MARYLAND'S SOURCE WATER ASSESSMENT PROGRAM

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CHAPTER I - *GOALS & OBJECTIVES*

1.0 Purpose

The purpose of this document is to describe the State of Maryland's Source Water Assessment Program (SWAP**)** to meet the requirements of Section 1453 of the Safe Drinking Water Amendments of 1996. This document provides guidelines for

- completion of source water assessments,
- the State's strategy for coordination,
- timetable for completion of assessments, and
- guidelines for public participation.

The document was prepared by the Maryland Department of the Environment's Water Supply Program with input and advice from convened Technical and Citizens' Advisory Groups and comments from the public. The Water Supply Program followed the U.S. EPA's final guidance published in August 1997 in putting together its plan.

1.1 Background

A safe and reliable drinking water supply has always played a large role in defining the quality of life for residents of developing cities and towns. From Roman times, history has recorded society's concerns related to "foul" water. Perhaps the most significant action linking disease prevention to water was Dr. John Snow's closure of the Broad Street pump in London (1854) to control an epidemic of cholera. As a result public health and water quality were now elevated to the same level of importance as the quantity of water available.

With the advancement of technology in the industrialized countries also came advances in water treatment processes. States, municipalities and water suppliers came to rely on engineering as the primary method of insuring a safe drinking water supply for their citizens. A multiple barrier treatment train consisting of mixing - coagulation/flocculation - sedimentation - filtration - disinfection evolved as a standard practice for treating surface waters.

The 1996 Amendments to the Safe Drinking Water Act (SDWA) reaffirmed the importance of source water protection as the first step in dealing with drinking water quality. A formalized Source Water Assessment Program (SWAP)

consisting of 1) delineating the boundaries of areas providing source waters for public systems; 2) inventorying significant potential sources of contamination; and 3) determining the susceptibility of the public water system to such contaminants is mandated by the SDWA. The data generated is intended to be incorporated into the next step which entails a complete Source Water Protection Program (SWPP). The foundation for prevention activities is a partnership among local governments, water suppliers, consumers and residents of the watershed. Assessments apply to all public water supplies whether the source is ground water or surface water.

The Maryland Department of the Environment already has two EPA approved programs in place which have provided the Department with a headstart for source water assessments for ground water systems. These programs are the Monitoring Waiver Program (approved 1995) and the Wellhead Protection Program (approved 1991). The monitoring waiver program established definitions and criteria for sources to be classified as confined aquifers and established procedures for reviewing potential contaminant sources within a fixed distance of wells. The waiver program helped prioritize the sampling of Maryland's water systems for pesticide and organic chemical analysis. Information on contaminant sources collected under the waiver program and associated monitoring will be instrumental for beginning the assessment process.

The Wellhead Protection Program has focused on community systems (1,000 or more people) using unconfined aquifers. Wellhead protection areas have been delineated, potential sources of contamination have been identified and an assessment of the risk and management recommendations have been made for these systems. Source water assessments for these systems will be completed by updating the wellhead protection studies with current sources, new land use maps and reviewing the most recent contaminant inventory and monitoring data as described in this document

Methodologies for surface water systems need to be tailored for the types of systems for assessing the impacts of potential contaminants. For example, given land uses will have different influences on supplies using river intakes than those using reservoir intakes. Guidelines for conducting assessments have been developed and are included in this document.

1.2 Mission Statement for Source Water Assessments

The Maryland Department of the Environment will implement a program that evaluates existing and potential contamination of Maryland's water supply sources. These assessments will be technically sound and widely disseminated so that locally based protection strategies can be established to ensure continued use and improved safety of our State's water supply sources.

1.3 Goals and Objectives for Source Water Assessments

The goals of the Water Supply Program's source water assessment efforts are:

1) to complete the assessments in accordance with Maryland's EPA-approved program
2) to develop appropriate monitoring requirements for systems based on the results of the assessments; and
3) to stimulate the development of source water protection programs for public water supplies.

The objectives of the assessments for both surface and ground water systems are:

1) to delineate source water assessment areas for all public water systems in accordance with methods outlined in this document;
2) to identify actual and potential contaminant sources, both point source and nonpoint source, and land uses and zoning within the assessment areas;
3) to assess the vulnerability to contamination of each water system;
4) to communicate the results of the evaluations to water suppliers, health and environmental agencies, local land use planners, and the public; and
5) continue to inform and update and receive input from both citizen and technical advisory committee members during the assessment process.

1.4 Goals for Source Protection

The desired outcome of completed source water assessments are to guide local, State and federal agencies and private landowners in partnerships for the protection of water supplies. Even though source protection is beyond the scope of this document, it is imperative that these goals be presented herein so that everyone knows why Maryland is undertaking such a great effort to complete assessments comprehensively and with participation from all interested parties.

The goals of the Water Supply Program's source protection efforts are:

1) to ensure the highest quality raw water source by establishing source protection as a first barrier in a multiple barrier treatment train;
2) to protect the health of individuals using water supplied by public systems;
3) to maintain the long-term viability of drinking water resources;
4) to increase public awareness and appreciation for drinking water supplies by establishing partnerships with citizens to promote source protection initiatives;
5) to prevent increased cost or reduce treatment costs for water suppliers; and
6) to protect the public investment in the infrastructure associated with water sources.

1.5 Public Participation

The importance of public participation and public education in achieving the goals and objectives stated above cannot be overestimated. The 1996 Amendments to the SDWA represent a national commitment on the part of EPA to allow flexible, state-driven prevention initiatives to be incorporated into specific protection plans designed for each public water supply source. It is MDE's intention to utilize the tremendous amount of public energy available to fuel the promotion of voluntary source protection measures for every community water supply.

CHAPTER II - *SOURCE WATER ASSESSMENTS*

2.0 Introduction

The 1996 Amendments to the Safe Drinking Water Act (Section 1453) require States to develop and submit to EPA, Source Water Assessment Programs (SWAP) for public drinking water supplies. Timing for program submittal was triggered by the August 6, 1997 EPA publication of the *State Source Water Assessment and Protection Programs - Final Guidance*. Maryland has an eighteen-month (18) deadline to submit its SWAP for federal approval. EPA has nine (9) months to review the document or it will be automatically approved. After EPA approval, the State must complete SWA's for all public water supplies within a two-(2) year period. As allowed in the Act**,** Maryland is requesting a one-time extension of eighteen months for full implementation of the Program. Justification is provided in Chapter IV.

MILESTONES

EPA Final Guidance	August 1997
Maryland SWAP Submittal	February 1999
EPA Approval	November 1999
Maryland Completion	November 2001
Possible Extension	May 2003

The SDWA prescribes the structure for an approvable source water assessment. Three individual components are integrated to produce the technical basis for all assessments. The three elements consist of: 1) delineating source water assessment areas; 2) identifying contaminants and their sources within that area; and 3) assessing the susceptibility of the public water supply to the identified contaminants. The Maryland Department of Environment has formed a Technical Advisory Group to assist in developing methodologies which produce valid and reliable scientific data for analysis of the different water sources for public supplies.

Public water supplies in Maryland use a variety of source types and have varying potential for contamination from surrounding land uses. Some supplies serve 25

persons while two large supplies each serve over 1 million people daily. The ready availability of ground water in the Coastal Plain has negated the need for using surface water in southern Maryland and the Eastern Shore. Some suppliers draw ground water from wells in unconfined aquifers while others use deep confined aquifers in the Coastal Plain areas. Systems located in the Piedmont and Western Provinces utilize surface water or wells obtaining water from fractures in crystalline or sedimentary rock aquifers. *(Figure 1* shows the distribution of ground water sources that supply community water systems*.)*

Surface water systems serve the bulk of the State's population, providing water to 3.4 million Marylanders (68% of the State) for their domestic needs*. (Figure 2* shows the location of surface water intakes for Maryland water systems*.)* These systems may take water from large rivers, such as the Potomac (e.g., Washington Suburban Sanitary Commission), or smaller creeks, such as Winter's Run (e.g., Town of Bel Air). Other surface water systems treat water from impoundments. These fundamental differences are the basis for Maryland's strategic planning approach to complete each of the source water assessment elements. Maryland will employ a series of assessment methodologies which will complement the individual characteristics of each supply.

Considerable data is available for ground water systems through the existing Monitoring Waiver Program and the Wellhead Protection Program. Assessment work for surface supplies is also being completed as part of special projects involving microbiological investigations on the Potomac River (Washington metropolitan area supply) and risk assessments for contingency planning, reservoir sedimentation and eutrophication in Loch Raven Reservoir watershed (Baltimore metropolitan area supply). Detailed watershed characterization is underway for the watershed supplying the Patuxent Reservoirs (Montgomery, Howard and Prince George's Counties, Central Maryland area supply).

2.1 Categorizing of Systems

MDE has divided Maryland's public water supplies into broad categories and will conduct the assessments based on the method assigned to each category. MDE plans to use existing data to the fullest extent possible and will collect new data when warranted. Classifications will be based on water usage, system type, and source types. Source types include:

* Wells in unconfined aquifers in the Coastal Plain
* Wells in semi-confined aquifers in the Coastal Plain
* Wells in confined aquifers in the Coastal Plain
* Wells in fractured rock
* Wells in carbonate rock
* Springs
* Surface water intakes from boundary or interstate rivers
* Surface water intakes from rivers and streams

* Surface water intakes from reservoirs or impoundments
(The numbers in the various groups are described in *Table 1)*

A standard designation for Public Water Systems outlined in Code of Maryland Regulations (COMAR 26.04.01.01) was the basis for categorizing each system type. The system type affects the types of contaminants for which they will be assessed. These are described below:

+ Community water system = a public water system which services at least 15 service connections used by year-round residents, or regularly at least 25 residents throughout the year

+ Nontransient noncommunity water system = a public water system that is not a community and regularly serves at least 25 of the same individuals over 6 months per year

+ Transient noncommunity water system = a noncommunity water system that does not regularly serve at least 25 of the same individuals over 6 months per year

For delineation purposes, the ground water based public water systems are divided into systems that use an average of 10,000 or more gallons per day (gpd) and those that use less than 10,000 gpd. MDE's Water Rights Division requires a detailed hydrogeologic evaluation for ground water appropriation permits using greater than 10,000 gpd, prior to issuance of a permit. As a result, good site specific hydrogeologic information is available for delineation of the areas, which can be used to justify a site specific approach.

Systems using less than 10,000 gpd do not significantly influence regional ambient ground water flow directions or flow systems. Hence, detailed hydrogeologic evaluation is not required for these permitees. The lack of site specific data makes a site specific model inappropriate. Methods being selected for systems in this size category include fixed radial distances and regional interpretation of ground water recharge areas.

2.2 Delineations for Ground Water Systems

Ground water systems delineations will be completed in accordance with the methods outlined in MDE's Wellhead Protection Program. The variable geology within the State and level of available information necessitates a differential approach to delineating wellhead protection areas. Each analytical or numerical method requires a value to represent the quantity of water pumped by the water supply system. The quantity to be used for delineating assessment areas will be based on the amount permitted for average use under the State's appropriation program. Applicable EPA recommended methods include:

TABLE 1

MARYLAND'S WATER SUPPLY IN SOURCE WATER ASSESSMENT DELINEATION CATEGORIES							
		SOURCES		PLANTS		SYSTEMS	
	SOURCE TYPE	CWS	NTNCWS	CWS	NTNCWS	CWS	NTNCWS
Ground Water	Confined	533	229	356	182	220	175
	Unconfined/Semi-conf. - Coastal Plain	242	118	142	85	100	74
	Fractured Rock	399	215	201	143	120	136
	Carbonate Rock	44	31	29	23	20	21
	Unknown Aquifer Type	24	106	20	102	20	95
	Springs	35	1	27	1	19	1
Surface Water	River Intakes	38	0	38	0	33	0
	Reservoirs	17	1	16	1	12	1
	Total	1332	701	829	537	544	503

Additionally there are 2559 active Transient Non-Community Systems with approximately:

1511 wells in the coastal plain
1048 wells in fractured bedrock
3 surface water sources

WELLS WITH DELINEATED WELLHEAD PROTECTION AREAS				
	SOURCES		SYSTEMS	
SOURCE TYPE	CWS	NTNCWS	CWS	NTNCWS
Confined	5	0	2	0
Unconfined/Semi-Conf.- Coastal Plain	154	0	30	0
Fractured Rock	160	2	33	2
Carbonate Rock	17	0	7	0
Total	336	2	72	2

* Arbitrary fixed radius
* Variable shapes
* Hydrogeologic mapping
* Calculated fixed radius
* Analytical methods
* Numerical modeling
* Conjunctive delineation

MDE'S RECOMMENDED DELINEATION METHODS

A. For Public Water Systems using an average of ≥10,000 gallons per day (gpd) the following methods will be used for the various aquifer types:

1. Unconfined Aquifers in the Coastal Plain
   WHPA Code (Analytical Method)

   The Coastal Plain of Maryland is composed of layers of unconsolidated sediments that gently dip to the southeast. The EPA's WHPA Code ground water model is recommended for WHPA delineation in this setting. The model provides a good estimate of time of travel zones for a well in an unconfined aquifer in the Coastal Plain. *(Figure #3)*

   At least Zone 1 and Zone 2 will be identified for assessment purposes.

   a) Zone 1: is based on a one-year time of travel (TOT) criterion. Zone 1 serves as the first zone of protection and is based on the maximum survival time of microbial organisms in ground water.
   b) Zone 2: is based on 10-year TOT criterion and provides adequate time for addressing chemical contamination before it can reach a well or well field.
   c) Zone 3 (OPTIONAL): area between the 10-year TOT boundary and the ultimate recharge area to the well or well field. Hydrogeologic mapping of ground water flow divides or more sophisticated modeling will be needed to determine ultimate recharge areas.

2. Semi-confined Aquifers in the Coastal Plain
   Numerical Modeling

   For semi-confined Coastal Plain aquifers, the three-dimensional capability of numerical modeling (MODFLOW-MODPATH) provides a better result for WHPA delineation than the two-dimensional capability of the WHPA Code. MODFLOW-MODPATH has been successfully used by Maryland Geological Survey to delineate WHPAs for the Northern Anne Arundel County well fields and the Perryman well field in Harford County. MODFLOW-MODPATH takes into account vertical ground water flow and can be used to accurately delineate zones of contribution for wells screened in a semi-confined aquifer. The assessment area will include the ultimate Zone of Contribution. Because of the presence of some confining material, the shortest time of travel

from the water table surface to the well screen may easily exceed 1 year. Alternate assessment zones will be used in those cases for Zones 1 and 2 (e.g., 3 and 20 years). *(Figure #4)*

3. Confined Aquifers in the Coastal Plain

   Assessment areas will be determined by using a volumetric calculation (i.e., "Florida Method") for determining zones of transport using TOT criteria. A 10-year TOT will provide an adequate area for assessment. The area for assessment purposes will be shown as the aquifer below the land surface.

4. Fractured Rock Aquifers

   In Maryland, the areas west of the Fall Line (generally west of I-95) are underlain by crystalline and sedimentary rocks. In this setting, the WHPA Code may not work well, since ground water flow is usually influenced by geological structure and fractures in the rock that cannot be accurately modeled by a homogeneous analytical model. In these areas, the watershed drainage area that contributes to the well is a good place to begin the WHPA delineation. This area should be modified by geological boundaries, ground water divides, and by annual average recharge needed to supply the well. Information on water level change in response to pumping wells are helpful in understanding the extent of the area that may contribute to a well. Hydrogeologic mapping is the primary method to be used for supplies in fractured rock aquifers.

   Where feasible, a fracture trace analysis is recommended to delineate areas most vulnerable to the well. The area around those fractures closely connected to the well can be considered as Zone 1. *(Figure #5)*

5. Carbonate Rock Aquifers

   Ground water flow in carbonate rock aquifers may be very rapid and vulnerable to surface contamination. Some wells intersect solution enlarged openings with close surface connections while other wells intersect small fracture systems that are hydraulically similar to other Piedmont and sedimentary rock systems. For those wells under surface water influence, in addition to the techniques described for bedrock aquifers, locating and mapping sinkholes, and conducting a dye trace study will help define the assessment area for the supply well. In some instances, due to Karst flow, this contributing area will cross surface watershed boundaries. *(Figure #6)*

B. Public water systems using an average of <10,000 gallons per day (gpd)

Listed below are the methods that the State will use for delineation of source assessment areas for sources in the different hydrogeologic settings. The State will allow a small system to use a more detailed or complex delineation method, provided that the method is reviewed and approved by the State.

1. Unconfined Aquifers in the Coastal Plain:

   Wells in unconfined Coastal Plain aquifers that are used to withdraw small quantities have little influence on ambient ground water flow. The origin of water withdrawn by such wells is the local recharge to the aquifer upgradient of the well. Due to the difficulty in ascertaining the precise direction of ambient ground water flow, an area necessary to provide sufficient recharge in the general upgradient flow direction will be mapped. For each system where the general ground water flow direction can be inferred, a wedge 1000 feet long with an angle width of 60° will be oriented in the uphill (upgradient) direction. A 100 foot buffer around the well is also included in the assessment area. Using a recharge rate of 12 inches per year a wedge of this size will support a withdrawal of 10,000 gpd. For water supply systems where the general flow direction is unknown, a circle of radius 1000 feet will be circumscribed around the supply well.

   Assessment areas (ground water recharge areas) for the small public systems will be mapped for the applicable wells for each county. County-wide maps will be produced for each class of system (community, nontransient noncommunity and transient noncommunity).

2. Confined Aquifers in the Coastal Plain:

   a) For Community and Nontransient Noncommunity Water Systems: A volumetric equation was used to calculate a fixed radius representing a 10-year zone of transport for system and aquifer conditions that will

provide the largest radius. A fixed radius of 600 ft. was calculated assuming a minimum aquifer thickness of 20 feet, porosity of 0.25 and an average daily pumpage of 10,000 gpd. A review of the potential for direct injection of contaminants into the aquifer will be undertaken in this area. This 600 feet assessment area will be shown as the aquifer below the surface of the land.

b) For Transient Noncommunity Water Systems: No system specific area will be delineated because the frequent monitoring of these wells for their regulated contaminants have established that they are not vulnerable to contamination. The boundaries of the confined aquifers are available through numerous publications of the Maryland and United States Geological Surveys.

3. Fractured Rock Aquifers:

A fixed radius of 1,000 feet around the well will be used. This radius is based on calculating the land area needed to provide a yield of 10,000 gpd assuming a 400 gpd/acre recharge (drought year recharge conditions), and a safety factor.

4. Carbonate Rock Aquifers:

Same methods as for the fractured rock aquifers, except for those sources that are determined to be under surface water influence. For these systems zones of contribution should be identified (see Carbonate Rock Aquifers under Section A above).

C. Springs

Springs are found in the Piedmont and Appalachian areas of Maryland where ground water discharges at the land surface along a fracture, bedding plane, contact between two rock types of different permeability, or where a significant change in slope causes the water table to reach the land surface. In each case hydrogeologic mapping of the recharge area will be used to delineate the source water assessment area. As with wells in fractured rock aquifers, the watershed drainage area that contributes to the spring will be modified by geological boundaries and ground water divides. The source assessment area for springs issuing from carbonate rock aquifers may be modified from the watershed drainage if tracer studies show additional contributing areas.

D. Conjunctive Delineations

Conjunctive delineations will be used if the modeling of a well in an unconfined or semi-confined aquifer system in the Coastal Plain shows a significant amount of recharge from a stream to the well. In this case a

portion of the stream's watershed may be delineated as part of the contributing area. MDE is using topographic boundaries as modified by geologic structure and recharge area consideration for all sources using >10,000 gpd that are not in the Coastal Plain of Maryland, therefore considering conjunctive delineations is not necessary for these sources. As described under both *C. Springs* and *A.5 Carbonate Rock Aquifers*, tracer studies will be used to assist in delineating assessment areas.

2.3 Delineations for Surface Water Systems

The U.S. EPA indicated in its August 1997 Final Guidance document for Public Water Supplies relying on surface waters that the delineation of the source water protection area will include the entire watershed upstream of the PWS's intake structure, up to the boundary of the State border. MDE's depiction of watershed areas will not stop at State borders to provide a truer depiction for watershed assessment and protection. Interstate Commissions and EPA Chesapeake Bay Programs will be looked at to provide digital files to complete this task. MDE will employ this topographic boundary delineation methodology but will augment the delineation by segmenting the streams and tributaries which contribute to the reservoirs or river intakes. *(*See *Figure #7)*

Segmentation will assist in evaluating if certain subwatershed areas play more significant roles in affecting the pollutant load to an intake or reservoir. Time of travel calculations may be performed based on locations that present a risk of spills to a surface intake. Ultimately this approach will assist in developing management strategies for source water protection programs.

The segmented watershed approach will enhance assessments for the surface water systems which draw from large rivers which transcend State boundaries (e.g., Potomac River and Susquehanna River). *(*See *Figure* #8 to see the Maryland portion of the Lower Susquehanna Watershed and water intake locations.) While each of these rivers present large drainage areas with contributions of contaminants from several states, the location of the system intakes may play a significant role in determining which tributaries pose a greater degree of risk to the supply. For example, MDE may conduct or contract out tracer studies to evaluate the contribution of local watersheds to the water withdrawn at an intake on a large river system. The USGS, US EPA, and River Basin Commissions represent administrative and technical resources which will help to evaluate these possibilities and consolidate data to promote a uniform and consistent assessment approach for the contributing states.

2.4 Mapping Source Water Assessment Areas

U.S.G.S. Quad Sheets will be utilized to determine the topography to facilitate communication of assessment results to the general public, data will be displayed through Geographic Information System variable scale maps. Scale will be

determined according to the actual size of the watershed and the desired detail for public presentations.

2.5 Contaminant Identification

After the watershed or wellhead protection areas have been delineated, the next step in the assessment process involves the task of identifying the significant potential sources of contamination. This exercise can be initiated by first identifying which individual contaminant or groups of contaminants will be the focus of the watershed or ground water assessment area search. The categories of concern to the Water Supply Program include those contaminants for which monitoring has been required under the Safe Drinking Water Act. Also included with this list are contaminants to be addressed by the Ground Water Rule, Enhanced Surface Water Treatment Rule and precursors for the Disinfectant By-Product Rule. *Table 2* summarizes contaminants which are and will be regulated under the Safe Drinking Water Act for the different classes of public water supplies**.** *Appendix 2-1* provides additional detail on the contaminants covered under the headings in *Table 2*.

There are other compounds which can affect raw water quality and produce undesirable health impacts or produce nuisance conditions. Such contaminants will be added to Maryland's assessments where past monitoring or experience has indicated such problems. As an example, excessive amounts of nutrients to some reservoir systems has led to algae blooms. Consequences of the blooms not only included foul tasting water and increased treatment expense but also adverse health reactions for certain people. Increases in nutrient loadings can also increase the production of dissolved organic compounds in the water leading to higher levels of disinfection by-products. For these reasons it is imperative that assessments for supplies be holistic and flexible to encompass the range of conditions facing the water suppliers and their consumers.

For reservoir systems, the problem of siltation and sedimentation affects a source's long-term viability even though turbidity values may be relatively low. Sedimentation rates are directly linked to land development practices and watershed characteristics. The rate of sedimentation buildup in a reservoir and the identification of sediment loadings are integral for conducting assessments for reservoir watersheds with significant agricultural or development activity. Maryland will incorporate these concepts in conducting assessments for reservoir supplies.

TABLE 2

Table showing contaminant groups considered in assessments. (For specific contaminants, see *Appendix 2-1*.)

Water System Type[1]	Ground	Surface
Community	Volatile Organic Compounds Synthetic Organic Compounds Heavy Metals Nitrate/Nitrite Fluoride Cyanide Asbestos Radionuclides Total/Fecal Coliform Protozoa Viruses	Volatile Organic Compounds Synthetic Organic Compounds Heavy Metals Nitrate/Nitrite Fluoride Cyanide Asbestos Radionuclides Total/Fecal Coliform Protozoa Viruses Disinfection By Product Precursors Turbidity
Non-Transient Non-Community	Volatile Organic Compounds Synthetic Organic Compounds Heavy Metals Nitrate/Nitrite Cyanide Asbestos Radionuclides Total/Fecal Coliform Protozoa Viruses	Volatile Organic Compounds Synthetic Organic Compounds Heavy Metals Nitrate/Nitrite Cyanide Asbestos Radionuclides Total/Fecal Coliform Protozoa Viruses Disinfection By Product Precursors Turbidity
Transient Non-Community	Total/Fecal Coliform Nitrate/Nitrite Protozoa Viruses	Total/Fecal Coliform Nitrate/Nitrite Viruses Protozoa Turbidity

[1]for definitions, see Section 2.1

Certain conditions may exist in a specific watershed or an aquifer that could eliminate classes of contaminants from the assessment. The Monitoring Waiver Program provides an example of this concept. MDE has already documented that synthetic organic contaminants (SOCs) do not occur in systems drawing water from confined aquifers and granted certain monitoring waivers to these systems. Since the wells are in confined aquifers, in fact the assessment would be restricted to the potential of injecting contaminants into the subsurface, issues related to the well's integrity and contaminants that are naturally occurring. This approach will direct MDE to focus its limited resources to those contaminants which are of greater potential to cause concern.

2.6 Sources of Contaminants

The second phase of contaminant identification centers on pinpointing those sources which could have a significant impact on the public water supply. The State of Maryland will inventory and map those sources which fall in the "significant" category. Past and present land uses and associated activities are the foundation for investigation into non-point sources of specific contaminants of significant interest. These land uses will be illustrated through GIS maps generated with the Maryland Office of Planning's latest data. The base maps for both ground and surface water systems will show for the delineated areas the following land use categories:

- Agriculture
  - This non-point source information will require expanded investigation to document potential contributions of sediments, nutrients and pesticides. Additional analysis of land use activities should elaborate on manure storage and chemical storage practices as well as the concentration of animals which are confined in feedlots.
    - Cropland
      - Tilled
      - Non-tilled
    - Pasture
- Forested
- Residential
  - Private sewage disposal systems
  - Areas in sewer service
  - Zoning (densities)
- Industrial
- Commercial
- Public Lands
- Mined Lands

Maps will also be generated to depict locations of the potential significant sources of contaminants listed below. Depending on the number of sources and map

scale, the land use designations may be overlain with the point discharges. Several maps may be needed to present the various significant sources for an assessment. The maps will provide an illustration of the existence of potential sources and the relative amounts of various land use activities within the assessment areas.

Significant Sources for Surface Water Supplies - to be inventoried and mapped

- NPDES - Municipal (WWTP) discharges
- NPDES - Industrial discharges (except non contact cooling water)
- NPDES - Agricultural waste management structures
- Sewer infrastructure - Pumping stations, force mains combined sewer overflows
- Pipelines - Fuel distribution facilities
- Transportation - Major highways, railroad lines, airports
- Land Disposal Sites that have been identified to have a surface water impairment - Possibilities include landfills, CERCLA sites, Superfund sites, or old dump sites
- Mining sites
- SARA (Title III) reporters

Significant Sources for Ground Water Supplies - to be inventoried and mapped

- Ground Water Discharge Permits
- Land Disposal Sites - Landfills, CERCLA sites, Superfund sites, old dump sites, and trenched sludge disposal (as provided by local entities)
- Leaking Underground Storage Tanks or Fuel Lines
- Underground Storage Tanks
- Coal Mining Areas
- Salt Water Intrusion

2.7 Susceptibility Analysis - Introduction

The culmination of the assessment process involves an analysis of the threats posed by the contaminants of concern and the likelihood of their delivery to the water supply (intake or well).

A. Definition

This evaluation or susceptibility analysis is an assessment of the potential for a water supply source to be contaminated at concentrations that would pose a concern or be affected in a way that is detrimental to the operation, health of consumers or long-term viability of the supply.

Factors involved in how Maryland will be analyzing the susceptibility of a source of supply are:

- The presence of contaminant sources within the source water assessment area;
- The conditions and the ability of watershed/soils/aquifer system to remove or reduce the impact of contaminants before reaching the source;
- The likelihood of contaminants or conditions changing the natural equilibrium , thereby affecting the safety of a source of supply; and
- Integrity of the well or surface intake.

The characteristics of the contaminants such as toxicity, solubility, degradation potentials, ability to stimulate eutrophication, environmental fate and transport must be considered in relationship to the location and time of travel from potential sources of contamination to the supply source.

Two examples are provided in *Figure 9a* that illustrate how these factors will be integrated in the susceptibility analysis process. Each illustration focuses on a contaminant group identified on *Table 2* (p. 14). The illustrations demonstrate that significant sources of the contaminants will be identified, differing sources prioritized and recommendations made for addressing possible contaminant sources. This evaluation will be repeated for the various classes of contaminants for each water supply source. If a contaminant group has little or no significant sources in the assessment area, naturally it will be identified as a lower priority for concern.

B. Approach

Maryland's approach to conducting its susceptibility analysis is described in the *Flow Chart (Figure 9b)*. The first five downward blocks represent the initial information gathering needed to complete tasks outlined in *2.2, 2.3, 2.4* and *2.6*. The next three diamonds represent questions and queries to review and enhance existing water quality data addressing tasks discussed in *2.5* and *2.7*. Data to be reviewed includes monitoring conducted at the well, water supply intake, water treatment plant and other water quality information within the watershed or wellhead protection area. Discharge data from specific contaminant sources will also be reviewed where there is a history of noncompliance or where justified by water quality concerns. Assessment staff will consult with MDE permit writers, enforcement personnel, and other agencies (e.g., Department of Agriculture, University of Maryland, Soil Conservation Society, County Health and Public Works Departments) to gain a better understanding of facilities and their risks. This is explained in some more detail in Chapter III, *Coordination.*

Another important aspect of the assessment will be the interviews which take place with the operators and technicians working with the water supply systems. This qualitative history of conditions and reactions to localized events, such as storm flows, sediment loadings and emergency responses

could also dictate a more intensive investigation of potential problems. This is particularly true of surface water intakes on river systems where the quality can change drastically in short periods of time.

Where justified by water quality conditions and system complexity, MDE may decide that modeling a watershed for eutrophication is essential and/or that additional monitoring of various segments within a watershed is needed to establish relative contaminant loadings from different areas.

Data from the water sources and water treatment plants will be compared with Maximum Contaminant Levels (MCLs). If the monitoring data is greater than 50% of a MCL, our written assessment will describe the sources of such a contaminant and, if possible, locate the specific sources which are the cause of the elevated contaminant level. MDE has conducted such analysis for ground water systems where water supplies had elevated nitrate levels, volatile organic contamination, and pesticide contamination.

To maintain MDE's conservative approach, we will not use the average of all values in comparison to the MCL but rather compare each sampling result to the MCL. If 10% or more of the data exceed the 50% level, then a detailed analysis will be conducted for that contaminant. The 10% cutoff will account for singularly unexplainable results but continue our conservative emphasis of the assessment process. If a particular contaminant of concern does not have an MCL, the health advisories will be used in place of the MCL.

A considerable amount of water quality data is collected following treatment. MDE will use available raw water data and levels of contaminants (chemical and radiological) in the treated water. MDE will consider the potential for contaminant removal in order to have the best estimate of raw water conditions. MDE will conduct paired sampling of raw and finished water at surface water plants in order to use the treated water monitoring data to estimate raw water conditions. Treatment at ground water facilities will also be evaluated for removal potential. For example, aeration for pH adjustment will also provide removal of volatile organic compounds (VOCs). Facilities with detectable VOCs following aeration will be evaluated as if levels exceeded >50% of MCLs.

The obvious differences between the movement of ground water and surface water make a single method of analyzing the susceptibility of a drinking water source impractical. While each source will be assessed following the basic procedures outlined in *Figure 9b* and described above, the more detailed analysis could be contaminant based, source based or subwatershed based. This means that a component of the assessment could focus on particular compounds (i.e., cyanide) or microorganisms (i.e., *Cryptosporidium*). For another system the assessment could focus on set of agricultural herbicides and investigate the particular non-point source contribution from cropland. This type of investigation could be further refined to look at only one or two

critical subwatersheds where active crop production is associated with the class of herbicides. Differentiation among surface intakes (river intakes vs. reservoir intakes) and ground water supplies (confined aquifers vs. unconfined aquifers) will help guide the State in the approach to the assessment process.

A review of the source integrity, available contaminant data, delineated area land use and point sources will be completed first before embarking on those site specific issues which are most critical to that supply.

The last step in the assessment process is the preparation and distribution of a report. This report will identify for each class of contaminants (e.g., volatile organic compounds, heavy metals, etc.) whether or not a supply source is susceptible to any contaminants within the group, what specific contaminants they are and from what sources (or types of sources). The report will also describe all maps produced and provide keys or lists of sites identified on the map. Finally, the report will contain various recommendations that should be considered for establishing or strengthening source water protection programs.

As shown in *Figure 9b*, there will be an opportunity for input in the report by the water supply and local stakeholders before it is finalized by MDE.

2.8 Susceptibility Analysis - Surface Sources

Surface water intakes on rivers and reservoirs are varied in terms of design and layout configuration for each water system. It's important to understand the existing condition of and differences between these raw water intakes. This aspect of the assessment will be accomplished by conducting site visits and review of the engineering drawings. The information, such as structural integrity, hydraulic capacity, overall condition of raw water pumping stations and raw water storage facilities will be compiled for each system.

With input from the water supplier and other informed parties, MDE will then review existing raw water monitoring data from the treatment plant files. Additional monitoring and survey data from NPDES discharge reports, Maryland Water Quality Inventory (305(b) Report) and Tributary Strategy Reports will be reviewed. If a class of contaminants exceeds 50% of the maximum contaminant level for 10% of sampling results, a further investigation of point and non-point sources or discharges will be made. Potential sources of the contaminant will be mapped as either distinct point discharger locations or specific land use types.

The fate and transport of selected contaminants may also be included in the assessment depending upon the location of significant sources in certain critical subwatersheds. These types of modeling exercises or time of travel computations may be relevant to a vulnerability assessment for river or stream intakes. Those supplies with intakes on large reservoirs could focus on the in-lake dynamics which move the contaminant through the reservoir. Those smaller reservoir systems might be better protected through knowledge of travel time zones where

containment or mitigative measures could be introduced to intercept contaminants before they enter the reservoir.

Reservoir and river systems are also subject to impacts from excessive nutrients, which can lead to algal blooms, taste and odor nuisances and excessive levels of disinfectant by product precursors. It is entirely appropriate for assessments to include an evaluation of the eutrophic condition of the water body and in some instances to apply various models in order to predict long term conditions, as might be affected by existing or changing land use conditions. More sophisticated models are warranted where data shows that the water system is stressed or where the supply serves major population centers.

For those systems where existing data indicate that classes of compounds are less than 50% of any MCL, the emphasis will be upon potential for microbiological contamination and formation of disinfectant by-products. For watersheds under pressure from residential or industrial/commercial development, additional investigation of pollutant contributions from future build out of current zoning may be undertaken.

Design of susceptibility analyses for public water systems in the State of Maryland must be flexible in order to accommodate the wide differences among the sources of drinking water. The inherent differences between small protected watersheds and the large river watershed does not allow for a one-size-fits-all approach. Population at risk, size of systems, types of land uses and hydrologic characteristics are only a few variables which necessitate the development of a variety of tools which focus on producing individual, assessments that contain a scientific foundation for building source water protection programs.

2.9 Susceptibility Analysis for Ground Water Sources

To evaluate the integrity of ground water sources, copies of well completion reports and results of sanitary surveys will be reviewed. If completion reports are not available and no other published information is available on the supply, an assessment of the well's integrity will be based on sanitary survey and water quality results.

I. Unconfined Aquifers

A. Systems using >10,000 gpd:

The susceptibility analysis described in this plan is generally consistent with the procedures established by MDE in developing wellhead protection plans for large community systems in unconfined aquifers. These procedures are outlined in the *Wellhead Protection Manual* prepared in 1997. (See *Appendix 2-2* for sample Wellhead Protection Plan for the City of Fruitland and Town of Myersville water supplies.) These plans will be updated so that the procedures described in this chapter are followed.

In the process of preparing wellhead protection plans for communities, MDE evaluates water quality results. Contaminants listed in *Table 2* are reviewed and evaluated to determine any association with a source of contamination, whether natural or man made. As described in *2.7,* contaminants exceeding 50% of MCL values will be investigated in great detail. For many water suppliers, the best available data will reflect the quality of several wells combined at one treatment facility.

B. Systems using <10,000 gpd:

Since these systems are small water users and typically privately owned, with source protection areas outside their property boundaries, the susceptibility analysis will be conducted on a regional basis. This will allow county governments to develop countywide approaches for protecting smaller systems that address regional concerns.

Table 2 identifies the contaminant groups, and Section 2.6 identifies the contaminant sources and land uses that will be displayed within these regional recharge areas.

Based on the location and the hydrogeology of the area, a particular type of contaminant source may impact several systems, hence assessment will focus on regional impacts of the contaminant on the systems rather than local impact on individual systems. As an example, agriculture land use and on-site disposal may contribute to elevated nitrate levels in many wells within a county. Summary data of the number of supplies exceeding various levels will be provided. If water quality data indicate a contaminant above 50% of an MCL in a system, these will be listed separately with a discussion explaining the most probable causes. Naturally occurring contaminants will be included in these discussions.

II. Confined Aquifers

For all the community and NTNC systems, a review of the potential for direct injection of contaminants into the aquifer will be undertaken within the source water assessment areas. Field inspections of commercial and industrial facilities in the identified areas will focus on discharges to ground water. Inquiries regarding product storage, waste disposal and unused wells will be noted. Any unregulated discharges will be required to comply with State and federal UIC regulations. Monitoring data will be reviewed for the occurrence of contaminants as listed on *Table 2*. Transient systems in confined settings are by definition not vulnerable to their regulated contaminants and no further assessment is needed. Monitoring results will be reviewed to ensure their lack of susceptibility.

CHAPTER III - *COORDINATION*

3.0 State's Strategy - Introduction

In order to develop a comprehensive and effective Source Water Assessment Program (SWAP), MDE's Water Supply Program (WSP) recognizes the importance of coordinating with other State programs, local stakeholders, federal agencies and other states. Developing partnerships is necessary for achieving environmental progress in today's world of multiple interests and limited resources. The establishment of partnerships and linkages will help the WSP receive insight and expertise during the assessment process. A coordinated approach will foster contributions from others which will be of great benefit toward WSP's ultimate goal of developing effective locally based source water protection programs.

Water supply sources are part of hydrologic systems that cross political boundaries and have many inputs (both natural and manmade) which ultimately affect their water quality and suitability. This leads to MDE's need to coordinate with a wide range of organizations to participate in source water assessments. This chapter will describe some of the key partnerships that the WSP will build on for conducting source water assessments. This chapter describes how the WSP will coordinate within MDE, other State agencies, local stakeholders, federal agencies, and finally other states and interstate agencies.

Naturally, the level of coordination needed to achieve a comprehensive assessment is variable dependent on the system type, location, and size. Completion of assessments for systems using surface water on large river systems will require more coordination and input than would be expected for a small ground water system with a very limited contributing area. Systems serving large populations will also have a greater level of local participation and interest. Examples throughout this chapter will be used to illustrate how the WSP has conducted and plans to conduct its work to coordinate inputs from others during the assessment process.

3.1 Coordination within MDE

Coordination of this effort begins within the Water Supply Program. The Source Water Protection and Administration Division is responsible for ensuring that all assessments are completed but uses information collected by other divisions to assist in this endeavor. Water quality monitoring data is maintained in the WSP Oracle database for chemical and radiological contaminants. This information will be consulted for every assessment. Inspection reports from sanitary surveys contain valuable information regarding system layout, treatment and well condition and nearby risks of contamination. The inspection reports will help interpret the water quality results. Monthly operating reports contain considerable amounts of information on usage and raw water quality. Water Rights Division maintains files for all water appropriations. Files for larger systems include aquifer properties, fracture traces and pump test results. Most of this information is readily accessible because it has been cross referenced through Public Water System identification numbers. An organizational chart for the Water Supply Program is in *Appendix 3-1*.

Other programs in MDE regulate specific types of potential pollution sources to the State's water resources and address compliance with State Water Quality Standards. These programs are authorized by State and often federal law and perform their tasks within MDE's Water, Waste, and Technical and Regulatory Services Administrations. Organizational charts are provided in *Appendix 3-2*. In addition to each program having expert staff which are informed of water quality issues relevant to their program area, programs maintain data bases for regulated facilities and sites of contamination.

The WSP will build upon existing Geographic Information System (GIS) efforts to determine locations of permitted facilities. Currently, Statewide GIS data layers exist for permitted dischargers (to ground and surface waters) solid waste disposal facilities, hazardous waste treatment storage and disposal facilities, superfund site locations, ground water investigation sites, and SARA Title 3 reporters. GIS layers for underground storage tank location sites with release of petroleum products to ground water have been partially developed. WSP will seek confirmation of the location of significant sources by direct contact with the individual programs during the assessment process. Currently the WSP conducts this type of exercise prior to approval of new well sites for community water systems. Programs which will be involved in this effort include Wastewater Permits Program, Mining Program, Water Quality Infrastructure Program (Countywide Water and Sewer Plans), Compliance Program, Solid Waste Program, Hazardous Waste Program, Oil Control Program, Environmental Restoration and Redevelopment Program, and Emergency Operations and Technical Support Programs. The Computer Modeling and Information Management System Program will continue to update the WSP with current departmental GIS coverages.

WSP routinely uses the State's well completion data base, which is maintained by the Ground Water Permits Division for information on the construction of public supplies. Another more recent coordinating effort with the Ground Water Permits Division is directed to identify and locate potential ground water discharges within delineated wellhead protection areas. Digitized maps of wellhead protection areas are provided and geographic coordinates of sites with ground water discharges are determined. Facilities without permits are required to cease discharge or apply for a permit. Procedures describing how commercial or industrial facilities can protect the ground water are provided to facility owners. This effort has begun with wellhead protection set-aside funding (State Revolving Fund).

3.2 Coordination with other State Agencies

Information compiled by other agencies will be used to assist the WSP in source water assessments. The WSP is involved in several interagency efforts which help facilitate the exchange of knowledge and data. As the lead program for the State's comprehensive ground water protection policy, the WSP have forged many cooperative links with the Department of Natural Resources and Maryland Department of Agriculture. Every year the WSP compiles an annual report on important ground water quality issues for the State with input from these agencies. The WSP also provides information related to ground water quality and aquifers in the State biannual 305(b) Water Quality Inventory Report.

A new coordinated effort led by Department of Natural Resources is Maryland's Clean Water Action Plan. This plan has developed a unified watershed assessment tool for determining priorities for Clean Water Action funding. The plan identifies 138 State watershed planning units based on the State's 8 digit watershed breakdown. The WSP has participated in the process by providing and verifying intake location information to DNR; convening a drinking water subcommittee and recommending stressed drinking watersheds at the 138 watershed scale for inclusion as areas eligible for Clean Water Action Plan funding. Communication of the results of complete source water assessments to the compilers of future unified assessment reports, will allow for future funding to address specific needs in watersheds used for drinking water sources. MDE's WSP will continue its role in the Unified Watershed Assessment Process through participation in the technical review committee.

MDE Water Supply Program has worked with the Maryland Geological Survey (MGS) of the Department of Natural Resources on projects related to the assessment of water supplies and ground water resources since the inception of MDE's Wellhead Protection Program. Example projects include the Statewide Ground Water Monitoring Network; wellhead protection projects for Anne Arundel County, Harford County and the City of Salisbury; occurrence and distribution of radium in several Coastal Plain counties; and the hydrogeology and aquifer vulnerability of Washington County. Water quality studies between MGS

and specific counties also provide good ground water information. Recent county projects involved Anne Arundel and Baltimore Counties. MGS published geologic maps, county bulletins and water resources studies are routinely relied upon for basic hydrogeologic framework information.

MDE has also developed a coordinated project with the MGS, the City of Baltimore and the USGS for the assessment of sedimentation in one of the City's reservoirs. This type of coordinated effort exemplifies how the WSP will depend on the expertise of other agencies to answer significant source water assessment questions.

The Maryland Department of Agriculture has worked closely with the MDE Water Supply Program on issues related to pesticide usage, and developing regulatory controls for storage of pesticides at dealer sites to prevent ground water contamination. Department of Agriculture will also help provide data on livestock distribution and implementation of farm practices including nutrient management plans.

An ongoing project between the Department of Agriculture and MGS is the development of maps of the State that indicates relative vulnerability of the shallow ground water to pesticide contamination. When this study is completed, it will be used to assist in assessing the susceptibility of supplies in unconfined aquifers from nonpoint sources of pesticides.

3.3 Coordination with Local Stakeholders

It is the Water Supply Program's experience that local involvement in the assessment process will facilitate communication of the results to stakeholders for individual water systems. By bringing local agencies and citizen groups into the process, an atmosphere of commitment and ownership can be nurtured. A smoother transition of analyzing the technical aspects of the assessments and incorporating recommendations into an action strategy for an effective Source Water Protection Program will be accomplished. This should assure community needs and expectations have a greater chance of being met. The end result will be a structured natural resource protection program individualized for the public drinking water supply and implemented by local stakeholders.

Coordination of the assessment program with local stakeholders will vary depending on the size of the community and vulnerability of the sources. WSP will notify all community and nontransient noncommunity water systems of its schedule for conducting a source water assessment of its supply. WSP will invite their participation and participation of other local stakeholders, presenting an opportunity for up-front involvement and input throughout the process. In particular, the WSP will request water quality data that the supplier may have on its sources.

During the implementation of MDE's wellhead protection program, the development of strong ties with the water supply and local governments has led to successful implementation of local programs. Local governments assist in providing information on well usage, water quality, future plans and contamination sources. Local systems have hired hydrogeological consultants for participation in various phases of the program from delineation, contaminant identification to and risk assessment developing plans for managing the risks.

MDE has developed a proactive coordinating strategy with Maryland Rural Water Association geared towards assisting small systems to develop wellhead protection plans. Maryland Rural Water Association has continually promoted MDE's wellhead protection goals to small systems and encouraged some communities in educational outreach efforts, such as posting notices in public places and installing road signs and meeting with elected officials. Maryland Rural Water has also helped small systems identify potential contaminant sources and delineate wellhead protection boundaries. WSP looks forward to continued partnership with Maryland Rural Water and local governments during our source water assessment/wellhead protection efforts.

For the larger surface water systems, ongoing efforts have already created local stakeholder groups, such as those represented by the Reservoir Technical Group Reservoir Subcommittee and Watershed Protection Coalition for the City of Baltimore's sources. Likewise, the Patuxent Reservoir Protection Group is established for the Washington Suburban Sanitary Commission's reservoir supply. In these cases, the suppliers and stakeholder groups will be looked to for active participation during the assessment, including defining specific goals and objectives. As an example, the City of Baltimore and Baltimore County and Carroll County are playing key roles in cooperation with MDE in collecting data and providing project direction to various aspects of a source water assessment for Baltimore City's Loch Raven Reservoir.

The tributary teams established under the Chesapeake Bay Program have natural constituencies who will be kept informed and asked for participation of source water assessment activities for surface sources. As described in *Appendix 3-3*, the State has created 10 different tributary teams who have been dealing with meeting Bay-wide nutrient reduction goals. We anticipate presenting assessment projects to tributary teams for corresponding surface supplies operating within their tributary regions.

County health departments have oversight responsibility for the State's transient water supplies. WSP has piloted the assessment of small systems through a memorandum of understanding for wellhead protection/source water assessment efforts with Allegany County. The agreement ensures that methods followed are consistent with MDE protocol, and receive the benefit of local knowledge obtained by their direct oversight of the systems. County health departments have been encouraged to participate and were informed of available funding through

the SRF wellhead protection set-aside funds. County Health Departments will be asked to comment on source water assessments performed for transient systems (see Chapter II) in their county before they are finalized.

3.4 Coordination with Federal Agencies

Partnership with the EPA is essential for the State to carry out the work of the assessments. Maryland has received a grant award through the Drinking Water State Revolving fund for conducting source water assessments. The year-by-year expenditure of this money will be described in grant workplans. Discussion review and approval of these workplans and submission of twice yearly progress reports will ensure that Maryland's SWAP continues to reflect the need for conducting the assessment for the protection and benefit of the public water systems.

EPA will also be requested to be involved if findings during the assessment show a need for federal action. The WSP point of contact for these issues will be with the EPA Region III Water Protection Division, Drinking Water Branch.

Federally owned facilities with water supplies may be requested to perform their own source water assessments. A prototype effort for the Department of Defense at Fort Meade, Maryland involved both the US Geological Survey and the US Army. MDE met with representatives during the process and provided guidance to ensure consistency with our assessment approach.

Regional data bases such as maintained by US EPA's Chesapeake Bay office will be extremely helpful in addressing data needs for the larger Potomac and Susquehanna River Basins. The regional office will also assist in coordinating assessment efforts for interstate rivers.

The United States Geological Survey (USGS), Water Resources Division Maryland District office has indicated a keen interest in assisting the State with cooperative projects to conduct technical aspects of source water assessment projects. The WSP is currently involved in three assessment projects with USGS and is in the process of formulating additional assessment projects. On-going efforts include MDE's funding of USGS's participation in the study of sedimentation in the Loch Raven Reservoir and the study of the occurrence and distribution of radium in certain Coastal Plain aquifers.

USGS is the lead partner with MDE in researching and analyzing the potential for viruses to be present in water supplies using unconfined aquifers in two counties in Maryland's Coastal Plain. The project also features the development of appropriate delineation techniques for supplies using less than 10,000 gallons per day (gpd) in unconfined Coastal Plain aquifers. These procedures will be applied to small systems in other Coastal Plain counties. In conjunction with the USGS, the WSP has developed a study proposal for evaluating the potential impact of

cryptosporidium on water utilities in the Potomac Basin. The WSP is in the beginning stages of this study and may formalize an agreement in federal fiscal year (FFY) 99 or 2000.

The Survey's past involvement in three different National Water Quality Assessment Programs (one on the Potomac River, one on the Susquehanna and one on the Delmarva Peninsula) has resulted in the development of a tremendous amount of information related to pesticides, metals, nutrients and other inorganic species in Maryland's waterways. The WSP anticipates developing a project that will help us "mine" the existing data and determine priority data needs for completing assessments for surface supplied systems. USGS may also assist the Department in projects related to ground water flow in fractured and carbonate rock terrane. Projects that focus on completing source water delineations for categories of systems in this area may be developed with the District Office.

Local soil conservation district offices (funded in part by the US Department of Agriculture) are active participants in both the City of Baltimore and Patuxent Watershed Reservoir Protection efforts. Expanded participation from other offices is anticipated as assessments are initiated in other regions. Past cooperative efforts with the Natural Resource conservation Service (NRCS) in Frederick County resulted in special approaches for protecting water supplies in karstic terrane. The NRCS office helped identify the location of sinkholes on agricultural land and achieving the repair of sinkholes in wellhead protection areas. The NRCS receives regular updates of wellhead protection areas from the WSP across the State in order to give proper credit for agriculture producers who want to enroll certain lands in the Conservation Reserve Program of the US Farm Bill.

3.5 Coordination with Other States and Interstate Agencies

With adjoining states, MDE will share information on boundary rivers and shared watersheds. Two major rivers, Potomac and Susquehanna provide particular challenges to Maryland's assessment program. The Potomac represents a true boundary river where several states (West Virginia, Virginia and Maryland) rely on surface drinking water system intakes for significant segments of their populations. There are seven (7) supplies in Maryland which draw directly from the river. Several other system intakes are located on tributaries within the drainage basin, which also includes parts of Pennsylvania. An existing organization, the Interstate Commission for the Potomac River Basin (ICPRB) provides a vehicle to foster interstate cooperation and facilitate the sharing of data. The ICPRB has received funding to assist states in their tasks of completing assessments. The WSP is anticipating that the ICPRB can be of assistance in obtaining information concerning basin water quality and non point sources of contamination within the River Basin.

The Susquehanna River intakes present another unique set of circumstances for Maryland's assessment program. Two (2) intakes are located in the Conowingo Dam pool and five (5) water treatment plants operate below the dam. Since only about 5% of the Susquehanna drainage basin is located in Maryland, any kind of meaningful assessment must involve interstate issues and data analysis. Here again, Maryland is fortunate to have available the resources of an existing organization, the Susquehanna River Basin Commission who has indicated a willingness to facilitate information exchange with Pennsylvania and New York Source Water Assessment Programs. A regional assessment approach complemented by individualized subwatershed assessments will be the target for Maryland's efforts on this river system.

3.6 Coordination with Universities and Academic Research

Universities in the Chesapeake Bay region conduct studies and perform research related to water quality and the health of the Chesapeake Bay and its tributaries. Data concerning water quality, indirectly applicable to the assessment of source water areas, will be sought from current and past research efforts. Academic research will be looked at for pertinent information, and researchers may be contracted to participate in new monitoring/data collection efforts for the assessment. Currently, the University of Virginia is participating in a reservoir modeling study of the Loch Raven Reservoir for the WSP.

In the past, co-operative monitoring and data collection studies have been undertaken between the WSP and universities. For example, the University of Maryland, in co-operation with the WSP, performed a study on comparative nitrate removal from septic systems in order to design improved septic system methods. Universities will be utilized as both a source of research data and as potential partners in data collection/monitoring efforts for the assessment.

3.7 Delegation

The volume of tasks involved in completing on time source water assessments for the five hundred twenty-five (525) community systems and five hundred two (502) nontransient, noncommunity systems and more than 2,500 transient water supplies in Maryland provides an administrative challenge for the Source Water Protection Team. A strategy to maximize available resources to meet the time-line for completing assessments was devised which relies on the contracting of certain responsibilities as one of the management options. Options involve contracting with government agencies (local, State or federal) engineering or environmental consultants with expertise in the area to complete all or parts of certain assessments.

The State does not intend to impose delegation on any local subdivision or water supplier. Any efforts for delegation are to be completely voluntary and must be initiated by the applicant. Applicants must be able to provide evidence of

technical and administrative capabilities to complete assessments in accordance with an EPA approved Maryland Source Water Assessment Program. Formal agreements will be signed by responsible parties and meet legal sufficiency. MDE will retain final approval authority before accepting the assessments.

CHAPTER IV - *TIMETABLE*

4.0 Purpose

The purpose of this chapter is to outline a plan which describes how the WSP will use the resources allocated to complete assessments for Maryland's public water systems. Each of the three sections within the Source Protection and Administration Division (see Appendix 3-1) has varying responsibilities to ensure that the assessments are completed. Responsibilities are divided between ground water systems, and surface water systems and oversight of transient non community water systems. A primary work product from this division over the next several years will be the completion of source water assessments, continuing ongoing protection efforts and initiation of new protection efforts. The WSP will also seek the assistance of other competent agencies or private contractors in order to complete this task. The funding from the SRF assessment set aside will be used to implement contracts, collect data, and purchase appropriate equipment (GIS) and supplies for analyzing and displaying the assessment results and making the results available to the public.

4.1 Justification for Extension

The MDE's request for an eighteen month extension (see beginning of Chapter II) is justified because of the length of time needed to complete the assessments. Assessments for supplies on large watersheds involve a significant amount of data compilations, analysis and new monitoring. Modeling of reservoirs, watersheds, and complex geologic conditions involve set up calibration and execution, typically 18-24 month projects. Developing and signing contracts to perform this work can take six to twelve months. Ensuring adequate public participation in the process also adds time into the project. For a large number of small transient systems, MDE needs to incorporate well information into our data base before assessments can start. It will not be possible to complete the assessments without the extension, even though five new staff positions have recently been added to MDE to assist in this program. As funding for these positions is not from the one-time set aside, the positions reflect MDE's commitment to not only completing assessments but the long-term commitment to protect water systems.

4.2 Plan for Ground Water Systems

Table 3 contains our schedule for completing the tasks for both community and non-transient water supplies. The schedule of our county-wide projects for transient systems will depend on willingness of local environmental health to complete these projects. The continued availability of wellhead protection set aside money from the SRF awards will ensure that the states will have the resources to complete the work by 2003. If county health departments are not able or interested in receiving funds to do this work, MDE will direct contracts with qualified consultants starting in 2001 to complete the effort.

4.3 Surface Water Systems

Table 4 describes the timetable proposed for surface systems. While there are only 50 or so intakes, the large land area involved in this effort will result in significant expenditures of effort. The schedule allows adequate time for collection of new data where needed and input from many local stakeholders.

4.4 Budgets

Specific expenditures will be described in state SRF application. Of the $1.7 million awarded in MDE's 97 SRF award, the WSP anticipates that the majority will be expended for surface watershed projects and special projects related to surface watershed assessments. Maryland's 106 ground water grant and yearly SRF wellhead protection set-asides will provide supplemental contract dollars for ground water assessments. As shown in the above table, MDE staff will perform the majority of the ground water assessments. The 1997 SRF portion for wellhead was about $300,000. Future years will be similar or somewhat higher.

4.5 Reporting to EPA

The WSP will report progress to EPA in twice yearly increments on the progress towards achieving the schedule outlined in *Tables 3 & 4*. The format for reporting is yet to be established.

Table#3

SOURCE ASSESSMENT SCHEDULE FOR GROUND WATER SYSTEMS

No.	System Type	No. Comm. + NTNC	Agency	1998				1999				2000				2001				2002				2003			
				1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
1	Systems involved in WHP	74	MDE				■	■	■																		
2	Pumpage >10,000 gpd carbonate aquifer	22	*1							■	■	■	■	■	■	■	■										
3	Springs	18	MDE					■	■	■	■																
4	Pumpage >10,000 gpd bedrock aquifer	55	MDE							■	■	■															
5	Pumpage >10,000 gpd coastal plain aquifer	51	MDE										■	■													
6	Pumpage <10,000 gpd carbonate aquifer	30	*1											■	■	■	■	■	■	■	■						
7	Pumpage <10,000 gpd bedrock aquifer	251	MDE												■	■	■	■									
8	Pumpage <10,000 gpd coastal plain aquifer	131	*1							■	■	■	■	■	■	■	■	■	■								
9	Pumpage >10,000 gpd coastal plain semi-confined	19	*1											■	■	■	■	■	■	■	■	■	■				
10	Pumpage >10,000 gpd coastal plain confined	278	MDE																■	■	■	■					
11	Pumpage <10,000 gpd coastal plain confined	235	MDE																				■	■	■		
	Other tasks:																										
1	Data Collection		MDE			■	■	■	■	■	■																
2	GIS Setup		MDE			■	■	■	■																		
3	Develop contracts w/ local environmental health and/or hydrologic consultants for unconfined transient systems		MDE and county health or contractors	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		

*1 MDE experts to contract determinations of contributing areas with studies by geologic surveys.

Table #4

OUTLINE OF PHASING AND TIMETABLE FOR SOURCE WATER ASSESSMENT (SURFACE)

Size of PWS/Source Category	Total No. of Intakes	Timeline		1998				1999				2000				2001				2002				2003			
		Activity	Agencies	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Large systems >100,000 pop. w/ on-going assessment efforts/ Reservoir	**3**	Collect and analyze existing data	MDE,WSSC,BALTO,MGS,RTG,USGS	■	■	■	■	■	■	■	■																
		Delineation	-do-	■	■	■	■	■	■	■	■	■	■	■	■												
		Contaminant's ID	-do-				■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
		Susceptibility Analysis	-do-							■	■	■	■	■	■	■	■	■	■	■	■	■	■				
Medium systems >10,000 pop. w/ on-going assessment efforts/ Reservoir	**1**	Collect and analyze existing data	MDE, City of Cumberland					■	■	■	■	■	■	■													
		Delineation	-do-						■	■	■	■	■	■	■												
		Contaminant's ID	-do-							■	■	■	■	■	■	■	■										
		Susceptibility Analysis	-do-								■	■	■	■	■	■	■	■	■	■	■	■	■				
Small systems <10,000 pop. w/ on-going assessment /River	**1**	Collect and analyze existing data	MDE,US Army, USGS				■	■	■	■	■	■	■	■													
		Delineation	-do-					■	■	■	■	■	■	■	■	■											
		Contaminant's ID	-do-						■	■	■	■	■	■	■	■	■	■	■								
		Susceptibility Analysis	-do-								■	■	■	■	■	■	■	■	■	■	■						
Large systems >100,000 pop./ Interstate Rivers Note- Conowingo Pool as reservoir	**2**	Collect and analyze existing data	MDE,ICBPRB,SRBC, WSSC,Baltimore			■	■	■	■	■	■																
		Delineation	MDE,USGS								■	■	■	■	■												
		Contaminant's ID	MDE											■	■	■	■	■	■								
		Susceptibility Analysis	MDE																■	■	■	■	■	■	■		
Medium systems >10,000 pop./ Interstate Rivers	**6**	Collect and analyze existing data	MDE,ICPRB,SRBC, Water Suppliers					■	■	■																	
		Delineation	MDE								■	■	■	■													
		Contaminant's ID	MDE												■	■	■	■	■								
		Susceptibility Analysis	MDE																	■	■	■	■				
Small systems <10,000 pop./ Interstate Rivers	**7**	Collect and analyze existing data	MDE,ICPRB,SRBC, Water Suppliers						■	■	■	■	■	■													
		Delineation	MDE								■	■	■	■	■												
		Contaminant's ID	MDE												■	■	■	■	■								
		Susceptibility Analysis	MDE																	■	■	■	■	■			
Medium systems >10,000 pop./ Reservoirs	**3**	Collect and analyze existing data	MDE,Water Suppliers, Local Gov.								■	■	■	■	■	■											
		Delineation	MDE												■	■	■	■	■	■	■						
		Contaminant's ID	MDE															■	■	■	■	■	■				
		Susceptibility Analysis	MDE																	■	■	■	■	■	■		
Small systems <10,000 pop./ Reservoirs	**11**	Collect and analyze existing data	MDE,Water Suppliers, Local Gov.									■	■	■	■	■	■	■									
		Delineation	MDE											■	■	■	■	■	■	■	■	■					
		Contaminant's ID	MDE													■	■	■	■	■	■	■	■				
		Susceptibility Analysis	MDE																	■	■	■	■	■	■		
Medium systems >10,000 pop./ Rivers and Creeks	**5**	Collect and analyze existing data	MDE,Water Suppliers, Local Gov.											■	■	■	■	■	■								
		Delineation	MDE												■	■	■	■	■	■	■	■					
		Contaminant's ID	MDE														■	■	■	■	■	■	■				
		Susceptibility Analysis	MDE																	■	■	■	■	■	■		
Small systems <10,000 pop./ Rivers and Creeks	**10**	Collect and analyze existing data	MDE,Water Suppliers, Local Gov.											■	■	■	■	■	■	■							
		Delineation	MDE												■	■	■	■	■	■	■	■					
		Contaminant's ID	MDE														■	■	■	■	■	■	■				
		Susceptibility Analysis	MDE																	■	■	■	■	■	■		

CHAPTER V - *PUBLIC PARTICIPATION*

5.0 Introduction and Background

The development of Maryland's Source Water Assessment Program (SWAP) builds on a strong history of public participation in the drinking water program. In July 1991, the Environmental Protection Agency approved Maryland's Wellhead Protection program following a process that involved the formation of a Technical Advisory Group and significant public participation *(*See *Appendix 5-1* for a copy of the public participation efforts in the wellhead protection program development*)*. In addition, Maryland's regulatory approach over the past decade has been to provide technical assistance rather than to penalize systems with water quality problems. As a result, the Maryland Department of the Environment's Water Supply Program has developed an excellent relationship with many of the State's water suppliers. This collaborative approach serves as a strong basis for ensuring stakeholder and public participation as the State develops the SWAP.

Maryland's Water Supply Program has also participated actively in advisory groups for systems with active source water protection programs, including the Baltimore City, the Washington Suburban Sanitary Commission, and the City of Cumberland *(*See *Appendix 5-2* for summaries of those efforts*)*. Maryland's Wellhead Protection Program has also assisted communities throughout the State, including the Towns of Hurlock, Manchester, Walkersville and Middletown and various county governments (e.g., Allegany, Anne Arundel, Baltimore, Carroll, Cecil and Harford) as well as the Cities of Fruitland and Salisbury, to protect their ground water supplies. These experiences have provided a basis for developing a statewide program using a partnership approach among the State, water suppliers, and other interested parties.

More recently, Maryland conducted a survey of surface water systems to obtain more information about the sources and any protection efforts currently being undertaken by these systems *(*See *Appendix 5-3* for a copy of this survey and a summary of the results*)*. The information obtained from this survey has helped the State to establish a statewide perspective on current watershed protection efforts, and provided the foundation for partnership between the State and water suppliers in these efforts.

5.1 Public Participation in the Source Water Assessment Program Development

The inclusion of stakeholders and citizens is a major aspect of the program development. Maryland has formed a Technical Advisory Group, and a Citizens' Advisory Group, and has focused on finding opportunities to share the program development process with interested citizens. A meeting inviting both groups to participate together was held in December of 1998. Members were also invited to attend the public meeting on January 13, 1999. A combined group will continue to advise MDE during the project implementation phase.

A. Technical Advisory Group

Maryland established a technical advisory group (TAG) to provide guidance for development of the State's SWAP. The committee is composed of 32 members who represent public water systems, federal, State and local government agencies, industry associations, and the Potomac and Susquehanna River Commissions. The group met five times from October 1997 to March 1998, and continued to participate by commenting on the project through December. *(*See *Appendix 5-4* for a list of group members and copies of the meeting agendas and summaries and written comments.*)* The technical advisory group provided valuable input on various technical and policy aspects of the SWAP.

B. Citizen Advisory Group

A citizen advisory group (CAG) was established to provide input on the SWAP and to advise the State on involving the public in the development of the SWAP, and communicating to the public the results of the assessments. Forty-four individuals from various environmental and political organizations, watershed protection groups, health organizations and the Maryland Rural Water Association were invited to participate. The meetings were held in April, September and December, 1998. (See *Appendix 5.5* documenting participation by the CAG.)

C. Public Involvement

Throughout the SWAP development process, MDE staff have conducted and/or participated in workshops, seminars and meetings intended to inform the public and stakeholders about the program and to invite their involvement in the process.

In early December of 1998, MDE completed its final draft of this document for public review and comment. A notice of the document's availability and information about the comment period and procedure were published in the *Maryland Register*. Press notices were sent out in January 1999 regarding the

program. The Source Water Assessment Program was accessible on MDE's web site (http://www.mde.state.md.us) in December 1998 and January 1999 for public comment. (*Appendix 5-7* documents public participation aspects of the program.)

5.2 Making Assessment Results Available to the Public

A. Content of Assessments

The Source Water Assessments will communicate the assessment information in a clear concise manner intended to give consumers a realistic view of the potential risks to a water supply. Assessments will include the delineated source water protection area, land uses within the area, identified contaminant sources, and an assessment of the system's vulnerability to specific contaminants.

The assessments will include two parts: maps of the area with potential contaminant sources and an understandable narrative (typically less than five pages) that highlights the results of the assessments. The narrative will point out significant findings, areas that may require further investigation, and priorities for protecting the water supply. The narrative will provide context for evaluating any risks relative to the capacity of the system to ameliorate those risks using protection measures, treatment, or contingency planning *(*See *Appendix 2-2* for sample Wellhead Protection Plans for the City of Fruitland and Town of Myersville water supplies*).* County-wide assessments will be prepared for the smaller systems.

B. Availability of Assessments

Assessments will be made available to the public and stakeholders upon completion. The State will provide copies of the assessments to the water supplier, county planning, environmental health, and public works programs, main branches of county libraries, interested citizens (upon request) and to stakeholder groups such as watershed protection groups, tributary teams, and environmental and political organizations. MDE staff will solicit opportunities to present assessment results to local governments, watershed groups, tributary teams, and local wellhead protection teams upon request. MDE will encourage schools to disseminate results of the assessments to students and families.

MDE will issue regional press releases approximately two times per year to announce the availability of the assessment documents. Water suppliers will be encouraged to include information about their assessments in their consumer confidence reports and/or water bills, as well as contact numbers, locations for reviewing their assessment documents, and instructions for obtaining a copy. MDE's web page will announce the availability of and

instructions for obtaining the documents, and local government agencies will be asked to include the information on their web pages where applicable. MDE is working on producing a web page dedicated to the Source Water Assessment Program so that the final reports and maps can be downloaded on line. In addition, MDE will include general information about the assessments and their availability on relevant fact sheets (including existing fact sheets about the Source Assessment Program, Wellhead Protection Program, and SRF funding availability). Fact sheets may be distributed at conferences, public media events, and environmental festivals. The State will seek out and take advantage of other opportunities such as public service radio programming to make this information available.

MDE will work with Departmental education coordinators to develop and/or locate appropriate educational resource materials for teachers. These materials would be distributed with the assistance of the State's education coordinator, and through environmental festivals.

C. Role of Stakeholder Groups in Public Participation

Stakeholder groups such as river commissions, watershed protection groups and tributary teams will be encouraged to assist the State with the public participation process. These organizations provide a unique perspective on water quality issues, and will be able to identify additional activities that may be occurring in the source assessment areas as well as information that will be useful in the assessment process. In addition, their established outreach tools such as newsletters will be useful for generating interest in the assessment process and transmitting assessment results.

Please contact the MDE Water Supply Program at (410) 631-3714 to obtain copies of the **Figures 1-8** and **Appendices** of the Source Water Assessment Plan.

Figure 9a - Susceptibility Analysis Flow Chart and Examples

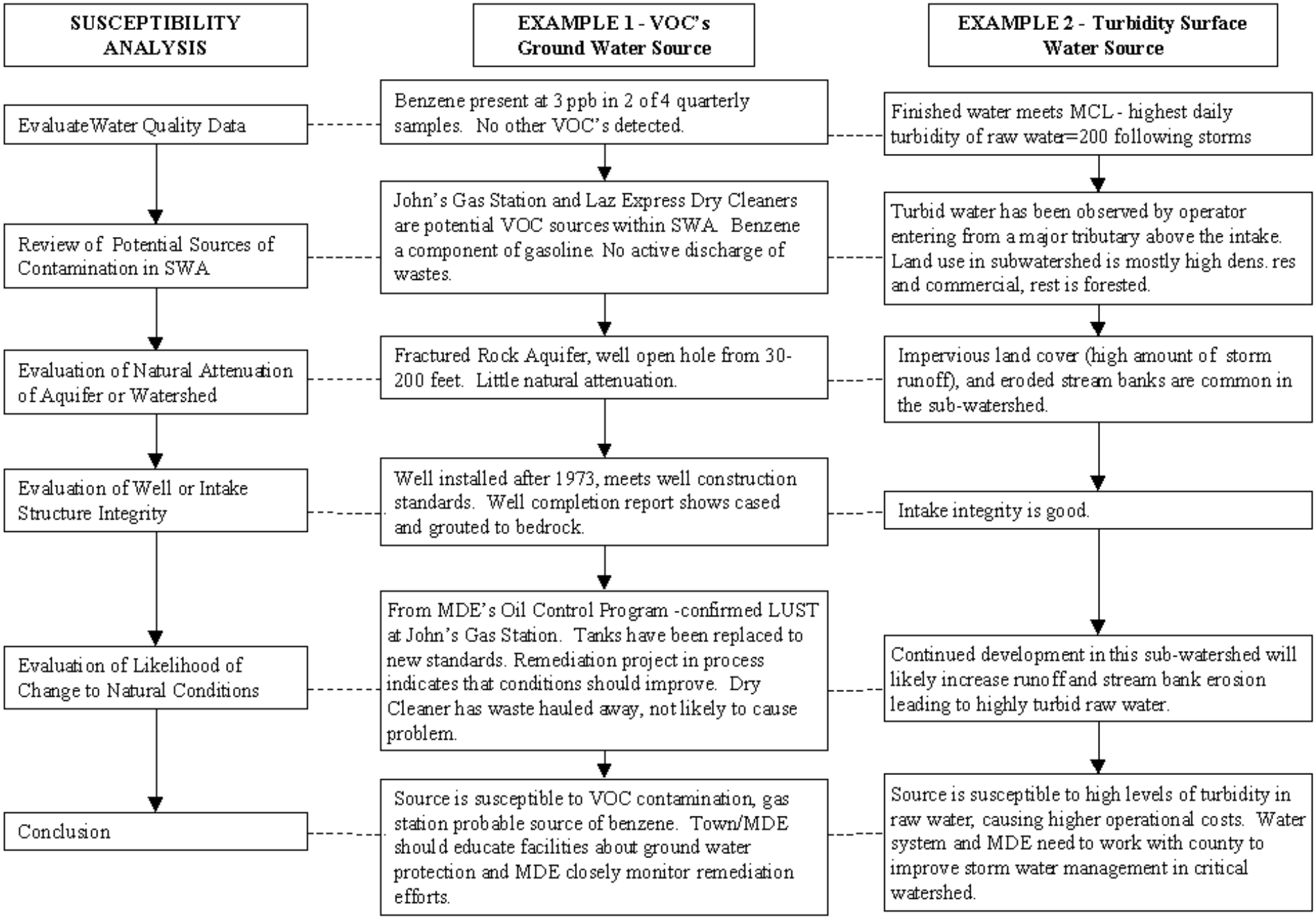

Figure 9b - Source Water Assessment Flow Chart