compounds. BPH Risk: 3.0.

Table 7. Locally Identified Potential Significant Sources of Contamination (*Continued*)

PSSC No.	Map Code	Site Name	Site Description	Comments
A-22	Not labeled individually	Agricultural land uses	Small farm	• Pesticides and other chemicals used for farm operations • Disposal of animal waste or burying dead livestock Increased nutrient load from these sources in surface water may result in algal growth. Algal presence may result in taste and odor issues. If stressed some algae also releases toxic chemicals that could cause a threat to human health
R-4	Not labeled individually	Residential septic system	56 total residences located outside of the area served by the public sewer system were identified. It is assumed that each has a septic system.	Common household products include household cleaners, oven cleaners, drain cleaners, toilet cleaners, disinfectants, metal polishes, jewelry cleaners, shoe polishes, synthetic detergents, bleach, laundry soil and stain removers, spot removers and dry cleaning fluid, solvents, lye or caustic soda, household pesticides, photochemicals, printing ink, and other common products. Wall and furniture treatments include paints, varnishes, stains, dyes, wood preservatives (creosote), paint and lacquer thinners, paint and varnish removers and de-glossers, paintbrush cleaners, and floor and furniture strippers. Mechanical repair and other maintenance products include automotive wastes, waste oils, diesel fuel, kerosene, #2 heating oil, grease, degreasers for driveways and garages, metal degreasers, asphalt and roofing tar, tar removers, lubricants, rust proofers, car wash detergents, car waxes and polishes, rock salt, and refrigerants. BPH risk: 2.3

Prioritization of Threats and Management Strategies

Following identification of local concerns, the utility developed a management plan that identifies specific activities that will be pursued by the utility in cooperation and concert with the WVBPH, local health departments, local emergency responders, LEPCs, and other agencies or organizations to protect the source water from contamination.

Depending on the number of PSSCs identified, it may not be feasible to develop management strategies for all of the PSSCs in the SWPA. The identified PSSCs have been prioritized by potential threat to water quality, proximity to the intake(s), and local concern. The highest priority PSSCs can be addressed first in the initial management plan. Lower ranked PSSCs can be addressed in the future as time and resources allow. To assess the threat to the source water, water systems should consider confidential information about each PSSC. This information may be obtained from state or local emergency planning agencies, Tier II reports, facility owners, facility groundwater protection plans, spill prevention and response plans, results of field investigations, and other sources.

In addition to identifying and prioritizing PSSCs within the SWPA, local source water concerns may also focus on critical areas. For the purposes of this Source Water Protection Plan, a critical area is defined as an area that is identified by local stakeholders and can lie within or outside of the ZCC. Critical areas may contain one or more PSSCs which would require immediate response to address a potential incident that could impact the source water. For Shepherdstown Water Department, the ZCCs for both the main intake and the secondary intake on Town Run are critical areas.

A list of priority PSSCs was selected and ranked by the Shepherdstown Water Department protection team. This list reflects the concerns of this specific utility and contains PSSCs not previously identified. **Table 8** contains a description of why each critical area or PSSC is considered a threat and what management strategies the utility is either currently using or could use in the future to address each threat.

IMPLEMENTATION PLAN FOR MANAGEMENT STRATEGIES

Shepherdstown Water Department reviewed the recommended strategies listed in their previous Source Water Protection Plan to consider if any of them should be adopted and incorporated in this updated plan. The system has also developed an implementation plan for the priority concerns listed in **Table 8**. **Table 9** provides a brief statement summarizing the status of the recommended strategies and includes strategies from a previous plan that are being incorporated in this plan update. Management strategies that address potential sources of contamination in the watershed that were not determined to be the highest priorities are also included in **Table 9**. Strategies that pertain to the highest priority sources will be addressed first, and those focused on lower priorities will be implemented as time and funding allow.

Shepherdstown Water Department has considered management strategies to address potential contaminants within its SWPA. Additionally, the utility's protection team has developed implementation plans, including responsible personnel and timelines, for each strategy. The implementation plan and potential cost of each strategy were estimated and are presented in **Table 9**. Additional meetings may be needed during the initial effort to complete activities, after which the protection team should consider meeting annually to review and update the Source Water Protection Plan. A system of regular updates should be included in every implementation plan.

Proposed commitments and schedules may change but should be well documented and reported to the local stakeholders.

Previous Plan Status

There were 15 management strategies recommended in the existing plan. Seven of these are included in this plan. Some of them have been adapted to more accurately describe the current needs of the system.

Table 8. Critical Areas

PSSC or Critical Area	Priority	Reason for Concern
Zone of Critical Concern for the Potomac River and Town Run intakes (critical area)	1	The ZCC warrants detailed scrutiny due to its proximity to the surface water intake and the intake's susceptibility to potential contaminants within that corridor. The Shepherdstown Water Department ZCC has been determined using a mathematical model that accounts for stream flows, gradient, and area topography. The length of the ZCC is based on a five-hour time-of-travel of water in the streams to the water intake. The width of the ZCC is 1,000 feet measured horizontally from each bank of the principal stream and 500 feet measured horizontally from each bank of the tributaries draining into the principal stream.
Septic systems	2	The aerial review of the Shepherdstown ZCC located 295 homes that are not supplied by the city sewer and are assumed to manage their own septic system. A review of the Town Run ZCC located an additional 56 homes not served by city sewer. While the relative risk of an individual septic system is low, due to the large number of septic systems in the area, these collectively should be considered as a potential source of contamination.
Dumping/contamination of Town Run	3	Town Run is the backup water supply for the Shepherdstown Water Department. This small creek starts as a spring just outside of Shepherdstown and flows through a park, neighborhoods, and the town of Shepherdstown. Due to the small size, improper management of household chemicals, purposeful dumping of chemicals, or poor or non-working septic systems can easily contaminate this small stream.

Table 9. PSSC Management Strategies

PSSC or Critical Area	Management Activity	Description of Activity	Responsible Party	Status/ Schedule	Estimated Cost
All contaminants during power outages	Backup generators	In the event of a power outage that affects the water treatment plant, Shepherdstown Water Department will need another source of power. Shepherdstown Water Department has access to generators that can be used should the treatment plant lose power. The utility has plans to obtain backup generators as part of long-term plans.	Shepherdstown Water Department	Long-term planning	Moderate
Any contaminant during an emergency situation	Develop Emergency Reponses Plan	Shepherdstown Water Department has prepared a formal Emergency Response Plan (ERP). It will be kept up and followed. Information on creating and updating the ERP can be found here: http://www.nesc.wvu.edu/plan_ahead4.cfm	Shepherdstown Water Department	Completed. Update annually.	None
Any contaminant during an emergency situation	Emergency planning and coordination	Shepherdstown Water Department will connect with local fire departments and County Emergency Services on a regular basis. The emergency response agencies will be informed of the extent of the ZCC. This will ensure that all the agencies are in constant communication with one another and prepared in the event of an emergency.	Shepherdstown Water Department	Ongoing	None

Table 9. PSSC Management Strategies (*Continued*)

PSSC or Critical Area	Management Activity	Description of Activity	Responsible Party	Status/ Schedule	Estimated Cost
Any contaminant during an emergency situation	Participation in Statewide Initiatives	Statewide initiatives for emergency response, including source water related incidents, are being developed. These include the West Virginia Water/Wastewater Agency Response Network (WVWARN, see http:i/www.wvwam.org/) and the Rural Water Association Emergency Response Team (link: http://www.wvrwa.org/). Shepherdstown Water participates in the Rural Water Association.	Shepherdstown Water Department	Ongoing	Minimal
Potomac River	Participate in Potomac River Drinking Water Source Protection Partnership	The Potomac River Drinking Water Source Protection Partnership is a network of water suppliers and government agencies focused on protecting sources of drinking water in the Potomac River Basin.	Shepherdstown Water Department	Ongoing	Minimal
Shepherd College	Communication with PCS and Facility Owners	Shepherdstown Water Department will communicate with facility owners the need for them to properly dispose of oil and other automobile products, ask them to follow regulations and institute Best Management Practices (BMPs) to contain and clean up spills, and ask that the facilities consider the source water in planning and implementing BMPs. The system will monitor compliance with state environmental regulations and review permits held by the facility, like stormwater management plans for parking lots and roads. A letter template that can be used to initiate a conversation with the facility is included in **Appendix E**.	Shepherdstown Water Department	Ongoing	Minimal

Table 9. PSSC Management Strategies (*Continued*)

PSSC or Critical Area	Management Activity	Description of Activity	Responsible Party	Status/ Schedule	Estimated Cost
Cress Creek Golf Course	Communication with PCS and facility owners	Shepherdstown Water Department will communicate with facility owners the need for them to properly dispose of oil and other automobile products, ask them to follow regulations and institute BMPs to contain and clean up spills, and ask that the facilities consider the source water in planning and implementing BMPs. The utility will work with the owner or operator of the Cress Creek Golf Course to implement an Integrated Pest Management System (IPM) and ensure the use of BMPs. For more information on developing an IPM, visit: http://www.epa.gov/opp00001/factsheets/ipm.htm. The utility will also work with the county extension service, the Soil and Water Conservation District, and/or the Natural Resource Conservation Service to provide copies of fact sheets covering BMPs for nutrient management, pesticide use, pest management, waste oil disposal, safe chemical handling, and/or safe chemical storage. A letter template that can be used to initiate a conversation with the facility is included in **Appendix E**.	Shepherdstown Water Department	Ongoing.	Minimal.

EDUCATION AND OUTREACH STRATEGIES

The goal of education and outreach is to raise awareness of the need to protect drinking water supplies and build support for implementation strategies. Education and outreach activities will also ensure that affected citizens and other local stakeholders are kept informed and provided an opportunity to contribute to the development of the source water protection plan. Shepherdstown Water Department has created an Education and Outreach plan that describes activities it has either already implemented or could implement in the future to keep the local community involved in protecting their source of drinking water. This information can be found in **Table 10**.

Table 10. Education and Outreach Implementation Plan

Education and Outreach Strategy	Description of Activity	Responsible Protection Team Member	Status/ Schedule	Comments	Estimated Cost
Brochures, pamphlets and letters, media outreach	Shepherdstown Water Department will post information about source water protection on the City of Shepherdstown's website and will provide source water protection information on other social media outlets. This information will alert the public of the need for source water protection and conservation. Information will also include proper handling and disposal of household chemicals and proper septic system maintenance.	City of Shepherdstown website administrator	Source Water Protection information will be posted on the website beginning as soon as possible and updated periodically throughout the year. Information will be shared through other outlets as they arise.	The links below provide educational materials that can be distributed: http://water.epa.gov/infrastructure/drinkingwater/sourcewater/protection/citizeninvolvementinsourcewaterprotection.cfm http://www2.epa.gov/sites/production/files/2014-06/documents/growthwater.pdf http://www.nesc.wvu.edu/pdf/WW/publications/pipline/PL_Su08.pdf http://www.epa.gov/owm/septic/pubs/homeowner_guide_long.pdf	Minimal
Plant tours	Shepherdstown Water Department will provide tours of the water plant to interested organizations such as watershed groups, schools, and civic organizations as requested.	Shepherdstown Water Department	Ongoing		None

Table 10. Education and Outreach Implementation Plan (Continued)

Education and Outreach Strategy	Description of Activity	Responsible Protection Team Member	Status/ Schedule	Comments	Estimated Cost
Public meeting	Shepherdstown Water Department has participated in a West Virginia Rivers Coalition informational meeting with local residents about source water protection efforts during 2016. They will also discuss source water protection efforts at a Water Board meeting.	Shepherdstown Water Department	Ongoing	West Virginia Rivers Coalition Event was held May 12, 2016. The Water Board meeting will be held during a regularly scheduled meeting.	Minimal
Communication with PCS and Facility Owners	Shepherdstown Water Department will communicate with PCS owners and regulated facility owners, explain that they are operating within the ZCC, and emphasize the need to follow all regulatory Best Management Practices (BMPs) via mail. This letter to businesses and facilities will also request that they share information with the utility related to chemical storage, such as SDS forms and Tier II reports for aboveground storage tanks.	Shepherdstown Water Department	Will begin in 2016	A template of a letter that can be sent to businesses is included in **Appendix F**.	Minimal

Table 10. Education and Outreach Implementation Plan (Continued)

Education and Outreach Strategy	Description of Activity	Responsible Protection Team Member	Status/ Schedule	Comments	Estimated Cost
Consumer Confidence Report	Shepherdstown Water Department publishes a Consumer Confidence Report (CCR) annually, as required by the Safe Drinking Water Act. The CCR is available to all water customers. The CCR describes the source water for the system, the levels of contaminants in the source water, the EPA safe contaminant levels, and information about Cryptosporidium. The system will also include information about their source water protection program.	Shepherdstown Water Department	Annually	The following paragraph or similar paragraph will be included in the CCR: Shepherdstown Water Department is committed to protecting its drinking water sources. The drinking water for Shepherdstown is sourced from the Potomac River. We updated our Source Water Protection Plan (SWPP) in 2016, based on the requirements of Senate Bill 373. The SWPP includes physical actions to protect the drinking water sources such as ensuring that the source spring is secured, and planning actions such as creating an emergency response plan. It also includes an assessment of potential sources of contamination. The SWPPs were developed by the Water Department in collaboration with a local source water protection team, and with the involvement of the public. Please contact Shepherdstown Water Department to learn more about source water protection.	Minimal

Table 10. Education and Outreach Implementation Plan (Continued)

Education and Outreach Strategy	Description of Activity	Responsible Protection Team Member	Status/ Schedule	Comments	Estimated Cost
Information about pharmaceuticals	Shepherdstown Water Department will provide information on its website on pharmaceuticals and how to properly dispose of them. The system will collaborate with the Sheriff's Department to share information about opportunities for pharmaceutical disposal in the area.	City of Shepherdstown website administrator, Sheriff's Department	Source Water Protection information will be posted on the website beginning as soon as possible and updated periodically throughout the year. Information will be shared through other outlets as they arise.	The Shepherdstown Sheriff's Office manages a drop box for pharmaceutical disposal at the city building and will help advertise this to the community. Additional information that can be shared with the public can be found at: http://www.nesc.wvu.edu/waterwedrink/education.cfm	Minimal

CONTINGENCY PLAN

The goal of contingency planning is to identify and document how the utility will prepare for and respond to any drinking water shortages or emergencies that may occur due to short- and long-term water interruption, or incidents of spill or contamination. Utilities should examine their capacity to protect their intake, treatment, and distribution system from contamination. They should also review their ability to use alternative sources and minimize water loss, as well as their ability to operate during power outages. In addition, utilities should report the feasibility of establishing an early warning monitoring system and meeting future water demands.

Isolating or diverting any possible contaminant from the intake for a public water system is an important strategy in the event of an emergency. One commonly used method of diverting contaminants from an intake is establishing booms around the intake. This can be effective, but only for contaminants that float on the surface of the water. Alternatively, utilities can choose to pump floating contaminants from the water or chemically neutralize the contaminant before it enters the treatment facility.

Public utilities using surface sources should be able to close the intake by one means or another. However, depending upon the system, methods for doing so could vary greatly from closing valves, lowering hatches or gates, raising the intake piping out of the water, or shutting down pumps. Systems should have plans in place in advance as to the best method to protect the intake and treatment facility. Utilities may benefit from turning off pumps and, if possible, closing the intake opening to prevent contaminants from entering the piping leading to the pumps. Utilities should also have a plan in place to sample raw water to identify the movement of a plume and allow for maximum pumping time before shutting down an intake (See **Appendix B**). The amount of time that an intake can remain closed depends on the water infrastructure and should be determined by the utility before an emergency occurs. The longer an intake can remain closed in such a case, the better.

Treated water storage capacity in the event of such an emergency also becomes extremely important. Storage capacity can directly determine how well a water system can respond to a contamination event and how long an intake can remain closed. Information regarding the water shortage response capability of Shepherdstown is provided in **Table 11**.

Response Networks and Communication

Statewide initiatives for emergency response, including source water related incidents, are being developed. These include the West Virginia Water/Wastewater Agency Response Network (WV WARN, see http://www.wvwarn.org/) and the Rural Water Association Emergency Response Team (see http://www.wvrwa.org/). Shepherdstown has analyzed its ability to effectively respond to emergencies and this information is provided in **Table 11**.

Table 11. Water Shortage Response Capability

Can the utility isolate or divert contamination from the intake or groundwater supply?	No
Describe the utility's capability to isolate or divert potential contaminants:	N/A
Can the utility switch to an alternative water source or intake that can supply full capacity at any time?	Yes
Describe in detail the utility's capability to switch to an alternative source:	The utility has used a diesel driven pump to withdraw water during an emergency; however there is no permanent intake structure.
Can the utility close the water intake to prevent contamination from entering the water supply?	Yes
How long can the intake stay closed?	The raw water intake can remain closed until the treated water storage levels become low.
Describe the process to close the intake:	The raw water pumps are shut off as soon as a contamination is known.
Describe the treated water storage capacity of the water system:	The current treated water storage amount for the system consists of two (2) water storage tanks totaling 1,400,000 gallons of treated water. At the time of this report, the Shepherdstown Water system was operating at 80% treated water storage capacity.
Is the utility a member of WVRWA Emergency Response Team?	Yes
Is the utility a member of WV-WARN?	No
List any other mutual aid agreements to provide or receive assistance in the event of an emergency:	N/A

It is suggested that, if the utility does not have the capability to divert contamination from the surface water intake, pre-cast concrete bases are constructed around the raw water intake to drop booms into the water and physically divert surface contaminants from entering the raw water intake.

Operation During Loss of Power

This utility analyzed and examined its ability to operate effectively during a loss of power. This involved ensuring a means to supply water through treatment, storage, and distribution without creating a public health emergency. Information regarding the utility's capacity for operation during power outages is shown in **Table 12**. The utility's standby capacity would have the capability to provide power to the system as if normal power conditions existed. The utility's emergency capacity would have the capability to provide power to only the essential equipment and treatment processes to provide water to the system. Information regarding the emergency generator capacity for each utility was calculated by the WV BPH and can be found in **Appendix E**.

Table 12. Generator Capacity

What is the type and capacity of the generator needed to operate during a loss of power?	The emergency generator capacity for the treatment facility is 250 kW.	
Can the utility connect to generator at the intake/wellhead? If yes, select a scenario that best describes system.	No	
Can the utility connect to generator at the treatment facility? If yes, select a scenario that best describes system.	No	
Can the utility connect to a generator in distribution system? If yes, select a scenario that best describes system.	No	
Does the utility have adequate fuel on hand for the generator?	No	
What is your on-hand fuel storage and how long will it last operating at full capacity?	**Gallons**	**Duration**
	N/A	N/A

Table 12. Generator Capacity (*Continued*)

		Supplier	Contact Name	Phone Number
Provide a list of suppliers that could provide generators and fuel in the event of an emergency:	**Generator**	N/A	N/A	N/A
	Fuel	N/A	N/A	N/A

Does the utility test the generator(s) periodically?	N/A
Does the utility routinely maintain the generator?	N/A
If no scenario describing the ability to connect to generator matches the utility's system or if utility does not have ability to connect to a generator, describe plans to respond to power outages:	The utility has not experienced power outages longer than one (1) day, which is under the system's existing treated water storage amount of 1,400,000 gallons, or two (2) days of average use.

Future Water Supply Needs

When planning for potential emergencies and developing contingency plans, a utility needs to not only consider their current demands for treated water but also account for likely future needs. This could mean expanding current intake sources or developing new ones in the near future. This can be an expensive and time consuming process, and any water utility should take this into account when determining emergency preparedness. Shepherdstown has analyzed its ability to meet future water demands at current capacity and this information is included in **Table 13**.

Table 13. Future Water Supply Needs

Is the utility able to meet water demands with the current production capacity over the next 5 years? If so, explain how you plan to do so.	Yes; there is little to no increase expected in the customer demand within the next five (5) years for Shepherdstown Water. If any increase is experienced, it is expected to be minimal and the plant is expected to remain under maximum.
If not, describe the circumstances and plans to increase production capacity:	N/A

Water Loss Calculation

In any public water system, there is a certain percentage of the total treated water that does not reach the customer distribution system. Some of this water is used in treatment plant processes such as backwashing filters or flushing piping, but there is usually at least a small percentage unaccounted. To measure and report on this unaccounted for water, a public utility must use the same method used in the Public Service Commission's rule, *Rules for the Government of Water Utilities*, 150CSR7, Section 5.6. The rule defines unaccounted for water as "the volume of water introduced into the distribution system less all metered usage and all known non-metered usage which can be estimated with reasonable accuracy."

To further clarify, metered usages are most often those that are distributed to customers. Non-metered usages estimated include water used by fire departments for fires or training, un-metered bulk sales, flushing to maintain the distribution system, backwashing filters, and cleaning settling basins. By totaling the metered and non-metered uses, the utility calculates unaccounted for water. Note: To complete annual reports submitted to the PSC, utilities typically account for known water main breaks by estimating the amount of water lost. However, for the purposes of the source water protection plan, any water lost due to leaks – even if the system is aware of how much water is lost at a main break – is not considered a use. Water lost through leaks and main breaks cannot be controlled during water shortages or other emergencies and should be included in the calculation of percentage of water loss for purposes of the source water protection plan. The data in **Table 14** is taken from the most recently submitted Shepherdstown PSC Annual Report.

Table 14. Water Loss Information

Total Water Pumped (gal.)		225,318,000
Total Water Purchased (gal.)		0
Total Water Pumped and Purchased (gal.)		225,318,000
Water Loss Accounted for Except Main Leaks (gal.)	**Mains, Plants, Filters, Flushing, etc.**	28,889,000
	Fire Department	0
	Back Washing	5,281,782
	Blowing Settling Basins	0
Total Water Loss Accounted For Except Main Leaks		34,170,782
Water Sold- Total Gallons (gal)		107,665,000
Unaccounted For Lost Water (gal)		59,761,218
Water lost from main leaks (gal)		23,721,000
Total gallons of Unaccounted for Lost Water and Water Lost from Main Leaks (gal.)		83,482,218
Total Percent Unaccounted For Water and Water Lost from Main Leaks (%)		**37.05**
If total percentage of Unaccounted for Water is greater than 15%, please describe any measures that could be taken to correct this problem:		The utility is conducting leak detection and making necessary repairs, as well as fixing leaks when they are discovered and planning to replace old line sections.

EARLY WARNING MONITORING SYSTEM

Public water utilities are required to provide an examination of the technical and economic feasibility of implementing an early warning monitoring system. Implementing an early warning monitoring system may be approached in different ways depending upon the water utility's resources and threats to the source water. A utility may install a continuous monitoring system that will provide real-time information regarding water quality conditions. This would require utilities to analyze the data in order to establish what condition is indicative of a contamination event. Continuous monitoring will provide results for a predetermined set of parameters. The more parameters being monitored, the more sophisticated the monitoring equipment will be. When establishing a continuous monitoring system, the utility should consider the logistics of placing and maintaining the equipment and receiving output data from the equipment.

Alternately, or in addition, a utility may also pull periodic grab samples on a regular basis or in case of a reported incident. The grab samples may be analyzed for specific contaminants. A utility should examine their PSSCs to determine what chemical contaminants could pose a threat to the water source. If possible, the utility should plan in advance how those contaminants will be detected. Consideration should be given for where samples will be collected, the preservations and hold times for samples, available laboratories to analyze samples, and costs associated with the sampling event. Regardless of the type of monitoring (continuous or grab), utilities should collect samples for their source throughout the year to better understand the baseline water quality conditions and natural seasonal fluctuations. Having a baseline will help determine if changes in the water quality are indicative of a contamination event and inform the needed response.

Every utility should establish a system or process for receiving or detecting chemical threats with sufficient time to respond to protect the treatment facility and public health. All approaches to receiving and responding to an early warning should incorporate communication with facility owners and operators that pose a threat to the water quality, state and local emergency response agencies, surrounding water utilities, and the public. Communication plays an important role in knowing how to interpret data and how to respond.

Shepherdstown has analyzed its ability to monitor for and detect potential contaminants that could impact its source water. Information regarding this utility's early warning monitoring system capabilities can be found in **Table 15** and in **Appendix B**.

Table 15. Early Warning Monitoring System Capabilities

<table>
<tr><td colspan="2">Does your system currently receive spill notifications from a state agency, neighboring water system, local emergency responders, or other facilities? If yes, from whom do you receive notices?</td><td colspan="2">The utility receives spill notifications from the WV Health Department and Maryland Department of Environment.</td></tr>
<tr><td colspan="2">Are you aware of any facilities, land uses, or critical areas within your protection areas where chemical contaminants could be released or spilled?</td><td colspan="2">No; however, the utility received a disk containing potential sources of significant contamination, zones of critical concern and zones of peripheral concern and watershed areas for the water source.</td></tr>
<tr><td colspan="2">Are you prepared to detect potential contaminants if notified of a spill?</td><td colspan="2">No</td></tr>
<tr><td rowspan="4">List laboratories (and contact information) on which you would rely to analyze water samples in case of a reported spill.</td><td colspan="3">Laboratories</td></tr>
<tr><td colspan="2">Name</td><td>Contact</td></tr>
<tr><td colspan="2">REI Consultants</td><td>(304) 255-2500</td></tr>
<tr><td colspan="2">WV Office of Lab Services</td><td>(304) 558-3530</td></tr>
<tr><td colspan="2">Do you have an understanding of baseline or normal conditions for your source water quality that accounts for seasonal fluctuations?</td><td colspan="2">Yes</td></tr>
<tr><td colspan="2">Does your utility currently monitor raw water (through continuous monitoring or periodic grab samples) at the surface water intake or from a groundwater source on a regular basis?</td><td colspan="2">Yes</td></tr>
<tr><td colspan="2" rowspan="2">Provide or estimate the capital and O&M costs for your current or proposed early warning system or upgraded system.</td><td>Capital</td><td>$50,000</td></tr>
<tr><td>Yearly</td><td>$750</td></tr>
<tr><td colspan="2">Do you serve more than 100,000 customers? If so, please describe the methods you use to monitor at the same technical levels utilized by ORSANCO.</td><td colspan="2">No</td></tr>
</table>

SINGLE SOURCE FEASIBILITY STUDY

If a public water utility's water supply plant is served by a single-source intake to a surface water source of supply or a surface water influenced source of supply, the submitted source water contingency protection plan must also include an examination and analysis of the technical and economic feasibility of alternative sources of water to provide continued safe and reliable public water service in the event its primary source of supply is detrimentally affected by contamination, release, spill event or other reason. These alternatives may include a secondary intake*, two days of raw or treated water storage, interconnections with neighboring systems, or other options identified on a local level.

In order to accomplish this requirement, utilities should examine all existing or possible alternatives and rank them by their technical, economic, and environmental feasibility. To have a consistent and complete method for ranking alternatives, WVBPH has developed a feasibility study guide. This guide provides several criteria to consider for each category, organized in a scoring matrix. By completing the matrix, utilities will demonstrate the process used to examine the feasibility of each alternative and document scores that compare the alternatives. The scoring matrix is then summarized in the Feasibility Study matrix which is weighted to display the most suitable alternative for the utility. Analysis of the evaluated alternatives and summary of the results are presented in an alternatives feasibility study attached as **Appendix D**.

Shepherdstown evaluated the technical and economic feasibility of the following alternatives to provide continued safe and reliable public water service in the event the Potomac River is detrimentally affected by contamination, release, spill or other reason.

Backup Intake

Town Run has adequate supply to provide the average water demand of Shepherdstown Water. The backup intake would be located on Town Run approximately 350 feet upstream of the mouth of the stream and will require 300 feet of 8" raw water line from the intake to the water treatment facility.

Interconnection

Shepherdstown Water is currently not interconnected with another utility. The Berkeley County Public Service Water District (BCPSWD) system is located approximately 12,500 feet from the Shepherdstown Water system. If the Shepherdstown Water active surface water source became contaminated, then their backup source of surface water would also become contaminated because both Shepherdstown Water

* *A secondary water source would draw water supply from a substantially different location or water source.*

and BCPSWD use the Potomac River as their source of water supply. This alternative was not analyzed in the feasibility analysis.

Treated Water Storage (Standpipe)

Shepherdstown Water currently has 1,400,000 gallons of treated water storage available. To satisfy the minimum required storage capacity, Shepherdstown Water needs 834,800 gallons of storage. The system does not meet the minimum required treated water storage capacity. Due to the topography of the water system, this alternative was analyzed but not considered in the feasibility analysis.

Raw Water Storage (Standpipe)

Shepherdstown Water currently has no raw water storage available. To satisfy the minimum required storage capacity, Shepherdstown Water needs 2,234,800 gallons of storage. The system does not meet the minimum required raw water storage capacity. Due to the topography of the water system, this alternative was analyzed but not considered in the feasibility analysis.

Treated Water Storage (Elevated)

Shepherdstown Water currently has 1,400,000 gallons of treated water storage available. To satisfy the minimum required storage capacity, Shepherdstown Water needs 834,800 gallons of storage. The system does not meet the minimum required treated water storage capacity. The construction of a 900,000 gallon elevated treated water storage tank was considered in the feasibility analysis.

Based on the evaluation of the water system, the most feasible alternative for Shepherdstown is the construction of a backup intake on Town Run. Additional detail of the selection of this alternative is provided in **Appendix D**.

COMMUNICATION PLAN

Shepherdstown has also developed a Communication Plan that documents the manner in which the public water utility, working in concert with state and local emergency response agencies, shall notify the local health agencies and the public of the initial spill or contamination event and provide updated information related to any contamination or impairment of the source water supply or the system's drinking water supply. The initial notification to the public will occur in any event no later than thirty minutes after the public water system becomes aware of the spill, release, or potential contamination of the public water system. A copy of the source water protection plan and the Communication Plan has been provided to the local fire department. Shepherdstown will update the Communication Plan as needed to ensure contact information is up to date.

Procedures should be in place for the kinds of catastrophic spills that can reasonably be predicted at the source location or within the SWPA. The chain-of-command, notification procedures and response actions should be known by all water system employees. The WVBPH has developed a recommended communication plan template that provides a tiered incident communication process to provide a universal system of alert levels to utilities and water system managers. The comprehensive Communication Plan for Shepherdstown is attached as **Appendix C** for internal review and planning purposes only.

The West Virginia Department of Environmental Protection is capable of providing expertise and assistance related to prevention, containment, and clean-up of chemical spills. The West Virginia Department of Environmental Protection Emergency Response 24-hour Phone is 1-800-642-3074. The West Virginia Department of Environmental Protection also operates an upstream distance estimator that can be used to determine the distance from a spill site to the closest public water supply surface water intake.

A public water utility must be prepared for any number of emergency scenarios and events that would require immediate response. It is imperative that information about key contacts, emergency services, and downstream water systems be posted and readily available in the event of an emergency. Elements of this source water protection plan, such as the contingency planning and communication plan, may contain similar information to the utility's emergency response plan. However, the emergency response plan is to be kept confidential and is not included in this source water protection plan. An Emergency Short Form is included in **Appendix C** to support the Communication Plan by providing quick access to important information about emergency response and is to be used for internal review and planning purposes only.

CONCLUSION & RECOMMENDATIONS

This report represents a detailed explanation of the required elements of the Shepherdstown's Source Water Protection Plan. Any supporting documentation or other materials that the utility considers relevant to their plan can be found in **Appendix E**.

This Source Water Protection Plan is intended to help prepare community public water systems all over West Virginia to properly handle any emergencies that might compromise the quality of the system's source water supply. It is imperative that this plan is updated as often as necessary to reflect the changing circumstances within the water system. The protection team should continue to meet regularly and continue to engage the public whenever possible. Communities taking local responsibility for the quality of their source water are the most effective way to prevent contamination and protect a water system against contaminated drinking water. Community cooperation, sufficient preparation, and accurate monitoring are all critical components of this source water protection contingency plan, and a multi-faceted approach is the only way to ensure that a system is as protected as possible against source water degradation.

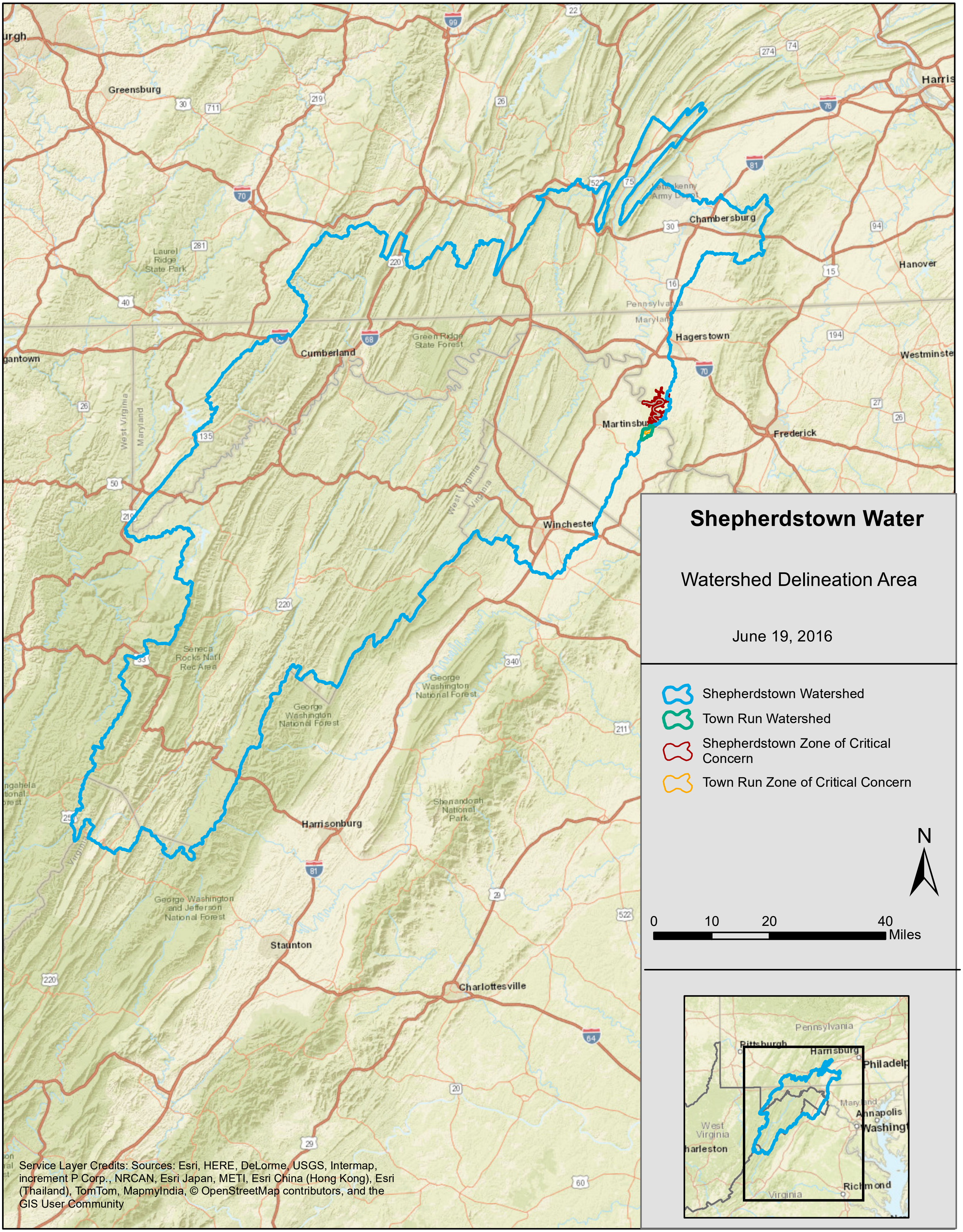
As shown in the Feasibility Matrix in **Appendix D**, the alternative with the highest final score of feasibility is the backup intake. The recommendation for Shepherdstown Water consists of the following: the construction of a backup intake located on Town Run approximately 350 feet upstream of the mouth of the stream, including 300 feet of 8” raw water line from the intake to the water treatment facility and all necessary appurtenances described in **Appendix E**. The backup intake shall provide the treatment facility with a “substantially different” source of water supply in the event that their primary water source becomes contaminated. A cost estimate is provided below. Further explanations of the costs are provided in **Appendix E**.

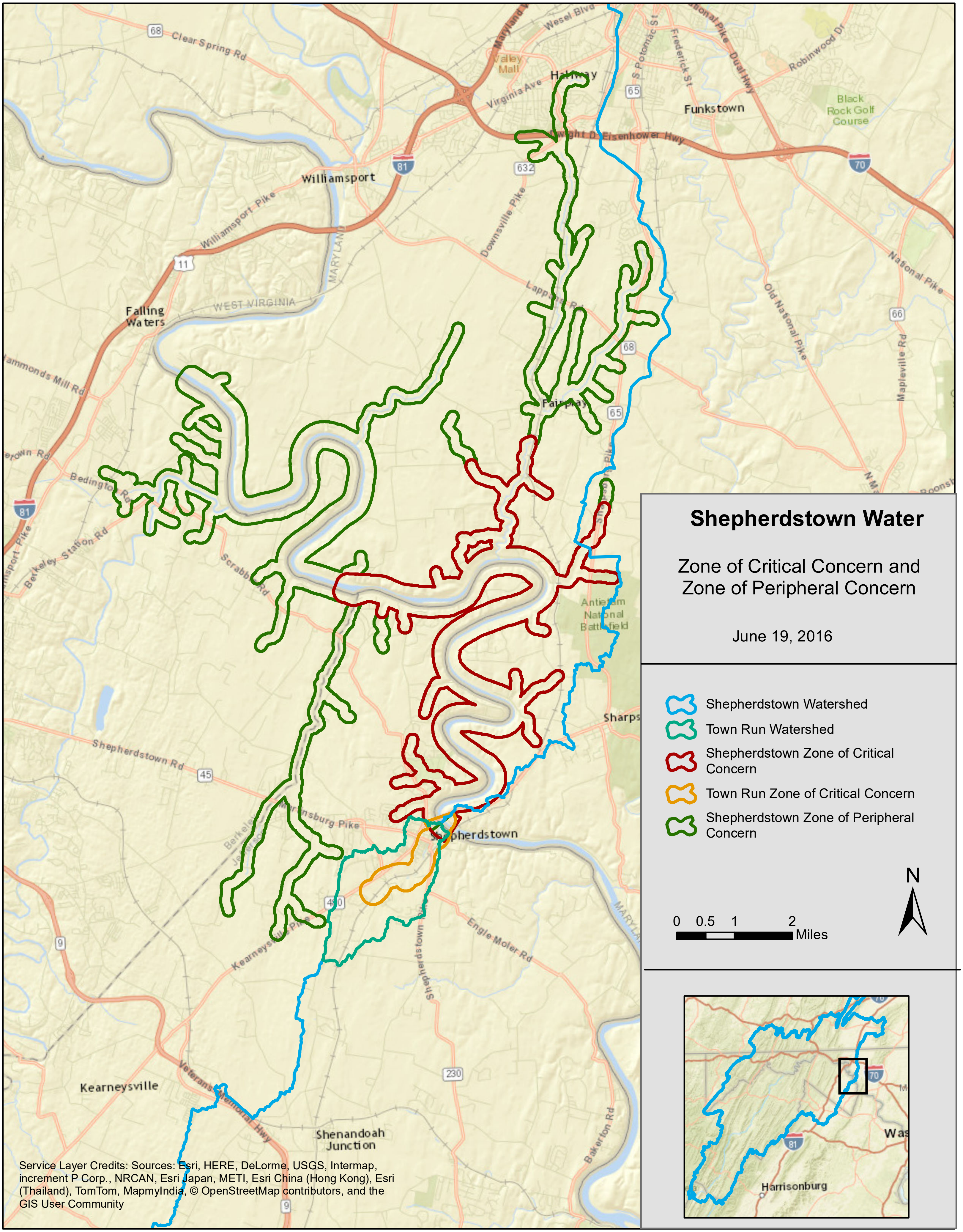
Recommended Alternative Cost Estimate

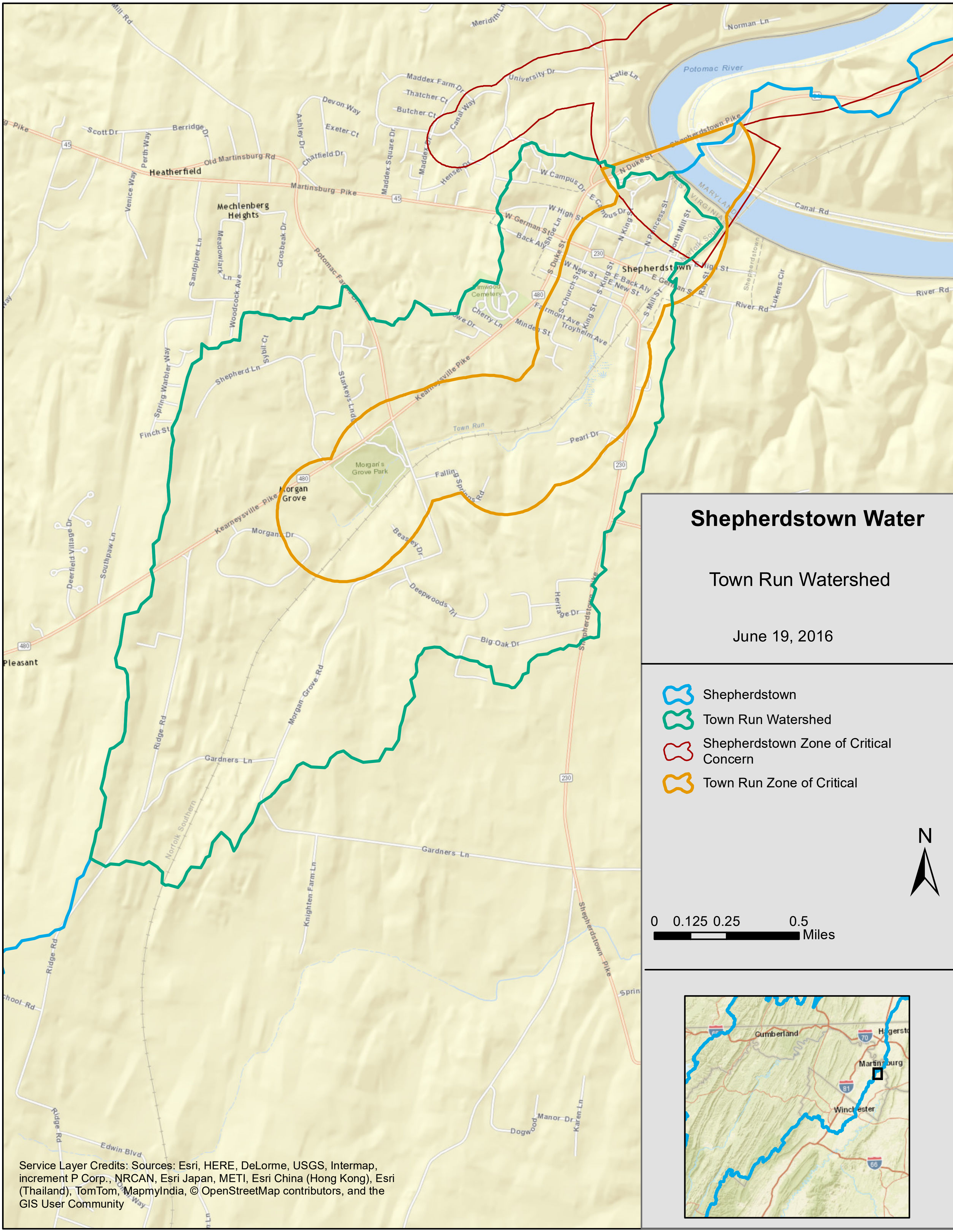
Description	Qty.		Unit Price	Total Cost
8” Raw Water Intake Piping	300	LF	$ 37.00	$ 11,100
Surface Water Intake including acreage, pumps, screens, concrete, raw water well, electricity, etc.	1	LS	$ 770,000.00	$ 770,000
Mussel Survey	1	LS	$ 13,000.00	$ 13,000
Permitting	1	LS	$ 7,500.00	$ 7,500
Engineering / Accounting / Legal Fees	1	LS	$ 200,400.00	$ 200,400
TOTAL				$1,002,000.00

ASSUMPTIONS: Water will be taken from Town Run, adjacent to the water treatment facility. According to the WV DNR, Town Run is a mussel stream and requires a survey to be completed during permitting. Permits required would include WV DEP, WV DNR, ACOE, WV SHPO, U.S. FWS, WV DOH, and County Floodplain. The piping route is included in the following page of supporting documentation. Additional fees are approximately 25% of the overall cost and include engineering, legal, and accounting needs.

APPENDIX A. FIGURES


Shepherdstown Water
Watershed Delineation Area
June 19, 2016
Shepherdstown Watershed
Town Run Watershed
Shepherdstown Zone of Critical Concern
Town Run Zone of Critical Concern
N
0 10 20 40
Miles
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community


Shepherdstown Water
Zone of Critical Concern and
Zone of Peripheral Concern
June 19, 2016
Shepherdstown Watershed
Town Run Watershed
Shepherdstown Zone of Critical Concern
Town Run Zone of Critical Concern
Shepherdstown Zone of Peripheral Concern
0 0.5 1 2
Miles
N
Williamsport
Funkstown
Falling Waters
Shepherdstown
Kearneysville
Shenandoah Junction
Harrisonburg
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community



Shepherdstown Water
Town Run Watershed
June 19, 2016
Shepherdstown
Town Run Watershed
Shepherdstown Zone of Critical Concern
Town Run Zone of Critical
N
0 0.125 0.25 0.5
Miles
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community
Potomac River
Shepherdstown
Heatherfield
Mechlenberg Heights
Morgan Grove
Morgan's Grove Park
Town Run
Pleasant
Martinsburg Pike
Kearneysville Pike
Shepherdstown Pike
Potomac Farms Dr
Morgan Grove Rd
Gardners Ln
Ridge Rd
Knighten Farm Ln
Big Oak Dr
Deepwoods Trl
Canal Rd
River Rd
Norfolk Southern
Cumberland
Hagerstown
Martinsburg
Winchester

List of Locally Identified PSSCs (Potomac River)

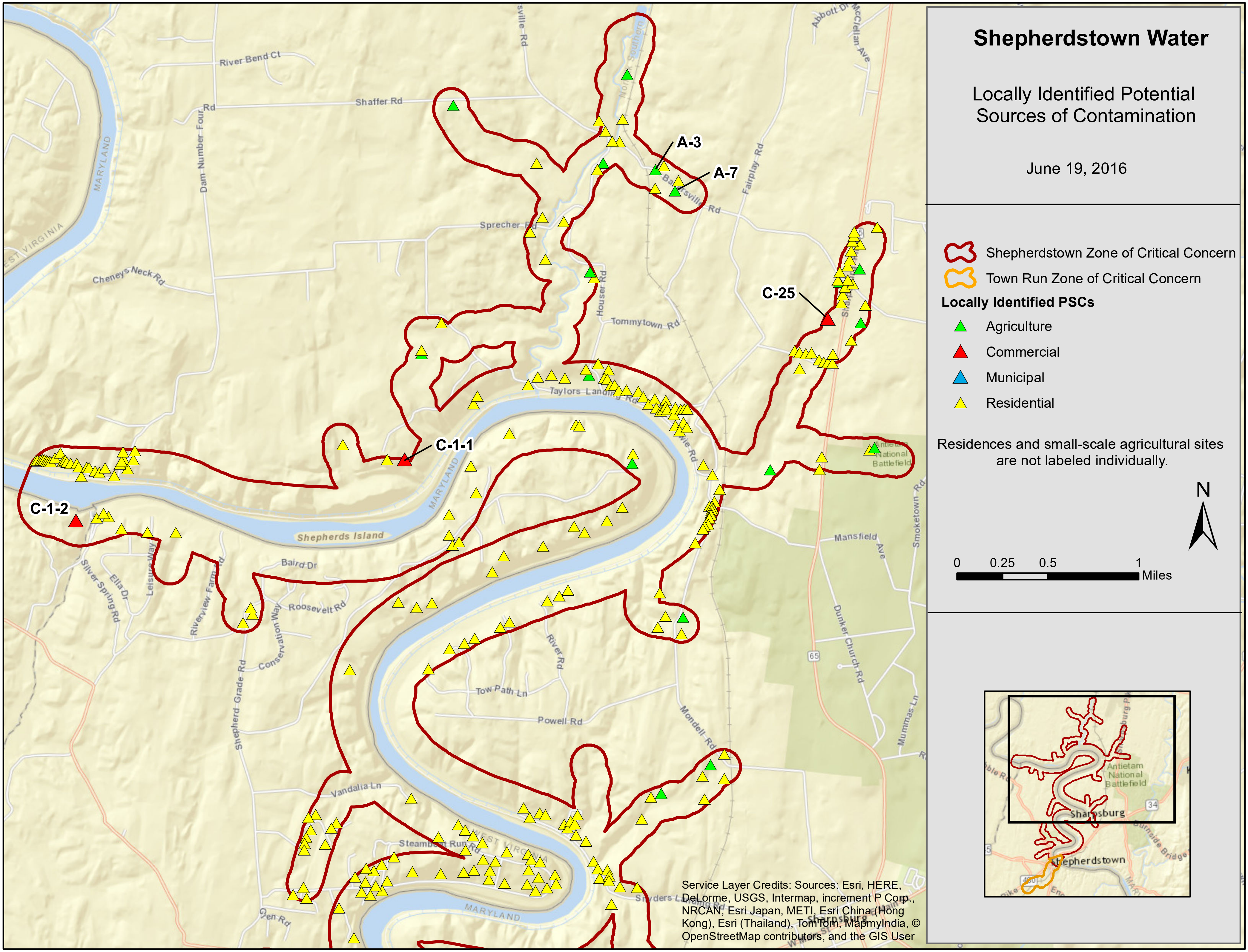
Map Code	Site Name	Site Description	Comments	BPH Risk
A-3	Dale Price Farm	Potential confined animal feeding operation. There appears to be a large poultry house onsite.	Potential contaminants include livestock sewage wastes; nitrates; phosphates; chloride; chemical sprays and dips for controlling insect, bacterial, viral, and fungal pests on livestock; coliform and non-coliform bacteria; and viruses.	4.9
A-7	Unknown agricultural facility	An agricultural facility that contains a tree farm and additional row crops.	Potential contaminants include pesticides, fertilizer, gasoline, and motor oils from chemical applicators.	3.2
C-58-2	Shepherd University buildings	Two large Shepherd University buildings were identified here that are located just outside of the public sewer boundary.	Potential contaminants include solvents, pesticides, acids, alkalis, waste oils, machinery/vehicle servicing wastes, gasoline and heating oil from storage tanks, and general building wastes.	1.1
C-58-3	Shepherd University buildings	One Shepherd University building that is located outside the public sewer service boundary	Potential contaminants include solvents, pesticides, acids, alkalis, waste oils, machinery/vehicle servicing wastes, gasoline and heating oil from storage tanks, and general building wastes.	1.1
C-58-4	Shepherd University buildings	One Shepherd University building that is located outside the public sewer service boundary.	Potential contaminants include solvents, pesticides, acids, alkalis, waste oils, machinery/vehicle servicing wastes, gasoline and heating oil from storage tanks, and general building wastes.	1.1
C-1-1	Unknown	A facility with potential aboveground storage tanks present was identified at this location.	Aboveground storage tanks may contain large quantities of potentially hazardous chemicals that can leak into surface waterways if not properly maintained. The contents of the tanks at this location are unknown and should be investigated.	6.8
C-1-2	Unknown	A facility with potential aboveground storage tanks present was identified at this location.	Aboveground storage tanks may contain large quantities of potentially hazardous chemicals that can leak into surface waterways if not properly maintained. The contents of the tanks at this location are unknown and should be investigated.	6.8
C-25	Junkyard	Junkyard	Oils, antifreeze, and other automobile fluids may leak from the used automobiles and contaminate the source waters if not cleaned up and disposed of properly.	3.4

List of Locally Identified PSSCs (Potomac River)

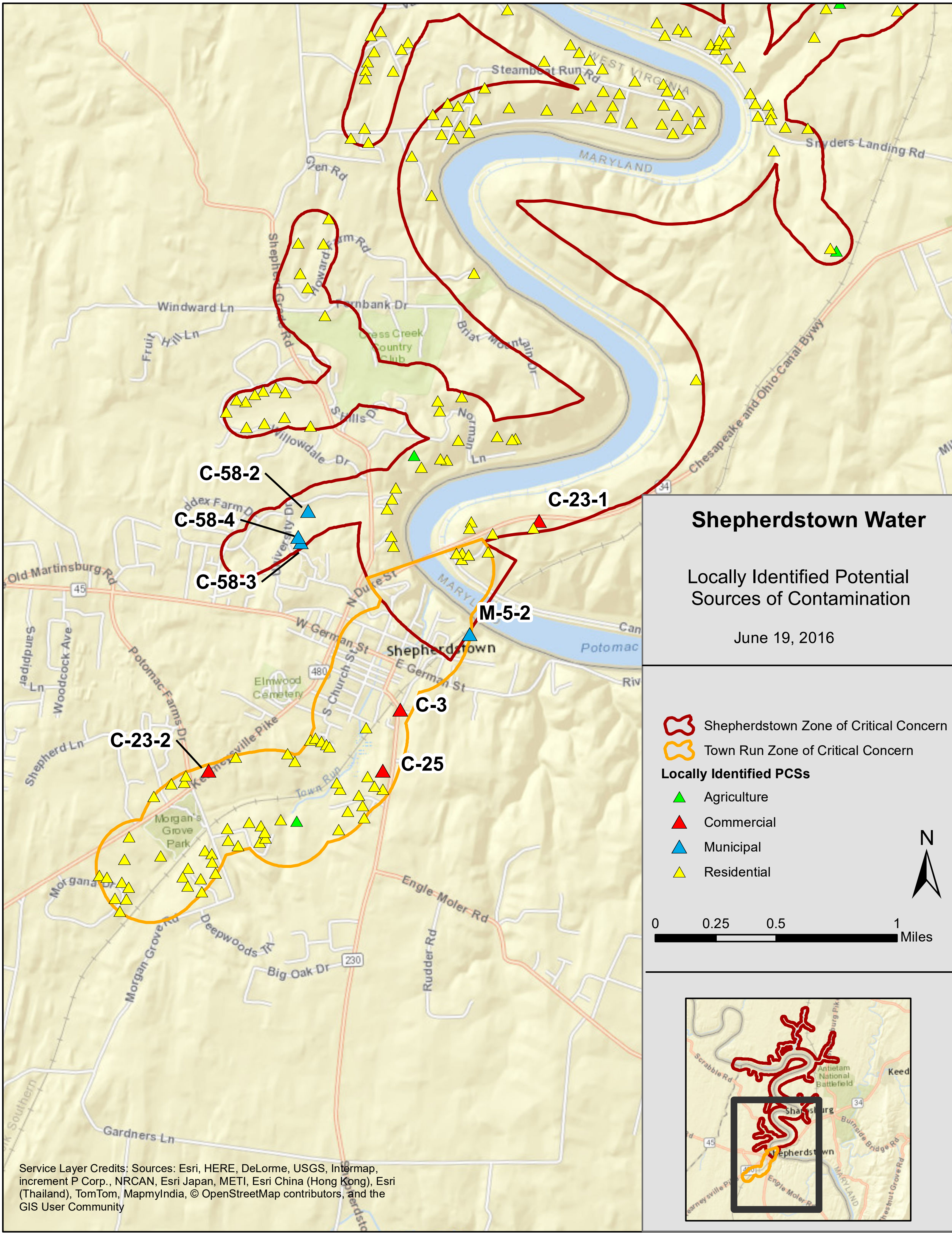
Map Code	Site Name	Site Description	Comments	BPH Risk
C-23-1	Historic gas station	Historic gas station	Potential contaminants include petroleum hydrocarbons, metals, and volatile organic compounds.	3.0
Not labeled individually	Agricultural land uses	17 locations were characterized as agricultural. This includes pastures, small crop plots, hay fields, greenhouses, and farms with some farm animals.	• Pesticides and other chemicals used for farm operations • Disposal of animal waste or burying dead livestock Increased nutrient load from these sources in surface water may result in algal growth. Algal presence may result in taste and odor issues. If stressed some algae also releases toxic chemicals that could cause a threat to human health	Variable.
Not labeled individually	Residential septic system	295 total residences located outside of the area served by the public sewer system were identified. It is assumed that each has a septic system.	Common household products, wall and furniture treatments, mechanical repair and maintenance products	2.3

List of Locally Identified PSSCs (Town Run)

Map Code	Site Name	Site Description	Comments	BPH Risk
C-3	Cool Green Auto & Tire	This is an auto shop on E. Washington Street.	Potential contaminants include waste oils, solvents, acids, paints, automotive wastes, and miscellaneous oils.	2.7
C-25	John Thompson	Junk yard	Oils, antifreeze, and other automobile fluids may leak from the used automobiles and contaminate the source waters if not cleaned up and disposed of properly.	3.4
M-5-2	Water Treatment Plant	Drinking Water Treatment Plant	Possibly related to the NOAA water treatment facility (PSSC number M-5 in SWAP PSSC table). Disinfection byproducts are a potential contaminant source.	1.5
C-23-2	Historic gas station/Sustainable Resources	Historic Gas Station that is now the site of Sustainable Resources, a natural resource management company.	Potential contaminants include petroleum hydrocarbons, metals, and volatile organic compounds.	3.0
Not labeled individually	Agricultural land uses	Small farm	• Pesticides and other chemicals used for farm operations • Disposal of animal waste or burying dead livestock Increased nutrient load from these sources in surface water may result in algal growth. Algal presence may result in taste and odor issues. If stressed some algae also releases toxic chemicals that could cause a threat to human health	4.9
Not labeled individually	Residential septic system	56 total residences located outside of the area served by the public sewer system were identified. It is assumed that each has a septic system.	Common household products, wall and furniture treatments, mechanical repair and maintenance products	2.3



Shepherdstown Water
Locally Identified Potential Sources of Contamination
June 19, 2016
Shepherdstown Zone of Critical Concern
Town Run Zone of Critical Concern
Locally Identified PSCs
Agriculture
Commercial
Municipal
Residential
Residences and small-scale agricultural sites are not labeled individually.
N
0 0.25 0.5 1 Miles
A-3
A-7
C-25
C-1-1
C-1-2
River Bend Ct
Shaffer Rd
Dam Number Four Rd
Sprecher Rd
Cheneys Neck Rd
Tommytown Rd
Taylors Landing Rd
Houser Rd
Fairplay Rd
Shepherds Island
Baird Dr
Roosevelt Rd
Silver Spring Rd
Ella Dr
Leisure Way
Riverview Farm Rd
Conservation Way
Shepherd Grade Rd
River Rd
Tow Path Ln
Powell Rd
Vandalia Ln
Steamboat Run Rd
Mondell Rd
Mansfield Ave
Dunker Church Rd
Smoketown Rd
Mummas Ln
Abbott Dr
McClellan Ave
Antietam National Battlefield
MARYLAND
WEST VIRGINIA
65
Sharpsburg
Shepherdstown
34
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User



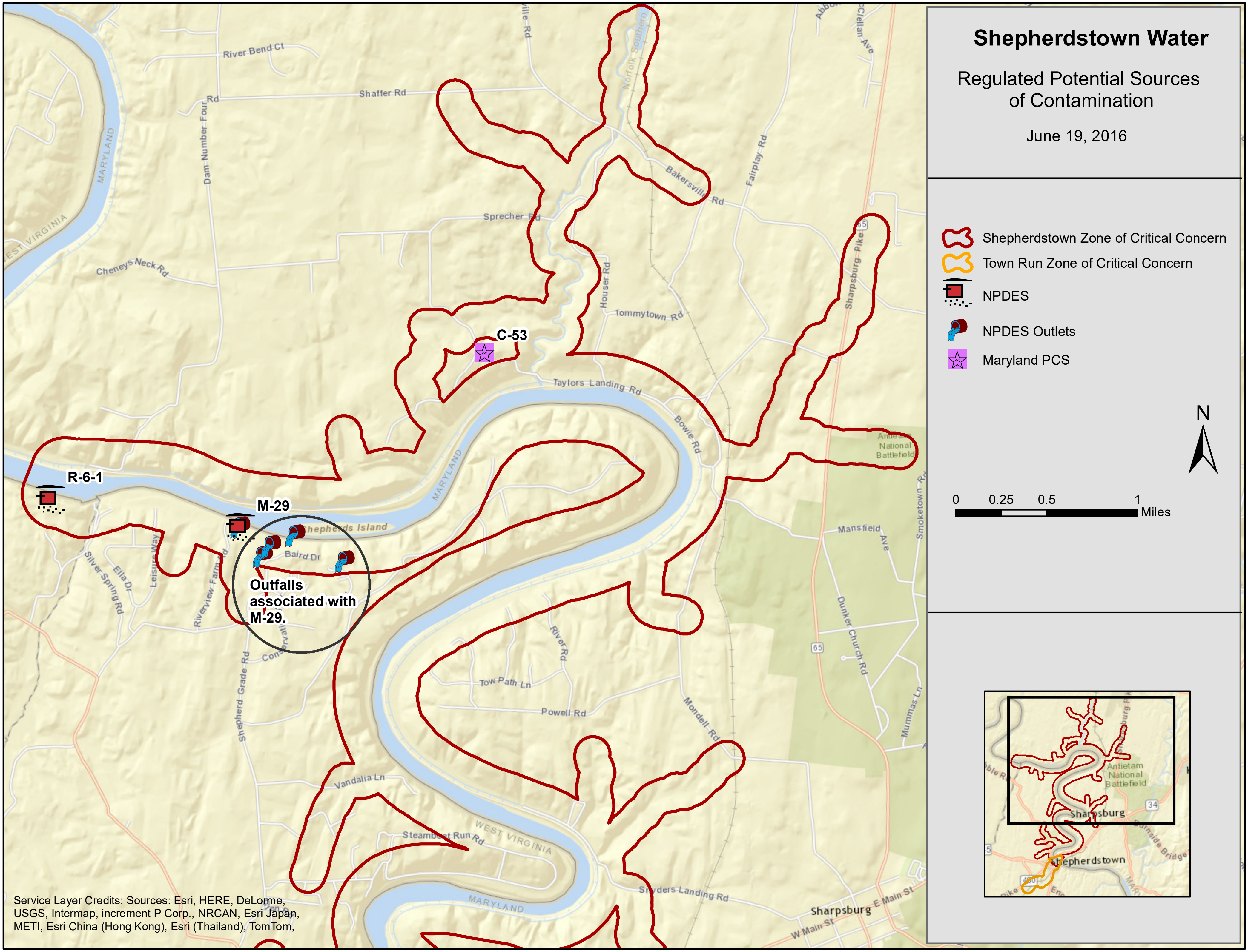
Shepherdstown Water
Locally Identified Potential Sources of Contamination
June 19, 2016
Shepherdstown Zone of Critical Concern
Town Run Zone of Critical Concern
Locally Identified PCSs
Agriculture
Commercial
Municipal
Residential
N
0
0.25
0.5
1
Miles
C-58-2
C-58-4
C-58-3
C-23-1
M-5-2
C-3
C-23-2
C-25
Steamboat Run Rd
WEST VIRGINIA
MARYLAND
Snyders Landing Rd
Glen Rd
Windward Ln
Fernbank Dr
Cress Creek Country Club
Willowdale Dr
Old Martinsburg Rd
W German St
E German St
Shepherdstown
N Duke St
S Church St
Elmwood Cemetery
Potomac
Chesapeake and Ohio Canal Bywy
Morgan's Grove Park
Engle Moler Rd
Deepwoods Tr
Big Oak Dr
Rudder Rd
Gardners Ln
Sandpiper Ln
Woodcock Ave
Potomac Farms Dr
Shepherd Ln
Morgan Grove Rd
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

List of Regulated PSSCs (Potomac River)

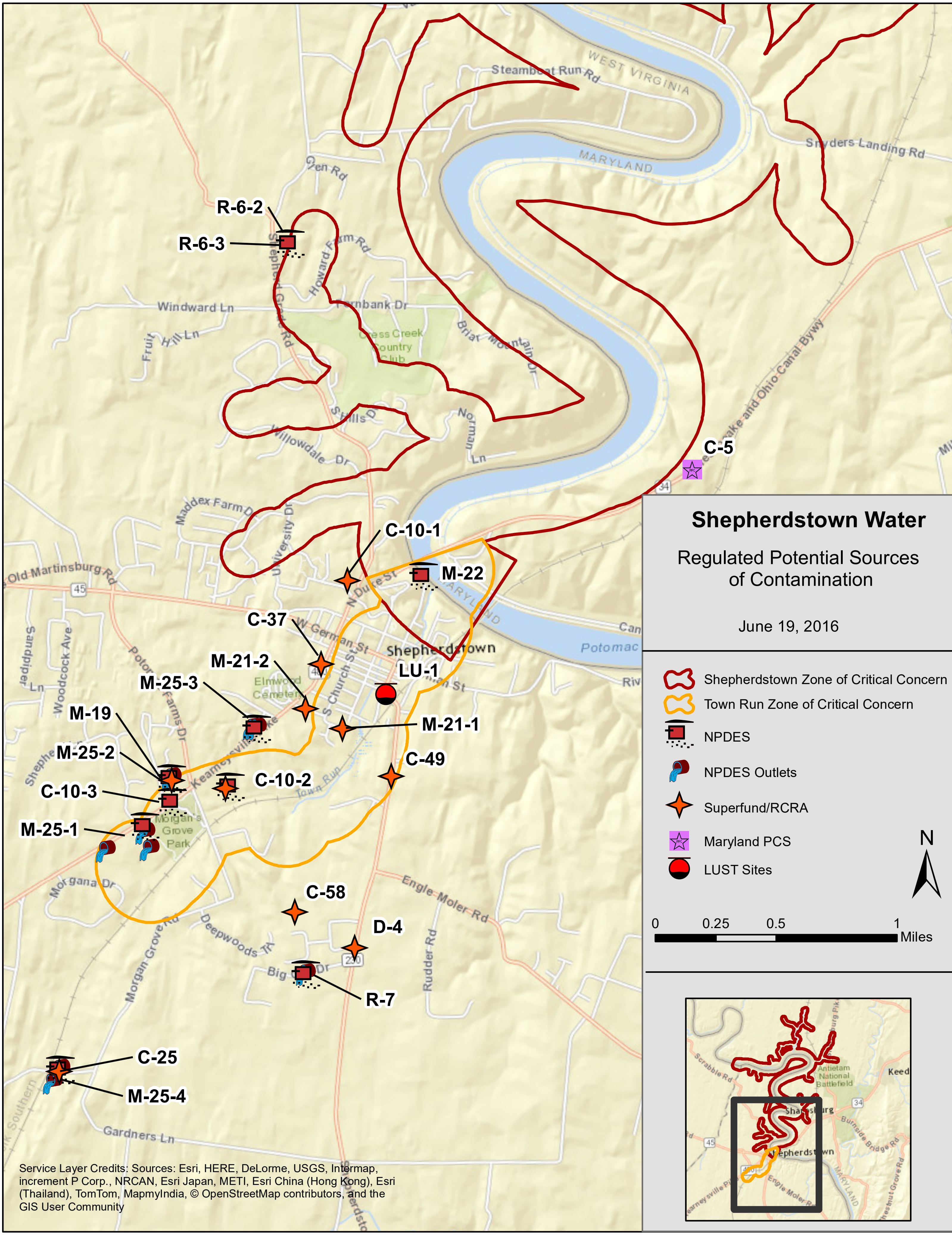
Map Code	Facility Name	Site Description	Database	Permit ID	BPH Risk
C-5	Canfield's Body Shop	Automotive body, paint, and interior repair and maintenance	Maryland PCS		2.8
C-53	Shepherd's Spring	Lodge, cabins. Amusement and recreation services, not elsewhere classified.	Maryland PCS		N/A
M-22	Potomac Portable Restrooms and Septic Service LLC	Sludge/Septic POTW Disposal (GP)	NPDES	WVSG20118	5.0
M-29	USFWS National Conservation Training Center	Water Treatment Facility operated by FWS. There are at least four and up to 9 potential tanks and several holding ponds onsite. 5 permitted outfalls.	NPDES	WV0105112	4.0
R-6-1	Longerbeam, Harry & Mary	Septic seal permit	NPDES	017367	2.1
R-6-2	Notting Hill HOA, John Kilroy	Septic seal permit	NPDES	036921	2.1
R-6-3	Notting Hill HOA, John Kilroy	Development, 15 septic seal permits Outside ZCC	NPDES	036920	2.1

List of Regulated PSSCs (Town Run)

Map Code	Facility Name	Site Description	Database	Permit ID	BPH Risk
C-10-1	Center For Contemporary Arts	Construction permit	Superfund/RCRA		3.5
C-10-2	Mark-Tollhouse Woods, LLC	Tollhouse Woods Subdivision	Superfund/RCRA NPDES	WVR102469	3.5
C-10-3	Asbury United Methodist Church	Church	NPDES	WVR106094	3.5
C-25	Capital Used Auto Parts Of Shepherdstown	RCRA facility	Superfund/RCRA		3.4
C-37	CVS Pharmacy #1428	Pharmacy	Superfund/RCRA		1.1
C-49	Cellco Partnership Dba Verizon Wireless	Utility substation transformer	Superfund/RCRA		2.9
C-58	Shepherd University	Small generator	Superfund/RCRA		1.1
D-4	Mercury Pickup - Rockenbaugh Site		Superfund/RCRA		4.5
LU-1	W H Knode's Sons	Leaking underground storage tank onsite	LUST	1901990	
M-19	Jefferson Recycling	Recycling Plant	Superfund/RCRA		2.4
M-21-1	Shepherdstown Elementary School	School	Superfund/RCRA		1.5
M-21-2	Shepherdstown Middle School	School	Superfund/RCRA		1.5
M-25-1	Town Run Commons	3 outlets	NPDES	WVR103534	4.1
M-25-2	Jefferson Recycling	1 outlet	NPDES	WVG610101	4.1
M-25-3	Hartzell Gardens	Storm water drainage wells, 8 outlets	NPDES	1061-07-037	4.1
M-25-4	Capital Used Auto Parts	2 outlets	NPDES	WVG611529	4.1
R-7	Covenant Baptist Church	Septic systems (Drain Field)	NPDES	1185-08-037	2.5



Shepherdstown Water
Regulated Potential Sources of Contamination
June 19, 2016
Shepherdstown Zone of Critical Concern
Town Run Zone of Critical Concern
NPDES
NPDES Outlets
Maryland PCS
N
0
0.25
0.5
1
Miles
R-6-1
M-29
C-53
Outfalls associated with M-29.
River Bend Ct
Shaffer Rd
Dam Number Four Rd
Sprecher Rd
Cheneys Neck Rd
Bakersville Rd
Fairplay Rd
Houser Rd
Tommytown Rd
Taylors Landing Rd
Bowie Rd
Sharpsburg Pike
Antietam National Battlefield
Mansfield Ave
Smoketown Rd
Dunker Church Rd
Mummas Ln
Shepherds Island
Baird Dr
Silver Spring Rd
Ella Dr
Leisure Way
Riverview Farm Rd
Shepherd Grade Rd
River Rd
Tow Path Ln
Powell Rd
Mondell Rd
Vandalia Ln
Steamboat Run Rd
WEST VIRGINIA
MARYLAND
Snyders Landing Rd
Sharpsburg
W Main St
E Main St
65
Shepherdstown
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom,



Shepherdstown Water
Regulated Potential Sources of Contamination
June 19, 2016
Shepherdstown Zone of Critical Concern
Town Run Zone of Critical Concern
NPDES
NPDES Outlets
Superfund/RCRA
Maryland PCS
LUST Sites
N
0
0.25
0.5
1
Miles
R-6-2
R-6-3
C-5
C-10-1
M-22
C-37
M-21-2
LU-1
M-25-3
M-19
M-21-1
M-25-2
C-49
C-10-3
C-10-2
M-25-1
C-58
D-4
R-7
C-25
M-25-4
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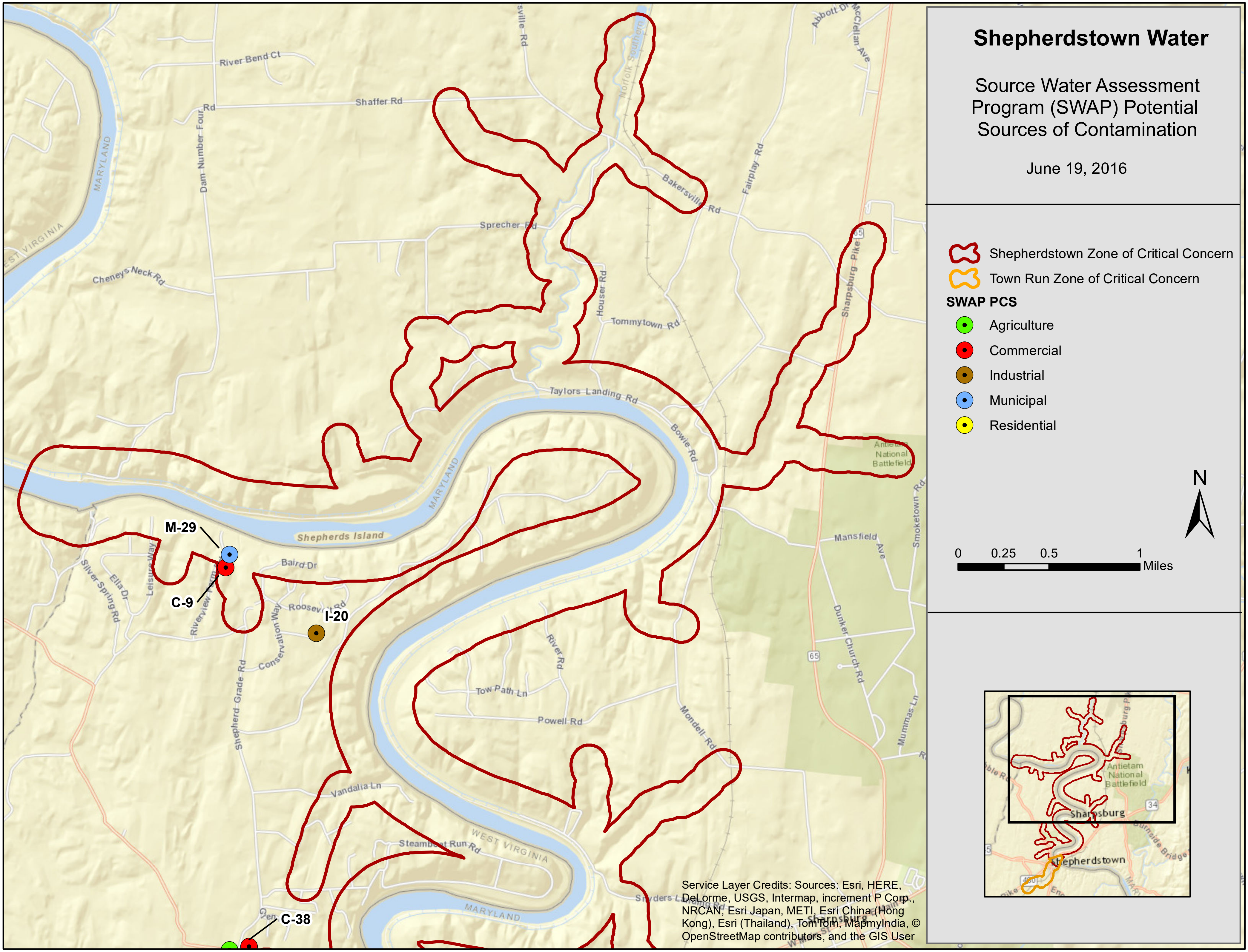
Source Water Assessment Program PSSCs

Potomac River

Map Code	Facility Name	Site Description	BPH Risk
A-7-1	Crops field/grazing field	Crops, corn, soybean, wheat	3.4
C-20	Cress Creek Golf Course	Golf courses, clubhouse	1.2
C-38	Specialty Binding, Inc.	Septic tank location	1.6
C-9	USFWS National Conservation Training Center	Cemeteries	1.2
I-20	USFWS National Conservation Training Center	Machine and metalworking shops	2.6
M-24	Storm Drain	Storm Drains, in neighborhood by golf course	4.2
M-29	USFWS National Conservation Training Center	Wastewater treatment plant	4
M-7	Rumsey Bridge	Highway, bridge on N. Duke Street crossing Potomac River	6.2

Town Run

Map Code	Facility Name	Site Description	BPH Risk
C-30	Boat Launch Area	Marina/boat docks. Concrete boat launch by bridge.	1
C-35	Shepherd University Parking Lot A	Parking lots/malls	1.5
C-41	Railroad Crossing	Railroad infrastructure, outside of Morgan Grove Park near spring	10
C-58	Shepherd University	Schools, buildings associated with University	1.1
M-32	Morgan Grove Park	Natural spring covered by building	
M-5	Noaa Water Treatment Facility	Drinking water treatment plants	1.5
R-4	Residential (Single Family Homes)	Residential (single family homes)	2.3
R-6-4	Morgan Grove Park	Septic Systems (leach field), concession stands and bathrooms	2.1


Shepherdstown Water
Source Water Assessment Program (SWAP) Potential Sources of Contamination
June 19, 2016
Shepherdstown Zone of Critical Concern
Town Run Zone of Critical Concern
SWAP PCS
Agriculture
Commercial
Industrial
Municipal
Residential
N
0
0.25
0.5
1
Miles
M-29
C-9
I-20
C-38
Shepherds Island
MARYLAND
WEST VIRGINIA
River Bend Ct
Shaffer Rd
Dam Number Four Rd
Cheneys Neck Rd
Sprecher Rd
Bakersville Rd
Fairplay Rd
Houser Rd
Tommytown Rd
Sharpsburg Pike
Taylors Landing Rd
Bowie Rd
Antietam National Battlefield
Mansfield Ave
Smoketown Rd
Baird Dr
Silver Spring Rd
Ella Dr
Leisure Way
Riverview Farm
Roosevelt Rd
Conservation Way
Shepherd Grade Rd
River Rd
Tow Path Ln
Powell Rd
Dunker Church Rd
Mummas Ln
Mondell Rd
Vandalia Ln
Steamboat Run Rd
Snyders Landing Rd
Sharpsburg
Shepherdstown
Service Layer Credits: Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User

Shepherdstown Water
Source Water Assessment Program (SWAP) Potential Sources of Contamination
June 19, 2016
Shepherdstown Zone of Critical Concern
Town Run Zone of Critical Concern
SWAP PCS
Agriculture
Commercial
Industrial
Municipal
Residential
N
0
0.25
0.5
1
Miles
A-7-1
C-38
M-24
C-20
M-7
C-30
C-58
M-5
C-35
R-6-4
M-32
C-41
R-4
Shepherdstown
Steamboat Run Rd
WEST VIRGINIA
MARYLAND
Snyders Landing Rd
Windward Ln
Fernbank Dr
Briar Mountain Dr
Norman Ln
Willowdale Dr
Maddex Farm Dr
University Dr
Old Martinsburg Rd
Chesapeake and Ohio Canal Bywy
Potomac
E German St
S Church St
Elmwood Cemetery
Potomac Farms Dr
Woodcock Ave
Sandpiper Ln
Shepherd Ln
Kearneysville Pike
Town Run
Morgana Dr
Morgan Grove Rd
Deepwoods Trl
Engle Moler Rd
Big Oak Dr
Rudder Rd
Gardners Ln
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List of Above Ground Storage Tanks

WV Department of Environmental Protection Database

[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]

[redacted]

[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]
[redacted]	[redacted]

APPENDIX B. EARLY WARNING MONITORING SYSTEM INFORMATION

Proposed Early Warning Monitoring System Worksheet – Surface Water Source

Describe the type of early warning detection equipment that could be installed, including the design.
The early warning detection equipment that could be installed includes a level controller, display module, back panel, level & trough (see cost estimate by Hach Company in **Appendix E**) along with conductivity, oil-in-water, ORP, and pH sensors.
Where would the equipment be located?
Early warning monitoring systems would be located on the raw water intake line where Potomac River surface water would enter the laboratory in the water treatment facility, or upstream of the raw water intake on the Potomac River.
What would the maintenance plan for the monitoring equipment entail?
The proposed maintenance plan for the monitoring equipment shall consist of annual cleaning and/or exchanging of the probe(s) for the controller. Periodic calibration of the unit may also be required.
Describe the proposed sampling plan at the monitoring site.
Sampling of water quality data occurs every fifteen (15) minutes allowing near real time observation at the water treatment facility.
Describe the proposed procedures for data management and analysis.
Data management for the early warning monitoring system consists of data points (up to 500 points or approximately six months per probe) being recorded in the "History" of the controller data collector. To access the "History", the probe has to be plugged into the controller. Data is able to be removed via USB or through a local SCADA system.

Literature related to the development and design of early warning systems is provided in the following pages courtesy of the American Water Works Association.

BY RICHARD W. GULLICK, LEAH J. GAFFNEY, CHRISTOPHER S. CROCKETT, JERRY SCHULTE, AND ANDREW J. GAVIN

Developing regional early warning systems FOR US SOURCE WATERS

REGIONAL EARLY WARNING SYSTEMS HELP IMPROVE MONITORING CAPABILITIES, FACILITATE COMMUNICATION AMONG UTILITIES, AND REDUCE RISKS TO PUBLIC HEALTH.

Early warning systems (EWSs) are used by water utilities to detect sudden changes in source water quality and are intended to provide information necessary to implement appropriate responses such as closing intakes or changing treatment methods. Rivers with several intakes over some distance are good candidates for multiple monitoring stations and coordinated data management and communication systems. In the United States, experience with such regional EWSs has largely been limited to the Ohio River and Lower Mississippi River. That situation has changed, however, with the recent development (or impending development) of regional systems on several other US rivers, including the Upper Mississippi, Schuylkill, Delaware, Allegheny, Monongahela, and Susquehanna. This article discusses the characteristics and ongoing development of these systems and the lessons learned through that process. These lessons may be applied to establish new regional EWSs on other rivers in the United States and elsewhere.

EWS OPERATIONS HAVE COMMON FUNCTIONS AND CHARACTERISTICS

Why EWSs are needed. Most raw drinking water sources are susceptible to disruptions in quality as a result of accidental, intentional, or natural contamination. To protect consumers from potentially harmful contaminants, avoid treatment process upsets, and ensure compliance with environmental regulations, utilities must respond rapidly to spills and other sudden pollution events and make appropriate adjustments in drinking water treatment and operations. The timely information provided by an EWS can help guide utility response decisions and ensure that such decisions reflect actual data and circumstances. EWSs are used mostly on riverine systems where water quality can change rapidly (as a result of a barge spill near an intake, for example); the systems are used less frequently for impoundments and rarely for groundwater.

Systems take various forms, serve several purposes. EWSs comprise a combination of frequent or continuous monitoring, other detection mechanisms, institutional arrangements, analysis tools, and response protocols. Certain components are common to all capable EWSs and include the following:

• *Detection:* a monitoring mechanism to detect pollution events and/or a public or self-reporting program.

• *Characterization:* a means to confirm and more completely characterize the event.

• *Communication:* the dissemination of data and other information to utility personnel and other decision-makers and response actions to the public and other stakeholders.

• *Response:* actions taken to minimize the potential effect of the contamination event. Responses could include source containment and/or cleanup, closure of water intakes and use of alternate sources or storage, and treatment process modifications.

Early warning monitoring can be used to detect rapid deterioration in water quality resulting from accidental or intentional discharges of toxic and hazardous chemicals near an intake. Such events as large-scale boat spills, pipeline breaks, industrial accidents, and terrorist attacks may be low in probability but can have significant consequences for water supplies. EWSs are also useful for monitoring during extreme natural events (such as heavy rains and flooding and algal blooms) and somewhat predictable events (such as seasonal runoff of herbicides).

Furthermore, EWSs can serve as a pollution prevention tool by tracking spill events and garnering information (to warrant followup activities and actions by agencies or prevention activities at similar sites), detecting unauthorized waste discharges, and serving as a sentinel of river water quality. In this last capacity, EWSs may tend to increase the number of spills reported but decrease the total number of spills, perhaps because of greater diligence on the part of potential dischargers.

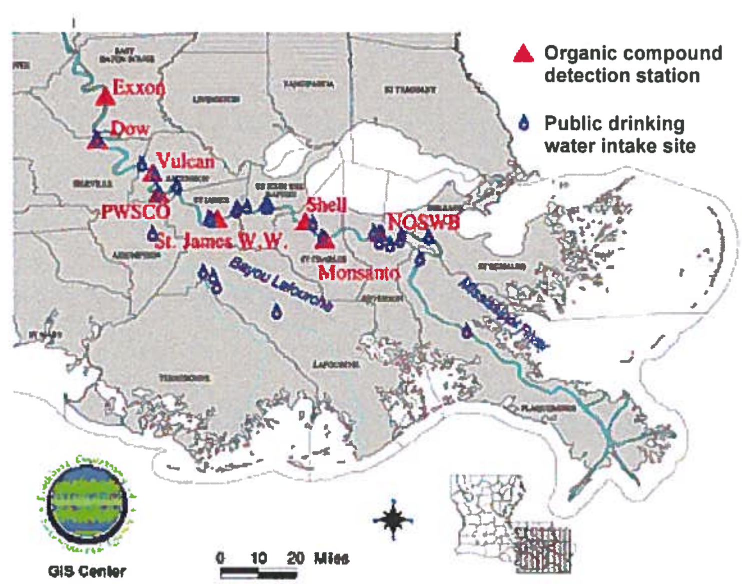
EWS scope depends on site-specific characteristics. Onsite early warning monitoring may be conducted by a single water supplier (e.g., a single instrument at an intake). However, source waters used by multiple water utilities (e.g., a large river) offer opportunities for cooperation and pooling of resources for development of integrated regional EWSs, including multiple monitoring stations, centralized data management and assessment, and coordinated information communication systems. This article uses the term "regional EWS" to refer to a system with multiple users and/or monitoring stations.

Most regional EWSs are developed in a phased approach that incorporates additional monitoring capability over time. Monitoring techniques range from relatively simple online measurements (e.g., pH, turbidity) to video surveillance to advanced analytical instrumentation to the use of living organisms as bioalarms. Gullick and colleagues (2003)

FIGURE 1 ORSANCO Organics Detection System stations on the Ohio River

ORSANCO—Ohio River Valley Water Sanitation Commission

FIGURE 2 Lower Mississippi River Early Warning Organic Compound Detection System



Source: Louisiana Department of Environmental Quality discuss EWS design for water utilities and the types of monitoring methods available; other references provide additional detail (Grayman et al, 2001; Gullick, 2001; Foran & Brosnan, 2000; ILSI, 1999). The sidebar on page 72 summarizes benefits provided by regional EWSs.

EXISTING SYSTEMS PROVE VALUE OF EARLY WARNING MONITORING

On many rivers, there is no systemic monitoring for sudden water quality changes, and no coordinated communication or central reporting system currently exists. Around the world, relatively few regional EWSs exist using monitoring, modeling, and communications in an integrated system to provide warning of contaminants in the source water. Several prominent systems (most of them located in Europe or Asia) were described in detail by Grayman and coworkers (2001) and summarized by Gullick and colleagues (2003). Many of these systems were developed in response to a specific contamination incident.

These systems are diverse but share some characteristics. They may vary greatly in their degree of complexity and in terms of the frequency of analysis and degree of automation. The more sophisticated networks include a coordinated monitoring, modeling, communication, and response program for an extended stretch of river. In all cases, some form of institutional structure coordinates efforts and communicates information so that appropriate actions can be taken.

Ohio River Organics Detection System. The most established regional EWS in the United States is led by Ohio River Valley Water Sanitation Commission (ORSANCO) on the Ohio River. The Ohio River is a source of drinking water for about 3 million people, and more than 25 million people live in the watershed. The river is also heavily industrialized in sections, serves a significant amount of commercial barge traffic, and has hundreds of municipal, industrial, and combined sewer overflow discharges. The EWS includes 15 gas chromatograph stations at various locations to detect and monitor organic chemical spills (Figure 1). Data management and communications are coordinated by a single central office that communicates to utilities the nature of any detected spills or other changes in river water quality.

EWSs alert utilities of contaminants and allow them to initiate cleanups such as this one along the Schuylkill River following a chemical spill caused by a train derailment.

PHOTO CHAD PINDAR, PHILADELPHIA (PA) WATER DEPT

Most of the monitoring stations are operated by water utilities at their intakes; others are run by industrial facilities. These organizations provide labor and space for sampling and analysis stations; analytical instruments are purchased and maintained by ORSANCO. All stations analyze at least one sample a day. Using a centralized data-analysis system and state-of-the-science contaminant transport models, ORSANCO is often able to provide utilities with specific estimates regarding the concentration–distance–time profile of chemicals spilled in the river. This information helps water utilities decide when to close their intakes and/or how to respond with modifications in treatment processes.

Lower Mississippi River early warning organic compound detection system. Another regional EWS is located in Louisiana on a 128 mi (206 km) stretch of the Lower Mississippi River from Baton Rouge to New Orleans (Figure 2). The system includes eight gas chromatographs (operated by three water utilities and five industries) monitoring for volatile organic chemicals. Although there is no central coordinating agency, the system is overseen by the Louisiana Department of Environmental Quality, which also provided financial support to purchase and maintain the gas chromatographs, accessories, and data-transmitting devices. The utility and industrial monitoring sites provide lab space and workers to analyze the samples. This system was inspired by the ORSANCO example and helps to protect the 1.5 million Louisiana residents who depend on the river for their drinking water supply (Grayman et al, 2001).

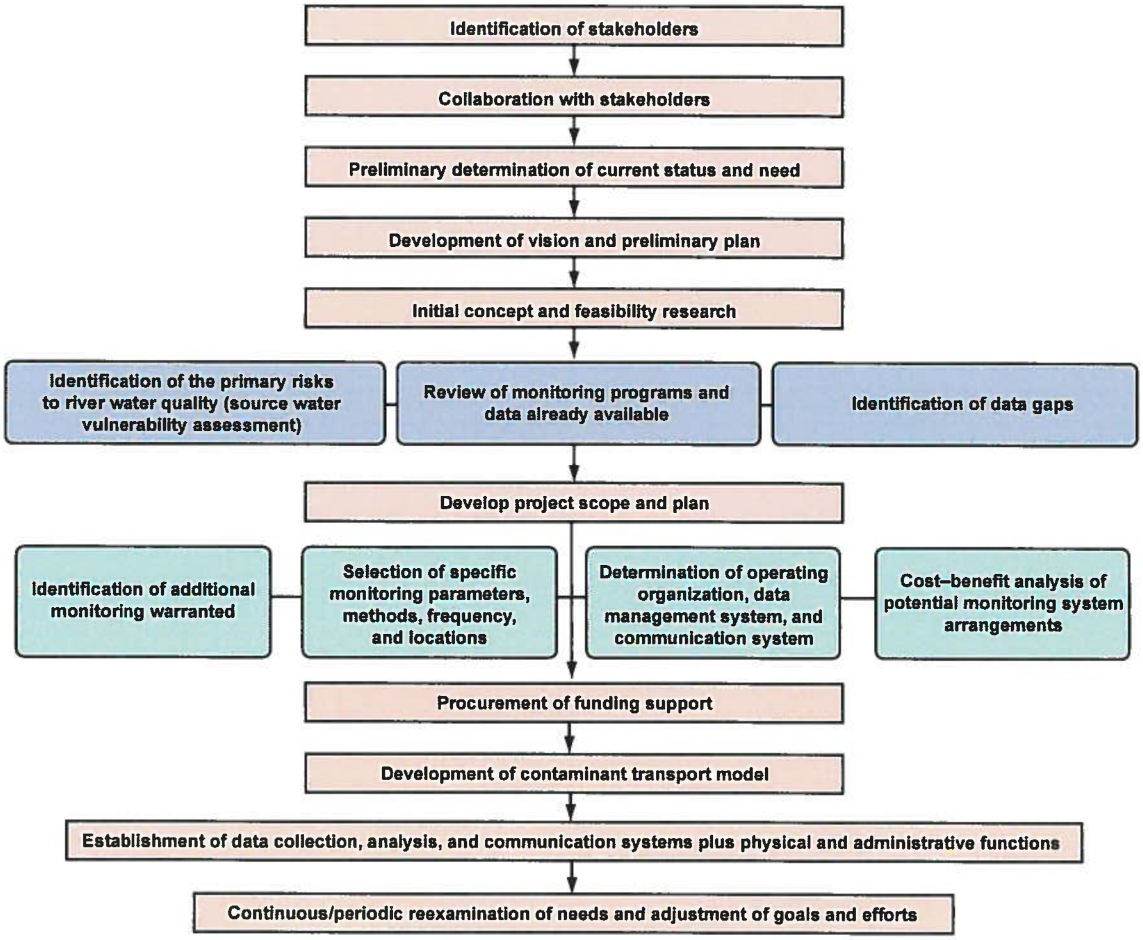
EARLY WARNING MONITORING IS ON THE RISE IN THE UNITED STATES

Interest in regional EWSs has increased in recent years, with systems currently in development for the Upper Mississippi, Schuylkill, Delaware, Allegheny, Monongahela, and Susquehanna rivers (Gullick, 2003). These systems are being designed to answer system-specific needs, and they reflect their individual locations and participating entities. However, the regional EWSs also have some characteristics in common. To some degree, each EWS was modeled after parts of the ORSANCO system, and each aspires to achieve these shared goals:

- Provide prompt notification of significant watershed events to downstream users.
- Provide information and tools to aid water suppliers in making decisions.
- Develop a framework to share information about water quality.
- Improve communication among water suppliers about water quality events.
- Improve communication between water suppliers and emergency responders.

The primary processes involved in the development of a typical regional EWS are shown in Figure 3. The following sections describe the monitoring and communication systems being developed as of April 2004 for the Delaware Valley, Upper Mississippi River, Allegheny and Monongahela rivers, and Susquehanna River.

FIGURE 3 Processes involved in the development of a typical regional early warning system



Delaware Valley (Schuylkill and Delaware rivers). The Delaware River Basin (Figure 4) drains an area of 13,300 sq mi (34,447 km^2) in the states of New York, Pennsylvania, New Jersey, and Delaware. The Delaware River is the longest undammed river east of the Mississippi, stretching 330 mi (531 km) from its headwaters in New York state to the mouth of the Delaware Bay (PWD, 2002). The Schuylkill River is 130 mi (209 km) long and is the largest tributary to the Delaware River. Its basin drains an area of 1,900 sq mi (4,921 km^2) in Pennsylvania.

The Delaware and Schuylkill rivers serve as the source water for more than 3 million people in southeastern Pennsylvania and southwestern New Jersey. Although both rivers originate in rural areas, their confluence in the Delaware Estuary promoted the development of the urban, industrial, and shipping center that is the Philadelphia–Camden metropolitan area. Their location and upstream activities render the rivers highly vulnerable to water quality contamination events and ideal candidates for a source water EWS.

Utility spearheaded EWS development. The Philadelphia Water Department (PWD) operates the three drinking water treatment plants farthest downstream on the Delaware and Schuylkill rivers. The utility gained familiarity with both watersheds during development of the Source Water Assessment Program (PWD, 2002). While working with neighboring water suppliers, PWD identified the need and gathered support for the development of a watershedwide EWS. In the aftermath of Sept. 11, 2001, and after five years of campaigning, PWD received a one-year, $725,000 grant from the Pennsylvania Department of Environmental Protection (PADEP) to develop an EWS. Although the monetary resources were significant, the one-year time frame posed a significant challenge.

PWD sought stakeholder input. From the beginning, stakeholder involvement was an integral part of the EWS development. Even before the grant was awarded, PWD approached a select group of water utilities to gain their support, identify the overall goals of the EWS, and develop the basis for a proposal. After PADEP awarded the grant and

POTENTIAL BENEFITS OF REGIONAL EARLY WARNING SYSTEMS

A regional early warning system shared and supported by a group of water providers offers numerous benefits.

- Improved monitoring can detect sudden changes in river water quality.
- Identification of spills/releases that are unknown to the dischargers may help them to prevent similar releases in the future.
- Communication of contamination events to water utilities is improved.
- Better information on contamination events allows for better response decisions.
- The overall risk to the public from spill events is reduced.
- Water providers share more kinds of information, and communication among utilities is increased.
- Monitoring efforts on the river are better coordinated.
- The system can serve as a monitoring sentinel, thus promoting greater diligence on the part of potential dischargers.
- Public confidence in potable water quality is improved.
- Additional information provided by the system can help in responding to the press during spill events.
- A central data warehouse may be beneficial to researchers studying the river.
- Source water protection of a large river is complex and may not be feasible. Time, energy, and money may be better spent on reliable early notification systems and installation of water treatment processes to deal with potential contamination events.

Adapted from Gullick et al, 2003

the project was formally under way, PWD approached a broader group of stakeholders through a series of meetings, site visits, and surveys. This group included representatives from 14 water utilities along the main stem of the Schuylkill and Delaware rivers, county emergency management agencies, and regulatory agencies (e.g., PADEP) the New Jersey Department of Environmental Protection, and the US Environmental Protection Agency (USEPA), as well as other organizations such as the US Geological Survey (USGS), the Delaware River Basin Commission, and the US Army Corps of Engineers (USACE). This diverse group brought a wide array of experiences, capabilities, priorities, and needs to the EWS development process. This in turn created both greater opportunities and significant challenges in meeting the varied expectations.

Input from the stakeholders helped to identify their needs and resources and enabled the design of an EWS that complemented existing emergency notification and response protocols. In addition, the stakeholder process identified the need for a system that could provide information and tools useful in the daily operation of a water treatment plant. This provision increases the overall value of the system and encourages users to become acquainted with the system as part of their routine operations.

System developed quickly. The Delaware Valley EWS was designed to provide the infrastructure for a notification, communication, monitoring and data-management system that could expand and develop over time. The objectives during the first year of the project were to build a framework that would support emergency notifications, promote routine information-sharing, and demonstrate the potential for a watershedwide water quality EWS. The resulting EWS is a fully integrated computer-based system that includes three major components: a telephone-based notification system, a website and data-management system, and a water quality-monitoring network (Figure 5).

The telephone notification system is an off-the-shelf application that was customized for the Delaware Valley EWS. The telephony system accepts calls from emergency responders or water utility personnel, records event information provided via touch-tone responses to a standard question-and-answer process, and makes telephone and e-mail notifications. The telephony system is integrated with the EWS server and can forward event information to the EWS database and website.

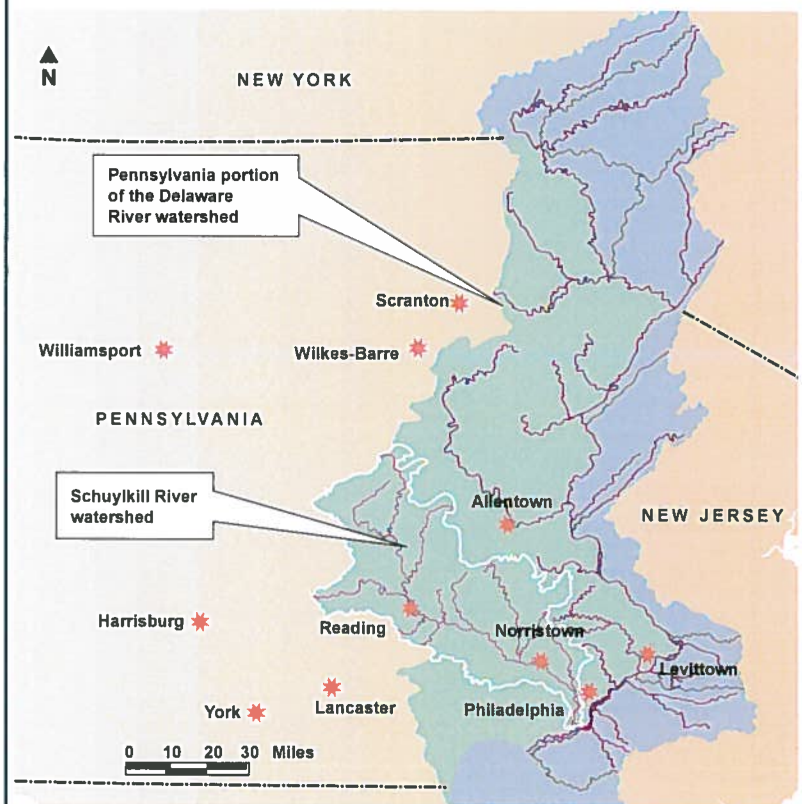
The computer server, which houses the website, data-management system, and telephony system, is the core of the Delaware Valley EWS and the central location for all EWS information. The data-management system stores and organizes information about contamination events, water quality, and plant operational characteristics in an accessible format. The result is a unique and powerful tool that sets this EWS apart from others currently in operation.

The Delaware Valley EWS website provides a dynamic and interactive user interface to the database, allowing users to access and share event and water quality information in a centralized and secure location. Various user interface formats are available, including forms for reporting and viewing the details of a water quality event (Figure 6), maps to identify the location of an event (Figure 7), graphs that show water quality data (Figure 8), and a time-of-travel estimator (Figure 9). The estimator uses real-time flow data from USGS gauging stations to provide plug-flow travel time estimates for each intake based on river conditions at the time of the event. To provide additional boundaries on this rough estimate, the historical highest flow and lowest flow on record at the gauging stations are used with a hydrodynamic water quality model to provide estimates of the earliest and latest times it would take for the spill to reach a downstream intake.

The water quality monitoring network compiles both near real-time and historic water quality data. The near real-time portion of the network uses simple and readily available technology to transmit data from remote monitors to the EWS server on a set time interval. Continuous monitors are located at select water treatment plant intakes and USGS gauging stations. Real-time monitoring was initially limited to simple water quality parameters such as turbidity and pH, but the network will be expanded in future years as monitoring technologies advance and additional monitoring needs are identified. In addition to the near real-time data, utilities will submit the results of their routine operational monitoring, creating a historical database that can be compared with real-time data.

Automation was essential to system design. One of the great challenges in designing this system was meeting the requirement that it operate essentially unstaffed. This is a different approach from that taken by many existing systems, which use an organization to oversee the monitoring and notification process 24 hours a day, seven days a week. With the Delaware Valley EWS, once an event is reported via telephone or the Internet, the system automatically performs the time-of-travel estimations and notifies downstream users. System users then supplement the event description by reporting updates and additional information to the website. This inherent reliance on the users places the success of the Delaware Valley EWS firmly in their hands.

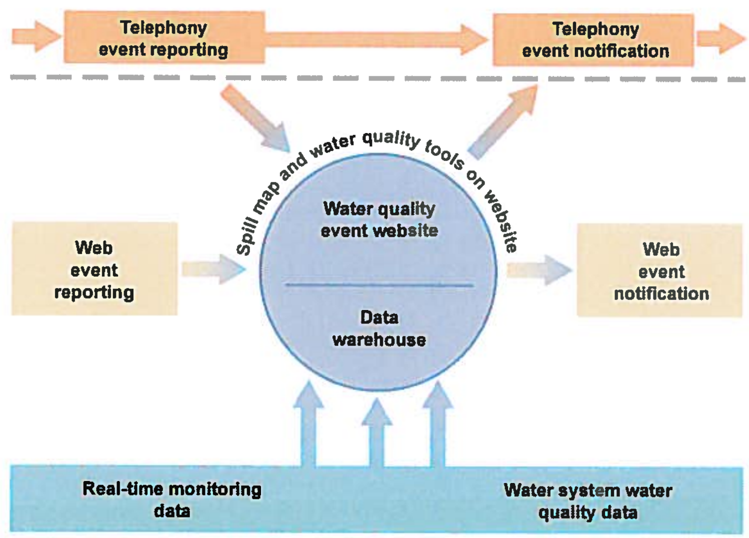
FIGURE 4 Delaware River Basin



Steps were taken to ensure organizational sustainability. Maintaining stakeholder partnership will be crucial to the long-term success of the Delaware Valley system. A steering committee was formed to act as the EWS governing body and to promote sustainability by giving stakeholders a more active role in defining the future of the system to meet their needs. The steering committee will identify issues and make decisions to guide the system's future development and maintenance, as well as locate and allocate funding. The steering committee comprises the nine voting seats of participating utilities (Table 1). Government agencies and other organizations do not have voting seats but participate by serving in an advisory role. Steering committee meetings are open to all stakeholders.

Implementation demonstrated system's value. During the first three months of EWS operation, seven water quality events of varying types and magnitudes were reported. Three events were associated with algal blooms or taste-and-odor events and their effects. One was related to high ammonia concentrations from road salt runoff affecting water treatment, and another was attributable to sewage main breaks spilling into the river. The final two events were related to spills—one a fuel spill of unknown origin and the other a tanker truck accident. The tanker truck accident in particular demonstrated the value of the Delaware Valley EWS. Initially the tanker truck was reported to have overturned on a bridge over the river just 3 mi (5 km) upstream of an intake, releasing approximately 100 gal (379 L) of diesel fuel into the river. During this event, the EWS was able to assist emergency response personnel and provide timely notification and pertinent data to downstream water sup-

FIGURE 5 Delaware Valley early warning system schematic



pliers so they could initiate their respective responses to the event with the best available information.

As system uses multiply, support for the Delaware Valley EWS grows. The response and enthusiasm for participation in the Delaware Valley EWS have been positive, and more industrial users, water suppliers, and organizations are participating in the system as word spreads and users are trained. For example, a county health department requested that the system be expanded to include its entire county. The growing support for the EWS is due primarily to the potential of the system's alternative uses that indirectly benefit the day-to-day activities of participants. Examples of indirect uses being explored include: health departments turning to the EWS for help with investigating disease clusters related to recreational waterborne outbreaks, food and beverage manufacturers obtaining advance warning of potential water quality changes that might affect processing, water suppliers obtaining official reports to justify additional chemical costs (e.g., carbon addition) during events, emergency responders using EWS data to assist in documenting accidents, and recreational events and users relying on the system for forecasts of water quality. As these potential multiple uses evolve, the usefulness and the long-term success and sustainability of the system increase.

Upper Mississippi River. The Upper Mississippi River refers to the approximately 1,300 mi (2,092 km) stretch of the Mississippi River from the headwaters to the confluence with the Ohio River at Cairo, Ill. (Figure 10). This definition excludes the Missouri River, the river's largest tributary. Other significant tributaries of the Upper Mississippi include the Illinois, Minnesota, St. Croix, Wisconsin, and Kaskaskia rivers (UMRBA et al, 2004).

A vital economic link for America's heartland, the Upper Mississippi River supports commercial navigation, water supply, recreation, wildlife, and waste-discharge assimilation. The river is a major transportation artery, and land use along its banks ranges from major metropolitan areas to rural farmland. A system of 29 locks and dams maintains a 9 ft (3 m) deep channel, allowing navigation as far upstream as Minneapolis, Minn. (UMRBA et al, 2004). The drainage area for the Upper Mississippi River is approximately 189,000 sq mi (489,510 km^2), primarily from the five states bordering the river (Minnesota, Wisconsin, Iowa, Illinois, and Missouri). The average flow of the river as it approaches Cairo is approximately 121 bgd (458 GL/d).

The Upper Mississippi River has 26 drinking water suppliers with a total of 29 intakes over an 874 mi (1,407 km) stretch from Minnesota to Missouri. Of these suppliers, 23 are community systems, and the remainder are industrial facilities (noncommunity systems). These 26 water suppliers combined provide approximately 360 mgd (1,363 ML/d) of potable water to almost 3 million people. There are three drinking water intakes between St. Cloud and the Twin Cities of Minneapolis and St. Paul in Minnesota. Then for a stretch of 370 mi (595 km) there are no drinking water intakes downstream until the Quad Cities (Davenport, Rock Island, Molina, and Bettendorf) of Illinois and Iowa.

Regional organization assumes project leadership. Initially the work to develop a regional EWS on the Upper Mississippi River was led by American Water, a privately owned water supplier with four intakes on the river (Gullick, 2001). With the support of Region 5 of the USEPA, the Upper Mississippi River Basin Association (UMRBA), an organization representing the five states bordering the river, eventually took over the lead for assessing the potential for a regional EWS. UMRBA then formed an official Upper Missouri River EWS scoping group to help explore design and operational issues. The group includes representatives of drinking water suppliers and state and federal response and drinking water programs.

Key stakeholders contribute to EWS development. Following American Water's first efforts to assess the potential for a regional EWS on the Upper Mississippi River, other entities have made important contributions to this collaborative effort. In addition to the water suppliers, UMRBA has been instrumental throughout the project. UMRBA coordinates the efforts of the Upper Mississippi River Hazardous Spills Coordination Group, composed of state and federal agencies that have various response-related roles on the river. Discussions were also held with many of the individual agency members of the spills group, including USEPA and USACE. Representatives from ORSANCO and a research project sponsored by the AWWA Research Foundation (Grayman et al, 2001) served as consultants and provided significant advice and input.

Coalition of water suppliers formed. Realizing that the support of the water suppliers on the river would be crucial to development of a regional EWS, American Water initiated steps early on to organize these providers into a coalition to better represent their collective interests. The first meeting of the Upper Mississippi River Water Suppliers Coalition was held in October 2001 in Davenport, Iowa. The primary goals of the coalition are to establish a formal communication network for the water suppliers on the river, develop a regional EWS, promote source water protection practices, provide educational opportunities for the membership and their consumers, develop working relationships with other river stakeholders, and serve as a resource clearinghouse for river water quality and related information.

Coalition members can include both public and privately owned water utilities as well as industries and other organizations that operate noncommunity water systems using the Upper Mississippi River as a source. State and federal agencies responsible for drinking water, river pollution, and spills response also participate in the coalition's meetings, although they are not official members of the coalition and have no voting powers.

A series of meetings and conference calls was held to initiate the project. More stakeholders have become involved at each step of the process and particularly at each of the meetings. One primary focus for the water suppliers was to encourage the spills group and the relevant state and federal agencies (public water supply and hazardous spill–response divisions) to support development of a monitoring network. On more than one occasion, the water suppliers coalition and the spills group have met jointly, providing opportunities to exchange experiences, perspectives, and concerns.

Existing monitoring programs identified. One important early step in the process was to identify and describe the existing river water quality monitoring programs conducted by the water suppliers as well as federal, state, and local agencies to ascertain what information would be useful for early warning monitoring. This investigation showed that despite the existence of numerous water quality monitoring programs on the Upper Mississippi River, little monitoring was being performed that would be applicable to an EWS because of the types of parameters monitored (primarily oriented toward Clean Water Act compliance or measurement of ecological health), the relatively low frequency of monitoring (e.g., once every two weeks or monthly), and the location of most of the monitoring stations substantial distances away from the water supply intakes (Gullick, 2001).

A survey of the water suppliers was used to identify the type and frequency of source water monitoring already being performed, as well as the primary risks to river water quality. Oil and petroleum products, bacteria, algae, ammonia, and pesticides (herbicides and/or insecticides) were identified as the most common contaminants of the source water. According to the water suppliers, the leading sources of contaminants on the river were barge and boat spills, industrial spills, low flows, wastewater treatment plants, and runoff. Transportation accidents were viewed as by far the biggest threat.

Despite these risks to water quality, however, the same survey indicated that little monitoring was being performed to provide advance warning of many of these contaminants.

FIGURE 6 Sample Delaware Valley early warning system user interface screen for a hypothetical spill event—water quality event report form

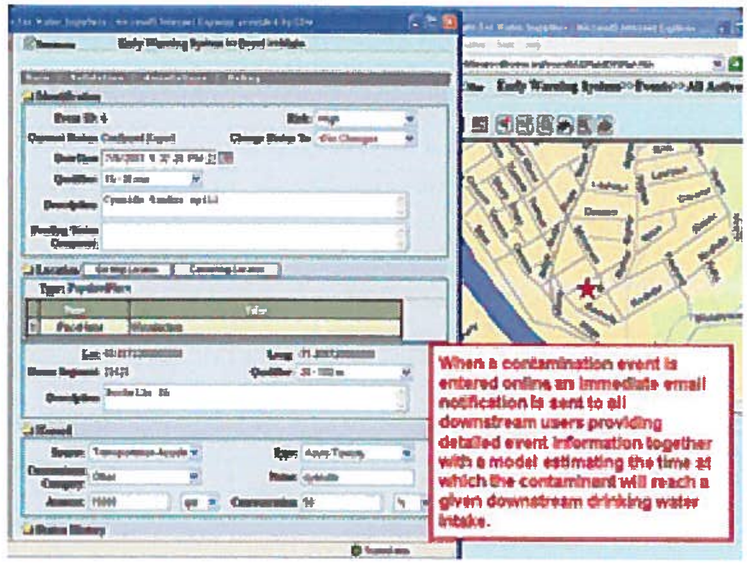
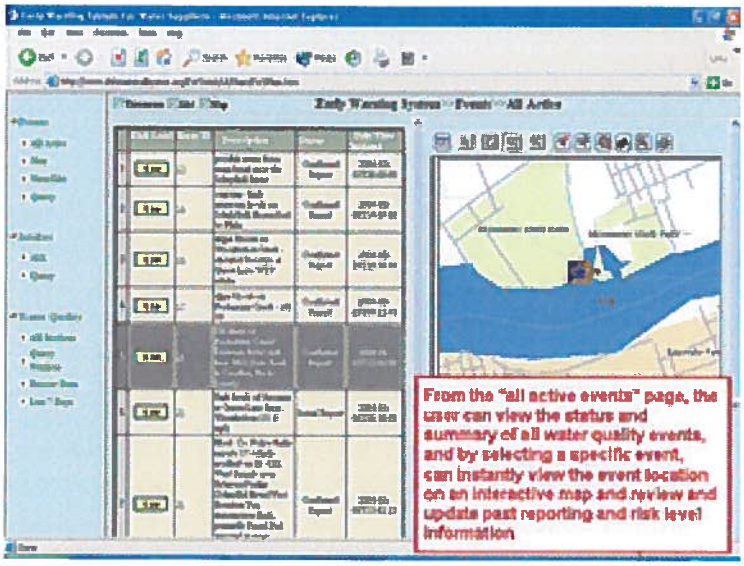


FIGURE 7 Delaware Valley early warning system user interface for a hypothetical spill event—all active events screen



Daily or frequent monitoring by intake operators was generally limited to basic physical and chemical parameters such as pH, turbidity, nutrients, and suspended solids. Turbidity and pH were the only two parameters that all of the survey respondents measured at least once a day, and only eight suppliers had continuous monitors for one or both of these parameters. Sampling frequencies for other parameters varied greatly and were typically low. In summary, the water quality data being collected were insufficient to support a regional EWS, and no central reporting system existed to track water quality data produced by the suppliers.

Funding draws on a range of sources. Initial financial support came from American Water and UMRBA, primarily in terms of personnel to perform the first exploratory work. More recently, USEPA Region 5 has provided up to $75,000 through a cooperative agreement with UMRBA to support the scoping effort and acquire monitoring equipment for a pilot station; USEPA has also provided additional contractor assistance in designing the system. Additional support has come from in-kind contributions of time from various members of the scoping group and water suppliers coalition.

Work proceeds on data collection, analysis, and dissemination system. Data-management and communication-system options are still being developed as part of the scoping effort. In April 2003, the scoping group surveyed members of the suppliers coalition concerning information dissemination and spill notification. Seventeen of the 23 organizations with intakes responded, generally expressing strong interest in a secure, web-based system that would notify them of contamination, provide ongoing information during an incident, and afford an opportunity to exchange information concerning routine operations. Most respondents indicated a willingness to share their own monitoring and testing results with other participants in the system, assuming a reasonable level of security could be ensured. This would allow the utilities to exchange data on parameters for which they test either routinely or seasonally but that may not be part of the EWS protocol; such parameters include bacteria, oxidant demand, and atrazine. The EWS scoping group is considering the results of this survey, as well as the experience of other EWSs, in identifying the key components of a data collection, analysis, and dissemination system. Particular attention will be paid to the potential to build off of one or more of the frameworks already in use or under development by the other regional EWSs discussed in this article.

Pilot program launched for Upper Mississippi River EWS. The EWS scoping group is currently coordinating implementation of a pilot monitoring station that is slated to include a multiparameter probe[1] for pH, turbidity, chlorophyll, conductivity, dissolved oxygen, temperature, and oxidation–reduction potential, as well as a continuous online fluorescence detector[2] for oil and petroleum products. The multiparameter probe was deployed in October 2003, and the initial experience with this equipment has generally been positive. Efforts are ongoing to address site and operating requirements related to the fluorescence detector. The scoping group's intent is to operate the pilot station for a sufficient period to gain operating experience over different conditions (winter temperature and ice conditions in the region can be particularly severe), identify threshold values for the various parameters, and evaluate alternative data-transmission options. Initially, the pilot station is transmitting data via satellite to a USACE website.

The pilot monitoring station is located at one of the USACE lock and dam sites where a municipal water supply intake for the city of Rock Island, Ill., is located. This location allows the scoping group to pilot an interagency, cooperative approach to operation of an EWS station. Corps personnel have provided extensive technical support concerning equipment installation and data transmission while also assisting Rock Island city personnel in maintaining and calibrating the equipment. If this interagency approach for the pilot is successful, it may prove to be a model for the final design of a regional EWS for the Upper Mississippi River.

Potential monitoring locations considered. Facilities that may serve as monitoring locations for the Upper Mississippi EWS include the water treatment plants, existing USGS and state monitoring stations, USACE lock and dam locations, and industrial facilities such as power plants. Factors determining the selection of monitoring sites will include the locations of potential contamination sources in relation to the location of water supply intakes, the risk these sources pose, and the willingness of various entities to participate.

Cost estimates vary. One proposed network of nine monitoring locations was estimated to cost about \$550,000–\$600,000 in capital expenses, \$40,000–\$50,000 for system startup, and \$280,000–\$340,000 in annual operating costs (Gullick, 2001). This estimate included purchase of monitoring (multiparameter probe and fluorescence detector) and telemetry equipment, daily analysis of oxidant demand, seasonal daily immunoassay analyses for atrazine, sheds for housing equipment, operating costs for the data-management and communication systems, and other items. It also assumed in-kind support from the water suppliers with monitoring stations to perform analyses and report results. The EWS scoping group will develop a refined estimate that reflects experiences with the pilot station, recommended monitoring locations, desired information system features, and other factors.

Project moves forward. Bringing the EWS to fruition involves the following steps: (1) complete pilot program, (2) develop institutional structure (data-management center and communications system), (3) complete full-scale system design (including finalizing monitoring parameters, methods, locations, and frequency), (4) develop contaminant transport model, (5) obtain long-term funding, and (6) launch system setup and operation. Several of these efforts will take place concurrently.

FIGURE 8 Example of Delaware Valley early warning system user interface screen—water quality data query results

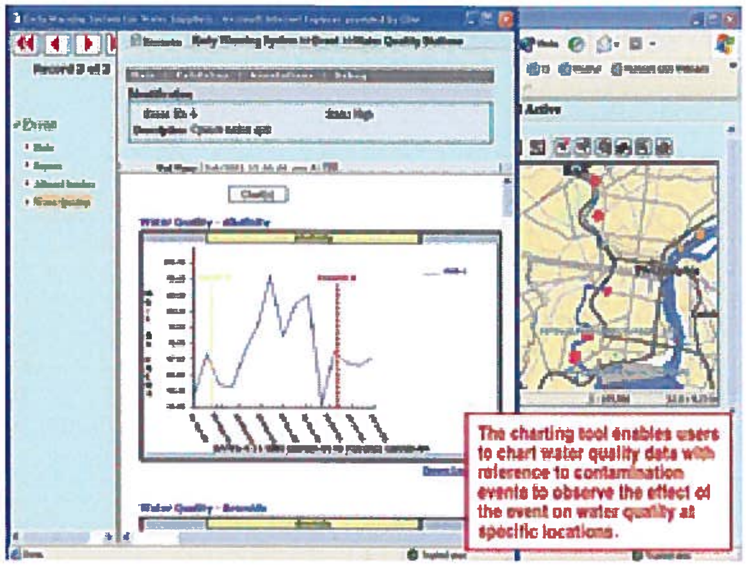
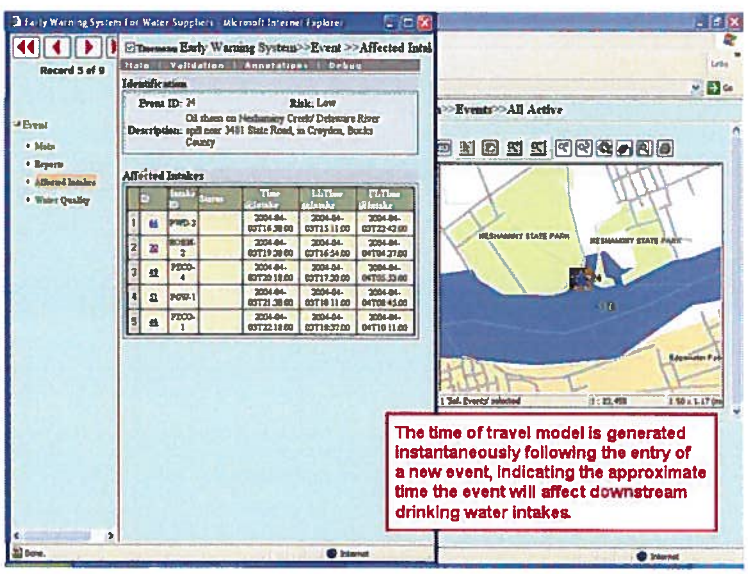


FIGURE 9 Example of Delaware Valley early warning system user interface screen for a hypothetical spill event—time-of-travel results



Allegheny and Monongahela rivers. The Allegheny and Monongahela rivers converge at Pittsburgh, Pa., where they form the Ohio River. The Allegheny River is 325 mi (523 km) long and drains 11,700 sq mi (30,303 km^2). There are 16 water suppliers on the Allegheny River serving 637,000 people. The Monongahela River is 128 mi (206 km) long and drains 7,400 sq mi

(19,166 km²). The 15 water suppliers on the Monongahela main stem serve approximately 771,000 people, and 4 water suppliers on the Youghiogheny River tributary serve 201,000 people. A system of locks and dams on the rivers supports commercial navigation; reservoirs located in the watersheds provide flood control storage. Figure 11 shows the Ohio River Basin area with the Allegheny and Monongahela rivers highlighted.

As noted previously, ORSANCO has operated a regional EWS on the Ohio River for many years. This Organics Detection System, however, provides organics monitoring only on the extreme lower reaches of these two Ohio River tributaries (the Allegheny and Monongahela rivers). In January 2002, the PADEP approached ORSANCO requesting assistance in establishing regional EWSs on these rivers, and PADEP provided $800,000 funding for system design and startup. Meetings held with drinking water utilities drawing from the Allegheny and Monongahela rivers found overwhelming support for the development and operation of a regional EWS.

System had to fit regional resources, capabilities. Initially envisioned as an expansion of the ORSANCO Organics Detection System, the Allegheny and Monongahela EWS evolved into an integrated source water monitoring network that would consider multiple parameters and host a secure website for the distribution of near real-time source water quality data. As part of the initial data-gathering effort, a suitability and susceptibility analysis of the drinking water utilities was conducted to evaluate each facility's needs and resources. The utilities located along the two river systems are relatively small; approximately 70% of the Allegheny and Monongahela river utilities serve 12,000 or fewer customers, with some serving as few as 1,000. Because utility plant personnel are already multitasking in their daily work, the addition or installation of any monitoring equipment that required significant time to operate, maintain, or interpret would not be accepted or successful.

FIGURE 10 Upper Mississippi River Basin

Source: USGS, 1999

In contrast to some other developing regional EWSs, the Allegheny and Monongahela system focused on enhanced monitoring of source waters. In 2002, instrument tests evaluated available online technologies that would provide useful source water quality data, require minimal time to operate and maintain, and deliver readily interpretable results. Test results were favorable for four types of water quality monitoring instruments: (1) a multiparameter probe measuring temperature, pH, conductivity, dissolved oxygen, chlorophyll, and turbidity; (2) a fluorometer measuring hydrocarbons or chlorophyll; (3) a total organic carbon analyzer; and (4) a portable, autosampling purge-and-trap gas chromatograph with argon ionization detector. Data gathered from these instruments can be transmitted via the Internet to a project computer server, displayed near real time on the website and archived for later assessment. Operation and maintenance time for this equipment was anticipated to be less than 1 hour per week.

A key step to the acceptance of this instrumentation was a demonstration of the proposed instruments to the water utilities. This helped allay concerns regarding the technical nature of the work required and the time commitment for operation and maintenance. Utility representatives provided input about which instruments they would be interested in supporting at their facility. This information provided the basis for the location and distribution of the monitoring equipment along the two rivers. Currently the Allegheny and Monongahela EWS has 11 monitoring locations operating a total of 7 multiparameter probes, 5 gas chromatographs, 3 total organic carbon analyzers, and 1 online fluorometer.

Another key component of the project was to foster the development of communications networks among the utilities. For several years, a communications network has existed on the Monongahela River for distribution of spill reports and spill information to downstream utilities. However, no such communication network existed on the Allegheny River. To answer this need, the Allegheny River Communication Network was organized during meetings of the Allegheny River utilities. The purpose of the group is to facilitate the exchange of spill and other water quality information of interest and concern to the drinking water providers.

This project has achieved and exceeded its initial goals. A state-of-the-art regional early warning system has been established that provides enhanced source water quality monitoring for multiple parameters, a mechanism for the distribution of these data in near real time via the Internet was developed, and a new communications network was created to facilitate information exchange among drinking water utilities using a common source water.

TABLE 1 Steering Committee for the Delaware Valley early warning system

Designated Voting Seats (Permanent)	Temporary Voting Seats (Annually Voted on by Membership)	Advisory Committee (Nonvoting)
Philadelphia (Pa.) Water Department	Trenton (N.J.) Water Works	Pennsylvania Department of Environmental Protection
Pennsylvania American Water Company (Hershey, Pa.)	Morrisville (Pa.) Municipal Authority	New Jersey Department of Environmental Protection
New Jersey American Water Company (Delran, N.J.)	Middlesex Water Company (Iselin, N.J.)	US Environmental Protection Agency
Aqua America Pennsylvania (Bryn Mawr, Pa.)	New Jersey Water Supply Authority (Clinton, N.J.)	Delaware River Basin Commission (West Trenton, N.J.)
	City of Pottstown (Pa.)	US Geological Survey

Susquehanna River. The main stem of the Susquehanna River flows 444 mi (715 km) from its headwaters at Otsego Lake in Cooperstown, N.Y., to the Chesapeake Bay. More than 20 public water systems within the Susquehanna Basin depend on the river as a source of drinking water; these systems serve in excess of 2.5 million people in New York, Pennsylvania, and Maryland. Twelve of these water suppliers draw from the main stem of the Susquehanna River in Pennsylvania. Figure 12 shows the Susquehanna River Basin and the location of some water suppliers participating in the EWS.

Commission spearheaded EWS development. Development of a regional EWS for these 12 water suppliers has been led by the Susquehanna River Basin Commission (SRBC), with the majority of funding provided by PADEP. In instigating the project, SRBC has taken a relatively progressive approach; many other regional EWSs have been developed because of requests from water suppliers to a basin commission (or association), as opposed to the basin commission initiating the effort. SRBC has a history of assisting water suppliers and has worked with Pennsylvania and Maryland since 1999 to develop Source Water Assessments (SWAs) required by the 1996 Amendments to the Safe Drinking Water Act. SWAs are designed to identify the susceptibility of water supplies to a variety of potential contamination sources and can provide information useful for establishment of source water protection and monitoring programs. SRBC also receives funds from USEPA to conduct water quality monitoring within its jurisdiction and assist with program coordination related to water quality issues.

Project scope defined. Initially, the EWS will extend only through the Pennsylvania part of the Susquehanna River Basin. However, SRBC and the states of New York and Maryland are engaged in discussions to extend the EWS into those jurisdictions.

The scope of work for developing this regional EWS entailed six major tasks in the first year of development:

- Task 1—establish a steering committee of different stakeholders.
- Task 2—establish an EWS project database.
- Task 3—establish a communications network that would coordinate large spills through the Pennsylvania Incident Response System and promote data-sharing by water utilities on a secure website.

FIGURE 11 Allegheny and Monongahela rivers

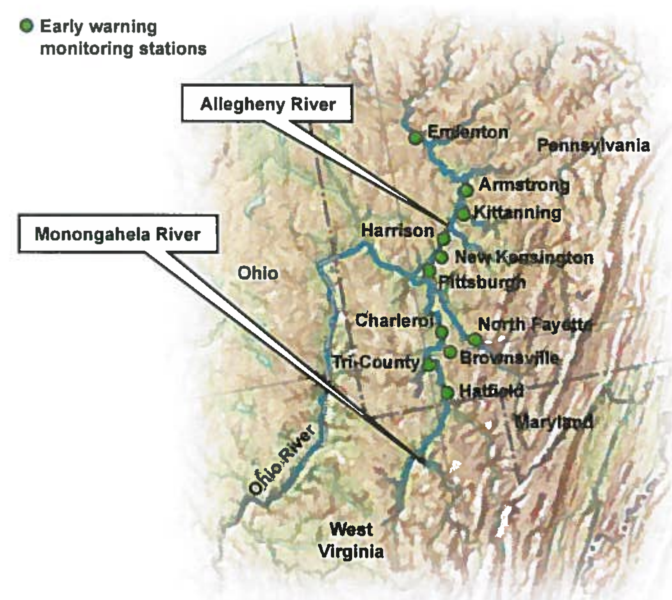


FIGURE 12 Susquehanna River Basin

• Task 4—design the full-scale monitoring system.

• Task 5—begin background work for development of a contaminant transport model.

• Task 6—assist water suppliers in connecting with other monitoring efforts (i.e., state and federal agency monitoring, citizen monitoring).

The initial phase of the project covered July 2002 through June 2003, during which time the framework for each of the six tasks was established. During the first year, three steering committee meetings were held, starting with a kickoff meeting in October 2002. Nine water suppliers have been active in the committee, assisting SRBC with decisions related to database and website design, monitoring data needs, emergency information needs, and contaminant information. Major efforts for the first year focused on establishing a website to serve as a hub for project communications and developing the monitoring resources needed to promote data exchanges and serve as indicator parameters for possible contamination events.

Communications efforts take off. A secure website was established and became operational in July 2003, allowing water suppliers to exchange water quality information and view emergency response bulletins and summaries distributed by PADEP. In addition, other information from project databases was made available through the website. Information includes stakeholder directories, contaminant inventories, project maps, Internet links to river flows and dam releases, and a time-of-travel calculator.

During the first year, development of the Susquehanna EWS focused on three baseline parameters: temperature, pH, and turbidity. By purchasing the equipment needed for online monitoring, SRBC increased the capabilities for five systems to provide real-time monitoring data for all three parameters. In addition, SRBC purchased a total organic carbon analyzer for another system that had existing online monitoring capabilities for the three base parameters. Beginning in July 2003, water suppliers started posting daily values to the website for temperature, pH, and turbidity. As of April 2004, three systems were posting data to the website at 4- to 6-hour intervals, and two more systems were expected to begin similar data posting soon.

Future plans focus on funding, system enhancement. In terms of future plans, SRBC will seek more stable funding for the operation and maintenance of the EWS and also investigate the potential for system enhancements and expansion. SRBC will be completing a study with USGS in December 2004 to characterize water quality and water velocity distributions across several transects of the Lower Susquehanna River. Because of the channel width and the presence of numerous islands and dams, the complex nature of the river presents challenges to establishing any sort of contaminant-tracking model. Study results should guide future model development efforts, as well as monitoring network enhancements.

LESSONS LEARNED OFFER ROAD MAP TO FUTURE EWS DEVELOPMENT

The development of regional EWSs in the United States has provided several lessons that can be applied to the successful establishment of similar systems on other rivers. These lessons center on securing strong water supplier involvement from an early stage, overcoming institutional constraints, obtaining initial funding for leading the project, and dealing with the sometimes very slow pace of a project of this magnitude.

Motivation for system development should not be driven by crisis. A specific chemical spill or release has been the initial impetus for development of several EWSs throughout the world. However, prudent utilities will not wait for an incident to occur on other rivers to provide incentive but instead will establish a system before occurrence of a large-scale contamination incident.

Stakeholder involvement can be the deciding factor in whether an EWS succeeds or fails. Cooperation between the affected water users, appropriate agencies, governments, and other stakeholders is critical to the development and operation of a successful regional EWS. In many instances, a variety of political jurisdictions may be involved, and EWS project leaders would do well to include input from these sectors.

Water supplier support is key. The most important collaboration within a regional EWS is that of the water providers themselves. Experience has shown that water utilities are the driving force and backbone for development of almost all regional EWSs, and their support and involvement are essential to EWS formation and operation. Without utility participation and endorsement, the project will likely not gain the necessary support from the applicable environmental agencies.

Limitations of water supplier resources must be recognized and reckoned with. Even if participating water providers offer strong conceptual support, their limitations of available time and money may prove an obstacle, and some suppliers may find it difficult to initially participate to the degree that they would prefer. The daily responsibilities of providing an adequate and safe drinking water supply for their communities keep many utilities (especially the smaller ones) fully occupied. Because of this, utility involvement in a long-term project such as a regional EWS may be sporadic. The successful EWS recognizes these limitations and makes the most of those resources that are available.

Individual leadership and institutional capacity must be developed. Someone must take the initial action to organize stakeholders and start the planning process. An organization must be identified to coordinate and manage the overall system (it often helps to have a single organization serve as the overall system coordinator). Funding must be obtained and data-management and communications systems developed. The primary obstacle to successful development of regional EWSs are often these and other institutional considerations, as opposed to the technological limitations presented by the monitoring methods currently available. Strong stakeholder support, particularly from water suppliers and other water users, can help overcome these obstacles.

Funding helps ensure project stability. Adequate resources must be available in the early stages of the process to lead and perform the initial project work. Continued progress will depend on outside funding, and as many potential sources as possible should be considered. Involvement of key environmental agencies can help identify funding sources and secure funding for continued operations.

Phased approach allows time for project to evolve. A phased approach to launching a regional EWS helps ensure that planners and users are not overwhelmed by the potential complexity of the proposed system. Instead of trying to gather support for a complete advanced system, project leaders may want to start small to showcase EWS uses and benefits. The system can then be expanded and fine-tuned over time as conditions dictate.

Salesmanship emphasizes obvious and not-so-obvious benefits of EWS. Much of the early work in developing a regional EWS involves convincing various stakeholders that the system is needed and will provide substantial benefit in comparison with expected costs. It helps to clearly define the program and its uses so that beneficiaries understand what they'll be getting and what they will need to do to participate in and benefit from the system. It can also help to emphasize less apparent advantages such as the coordinated communication and notification aspects of an EWS program.

Project team characteristics ultimately shape project outcome. If a regional EWS undertaking is to be successful, the core team leading the project must encompass certain characteristics. The numerous stakeholders participating in such a process (especially the many regulatory agencies and water suppliers) and the extensive institutional considerations involved may present challenges in resolving various views, priorities, and expectations. At times, the process of developing an EWS can be quite slow. Members of the project team must exhibit and maintain a high degree of motivation, determination, enthusiasm, patience, and perseverance. With these traits, the team can help prevent the project from coming to a standstill and lead it on a continuing course toward success.

WHAT DOES THE FUTURE HOLD FOR EARLY WARNING MONITORING?

The implementation of EWSs and regional EWSs within the United States is growing, and surveys by the AWWA Research Foundation indicate that most surface water users want these capabilities. It is anticipated that in the coming years, most major US river systems used as supplies for drinking water may develop these systems.

In the future, EWSs will likely become another part of routine activities for water systems in their multiple barrier approach. These systems will use extensively integrated information-management, data-management, and communication technologies that provide reliable and real-time information to all users as new technologies become available. The next generation of EWSs could include satellite communication, real-time monitoring technologies for pathogens as well as chemical and biowarfare agents, neural networks for predicting events based on current conditions, and web-based applications—all integrated with next-generation personal communication devices such as cell phones and personal digital assistants.

Stakeholder challenges to regional EWSs may significantly decrease as more systems are developed and demonstrate a degree of reliability, trust, cooperation, and value. Ultimately, regional EWSs that were developed individually could be tied together. For example, the systems for the Ohio River, Allegheny and Monongahela rivers, Lower Mississippi River, Upper Mississippi River, Delaware and Schuylkill rivers, and Susquehanna River could potentially be linked to create a "super-regional" EWS. This would enable individual regional systems to share relevant information, take advantage of administrative economies of scale, and work together to secure funding.

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FOOTNOTES

[1] Series 6 multiparameter probe, YSI Inc., Yellow Springs, Ohio

[2] Model TD-4100, Turner Designs Inc., Sunnyvale, Calif.

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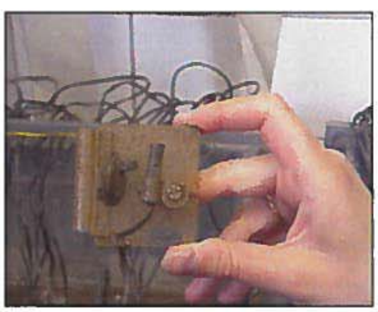
BY RICHARD W. GULLICK, WALTER M. GRAYMAN, ROLF A. DEININGER, AND RICHARD M. MALES

DESIGN OF Early Warning Monitoring Systems FOR SOURCE WATERS

WITH EARLY WARNING MONITORING SYSTEMS, WATER PROVIDERS CAN RESPOND MORE QUICKLY AND EFFECTIVELY TO CONTAMINATION OF WATER SUPPLIES.



This monitor uses a reed switch to detect whether the mussel's shell is open or closed. The mussels close their shells when sensitized by a toxicant.

Most raw drinking water sources are susceptible to a variety of disruptions in water quality as a result of accidental, intentional, or natural contamination. Rapid response to spills and other sudden pollution events is necessary to determine appropriate changes in drinking water treatment and operations in order to protect water consumers from potentially harmful contaminants, avoid treatment process upsets, and ensure compliance with environmental regulations. Early warning monitoring systems provide timely information on changes in source water quality so that knowledgeable response decisions can be made. Early warning systems can be a cost-effective mechanism for reducing risks, help boost public confidence in the water utility, and serve to encourage good practice and careful reporting on the part of dischargers.

Although the US Environmental Protection Agency (USEPA) does not mandate monitoring of raw water by water utilities, many utilities do so to some degree in order to (1) detect the existence of contaminants, (2) ascertain that existing treatment is adequate (and if not, to provide information that will help identify an appropriate improvement), and (3) provide real-time treatment process control. The monitoring data, however, are often limited regarding the number of parameters measured and the frequency of monitoring and may not be conducive to detecting spills and other sudden changes in water quality.

A 1999 survey of 153 water providers in the United States, Canada, and the United Kingdom found that a majority of utilities had experienced a significant source water contamination event in the past five years, adequate warning is not always available, the most serious perceived threats for the future are transportation accidents, and source water contamination is a significant issue that should be addressed through improved early warning systems (Grayman et al, 2001). The threats most commonly cited by drinking water utilities with intakes on rivers included spills of oil, petroleum, and chemical products from transportation accidents and pipeline and storage tank releases; insecticides and herbicides from agricultural runoff; and pathogens from untreated sewage discharges.

This article summarizes key results from two cooperative research projects (Grayman et al, 2001; Gullick, 2001). To examine the state of the art in early warning systems, these researchers surveyed utility practices and perceived needs for early warning and source water monitoring, performed a literature review of available monitoring methods, studied early warning systems around the world, examined case studies of monitoring practices at US utilities, developed a risk-based computer model for design and analysis of early warning systems, created a generic riverine contaminant transport model, and initiated development of an early warning monitoring network on the Upper Mississippi River. Though the principles of early warning monitoring apply to water quality changes from any source, this work focuses on source waters and does not directly address treated water in the distribution system or threats to the water supply infrastructure.

Multiple sampling ports on Germany's Rhine River are used to monitor water quality. The center two intakes monitor the general river water. The one close to shore represents and monitors the effluent of a large industrial complex located upstream on the same side of the river. The fourth intake is near the far shore to sample water that is primarily from an upstream tributary on that side of the river.

SYSTEM COMPONENTS AND CHARACTERISTICS DEFINED

Early warning systems include a combination of continuous or frequent monitoring, other detection mechanisms, institutional arrangements, analysis tools, and response mechanisms. They can be used to detect rapid deterioration in water quality resulting from accidental or intentional discharges of toxic and hazardous materials near an intake (e.g., low probability/high impact events such as large-scale boat spills, pipeline breaks, industrial accidents, terrorist attacks). They are also useful for monitoring during extreme natural events (e.g., heavy rains and flooding, algal blooms) and somewhat predictable events (e.g., seasonal runoff of herbicides). Early warning systems are used mostly on riverine systems where water quality can change rapidly (see example scenario in Figure 1), less frequently for impoundments, and rarely for groundwaters.

An ideal warning system features key components. The scope of an early warning monitoring program will depend on site-specific characteristics. Systems vary from a single instrument at an intake to large river systems with networks of sophisticated monitoring stations combined with coordinated data management and information communication systems. Certain components, however, are generic to all good early warning systems and include the following:

- detection—a monitoring mechanism to detect pollution events and/or a public or self-reporting program,
- characterization—a means to confirm and more completely characterize the event,
- communication—a way to disseminate data to utility personnel and other decision-makers as well as to inform the public of response actions, and
- response—actions that minimize the potential effect of the contamination event.

An ideal early warning monitor would cover all threats, monitor continuously, provide warning in suffi-

FIGURE 1 Schematic example of an early warning system

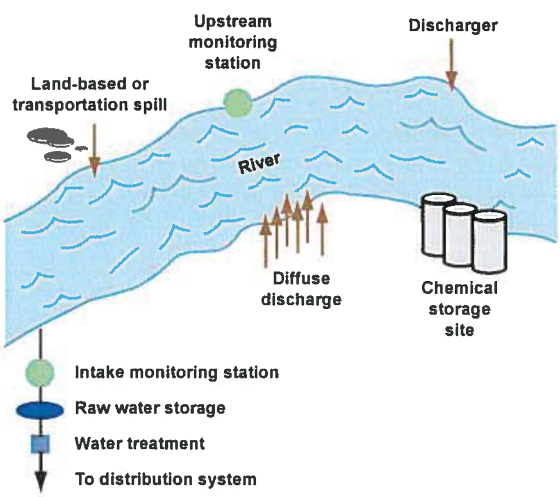
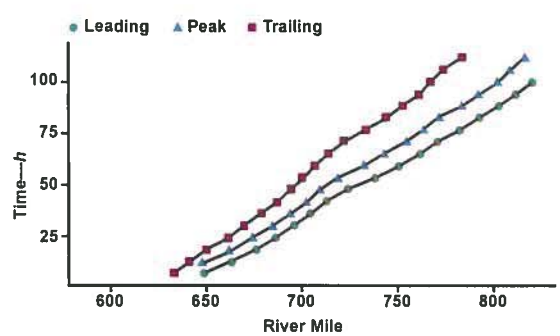


FIGURE 2 Example of riverine contaminant transport model output



Time of leading edge, peak, and trailing edge as predicted by model

Design Process and Components for Early Warning Monitoring Systems

- **Analysis of the need for early warning monitoring**
  - Preliminary vulnerability and susceptibility analysis
  - Review of available monitoring programs and data
- **Determination of program scope**
  - Selection of parameters to be monitored, monitoring methods, number and location of monitoring stations, and frequency of monitoring
  - Data management and interpretation
  - Cost–benefit analysis
- **Development of system organization and function**
  - Physical features
  - Administrative components
  - Response and communication plans
  - Funding
- **Implementation**
  - Monitoring program
  - Identification of response thresholds
  - Event confirmation procedures
  - Characterization of contamination
    - Data management, interpretation, and dissemination
    - Water quality modeling
  - Communication systems and plans
  - Response plans
- **System review and improvement**

cient time for action, give minimal false-positive or false-negative responses (such that the frequency of alarms is neither too high nor too low), be able to identify the source of contamination, be sensitive to water quality changes at regulatory levels, be reproducible and verifiable, require low skill level and training, allow remote operation, be affordable and robust, and function year-round (ILSI, 1999). Naturally, analysis of the system benefits, costs, and available resources may reduce the number of these characteristics that are applicable to specific situations, but the list provides guidance for development of such systems.

Monitoring techniques range from relatively simple online measurements of such parameters as pH and turbidity to video surveillance to advanced analytical instrumentation to the use of living organisms as bioalarms. Some methods (e.g., general water quality indicators such as bioalarms and dissolved oxygen [DO]) measure effects in the water, thus indicating that "something is not normal" but not necessarily what it is. Early warning monitors sometimes have less-sensitive detection levels than those of conventional monitoring, are often more qualitative and not compound-specific, and because they are concerned with identifying large changes in concentrations generally need less quality assurance/quality control (QA/ QC) than conventional or compliance monitoring.

DESIGN SHOULD BE INCORPORATED INTO OVERALL SYSTEM

Early warning systems should be viewed, designed, and operated as an integral part of the operation of the overall water supply system (including source water quality protection programs and monitors, as well as intake, storage, treatment, and distribution system characteristics) in order to minimize the risks associated with degraded drinking water quality under various cost and technology constraints. The key components and steps in development of an early warning monitoring system are summarized in the sidebar on this page.

The type and scope of the system to be developed should be guided primarily by the relative potential risks (source water vulnerability/susceptibility assessment), cost–benefit analysis, availability of resources and technical capabilities, and current treatment capabilities. In some water supplies, continuous monitoring of a select few parameters at, or just upstream of, the intake may be sufficient. In other cases, particularly on busy commercial rivers with numerous intakes and potential contamination sources, a more extensive and coordinated network may be appropriate. Some water utilities use early warning systems to assess the quality of multiple source waters in order to be able to continuously use the highest quality source of those available. Reducing the time between occurrence of an event and implementation of response actions is critical and is accomplished through selection of appropriate detection methods; prompt data review, confirmation, and event characterization; efficient communication infrastructure; and rapid relaying of information to decision-makers. The design of early warning monitoring systems has been discussed in the literature (Grayman et al, 2001; Gullick, 2001; Foran & Brosnan, 2000; ILSI, 1999). Sanders and colleagues (1983) examined the process for water quality monitoring system design, including statistical analyses for optimizing monitoring locations and frequency.

Vulnerability assessments help identify needs. The types of land and water uses and activities (e.g., industries, agriculture, transportation, and other commercial enterprises) located near a water source can be used to identify potential contamination scenarios, rank their relative potential occurrence and effect, and prioritize a list of pollutants of concern to be considered for monitoring. The vulnerability assessment can be used to determine not only the requirements and scope of an early warning monitoring system but also the potential need for alternate raw water sources, treatment process alternatives, increased raw water or finished water storage capacity, and other system characteristics. Vulnerability assessments are already being performed for all US public water supply systems as part of the Source Water Assessment Programs (SWAPs) required of each state by the 1996 Safe Drinking Water Act (P.L. 104-182) (see www.epa.gov/safewater/protect.html). The SWAP requirements are separate and different from the security vulnerability assessments required of many water utilities by the US Bioterrorism Act of 2002 (P.L. 107-188) (see www.epa.gov./safewater/security/security_act.pdf).

Detection mechanisms determined by site and system characteristics. The decision of what parameters to monitor should be made on a site-specific basis and take into account both watershed and water supply system characteristics. The vulnerability assessment can provide a prioritized optimal list of parameters, which is then evaluated given practical, technical (including adequacy of available monitoring methods), resource, and budgetary constraints. A review of other existing monitoring programs for the source water (e.g., by state or federal agencies, industries, and other water suppliers) should be performed to capitalize on any potential synergies.

Range of monitoring methods are available. The primary mechanisms for detecting spills and other events include water quality monitors, self-reporting by the dischargers themselves, and sighting and reporting by the observing public or by public or private agencies and organizations. The most effective early warning systems combine all three means of detecting contamination events.

Because rapid, responsible self-reporting of spill events provides the most dependable detection method, regulations and protocols should be established and enforced to strongly encourage such actions. However, the existence of and compliance with such laws vary significantly around the world. Reporting by spill-response personnel and other governmental agencies and organizations is the most common means by which many US utilities learn of source water contamination events. Public reporting is most effective with larger contamination events that have observable results (e.g., fish kills, oil sheens, odor) and events in more heavily populated areas. The effectiveness of this method depends on a population that has been sensitized to reporting such events. In Japan, for example, public reporting is the most common early warning method.

Some utilities use daily or more frequent visual inspection of source waters to monitor for gross visible pollutants such as oil sheens and algal blooms. Video cameras are sometimes used to aid in visually monitoring intake water and also to monitor upstream areas where large-scale accidents could occur (e.g., bridge abutments, highway or railway overpasses). Images can be sent directly to the treatment plant control room, and computerized image analysis technologies can be used to detect certain changes in the video images and then issue an alarm when something changes in the picture. Use of video cameras at night can be problematic, of course, and lights may be necessary to provide better 24-hour visual monitoring.

Water quality monitors include physical, chemical, radioactive, and microbiological analyses that can identify and quantify either a specific water quality parameter or a surrogate parameter selected to provide a conservative indication of the presence of a more harmful but more difficult to analyze contaminant. When surrogates are used, an adequate site-specific correlation should be established with the parameter of primary concern. In addition, biomonitoring techniques that use living organisms can be helpful in detecting general changes in water quality and toxicity. Available monitoring technologies are discussed later.

The "smell bell" test is being performed here on a sample from the River Trent in the United Kingdom. The smell bell test is an inexpensive method of physical analysis but requires trained personnel with good noses and usually is not performed more than once per shift or once per day.

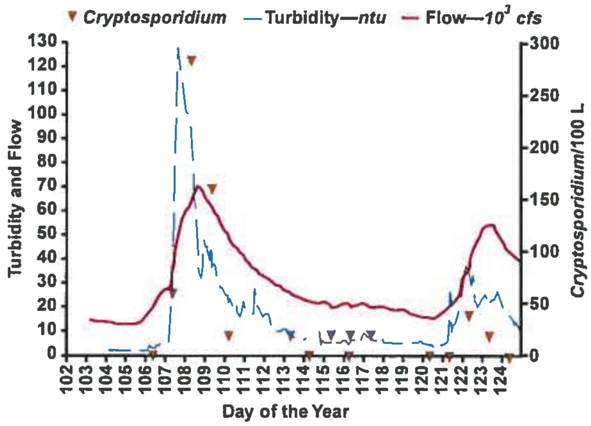
Several factors influence location of monitoring stations. Monitoring systems should be installed far enough upstream from the point of water abstraction to allow for timely warning. On the other hand, monitoring stations located too far upstream will not provide coverage for pollution sources entering between the station and the intake. These somewhat conflicting considerations must be balanced with the available resources when water providers are determining the number and location of monitoring stations. If multiple water utilities use the same source (e.g., a river), they can take advantage of opportunities for cooperation and pooling of resources in terms of multiple monitoring locations.

Potential factors to consider in the selection of monitoring locations include the following:

- the location of potential contaminant sources,
- the river's flow rate (i.e., time of travel from major potential contamination sources to the intakes)
- the magnitude of mixing and dilution attributable to currents and hydrodynamic dispersion,
- consideration of all three spatial dimensions (e.g., how far upstream, where across the river, and how deep),

- the type of contaminants (e.g., contaminants such as floating oils may determine monitor depth),
- the monitoring instruments' response time and frequency of analysis and data review,
- the nature of the treatment process (i.e., what can the processes handle, how much time is needed to make any potential adjustments),
- precautions to protect the instrumentation from the elements,
- security to prevent vandalism,
- access to electricity,
- means of telemetry (e.g., cellular telephone or radio versus need to acquire access to telephone lines), and
- access for monitor maintenance and upkeep.

FIGURE 3 **Variation in turbidity, river flow, and *Cryptosporidium* concentrations during spring sampling in the Delaware River**



Source: LeChevallier et al, 1998

Attention must also be given to the potential for mixing (or lack thereof) of contaminants both laterally and vertically in a river. Field tracer dye studies can be used to help elucidate river-mixing patterns between potential outfalls and water supply intake(s). With a small or well-mixed system, a single monitor near the river's center or bank may be sufficient. In other instances, multiple intakes may be necessary to adequately characterize water quality across the river.

System efficacy depends on frequency of monitoring. The effectiveness of an early warning system improves as the monitoring frequency increases, and monitoring continuously via real-time online monitors is usually preferred. Longer times between samples can not only result in some short-duration events being missed but also delay the detection of the contamination event and the resulting mitigating actions. More-frequent analysis is suggested for monitors at intakes (given the lack of time between detection and entering the intake) as well as for faster rivers and rivers with lower dispersion. For upstream monitoring stations, the analysis frequency should take into consideration the contaminant travel time from the monitoring location to the intake.

System only as reliable as its data. With any monitoring system, appropriate QA/QC measures are necessary to ensure reliability of the analytical data generated and foster confidence in the appropriateness of potential responses. Because early warning monitors are concerned with identifying substantial changes in concentrations, however, they generally require less QA/QC than conventional or compliance monitoring, and precision and consistency are more important than accuracy.

Modern technology simplifies data transmission. Data from automated onsite or remote monitoring stations are usually easily transmitted for immediate use via modern electronic information transmission (telemetry) technologies such as telephone (wire and cellular), radio waves, and satellite-based communications systems. Telemetry devices are discussed in the AWWA manual for instrumentation and control (AWWA, 2001).

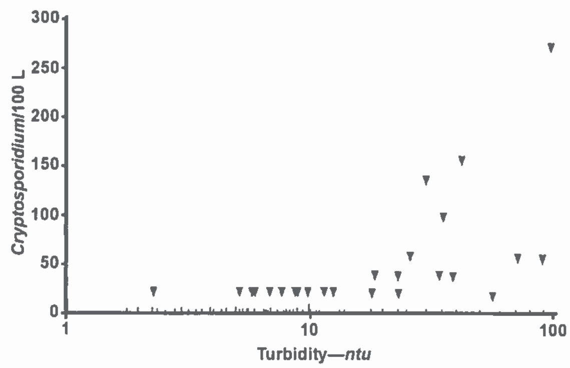
Risk-based models facilitate system design and analysis. Spill events are highly probabilistic occurrences, but major spills are relatively rare. Minor spills are much more common yet generally have little effect. The recommended approach to designing and evaluating early warning monitoring is a systematic method that considers the highly variable, probabilistic nature of many aspects of the system. These aspects include the probability of spills, the behavior of monitoring equipment, variable hydrology, and the probability of obtaining information about spills independent of analytical monitoring.

Spill Risk, a risk-based model using Monte Carlo (probabilistic) simulation techniques, was developed to aid in the design and analysis of early warning monitoring systems (Grayman & Males, 2002; Grayman et al, 2001). This tool uses a one-dimensional advection–dispersion contaminant transport model for a single reach of river (no tributaries). Probabilities are assigned to different types of fixed and mobile spills and discharges. Numerous simulations are run with varying inputs, and the results are used to assess the impact reduction for a single water intake (in population exposure above preset limits) provided by a variety of alternative early warning system configurations. Specifically, the model can help to determine the optimum type, number, and location of monitors; the optimum frequency of analysis; and various response scenarios.

Response thresholds determined by variety of factors. Every early warning monitoring system should include predetermined response thresholds (i.e., an increase in response above normal fluctuations from baseline levels) that warrant identification as a contamination event and trigger additional action such as confirmation procedures, additional investigation and characterization of the event, and assorted prospective response actions. Selection of response thresholds should take into consideration such factors as

- historical patterns of water quality;
- the actual or perceived threat from various levels of contamination or events;
- the toxicity of the chemical or pathogen being monitored, with consideration given to regulatory limits and advisories;
- the nature and size of the population exposed;
- the ability of the treatment processes to remove the contaminant;
- the sensitivity and specificity of the monitoring method;
- the potential for false-positive or false-negative monitoring results; and
- the type and severity of action that might be taken if the trigger level is exceeded.

FIGURE 4 **Correlation of turbidity and *Cryptosporidium* in the Delaware River**



Source: LeChevallier et al, 1998

Response thresholds should be set at a reasonable level such that they don't occur either too frequently (too many alarms can be problematic) or too rarely (i.e., serious events are missed). A contaminant that could have severe public health effects would warrant a more stringent action trigger level than would a less harmful contaminant. Federal or state standards may be used as a guide, although in some cases, a lower value may be desirable; if existing treatment processes are efficient for that contaminant, then perhaps a concentration somewhat higher may be acceptable.

Protocol needed to confirm initial monitoring results. Initial detection results should be confirmed because false-positives may be associated with monitoring instrumentation or incorrect public reports. The confirmation process may include thoroughly checking the result's QA/QC, resampling and repeating the analysis, and performing more-accurate or more-specific alternative methods of analysis. Optimally, this step would not necessarily preclude or delay a necessary response action; any such delay should consider the immediacy of the situation, the potential magnitude of the event and corresponding possible effects (or perceived effects) on public health or the treatment systems, and the risks the water supplier is willing to take (if any), as well as other site-specific circumstances. If intakes can be closed with no substantial adverse ramifications, then it would be prudent to do so during the wait for event confirmation. To aid in confirmation, some advanced monitoring stations automatically take samples at fixed intervals and store these samples for a fixed period (e.g., 24 h); other stations are designed to take samples automatically when a monitor detects an unusual event. In either case, these samples can then be analyzed using standard tests to confirm and characterize the nature of the contaminant.

Characterization of contamination guides response. Characterization of a contamination event is imperative in order for the utility to predict with reasonable accuracy the event's effects on intake water quality over time. Contamination characterization is a six-step process:

- Step 1: Determine the specific contaminant(s) involved.
- Step 2: Identify the likely source of the contaminant (if unknown).
- Step 3: Determine the spatial and temporal variation in concentration in the source water.
- Step 4: Assess the dynamic behavior of the contaminant in the water body (mixing and decay behavior).
- Step 5: Predict the movement of the contaminant within the water body in order to predict both the time that the leading and trailing edges reach water intakes and the likely concentration.
- Step 6: Determine the effects on the waterway itself (e.g., fish kills).

Characterization of the contamination event is generally accomplished through sample collection, field and laboratory monitoring, instream tracking of the event, and use of mathematical models to predict the movement of the contaminants in the water body. Depending on the extent and severity of the event, the amount of field work and monitoring can vary significantly.

Predictions of the concentration–time–distance profile of a contaminant event can be developed to warn water users in advance of the time period when the contaminant will be at their intakes and what concentrations they will be subject to. Mathematical hydrodynamic contaminant transport models that are properly developed, calibrated, and operated can provide reasonable predictions in many cases. These models include a hydrological component that predicts contaminant transport via water flow and dispersion; often various contaminant fate processes are included as well. Models intended for use in rapid-response scenarios should be easy and quick to use, generate predictions with reasonable accuracy, and provide output that is easily interpreted. In addition to testing the model on a routine basis, water providers should establish protocols, train personnel, and set up a

General Research and Development Needs for Early Warning Monitoring Systems

- Development of a continuous monitor capable of detecting low levels of dissolved oil and petroleum products without significant limitations from chemical and physical interferences
- Continued development of rapid and automated sensors for established and emerging pathogens and biowarfare agents
- Development of sensors for simultaneous identification of multiple pathogens (combined biosensors)
- Improvements in sensor sensitivity
- Continuous, online, and remote-sensing monitors for a greater number of chemical parameters
- Improvements in electronic nose technology, especially for detecting odors in surface waters in which the complex chemical composition can create a combination of smells that make it difficult to monitor electronically
- Improvement of biological monitors through better means of sensing behavioral changes in response to sudden exposure to toxins
- Greatly improved technology exchange between the water supply industry and the many different industries developing innovative sensor technologies

fast mechanism for acquiring flow and velocity information. Current flow data for many rivers may be obtained electronically from US Geological Survey or US Army Corps of Engineers gauging stations; alternatively a flow gauge can be installed at the monitoring station.

Water quality models should be used as a guide to what may happen and are intended to supplement (but not replace) collection of actual real-time data as a source of information. Grayman and co-workers (2001) reviewed available models of varying complexity and also developed a one-dimensional Riverine Spill Modeling System that can be easily adapted for use for a wide range of rivers. An example output from such a model (Figure 2) identifies the expected time at which a spill will reach downstream locations.

Response actions and plans must be prepared ahead of time. Often, initial information about the nature and extent of a contamination event is limited. A water utility must first determine whether to act immediately or delay action pending confirmation and additional information. When the warning has been triggered by monitoring at the intake, then the need for near instantaneous decision-making is more acute. Appropriate water supplier responses to changes in source water quality depend on the type and potential extent of contamination, efficacy of existing and available treatment processes, and projected risks to public health or treatment process efficiency. General guidance and operating policies for response activities for a range of possible contamination events should be operative before an event occurs. Policies may include taking immediate action, waiting until the contaminant event has been confirmed and the nature (extent, location, arrival time, etc.) of the event determined, or opting for a more complex action plan determined by the type and location of the warning.

Responses to mitigate the effects of a spill event can include (1) closure of water intakes and use of alternate sources or storage, (2) cleanup of the spill before it can affect water intakes, (3) adjustment of existing treatment processes or use of additional ones, and (4) public notification (e.g., boil-water notices). Closure of water intakes provides the most absolute barrier; for optimum effectiveness, this action should be guided by information from the early warning system to coincide with the period of highest concentrations. If the water intake can be closed for only a limited time period (e.g., a few hours), then this places a premium on accurate predictions of concentration. The availability of raw and finished water storage capacity can help facilitate intake closure. In some cases, the intake location can be switched to draw water from different depths or lateral positions within the same source. Bank filtration and groundwater injection–recovery systems provide for additional treatment and place an additional time lag between the surface water source and the treatment plant.

Communication systems and plans are key to the efficacy of early warning monitoring. The effectiveness of an early warning system relies on accurate and timely information being communicated to those responsible for making response action decisions. The emergency response plan should include detailed instructions for communication between appropriate parties, with decision-makers, and to other stakeholders and the public, as necessary. Means of communication to the various parties can include face-to-face meetings, telephone, facsimiles, e-mail, websites, electronic bulletin boards, the media, and other methods.

Cooperative networks make the most of resources. Although onsite early warning monitoring may be conducted by a single water supplier, source waters used by multiple water utilities (e.g., a large river) offer opportunities for cooperation and pooling of resources for development

TABLE 1 Select approaches for detecting chemical and radioactive threats to drinking water*

	Approach†								
	High End			Middle			Low End		
Threats	$100,000s	Pros	Cons	$10,000s	Pros	Cons	$1,000s	Pros	Cons
Ions (salts)				IC	Fast, broad, sensitive		Ion probe	Sensitive	Selective
Metals	ICP–MS	Fast, broad ID, sensitive	Staff, lab	AAS Polarography	Fast, sensitive Fast, fairly selective	Staff, lab Selective	Ion probe	Sensitive	Selective
Polar organics	LC–MS	Broad ID	Staff, lab	LC TOC	Broad ID Broad ID	Staff, lab Lack of sensitivity	UV		Lack of sensitivity
Nonpolar organics	GC–MS	Broad ID	Staff, lab	LC	Broad ID	Staff, lab			
Volatiles, oil, hydrocarbons	GC–MS	Broad ID	Staff, lab	P&T–GC GC Fluorescence (oil, HC)	Broad ID Broad ID Broad ID	Staff, lab Staff, lab Interferences	Smell bell	Fast	Human testers
Specific compounds	GC–MS, LC–MS	Broad ID	Staff, lab				Immunoassay (pesticides)	Fast, specific	Staff
Biotoxics				Biomonitors‡	Continuous, fast	Lack of specific ID			
Radiation				Tritium Gamma detector Beta or alpha detector	Fast, specific Fast, broad ID, available online Fast	Not available online Lack of specific ID Lack of specific ID, lab, evaporation step, not available online			

*Modified from ILSI (1999)
†AAS—atomic absorption spectrometry (furnace or flame), Broad ID—can monitor for many compounds simultaneously, GC—gas chromatography, HC—hydrocarbons, IC—ion chromatography, ICP-MS—inductively coupled plasma mass spectroscopy, ID—identification, LC—liquid chromatography, MS—mass spectrometry, P&T—purge and trap, Selective—monitors for a single compound, TOC—total organic carbon, UV—ultraviolet
‡Biomonitors—fish, daphnids, mussels, algal fluorescence, and luminescent bacteria

of an integrated early warning monitoring network, including multiple monitoring stations, centralized data management and assessment, and coordinated communication systems. Case studies of such networks are reviewed later and have been discussed by other researchers (Grayman et al, 2001; AWWARF & CRS PROAQUA, 2002).

ANALYTICAL METHODS OFFER PROS AND CONS

Although the technology exists to monitor for regulated compounds in drinking water, it is neither technically nor economically feasible to monitor for all chemical and microbiological parameters. Utilities must consider the tradeoffs between costs and the range and type of monitors used. Selection of the specific methods for monitoring the parameters of concern should be based on a variety of factors, including method-response sensitivity (which should be compared with source water baseline levels), speed, desired frequency of analysis, available means of data development and retrieval, labor and maintenance requirements, initial and ongoing operating costs, and space availability. Potential water quality monitors include physical, chemical, radioactive, and microbiological analyses, as well as bioalarm systems that use living organisms to act as sensors for extreme changes in water quality. Many researchers have examined rapid or online monitoring techniques for the water industry (AWWARF & CRS PROAQUA, 2002; Frey et al, 2001; Grayman et al, 2001; Gullick, 2001; Dippenaar et al, 2000; Pollack et al, 1999; Reinhard & Debreaux, 1999). The following sections offer a brief overview of select methods for early warning.

Some of the more common physical and chemical monitoring methods used in early warning systems include simple probes measuring various parameters (e.g., turbidity, pH, temperature, conductivity, DO, chlorophyll), relatively simple batch tests (e.g., immunoassays for herbicides), and more advanced monitoring for chemicals (e.g., fluorescence for oils and chromatography for oil and petroleum constituents, volatile organic chemicals, and phenols). Some of the primary surrogates used include turbidity, DO, odor, conductivity, and general measures of organic carbon content (e.g., oxidant demand, total organic carbon). However, some of the parameters that are easily and inexpensively monitored via online probes (e.g., temperature, conductivity, pH) provide little information on detecting many spill events (e.g., oil spills). Although the more

FIGURE 5 Schematic of a commercial flow-through fish biomonitor tank

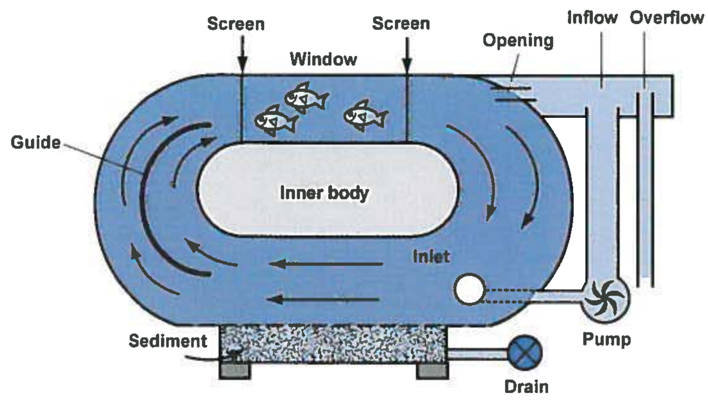
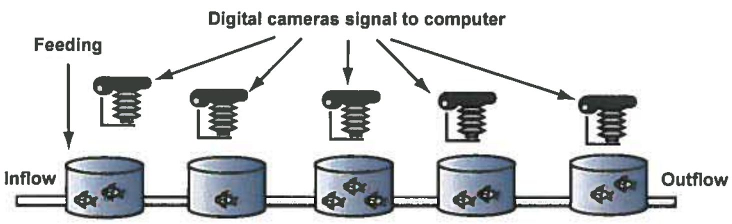


FIGURE 6 Schematic of fish-avoidance monitoring system in Osaka, Japan



advanced monitors are more expensive and require more maintenance and expertise, they are better at detecting many spill events.

Physical analyses offer speed, up-to-date information. Most physical monitoring methods are relatively rapid for most parameters (e.g., turbidity, conductivity, temperature, odor), and many can generate continuous real-time online data. Continuous online turbidity measurements are regularly used in treatment process–control application, and more expensive online particle counters are sometimes also used. Large increases in turbidity are frequently correlated with adverse changes in microbial water quality because both turbidity and microbial concentrations often increase substantially in surface waters during and after storm events because of surface runoff. Figure 3 shows an example of the correlation among increased river flow from storm events, turbidity, and the presence of the protozoan parasite *Cryptosporidium* (LeChevallier et al, 1998). High *Cryptosporidium* loadings at this location can typically be avoided by shutting an intake and using water from onsite storage when turbidity rises above a certain level (e.g., >15 ntu in Figure 4).

The presence of unusual odors can be a useful indicator for certain contamination events, including those resulting from algal by-products such as geosmin and methylisoborneol, phenols, petroleum products, and assorted volatile organics. One means for detecting odors is the "smell bell." Because it requires trained personnel with good noses, the smell bell test is not usually performed more than once per shift or once per day, thus limiting its use in early warning systems. Recent research suggests that it may soon be feasible to use electronic odor-sensing technologies ("electronic noses") that can operate continuously with less bias and greater repeatability and precision (Grayman et al, 2001).

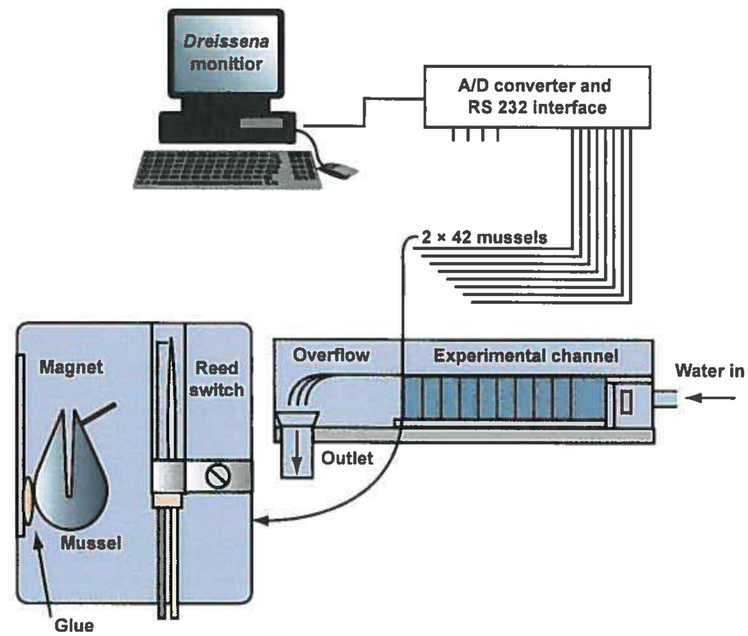
Chemical analyses come in many forms, range of costs. Many standard chemical analyses can be used for early warning monitoring, and several methods have been adapted for automated online applications and remote data access. Table 1 summarizes the relative costs as well as pros and cons for different early warning monitoring technologies for select chemical constituents.

Online analytical probes. Online analytical probes are relatively inexpensive, are easy to use, can provide continuous or nearly continuous monitoring with remote access to data, and are available from a variety of manufacturers. Ion-selective electrodes can quantify many inorganic ions including pH, elemental anions (e.g., chloride, bromide, fluoride, and iodide), ammonium, nitrite/nitrate, cyanide, certain metals (e.g., lead, cadmium, copper, aluminum, and manganese), and several other inorganic pollutants (Table 2). Probes are also available for turbidity, chlorophyll, and DO. Some manufacturers combine a variety of electrodes into one convenient and efficient multiparameter instrument. Because probes can foul in many raw water environments, some models use self-cleaning systems to reduce maintenance requirements.

DO. The DO concentration is a major parameter for the survival of aquatic life and for early warning applications is typically measured with a simple online probe. A decrease in DO can indicate the presence of organic compounds from sewage or surface water runoff. In addition, diurnal fluctuations in DO can be indicative of the presence of algae; for this reason, DO is sometimes used in conjunction with chlorophyll and turbidity measurements to monitor for algal blooms.

Nitrate and ammonia. Nitrate and ammonia/ammonium may be measured with a specific ion electrode; more sensitive but more expensive instruments for online colorimetric and ultraviolet (UV) analyses are also available. Both parameters may be indicative of agricultural pollution (i.e., fertilizers). Ammonia may come from sewage and animal waste discharges.

FIGURE 7 Schematic of a *Dreissena* monitor featuring two channels, each with 42 mussels



Metals. Ion-specific electrodes are available for certain metals, including lead, cadmium, copper, aluminum, and manganese. Anodic stripping voltametry–polarography is an excellent alternative for rapid analysis (<1–10 min) of low concentrations (nanogram-per-litre range) of certain metals and is used online at various monitoring stations in Europe. The instruments are priced in the range of $10,000–$17,000 and can detect four to six metals simultaneously; however, the method is restricted to amalgam-forming metals (e.g., cadmium, chromium, copper, lead, and zinc) and is subject to matrix interferences. Colorimetric methods are relatively inexpensive, typically apply to a single metal, and are subject to more interferences than more sophisticated methods. Atomic absorption spectrometry and plasma emission spectroscopy instruments are expensive and typically available only in commercial laboratories. One promising new technology, which has been applied to analysis of zinc, mercury, and cadmium, uses fluorescent molecules that react to specific metals in the presence of UV light (Bronson et al, 2001). Other developing methods for a variety of heavy metals include enzyme sensors and biosensors using genetically engineered microorganisms (Rogers & Gerlach, 1999).

General organic chemical parameters. Total organic carbon (TOC) and UV light absorption at 254 nm (UV_{254}) are general measures of organic content that can be performed in minutes and online. Though TOC is generally more sensitive and thus used more often for early warning, its natural variability in source waters is often greater than the concentrations of specific organics of concern. Simpler bench-scale test kits for organic carbon are also available.

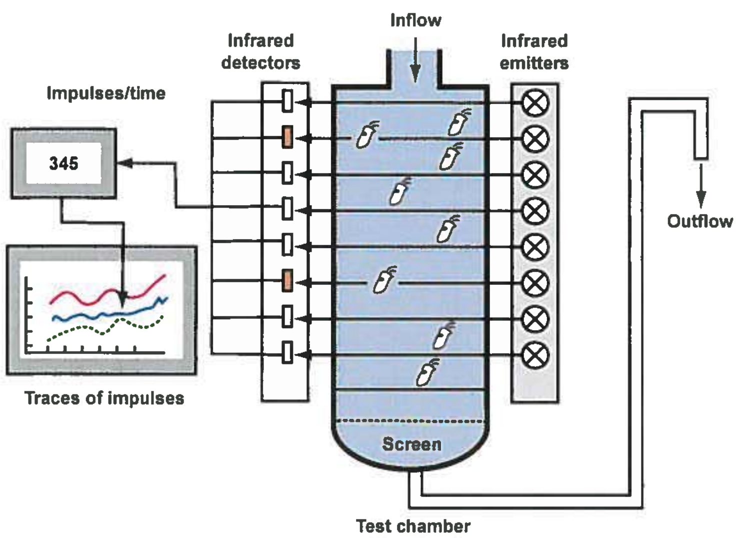
Oxidant demand and oxidant residual. Oxidant demand can be a general indicator of organic carbon content and ammonia in the source water. Because many utilities practice preoxidation (i.e., addition of chlorine, chlorine dioxide, ozone, or permanganate) and use online monitors to measure downstream oxidant residual, the oxidant demand can be calculated if the oxidant dosage and flow rates are known. Of course, oxidant residual is not applicable to raw waters but can be a useful warning measure of changes in distribution system water quality if residual disinfection is used by the utility.

Oil and petroleum. The primary techniques for online oil monitoring use light-scattering for floating oil and fluorescence for dissolved oil although each method has its limitations (He et al, 2001). Common chemical and physical interferences (e.g., particles, detergents, and floating debris) can cause frequent false alarms and make it difficult to track an oil spill during rain events that increase turbidity. Most commercial oil-in-water monitors use light-scattering techniques and thus are primarily useful only for major spills (e.g., for a 0.33 mm [0.013 in.] or greater layer of floating product).

Fluorometry can be used for dissolved gasoline, diesel, jet fuel, and oil components (such as BTEX [benzene, toluene, ethylbenzene, and xylenes]), as well as chlorophyll from algae. Continuous fluorescence oil detectors cost in the range of $12,000–$24,000, are very sensitive (low microgram-per-litre range in fairly clean water), and are used in several monitoring programs worldwide, although turbidity and humic substances can interfere. Although manual solvent extraction methods are labor-intensive, some European monitoring stations use an automated system for extraction and spectrophotometric analysis of total dissolved hydrocarbons (between 0.2 and 10 mg/L). Online monitors for low concentrations of oil need improvement. The introduction of genetically engineered microorganisms as biosensors for BTEX (Rogers & Gerlach, 1999) may prove useful in the future.

Organic chemicals. Manual and online gas chromatographs (GCs) range in cost from $30,000 to $50,000 and are used in several early warning systems worldwide to monitor for volatiles or other organic chemicals (including fuel oil components). Only a few stations use liquid chromatography, which costs in the range of $50,000–$100,000. Analyses can typically be performed in less than an hour by trained operators.

FIGURE 8 Schematic of original *Daphnia* monitor



Mass spectrometry (MS) is even more expensive and would be used primarily during the event confirmation step to provide accurate identification of organics in select samples. For some chromatography analyses, sample preparation can add significantly to the work required, and the necessary QA/QC can be more time-consuming than that for some of the simpler analyses.

Pesticides. Pesticide (herbicide and insecticide) contamination of surface waters is often seasonal because it primarily results from nonpoint source rainfall runoff from agricultural areas during periods of high pesticide application. The inexpensive batch ELISA (enzyme-linked immunosorbent assay) procedure, which is often used for the herbicide atrazine, takes approximately 40 minutes and compares reasonably well with GC–MS results for concentrations on the order of 3 µg/L, i.e., the level of the USEPA drinking water standard (Lydy et al, 1996).

Radioactivity. Early warning for radioactivity in surface waters may be applicable for facilities downstream from a nuclear power plant or other potential large source of radioactivity. Both gross radioactivity and specific radioactive substances may be measured. Tritium (hydrogen-3) may be an especially good indicator for nuclear power waste because it behaves as a conservative tracer in water and would reach an intake prior to other radioactive constituents that have larger retardation factors. Monitoring stations on the Rhine River measure for total alpha, total beta, tritium, cesium-137, and strontium-90 activity (Grayman et al, 2001).

Advances make microbiological analyses more feasible for early warning use. Conventional methods of microbial analysis require a relatively long time period (e.g., hours or days) for isolation and reproduction (amplification) of the microbial species, and many tests are specific only to a single species or class of organisms. Because of these limitations, these analyses are not often used for early warning applications. However, significant recent advances in microbial monitoring and related technology offer increased sensitivity, specificity, and more-rapid analysis, including deoxyribonucleic acid (DNA) microchip arrays, rapid DNA probes, immunologic techniques, cytometry, laser scanning, laser fingerprinting, optical technologies, and luminescence (Grayman et al, 2001; Rose & Grimes, 2001; Foran & Brosnan, 2000; Quist, 1999; Rogers & Gerlach, 1999). Most of these methods are still being developed or were only recently introduced. However, their use is likely to increase in the future. Relatively rapid existing methods for microbes are summarized in *Standard Methods* (1998) and Venter (2000).

Nucleic acid–based systems measure the genome of the organisms, which gives a high degree of specificity, but sample processing typically takes at least 2–4 hours. Several different kits are available for these tests. Rapid DNA probes are species-specific and use a robot-assisted microplate analysis of amplified samples of DNA (Quist, 1999). DNA microchip arrays are a developing technology that can detect and identify multiple microorganisms within 4 hours. Laser-scanning cytometry can be used to rapidly detect any organism for which there is a specific antibody, but the instruments are expensive.

Immunoassays use target-specific fluorescent antibodies that bind with an antigen of the target species, and test kits for a variety of pathogens are available that are relatively rapid, inexpensive, sensitive and simple to use (www.aoac.org/testkits/microbiologykits.htm).

Commercial methods[1–3] for measuring bacterial counts within 8–24 hours are readily available. Thanks to recent advances, the potential analysis time for bacteria (e.g., total coliforms, *E. coli*, or heterotrophic plate counts [HPC]) has been reduced to 4–8 hours or less. For example, a new modification of method 9211C.1 (*Standard Methods*, 1998) using adenosine triphosphate bioluminescence allows quantification of HPC within minutes (Lee & Deininger, 1999).

The conventional tests for protozoan parasites such as *Giardia* and *Cryptosporidium* (USEPA methods 1622 and 1623) require extensive training and are too time-consuming for early warning monitoring applications. Commercial instruments are available that can provide for screening of protozoan parasites in aqueous samples, but the tests still take a few hours because of sample preparation requirements.

When algae blooms are detected at their earliest stages, the algae can be treated in the reservoir before they grow out of control, thus reducing taste and odor problems and saving on treatment costs. Several commercial continuous monitors are available that rely on an online fluorescence detector to measure chlorophyll a, the principle photosynthetic pigment in all algae. Some probes costing ~$5,000 combine these measurements with those for water clarity (turbidity) and oxygen to provide early warning of algal blooms. A more expensive and sophisticated system was used in Los Angeles, Calif., to detect algae in supply reservoirs and resulted in substantial cost savings for treatment chemicals (Morrow et al, 2000).

TABLE 2 Specific ion electrodes used in monitoring raw water

Ion	Type	Range—*mg/L*	Interferences*
Ammonium	PVC† membrane	0.1–18,000	K
Bromide	Solid state	0.4–80,000	S, I, CN
Cadmium	Solid state	0.01–11,000	Ag, Hg, Cu, Pb, Fe
Calcium	PVC membrane	0.2–40,000	Pb, Hg, Cu, Ni
Chloride	Solid state	1.8–33,000	S, I, CN, Br, OH, NH_3
Copper	Solid state	0.0006–6,350	Ag, Hg, Cl, Br, Fe, Cd
Cyanide	Solid state	0.1–260	S, I, B, Cl
Fluoride	Solid state	0.02 to saturation	OH
Iodide	Solid state	0.006–127,000	S, CN, Br, Cl, NH_3
Lead	Solid state	0.2–20,700	Ag, Hg, Cu, Cd, Fe
Nitrate	PVC membrane	0.5–62,000	I, CN, BF_4
pH	PVC membrane	1–14 (pH units)	
Surfactant	PVC membrane	1–12,000	
Hardness	PVC membrane	0.4–40,000	Cu, Zn, Ni, Fe

*Ag—silver, B—boron, BF_4—tetrafluoroborate, Br—bromine, Cd—cadmium, Cl—chlorine, CN—cyanide, Cu—copper, Fe—iron, Hg—mercury, I—iodine, K—potassium, NH_3—ammonia, Ni—nickel, OH—hydroxide, Pb—lead, S—sulfur, Zn—zinc

Biomonitors track pollutants through their effect on organisms. The sheer magnitude of the number of pollutants of concern and the inability to monitor many of them continuously or at all have led to the use of online biomonitors. Biomonitors measure the changes in the behavior or properties of living organisms resulting from stresses placed on them by the presence of toxic materials. Conceptually biomonitors are analogous to the canaries used by miners to detect the presence of toxic gases. Though biomonitors do not provide information on the specific contaminant or cause of the stress on organisms, they warn that something unusual in the water is affecting the organisms, thus warranting further investigation such as specific chemical analyses (Penders & Stoks, 1999). Some biomonitors respond rapidly to elevated concentrations of a wide range of toxic compounds, and some can also be used to assess low-level chronic contamination by persistent, bioaccumulative toxins (e.g., from xenoestrogens, biocides, pharmaceuticals, and pesticides).

Examples of biomonitors include the dynamic fish (Figures 5 and 6), mussel (Figure 7), and *Daphnia* or water flea (Figure 8) tests as well as delayed algal fluorescence and luminescent bacteria response. The dynamic tests involve measuring changes (typically via electronic means) in movement or physiological responses by an organism as it tries to avoid toxic chemicals in the water. Because different species respond to different chemicals to varying degrees, the simultaneous use of different types of bioalarms (including some from different trophic levels) is often recommended (Penders & Stoks, 1999; LAWA, 1998).

The generally preferred method seems to be the *Daphnia* monitors, especially the newer ones that use digital cameras and are capable of following the behavior of each daphnid. The newer mussel tests appear to be well-suited because of the large filtering capacity of the mussels, their sensitivity, and their longevity. The simpler bacterial tests using luminescent bacteria are promising methods to determine the toxicity of the river water. Likewise, the delayed fluorescence of algae can be measured relatively easily. Although algae and bacteria monitors are not currently in wide use, and more experience with these monitors is needed, neither of these facts should deter water suppliers from using them. A report of German field experiences rated the dynamic *Daphnia* test as the first priority for developing a bioalarm station, followed in order by fluorescent algae, bacteria tests, and mussel monitors (LAWA, 1998). Fish monitors were not recommended primarily because the sensitivity was problematic and not reproducible (e.g., problems were encountered with both false alarms and the systems not responding to pollution events) (LAWA, 1998).

Very few biomonitors are in use in the United States, but dozens are operating in Europe (LAWA, 1998). Practically every station with a biomonitor uses a *Daphnia* test, but some also use fish, mussels, algae, and bacteria to test the water with organisms from different trophic levels. Japan and Korea have installed several of these systems, and the numbers are currently expanding. In the United States, USEPA research laboratories in Cincinnati, Ohio, are investigating the effectiveness of biomonitors at different trophic levels (Haught, 2000), and *Daphnia* toximeters were used for assessing source water quality during the 2002 Winter Olympics in Salt Lake City, Utah (Yates et al, 2002).

Purchase costs for these systems typically range from about $10,000 to near $50,000 and up. The manual

TABLE 3 **Summary of advanced early warning systems around the world**

River	Country	Administration	Monitoring Program	Comments	Websites
Ohio River	United States	ORSANCO (Ohio River Valley Water Sanitation Commission)	Organics Detection System (15 gas chromatographs)	Federal–state commission working with water utilities	www.orsanco.org
Mississippi River	United States	Louisiana Department of Environmental Quality	8 gas chromatographs for organics detection	Cooperative effort among the state, water utilities, and industries	www.deq.state.la.us/surveillance/ewocds/index.htm
Rhine River	Germany, Holland, Switzerland	International Commission for the Protection of the Rhine	9 international stations plus 20 national monitoring stations	Multinational early warning system; extensive use of biomonitors.	www.iksr.org
River Trent	United Kingdom	Severn Trent Water	1 station at intake	Provides real time warnings and historical database	
River Dee	United Kingdom	Hyder Lab and Sciences	3 stations	Cooperative effort among three water companies and government	
River Tyne	United Kingdom	Northumbrian Water Group	2 stations	Wide range of advanced monitors	
Llobregat River	Spain	Grupas Aguas de Barcelona	10 stations	Extensive network of automated monitors	
River Seine	France	SEDIF (Syndicat des Eaux d'Ile-de-France)	Automatic monitoring stations and samplers serving three plants	Combines sophisticated treatment, monitors, and early warning system	
North Saskatchewan River	Canada	EPCOR Utilities Inc.	2 stations located at intakes	Includes online monitors for chemical dosing decisions	
St. Clair River	Canada	ORTECH Environmental Inc.	1 monitoring station	Effective system in industrialized area since 1987	
Yodo River	Japan	Yodo River Water Quality Consultative Committee	Monitors at intakes	Cooperative effort among 10 water companies; unique monitoring systems	
River Han (and other rivers)	Korea	National Institute of Environmental Research	20 stations on four rivers	Combination of standard and advanced instruments and biomonitors	www.nier.go.kr
Danube River	Parts of 17 European countries	International Commission for the Protection of the Danube River	Mostly conventional monitors	Primarily a network for sharing spill information; 11-nation commission	www.icpdr.org
Moselle River	France and Germany	International Commission for the Protection of the Moselle and the Saar	Several advanced monitoring stations with chemical and biomonitors	Primarily agricultural area with good water quality	www.iksms-cipms.org
Elbe River	Germany and Czech Republic	International Commission for the Protection of the Elbe	17 monitoring stations	Significant improvement in water quality since the reunification of Germany	www.arge-elbe.de www.bafg.de/html/ikse/ikse.htm

batch bacteria tests can be the least expensive in terms of capital costs. The algae, *Daphnia,* and mussel tests are fairly comparable in expense (~$20,000–$40,000) and cost less than fish monitor units (LAWA, 1998; Stoks, 1998). Operating costs are fairly low for all these methods (except the luminescent bacteria test) and primarily involve replacement organisms and electricity.

False-positive results can result from interferences from a variety of environmental factors other than contaminants (e.g., temperature changes or low oxygen). Data on the sensitivity and minimum detection limits of online biomonitors are relatively limited, and the methods demonstrate a relative lack of sensitivity for some chemicals of interest. Other drawbacks include the high cost for more sophisticated biomonitors and maintenance requirements for the living systems. The interpretation of the signals from biological monitors is also an important consideration; as this improves, the value of biomonitors will likely increase.

New monitoring methods emerge, research and development needs identified. Electronic noses and rapid bacterial methods have been identified as areas in which developments are taking place, and the use of these as early warning systems is likely to increase. Selected general research and development needs are summarized in the sidebar on page 64. Numerous research projects by the AWWA Research Foundation and the Water Environment Research Foundation are investigating rapid and online monitoring technologies. Generally speaking, however, many of the advances in monitoring technologies occur from research in other scientific fields (e.g., the food and beverage industry, analytical chemistry, the sensor industry, and the military); these advances include biosensor and biochip technology, fiber optics, genetically engineered organisms, immunoassays, and microelectronics. Research on rapid and online monitoring systems for a variety of contaminants is being conducted by a number of US government organizations including the USEPA (Panguluri et al, 1999; Rogers & Gerlach, 1999) and the US Army's Joint Service Agent Water Monitor program (ILSI, 1999).

SUCCESS OF EXISTING SYSTEMS MAY WIN NEW USERS

Case studies provide snapshots of monitoring applications. There are relatively few advanced early warning systems around the world that are extensive in size and scope, employ significant online state of the art monitoring equipment, and utilize monitoring, modeling, and communications in an integrated system to warn of contaminants in source water. Table 3 summarizes 15 prominent systems described by Grayman and colleagues (2001); taken together, these installations provide a fairly complete picture of the potential for early warning systems. Other research has documented case studies of online monitoring, some of which focus on early warning (AWWARF & CRS PROAQUA, 2002). These references include an evaluation of the successes and limitations of the systems.

There are both significant commonality and diversity among the systems. All of the systems depend on a combination of monitors, self-reporting, and/or public reporting. The monitoring systems used range from simple probes (e.g., pH, turbidity, conductivity) to advanced instruments such as GCs and UV monitors to biomonitors. Many of the systems employ mathematical models to predict arrival times for a spill at downstream intakes. In all cases, some form of institutional structure coordinates efforts and communicates information so that appropriate actions can be taken. The impetus for several of these systems and networks has been an unfortunate large spill or release of a toxic or hazardous chemical.

Systems vary in their degree of complexity (Table 3). For example, the system on the River Rhine has nine international monitoring stations and 20 national stations monitoring for numerous parameters, including general water quality parameters, organic carbon indicators, nutrients, inorganics and metals, organic compounds (pesticides and volatile organics), and radioactivity. Other systems may contain only a single monitoring station. Systems also vary in terms of the frequency of analysis and degree of automation. Many of the systems are highly automated, with both alarm signals and maintenance performed remotely. The more sophisticated networks include a coordinated monitoring, modeling, communication, and response program for an extended stretch of river.

With a few notable exceptions (e.g., the Ohio River and Lower Mississippi River), US experience with advanced early warning monitoring systems and networks is limited, and many US water suppliers have little or no early warning system in place. However, interest in early warning monitoring networks has increased in recent years, and such systems are currently being developed for the Upper Mississippi, Schuylkill, Delaware, Allegheny, Monongahela, and Susquehanna rivers (Gullick, 2003).

Future holds developments for early warning systems. A vision for the future of early warning monitoring systems would address the reduction of contamination events and a plan to mitigate the effects of unexpected discharges. Key elements would include (1) an active program for reducing the likelihood of the discharges, (2) an enforced set of regulations that strongly encourages self-reporting of any nonroutine discharges, (3) a monitoring system for detecting contaminants in the source waters, (4) a mathematical tool (model) for predicting the movement of a contaminant from its source to the water intakes, (5) a communications and organizational infrastructure for coordinating and disseminating information on the contaminant event, and (6) effective means for reducing the effects of the contaminant on the water system through intake closure, treatment, and use of raw or finished water storage or alternative sources.

This vision is looking brighter but has not yet been fulfilled. In some instances, early warning systems that include many of these elements have been implemented. However, most raw water sources continue to be vulnerable to contamination, and the water community still has far to go to safeguard water supplies. Ongoing research is expected to produce substantial advances in monitoring technologies in the near future.

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APPENDIX C. COMMUNICATION PLAN

THRASHER

COMMUNICATION PLAN

FOR THE

CORPORATION OF SHEPHERDSTOWN

JEFFERSON COUNTY, WEST VIRGINIA

PWSID No. WV3301933

JULY 2016

THRASHER PROJECT No. 101- 010-1046.805

600 White Oaks Boulevard • PO Box 940 • Bridgeport, WV 26330 • 304.624.4108 phone • 304.624.7831 fax • www.thrashereng.com

COMMUNICATION PLAN
FOR THE
CORPORATION OF SHEPHERDSTOWN
PWSID No. WV3301933

Prepared By:
Project Engineer

THE THRASHER GROUP, INC.

600 White Oaks Boulevard
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Plan Developed On: July 1,2016   Plan Update Due On: July 1, 2019

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THRASHER PROJECT No. 101-010-1046.805

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INTRODUCTION

Legislative Rule 64CSR3 requires public water systems to develop a Communication Plan that documents how public water suppliers, working with state and local emergency response agencies, shall notify state and local health agencies and the public in the event of a spill or contamination event that poses a potential threat to public health and safety. The plan must indicate how the public water supplier will provide updated information, with an initial notification to the public to occur no later than thirty minutes after the supplier becomes aware that the spill, release or potential contamination of the public water system poses a potential threat to public health and safety.

The public water system has responsibility to communicate to the public, as well as to state and local health agencies. This plan is intended to comply with the requirements of Legislative Rule 64CSR3, and other state and federal regulations.

TIERS REPORTING SYSTEM

This water system has elected to use the Tiered Incident or Event Reporting System (TIERS) for communicating with the public, agencies, the media, and other entities in the event of a spill or other incident that may threaten water quality. TIERS provides a multi-level notification framework, which escalates the communicated threat level commensurate with the drinking water system risks associated with a particular contamination incident or event. TIERS also includes a procedural flow chart illustrating key incident response communication functions and how they interface with overall event response / incident management actions. Finally, TIERS identifies the roles and responsibilities for key people involved in risk response, public notification, news media and other communication.

TIERS provides an easy-to-remember five-tiered **A-B-C-D-E** risk-based incident response communication format, as described below. **Table 1** also provides associated risk levels.

A = Announcement. The water system is issuing an announcement to the public and public agencies about an incident or event that may pose a threat to water quality. Additional information will be provided as it becomes available. As always, if water system customers notice anything unusual about their water, they should contact the water system

B = Boil Water. A boil water advisory has been issued by the water system. Customers may use the water for showering, bathing, and other non-potable uses, but should boil water used for drinking or cooking.

C = Cannot Drink. The water system asks that users not drink or cook with the water at this time. Non- potable uses, such as showering, bathing, cleaning, and outdoor uses are not affected.

D = Do Not Use. An incident or event has occurred affecting nearly all uses of the water. Do not use the water for drinking, cooking, showering, bathing, cleaning, or other tasks where water can come in contact with your skin. Water can be used for flushing commodes and fire protection.

E = Emergency. Water cannot be used for any reason.

Table 1. Tier Categories

Tier	Tier Category	Risk Level	Tier Summary
A	**A**nnouncement	Low	The water system is issuing an announcement to the public and public agencies about an incident or event that could pose a threat to public health and safety. Additional information will be provided as it becomes available.
B	**B**oil Water Advisory	Moderate	Water system users are advised to boil any water to be used for drinking or cooking, due to possible microbial contamination. The system operator will notify users when the boil water advisory is lifted.
C	**C**annot Drink	High	System users should not drink or cook with the water until further notice. The water can still be used for showering, bathing, cleaning, and other tasks.
D	**D**o Not Use	Very High	The water should only be used for flushing commodes and fire protection until further notice. More information on this notice will be provided as soon as it is available.
E	**E**mergency	Extremely High	The water should not be used for any purpose until further notice. More information on this notice will be provided as soon as it is available.

COMMUNICATION TEAM

The Communication Team for the water system is listed in the table below, along with key roles. In the event of a spill or other incident that may affect water quality, the water system spokesperson will provide initial information, until the team assembles (if necessary) to provide follow-up communication.

Table 2. Water System Communication Team Members, Organizations, and Roles

Team Member Name	Organization	Phone	Email	Role
Frank Welch	Corp. of Shepherdstown	304-876-3322	fwelch@shepherdstown.us	Primary Spokesperson
Charles Coe	Corp. of Shepherdstown	304-876-2394	ccoe@shepherdstown.us	Secondary Spokesperson
Lori Robertson	Town Recorder	540-336-4737	lahraven@comcast.net	Member
Amy Boyd	Corp. of Shepherdstown	304-876-2398	clerk@shepherdstown.us	Member
Jerry Bock	Water & Sewer Board Member	304-283-8338	jerrybock@comcast.net	Member
John Brady	Water & Sewer Board Member	304-876-2516	jkbrady@mac.com	Member

In the event of a spill, release, or other incident that may threaten water quality, members of the team who are available will coordinate with the management staff of the local water supplier to:

- Collect information needed to investigate, analyze, and characterize the incident/event
- Provide information to the management staff so they can decide how to respond
- Assist the management staff in handling event response and communication duties
- Coordinate fully and seamlessly with the management staff to ensure response effectiveness

COMMUNICATION TEAM DUTIES

The communication team will be responsible for working cooperatively with the management staff and state and local emergency response agencies to notify local health agencies and the public of the initial spill or contamination event. The team will also provide updated information related to any contamination or impairment of the source water supply or the system's drinking water supply.

According to Legislative Rule 64CSR3, the initial notification to the public will occur no later than thirty minutes after the public water system becomes aware that the spill, release or potential contamination of the public water system poses a potential threat to public health and safety.

As part of the group implementing the Source Water Protection Plan, team members are expected to be familiar with the plan, including incident/event response and communication tasks. Specifically, team members should:

- Be knowledgeable on elements of the Source Water Plan and Communication Plan
- Attend team meetings to ensure up-to-date knowledge of the system and its functions
- Participate in periodic exercises that "game out" incident response and communication tasks
- Help to educate local officials, the media, and others on source water protection
- Cooperate with water supplier efforts to coordinate incident response communication
- Be prepared to respond to requests for field investigations of reported incidents
- Not speak on behalf of the water supplier unless designated as the system's spokesperson

The primary spokesperson will be responsible for speaking on behalf of the water system to local agencies, the public, and the news media. The spokesperson should work with the management staff and the team to ensure that all communication is clear, accurate, timely, and consistent. The spokesperson may authorize and/or direct others to issue news releases or other information that has been approved by the system's management staff. The spokesperson is expected to be on call immediately when an incident or event which may threaten water quality occurs. The spokesperson will perform the following tasks in the event of a spill, release, or other event that threatens water quality:

- Announce which risk level (A, B, C, D, or E) will apply to the public notification
- Issue news releases, updates, and other information regarding the incident/event
- Use the news media, email, social media, and other appropriate information venues
- Ensure that news releases are sent to local health agencies and the public
- Respond to questions from the news media and others regarding the incident/event
- Appear at news conferences and interviews to explain incident response, etc.

INCIDENT / EVENT COMMUNICATION PROCEDURE

The flow chart in this section illustrates how the water system will respond when it receives a report that a spill, release, or other contamination event may have occurred. Key elements of the flow chart are described below.

Communication during Threat Incidents

Upon initial notification of the incident/event, system managers and staff will collect information and verify the need for further investigation. If further investigation is warranted, and the initial facts support it, the water system spokesperson will issue a public communication statement consistent with the threat level. In addition, water system personnel and partners will be dispatched to conduct reconnaissance, a threat assessment, and a threat characterization, if present. This work may include:

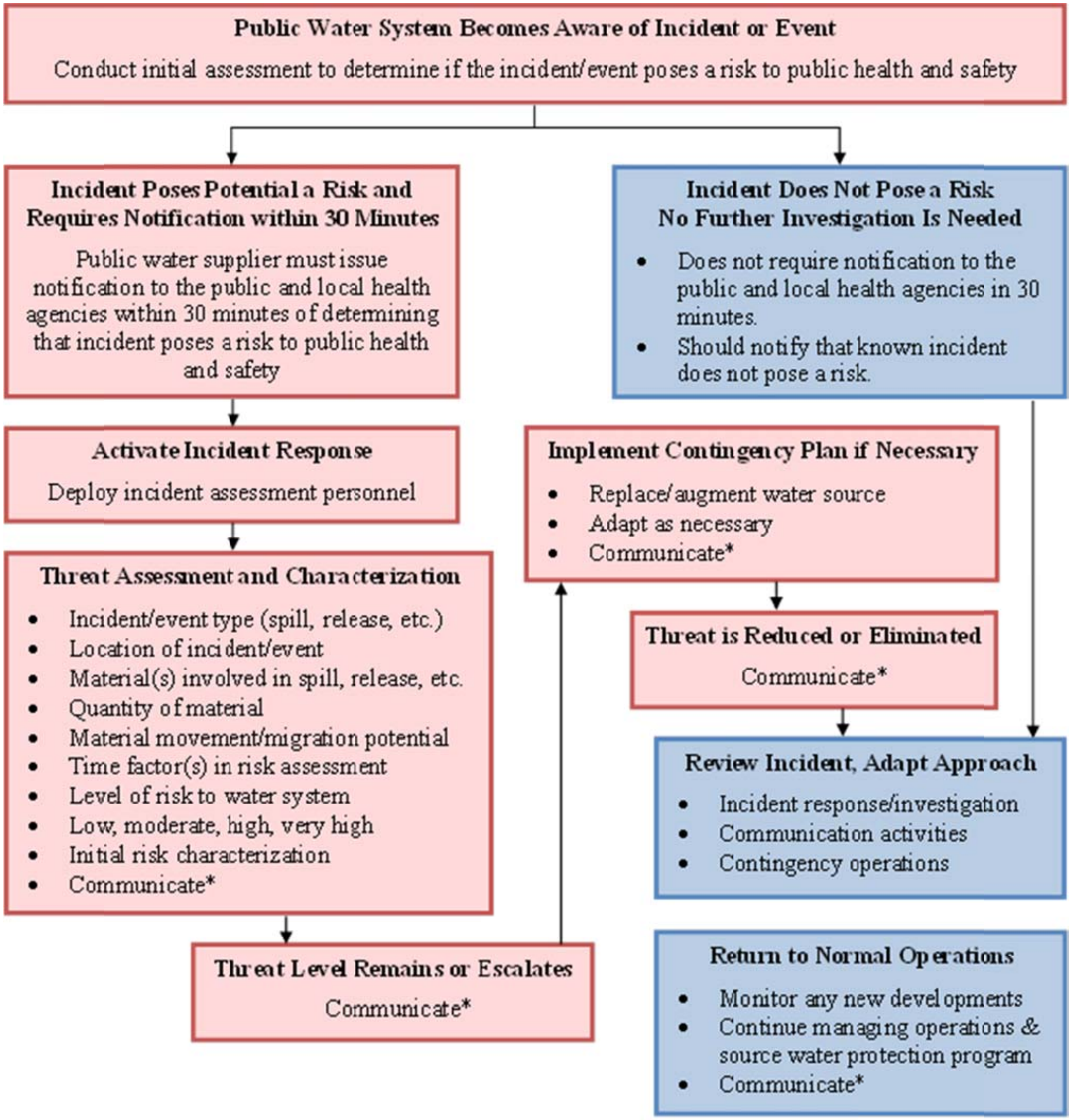
- Verification of the incident type
- Location of incident/event
- Quantity of material involved
- Relevant time factor(s) in the risk assessment
- Type of material(s) involved
- Potential of the material to move, migrate, or be transported
- Overall level of risk to water system
- Development of the initial risk characterization

As the flow chart indicates, several iterative cycles will occur after the initial threat assessment, including communication with local agencies and the public, further investigation of the incident, possible implementation of the water system's contingency plan, and eventual elimination of the threat and a return to normal operations. Communication activities during this period will include:

- The initial release (i.e., Announcement, Boil Water, Cannot Drink, Do Not Use, Emergency) sent to local health agencies, the public, and the news media within 30 minutes
- Notification of the local water system's source water protection and communication teams if warranted by initial findings regarding the spill, release, or incident
- Notification of the WV Bureau of Public Health as required
- Periodic information updates as incident response information is received
- Updates to the applicable A-B-C-D-E advisory tier, as necessary

After the threat level is reduced, and operations return to normal, the water system staff, the communication and source water protection teams, and their partners will conduct a post-event review and assessment. The purpose of the review is to examine the response to the incident, relevant communication activities, and overall outcomes. Plans and procedures may be updated, altered, or adapted based on lessons learned through this process.

TIERS FLOW CHART



Communicate*

Constant communication with local agencies, public, and the media is critical throughout the entire process. The initial notification should include all pertinent information, depending on the TIERS level. Regular information updates should be provided. The **A-B-C-D-E** TIERS should be updated and explained as necessary.

PRESS RELEASE ATTACHMENTS

UTILITY ISSUED NOTICE – LEVEL A

PUBLIC WATER SYSTEM ANNOUNCEMENT

A WATER SYSTEM INVESTIGATION IS UNDERWAY

On _________ at ___:____ AM/PM, the __________________________ Water System began investigating an incident that may affect local water quality.

The incident involves the following situation at this location: ____ ____ ____.

There are no restrictions on water use at this time. As always, if water system customers notice anything unusual about their water – such as abnormal odors, colors, sheen, etc. – they should contact the water system at ___________________.

At this time there is no need for concern if you have consumed or used the water. Regular updates will be provided about this Announcement as water system staff continue their investigation. Again, there are no restrictions on water use at this time.

State Water System ID# ________________________ Date Distributed: ___________

UTILITY ISSUED NOTICE – LEVEL B
BOIL WATER ADVISORY
A BOIL WATER ADVISORY IS IN EFFECT

On _________ at ___:____ am/pm, a water problem occurred causing contamination of your water. The areas that are affected are as follows:

□ Entire Water System or □ Other: ____________________________________

____

CONDITIONS INDICATE THERE IS A HIGH PROBABILITY THAT YOUR WATER IS CONTAMINATED. TESTING HAS NOT OCCURRED TO CONFIRM OR DENY THE PRESENCE OF CONTAMINATION IN YOUR WATER.

What should I do?

- **DO NOT DRINK THE WATER WITHOUT BOILING IT FIRST.** Bring all water to a boil, let it boil for one minute, and let it cool before using, or use bottled water. Boiled or bottled water should be used for drinking, making ice, brushing teeth, washing dishes, bathing, and food preparation **until further notice**. Boiling kills bacteria and other organisms in the water.

What happened?

- **The problem is related to** ____

What is being done?

- **The water system is taking the following action:** ______________________
  ____

What should a customer do if they have consumed or used the water?

- ____

We will inform you when you no longer need to boil your water. We anticipate resolving the problem within _________ hours/days. For more information, please contact ___________________ at ______________ or ___________________ at _________.

General guidelines on ways to lessen the health risk are available from the EPA Safe Drinking Water Hotline at 1 (800) 426-4791.

Please share this information others who use this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice was distributed by ____
State Water System ID# ________________________ Date Distributed: ___________

UTILITY ISSUED NOTICE – LEVEL C
"CANNOT DRINK" WATER NOTIFICATION
A LEVEL C WATER ADVISORY IS IN EFFECT

On _________ at ___:____ am/pm, a water problem occurred causing contamination of your water. The areas that are affected are as follows:

□ Entire Water System or □ Other: ____
____

CONDITIONS INDICATE THERE IS A HIGH PROBABILITY THAT YOUR WATER IS CONTAMINATED. TESTING HAS NOT OCCURRED TO CONFIRM OR DENY THE PRESENCE OF CONTAMINATION IN YOUR WATER.

What should I do?

- **DO NOT DRINK THE WATER.** You can't drink the water, but you can use it for showering, bathing, toilet-flushing, and other non-potable purposes.
- **BOILING WILL NOT PURIFY THE WATER.** Do not drink the water, even if it is boiled. The type of contamination suspected is not removed by boiling.

What happened?

- **The problem is related to** ____

What is being done?

- **The water system is taking the following action:** ______________________
  ____

What should a customer do if they have consumed or used the water?

- ____

We will inform you when the water is safe to drink. We anticipate resolving the problem within _________ hours/days. For more information – or to report unusual water conditions such as abnormal odors, colors, sheen, etc. – please contact _______________ at __________ or ___________________ at _________.

Please share this information others who use this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice was distributed by ____
State Water System ID# ________________________ Date Distributed: ___________

UTILITY ISSUED NOTICE – LEVEL D
“DO NOT USE” WATER NOTIFICATION
A LEVEL D WATER ADVISORY IS IN EFFECT

On _________ at ___:____ am/pm, a water problem occurred causing contamination of your water. The areas that are affected are as follows:

□ Entire Water System or □ Other: ____

____

CONDITIONS INDICATE THERE IS A HIGH PROBABILITY THAT YOUR WATER IS CONTAMINATED. TESTING HAS NOT OCCURRED TO CONFIRM OR DENY THE PRESENCE OF CONTAMINATION IN YOUR WATER.

What should I do?

- **DO NOT DRINK THE WATER.** The water is contaminated.
- **DO NOT SHOWER OR BATHE IN THE WATER.** You can’t use the water for drinking, showering, or bathing. It can be used for toilet flushing and firefighting.
- **BOILING WILL NOT PURIFY THE WATER.** Do not use the water, even if it is boiled. The type of contamination suspected is not removed by boiling.

What happened?

The problem is related to ____

What is being done?

- **The water system is taking the following action:** ______________________

What should a customer do if they have consumed or used the water?

- ____

We will inform you when the water is safe to drink. We anticipate resolving the problem within _________ hours/days. For more information – or to report unusual water conditions such as abnormal odors, colors, sheen, etc. – please contact _______________ at __________ or ___________________ at _________.

Please share this information others who use this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice was distributed by ____
State Water System ID# ________________________ Date Distributed: ___________

UTILITY ISSUED NOTICE – LEVEL E
EMERGENCY WATER NOTIFICATION
A LEVEL E WATER ADVISORY IS IN EFFECT

On _________ at ___:____ am/pm, a water problem occurred causing contamination of your water. The areas that are affected are as follows:

□ Entire Water System or □ Other: ____

____

CONDITIONS INDICATE THERE IS A HIGH PROBABILITY THAT YOUR WATER IS CONTAMINATED. TESTING HAS NOT OCCURRED TO CONFIRM OR DENY THE PRESENCE OF CONTAMINATION IN YOUR WATER.

What should I do?

- **DO NOT DRINK THE WATER.** The water is contaminated.
- **DO NOT USE THE WATER FOR ANY PURPOSE!** You can't use the water for drinking, showering, or bathing, or any other use – not even for toilet flushing.
- **BOILING WILL NOT PURIFY THE WATER.** Do not use the water, even if it is boiled. The type of contamination suspected is not removed by boiling.

What happened?

- **The problem is related to** ____

What is being done?

- **The water system is taking the following action:** ______________________

What should a customer do if they have consumed or used the water?

- ____

We will inform you when the water is safe to drink. We anticipate resolving the problem within _________ hours/days. For more information – or to report unusual water conditions such as abnormal odors, colors, sheen, etc. – please contact _______________ at __________ or ___________________ at _________.

Please share this information others who use this water, especially those who may not have received this notice directly (for example, people in apartments, nursing homes, schools, and businesses). You can do this by posting this notice in a public place or distributing copies by hand or mail.

This notice was distributed by ____
State Water System ID# ________________________ Date Distributed: ___________

EMERGENCY INFORMATION FORMS

Emergency Communication Information

	Name	Phone Number	Email
Designated Spokesperson	Frank Welch	304-876-3322	fwelch@shepherdstown.us
Alternate Spokesperson	Charles Coe	304-876-2394	ccoe@shepherdstown.us
Designated Location to Disseminate Information to Media:	Shepherdstown Town Hall 104 N King		

Methods of Contacting Affected Residents:				
	Word of mouth		**Posted Notices**	✓
	Door-to-door canvasing		**Radio**	
	Newspaper	✓	**Other**	Call System

Media Contacts	Name	Title	Phone Number	Email
	Toni Milbourne	Editor	304-876-3380	tmilbourne@shepherdstownchronicle.com
	Vanessa McGuigan	Editorial Assistant	304-876-3380	vmcguigan@shepherdstownchronicle.com

Emergency Services Contacts

	Name	Emergency Phone	Alternate Phone	Email
Local Police	Shepherdstown Police Dept.	911	304-876-6036 304-876-6513	mking@shepherdstown.us
Local Fire Department	Shepherdstown Fire Hall	911	304-876-2311	N/A
Local Ambulance Service	Shepherdstown Fire Hall	911	304-876-2311	N/A
Hazardous Material Response Service	OHSEM Headquarters	911	304-263-1345	N/A

Key Personnel

	Name	Title	Phone	Email
Key staff responsible for coordinating emergency response procedures?	Frank Welch	Public Works Director	304-876-3322	fwelch@shepherdstown.us
	Charles Coe	Chief Water Operator	304-876-2394	ccoe@shepherdstown.us
Staff responsible for keeping confidential PSSC information and releasing to emergency responders:	Frank Welch	Public Works Director	304-876-3322	fwelch@shepherdstown.us
	Charles Coe	Chief Water Operator	304-876-2394	ccoe@shepherdstown.us

Sensitive Populations

<table>
<tr><th>Other communities that are served by the utility:</th><td colspan="4">None</td></tr>
<tr><th rowspan="2">Major user/sensitive population notification:</th><th colspan="2">Name</th><th>Emergency Phone</th><th>Alternate Phone</th></tr>
<tr><td colspan="2">Shepherd University</td><td>714-356-9699</td><td>304-876-5148</td></tr>
<tr><th rowspan="2">EED District Office Contact:</th><th colspan="2">Name</th><th>Phone</th><th>Email</th></tr>
<tr><td colspan="2">Bradley Reed</td><td>304-725-9453</td><td>bradley.r.reed@wv.gov</td></tr>
<tr><th rowspan="2">OEHS Readiness Coordinator</th><th colspan="2">Name</th><th>Phone</th><th>Email</th></tr>
<tr><td colspan="2">Warren Von Dollen</td><td>304-356-4290(main)
304-550-5607(cell)</td><td>warren.r.vondollen@wv.gov</td></tr>
<tr><th rowspan="2">Downstream Water Contacts:</th><th>System Name</th><th>Contact Name</th><th>Emergency Phone</th><th>Alternate Phone</th></tr>
<tr><td>Brunswick Water Plant</td><td>Patrick Hoffmaster</td><td>240-409-7081</td><td>301-834-7737</td></tr>
<tr><th colspan="2">Are you planning on implementing the TIER system?</th><td colspan="3">Yes</td></tr>
</table>

Emergency Response Information

Has the utility developed a detailed Emergency Response Plan in accordance with the Public Health Security Bioterrorism Preparedness and Response Pan Act of 2002 that covers the following areas?	Yes
When was the Emergency Response Plan developed or last updated?	2016

Emergency Contact Information

State Emergency Spill Notification

1-800-642-3074

Office of Emergency Services

http://www.wvdhsem.gov/ Charleston, WV- (304) 558-5380

WV Bureau for Public Health Office of Environmental Health Services (OEHS)

www.wvdhhr.org/oehs

Readiness Coordinator- Warren Von Dollen

Phone:	304-356-4290
Cell:	304-550-5607
e-mail:	warren.r.vondollen@wv.gov

Environmental Engineering Division Staff

Charleston, Central Office	(304) 558-2981
Beckley, District 1	(304) 256-6666
St. Albans, District 2	(304) 722-0611
Kearneysville, District 4	(304) 725-9453
Wheeling, District 5	(304) 238-1145
Fairmont, District 6	(304) 368-2530

National Response Center - Chemical, Oil, & Chemical/Biological Terrorism

1-800-424-8802

WV State Fire Marshal's Office

1-800-233-3473

West Virginia State Police

1-304-746-2100

WV Watch – Report Suspicious Activity

1-866-989-2824

DEP Distance Calculator

http://tagis.dep.wv.gov/pswicheck/

APPENDIX D. SINGLE SOURCE FEASIBILITY STUDY

Shepherdstown Water currently has no alternative source of water supply in the event that the primary water source becomes contaminated.

1. **Backup Intake**

   The Shepherdstown Water surface water intake located on the Potomac River is currently the primary source of water supply. There is one source of water supply near the water treatment facility that is large enough to supply sufficient capacity – Town Run.

$$0.044 \text{ cubic feet per second} * \left(\frac{448.83 \text{ gpm}}{1 \text{ cfs}}\right) = 19.75 \text{ gpm}$$

   The average required capacity for the treatment facility is 520 gallons per minute, which is not satisfied by Town Run. However, in September 2015, a chemical spill on the Potomac River in Maryland prompted a situation where the Shepherdstown Water treatment facility was projected to be without water supply for a significant amount of time (see article from The Picket, September 30, 2015, in **Appendix E**).

   The existing treated water storage amount of 1,400,000 gallons was projected to last approximately two (2) days of average use. The expected time for the contaminant to pose a threat to the water supply was greater than five (5) days. Due to investigations by Shepherdstown Water operators and staff, the utility was able to analyze Town Run, the stream running parallel to North Princess Street into the Potomac River approximately 100 feet downstream of the existing surface water intake, to supply water to the treatment facility. There is no other source of water supply in the area that would be able to provide sufficient capacity (520 gallons per minute) to the water treatment facility.

   Town Run was tested for contaminants by the WV DEP and was determined to be able to provide adequate flow for the water treatment facility while meeting water quality standards (see testing data in **Appendix E**). Once the contaminant reached the Shepherdstown Water surface water intake area, the intake was closed off and the utility switched to the Town Run temporary surface water intake. The utility was able to obtain water from Town Run for eight (8) days before resuming normal operations with the Potomac River surface water intake.

   Thus, the construction of a backup intake located on Town Run, approximately 350 feet upstream of the mouth of the stream, including 300 feet of 8" raw water line from the intake to the water treatment facility (see map in **Appendix E**) will be considered in the feasibility analysis. A cost analysis is provided in **Appendix E**.

2. **Interconnection**

Shepherdstown Water is not currently interconnected with another utility. The consideration of an alternative source of water could be determined using one other utility – Berkeley County Public Service Water District (BCPSWD). The BCPSWD system is located approximately 12,500 feet from the Shepherdstown Water system (see map in **Appendix E**).

If the Shepherdstown Water active surface water source became contaminated, then their backup source of surface water would also become contaminated because both Shepherdstown Water and BCPSWD use the Potomac River as their source of water supply. Shepherdstown Water does not have another reasonable alternative source of water supply.

Thus, this alternative will not be considered in the feasibility analysis.

3. **Treated Water Storage**

The Shepherdstown Water treated water storage capacity for the system consists of two (2) elevated water storage tanks totaling 1,400,000 gallons. On average, the water treatment facility produces 636,400 gallons per day of water. The maximum produced by the water treatment facility from September 2014 to August 2015 was 1,117,400 gallons per day, according to monthly operating reports provided by the utility.

The minimum required treated storage capacity, according to Senate Bill 373, is equal to two (2) days of system storage based on the plant's maximum level of production experienced within the past year, and the maximum required is equal to five (5) days of the average production, according to WV BPH standards requiring 20% turnover per day.

The minimum required treated water storage capacity for the system would be:

$$1{,}117{,}400\ gallons\ per\ day\ *2\ days = 2{,}234{,}800\ gallons$$

Therefore, the system currently does not meet the minimum required treated water storage capacity.

The remaining minimum required treated water storage capacity for the system would be:

$$2{,}234{,}800\ gallons - 1{,}400{,}000\ gallons = 834{,}800\ gallons$$

The construction of a 948,000 gallon standpipe treated water storage tank cannot be considered in the feasibility analysis due to the topography of the water system.

Thus, the alternative will not be considered in the feasibility analysis.

4. Raw Water Storage

Shepherdstown Water does not have any raw water storage capacity for the system. As mentioned in Section #3, the water treatment facility produces 636,400 gallons per day on average and has a maximum production of 1,117,400 gallons per day. The minimum required raw storage capacity, according to Senate Bill 373, is equal to two (2) days of system storage based on the plant's maximum level of production experienced within the past year, and the maximum required is equal to five (5) days of the average production, according to WV BPH standards requiring 20% turnover per day. The minimum required raw water storage capacity for the system would be:

$$1{,}117{,}400 \ gallons \ per \ day \ * 2 \ days = 2{,}234{,}800 \ gallons$$

Therefore, the system currently does not meet the minimum required raw water storage capacity. The construction of a 2,234,800 gallon standpipe raw water storage tank in the area is not feasible as an alternative due to the topography of the water system. Thus, this alternative will not be considered in the feasibility analysis.

5. Other (Elevated Treated Water Storage)

An alternative being considered for the feasibility analysis is to construct an elevated treated water storage tank as opposed to a standpipe treated water storage tank. The main constraint of this alternative is when preparing to obtain clearance from the West Virginia Division of Culture and History State Historic Preservation Officer (SHPO). SHPO described to Shepherdstown Water that the elevated storage tanks, if constructed on land that was not previously disturbed, would disrupt the historical view shed. When constructing elevated storage tanks in the past, the engineer has constructed the new elevated storage tanks on previously disturbed property already owned by the utility; thus, allowing Shepherdstown Water to avoid clearance problems with WV SHPO.

As discussed in #3, the minimum required treated water storage capacity for the system would be:

$$1{,}117{,}400 \ gallons \ per \ day \ * 2 \ days = 2{,}234{,}800 \ gallons$$

Therefore, the system currently does not meet the minimum required treated water storage capacity. The remaining minimum required treated water storage capacity for the system would be:

$$2{,}234{,}800 \ gallons - 1{,}400{,}000 \ gallons = 834{,}800 \ gallons$$

Thus, the construction of a 900,000 gallon elevated treated water storage tank will be considered in the feasibility analysis. A cost analysis is provided in **Appendix E**.

Matrix Explanation

The alternative analysis matrix evaluates the utility's ability to implement each of the additional sources outlined. Alternative sources are evaluated for economic, technical, and environmental feasibility. The matrix uses a zero (0) to three (3) rating system, with three (3) being very feasible and zero (0) being not feasible. Each category has sub questions to develop an average for the alternative. Once all areas are evaluated, a final feasibility score is given for each of the alternatives for use in determining which option will best suit the utility's needs.

Economic factors evaluated in the matrix include all information needed to fund the alternative source. The matrix considers the current utility budget available per the latest annual report, operation and maintenance costs for each alternative, and the capital cost needed to construct each alternative. Supporting documentation is included in **Appendix E** of the report, which provides a breakdown of costs for each alternative that are used as capital costs in the matrix. The economic feasibility of each alternative is compared on a cost per gallon ratio. This ratio is determined by dividing the capital cost of the improvements by the total number of gallons of water produced per year. An average of the economic feasibility factors is then calculated and entered into the overall feasibility matrix on the following page.

Technical criteria evaluated include permitting, flexibility, institutional and resilience factors. Permitting costs are included in all supporting documentation for each alternative source. The permitting factors included the permits that would be needed to construct the alternative source for the utility. An additional environmental factor is the feasibly of obtaining each permit. Permits were rated from zero (0) to three (3) based on the difficulty of obtaining the permits for the project. Depending on the project area, some permits may be very difficult and costly to obtain. Flexibility factors evaluate the ability of the alternative to be used as a permanent source of water or if it can only be used on a temporary basis.. The intake and interconnections can be used as both temporary and permanent sources. The alternatives' ability to help the utility during seasonal or population increases is also evaluated in the resilience factors. The alternatives that can produce additional water were rated as very feasible (3). Additional criteria evaluated are easements and rights-of-ways that will need to be acquired to construct the alternative source. For interconnections and intakes rights-of-ways would be needed to lay the new water line. The feasibility of obtaining the rights-of-ways was evaluated. All technical criteria was averaged and entered into the feasibility summary.

Environmental aspects for each alternative include impacts, aesthetics and stakeholders. Environmental impacts included any areas in the proposed alternative source area that are protected. Areas that are protected would have a low feasibility because the impacts could be large if the project were constructed. Aesthetics factors include noise, visual impacts, and mitigation measures that could affect the project's feasibility. The aesthetic factors relate to the stakeholder factors. The stakeholders' portion of the environmental criteria involves the community and their acceptance of the new source alternative and the structures that will be constructed.

Feasibility Matrix | Corporation of Shepherdstown Water Dept. | PWSID: WV 3301933 | Date: 11/20/2015 | Completed by: Project Engineer - The Thrasher Group, Inc.

Criteria	Question	Backup Intake	Feasibility	Interconnect	Feasibility	Treated Water Storage	Feasibility	Raw Water Storage	Feasibility	Other (Elevated Treated Water Storage)	Feasibility
Economic Criteria											
What is the total current budget year cost to operate and maintain the PWSU (current budget year)?		$1,025,579.00		$1,025,579.00		$1,025,579.00		$1,025,579.00		$1,025,579.00	
O and M Costs	Describe the major O&M cost requirements for the alternative?	Labor, power and materials for maintenance	2	N/A	0	N/A	0	N/A	0	Labor and materials for maintenance	2
	What is the incremental cost ($/gal) to operate and maintain the alternative?	$0.00	3	$0.00	0	$0.00	0	$0.00	0	$0.00	3
	Cost comparison of the incremental O&M cost to the current budgeted costs (%)	0.00%	3	0.00%	0	0.00%	0	0.00%	0	0.00%	3
O and M-Feasibility Score			*2.7*		*0.0*		*0.0*		*0.0*		*2.7*
Describe the capital improvements required to implement the alternative.		Construction of a secondary intake, raw water pump and approximately 300 LF of 8" intake line		N/A		N/A		N/A		Construction of a 900,000 gallon elevated treated water storage tank.	
Capital Costs	What is the total capital cost for the alternative?	$1,002,000.00	3	$0.00	0	$0.00	0	$0.00	0	$2,145,000.00	2
	What is the annualized capital cost to implement the alternative, including land and easement costs, convenience tap fees, etc. ($/gal)	$0.00	3	$0.00	0	$0.00	0	$0.00	0	$0.01	3
	Cost comparison of the alternatives annualized capital cost to the current budgeted costs (%)	0.00%	3	0.00%	0	0.00%	0	0.00%	0	0.00%	3
Capital Cost-Feasibility Score			*3.0*		*0.0*		*0.0*		*0.0*		*2.7*
Technical Criteria											
Permitting	Provide a listing of the expected permits required and the permitting agencies involved in their approval.	WV DEP, WV DNR, ACOE, WV SHPO, US FWS, WV DOH and County Floodplain	2	N/A	0	N/A	0	N/A	0	WV DEP, WV DNR, ACOE, WV SHPO, US FWS, WV DOH and County Floodplain	2
	What is the timeframe for permit approval for each permit?	WV DEP (90 days), WV DNR (60 days), ACOE (90 days), WV SHPO (60 days), US FWS (60 days), WV DOH (90 days) and County Floodplain (90 days)	2	N/A	0	N/A	0	N/A	0	WV DEP (90 days), WV DNR (60 days), ACOE (90 days), WV SHPO (60 days), US FWS (60 days), WV DOH (90 days) and County Floodplain (90 days)	2
	Describe the major requirements in obtaining the permits (environmental impact studies, public hearings, etc.)	Environmental impact studies.	3	N/A	0	N/A	0	N/A	0	Environmental impact studies.	2
	What is the likelihood of successfully obtaining the permits?	Good	3	N/A	0	N/A	0	N/A	0	Good	2
	Does the implementation of the alternative require regulatory exceptions or variances?	No	3	N/A	0	N/A	0	N/A	0	No	2
Permitting-Feasibility Score			*2.6*		*0.0*		*0.0*		*0.0*		*2.0*
Flexibility	Will the alternative be needed on a regular basis or only used intermittently?	Intermittently	3	N/A	0	N/A	0	N/A	0	Regular Basis or Intermittently	3
	How will implementing the alternative affect the PWSU's current method of treating and delivering potable water including meeting Safe Drinking Water Act regulations? (ex. In the case of storage, will the alternative increase the likelihood of disinfection byproducts?)	No impact	3	N/A	0	N/A	0	N/A	0	The alternative will add 900,000 gallons of treated water storage to the system, and will not have any other impact.	3
Flexibility-Feasibility Score			*3.0*		*0.0*		*0.0*		*0.0*		*3.0*

Criteria	Question	Backup Intake	Feasibility	Interconnect	Feasibility	Treated Water Storage	Feasibility	Raw Water Storage	Feasibility	Other (Elevated Treated Water Storage)	Feasibility
Resilience	Will the alternative provide any advantages or disadvantages to meeting seasonal changes in demand?	Yes	3	N/A	0	N/A	0	N/A	0	Yes	3
	How resistant will the alternative be to extreme weather conditions such as drought and flooding?	Drought may limit the availability of water.	2	N/A	0	N/A	0	N/A	0	Drought may limit the availability of water.	2
	Will the alternative be expandable to meet the growing needs of the service area?	Yes	3	N/A	0	N/A	0	N/A	0	Yes	3
Resilience-Feasibility Score			***2.7***		***0.0***		***0.0***		***0.0***		***2.7***
Institutional Requirements	Identify any agreements or other legal instruments with governmental entities, private institutions or other PWSU required to implement the alternative.	An agreement by the WV BPH and the WV DEP stating Town Run is an acceptable stream would be necessary.	3	N/A	0	N/A	0	N/A	0	None	3
	Are any development/planning restrictions in place that can act as a barrier to the implementation of the alternative.	No	3	N/A	0	N/A	0	N/A	0	No	3
	Identify potential land acquisitions and easements requirements.	Easements (permanent and temporary) may be required for the construction of the intake line.	2	N/A	0	N/A	0	N/A	0	Property acquisition would be required for the tank.	2
Institutional Requirements-Feasibility Score			***2.7***		***0.0***		***0.0***		***0.0***		***2.7***
Environmental Criteria											
Environmental Impacts	Identify any environmentally protected areas or habitats that might be impacted by the alternative.	None are known.	3	N/A	0	N/A	0	N/A	0	Problems may arise when obtaining clearance from the WV State Historic Preservation Officer (see Alternatives Analysis narrative, #5, for details).	1
Environmental Impacts-Feasibility Score			***3.0***		***0.0***		***0.0***		***0.0***		***1.0***
Aesthetic Impacts	Identify any visual or noise issues caused by the alternative that may affect local land uses?	Fencing and a control panel for the pump station would be constructed, and construction would cause temporary noise issues.	2	N/A	0	N/A	0	N/A	0	Construction would cause temporary noise issues, and some visual impact would be made by the tank.	2
	Identify any mitigation measures that will be required to address aesthetic impacts?	The construction would need to be as quick as possible.	2	N/A	0	N/A	0	N/A	0	The construction would need to be as quick as possible.	2
Aesthetic Impacts-Feasibility Score			***2.0***		***0.0***		***0.0***		***0.0***		***2.0***
Stakeholder Issues	Identify the potential stakeholders affected by the alternative.	Water customers and land owners.	2	N/A	0	N/A	0	N/A	0	Water customers and land owners.	2
	Identify the potential issues with stakeholders for and against the alternative.	A rate increase may be required to implement construction, and possible land ownership issues may arise.	2	N/A	0	N/A	0	N/A	0	A rate increase may be required to implement construction, and possible land ownership issues may arise.	2
	Will stakeholder concerns represent a significant barrier to implementation (or assistance) of the alternative?	No	3	N/A	0	N/A	0	N/A	0	No	3
Stakeholder Issues-Feasibility Score			***2.3***		***0.0***		***0.0***		***0.0***		***2.3***
Comments		Town Run was previously used as a source of surface water for the utility, so the permitting process and approval by WV BPH and WV DEP will be of no significant problem.		There are no known utilities that can supply adequate capacity for the treatment facility.		Due to the elevation of the Town, standpipe treated water storage tanks cannot be considered as an alternative.		Due to the elevation of the Town, standpipe raw water storage tanks cannot be considered as an alternative.		No comment	

Feasibility Matrix | Corporation of Shepherdstown Water Dept. | PWSID: WV 3301933 | Date: 11/20/2015 | Completed by: Project Engineer - The Thrasher Group, Inc.

Alternative Strategy Description	Economic Criteria					Technical Criteria							Environmental Criteria						Final Score	Total Capital Cost	Comments
	Operation & Maintenance Costs	Capital Costs	**Total**	**Total %**	**Weighted Total**	Permitting	Flexibility	Resilience	Institutional Requirements	**Total**	**Total %**	**Weighted Total**	Environmental Impacts	Aesthetic Impacts	Stakeholder Issues	**Total**	**Total %**	**Weighted Total**			
Backup Intake	2.7	3.0	**5.7**	**94.4%**	**37.8%**	2.6	3.0	2.7	2.7	**10.9**	**91.1%**	**36.4%**	3.0	2.0	2.3	**7.3**	**81.5%**	**16.3%**	**90.5%**	**$1,002,000.00**	Town Run was previously used as a source of surface water for the utility, so the permitting process and approval by WV BPH and WV DEP will be of no significant problem.
Interconnect	0.0	0.0	**0.0**	**0.0%**	**0.0%**	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**	**0.0%**	**$0.00**	There are no known utilities that can supply adequate capacity for the treatment facility.
Treated Water Storage	0.0	0.0	**0.0**	**0.0%**	**0.0%**	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**	**0.0%**	**$0.00**	Due to the elevation of the Town, standpipe treated water storage tanks cannot be considered as an alternative.
Raw Water Storage	0.0	0.0	**0.0**	**0.0%**	**0.0%**	0.0	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**	0.0	0.0	0.0	**0.0**	**0.0%**	**0.0%**	**0.0%**	**$0.00**	Due to the elevation of the Town, standpipe raw water storage tanks cannot be considered as an alternative.
Other (Elevated Treated Water Storage)	2.7	2.7	**5.3**	**88.9%**	**35.6%**	2.0	3.0	2.7	2.7	**10.3**	**86.1%**	**34.4%**	1.0	2.0	2.3	**5.3**	**59.3%**	**11.9%**	**81.9%**	**$2,145,000.00**	No comment

Scoring:

0 - Not feasible. Criterion cannot be met by this alternative and removes the alternative from further consideration.

1 - Feasible but difficult. Criterion represents a significant barrier to successful implementation but does not eliminate it from consideration.

2 - Feasible. Criterion can be met by the alternative.

3 - Very Feasible. Criterion can be easily met by the alternative.

APPENDIX E. SUPPORTING DOCUMENTATION

INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN

30 West Gude Dr., Suite 450, Rockville, Md. 20850

(301) 984-1908 | info@icprb.org | www.PotomacRiver.org

Emergency River Spill Model:

A Model that Provides Protection

Recent events have increased the focus on infrastructure security throughout the United States, including that for water supplies. The Potomac River basin is no exception. In the metro Washington area, about 75% of drinking water comes from the Potomac River. Across the basin there are 77 public water supply systems with surface water intakes. When spills occur, water suppliers, local emergency responders, state emergency management agencies, and federal agencies mobilize quickly to protect public health and minimize environmental impacts. During the spill response, the Interstate Commission on the Potomac River Basin's (ICPRB) Emergency River Spill Model (ERSM) is an important tool in protecting public water supplies along the Potomac River from an upstream contamination threat.

The Model estimates the movement of spills along the Potomac, from Cumberland in western Maryland to Little Falls dam upstream of Washington, D.C., and several major tributaries. It provides timely information to water suppliers and emergency response agencies along the river so they can appropriately respond to the situation and protect water supplies and other uses of the river. The ERSM provides estimates of travel times from the site of the spill to downstream points of interest or concern, including estimates for the leading edge of the spill, time of maximum concentration, the trailing edge, and estimates of the maximum concentration.

Reporting a Spill

Once the appropriate emergency response procedures have been followed, please notify ICPRB at (301) 274-8133 and provide the following information:

1. Name and telephone number
2. Location of spill, including a) name of affected stream and b) street address and/or latitude and longitude;
3. Identity of spill material
4. Estimated quantity of material spilled (total mass or volume or discharge rate).

The Emergency River Spill Model was developed based on dye studies conducted in the river by the U.S. Geological Survey. In those studies, a fluorescent dye was put into the river and its downstream travel monitored. The model is best suited for substances that mix in the water column, including bacteria in sewage spills. The model is less suited for floating products such as oil but still can provide useful information about those events and ICPRB is developing additional tools to model these types of events.

Sewage, oil, and other types of spills contaminate water needed by residents of the basin.

The ESRM's travel time information and characteristics of the spilled material gives emergency responders, water suppliers, and other river users advance notification of when a spill might arrive at downstream points of interest. This information is integrated into many government and facility emergency response plans and is used to make decisions about when and where to collect water samples, warnings to the public, modification to water treatment methods, or even temporary closure of a drinking water intake.

An important component of ICPRB's response to material spills is the dissemination of information to the media and other stakeholders in the basin. As needed, ICPRB shares information with the public, including advisories from the suppliers. These advisories could involve a variety of actions, including water conservation or a recommendation to boil the water before use.

Created with an interstate compact by an Act of Congress in 1940, the Interstate Commission on the Potomac River Basin (ICPRB) is composed of commissioners representing the federal government, the states of Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia. The ICPRB mission is to enhance, protect, and conserve the water and associated land resources of the Potomac River basin and its tributaries through regional and interstate cooperation.

ICPRB accomplishes this mission through a variety of actions to conduct, coordinate, and cooperate in studies and programs in the areas of water quality, water supply, living resources, and land resources. The Section for Cooperative Water Supply Operations on the Potomac River (CO-OP), a special section of the Commission, was created as a technical operations center for management and coordination among the regional water utilities to avoid water supply shortages in Metropolitan Washington during droughts.

For additional information, contact the Interstate Commission on the Potomac River Basin:

(301) 984-1908 | info@icprb.org | www.PotomacRiver.org

PWS_ID	System Name	County	Existing Generator?	# of Generators	Generator Facility	Generator Location	Gen. KVA	Gen. KW	Amp Load	Amp Load Basis	Volts	Phases	Fuel Type	Fuel Tank	Fuel Tank Size	Generator Connection Point	Generator Cable Size	Generator Cable Note	Generator Cable Length	Cable Length Note	Other Information	District
WV3301933	SHEPHERDSTOWN WATER	JEFFERSON	NO	1	TREATMENT PLANT	TREATMENT PLANT ON PRINCESS STREET IN SHEPHERDSTOWN	312	250	376	63% LOADING ON 600 AMP MAIN BREAKER	277 / 480	3 PHASE WYE	DIESEL	ATTACHED	200 GAL	ATTACH TO BUSS ON THE LOAD SIDE OF THE 600 AMP MAIN BREAKER	500 MCM	TYPE W, PORTABLE POWER CABLE	70 FEET	TOTAL LENGTH OF CABLE IS 70 FEET (4 CONDUCTOR WITH GROUND)	(A) NO TRANSFER SWITCH (B) HAVE ELECTRICIAN (C) LARGEST MOTOR IS 75 HP (D) 80% POWER FACTOR USED IN CALCULATIONS (E) POWER COMPANY SERVICE TRANSFORMER SIZES UNKNOWN (F) NO FUEL STORAGE ON SITE	DIST4

UTILITY: Shepherdstown Water

TELEPHONE: 304-876-3322

METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 6/16/2014 TO: 7/15/2014

1. Water Delivered to System for Retail Service 16,849,800 (D)

2. Metered Water — Gallons

   a. Residential 5,420,600

   b. Commercial 2,078,805

   c. Govt. 1,196,100

   d. Other ______

TOTAL 8,695,505 (M)

3. Metered Ratio ($= \frac{M}{D} \times 100$) 51.6 Percent

4. Unmetered Water (UM=D-M) 8,154,295 UM

5. Allowances (A) (Known or Estimated)

   a. Municipal Use 1,845,912

   b. Hydrant Use 119,134

   c. Tank Overflow ______

   d. Other (attach list) 501,720

TOTAL: 2,466,766 (A)

6. Unaccounted-For Water (UFW=UM-A) 5,687,529 (UFW)

7. Unaccounted for Ratio ($\frac{UFW}{D} \times 100$) 33.8 Percent

REPORTED BY: ______________________

Send Copy to: Public Service Commission of West Virginia
Water & Sewer Section/Engineering
201 Brooks St., P.O. Box 812
Charleston, WV 25323

PH: (304)340-0300

UTILITY: Shepherdstown Water

TELEPHONE: 304-876-3322

METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 7/16/2014 TO: 8/15/2014

1. Water Delivered to System for Retail Service 16,342,200 (D)

2. Metered Water — Gallons

	Gallons
a. Residential	5,541,600
b. Commercial	2,367,100
c. Govt.	1,247,500
d. Other	

TOTAL 9,156,200 (M)

3. Metered Ratio (=M/D x 100) 56.0 Percent

4. Unmetered Water (UM=D-M) 7,186,000 UM

5. Allowances (A) (Known or Estimated)

a. Municipal Use	1,898,280
b. Hydrant Use	88,116
c. Tank Overflow	
d. Other (attach list)	644,860

TOTAL: 2,631,256 (A)

6. Unaccounted-For Water (UFW=UM-A) 4,554,744 (UFW)

7. Unaccounted for Ratio (UFW/D x 100) 27.9 Percent

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METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 8/16/2014 TO: 9/15/2014

1. Water Delivered to System for Retail Service 18,422,000 (D)

2. Metered Water — Gallons

a. Residential 4,954,400

b. Commercial 2,162,200

c. Govt. 2,570,400

d. Other

TOTAL 9,687,000 (M)

3. Metered Ratio ($= \frac{M}{D} \times 100$) 52.6 Percent

4. Unmetered Water (UM=D-M) 8,735,000 UM

5. Allowances (A) (Known or Estimated)

a. Municipal Use 2,293,718

b. Hydrant Use 88,116

c. Tank Overflow

d. Other (attach list) 876,874

TOTAL: 3,258,708 (A)

6. Unaccounted-For Water (UFW=UM-A) 5,476,292 (UFW)

7. Unaccounted for Ratio ($\frac{UFW}{D} \times 100$) 29.7 Percent

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METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 9/16/2014 TO: 10/15/2014

1. Water Delivered to System for Retail Service 17,500,300 (D)

2. Metered Water — Gallons

a. Residential 4,807,600

b. Commercial 2,047,600

c. Govt. 2,937,400

d. Other

TOTAL 9,792,600 (M)

3. Metered Ratio ($= \frac{M}{D} \times 100$) 56.0 Percent

4. Unmetered Water (UM=D-M) 7,707,700 UM

5. Allowances (A) (Known or Estimated)

a. Municipal Use 2,194,808

b. Hydrant Use 88,116

c. Tank Overflow

d. Other (attach list) 1,179,708

TOTAL: 3,462,632 (A)

6. Unaccounted-For Water (UFW=UM-A) 4,245,068 (UFW)

7. Unaccounted for Ratio ($\frac{UFW}{D} \times 100$) 24.3 Percent

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METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 10/16/2014 TO: 11/15/2014

1. Water Delivered to System for Retail Service ______ 17,178,700 (D)

2. Metered Water
   - a. Residential ______ 4,904,300
   - b. Commercial ______ 2,184,600
   - c. Govt. ______ 2,923,800
   - d. Other ______

TOTAL ______ 10,012,700 (M)

3. Metered Ratio ($= \frac{M}{D} \times 100$) ______ 58.3 Percent

4. Unmetered Water (UM=D-M) ______ 7,166,000 UM

5. Allowances (A) (Known or Estimated)
   - a. Municipal Use ______ 2,160,444
   - b. Hydrant Use ______ 634,836
   - c. Tank Overflow ______
   - d. Other (attach list) ______ 2,511,648

TOTAL: ______ 5,306,928 (A)

6. Unaccounted-For Water (UFW=UM-A) ______ 1,859,072 (UFW)

7. Unaccounted for Ratio ($\frac{UFW}{D} \times 100$) ______ 10.8 Percent

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METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 11/16/2014 TO: 12/15/2014

1. Water Delivered to System for Retail Service 16,623,600 (D)

2. Metered Water
   a. Residential 4,445,200
   b. Commercial 1,987,900
   c. Govt. 1,963,200
   d. Other

TOTAL 8,396,300 (M)

3. Metered Ratio ($= \frac{M}{D} \times 100$) 50.5 Percent

4. Unmetered Water (UM=D-M) 8,227,300 UM

5. Allowances (A) (Known or Estimated)
   a. Municipal Use 2,047,870
   b. Hydrant Use 88,116
   c. Tank Overflow
   d. Other (attach list) 917,640

TOTAL: 3,053,626 (A)

6. Unaccounted-For Water (UFW=UM-A) 5,173,674 (UFW)

7. Unaccounted for Ratio ($\frac{UFW}{D} \times 100$) 31.1 Percent

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UTILITY: Shepherdstown Water

TELEPHONE: 304-876-3322

METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 12/16/2014 TO: 1/15/2015

1. Water Delivered to System for Retail Service 17,625,800 (D)

2. Metered Water

a. Residential 4,745,000

b. Commercial 1,647,600

c. Govt. 1,947,300

d. Other ______

TOTAL 8,339,900 (M)

3. Metered Ratio ($= \frac{M}{D} \times 100$) 47.3 Percent

4. Unmetered Water (UM=D-M) 9,285,900 UM

5. Allowances (A) (Known or Estimated)

a. Municipal Use 2,236,719

b. Hydrant Use 88,116

c. Tank Overflow ______

d. Other (attach list) 2,457,996

TOTAL: 4,782,831 (A)

6. Unaccounted-For Water (UFW=UM-A) 4,503,069 (UFW)

7. Unaccounted for Ratio ($\frac{UFW}{D} \times 100$) 25.5 Percent

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Charleston, WV 25323

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UTILITY: Shepherdstown Water

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METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 1/16/2015 TO: 2/15/2015

1. Water Delivered to System for Retail Service	22,840,400	(D)
2. Metered Water		
a. Residential	4,557,000	
b. Commercial	1,709,400	
c. Govt.	2,020,700	
d. Other		
TOTAL	8,287,100	(M)
3. Metered Ratio ($= \frac{M}{D} \times 100$)	36.3	Percent
4. Unmetered Water (UM=D-M)	14,553,300	UM
5. Allowances (A) (Known or Estimated)		
a. Municipal Use	2,746,415	
b. Hydrant Use	88,116	
c. Tank Overflow		
d. Other (attach list)	3,823,200	
TOTAL:	6,657,731	(A)
6. Unaccounted-For Water (UFW=UM-A)	7,895,569	(UFW)
7. Unaccounted for Ratio ($\frac{UFW}{D} \times 100$)	34.6	Percent

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METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 2/16/2015 TO: 3/15/2015

1. Water Delivered to System for Retail Service 23,423,300 (D)

2. Metered Water

a. Residential 5,085,300

b. Commercial 2,446,700

c. Govt. 2,074,500

d. Other ____________

TOTAL 9,606,500 (M)

3. Metered Ratio (=M/D x 100) 41.0 Percent

4. Unmetered Water (UM=D-M) 13,816,800 UM

5. Allowances (A) (Known or Estimated)

a. Municipal Use 2,829,676

b. Hydrant Use 88,116

c. Tank Overflow ____________

d. Other (attach list) 3,049,440

TOTAL: 5,967,232 (A)

6. Unaccounted-For Water (UFW=UM-A) 7,849,568 (UFW)

7. Unaccounted for Ratio (UFW/D x 100) 33.5 Percent

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METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 3/16/2015 TO: 4/15/2015

1. Water Delivered to System for Retail Service 20,584,300 (D)

2. Metered Water

a. Residential 3,973,600

b. Commercial 1,845,500

c. Govt. 2,438,200

d. Other ______

TOTAL 8,257,300 (M)

3. Metered Ratio $(= \frac{M}{D} \times 100)$ 40.1 Percent

4. Unmetered Water (UM=D-M) 12,327,000 UM

5. Allowances (A) (Known or Estimated)

a. Municipal Use 2,462,523

b. Hydrant Use 88,116

c. Tank Overflow ______

d. Other (attach list) 3,263,040

TOTAL: 5,813,679 (A)

6. Unaccounted-For Water (UFW=UM-A) 6,513,321 (UFW)

7. Unaccounted for Ratio $(\frac{UFW}{D} \times 100)$ 31.6 Percent

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UTILITY: Shepherdstown Water

TELEPHONE: 304-876-3322

METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 4/16/2015 TO: 5/15/2015

1. Water Delivered to System for Retail Service 19,121,200 (D)

2. Metered Water
   a. Residential 4,577,000
   b. Commercial 2,101,400
   c. Govt. 1,638,400
   d. Other ______

TOTAL 8,316,800 (M)

3. Metered Ratio ($=\frac{M}{D} \times 100$) 43.5 Percent

4. Unmetered Water (UM=D-M) 10,804,400 UM

5. Allowances (A) (Known or Estimated)
   a. Municipal Use 2,268,167
   b. Hydrant Use 88,116
   c. Tank Overflow ______
   d. Other (attach list) 1,952,640

TOTAL: 4,308,923 (A)

6. Unaccounted-For Water (UFW=UM-A) 6,495,477 (UFW)

7. Unaccounted for Ratio ($\frac{UFW}{D} \times 100$) 34.0 Percent

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201 Brooks St., P.O. Box 812
Charleston, WV 25323

PH: (304)340-0300

UTILITY: Shepherdstown Water

TELEPHONE: 304-876-3322

METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 5/16/2015 TO: 6/15/2015

1. Water Delivered to System for Retail Service	18,807,000	(D)
2. Metered Water		
a. Residential	5,687,600	
b. Commercial	2,299,800	
c. Govt.	1,186,000	
d. Other		
TOTAL	9,173,400	(M)
3. Metered Ratio (=M/D x 100)	48.8	Percent
4. Unmetered Water (UM=D-M)	9,633,600	UM
5. Allowances (A) (Known or Estimated)		
a. Municipal Use	2,269,731	
b. Hydrant Use	88,116	
c. Tank Overflow		
d. Other (attach list)	2,541,792	
TOTAL:	4,899,639	(A)
6. Unaccounted-For Water (UFW=UM-A)	4,733,961	(UFW)
7. Unaccounted for Ratio (UFW/D x 100)	25.2	Percent

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Charleston, WV 25323

UTILITY: Shepherdstown Water

TELEPHONE: 304-876-3322

METERED RATIO AND UNACCOUNTED FOR WATER WORK SHEET

DATES: FROM: 6/16/2014 TO: 6/15/2015

1. Water Delivered to System for Retail Service 244,125,600 (D)

2. Metered Water

a. Residential	58,699,200
b. Commercial	24,878,605
c. Govt.	24,143,500
d. Other	0

TOTAL 107,721,305 (M)

3. Metered Ratio ($= \frac{M}{D} \times 100$) 44.1 Percent

4. Unmetered Water (UM=D-M) 136,404,295 UM

5. Allowances (A) (Known or Estimated)

a. Municipal Use	27,254,263
b. Hydrant Use	1,635,130
c. Tank Overflow	0
d. Other (attach list)	23,720,558

TOTAL: 52,609,951 (A)

6. Unaccounted-For Water (UFW=UM-A) 83,794,344 (UFW)

7. Unaccounted for Ratio ($\frac{UFW}{D} \times 100$) 34.3 Percent

REPORTED BY: ______________________

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Charleston, WV 25323

MONTHLY OPERATING REPORT DATA

Corporation of Shepherdstown Water Department

September 2014

Date	Plant Op. Time (hrs)	Filtered Water (gal)	Filter Wash Water (gal)
1	15	668,500	9,480
2	15	696,800	8,825
3	14	566,700	8,135
4	15	652,300	8,190
5	15	660,800	8,271
6	13	563,000	8,959
7	7	320,600	
8	16	717,500	10,315
9	14	621,800	7,849
10	15	676,300	8,988
11	16	704,700	8,384
12	16	718,800	8,833
13	13	571,700	6,973
14	8	354,400	
15	16	717,100	8,770
16	16	637,500	9,274
17	15	637,400	8,102
18	16	659,300	10,208
19	16	719,100	8,082
20	14	597,500	
21	7	302,700	
22	15	683,400	7,798
23	15	707,500	9,005
24	22	930,100	9,222
25	11	453,500	8,388
26	14	596,000	7,883
27	12	503,900	
28	8	330,500	
29	16	683,600	8,199
30	16	675,500	7,974
31			
TOTAL	421	18,328,500	206,107
AVG	14	610,950	8,588
MAX	22	930,100	10,315
MIN	7	302,700	6,973

October 2014

Day of Month	Plant Op. Time (hrs)	Filtered Water (gal)	Filter Wash Water (gal)
1	11	480,000	6,573
2	12	537,100	7,913
3	14	617,900	
4	11	498,000	7,124
5	8	360,300	
6	15	665,900	8,004
7	15	639,200	8,590
8	14	590,100	8,072
9	12	499,900	8,038
10	16	705,800	7,619
11	12	508,000	
12	7	296,700	7,268
13	15	671,600	8,431
14	17	698,300	8,088
15	15	604,000	8,559
16	11	491,800	7,889
17	15	598,300	
18	12	480,700	8,239
19	8	318,000	
20	14	619,600	9,921
21	13	569,900	7,950
22	13	541,700	8,718
23	13	660,200	8,197
24	14	584,300	7,280
25	13	553,000	6,499
26	8	335,900	
27	15	657,700	8,280
28	15	667,100	8,291
29	15	590,800	7,226
30	13	559,500	8,198
31	14	576,700	7,407
TOTAL	400	17,178,000	198,374
AVG	13	554,129	7,935
MAX	17	705,800	9,921
MIN	7	296,700	6,499

November 2014

Day of Month	Plant Op. Time (hrs)	Filtered Water (gal)	Filter Wash Water (gal)
1	12	497,400	8,009
2	8	331,300	
3	15	685,800	8,643
4	14	612,200	8,295
5	16	693,500	8,464
6	14	598,400	6,942
7	13	541,300	8,994
8	15	642,700	
9	8	318,200	9,927
10	15	655,100	8,157
11	12	509,900	8,084
12	13	556,300	8,132
13	13	552,500	7,795
14	14	585,900	
15	12	493,000	6,985
16	8	335,900	
17	15	673,500	9,533
18	15	661,700	9,541
19	15	660,100	7,819
20	15	648,100	9,628
21	14	623,000	9,634
22	13	543,700	
23	7	313,700	7,256
24	15	646,600	8,470
25	15	605,900	7,983
26	14	567,200	7,520
27			
28	15	757,300	8,392
29	14	624,300	
30	8	269,900	7,545
31			
TOTAL	377	16,204,400	191,748
AVG	13	558,772	8,337
MAX	16	757,300	9,927
MIN	7	269,900	6,942

December 2014

Day of Month	Plant Op. Time (hrs)	Filtered Water (gal)	Filter Wash Water (gal)
1	16	704,500	9,355
2	15	677,100	9,773
3	13	561,800	9,119
4	13	585,000	9,341
5	14	606,300	8,969
6	14	589,400	8,160
7	6	488,200	
8	14	656,000	
9	13	594,900	10,908
10	14	619,800	8,065
11	14	615,600	9,567
12	13	570,600	9,495
13	12	498,500	6,641
14	8	333,300	
15	13	591,700	8,986
16	13	566,000	9,034
17	15	615,900	8,448
18	14	564,000	8,216
19	15	592,500	7,765
20	12	473,000	7,554
21	8	330,500	
22	15	619,000	8,358
23	14	601,000	7,370
24	15	608,600	7,559
25			
26	15	697,300	8,711
27	15	638,500	7,557
28	9	381,800	
29	16	688,500	9,092
30	15	639,600	
31	16	655,300	9,387
TOTAL	399	17,364,200	207,430
AVG	13	578,807	8,643
MAX	16	704,500	10,908
MIN	6	330,500	6,641

January 2015

Day of Month	Plant Op. Time (hrs)	Filtered Water (gal)	Filter Wash Water (gal)
1			
2	15	694,600	16,386
3	13	601,200	13,352
4	15	653,200	14,214
5	14	663,800	15,380
6	14	684,600	20,028
7	15	698,900	22,040
8	15	680,400	20,888
9	16	730,300	23,888
10	15	680,500	21,772
11	9	415,100	21,544
12	14	665,600	22,178
13	14	647,200	23,742
14	16	743,900	21,030
15	22	1,050,300	43,486
16	21	911,800	35,852
17	12	545,900	18,494
18	15	691,900	17,078
19	15	707,700	18,446
20	15	697,300	20,066
21	15	706,900	19,458
22	14	671,400	17,040
23	22	1,013,600	15,970
24	14	633,700	14,866
25	14	677,600	15,434
26	15	695,000	18,424
27	16	734,800	19,026
28	22	956,500	33,350
29	14	615,900	20,080
30	22	718,400	19,442
31	14	660,200	14,832
TOTAL	467	21,248,200	617,786
AVG	16	708,273	20,593
MAX	22	1,050,300	43,486
MIN	9	415,100	13,352

	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	
Total Wash Water =	206,107	198,374	191,748	207,430	617,786	670,321	745,738	513,365	604,134	453,351	428,852	444,576	***5,281,782***
Average Filtered Water =	610,950	554,129	558,772	578,807	708,273	773,157	767,503	656,113	619,413	573,777	592,545	642,965	***636,367***
Max Produced =	930,100	705,800	757,300	704,500	1,050,300	1,106,700	1,063,900	764,000	1,117,400	755,300	720,200	790,100	***1,117,400***
Min Produced =	302,700	296,700	269,900	330,500	415,100	510,100	347,900	350,600	297,300	315,400	341,500	335,000	***269,900***
Average Hours Pumped =	14	13	13	13	16	17	17	14	14	12	13	14	***14***
Max Hours Pumped =	22	17	16	16	22	24	23	16	24	16	16	17	***24***
Min Hours Pumped =	7	7	7	6	9	10	8	8	6	7	8	8	***6***

February 2015			
Day of Month	**Plant Op. Time (hrs)**	**Filtered Water (gal)**	**Filter Wash Water (gal)**
1	16	757,100	17
2	22	913,400	36,110
3	17	759,600	18,876
4	15	705,300	19,014
5	15	688,600	18,258
6	15	682,600	18,495
7	17	786,100	18,684
8	16	751,500	15,314
9	22	962,000	34,948
10	18	807,900	18,850
11	15	699,600	20,464
12	16	727,600	18,774
13	10	510,100	15,746
14	16	761,700	17,942
15	15	692,300	18,358
16	24	1,106,700	31,108
17	19	849,600	17,272
18	16	720,400	16,786
19	16	738,500	31,424
20	17	809,900	16,870
21	13	591,400	42,872
22	15	685,400	32,524
23	16	786,800	32,125
24	21	1,004,900	32,616
25	15	724,200	27,974
26	16	785,100	35,206
27	17	829,400	35,752
28	17	810,700	27,942
29			
30			
31			
TOTAL	467	21,648,400	670,321
AVG	17	773,157	23,940
MAX	24	1,106,700	42,872
MIN	10	510,100	17

March 2015			
Day of Month	**Plant Op. Time (hrs)**	**Filtered Water (gal)**	**Filter Wash Water (gal)**
1	20	954,700	35,964
2	15	728,900	34,346
3	21	1,005,700	47,427
4	23	1,063,900	34,668
5	21	985,100	33,394
6	15	682,500	39,596
7	22	1,032,600	29,216
8	23	1,035,100	21,982
9	22	983,900	34,794
10	20	891,800	24,106
11	16	713,700	27,984
12	17	801,200	23,284
13	21	925,000	24,674
14	15	676,400	16,480
15	11	499,800	16,250
16	11	501,300	59,737
17	19	841,100	20,540
18	16	721,200	19,296
19	16	712,500	19,644
20	16	701,900	19,316
21	15	653,100	14,926
22	8	347,900	
23	16	746,500	19,098
24	16	774,400	19,666
25	16	755,600	18,440
26	16	734,800	19,674
27	17	753,200	19,364
28	15	673,900	16,212
29	8	354,200	
30	17	798,900	18,814
31	16	741,800	16,846
TOTAL	520	23,792,600	745,738
AVG	17	767,503	25,715
MAX	23	1,063,900	59,737
MIN	8	347,900	14,926

April 2015			
Day of Month	**Plant Op. Time (hrs)**	**Filtered Water (gal)**	**Filter Wash Water (gal)**
1	16	756,400	18,990
2	16	751,800	19,858
3	15	699,800	20,070
4	13	617,700	18,016
5	10	361,000	
6	15	699,800	19,338
7	16	761,100	20,040
8	15	699,400	19,416
9	16	707,800	18,220
10	13	602,400	17,232
11	13	572,500	15,412
12	8	353,200	
13	15	739,700	21,568
14	16	743,000	22,116
15	16	706,400	20,024
16	16	748,500	19,798
17	15	684,400	19,720
18	15	658,900	15,175
19	8	351,900	
20	16	740,400	23,716
21	16	755,900	24,942
22	16	717,200	21,980
23	15	686,100	20,268
24	15	685,800	19,584
25	13	572,800	18,600
26	8	350,600	
27	16	764,000	22,230
28	16	755,400	19,124
29	16	749,900	19,970
30	15	689,600	17,958
31			
TOTAL	429	19,683,400	513,365
AVG	14	656,113	19,745
MAX	16	764,000	24,942
MIN	8	350,600	15,175

May 2015			
Day of Month	**Plant Op. Time (hrs)**	**Filtered Water (gal)**	**Filter Wash Water (gal)**
1	14	639,700	17,524
2	13	597,500	16,818
3	9	424,700	
4	14	655,600	20,806
5	13	604,500	19,740
6	14	657,600	18,220
7	14	617,300	16,750
8	15	655,900	19,000
9	13	570,400	13,364
10	8	344,200	
11	16	742,200	20,806
12	16	723,500	18,220
13	16	698,100	17,524
14	13	584,400	19,757
15	15	694,200	17,359
16	14	601,300	18,225
17	24	1,117,400	16,785
18	16	707,200	16,573
19	14	611,300	18,785
20	14	619,500	19,275
21	12	527,400	18,312
22	14	624,500	17,685
23	12	527,700	17,943
24	8	340,700	
25	16	764,400	20,806
26	18	785,400	21,852
27	6	297,300	125,200
28	17	777,700	22,115
29	17	766,900	20,103
30	13	559,400	14,587
31	8	363,900	
TOTAL	426	19,201,800	604,134
AVG	14	619,413	22,375
MAX	24	1,117,400	125,200
MIN	6	297,300	13,364

June 2015			
Day of Month	**Plant Op. Time (hrs)**	**Filtered Water (gal)**	**Filter Wash Water (gal)**
1	16	755,300	18,525
2	15	711,700	18,285
3	13	591,600	17,582
4	13	577,000	17,285
5	13	549,300	17,528
6	11	500,800	13,500
7	8	332,900	
8	16	723,500	20,150
9	15	713,500	18,325
10	13	597,100	18,202
11	13	612,500	17,825
12	13	572,000	17,285
13	13	578,900	17,000
14	7	334,700	
15	14	664,200	18,133
16	15	676,400	18,205
17	12	544,300	18,325
18	12	558,000	18,193
19	12	550,400	19,021
20	11	462,600	17,400
21	9	424,700	
22	15	733,200	20,154
23	11	509,100	18,250
24	12	545,200	18,125
25	10	473,200	
26	15	724,300	19,185
27	11	545,200	18,000
28	7	315,400	
29	15	741,400	20,193
30	13	594,900	18,675
31			
TOTAL	373	17,213,300	453,351
AVG	12	573,777	18,134
MAX	16	755,300	20,193
MIN	7	315,400	13,500

July 2015				*August 2015*			
Day of Month	**Plant Op. Time (hrs)**	**Filtered Water (gal)**	**Filter Wash Water (gal)**	**Day of Month**	**Plant Op. Time (hrs)**	**Filtered Water (gal)**	**Filter Wash Water (gal)**
1	11	532,700	17,225	1	13	607,400	16,000
2	14	650,900	18,035	2	8	380,000	
3	14	669,800	17,825	3	16	766,000	17,540
4	13	600,800	18,283	4	15	687,900	16,925
5	8	341,500		5	14	640,400	16,450
6	16	720,200	18,525	6	13	621,800	16,683
7	12	576,800	17,112	7	14	644,800	16,400
8	13	600,600	17,425	8	13	598,000	16,500
9	13	592,300	16,685	9	9	406,500	
10	13	587,200	16,215	10	15	721,900	18,250
11	8	370,800		11	14	659,700	17,482
12	15	689,300	17,425	12	14	672,000	17,103
13	14	644,000	16,123	13	14	644,200	16,892
14	12	537,900	16,621	14	15	717,900	17,125
15	12	568,500	16,325	15	12	561,800	17,252
16	12	534,700	15,893	16	8	373,300	
17	13	566,300		17	15	735,500	17,886
18	13	594,800	17,000	18	15	702,800	16,482
19	8	400,300		19	16	746,100	17,125
20	15	713,800	18,623	20	16	732,600	17,803
21	14	645,700	15,122	21	16	740,300	17,264
22	14	641,700	15,685	22	15	656,900	16,000
23	14	611,500	15,531	23	8	335,000	
24	14	606,800	15,123	24	16	780,300	17,562
25	13	598,000		25	15	725,800	17,689
26	10	453,600	16,552	26	16	747,900	17,128
27	15	712,800	15,125	27	15	699,000	17,152
28	15	716,000	15,387	28	17	779,300	17,102
29	14	645,800	15,225	29	15	686,900	17,000
30	13	603,400	14,652	30	8	369,800	
31	14	640,400	15,110	31	17	790,100	17,781
TOTAL	399	18,368,900	428,852	TOTAL	427	19,931,900	444,576
AVG	13	592,545	16,494	AVG	14	642,965	17,099
MAX	16	720,200	18,623	MAX	17	790,100	18,250
MIN	8.0	341,500	14,652	MIN	8	335,000	16,000

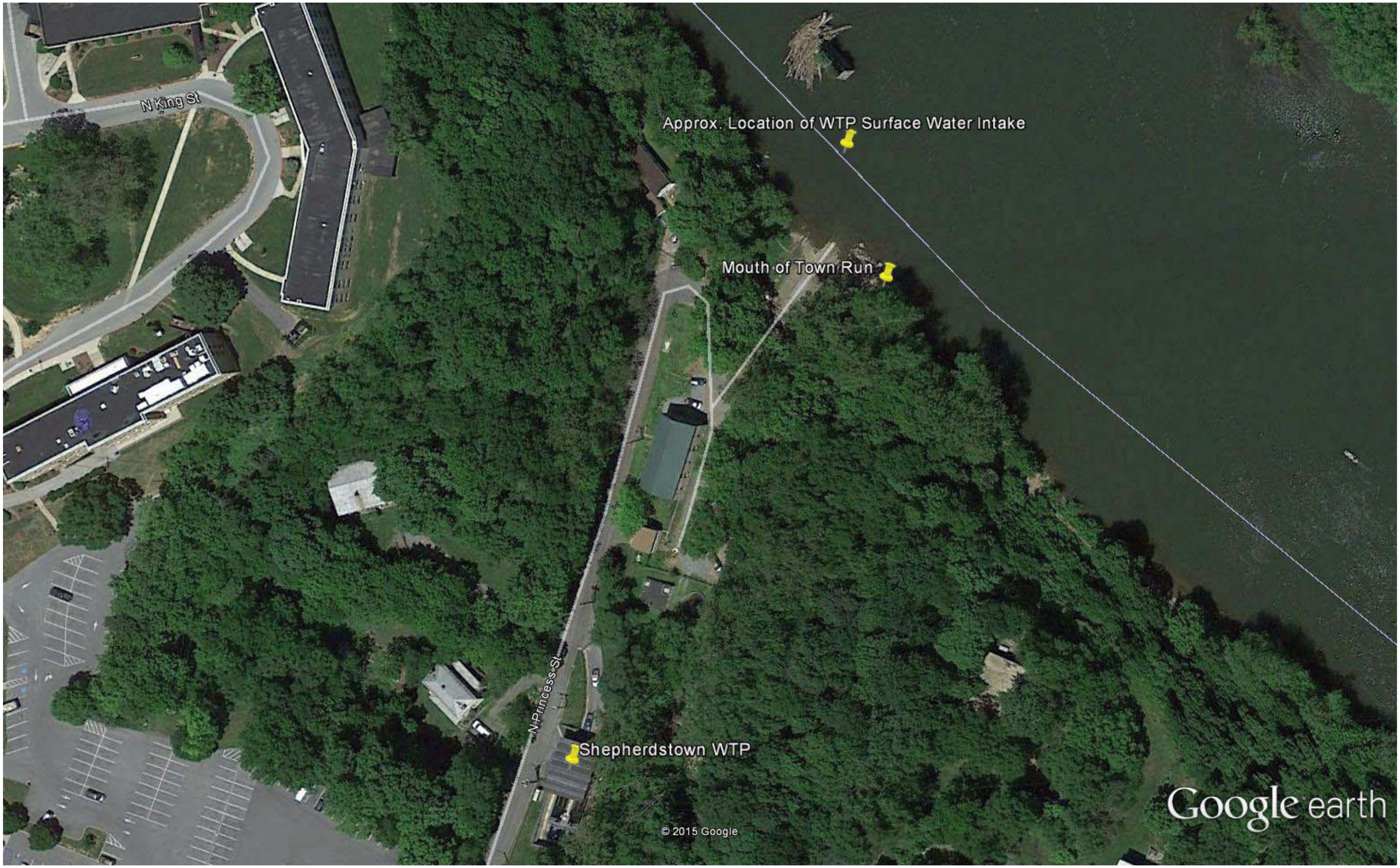
EARLY WARNING MONITORING COST ESTIMATE

Description	Qty.		Unit Price	Total Cost
Back Panel / Trough / Level (required)	1	EA	$4,350.00	$4,350.00
Probe Module SC1000 (6 sensors)	1	EA	$ 1,344.00	$ 1,344.00
Internal Card SC1000 (4 mA inputs)	1	EA	$ 879.00	$ 879.00
Display Module SC1000	1	EA	$ 2,770.00	$ 2,770.00
Conductivity Sensor	1	EA	$ 860.00	$ 860.00
FP360 SC Sensor, 500 ppb, SS, 1.5 m Cable	1	EA	$ 17,480.00	$ 17,480.00
ORP Sensor	1	EA	$ 880.00	$ 880.00
pH Sensor, Ryton	1	EA	$ 800.00	$ 800.00
Installation	1	LS	$ 20,637.00	$ 20,637.00
TOTAL				$50,000.00

OPERATION & MAINTENANCE COST ESTIMATE

Description	Qty.		Unit Price	Total Cost
Annual O&M Cost	1	LS	$750.00	$ 750.00
TOTAL				$ 750.00

In addition to the early warning system, Shepherdstown should establish a baseline water quality for their sources.



Google earth

feet 600
meters 100

Caitlyn M. Preast

From: Phillips, David B <David.B.Phillips@wv.gov>
Sent: Wednesday, October 07, 2015 9:20 AM
To: Caitlyn M. Preast
Subject: RE: Stream Flows

Hey Caitlyn,

7Q10 = 0.044 cfs
DA = 2.799 sq. mi.

From: Caitlyn M. Preast [mailto:cpreast@thrashereng.com]
Sent: Thursday, October 01, 2015 11:17 AM
To: Phillips, David B
Subject: Stream Flows

Hi David!

I am wondering about another stream… Could you please get me the 7Q10 value for Town Run (39.433888, -77.801634)?

Please let me know if you have any questions. Thanks!

Caitlyn M. Preast, E.I.
Staff Engineer

THRASHER
300 Association Drive
Charleston, WV 25311
O: (304) 343-7601
C: (304) 687-8367
F: (304) 343-7604
cpreast@thrashereng.com
www.thrashereng.com

DEVELOPING: Chemical spill in Potomac River to reach Shepherdstown by Saturday

Wednesday, September 30, 2015 by Emily Daniels, Staff Writer, *The Picket*

TODD BOWMAN / The Picket

Rain clouds move in over the Potomac River near the Shepherdstown water in-take Wednesday. Increased rain in the area is expected to make the chemical reach the in-take sooner.

[THE PICKET] – Some 10,000 gallons of a latex chemical that was spilled into the Potomac River in Allegany County, Md., is expected to reach Shepherdstown around 10 a.m. Saturday, Oct. 3.

The spill occurred Wednesday, Sept. 23, about 150 miles upstream from Shepherdstown. Initially predicted to reach Shepherdstown late next week, recent heavy rains have moved up its arrival.

In an effort to protect Shepherdstown's water supply, shifts at the water plant have also been increased to ensure that tanks will be full as soon as they are needed. The plant will have two full days of water storage on hand once the chemical reaches the intake, and they will be pumping water from an emergency secondary source, which has been tested for contaminants.

The water being pulled from the secondary source has been tested and meets standards as being free of primary contaminants.

"We would like to assure our customers that the water is safe now and will continue to be safe while the intake is shutdown," said Charles Coe, assistant chief operator of the water department.

The water department will be shutting down the Potomac River intake in Shepherdstown Thursday, Oct. 1, and using stored water and water from a secondary source to provide water for the community. The Shepherdstown intake from the river is to be reopened Friday, Oct. 9.

TODD BOWMAN / The Picket

The entrance to the Potomac River at the Shepherdstown boat ramp off Princess Street. The intake wil be shut down Thursday, Oct. 1, and water will be taken from an emergency secondary source, which has been tested for contaminants, Charles Coe said.

The water department will be taking samples Wednesday, Oct. 7, and Thursday, Oct. 8, to make sure the contamination has completely passed the Shepherdstown intake before it reopens.

Once the chemical reaches Shepherdstown's intake, it will presumably remain there for 116 hours—nearly five days—with the peak concentration penetrating the water 34 hours after it arrives, according to the latest model created by the Shepherdstown Water Department.

"We feel confident that the plan that we have constructed will get us through this incident safely," Coe said.

The Verso paper mill in Luke, a small town in Allegany County, Md., is where the 10,000-gallon spill of a latex chemical originated.

TODD BOWMAN / The Picket
Rain showers on Wednesday caused additional ripples in the Potomac River as Shepherdstown Water Department prepared for contaminated water to arrive from a spill in Western Maryland.

The spill occurred when a Verso worker didn't close the drain line of a 26,500-gallon storage tank being filled from a railroad tank car, according to a recent Washington's Top News article. According to Washington's Top News, Verso spokeswoman Kathi Rowzi described the chemical as being a synthetic form of latex used to coat paper. The chemical is half water and half styrene-butadiene, the paper coating substance.

For more information, contact the Shepherdstown Water Department at 304-876-2394.

Check back with The Picket for posted updates as soon as we receive them.

Emily Daniels is a staff writer for The Picket. She can be reached at edanie02@rams.shepherd.edu or followed on Twitter @emilykdaniels

Tags: chemical spill, latex spill, potomac river, shepherdstown, water contamination

http://supicket.com/news/2015/09/30/developing-chemical-spill-in-potomac-river-to-reach-shepherdstown-by-saturday/?utm_campaign=shareaholic&utm_medium=twitter&utm_source=socialnetwork

RELIANCE LABORATORIES, INC. - CHAIN OF CUSTODY RECORD

☐ 2044 MEADOWBROOK ROAD
POST OFFICE BOX 4657
BRIDGEPORT, WV 26330
TEL. (304) 842-5285 • FAX (304) 842-5351
E-MAIL reliancelabs@wvdsl.net
INTERNET www.RelianceLabs.net

☐ RIDGEFIELD BUSINESS CENTER
25 CRIMSON CIRCLE
MARTINSBURG, WV 25403
TEL. (304) 596-2084 • FAX (304) 596-2086

*CLIENT NAME Corporation Of Shepherdstown

*ADDRESS

CUSTOMER # C010469 *TEL. # FAX #

*SAMPLER (S) C. Coe E-MAIL

SHEET NO. 1 OF 1

LABORATORY #	*DATE	*TIME	COMP	GRAB	MATRIX W, DW, S, O, M	TEMP. ≤ 4°C Yes / No	*# OF CONTAIN.	HN03	H2S04	HCL	NaOH	BAC-T	NO PRES.	Other	SOC						*PROJECT/REMARKS
2379609	9/29/15	1124		✓	DW	1.6 (Yes)	~~16~~ 14			~~16~~ 4			~~6~~	8	✓						Secondary Source

SAMPLES DO ✓ DO NOT ____ MEET USEPA GUIDELINES FOR HOLDING TIMES
SAMPLES DO ✓ DO NOT ____ MEET USEPA GUIDELINES FOR CHEMICAL PRESERVATIVES
SAMPLES DO ✓ DO NOT ____ MEET USEPA GUIDELINES FOR SAMPLE CONTAINERS
SAMPLES ARE ____ ARE NOT ✓ FOR REGULATORY COMPLIANCE PURPOSES

*RELINQUISHED BY:	*DATE/TIME	*RECEIVED BY:
PRINT: [signature] SIGN: [signature]	DATE: 9-29-15 TIME: 1326	PRINT: Unnegan Ramirez SIGN:
*RELINQUISHED BY: PRINT: SIGN:	*DATE/TIME DATE: TIME:	*RECEIVED BY: PRINT: SIGN:
*RELINQUISHED BY: PRINT: SIGN:	*DATE/TIME DATE: TIME:	*RECEIVED BY: PRINT: SIGN:
*COURIER: TRACKING #:	*DATE/TIME DATE: TIME:	*RECEIVED BY: PRINT: SIGN:

REMARKS:

PWS#

WEATHER/TEMPERATURE:

☒ RUSH STATUS (INITIAL ACCEPTANCE AHS)
*** ADDITIONAL LABORATORY FEES MAY APPLY***

EXTENT OF LIABILITY

SHOULD RELIANCE LABORATORIES, INC. BE AT FAULT AND ANY DISPUTE ARISE REGARDING ANALYTICAL DATA GENERATED BY THE LABORATORY, THE EXTENT OF THE LIABILITY TO RELIANCE WILL BE A DUPLICATE ANALYSIS OF THAT SAMPLE (PROVIDING ADEQUATE SAMPLE REMAINS) OR A REFUND OF THE ANALYTICAL FEE. IN NO EVENT WILL RELIANCE LABORATORIES BE LIABLE FOR DAMAGES INCLUDING BUT NOT LIMITED TO DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES ARISING FROM SUCH DISPUTE.

NOTE: TYPICAL SAMPLE TURN AROUND FOR ROUTINE SAMPLES IS 5 TO 10 WORKING DAYS. THIS IS NOT A GUARANTEE THAT SAMPLES WILL BE COMPLETED IN THIS TIME FRAME, HOWEVER. NON-ROUTINE SAMPLES MAY REQUIRE ADDITIONAL TIME.

*** TO BE COMPLETED BY CLIENT**

ORIGINAL CHAIN OF CUSTODY DOCUMENT MUST BE EXECUTED IN INK

WHITE - LABORATORY YELLOW - CLIENT

Reliance Laboratories, Inc.
2044 Meadowbrook Road | P.O. Box 4657
Bridgeport, WV 26330
Phone: 304.842.5285 | Fax: 304.842.5351

Martinsburg Laboratory
Ridgefield Business Center | 25 Crimson Circle
Martinsburg, WV 25403
Phone: 304.596.2084 | Fax: 304.596.2086

Certifications: WV Department of Health #: 00354, 00443 | WV Department of Environmental Protection #: 158, 181
MD Department of Environment #: 336, 337 | US Environmental Protection Agency #: WV00042, WV00901

Environmental Analysis and Consultants
Reliancelabs@wvdsl.net | www.Reliancelabs.net

PURGEABLE ORGANICS – CHAIN OF CUSTODY & SAMPLE COLLECTION PROCEDURE

1. Samples should be grab samples and should be taken from a cold water tap where drinking water or water for human consumption is normally obtained.
2. Sample bottles should be handled aseptically to prevent contamination of samples. Do not touch the inside of the bottles or caps. Do not allow either to touch the faucet. Do not remove any preservatives present.
3. Open the cold water tap and allow water to run evenly for three to five minutes in order to equilibrate system. Generally, the water temperature will stabilize indicating complete equilibration.
4. Fill all containers completely allowing no air space to remain. If your samples include a trip blank, please return the trip blank unaltered to the laboratory with sample vials.
5. Complete all information below and return with sample to the laboratory.
6. Carefully pack all sample containers on ice when shipping/delivering to the laboratory.

***CAUTION*: Some sample bottles contain stabilizing reagents which are corrosive and should be handled carefully. If reagents come in contact with skin, flush with water.**

SAMPLING INFORMATION – COMPLETE THIS DOCUMENT IN INDELIBLE INK

Client Name: SHEPHERDSTOWN WATER

Address: PO BOX 248 SHEPHERDSTOWN WV 25443

Telephone: 304-876-2394 Fax: 304-876-8312 Public Water System (PWS) I.D.: 3301953

Sample Location: SECONDARY SOURCE

Sample Date: 9-29-15 Sample Time: 11:24 AM Collected By: C COE

Sample Witnessed By: ______ Date Received at Laboratory: ______

Preserved at Lab (Y/N): ______ Proper Preservatives: ______ Proper Containers Used: ______

Holding Times Observed: ______ Disinfectant Residual: ______ Received By: ______

Sample Temperature Upon Receipt: ______ Shipper/Tracking #: ______

Results Authorized By: ______ Date: ______

SUMMIT
ENVIRONMENTAL TECHNOLOGIES, INC
Analytical Laboratories

Summit Environmental Technologies, Inc.
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

October 07, 2015

Tenley Miller
Reliance Laboratories
25 Crimson Circle
Martinsburg, WV 25403
TEL: 304-596-2084
FAX: 304-596-2086

RE: 237960-2015-DW

Order No.: 15100043

Dear Tenley Miller:

Summit Environmental Technologies, Inc. received 3 sample(s) on 10/1/2015 for the analyses presented in the following report.

There were no problems with the analytical events associated with this report unless noted in the Case Narrative.

Quality control data is within laboratory defined or method specified acceptance limits except where noted.

If you have any questions regarding these tests results, please feel free to call the laboratory.

Sincerely,

Bachar Najm
Project Manager
3310 Win St.
Cuyahoga Falls, Ohio 44223

A2LA 0724.01, Alabama 41600, Arizona AZ0788, Arkansas 88-0735, California 07256CA, Colorado, Connecticut PH-0105, Delaware, Florida NELAC E87688, Georgia E87688 and 943, Idaho OH00923, Illinois 200061 and Reg 5, Indiana C-OH-13, Kansas E-10347, Kentucky (Underground Storage Tank) 3, Kentucky 90146, Louisiana 04061 and LA12004, Maine 2012015, Maryland 339, Massachusetts M-OPH923, Minnesota 409711, Montana CERT0099, New Hampshire 2996, New Jersey OH006, New York 11777, North Carolina 39705 and 631, Ohio Drinking Water 4170, Ohio VAP CL0052, Oklahoma 9940, Oregon OH200001, Rhode Island LA000317, South Carolina 92016001, Tennessee TN04018, Texas T104704466-11-5, Region 8 8TMS-L, USDA/APHIS P330-11-00244, Utah OH009232011-1, Vermont VT-87688, Virginia 00440 and 1581, Washington C891, West Virginia 248 and 9957C and E87688, Wisconsin 399013010

SUMMIT ENVIRONMENTAL TECHNOLOGIES, INC.
Analytical Laboratories

Summit Environmental Technologies, Inc.
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

Case Narrative

WO#: 15100043
Date: 10/7/2015

CLIENT: Reliance Laboratories
Project: 237960-2015-DW

This report in its entirety consists of the documents listed below. All documents contain the Summit Environmental Technologies, Inc., Work Order Number assigned to this report.

Paginated Report including Cover Letter, Case Narrative, Analytical Results, Applicable Quality Control Summary Reports, and copies of the Chain of Custody Documents are supplied with this sample set.

Concentrations reported with a J-Flag in the Qualifier Field are values below the Limit of Quantitation (LOQ) but greater than the established Method Detection Limit (MDL).

Method numbers, unless specified as SM (Standard Methods) or ASTM, are EPA methods.

Estimated uncertainty values are available upon request.

Analysis performed by DBM, VRM, or SFG were performed at Summit Labs 2704 Eatonton Highway Haddock, GA 31033

All results for Solid Samples are reported on an "as received" or "wet weight" basis unless indicated as "dry weight" using the "-dry" designation on the reporting units.

Summit Environmental Technologies, Inc., holds the accreditations/certifications listed at the bottom of the cover letter that may or may not pertain to this report.

This report is believed to meet all of the requirements of NELAC or the accrediting / certifying agency. Any comments or problems with the analytical events associated with this report are noted below.

Analytical Comments for SVOC-Add_DW(531.2), Sample R44392CCV0.9, Batch ID R44392 : The

EPA531.2 DETL (Batch 44392) exhibited high recoveries for Carbaryl and Methomyl; All samples were ND.

Analytical Comments for svoc_dw(515.1), Sample 16163-detl, Batch ID R44493 : The EPA515.1 (Batch 16163) exhibited high recovery for 2,4-DB.

Analytical Comments for SVOC_DW(508), Sample ccv-16262, Batch ID R44581 : The EPA508 Opening CCV (Batch R44581) exhibited high recoveries for Endrin, Heptachlor, Methoxychlor, Surrogate: DCB, and Surrogate: TCMX.
Analytical Comments for SVOC_DW(508), Sample ccv-16262, Batch ID R44581 : The EPA508 Mid-CCV (Batch R44581) exhibited high recoveries for Endrin, Heptachlor, Methoxychlor, Surrogate: DCB, and Surrogate: TCMX.
Analytical Comments for SVOC_DW(508), Sample ccv-16196, Batch ID R44581 : The EPA508 Ending CCV (Batch 44581) exhibited high recoveries for Dieldrin, Endrin, Heptachlor, Methoxychlor, Surrogate: DCB, and Surrogate: TCMX.
Analytical Comments for SVOC_DW(508), Sample mb-16262, Batch ID 16262 : The EPA508 Method Blank (Batch 16262) exhibited poor recovery for Surrogate: TCMX.
Analytical Comments for SVOC_DW(508), Sample lcs-16262, Batch ID 16262 : The EPA508 LCS (Batch 16262) exhibited high recoveries for all analytes.
Analytical Comments for SVOC_DW(508), Sample lcsd-16262, Batch ID 16262 : The EPA508 LCSD (Batch 16262) exhibited high recoveries for all analytes.
Analytical Comments for SVOC_DW(508), Sample 16262-detl, Batch ID 16262 : The EPA508 DETL (Batch 16262) exhibited poor recoveries for Aldrin, Heptachlor, and Surrogate: TCMX. High recovery was observed for Methoxychlor.
Analytical Comments for SVOC_DW(508), Sample 15100043-001a, Batch ID 16262 : Sample exhibited poor recovery for Surrogate: TCMX. Surrogate: DCB exhibited control.

Analytical Comments for SVOC_DW(525.2), Sample LCS-16197, Batch ID 16197 : The EPA525.2 LCS (Batch 16197) exhibited poor recoveries for Hexachlorocyclopentadiene.
Analytical Comments for SVOC_DW(525.2), Sample 16197-DETL, Batch ID R44588 : The EPA525.2 DETL (Batch 16197) exhibited high recoveries from Benzo(a)pyrene, Bis(2-ethylhexyl)phthalate, Bis(2-ethylhexyl)adipate, and Hexachlorocyclopentadiene.
Analytical Comments for SVOC_DW(525.2), Sample LCSD-16197, Batch ID R44588 : The EPA525.2 LCS (Batch16197) exhibited high recovery for Bis(2-ethylhexyl)adipate and Alachlor.
Analytical Comments for SVOC_DW(525.2), Sample MB-16197, Batch ID 16197 : The EPA525.2 Method Blank (Batch 16197) exhibited a hit for Bis(2-ethylhexyl)phthalate above the MDL but below

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Cuyahoga Falls, Ohio 44223
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Website: http://www.settek.com

Case Narrative

WO#: **15100043**
Date: **10/7/2015**

CLIENT: Rellance Laboratories
Project: 237960-2015-DW

the PQL.
Analytical Comments for SVOC_DW(525.2), Sample 525 ICV_A_5 5ug/, Batch ID R44588 : The EPA525.2 ICV (Batch R44588) exhibited high recoveries for Bis(2-ethylhexyl)phthalate and Bis(2-ethylhexyl)adipate.

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Website: http://www.settek.co

Qualifiers and Acronyms

WO#: 15100043
Date: 10/7/2015

These commonly used Qualifiers and Acronyms may or may not be present in this report.

Qualifiers

U	The compound was analyzed for but was not detected.
J	The reported value is greater than the Method Detection Limit but less than the Reporting Limit.
H	The hold time for sample preparation and/or analysis was exceeded.
D	The result is reported from a dilution.
E	The result exceeded the linear range of the calibration or is estimated due to interference.
MC	The result is below the Minimum Compound Limit.
*****	The result exceeds the Regulatory Limit or Maximum Contamination Limit.
m	Manual integration was used to determine the area response.
N	The result is presumptive based on a Mass Spectral library search assuming a 1:1 response.
P	The second column confirmation exceeded 25% difference.
C	The result has been confirmed by GC/MS.
X	The result was not confirmed when GC/MS Analysis was performed.
B/MB+	The analyte was detected in the associated blank.
G	The ICB or CCB contained reportable amounts of analyte.
QC-/+	The CCV recovery failed low (-) or high (+).
R/QDR	The RPD was outside of accepted recovery limits.
QL-/+	The LCS or LCSD recovery failed low (-) or high (+).
QLR	The LCS/LCSD RPD was outside of accepted recovery limits.
QM-/+	The MS or MSD recovery failed low (-) or high (+).
QMR	The MS/MSD RPD was outside of accepted recovery limits.
QV-/+	The ICV recovery failed low (-) or high (+).
S	The spike result was outside of accepted recovery limits.

Acronyms

ND	Not Detected	**RL**	Reporting Limit
QC	Quality Control	**MDL**	Method Detection Limit
MB	Method Blank	**LOD**	Level of Detection
LCS	Laboratory Control Sample	**LOQ**	Level of Quantitation
LCSD	Laboratory Control Sample Duplicate	**PQL**	Practical Quantitation Limit
QCS	Quality Control Sample	**CRQL**	Contract Required Quantitation Limit
DUP	Duplicate	**PL**	Permit Limit
MS	Matrix Spike	**RegLvl**	Regulatory Limit
MSD	Matrix Spike Duplicate	**MCL**	Maximum Contamination Limit
RPD	Relative Percent Different	**MinCL**	Minimum Compound Limit
ICV	Initial Calibration Verification	**RA**	Reanalysis
ICB	Initial Calibration Blank	**RE**	Reextraction
CCV	Continuing Calibration Verification	**TIC**	Tentatively Identified Compound
CCB	Continuing Calibration Blank	**RT**	Retention Time
RLC	Reporting Limit Check	**CF**	Calibration Factor
DF	Dilution Factor	**RF**	Response Factor

This list of Qualifiers and Acronyms reflects the most commonly utilized Qualifiers and Acronyms for reporting. Please refer to the Analytical Notes in the Case Narrative for any Qualifiers or Acronyms that do not appear in this list or for additional information regarding the use of these Qualifiers on reported data.

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Workorder Sample Summary

WO#: 15100043
07-Oct-15

CLIENT: Reliance Laboratories
Project: 237960-2015-DW

Lab SampleID	Client Sample ID	Tag No	Date Collected	Date Received	Matrix
15100043-001	237960-2015-DW		9/29/2015 11:24:00 AM	10/1/2015 9:50:00 AM	Drinking Water
15100043-002	FIELD BLANK		9/29/2015 11:24:00 AM	10/1/2015 9:50:00 AM	Drinking Water
15100043-003	TRIP BLANK		9/29/2015	10/1/2015 9:50:00 AM	Drinking Water

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Website: http://www.settek.com

WO#: **15100043**
Date Reported: **10/7/2015**
Company: Reliance Laboratories
Address: 25 Crimson Circle
Martinsburg WV 25403
Received: 10/1/2015
Project#: 237960-2015-D

Client ID#	Lab#	Collected	Analyte	Result	Units	Qual	Matrix	Method	DF	LOD	LOQ	Run	Analys
237960-2015-DW	001	9/29/2015	1,2-Dibromo-3-chloropropane	ND	mg/L		Drinking Water	EPA 504.1	1	0.0000400	0.0000400	10/2/2015	DLW
237960-2015-DW	001	9/29/2015	Ethylene dibromide	ND	mg/L		Drinking Water	EPA 504.1	1	0.0000200	0.0000200	10/2/2015	DLW
237960-2015-DW	001	9/29/2015	Aroclor 1016	ND	mg/L		Drinking Water	EPA 508	1	0.000510	0.000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Aroclor 1221	ND	mg/L		Drinking Water	EPA 508	1	0.000510	0.000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Aroclor 1232	ND	mg/L		Drinking Water	EPA 508	1	0.000510	0.000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Aroclor 1242	ND	mg/L		Drinking Water	EPA 508	1	0.000510	0.000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Aroclor 1248	ND	mg/L		Drinking Water	EPA 508	1	0.000510	0.000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Aroclor 1254	ND	mg/L		Drinking Water	EPA 508	1	0.000510	0.000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Aroclor 1260	ND	mg/L		Drinking Water	EPA 508	1	0.000510	0.000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Chlordane	ND	mg/L		Drinking Water	EPA 508	1	0.000255	0.000255	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Endrin	ND	mg/L	QC+QL+	Drinking Water	EPA 508	1	0.0000510	0.0000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Heptachlor	ND	mg/L	QC+QL+	Drinking Water	EPA 508	1	0.0000510	0.0000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Heptachlor epoxide	ND	mg/L	QL+	Drinking Water	EPA 508	1	0.0000510	0.0000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Lindane	ND	mg/L	QL+	Drinking Water	EPA 508	1	0.0000510	0.0000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Methoxychlor	ND	mg/L	QC+QL+	Drinking Water	EPA 508	1	0.0000510	0.0000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	Toxaphene	ND	mg/L		Drinking Water	EPA 508	1	0.000510	0.000510	10/6/2015	JBN
237960-2015-DW	001	9/29/2015	2,4,5-TP	ND	ng/mL		Drinking Water	EPA 515.1	2	0.880	0.880	10/3/2015	JBN
237960-2015-DW	001	9/29/2015	2,4-D	ND	ng/mL		Drinking Water	EPA 515.1	2	0.260	0.260	10/3/2015	JBN
237960-2015-DW	001	9/29/2015	Dalapon	ND	ng/mL		Drinking Water	EPA 515.1	2	4.40	4.40	10/3/2015	JBN
237960-2015-DW	001	9/29/2015	Dinoseb	ND	ng/mL		Drinking Water	EPA 515.1	2	1.00	1.00	10/3/2015	JBN
237960-2015-DW	001	9/29/2015	Pentachlorophenol	ND	ng/mL		Drinking Water	EPA 515.1	2	0.176	0.176	10/3/2015	JBN
237960-2015-DW	001	9/29/2015	Picloram	ND	ng/mL		Drinking Water	EPA 515.1	2	0.200	0.200	10/3/2015	JBN
237960-2015-DW	001	9/29/2015	Alachlor	ND	mg/L		Drinking Water	EPA 525.2	1	0.000100	0.000200	10/5/2015	AJG
237960-2015-DW	001	9/29/2015	Atrazine	ND	mg/L		Drinking Water	EPA 525.2	1	0.000100	0.000300	10/5/2015	AJG
237960-2015-DW	001	9/29/2015	Benzo(a)pyrene	ND	mg/L		Drinking Water	EPA 525.2	1	0.000100	0.000100	10/5/2015	AJG
237960-2015-DW	001	9/29/2015	Bis(2-ethylhexyl) phthalate	0.00107	mg/L	MB+QV+	Drinking Water	EPA 525.2	1	0.000100	0.00100	10/5/2015	AJG
237960-2015-DW	001	9/29/2015	bis(2-Ethylhexyl)adipate	ND	mg/L	QV+	Drinking Water	EPA 525.2	1	0.000100	0.000600	10/5/2015	AJG
237960-2015-DW	001	9/29/2015	Hexachlorobenzene	ND	mg/L		Drinking Water	EPA 525.2	1	0.000100	0.000100	10/5/2015	AJG

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Website: http://www.settek.com

WO#: 15100043
Date Reported: 10/7/2015
Company: Reliance Laboratories
Address: 25 Crimson Circle
Martinsburg WV 25403
Received: 10/1/2015
Project#: 237960-2015-D

Client ID#	Lab#	Collected	Analyte	Result Units	Qual	Matrix	Method	DF	LOD	LOQ	Run	Analys
237960-2015-DW	001	9/29/2015	Hexachlorocyclopentadien e	ND mg/L	QL-	Drinking Water	EPA 525.2	1	0.000100	0.000500	10/5/2015	AJG
237960-2015-DW	001	9/29/2015	Simazine	ND mg/L		Drinking Water	EPA 525.2	1	0.000100	0.000350	10/5/2015	AJG

NOTES:
The EPA525.2 ICV (Batch R44588) exhibited high recoveries for Bis(2-ethylhexyl)phthalate; Data may be biased high.

Client ID#	Lab#	Collected	Analyte	Result Units	Qual	Matrix	Method	DF	LOD	LOQ	Run	Analys
237960-2015-DW	001	9/29/2015	Carbofuran	ND mg/L		Drinking Water	EPA 531.2	1	0.00100	0.00100	10/1/2015	AYS
237960-2015-DW	001	9/29/2015	Oxamyl	ND mg/L		Drinking Water	EPA 531.2	1	0.00100	0.00100	10/1/2015	AYS
FIELD BLANK	002	9/29/2015	Dibromochloropropane	ND mg/L		Drinking Water	EPA 504.1	1	0.0000400	0.0000400	10/2/2015	DLW
FIELD BLANK	002	9/29/2015	Ethylene dibromide	ND mg/L		Drinking Water	EPA 504.1	1	0.0000200	0.0000200	10/2/2015	DLW
TRIP BLANK	003	9/29/2015	Dibromochloropropane	ND mg/L		Drinking Water	EPA 504.1	1	0.0000400	0.0000400	10/2/2015	DLW
TRIP BLANK	003	9/29/2015	Ethylene dibromide	ND mg/L		Drinking Water	EPA 504.1	1	0.0000200	0.0000200	10/2/2015	DLW

RELIANCE LABORATORIES, INC. - CHAIN OF CUSTODY RECORD

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☐ RIDGEFIELD BUSINESS CENTER
25 CRIMSON CIRCLE
MARTINSBURG, WV 25403
TEL. (304) 596-2084 • FAX (304) 596-2086

*CLIENT NAME Corporation of Shepherdstown

*ADDRESS

CUSTOMER # C06409 *TEL. # FAX #

*SAMPLER (S) C. Coe E-MAIL

SHEET NO. 1 OF 1

LABORATORY #	*DATE	*TIME	COMP	GRAB	MATRIX W, DW, S, O, M	TEMP. ≤ 4°C Yes No	*# OF CONTAIN.	HNO3	H2SO4	HCL	NaOH	BAC-T	NO PRES.	Cu Hg Cy	Inorg/NN	VOC					*PROJECT/REMARKS
237908	9/28/15	1200		✓	DW	0.6	6	1			1		1	3	✓	✓					Town Run/ Emergency Source

SAMPLES DO ✓ DO NOT ____ MEET USEPA GUIDELINES FOR HOLDING TIMES
SAMPLES DO ✓ DO NOT ____ MEET USEPA GUIDELINES FOR CHEMICAL PRESERVATIVES
SAMPLES DO ✓ DO NOT ____ MEET USEPA GUIDELINES FOR SAMPLE CONTAINERS
SAMPLES ARE ____ ARE NOT ✓ FOR REGULATORY COMPLIANCE PURPOSES

*RELINQUISHED BY:	*DATE/TIME	*RECEIVED BY:
PRINT: [illegible] SIGN: [signature]	DATE: 9-28-15 TIME: 1357	PRINT: Megan Ramirez SIGN:
*RELINQUISHED BY: PRINT: Megan Ramirez SIGN:	DATE: TIME:	*RECEIVED BY: PRINT: SIGN: Fedex
*RELINQUISHED BY: PRINT: SIGN: Fedex	DATE: 9/29/15 TIME: 10:40	*RECEIVED BY: PRINT: KDavis SIGN: KDavis
*COURIER: TRACKING #:	DATE: TIME:	*RECEIVED BY: PRINT: SIGN:

REMARKS:

PWS# ____

WEATHER/TEMPERATURE:

RUSH STATUS (INITIAL ACCEPTANCE AAB)

** ADDITIONAL LABORATORY FEES MAY APPLY**

EXTENT OF LIABILITY

SHOULD RELIANCE LABORATORIES, INC. BE AT FAULT AND ANY DISPUTE ARISE REGARDING ANALYTICAL DATA GENERATED BY THE LABORATORY, THE EXTENT OF THE LIABILITY TO RELIANCE WILL BE A DUPLICATE ANALYSIS OF THAT SAMPLE (PROVIDING ADEQUATE SAMPLE REMAINS) OR A REFUND OF THE ANALYTICAL FEE. IN NO EVENT WILL RELIANCE LABORATORIES BE LIABLE FOR DAMAGES INCLUDING BUT NOT LIMITED TO DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES ARISING FROM SUCH DISPUTE.

NOTE: TYPICAL SAMPLE TURN AROUND FOR ROUTINE SAMPLES IS 8 TO 10 WORKING DAYS. THIS IS NOT A GUARANTEE THAT SAMPLES WILL BE COMPLETED IN THIS TIME FRAME, HOWEVER. NON-ROUTINE SAMPLES MAY REQUIRE ADDITIONAL TIME.

* TO BE COMPLETED BY CLIENT

ORIGINAL CHAIN OF CUSTODY DOCUMENT MUST BE EXECUTED IN INK

WHITE - LABORATORY YELLOW - CLIENT

Reliance LABORATORIES

Reliance Laboratories, Inc.
2044 Meadowbrook Road | P.O. Box 4657
Bridgeport, WV 26330
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Martinsburg Laboratory
Ridgefield Business Center | 25 Crimson Circle
Martinsburg, WV 25403
Phone: 304.596.2084 | Fax: 304.596.2086

Certifications: WV Department of Health #: 00354, 00443 | WV Department of Environmental Protection #: 158, 181
MD Department of Environment #: 336, 337 | US Environmental Protection Agency #: WV00042, WV00901

Environmental Analysis and Consultants

Reliance Labs@... | www.Reliancelabs.net

WATER SUPPLY SAMPLING – CHAIN OF CUSTODY & SAMPLE COLLECTION PROCEDURE

1. Samples should be grab samples and should be taken from a cold water tap where drinking water or water for human consumption is normally obtained.
2. Sample bottles should be handled aseptically to prevent contamination of samples. Do not touch the inside of the bottles or caps. Do not allow either to touch the faucet.
3. Open the cold water tap and allow water to run evenly for three to five minutes in order to equilibrate system. Generally, the water temperature will stabilize indicating complete equilibration.
4. Fill all containers completely allowing no air space to remain and close bottles tightly.

MICROBIOLOGICAL/BACTERIOLOGICAL SAMPLES ONLY

Collect at least 100 ml of sample (fill to the mark on the sample container). Allow one (1) inch of airspace in the sample container. Water taps selected for sampling must be free of aerators, strainers, hose attachments, mixing devices and purification devices. THE SAMPLE CONTAINER IS STERILE. The pill included in the container removes chlorine residual. Samples should be analyzed within 30 hours of collection (HPC 8 hours). Samples should remain < or = 10 degrees C during shipment.

5. Complete all information below and return with sample to the laboratory.
6. Carefully pack all sample containers on ice when shipping/delivering to the laboratory.

***CAUTION*: Some sample bottles contain stabilizing reagents which are corrosive and should be handled carefully. If reagents come in contact with skin, flush with water.**

SAMPLING INFORMATION – COMPLETE THIS DOCUMENT IN INDELIBLE INK

Client Name: SHEPHERDSTOWN WATER
Address: PO BOX 248 SHEPHERDSTOWN WATER
Telephone: 304-876-2394 Fax: 304-876-8812 Public Water System (PWS) I.D.: 3301933
Describe Sample Location: TOWN RUN / EMERGENCY SOURCE
Sample Date: 9-28-15 Sample Time: 12:00PM Collected By: C COE
Sample Witnessed By: B MYERS Date Received at Laboratory: 9-28-15
Preserved at Lab (Y/N): ✓ Proper Preservatives: ✓ Proper Containers Used: ✓
Holding Times Observed: ✓ Disinfectant Residual: ______ Received By: Megan
Sample Temperature Upon Receipt: 0.6°C Shipper/Tracking #: ______
Results Authorized By: ______ Date: ______

*1 DAY RUSH

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Bridgeport, WV 26330
Phone: 304.842.5285 | Fax: 304.842.5351

Martinsburg Laboratory
Ridgefield Business Center | 25 Crimson Circle
Martinsburg, WV 25403
Phone: 304.596.2084 | Fax: 304.596.2086

Certifications: WV Department of Health #: 00354, 00443 | WV Department of Environmental Protection #: 158, 181
MD Department of Environment #: 336, 337 | US Environmental Protection Agency #: WV00042, WV00901

LABORATORY REPORT SUMMARY

Client: C06469

Wednesday, September 30, 2015

Corporation of Shepherdstown
PO Box 248
Shepherdstown WV 25443-

Total Number of Pages: 3
(Not Including C.O.C.)
Page 1 of 3

Lab ID	Sample ID	Sample ID 2	Sample Date
237908-2015-DW	Town Run/Emergency Source		9/28/2015

The enclosed results have been analyzed according to the referenced method and SOP. Any deviations to the method have been noted on the report. Unless otherwise noted, all results have been verified to meet quality control requirements of the method. All analysis performed by Reliance Laboratories, Bridgeport, WV unless otherwise noted. Parameters analyzed by Reliance Laboratories, Martinsburg, WV are noted with @ on laboratory report. This report may not be reproduced, except in full, without written approval of Reliance Laboratories, Inc.

Report Reviewed By: Tenley Miller

Digitally signed by Tenley Miller
DN: cn=Tenley Miller, o=Reliance Laboratories, Inc., ou, email=tmiller@wvdsl.net, c=US
Date: 2015.09.30 12:58:33 -04'00'

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Martinsburg Laboratory
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Certifications: WV Department of Health #: 00354, 00443 | WV Department of Environmental Protection #: 158, 181
MD Department of Environment #: 336, 337 | US Environmental Protection Agency #: WV00042, WV00901

Corporation of Shepherdstown
PO Box 248

Shepherdstown, WV 25443-

Wednesday, September 30, 2015

Lab Number: 237908-2015-DW **Sample ID:** Town Run/Emergency Source

Analyte Group: **Inorganics**

Parameter	Value	Units	Method	Date/Time Analyzed		Analyst	MRL	MCL
Free Cyanide	ND	mg/l	SM4500CNF-99	9/29/2015	12:30	CH	0.05	0.2
Total Antimony	ND	mg/l	EPA 200.8 R5.4	9/29/2015	14:03	TH	0.004	0.006
Total Arsenic	ND	mg/l	EPA 200.8 R5.4	9/29/2015	14:03	TH	0.005	0.01
Total Barium	0.059	mg/l	EPA 200.8 R5.4	9/29/2015	14:03	TH	0.01	2
Total Beryllium	ND	mg/l	EPA 200.8 R5.4	9/29/2015	14:03	TH	0.002	0.004
Total Cadmium	ND	mg/l	EPA 200.8 R5.4	9/29/2015	14:03	TH	0.002	0.005
Total Chromium	ND	mg/l	EPA 200.8 R5.4	9/29/2015	14:03	TH	0.01	0.10
Total Fluoride	0.28	mg/l	EPA 300.0 R2.1	9/29/2015	14:54	MC	0.2	4.0
Total Mercury	ND	mg/l	EPA 200.8 R5.4	9/29/2015	14:03	TH	0.001	0.002
Total Nickel	ND	mg/l	EPA 200.8 R5.4	9/29/2015	14:03	TH	0.01	0.10
Total Nitrate as N	2.91	mg/l	EPA 300.0 R2.1	9/29/2015	14:54	MC	0.1	10
Total Nitrite as N	ND	mg/l	EPA 300.0 R2.1	9/29/2015	14:54	MC	0.2	1
Total Selenium	ND	mg/l	EPA 200.8 R5.4	9/29/2015	14:03	TH	0.01	0.05
Total Sodium	9.52	mg/l	EPA 200.7 R4.4	9/30/2015	11:08	TH	1	[20]
Total Thallium	ND	mg/l	EPA 200.8 R5.4	9/29/2015	14:03	TH	0.001	0.002

Remarks:

Date Sample Collected: 9/28/2015 12:00
Sample Submitted By: C. Coe
Date Sample Received: 9/28/2015 13:57
Sample temp. upon receipt: 0.6 Deg C

MDL - Minimum Detectable Limit
MCL - Maximum Contaminant Level, USEPA Regulated
ND = Not Detected at the MDL or MRL
MRL - Minimum Reporting Limit
[MCL] = Maximum Contaminant Level, Non-Regulated

***Method Code: STANDARD METHODS ONLINE ED; US EPA METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES, Rev. 83; US EPA METHODS FOR THE DETERMINATION OF METALS IN ENVIRONMENTAL SAMPLES, May 1994; TEST METHODS FOR EVALUATING SOLID WASTE, SW-846, 3rd ED; USEPA Manual for Certification of Laboratories Analyzing Drinking Water, 5th ED. In accordance with EPA Regulations, all reports, including raw data and quality control data, are maintained by the laboratory for a minimum of 5 years.**

NOTE: ND or Not Detected indicates that the analytical value obtained is below the minimum reportable limit (MRL) which is equivalent to the lowest standard utilized in preparation of the method calibration curve

Reliance LABORATORIES

Reliance Laboratories, Inc.
2044 Meadowbrook Road | P.O. Box 4657
Bridgeport, WV 26330
Phone: 304.842.5285 | Fax: 304.842.5351

Martinsburg Laboratory
Ridgefield Business Center | 25 Crimson Circle
Martinsburg, WV 25403
Phone: 304.596.2084 | Fax: 304.596.2086

Certifications: WV Department of Health #: 00354, 00443 | WV Department of Environmental Protection #: 158, 181
MD Department of Environment #: 336, 337 | US Environmental Protection Agency #: WV00042, WV00901

Corporation of Shepherdstown
PO Box 248

Shepherdstown, WV 25443-

Wednesday, September 30, 2015

Lab Number: 237908-2015-DW **Sample ID:** Town Run/Emergency Source

Analyte Group: **Organics**

Parameter	Value	Units	Method	Date/Time Analyzed		Analyst	MRL	MCL
1, 1, 1-Trichloroethane	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.20
1, 1, 2-Trichloroethane	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.005
1, 2, 4-Trichlorobenzene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.07
1, 2-Dichloroethane	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.005
1, 2-Dichloropropane	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.005
1,1-Dichloroethylene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.007
Benzene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.005
Carbon Tetrachloride	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.005
Chlorobenzene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.10
cis-1, 2-Dichloroethylene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.07
Dichloromethane	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.005
Ethylbenzene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.70
o-Dichlorobenzene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.60
p-Dichlorobenzene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.075
Styrene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.10
Tetrachloroethylene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.005
Toluene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	1.0
trans-1, 2-Dichloroethylene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.1
Trichloroethylene	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.005
Vinyl Chloride	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	0.002
Xylenes	ND	mg/l	EPA 524.2 R4.1	9/29/2015	13:27	MC	0.0005	10
1,4-dichlorobenzene-d4 (Surrogate)	82.6	%	EPA 524.2 R4.1	9/29/2015	13:27	MC		
4-Bromofluorobenzene (Surrogate)	81.8	%	EPA 524.2 R4.1	9/29/2015	13:27	MC		

Remarks:

Date Sample Collected: 9/28/2015 12:00
Sample Submitted By: C. Coe
Date Sample Received: 9/28/2015 13:57
Sample temp. upon receipt: 0.6 Deg C

ND = Not Detected at the MDL or MRL
MDL - Minimum Detectable Limit
MRL - Minimum Reporting Limit
MCL - Maximum Contaminant Level, USEPA Regulated
[MCL] = Maximum Contaminant Level, Non-Regulated

***Method Code: STANDARD METHODS ONLINE ED; US EPA METHODS FOR THE CHEMICAL ANALYSIS OF WATER AND WASTES, Rev. 83; US EPA METHODS FOR THE DETERMINATION OF METALS IN ENVIRONMENTAL SAMPLES, May 1994; TEST METHODS FOR EVALUATING SOLID WASTE, SW-846, 3rd ED; USEPA Manual for Certification of Laboratories Analyzing Drinking Water, 5th ED. In accordance with EPA Regulations, all reports, including raw data and quality control data, are maintained by the laboratory for a minimum of 5 years.**

NOTE: ND or Not Detected indicates that the analytical value obtained is below the minimum reportable limit (MRL) which is equivalent to the lowest standard utilized in preparation of the method calibration curve

REI Consultants, Inc. - Analytical Report

WO#: 1510699

Date Reported: 10/19/2015

Client:	SHEPHERDSTOWN WATER DEPT	**Collection Date:**	10/5/2015 11:30:00 AM
Project:	OCT 15 TOC/ALK/DBP SS	**Date Received:**	10/6/2015
Lab ID:	1510699-02A	**Matrix:**	Liquid
Client Sample ID:	FIN TOC/SUVA	**Site ID:**	

Analysis	Result	MDL	PQL	MCL	Qual	Units	Date Analyzed	NELAP
SPECIFIC ULTRAVIOLET ABSORBENCY			**Method: SM5910B/5310C-1994/2000**				**Analyst: VS**	
SUVA	0.14	NA	NA	NA		L/mg-m	10/12/15	
ORGANIC CARBON, Total			**Method: SM5310 C-2000**				**Analyst: VS**	
Total Organic Carbon	0.74	0.20	1.00	NA	J	mg/L	10/09/15	

REI Consultants, Inc. - Analytical Report

WO#: 1510699

Date Reported: 10/19/2015

Client:	SHEPHERDSTOWN WATER DEPT	**Collection Date:**	10/5/2015 11:30:00 AM
Project:	OCT 15 TOC/ALK/DBP SS	**Date Received:**	10/6/2015
Lab ID:	1510699-01A	**Matrix:**	Liquid
Client Sample ID:	RAW TOC/ALK	**Site ID:**	

Analysis	Result	MDL	PQL	MCL	Qual	Units	Date Analyzed	NELAP
ALKALINITY			**Method: SM2320 B-1997**				**Analyst: VS**	
Alkalinity, Total (As CaCO3)	243	1.0	20.0	NA		mg/L	10/14/15	PA/VA
ORGANIC CARBON, Total			**Method: SM5310 C-2000**				**Analyst: VS**	
Total Organic Carbon	0.94	0.20	1.00	NA	J	mg/L	10/09/15	

REI Consultants, Inc. - Analytical Report

WO#: 1510699
Date Reported: 10/19/2015

Client:	SHEPHERDSTOWN WATER DEPT	**Collection Date:**	10/5/2015 11:30:00 AM
Project:	OCT 15 TOC/ALK/DBP SS	**Date Received:**	10/6/2015
Lab ID:	1510699-03A	**Matrix:**	Liquid
Client Sample ID:	PLANT	**Site ID:**	

Analysis	Result	MDL	PQL	MCL	Qual	Units	Date Analyzed	NELAP
SEMIVOLATILE ORGANIC COMPOUNDS			**Method: EPA 552.2, Rev. 1.0**				**Analyst: NC**	
Bromoacetic acid	ND	0.310	1.00	NA		µg/L	10/08/15	
Chloroacetic acid	4.63	0.960	1.00	NA		µg/L	10/08/15	
Dibromoacetic acid	ND	0.350	1.00	NA		µg/L	10/08/15	
Dichloroacetic acid	6.69	0.850	1.00	NA		µg/L	10/08/15	
Trichloroacetic acid	8.74	0.300	1.00	NA		µg/L	10/08/15	
Total Haloacetic acids (HAA5)	20.1	0.500	NA	60.0		µg/L	10/08/15	
VOLATILE ORGANIC COMPOUNDS			**Method: EPA 502.2, Rev.2.1**				**Analyst: MD**	
Bromodichloromethane	2.1	0.5	1.0	NA		µg/L	10/13/15	
Bromoform	ND	0.5	1.0	NA		µg/L	10/13/15	
Chloroform	4.6	0.5	1.0	NA		µg/L	10/13/15	
Dibromochloromethane	0.9	0.5	1.0	NA	J	µg/L	10/13/15	
Total Trihalomethanes (TTHM)	7.6	NA	NA	80.0		µg/L	10/13/15	

GPM of Existing Pump **700** **GPM**

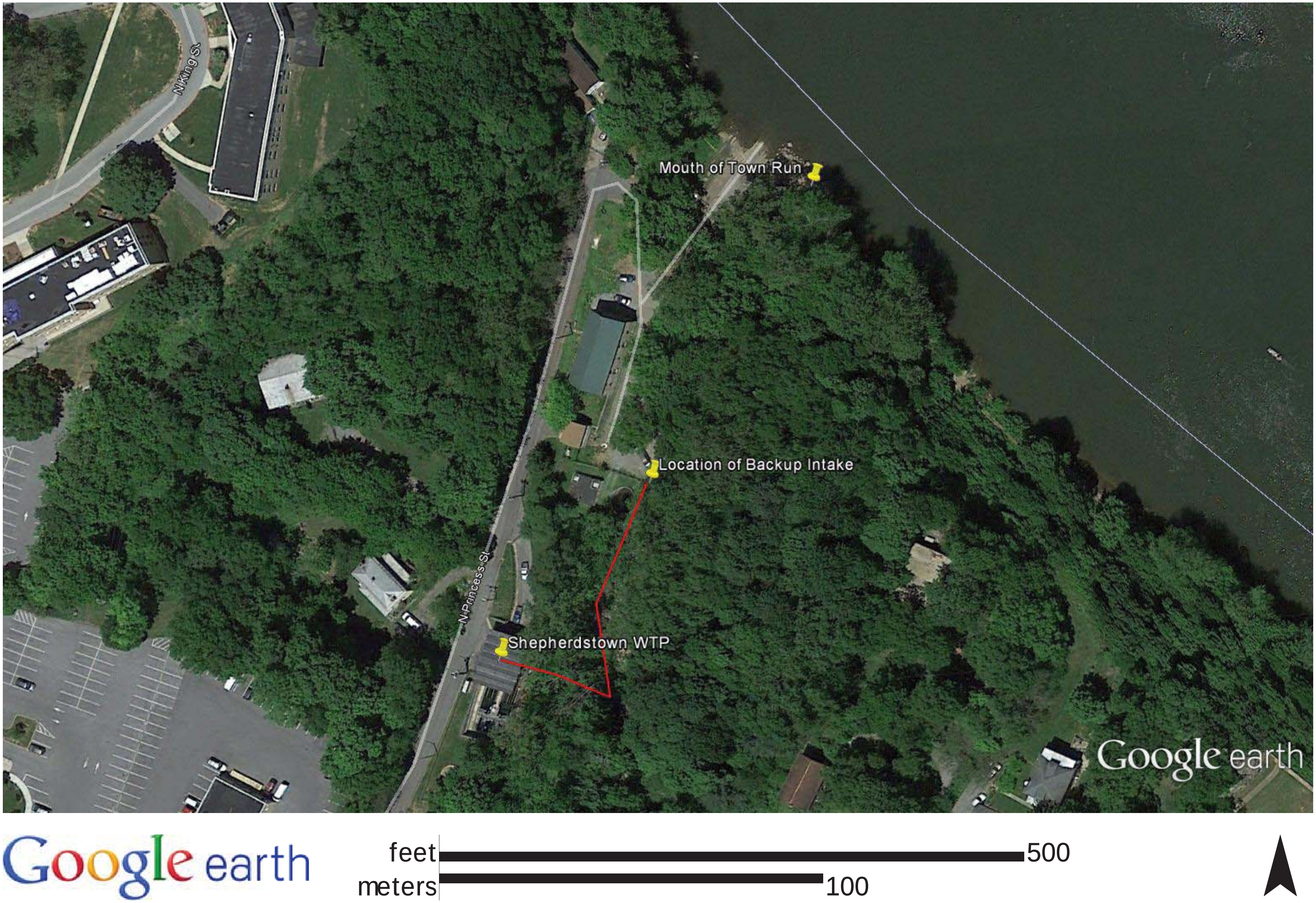
Intake Pricing Parameters	Cost per GPM
If the GPM needed is Greater than or Equal to 1,000 GPM (12" Pipe)	$ 1,000.00
If the GPM needed is between 700 GPM to 999 GPM (8" Pipe)	$ 1,100.00
If the GPM needed is less than 700 GPM (6" Pipe)	$ 1,250.00
Intake pricing includes acreage, pumps, screens, concrete, raw water well, electricity, etc.	**$ 770,000.00**

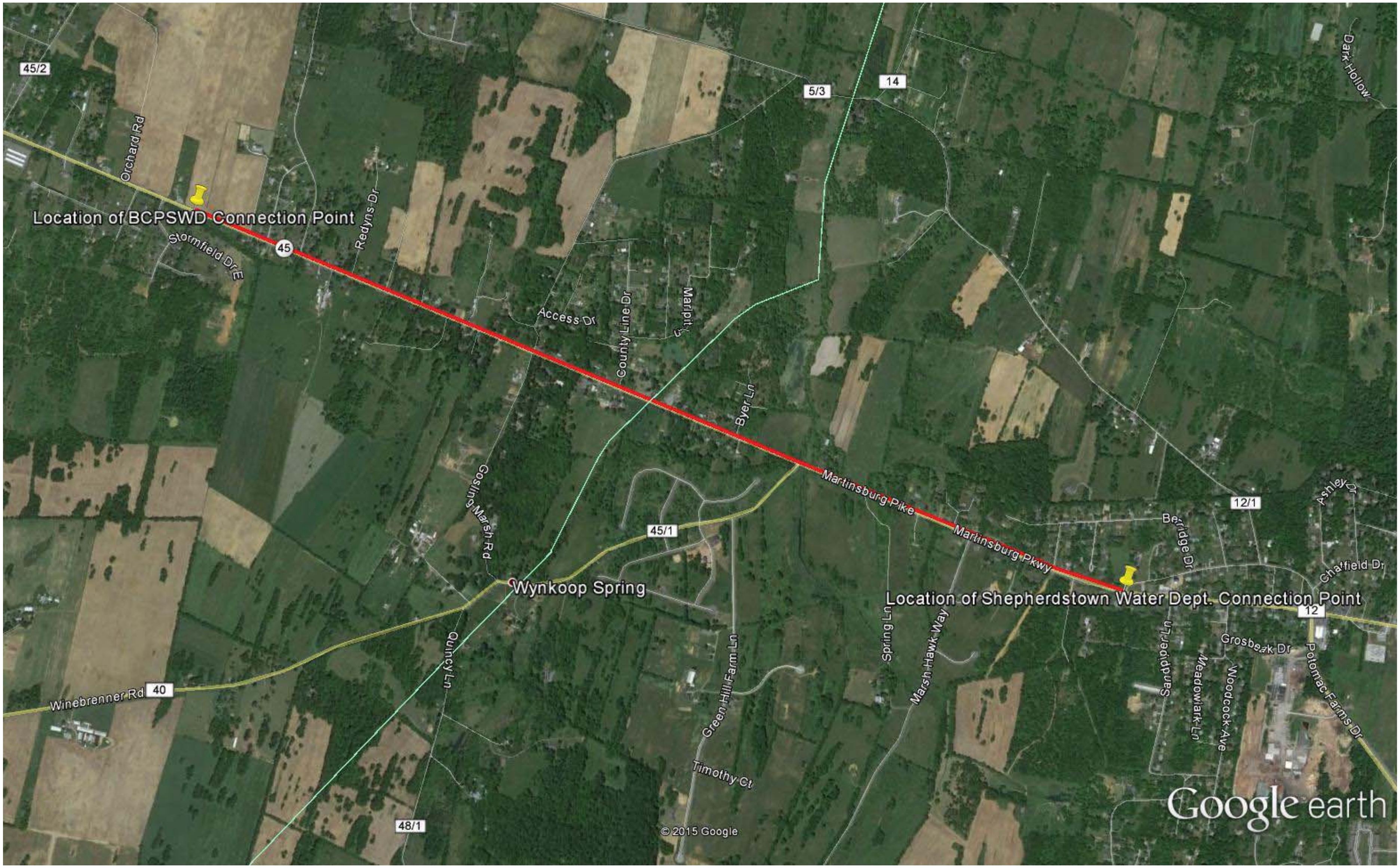
Additional Environmental Costs		
Mussel Survey	Yes	$ 13,000.00
Permits	Yes	$ 7,500.00
		$ 20,500.00

Piping Size	Cost per Foot	Footage	Totals
6" Pipe	$ 34.00		$ -
8" Pipe	$ 37.00	300	$ 11,100.00
12" Pipe	$ 60.00		$ -
			$ 11,100.00

Totals	
Intake	$ 770,000.00
Permitting	$ 20,500.00
Piping	$ 11,100.00
Additional Fees	$ 200,400.00
Total Cost	**$ 1,002,000.00**

Assumptions
Water will be taken from Town Run, a tributary of the Potomac River downstream of the existing surface water intake. According to the WVDNR, Town Run is a mussel stream and requires a survey to be completed during permitting. Permits required would include WV DEP, WV DNR, ACOE, WV SHPO, US FWS, WV DOH and County Floodplain. The piping route is included in the following page of supporting documentation. Additional fees are predicted to be 25% of overall cost. The fees include legal, engineering and accounting needs.


N King St
Mouth of Town Run
Location of Backup Intake
N Princess St
Shepherdstown WTP
Google earth
Google earth
feet
500
meters
100



Google earth

miles 1
km 2

ELEVATED WATER STORAGE TANK COST ESTIMATE

Qty.	Unit	Description	Unit Price	Total Cost
1	LS	900,000 gal. elevated treated water storage tank	$ 1,500,000.00	$ 1,500,000
1	LS	Access Road and Site Preparation	$ 30,000.00	$ 30,000
1	LS	Yard Piping and Vault	$ 75,000.00	$ 75,000
1	LS	Bonds / Permits	$ 20,000.00	$ 20,000
1	LS	Fencing	$ 35,000.00	$ 35,000
1	LS	Level-Sensing and Measuring Equipment	$ 10,000.00	$ 10,000
1	LS	Rock Excavation of Foundation (if encountered)	$ 75,000.00	$ 75,000
1	LS	Engineering / Legal / Accounting Fees	$ 400,000.00	$ 400,000
			TOTAL =	**$ 2,145,000**

ASSUMPTIONS: *Costs are based on an elevated treated water storage tank. Price includes access roads and site preparation (assuming land would need to be purchased for the tank site), telemetry, excavation in rock (5% of tank cost), valve vault and piping (13% of tank cost), and fencing. Price does not include additional water line from site to water system. Fees for engineering, legal, and accounting services are approximately 25% of the overall project cost.*

APPENDIX F. LETTER TEMPLATES

[Contact name]
[Facility address]

Re: Protecting drinking water quality within the Shepherdstown Water Department **ZCC**

Dear [XXX]:

As you may be aware, [the proposed activities] are located within the Zone of Critical Concern (ZCC) for the Shepherdstown Water Department. The ZCC represents a five-hour time of travel to the drinking water source intake and has been designated as an area that deserves special scrutiny regarding potential sources of contamination. The ZCC was established by the West Virginia Bureau for Public Health, as part of the Source Water Assessment and Protection Program to inventory the most likely potential sources of contamination.

Shepherdstown Water Department has completed a Source Water Protection Plan (SWPP), as required by Senate Bill 373. SB 373 requires the SWPP to be a public, collaborative process. One of the requirements is for the utility to develop a management plan, which details actions to minimize potential threats to source water. Shepherdstown Water Department's management plan includes contacting entities interested in development within the ZCC to educate them on source water protection and gather information about the planned development.

Shepherdstown Water Department encourages economic development within the community, but we want to see responsible development that protects our drinking water supply. We encourage all facilities to follow all applicable regulations and Best Management Practices (BMPs) in order to minimize the chance of impact on our drinking water resources. We ask to be a stakeholder and to be involved in discussions as development moves forward. We also seek to be a source of information on actions that this facility can take to protect drinking water.

Knowledge of all chemicals stored within the ZCC will help our staff plan for and be prepared in the case of a chemical release. Therefore, we ask that you provide the following:

1. Please identify any and all chemicals stored at your site or property that, if released to the water in any manner, may impact human health or the environment.
2. For every chemical listed for #1, please identify the maximum amount that may be stored at your site.
3. Please provide the current safety data sheet (SDS) for every chemical listed for #1.
4. Please provide the Spill Prevention and Response Plan for your facility.

This information is for our planning purposes only. Information that is not already public will not be disseminated by Shepherdstown Water Department.

If you have any questions regarding Shepherdstown Water Department’s Source Water Protection Program, please contact [contact information]. We thank you for your cooperation and look forward to continued collaboration to protect our drinking water.

[Contact name]
[Facility address]

Re: Protecting drinking water quality within the Shepherdstown Water Department ZCC

Dear [Name of specific facility (Potomac Portable Restrooms and Septic, Cress Creek Golf Course, etc.)],

Shepherdstown Water Department is updating its Source Water Protection Plan (SWPP) as mandated by Senate Bill (SB) 373, and is reaching out to facilities to open communication about protecting public drinking water supplies. Because your facility is located within the Zone of Critical Concern (ZCC), we are also requesting certain information. The ZCC represents a five-hour time of travel to the drinking water source intake and has been designated as an area that deserves special scrutiny regarding potential sources of contamination. The ZCC was established by the West Virginia Bureau for Public Health, as part of the Source Water Assessment and Protection Program to inventory the most likely potential sources of contamination.

SB 373 requires the SWPP to be a public, collaborative process. One of the requirements is for the utility to develop a management plan, which details actions to minimize potential threats to source water. One strategy included in Shepherdstown Water Department's management plan is communication with facilities within the ZCC to educate them on source water protection efforts and to gather information from the facilities.

We encourage all facilities to follow all applicable regulations and Best Management Practices (BMPs) to minimize the chance of impact on our drinking water resources.

Shepherdstown Water Department is proud to have provided clean drinking water to the community that meets regulatory requirements. However, our past success should not prevent us from preparing for a future anomaly that may threaten the health and safety of our water customers. We are therefore requesting the following information from your facility:

1. Please identify any and all chemicals stored at your site or property that, if released to the water in any manner, may impact human health or the environment.
2. For every chemical listed for #1, please identify the maximum amount that may be stored at your site.
3. Please provide the current safety data sheet (SDS) for every chemical listed for #1.
4. Please provide the Spill Prevention and Response Plan for your facility.

This information is for our planning purposes only. Information that is not already public will not be disseminated by Shepherdstown Water Department.

We hope that you will keep Shepherdstown Water Department in the communication chain in the unfortunate instance of an accidental release. If an accidental release occurs, in addition to contacting the state Spill Response Hotline at 800-442-3974, please also immediately contact [relevant point of contact] at Shepherdstown Water Department at [contact information].

If you have any questions regarding Shepherdstown Water Department’s Source Water Protection Program, please contact [contact information]. We thank you for your cooperation and look forward to continued collaboration to protect our drinking water.

Source water protection fact sheet

Shepherdstown Water Department is updating its Source Water Protection Plan based on the requirements in Senate Bill 373, which was passed in 2014 after the chemical spill on the Elk River that affected 300,000 people in and around Charleston. The new requirements include providing engineering information on the water treatment system, listing potential contaminant sources, and creating a management plan which details actions to prevent contamination, and a contingency plan, which details actions in the event of an emergency.

While Shepherdstown Water Department is working diligently to protect source water, there are a number of actions that individuals can take to help minimize the chance of contamination.

Be informed

- Read the annual Consumer Confidence Report provided by your public water system, sometimes referred to as a Water Quality Report.
- Use information from your state's Source Water Assessment to learn about potential threats to your water source.
- Find out about how the Clean Water Act's water quality standards for your drinking water source protect your tap water, in addition to aquatic life and swimmers.

Be observant

- Look around your watershed and be alert to announcements in the local media for activities that may pollute your source water.
- If you see any suspicious activities in or around your water supply, please notify the local authorities or call 9-1-1 immediately and report the incident.

Be involved

- Read local newspapers to stay informed
- Attend public hearings on new construction, storm water permitting, and town planning.
- Keep your public officials accountable to drinking water protection.
- If a new development is planned, ask to see the environmental impact statement for the facility.
- Ask questions on any issue that may impact your water source. What specific plans have been made to prevent the contamination of your water source? Notices about hearings often appear in the newspaper or in government office buildings.
- Volunteer or help recruit volunteers: participate in your community's contaminant monitoring activities, and encourage testing water upstream of your drinking water supply.
- Help ensure that local utilities that protect your water have adequate resources to do their job.

Don’t contaminate

- **Reduce paved areas**: Use permeable surfaces such as wood, brick and gravel that allow rain to soak in, not run off for decks, patios and walkways.
- **Reduce or eliminate pesticide application**: Test your soil before applying chemicals, and design your lawn and garden with hardy plants that require little or no watering, fertilizers or pesticides.
- **Reduce the amount of trash you create:** Reuse containers, recycle plastics, aluminum, and glass.
- **Recycle used oil:** A single quart of motor oil can contaminate up to 2 million gallons of drinking water; take used oil or antifreeze to a service station or recycling center.
- **Be careful of what you put into your septic system**: Harmful chemicals may end up in your drinking water.

PUBLIC COMMENTS

Dr. Rahul Gupta,

Dear Bureau for Public Health,

I'm writing to comment on the Shepherdstown SWPP. First, though, I want to applaud BPH for coordinating these plans across the state. I also want to commend Monica Whyte for being such an informative and reliable resource throughout the process; there were many times Monica was able to help the process get "unstuck" and moving forward.

My comments mirror my oral comments made at the Jefferson County hearing, with a few additions.

Overall, it is a well-designed plan. I think the contractor and utility did an excellent job of making a complicated document easy to read and easy to understand.

I ask that you consider the following improvements.

The plan contains many "plans to make plans." The timelines and strategies for these plans should be made clear in the SWPP.

Not addressed in the plan is a timeline to modernize how the storage tank is charged. My understanding is that the tank is filled by having it fully pressurized by having water lines fully charged throughout the system -- rather than having water go from the plant directly to the storage tank that feeds the system. This results in unnecessary disruption of service while repairing the many leaks in the lines (see below).

With 37 percent of water in the system lost to leaks, a long-term plan to repair this problem should be specified as the backup supply of Town Run is not sufficient for an extended period.

The plan should describe the response and notification plans in place among railroads, the Jefferson County Office of Homeland Security, and the utility.

There is no correlation between Potential Sources of Significant Contamination in the Zone of Critical Concern and the monitoring regimen. This should be addressed.

Thank you for the opportunity to comment on this critical plan. It is my hope that this is the first step in an ongoing process of public engagement and for plans that are fluid and updated regularly.

David Lillard
david@lillards.com
526 Spring Warbler Way
Shepherdstown, West Virginia 25443

Monica Whyte, ERS III
WV Department of Health and Human Resources, Bureau for Public Health
Source Water Assessment and Protection Program
1948 Wiltshire Road, Suite 6
Kearneysville WV 25430

Scott Rodenheaver, ERPM 1
WV Department of Health and Human Resources, Bureau for Public Health
Source Water Assessment and Protection Program
350 Capitol Street, Room 313
Charleston WV 25301-3713

27 September 2016

Dear Ms. White and Mr. Rodenheaver,

I appreciate the opportunity to comment on the Source Water Protection Plan documentation for West Virginia. I strongly believe that source water protection is critical for public health and economic development in West Virginia, and I commend your staff for investing time and resources in this vital issue. My perspective on these issues is informed by my research as a biologist at the US Geological Survey's Leetown Science Center (Kearneysville WV) where I address issues of water quality and climate change on river and stream ecosystems. I also serve on the Planning Commission in Shepherdstown where my responsibilities include considerations of storm water management and development. My comments here are exclusively my own and do not imply any endorsement or opinion by the US Geological Survey or the Shepherdstown Planning Commission.

I have reviewed the draft Source Water Protection Plan (SWPP, "Plan") developed by the Thrasher Group in conjunction with the Shepherdstown Public Works Department. The Plan accurately describes the importance of source water protection and successfully identifies some key concerns and opportunities for improvement. I commend the authors of the Plan and the Shepherdstown Public Works Department for their attention to this important document. My main concerns can be summarized in three points.

1. The geographic scope of the Plan is too small.

The "zone of critical concern" (ZCC) and "zone of peripheral concern" (ZPC) are not large enough to encompass the true areas of concern for the Shepherdstown water system. I realize that travel-time guidance for ZCCs and ZPCs were defined by the State and are not subject to revision at the local level. Nonetheless, planning should address the physical reality of our situation: Shepherdstown's water quality is influenced by conditions much further upstream than indicated by the Plan.

Events of 2015 clearly demonstrate this point. On 23 September 2015 a latex-solution release into the North Branch of the Potomac River traveled downstream to Shepherdstown and other municipal water intakes. We were fortunate in that (a) the public health risks of the chemical contaminants were low and (b) the plume was visible and therefore was reported (see comment #3 below). However, this event demonstrates clearly that we must be concerned with conditions further upstream than considered by the Plan. Moreover, the implication of defining a zone of "peripheral" concern is that locations past this zone are of less-than-peripheral concern (i.e., not a concern), but this clearly is not the reality of our situation.

2. The Plan lacks monitoring for the risks it documents.

As intended, the Plan identifies important risks to the Shepherdstown water system. Specifically, the Plan identified several "potential sources of significant contamination" associated with confined animal feeding operations, aboveground storage tanks, golf course management, and sludge and septic disposal operations. However, current and proposed monitoring described in the Plan appears to be largely disconnected to these recognized threats. The current approach of monitoring raw water for dissolved oxygen, pH, temperature, and conductivity is useful and necessary, but insufficient to identify contamination from the recognized risks. Even though Shepherdstown is a relatively small municipality, I believe we deserve an "early warning" monitoring system as required by larger municipalities in West Virginia. I recognize that this will require additional funding and staff support, but I believe that the benefits will likely outweigh the costs.

3. The existing spill monitoring network is insufficient because it relies on visual identification.

I was surprised that the Plan did not mention the spill monitoring network that currently exists for the Potomac River. The Potomac River Drinking Water Source Protection Partnership[1] was formed in 2005 as a network of municipal water suppliers and government agencies (including the Town of Shepherdstown) focused on protecting sources of drinking water in the Potomac River basin. A complete Plan requires some acknowledgment of this important existing network, as well as a discussion of its vulnerabilities and opportunities for improvement. I was also surprised to see no mention of the Emergency Spill Model developed by the Interstate Commission on the Potomac River Basin (ICPRB)[2] with flow travel-time data provided by the US Geological Survey. This tool was implemented with success during the North Branch latex spill last year, and needs to be addressed in the Plan. This requires more than simply listing the existing tools and networks in the Plan but also describing their strengths and weaknesses.

The Plan does not address one of our most important current vulnerabilities: our existing spill monitoring network assumes that contaminant plumes will be visible and therefore likely to be reported. This was the case in the North Branch spill of 2015 but was not the case in the Elk River spill in 2014, so a visual assessment of contamination provides little confidence for

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[1] http://www.potomacdwspp.org/

[2] https://www.potomacriver.org/focus-areas/water-resources-and-drinking-water/drinking-water/spill-response/

municipal water users. An obvious catastrophic event such as a train derailment or tanker crash on I-81 (although further upstream than the designated ZPC) would be reported quickly, and the DWSPP network would take action. However, many of the contaminant risks identified in the Plan are not likely to emerge from a publically visible location, nor are they likely to show obvious visible plumes. Therefore the existing spill monitoring network is incomplete, and the Plan should recognize this and provide recommendations for improvement.

In summary, the stated purpose of the Plan is to “assess, preserve, and protect the raw water source used to for their Public drinking Water Supply System…” and I commend the efforts of the WV Department of Health and Human Resources and local municipalities for addressing these vital issues. The draft Plan provides important contributions for assessment of some of the upstream risks, but lags behind the targeted monitoring and incentives necessary for preservation and protection. I believe the final Plan would be greatly improved by addressing the three main points raised here.

Thank you for considering my comments on this matter. Please feel free to contact me for clarification or additional information.

Sincerely,

Nathaniel (Than) P. Hitt, PhD
PO Box 459
Shepherdstown WV 25443
304-268-4886

cc. Frank Welch, Public Works Director, Town of Shepherdstown
Jim Auxer, Mayor, Town of Shepherdstown
David Didden, MD, Jefferson County Health Department
Brent Walls, Upper Potomac River Keeper
Cartlon Haywood, ICPRB
David Lillard, WV Rivers Coalition
Angie Rosser, WV Rivers Coalition
Toni Milbourne, Shepherdstown Chronicle
Michael Chalmbers, Observer