

## **6.0 GUIDANCE FOR MONITORING WELL INSTALLATION & MONITORING**

### **6.1 Guidance for Monitoring Well Installation**

The department has developed general guidance for responsible parties and their environmental consultants concerning the need for installing monitoring wells at release sites. The department has developed this guidance with the understanding that there will always be situations where this guidance may not apply. This guidance is also presented in tabular form in Table 6.1 and graphically in Figures 6.1 and 6.2.

The Tier 1 assessment must provide the information needed to make decisions on well installation. See Chapter 4 for more information on Tier 1 assessments.

#### **6.1.1 Site is in a Formation That is Not an Aquifer and is Not Likely to be Hydrologically Connected to an Aquifer**

The department has developed the following guidance for sites located in a formation that is not an aquifer and is not likely to be hydrologically connected to an aquifer (see Table 6.1 and Figure 6.1). In general, the following situations are likely to be observed:

- A) Soil contamination at the site does not exceed detection limits;
- B) Soil contamination at the site exceeds detection limits, but did not exceed Tier 1 Action Levels or 500 parts per million total petroleum hydrocarbons;
- C) Soil exceeding Tier 1 Action Levels and 500 parts per million total petroleum hydrocarbons has been removed, but not to non-detect; or,
- D) Soil contamination exceeding Tier 1 Action Levels and/or 500 parts per million total petroleum hydrocarbons is present.

##### **6.1.1.1 Soil Contamination Less Than Detection Limits**

The department has developed the following guidance for situations where soil contamination does not exceed detection limits.

Monitoring wells may not be required if the following conditions are present:

- A) Soil contamination was not detected; or,
- B) All contaminated soil was removed to non-detectable levels, regardless of initial concentrations. However, a Tier 2 assessment may be required if soil contamination exceeded 500 parts per million total petroleum hydrocarbons before excavation. See Chapter 4 for more information.

### **6.1.1.2 Soil Contamination Less Than Tier 1 Action Levels and 500 Parts Per Million Total Petroleum Hydrocarbons**

The department has developed the following guidance for situations where soil contamination exceeds detection limits, but did not exceed Tier 1 Action Levels or 500 parts per million total petroleum hydrocarbons.

- A) Monitoring wells may not be required if there is no potential for impacts to receptors; there are no receptors; or the responsible person proves to the department's satisfaction that receptors have not been, and will not be, impacted. The department will determine if the site may be closed.
- B) Monitoring wells may be required if there is potential for impacts to receptors.

If monitoring wells are required, install at least one monitoring well in the area of worst soil contamination, or as close as possible in the presumed downgradient direction. Additional monitoring wells may be required if there are multiple areas of contamination. See Section 6.3 for guidance on well installation at sites with multiple sources. Additional wells may be required if wells are not positioned correctly, or within a reasonable distance of the area of worst soil contamination.

- A) If free product is present, begin free product recovery. See Section 5.1.1 for more information.
- B) If petroleum contamination is not detected in the initial ground water sample, or petroleum contamination is detected in the initial ground water sample, but it is below standards, the department will determine if the site may be closed.
- C) If petroleum contamination in the initial ground water sample exceeds standards; additional monitoring wells to define the extent of ground water contamination may be required. Begin a quarterly ground water monitoring program. The department may require additional corrective action and/or RBCA modeling (see Section 4.2.2) if there are potential risks to human health or the environment.

### **6.1.1.3 Soil Exceeding Tier 1 Action Levels and 500 Parts Per Million Total Petroleum Hydrocarbons Removed**

The department has developed the following guidance for situations where soil exceeding Tier 1 Action Levels and 500 parts per million total petroleum hydrocarbons has been removed, but not to non-detect.

- A) A Tier 2 assessment may be required if soil contamination exceeded 500 parts per million total petroleum hydrocarbons before excavation. See Chapter 4 for more information.
- B) Monitoring wells may not be required if all the following conditions are present:
  - 1) Ground water or evidence of ground water in contact with contaminated soils was not observed in the excavation; and ground water is unlikely to

have been in contact with soil contamination that exceeded Tier 1 Action Levels or 500 parts per million total petroleum hydrocarbons (water level measurements from nearby sites may be used to make this determination); and,

- 2) There is no potential for impacts to receptors; there are no receptors; or the responsible person proves to the department's satisfaction that receptors have not been, and will not be, impacted.
- C) Monitoring wells may be required if either of the following conditions are present:
- 1) Ground water was, or is likely to have been, in contact with soil contamination that exceeded Tier 1 Action Levels or 500 parts per million total petroleum hydrocarbons (water level measurements from nearby sites may be used to make this determination); or,
  - 2) There is potential for impacts to receptors.

If monitoring wells are required, install at least one monitoring well in the area of worst soil contamination, or as close as possible in the presumed downgradient direction. Additional monitoring wells may be required if there are multiple areas of contamination. See Section 6.3 for guidance on well installation at sites with multiple sources. Additional wells may be required if wells are not positioned correctly, or within a reasonable distance of the area of worst soil contamination.

- A) If free product is present, begin free product recovery. See Section 5.1.1 for more information.
- B) If petroleum contamination is not detected in the initial ground water sample, or petroleum contamination is detected in the initial ground water sample, but it is below standards, the department will determine if the site may be closed.
- C) If petroleum contamination in the initial ground water sample exceeds standards; additional monitoring wells to define the extent of ground water contamination may be required. Begin a quarterly ground water monitoring program. The department may require additional corrective action and/or RBCA modeling (see Section 4.2.2) if there are potential risks to human health or the environment.

#### **6.1.1.4 Soil Contamination Exceeding Tier 1 Action Levels and/or 500 Parts Per Million Total Petroleum Hydrocarbons Present**

The department has developed the following guidance for situations where soil contamination exceeding Tier 1 Action Levels and/or 500 parts per million total petroleum hydrocarbons is present.

- A) A Tier 2 assessment is required if soil contamination exceeds 500 parts per million total petroleum hydrocarbons. **See Chapter 4 for more information.**

- B) The department will require additional assessment to define the extent of soil contamination that exceeds Tier 1 Action Levels. **See Chapter 4 for more information.**
- C) Monitoring wells may not be required if all the following conditions are present:
  - 1) Ground water is unlikely to be, or to have been, in contact with soil contamination that exceeds Tier 1 Action Levels or 500 parts per million total petroleum hydrocarbons (water level measurements from nearby sites may be used to make this determination);
  - 2) There is no potential for impacts to receptors; there are no receptors; or the responsible person proves to the department's satisfaction that receptors have not been, and will not be, impacted; and,
  - 3) Site conditions do not suggest free product is present on the ground water.
- D) Monitoring wells may be required if any of the following conditions are present:
  - 1) Ground water is, or is likely to have been, in contact with soil contamination that exceeds Tier 1 Action Levels or 500 parts per million total petroleum hydrocarbons (water level measurements from nearby sites may be used to make this determination);
  - 2) There is potential for impacts to receptors; or,
  - 3) Site conditions suggest free product may be present on the ground water.

If monitoring wells are required, install at least one monitoring well in the area of worst soil contamination, or as close as possible in the presumed downgradient direction. Additional monitoring wells may be required if there are multiple areas of contamination. See Section 6.3 for guidance on well installation at sites with multiple sources. Additional wells may be required if wells are not positioned correctly, or within a reasonable distance of the area of worst soil contamination. Determine if RBCA modeling is required (see Section 4.2.2).

- A) If free product is present, begin free product recovery. See Section 5.1.1 for more information.
- B) If petroleum contamination is not detected in the initial ground water sample, the department will determine if the site may be closed.
- C) If petroleum contamination is detected in the initial ground water sample, but it is below standards, the department will determine if the site may be closed. However, if there was a recent release and the monitoring well is not reasonably close to the site of the release, the department may require additional monitoring.
- D) If petroleum contamination in the initial ground water sample exceeds standards, additional monitoring wells to define the extent of ground water contamination will be required. Begin a quarterly ground water monitoring program. The

department may require additional corrective action if there are potential risks to human health or the environment.

### **6.1.2 Site is in a Formation That is an Aquifer or is Likely to be Hydrologically Connected to an Aquifer**

The department has developed the following guidance for sites located in a formation that is an aquifer or is likely to be hydrologically connected to an aquifer (see Table 6.1 and Figure 6.2). In general, the following situations are likely to be observed:

- A) Soil contamination at the site does not exceed detection limits;
- B) Soil contamination at the site exceeds detection limits, but did not exceed Tier 1 Action Levels or 500 parts per million total petroleum hydrocarbons;
- C) Soil exceeding Tier 1 Action Levels and 500 parts per million total petroleum hydrocarbons has been removed, but not to non-detect; or,
- D) Soil contamination exceeding Tier 1 Action Levels and/or 500 parts per million total petroleum hydrocarbons is present.

#### **6.1.2.1 Soil Contamination Less Than Detection Limits**

The department has developed the following guidance for situations where soil contamination does not exceed detection limits.

Monitoring wells may not be required if the following conditions are present:

- A) Soil contamination was not detected; or,
- B) All contaminated soil was removed to non-detectable levels, regardless of initial concentrations. However, a Tier 2 assessment may be required if soil contamination exceeded 500 parts per million total petroleum hydrocarbons before excavation. See Chapter 4 for more information.

#### **6.1.2.2 Soil Contamination Less Than Tier 1 Action Levels and 500 Parts Per Million Total Petroleum Hydrocarbons**

The department has developed the following guidance for situations where soil contamination exceeds detection limits, but did not exceed Tier 1 Action Levels or 500 parts per million total petroleum hydrocarbons.

- A) Monitoring wells may not be required if ground water is not present within 10 feet of soil contamination that exceeds detection limits. Water level information from nearby sites may be used to make this determination. The department will determine if the site may be closed.
- B) Monitoring wells may be required if ground water is present within 10 feet of soil contamination that exceeds detection limits. Water level information from nearby sites may be used to make this determination.

If monitoring wells are required, install at least one monitoring well in the area of worst soil contamination, or as close as possible in the presumed downgradient direction. Additional monitoring wells may be required if there are multiple areas of contamination. See Section 6.3 for guidance on well installation at sites with multiple sources. Additional wells may be required if wells are not positioned correctly, or within a reasonable distance of the area of worst soil contamination.

- A) If free product is present, begin free product recovery. See Section 5.1.1 for more information.
- B) If petroleum contamination is not detected in the initial ground water sample, the department will determine if the site may be closed.
- C) If petroleum contamination is detected in the initial ground water sample, but it is below standards, sample the well six months after the initial sampling event. If contamination remains below standards, and is not increasing, the department will determine if the site may be closed. If contaminant concentrations increase, the department will determine an appropriate sampling schedule, or if additional assessment/corrective action is required.
- D) If petroleum contamination in the initial ground water sample exceeds standards, additional monitoring wells to define the extent of ground water contamination will be required. Determine if RBCA modeling is required (see Section 4.2.2). Begin a quarterly ground water monitoring program. The department may require additional corrective action if there are potential risks to human health or the environment.

### **6.1.2.3 Soil Exceeding Tier 1 Action Levels and 500 Parts Per Million Total Petroleum Hydrocarbons Removed**

The department has developed the following guidance for situations where soil exceeding Tier 1 Action Levels and 500 parts per million total petroleum hydrocarbons has been removed, but not to non-detect.

- A) A Tier 2 assessment may be required if soil contamination exceeded 500 parts per million total petroleum hydrocarbons before excavation. See Chapter 4 for more information.
- B) Monitoring wells may not be required if ground water is not present within 10 feet of soil contamination that exceeds detection limits. Water level measurements from nearby sites may be used to make this determination.
- C) Monitoring wells may be required if ground water is present within 10 feet of soil contamination that exceeds detection limits. Water level measurements from nearby sites may be used to make this determination.

If monitoring wells are required, install at least one monitoring well in the area of worst soil contamination, or as close as possible in the presumed downgradient direction. Additional monitoring wells may be required if there are multiple areas of contamination. See Section 6.3

for guidance on well installation at sites with multiple sources. Additional wells may be required if wells are not positioned correctly, or within a reasonable distance of the area of worst soil contamination.

- A) If free product is present, begin free product recovery. See Section 5.1.1 for more information.
- B) If petroleum contamination is not detected in the initial ground water sample, the department will determine if the site may be closed.
- C) If petroleum contamination is detected in the initial ground water sample, but it is below standards, sample the well six months after the initial sampling event. If contamination remains below standards, and is not increasing, the department will determine if the site may be closed. If contaminant concentrations increase, the department will determine an appropriate sampling schedule, or if additional assessment/corrective action is required.
- D) If petroleum contamination in the initial ground water sample exceeds standards, additional monitoring wells to define the extent of ground water contamination will be required. Determine if RBCA modeling is required (see Section 4.2.2). Begin a quarterly ground water monitoring program. The department may require additional corrective action if there are potential risks to human health or the environment.

#### **6.1.2.4 Soil Contamination Exceeding Tier 1 Action Levels and/or 500 Parts Per Million Total Petroleum Hydrocarbons Present**

The department has developed the following guidance for situations where soil contamination exceeding Tier 1 Action Levels and/or 500 parts per million total petroleum hydrocarbons is present.

- A) A Tier 2 assessment is required if soil contamination exceeds 500 parts per million total petroleum hydrocarbons. See Chapter 4 for more information.
- B) The department will require additional assessment to define the extent of soil contamination that exceeds Tier 1 Action Levels. See Chapter 4 for more information.
- C) Monitoring wells will be required. Install at least one monitoring well in the area of worst soil contamination, or as close as possible in the presumed downgradient direction. Additional monitoring wells may be required if there are multiple areas of contamination. See Section 6.3 for guidance on well installation at sites with multiple sources. Additional wells may be required if wells are not positioned correctly, or within a reasonable distance of the area of worst soil contamination. Determine if RBCA modeling is required (see Section 4.2.2).
  - 1) If free product is present, begin free product recovery. See Section 5.1.1 for more information.

- 2) If petroleum contamination is not detected in the initial ground water sample, sample the well six months after the initial sampling event. If contamination is not detected, the department will determine if the site may be closed.
- 3) If petroleum contamination is detected in the initial ground water sample, but it is below standards, sample the well quarterly for one year. If contamination remains below standards, and is not increasing, the department will determine if the site may be closed. If contaminant concentrations increase, the department will determine an appropriate sampling schedule, or if additional assessment/corrective action is required.
- 4) If petroleum contamination in the initial ground water sample exceeds standards, additional monitoring wells to define the extent of ground water contamination will be required. Begin a quarterly ground water monitoring program. The department may require additional corrective action if there are potential risks to human health or the environment.

## **6.2 General Monitoring Well Requirements**

The department has developed the following general guidance when installing ground water monitoring wells.

- A) Monitoring well design must follow the department's monitoring well construction specifications in Appendix C – SOP No. 3. Modifications to these specifications may be allowed at the discretion of the department. Contact the department's Water Rights Program (605-773-3352) for more information. See Section 6.7 for information on direct-push wells.
- B) All monitoring wells must be installed by a South Dakota licensed well driller in accordance with ARSD Chapter 74:02:04. Well completion forms must be completed by the well driller for each monitoring well and submitted to the department's Water Rights Program.
- C) Continuous split spoon sampling should be conducted at all monitoring well locations to characterize site stratigraphy. Continuous split spoon sampling may not be required under the following circumstances:
  - 1) The monitoring well is being installed in a hard rock formation (coring may be required at the department's discretion);
  - 2) The monitoring well is being installed within five feet of a previous soil boring;
  - 3) The monitoring well is being installed in an area previously excavated (split spoon sampling is required once the native material below the excavation backfill has been reached); or,



- 4) The purpose of the boring is to install a monitoring well to define the extent of free product on the ground water (continuous split spoon sampling is recommended if variable lithology was observed in previous soil borings, or if an active recovery or treatment system may be installed).
- D) Any boring not completed as a well must be sealed in accordance with ARSD 74:02:04:69 and under Appendix C – SOP No. 5.
- E) Measure water levels in all monitoring wells unless a well is not accessible, or with prior approval from the department.
- F) If an initial monitoring well is required the well must be placed in the area of worst soil contamination, or as close as possible in the presumed downgradient direction. Additional wells may be required if wells are not positioned correctly, or within a reasonable distance of the area of worst soil contamination.
  - 1) The well must monitor the first water encountered.
  - 2) The well should extend 5-15 feet into the water table with sufficient screen above the water table to detect free product. The length of the screen should be based on the detection of the worst area of contamination, allowance for water table fluctuations and other site conditions (such as confining layers). If there is a less permeable layer below saturated sands and gravels, the soil boring and the screen should extend into that layer.
  - 3) A well must not be drilled through the backfill of an active tank.
- G) “Downgradient” may be predicted based on topography, location of surface water bodies, structural controls in bedrock, location of pumping wells, and subsurface conduits at or below the water table. Water level information from nearby sites may also be used to predict ground water flow direction. The proximity and direction of water supply wells, structures, or surface water bodies should be considered when determining well placement.
- H) Well development may be initiated shortly after installation. However, the department recommends waiting a minimum of 48 hours between installation and development if liquid bentonite slurry was used, or if surging, jetting, overpumping, or other rigorous methods are used for developing the well. Well development should continue until the water is clear and appears to be free of sediment. See SOP No. 3 for details on well development.
- I) Ground water samples may be collected shortly after well development unless fluids were introduced during drilling. If drilling fluids were used, the well should not be sampled for at least one week after well development. See SOP No. 4 for details on monitoring well sampling.
- J) Monitoring wells must be purged prior to sampling. At a minimum, three well volumes should be purged if recharge to the well is sufficient. See SOP No. 4 for details on well purging.

- K) Ground water sampling should be conducted starting with the least contaminated well and end with the most contaminated well.
- L) Monitoring wells installed for the purpose of defining the extent of free product may not need to be sampled. If the site is in an aquifer, sample the well prior to site closure. If the site is not in an aquifer, it may not be necessary to sample the well prior to site closure.
- M) Low- flow purging and sampling may be allowed with prior approval from the department (See SOP 4, Section 8.0).
- N) See Chapter 9.0 for information regarding proper handling and disposal of water from well development, purging, equipment decontamination, and sampling.
- O) When a site is closed, all monitoring wells must be abandoned within 30 days, in accordance with ARSD 74:02:04:69 and 74:02:03:71. Contact the department's Water Rights Program for more information, or for copies of the department's Well Abandonment Form. Notify the department's Inspection, Compliance, and Remediation Program in writing when monitoring wells have been abandoned.

### **6.3 Multiple Sources of Contamination**

The department has developed the following guidance for situations where there are multiple potential sources of contamination at a site. The number of monitoring wells needed should be based on the criteria below; ground water flow direction; and the location of the potential sources of contamination in relation to potential receptors. The number and placement of wells should be determined in consultation with the department's project reviewer.

- A) In general, one monitoring well should be installed in or as close as possible to each potential source of contamination at a site or in the area of worst soil contamination. Potential sources may include tanks, pump islands, and distribution lines.
- B) The actual number of wells for a particular site is subject to a number of factors. In some cases a well installed to monitor ground water near a tank may also serve to monitor ground water near tank piping. A pump island may be located in close proximity to a tank and both may be monitored with the same well. It may also be appropriate to install an additional monitoring well between the most downgradient source and potential receptors. However, if contamination is detected above ground water quality standards, a sufficient number of monitoring wells must be installed to determine the ground water gradient and the location of the leading edge of any free product and/or dissolved phase plume.

### **6.4 Periodic Ground Water Monitoring**

The department has developed general guidelines for responsible parties and their environmental consultants concerning how long ground water monitoring will be required for individual wells. The department has developed these guidelines for several "typical" situations, with the understanding that there will be situations where these guidelines may not apply.

### 6.4.1 Monitoring Upgradient and Side-Gradient Wells

The purpose of this section is to provide general guidance for sampling upgradient and side-gradient monitoring wells. This guidance applies to situations where soil borings and monitoring wells have defined the extent of soil and ground water contamination and there are wells on the site that contain contamination above ground water standards. The following must also be true in order to apply this guidance as written:

- A) Initial ground water samples from perimeter wells were non-detect or below standards for petroleum contamination;
- B) The reviewer is confident that “side-gradient” wells are actually side- gradient, and not downgradient;
- C) The reviewer is confident that the potential for side-gradient wells to become impacted in the future is minimal;
- D) Corrective actions in the contaminated area are unlikely to effect contaminant levels in side-gradient and upgradient wells;
- E) There are no receptors within the contaminant plume (**Note:** If receptors are present within the contaminant plume, modifications to the monitoring plan will be conducted on a case-by-case basis.); and,
- F) There are no in-situ treatment systems operating on the site (if an in-situ treatment system is operating or is installed at the site, see Section 6.4.4 for guidance on ground water monitoring during system operation).

#### General Guidance:

If all of the situations described above are true, the department has the following general guidance for monitoring upgradient and side-gradient wells.

- A) All monitoring wells will be sampled at least twice for all petroleum constituents identified at the site (the initial ground water sample and the first quarterly ground water sample).
- B) Following the first quarterly ground water sampling event (second ground water sample) evaluate results to reduce monitoring frequency and drop unnecessary constituents.
  - 1) Clean (non-detect) upgradient wells may be dropped from the monitoring schedule.
  - 2) Clean (non-detect) side-gradient wells may be reduced to annual monitoring. Consider dropping these wells from the monitoring schedule after the first annual monitoring event (wells will be sampled at least three times before dropping them from the monitoring schedule).

- 3) Upgradient wells with ground water contamination less than standards may be reduced to annual monitoring.
- 4) Side- gradient wells with ground water contamination less than standards may be reduced to semi-annual monitoring.
- 5) Drop unnecessary constituents (see Section 6.4.3).
- 6) Measure water levels in all monitoring wells unless approved by the department.
- 7) No additional reductions in monitoring frequency and/or constituents until the end of one year of quarterly monitoring. However, the monitoring data will be reviewed on a quarterly basis and additional reductions in monitoring frequency and/or constituents may be made on a case-by-case basis.
- 8) If ground water flow direction fluctuates, free product appears, contaminant concentrations show an increasing trend, site conditions change substantially, there is a change in potential receptors, or additional information becomes available, evaluate the monitoring program to determine if previously dropped/reduced wells need to be added to the sampling schedule.

#### **6.4.2 Downgradient Wells and Wells in the Contaminant Plume**

The purpose of this section is to provide general guidance for sampling downgradient wells and wells in the contaminant plume. This guidance applies to situations where soil borings and monitoring wells have defined the extent of soil and ground water contamination and there are wells on the site that contain contamination above ground water standards. The following must also be true in order to apply this guidance as written:

- A) There are no in-situ treatment systems operating on the site (if an in-situ treatment system is operating or is installed at the site, see Section 6.4.4 for guidance on monitoring during system operation); and,
- B) There are no receptors within the contaminant plume. (**Note:** If receptors are present within the contaminant plume, modifications to the monitoring plan will be conducted on a case-by-case basis.)

#### **General Guidance:**

If all of the situations described above are true, the department has the following general guidance for monitoring down-gradient wells and wells in the contaminant plume.

- A) Sample all wells exceeding ground water standards quarterly for a minimum of one year.
- B) Following a year of quarterly monitoring, determine if some of the wells within the contaminant plume may be reduced or dropped (assuming the contaminant concentrations have been steady or decreasing). In general, continue to monitor the following wells:

- 1) The well closest to the source of contamination, or the well that contains the highest contaminant concentrations. If there are multiple sources of contamination, or if the contaminant plume is large, look at the relationship between the location of the sources and the location of potential receptors to determine if one well is sufficient to monitor all sources or if other wells need to be monitored.
- 2) The clean downgradient well(s).
- 3) If the contaminant plume has spread past a potential receptor, like a water line, continue to monitor the well(s) closest to the receptor. In this case, it may be appropriate to reduce the monitoring of the clean downgradient well(s).
- 4) Any well with contaminant concentrations exceeding standards at the time it was dropped from the monitoring schedule must be sampled prior to site closure.
- 5) Any well with contaminant concentrations exceeding standards at the time it was dropped from the monitoring schedule may be sampled prior to inactive closure.
- 6) If ground water flow direction fluctuates, free product appears, contaminant concentrations show an increasing trend, site conditions change substantially, there is a change in potential receptors, or additional information becomes available, evaluate the monitoring program to determine if previously dropped/reduced wells need to be added to the sampling schedule.

### **6.4.3 Unnecessary Constituents**

The purpose of this section is to provide general guidance for situations where more than one petroleum product is likely to be present (i.e. both gasoline and diesel tanks are/were present). This guidance applies to situations where soil borings and monitoring wells have defined the extent of soil and ground water contamination and there are wells on the site that contain contamination above ground water standards.

#### **General Guidance:**

For the initial sampling event and first quarterly monitoring event, analyze the ground water samples for all constituents likely to be present on the site. Evaluate the results of the first two sampling events for unnecessary constituents.

- A) Example 1: Gasoline constituents (TPH- gas, BTEX, MTBE) are present in the well but diesel constituents (TPH-diesel, naphthalene) are non-detect – drop diesel constituents from the monitoring schedule for that well.
- B) Example 2: Gasoline constituents and diesel constituents are both present in the well at concentrations exceeding standards, however, diesel constituents are not significant compared to gasoline constituents – drop diesel constituents from the monitoring schedule for that well.
  - 1) The well must be analyzed for diesel constituents prior to dropping the well from the monitoring schedule or before closure. However, if the

laboratory indicates the diesel range constituents are heavy-end gasoline components it may not be necessary to analyze for TPH-diesel before closure.

- 2) The well may be analyzed for diesel constituents prior to inactive closure.
- C) Example 3: Gasoline constituents and diesel constituents are both present in the well in roughly equal amounts or in significant amounts – analyze samples from the well for both gasoline and diesel constituents.

#### **6.4.4 Ground Water Sampling During Operation of In-Situ Treatment Systems**

Ground water sampling during operation of in-situ treatment systems is typically performed for two reasons ; to evaluate the effectiveness of the treatment system, and to ensure the system is not pushing contamination off-site. The department will determine the appropriate sampling schedule for each monitoring well at these sites. The ground water sampling schedule at sites with in-situ treatment systems will generally not differ from the guidance described in the sections above, however site-specific conditions may require a different schedule.

The department may also require that ground water samples be analyzed for more than petroleum constituents. See Chapter 5 for more information.

#### **6.5 Flooded Screens**

Specify in the monitoring report if the water table is above the top of the screen in each well. The department will determine if the well needs to be replaced. The decision will be based on site conditions, including, but not limited to:

- A) Potential for free-product;
- B) Relative importance of the ground water quality information at that location;
- C) Location of the well relative to potential receptors;
- D) Location of the screened interval relative to the water table;
- E) Location of the screened interval relative to soil contamination;
- F) How long/often the screen is submerged; and,
- G) The permeability and lithology of the soil.

#### **6.6 Direct-Push Wells**

Direct-push wells may be allowed if site (or other) conditions do not allow installation of a standard monitoring well. The responsible party or their environmental consultant must obtain department approval before installing a direct-push well. They must also obtain a variance from the department's Water Rights Program in order to install this type of well. Contact the Water Rights Program at 605-773-3352 for more information.

## **6.7 Quality Assurance/Quality Control Samples**

The department has the following requirements regarding quality assurance/quality control samples for ground water monitoring (See SOP 6 for additional information):

- A) One trip blank in every cooler;
- B) One field duplicate sample at each site or one for every 20 samples at sites with more than 20 wells; and,
- C) One bailer blank per day unless all sites visited on a sampling trip have dedicated bailers.

## **6.8 Damaged Wells**

The department will determine if damaged or destroyed wells need to be replaced. This decision will be based on the relative importance of the ground water quality information at that location.

**Table 6.1 Monitoring Well Installation**

<b>NON-AQUIFER</b> (Section 6.1.1)	<b>AQUIFER</b> (Section 6.1.2)
<b>SOIL CONTAMINATION NOT DETECTED</b> (Section 6.1.1.1)	<b>SOIL CONTAMINATION NOT DETECTED</b> (Section 6.1.2.1)
<i>Wells may not be required; determine if site may be closed</i>	<i>Wells may not be required; determine if site may be closed</i>
<b>SOIL CONTAMINATION REMOVED TO NON-DETECT</b> (Section 6.1.1.1)	<b>SOIL CONTAMINATION REMOVED TO NON-DETECT</b> (Section 6.1.2.1)
<i>Wells may not be required; perform a Tier 2 Assessment if soil contamination exceeded 500 ppm TPH (see Chapter 4)</i>	<i>Wells may not be required; perform a Tier 2 Assessment if soil contamination exceeded 500 ppm TPH (see Chapter 4)</i>
<b>SOIL CONTAMINATION DID NOT EXCEED TIER 1/500 PPM TPH</b> (Section 6.1.1.2)	<b>SOIL CONTAMINATION DID NOT EXCEED TIER 1/500 PPM TPH</b> (Section 6.1.2.2)
<b>No potential for impacts to receptors, no receptors, or proven no impacts to receptors</b>	<b>Ground water not present within 10 feet of soil contamination that exceeds detection limits</b>
<i>Wells may not be required; determine if site may be closed</i>	<i>Wells may not be required; determine if site may be closed</i>
<b>Potential for impacts to receptors</b>	<b>Ground water present within 10 feet of soil contamination that exceeds detection limits</b>
<i>Install monitoring well(s)</i>	<i>Install monitoring well(s)</i>
<b>Free product is present</b>	<b>Free product is present</b>
<i>Begin free product recovery; see Section 5.1.1 for guidance</i>	<i>Begin free product recovery; see Section 5.1.1 for guidance</i>
<b>Free product is not present</b>	<b>Free product is not present</b>
<i>Collect ground water sample</i>	<i>Collect ground water sample</i>
<b>Contamination in ground water not detected</b>	<b>Contamination in ground water not detected</b>
<i>Determine if site may be closed</i>	<i>Determine if site may be closed</i>
<b>Contamination in ground water below stds.</b>	<b>Contamination in ground water below stds.</b>
<i>Determine if site may be closed</i>	<i>Resample in six months; if below standards and not increasing, determine if site may be closed</i>
<b>Contamination in ground water exceeds stds.</b>	<b>Contamination in ground water exceeds stds.</b>
<i>Define extent of ground water contamination; begin quarterly monitoring; implement corrective action and/or RBCA modeling (see Section 4.2.2) if risks to human health or environment</i>	<i>Define extent of ground water contamination; determine if RBCA modeling is required (see Section 4.2.2) begin quarterly monitoring; implement corrective action if risks to human health or environment</i>



**Table 6.2 Monitoring Well Installation**

<b>NON-AQUIFER</b>	<b>AQUIFER</b>
<b>SOIL EXCEEDING TIER 1/500 PPM TPH REMOVED (NOT TO NON-DETECT)</b> (Section 6.1.1.3)	<b>SOIL EXCEEDING TIER 1/500 PPM TPH REMOVED (NOT TO NON-DETECT)</b> (Section 6.1.2.3)
<i>Perform a Tier 2 Assessment if soil contamination exceeded 500 ppm TPH before excavation (see Chapter 4)</i>	<i>Perform a Tier 2 Assessment if soil contamination exceeded 500 ppm TPH before excavation (see Chapter 4)</i>
<b>Ground water was not in contact with soil contamination that exceeded Tier 1/500 ppm TPH</b>	<b>Ground water not present within 10 feet of soil contamination that exceeds detection limits</b>
<b>No potential for impacts to receptors, no receptors, or proven no impacts to receptors</b>	
<i>Wells may not be required; determine if site may be closed</i>	<i>Wells may not be required; determine if site may be closed</i>
<b>Potential for impacts to receptors</b>	
<i>Install monitoring well(s)</i>	
<b>Free product is present</b>	
<i>Begin free product recovery; see Section 5.1.1 for guidance</i>	
<b>Free product is not present</b>	
<i>Collect ground water sample</i>	
<b>Contamination in ground water not detected</b>	
<i>Determine if site may be closed</i>	
<b>Contamination in ground water below stds.</b>	
<i>Determine if site may be closed</i>	

**Table 6.2 Monitoring Well Installation Cont'd**

<b>Contamination in ground water exceeds stds.</b>	
<i>Define extent of ground water contamination; begin quarterly monitoring; implement corrective action and/or RBCA modeling (see Section 4.2.2) if risks to human health or environment</i>	
<b>Ground water was in contact with soil contamination that exceeded Tier 1/500 ppm TPH</b>	<b>Ground water present within 10 feet of soil contamination that exceeds detection limits</b>
<i>Install monitoring well(s)</i>	<i>Install monitoring well(s)</i>
<b>Free product is present</b>	<b>Free product is present</b>
<i>Begin free product recovery; see Section 5.1.1 for guidance</i>	<i>Begin free product recovery; see Section 5.1.1 for guidance</i>
<b>Free product is not present</b>	<b>Free product is not present</b>
<i>Collect ground water sample</i>	<i>Collect ground water sample</i>
<b>Contamination in ground water not detected</b>	<b>Contamination in ground water not detected</b>
<i>Determine if site may be closed</i>	<i>Determine if site may be closed</i>
<b>Contamination in ground water below stds.</b>	<b>Contamination in ground water below stds.</b>
<i>Determine if site may be closed</i>	<i>Resample in six months; if below standards and not increasing, determine if site may be closed</i>
<b>Contamination in ground water exceeds stds.</b>	<b>Contamination in ground water exceeds stds.</b>
<i>Define extent of ground water contamination; begin quarterly monitoring; implement corrective action and/or RBCA modeling (see Section 4.2.2) if risks to human health or environment</i>	<i>Define extent of ground water contamination; determine if RBCA modeling is required (see Section 4.2.2) begin quarterly monitoring; implement corrective action if risks to human health or environment</i>

**Table 6.3 Monitoring Well Installation**

<b>NON-AQUIFER</b>	<b>AQUIFER</b>
<b>SOIL CONTAMINATION EXCEEDING TIER 1/500 PPM TPH PRESENT</b> (Section 6.1.1.4)	<b>SOIL CONTAMINATION EXCEEDING TIER 1/500 PPM TPH PRESENT</b> (Section 6.1.2.4)
<i>Perform a Tier 2 Assessment if soil contamination exceeds 500 ppm TPH (see Chapter 4)</i>	<i>Perform a Tier 2 Assessment if soil contamination exceeds 500 ppm TPH (see Chapter 4)</i>
<i>Perform additional assessment to define extent of soil contamination exceeding Tier 1 Action Levels</i>	<i>Perform additional assessment to define extent of soil contamination exceeding Tier 1 Action Levels</i>
<b>Ground water not in contact with soil contamination exceeding Tier 1/500 ppm TPH</b>	
<b>No potential for impacts to receptors, no receptors, or proven no impacts to receptors</b>	
<b>Site conditions do not suggest free product may be present on ground water</b>	
<i>Wells may not be required; determine if site may be closed</i>	
<b>Site conditions suggest free product may be present on the ground water</b>	
<i>Install monitoring well(s); determine if RBCA modeling is required (see Section 4.2.2)</i>	<i>Install monitoring well(s); determine if RBCA modeling is required (see Section 4.2.2)</i>
<b>Free product is present</b>	<b>Free product is present</b>
<i>Begin free product recovery; see Section 5.1.1 for guidance</i>	<i>Begin free product recovery; see Section 5.1.1 for guidance</i>
<b>Free product is not present</b>	<b>Free product is not present</b>
<i>Collect ground water sample</i>	<i>Collect ground water sample</i>
<b>Contamination in ground water not detected</b>	<b>Contamination in ground water not detected</b>
<i>Determine if site may be closed</i>	<i>Resample in six months; if non-detect, determine if site may be closed</i>
<b>Contamination in ground water below stds.</b>	<b>Contamination in ground water below stds.</b>
<i>Determine if site may be closed or if additional monitoring is required, depending on site conditions</i>	<i>Sample quarterly for one year; if below standards and not increasing, determine if site may be closed</i>
<b>Contamination in ground water exceeds stds.</b>	<b>Contamination in ground water exceeds stds.</b>
<i>Define extent of ground water contamination; begin quarterly monitoring; implement corrective action and/or RBCA modeling (see Section 4.2.2) if risks to human health or environment</i>	<i>Define extent of ground water contamination; begin quarterly monitoring; implement corrective action if risks to human health or environment</i>

**Table 6.3 Monitoring Well Installation Cont'd.**

<b>Potential for impacts to receptors</b>	
<i>Install monitoring well(s); determine if RBCA modeling is required (see Section 4.2.2)</i>	
<b>Free product is present</b>	
<i>Begin free product recovery; see Section 5.1.1 for guidance</i>	
<b>Free product is not present</b>	
<i>Collect a ground water sample</i>	
<b>Contamination in ground water not detected</b>	
<i>Determine if site may be closed</i>	
<b>Contamination in ground water below stds.</b>	
<i>Determine if site may be closed or if additional monitoring is required, depending on site conditions</i>	
<b>Contamination in ground water exceeds stds.</b>	
<i>Define extent of ground water contamination; begin quarterly monitoring; implement corrective action and/or RBCA modeling (see Section 4.2.2) if risks to human health or environment</i>	
<b>Ground water in contact with soil contamination that exceeds Tier 1/500 ppm TPH</b>	
<i>Install monitoring well(s); determine if RBCA modeling is required (see Section 4.2.2)</i>	
<b>Free product is present</b>	
<i>Begin free product recovery; see Section 5.1.1 for guidance</i>	
<b>Free product is not present</b>	
<i>Collect ground water sample</i>	
<b>Contamination in ground water not detected</b>	
<i>Determine if site may be closed</i>	
<b>Contamination in ground water below stds.</b>	
<i>Determine if site may be closed or if additional monitoring is required, depending on site conditions</i>	
<b>Contamination in ground water exceeds stds.</b>	
<i>Define extent of ground water contamination; begin quarterly monitoring; implement corrective action and/or RBCA modeling (see Section 4.2.2) if risks to human health or environment</i>	

Figure 6.1

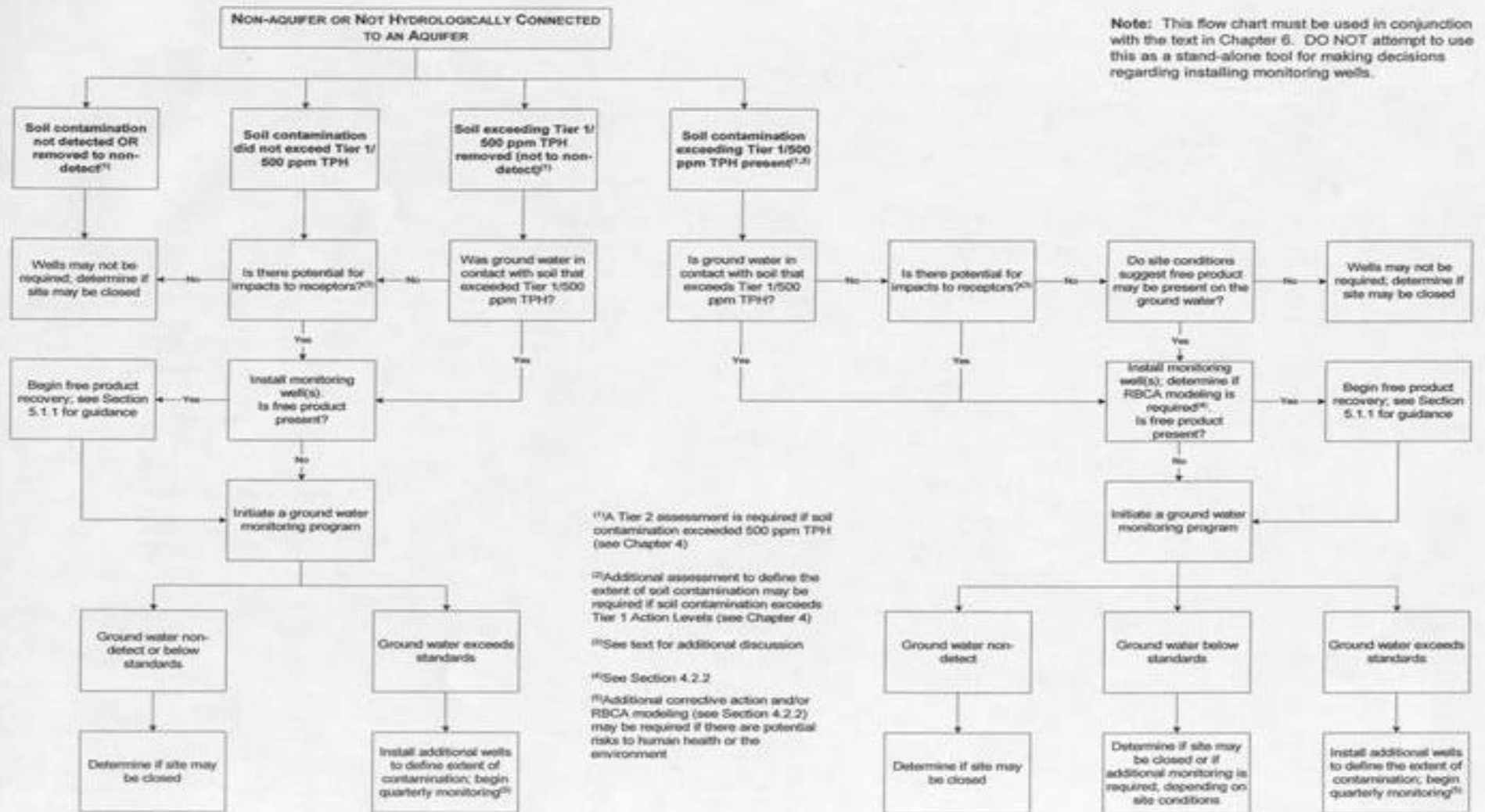
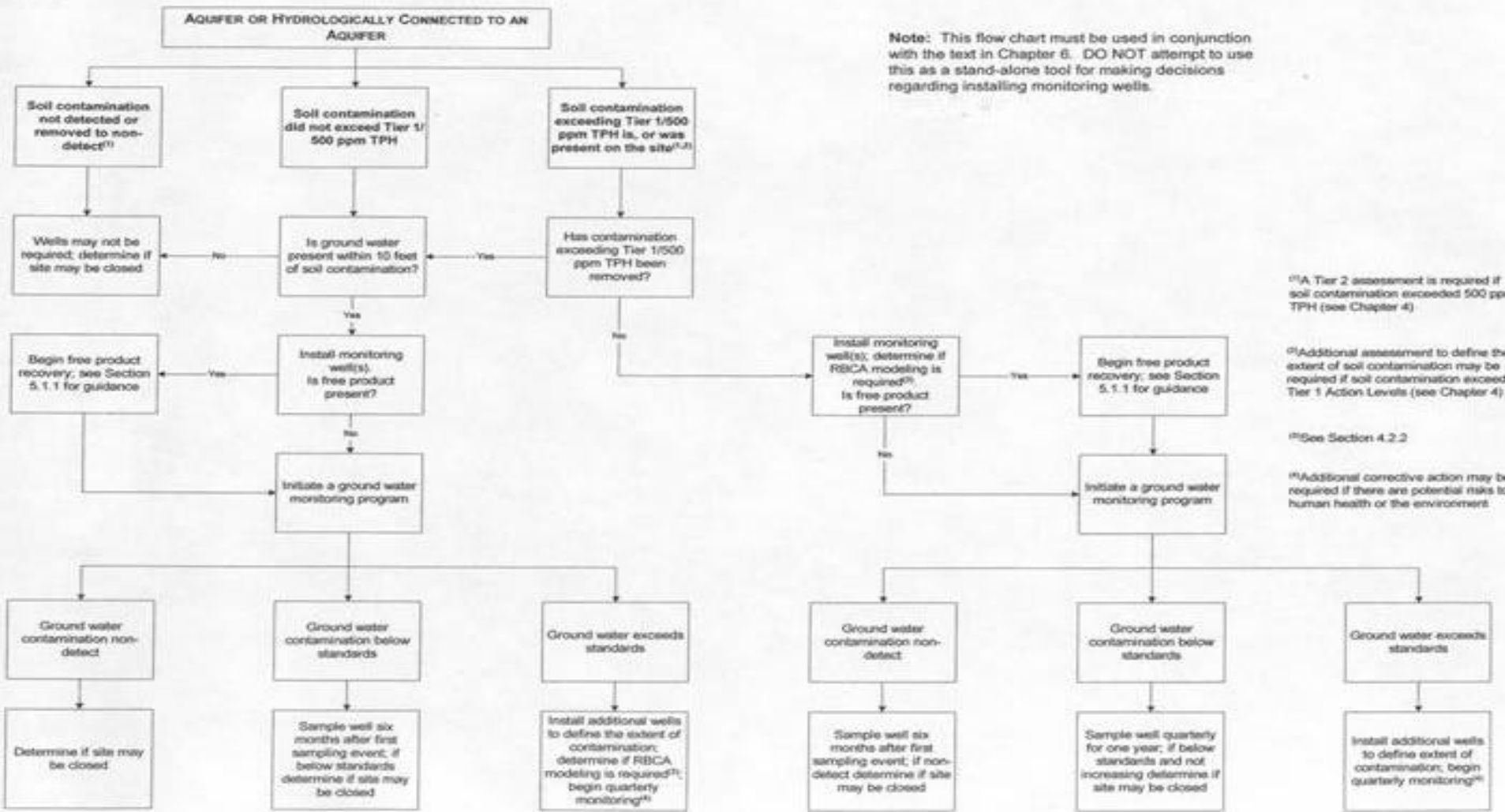


Figure 6.2



Note: This flow chart must be used in conjunction with the text in Chapter 6. DO NOT attempt to use this as a stand-alone tool for making decisions regarding installing monitoring wells.

<sup>(1)</sup>A Tier 2 assessment is required if soil contamination exceeded 500 ppm TPH (see Chapter 4)

<sup>(2)</sup>Additional assessment to define the extent of soil contamination may be required if soil contamination exceeds Tier 1 Action Levels (see Chapter 4)

<sup>(3)</sup>See Section 4.2.2

<sup>(4)</sup>Additional corrective action may be required if there are potential risks to human health or the environment.