(**THIS POLICY DOES NOT HAVE THE FORCE OF LAW)**

Criteria for Approving Public Water Supply Wells with Detectable Levels of a Contaminant	Division:	DDAGW
	Number:	WQ-XX-001
	Category:	Water Quality - Policy
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I. PURPOSE

This document was developed to provide direction to Ohio EPA staff regarding the approval process for a well that contains detected levels of a regulated contaminant pursuant to Ohio Administrative Code (OAC) Chapter 3745-9.

II. BACKGROUND

The objectives of this document are to describe the well approval process and the requirements for approval under a variance based on the types and levels of a contaminant which may be found in the well. In addition to this analysis, detail plans must be submitted to and approved by the Director before a well can be placed into service by a public water system.

In accordance with division (E) of section 6111.42 of the Ohio Revised Code (ORC), OAC Chapter 3745-9 applies to the drilling, operation, maintenance, and abandonment of wells to prevent contamination of ground water for all types of public water systems.

OAC Rule 3745-9-01 paragraph (A) refers to OAC Rule 3745-81-01 for the definition of a contaminant. Rule 3745-81-01 defines a contaminant as “any physical, chemical, biological or radiological substance or matter in water.” According to this definition, any detection from a well analysis may be viewed as contamination.

OAC Rule 3745-9-02 paragraph (D) states “The director shall not issue a plan approval for a well serving a public water system or alteration of such a well… which will cause or contribute to contamination of the well or ground water”.

OAC 3745-9-02 paragraph (E) allows for a variance if the public water system demonstrates contamination of the ground water will not result from the well operation, public health and welfare will not be endangered, and other technically feasible alternatives do not exist.

OAC 3745-9-04 paragraph (A)(2) states “A well, other than a well for the removal of contaminants, shall be located only where surface and subsurface conditions will not allow contaminants to be conducted into the well.

The contaminants included in the “Required Analyses for Wells” are listed in the appendix of OAC Rule 3745-9-09. Samples are collected after the completion of well development and the conclusion of the pump test for analysis of these contaminants.

In summary, Ohio Administrative Code (OAC) Chapter 3745-9 allows for approval of a well when the results from the well analysis indicate contamination provided the variance requirements of OAC 3745-9-02 paragraph (E) are met. However, specifics are not given as to how this determination is made. This policy helps clarify how the Agency will make this determination.

III. POLICY

Well Approval Process

The Director may issue plan approval for a well with detectable levels of a contaminant provided the level is acceptable and will not be introduced or increased by operation of the well. Primary Maximum Contaminant Level (MCL) and Secondary Maximum Contaminant Level (SMCL) standards are used to determine if the level of contamination is acceptable. MCL standards specify a level at which a regulated contaminant may be present without posing an unacceptable risk to human health. If an MCL standard is exceeded, additional requirements must be met in order to evaluate a well for approval. Contaminants at levels less than the SMCLs normally do not cause aesthetic concerns. Except for iron and manganese samples from community public water systems, SMCLs and health advisory levels are not enforceable and serve as recommendations. The required contaminant standards included in the well review process are listed in appendix to OAC 3725-9-09. Additional water quality parameters which require analysis during well approval are provided in Table 1 of attachment A. All samples must be analyzed by a certified laboratory. All applicable sample results must be received and approved by the Ohio EPA before the well can be considered for use as a public water source. Additional analyses beyond those listed may be recommended.

The results for the well analyses are reviewed and compared to MCL and SMCL standards. Except for Volatile Organic Chemicals (VOCs) and Synthetic Organic Chemicals (SOCs), if the results indicate contaminant levels are not likely to exceed these standards, the well can be approved. Since VOCs and SOCs are predominantly man-made in origin, additional review is needed to ensure contamination will not be introduced or increased by use of the well. When results indicate contaminant levels may exceed the MCL or SMCL standard or indicate VOC and/or SOC detections, additional actions must be taken and conditions met for approval of the well. After these actions are taken, if contamination levels still exceed or are likely to exceed the MCL and/or use of the well is likely to spread or increase contamination levels above the MCL(s), staff will inform the applicant the Division will recommend to the Director the plans should be denied, except in hardship cases where no other feasible options exist for supplying water. For the purposes of this policy, hardship is defined as follows: hardship means the lack of financial resources or lack of an alternative source of water considering factors such as cost of treatment, operation and maintenance, operator certification requirements and technical, managerial and capability assurance considerations. The Agency will evaluate each hardship determination on a case by case basis.

A flowchart of the process for evaluating new well water quality analyses is presented below and a description of the process is presented in attachment B. Details for the evaluation of specific contaminants are presented in four additional sheets: A (nitrate/nitrite), B (MCL inorganics and radionuclides), C (VOCs and SOCs) and D (bacteria). The flowchart and attachment B do not reflect the entire plan approval process for a well.

Details on Well Process Actions, Conditions and Options

Additional information is provided concerning the actions, conditions and options for the well approval process.

1. Rule out human or laboratory error/resample

   Information on sample collection and analysis should be reviewed to determine if the result could be suspect and invalidated. If the sample result is suspect, quality assurance/quality control information should be reviewed with the laboratory to determine the validity of the results. If no obvious reason can be found for invalidation, a resample should be collected. Prior to collection of a resample, review information on the well log and well development to verify the original sample was representative of the water quality and ensure proper collection of the resample.

   When resampling is performed, the result of the resample is averaged with the original result unless the resample result is a non-detection or significantly different from the original sample result. When the resample does not support the original result, a basis for invalidating one of the sample results should be sought; for example, drilling contaminant or sampling error. If no justification is found for invalidation, a second resample should be collected and all results averaged to assess the level of contamination present in the well.

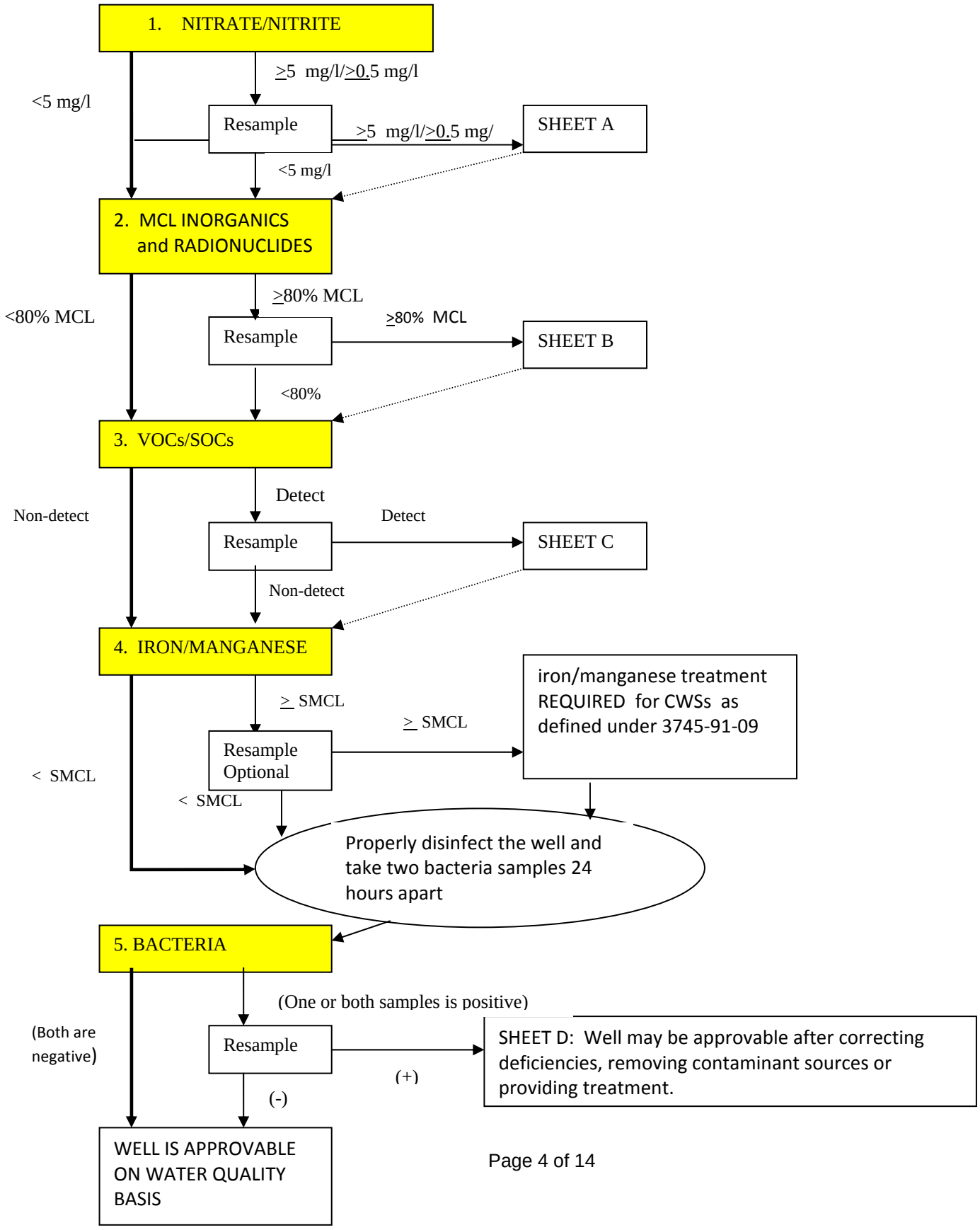
2. Rule out improper well construction

   Defects in the well construction may be responsible for the introduction of a contaminant. Rehabilitation of the well may be possible as confirmed by the results of follow-up sampling. Reviewing the well log may provide useful information for decreasing or eliminating contamination; for example, drilling deeper past a confining layer to prevent contamination.

3. Rule out potential contamination sources

   If not already done, the well site and surrounding area (five year time-of-travel) should be examined for sources of contamination such as failing septic systems for nitrate, underground storage tanks for VOCs, etc.

Figure 1. Flow Chart for Evaluating New Well Water Quality Analyses



4. Propose alternate source of water or well site

   In consultation with the public water system owner, an evaluation should be done to determine if other feasible options exist for supplying water. Options may include locating in a different well site, connecting to another public water system, or installing a hauled water system. Based on this evaluation, an option can be identified to ensure a source with acceptable water quality.

5. Conduct hydrogeologic investigatory activities

   If the contamination levels exceed or are likely to exceed MCL standards, one or more hydrogeologic investigatory activities may be required as specified in sheets A-D. The activities are selected based on the type of contaminant, contamination level, and information available for the well site.

6. Provide treatment space

   When the results of the well analyses and any required follow-up actions indicate contamination levels are variable or are likely to increase above the MCL standards, the system should allocate space to allow the installation of any necessary treatment equipment for future mitigation.

7. Arrange for on-going monitoring

   This action may be recommended when contaminants are detected at levels below the MCL and is required when contaminants exceed 80% of the MCL standards. On-going monitoring is a condition whenever treatment is being installed to decrease contamination below the MCL as verification of effective operation. Central Office Compliance Assurance Section staff should be notified of this requirement to make any necessary adjustments to monitoring schedules for the system.

8. Install treatment

   When the water quality results of the original sample and resample exceed or are likely to exceed a MCL standard, staff will inform the applicant the Division will recommend to the Director the plans should be denied, except in hardship cases where no other feasible options exist for supplying water. If a public water system presents a hardship case, treatment should be required as a condition for use of the well. Ohio EPA staff should recommend the water system and their consulting engineer meet with Ohio EPA engineering staff to discuss effective treatment options for the system prior to submission of detail plans.

<u>Other Considerations</u>

Several situations may occur which are difficult to resolve. These problematic situations are described below along with suggestions for addressing them.

1. A transient noncommunity system exceeds an MCL standard for a contaminant other than nitrate or total coliform or a nontransient noncommunity system exceeds an MCL standard for a radiological contaminant.

   In this situation, treatment cannot be required; however, the review letter should recommend treatment and continuous posting of a notice regarding potential health effects. A public notice should be enclosed for use by the public water system.

2. If the public water system is unable to obtain two total coliform negative water samples 24 hour apart, the well should not be approved without additional requirements. Staff should recommend the applicant have samples analyzed using the membrane filter method to assess potential MMO-Mug false-positive results.

   Sheet D explains additional sampling and treatment recommendations for wells with total coliform positive and *E. coli* positive results.

IV. HISTORY

The Division of Drinking and Ground Waters first issued this document on _____.

Attachment A

Table 1. Additional Water Quality Parameters
Rule OAC 3745-9-09 also includes sampling requirements for the parameters listed in the table below. The water quality sample results, for these non-enforceable standards, are reviewed to make recommendations concerning operational and treatment considerations.

Parameter	Secondary Standard
Alkalinity	No Standard
Calcium	No Standard
Chloride	250 mg/L
Magnesium	No Standard
Nickel	No Standard
pH	7-10.5 S.U.
Total Dissolved Solids	500 mg/L
Silver	0.1 mg/L
Sodium	60.0 mg/l
Sulfate	250 mg/L
Zinc	5 mg/L

Attachment B

Process for Evaluating Well Water Quality Analysis Results

STEP ONE: Nitrate/Nitrite

1) If nitrate result is non-detect to 5 mg/l or nitrite result is non-detect to 0.5 mg/l , go to STEP TWO
2) If the nitrate result exceeds 5 mg/l or nitrite result exceeds 0.5 mg/l, resample
3) If the average of the original sample and resample is less than 5 mg/l for nitrate and 0.5 mg/l for nitrite, go to STEP TWO
4) If the average of the original sample and resample exceeds 5 mg/l for nitrate or 0.5 mg/l for nitrite, refer to instructions on **Sheet A**. Then, if appropriate, continue to STEP TWO.

STEP TWO: MCL Inorganics (other than iron, manganese, nitrate and nitrite) **and Radionuclides**

1) If result is less than 80% MCL, go to STEP THREE
2) If result equals or exceeds 80% MCL, resample
3) If the average of the original sample and resample is less than 80% MCL, go to STEP THREE
4) If the average of the original sample and resample equals or exceeds 80% MCL, refer to instructions on **Sheet B**. Then, if appropriate, continue to STEP THREE.

STEP THREE: VOCs and SOCs

1) If result is non-detection, go to STEP FOUR
2) If result is detection, resample
3) If resample is nondetect, go to STEP FOUR
4) If resample is detection, refer to instructions on **Sheet C**. Then, if appropriate, continue to STEP FOUR.

STEP FOUR: Iron and Manganese

1) If result is less than SMCL, disinfect the well and analyze for bacteria
2) If result exceeds SMCL, resample
3) If resample is less than SMCL, disinfect the well and analyze for bacteria
4) If resample exceeds SMCL, iron and manganese treatment may be required for community public water system in accordance with OAC 3745-91-09. This requirement depends on whether the system is new or the well is for an existing system and the level detected and whether treatment is already in-place. Disinfect the well and analyze for bacteria.

STEP FIVE: Bacteria

1) Analyze two samples taken 24 hours apart
2) If both are negative, WELL IS APPROVABLE ON WATER QUALITY BASIS
3) If either or both are positive, resample
4) If resample is negative, WELL IS APPROVABLE ON WATER QUALITY BASIS
5) If resample is positive, refer to instructions on **Sheet D**.

Sheet A: Nitrate/Nitrite

Analysis

Common sources of elevated nitrate/nitrite in a well include application of fertilizers, wastewater discharge from septic systems, leaking sanitary sewer lines, land application of sewage sludge or animal manure within the vicinity of the well. Nitrate is a common water quality problem which can sometimes be avoided by drilling into a different interval within the same aquifer. Nitrate sources tend to be limited to the upper 50 to 70 of an aquifer, so drilling deeper may be a viable strategy. However, there may be trade-offs with other water quality concerns (e.g. elevated arsenic) when drilling deeper within the aquifer.

Action

1) **Rule out improper construction** that would allow nitrogen-laden surface water into the well. Check for depressions around well casing, allowing water to pond. Check for cracks in the surficial grout. Correct any defects found.

2) **Rule out nearby sources of nitrate/nitrite**. The owner/operator may take corrective action on any nitrate/nitrite contaminant source identified, if possible. Purchasing agricultural land just upgradient of the well and taking it out of production may reduce nitrate levels in raw water at the well. If septic systems are suspect, investigate them and correct if determined to be failing. If no sources are found, or if they are found but not corrected, see Options. If sources were located and corrected, resample. If the sample results for nitrate exceeds 5 mg/L or nitrite exceeds 0.5 mg/l, go to Options.

3) OPTIONS:

a) ***Propose alternate source of water.***

b) ***Propose alternate well site.***

c) ***Conduct one or more of the following hydrogeologic investigatory activities,*** *per rule OAC 3745-9-04:*

i) ***Re-drill the well to screen in a deeper aquifer***, if one exists, and resample.

ii) ***Demonstrate that pumping the well will not draw in higher nitrate/nitrite levels***. Sample other wells completed into the same geologic unit within five year time-of-travel. This will involve collecting well logs from ODNR, studying aquifer maps, and arranging for sampling.

- If all samples from monitored wells are less than 50 percent of the MCL, **CONTINUE DOWN FLOW CHART (Figure 1).**
- If any sample results are 50 to 80 percent of the MCL, well is approvable with quarterly sampling for nitrate/nitrite and space provided for treatment. **CONTINUE DOWN FLOW CHART (Figure 1).**
- If some samples exceed 80 percent of the MCL, **WELL SHOULD NOT BE APPROVED**. In hardship circumstances only, well may be approved with quarterly nitrate sampling and treatment.

Sheet B: MCL Inorganics and Radionuclides

Analysis

High levels of inorganics and radionuclides can be naturally-occurring in ground water, but their level of mobility tends to depend on factors such as oxidation-reduction, pH, cation exchange capacity, organic content and clay content of the aquifer, etc. The most common water quality problem in the category is arsenic which can sometimes be avoided by drilling into a different interval within the same aquifer. Arsenic tends to be found in deeper intervals, and is usually associated with high iron levels.

Action

1) **Rule out <u>un</u>-natural sources of inorganic contamination**, such as metal-working foundries for metals and pesticide production for arsenic. If no sources are located, go to 2). If a source is located and can be removed or neutralized (unlikely), resample.
   - If resample is less than 80% MCL, **CONTINUE DOWN FLOW CHART (Figure 1)**
   - If resample equals or exceeds 80% MCL, go to 2)

2) **OPTIONS:**
   a) ***Propose alternate source of water.***
   b) ***Propose an alternate well site.***
   c) ***Conduct one or more of the following hydrogeologic investigatory activities,*** *per OAC 3745-9-04:*
      i) ***Screen in a different interval of the same aquifer*** and resample
         - If resample is less than 80% MCL, **CONTINUE DOWN FLOW CHART (Figure 1)**
         - If resample is between 80 and 100% of the MCL, go to ii) or iii)
      ii) ***Re-drill this well to screen in a deeper aquifer***, if one exists, and resample.
         - If sample is less than 80% MCL, **CONTINUE DOWN FLOW CHART (Figure 1)**
         - If sample is between 80 and 100% of the MCL, well is approvable with quarterly sampling for inorganic or radionuclide of concern and space provided for treatment. **CONTINUE DOWN FLOW CHART (Figure 1)**.
         - If sample exceeds MCL, **WELL SHOULD NOT BE APPROVED**. In hardship cases, the well may be approved with treatment and quarterly sampling for the inorganic or radionuclide constituent of concern.
      iii) ***Demonstrate that pumping the well will not draw in inorganic levels above MCL.*** Sample other wells completed into the same geologic unit/interval within five year time-of-travel. This will involve collecting well logs from ODNR, studying aquifer maps, and arranging for sampling.
         - If all samples from monitoring wells are below 80% MCL, **CONTINUE DOWN FLOW CHART (Figure 1)**
         - If some samples exceed 80% MCL but are less than the MCL, well is approvable with quarterly sampling for inorganic or radionuclide of concern and space provided for treatment. **CONTINUE DOWN FLOW CHART (Figure 1)**
         - If some samples exceed MCL, **WELL SHOULD NOT BE APPROVED**. In hardship cases, the well may be approved with treatment and quarterly sampling for the inorganic or radionuclide constituent of concern.

Sheet C: VOCs and SOCs

Analysis

The majority of VOCs and SOCs are man-made and indicate non-naturally occurring sources of contamination. Many VOCs (such as carbon tetrachloride, aka methylene chloride) may be laboratory error. Occasionally running a motor while taking a sample will lead to detections of BTEX in the water sample. These kind of errors are the the first items to be evaluated. The next step is to search for surface or subsurface sources of VOCs/SOCs. If a discrete source is located and can be removed, this is the ideal solution, but this rarely happens in a timeframe suitable to the applicant for a new well. More often another site or aquifer interval must be sought.

Action

1) **Rule out human or laboratory error.** If none can be found, go to Options.
   - If human or laboratory error is strongly suspected, resample.
     If resample is nondetection, **CONTINUE DOWN FLOW CHART (Figure 1)**
   - If resample is detection, go to Options.

2) **OPTIONS:**
   a) ***Find alternate source of water.***
   b) ***Find alternate well site.***
   c) ***Find source of contamination and remove.***
   d) ***Conduct one or more of the following hydrogeologic investigatory activities,*** *per OAC 3745-9-04, and then resample.*
      i) Find cleaner interval of proposed well. Using the same well site, drill into a deeper aquifer, if one exists, or pack off a specific interval of the same aquifer. Resample. (Note: This strategy <u>must</u> be followed by ii), iii), or iv) to verify that pumping will not draw contaminated water into the new screened interval.)
      ii) Demonstrate confining layer. Demonstrate confining layer between contaminated zone and interval to be pumped. Use well logs to demonstrate a continuous confining layer between the contaminated aquifer and the aquifer into which the proposed well is drilled. (Number of well logs needed will be District Office hydrogeologist's decision). If insufficient, go to iii) or iv).
      iii) Demonstrate lack of hydraulic connection. Demonstrate lack of hydraulic connection between the contaminated area and the interval to be pumped via:
         - a <u>pumping test</u> of the lower aquifer with observation wells in the contaminated aquifer to demonstrate no connection between the two layers. These observation wells must be within a distance where the effect of pumping is expected to cause a noticeable drawdown,
           OR
         - <u>ground water flow modeling</u>, using a 3-D model such as MODFLOW.
      iv) Demonstrate dilution. Where a discrete source area or discrete plume can be identified, an applicant may consider contaminant transport modeling to demonstrate the highest concentrations of contamination will be diluted to acceptable levels by the time they reach the well. This may be based on a ground water flow/contaminant transport modeling package (especially for extended plumes or extensive areas of contamination) or contaminant flow equations (where a discrete point of contamination can be used).

3) **Make decision.**

Results of resampling per option **2) d** yields	Applicant has demonstrated that additional contamination will NOT be drawn into the well	**Decision Recommendation**
Non-detection	YES	Approvable. Continue down flow chart (Figure 1).
Non-detection	NO	Approvable with periodic monitoring for VOC/SOC of concern. Continue down flow chart (Figure 1).
Detection to <80% MCL	YES	Approvable with periodic monitoring for VOC/SOC of concern. Continue down flow chart (Figure 1).
Detection to <80% MCL	NO	Approvable with periodic monitoring for VOC/SOC of concern AND space set aside for treatment. Continue down flow chart (Figure 1).
>80% MCL		**WELL SHOULD NOT BE APPROVED**. Under hardship circumstances only, the well may be allowed with treatment and quarterly sampling for the VOCs/SOCs of concern

Sheet D: Bacteria

Analysis

The possible reasons for bacteria in a newly-drilled well are:

- Bacteria was introduced during drilling or sampling (most likely).
- The well was improperly constructed, allowing entry of precipitation.
- Well is drawing in water from a nearby surface water body (pond, stream, etc.) Little can be done to fix this problem, other than moving the well farther from the surface water body.
- A source of bacterial contamination is located nearby that was not identified during the inventory.

Action

1) Rule out improper construction; check for depressions around well casing, allowing water to pond. Check for cracks in grout. Correct any defects found.

2) Rule out nearby sources of bacteria, such as manure piles, septic tanks, leaking wastewater pipes.

3) Disinfect well and resample, per OAC 3745-9-08.

4) If resample is negative, **CONTINUE DOWN FLOW CHART (Figure 1)**.

5) If resample is total coliform positive and *E. coli* negative, recommend the applicant have additional samples analyzed using the membrane filter method to assess potential MMO-Mug false-positive results. If membrane filter samples are total coliform negative, **CONTINUE DOWN FLOW CHART (Figure 1)**. Note: This step is optional, continue to Step 6 if applicant does not want to perform this additional sampling.

6) If resample results are total coliform positive and *E. coli* negative, inform Applicant the well can be approved only if a) there is no evidence of *E. coli* sources in the sanitary isolation radius; b) one year of monthly raw water *E. coli* sampling with counts (e.g. quantitray) is performed; and c) disinfection (without retention requirements) is provided subject to additional treatment requirements pending the outcome of the hydrogeologic sensitivity assessment or raw water sampling results. **CONTINUE DOWN FLOW CHART (Figure 1)**.

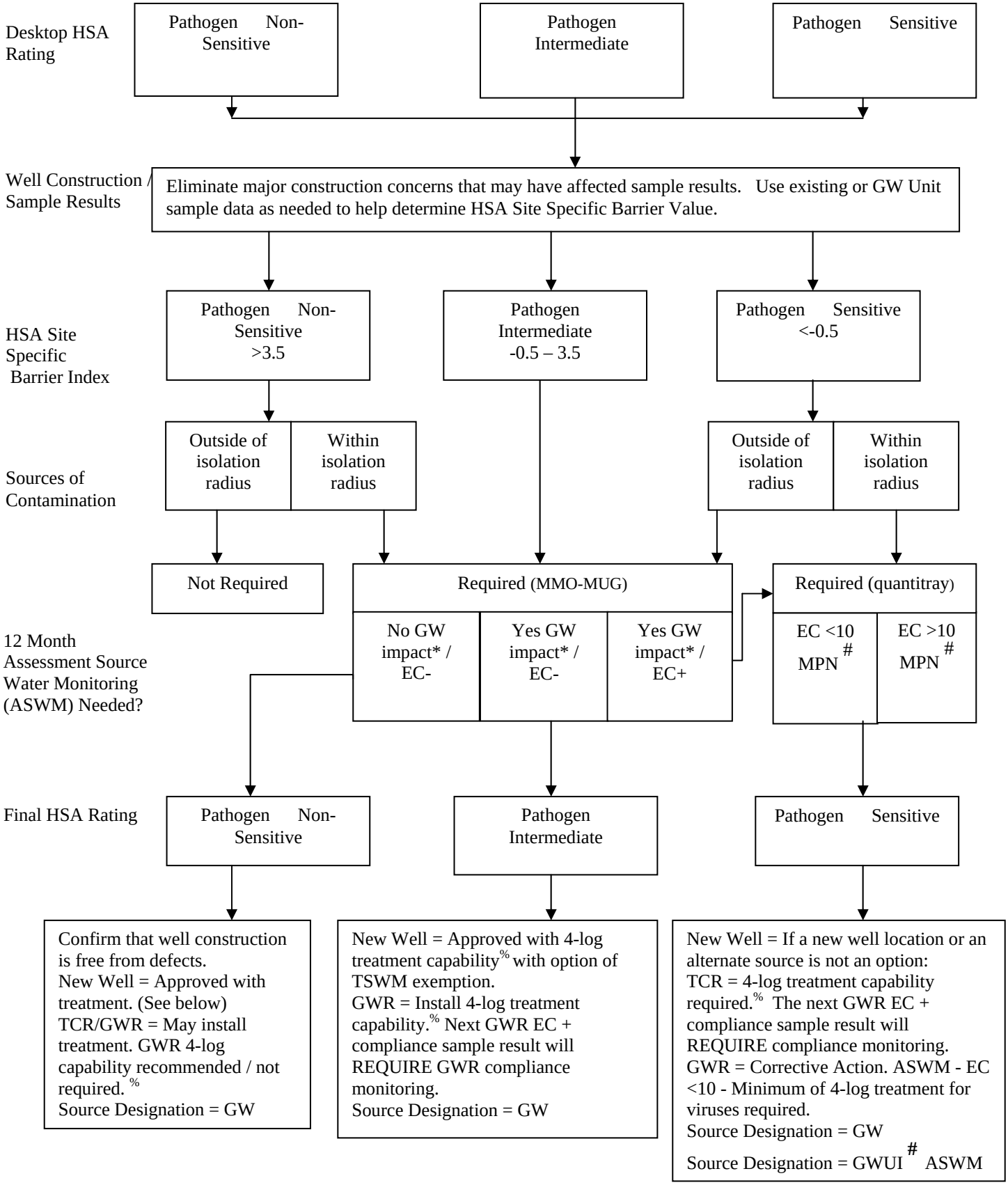
7) If resample results are total coliform positive and *E. coli* positive, inform Applicant the well can be approved if a) one year of monthly raw water *E. coli* sampling with counts (e.g. quantitray) is performed; b) treatment (disinfection with 4 log removal of viruses) is provided; and c) additional treatment space is available to meet the surface water rule treatment requirements in accordance with 3745-81 of the administrative code. **CONTINUE DOWN FLOW CHART (Figure 1)**.

   If the annual average of *E. coli* is less than ten colonies per 100 ml, then surface water treatment rule requirements are not required.

   If the annual average of *E. coli* is greater than ten *E. coli* colonies per 100 ml, then re-designate the well as ground water under the direct influence of surface water and surface water rule treatment requirements in accordance with 3745-81 of the administrative code must be installed.

8) If Applicant does not comply Steps 5, 6 or 7, **WELL MUST BE DENIED**. An alternate source of drinking water must be obtained.

Bacteriological Water Quality Evaluation of a New Well



* = Inorganic parameters - referenced on page 25 of the Guidance for Hydrogeologic Sensitivity Assessment and Assessment Source Water Monitoring document.

= per 3745-81-76(B)(2)(c) of OAC – Water Source Designation

****** = Examples only. Does not include all possible outcomes determined by Ohio EPA DDAGW Drinking Water (DW) or Groundwater (GW) Units.

% = Condition of plan approval may require quarterly or 12 months of raw water testing for first year that will be used as GWR complaint samples or to confirm source designation.