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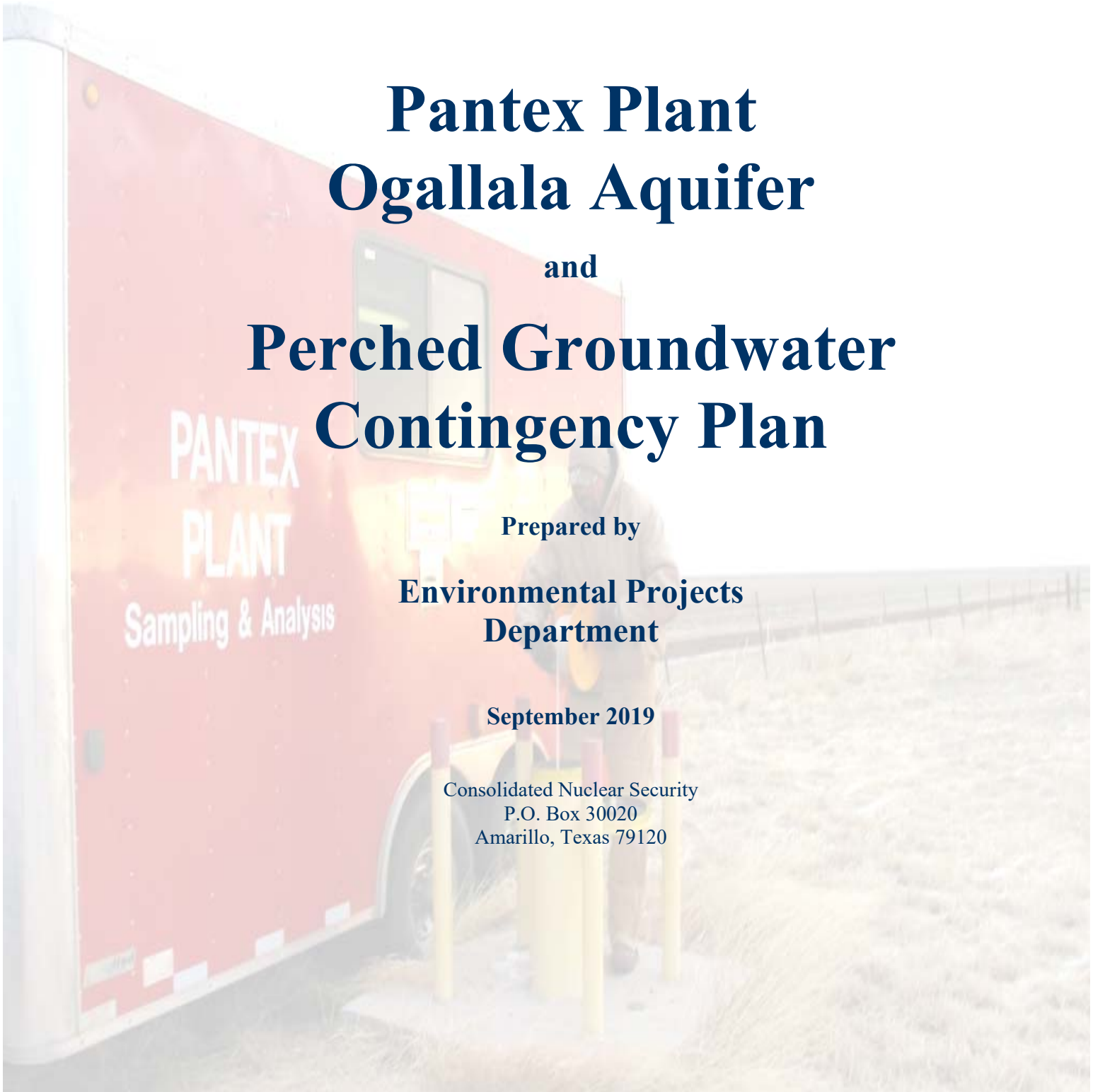

Pantex Plant
Ogallala Aquifer

and

Perched Groundwater
Contingency Plan

Prepared by

Environmental Projects Department

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Consolidated Nuclear Security
P.O. Box 30020
Amarillo, Texas 79120

Executive Summary

The Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan has been developed in accordance with the requirements identified in the:

- *Interagency Agreement for the Pantex Superfund Site, Article 8.5 Work to be Performed,*
- *Compliance Plan Provision of Hazardous Waste Permit No. 50284,* and
- *Record of Decision for Groundwater, Soil, and Associated Media, Pantex Plant.*

A Long Term Monitoring System Design has been designed to monitor conditions in the perched groundwater including changes in the perched aquifer as a result of implementing the response actions. Monitoring is required for verifying the effectiveness of perched groundwater response actions (i.e., conditions in the perched aquifer are being affected as intended) and for confirming that the perched aquifer and Ogallala Aquifer characterization as defined in the Resource Conservation and Recovery Act Facility Investigation Report and the Corrective Measure Studies/Feasibility Study remains accurate. If monitoring results obtained through the monitoring network identify an unexpected condition or deviation, contingent actions will be considered and implemented as necessary to ensure continued protection of the Ogallala Aquifer and human health and the environment.

Potential deviations to expected technology performance may be encountered for each of the four primary response actions that compose the selected remedy for perched groundwater; Playa 1 Pump and Treat System, Southeast Area Pump and Treat System, Southeast Area *In-Situ* Bioremediation System (comprised of the Southeast *In-Situ* Bioremediation System Original System, the Southeast Area *In-Situ* Bioremediation System Extension System, and the planned Offsite *In-Situ* Bioremediation System System), and Zone 11 *In-Situ* Bioremediation System. Monitoring will also be conducted to determine if there are deviations to the expected characterization, e.g., contaminants not expected as a result of the RCRA Facility Investigation characterization. Deviations to expected conditions in the Ogallala Aquifer could also be encountered if the response actions in the perched groundwater are not performing as expected, i.e., preventing contaminants from migrating to the Ogallala Aquifer.

This Plan was developed to identify the contingent action modifications necessary to mitigate impacts to the implemented response actions resulting from deviations to site conditions or response action performance. The Plan defines the environmental problem being addressed by the response actions, clarifies the expected conditions and objectives of the response actions, and identifies the potential deviations to the response actions (due to site conditions or technology performance) that could be encountered. The deviations were evaluated to determine the likelihood of occurrence, potential impact, and time to respond to avoid impact. The Plan also identifies the monitoring outlined in the Long Term Monitoring System Design Report and Sampling Analysis Plan that will be used to detect the deviations. Lastly, the Plan specifies the contingent actions that could be implemented in response to the deviations.

Because each response focuses on a discrete portion of the perched aquifer and contaminant plume, each response action has a different set of expected conditions, and therefore differing impacts from deviations to the site and technology expectations. As a result, the contingent actions are identified for each response action and potential deviation including specific constituents, location, and conditions. If deviations are encountered that impact the ability of the response action to meet performance objectives, the contingent actions will be focused on ensuring the response action can meet the performance objective. Contingent actions may be implemented as interim actions (ISMs/removal actions) in accordance with the Record of Decision, Interagency Agreement, and Hazardous Waste Permit-50284, if warranted by the specific circumstances.

For deviations to site characterization expected conditions, the contingent action will likely focus on determination of the source of the deviation, determination of the appropriate response, and evaluation of additional work to be completed. However, if the deviation to characterization impacts the performance of the response action, the contingent action will again focus on ensuring performance objectives can be met.

Early source term removals and cleanup actions have been implemented to protect the Ogallala Aquifer. Because of these actions and based on modeling results, the expected conditions in the Ogallala Aquifer are that constituents of concern will not be detected above the Groundwater Protection Standards nor will they reach potential points of exposure above the Groundwater Protection Standards. The primary deviation of concern for the Ogallala is if constituents are detected in the Ogallala Aquifer near or above Groundwater Protection Standards. If it occurs, this change in expected conditions would require further evaluation of site and contaminant characteristics to determine an appropriate course of action. The evaluation would include additional monitoring, source identification, implementation of interim protective measures (if necessary), and delineation of extent. These evaluations are necessary to determine an appropriate response action for the Ogallala.

The primary goal of the Plan is to provide for the continued protection of the Ogallala Aquifer and the health of its consumers. In recognition, this Plan presents a flexible and rational approach for making future decisions associated with confirming the change in perched and Ogallala aquifer conditions and response (technical activities, changes to response actions, regulatory oversight, and public involvement).

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Acronyms

AOC	Area of Concern
ATSDR	Agency for Toxic Substances and Disease Registry
Bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CNS	Consolidated Nuclear Security, LLC
CM	Corrective measure
CMS/FS	Corrective Measure Study/Feasibility Study
COCs	Contaminants of Concerns
CR	Chromium
CSMs	Conceptual site models
D and D	Deactivation and decommissioning
DNAPL	Dense non-aqueous phase liquid
DOE	U.S. Department of Energy
EA	Environmental Assessment
EPA	U.S. Environmental Protection Agency
FGZ	Fine-grained zone
FM	Farm-to-Market
GAC	Granular activated carbon
GWPS	Ground Water Protection Standard
HE	High explosive
HCl	Hydrochloric acid
HDPE	High-density polyethylene
IAG	Interagency Agreement
ICMD	Interim Corrective Measure Design
ISB	*In-Situ* Bioremediation System
ISM	Interim Stabilization Measure
LTM	Long-Term Groundwater Monitoring System Design Report
MCL	Maximum Contaminant Level
MRC	Mass Removed Cumulative
MSC	Medium Specific Concentration
NAPL	Non-aqueous phase liquid
NCP	National Contingency Plan
NNSA	National Nuclear Security Administration
NPO	NNSA Production Office
O&M	Operations and maintenance
OSTP	Old Sewage Treatment Plant
P&A	Plugged and abandoned
P1PTS	Playa 1 Pump and Treat System
Ppmv	Parts per million by volume
RAO	Remedial action objectives
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
RFI	RCRA Facility Investigation
RFIR	RCRA Facility Investigation Report
RRS	Risk Reduction Standard
SEISB	Southeast *In-Situ* Bioremediation System
SCFM	Standard cubic foot per minute
SEP/CBP	Solvent evaporation pit/chemical burn pit

SEPTS	Southeast Pump and Treat System
SVE	Soil vapor extraction
SWMU	Solid Waste Management Unit
TCE	Trichloroethylene
TCEQ	Texas Commission on Environmental Quality
TLAP	Texas Land Application Permit
TNRCC	Texas Natural Resources Conservation Commission
VOC	Volatile organic compound
WMG	Waste management group

1. Introduction

1.1 Purpose

The primary purpose of the Pantex Plant Ogallala Aquifer and Perched Groundwater Contingency Plan (Plan) is twofold; first to describe appropriate and immediate contingent actions (i.e., actions taken to compliment response actions) to be taken if unexpected results are identified in the perched groundwater underlying or within the control or responsibility of the U.S. Department of Energy/National Nuclear Security Agency (USDOE/NNSA) Pantex Plant; second, to define the process for responding to the unexpected result of contamination associated with past Pantex releases discovered in the Ogallala Aquifer. The objective of this document is to provide a clear but flexible process for determining the significance and subsequent actions to be taken if unexpected conditions/deviations are identified in the perched groundwater or Ogallala Aquifer. Such actions would be implemented in accordance with applicable regulations, the *Pantex Plant Record of Decision (ROD)*, *Interagency Agreement for the Pantex Superfund Site (IAG),* and the Compliance Plan Provision of *Hazardous Waste Permit No. 50284 (HW-50284)*, as required to protect human health and the environment.

The Pantex Plant has been the focus of defense-related industrial operations since 1942. Historical waste management practices at Pantex included discharges of contaminated wastewater to unlined ditches and playas. These practices resulted in high explosive, solvent, and metal contamination of the subsurface soil and perched groundwater.

In accordance with the ROD, IAG and HW-50284, various regions of the perched groundwater and overlying vadose zone are undergoing active remediation by pump and treat, soil gas extraction, and in-situ bioremediation. The overall goal of the stabilization and remediation measures is to protect the underlying Ogallala Aquifer which is a major water resource for the region.

1.2 Integration with Long Term Groundwater Monitoring System

As part of implementing the selected remedy, a Long-Term Monitoring System Design Report (LTM) has been developed to monitor the effectiveness of the response actions, determine if the perched groundwater plume is being stabilized, provide early detection of constituents in the Ogallala Aquifer, and confirm expected aquifer conditions at locations downgradient of waste management units (both perched groundwater and Ogallala Aquifer). The specific requirements for monitoring are detailed in the Sampling and Analysis Plan (SAP) and the supporting LTM developed for HW-50284 and the IAG. Pantex has established a program to sample, analyze, and review analytical data in accordance with the SAP, HW-50284 and the IAG to ensure that monitoring objectives are met and unexpected conditions are identified.

The Plan has been developed to identify what contingent actions are necessary if unexpected conditions resulting from changes in planned actions or site conditions (technology performance or site characterizations) are encountered during the remediation of the perched groundwater and will cause unacceptable impacts to the ability of the response action to meet performance objectives. The Plan defines the problem being addressed by the response actions, the expected conditions and objective of the response actions and identifies the potential deviations to the response actions. The deviations were evaluated in the Plan to determine the likelihood of occurrence, potential impact, and time to respond to avoid impact. The Plan identifies the monitoring outlined in the SAP to identify deviations. Finally, the Plan specifies the contingent actions that could be implemented in response to the deviations.

The SAP, LTM, and Contingency Plan are interrelated; that is the information collected through implementation of the SAP will be used to determine if a deviation is occurring that would result in the

implementation of a contingent action. The LTM System Design Report will be used during progress evaluations as part of the basis for the expected conditions against which monitoring data will be compared to determine deviations for the systems.

1.3 Regulatory Requirements

Monitoring is required to confirm future expected conditions within the perched groundwater and the Ogallala Aquifer at the Pantex Plant and to determine if the response actions are achieving performance goals and remedial action objectives (RAOs). This Plan was developed in accordance with Article 8.5 of the IAG as part of the Remedial Design (RD) Submittal Package and HW-50284.

1.4 Roles and Responsibilities

The Pantex Plant is owned by the USDOE/NNSA, and managed and operated by Consolidated Nuclear Security, LLC (CNS). The Texas Commission on Environmental Quality (TCEQ) has authority under the Resource Conservation and Recovery Act (RCRA) process; and, the Environmental Protection Agency (EPA) has authority under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). Both TCEQ and EPA reviewed and approved the Plan as a part of the RD Submittal Package. Updates to the plan will be prepared as necessary and will be reviewed and approved by TCEQ and EPA before implementation.

The Agency for Toxic Substances and Disease Registry (ATSDR) is a public health agency that reviews, assesses, and provides information to the public on the effects of hazardous substances at waste sites. The ATSDR has completed a public health assessment for Pantex and will be provided with future information that is substantially different than the basis for the original assessment. Affected off-site landowners are provided monitoring results for wells located on their property.

CNS, as contracted by the USDOE/NNSA, is responsible for implementing all requirements of the Pantex Plant ROD, IAG, and HW-50284, including actions listed in this Plan. The HW-50284 has specific reporting requirements relative to detections of contaminants in the Ogallala Aquifer or if unexpected results are identified in the perched groundwater. These reporting requirements, as well as others, are further presented in Appendices B and C. As contracted by USDOE/NNSA, CNS is also responsible for confirming that training is periodically conducted to ensure readiness and that this Plan is reviewed at least once every five (5) years and updated as needed.

2. Expected Conditions for Perched Aquifer Response Actions

The Plan has been developed to identify contingent actions necessary if unexpected conditions resulting from changes are encountered during the remediation of the perched groundwater that cause unacceptable impacts to the ability of the response action to meet performance objectives; deviations exist for both technology performance and site characterization.

The expected conditions for site characterization are identified in the Pantex Plant RCRA Facility Investigation Reports, Risk Assessment, Corrective Measure Study/Feasibility Study (CMS/FS)[1], and remedial action progress reports. Therefore, this section focuses on identifying the expected conditions of technology performance for each of the response actions. Deviations to these technical expected conditions will impact the ability of the selected groundwater remedy to meet the RAOs defined in the ROD. The RAOs for perched aquifer groundwater are:

- Reduce the risk of exposure to perched groundwater through contact prevention.
- Achieve cleanup standards for the perched groundwater COCs, i.e., restoration of the perched groundwater.
- Prevent growth of perched groundwater contaminant plumes.
- Prevent contaminants from exceeding cleanup standards in the Ogallala Aquifer.

There are four major response actions that were constructed to address the problems identified in the perched groundwater; Playa 1 Pump and Treat System, Southeast Area Pump and Treat System, Southeast Area *In-Situ* Bioremediation System (SEISB) [consisting of the SEISB Original System, Extension System, and planned Offsite System], and Zone 11 *In-Situ* Bioremediation System. The SEISB has been expanded to include two separated extensions needed to address the southeast lobe of the plume, as it has expanded over the past decade. Together, the existing SEISB Extension and the Offsite ISB that will be installed south of Highway 60 comprise the response to expansion of the plume in the southeast area. The response actions are generally located downgradient of Playa 1 and Zones 11 and 12. Each response action was developed to meet one or more of the RAOs. In addition to identifying which RAO the action was developed to address, the function and expected conditions for each system are defined below.

2.1 Playa 1 Pump and Treat System

The function of the Playa 1 Pump and Treat System (P1PTS) is to remove affected perched groundwater in the Playa 1 area and treat it for industrial and/or irrigation reuse. The primary intent of the response action is the removal of water from this area resulting in a gradual decrease in the volume of perched groundwater moving radially from this feature. The response action will also result in a decrease in the volume of perched groundwater moving down gradient (south) towards the Southeast Pump and Treat System. An additional benefit to this action will be a reduction in the head (driving force) for vertical migration of perched groundwater into the fine-grained zone in the Playa 1 area. While some reduction of the mass of contaminants in the perched aquifer will occur through this action, this benefit is secondary to that afforded through reducing the mounded perched groundwater beneath Playa 1. Targeted constituents to be addressed by the treatment system are RDX (*hexahydro-1,3,5-trinitro-1,3,5-triazine*) and its breakdown products, and the other high explosive constituents of concern. The goals of the P1PTS are

[1] Expected conditions for the Pantex Plant soils and groundwater were identified throughout the environmental restoration project in several documents including investigation, risk assessment reports and decision reports. These reports are listed in the *Pantex Plant Site-Wide Proposed Plan.* Annual Progress Reports and 5-Year Review Reports present the current status of effects of remedial actions on the perched groundwater.

consistent with the RAOs of preventing the growth of perched groundwater contaminant plumes and achieving cleanup standards for the perched groundwater.

The primary metric for successful operation of this system is reduction of the mounded water beneath the Playa 1 area and corresponding reduction in the flux of water leaving this region of the perched groundwater moving towards the Southeast Pump and Treat System. Accordingly, perched groundwater thickness is expected to decline at a rate of one to two feet per year from the 2008 perched groundwater potentiometric surface contours during the first five years of implementation and more slowly thereafter. This will be a function of reduced yield from the extraction wells over time. Contaminant concentrations are expected to decrease after five to ten years of operation through treatment of the extracted water; the overall mass of contaminants in the perched aquifer will be reduced as the volume of water decreases. However, the rate of contaminant mass reduction will decrease as the water yield decreases.

The following is a summary of the Playa 1 Pump and Treat System:

Treatment System
(Capacity = 250 gpm or 324,000 gpd/118 million gal/yr at a 90% operational efficiency)

- Granular Activated Carbon
- Boron Ion Exchange (for irrigation quality)

Extraction Wells and Conveyance Lines

- 11 Extraction Wells
- Two miles of conveyance line connecting extraction wells to the treatment units
- Discharge line to the subsurface irrigation holding lagoon

This system and its components are described in detail in the *Construction Completion Report – Playa 1 Perched Aquifer Dewatering Project, December 2008* and *Final Design Basis Document– Playa 1 Perched Aquifer Dewatering Project*, March 2007. The new extraction well (EW-81A) and associated infrastructure is described in updated As-Built Drawings, June 2017.

2.2 Southeast Area Pump and Treat System

The Southeast Pump and Treat System's (SEPTS) function is to remove perched groundwater and treat it for industrial and/or irrigation reuse. The primary intent of the response action is the removal of water from this area resulting in a gradual decrease in the volume of perched groundwater moving down gradient (south) towards the Southeast In-Situ Bioremediation treatment zones. This will achieve two important goals; gradual reduction of the volume of perched groundwater moving downgradient toward the southeast and a reduction in the head (driving force) for vertical migration of perched groundwater into the fine-grained zone in this area. These goals are consistent with the RAO of preventing the growth of perched groundwater contaminant plumes.

The secondary benefit of this action is to reduce the mass of contaminants in the perched aquifer. Targeted constituents to be addressed by the treatment system are RDX and its breakdown products, other high explosive constituents of concern, hexavalent chromium, and volatile organic constituents of concern. Treating the contaminated perched groundwater will attain the RAO of achieving cleanup standards for the perched groundwater contaminants of concerns (COCs), i.e., restoration of the perched groundwater.

Reduction of perched groundwater saturation and contaminant mass are the most important metrics to determine if the system is achieving objectives. Perched groundwater thickness is expected to decline at

an average rate of 0.5 feet per year. Contaminant concentrations remained stable for the first several years following implementation of the final remedy phase of this system; the overall mass of contaminants in the perched aquifer will be reduced as the volume of water decreases. However, the rate of contaminant mass reduction will decrease as the water yield decreases.

The 5-Year Review conducted in 2013 recognized plume expansion east of FM 2373 as a basis for installing extraction wells for pump testing to determine the viability of connecting them to SEPTS for extraction of perched groundwater and ex situ treatment. In 2015/2016, seven wells were installed; six were later connected to SEPTS, and began extraction in 2019. These wells will target removal of perched groundwater moving southeast toward the Southeast ISB Extension, with the goal of eventually reducing the flux of perched groundwater moving offsite.

The following is a summary of the Southeast Area Pump and Treat System:

Treatment System
(Capacity = 300 gpm or 389,000 gpd/142million gal/yr at a 90% operational efficiency)

- Granular Activated Carbon
- Chromium Ion Exchange
- Boron Ion Exchange (for irrigation quality)

Extraction Wells and Conveyance Lines

- 65 Extraction Wells
- Seven miles of conveyance line connecting extraction wells to treatment units
- Discharge lines from the treatment system to:
    - Subsurface irrigation holding lagoon
    - Two injection wells completed into the perched groundwater

This system and its components are described in detail in the *Southeast Pump & Treat Implementation Report, February 2009*, and the SEPTS Treatment System Upgrade As-Built Drawings, June 2016. Final Implementation Report, BOA 70, Release 2 includes details of the installation of extraction wells EW-83, EW-84, EW-87, and EW-88, October 2016.

2.3 Southeast Area In-Situ Bioremediation System

The function of the Southeast Area In-Situ Bioremediation System is to establish an anaerobic biodegradation treatment zone capable of reducing contaminants to drinking water standards, medium specific concentration/maximum containment levels (MCLs/MSCs), by injecting the necessary amendments and nutrients. The primary intent is to reduce the concentration of contaminants in the southeast area of the perched aquifer that is more susceptible to vertical migration, i.e., reduce potential breakthrough to the Ogallala Aquifer. This action is consistent with the RAOs of achieving cleanup standards for the perched groundwater and preventing contaminants from exceeding cleanup standards in the Ogallala Aquifer.

Injection wells were drilled in two areas to intercept water that flows through separate zones and treat it before it flows downgradient of (1) The Southeast Area ISB Original System - an area on Texas Tech property where the fine-grained zone (FGZ) becomes less resistant to vertical migration than beneath the majority of the Pantex Plant, and (2) The Southeast Area ISB Extension - an area east of FM 2373 near Highway 60 that extends southward. Another system, the Offsite ISB System, is being planned for implementation south of Highway 60 to fully address expansion of the perched groundwater plume.

2.3.1 The Southeast Area In-Situ Bioremediation Original System

Based on the current rate of perched groundwater flow and amendment longevity, injections will be necessary about every two years. As perched groundwater has been removed from the subsurface, the frequency of injections and volume of amendment to be injected has gradually decreased and part of the system has dried up. Exceptions for the system is for the system is to dry up and no longer require injections. Targeted constituents for this system are RDX and its breakdown products, other high explosive constituents of concern, and hexavalent chromium.

Reduction of contaminant concentrations in the treatment zone is the most important metric to determine if the system is achieving its objective. RDX (and other high explosives) and hexavalent chromium have been observed to be treated to concentrations below the GWPS in performance monitoring wells more than 200 feet downgradient of the treatment zone in all but one area. The area not indicating treatment is around and immediately up-gradient of PTX06-1153. A molasses amendment will be injected at about 300% of past injection volumes to attempt to achieve treatment in this area.

The following is a summary of the Southeast Area In-Situ Bioremediation System:

Amendment Injection Delivery Trailer

- Designed to allow for transport to other locations for use, as necessary.

Injection Wells and Conveyance System

- 46 Injection Wells (only approximately 23 wells still intercept saturation as a result of effective SEPTS performance over the first decade of remedial action)
- Injection pad, conveyance lines and distribution vaults provided for use in periodic injections

This system and its components are described in the *Final Implementation Report, Southeast Perched Groundwater In-Situ Bioremediation Corrective Measures Design and Construction,* June 2008 and the *Final Design Basis Document – In Situ Bioremediation Corrective Measures Design,* May 2007.

2.3.2 Southeast Area In-Situ Bioremediation System Extension

The Southeast Area In-Situ Bioremediation System Extension was added in 2017/2018 to treat the expanding southeast lobe of contaminated perched groundwater moving offsite to the southeast. Its function is to establish an anaerobic biodegradation treatment zone capable of reducing contaminants to drinking water standards (MCLs/MSCs) by injecting the necessary amendments and nutrients along the southern property boundary, east of FM 2373. The primary intent is to reduce the concentration of contaminants in the southeast area of the perched aquifer moving laterally to the south of Highway 60 through what appears to be interbedded paleo-channels. To fully address this expanding area of the plume, additional treatment will be installed offsite to the south when access is established with the neighboring landowner for this purpose. This action is consistent with the RAOs of achieving cleanup standards for the perched groundwater and preventing contaminants from exceeding cleanup standards in the Ogallala Aquifer.

Twenty-five injection wells were drilled in a line alone the southern property boundary to intercept water that flows through this zone and treat it before it moves offsite. Based on the current rate of perched groundwater flow and amendment longevity, injections will be necessary about every nine months. As perched groundwater is removed from the subsurface, the frequency of injections and volume of amendment to be injected should gradually decrease. Targeted constituents for this system are RDX and its breakdown products and other high explosive constituents of concern.

Reduction of contaminant concentrations in the treatment zone is the most important metric to determine if the system is achieving its objective. RDX (and other high explosives) in and 400 feet downgradient of the treatment zone are expected to meet cleanup standards within two or three years of implementation. Residual concentrations of breakdown products may persist, but should also be treated resulting in declining concentration trends within five years of implementation.

The following is a summary of the Southeast Area In-Situ Bioremediation System Extension:

Amendment Injection Delivery Trailer
- Designed to allow for transport to other locations for use, as necessary.

Injection Wells and Conveyance System
- 25 Injection Wells
- Injection pad provided for use in periodic injections

This system and its components are described in the *Final Implementation Report, BOA 70, Release 5, March 2018*, and the *Final Implementation Report, Southeast In-Situ Bioremediation Expansion, August 2019*.

2.3.3 Off-Site In-Situ Bioremediation System

The contaminants RDX and DNT4A, have now moved into the southeast lobe of the perched groundwater plume to an area beneath a neighboring landowner's property south of Highway 60. Concentrations exceed groundwater protection standards (GWPSs) and, therefore, further active treatment is needed. A conceptual design for this system is being planned to extend the Southeast ISB into this new area for treatment. Modeling simulations are being performed to aid in determining the scale of the system required and estimate the time needed to attain GWPSs.

The following is a summary of the estimated Off-Site In-Situ Bioremediation System:

Amendment Injection Delivery Trailer
- Designed to allow for transport to other locations for use, as necessary.

Infrastructure
- Electrical Service Drops from Existing Overhead Transmission Lines South of Highway 60
- Temporary Roads for ingress and egress
- Perched groundwater extraction wells (~ 40) and conveyance piping to supply water for mixing amendment to inject and aid in distributing the amendment

Injection Wells and Conveyance System
- ~ 50 Injection Wells
- Injection pads provided for use in periodic injections

2.4 Zone 11 In-Situ Bioremediation System

The objective of the Zone 11 In-Situ Bioremediation System is to establish an anaerobic biodegradation treatment zone capable of reducing contaminants to drinking water standards (MCLs/MSCs) by injecting the necessary amendments and nutrients. The primary intent is to reduce the highest concentration of

contaminants in the perched groundwater underlying Zone 11. This action is consistent with the RAO of achieving cleanup standards for the perched groundwater.

The injection wells were installed in a line perpendicular to the gradient so water flowing through this zone will be treated before it reaches the area beneath Texas Tech property near Playa 4. Based on the current rate of perched groundwater flow and amendment longevity, injections will be necessary about every year. Targeted constituents for this system are perchlorate, trichloroethene (TCE) (and its breakdown product)s, and RDX (and its breakdown products).

Reduction of contaminant concentrations in the treatment zone is the most important metric to determine if the system is achieving its objective. TCE and perchlorate are expected to be treated within about 200 feet of the treatment zone to cleanup standards within two years of implementation. Residual concentrations of TCE breakdown products persist, but can also be treated resulting in declining concentration trends. TCE and its breakdown products are recalcitrant and several modifications have been made to expand the treatment zone.

1) 20 injection wells were added in 2014 to expand the system to the west.
2) The treatment zone was biologically augmented with a culture of dehaloccoides (DHC) in 2016.
3) Dose response monitoring was performed in 2018 leading to changing the amendment to molasses, a much more soluble option, and increasing the injection volume approximately three-fold to improve distribution.

The following is a summary of the Zone 11 In-Situ Bioremediation System:

Amendment Injection System

- The Amendment Injection Delivery Trailer constructed for the Southeast Area ISB System will be used to inject amendments into the Zone 11 ISB injection wells.

Injection Wells and Conveyance System

- 52 Injection Wells
- Two injection pads and connection hoses will be used for periodic injections

This system and its components are described in the *Design Basis Document, In-Situ Bioremediation Corrective Measure Design, November 2008*, *Final Implementation Report, BOA 52, Release 4, December 2014*, and *Post Injection Report*, *November 2016*.

3. Process for Identifying Potential Deviations

Potential deviations may be encountered for each of the response actions that compose the selected remedy for perched groundwater, resulting from performance or characterization uncertainties. Deviations could also be encountered in the Ogallala if the response actions are not meeting the expected condition of protecting the Ogallala Aquifer.

Monitoring is important for confirming the effectiveness of perched groundwater response actions, for monitoring for uncertainties defined in the RCRA Facility Investigation (RFI) and CMS/FS, and for confirming future expected conditions within the perched groundwater and Ogallala Aquifer. If monitoring results obtained through the monitoring network identify an unexpected condition or deviation, contingent actions will be considered and implemented (if necessary) to ensure continued protection of the Ogallala Aquifer and human health and the environment.

Figure 3.1 provides an overview of the process that will be followed to validate the monitoring data to determine whether deviations have been identified during the monitoring process. The process consists of monitoring, evaluation of monitoring data, identification of deviations, then determination of whether contingency actions are needed. Appendices A, B, and C describe the validation process that will be used to evaluate the data and the administrative actions required for notification if unexpected conditions are found.

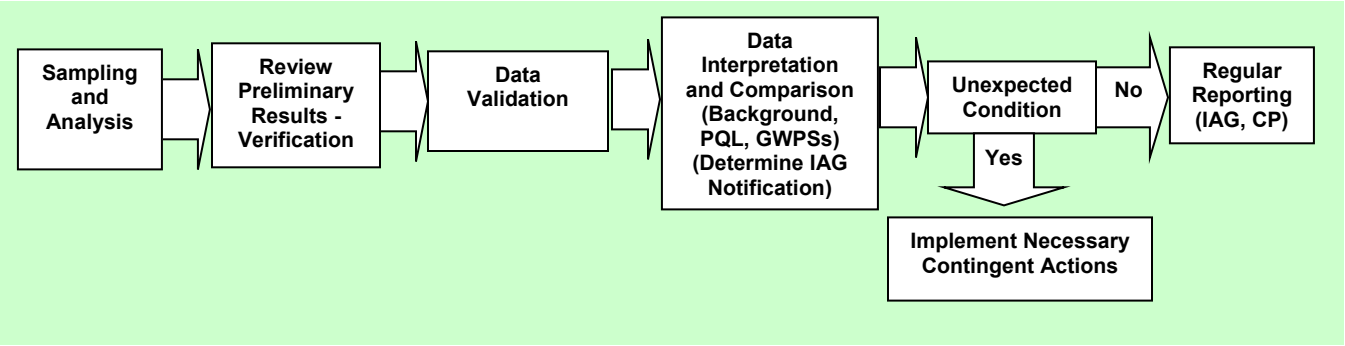

Figure 3-1 Flowchart of Groundwater Data Review Process

3.1 Perched Groundwater Monitoring Well Network

Key objectives evaluated by the perched groundwater monitoring network are plume stability, response action effectiveness, and uncertainty management. These objectives were selected because they will provide the best indicators to determine if the selected remedy is achieving RAOs.

In the LTM, the monitoring wells were assigned an objective (plume stability, response action effectiveness, and uncertainty management wells) to ensure the system was designed with enough wells to provide information for each objective. However, each type of monitoring well (regardless of classification) will be able to provide information to determine if the four remedial action systems are achieving specific performance objectives, resulting in overall RAOs for the selected remedy being achieved. In the event deviations are discovered through the perched groundwater monitoring system, contingent actions will be implemented based on a thorough examination (including location, nature and extent of the event and the potential impact on public health, safety and the environment) and evaluation of the deviation. Results of evaluation will be utilized to determine potential consequences and establish

logical, rational steps needed to respond, mitigate, and implement the appropriate contingent action in conjunction with the requirements of the ROD and HW-50284.

Another important role of the information collected from the monitoring wells is to determine if contaminants are being detected in areas where they are not expected based on the RFI. These results could indicate the problems have not been accurately defined, the extent of contamination may be larger than expected and additional investigations may be necessary to determine the appropriate response to the newly discovered contamination. This monitoring will be conducted for uncertainty management purposes, to determine if uncertain conditions (as defined in the RFIs) are occurring. Figure 3-2 depicts the perched groundwater monitoring network well locations and objectives.

3.1.1 Perched Groundwater Remedy System Interactions

As described in Section 2, the four components of the selected remedy for perched groundwater are intended to work together to create conditions that both stabilize and cleanup the contaminants. The pump and treat systems in the southeast perched groundwater and the Playa 1 area focus on the hydraulics of the system, that is groundwater removal as a means of reducing the potential for both vertical and lateral migration of contaminants. With this understanding, the primary metric for success of the pump and treat systems is perched groundwater thickness, as determined through periodic water level measurements. Routine monitoring for this parameter will provide the basis for determining flow direction, gradient, and thickness. These determinations will aid the prediction of plume movement and rate, as well as vertical flux of contaminants. A secondary benefit of the pump and treat systems is contaminant mass removal. Therefore, chemical analysis is also important as it allows the risk posed by the contaminant plumes to be evaluated periodically.

The Southeast Area and Zone 11 *in-situ* treatment systems target contaminant mass removal as a means of cleaning up the perched groundwater and protecting the underlying Ogallala Aquifer from future degradation that could affect its use as a drinking water source. These systems are downgradient of the perched groundwater plumes, in the areas that pose the greatest potential for vertical migration to the Ogallala Aquifer. Chemical analysis and parameters associated with oxidation/reduction (redox) potential of the perched groundwater will provide the most important information for determining the effectiveness of these systems. Figure 3-3 depicts how the components work together in the southeast area to achieve the RAOs.

3.2 Ogallala Monitoring Well Network

The Ogallala Aquifer will be monitored according to the SAP. Early detection monitoring is important for ongoing confirmation of the effectiveness of perched groundwater response measures and monitoring for uncertainties defined in the CMS/FS and ROD. If monitoring results obtained through the implementation of the SAP will be evaluated within the context of the LTM System Design Report to identify an unexpected condition, actions will be considered and implemented, as necessary, to ensure continued protection of the Aquifer and human health and the environment.

The purpose of monitoring wells in the Ogallala Aquifer is to confirm expected conditions identified in the RFIs, fill potential data gaps, and fulfill long-term monitoring requirements for soil units closed to RRS 3 under the Texas Risk Reduction Rules (30 TAC 335 Subchapter S). The wells will also be used to identify breakthrough of constituents to the Ogallala Aquifer from overlying perched groundwater, where present, or potential source areas in the unsaturated zone before potential points of exposure have been impacted. As was the case for the perched monitoring network wells, the Ogallala monitoring wells were assigned objectives in the LTM System Design Report. These objectives were early detection and

uncertainty management. However, the information from either category of well can be used to determine if expected conditions are not being met. Figure 3-4 shows the locations of the Ogallala Aquifer monitoring network wells and identifies the objectives of each.

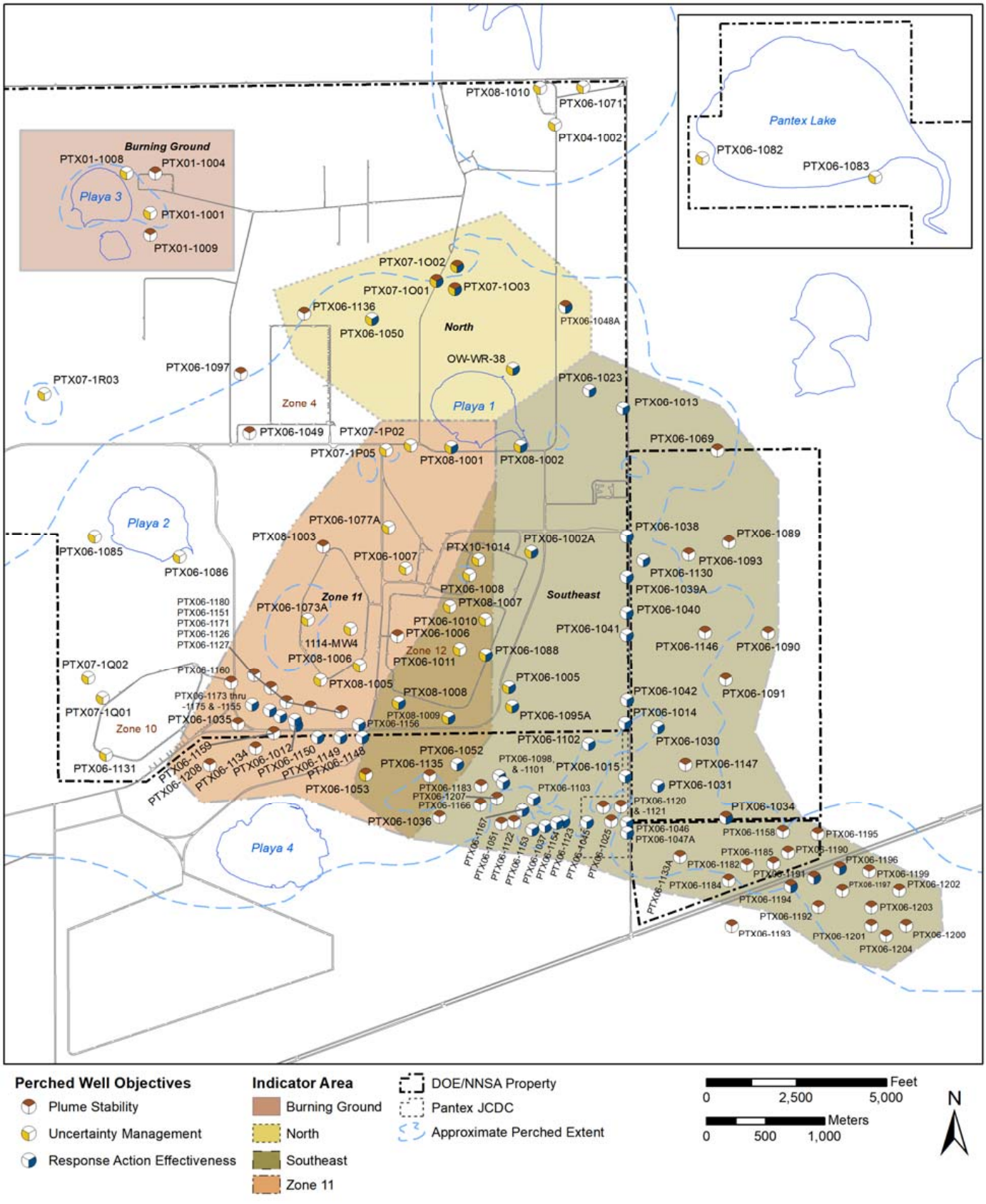

Figure 3-2. Perched Groundwater Monitoring Wells

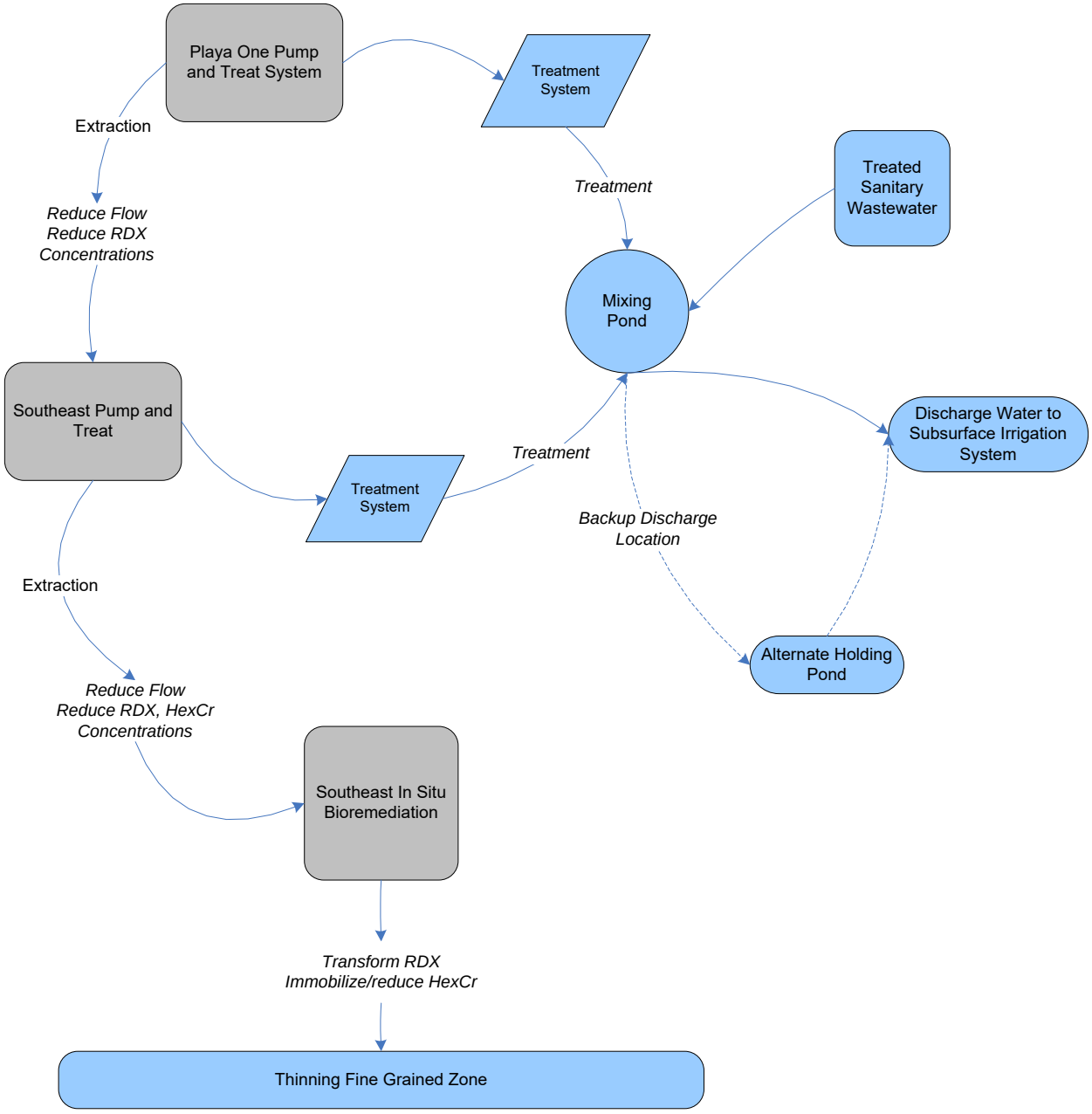

Figure 3-3. Southeast Area Remedies System Interaction

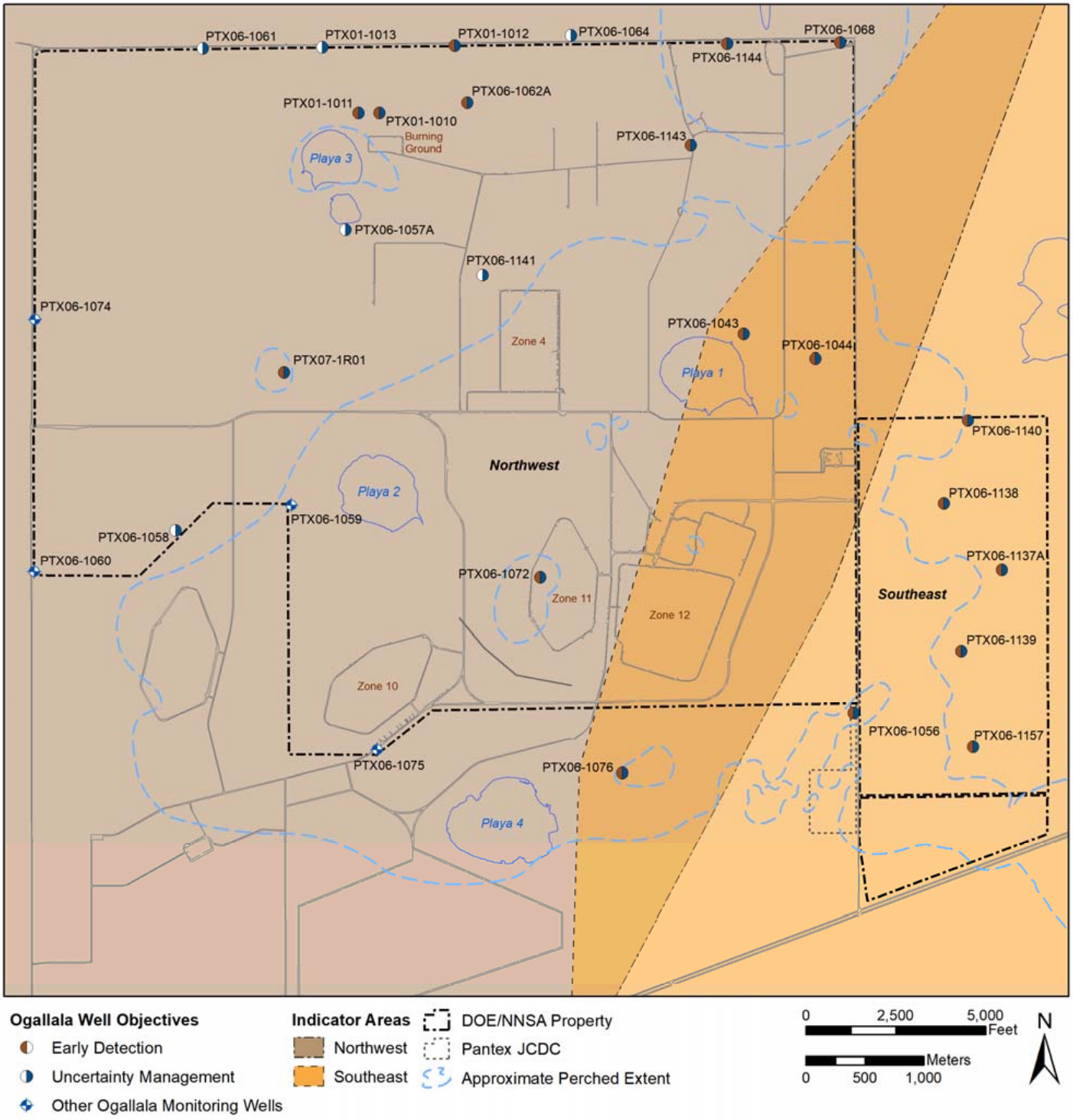

Figure 3-4. Ogallala Aquifer Monitoring Wells

4. Potential Deviations

Potential deviations differ for each of the four primary remediation system components, as does the impact, likelihood of occurrence, and time to respond for each deviation. These parameters were used to provide an evaluation of each deviation. Impact is defined as the impact the deviation would have on meeting the performance objectives of the remedy and/or the impact to achieving the overall RAOs. Time to respond is based on the timeframe from when the deviation is detected to when the impact would be incurred if a contingent action is not implemented to respond to the deviation.

This section identifies the technological deviations that could be encountered for each of the remediation systems and provides an evaluation of the deviations against the four parameters defined above. The evaluation also will include the type of monitoring data that will be used to determine if the deviation is occurring.

The perched monitoring network is also monitoring the perched groundwater to confirm expectations of site characterization. Deviations from site characterization expectations could be encountered in the monitoring wells; the results will be evaluated to determine the effect. The characterization deviations could impact the operation of the response actions, but more than likely will indicate the existence of a new problem.

Deviations also exist for the Ogallala Aquifer, specifically, constituents detected by the monitoring network that are approaching or above GWPS. As further discussed in Section 6, the actions taken for the Ogallala Aquifer will differ from the perched groundwater because active remediation systems are not a necessary part of the selected remedy.

4.1 Playa 1 Pump and Treat System

The system could encounter two major types of technical deviations; deviations related to pumping and extraction and deviations related to treatment and discharge of extracted water.

Pumping and Extraction Deviations

As described in Section 2, it is expected that the P1PTS will remove the mounded perched groundwater beneath Playa 1 in sufficient volume to decrease the flux of groundwater moving radially out from the Playa 1 area. Removing the water will also reduce the flux of groundwater moving to the SEPTS and the head that is causing vertical migration to the Ogallala Aquifer. This is possible because infiltration to the perched is negligible.

The main deviation related to this expected condition is that the mounding beneath Playa 1 is not reduced because the rate of infiltration is much greater than expected. This condition will be detected by monitoring water levels in the perched monitoring wells identified in the SAP. Also, if the deviation were to occur, the gradient of water moving towards the SEPTS will not decline, as expected. Thus far, P1PTS has effectively reduced the mound of perched groundwater beneath Playa 1. From 2017 to 2019, treated water commingled with the effluent from the wastewater treatment facility has been continually discharged to Playa 1. The portion of this flow not lost to evapotranspiration resulted in recharge to the perched aquifer. The time to respond to the deviation is approximately five to ten years; in the short term (within five years) the inability to reduce flux will not impact the overall ability of the SE Pump and Treat and ISB systems to meet the RAOs. If the mounding persists for over five years, the SE Pump and Treat and ISB systems will be unable to meet the goal of restoration if the deviation is not addressed. The likelihood of the deviation occurring is low.

It is expected that by extracting groundwater contaminated with RDX, RDX mass removal will also be accomplished. Since new sources of RDX are not expected and mass is being removed, the RDX concentration is expected to decrease in the Playa 1 area. As more water is removed, it is also expected that the rate of RDX mass removal will decrease, primarily due to decreasing saturated thickness of the perched aquifer. The main deviation is that perchlorate was observed at levels exceeding the GWPS in the area southwest of Playa 1, which is closest to the migrating perchlorate plume. Although perchlorate has not been detected in the P1PTS influent since the start of remedial action, monitoring will be performed at the extraction wellhead annually, and will be performed upstream of the treatment system monthly. The time to respond to the deviation is moderate (two years) as the impacted extraction well will need to be taken offline or extraction rates will need to be modified until the treatment system can be modified to address perchlorate and continue to meet discharge requirements. This will have a low impact on overall extraction rates; the likelihood of this deviation occurring is low.

Treatment and Discharge Deviations

It is expected that the extracted groundwater will contain RDX. Treatment to remove RDX will require granular activated carbon (GAC). Boron is also treated via selective ion exchange. COCs requiring treatment other than GAC are not expected. The previously identified deviation of perchlorate entering the treatment system at levels in excess of the GWPS appears to be unfounded, as the perchlorate plume has receded back to a region of the perched aquifer beneath the northeastern area of Zone 11.

The expected condition for the treated water is that it will meet the GWPS downstream of the holding pond noted in the Texas Land Application Permit (TLAP) permit and will be discharged to the soil via subsurface irrigation. It is expected the volume of discharge water will not exceed evapotranspiration rates, preventing any deep percolation into the underlying vadose zone. Treated sewage effluent will also discharge to the holding pond noted in the TLAP permit, mixing with the treated water from Playa 1 Pump and Treat prior to discharge to the subsurface irrigation system. A deviation would occur if discharge to the subsurface irrigation exceeds evapotranspiration rates. Soil borings would be used to determine if discharged water is infiltrating the vadose at a rate greater than expected. The response time for this deviation is one month for changes to discharge methods and extraction rates, two years for changes to high demand crops at the subsurface irrigation system. The impact of this deviation is medium.

4.2 Southeast Area Pump and Treat System

The system could encounter two major types of technical deviations; deviations related to pumping and extraction and deviations related to treatment and discharge of extracted water.

Pumping and Extraction Deviations

It is expected that the SEPTS will remove perched groundwater in the southeast area in sufficient volume to decrease the flux of groundwater moving towards the Southeast In Situ Bioremediation (SEISB) [Original and Extension Systems]. This will also reduce the head, reducing the potential for vertical migration to the Ogallala Aquifer. Perched groundwater will be removed in sufficient volume such that the RDX and chromium plumes are stabilized and the contaminant center of mass is not moving. This is possible because infiltration to the perched is negligible and the Playa 1 Pump and Treat system is decreasing the flow to the southeast area. There are three deviations to the above expected conditions

1. The Playa 1 Pump and Treat System does not remove sufficient flow and the SEPTS is overloaded. Monitoring of the Playa 1 Pump and Treat performance will determine if the

deviation is occurring. The time to respond to this deviation is less than two years and the impact is high because the SEISB [Original and/or Extension System] will require modification if the lateral flux is not sufficiently reduced by the pump and treat systems. The likelihood of the deviation occurring is low, as supported through observations during the first decade of remedial action.

2. Infiltration from the SWMU 5-12 Ditch is greater than expected and the SEPTS is overloaded and cannot sufficiently reduce lateral flux. Potentiometric surface measurements will be collected from wells PTX06-EW 1 thru EW68 and perched MWs adjacent the system and along and east of FM 2373 to determine if the deviation is occurring. The time to respond to the deviation is less than two years and the impact is high because the SEISB [Original and/or Extension System] will require modification if the lateral flux is not sufficiently reduced by the pump and treat systems. The likelihood of the deviation occurring is low, as supported through observations during the first decade of remedial action.

3. The subsurface irrigation system fails which requires injection of treated water into the SEPTS area. Monitoring of the subsurface irrigation performance will determine if the deviation is occurring. The time to respond to this deviation is less than two years and the impact is high because the SEISB [Original and/or Extension System] will require modification if the lateral flux is not sufficiently reduced by the pump and treat systems. The likelihood of the deviation occurring is moderate, as components of the filter bank failed in 2017 and the subsurface irrigation is just now being restarted.

It is expected that by extracting groundwater contaminated with RDX and chromium, RDX and chromium mass removal will also be accomplished. Since new sources of RDX and chromium are not expected and mass is being removed, the RDX and chromium concentrations are expected to decrease in the SE area over several decades. Yield from the perched should decline as extraction continues, and this impact will first be seen in the southern wells in less than five years. The decreased yield will cause the RDX and chromium mass removal rate to decrease. The main deviation is that perchlorate is present at levels that exceed its GWPS. Perchlorate will likely first be detected in the extraction wells PTX06-EW9, EW-10, EW-15, and EW-51 which are closest to the perchlorate plume migrating from Zone 11. Monitoring will be performed at the extraction wellhead annually and will be performed upstream of the treatment system annually, as well. The time to respond to the deviation is short (less than six months) because the impacted extraction well(s) will need to be taken offline or extraction rates will need to be modified until the treatment system can be modified to address perchlorate and continue to meet discharge requirements. This will have a high impact because the extraction wells that would first encounter perchlorate from Zone 11 are used to stabilize the chromium plume and should not be taken offline for an extended period. This deviation began in 2017 and influent concentrations have not yet exceeded the GWPS, so contingency actions have not been implemented.

Another deviation could be that extraction east of FM 2373 is unable to reduce flow to the southeast toward the Southeast ISB Extension. If estimated flux of perched toward the south property boundary does not decrease, another extraction well may be needed east of PTX06-EW88. The time to respond to this deviation will be two years or less.

Treatment and Discharge Deviations

It is expected that the extracted groundwater will contain RDX. Treatment to remove RDX will require GAC. Boron is also treated via selective ion exchange. COCs requiring treatment other than GAC are not expected. The deviation could develop that perchlorate is detected in the extracted water at levels that exceed the GWPS. Perchlorate is monitored at the extraction wells annually and upstream of the treatment system twice a month. If perchlorate is detected, the time to respond is short (a year) and the

impact would be high if the discharge permit (TLAP) limits are exceeded. This deviation is occurring as was predicted and the contingent action of perchlorate treatment is being planned.

The expected condition for the treated water is that it will meet discharge criteria downstream of the holding pond noted in the TLAP permit and will be discharged to the soil via subsurface irrigation; the volume of discharged water should not exceed evapotranspiration rates, preventing any deep percolation into the underlying vadose zone. Treated sewage effluent will also discharge to the holding pond noted in the TLAP permit, mixing with the treated water from Playa 1 Pump and Treat prior to discharge to the subsurface irrigation system. Discharge to the subsurface irrigation could exceed evapo-transpiration rates. Soil borings would be used to determine if discharged water is infiltrating into the vadose at a rate greater than expected. The response time for this deviation is one month for changes to discharge methods and extraction rates, but one year for changes to high demand crops at the subsurface irrigation system. The impact of this deviation is medium.

4.3 Southeast Area In-Situ Bioremediation System

This system is comprised of two existing separated installations (the Original SEISB and the SEISB Extension) and a planned Offsite ISB. The system could encounter two major types of deviations; deviations related to the treatment zone and deviations related to the effectiveness of treatment.

Treatment Zone Uncertainties

As described in Section 2, the SEISB will establish an anaerobic treatment zone on the southeast edge of the perched aquifer susceptible to vertical migration that will treat/transform RDX and hexavalent chromium to drinking water standards. The volume of water moving into the area will have been reduced by the Playa 1 and Southeast Pump and Treat Systems so the treatment zone will be easier to maintain, e.g., less water makes the zone easier to maintain and allows for greater confidence that the ISB will provide protection to the Ogallala. However, there are three deviations to the expected conditions:

1. The treatment zone cannot be maintained because the volume of water in the area is greater than expected because the upstream Pump and Treat Systems are not meeting expected conditions to reduce lateral flux. The deviations will be detected by evaluating the potentiometric surface measurements from the monitoring wells upstream of the treatment zone to calculate the treatment zone area and the flow gradient. The time to respond would be approximately two years. The deviation would have a high impact on the resources necessary to establish the treatment zone because additional amendment injections would be necessary more frequently. The likelihood of the deviation occurring is low, as supported by the expected decreasing water levels in the vicinity.

2. Injection wells that are currently dry (to the west and east of the original system) become saturated and require injections to maintain the treatment zone. The deviation will be detected by collecting information about water levels in the dry monitoring wells twice a year. The time to respond to the deviation is one year. The overall impact will be low as the newly saturated wells would require injection of amendment to expand the treatment zone. There is a low likelihood of this deviation occurring.

3. The treatment zone cannot be maintained due to biofouling, resulting in the amendment not being distributed effectively. Biofouling could result from plugged injection wells or the pore spaces become plugged in the geologic formation. The deviation will be detected for injection wells if the extraction rates for sampling the wells decrease and/or the injection rates decrease substantially from baseline conditions. If injection rates decrease enough that the amendment

cannot be distributed adequately to maintain the treatment zone, the ineffective wells will need to be replaced. There is a medium probability that this could occur and some evidence of it has been observed in recent years. If the geologic formation is plugged, the potentiometric surface upstream of the injection wells will rise; this phenomenon has not been observed. The time to respond to the deviation is approximately one year. The overall impact will be high because it would result in ineffective distribution of the amendment and would hinder maintenance of the treatment zone. There is a medium likelihood of this deviation occurring.

Treatment Uncertainties

It is expected that the Southeast ISB will treat/transform RDX (and other high explosive compounds) and hexavalent chromium (and other COCs) to the cleanup standards in the perched groundwater in and downgradient of the anaerobic treatment zone. With changing redox conditions, it is expected there will be a temporary elevation of the metals concentrations in the treatment zone following the amendment injection (up to two years). However, metals concentrations are expected to meet cleanup standards downstream of the treatment zone in the long term (within four years) where measurements will be collected by sampling the monitoring wells. It is also expected the concentration of RDX breakdown products will increase in the treatment zone in the short term (up to a year) following the injection of amendment as a result of the breakdown of RDX. These levels will also decrease and will meet cleanup standards downstream of the treatment zone. The expected conditions also include encountering low levels (four times the drinking water standard) of TCE and TCE breakdown products in the treatment zone.

There are three deviations to the expected conditions for the treatment at the SEISB system:

1. RDX and/or breakdown products are not treated to cleanup standards downstream of the treatment zone. The deviation will be detected by collecting contaminant concentration information from the monitoring wells that are located downstream of the treatment zone and are monitored twice a year. The time to respond to the deviation is less than two years and the overall impact of the deviation is high because the RDX above groundwater protection standards could migrate to the Ogallala aquifer. The likelihood of the deviation occurring is low.

2. Cr and other metals are not reduced to cleanup standards downstream of the treatment zone. The deviation will be detected by collecting contaminant concentration information from the monitoring wells downstream of the treatment zone twice a year. The time to respond to the deviation is two years. The overall impact of the deviation is high because it will impact the ability of the system to meet restoration goals to reduce the levels of hexavalent chromium, which could eventually reach the Ogallala Aquifer if it is not treated. There is a medium likelihood of this deviation occurring.

3. TCE and breakdown products are encountered at concentrations higher than expected. The deviation will be detected by collecting information from the monitoring wells downstream of the treatment zone twice a year. The time to respond to the deviation is two years. The overall impact of the deviation is medium because it could impact the ability of the system to meet restoration goals to reduce the levels of TCE and its breakdown products which could eventually reach the Ogallala Aquifer if they are not treated. There is a low likelihood of this deviation occurring.

4.4 Zone 11 In-Situ Bioremediation System

The system could encounter two major types of deviations; deviations related to the treatment zone and deviations related to the effectiveness of treatment.

Treatment Zone Uncertainties

As described in Section two, the Zone 11 In-Situ Bioremediation System (Zone 11 ISB) will establish an anaerobic treatment zone in the perched aquifer on the edge of Zone 11 in the area of high TCE and perchlorate concentrations to treat/transform TCE and perchlorate to meet drinking water standards. However, there are two deviations to the expected conditions:

1. The treatment zone cannot be maintained because the volume of water in the area is greater than expected. This deviation will be detected by evaluation of the potentiometric surface measurements from the monitoring wells upstream of the treatment zone to calculate the treatment zone area and the flow gradient. The time to respond would be approximately three years. The deviation would have a high impact on the resources necessary to establish the treatment zone because additional amendment injections would be necessary more frequently. The likelihood of the deviation occurring is low.

2. The treatment zone cannot be maintained due to biofouling, resulting in the amendment not being distributed effectively. Biofouling could result from plugged injection wells or the pore spaces become plugged in the geologic formation. The deviation will be detected for injection wells if the extraction rates for sampling the wells decrease or if the injection rates decrease significantly from one injection event to another. If the geologic formation is plugged, the potentiometric surface upstream of the injection wells will rise; this has not been observed. The time to respond to the deviation is approximately one year. The overall impact will be high because it would result in ineffective distribution of the amendment and difficulty maintaining the treatment zone. There is a medium likelihood of this deviation occurring and some evidence of it has been observed in recent years.

Treatment Uncertainties

It is expected that the Zone 11 ISB will treat/transform TCE and perchlorate to the cleanup standards in the perched in and downgradient of the anaerobic treatment zone. There are two deviations to the expected conditions for the treatment at the Zone 11 ISB system:

1. Perchlorate is not treated to cleanup standards downstream of the treatment zone. The deviation will be detected by collecting information from the monitoring wells downstream of the treatment zone twice a year. The time to respond to the deviation is less than two years. The overall impact of the deviation is high because it could impact the ability of the system to meet restoration goals to reduce the levels of perchlorate which could eventually reach the Ogallala Aquifer if not treated, but the likelihood of the deviation occurring is low.

2. TCE and breakdown products persist at concentrations greater than drinking water standards. The deviation will be detected by collecting information from the monitoring wells downstream of the treatment zone twice a year. The time to respond to the deviation is less than two years. The overall impact of the deviation is high because it could impact the ability of the system to meet restoration goals to reduce the levels of TCE and its breakdown products which could eventually reach the Ogallala Aquifer if not treated. There is a medium likelihood of this deviation occurring.

4.5 Uncertainty Management Monitoring

The monitoring well network will also be used to confirm expected conditions identified during site characterization. A characterization deviation would occur if monitoring results indicate new contaminants not expected as a result of the site characterization; these results would potentially signal a previously unidentified problem has been detected. The new problem may require a new response action, or it could potentially be addressed by changing the existing response action.

Additional assessments or investigations may be performed to fill potential data gaps or address areas of perceived risk; these steps are necessary to determine what contingent actions may be necessary. The actions that will be implemented to further evaluate the deviation are described in Section 5.

4.6 Ogallala Aquifer

The response actions described above have been implemented to protect the Ogallala Aquifer. Because of these actions, the expected conditions are that constituents will not be detected above the GWPS and those constituents will not reach potential points of exposure above the GWPS. If constituents are detected by the Ogallala Aquifer monitoring system near or above GWPSs and are confirmed through repeated sampling results and/or trending as discussed in Appendix A, then further actions will be implemented that are commensurate with the potential consequences and risks. These actions are described in Section 6.

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5. Perched Contingent Actions

As discussed in the previous sections, deviations for each of the response actions will differ. Therefore, the contingent actions considered when a deviation arises will be dependent on the specific constituents, location, and conditions associated with the deviation. Contingent actions may be implemented as interim actions (ISMs/removal actions) in accordance with the ROD, IAG, and HW-50284, if warranted by the specific circumstances.

Following confirmation and evaluation of the deviation, defining a response will require interpretation of the detection with regard to the location of the monitoring well relative to potential sources and available migration mechanisms. The Pantex Groundwater Media Scientist will determine probable causes of deviations and recommend contingent actions appropriate for specific situations to Pantex Plant Management. The Pantex Groundwater Media Scientist will validate usability of results with respect to data needs for interpreting the deviation (Appendix A). If newly detected constituents are confirmed or changes occur at a much greater rate than expected, written and oral notifications will be made (See Appendix B).

If characterization deviations are detected as part of uncertainty management activities, actions will need to be implemented to determine the source of detections. The actions that will be instigated in response to deviations to site characterization are identified in this section.

5.1 Playa 1 Pump and Treat System

The overall objective of the Playa 1 Pump and Treat System is to reduce mounding beneath Playa 1 to reduce radial flow and the volume of water flowing to the SEPTS and to the Ogallala Aquifer through vertical migration. The system will also remove RDX mass in the perched aquifer working towards restoration; RDX and boron also will be treated sufficiently to meet discharge requirements (TLAP permit) and the treated water will be discharged in a manner that will not impact the vadose zone. The deviations evaluated in Section 4 will be addressed by potential contingent actions.

If the mounding of groundwater underneath Playa 1 is not reduced because the infiltration rate is greater than expected, then contingent action would include adding extraction wells in the Playa 1 area to increase the extraction rate. If the extraction rate is increased with additional wells, then the treatment system will also need to be expanded. An additional contingent action would be to use the SEPTS to extract the additional volume of water.

If discharge is greater than the evapo-transpiration rates, impacting the vadose zone, then alternative discharge methods including reinjection to the extraction wells or modification of the rate of extraction will be necessary; additionally, the type of crop being raised using the discharge water could be changed to one with a higher water demand.

5.2 Southeast Area Pump and Treat System

The overall objective of the SEPTS is to reduce lateral flux and the volume of water flowing to the Southeast ISB and vertical flux to the Ogallala Aquifer. The system will also remove RDX and chromium mass in the perched aquifer working towards restoration; RDX, chromium and boron also will be treated sufficiently to meet discharge requirements (TLAP permit) and the treated water will be discharged in a manner that will not impact the vadose zone. The deviations evaluated in Section 4 will be addressed by potential contingent actions.

There are four conditions that would lead to lateral flux not being reduced and all have different contingent actions:

1. If the Playa 1 Pump and Treat is not removing sufficient flow, the SEPTS will become overloaded and will be unable to reduce lateral flux. The contingent action would include adding extraction wells in the Playa 1 area to increase the extraction rate. If the extraction rate is increased with additional wells, then the Playa 1 Pump and Treat treatment system will also need to be expanded.

2. Infiltration from the SWMU 5-12 Ditch could be greater than expected, overloading the SEPTS. In this case, the contingent action would involve re-grading or lining portions of the SWMU 5-12 Ditch to reduce infiltration.

3. The subsurface irrigation system could fail, which would require treated water be re-injected into the perched, increasing infiltration and overloading the SEPTS. To address this deviation, the treatment system would need to be modified so that the subsurface irrigation system could be used.

4. Flux of perched groundwater could continue at present levels without reduction. The contingent action would be addition of another extraction well east of PTX06-EW88.

If perchlorate is detected in the extraction wells at levels that exceed the GWPS, then the extraction from wells closest to the perchlorate migrating from Zone 11 will need to be modified temporarily until the treatment system can be modified to treat perchlorate. The treatment system will need to be upgraded through a building modification and addition of treatment vessels and ion exchange to appropriately treat perchlorate to the GWPS.

If discharge is greater than the evapotranspiration rates, impacting the vadose zone, then alternative discharge methods including reinjection or modification of the rate of extraction will be necessary; additionally, the type of crop being raised using the discharge water could be changed to one with a higher water demand.

5.3 Southeast Area *In-Situ* Bioremediation System

The objective of the SEISB is to treat or transform RDX and hexavalent chromium to prevent vertical migration of RDX and hexavalent chromium to the Ogallala. The system will meet cleanup standards of RDX and hexavalent chromium and other COCs downstream of the treatment zone, working towards restoration. The deviations evaluated in Section 4 will be addressed by potential contingent actions.

Three conditions would lead to the inability of the system to meet the objective of treating and transforming RDX and hexavalent chromium through the formation of a treatment zone.

1. The treatment zone cannot be maintained because the volume of water in the southeast area has not been reduced enough by the Playa 1 Pump and Treat and the SEPTS. The contingent action would involve increasing the extraction rates from the Playa 1 and Southeast Pump and Treat Systems to reduce the flow to the SEISB area.

2. The treatment zone cannot be maintained due to biofouling either in the injection wells or in the geologic formation. To reduce the likelihood of the injection wells becoming biofouled, a

rigorous well maintenance program will be developed. If the geologic formation is blocked through biofouling, the treatment zone will need to be expanded beyond the plugged area.

3. Injection wells that are currently dry (to the west and east of the existing system) become saturated and require injections to maintain the treatment zone. The contingent action would be to inject amendment into the wells west and east of FM 2373 that have become saturated to expand the treatment zone.

There are also three conditions that will not allow the system to meet the cleanup standards for RDX, hexavalent chromium and other COCs downstream of the treatment zone.

1. RDX and/or breakdown products not treated to cleanup standards downstream of the treatment zone. One contingent action would be to change the type of amendment to one that is better able to treat RDX and breakdown products to meet cleanup standards. Another approach would be to inject a greater amount of amendment into the treatment zone, or more volume to better distribute the amendment.

2. Chromium and other metals are not reduced to cleanup standards downstream of the treatment zone. In this case, a contingent action would be to change the type of amendment to one that will treat chromium and other metals to meet cleanup standards. If the levels that are entering the treatment zone are too high, levels could be lowered if there was an increased extraction in the SEPTS in the chromium hotspot up-gradient of the Southeast ISB system.

3. TCE and breakdown products are encountered at concentrations higher than expected. The contingent action would be bio augmentation of the treatment zone with dehalococcoides if the levels of TCE remain greater than what would be protective of the Ogallala Aquifer (two times the drinking water standards) and/or the treatment stalls resulting in increasing concentrations of breakdown products (DCE and VC) that exceed the drinking water standard.

5.4 Zone 11 *In-Situ* Bioremediation System

The objective of the Zone 11 *In-Situ* Bioremediation System is to establish an anaerobic biodegradation treatment zone capable of reducing contaminants to drinking water standards (MCLs/MSCs) by injecting the necessary amendments and nutrients. If the deviations described in Section 4 were to occur, the potential contingent actions would differ based on the results from the monitoring network.

Two conditions would lead to the inability of the system to meet the objective of treating and transforming RDX and hexavalent chromium through the formation of a treatment zone.

1. The treatment zone cannot be maintained because the volume of water in the area is greater than expected. The contingent action would be to install extraction wells upstream of the treatment zone to reduce flow to the treatment zone.

2. The treatment zone cannot be maintained due to biofouling either in the injection wells or in the geologic formation. To reduce the likelihood of the injection wells becoming bio fouled, a rigorous well maintenance program will be developed. If the geologic formation is blocked through biofouling, the treatment zone will need to be expanded beyond the plugged area.

Two conditions will not allow the system to meet the cleanup standards for TCE and perchlorate downstream of the treatment zone.

1. Perchlorate is not treated to cleanup standards downstream of the treatment zone. One contingent action would be to change the type of amendment to one that treats perchlorate to meet cleanup standards. Another approach would be to inject a greater amount of amendment into the treatment zone.

2. TCE and breakdown products are encountered at concentrations higher than expected. The contingent action would be bio augmentation of the treatment zone with dehalococcoides if the levels of TCE or breakdown products (such as DCE and VC) persist at concentrations greater than the drinking water standards.

5.5 Uncertainty Management Monitoring

Monitoring requirements include monitoring to confirm expected conditions identified during site characterization. Should results indicate a significant characterization deviation from expected conditions, additional assessments, or investigations may be taken to fill potential data gaps or address areas of perceived risk. Information received from these wells will be utilized to update the hydrological model and determine whether additional contingent actions are warranted. Figure 5-1 shows a logic flow diagram for how contingent actions will be evaluated if deviations are encountered.

If contaminants are detected in previously unaffected wells, the following actions will be considered:

- Conditions will be evaluated to determine if the detection is related to a new or existing contaminant source:
  - If conditions are determined to be from a new source, then conditions of up gradient SWMUs will be evaluated.
  - If conditions are determined to be from an existing source, then conditions affecting plume movement will be reviewed to determine the root cause.
- Evaluate need for additional response actions.

If previously undetected contaminants are discovered, the following process will be used to determine if contingent actions are necessary:

- Determine probable source/cause.
- Evaluate up gradient SWMU conditions.
- Evaluate perched groundwater flow, gradient, and analytical data.
- Evaluate potential for previously unidentified SWMUs using fate and transport tools, as necessary and appropriate.
- Evaluate need for modification of existing remedies (including in-situ and ex-situ treatment processes).
- Evaluate need for additional response actions, to be implemented in the perched groundwater as appropriate.

Further evaluations will be made to determine if additional response actions are appropriate for the perched groundwater. These actions could include enhancing the existing response actions or identifying new response actions.

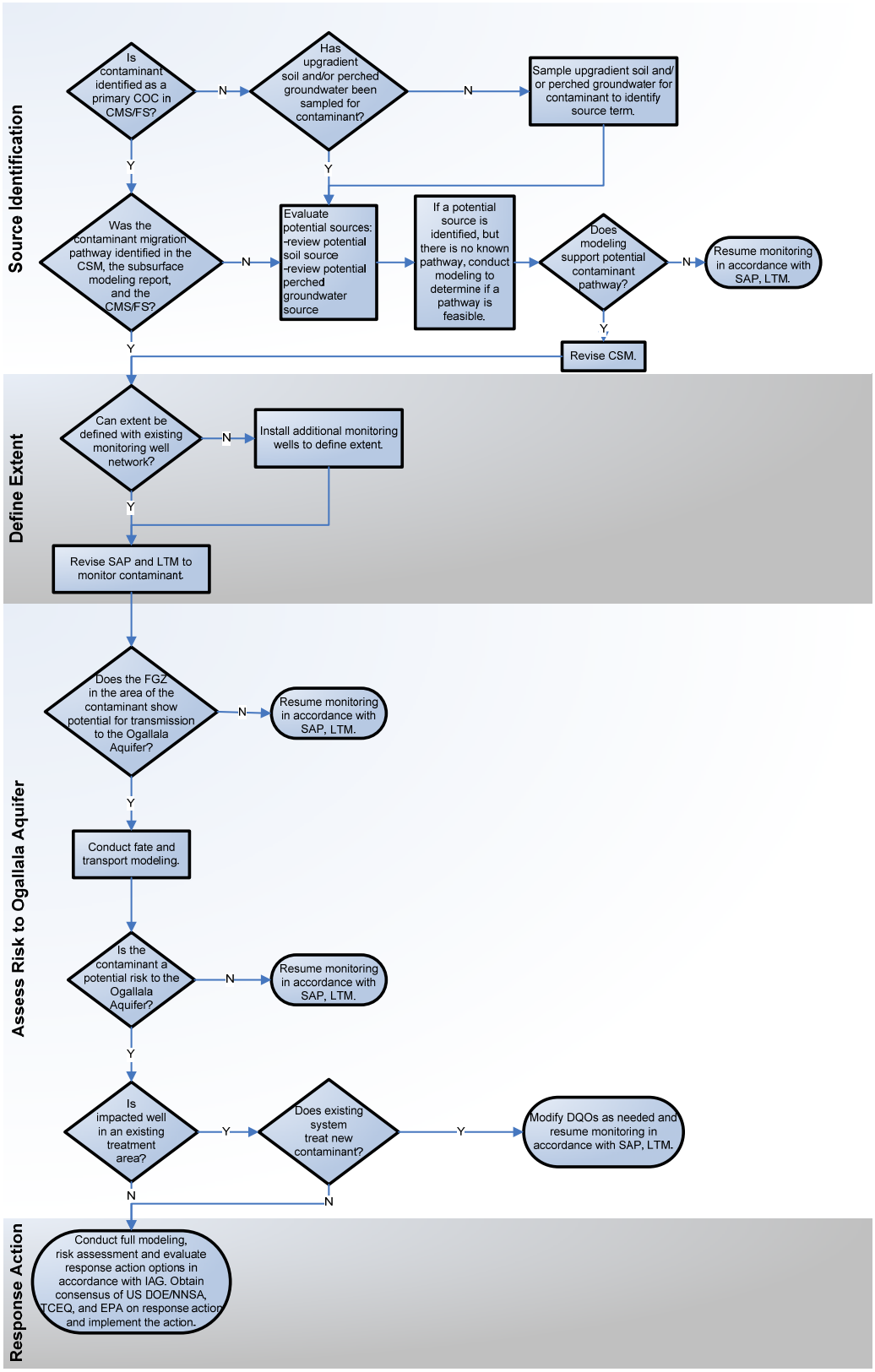

Figure 5-1. Flowchart of Perched Uncertainty Management Contingency Action Process

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6. Ogallala Actions

Early removals and cleanup actions have been implemented to protect the Ogallala Aquifer. Because of these actions, the expected conditions are that constituents will not be detected above the GWPS and those constituents will not reach potential points of exposure above the GWPS. If constituents are detected in the Ogallala Aquifer near or above GWPSs and are confirmed through the data validation process (Appendix A) then actions will be implemented that are commensurate with the potential consequences and risks. The actions would include additional monitoring, source identification, implementation of interim protective measures (if necessary), and delineation of extent. These actions are necessary to determine if contingent actions can be considered. Figure 6-1 shows a logic flow diagram for how actions will be evaluated if deviations are encountered in the Ogallala Aquifer monitoring network.

6.1 Monitoring

Once detection is verified, validated, and confirmed utilizing the process described in Appendix A, the Pantex Groundwater Media Scientist will make proper management notifications (Appendix C) and gather input and agreement to increase the frequency of continued monitoring to at least quarterly. The increase in sampling frequency will help to more accurately quantify the concentration in the Ogallala Aquifer.

If the detection is up gradient of a potential drinking water or irrigation water source and there is no monitoring well downgradient of the affected well, potentially affected wells will be sampled, after obtaining agreement from the landowner.

6.2 Source Identification

Efforts will be made to make an exact source term determination as reasonably as practicable. Source identification considerations include:

- Review of potential sources based on the location of the detection. This can include review of soil sources (where applicable) and perched groundwater.
- Modeling would be considered with this option to understand the source and extent of contamination.
- Installation of additional monitoring wells would be considered, if needed to understand the source and extent of the contamination.
- Evaluation of the extent of the perched groundwater, the amount of dispersion that will occur over distances traveled, and the spatial variability of contaminant plumes.

6.3 Implementation of Interim Protective Measures

Interim protective measures will be enacted based on concentration of the constituent, location of the exceedance and extent of the constituent measured. The contingent actions listed in the ROD will be first considered to determine if these actions are appropriate considering the type of contamination and hydro geologic conditions. If results in the Ogallala Aquifer indicate contamination above the GWPS, the risk to potential receptors will be evaluated.

If necessary to protect human health or the environment, measures to control use of Ogallala groundwater will be implemented, including the following.

6.3.1 Discontinue Well Use

If a private or public water supply well is threatened due to its proximity to a contaminant plume, Pantex will contact the owner with a recommendation to discontinue use of the well as long as necessary to prevent the potential for exposure. When the pump is de-energized, it will be locked out with each responsible entity providing a lock. This measure may serve as an interim measure until treatment systems can be installed to allow continued use.

6.3.2 Develop Alternative Water Supply

If monitoring results indicate that private or public water supply wells may be directly threatened due to releases related to Pantex Plant, an alternative water supply will be provided and maintained while long-term response actions are explored.

6.3.3 Treat Water Prior to Use

If monitoring results indicate that private or public water supply wells may be directly threatened due to releases related to Pantex Plant, then localized treatment at a well head will be evaluated as a long-term response action.

6.4 Delineation of Extent

If no downgradient monitoring wells are present, investigative wells may be drilled to determine the extent of newly detected contaminants. Precautions will be taken to avoid additional risk for cross-contamination as an artifact of the well installation process (e.g., ideally these wells will be installed outside of the perched contaminant footprint). If a well must be installed through the perched groundwater and into the Ogallala Aquifer, precautions outlined in the well specifications criteria in HW-50284 will be followed to minimize risk during the investigation process.

6.5 Contingent Actions

The contingent actions would be dependent on the specific constituents, location, and conditions associated with the impact. Contingent actions may include interim protective measures or removal actions. Any actions will be implemented in accordance with the National Contingency Plan (NCP), the HW-50284, the IAG, and the ROD.

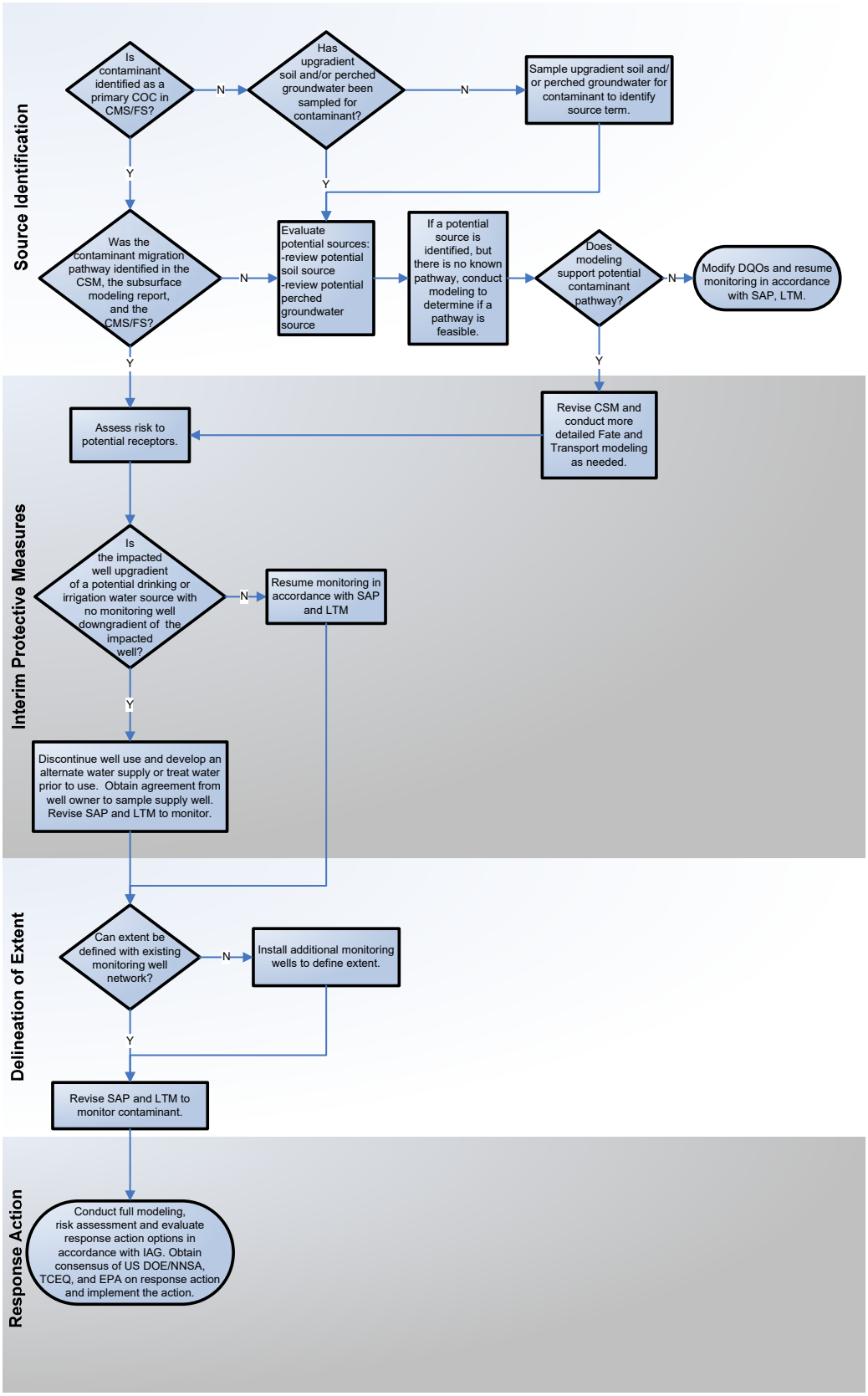

Figure 6-1. Flowchart of Ogallala Monitoring Well Contingent Action Process

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7. Summary

The objective of the Plan is to respond to technology and characterization deviations detected by the long-term monitoring network in the perched groundwater and Ogallala Aquifer. Implementation of the appropriate contingency actions in response to the deviations will provide for the continued protection of the Ogallala Aquifer and the health of its consumers.

This Plan outlines the objectives for each of the perched groundwater response actions and identifies and evaluates the potential deviations that may be encountered. Contingent actions for each of the deviations are also detailed. It also outlines the approach for the perched groundwater, if the long-term monitoring network identifies deviations from the expected conditions identified during site characterization, and for the Ogallala Aquifer if constituents are detected approaching the GWPS.

Table 7-1 summarizes all the information provided in the Plan for each of the perched response actions. The table provides an evaluation of each potential deviation and the associated contingent actions and can be used as the framework for determining the appropriate action if a deviation is encountered.

Table 7-1. Contingent Actions for Perched Groundwater Response Action Systems

Playa 1 Pump and Treat System

Expected Conditions	Remedy Objective	Uncertainties / Deviations	Evaluation			Monitoring	Contingent Actions
			Time to Respond	Impact of Occurrence	Likelihood		
Pumping and Extraction Perched groundwater will be removed in sufficient volume to decrease the flux of groundwater moving radially out from Playa 1. This will also reduce the flux of groundwater moving to the Southeast Pump and Treat System (SEPTS) and the head that is causing vertical migration to the Ogallala Aquifer. This is possible because inflow to the perched is negligible.	Reduce mounding beneath Playa 1 to reduce radial flow and the volume of water flowing to the SEPTS and to the Ogallala Aquifer through vertical migration.	Mounding is not reduced; primary cause would be that infiltration is much greater than expected.	Five to Ten Years	Low in the short term. Medium in the long term because the SEPTS could become stressed.	Low	Potentiometric surface measurements to indicate saturated thickness is decreasing. Gradient toward the SEPTS should be decreasing within two years.	1. Add extraction wells in the Playa 1 area to increase the extraction rate; expand the treatment system. 2. Use the SEPTS to extract the additional volume of water.
Treatment and Discharge Treated water will meet discharge criteria downstream of the holding pond as noted in the TLAP and will be discharged to the soil via subsurface irrigation. Volume of discharge water will not exceed evapo-transpiration rates, preventing any deep percolation into the underlying vadose zone. Treated sewage effluent will also discharge to the holding pond noted in the TLAP, mixing with the treated water from Playa 1 Pump and Treat prior to discharge to the subsurface irrigation system.	Discharge treated water in a manner that will not impact the vadose zone.	Discharge is greater than evapo-transpiration rate.	Month-to-Month for alternative discharge and extraction rate changes. One year on crop selection.	Medium	Low	Soil borings.	1. Implement alternative discharge methods; can include injection back into the perched (not preferred over the long term). 2. Reduce the rate of extraction (a short-term contingent action only). 3. Raise crops with higher water demand.

SE Pump and Treat

Expected Conditions	Remedy Objective	Uncertainties/ Deviations	Evaluation			Monitoring	Contingent Actions
			Time to Respond	Impact of Occurrence	Likelihood		
Pumping and Extraction Perched groundwater will be removed in sufficient volume to decrease the flux of groundwater moving towards the SEISB. This will also reduce the head, reducing the potential for vertical migration to the Ogallala Aquifer. Perched groundwater will be removed in sufficient volume such that the RDX and Cr plumes are stabilized and the contaminant center of mass is not moving. This is possible because inflow to the perched is negligible and the Playa 1 Pump and Treat system is decreasing the flow to the southeast area.	Reduce lateral flux and the volume of water flowing to the Southeast ISB and vertical flux to the Ogallala Aquifer.	Playa 1 Pump and Treat is not removing sufficient flow and the SEPTS is overloaded.	Two years	High The SEISB will require modification if the Playa 1 or SEPTS cannot efficiently reduce the lateral flux.	Low	Playa 1 Pump and Treat performance and results	Modify Playa 1 Pump and Treat to allow for an increased extraction rate, including additional wells or increased treatment capacity.
		Infiltration from the SWMU 5-12 Ditch is greater than expected, overloading the SEPTS.				Potentiometric surface measurements	Regrade or line portions of the SWMU 5-12 Ditch.
		Subsurface irrigation system fails which requires injection of treated water into the SEPTS area.				Subsurface irrigation performance and results	1. Modify treatment system so it can discharge to an unrestricted irrigation system. 2. Add permitted options for treated water disposition.
		New extraction wells east of FM 2373 fail to reduce the flux of perched groundwater moving toward the SEISB Extension area.				Perched water levels east of FM 2373 and estimated flux	Add an extraction well east of PTX06-EW88.

Expected Conditions	Remedy Objective	Uncertainties/ Deviations	Evaluation			Monitoring	Contingent Actions
			Time to Respond	Impact of Occurrence	Likelihood		
By extracting groundwater contaminated with RDX and Cr, RDX and Cr mass removal will also be accomplished. Since new sources of RDX and Cr are not expected and mass is being removed, the RDX and Cr concentrations are expected to decrease in the SE area over several decades. Yield from the perched should decline as extraction continues, and this impact will first be seen in the southern wells in less than five years. The decreased yield will cause the RDX and Cr mass removal rate to decrease.	Reduce RDX and Cr mass in perched aquifer working towards restoration.	Perchlorate migrates from Zone 11 into the SEPTS well field.	One year- need to modify extraction quickly because the extraction wells in this area cannot be taken offline for long as they are being used to stabilize the Cr plume to prevent high Cr concentrations from reaching the SEISB.	High- the extraction wells that would first encounter perchlorate from Zone 11 are used to stabilize the Cr plume and should not be taken offline for long.	Medium because perchlorate continues to migrate toward the system.	Monitoring is performed upstream of the treatment system twice a month and at the extraction well heads closest to the Zone 11 ISB annually.	Temporarily modify extraction from extraction wells impacted by the perchlorate until the treatment process is modified for perchlorate.
Treatment and Discharge Extracted groundwater will contain RDX and other HE breakdown products, Cr, and VOCs. Treatment to remove RDX and Cr will require GAC. Boron is also treated via selective ion exchange. COCs requiring treatment other than GAC are not expected.	Remove RDX and Boron sufficiently to meet discharge requirements (TLAP).	Perchlorate is present at levels that exceed the GWPS.	One year	High impact to disposition options.	High - perchlorate is entering the SEPTS wellfield.	Monitoring is performed upstream of the treatment system twice a month and at the extraction well heads annually.	Modify the treatment system to treat perchlorate through building modification and addition of treatment vessels and ion exchange.

Expected Conditions	Remedy Objective	Uncertainties/ Deviations	Evaluation			Monitoring	Contingent Actions
			Time to Respond	Impact of Occurrence	Likelihood		
Treated water will meet discharge criteria downstream of the holding pond noted in the TLAP permit and will be discharged to the soil via subsurface irrigation. Treated sewage effluent will also discharge to the holding pond noted in the TLAP permit. Volume of discharged water will not exceed evapo-transpiration rates, preventing any deep percolation into the underlying vadose zone.	Discharge treated water in a manner that will not impact the vadose zone.	Discharge is greater than evapo-transpiration rate.	Month-to-Month for alternative discharge and extraction rate changes. One year on crop selection.	Medium	Low	Soil borings.	1. Implement alternative discharge methods; can include injection back into the perched (which is not preferred over the long term). 2. Reduce the rate of extraction (a short-term contingent action only). 3. Raise crops with higher water demand.

Southeast Area ISB

Expected Conditions	Remedy Objective	Uncertainties/ Deviations	Evaluation			Monitoring	Contingent Actions
			Time to Respond	Impact of Occurrence	Likelihood		
Treatment Zone An anaerobic treatment zone will be established on the southeast edge of the perched aquifer susceptible to vertical migration that will treat/transform RDX and Cr-6 to drinking water standards. The volume of water moving into the area will have been reduced by the Playa 1 and Southeast Pump and Treat Systems so the treatment zone will be easier to maintain, e.g., less water makes the zone easier to maintain and allows for greater confidence the ISB will provide protection to the Ogallala.	Treat/transform RDX and Cr-6 to work towards restoration and prevent vertical migration of RDX and Cr-6 to the Ogallala.	Not able to maintain the treatment zone because the volume of water in the area is greater than expected (Pump and Treat systems are not meeting expected conditions).	Two years	High impact on resources because additional injections are resource intensive.	Low	Potentiometric surface measurements from the monitoring wells to calculate the treatment zone area and flow gradient.	1. Increase the extraction rates from the Playa 1 and Southeast Pump and Treat Systems to reduce flow to the SEISB area. 2. Install an additional row of injection wells to extend the treatment zone.
		The treatment zone cannot be maintained due to biofouling, resulting in the amendment not being distributed effectively. Biofouling could result from ▪ plugged injection wells or ▪ pore spaces become plugged in the geologic formation.	One year	High for both wells and the geologic formation.	High for the wells, but low for the geologic formation.	If the wells are bio fouled, the degree of difficulty in sampling the wells will change. Specifically the extraction (purge) rate will decrease. If the geologic formation was plugged due to biofouling, the potentiometric surface upstream of the injection wells would rise.	1. Develop a rigorous well maintenance program for the injection wells. 2. If the geologic formation is plugged or biofouling prevents effective amendment distribution, the treatment zone may need to be expanded.

Expected Conditions	Remedy Objective	Uncertainties/ Deviations	Evaluation			Monitoring	Contingent Actions
			Time to Respond	Impact of Occurrence	Likelihood		
		Injection wells that are currently dry (to the west and east of the existing system) become saturated and require injections to maintain the treatment zone.	One to two years	Low, the newly saturated wells would require injection of amendment.	Medium	Water level measurements are collected for the currently dry wells twice a year.	1. Inject amendment into the wells west and east of the existing system that have become saturated to expand the treatment zone.
Treatment Treat/transform RDX and Cr-6 and other COCs to the cleanup standards in the perched in and downgradient of the anaerobic treatment zone.	Meet cleanup standards of RDX and Cr-6 and other COCs downstream of the treatment zone working towards restoration.	RDX and/or breakdown products not treated to cleanup standards downstream of the treatment zone.	Two years	High	Low	The monitoring wells downstream of the treatment zone are monitored twice a year and contaminant level concentrations are collected.	2. Change the type of amendment to one that treats RDX and breakdown products to meet cleanup standards. 3. Inject a greater amount of amendment into the treatment zone or a greater volume to improve distribution.
Expect a temporary elevation of the metals concentrations in the treatment zone following the amendment injection (up to two years), but expect metals concentrations to meet cleanup standards downstream of the treatment zone in the long term (within four years) where		Cr and other metals are not reduced to cleanup standards downstream of the treatment zone.		High to medium	Medium	The injection wells in the treatment zone are monitored quarterly.	1. Change the type of amendment to one that treats Cr and other metals to meet cleanup standards. 2. Increase extraction in the SEPTS in the Cr-6 hotspot to reduce the levels of Cr-6 being treated by the SEISB.

Expected Conditions	Remedy Objective	Uncertainties/ Deviations	Evaluation			Monitoring	Contingent Actions
			Time to Respond	Impact of Occurrence	Likelihood		
measurements are collected in monitoring wells. Expect the concentration of RDX breakdown products to increase in the treatment zone in the short term (up to one year) following the injection of amendment. Expect to encounter low levels (four times the drinking water standard) of TCE and TCE breakdown products in the treatment zone.		TCE and breakdown products are encountered at concentrations higher than expected.		Medium	Low		Consider bio augmentation of the treatment zone with dehalococcoides if the levels of TCE remain greater than what would be protective of the Ogallala Aquifer (two times the drinking water standards) and/or the treatment stalls resulting in increasing concentrations of breakdown products (DCE and VC) that exceed the drinking water standard.

Zone 11 ISB

Expected Conditions	Remedy Objective	Uncertainties/ Deviations	Evaluation			Monitoring	Contingent Actions
			Time to Respond	Impact of Occurrence	Likelihood		
An anaerobic treatment zone will be established in the perched aquifer on the edge of Zone 11 in the area of high TCE and perchlorate concentrations to treat TCE and perchlorate.	Treat TCE and perchlorate to work towards restoration and prevent migration of contaminated perched groundwater onto the Texas Tech property near Playa 4.	Not able to maintain the treatment zone because the volume of water in the area is greater than expected.	Three years	High impact on resources because additional injections are resource intensive.	Low	Potentiometric surface measurements from the monitoring wells to calculate the treatment zone area and flow gradient.	1. Install extraction wells upstream of the treatment zone to reduce flow to Zone 11 ISB area. 2. Expand the treatment zone.
		The treatment zone cannot be maintained due to biofouling, resulting in the amendment not being distributed effectively. Biofouling could result from ▪ plugged injection wells or ▪ pore spaces become plugged in the geologic formation.	One year	High for both wells and the geologic formation.	High for the wells, but low for the geologic formation.	If the wells are bio fouled, the degree of difficulty in sampling the wells will change. Specifically the extraction (purge) rate will decrease. If the geologic formation was plugged due to biofouling, the potentiometric surface upstream of the injection wells would rise.	1. Develop a rigorous well maintenance program for the injection wells. 2. If the geologic formation is plugged or biofouling prevents effective amendment distribution, the treatment zone will need to be expanded.
Treatment Treat TCE and perchlorate to the cleanup standards in the perched in and downgradient of the anaerobic treatment zone.	Meet cleanup standards of TCE and perchlorate downstream of the treatment zone working towards restoration.	Perchlorate is not treated to cleanup standards downstream of the treatment zone.	Less than two years for perchlorate deviation.	High	Low	The monitoring wells downstream of the treatment zone are monitored twice a year. The injection wells in the treatment zone are monitored quarterly.	1. Change the type of amendment to one that treats perchlorate to meet cleanup standards. 2. Inject a greater amount of amendment into the treatment zone or greater volume to improve amendment distribution.

Expected Conditions	Remedy Objective	Uncertainties/ Deviations	Evaluation			Monitoring	Contingent Actions
			Time to Respond	Impact of Occurrence	Likelihood		
		TCE and breakdown products persist at concentrations greater than the drinking water standard	Two to Four years for TCE deviation.	High	Medium		Consider bio augmentation of the treatment zone with dehalococcoides if the levels of TCE or breakdown products (such as DCE and VC) persist at concentrations greater than the drinking water standards.

8. References

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Appendix A: Data Validation Process

It is important that the information collected from the monitoring network be accurate to ensure appropriate implementation of potential contingent actions. Pantex has developed a data validation process in accordance with the IAG and HW-50284 to ensure the monitoring data that will be used to make decisions for implementation of contingent actions is properly vetted. Figures A-1 and A-2 are process flow diagrams that represent the data validation process for groundwater monitoring samples collected from the perched and Ogallala monitoring wells that indicate a deviation may be occurring. The process is further described in the following sections.

Sampling and Analysis

Samples are collected in accordance with the approved Sampling and Analysis Plan. Analyses may be performed using both Plant personnel and contracted laboratories. Data are collected, analyzed, verified, and validated within 90 days in accordance with the IAG and HW-50284.

Review Preliminary Results

A preliminary review (verification) of all data packages is performed to evaluate the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural or contractual requirements. The goal of data verification is to ensure that the reported results reflect the outcome of what was actually done (what was sampled and how the analysis was performed) and that deviations from the planned process are understood. When data are determined to be suspect, results will be flagged with qualifier(s). Usable data are recorded in the Integrated Environmental Database.

If the verification process identifies the source of the detection as laboratory error or laboratory contamination, sampling and analysis of the well will resume as specified in the SAP and LTM. If the result is verified, or if the verification process is inconclusive, re-sampling of the well and/or reanalysis of the original sample will be performed to confirm the original result. Both results will be evaluated in the data interpretation step.

To assist with preliminary review of data, Pantex has developed an automated review algorithm (Suspect Anomaly Report) that has been implemented to flag results with the following anomalies:

- Laboratory solvents above detection
- Organics in Ogallala Aquifer wells above detection
- First time detection of an inorganic
- New minimum level
- New maximum level
- Variation from gross historical trend

If anomalies are flagged, then data validation will be performed including review of field logs. The Suspect Anomaly Report is provided to the Pantex Media Scientist to perform data validation.

Data Validation

When the integrity and quality of data is determined usable, it will be provided to the Pantex Groundwater Media Scientist to determine if the data is valid. Data Validation is an analyte and sample specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set. This includes the evaluation of the result against historic trends, known contaminant migration pathways, and site hydrology.

This evaluation will also consider the possibility of cross-contamination of the sample, e.g., as a result of the well construction itself for some metals. This would include reviews of well completion reports, lithologic and geophysical logs, and use of a down-hole camera to check for well casing corrosion.

The goals of data validation are to evaluate whether the data quality goals established during development of the Sampling and Analysis Plan have been achieved, ensure all project requirements are met, determine the impact on data quality of those that were not met, and document the results of the data validation. If the result is validated, or if the validation process is inconclusive, re-sampling of the well and/or reanalysis of the original sample will be performed to confirm the original result. Both results will be evaluated in the data interpretation step.

Data Interpretation and Comparison

Results below background or PQL will not be further considered for reanalysis or resampling. The original sample and subsequent re-sampling and/or re-analysis will be compared to regulatory standards, including established backgrounds, PQLs, and the groundwater protection standard (GWPS). The focus of this evaluation is to determine if there is a threat of endangerment or actual endangerment to the Ogallala Aquifer or if the unexpected conditions warrant contingency actions. Results above background or PQL will be evaluated with respect to the GWPS and proximity to a receptor to determine if immediate action is required to protect human health or the environment. Otherwise, contingency actions will be evaluated and implemented, as needed.

Because protection of the Ogallala Aquifer is a primary goal, verified and validated results above background or the PQL will initiate a more frequent sampling regimen. The affected well will be sampled on a monthly basis to gather more information about the constituent. If three consecutive monthly sampling results show no contamination (no detection of an organic COC; no exceedance of cleanup standards for inorganic COCs), monitoring will resume in accordance with the SAP and LTM. If consecutive sampling shows inconsistent results, or confirms the presence of contamination, the deviation will be evaluated to determine the appropriate contingent actions.

If an unexpected condition is detected in the Ogallala Aquifer or perched groundwater, preliminary notification requirements in the IAG may be implemented if the data indicate there is a threat of endangerment or actual endangerment to the Ogallala Aquifer and the administrative requirements in Appendix B (for Ogallala) or Appendix C (for perched) will be followed. Two factors will be considered in the determination of the threat of endangerment including: (1) proximity to a receptor location (TCEQ defines a threat as a downgradient receptor well within ½ mile of the groundwater contamination – receptor locations may include Pantex production wells, neighbor wells, and/or City of Amarillo production wells), (2) concentration with respect to the GWPS. Further sampling and analysis may be performed to confirm the original concentrations.

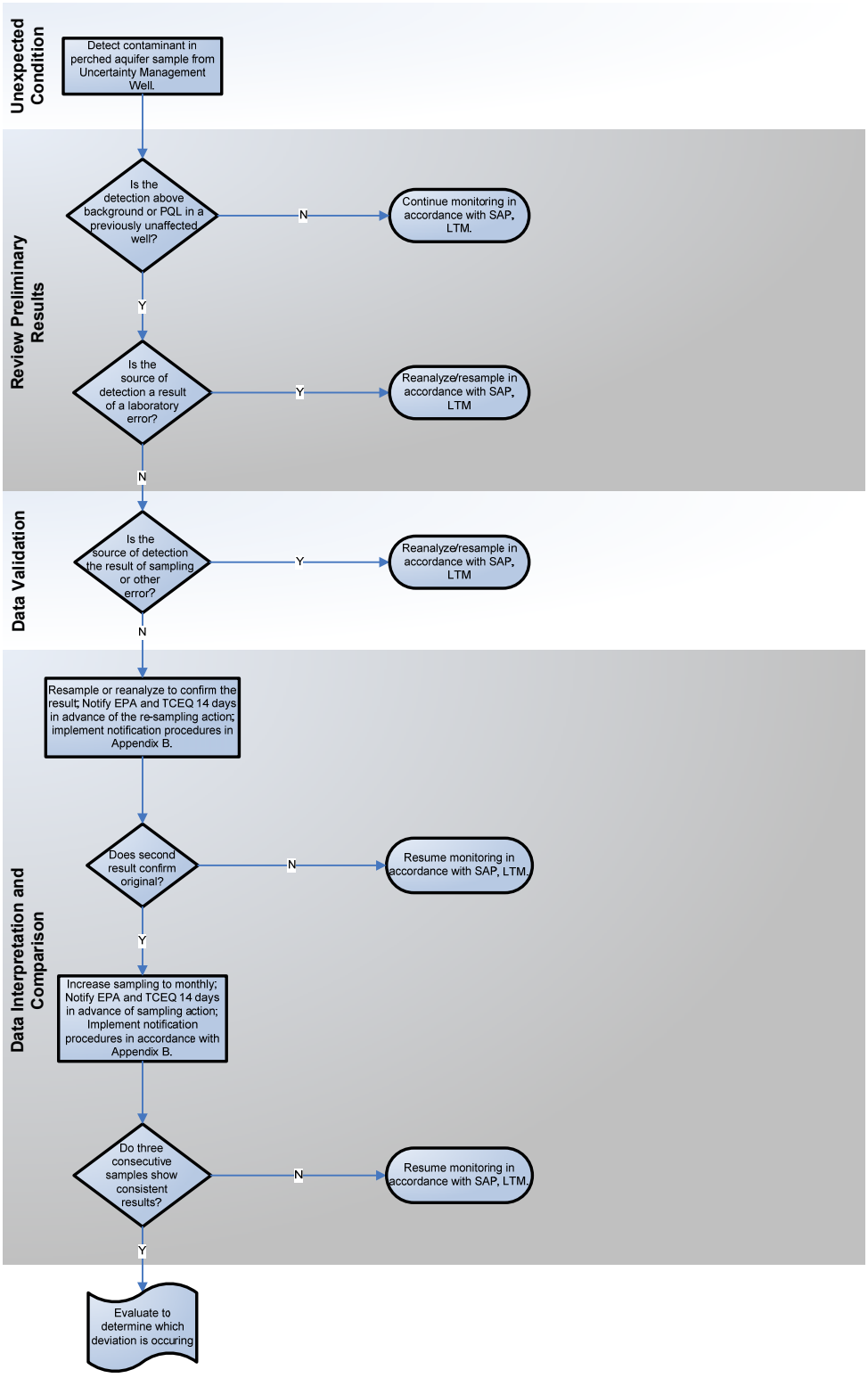

Figure A-1. Flowchart of Perched Contingent Action Process

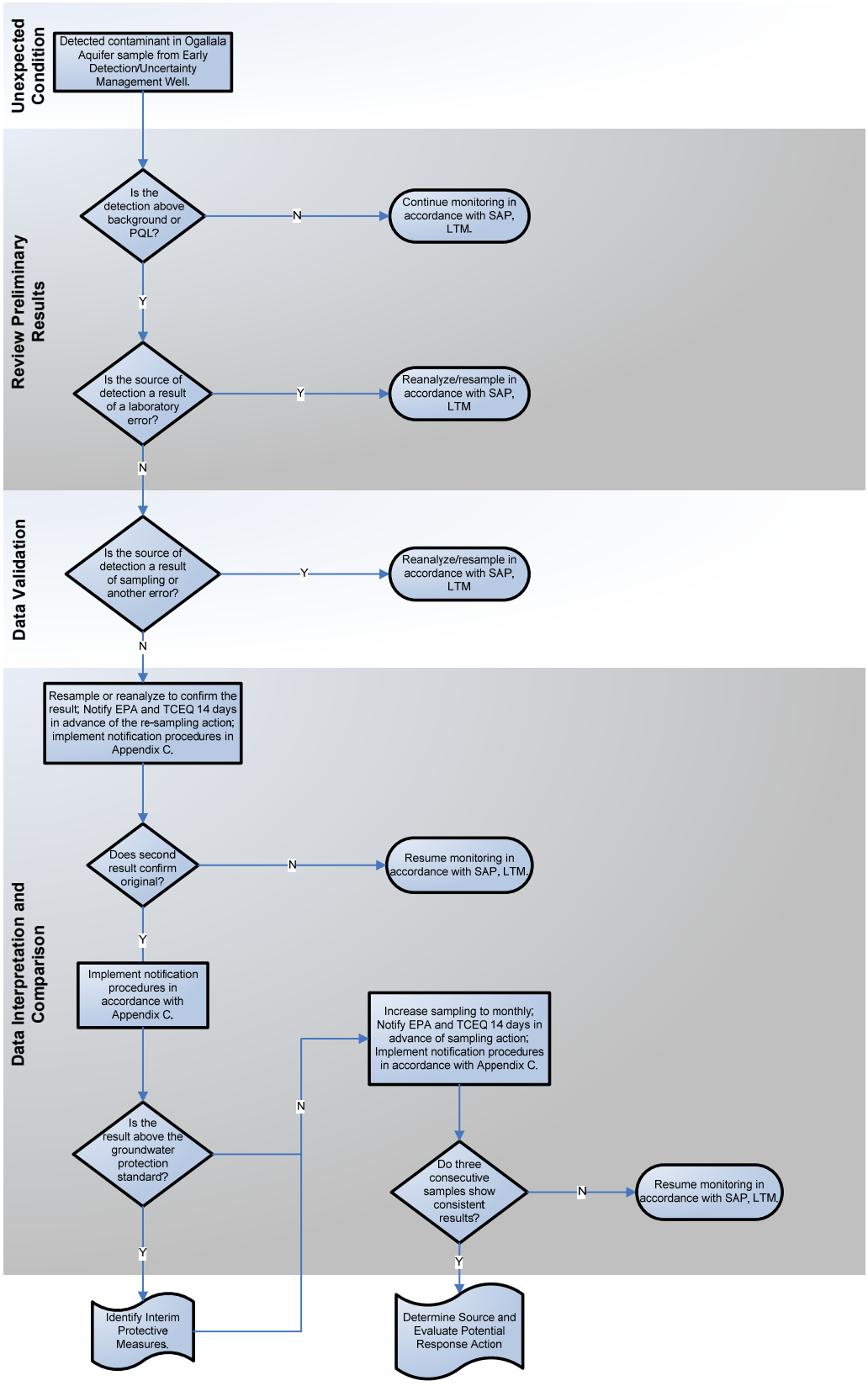

Figure A-2. Flowchart of Ogallala Contingent Action Process

Appendix B – Perched Notification and Reporting Process

The notification process will be used to notify the appropriate people if an unexpected condition in the perched groundwater is encountered, e.g. at or above drinking water standards in an area outside of the previously identified contaminant plume. The process is consistent with the reporting requirements defined in the IAG, the SAP, and the LTM System Report and SAP, and should be used in conjunction with the notification tables on B-2.

Perched Groundwater Wells
Notification Process

- The Pantex Groundwater Data Verifier
  - Tabulates results
  - Forwards results to the Pantex Groundwater Media Scientist for validation

- The Pantex Groundwater Media Scientist
  - Conducts data usability review
  - Informs the Pantex Environmental Program Department Manager of the results of data usability review

If an unexpected condition is determined to exist:

- The Pantex Environmental Program Department Manager
  - Informs the Pantex Environmental Program Division Manager
  - Informs the Pantex Environmental Program Community Liaison

- The Pantex Environmental Program Division Manager
  - Informs the Pantex General Manager
  - Informs the Pantex Legal Manager
  - Informs the Pantex Communications Manager
  - Informs the USDOE/NNSA NPO Environmental Management Groundwater Representative
  - Informs the USDOE/NNSA NPO Environmental Manager (who informs the NPO Site Manager)
  - Informs TCEQ executive director and Region I, and EPA

- The Pantex Environmental Program Community Liaison
  - Coordinates with the USDOE/NNSA Public Affairs Officer, TCEQ and EPA to notify news media, as needed
  - Coordinates with the Pantex Environmental Program Division Manager to set up meetings with Texas Tech and affected neighbors, as needed

- The Pantex Groundwater Media Scientist
  - Contacts TCEQ executive director and Region I, and EPA to discuss co-sampling requirements

- The Pantex Groundwater Media Scientist
  - Issues a special sample request to confirm exceedances/significant results

(See notification table on next page.)

Perched Groundwater Wells Notification Table		
Result	**Procedure**	**Timeframe**
Result ≥ GWPS; and well(s) outside previously identified contaminant plume	***Inform*** TCEQ Executive Director and Region I, and EPA of results and intent to resample	10 days
	Resample to confirm exceedance and determine co-sampling requirements with TCEQ Executive Director and Region I, and EPA	30 days (notify verbally and by e-mail at least 14 days before resample)
	Notify TCEQ Executive Director and Region I, and EPA	*10 days, phone (or e-mail) and written
	Report (Hardcopy) results to the TCEQ and EPA	Annual, written
PQL/Background ≤ Result < GWPS	***Report*** (Hardcopy) results to the TCEQ and EPA	Annual, written

GWPS = Groundwater Protection Standard
PQL = Practical Quantitation Limit

Appendix C – Ogallala Aquifer Notification and Reporting Process

The notification process will be used to notify the appropriate people if an unexpected condition in the Ogallala Aquifer is encountered. The process is consistent with the reporting requirements defined in the IAG, the SAP, and the LTM System Report and SAP and should be used in conjunction with the notification tables on pages C-2 and C-3.

Ogallala Wells
Notification Process

- The Pantex Groundwater Data Verifier
  - Reviews laboratory data packages and qualifies data as needed
  - Forwards results to the Pantex Groundwater Media Scientist for review

- The Pantex Groundwater Media Scientist
  - Conducts data usability review
  - Informs the Pantex Environmental Program Department Manager of the results of data usability review

If an unexpected condition is determined to exist:

- The Pantex Environmental Program Department Manager
  - Informs the Pantex Environmental Program Division Manager
  - Informs the Environmental Program Community Liaison
  - Informs the Pantex Utilities Department Manager if potential impact to Plant water supply wells.
  - Informs the OC

- The Pantex Environmental Program Division Manager
  - Informs the Pantex General Manager
  - Informs the Pantex Law Manager
  - Informs the Pantex Communications Manager
  - Informs the USDOE/NNSA NPO Environmental Management Groundwater Representative
  - Informs the USDOE/NNSA NPO Environmental Manager (who informs the NPO Site Manager)
  - Informs TCEQ Region I and executive director
  - Informs EPA Region 6
  - Informs the Agency for Toxic Substances and Disease Registry (ATSDR) of condition if determined to pose a risk not evaluated in the previous assessment

- The Pantex Environmental Program Community Liaison
  - Coordinate with the USDOE/NNSA Public Affairs Officer, TCEQ and EPA to notify news media, if needed
  - Prepare notification for potentially affected public and private water well users

- The Pantex Communications Manager
  - Prepares facts sheets, news releases and contacts the Media, in accordance with the outcome of the Pantex Environmental Program Community Liaison's coordination activities

- The Pantex Groundwater Media Scientist
  - Contacts TCEQ Region I and EPA to determine co-sampling requirements

- The Pantex Groundwater Media Scientist
  - Issues a special sample request to confirm exceedances/significant results

(See notification table on next page.)

Ogallala Wells Notification Table		
Result	**Procedure**	**Timeframe**
Result ≥ GWPS	***Inform*** TCEQ executive director and Region 1, and EPA Region 6 of a first-time or subsequent new analyte exceedance and intent to resample	*24 hours, phone and 10 day written
	Inform public or private users of affected or potentially affected water wells of a first-time or subsequent new analyte exceedance when the result is for a well within ½ mile of property boundary associated with subject result (prepare drinking water survey report in accordance with TCEQ RG-428)	*24 hours, verbal and 10 day written
	Inform the Utilities Department Manager of result	*24 hours
	Optional - Coordinate with the USDOE/NNSA Public Affairs Officer, TCEQ and EPA to notify news media, if needed	7 days
	Resample to confirm exceedance and determine co-sampling requirements with TCEQ Region I and EPA (*Optional - Have lab re-analyze sample*)	30 days (notify verbally and by e-mail at least 14 days before resample)
	Notify (upon confirmation) the Operations Center, public or private users of affected or potentially affected water wells when the result is for a well within ½ mile known contaminant boundary or within ½ mile of property boundary associated with subject result	24 hours from confirmation, verbal, 10 days written
	Notify TCEQ executive director and Region I, EPA, and PGWCD NO. 3	24 hours from confirmation, verbal, 10 days written
	Notify ATSDR	10 days, written
	Submit drinking water survey report in accordance with TCEQ RG-428 to TCEQ executive director and EPA	20 days

* Timeframe begins when the Pantex Groundwater Media Scientist determines that confirmed results are usable and validated.

Ogallala Wells Notification Table		
Result	**Procedure**	**Timeframe**
PQL/Background ≤ Result < GWPS	***Notify*** TCEQ executive director and Region 1, and EPA of need to resample to confirm result	14 days before resample verbally and by e-mail
	Resample or re-analyze to confirm result	30 days
	Inform (upon confirmation) TCEQ and EPA of resample	24 hours, verbal
	Inform TCEQ executive director and EPA Region 6	10 days written from confirmation, verbal
	Inform affected or potentially affected public or private water wells if water well is within 1/2 mile of known contaminant boundary or within 1/2 mile of property boundary associated with subject result. Utilities Department Manager if Plant water supply is within 1/2 mile of known contaminant • First-time analyte detection • Near GWPS • Significantly higher than historical • Trending significantly higher	10 days written from confirmation, verbal
	Notify TCEQ executive director and Region I, EPA, and PGWCD No.3	10 days written from confirmation, phone or e-mail and written
	Coordinate with the USDOE/NNSA Public Affairs Officer, CNS Public Information Coordinator, TCEQ and EPA to notify new media, if needed	10 days from confirmation
	Report (hardcopy) results to TCEQ executive director and Region I, and EPA	Annual, written

GWPS = Groundwater Protection Standard
PQL = Practical Quantitation Limit