Pantex Plant

Final
Five-Year Review Report

First Five-Year Review Report

Remedial Action Progress

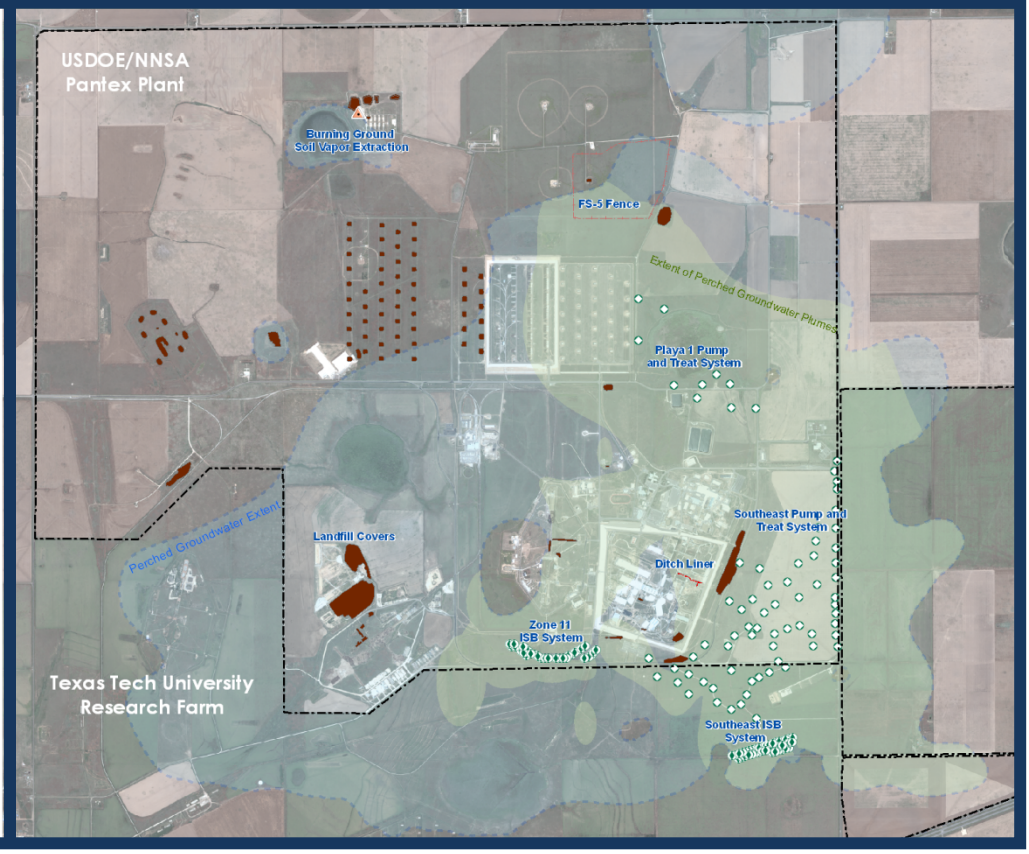
Pantex Plant

August 2013

Pantex Plant
FM 2373 and U.S. Highway 60
Carson County
P.O. Box 30030

EPA ID No. TX4890110527
RN 100210756 (Pantex Plant)
CN 600125009 (USDOE/NNSA)

Pantex Plant Remedial Action Systems



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS TX 75202-2733

November 8, 2013

Mr. Kenneth A. Hoar
Assistant Manager for Environment, Safety and Health
U.S. Department of Energy
NNSA Production Office – Pantex
P.O. Box 30030
Amarillo, Texas 79120

Mr. Dennis E. Huddleston
Projects Division Manager
Babcock & Wilcox Technical Services Pantex, LLC
P.O. Box 30020, M/S T9-130
Amarillo, TX 79120

Re: USDOE/NNSA Pantex Plant (EPA ID# TX7572024605)
First Five-Year Review

Dear Mr. Hoar and Mr. Huddleston,

The attached First Five-Year Review Memorandum documents the U.S. Environmental Protection Agency's (EPA's) concurrence with the protectiveness determinations in the first Five-Year Review for the U.S. Department of Energy (USDOE)\National Nuclear Security Administration (NNSA) Production Office Pantex Plant Superfund Site (EPA ID# TX4890110527). The USDOE/NNSA findings and recommended actions are summarized in the EPA Memorandum, signed September 27, 2013. All remedial components are in place for the site, including the institutional controls necessary to ensure continued protectiveness for human health and the environment. Long-term remedial actions to address ground water contamination (Perched Aquifer) will be ongoing.

The USDOE/NNSA, as lead agency for Pantex Plant Superfund project, with support from Babcock & Wilcox Technical Services Pantex, LLC (B&W Pantex), conducted this review and submitted the final Five-Year Review (signed by USDOE/NNSA and B&W Pantex on August 22, 2013). The next Five-Year Review is scheduled for September 2018. Should you have any questions pertaining to this letter or the attached Memorandum, please contact Camille Hueni of my staff at hueni.camille@epa.gov or (214) 665-2231.

Sincerely Yours,

Cathy Gilmore

for Charles Faultry
Associate Director
Remedial Branch

Attachment

Cc: Camille Hueni, EPA Region 6
Carlos Sanchez, EPA Region 6
Kristy Livingston, TCEQ
Monica Harris, TCEQ

EPA Region 6 First Five-Year Review Memorandum

U. S. Department of Energy/National Nuclear Security Administration (USDOE/NNSA)
Pantex Plant Superfund Site
EPA ID No. TX4890110527
FM 2373 and U.S. Highway 60
Carson County, Texas

Introduction

The U.S. Environmental Protection Agency (EPA) First Five-Year Review Memorandum documents the performance, determinations and approval of the U.S Department of Energy/National Nuclear Security Administration (DOE/NNSA) Pantex Plant Superfund Site First Five-Year Review, including the attached *Final First Five-Year Review Report (August 2013) Vol. 1: Text,* and supporting documents. USDOE/NNSA presents a comprehensive Five-Year Review that evaluates the progress to meet the Remedial Action Objectives for the ground water project and assesses whether the selected remedy, for soils and ground water, is protective of human health and the environment. This Memorandum summarizes and cites details of the *First Five-Year Review Report*. In the final report, USDOE/NNSA identified the following issues with recommendations:

Remedy Performance

1. **Ground Water: Plumes of high explosives (primarily RDX) are expanding east of FM 2373 and in the southeast lobe of the perched aquifer.**
   Recommendation: 1) Evaluate effects of the remedial actions on this portion of the perched aquifer as part of each annual progress report. 2) Perform aquifer tests on PTX06-1146 and PTX06-1147 in FY14 to improve hydrogeologic understanding and anticipated effectiveness of options for expanding the existing Southeast Pump and Treat System (SEPTS). 3) Collect and evaluate data to estimate the site-specific rate of natural attenuation for risk driving contaminants like RDX and TNT to determine if natural attenuation is a viable part of the groundwater remedy.

   Affects current protectiveness: No
   Affects future protectiveness: Yes

2. **Ground Water: Incomplete treatment of contaminants (high explosives and hexavalent chromium) downgradient of the west end of the SEISB (at PTX06-1153).**
   Recommendation: Collect and analyze data from the newly installed monitor well northwest of the system to better assess groundwater flow paths at the west end of the Southeast In-Situ Bioremediation (SEISB). Decide if water is flowing through the well field or around the end and determine a path forward based on results.

   Affects current protectiveness: No
   Affects future protectiveness: Yes

Changed Site Conditions

3. **Ground Water: Other metals solubilized as a result of both ISB treatment zones (arsenic, barium, manganese) could result in residual risk.**
   Recommendation: Continue monitoring for metals solubilized by In-Situ Bioremediation (ISB) Systems (arsenic, barium, and manganese) in Zone 11 and Southeast (SE) Perched Aquifer to determine the fate downgradient of the treatment zones and confirm the expectation of attenuation. Include changes to the Sampling and Analysis Plan needed to evaluate the potential for migration to the Ogallala Aquifer.

   Affects current protectiveness: No
   Affects future protectiveness: Yes

4. **Ground Water: Plumes of TCE and perchlorate extend north and west of the Zone 11 ISB treatment zone.**
   Recommendation: Collect and analyze data from installed wells to assess hydrogeologic conditions north and west of the Zone 11 ISB System. Recommend a path forward based on results of the analysis for enhancing this remedy.

   Affects current protectiveness: No
   Affects future protectiveness: Yes

5. **Soils: Vegetation on the protective covers has been impacted by drought conditions.**
   Recommendation: Develop and implement a phased plan to address more recent problems with vegetation loss associated with extreme drought conditions in 2011 and 2012. This will ensure that erosion of the protective covers does not occur.

   Affects current protectiveness: No
   Affects future protectiveness: Yes

6. **Soils: Ecological risk assessment for Firing Site 5 was performed before the TCEQ Guidance was issued. This guidance would require the depression east of Firing Site 5 to be included in the assessment.**
   Recommendation: Perform assessment of the depression east of Firing Site 5 per the TCEQ Ecological Risk Assessment Guidance.

   Affects current protectiveness: No
   Affects future protectiveness: No

7. **Ground Water: Cadmium concentrations exceeded the MCL in 2011 beneath Zone 12 South (WMG 6/7) at PTX06-1010.**
   Recommendation: Concentrations of cadmium should be monitored at PTX06-1010 and downgradient well PTX06-1088 to ensure that the source of the original detection depletes as expected.

Affects current protectiveness: No
Affects future protectiveness: No

8. **Ground Water: Detections of hexavalent chromium in Zone 11 (PTX08-1005).**
Recommendation: While hexavalent concentrations are still slightly below the Ground Water Protection Standards (GWPS), data from monitor wells in the area will need to be evaluated and trended in the future to determine if the chromium persists.

Affects current protectiveness: No
Affects future protectiveness: No

9. **Ground Water: Detections of 1,4-dioxane in Zone 11 ISB.**
Recommendation: Concentrations of 1,4-dioxane in and near the Zone 11 ISB should be monitored to evaluate the effect of the system on this compound and trend concentrations. Include changes to the Sampling and Analysis Plan needed to evaluate the potential for migration to the Ogallala Aquifer.

Affects current protectiveness: No
Affects future protectiveness: No

The USDOE/NNSA also recommended the following actions for remedy optimization and monitoring [no impact to ongoing protectiveness of the remedy]:

Soil Remedy
- Update Worker Protection Values for se in SWMU Interference Process;
- Establish criteria for ceasing SVE system operations at the Burning Grounds;

Ground Water Remedy
- Ensure Pump and Treat Systems (PTS) operational priorities focus on reducing reliance on injection of treated water back into the perched aquifer;
- Evaluate addition of another extraction well (or two) to improve consistency of achieving throughput goals at the Playa 1 Pump and Treat System (PTS);
- Shorten time between amendment injections for the SEISB; monitoring data indicates that two years is too long;

Long-term Monitoring (LTM) Network
- Consider recommendations for improving early detection monitoring of the Ogallala (of the overlying perched aquifer contaminants);
- Update the LTM Network design and Sampling and Analysis Plan documents to capture changes approved and implemented in 2012 and recommendations from the Review to be implemented;

Institutional Controls
- Finalize well Maintenance Plan to ensure continued inspection, maintenance and repair of system and monitoring wells;

Community Involvement
- Implement measures to better inform neighbors of the Remedial Actions.

Summary of the First Five-Year Review Findings

The U.S. Department of Energy/National Nuclear Security Administration (USDOE/NNSA), as lead agency for Pantex Plant, Carson County, Texas, conducted the First Five-Year Review ("Review") from June 4, 2012 to December 14, 2012. The findings and conclusions are summarized in the attached *Final First Five-Year Review Report (August 2013) Vol. 1: Text.* The *Volume 2*, contains the site inspection details, interviews, and the public notice for the review. Stand-alone evaluations of different aspects of the remedy further supported the review and conclusions summarized in the *Report, Vol. 1.* Those reports included:

- Sampling Evaluation for High Plains (Ogallala) Aquifer Monitoring Wells (RPS Espey; September 2012);
- Groundwater Remedy Effectiveness Evaluation for the CERCLA Five-Year Review (Trihydro; November 2012);
- CERCLA Five-Year Review Institutional Controls (ICs) Review (Sapere Consulting; November 2012);
- Groundwater Monitoring Network Optimization 2012 (GSI Environmental Inc., August 2012).

The Five-Year Review is required by Section 121(c) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. §9621(c), which requires that a periodic review be conducted no less often than every five years after the initiation of remedial action at sites where hazardous substances, pollutants or contaminants will remain onsite above levels that allow for unlimited use and unrestricted exposure. The First Five-Year Review for this site was triggered by implementation of remedial action by the 2008 Record of Decision (ROD), signed on September 25, 2008. The Sitewide ROD included all remedial actions taken for the site, including those taken as interim corrective measures under the Texas Commission on Environmental Quality's (TCEQ) Resource Conservation and Recovery Act (RCRA) Corrective Action authority, as well as those implemented under EPA's CERCLA authority. [Pantex Plant is a joint authority site.] Based on consensus to include all environmental actions in the Sitewide ROD, the Five-Year Review evaluates all those investigation sites at Pantex Plant, where contaminants were left in place at concentrations above levels appropriate for unrestricted use. The remedial design and construction was achieved in 2009. The site is now in the long-term operation and maintenance phase.

This Five-Year Review evaluates the status of actions, taken for both soils and ground water, and the ongoing effectiveness of Institutional Controls implemented for impacted properties. The Remedial Action Objectives (RAOs) for the Selected Remedy as defined in the ROD are:

RAOs: Soils

- Reduce the exposure risk to onsite industrial and construction/excavation workers through removal, treatment, or prevention of contact with constituents of concern (COCs) in the soil.
- Reduce potential impact to perched groundwater and the Ogallala Aquifer (also referred to as the High Plains Aquifer) through source abatement and stabilization/control measures in the vadose zone.

RAOs: Perched Ground Water

- 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.
- The components of the Selected Remedy addressed both the soil sites requiring a remedial response and the perched ground water contaminants in two focus areas, the Southeast Area and Zone 11.

Selected Remedy: Soils

The Selected Remedy for soils containing contaminants at concentrations that do not allow for unrestricted access and unlimited use includes:

- Presumptive Remedy of Soil Vapor Extraction (SVE) and Institutional Controls (ICs) for SWMU 47 at the Burning Ground.
- Protective Covers for the Burning Ground Former Ash Disposal Trench (SWMUs 14-24), the former operational area of Firing Site 5 (SWMU 70) and Pantex Plant landfills (consisting of 27 units).
- Ditch Liners for Zone 12 ditches (SWMU 2 and SWMU 5/5).
- ICs for select sites (Limited Action Soil Units, Burn Pads 11 through 13 (SWMUs 25, 26 and 27), and the Main Perimeter Ditch (SWMU 5/12a)).

Selected Remedy: Ground Water

The Selected Remedy for the Southeast Area and Zone 11 perched ground water includes:

- Two Pump and Treat Systems: the Southeast Pump and Treat System (SEPTS) and the Playa 1 Pump and Treat System (P1PTS) for the SE Area.
- In-situ Bioremediation Systems to treat high explosive (HE) contaminants (and hexavalent chromium) for the Southeast Area and trichloroethene (TCE) and perchlorate contaminants for Zone 11.
- ICs to prevent exposure to contaminants and cross-contamination to the regional Ogallala Aquifer for both the SE Area and Zone 11.

Remedial Action Performance

The site-wide remedy for the Pantex Plant is functioning as intended for the short-term. All soil remedies are performing as designed and expected. The ICs and engineered controls (e.g., fencing, protective covers, and ditch liner) currently protect workers and the general public from exposure to soil by restricting access and from impacted perched groundwater by restricting use, drilling and access. These measures are expected to continue to be protective. The SVE is removing soil gas and residual Non-Aqueous Phase Liquids (NAPLs) in soils to protect the underlying drinking water aquifer. A Burning Ground SVE Performance Monitoring approach will be developed to define expected conditions, as well

as an exit strategy to close operations. Ground water monitoring indicates the system has been effective in meeting the objective of protecting the underlying Ogallala Aquifer. Access to the area is restricted in accordance with established ICs, thereby preventing exposure.

Protective covers for landfills continue to prevent exposure to contaminants and prevent the eventual migration of rainfall, through contaminated soils, to the underlying ground water. Programs are in place to repair the protective covers by filling holes and controlling burrowing animals as part of ongoing maintenance. Pantex is developing a plan to address vegetation loss associated with extreme drought conditions in 2011 and 2012 to ensure that covers continue to be protective. The ditch liner has been effective at preventing infiltration of water through the ditch soil contaminants. Due to excessive sedimentation that could not be completely flushed in 2010, Pantex replaced the ballast system originally installed in the bottom of the liner with a flat-plate anchoring system to improve maintenance.

Ground water monitoring, for both the impacted Perched Aquifer and the underlying Ogallala, has demonstrated that the ground water remedy (fully implemented in 2009) is performing as expected and concentrations of COCs and water levels are declining in most areas. The Playa1 Pump and Treat System (P1PTS) reduces the flux to the Southeast Pump and Treat System (SEPTS) and the down-gradient edge of the perched ground water and the Southeast In-Situ Bioremediation area (SEISB). The SEISB treats water that is moving into a limited saturated zone of the perched aquifer that is sensitive to vertical migration. The effects of each system are intended to combine synergistically to achieve the RAOs and eventually long-term protectiveness through cleanup of the perched groundwater.

The two pump and treat systems (SEPTS and P1PTS) are operating and functioning as designed. The SEISB is creating and maintaining an anaerobic treatment zone that is generally treating the target COCs to concentrations below the ground water cleanup goals. However, portions of Southeast Area, a southeast "lobe" and the area east of FM2373, are not under the short- or long-term influence of the SEPTS due to limiting hydrogeologic conditions. The impacted ground water, in this area, is expected expand and to remain outside the influence of the existing remedial systems. Therefore, aquifer testing is needed to evaluate the hydrogeologic constraints in the area east of FM 2373 and options for expanding the existing SEPTS to this area. Natural attenuation appears to be addressing high explosive (HE) contamination to some degree in those areas outside the influence of the active remedies, as breakdown products for the primary risk driver (RDX) have been detected in most of the southeast plume. Pantex is currently collecting data that should lead to improved quantification of natural attenuation in the perched aquifer in the future. Evaluation of this data will be continued to determine if a natural attenuation component to the current ground water remedy would be feasible.

The SEISB and Zone 11 ISB (ZN11ISB) systems are currently meeting the design objective of creating and maintaining anaerobic treatment zones capable of reducing the target COCs to concentrations below the ground water cleanup goals down-gradient of the ISB treatment zones. While performance monitoring for the Zone 11 ISB has not yet demonstrated attainment of the ground water protection standards for TCE, the current decreasing trend in concentration is expected as TCE concentrations move through the treatment zone and are degraded.

EPA Comments on the First Five-Year Review

The EPA comments and USDOE/NNSA responses on the Draft Final *Five-Year Review Report, First Five Year Review of the Remedial Action Progress for the Pantex Plant (December 2012)* are included as an attached file to this Memorandum. The Five-Year Review was revised to address these comments and those of TCEQ. The USDOE/NNSA responses are adequate and addressed each concern.

Actions Needed

The Five-Year Review indicates that the Selected Remedy is performing as intended and is protective of human health and the environment in the short-term. In particular, there are four issues identified that could impact the long-term protectiveness of the ground water remedy: plumes of TCE and perchlorate extend north and west of the west side of the ZN11ISB; there is incomplete treatment of contaminants down-gradient of the west end of the SEISB (PTX06-1153); plumes of high explosives (primarily RDX) are expanding east of FM2373 and in the far southeast part of the Perched Aquifer; and other metals currently detected in both ISB treatment zones.

Also, future monitoring will be required to evaluate increasing concentrations of 1, 4 dioxane at the ZN11ISB; to evaluate the occurrence of new perched ground water contaminants (cadmium in Zone 12 South; hexavalent chromium near ZN11ISB; metals solubilized in the ISB treatment zones). These issues are fully discussed in Sections 7, 8, and 9 of the Review (Vol. 1). Section 9 (Table 9-1)identifies each issue, recommendations and follow-up actions, impact to short- and long-term protectiveness, and a milestone date to complete each action. Table 9-2 similarly addresses recommendations for remedy optimization and monitoring. These issues and actions were fully discussed with USDOE/NNSA and their contractor, B&W Technical Services Pantex, LLC, as well as the path forward to meet milestones. If natural attenuation is verified as an ongoing viable process to further reduce contaminant concentrations, that process will be considered and proposed as a component of the current remedy. Natural attenuation was not part of the 2008 ROD remedy (for the perched ground water).

The Pantex 2008 ROD set a ground water protection standard of 26 ug/L for perchlorate using residential site-specific parameters. On January 8, 2009, EPA issued guidance recommending the use of 15 ug/L as a preliminary remediation goal (PRG) for perchlorate. This EPA guidance also promoted the consideration of appropriate State standards. The 15 ug/L ground water remediation goal is based on an EPA interim Drinking Water Health Advisory. The Texas Risk Reduction Program established a residential ground water protection concentration level (PCL) of 17 ug/L for perchlorate based upon 30 TAC § 350.74(a). The EPA PRG and the Texas residential PCL are both more stringent than 26 ug/L. The EPA also announced in 2011 its decision (*See* 76 Fed. Reg. 7762-7767) to regulate perchlorate under the Safe Drinking Water Act, and is in the process of developing a maximum contaminant level (MCL) for perchlorate. In light of the above information, the USDOE/NNSA should continue to reassess and re-evaluate whether the perchlorate standard utilized here remains protective.

Determination

In summary, the remedy at the Pantex Plant currently protects human health and the environment because:

- All soil remedies are functioning as designed and performing as expected.
- Risk of exposure to contaminated soils and affected perched groundwater is being minimized through contact prevention (maintenance and enforcement of institutional controls).
    - Access to contaminated surface soil is prevented through a combination of protective covers, fencing, and other access controls associated with the active mission of the site.
    - Access to contaminated perched groundwater is prevented through a combination of use, drilling, and access restrictions.
- The pump and treat systems continue to reduce saturated thickness of the perched aquifer, thus reducing the potential for vertical movement of affected perched ground water to the underlying Ogallala Aquifer.
- The Southeast ISB system is reducing COC concentrations below ground water cleanup levels in an area sensitive to vertical movement of affected perched ground water to the underlying Ogallala Aquifer.
- The Zone 11 ISB has established a reducing zone, which has decreased perchlorate to concentrations below ground water cleanup levels, and appears to be reducing TCE concentrations down-gradient of the treatment zone.

However, in order for the remedy to be protective in the long-term, the following actions need to be implemented:

- Continue operation and maintenance of the soil remedies to prevent exposure and also infiltration that would result in vertical migration of contaminants to underlying ground water;
- Operate and maintain groundwater remedies to continue progress to meet cleanup standards in the perched aquifer. Although significant progress has been achieved in just a few years Contaminants of Concern (COC) concentrations have not yet been significantly reduced except in areas near the ISB systems;
- Prevent growth of perched ground water contaminant plumes. Perched groundwater COC plumes continue to move and/or expand down-gradient, in the east and in the southeastern lobe of the perched aquifer. While perched groundwater is expanding slightly, as predicted through fate and transport modeling, options for modifying the existing extraction system to extend active remediation should be evaluated for the part of the perched groundwater east of FM 2373;
- Continue to maintain and enforce the established institutional controls to restrict access, use of perched ground water, and drilling;

- Address the issues discussed in the Five-Year Review Section 8 (Table 8-1); Section 9 (Table 9-1); and Table 9-2 (Recommendations for Remedy Optimization and Monitoring) by implementing the follow-up actions identified for each.

The EPA concurs that the results of the First Five-Year Review indicate that the selected remedy is performing as intended and is protective of human health and the environment in the short-term because there is no completed exposure pathway to human or environmental receptors for soil or perched ground water. Access to contaminated surface soil is prevented through a combination of protective covers, fencing, and other access controls associated with the active mission of the site. Access to contaminated perched groundwater is prevented through a combination of use, drilling, and access restrictions. In order to achieve long-term protectiveness of human health and the environment, operation and maintenance of the remedial action systems must continue and enhancements to existing systems need to be evaluated, planned and implemented to address the aforementioned issues.

Approved by:

for

Carl E. Edlund, P.E., Director
Superfund Division
U.S. Environmental Protection Agency, Region 6

9/27/13
Date

Routing and Concurrence Slip | **Begin Routing Date:** 09/24/2013

Routing Status: High

To: (Name, office symbol, route number, building, Agency/Post	Initials	Date
1. Camille Hueni /s Carlos Sanchez	CS	09/24/2013
2. Carlos Sanchez	CS	09/24/2013
3. John Meyer /s Carlos Sanchez	CS	09/24/2013
4. Charles Faultry Stephanie Delgado	CF	09/25/2013
5. George Malone	GM	09/26/2013
6. Mark Peycke	MP	09/26/2013
7. Stephanie Delgado		
8.		

Office:	☐ Remedial Branch - Arkansas/Texas Section
Tracking Category:	☐ Five-Year Review
Enforcement Confidential:	○ Yes ● No
Email Subject:	Pantex Five Year Review Memo
Due Date:	09/27/2013
DD/DDD Assigned:	
DD/DDD Status:	Pending
DD/DDD Remarks:	
Front Office Assigned:	

☐ Action	☐ Coordination	☐ Justify	☐ Signature
☐ Approval	☐ File	☐ Note and Return	☐ AD Signature
☐ As Requested	☐ For Clearance	☐ Per Conversation	☒ DD/DDD Signature
☐ Circulate	☐ For Correction	☐ Prepare Reply	☐ RA Signature
☐ Comment	☐ For Your Information	☐ Review	
☒ Concurrence	☐ Investigation	☐ See Me	

Remarks:

From: (Name, org, symbol, Agency/Post)
Carlos Sanchez

Room No./Bldg: 6SF-RA
Phone Number: 214.665.8507

Choose EDIT document and turn on Track changes in WORD.
Remember to SAVE the Word Document before exiting Word.

Then Click on Save & Exit or Save and Route Next.
Otherwise your changes will not be saved.

For Signature : Choose EDIT document	- Pantex First 5YR Review Memorandum 09252013Final.docx
Inquiry/Supporting Documents:	- Pantex 5YR Vol 1 - Final Rpt - Main Text - Aug 2013.pdf - EPA Comments 08112013 Pantex 5YR.pdf
Final Document(s):	

DO NOT ATTACH DOCUMENTS BELOW HERE!
USE THE ATTACH DOCUMENT BUTTON!

Bryan W. Shaw, Ph.D., *Chairman*
Carlos Rubinstein, *Commissioner*
Toby Baker, *Commissioner*
Zak Covar, *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

October 8, 2013

Mr. Kenneth A. Hoar
Assistant Manager for Environment, Safety & Health
U.S. Department of Energy
NNSA Production Office – Pantex
P.O. Box 30030
Amarillo, Texas 79120-0020

Re: Approval- *Final Five-Year Review Report,* dated August 2013
U.S. Department of Energy (DOE), Pantex Plant, FM2373 and U.S. Highway 60, P.O. Box 30030, Amarillo, Texas, 79120
TCEQ Solid Waste Registration (SWR) No. 30459
TCEQ Hazardous Waste Permit No. HW-50284, CN600125009, RN100210756

Dear Mr. Hoar:

The Texas Commission on Environmental Quality (TCEQ) has reviewed and approved the referenced report. TCEQ Comments on the draft report have been fully and adequately addressed in the final report.

Questions concerning this letter should be directed to me at (512) 239-2252 or kristian.livingston@tceq.texas.gov. When responding by mail, please submit an original and one copy of all correspondence and reports to the TCEQ Remediation Division at Mail Code MC-127. An additional copy should be submitted to the local TCEQ Region Office. Please note that the Remediation Division sends letters via email when appropriate. Therefore, current email addresses and the site identification information in the reference block should be included in all future submittals.

Sincerely,

K. M. Livingston

Kristy M. Livingston, Project Manager
Team 1, VCP-CA Section
Remediation Division

KML/mdh

cc: Ms. Camille Hueni, Remedial Project Manager, USEPA Region 6
Mr. Dennis Huddleston, BWXT-Environmental Projects and Operations
Mr. Jim McWilliams, Project Manager, TCEQ Region 1 Office, Amarillo

First Five-Year Review Report

Remedial Action Progress

For Pantex Plant

Prepared By:
Babcock & Wilcox Technical Services Pantex, LLC (B&W Pantex)
For
U.S. Department of Energy/National Nuclear Security Administration
NNSA Production Office

CERTIFICATION STATEMENT

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Dennis Huddleston 22 August 2013

Dennis E. Huddleston Date
Projects Division Manager
Babcock & Wilcox Technical Services Pantex, LLC

8/22/2013

Kenneth A. Hoar, Assistant Manager Date
for Environment, Safety, Health & Quality
U. S. Department of Energy
National Nuclear Security Administration
NNSA Production Office

First Five-Year Review
in Support of Pantex Plant Interagency Agreement
and Compliance Plan No. 50284
for the Pantex Plant, Amarillo, Texas
August 2013

Prepared by:

Babcock & Wilcox Technical Services Pantex, LLC (B&W Pantex)
P.O. Box 30020
Amarillo, Texas 79120

In accordance with 30 TAC §335.553 (g), this report has been prepared and sealed by an appropriately qualified licensed professional engineer or licensed professional geoscientist.

Matthew W. Jones, Ph.D., P.E.
B&W Pantex

8/22/13
Date

Project Team

B&W Pantex: Martin Amos, Michelle Jarrett, Dr. Matthew Jones, Matt Monroe

GSI Environmental, Inc: Dr. Mindy Vanderford

RPS Espey: Dr. Jeff Stovall and Dr. Victoria Harkins

Sapere Consulting, Inc: Kirsten Gable, Courtney Fairbrother

Trihydro Corporation: Dr. Wilson Clayton, Fritz Krembs

ES-1 Executive Summary

The U.S. Department of Energy/National Nuclear Security Administration (USDOE/NNSA) has conducted the first five-year review (FYR) of the remedial action (RA) implemented at the Pantex Plant Superfund Site, in Carson County, Texas. The purpose of this FYR is to determine whether the selected remedy for the Pantex Plant is protective of human health and the environment. This review was conducted from June 4, 2012 to December 14, 2012 and its findings and conclusions are documented in this report.

ES-1.1 Background

The Pantex Plant is charged with maintaining the safety, security, and reliability of the nation's nuclear weapons stockpile. The Pantex Plant is a Federal Facility owned by the USDOE/NNSA and is managed by Babcock & Wilcox Technical Services Pantex, LLC (B&W Pantex).

Pantex Plant began as a conventional munitions and high explosives production facility in 1942. After World War II, the Site was deactivated and used for agricultural purposes until 1951. Since 1951, the property has been used as a nuclear weapons assembly/disassembly facility. Industrial operations occur primarily on about 2,000 acres in the central portion of the USDOE/NNSA-owned Site.

Historical waste management practices at the Site have included thermal treatment of explosives, explosive components and contaminated liquids and solvents (including test residues of explosives and depleted uranium); burial of industrial, construction, and sanitary waste in unlined landfills; disposal of solvents in pits or sumps; discharge of untreated industrial wastewaters to unlined ditches and playas; and the use of surface impoundments for the disposal of chemical constituents. These prior practices led to the release of both chemical constituents and radionuclides to the environment, specifically soil and perched groundwater.

The Site was listed on the National Priorities List in 1994. Investigation of the historic releases ensued and was completed in 2005. Human health and ecological risk assessments were conducted to focus the feasibility study on release areas and media requiring active remediation. In 2007, the Feasibility Study was completed and a Proposed Plan was issued in April 2008. Following public participation, a Record of Decision (ROD) was issued on September 25, 2008 identifying the Selected Remedy. Remedial design approval and construction completion were achieved in 2009. The Interim Remedial Action Report was finalized and approved in 2010, at which time long-term operation and maintenance activities began.

Since selection of the remedy in 2008, remedial actions were designed, constructed, and have been operated and maintained. Progress reports are submitted quarterly, complemented by a

comprehensive annual report that documents each calendar year's efforts toward achieving the remedial action objectives (RAOs). This is the first FYR conducted for the Pantex Plant Selected Remedy.

ES-2.1 Remedial Action Objectives

RAOs for the Selected Remedy as defined in the ROD are:

- **Soils**
  - Reduce the exposure risk to onsite industrial and construction/excavation workers through removal, treatment, or prevention of contact with constituents of concern (COCs) in the soil.
  - Reduce potential impact to perched groundwater and the Ogallala Aquifer (also referred to as the High Plains Aquifer) through source abatement and stabilization/control measures in the vadose zone.

- **Perched Groundwater**
  - 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.

ES-3.1 Selected Remedy

Site-wide RAs were established in the Final Pantex ROD, which is the single document for the Selected Remedy for all Solid Waste Management Units (SWMUs), Areas of Concern (AOCs), and Supplemental Verification Sites (SVSs) at Pantex. The Selected Remedy addresses all sites with commingled plumes and impacts to the perched groundwater beneath Pantex. Construction of the selected remedy was completed in June 2009.

The components of the Selected Remedy address both the soil sites requiring a remedial response and the perched groundwater contaminants in two focus areas, the Southeast Area and Zone 11.

The Selected Remedy for soils containing contaminants at concentrations that do not allow for unrestricted access and unlimited use is:

- Presumptive Remedy of Soil Vapor Extraction (SVE)[1] and Institutional Controls (ICs) for SWMU 47 at the Burning Ground.

[1] In the future, modifications to the SVE system may be necessary to effectively reduce the source term.

- Protective Covers for the Burning Ground Former Ash Disposal Trench (SWMUs 14-24), the former operational area of Firing Site 5 (SWMU 70) and Pantex Plant landfills (consisting of 27 units).
- Ditch Liners for Zone 12 ditches (SWMU 2 and SWMU 5/5).
- ICs for select sites (Limited Action Soil Units, Burn Pads 11 through 13 (SWMUs 25, 26 and 27), and the Main Perimeter Ditch (SWMU 5/12a)).

The Selected Remedy for the Southeast Area and Zone 11 perched groundwater is:

- Two Pump and Treat Systems: the Southeast Pump and Treat System (SEPTS) and the Playa 1 Pump and Treat System (P1PTS) for the SE Area.
- In-situ Bioremediation Systems to treat high explosive (HE) contaminants (and hexavalent chromium) for the Southeast Area and trichloroethene (TCE) and perchlorate contaminants for Zone 11.
- ICs to prevent exposure to contaminants and cross-contamination to the regional Ogallala Aquifer for both the SE Area and Zone 11.

Effectiveness of the Selected Remedy for the Pantex Plant Site is determined through groundwater monitoring implemented through a Long-Term Groundwater Monitoring Plan, developed as part the Remedial Design, in accordance with the Interagency Agreement (IAG). The monitoring network provides data for evaluation of both the soil and groundwater remedies.

ES-3.1.1 Soil Remedy Performance

All soil remedies are performing as designed and expected. Some minor deficiencies have been noted, but the deficiencies have not affected the ability to meet the RAOs.

The Burning Ground SVE system is operating as designed. The system is continuing to remove soil gas and reduce the mass of volatile organic compounds (VOCs) in the vadose zone. Groundwater monitoring indicates the system has been effective in meeting the objective of protecting the underlying Ogallala Aquifer. Access to the area is restricted in accordance with established ICs, thereby preventing exposure. A Burning Ground SVE Performance Monitoring approach will be developed to define expected conditions and a path towards determining when to cease operation, i.e. an exit strategy.

A new catalytic oxidation (CatOx) treatment unit was proposed in 2011 and installed in 2012 to address system improvements needed because of inefficiencies associated with break-through of previously used GAC units, as well as greater than anticipated Operation and Maintenance (O&M) costs. O&M costs for this system should decrease appreciably with the new CatOX unit as monitoring costs decrease and granular activated carbon replacement and regeneration costs

of the former system have been eliminated. Reduced future O&M costs will offset the initial cost to install the new CatOx unit within a few years.

Containment of landfill materials has been effective at preventing exposure to contaminants and protecting underlying groundwater. Programs are in place for repairing the protective covers by filling holes and controlling burrowing animals as part of ongoing maintenance. Pantex will develop and begin implementing a plan in 2013 to address vegetation loss associated with extreme drought conditions in 2011 and 2012 to ensure that erosion of the protective covers does not occur.

The ditch liner has been effective at preventing infiltration of water through the ditch soil contaminants. Due to excessive sedimentation that could not be completely flushed in 2010, Pantex replaced the ballast system originally installed in the bottom of the liner with a flat-plate anchoring system to allow for better maintenance. The new anchoring system will be evaluated with respect to maintenance in the next FYR.

ES-3.2.1 Groundwater Remedy Performance

The P1PTS reduces flux into the SEPTS, the SEPTS reduces flux into the Southeast ISB (SEISB) and to the downgradient edge of the perched groundwater, and the SEISB treats water that is moving into a limited saturated zone of the perched aquifer that is sensitive to vertical migration. The effects of each system are intended to combine synergistically to achieve the RAOs and eventually long-term protectiveness through cleanup of the perched groundwater.

The two pump and treat systems (SEPTS and P1PTS) are operating and functioning as designed. The SEISB is creating and maintaining an anaerobic treatment zone that is generally treating the target COCs to concentrations below the groundwater protection standards (GWPSs). However, portions of Southeast areas are not under the short-term influence of the SEPTS and may not be under the long-term influence due to limited saturated thickness or other limiting hydrogeologic conditions. It is likely that the area of influence will expand with time; however, it is unlikely that all of the down-gradient areas will be impacted by the pump and treat systems. Therefore, aquifer testing is needed to improve hydrogeologic understanding in the area east of FM 2373 to support evaluation of options for expanding the existing SEPTS. Natural attenuation appears to be addressing HE contamination to some degree in those areas outside the influence of the active remedies, as breakdown products for the primary risk driver (RDX) have been detected in most of the southeast plume. Pantex is currently collecting data that should lead to improved quantification of natural attenuation in the perched aquifer in the future. Ongoing evaluations of these data will be conducted to determine if future inclusion of Monitored Natural Attenuation (MNA) as a part of the Selected Remedy is appropriate.

The SEISB and Zone 11 ISB (ZN11ISB) systems are currently meeting the design objective of creating and maintaining anaerobic treatment zones capable of reducing the target COCs to

concentrations below the GWPSs. While performance monitoring for the Zone 11 ISB has not yet demonstrated attainment of the GWPS for TCE, it is expected that the decreasing trend will continue as the system continues to degrade the TCE in perched groundwater that moves through the treatment zone, as well as TCE that desorbs from the soil matrix.

ES-3.3.1 Remedial Action Performance

The site-wide remedy for the Pantex Plant is functioning as intended for the short-term. The ICs and engineered controls (e.g., fencing, protective covers, and ditch liner) currently protect workers and the general public from exposure to soil by restricting access and from impacted perched groundwater by restricting use, drilling and access. These measures are expected to continue to be protective. The SVE is removing soil gas and residual Non-Aqueous Phase Liquids (NAPLs) in soils to protect the underlying drinking water aquifer.

Groundwater monitoring has demonstrated that the groundwater remedy is performing as expected and concentrations of COCs and water levels are declining in most areas. Some regions of the perched aquifer are not responding yet, but are expected to respond in the long-term considering the continuing effect of the remedies and preliminary evidence of natural attenuation.

The Selected Remedy will continue to be implemented as designed during the next five years to allow for a more complete expression of its effects on the perched groundwater. Data will continue to be collected through the LTM network to assess natural attenuation to better define the long-term period of restoration. Specifically, the areas outside the influence of the active groundwater remedy, including perched groundwater east of FM 2373 and in the southeast lobe (where expansion of HE plumes has been noted), require continued collection of data to assess natural attenuation of HEs and other risk driving COCs to better understand timing associated with the long-term goal of achieving restoration of the perched aquifer. For the area east of FM 2373, aquifer testing data are also needed to support evaluation of options for expansion of the existing SEPTS.

Two other areas where the groundwater remedies need further evaluation and potential enhancement to achieve long-term protectiveness are the west end of the SEISB and the area north and west of the ZN11ISB. Unexpected hydrogeologic conditions and plume characteristics contributing to these issues will be addressed through continued evaluation to assess a path forward for cleanup and attainment of long-term protection.

ES-4.1 Conclusions and Recommendations

The FYR indicates that the Selected Remedy is performing as intended and is protective of human health and the environment. The recommendations and follow-up actions identified in this FYR should be addressed to ensure that the remedy will result in long-term protectiveness of human health and the environment.

The remedy at the Pantex Plant currently protects human health and the environment because:

- All soil remedies are functioning as designed and performing as expected.
- Risk of exposure to contaminated soils and affected perched groundwater is being minimized through contact prevention (maintenance and enforcement of institutional controls).
    - Access to contaminated surface soil is prevented through a combination of protective covers, fencing, and other access controls associated with the active mission of the site.
    - Access to contaminated perched groundwater is prevented through a combination of use, drilling, and access restrictions.
- The pump and treat systems continue to reduce saturated thickness of the perched aquifer, thus reducing the potential for vertical movement of affected perched groundwater and protecting the underlying Ogallala Aquifer.
- The Southeast ISB system is reducing COC concentrations below GWPS in an area sensitive to vertical movement of affected perched groundwater, thus protecting the underlying Ogallala Aquifer.
- The Zone 11 ISB has established a reducing zone, which has decreased perchlorate to concentrations below the GWPS, and appears to be reducing TCE concentrations downgradient of the treatment zone.

However, in order for the remedy to be protective in the long-term, the following actions need to be implemented:

- Continue operation and maintenance of the soil remedies.
- Operate and maintain groundwater remedies to continue achieving progress toward cleanup standards in the perched aquifer.
- Continue to maintain and enforce the established institutional controls to restrict access, use of perched groundwater, and drilling.
- Address the issues identified in the Five-Year Review Summary Form (Section ES-5.1) by implementing the follow-up actions identified for each.

ES-5.1 Five-Year Review Summary Form

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Pantex Plant Superfund Site		
EPA ID: 4890110527		
Region: 6	**State:** TX	**City/County:** Carson County

SITE STATUS	
NPL Status: Final	
Multiple OUs? No	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** USDOE/NNSA
Author name (Federal or State Project Manager): Kenneth A. Hoar
Author affiliation: USDOE/NNSA, NPO
Review period: June 4, 2012 – December 14, 2012
Date of site inspection: August 7 – 9, 2012
Type of review: Statutory
Review number: 1
Triggering action date: September 25, 2008 – ROD Signature
Due date *(five years after triggering action date)*: September 25, 2013

Five-Year Review Summary Form (continued)

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
Not Applicable.

Issues and Recommendations Identified in the Five-Year Review:				
Media Type: Soils	**Issue Category: Changed Site Conditions**			
	Issue: Vegetation on the protective covers has been impacted by drought conditions.			
	Recommendation: Develop and implement a phased plan to address more recent problems with vegetation loss associated with extreme drought conditions in 2011 and 2012. This will ensure that erosion of the protective covers does not occur.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	September 2014

Media Type: Soils	**Issue Category: Changed Site Conditions**			
	Issue: Ecological risk assessment for Firing Site 5 was performed before the TCEQ Guidance was issued. This guidance would require the depression east of Firing Site 5 to be included in the assessment.			
	Recommendation: Perform assessment of the depression east of Firing Site 5 per the TCEQ Ecological Risk Assessment Guidance.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	Federal Facility	EPA/State	April 2014

Five-Year Review Summary Form (continued)

Media Type: Groundwater	**Issue Category: Remedy Performance**			
	Issue: Plumes of high explosives (primarily RDX) are expanding east of FM 2373 and in the southeast lobe of the perched aquifer.			
	Recommendation: 1) Evaluate effects of the remedial actions on this portion of the perched aquifer as part of each annual progress report. 2) Perform aquifer tests on PTX06-1146 and PTX06-1147 in FY14 to improve hydrogeologic understanding and anticipated effectiveness of options for expanding the existing SEPTS. 3) Collect and evaluate data to estimate the site-specific rate of natural attenuation* for risk driving contaminants like RDX and TNT to determine if natural attenuation is a viable part of the groundwater remedy.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	Annually/September 2014

*Note: The 2008 Record of Decision did not officially include natural attenuation as part of the remedial action processes, pending collection and evaluation of additional information.

Media Type: Groundwater	**Issue Category: Changed Site Conditions**			
	Issue: Plumes of TCE and perchlorate extend north and west of the Zone 11 ISB treatment zone.			
	Recommendation: Collect and analyze data from installed wells to assess hydrogeologic conditions north and west of the Zone 11 ISB System. Recommend a path forward based on results of the analysis for enhancing this remedy.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	December 2013

Media Type: Groundwater	**Issue Category: Remedy Performance**			
	Issue: Incomplete treatment of contaminants (high explosives and hexavalent chromium) downgradient of the west end of the SEISB (at PTX06-1153).			
	Recommendation: Collect and analyze data from the newly installed monitor well northwest of the system to better assess groundwater flow paths at the west end of the SEISB. Decide if water is flowing through the well field or around the end and determine a path forward based on results.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	February 2014

Five-Year Review Summary Form (continued)

Media Type: Groundwater	**Issue Category: Changed Site Conditions**			
	Issue: Other metals solubilized as a result of both ISB treatment zones (arsenic, barium, manganese) could result in residual risk.			
	Recommendation: Continue monitoring for metals solubilized by ISB Systems (arsenic, barium, and manganese) in Zone 11 and SE Perched Aquifer to determine the fate downgradient of the treatment zones and confirm the expectation of attenuation. Include changes to the Sampling and Analysis Plan needed to evaluate the potential for migration to the Ogallala Aquifer.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	Federal Facility	EPA/State	Annually/January 2014

Media Type: Groundwater	**Issue Category: Changed Site Conditions**			
	Issue: Cadmium concentrations exceeded the MCL in 2011 beneath Zone 12 South (WMG 6/7) at PTX06-1010.			
	Recommendation: Concentrations of cadmium should be monitored at PTX06-1010 and downgradient well PTX06-1088 to ensure that the source of the original detection depletes as expected.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	Federal Facility	EPA/State	Annually

Media Type: Groundwater	**Issue Category: Changed Site Conditions**			
	Issue: Detections of hexavalent chromium in Zone 11 (PTX08-1005).			
	Recommendation: While hexavalent concentrations are still slightly below the GWPS, data from monitor wells in the area will need to be evaluated and trended in the future to determine if the chromium persists.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	Federal Facility	EPA/State	Annually

Five-Year Review Summary Form (continued)

Media Type: Groundwater	**Issue Category: Changed Site Conditions**			
	Issue: Detections of 1,4-dioxane in Zone 11 ISB.			
	Recommendation: Concentrations of 1,4-dioxane in and near the Zone 11 ISB should be monitored to evaluate the effect of the system on this compound and trend concentrations. Include changes to the Sampling and Analysis Plan needed to evaluate the potential for migration to the Ogallala Aquifer.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	Federal Facility	EPA/State	Annually/January 2014

Protectiveness Statement(s)
Include each individual OU protectiveness determination and statement. If you need to add more protectiveness determinations and statements for additional OUs, copy and paste the table below as many times as necessary to complete for each OU evaluated in the FYR report.

Media Type: Soil	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):* Not Applicable.
Protectiveness Statement: The soil remedy is in place and progressing as expected. It is currently meeting RAOs intended to prevent exposure and also prevent infiltration that would result in vertical migration of contaminants to underlying groundwaters. ICs are in place to restrict public access and potential for exposure. The remedy is expected to protect future groundwater resources.		
Media Type: Groundwater	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):* Not Applicable
Protectiveness Statement: The groundwater remedy is progressing as expected and is currently meeting RAOs intended to prevent exposure by restricting access, drilling and use. However, the remedy has not yet achieved RAOs that ensure protectiveness of future groundwater resources: 1. <u>Achieve cleanup standard for the perched groundwater COCs (i.e., restoration of the perched aquifer)</u> - Although significant progress has been achieved in just a few years, COC concentrations have not yet been significantly affected except in areas near the ISB Systems. 2. <u>Prevent growth of perched groundwater contaminant plumes</u> - Perched groundwater COC plumes continue to move and/or expand downgradient, in the east and in the southeastern lobe of the perched aquifer. While perched groundwater is expanding slightly, as predicted through fate and transport modeling, options for modifying the existing extraction system to extend active remediation should be evaluated for the part of the perched groundwater east of FM 2373.		

Five-Year Review Summary Form (continued)

Sitewide Protectiveness Statement (if applicable)	
For sites that have achieved construction completion, enter a site-wide protectiveness determination and statement.	
Protectiveness Determination: Protective	*Addendum Due Date (if applicable):* *Not Applicable*
Protectiveness Statement: Results of the five-year review indicate that the selected remedy is performing as intended and is protective of human health and the environment in the short-term because there is no completed exposure pathway to human or environmental receptors for soil or perched groundwater. Access to contaminated surface soil is prevented through a combination of protective covers, fencing, and other access controls associated with the active mission of the site. Access to contaminated perched groundwater is prevented through a combination of use, drilling, and access restrictions. In order to achieve long-term protectiveness of human health and the environment, operation and maintenance of the remedial action systems must continue and enhancements to existing systems need to be evaluated, planned and implemented to address the aforementioned issues.	

Contents

ES-1 Executive Summary 1
ES-1.1 Background 1
ES-2.1 Remedial Action Objectives 2
ES-3.1 Selected Remedy 2
ES-3.1.1 Soil Remedy Performance 3
ES-3.2.1 Groundwater Remedy Performance 4
ES-3.3.1 Remedial Action Performance 5
ES-4.1 Conclusions and Recommendations 5
ES-5.1 Five-Year Review Summary Form 7
1 Introduction 1-1
2 Site Chronology 2-1
3 Background 3-1
3.1 Land and Resource Use 3-1
3.2 History of Contamination 3-5
3.2.1 Historical Practices Leading to Chemical Contaminants 3-5
3.2.2 Historical Practices Leading to Radiological Contaminants 3-7
3.3 Site Investigation and Response Actions 3-8
3.3.1 Release Unit Status 3-9
3.4 Scope and Role of Response Actions 3-10
3.4.1 Past Response Actions 3-10
3.4.2 Remedial Actions for Pantex 3-11
3.5 Basis for Response Action 3-13
4 Remedial Actions 4-1
4.1 Remedy Selection 4-1
4.1.1 Remedial Action Objectives 4-2
4.2 Remedy Implementation 4-3
4.2.1 Soil Remedy Implementation 4-3

4.2.2 Groundwater Remedy Implementation 4-6
4.2.3 Institutional Controls Remedy Implementation 4-14
4.3 Systems Operation / O&M 4-15
4.3.1 Soils O&M 4-15
4.3.2 Groundwater O&M 4-18
4.3.3 Institutional Controls 4-29
5 Progress since Last Review 5-1
6 Five-Year Review Process 6-1
6.1 Administrative Components of the Five-Year Review Process 6-1
6.2 Community Notification and Involvement 6-2
6.3 Document Review 6-2
6.4 Data Review 6-3
6.4.1 Data Reviewed 6-3
6.4.2 Relevant Trends and Levels 6-3
6.4.3 Long Term Monitoring Network Recommendations 6-5
6.5 Site Inspection 6-6
6.6 Interviews 6-8
6.6.1 Input from General Public 6-8
6.6.2 Input from Adjacent Landowners 6-9
6.6.3 Input from Government Officials 6-9
7 Technical Assessment 7-1
7.1 Soil Remedies 7-1
7.1.1 Question A: Is the remedy functioning as intended by the decision documents? 7-1
7.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid? 7-3
7.1.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy? 7-5
7.2 Groundwater Remedies 7-5

7.2.1 Question A: Is the remedy functioning as intended by the decision documents? 7-5
7.2.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid? 7-13
7.2.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy? 7-19
7.3 Technical Assessment Summary 7-20
8 Issues 8-1
8.1 Protective Covers- Vegetation Loss 8-2
8.2 Ecological Risk Assessment – Changed Guidance 8-2
8.3 Plumes of High Explosives Expanding - East of FM 2373 8-2
8.4 Plumes of TCE and Perchlorate Expanding West of ZN11ISB 8-3
8.5 Incomplete Treatment SEISB 8-3
8.6 New Contaminants 8-4
8.6.1 Cadmium 8-4
8.6.2 Hexavalent Chromium 8-4
8.6.3 Metals Solubilized Through ISB Treatment 8-4
8.7 Increased Concentrations – 1,4-Dioxane 8-5
9 Recommendations and Follow-up Actions 9-1
10 Protectiveness Statements 10-1
11 Next Review 11-1

List of Attachments

1. Public Notices for the Pantex First Five-Year Review
2. References and Documents Reviewed
3. Site Inspection Checklist and Photos for the Pantex First Five-Year Review
4. Interview Records
5. Solid Waste Management Unit Status and Response Actions
6. Data Used in the First Five-Year Review
7. Soil Remedial Action Effectiveness
8. Groundwater Remedial Action Effectiveness Evaluation
9. COC Concentration Graphs, Trends, and Comparisons to Expected Conditions
10. Groundwater Hydrographs, Trends, and Comparisons to Expected Conditions
11. Perched Aquifer Monitoring Network Evaluation
12. High Plains Aquifer Monitoring Evaluation
13. Groundwater Data Evaluation
14. Risk Evaluation for the Pantex First Five-Year Review
15. Institutional Control Evaluation

List of Tables

Table 2-1. Chronology of Remedial Actions at Pantex Plant 2-1
Table 4-1. O&M Costs for Soil Remedies 4-18
Table 4-2. ISB Injection Events 4-24
Table 4-3. O&M Cost for the SEPTS 4-27
Table 4-4. O&M Costs for the P1PTS 4-27
Table 4-5. O&M Costs for the SEISB System 4-28
Table 4-6. O&M Costs for the ZN11ISB 4-28
Table 4-7. LTM Network O&M Costs 4-29
Table 4-8. ICs O&M Costs 4-30
Table 7-1. Potential Changes to Groundwater Cleanup Levels 7-16
Table 7-2. 1,4-Dioxane Risk Summary 7-17
Table 8-1. Issues Identified 8-1
Table 9-1. Recommendations and Follow-up Actions for Issues Identified in the FYR 9-3
Table 9-2. Recommendations for Remedy Optimization and Monitoring 9-6

List of Figures

Figure 1-1. Status of Remedial Action Units 1-5
Figure 1-2. Status of Groundwater Remedial Action 1-7
Figure 3-1. Pantex Plant Location and Site Features 3-3
Figure 3-2. Groundwater Beneath Pantex Plant 3-4
Figure 3-3. Perched Groundwater Extent and Major Constituent of Concern (COC) Plumes 3-6
Figure 4-1. SEPTS Extraction Wells and Conveyance Lines 4-7
Figure 4-2. P1PTS Extraction Wells and Conveyance 4-9
Figure 4-3. SEISB System Injection Well Field and Performance Monitoring Wells 4-11
Figure 4-4. ZN11ISB Injection Well Field and Performance Monitoring Wells 4-12
Figure 4-5. BGSVE System Operational Time 4-16
Figure 4-6. BGSVE VOC Recovery 4-16
Figure 4-7. SEPTS Operational Time vs. Target 4-19
Figure 4-8. SEPTS GPM and % Capacity 4-19
Figure 4-9. SEPTS GPD and % Capacity 4-20
Figure 4-10. Disposition of SEPTS Effluent 4-21
Figure 4-11. SEPTS Hexavalent Chromium Removal 4-21
Figure 4-12. SEPTS HE Removal 4-21
Figure 4-13. P1PTS Operational Time vs. Target 4-23
Figure 4-14. P1PTS Average GPM and % Capacity 4-23
Figure 4-15. P1PTS Average GPD and % Capacity 4-24
Figure 7-1. New Monitoring Wells Installed South of Zone 11 7-13

Acronyms and Abbreviations

AO	administrative order
AOC	area of concern
AR	administrative record
ARAR	applicable, relevant and appropriate requirement
B&W Pantex	Babcock and Wilcox Technical Services Pantex, LLC
BG	Burning Ground
BWXT	Babcock and Wilcox Technologies, LLC
CatOx	catalytic oxidation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CMS/FS	corrective measure study/feasibility study
COC	constituent of concern
COPC	constituent of potential concern
CP-50284	Compliance Plan No. 50284
DNT	dinitrotoluene
DNX	hexahydro-1,3-dinitroso-5-nitro-1,3,5-triazine
DU	depleted uranium
ERA	ecological risk assessment
FFA	Federal Facility Agreement
FGZ	fine-grain zone
FM	Farm-to-Market
FR	Federal Register
FS-5	Firing Site 5
FYR	Five-Year Review
GAC	granular activated carbon
gpd	gallons per day
gpm	gallons per minute
GSI	Groundwater Specialists, Inc.
GWPS	groundwater protection standard
HE	high explosive
HHRA	human health risk assessment
HMX	high melting explosive (cyclotetramethylene tetramine)
HQ	hazard quotient
HSWA	Hazardous Solid Waste Amendment
HW-50284	Hazardous Waste Permit No. 50284
IAG	Interagency Agreement
IC	institutional control
ICM	interim corrective measure
ISB	in situ bioremediation
ISM	interim stabilization measure

Acronyms and Abbreviations (continued)

ISPM	in situ performance monitoring
km	kilometer
lb	pound
LGWUCIP	Land and Groundwater Use Control Implementation Plan
LTM	long-term monitoring
MAROS	Monitoring and Remediation Optimization System
MCL	maximum contaminant level
Mgal	million gallons
MHC	Mason & Hanger Corporation
MNA	monitored natural attenuation
MNX	hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine
NAPL	non-aqueous phase liquid
NCP	National Contingency Plan
NPL	National Priority List
NWAR	nuclear weapon accident residue
O&M	operation and maintenance
OSTP	Old Sewage Treatment Plant
OU	operable unit
P1PTS	Playa 1 Pump and Treat System
PQL	practical quantitation limit
PRG	preliminary remediation goal
RA	Remedial Action
RAO	remedial action objective
RCRA	Resource Conservation Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
ROD	Record of Decision
RRR	Risk Reduction Rule
SEISB	Southeast ISB
SEPTS	Southeast Pump and Treat System
SVE	soil vapor extraction
SVS	supplemental verification site
SWDA	Solid Waste Disposal Act
SWMU	solid waste management unit
TAC	Texas Administrative Code
TCE	trichloroethene
TCEQ	Texas Commission on Environmental Quality
TLAP	Texas Land Application Permit
TNX	hexahydro-1,3,5-trinitroso-1,3,5-triazine

Acronyms and Abbreviations (continued)

TPDES	Texas Pollution Discharge Elimination System
TSWDA	Texas Solid Waste Disposal Act
TTRF	Texas Tech Research Farm
TTU	Texas Tech University
USC	United States Code
USDOE/NNSA	U.S. Department of Energy/National Nuclear Security Administration
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
WMG	waste management group
WWTF	wastewater treatment facility
ZN11ISB	Zone 11 ISB

1 Introduction

This five year review (FYR) was conducted to ensure that the remedial actions (RAs) for soils and groundwater at the Pantex Plant are protective of human health and the environment. The methods, findings, and conclusions of reviews of several projects are documented in this report, as well as any issues and recommendations to address them. This FYR is part of the Administrative Record (AR).

This is the first FYR for the Pantex Plant. The triggering action for this review is the Record of Decision (ROD) issued September 25, 2008. The U.S. Department of Energy/National Nuclear Security Administration (USDOE/NNSA) conducted this first FYR in accordance with requirements in the Pantex Plant Interagency Agreement (IAG) and the Pantex Compliance Plan (CP-50284) as well as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) [42 USC § 9621(c)], and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) [40 Code of Federal Regulation (CFR) § 300.400(O(4)(ii)]. Additionally, this document meets guidance set forth in the CERCLA FYR Guidance, (EPA 540-R-01-007). Per this guidance, USDOE/NNSA notified the public (Attachment 1) that the FYR had been initiated.

The USDOE/NNSA serves as the lead agency for conducting and reporting the findings of the FYR. B&W Pantex, the managing and operating contractor for the Pantex Plant, conducted the FYR and prepared the report. The FYR was conducted from June 4, 2012 through December 14, 2012 and this report documents the results of the review. The FYR schedule was implemented such that it would be approved within five years from the issuance of the ROD.

The purpose of the FYR is to:

- Evaluate the implementation and performance of the RAs at the Pantex Plant,
- Determine if the RAs are, or will be, protective of human health and the environment,
- Determine what corrective measures are required to address any identified deficiencies; and,
- Evaluate whether there are opportunities to optimize the long-term performance or reduce life-cycle costs of the RAs.

This FYR focuses on the following RAs and continued protectiveness.

For soils:

- Institutional controls (ICs) for select sites (Limited Action Soil Units [identified in blue on Figure 1-1]), Burn Pads 11-13 at the Burning Ground (Solid Waste Management Units (SWMUs) 25, 26 and 27), and the Zone 12 Main Perimeter Ditch (SWMU 5-12a) along the east side of Zone 12.
- Presumptive Remedy of Soil Vapor Extraction (SVE) (with potential for future modifications to effectively reduce the source term) and ICs for SWMU 47 at the Burning Ground (BG).

Containment and ICs for the following sites:

- Covers installed for the BG Former Ash Disposal Trench (SWMUs 14-24) and the former operational area of Firing Site-5 (FS-5) (SWMU 70) will control the potential for exposure to contaminants in soil and minimize the potential for migration of contaminants from soil to groundwater via infiltration. ICs implemented to maintain these protective covers and provide for continued containment of contaminated soils, while also restricting access and land use to prevent exposure.
- Installed synthetic liners in Zone 12 ditches (SWMU 2 and SWMU 5/5) to prevent leaching of contaminants to perched groundwater via infiltration. ICs restrict access and land use, and protect the integrity of the liners to prevent exposure to contaminants.
- Containment (presumptive remedy) and ICs for the 27 Pantex Plant landfills. Covers installed prevent exposure to soil contaminants, minimize the potential for contaminant leaching to groundwater, and promote surface water runoff and erosion control. ICs restrict access and property use, and ongoing inspection and maintenance ensure continued integrity of the covers.

For Southeast perched groundwater:

- Continued operation of the installed Southeast Pump and Treat System (SEPTS) to stabilize migration and treat perched groundwater contaminants.
- Continued operation of the Playa 1 Pump and Treat System (P1PTS) to reduce the mounding of perched groundwater in the Playa 1 area, mitigating the potential for contaminant migration from the perched groundwater to the Ogallala Aquifer (also referred to herein and throughout the supporting evaluations as the High Plains Aquifer).
- Continued operation of the Southeast In-situ Bioremediation (SEISB) System to treat high explosive (HE) contaminants.

- ICs to prevent exposure to contaminants and cross-contamination to the regional Ogallala Aquifer through access, drilling, and land use restrictions.

For Zone 11 perched groundwater:

- Continued operation of the Zone 11 In-situ Bioremediation (ZN11ISB) System to treat trichloroethene (TCE) and perchlorate contaminants.
- ICs to prevent exposure to contaminants and cross-contamination to the regional Ogallala Aquifer through access, drilling, and land use restrictions.

Other units were investigated and RAs were conducted to close the sites. In total, 254 units were investigated. 16 of those units are active and 79 were investigated and closed either administratively or to background. Soils at the remaining 159 units contain contaminants at concentrations that do not allow for unrestricted use and therefore, required evaluation as part of this review to ensure that the Selected Remedy is protective of human health and the environment.

The 16 units still in active use will be closed in accordance with CERCLA and Resource Conservation and Recovery Act (RCRA) permit provisions when they become inactive and are determined to be of no further use. The units undergoing RAs are listed above. All of the units and their closure status are depicted in Figure 1-1. The affected groundwater and RAs are depicted in Figure 1-2. Attachment 5 provides a detailed summary of the units identified during the RCRA Facility Assessment (RFA) and their status. Chapter 3 also provides a summary of the units, previous removal actions, closure status, and current RAs.

The 15 attachments present information that supports this FYR, including RA effectiveness evaluations for soil and perched groundwater remedies, COC trend charts and groundwater hydrographs, perched groundwater and Ogallala Aquifer monitoring evaluations, a risk assessment evaluation, and an ICs evaluation. These attachments reference four evaluation reports provided under separate cover.

This report provides a summarized level of information regarding these evaluations. Reference the attachments for further details.

This page intentionally left blank.

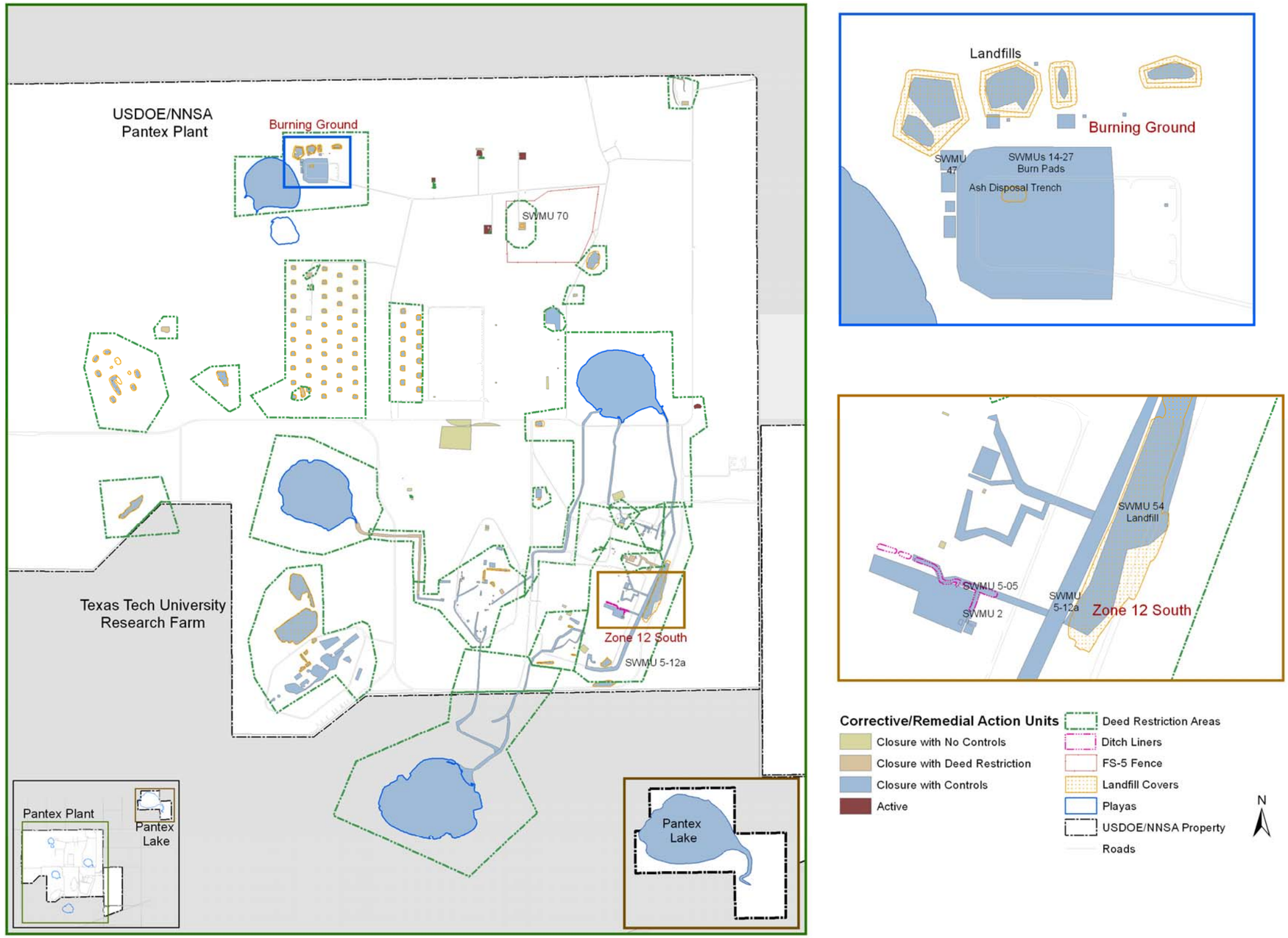


Figure 1-1. Status of Remedial Action Units

This page intentionally left blank.

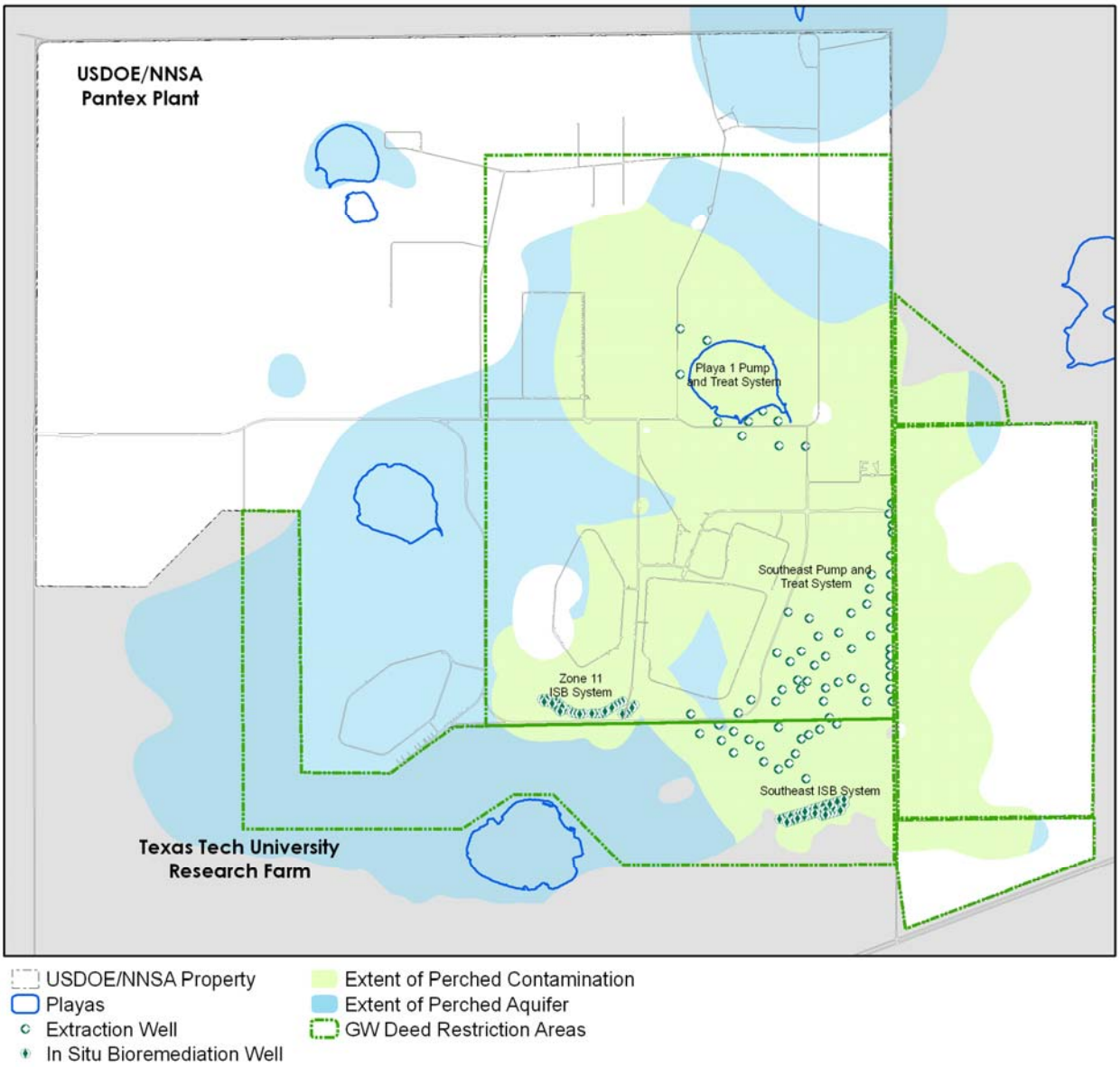


Figure 1-2. Status of Groundwater Remedial Action

This page intentionally left blank.

2 Site Chronology

In 1986, contaminants were discovered in soils and perched groundwater at the Pantex Plant. As a result, groundwater monitoring and investigation of site media were initiated to define the nature and extent of contaminants. Since that time, several investigations and response actions have occurred. Those included in this review are listed in the table below, along with other dates that are important to the environmental response program at the Pantex Plant.

Table 2-1. Chronology of Remedial Actions at Pantex Plant

Event	Date
Operations begin at Pantex Plant	1942
Initial discovery of problem or contamination – ***Comprehensive Environmental Assessment and Response Program*** ***RFA Visual Site Inspection Report***	 October 1986 March 1989
RCRA permit (HW-50284) issued	April 25, 1991
NPL listing	May 31, 1994
Enforcement documents **Section 3008(h) AO on Consent** **Notice of Enforcement Action – TCEQ**	 December 11, 1990 July 11, 2000
Remedial Investigation/Feasibility Studies approved: ***Firing Sites 5, 6, and 15 RCRA Facility Investigation Report (RFIR)*** ***Active Firing Sites Preliminary RFIR*** ***Fire Training Area RFIR*** ***BG Waste Management Group RFIR*** ***Independent Sites RFIR*** ***Zone 10 RFIR*** ***Zone 11 RFIR*** ***Zone 12 RFIR*** ***Ditches and Playas RFIR*** ***Groundwater RFIR*** ***Radiological Investigation Report*** ***Corrective Measures Study/Feasibility Study*** ***Proposed Plan***	 September 1999 July 2000 March 2002 September 2003 August 2004 August 2004 August 2004 August 2004 August 2004 July 2005 September 2005 April 2008 April 2008
ROD signature (Benchmark for Five-Year Review Completion)*	September 25, 2008
Compliance Plan (CP) 50284: **Interim Stabilization Measure CP** **Corrective Action System CP**	 October 21, 2003 September 16, 2010
IAG (Effective)	February 22, 2008
Physical Construction /Remedial Design Approval/Actual RA Start	August 30, 2010

*Since many interim actions were taken at the site under RCRA authority it was difficult to gain consensus on the date the selected remedial action was initiated. This resulted in selection of the ROD signature as the benchmark for determining when to conduct the first Five-Year Review.

This page intentionally left blank.

3 Background

The Pantex Plant, located in the Texas Panhandle approximately 17 miles northeast of Amarillo (see Figure 3-1), was established in 1942 to build conventional munitions in support of World War II. The Plant was deactivated in 1945, and was sold to Texas Tech University (TTU). In 1951, it was reclaimed for use by the Atomic Energy Commission to build nuclear weapons. The Pantex Plant continues an active mission to support the nuclear weapons stockpile for the USDOE/NNSA.

3.1 Land and Resource Use

The main Pantex Plant site encompasses approximately 9,100 acres. Approximately 2,000 acres of the USDOE/NNSA-owned property are used for industrial operations at the Pantex Plant, excluding the BG, Firing Sites, and other outlying areas. The BG and Firing Sites occupy approximately 489 acres. Remaining USDOE/NNSA-owned land serves safety and security purposes. Approximately 1,526 acres east of Farm-to-Market (FM) 2373 was purchased in 2008 to provide better access and control of perched groundwater areas included in the RA. USDOE/NNSA also owns a detached piece of property, called "Pantex Lake," approximately 2.5 miles northeast of the main Pantex Plant. This property, comprised of 1,077 acres, includes the playa lake itself. No industrial operations are conducted at the Pantex Lake property.

Pantex Plant will continue as an active USDOE/NNSA facility and current and future land use is industrial. Three distinct types of land use were identified within Pantex Plant:

- Industrial areas – Industrial areas include active operational areas and inactive areas around the operations that serve as safety and security buffers. The main plant mission is carried out in specific zones. These areas are contained in high security fencing; and therefore, are subject to restricted access. Support facilities occur in Zones 10, 11, 12, the BG, Firing Ranges, and Firing Sites. The active operational areas are mowed and maintained in short grass prairie. Shrubs, trees, and watered lawns are present around some of the administrative buildings in the operational areas. Denuded areas are also maintained as a safety and security buffer for portions of the operational areas.

- Agricultural areas – Agricultural lands within the combined main Pantex Plant area and Pantex Lake (that is, not including the TTU property) are owned by USDOE/NNSA but managed by Texas Tech Research Farm (TTRF). Through a service agreement with USDOE that allows TTU to use the land for farming and ranching, about 4,400 acres are available for cultivation, and about 3,200 acres are available for grazing. These areas are required to be managed in accordance with the Pantex Plant mission, including

protection of the environment, safety and health of employees and the public and national security.

- Playas/playa management units – Playas are ephemeral water bodies often having water only seasonally. Many playas meet the soils, hydrology, and vegetation criteria for classification as wetlands. Playas are considered as closed drainage basins and typically do not drain to other surface water tributaries or bodies. Playas are the most significant topographical expression and provide some of the most important wildlife habitat on the Southern High Plains. Generally playas are dry during one or more periods each year, usually late winter, early spring, and late summer. Playas at the Pantex Plant are typically managed for wildlife use; although, release of treated wastewater to Playa 1 is permitted, when necessary. This type of use was common in the past; however, an irrigation system has been installed that allows for beneficial use of the treated water, so discharge to Playa 1 has not occurred since before issuance of the ROD in 2008. The playas at the Pantex Plant are also grazed periodically.

The predominant land use within a 10-mile (16- kilometers (km)) radius of Pantex Plant is agricultural, including both grazing and cultivation of crops. Grazing is the predominant land use west and northwest of Pantex Plant. Cultivated land, with scattered grazing, predominates the areas immediately surrounding Pantex Plant and areas north, northeast, east, southeast, south, and southwest of the Pantex Plant. Some industrial areas are located south and southwest of the Pantex Plant. The only urban centers in this area are Highland Park Village to the southwest on the outskirts of Amarillo, Texas; Panhandle, Texas to the east; and Washburn, Texas to the south. Land use surrounding the Pantex Plant is expected to continue as agricultural. The current land use surrounding Pantex is not expected to change in the forseeable future.

The only environmentally sensitive areas are the playa lakes at the Pantex Plant. These areas serve as ephemeral wetlands, providing food and habitat for a variety of flora and fauna. Playa lakes also occur in the surrounding lands and across the Texas panhandle area

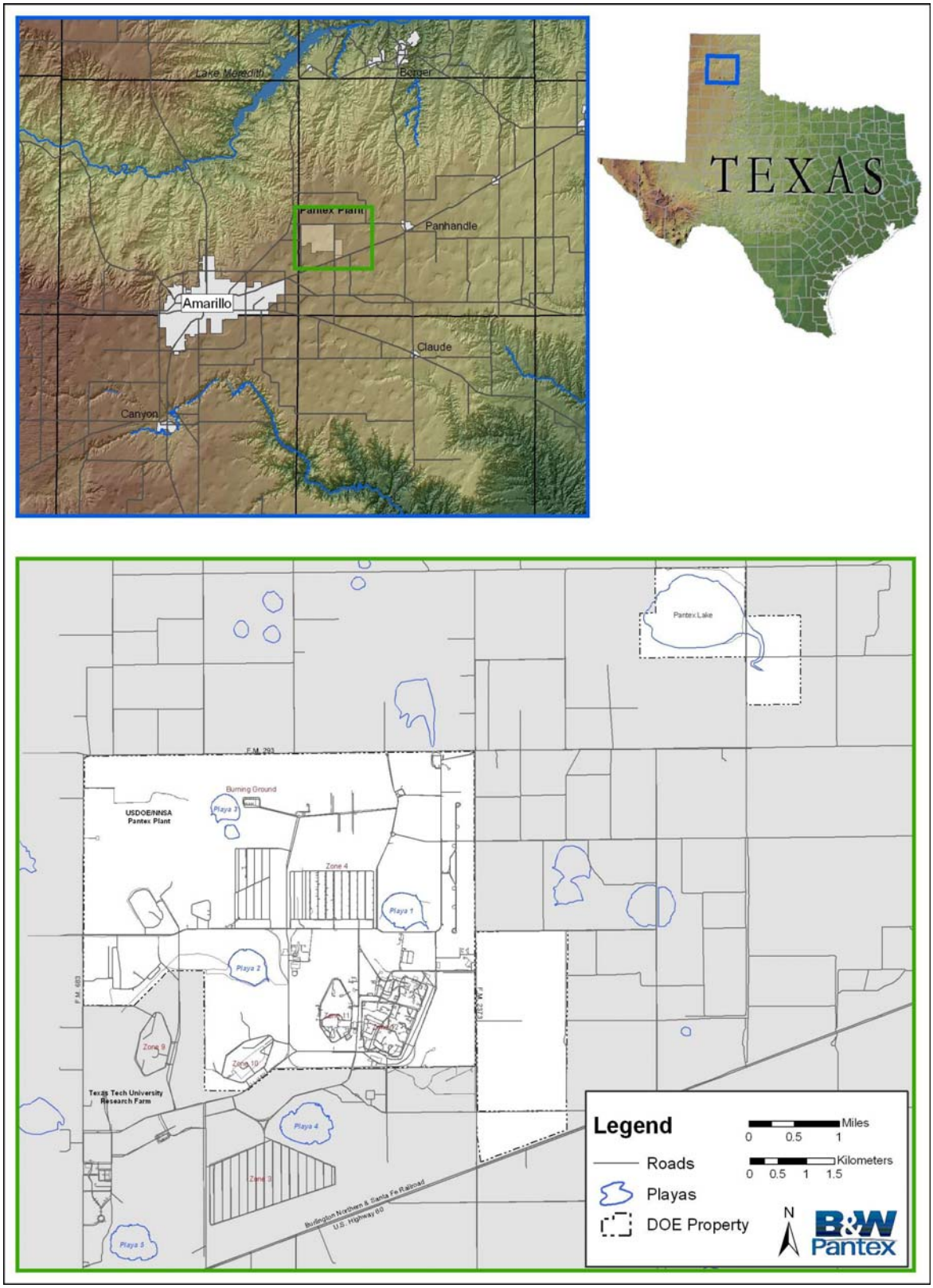


Figure 3-1. Pantex Plant Location and Site Features

Groundwater beneath the Pantex Plant and vicinity occurs in the Ogallala and Dockum Formations at two intervals (Figure 3-2). The first water-bearing unit below the Pantex Plant in the Ogallala Formation is a discontinuous zone of perched groundwater located at approximately 200 to 300 feet below ground surface and 100 to 200 feet above the drinking water aquifer. A zone of fine-grained sediment (consisting of sand, silt, and clay) that created the perched groundwater by impeding vertical migration of recharge is found between the perched groundwater and the underlying drinking water aquifer. The fine-grained zone (FGZ) acts as a significant barrier to downward migration of contaminated water. The perched groundwater ranges in saturated thickness from less than a foot at the margins to more than 75 feet beneath Playa 1. The largest area of perched groundwater beneath Pantex is associated with natural recharge from Playas 1, 2, and 4, treated wastewater discharge to Playa 1, historical releases to the ditches draining Zones 11 and 12, and storm water runoff that drains to the unlined ditches and playas. Perched groundwater at the Pantex Plant flows outward in a radial manner away from the playa lakes and is then influenced by the regional south to southeast gradient. Two hydraulically separate, relatively small, perched zones occur around Playa 3 (near the BG in the north central portion of the Plant) and near the Old Sewage Treatment Plant (OSTP) in the northeast corner of the Pantex Plant (Figure 3-3). Untreated perched groundwater at the Pantex Plant is not used for any purpose and is restricted by Pantex Plant. TTU and one offsite property owner to the east have placed a deed restriction on their property to control use of perched groundwater and restrict drilling through the perched groundwater in areas that are impacted.

A second water-bearing zone is located below the FGZ in the Ogallala and Dockum Formations. The Ogallala Aquifer, referred to herein and in supporting documents as the High Plains Aquifer, is a primary drinking and irrigation water source for most of the High Plains. The groundwater surface beneath the Plant is approximately 400-500 feet below ground surface; saturated thickness is approximately 1 to 100 feet in the southern regions of the Plant and approximately 250 to 400 feet in the northern regions. In the vicinity of the Plant, the primary flow direction of the Ogallala Aquifer is north to northeast due to the influence of the City of Amarillo's well field located north of the Plant.

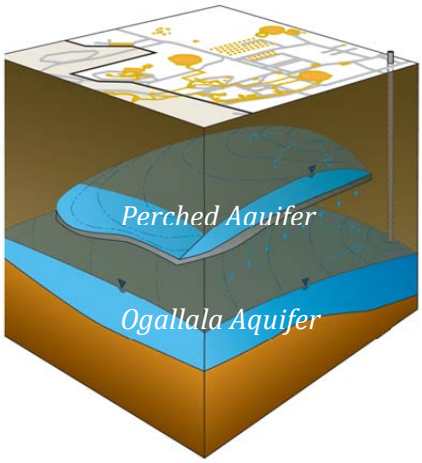


Figure 3-2. Groundwater Beneath Pantex Plant

3.2 History of Contamination

Historical waste management practices at the Pantex Plant resulted in the release of contaminants through various waste streams. Chemical and radionuclide contamination has been contributed to soils at the Pantex Plant. Chemical impacts have occurred to perched groundwater at the Pantex Plant.

3.2.1 Historical Practices Leading to Chemical Contaminants

The Pantex Plant's historical waste management practices have included thermal treatment of explosives, explosive components, and contaminated liquids and solvents (including test residues of explosives and depleted uranium); burial of industrial, construction, and sanitary waste in unlined landfills; disposal of solvents in pits or sumps; discharge of untreated industrial wastewaters to unlined ditches and playas; and the use of surface impoundments for the disposal of chemical constituents. These prior practices have resulted in the release of both chemical constituents and radionuclides to the environment.

During Cold War operations, industrial process wastewaters were discharged directly to the unlined ditches that were used to carry water from effluent sources (industrial wastewater, treated sanitary wastewater, cooling water discharge, and storm water runoff) at the Pantex Plant to Playas 1, 2, and 4. The majority of the wastewaters from the production facilities, and their supporting operations were generated on the east side of Zone 12, flowed into the eastern ditch system, and either infiltrated into the ditch soils or flowed into Playa 1. Wastewater was primarily impacted with HEs from major Pantex Plant operations. The volume of wastewater discharged on the east side averaged approximately 224,000 gallons per day (gpd) up to an estimated maximum of 314,000 gpd (Ramsey, et al., 1995). Operations in Zone 11 produced relatively small amounts of wastewater (66,000-gpd average to a maximum of 95,000 gpd) that entered the Zone 11 ditch system, but most infiltrated into the ditch soils rather than flowing to the playas.

The high volume of treated and untreated wastewater discharge that entered Playa 1 and its ditch system, primarily from Zone 12 with smaller amounts from Zone 11, impacted perched groundwater beneath the Pantex Plant. See Figure 3-3 for the extent of perched groundwater and groundwater plumes at the Pantex Plant.

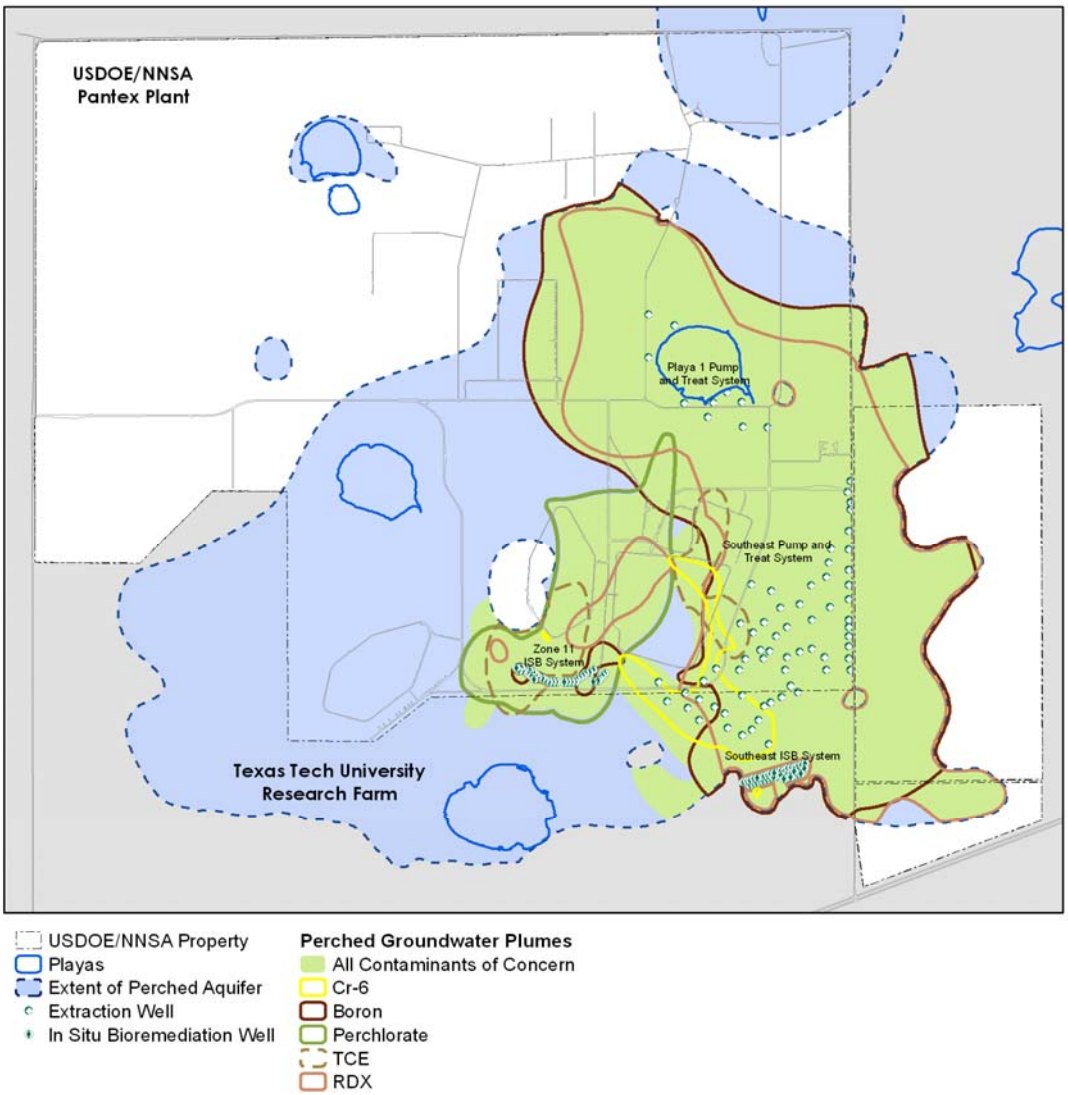


Figure 3-3. Perched Groundwater Extent and Major Constituent of Concern (COC) Plumes

Discharges of untreated industrial wastewater to the ditch system were eliminated in the late 1980s to implement improved environmental controls and to comply with permit requirements. During the 1990s, the Pantex Plant began reducing the discharge of treated wastewater to the ditches, and by 1999 all discharges to the ditches were discontinued (Mason & Hanger Corporation (MHC), 2000). Since 1999, all wastewaters have been discharged to the sanitary sewer system and directed to the Pantex Plant Waste Water Treatment Facility (WWTF).

Until 2005, treated effluent from the WWTF was released into an outfall approximately 350 feet from Playa 1. A new subsurface irrigation system for the beneficial reuse of treated wastewater was constructed, and routine discharge to Playa 1 has been eliminated. Flow in the other

ditches since 1999 consisted of only storm water runoff and infrequent releases of potable water related to maintenance and testing of the Plant's fire protection systems.

Infrequent future discharge of treated sanitary wastewater could still occur when the subsurface irrigation is unavailable, in accordance with the Texas Pollution Discharge Elimination System (TPDES) permit requirements. The elimination of discharge to the ditches and Playa 1 has removed the primary driving force for further movement of constituents of potential concern (COPCs) through the ditches and Playa 1 soils, as well as the driving force that caused the expansion of the perched groundwater to its current extent.

3.2.2 Historical Practices Leading to Radiological Contaminants

As a final nuclear weapons assembly plant, the Pantex Plant primarily handles sealed nuclear weapon components. As a result of this particular type of nuclear material, and because of the stringent safety and material accountability controls, the Pantex Plant represents a unique USDOE nuclear facility that manages significant quantities of nuclear materials in a manner and form that has not resulted in significant environmental risk from radionuclides.

In addition to the extensive historical knowledge of nuclear operations at the site, the types, quantities, and form of nuclear sources managed at the Pantex Plant over its entire history of operations is well recorded. The potential for radiological release at the Pantex Plant is low because of the type of nuclear material handled (primarily sealed nuclear components), the historic reporting requirements, and stringent safety controls in place.

There are three primary types of nuclear materials that have been handled at the Pantex Plant:

- Non-weapon nuclear sources (calibration sources and radiography/equipment sources – the majority of which are sealed sources)
- Weapon nuclear sources (sealed and tracked special nuclear material and un-encapsulated depleted uranium and thorium)
- Other sources not produced at the Pantex Plant (stored U.S. Department of Defense nuclear weapon accident debris and depleted uranium components for high explosive firing tests).

As a result of past operations, three sites at the Pantex Plant are known to have been radiologically impacted:

- The Nuclear Weapon Accident Residue (NWAR) site, where depleted uranium from weapons operations and from the Firing Sites and nuclear weapon accident debris was temporarily stored
- The BG, where depleted uranium residue was identified in limited areas

- The Firing Sites, where test shots, containing depleted uranium (DU) as a surrogate material, were detonated. FS-5 is a closed firing site that was used for detonation of test shots containing DU.

3.3 Site Investigation and Response Actions

Beginning in the 1980s, the Pantex Environmental Restoration Project personnel investigated historical release sites, as well as sites impacted by past waste management practices, and conducted cleanup actions to remediate impacts at release units. In January 1988, the EPA conducted a RFA at the Pantex Plant that identified SWMUs that potentially required investigation/corrective action under the 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA. The RFA report listed SWMUs and Areas of Concern (AOCs), identified during site assessment activities. In September 1989, a draft Administrative Order (AO) on Consent for corrective action at the Pantex Plant was issued to the USDOE/NNSA by the EPA. The terms of the AO were negotiated and a final AO (U.S. EPA Docket Number VI-002(h)-89-H) was issued pursuant to Section 3008(h) of the Solid Waste Disposal Act (SWDA), 42 U.S.C. 6928(h), as amended by RCRA, and HSWA of 1984. The final AO was signed by the EPA and USDOE/NNSA in December 1990. The AO outlined requirements for performing interim corrective measures (ICMs), RCRA facility investigations (RFIs), corrective measure studies, and corrective measure implementations at identified release sites or potential release sites at the Pantex Plant. Sites were assigned to 14 operable units (OUs) based on historical process and expected contaminants. Investigations and corrective action were to be implemented independently for each OU. In 1991, USEPA and Texas Commission on Environmental Quality (TCEQ) jointly issued Hazardous Waste Permit No. 50284 (HW-50284) that authorized the Pantex Plant to store and process hazardous waste. TCEQ regulates waste at the Pantex Plant under both state- and federally-authorized programs. In 1984, TCEQ received authorization to carry out the Texas hazardous waste program, in lieu of the federal program, under § 3006 of RCRA, 42 U.S.C. § 6926(b). Since then, under the Texas Solid Waste Disposal Act (TSDWA), TCEQ has continued to revise the Texas hazardous waste rules so that the Texas rules are equivalent to, and no less stringent than, the federal regulations.

On July 29, 1991, EPA proposed the Pantex Plant for inclusion on the National Priorities List (NPL). The Pantex Plant was listed on the NPL on May 31, 1994 (59 Federal Register (FR) 27989), making it subject to the CERCLA requirements in addition to those of RCRA.

On February 16, 1996, the TCEQ modified the original 1991 Hazardous Waste Permit and replaced it with a Permit for Industrial Solid Waste Management (HW-50284), issued pursuant to Chapter 361 of the Texas Health and Safety Code. The requirements outlined in the 1989 AO for performing ICMs, RFIs, corrective measures studies, and corrective measures implementations at

identified Pantex Plant SWMUs were incorporated into this original permit and the subsequent renewal.

In 2003, HW-50284 was renewed again. With this renewal, Compliance Plan (CP-50284) was issued to maintain the RFI and corrective action requirements, and establish a RCRA Interim Stabilization Measure (ISM) program for the Pantex Plant. The ISM program implemented two specific ISMs; the SEPTS and the BG SVE System, and established a network of perched and Ogallala groundwater wells to monitor the stabilization effectiveness. The Compliance Plan also replaced the process/contaminant-driven OUs. The units were grouped according to spatial proximity, referred to as Waste Management Groups (WMGs) and Zones, to complete the investigations. This approach increased the efficiency and effectiveness of final characterization, the risk assessment and RA efforts. A Site-wide ROD was implemented to select a remedy for releases across the Pantex Plant, including select RCRA ICMs and ISMs, as appropriate. The ROD was issued September 25, 2008.

3.3.1 Release Unit Status

Through the RFA, a total of 254 release units were initially identified at Pantex Plant because further investigation and/or cleanup activities were warranted at the units. Inactive units were investigated and some units were closed early because either contamination was not found or the early cleanup actions met regulatory standards. 95 of the units are active or were investigated and closed either administratively or to background. Soils at the remaining 159 units contain contaminants at concentrations that do not allow for unrestricted access and use and therefore, are discussed as part of this review. The status of the 159 units requiring consideration is as follows:

- 24 units were closed to screening levels – investigation of these units under RCRA indicated that residual contamination was protective of human health and the environment based on comparison of data to risk-based screening levels and results of the ecological risk assessment (ERA). Some of these units underwent an early response action to mitigate risks to workers. These units required ICs (deed recordation) to ensure continued industrial use and to document the residual contamination because the contaminant levels do not allow for unrestricted access and unlimited use.
- 135 units were evaluated in a baseline risk assessment to determine current future risks from soil and groundwater.
    - 90 units required limited RA – ICs with long-term groundwater monitoring was implemented at these sites because the risk assessment determined no further action was necessary to protect human health and the environment. ICs are

sufficient for future protection of human health and the environment and current industrial site use.

- 45 units required RA to control or reduce risks to onsite and/or offsite receptors. No actions were required at these units for protection of ecological receptors.

Attachment 5 provides a detailed table listing each of the 254 units and its closure status. Figure 1-1 depicts the location of the units and their closure status.

3.4 Scope and Role of Response Actions

ICMs, non-time critical removal actions, and final RAs have been implemented at Pantex Plant.

3.4.1 Past Response Actions

RCRA ICMs were completed during the period from 1989 to the present. Four RCRA regulatory drivers (AO-1989, HW-50284-1991, HW-50284-1996, and CP-50284) directed USDOE/NNSA to cease industrial discharges to the ditches to eliminate the driving force for further migration of contaminants to perched groundwater; to perform ICMs, investigations, corrective measures studies, and corrective measures implementations at identified Pantex Plant SWMUs; and to conduct corrective action as necessary to protect human health and the environment for releases from any SWMU, AOC, or WMG defined in CP-50284.

ICMs were taken under RCRA authority to address immediate risk, implement protective measures, and control exposure, as necessary. Attachment 5 contains a table that identifies specific ICMs and removal actions implemented at the site were later recognized in the ROD, RD, and IRAR as part of the Final RA. This table identifies the regulatory driver under which each ICM or removal action was completed. All but two of the cleanup actions taken at the site before the ROD (the P1PTS and the Southeast ISB (SEISB) System) were performed under RCRA authority. The interim response actions are discussed further in the remainder of this section.

Two of the aforementioned actions that were initiated under RCRA authority, the BG SVE System and the SEPTS, were recognized as ISMs in CP-50284 when it was issued in 2003. CP-50284 required these ISMs to be modified, as needed, to effectively stabilize the contaminants. Therefore, both systems have changed over time.

The SEPTS started as a treatability study when it was first installed in 1995. It later became an ICM through expansions designed to make it capable of capturing and removing more of the contaminants. The SEPTS was expanded to improve its capability to control and begin to reduce saturation in the impacted areas of the perched groundwater, reduce contaminants in the sensitive areas of the perched groundwater, and mitigate potential impacts from the perched groundwater to the Ogallala Aquifer.

The BG SVE System, originally installed with 28 extraction wells, has been reduced to focus treatment on the area of the solvent evaporation pit (SWMU 47) through extraction from a single well (SVE-S-20) which is completed in the shallow portion of the unsaturated zone just above the caliche caprock. SVE-S-20, which is screened to intercept the zone about 50 to 80 feet below ground surface, continues to yield sustained solvent vapor concentrations. Treatment of the extracted vapors is now accomplished using a small-scale catalytic oxidation (CatOx) unit that was installed in 2012.

In accordance with CP-50284, several other ISMs were implemented under RCRA authority as information from the Human Health Risk Assessments (HHRAs) and the Corrective Measure Study/Feasability Study (CMS/FS) efforts progressed. Engineered covers were placed on the BG Landfills (SWMUs 37 through 44), synthetic liners were installed in SWMU 2 and 5/5 ditches that drain Zone 12, and soil removals were performed at Burn Pad 16, and SWMUs 1, 5/4, 5/7, 64, 117, 118, and 122b to eliminate the hot spots driving the direct contact risk in these areas. In addition, a SVE system was installed at SWMU 113 (Building 11-36) as an ICM. This system was a best management practice undertaken by USDOE/NNSA to reduce future risk of cross-media migration, even though fate and transport evaluations performed as part of the HHRA for Zone 11 did not indicate that the area was a threat to human health or the environment. As such, the SWMU 113 stabilization was not carried forward in the ROD.

3.4.2 Remedial Actions for Pantex

RAs have been implemented for soils and groundwater at the Pantex Plant. The RAs and units at the Pantex Plant are depicted in Figures 1-1 and 1-2. The ROD implements site-wide actions to mitigate risks from commingled plumes and to provide consistent controls and monitoring across the Pantex Plant.

The site-wide response actions address all inactive areas at the Pantex Plant and perched groundwater. The selected response actions address current and potential future threats to human health and the environment, including:

- Releases to soils that pose a direct contact risk to onsite workers.
    - Contaminants include volatile organic compounds (VOCs), semi-volatile organic compounds, depleted uranium, HEs, poly-aromatic hydrocarbons, poly-chlorinated biphenyls, dioxins/furans, metals, and pesticides.
- Releases to soils at concentrations that may impact perched groundwater above the Groundwater Protection Standards (GWPS).

- Perched groundwater that is impacted above GWPS and requires RAs. Perched groundwater COCs[1] by area include:
    - Southeast plumes: hexavalent chromium; total chromium; TCE; 2-amino-4,6-dinitrotoluene (DNT); 4-amino-2,6-DNT; 1,3-dinitrobenzene; 2,4-DNT; 2,6-DNT; HMX; hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX); 1,3,5-trinitrobenzene; and 2,4,6 trinitrotoluene (TNT).
    - Zone 11 plumes: 1,2-dichloroethane; 1,4-dioxane; perchloroethene; TCE; RDX; and perchlorate.
- Perched groundwater impacted above GWPS that could potentially impact the Ogallala Aquifer above the GWPS.

RAs at the Pantex Plant are dominated by actions to mitigate perched groundwater contamination. Perched groundwater remedies include both pump and treat and in situ bioremediation technologies that work together to remove water in an effort to reduce the driving forces for lateral and vertical migration and reduce the mass of the contaminants, particularly in areas sensitive to vertical migration. The effectiveness of these actions is determined by sampling an established network of monitoring wells. The perched groundwater meets the yield and quality criteria to be considered a potential drinking water source, so its restoration to GWPS is one goal of the remedy. An equally important concern is the potential for perched groundwater to act as a source of future impacts to the underlying Ogallala Aquifer. Contaminant concentrations in the perched groundwater exceed GWPS throughout all or most of the plume for many COCs, including: RDX, the primary risk driver for the southeast plume; hexavalent chromium; TNT; 2-amino-4,6-DNT; 4-amino-2,6-DNT; 2,4-DNT; perchlorate; and TCE. Most importantly, if no action is taken, vertical migration of perched groundwater contaminants to the Ogallala Aquifer is likely in the southeast area. The RA was designed to reduce and stabilize the perched groundwater contaminants upgradient of this critical area. If contaminants migrate downward to the Ogallala Aquifer, a groundwater exposure pathway to receptors onsite or offsite would be complete with potential for impacts to human health. Therefore, protecting the Ogallala Aquifer from future impact is one of the primary goals of the RA.

The RAs for soils, identified in the ROD, eliminate direct contact risks to onsite workers and minimize further migration of contaminants into the soil column and perched groundwater

[1] Boron, although not included in this list, is monitored like a COC because it was a constituent of some HE formulations and is present at elevated concentrations in the perched groundwater. Boron does not exceed the GWPS but can have deleterious effects on some crops grown on subsurface irrigation tracts where the treated perched groundwater from the pump and treat systems is beneficially used, so it is monitored.

beneath the site. The RA for soils includes containment for sites with those potential risks, and includes protective covers and liners installed as ICMs under the State RCRA authority. Similarly, the BG SVE System was installed as a stabilization measure under the State program to mitigate potential impact to the perched groundwater from residual contaminants in soil gas, and became part of the final RA.

ICs, such as restrictive covenants to prohibit drilling through contaminated portions of the perched groundwater beneath USDOE/NNSA-owned property and to the east and south of the main property, are also a part of the RA for perched groundwater. Restrictions that prohibit the use of the perched groundwater as a source of drinking water or for industrial purposes have been placed onsite and at select areas offsite. ICs have also been implemented to prevent unauthorized access to soils containing residual contaminants at levels that prohibit unrestricted use of the land. Land use controls were implemented to prohibit the use of units for residential housing, elementary or secondary schools, childcare facilities, or playgrounds. Engineered controls (i.e. fences, barriers) and security measures minimize access, and protect components, of the active RA.

3.5 Basis for Response Action

The actual or threatened release of hazardous substances from the Pantex Plant, if not addressed by implementing the Selected Remedy, presents a current or potential threat to public health, welfare, or the environment.

This page left intentionally blank.

4 Remedial Actions

4.1 Remedy Selection

The Selected Remedy addresses all sites with commingled plumes and impacts to the perched groundwater beneath the Pantex Plant. All components were in place to work towards meeting the overall cleanup objectives when construction of the Selected Remedy was completed in June 2009.

The components of the Selected Remedy address both the soil sites requiring a remedial response and the perched groundwater contaminants in two focus areas, the Southeast Area and Zone 11.

The Selected Remedy for soils is:

- Presumptive Remedy of SVE[1] and ICs for SWMU 47.
- Protective Covers:
    - The BG Former Ash Disposal Trench (SWMUs 14-24) and the former operational area of FS-5 (SWMU 70)- the installed covers control the potential for exposure to contaminants in soil and minimize the potential for migration of contaminants from soil to groundwater via infiltration. ICs were implemented to maintain these protective covers and provide for continued containment of contaminated soils, while also restricting access and land use.
    - Pantex Plant landfills (consisting of 27 units described in further detail in Section 4.2.1.2) - the installed covers (the presumptive remedy) prevent exposure to soil contaminants, minimize the potential for contaminant leaching to groundwater, and promote surface water runoff and erosion control. ICs restrict access and property use, and ensure continued integrity of the protective covers.
- Ditch Liners:
    - Zone 12 ditches (SWMU 2 and SWMU 5/5) - the installed synthetic liners prevent leaching of contaminants to perched groundwater via infiltration. ICs restrict access, land use, and protect the integrity of the liners.

[1] In the future, modifications to the SVE system may be necessary to effectively reduce the source term.

- ICs for select sites (Limited Action Soil Units, Burn Pads 11 through 13 (SWMUs 25, 26 and 27), and SWMU 5/12a).

The Selected Remedy for the Southeast Area perched groundwater is:

- SEPTS to stabilize migration and treat perched groundwater contaminants.
- P1PTS to reduce the mounding of perched groundwater in the Playa 1 area, mitigating the potential for contaminant migration from the perched groundwater to the Ogallala Aquifer.
- SEISB System to treat high explosive (HE) contaminants (and hexavalent chromium).
- ICs to prevent exposure to contaminants and cross-contamination to the regional Ogallala Aquifer.

The Selected Remedy for the Zone 11 perched groundwater is:

- ZN11ISB System to treat TCE and perchlorate contaminants.
- ICs to prevent exposure to contaminants and cross-contamination to the regional Ogallala Aquifer.

Effectiveness of the Selected Remedy for the Pantex Plant Site is determined through groundwater monitoring implemented through a Long-Term Groundwater Monitoring Plan, developed as part the Remedial Design, in accordance with the IAG.

4.1.1 Remedial Action Objectives

RAOs were developed in the ROD to focus the design of individual RA components in a way that leads to achieving short-term protectiveness and fosters synergistic effects that will eventually progress toward long-term protectiveness. RAOs were developed for soil and groundwater.

4.1.1.1 RAOs for Soil

RAOs were developed for surface and subsurface soils to address risk to potential workers at the units, as well as to prevent migration to groundwater.

- Surface Soil RAO- Reduce the exposure risk to onsite industrial and construction/excavation workers through removal, treatment, or prevention of contact with COCs in the soil.

- Subsurface Soil RAO- Reduce potential impact to perched groundwater and the Ogallala Aquifer through source abatement and stabilization/control measures in the vadose zone.

4.1.1.2 Perched Groundwater RAOs

Perched groundwater RAOs were developed to address two separate groundwater issues: 1) restoration of perched groundwater to drinking water standards, and 2) protection of the Ogallala Aquifer. While RAs address both objectives, protection of the Ogallala Aquifer is the primary goal of implementing RAs for groundwater at the Pantex Plant.

RAOs for Perched Groundwater:

- 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.

4.2 Remedy Implementation

Remedies for soil and groundwater have been implemented at the Pantex Plant as described in the ROD (i.e., the Selected Remedy). The Selected Remedy continues to be enforced by the standards set forth in the IAG as agreed upon by the USDOE/NNSA, EPA, and TCEQ.

4.2.1 Soil Remedy Implementation

The active remedies established for the soils throughout the site consist of a SVE system at the Burning Grounds, protective covers, and ditch liners. All three remedies are detailed further below.

4.2.1.1 Burning Ground Soil Vapor Extraction System

A SVE system was installed at the BG in February 2002 to remediate VOCs present in the shallow and intermediate depth vadose zone at the BG (SWMUs 47 and 38) with the objective of ground water protection. Operations at the Burning Ground are transient and workers only occupy one structure over 1,000 feet from the SVE-S-20 for short periods of time, so no potential for exposure by vapor intrusion exists. The original SVE system consisted of 28 vapor extraction wells, conveyance lines, and a treatment system consisting of a natural gas fired CatOx and wet scrubber. The SVE wells were installed in the shallow soil zone (surface to caliche caprock) and

intermediate zone (caliche caprock to the FGZ). This system operated for a period of 40 months and recovered approximately 12,000 pounds of VOCs.

In 2006, the full-scale CatOX/wet scrubber treatment system was replaced with a smaller treatment system that focused on SVE-S-20 adjacent to SWMU 47, because the large treatment system became inefficient at treating vapors extracted from a single well. The smaller-scale vapor treatment system consisted of a small blower and six granular activated carbon (GAC) drums connected in series. The GAC system was replaced in the spring of 2012 with a small electric catalytic oxidizer/wet scrubber vapor treatment system due to excessive Operations and Maintenance (O&M) costs driven by GAC regeneration and replacement, and labor for monitoring to comply with permit-by-rule requirements under 30 Texas Administrative Code (TAC) 106.533. This action was a modification of the vapor treatment portion of the SVE System that was selected as a presumptive remedy under the ROD to address SWMU 47 and represents a re-tooling of the System, not a change in the Selected Remedy.

4.2.1.2 Protective Covers

The RA for landfills included maintenance of protective covers for the Former BG Ash Disposal Trench (SWMUs 14-24), the former operational area of FS-5, and the following 27 units.

Zone 10

- SVS 8: Abandoned Zone 10 Landfill
- Zone 10 Building Construction Debris Landfills
- SWMU 68d: Active Sanitary Landfill

Zone 11

- SVS 5: Landfill East of 11-13 Pad
- SWMU 60: Landfill 9
- SWMU 61: Landfill 10

Zone 12

- SWMU 54: Landfill 3
- SWMU 55: Landfill 4
- SWMU 56: Landfill 5
- SWMU 57: Landfill 6
- SWMU 68a North: Original General Purpose Sanitary Landfill

BG

- SWMU 37: BG Landfill 1
- SWMU 38: BG Landfill 2
- SWMU 39: BG Landfill 3
- SWMU 40: BG Landfill 4
- SWMU 41: BG Landfill 5
- SWMU 42: BG Landfill 6
- SWMU 43: BG Landfill 7
- SWMU 44: BG Landfill 8

Units in Miscellaneous Areas

- SWMU 58: Landfill 7 Associated with Concrete Batch Plant
- SWMU 63: Landfill 12
- SWMU 64: Landfill 13
- SWMU 66: Landfill 15
- SWMU 68b: General Purpose Sanitary Landfill 1
- SWMU 68c: General Purpose Sanitary Landfill 2
- SVS 7a and 7b: Igloo Demolition Debris Landfills Zone 4 (SVS 7a) and Zone 5 (SVS 7b)
- SVS 6: Unnumbered Zone 7 Landfills

These protective covers were either placed at end of landfilling operations or as ICMs taken under State RCRA Authority to prevent worker contact and infiltration of water through the landfill materials that could lead to migration of contaminants to the underlying aquifer without mitigation. Construction of all the protective covers was completed and approved in 2009. Evaluation of the protective covers indicates that they remain intact with the exception of some holes due to voids in construction debris landfills and burrowing animals. Stressed vegetation was noted at newer protective covers due to extreme drought conditions that occurred in 2011. Actions to address these finding are described in Chapter 7.

4.2.1.3 Ditch Liners

A total of five ditch sections representing SWMUs 2 and 5/5, with a total length of approximately 832 feet, were synthetically lined as an ICM in 2004 to prevent migration of soil contamination to the perched groundwater. The liner was installed in sections, which were welded together in the factory using a single-track hot wedge fusion machine. The edges of the liner were anchored into the shoulders of the ditches at least one foot deep to control against erosion and to guard the liner edges against uplift from strong winds. River rock was placed in the bottom of the lined ditches to provide ballast for the liner and also to protect against uplift.

4.2.2 Groundwater Remedy Implementation

Remedies were established for the Southeast Area perched groundwater and the Zone 11 perched groundwater. The Remedy for the Southeast Area consists of three separate active RAs (SEPTS, P1PTS, and SEISB) that were designed to work together to achieve the RAOs. One active RA was implemented for Zone 11; the Zone 11 In Situ Bioremediation System (ZN11ISB). In addition, all areas covered in this review also have ICs. All remedies are detailed further below.

4.2.2.1 SEPTS

The SEPTS was originally installed at the Pantex Plant in 1995 as part of a treatability study to address HEs and hexavalent chromium. Since then, the pump and treat system has been expanded to meet the objectives of the environmental restoration project and final remedy established in the ROD and CP-50284.

The SEPTS currently consists of a treatment building, 62 extraction wells, and three injection wells (see Figure 4-1). This system treats the water through a series of GAC vessels and ion exchange resin beds to reduce concentrations below the GWPS.

The SEPTS was originally designed for injection of the treated water back into the perched aquifer. All treated water was injected until May 2005 when the original irrigation system (consisting of three 100- acre tracts) was placed online to receive water through the WWTF. The SEPTS has continued to inject water when the irrigation system or WWTF throughput was reduced or temporarily suspended; however, the goal is to continually reduce and eventually eliminate injection as beneficial use of the water can consistently support the extraction goals. The irrigation system was upgraded during 2011 and 2012 to include an additional 100-acre tract, as another step towards reducing injection. The system was still undergoing final testing and acceptance in October 2012. The additional tract is expected to eliminate injection during the summer and fall and greatly reduce or eliminate the need for injection during winter and early spring.

An evaluation of the SEPTS was conducted by Trihydro Corporation (2012) as part of a Groundwater Remedy Effectiveness Evaluation. The complete evaluation is provided in Attachment 8. Overall, the SEPTS is meeting the design objective of reducing perched aquifer saturated thickness as groundwater elevations declined at each monitoring location within its area of influence regardless of the injection of treated water back into the perched aquifer. An evaluation of flux upgradient and downgradient of the SEPTS indicates that the system is removing more groundwater than is flowing into the well field, thus reducing saturated thickness. The rate of decline in saturated thickness could be significantly enhanced by discontinuing or decreasing injection of the treated water.

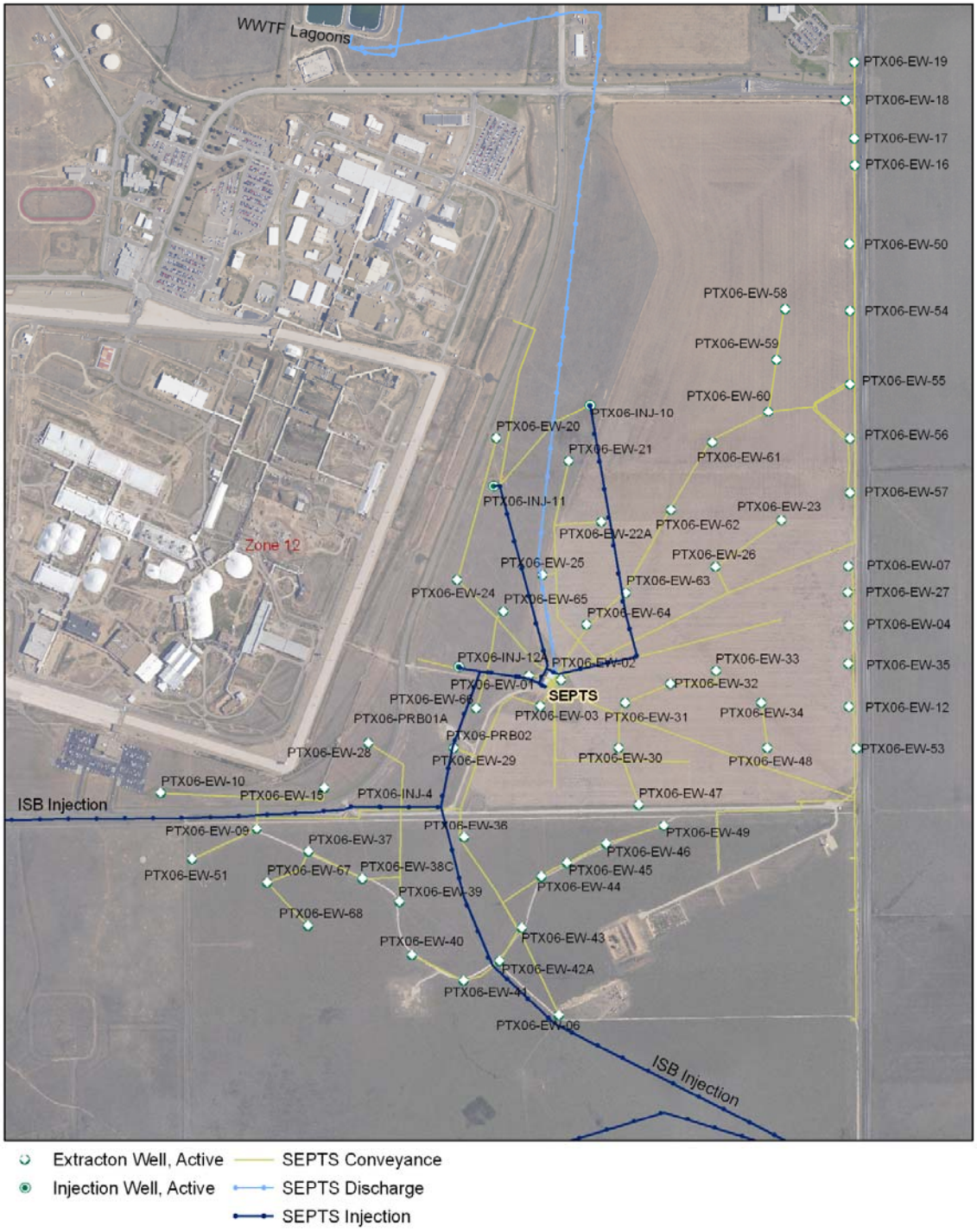


Figure 4-1. SEPTS Extraction Wells and Conveyance Lines

If injection can be eliminated, the volume of groundwater extracted would be about 300% greater than the amount of groundwater entering the SEPTS based on data evaluated. Over the FYR period, the extraction rate was estimated at only about 50 to 100% greater than the amount of groundwater entering the SEPTS area.

The SEPTS is achieving progress toward RAOs by reducing saturation to lessen the driving force for vertical migration, stabilizing the contaminants within the influence of the well field, and decreasing the flux of water moving downgradient toward the SEISB. The system is achieving mass removal of COCs (primarily RDX and hexavalent chromium) and concentrations are generally demonstrating signs of stabilization or decrease at wells that are within the area of influence of the system. Some wells had anomalous increases due to temporary impacts from study systems or effects of wells being down during the SEPTS system upgrade during 2010 and 2011. Performance improvements are possible as described in Chapter 7.

4.2.2.2 P1PTS

The P1PTS was completed during 2008 as an early action to address HEs with operations starting in September 2008. The P1PTS extracts water from ten wells near Playa 1 and treats the water through a series of GAC beds and ion exchange process units to reduce HEs and metals below the GWPS established in the ROD. Figure 4-2 depicts the P1PTS wells and conveyance. This system focuses on reducing the mound of perched groundwater associated with Playa 1, affecting the movement of the southeast plume by reducing the hydraulic head, as well as achieving mass removal. Significant progress has been made to increase the capacity of the irrigation system by adding an additional 100-acre tract. The revised Texas Land Application Permit (TLAP) was approved in April 2012 and the new 100-acre tract continued undergoing testing, repair, and final acceptance as crops were planted on the tract in summer and fall 2012.

An evaluation of the P1PTS was conducted by Trihydro Corporation (2012) as part of a Groundwater Remedy Effectiveness Evaluation. The complete evaluation is provided in Attachment 8. Overall, the P1PTS is meeting the design objective of reducing perched aquifer saturated thickness as groundwater elevations declined at each monitoring location within its area of influence. Water level trends indicate that saturated thickness was declining prior to the operation of the P1PTS because routine discharge of treated water to Playa 1 ceased in 2005. The rate of decline increased after the P1PTS became operational, despite two impediments, (1) a record rainfall event in July 2010 that temporarily increased water levels at wells around Playa 1 and (2) intermittent operations due to irrigation upgrades or WWTF and/or irrigation downtime.

Figure 4-2. P1PTS Extraction Wells and Conveyance

The system was unable to consistently operate at the design goal of 90% at all times primarily due to downtime of the irrigation or WWTF, but was also occasionally impacted by well downtime as this system has fewer wells and throughput can be noticeably constrained if more than one well is not operating.

The P1PTS is achieving progress toward RAOs by reducing saturation to lessen the driving force for vertical migration, and decreasing the flux of water moving downgradient toward the SEPTS. This system is also achieving mass removal from water that is extracted and treated. Additionally, the COC concentrations in monitoring wells under the influence of this system indicated stable or decreasing trends. Further performance improvements are possible as described in Chapter 7.

4.2.2.3 SEISB System

The SEISB System is on TTU property south of the Pantex Plant. The system was installed in 2007 as an early action and consists of 42 injection wells within the treatment zone and six performance monitoring wells. COCs targeted for treatment by this system are RDX, other HE COCs (DNTs and 1,3,5-TNB), and hexavalent chromium. There were no notable changes or difficulties that occurred during the remedial design of this system. Figure 4-3 depicts the SEISB System Injection Well field and Performance Monitoring Wells.

An evaluation of the SEISB was conducted by Trihydro Corporation (2012) as part of a Groundwater Remedy Effectiveness Evaluation (Attachment 8). The goal of this system is to create an anaerobic treatment zone that reduces concentrations of COCs to below GWPS in an area where the FGZ is thinner and more permeable and COCs may impact the underlying Ogallala Aquifer within a relatively short timeframe (modeling projected within approximately 40 years).

The SEISB is currently meeting the design objective of creating and maintaining an anaerobic treatment zone capable of treating the target COCs to concentrations below the GWPS. This is important in achieving RAOs since the area is sensitive to vertical migration and protection of the underlying Ogallala Aquifer depends on effective treatment.

During the FYR period, COC concentrations decreased by up to three orders of magnitude in treatment zone wells and downgradient performance monitoring wells that are currently under the influence of the system. Concentrations have declined to near or below the GWPS in three of the five downgradient wells.

Concentrations of RDX and one of its degradation products (hexahydro-1,3,5-trinitroso-1,3,5-triazine [TNX]) are consistently present at about 100 times the cleanup standard at

downgradient well PTX06-1153. Hexavalent chromium is also exhibiting an increasing trend at PTX06-1153. Also, monitoring data for another of the downgradient wells (PTX06-1154) indicates that TNX is consistently present at higher concentrations than expected.

The persistence of low-level concentrations may be due to incomplete treatment at higher velocity zones and/or a result of desorption and back-diffusion of COCs from the soil matrix, but concentrations are expected to continue to decline with time. System monitoring has also indicated that the time between injections may be too long as some breakthrough of COCs has been noted and the treatment zone was starting to demonstrate signs of rebound to unaltered conditions in 2012. Recommended actions are described in Chapter 7.

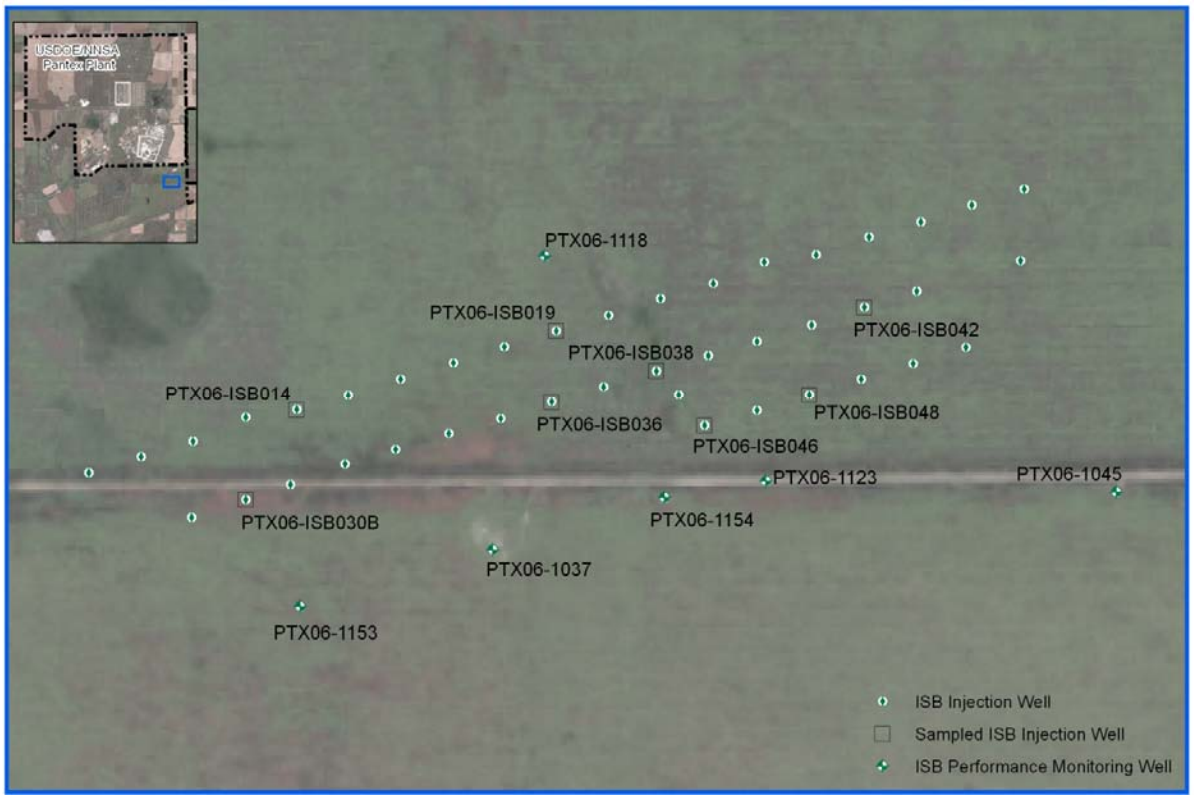


Figure 4-3. SEISB System Injection Well Field and Performance Monitoring Wells

4.2.2.4 Zone 11 ISB System

The current ZN11ISB system consists of 32 injection wells and three downgradient performance monitoring wells installed in a zone of saturated thickness of approximately 15-20 ft to address VOCs and perchlorate. The ZN11ISB, originally consisting of 23 wells, was installed by March 2009. An additional nine wells were installed in September 2009 to better treat the perchlorate

plume on the eastern side and the TCE plume on the western side of the ISB. As defined in the SAP, eight treatment zone wells and three downgradient performance monitoring wells are used to evaluate the ZN11ISB (see Figure 4-4). Three additional treatment zone wells are also monitored to provide more information from newer injection wells that were installed after the original 23 wells.

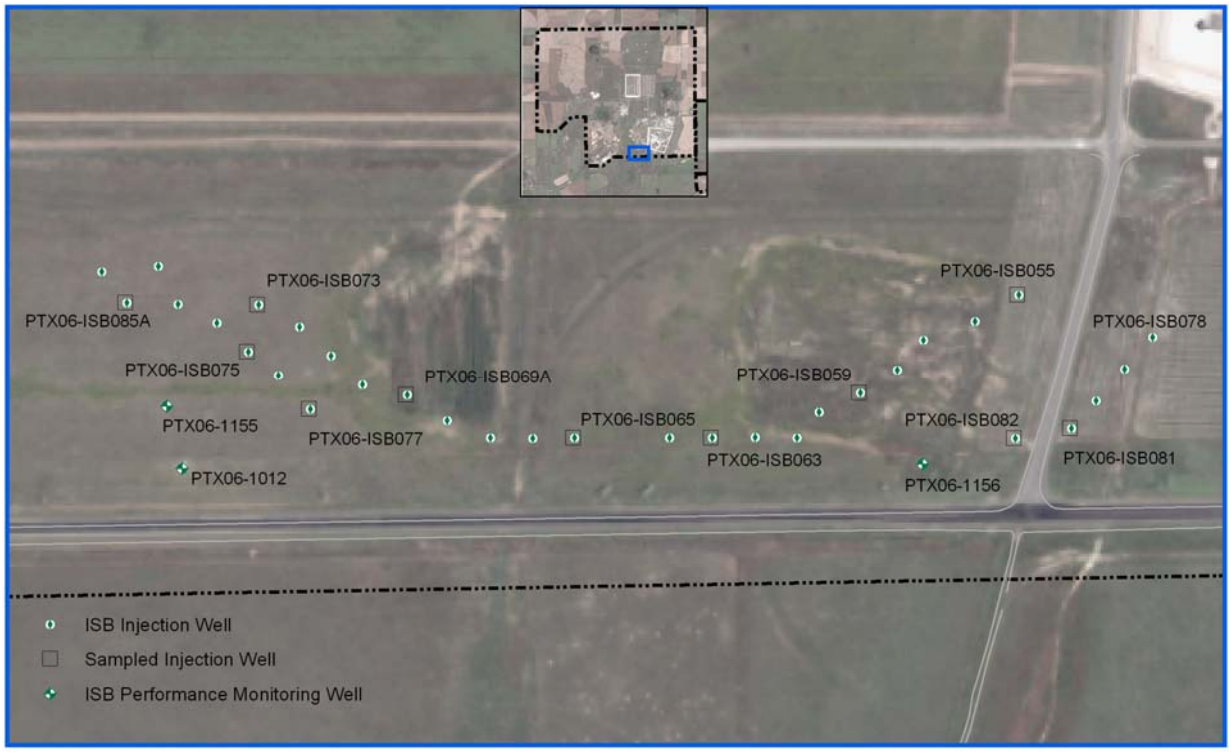


Figure 4-4. ZN11ISB Injection Well Field and Performance Monitoring Wells

An evaluation of the ZN11ISB was conducted by Trihydro Corporation (2012) as part of a Groundwater Remedy Effectiveness Evaluation (Attachment 8). The ZN11ISB system is currently meeting the design objective of creating and maintaining an anaerobic treatment zone capable of treating the target COCs to concentrations below the GWPS. This is important in achieving RAOs since the plume containing primarily TCE and perchlorate would move south toward TTU property without effective treatment. The conditions are still changing, but during the FYR period perchlorate concentrations have decreased to non-detect values in downgradient in-situ performance monitoring (ISPM) wells currently under the influence of the system. TCE has peaked at the ISB downgradient monitoring wells and they are now demonstrating a decreasing trend in concentrations; breakdown products have only been observed at low concentrations and have not persisted. It is expected that the decreasing trend will continue as the treatment zone continues to treat the TCE in groundwater that moves through, as well as TCE that desorbs from the soil matrix.

While the ZN11 ISB system has been effective at treating the contamination flowing through the well field, implementation of the remedy and associated monitoring has identified larger areas of contamination than were originally identified in the investigation. Plumes containing TCE and perchlorate have been found to extend to the southwest of Zone 11, in an area to the north of the ISB treatment zone. This area is not being treated as the general downgradient movement of groundwater on this side of the system is to the west, rather than south through the ISB treatment zone. In addition, the 1,4-dioxane plume is larger than initially characterized before the ROD and concentrations are greater than indicated by data available at that time. The ISB system was not designed to treat 1,4-dioxane. Three wells (PTX06-1148, -1149, and -1150), located directly south of the center of the ISB treatment zone, have been slower at demonstrating treatment than originally expected. Based on newer data collected in the ISB treatment zone, the rate of groundwater movement through the center of the well field is slower than originally estimated. These three wells are not likely to demonstrate a decreasing trend within the timeframe specified in the Long-Term Monitoring (LTM) System Design Report.

4.2.2.5 Long-Term Monitoring Network

A comprehensive groundwater monitoring program to evaluate the effectiveness of the RAs, ensure the RAOs (from the ROD) are achieved, and to confirm the expected future conditions within the perched aquifer and the Ogallala Aquifer was implemented at the Pantex Plant. The LTM design and evaluation criteria are provided in the *LTM System Design Report* (B&W Pantex, 2009a). The final system design was incorporated into CP-50284 when it was issued effective September 16, 2010. The design was further detailed in CP-50284 to include point of exposure and point of compliance wells where the GWPS is required to be met.

The final network consists of:

- 113 perched aquifer wells that monitor water levels and COCs, as appropriate.
- 26 Ogallala Aquifer wells that are monitored for water levels and COCs found in the perched aquifer, as applicable. A portion of these wells (seven total) are monitored at multiple levels.

Since the remedy effectiveness is determined through groundwater monitoring implemented through a Long-Term Groundwater Monitoring Plan, the perched aquifer LTM network was evaluated by Groundwater Specialists, Inc. (GSI Environmental, Inc.) in August 2012. The goal of the evaluation was to review the network for its ability to support site monitoring goals, including remedy effectiveness, plume stability, and uncertainty management; and to then make any recommendations to improve the network. Well and groundwater analytical data (2000 –

2011) were analyzed using the Monitoring and Remediation Optimization System (MAROS) version 2.2 and 3.0 (beta) developed by GSI. In this evaluation, perched groundwater was divided into three sectors for analysis. Then the network in each sector was evaluated for plume stability, spatial redundancy and sufficiency, and frequency analysis. Individual well statistics and trends were also evaluated. The full report is included in Attachment 11.

The overall conclusion of the evaluation was that the monitoring network is adequate to meet the site monitoring goals. Recommendations for the LTM network are discussed in Chapter 6.

4.2.3 Institutional Controls Remedy Implementation

In accordance with RCRA and CERCLA, Pantex and regulatory agencies identified 254 units at the Pantex Plant for further investigation and cleanup. Investigations that identified the nature and extent of contamination at SWMUs and associated groundwater were submitted to the TCEQ and EPA in the form of RFIRs. Those investigation reports closed many units through interim RAs and no further controls other than deed recordation. Other units were evaluated in human health and ERAs to identify units that required further RAs to protect human health and the environment. A detailed summary of actions for the 254 units can be found in the ROD (B&W Pantex and Sapere Consulting 2008). Of the 254 units, 159 contain contaminants at levels that do not allow for unrestricted access and unlimited use. Accordingly, deed restrictions were developed to define the requirements for access, soil disturbance, drilling and use of perched groundwater.

The ICs focused on the areas listed below:

- BG Former Ash Disposal (SWMUs 14-24), operational area of FS-5 (SWMU 70) and the 27 Pantex Plant landfills.
- Zone 12 ditches (SWMUs 2 and 5/5).
- Limited Action Soil Units, Burn Pads 11-13 (SWMUs 25-27) and the Zone 12 Main Perimeter Ditch (SWMU 5/12a).
- Southeast Area and Zone 11 perched groundwater

Remedial design of the ICs was completed in 2009. Access controls and restrictions associated with the Pantex Plant mission and postings/signage installed during investigation to notify Pantex Plant workers of contaminants formed an existing basis for the ICs. Much of the property east of FM 2373 underlain by contaminated perched groundwater was purchased from private landowners in 2008, providing for swift access to implement future remedies, as needed,

and direct control for enforcing deed restrictions filed in the Carson County records. This resulted in the need to place deed restrictions on only two properties that are not owned by USDOE/NNSA. Implementation of the deed restrictions was completed in 2010.

All Pantex ICs were reviewed by Sapere Consulting, Inc (Attachment 15) as part of the FYR process in November 2012. All ICs have been implemented and are working as intended to prevent exposure. One needed improvement was noted for groundwater ICs associated with the well maintenance plan. Although inspection and maintenance activities are being implemented, this well maintenance plan has not yet been finalized (see Chapter 7 for recommended action). No other deficiencies related to the implementation, maintenance, operation, and enforcement of the ICs were noted in the independent review.

4.3 Systems Operation / O&M

This section discusses the O&M of the soil and groundwater remedies (i.e., the Selected Remedy). It details any problems encountered during operations and any system modifications that were made as a result. It also provides the actual cost of O&M of the Selected Remedy since implementation.

4.3.1 Soils O&M

O&M of the SVE system in the BG, the ditch liner, and the protective covers installed for the 27 landfills are described in the following subsections.

4.3.1.1 Burning Ground Soil Vapor Extraction System Operation

The Burning Ground SVE system, which addresses SWMU 47, has been operated intermittently during the FYR period. The system was shut down for GAC exchange, repairs, and maintenance. Freezing temperatures affected the operation of the GAC-based system, so it was shut off at times during freezing weather, typically in the months of December, January, and February. The GAC was replaced as needed, based on operational knowledge, calculated breakthrough, and photoionization detector readings between the 5th and 6th drum.

Figure 4-5 and Figure 4-6 summarize the SVE system operations over the FYR period. The system removed over 1,500 pounds (lbs) of soil gas VOCs during this period. Soil gas recovery has been variable throughout the review period, ranging from less than ten lbs in May 2010 to almost 120 lbs in October 2010. Estimated recovery is affected by system operational time, air flow rates, and influent analytical data.

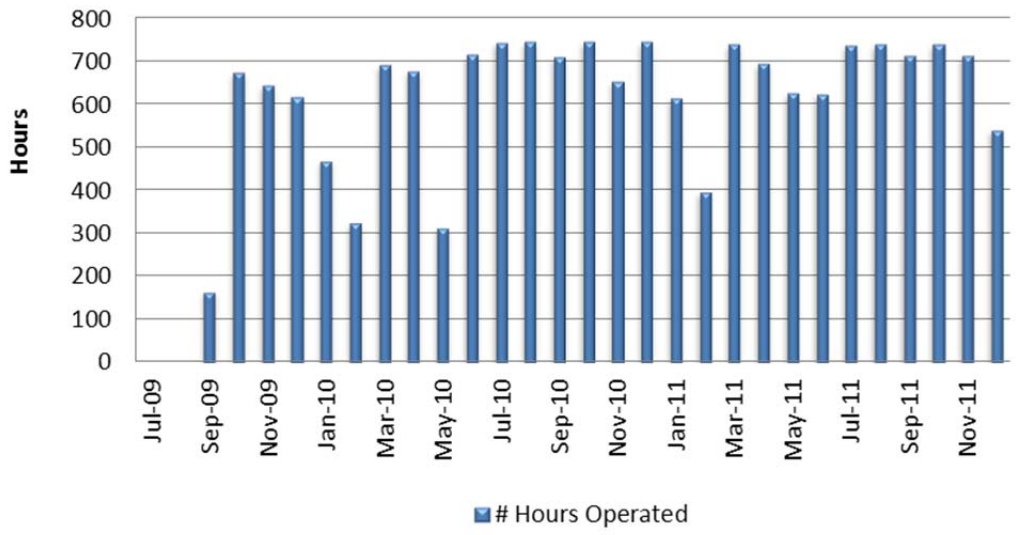


Figure 4-5. BGSVE System Operational Time

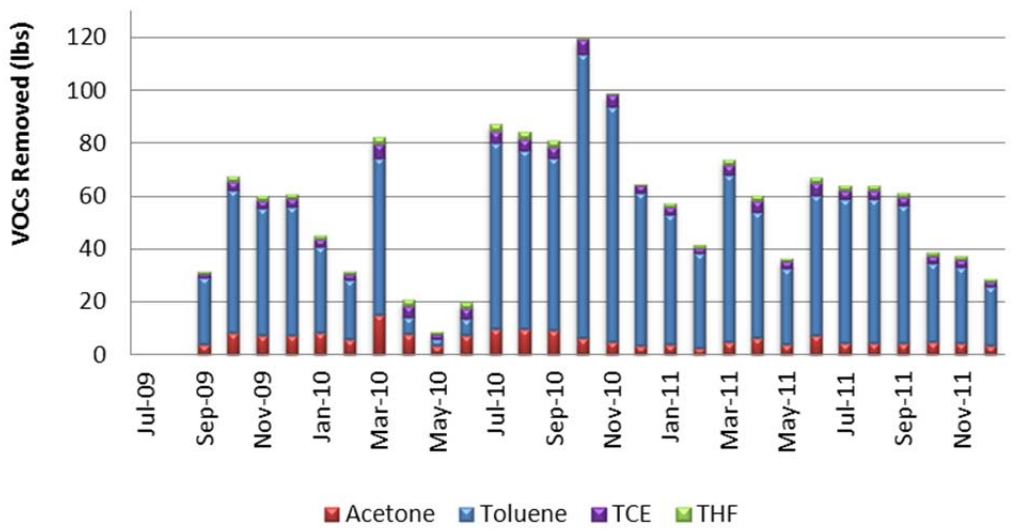


Figure 4-6. BGSVE VOC Recovery

4.3.1.2 Landfill Cover O&M

Inspections of all protective covers, including the BG Former Ash Disposal Trench (SWMUs 14-24) and the FS-5 operational area are conducted quarterly. Inspections also occur after rainfall events of greater than 0.5 inches. Also, a Light Detection and Ranging (LiDAR) Survey was conducted to aid in evaluation of the surfaces of the protective covers for this review. The resolution and efficiency of this survey focused field verifications to provide confidence in

detection of areas requiring repair. Any holes in landfills that result from settling of construction debris or burrowing animal activity are identified and addressed. Stressed vegetation has been noted due to drought conditions experienced at various times, particularly in 2011 and 2012.

Work has been completed using internal equipment and labor to fill small holes. For the larger holes or areas where settling has occurred, work is typically contracted for maintenance as needed. A contract to control burrowing animals in the landfills is maintained. A program to reestablish vegetation in areas that have been heavily affected by drought has not yet been developed.

4.3.1.3 Ditch Liner O&M

The ditch liner is inspected periodically to identify tears and problems with sedimentation. To control sedimentation, the liner is periodically flushed, but complete removal of sedimentation was not achievable when flushing was attempted in 2010. To address this issue, a contract was issued to repair tears in the liner, reattach the liner to headwalls, and to implement improvements to allow for flushing sediment from the liner.

In 2011, the rock ballast and collected sediment were removed from the bottom of the liner, repairs were made, and an alternate system consisting of flat-plate anchors was installed. The flat-plate anchors were installed no more than five feet apart and the anchors were driven to a depth of 30 – 48 inches to provide sufficient maximum pullout resistance. A geotextile fabric was then placed over each anchor and a piece of polypropylene was welded to the existing liner to ensure a water-tight seal in the ditch bottom. Inspection and maintenance of this liner has been continued and flushing and hydrovac techniques to control sedimentation will continue to be used.

4.3.1.4 Soils O&M Costs

O&M costs for the Soil Remedies are presented in Table 4-1. These costs are primarily related to maintaining protective covers and operating the BG SVE System. Costs for this program exceeded the estimate in FY2010 and FY2011 for three reasons; (1) more media changes and labor were required for GAC vapor treatment at the BG SVE than estimated, (2) contracted labor was needed to improve and maintain the landfill cover at SVS 6, and (3) synthetic liner repairs, reattachment to headwalls, and correction of erosion at a portion of the anchor trench was required for the SWMU 2 and 5/5 ditch liner. Annual analysis of maintenance costs for the soil remedies resulted in two actions to reduce costs that have already been implemented; (1) replacement of GAC treatment at the BG with a small CatOx unit in 2012 and (2) replacement of the ballast system in the SWMU 2 and 5/5 ditch liner with an anchor system in 2011 to facilitate sediment removal.

Table 4-1. O&M Costs for Soil Remedies

Dates		O&M Cost Rounded to Nearest $1,000
From	To	
Annual ROD Estimate		150
Annual PCOR Estimate		246
10/1/2008	9/30/2009	219
10/1/2009	9/30/2010	402
10/1/2010	9/30/2011	320
10/1/2011	9/30/2012	152

4.3.2 Groundwater O&M

4.3.2.1 SEPTS

Operational goals of 90% operational time and 90% design capacity were established in order to reduce saturated thickness of the perched aquifer, as well as achieve mass removal. This approach will gradually reduce the volume of perched groundwater (and contamination) moving downgradient toward the extent of the perched aquifer, and reduce the head (driving force) for vertical migration of perched groundwater into the FGZ and toward the underlying Ogallala Aquifer.

These goals provide for about 142 million gallons (Mgal) of perched groundwater to be removed and treated through the SEPTS each year. Figures 4-7 to 4-9 summarize SEPTS operations during the reporting period and compare the operational time and treatment flow to operational goals. The design capacity of the treatment system is 300 gallons per minute (gpm). The average gpd summarized in Figure 4-9 accounts for both system flow and system down time while the average gpm summarized in Figure 4-8 does not account for system down time and is thus a measure of the well field production.

The SEPTS underwent an upgrade starting October 2010 and completing in October 2011 to reconfigure well-heads to provide improved freeze protection, upgrade flow meters and piping, and install temperature indicators on all wells. Improvements resulting from the upgrade project allows for more consistent operation of the wells during the coldest months of the year. While this project was underway, many wells were shut down to reconfigure those connected to a common conveyance line and common electrical service. As a result, operation of high priority wells that control downgradient plume movement were offline during portions of the year.

As depicted in Figure 4-7, average operational time consistently exceeded the 90% goal during the FYR reporting period.

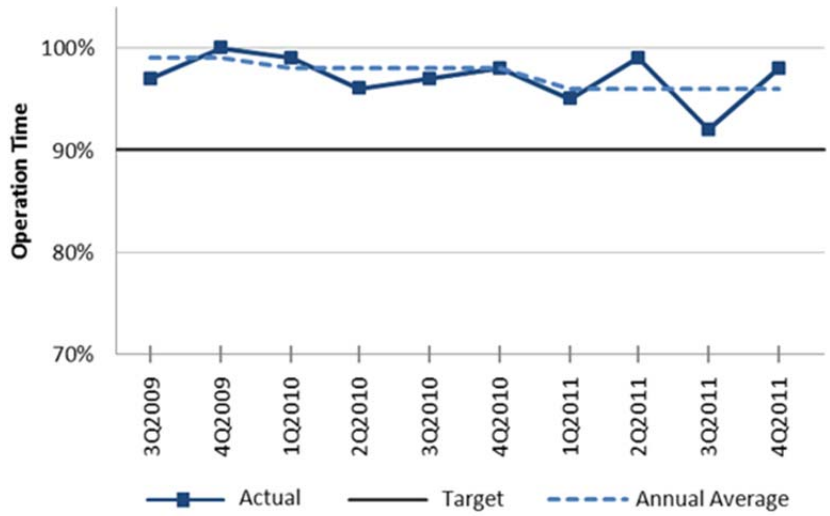


Figure 4-7. SEPTS Operational Time vs. Target

As depicted in Figure 4-8 and Figure 4-9, the SEPTS met throughput goals through 2010 and then steadily decreased through 2011. System throughput was affected by the well-head reconfiguration project that occurred from October 2010 to October 2011, as well as reduced system throughput to limit injection of treated water back into the perched zone.

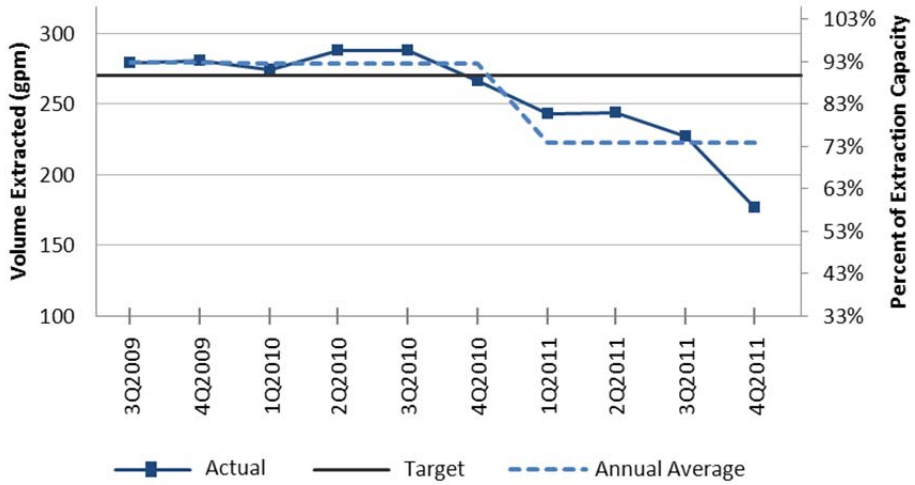


Figure 4-8. SEPTS GPM and % Capacity

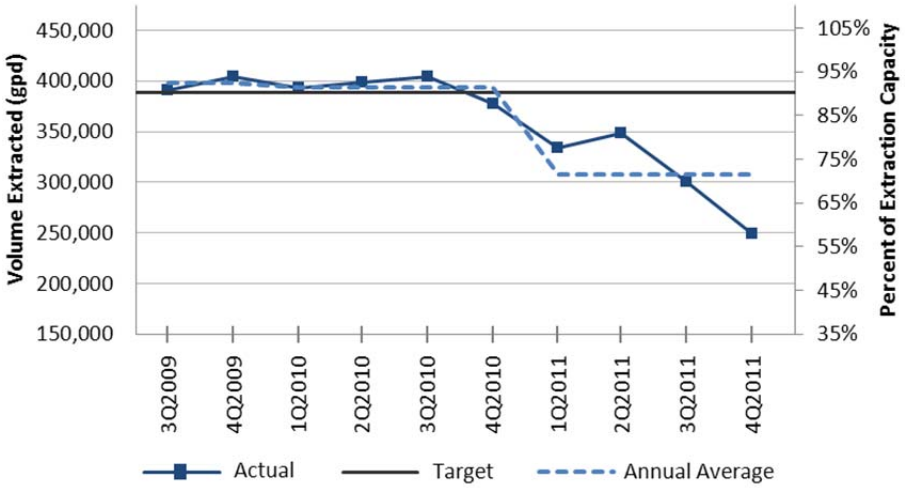


Figure 4-9. SEPTS GPD and % Capacity

As discussed in the *4th Quarter 2010 Progress Report* (B&W Pantex 2011a) and the *2010 Annual Progress Report* (B&W Pantex, 2011b), injection of all the treated water, or large volumes of it, is in conflict with the overall RA goal of reduction in saturated thickness for this system. Therefore, it was recommended that throughput be decreased to maintain an annual injection volume of 40 Mgal or less during 2011, while upgrades to the irrigation system were being completed. As depicted in Figure 4-10 almost 185 Mgal of treated water was sent to the WWTF while approximately 131 Mgal were injected back into the perched aquifer during the FYR reporting period. Almost five Mgal were used for ISB system operations.

System mass recovery has been variable over the reporting period as recovery is based on system throughput, as well as measured influent concentrations. The system removed a total of 520 lbs of hexavalent chromium during the reporting period. As depicted in Figure 4-11, hexavalent chromium removal was low during the third and fourth quarter of 2010 as several of the extraction wells installed in the heart of the hexavalent chromium plume were offline due to the well-head reconfiguration project. As depicted in Figure 4-12, 1,344 lbs of RDX and 520 lbs of other HEs were removed during the FYR reporting period. All COCs were treated to concentrations below the GWPS.

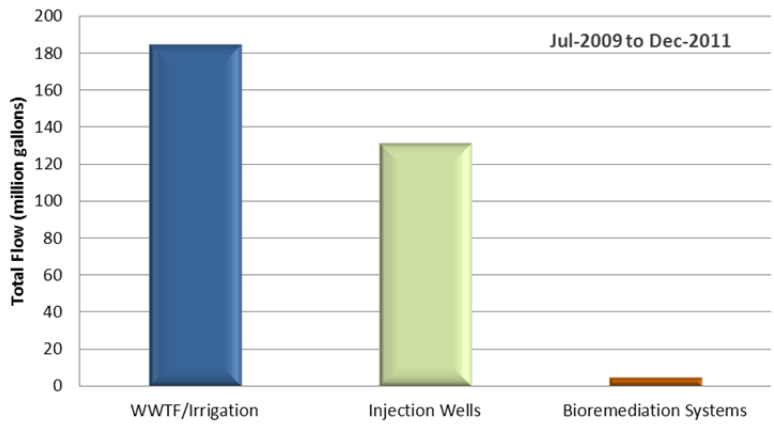


Figure 4-10. Disposition of SEPTS Effluent

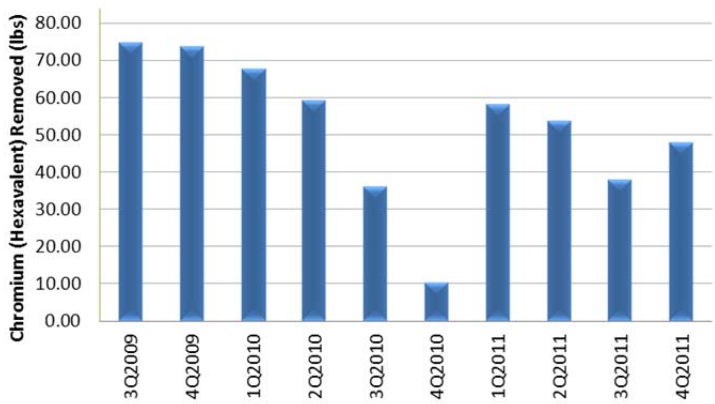


Figure 4-11. SEPTS Hexavalent Chromium Removal

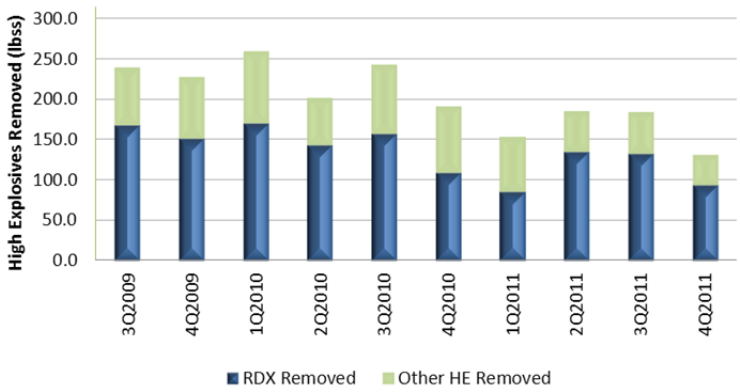


Figure 4-12. SEPTS HE Removal

4.3.2.2 P1PTS

Operational goals of 90% operational time and 90% design capacity were established in order to reduce the mound of perched groundwater associated with Playa 1, which will affect the movement of the southeast plume by reducing the hydraulic head, as well as achieving mass removal. P1PTS beneficially uses all treated water by sending it through the WWTF to the irrigation system. The 90% operational time and design capacity goals for the P1PTS provide for about 118 Mgal of perched groundwater to be removed and treated each year. Because this system does not have the capability to inject the treated water back into the perched aquifer, the treatment throughput must be adjusted or discontinued to meet the demands of the WWTF or irrigation system.

As depicted in Figure 4-13, P1PTS operations continuously improved in 2009 and have thereafter consistently exceeded the operational goals, with the following exceptions:

- P1PTS operations in 3Q2009 were affected by rainfall that kept the WWTF ponds full, irrigation system repairs, loss of electricity, and GAC change-out.
- P1PTS operations in 3Q2010 were affected by a 15-day shutdown in July. This shutdown was caused by record rainfall event in July 2010 that prevented use of the WWTF and irrigation system. The system exceeded operational goals in August and September 2010.
- P1PTS operations in 1Q2011 were affected by shutdowns in January and February due to freezing temperatures and upgrades to the irrigation system. The system exceeded operational goals in March 2011.

The calculated gpm depicted in Figure 4-14 accounts for water extracted from the well field during the time the system operates and is affected by the yield from each well, well downtime, or reduced flow required by restrictions associated with the WWTF/irrigation system. As shown in Figure 4-14, the gpm goal has been met for two quarters during the review period.

The most significant contributors to the reduced gpm are:

- WWTF repairs and irrigation system upgrades which kept those systems from being able to receive the amount of treated water required to meet goals.
- Weather conditions, including freezing temperatures and excessive rainfall, which affected irrigation system operations.
- Mechanical or electrical issues with individual extraction wells; the loss of more than one well can affect the ability of the P1PTS to meet the established 90% throughput goals.

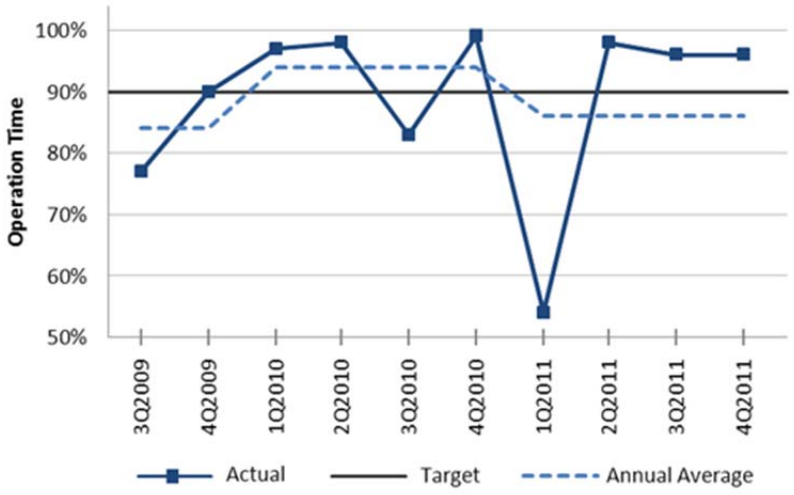


Figure 4-13. P1PTS Operational Time vs. Target

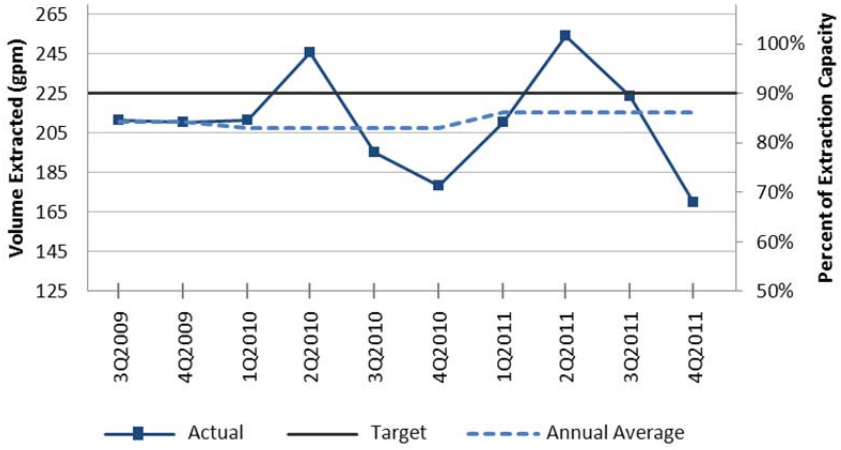


Figure 4-14. P1PTS Average GPM and % Capacity

Figure 4-15 depicts the average gpd by quarter, the percentage of total capacity achieved, and the goal for the system. The calculated gpd accounts for flow from the well field, as well as system operation time during the day, and is affected by system operational time, ability to extract water from the wells, and reduced flow to the WWTF and irrigation system. Therefore the P1PTS gpd was affected by the aforementioned plant shutdowns, WWTF/irrigation issues, and extraction well issues.

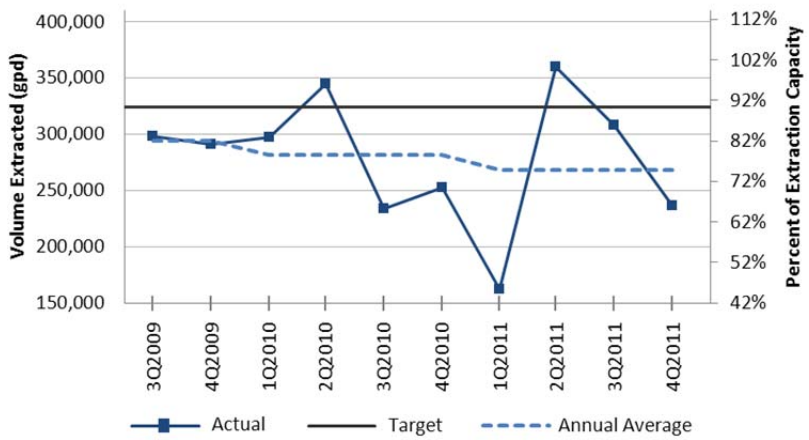


Figure 4-15. P1PTS Average GPD and % Capacity

Significant progress has been made toward increasing the capacity of the irrigation system by adding an additional 100-acre tract. Improvements in system throughput, both in gpd and gpm, were achieved during second quarter 2012 and it is anticipated that this upgrade will allow for both pump and treat systems to meet or exceed throughput goals during spring and summer months. Nevertheless, excessive rainfall or freezing temperatures in the winter may potentially result in irrigation system shut downs and affect P1PTS operations.

System mass recovery has been variable over the FYR reporting period as recovery is based on system throughput as well as measured influent concentrations. The system removed a total of 217 lbs of RDX and 90 lbs of other HEs during the FYR reporting period. The system extracted almost 250 Mgal of groundwater and treated all COCs to concentrations below the GWPS.

4.3.2.3 SEISB System

Based on the baseline rate of perched groundwater flow and estimated amendment longevity, injections were estimated to be necessary about every 12 to 24 months. The injection events for the first FYR period at the SEISB system are summarized in Table 4-2.

Table 4-2. ISB Injection Events

ISB System	Injection Event	Completion Date
Southeast	1	March 2008
	2	March 2010
Zone 11	1	June 2009 (original 23 wells) November 2009 (9 new wells)
	2	September 2010
	3	October 2011

Before each injection event, the injection wells are rehabilitated to address bio-fouling. Well maintenance chemicals, usually acid and caustic based products, are used to aid in the efforts. Surge, brush and bail techniques as well as a combination of brushing and air-lift methods have been implemented to attempt to return the wells to

pre-injection hydraulic connectivity with the formation. These techniques appear to be effective in preparing the well field for injection, as indicated by sustained injection rates and performance monitoring data collected from downgradient wells. During this FYR period, two injection wells were damaged as a result of maintenance activities, and subsequently replaced. These wells are PTX06-ISB013 and ISB044.

Both the SEISB injection wells and downgradient ISPM wells are sampled quarterly and the data are evaluated in the Quarterly and Annual Progress Reports.

4.3.2.4 ZN11ISB System

Based on the rate of perched groundwater flow and estimated amendment longevity, injections for this system were estimated to be necessary about every 12 to 18 months. Rehabilitation and injection activities have been scheduled every 12 months because of greater saturated thickness and higher groundwater velocity encountered in the well field. Three injection events have been completed for this system during this FYR period. Table 4-2 summarizes the injection events during the FYR period.

Before each injection event, wells are rehabilitated using the techniques and well maintenance chemicals described in Section 4.3.2.3. Results have been similar to those observed at the SEISB System. During this FYR period, four injection wells were damaged as a result of maintenance activities, and subsequently replaced. These wells are PTX06-ISB057, -ISB066, -ISB073, and –ISB075. Two of the wells (-ISB066 and –ISB075) were just replaced in September 2012.

Both the ZN11ISB injection wells and downgradient ISPM wells are sampled quarterly and the data are evaluated in the Quarterly and Annual Progress Reports.

4.3.2.5 Long-Term Monitoring

The LTM design and evaluation criteria are provided in the *LTM System Design Report* (B&W Pantex, 2009a). Monitoring occurs on a quarterly basis near the ISB Systems and on a semi-annual or annual basis elsewhere for perched groundwater COCs. B&W Pantex technicians sample the wells in accordance with the *Sampling and Analysis Plan for the USDOE/NNSA Pantex Plant Groundwater Remedial Action Project* (B&W Pantex, April 2009) and the *Field Sampling Plan Update* (B&W Pantex, November 2011).

A subset of perched and Ogallala Aquifer wells is monitored for an expanded list of constituents every five years to monitor for uncertainties at the source areas. These lists are a modified subset of the Appendix IX groundwater parameters presented in 40 CFR 264 that include COCs that might be contributed by the source areas. ISB well monitoring also contains specific lists of

parameters to evaluate the conditions in the treatment zone and downgradient wells. Due to documented evidence of corrosion of stainless steel wells, a subset of wells is also monitored for corrosion indicators. Specific parameters were also added at wells in the southeast area groundwater to assist with future evaluation of natural attenuation and estimation of degradation rates for HEs.

The wells that comprise the LTM Network are visually inspected for surface defects (well pad integrity, locking cap, etc) during each sampling event and any anomalies (groundwater color and odor, unusual depth to water, obstruction in casing, etc.) are noted for further evaluation as needed. Also, each well is thoroughly inspected (including down-hole video) on a schedule designed to account for its age, material of construction, and history of past needs. These inspections form the basis for maintenance activities and well replacement determinations. During this FYR period, four monitoring wells were replaced; three completed in the perched aquifer and one completed in the Ogallala Aquifer. The three perched aquifer monitor wells were replaced to ensure representative samples could continue to be obtained; OW-WR-38 (23 years old, severe screen corrosion), PTX08-1007 (18 years old, screen failed), and PTX06-1103 (integrity uncertainty, potential vertical pathway). Ogallala Aquifer monitor well PTX06-1032 was replaced with new well PTX06-1157, after concerns with ineffective seals associated with trace detections of HEs were confirmed.

4.3.2.6 Groundwater O&M Costs

Overall, the cost of O&M for the groundwater remedies has been achieved within the budget established for the Pantex Plant Long-Term Stewardship Program. As presented in the discussion of cost for each of the individual RA components, one of the systems (the ZN11ISB) is costing more to operate and maintain than estimated in the ROD.

The cost to operate and maintain the SEPTS has been consistent with the ROD estimate except for Fiscal Year 2010 (10/1/2009 to 9/30/2010) (Table 4-3). During FY2010, the SEPTS was operated consistently at design capacity. This required frequent treatment media changes and part replacements. A spare parts inventory was also established to ensure the ability to maintain consistent operation.

Table 4-3. O&M Cost for the SEPTS

Dates		Total Cost ($K) Rounded to Nearest $1,000
From	To	
Annual ROD Estimate		1064
Annual PCOR Estimate		1240
10/1/2008	9/30/2009	1097
10/1/2009	9/30/2010	1600
10/1/2010	9/30/2011	1069
10/1/2011	9/30/2012	1050

The cost to operate the P1PTS has been less than was estimated in the ROD (Table 4-4). During its first year, the facility was new and going through start-up activities. Intermittent operation and reduced throughput during the startup period resulted in fewer media changes and virtually no parts replacement. In subsequent years, the cost was closer to the ROD estimate, but still lower. Since the system only has a single outlet for the treated perched groundwater (subsurface irrigation by way of the WWTF) throughput was reduced at times, resulting in lower costs related to media exchanges. With upgrades to the irrigation system and the addition of another 100-acre tract to receive the treated water, the O&M estimate is expected to be realized during the next five years.

Table 4-4. O&M Costs for the P1PTS

Dates		Total Cost ($K) Rounded to Nearest $1,000
From	To	
Annual ROD Estimate		888
Annual PCOR Estimate		1064
10/1/2008	9/30/2009	353
10/1/2009	9/30/2010	647
10/1/2010	9/30/2011	670
10/1/2011	9/30/2012	663

The O&M cost for the SEISB System has not been consistent with the estimate from the ROD (Table 4-5). During injection years the cost of injection has been approximately half of the estimate. During the first year after issuance of the ROD (10/1/2008 to 9/30/2009), the system was monitored to determine the effects of the first injection completed in March 2008. Treatment zone monitoring was conducted and the upper boundary of the estimated injection frequency (24 months) was evaluated. Another injection of amendment occurred in 2010 at the design dosage of 5%. Monitoring of the treatment zone occurred again during 2011, with the third injection occurring in 2012. During the third injection, amendment dosage was optimized

to be roughly proportional to contaminant flux through the well field. Based on the treatment zone and performance monitoring data, the injection frequency is being shortened to about once every 18 months.

Table 4-5. O&M Costs for the SEISB System

Dates		Total Cost ($K) Rounded to Nearest $1,000
From	To	
Annual ROD Estimate		2612
Annual PCOR Estimate		1830
10/1/2008	9/30/2009	123
10/1/2009	9/30/2010	1173
10/1/2010	9/30/2011	87
10/1/2011	9/30/2012	1464

The O&M cost for the ZN11ISB System was estimated based on just ten injection wells at the time the ROD was issued in 2008. The initial concept for the system was to install a shorter well field. Through remedial design and construction, the resulting system is three times larger, consisting of 32 injection wells. Subsequent treatment zone and performance monitoring indicate that injection is needed annually. The first injection occurred in June 2009 as part of the construction cost, so monitoring of the system occurred as O&M cost in the first year after the ROD. In 2010, the second injection was conducted at the design basis dosage of 5% amendment. As the conceptual site model for the system was updated, the injection was optimized to increase the dosage in a manner roughly proportional to contaminant flux across the well field. This can be inferred from the slightly greater FY2011 and FY2012 O&M costs in Table 4-6.

Table 4-6. O&M Costs for the ZN11ISB

Dates		Total Cost ($K) Rounded to Nearest $1,000
From	To	
Annual ROD Estimate		1234
Annual PCOR Estimate		1234
10/1/2008	9/30/2009	124
10/1/2009	9/30/2010	1937
10/1/2010	9/30/2011	2139
10/1/2011	9/30/2012	2155

The costs for groundwater monitoring and well maintenance activities are presented in Table 4-7. The Sampling and Analysis Plan (B&W Pantex, April 2009) approved as part of the Remedial Design package was implemented toward the end of FY2009 (i.e. in July 2009). Therefore, the costs for FY2009 are representative of only partial implementation of the Final LTM Network Monitoring Program. Costs for the next three years (FYs 2010, 2011, and 2012) indicate a consistent level of effort for the Program, as fully implemented.

Table 4-7. LTM Network O&M Costs

Dates		O&M Cost ($K) Rounded to Nearest $1,000
From	To	
Annual ROD Estimate		583
Annual PCOR Estimate		679
10/1/2008	9/30/2009	477
10/1/2009	9/30/2010	768
10/1/2010	9/30/2011	627
10/1/2011	9/30/2012	589

4.3.3 Institutional Controls

O&M of the ICs usually focuses on identifying and replacing SWMU signs, inspecting fencing, actively watching for signs of unauthorized drilling in areas outside of the Pantex Plant, and continued training of onsite workers and contractors. The O&M of protective covers, SVE, and liners are discussed in previous sections.

- Protective Covers: IC O&M includes inspecting protective covers and ensuring access restriction controls are in good condition per the *Maintenance Plan for Landfill Covers*.

- Zone 12 ditches (SWMUs 2 and 5/5): IC O&M includes inspecting integrity of liners and ensuring access restriction measures are in good condition per *Final Maintenance Plan: Zone 12 ICMs for SWMUs 2 and 5/5 Ditch Lining*.

- Limited Action Soil Units, Burn Pads 11-13 (SWMUs 25-27) and SWMU 5/12a: IC O&M includes maintenance of fencing, signage, training, and implementation of SWMU Interference Notifications if a need arises to disturb soils in SWMUs across the Plant.

- Southeast Area and Zone 11 perched groundwater: IC O&M includes ensuring access restriction measures (e.g., notices of restricted areas; fencing) are in good condition and employee training per the Land and Groundwater Use Control Implementation Plan (*LGWUCIP*).

4.3.3.1 Institutional Controls O&M Costs

O&M costs are comprised of primarily labor needed to review upcoming projects and maintenance activities to determine whether soil disturbance will occur or if RA system components and monitoring wells could be damaged. Other aspects of each project are also evaluated, such as whether the project would lead to increased recharge potential in SWMU areas or involve drilling activities to the depths of the perched groundwater. Maintenance of postings (SWMU signs) and development and implementation of SWMU Interference controls are also accomplished through this funding. As depicted in Table 4-8, the annual O&M costs are within the ROD estimate. Although, the annual cost fluctuates somewhat, it appears to be sufficient to maintain and implement the controls.

Table 4-8. ICs O&M Costs

Dates		O&M Cost($K) Rounded to Nearest $1,000
From	To	
Annual ROD Estimate		150
Annual PCOR Estimate		150
10/1/2008	9/30/2009	98
10/1/2009	9/30/2010	80
10/1/2010	9/30/2011	89
10/1/2011	9/30/2012	50

5 Progress since Last Review

This is the first FYR for the Pantex Selected Remedy. Information contained herein represents evaluation of the progress achieved since construction completion was approved in July 2009.

This page left intentionally blank.

6 Five-Year Review Process

6.1 Administrative Components of the Five-Year Review Process

The FYR began on June 4, 2012 and was completed on December 14, 2012. Public notifications of the initiation of the Five-Year Review were published in the Amarillo Globe-News and Panhandle Herald on May 31, 2012 to notify any potentially interested parties of the start of the FYR. Copies of the notices are included in Attachment 1.

The B&W Pantex review team included:

- Martin Amos - Project Manager/Regulatory Liaison
- Dr. Matthew Jones – Hydrogeologist
- Michelle Jarrett – Risk Assessor/RA Progress Specialist.

In addition several subcontractors were hired to perform specific tasks as outlined below. The subcontractors included:

- GSI Environmental, Inc. – Conducted a MAROS evaluation of the perched aquifer LTM Network (completed in August 2012).
- Sapere Consulting, Inc. – Conducted a review of the ICs (completed November 2012).
- Trihydro Corporation – Conducted an evaluation of the groundwater RA effectiveness (completed in November 2012).
- RPS Espey – Conducted an evaluation of the sampling methods of the Ogallala Aquifer wells (completed in October 2012).

The draft final FYR Report was provided to TCEQ and EPA for review in January 2013. Comments were received from TCEQ and EPA through correspondence of February 28, 2013, and August 11, 2013, respectively. This Final Report incorporates changes resulting from resolution of the aforementioned comment. EPA and TCEQ concurrence with the Final FYR Report is anticipated by September 25, 2013.

6.2 Community Notification and Involvement

Public notifications of the initiation of the Five-Year Review were published in the Amarillo Globe-News and Panhandle Herald on May 31, 2012. Copies of the notices are included in Attachment 1. TCEQ and the Pantex Plant host semi-annual public meetings to share information about the Long-Term Stewardship Program (May and November of each year) in accordance with the approved Community Involvement Plan. RA progress is presented as part of each of these meetings. FYR information and progress was presented at Long-Term Stewardship Public Meetings conducted on November 11, 2011, May 7, 2012, November 5, 2012, and June 3, 2013.

Since remedy selection, many of the landowners adjacent to the Pantex Plant have changed. Efforts to share information with this part of the community should be improved. One tool used in the past was a neighbor newsletter that shared pertinent information on cleanup activities. Pantex will consider reinstituting this mode of communication.

6.3 Document Review

Documents reviewed as part of the Five-Year Review process included the Pantex Plant decision documents, regulatory guidance documents, and other documents. A full list of documents reviewed is presented in Attachment 2.

RAOs were defined in the ROD (B&W Pantex and Sapere Consulting, 2008).

Applicable or relevant and appropriate requirements (ARARs) for soil alternatives were defined in the ROD and determined from:

- RCRA (40 CFR parts 260-280, 42 United States Code [USC] § 6901-6933).
- Pantex Plant Compliance Plan for Industrial and Solid Waste Management (CP-50284) (TSWDA, Texas Health & Safety Code, Chapter 361; 30 TAC Chapters 305, 335 and 350).
- Texas Health & Safety Code, Section 382.085: Unauthorized Emissions Prohibited.
- Procedures for Planning and Implementing Offsite Response Actions [The EPA Offsite Rule] (40 CFR §300.440).
- Shipping and Reporting Procedures Applicable to Generators of Hazardous Waste or Class 1 Waste and Primary Exporters of Hazardous Waste (30 TAC §335.10).
- Hazardous Material Transportation Act (49 USC § 5101-5127).
- Hazardous Materials Regulations (49 CFR §171.1 et seq.).

- Underground Injection Control (40 CFR Parts 144-148, et. seq.; 30 TAC 331).

GWPS (i.e., cleanup levels) were defined in the ROD in 2008 and incorporated into CP-50284 (TCEQ, 2010) through a modification to recognize the RAs as final corrective action systems. The ARARs for perched groundwater alternatives were defined in the ROD and determined from:

- Safe Drinking Water Act (SDWA, P. L. 104-182, 40 CFR Part 141, et. seq.).
- RCRA (40 CFR parts 260-280, 42 USC § 6901-6933).
- Pantex Plant Compliance Plan for Industrial and Solid Waste Management (CP-50284) (TSWDA, Texas Health & Safety Code, Chapter 361; 30 TAC Chapters 305, 335 and 350).
- General Regulations Incorporated into Permits (30 TAC 305 and 30 TAC 319) and Chapter 26 of the Texas Water Code.
- Texas Water Code, Chapter 26, 30 TAC 305.
- Section 402 of the Clean Water Act and Chapter 26 of the Texas Water Code (TPDES MSGP, TXR 150000).
- Underground Injection Control (40 CFR Parts 144-148, et. seq.; 30 TAC 331).

A review of regulatory changes since issuance of the ROD resulted in no changes to the aforementioned ARARs for soil and groundwater.

6.4 Data Review

6.4.1 Data Reviewed

All perched and Ogallala aquifer data collected during the FYR period (July 1, 2009 through December 31, 2011), as well as older groundwater data that provided historical context (some from samples collected and analyzed as early as 1996) were evaluated in this review. Groundwater data were evaluated in multiple sections of this Five-Year Review report and can be found in Chapter 4, Chapter 7, Attachment 8, Attachment 11, Attachment 13, and Attachment 14.

6.4.2 Relevant Trends and Levels

Short-term, long-term, and FYR period COC concentration trends and water level trends were calculated for this review. Since this is the first FYR, the data range for trending was only 30 months long (July 2009 through December 2011). For wells sampled annually, not enough

measurements were available to trend. For wells sampled semi-annually, enough measurements were available to trend, but the trends were susceptible to skewing by a single measurement if it varied substantially from the rest of the measurements. Accordingly, data outside the FYR period were used, when available, to aid in interpretation of trends and provide the appropriate context. All COC concentration and perched aquifer water level trends/hydrographs can be found in Attachments 9 and 10, respectively.

As stated in Attachment 8 - Groundwater RA Effectiveness Evaluation (Trihydro 2012) the vast majority of groundwater trends and concentrations are already meeting expected conditions outlined in the LTM Design. These results are positive since the RAs have only been operating since July 2009. A brief summary of findings from this evaluation for each of the main RA systems follows.

- The SEPTS is meeting the design objective of reducing the saturated thickness in its area of influence. Groundwater elevations declined at each of the monitoring locations in the SEPTS area during the FYR period. The SEPTS is removing more groundwater than is estimated to be flowing into the upgradient side of the well field.

- The P1PTS is meeting the design objective of reducing the saturated thickness in its area of influence. Groundwater elevations declined at each of the monitoring locations in the P1PTS area during the FYR period.

- The SEISB System is meeting the design objective of creating an anaerobic treatment zone capable of degrading/converting target COCs to below the GWPS. SEISB conditions are still changing, but during the FYR period, COC concentrations decreased by approximately three orders of magnitude at downgradient locations that have been influenced by the SEISB System. Two of the five downgradient monitoring locations are not yet exhibiting complete treatment. Concentrations of hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine (DNX), chromium, and hexavalent chromium have been reduced to below GWPS at downgradient locations, while RDX and TNX remain above the GWPS. Concentrations of RDX and TNX above the GWPS are attributed to desorption and back-diffusion, and are anticipated to decrease to below the GWPS during the next FYR period. Also, hexavalent chromium is exhibiting an increasing trend at one downgradient location; PTX06-1153.

- The ZN11ISB System is meeting the design objective of creating an anaerobic treatment zone capable of degrading target COCs to below the GWPS. ZN11ISB conditions are still changing, but during the FYR period, perchlorate decreased to non-detect

concentrations at downgradient locations that have been influenced by the ZN11ISB System. Concentrations of TCE have been reduced and continued in a declining trend during 2012, after this FYR period, but are not yet below the GWPS at downgradient locations. TCE is being degraded by the ZN11ISB System, though cis-DCE and vinyl chloride were observed at low concentrations as transient by-products. Concentrations of TCE above the GWPS downgradient of the treatment zone are attributed to desorption and back-diffusion, and are expected to decrease to below the GWPS during the next FYR period.

6.4.3 Long Term Monitoring Network Recommendations

6.4.3.1 MAROS Evaluation of Perched Aquifer Network

Remedy effectiveness is determined through groundwater monitoring implemented through a Long-Term Groundwater Monitoring Plan. The perched aquifer LTM network was evaluated by GSI Environmental, Inc to review the network for its ability to support site monitoring goals, including remedy effectiveness, plume stability, and uncertainty management, and then make recommendations to improve the network (Attachment 11). Well and groundwater analytical data (using a period from 2000 – 2011) were analyzed using the MAROS version 2.2 and 3.0 (beta) developed by GSI. In this evaluation, perched groundwater was divided into 3 sectors for analysis. Then the network in each sector was evaluated for plume stability, spatial redundancy and sufficiency, and frequency analysis. Individual well statistics and trends were also evaluated. The full report is included in Attachment 11. The overall conclusions of the evaluation included:

- Four additional perched aquifer monitoring wells are recommended (Figure 4-8). These four additional monitoring wells were installed proactively in August 2012 and are needed to help delineate plume boundaries, determine stability, and address uncertainty in the perched aquifer.

- The networks monitoring the pump and treat extraction well fields and ISB systems were determined to be adequate to evaluate remedy performance.

- No wells are recommended for removal from the monitoring network.

- There are no strong recommendations to change the sampling frequencies detailed in the LTM Design Report (B&W Pantex 2009).

6.4.3.2 Ogallala Aquifer (High Plains Aquifer) Monitoring Network

RPS Espey was commissioned to review state-of-the-industry sampling methods, evaluate well construction details of the Ogallala Aquifer wells, and develop recommendations for changes to

the sampling program. The evaluation report is included in Attachment 12. Key findings and recommendations include:

- The assumption that the well is in good hydraulic communication with the aquifer is the key to obtaining representative samples in long-screen wells by any method. Therefore, well-specific evaluations of flow could be conducted on each well to verify flow through performance.

- The use of a default purge time for all wells regardless of purge flow rate or well-specific conditions is arbitrary and leads to inconsistent attainment of purge parameter stabilization. For continued use of low-flow purging and sampling, development of well-specific purge stabilization criteria based on non-parametric tolerance interval or purge flow-rate-specific criteria based on achieving a minimum two-volume purge of the sample tubing and pump should be considered.

- Passive sampling technologies, such as snap samplers, may be a viable alternative to low-flow sampling methods. Multiple government-funded research studies at several Department of Defense facilities have demonstrated that passive samplers can provide representative data with quality as good as or better than low-flow methods. In long-screen wells like those found at the Pantex Plant, the requirements of well flow through and mixing are the same for both low flow sampling and passive sampling. Testing of passive samplers should be considered, specifically the snap sampler in combination with baffles (diverters) to isolate the sample interval.

- The well construction design specified in the LTM System Design Report provides flexibility for sampling from multiple intervals, allows isolation of individual screen intervals, and extends the life span of wells in relation to the declining water table of the aquifer. Several wells have been constructed using this design and successfully sampled at multiple depths using available sampling equipment. Therefore, this design should continue to be used for replacement of detection monitoring wells in the Ogallala Aquifer, as needed in the future.

6.5 Site Inspection

The Five-Year Review Site Inspection was conducted on August 7 – 9, 2012. The inspection was conducted by B&W Pantex and USDOE/NNSA personnel with EPA Project Manager, Ms. Camille Hueni and TCEQ Project Manager, Ms. Fay Duke. The inspection focused on evaluating the groundwater and soil RAs. Inspection forms were developed using the EPA Five-Year Review

guidance and were tailored for the specific RAs at the Pantex Plant. The completed forms and pictures taken during the Site Inspection are presented in Attachment 3.

The P1PTS, SEPTS, and ZN11ISB System were inspected and discussions were held with the O&M Managers for each of these systems. The SEISB System was not inspected with TCEQ and EPA, because the injection trailer was in use at the ZN11ISB System in August 2012. B&W Pantex personnel inspected the SEISB well field independently in November 2012.

The BG SVE System (including CatOx Unit and Scrubber), the SWMU 2 and 5/5 Ditch Liner, and Landfill Covers for Firing Site 5 (SWMU 70), the BG (SWMUs 37-44), and the Original Sanitary Landfill (SWMU 68a), and Landfills 1, 2, 3, and 6 (i.e., SWMUs 68b, 68c, 54, and 57) were inspected during the Site Inspection. All other landfill covers were inspected by B&W Pantex personnel independently in October 2012.

The SEPTS and P1PTS were observed to be operating and in good condition. The facilities are well maintained and operating personnel were knowledgeable about the systems and the objectives they are striving to attain. The extraction wells at each system are constructed in below-ground vaults with insulated lids to provide freeze protection from winter weather, allowing for year-round operation.

The ZN11ISB was undergoing injection of bio-amendment. The injection trailer was drawing bio-amendment from one of the tankers at the equipment pad through metering pumps that mix it with treated perched groundwater. The treated groundwater is obtained via conveyance line from the SEPTS and stored in a series of three 20,000-gallon portable tanks adjacent to the injection trailer near the well field. The mixed amendment was being pumped through hoses into injection well PTX06-ISB061. This process is controlled using a process-logic-controller (PLC) interface in the trailer to obtain the planned volume and dosage needed to continue to stimulate indigenous anaerobes to maintain reducing conditions needed to treat TCE and perchlorate in perched groundwater underlying the area. The injection trailer, tanks, hoses and associated equipment were in good condition and appeared to be operating well.

The BG SVE system consisted of a new CatOx unit and wet scrubber to treat the solvent vapors extracted from SVE-S-20, the single well installed adjacent the former solvent evaporation/ chemical burn pit (SWMU 47), and associated equipment and chemicals. The vapor treatment and scrubber are housed in a conex container. The extraction well is connected through underground piping to a manifold, which was part of the original system installed and operated as an ISM implemented under state RCRA authority, and is attached to the CatOx unit by an industrial grade hose. B&W Pantex personnel were still troubleshooting system fail-safes and electrical service breakers, so the system was not operating at the time of the inspection.

Landfill covers were observed to be adequate. Ongoing maintenance to control damage associated with prairie dogs and discourage encroachment into new areas containing landfills, and fill holes resulting from other burrowing animals and settling within construction debris voids pose continuing challenges. Extreme drought conditions in 2011 and 2012 led to observably less vegetation of the protective covers. No damage has resulted from erosion, but efforts to establish vegetation are needed before erosion of the cover material occurs.

The SWMU 2 and 5/5 ditch liners were observed to be in good condition with only minor silt accumulation. The synthetic liner was in good condition with no observed punctures or separation from headwalls, as liner tears and anchor trench erosion were repaired in 2011. Also, the former river rock ballast system was replaced with a flat-plate anchoring system at the same time as the repairs to facilitate periodic removal of silt accumulation.

6.6 Interviews

Interview questions were drafted and surveys were sent by mail to neighbors, interested parties, and public officials on October 4, 2012. Specific interview questions can be found in Attachment 4.

To understand the perspective of the adjacent landowners, the general public, and other government officials, USDOE/NNSA initiated a survey to determine how well the Selected Remedy progress has been communicated. The survey forms that were sent out to the stakeholders are included in Attachment 4.

The survey was completed by mail; thirty-five stakeholders were sent survey forms on October 4, 2012 and responses were requested to be postmarked by October 22, 2012. B&W Pantex also provided stakeholders with an opportunity to complete the interview by phone or in person. Responses were received from seven stakeholders and are summarized below by stakeholder type.

6.6.1 Input from General Public

Based on survey responses, the general public perceives that cleanup activities at the Pantex Plant are completed with professionalism and good science and site security has been maintained. The general public appears to be pleased with communication regarding the cleanup activities at the Pantex Plant, and continued improvement in that area. Suggestions for further improvement included the choice of meeting locations. Currently public meetings are held in Panhandle, Texas and one survey respondent suggested holding some meetings in Amarillo, Texas to allow for greater public access and awareness.

6.6.2 Input from Adjacent Landowners

One adjacent landowner questioned how effective the cleanup efforts really are and whether the pump and treat water used for the drip irrigation is free of contaminants. He also stated that he didn't feel well-informed of the RA progress. Pantex personnel contacted this landowner to discuss his concerns and added him to the mailing list for notices of the public meetings. Another landowner indicated that the remediation work is effectively addressing the cleanup issues at the Pantex Plant. Surveys included a neutrally stated perception that more jobs have been created due to the clean-up efforts.

TTRF, one of the largest adjacent landowners, leases its property to USDOE/NNSA for a security buffer and also conducts some work on Pantex Plant. Semi-annual meetings are held to ensure effective communication and coordination of efforts. The TTRF Manager encouraged B&W Pantex and USDOE/NNSA to maintain these open lines of communication regarding activities at the Pantex Plant, as has been the case historically.

6.6.3 Input from Government Officials

Government officials noted that the operations at the Pantex Plant are both professional and effective. The government officials stated that they have not been contacted about any concerns, complaints, or violations since issuance of the ROD in 2008. They feel well-informed from the routine communications occurring in the form of Public Meetings and Agreement in Principle Meetings (held semi-annually). Further suggestions for improving the Pantex RA management or operation were not provided.

This page left intentionally blank.

7 Technical Assessment

The soil and groundwater remedies were designed to be a comprehensive action to remedy commingled widespread plumes. This assessment focuses on the soils and groundwater remedies separately, with a technical assessment summary of the entire action at the end of this chapter.

Detailed supporting information for this assessment can be found in Attachments 7, 8, 11, 12, 13, 14, and 15.

7.1 Soil Remedies

For this assessment all soil remedies will be evaluated comprehensively. The following soil units and remedies are included in this evaluation:

- Containment and ICs in the Zone 12 ditches prevent infiltration of HEs to perched groundwater (SWMUs 2 and 5/5).
- Containment and ICs for Former Ash Disposal Trench, FS-5, and Landfills, (SWMUs 14-24 and 70, and 27 other Pantex landfills).
- ICs for select soil sites (SWMUs 25-27 and 5/12a).
- SVE system at the BG (SWMU 47).
- Fencing at FS-5 (SWMU 70).

7.1.1 Question A: Is the remedy functioning as intended by the decision documents?

Yes. The remedies have been maintained to achieve the RAOs as intended. The soil remedies are functioning as intended and are still protective.

7.1.1.1 Remedial Action Performance

All soil remedies are performing as designed and expected. Some minor deficiencies have been noted, but the deficiencies have not affected the remedy's ability to meet the RAOs. The deficiencies have already been addressed by the Pantex Plant or are planned to be addressed as noted in Chapter 9 and discussed below.

The SVE system is operating as designed. The system is continuing to remove soil gas and reduce the mass of VOCs in the vadose zone. Groundwater monitoring indicates the system has been effective in protecting the underlying Ogallala Aquifer, which is the main objective of this

system. SVE was selected as the presumptive remedy for SWMU 47 and is continuing to achieve VOC mass reduction in the vadose zone. A BG SVE Performance Monitoring approach will be developed to define expected conditions and a path towards determining when to cease operation, i.e. an exit strategy.

A new CatOx treatment unit was proposed in 2011 and installed in 2012 to address system improvements needed because of inefficiencies associated with break-through of the GAC units, as well as greater than anticipated O&M costs as described in Section 4.2.1.1 of Chapter 4. O&M costs for this system should decrease appreciably as monitoring costs decrease and GAC replacement and regeneration costs of the former system have been eliminated. This reduced O&M cost will offset the initial cost to install the new CatOx unit within a few years.

Containment of landfill materials has been effective. Areas of the protective covers where holes were identified have been filled, and a program for burrowing animal control is in place. A plan will be developed in 2013 to address more recent problems with vegetation loss associated with extreme drought conditions from 2011 and 2012 to ensure that erosion of the protective covers does not occur and long-term effectiveness is maintained.

The ditch liner has been effective at preventing infiltration of water through the ditch soil contaminants. Due to excessive sedimentation that could not be completely flushed in 2010, the ballast system originally installed in the bottom of the liner was replaced with a flat-plate anchoring system to allow better maintenance as described in Section 4.2.1.3 of Chapter 4. That new anchoring system will be evaluated with respect to maintenance in the next FYR.

7.1.1.2 System Operations/O&M

O&M in accordance with the established procedures for the remedies will ensure continued effectiveness of the soil remedies. However, the upgrade to the ditch liner will require assessment in the next FYR as accumulated sediment has not needed to be removed yet; therefore, an assessment of the maintenance procedures at this ditch since the installation of the new flat-plate anchor system has not occurred.

7.1.1.3 Opportunities for Optimization

No opportunities have been identified to improve the performance and/or reduce costs of the Soil Remedy during this FYR other than the aforementioned installation of the CatOx unit at the Burning Ground SVE System.

7.1.1.4 Early Indicators of Potential Issues

As described in Section 7.1.1.1, extreme drought conditions during the past two years have resulted in vegetation loss across protective covers. This is a precursor to potential erosion problems.

7.1.1.5 Implementation of ICs and Other Measures

All Pantex ICs were reviewed by Sapere Consulting (Attachment 15) as part of the FYR process in November 2012. All soil ICs have been implemented and are working as intended to prevent exposure. No deficiencies related to the implementation, maintenance, operation, and enforcement of the soil ICs were noted in the independent review.

7.1.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

Yes. Exposure assumptions and RAOs still remain valid. Although there have been some changes in the toxicity data and risk assessment methods, no changes in the RA or RAOs are recommended for soil sites.

7.1.2.1 Changes in Standards and TBCs

Cleanup levels were developed and documented in the *Final Risk Reduction Rule Guidance to the Pantex Plant RFI, (BWXT, 2002 and updates in 2004)* based on calculated health-based standards under the Risk Reduction Rule ([RRR] 30 TAC 335 Subchapter S)/EPA Preliminary Remediation Goal (PRG) Calculator. The MSC table that supported the RRR is no longer supported by TCEQ, so other methods and toxicological information sources will be used to develop updated site specific values for SWMU Interference screening. Cleanup criteria were initially developed for radionuclide sites; however, final decision of whether the cleanup was protective of human health and the environment was based on a final human health and ERA. Changes to slope factors, toxicity criteria, or other criteria used in those assessments or development of cleanup values for the RRR are considered below.

7.1.2.2 Changes in Exposure Pathways

Land at the Pantex Plant is used for industrial operations. This use is anticipated to continue for the foreseeable future, so there has been no change in the land use considered in the risk assessment. No new human or ecological receptors, pathways, soil contaminants or sources were identified during this FYR.

7.1.2.3 Changes in Toxicity and other Contaminant Characteristics

Toxicity changes were identified for many analytes at the Pantex Plant. Although cleanup values were developed using the RRR at the Pantex Plant, soil sites are also controlled and undergo a site review to evaluate necessary worker protection and soil control measures, and work procedures must be approved prior to any activity that will disturb the soils. For these reasons,

new toxicity changes were not evaluated for soil sites during this FYR. However, it should be noted that older cleanup values calculated for an industrial worker are being used as screening values to aid in determining protective equipment and safeguards for workers at the sites. The screening values will be reviewed and updated to improve the process of continuing worker protection by 2014.

7.1.2.4 Changes in Risk Assessment Methods

EPA released new guidance for dermal, inhalation, and cancer risk assessment. As stated above, the soil sites were not reevaluated for risk at the Pantex Plant because there is a process in place to review worker protection at sites where soils will be disturbed through work practices or construction/excavation practices. Updates to those worker protective values are proposed to include newer methods and pathways by 2014. Changes in the guidance will be considered in the development of screening levels for worker protection at the sites.

The ERA for FS-5 (SWMU 70) was updated in 2012 (Attachment 14a) to reflect newer guidance and methods used for other sites at the Pantex Plant and to address total uranium as well as other contaminants in soil at the site. The risk assessment was completed using post-ICM data and considered placement of the protective cover over the facility area that was decontaminated and decommissioned as part of the ICM. The conclusions were no further RA is necessary for protection of ecological receptors. The detailed risk information is included in Attachment 14. TCEQ agreed that the conclusions of the updated evaluations are most likely valid, but requested that the small depression east of FS-5 be included to fully meet the TCEQ ERA Guidance. This additional assessment will be conducted in 2014.

No other changes in risk assessment methods impacted previous risk assessments or conclusions.

7.1.2.5 Expected Progress Toward Meeting RAOs

The RAOs for soil are:

- Reduce the exposure risk to onsite industrial and construction/excavation workers through removal, treatment, or prevention of contact with COCs in the soil.

- Reduce potential impact to perched groundwater and the Ogallala Aquifer through source abatement and stabilization/control measures in the vadose zone.

The soil remedy is progressing as expected and is currently meeting RAOs intended to protect workers. The remedy is expected to protect future groundwater resources.

7.1.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No. The soil remedy is currently protective and is expected to remain protective in the future. No changes are needed relative to ecological risks, natural disasters, or land use changes.

7.2 Groundwater Remedies

For this assessment all groundwater remedies will be evaluated comprehensively for questions relating to operation, maintenance, and performance of the remedy, with a more detailed assessment of the remedy components following each question. The following groundwater remedies are included in this evaluation:

- Southeast Area Perched Groundwater Remedy
  - Pump and Treat Systems (SEPTS and P1PTS)
  - In Situ Bioremediation System (SEISB)
  - ICs for groundwater
  - LTM to confirm effectiveness

- Zone 11 Perched Groundwater Remedy
  - In Situ Bioremediation System (ZN11ISB)
  - ICs for groundwater
  - LTM to confirm effectiveness

7.2.1 Question A: Is the remedy functioning as intended by the decision documents?

The groundwater remedy is functioning as intended in the short-term. The complete remedy for groundwater has only been functioning since 2009, and long-term goals are not expected to be met at this time.

Three issues have been identified that could affect long-term protectiveness of the remedy;

- Plumes of TCE and perchlorate extend north and west of the west side of the ZN11ISB treatment zone.

- Incomplete treatment of contaminants downgradient of the west end of the SEISB (PTX06-1153).

- Plumes of HEs (primarily RDX) are expanding east of FM 2373 and in the far southeast lobe of the perched aquifer.

Two other issues are related to changed conditions that require future monitoring;

- Increasing concentrations of 1,4 dioxane at the ZN11ISB

- New perched groundwater contaminants
    - Cadmium beneath Zone 12 South
    - Hexavalent Chromium near ZN11ISB
    - Metals solubilized as a result of the ISB systems (arsenic, barium and manganese)

Each of these issues require action as described further in the remainder of Chapter 7 and documented more succinctly in Chapter 8. Also, note that areas outside the direct influence of the groundwater remedy, such as the area of perched groundwater east of FM 2373, require continued collection of data to assess natural attenuation of HEs and other COC risk drivers, to improve the understanding of these processes and the relationship to the long-term goal of meeting restoration of the perched aquifer.

7.2.1.1 Southeast Area Perched Groundwater Remedy

The Southeast Area Perched Groundwater Remedy includes the following individual RAs:

- Two groundwater pump and treat systems (P1PTS and SEPTS)
- SEISB
- ICs to prevent exposure to groundwater
- LTM to confirm remedy effectiveness

7.2.1.1.1 Remedial Action Performance

The P1PTS reduces flux into the SEPTS, the SEPTS reduces flux into the SEISB and to the downgradient edge of the perched, and the SEISB treats water that is moving into a limited saturated zone of the perched aquifer that is sensitive to vertical migration. The effects of each system are intended to combine synergistically to achieve the RAOs and eventually long-term protectiveness through cleanup of the perched groundwater.

The two pump and treat systems (SEPTS and P1PTS) are operating and functioning as designed. Both systems are extracting groundwater and treating COCs in the extracted water to concentrations below the respective GWPSs. Groundwater levels are declining in the areas currently under the influence of the SEPTS and P1PTS extraction well fields; additionally, the P1PTS is reducing flux into the SEPTS well field. The reduction in saturated thickness reduces vertical movement of perched groundwater, thus protecting the underlying Ogallala Aquifer.

The SEISB is creating and maintaining an anaerobic treatment zone that is generally treating the target COCs to concentrations below the GWPS. Concentrations have declined to near or below

the GWPS in three of the five downgradient wells, so progress toward restoring the perched to drinking water standards is being achieved in this area.

As stated in the Groundwater Remedy Effectiveness Evaluation (Trihydro 2012) [Attachment 8], portions of the Playa 1 and Southeast areas are not under the short-term influence of the SEPTS and P1PTS and may not be under the long-term influence due to limited saturated thickness or other limiting hydrogeologic conditions. It is likely that the area of influence will expand with time; however, it is unlikely that all of the downgradient areas, especially perched groundwater underlying the part of the site east of FM 2373, will be impacted by the pump and treat systems. Upgradient source areas will be treated by the pump and treat systems as the water moves downgradient. The COC concentrations in the source areas are generally decreasing. The downgradient areas to the east and in the far southeast lobe are demonstrating a mixture of stable and increasing concentrations.

Natural attenuation appears to be addressing HE contamination to some degree in those areas, as RDX breakdown products have been detected in most of the southeast plume. Currently data is being collected that should lead towards improved quantification of natural attenuation in the perched aquifer in the future. Ongoing evaluations of these data annually and at each FYR will be conducted to determine if future inclusion of Monitored Natural Attenuation (MNA) as a part of the Selected Remedy is appropriate.

An overview of each individual system that comprises the Southeast Area Perched Groundwater Remedy is provided as follows.

7.2.1.1.1.1 P1PTS

Overall, the P1PTS is meeting the design objective of reducing perched aquifer saturated thickness as groundwater elevations declined at each monitoring location within its area of influence. Water level trends indicate that saturated thickness was declining prior to the operation of the P1PTS because routine discharges of treated water to Playa 1 ceased in 2005. The rate of decline increased after the P1PTS became operational despite (1) a record rainfall event in July 2010 that temporarily increased water levels at wells around Playa 1, and (2) intermittent operations due to irrigation upgrades or WWTF and/or irrigation downtime. The system is expected to consistently operate at design levels (90% of capacity) during the next FYR period due to the expansion of the irrigation system that will allow more consistent output from the P1PTS. During this FYR, the system was unable to consistently operate at the design goal of 90% at all times primarily due to irrigation system downtime. The system was also impacted by occasional extraction well downtime as this system has fewer wells so throughput can be noticeably affected if more than one well is not operating.

This system is also achieving mass removal from water that is extracted and treated. The COC concentrations in monitoring wells under the influence of this system indicated stable or decreasing trends.

7.2.1.1.1.2 SEPTS

Overall, the SEPTS is meeting the design objective of reducing perched aquifer saturated thickness as groundwater elevations declined at each monitoring location within its area of influence. An evaluation of flux upgradient and downgradient of the SEPTS indicated the system is removing more groundwater than is flowing into the well field, thus reducing saturated thickness. The rate of decline in saturated thickness could be significantly enhanced by discontinuing or decreasing injection of the treated water into the perched aquifer. During this FYR period, the extraction rate was only about 50 to 100% greater than the amount of groundwater entering the SEPTS area. If injection were eliminated, the volume of groundwater extracted would be about 300% greater than the amount of groundwater entering the SEPTS well field based on data evaluated.

The system is achieving mass removal of COCs and concentrations are generally demonstrating signs of stabilization or decrease at wells that are within the area of influence of the system. Some wells had anomalous increases due to temporary impacts from pilot studies conducted in localized areas of the plumes or effects of wells being down during the SEPTS upgrade during 2010 and 2011.

7.2.1.1.1.3 SEISB

The SEISB is currently meeting the design objective of creating and maintaining an anaerobic treatment zone capable of treating the target COCs to concentrations below the GWPS. During the FYR period, COC concentrations decreased by up to three orders of magnitude in treatment zone wells and downgradient performance monitoring wells that are currently under the influence of the system. Concentrations have declined to near or below the GWPS in three of the five downgradient wells. Therefore, significant progress has been made towards meeting RAOs in the perched groundwater downgradient of the SEISB with the exception of a single well on the west end, PTX06-1153.

Monitoring data for PTX06-1153 indicate that chromium has increased, and RDX and one of its breakdown products (TNX) are consistently present at higher concentrations than expected. TNX is also persisting at elevated levels in one other well (PTX06-1154). The persistence of low-level concentrations of RDX and TNX may be due to incomplete treatment within higher velocity zones in the well field and/or a result of desorption and back-diffusion of COCs from the soil matrix, but concentrations are expected to continue to decline with time. A new monitoring well

has been installed to better delineate the chromium/RDX plume boundaries as well as improve understanding of groundwater flow patterns in the area.

7.2.1.1.2 System Operations/O&M

Operations of the two pump and treat systems and SEISB system are described in Chapter 4 and detailed evaluation information can be found in Attachment 8. The systems are operating as intended within their area of influence and are expected to maintain their effectiveness.

As discussed in Chapter 3, nearly 131 Mgal of treated water (approximately 23% of the total volume treated during the FYR period) from the SEPTS was injected back into the perched aquifer to meet the 90% throughput goal and allow for consistent operation of P1PTS when the irrigation system was unable to receive treated water. Injection of treated water back into the perched zone conflicts with the overall RA goal of reduction in saturated thickness, which may affect the RAO of protecting the Ogallala Aquifer in the future. In addition, it appears that injection of treated water back into the perched zone has also affected COC plumes in the vicinity of injection wells. Because injection was not in alignment with the RAOs, Pantex recommended decreasing throughput in late 2010 to maintain an annual injection volume of 40 Mgal or less during 2011, while irrigation system upgrades were completed.

The irrigation system has been upgraded to include an additional 100-acre plot. This additional irrigation plot is expected to reduce the need for injection of treated water during winter months and eliminate the need for injection during the heaviest growing season. However, considering the importance that minimizing injection of treated water back into the perched zone has on progress toward achieving RAOs for the groundwater remedy, system operational goals should be redefined to place a higher priority on the reduction of saturated thickness by eliminating injection of treated water. Appropriate definition of the operational goals will be possible after evaluating operational efficiency of the irrigation system with the full implementation of the upgrades.

Regarding operation of the SEISB, recent data (2nd Quarter 2012) collected at the SEISB suggest the extended time between injections (approximately two years) may have been too long, as RDX increased above its GWPS for the first time since 2nd Quarter 2010. Planning has already begun to shorten the time between injections to approximately 18 months.

7.2.1.1.3 Opportunities for Optimization

Several opportunities have been identified for individual RAs which would improve the overall performance of the Southeast Area Perched Groundwater Remedy.

While P1PTS throughput has primarily been affected by WWTF, irrigation system, and weather issues; throughput has also been affected at times by mechanical or electrical issues with

individual extraction wells. The P1PTS consists of only ten extraction wells, so more than one inoperable well can cause the system not to meet throughput goals. In contrast, the SEPTS well field extraction capacity currently exceeds the design capacity of the treatment system, so if several wells are experiencing mechanical or electrical issues, the system throughput is unaffected. Therefore, the installation of one or two extraction wells in the P1PTS well field could allow the system to continue to meet throughput goals while mechanical or electrical issues are resolved.

While the expanded irrigation system will provide for treated water disposal during the growing season, additional beneficial use opportunities should continue to be evaluated, including options allowed through the new TLAP. One option would be to provide additional storage for treated water from the pump and treat systems for times when the subsurface irrigation system cannot accept water. Another option may be to irrigate additional plots on plant site when the subsurface irrigation system cannot accept it. Treated water from the pump and treat systems is also being considered for controlled application on protective covers as part of a program to maintain vegetation and mitigate the potential for erosion.

Also, construction is underway for the Pantex Renewable Energy Project which will be placed on the property east of FM 2373. This project consists of installing five 2.3 megawatt wind turbines that will enable the Pantex Plant to meet the President's initiatives for green energy. In total, the system will provide almost two-thirds of the energy required for Pantex Plant operations, including all of the cleanup remedies.

The infrastructure associated with this effort will provide a future basis for powering an active remedy for perched groundwater beneath this property, if needed in the future.

7.2.1.1.4 Early Indicators of Potential Issues

Two potential issues have been identified with the performance of the Southeast Area Perched Groundwater Remedy:

- Treatment uncertainty for HEs and hexavalent chromium downgradient of the west end of the SEISB as documented through evaluation of performance monitoring data obtained from PTX06-1153.
- Plumes of HEs (primarily RDX) expanding east of FM 2373 and in the far southeast lobe of the perched aquifer where there is limited saturated thickness or limiting hydrogeologic conditions.

Short-term protectiveness is not affected by these two issues, but the uncertainty leads to a determination that the Remedy is not protective in the long-term.

7.2.1.1.5 Implementation of ICs and Other Measures

All Pantex ICs were reviewed by Sapere Consulting, Inc (Attachment 15) as part of the FYR process in November 2012. All ICs have been implemented and are working as intended to prevent exposure by restricting access, drilling, and perched groundwater use. One needed improvement was noted for groundwater ICs associated with the well maintenance plan. Although inspection and maintenance activities are being implemented, this plan has not yet been finalized and needs to be to ensure continuity of this process. No other deficiencies related to the implementation, maintenance, operation, and enforcement of the ICs were noted in the independent review.

7.2.1.2 Zone 11 Perched Groundwater Remedy

The Zone 11 Perched Groundwater Remedy includes the following individual RAs:

- ZN11ISB System
- ICs to prevent exposure to groundwater
- LTM to confirm remedy effectiveness

7.2.1.2.1 Remedial Action Performance

The Zone 11 ISB system is currently meeting the design objective of creating and maintaining an anaerobic treatment zone capable of treating the target COCs to concentrations below the GWPS. The conditions are still changing, but during the FYR period, perchlorate concentrations have decreased to non-detect values in three downgradient ISPM wells currently under the influence of the system. TCE has peaked at the ISB downgradient monitoring wells and they are now demonstrating a decreasing trend in concentrations; breakdown products have only been observed at low concentrations and have not persisted. It is expected that the decreasing trend will continue as the treatment zone continues to treat the TCE in groundwater that moves through the treatment zone, as well as TCE that desorbs from the soil matrix. Therefore, significant progress has been made towards meeting RAOs in the perched groundwater downgradient of the ZN11ISB.

7.2.1.2.2 System Operations/O&M

All data evaluated during this review indicate Zone 11 Groundwater Remedy operating procedures, as implemented, will maintain the effectiveness of the treatment zone established through the existing ZN11ISB well field. Three wells (PTX06-1148 through PTX06-1150) located directly south of the center of the ZN11ISB treatment zone have been slower at demonstrating treatment than originally expected. Based on newer data collected in the ISB treatment zone, the rate of groundwater movement in the center of the ZN11ISB well field is slower than

originally estimated. So, although future monitoring is expected to demonstrate treatment in these wells, decreasing trends will require more time to be realized than is currently specified in the LTM Monitoring Design.

7.2.1.2.3 Opportunities for Optimization

No opportunities have been identified to improve the performance and/or reduce costs of the Zone 11 Groundwater Remedy during this FYR.

7.2.1.2.4 Early Indicators of Potential Issues

One potential issue with the Zone 11 groundwater remedy has been identified that could affect long-term protectiveness. Currently, plumes of TCE and perchlorate extend north and west of the west end of the ZN11ISB treatment zone.

Additional monitoring data acquired from the injection wells during construction of the ZN11ISB and new monitor wells installed to finalize the LTM Network indicate that COC plumes extend further to the west than expected. Therefore, even though the system is operating as intended when designed, several COCs are flowing downgradient past the treatment zone. Options for addressing the plumes that extend beyond the west end of the ZN11ISB system are currently under evaluation, and include:

- Expansion of the current ZN11ISB well field,
- Installation of a small pump and treat system north and west of the ZN11ISB system, and;
- Installation of extraction wells north and west of the ZN11ISB system and construction of a conveyance line to the Southeast Pump and Treat building.

As depicted Figure 7-1, five additional wells were installed north and west of the ZN11ISB treatment zone in September 2012 to evaluate the options for addressing the plumes north and west of the west end of ZN11ISB. Two of these wells were installed approximately 50 and 100 feet southwest of PTX08-1005 (PTX06-1161 and PTX06-1162) and three wells were installed approximately 500 feet northeast of the ZN11ISB well field (PTX06-1163 – PTX06-1165). The purpose of all five of the wells is to perform aquifer testing to evaluate the potential for pump and treat operations; however, the three wells (PTX06-1163 – PTX06-1165) installed nearer the ZN11ISB system could be incorporated as future injection wells, if the evaluation supports ZN11ISB expansion as the preferred option to treat the plumes west of the ZN11ISB.

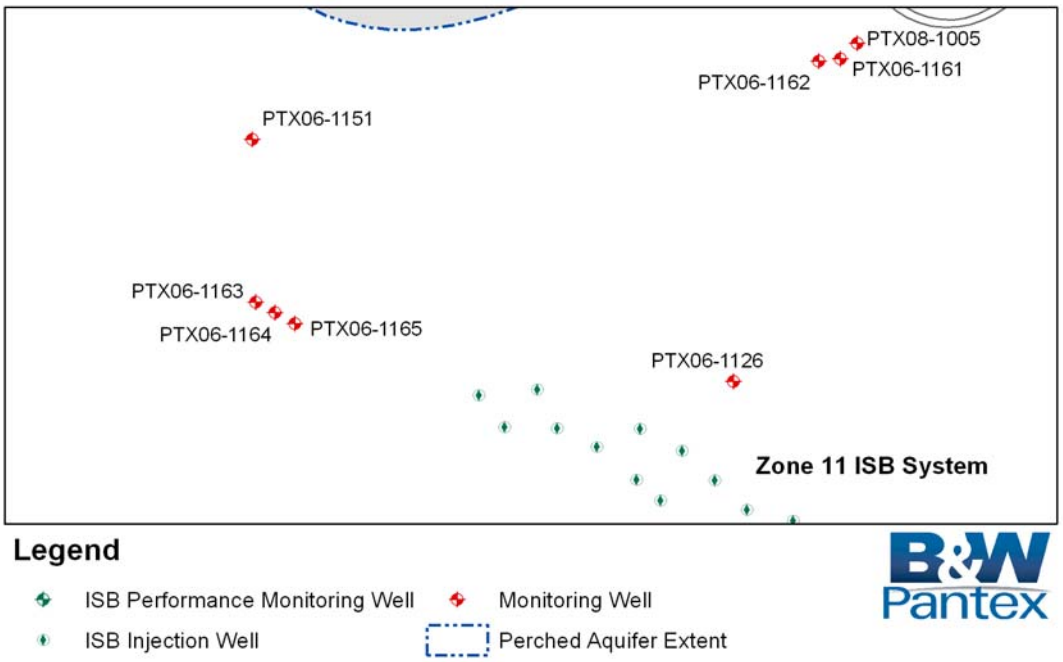


Figure 7-1. New Monitoring Wells Installed South of Zone 11

7.2.1.2.5 Implementation of Institutional Controls and Other Measures

As noted in Section 7.2.1.1.5, all Pantex ICs were reviewed by Sapere Consulting (Attachment 15) as part of the FYR process in November 2012. All ICs have been implemented and are working as intended to prevent exposure. One needed improvement was noted for groundwater ICs associated with the well maintenance plan. Although inspection and maintenance activities are being implemented, this plan has not yet been finalized. No other deficiencies related to the implementation, maintenance, operation, and enforcement of the ICs were noted in the independent review.

7.2.2 Question B: Are the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of remedy selection still valid?

Yes. Changes to the GWPS, RA, and RAOs are not recommended at this time. Exposure assumptions for the RA remain valid.

Although toxicity and risk assessment methods have changed some; the effect on the GWPS is minor and does not require a change in the RAOs or RA; so no changes are recommended. Evaluation of changes in risk assumptions, methods, toxicity data, and cleanup levels are summarized in the following sections.

7.2.2.1 Changes in Standards and TBCs

As noted in the ROD, Pantex used the promulgated MCL as the GWPS when one was available. For RDX, the published life-time health advisory was used as the GWPS. The life-time health advisory was considered for this COC because it was the primary risk driver in groundwater and was widespread across the southeast plume.

The MCLs and health advisory that were used have not changed since the ROD was issued.

7.2.2.2 Changes in Exposure Pathways

Pantex is used for industrial purposes and access is strongly controlled because of the Plant mission. There are no changes in land use, human or ecological receptors, or physical site conditions that would affect the protectiveness of the groundwater remedy. Some adjustments to the Sampling and Analysis Plan are needed based on monitoring data observations described in the following subsections.

7.2.2.2.1 Potential New COC - Cadmium

Based on data collected in 2011 in uncertainty management wells for the FYR, cadmium was identified as a new COC. Cadmium was detected at 10.8 µg/l in PTX06-1010 in early 2011, which exceeds the MCL of 5 µg/l. A subsequent sample collected for this well in December 2011 indicates that concentrations have dropped below the MCL. This COC is not associated with a new source area, but indicates that the sourcing from soils in this area (from previously investigated releases in Zone 12) has been slower than other COCs. Cadmium has been previously detected in this well, but had not been identified as a COC based on the data collected to support the investigations and risk assessment. A sample collected after the risk assessment in 2006 also indicated a concentration of 10.3 µg/l.

Due to the isolated nature of these exceedences, the close proximity of the exceedences to the source area, and recognition that cadmium concentrations have dropped below the MCL, no changes in the remedy are recommended at this time. Cadmium is expected to attenuate quickly through advection and dispersion. However, it is recommended that cadmium be added to the analytes for samples obtained from PTX06-1010 and downgradient well PTX06-1088 on the same frequency as other COCs. This sampling will allow trending of the COC to ensure that the source is depleting and that concentrations continue to trend downward.

7.2.2.2.2 Potential New COC - Hexavalent Chromium

Review of the monitoring data also indicates that hexavalent chromium is increasing at one well (PTX08-1005) in Zone 11 where hexavalent chromium has not been previously identified as a COC. While concentrations are still slightly below the GWPS, the well will need to be evaluated

and trended in the future to determine if the chromium persists. Potential changes to the cleanup standard for hexavalent chromium are discussed in section 7.2.2.3.2.

7.2.2.2.3 Potential New COCs – Metals

Review of data collected at the SEISB and ZN11ISB systems indicates that secondary impacts have occurred due to the change in redox state caused by the treatment. Geochemically reduced water following through and downgradient of the treatment zones result in some naturally occurring metals becoming more soluble. Arsenic, barium, iron, and manganese concentrations have increased within and downgradient of the treatment zones. These metals typically precipitate out of groundwater as it moves downgradient into more oxidizing conditions and groundwater concentrations return to background. With time and distance, it is expected that most of these metals concentrations will reduce below levels that would cause a health-based concern, particularly in the Zone 11 area.

Data collected at the SEISB system also indicates that the treatment zone is expanding downgradient and may eventually expand to the extent of the perched aquifer in the downgradient direction. The metals will require continued monitoring to determine whether arsenic, barium, and manganese concentrations persist or if concentrations decline over time in the areas downgradient of the treatment zones.

In general, arsenic and barium levels exceeded respective GWPSs by 8 to 9 times. Since a primary MCL has not been established for manganese, it was determined through evaluation that it poses downgradient risks that only slightly exceed a hazard quotient (HQ) of 1 (HQs range from 1.8 to 4.3). Details regarding evaluation risk associated with this condition are provided in Attachment 14.

7.2.2.2.4 Increased COC Concentrations – 1,4-Dioxane

New wells (ISB and monitoring) that were installed for the Zone 11 RA better defined the concentrations and plume size for 1,4-dioxane. Concentrations of 1,4-dioxane were previously screened out in the risk assessment, indicating risk from this COC was less than 1.0E-6 for the perched groundwater and the Ogallala Aquifer. New concentration data indicate that risk would now exceed 1.0E-06 in the perched groundwater. Since toxicity criteria also changed for this COC, the risk and protectiveness of the remedy for perched groundwater are discussed in section 7.2.2.3.1.

7.2.2.3 Changes in Toxicity and other Contaminant Characteristics

Toxicity tables used in the risk assessment were compared to new toxicity tables published by the TCEQ for the Texas Risk Reduction Program (TRRP) in 2012. Changes that would cause perched groundwater risk to increase (and cleanup values to decrease) were identified and are summarized in Attachment 14. All detected groundwater analytes were reviewed for changes to

ensure that analytes previously screened out of the risk assessment would not significantly contribute to risk and require a change to the RA and/or addition to the list of COCs for monitoring. Two analytes were identified that could require a change to the RA; 1,4-dioxane and hexavalent chromium. The changes to the cleanup levels are summarized in Table 7-1.

Table 7-1. Potential Changes to Groundwater Cleanup Levels

Groundwater Contaminants	Cleanup Level (µg/l)	Standard (µg/l)		Citation	Impacts to Selected Remedy
1,4-Dioxane	7.7	Previous	7.7	RRR	Unknown, may be unaffected by ISB, continue to monitor.
		New	0.85	RRR	
Hexavalent Chromium	15 (PQL)	Previous	100	MCL	Unknown, it is reduced by ISB, continue to monitor.
		New	TBD	Draft Toxicity Assessment (EPA)	

7.2.2.3.1 1,4-Dioxane

The current GWPS for 1,4-dioxane is 7.7 µg/l, which falls between the cleanup values calculated at the 1.0E-6 (0.85 µg/l) to 1.0E-4 (85 µg/l) risk range using the new oral slope factor. Because the current cleanup value is within the risk range typically accepted by EPA, and as provided in Appendix G of the *Comprehensive Five Year Review Guidance* (EPA, 2001), no change in GWPS is recommended based on change in toxicity.

1,4-Dioxane is present at appreciable concentrations in the ZN11ISB area. Data acquired from monitor wells upgradient of the ZN11ISB System since start of RAs indicate that 1,4-dioxane is more widely spread than identified during the remedial design, but concentrations appear to be relatively stable. Available research does not indicate that ISB treatment will reduce 1,4-dioxane, so residual risk could result even if the ZN11ISB completely degrades the other COCs in perched groundwater south of Zone 11.

Accordingly, risk calculations were performed for six wells in the Zone 11 area. All cancer risks were within the 1.0E-6 to 1.0E-4 risk range, as presented in Table 7-2. All non-cancer HQs were less than one.

Table 7-2. 1,4-Dioxane Risk Summary

	Number Samples	Number Detected	Min Detect (µg/l)	Max Detect (µg/l)	Distribution	95% UCL (µg/l)	Cancer Risk	Non-Cancer Risk
PTX06-1126	14	14	7.35	120	LN	37.0	4.4E-05	0.03
PTX06-1127	14	14	4.63	100	G	41.5	5.0E-05	0.04
PTX06-1151	6	6	5.3	13	N	10.4	1.3E-05	0.01
PTX06-1155	11	11	2	9.9	G	4.9	5.9E-06	0.00
PTX08-1005	14	12	1.35	15	N	10.1	1.2E-05	0.01
PTX08-1006	20	20	31.4	74	N	61.6	7.4E-05	0.06

N= normal LN=lognormal G=gamma UCL=upper confidence limit

The Selected Remedy was not designed to treat 1,4-dioxane because:

- The majority of past concentrations were low, and;
- Only four wells exceeded the GWPS and the plume was small, at the time the RD was approved.

The current ZN11ISB treatment is effective for HEs, hexavalent chromium, and perchlorate; however, the effectiveness of ISB on 1,4-dioxane needs to be evaluated as it moves downgradient from the ZN11ISB system to monitor for uncertainty regarding future risk and determine if the treatment zone exhibits some effect on concentrations.

7.2.2.3.2 Hexavalent Chromium

The current GWPS of 100 µg/l for both total and hexavalent chromium is based on the EPA MCL for total chromium. In 2010, the EPA released a draft Toxicological Review of hexavalent chromium (oral exposure only). The final assessment is scheduled for completion in FY2014. If the final toxicity information remains unchanged, a standard for hexavalent chromium could be calculated at a concentration less than the current Pantex PQL. These factors indicate a high probability of a future change to the MCL and possibly a separate EPA MCL for hexavalent chromium. This change could affect the ability to meet the future GWPS for hexavalent chromium through the RAs implemented to address the plume in the perched groundwater and the approach to early detection monitoring in the Ogallala Aquifer. However, no change is needed at this point in time.

The site-specific background for total chromium is 31.8 µg/l, as calculated in the Final RRR Guidance to the Pantex Plant RFI (BWXT 2002). Hexavalent chromium was not considered to be

naturally occurring so no site-specific background was calculated. Historically, hexavalent chromium has been sporadically detected at low concentrations in Ogallala Aquifer wells since 1996. The results were typically less than the laboratory PQL (>80% of total detections) and not confirmed by total chromium results (>50% of cases with detections of both total and hexavalent chromium) and have been considered to be false positives. The colorimetric method currently used for hexavalent chromium analysis is prone to false positives and considered to be unreliable at these low concentrations. Laboratory PQLs for total chromium have ranged from 3 – 100 ppb during the FYR period while hexavalent chromium PQLs have consistently been about 15 µg/l.

Hexavalent chromium was detected and confirmed at a concentration of approximately 20 µg/l in Ogallala monitor well PTX06-1068 in January 2012. In this case, the hexavalent chromium was not below the laboratory PQL and was confirmed by total chromium results. However, the total chromium concentrations were below the site-specific background. The hexavalent chromium detections were determined to be most likely due to corrosion of the stainless steel sampling pump or screen, which released chromium. The chromium then possibly converted to hexavalent chromium due to the higher gradients and more oxidized conditions in the regional groundwater due to pumping at the City of Amarillo's well field to the north. The pump was replaced, the well was redeveloped, and three subsequent hexavalent chromium results were non-detect. However, some uncertainty in the hexavalent chromium source still remains considering hexavalent chromium had been historically detected in the perched groundwater in the OSTP area.

In addition, hexavalent chromium was detected at a concentration above the PQL (24 µg/l) in Ogallala well PTX06-1140 in April 2012. This detection was not confirmed by total chromium results and a subsequent re-sample was non-detect, but the original hexavalent chromium result was higher than the range typically considered to be false positives.

Pantex will continue to monitor EPA's progress toward revising the chromium MCL, or developing a new one for hexavalent chromium, to determine if the GWPS for hexavalent chromium should be updated. Also, changes to monitoring for hexavalent chromium will be evaluated to improve reliability of early detection in the Ogallala Aquifer.

7.2.2.4 Changes in Risk Assessment Methods

New EPA dermal and cancer assessment documents were released as the Pantex Plant risk assessments were being completed and a new dermal guidance was released in 2009. Changes were adopted where possible during the completion of the HHRA, but guidance documents released after the HHRA were reviewed to determine if further risk evaluation, change in GWPS, or RA is necessary. A change in methods for calculating the residential cleanup value was noted

based on review of methods for calculating EPA PRGs and in the new Texas Risk Reduction Program (30 TAC 350). The primary change in the residential scenario is that an age adjusted cleanup value was developed for the 30-year exposure, with 24 years as an adult and six years as a child.

Although the changes would result in lower cleanup values for some of the COCs, the changes would be very small. Many of the COCs already have a cleanup value near the PQL and those changes would require lowering the GWPS to the PQL. The GWPS would only change by a factor of about 1.2 to 3.7 (see Attachment 14 for detailed information). The RA would not be affected by these small changes, so no changes to the GWPSs are recommended for this FYR.

7.2.2.5 Expected Progress Toward Meeting RAOs

The groundwater RAOs 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.

The groundwater remedy is progressing towards meeting RAOs with two exceptions.

- Achieve cleanup standard for the perched groundwater COCs (i.e., restoration of the perched aquifer) – Although progress has been achieved in the areas of the ISB Systems, COC concentrations have not yet been significantly affected across the perched groundwater.

- Prevent growth of perched groundwater contaminant plumes - Perched groundwater COC plumes continue to slowly move and/or expand downgradient, specifically to the east of FM 2373 and in the far southeastern lobe of the perched aquifer.

7.2.3 Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No. The groundwater remedy is currently protective and is expected to remain protective in the future as the Pantex Plant progresses toward cleanup. No changes are needed relative to ecological risks, natural disasters, or land use changes.

7.3 Technical Assessment Summary

The site-wide remedy for the Pantex Plant consists of remedies for soil and groundwater. The soil remedies are designed to be protective of workers and future groundwater resources. The groundwater remedies are designed to be protective of the public as well as current and future drinking water. The groundwater remedy is also designed to restore the currently unused impacted perched groundwater to drinking water standards.

The site-wide remedy is functioning as intended for the short-term. The ICs and engineered controls (e.g., fencing, protective covers, and ditch liner) currently protect workers and the general public from exposure to soil and perched groundwater that is impacted and these actions are expected to continue to be protective. The SVE is removing soil gas and residual Non-Aqueous Phase Liquids (NAPLs) in soils to protect the underlying drinking water aquifer.

Groundwater monitoring has demonstrated that the groundwater remedy is performing as expected and concentrations of COCs and water levels are declining in most areas. Some regions of the perched aquifer are not responding yet and a plan has been established to evaluate options for expanding/enhancing existing remedies while continuing to evaluate the efficacy of natural attenuation processes. Each of the issues identified with respect to the remedy are described in further detail in Chapter 8. Also, opportunities for improvement of the remedy and the long-term monitoring network are explained in Chapter 9.

The Selected Remedy will continue to be implemented as designed during the next five years to allow for a more complete expression of its effects on the perched groundwater. While continuing operation and maintenance, evaluations will be conducted to develop options for expanding/enhancing two existing systems, the SEPTS and the ZN11ISB. Options will be evaluated for expanding the SEPTS well field to actively remediate the portion of perched groundwater underlying the site east of FM 2373 that it is amenable to extraction. For the Zone 11 plume, options will be evaluated to determine the best way to enhance the ZN11 ISB to address the contaminants that extend west of the existing injection well field.

Also, data will continue to be collected through the LTM network to assess natural attenuation to better define the anticipated effect of these processes on the long-term period of restoration. Specifically, the areas outside the influence of the groundwater remedy, including perched groundwater east of FM 2373 and in the far southeast lobe (where expansion of HE plumes has been noted), require continued collection of data to assess natural attenuation of HEs and other risk driving COCs to better understand timing associated with the long-term goal of achieving restoration of the perched aquifer.

Another area where the groundwater remedy is not performing exactly as expected is the west end of the SEISB. Unexpected conditions contributed to this issue which will require continued evaluation to assess a path forward for cleanup.

This page left intentionally blank.

8 Issues

Table 8-1 lists the issues identified through this FYR and how each affects the protectiveness of the Selected Remedy.

Table 8-1. Issues Identified

Issues	Affects Current Protectiveness	Affects Future Protectiveness
Soil Remedies		
Vegetation loss on the protective covers due to extreme drought.	No	Yes
Ecological risk assessment for Firing Site 5 was performed before the TCEQ Guidance was issued. This guidance requires the depression east of Firing Site 5 to be incorporated into the assessment.	No	No
Groundwater Remedies		
Plumes of HEs expanding east of FM 2373 and in the far southeast lobe of the perched aquifer.	No	Yes
Plumes of TCE and perchlorate extend west of the ZN11ISB treatment zone.	No	Yes
Incomplete treatment of contaminants (HEs and hexavalent chromium) downgradient of the west end of the SEISB (PTX06-1153).	No	Yes
New perched groundwater contaminants: • Metals solubilized as a result of both ISB treatment zones (arsenic, barium, and manganese) • Cadmium beneath Zone 12 South (WMG 6/7) • Hexavalent chromium near ZN11ISB	No No No	Yes No No
Increased concentrations of 1,4 dioxane at ZN11ISB.	No	No

8.1 Protective Covers- Vegetation Loss

A plan will be developed and implemented in 2013 and 2014 to address more recent problems with vegetation loss associated with extreme drought conditions from 2011 and 2012. The plan will be implemented in a phased manner to ensure that erosion of the protective covers does not occur, and instead long-term effectiveness of this remedy is achieved.

8.2 Ecological Risk Assessment – Changed Guidance

The Firing Site 5 ecological risk assessment was conducted before the TCEQ guidance was issued. This guidance requires the assessment to include a small depression east of the firing site. Incorporating the depression into the assessment is not anticipated to change the outcome or require additional action. This expectation will be verified through additional assessment conducted in 2014.

8.3 Plumes of High Explosives Expanding - East of FM 2373

Perched groundwater COC plumes continue to move and/or expand downgradient, especially to the east of FM 2373 and in the far southeastern lobe of the perched aquifer. As stated in The Groundwater Remedy Effectiveness Evaluation (Trihydro 2012) referenced in Attachment 8, portions of these areas are not under the short-term influence of the SEPTS and may not be under the long-term influence due to limited saturated thickness or other limiting hydrogeologic conditions.

While some regions of the perched aquifer (such as that beneath the property east of FM 2373) are not responding yet, the Selected Remedy will continue to be implemented as designed and evaluated annually during the next five years to allow for a more complete expression of its longer-term effects. During this period of time, hydrogeologic information will be acquired to allow for evaluation of options for expanding the SEPTS well field to actively extract perched water from the portion of the plume that extends east of FM 2373.

Also, natural attenuation processes appear to be addressing HE contamination to some degree in areas outside the present influence of the active remedies, as RDX breakdown products have been detected in most of the southeast plume. Monitoring data will continue to be collected to provide for improved quantification of natural attenuation in the perched aquifer. Ongoing evaluations of these data will be conducted annually as part of the continuing effort to determine if future inclusion of MNA as a part of the Selected Remedy becomes appropriate.

Infrastructure associated with the Pantex Renewable Energy Project to be constructed in 2013/2014 will provide a basis for powering active remedies for perched groundwater beneath this property, if needed in the future.

8.4 Plumes of TCE and Perchlorate Expanding West of ZN11ISB

Additional monitoring data acquired from the injection wells during construction of the ZN11ISB and new monitor wells installed to finalize the LTM Network indicate that COC plumes extend further to the west than expected. Therefore, even though the system is operating as intended when designed by effectively treating the primary COCs, part of the plume is flowing past the west-end of the treatment zone. Options for addressing this issue are currently being evaluated. Options under evaluation are:

- Expansion of the current ZN11ISB well field
- Installation of a small pump and treat system north and west of the ZN11ISB system
- Installation of extraction wells north and west of the ZN11ISB system and construction of a conveyance line to the Southeast Pump and Treat building

Five additional wells were installed north and west of the ZN11ISB treatment zone in September 2012 to evaluate the options for addressing the plumes west of the ZN11ISB. Two of these wells were installed approximately 50 and 100 feet southwest of PTX08-1005 (PTX06-1161 and PTX06-1162) and three wells were installed approximately 500 feet northwest of the ZN11ISB well field (PTX06-1163 – PTX06-1165). The purpose of all five of the wells is to perform aquifer testing to evaluate the potential for pump and treat operations; however, the three wells (PTX06-1163 – PTX06-1165) installed nearer the ZN11ISB system could be incorporated as future injection wells, if the evaluation supports ZN11ISB expansion as the preferred option to treat the plumes west of the ZN11ISB.

8.5 Incomplete Treatment SEISB

One ISPM well, PTX06-1153, located on the west end of the SEISB has not responded in a manner similar to other downgradient wells believed to be currently under the effect of the SEISB. Data indicate that treated water had reached this well by late 2010 as documented by field parameters and volatile fatty acid concentrations, but subsequent data did not confirm these results. Several scenarios could be causing these observations:

- Untreated water may be flowing around the treatment zone, in between the estimated perched aquifer extent and western edge of the well-field.
- Untreated water may be flowing through the well-field, possibly through a preferential flow path.
- The estimated perched extent defined by dry wells PTX06-1051 and PTX06-1122 is actually a local high in the fine grained zone creating a “dry spot” in the perched aquifer and untreated water may be flowing south of the dry spot towards PTX06-1153.

An additional monitoring well was installed northwest of the SEISB well field to better delineate the chromium and RDX plume boundaries, as well as improve understanding of groundwater flow patterns in the area. Data will continue to be evaluated to determine why PTX06-1153 is not responding in the same manner as the other SEISB ISPM wells.

8.6 New Contaminants

8.6.1 Cadmium

Based on data collected in 2011 in uncertainty management wells for the FYR, cadmium was identified as a new COC. Cadmium was detected at 10.8 µg/l in PTX06-1010 in early 2011, which exceeds the MCL of 5 µg/l. A subsequent sample collected for this well in December 2011 indicates that concentrations have dropped below the MCL. This COC is not associated with a new source area, but monitoring data indicate that the sourcing from soils in this area (from previously investigated releases in Zone 12) has been slower than other COCs. Cadmium has been previously detected in this well, but had not been identified as a COC based on the data collected to support the investigations and risk assessment. A sample collected after the risk assessment in 2006 also indicated a concentration of 10.3 µg/l.

Due to the isolated nature of the exceedences, the close proximity of the exceedences to the source area, and the recognition that cadmium concentrations have dropped below the MCL, no changes in the remedy are recommended at this time. Cadmium is expected to attenuate quickly through advection and dispersion. However, it is recommended that cadmium be added to the analytes for samples obtained from PTX06-1010 and downgradient well PTX06-1088 on the same frequency as other COCs. This sampling will allow trending of cadmium data to ensure that the source is depleting and that concentrations continue to trend downward.

8.6.2 Hexavalent Chromium

Review of the monitoring data indicate that hexavalent chromium is increasing at one well (PTX08-1005) in Zone 11 where hexavalent chromium has not been previously identified as a COC. While concentrations are still slightly below the GWPS, hexavalent and total chromium data from this area need to be evaluated and trended in the future to determine if the chromium persists. Reducing conditions created through ISB will effectively treat hexavalent chromium if it persists, but monitoring for remedy effectiveness will be needed if this occurs.

8.6.3 Metals Solubilized Through ISB Treatment

Reducing conditions established through ISB treatment cause some naturally occurring metals in the formation to solubilize. Arsenic, barium, and manganese are three metals observed downgradient of both ISB Systems that could prevent attainment of the RAO for restoring perched groundwater to drinking water standards if the metals remain in a dissolved state and

do not attenuate. Concentrations of these metals in perched groundwater are expected to decrease as the geochemistry of the water reverts to more oxidizing conditions downgradient of the systems. Therefore, monitoring for these metals is needed to determine if concentrations eventually decrease as expected. Changes to the monitoring will be included in the update to the Sampling and Analysis Plan in 2014 to ensure that data needed to evaluate the potential for impacts to the Ogallala Aquifer are collected.

8.7 Increased Concentrations – 1,4-Dioxane

New wells (ISB and monitoring) that were installed for the Zone 11 RA better defined the concentrations and plume size for 1,4-dioxane. Concentrations of 1,4-dioxane were previously screened out in the risk assessment, indicating risk from this COC was less than 1.0E-6 for the perched groundwater and the Ogallala Aquifer. Newer concentrations indicate that risk would now exceed 1.0E-06 in the perched groundwater. The effectiveness of ISB in treating 1,4-dioxane has not been demonstrated. This COC would still not present a risk to the underlying Ogallala Aquifer, as particle tracking conducted as part of the fate and transport modeling for the site indicated that perched groundwater in the Zone 11 area would not reach a point of exposure in the underlying aquifer for more than 1,000 years.

This page left intentionally blank.

9 Recommendations and Follow-up Actions

Improvements required to address issues that could affect the long-term protectiveness of the Selected Remedy are listed in Table 9-1. This table lists actions and milestones important to achieving the objectives of the Selected Remedy and RAOs and addressing the issues identified in Chapter 8. Other improvements identified through this FYR for optimizing the RA systems and LTM Network are presented in Table 9-2.

This page left intentionally blank.

Table 9-1. Recommendations and Follow-up Actions for Issues Identified in the FYR

Issue	Recommendations & Follow-up	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness Without Action	
					Short-Term	*Long-Term*
Soil Remedies						
Vegetation loss on the protective covers due to extreme drought.	Develop and implement a phased plan to address problems with vegetation loss associated with extreme drought conditions in 2011 and 2012 to ensure that erosion does not occur.	Pantex	EPA/TCEQ	September 2014	No	Yes
Ecological risk assessment guidance changed after the Firing Site 5 assessment was conducted.	Ecological risk assessment for Firing Site 5 was performed before the TCEQ Guidance was issued. This guidance requires the depression east of Firing Site 5 to be incorporated into the assessment.	Pantex	EPA/TCEQ	April 2014	No	No
Groundwater Remedies						
Plumes of high explosives (primarily RDX) expanding east of FM 2373 and in the southeast lobe of the perched aquifer.	• Evaluate effects of RAs annually to determine if implementation of active remedies is needed in the portion of the perched aquifer before the 2nd FYR. • Perform and evaluate aquifer testing data from PTX06-1146 and PTX06-1147 to improve understanding of hydrogeology and effectiveness of potential active remedial alternatives, most likely an expansion of the existing SEPTS well field. • Collect and evaluate natural attenuation data to estimate the site-specific rate of natural attenuation for risk driving contaminants like RDX and TNT.	Pantex	EPA/TCEQ	Annually through progress reports/ September 2014.	No	Yes

Issue	Recommendations & Follow-up	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness Without Action	
					Short-Term	*Long-Term*
Plumes of TCE and perchlorate extend north and west of the ZN11ISB treatment zone.	Collect and analyze data from five newly installed installed wells to assess hydrogeologic conditions north and west of the ZN11ISB System. Recommend a path forward based on results of the analysis.	Pantex	EPA/TCEQ	December 2013	No	Yes
Incomplete treatment of contaminants (HEs and hexavalent chromium) downgradient of the west end of the SEISB (PTX06-1153).	Collect and analyze data from the newly installed well to better assess groundwater flow paths at the west end of the SEISB. Determine a path forward based on results.	Pantex	EPA/TCEQ	February 2014	No	Yes
Increased concentrations of 1,4-dioxane at ZN11ISB	Concentrations of 1,4-dioxane inside and around the ZN11ISB should be monitored to evaluate the effect of the system on this compound. Include changes to the Sampling and Analysis Plan to evaluate the potential impacts to the Ogallala Aquifer.	Pantex	EPA/TCEQ	Annually through Progress Reports/ January 2014	No	No
New Perched Groundwater COCs						
Cadmium concentrations exceeded the MCL in 2011 beneath Zone 12 South (WMG 6/7) at PTX06-1010	Concentrations of cadmium should be monitored at PTX06-1010 and down-gradient well PTX06-1088 to ensure that the source of the original detection depletes.	Pantex	EPA/TCEQ	Annually through Progress Reports	No	No

Issue	Recommendations & Follow-up	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness Without Action	
					Short-Term	*Long-Term*
Detections of hexavalent chromium in Zone 11 (PTX08-1005)	While hexavalent concentrations are still slightly below the GWPS, the area will need to be evaluated and trended in the future to determine if the chromium persists.	Pantex	EPA/TCEQ	Annually through Progress Reports	No	No
Metals solubilized as a result of both ISB treatment zones (arsenic, barium, manganese)	Continue monitoring for metals solubilized by ISB Systems (arsenic, barium, and manganese) in Zone 11 and SE Perched Aquifer to determine the fate downgradient of the treatment zones to confirm expectation of future attenuation. Include changes to the Sampling and Analysis Plan to evaluate the potential impacts to the Ogallala Aquifer.	Pantex	EPA/TCEQ	Annually through Progress Reports/ January 2014	No	Yes

Table 9-2. Recommendations for Remedy Optimization and Monitoring

Recommendation	Follow-up Action	Party Responsible	Oversight Agency	Milestone Date
Soil Remedies				
Update Worker Protection Values for use in SWMU Interference Process.	Use updated worker protection values to evaluate soil data for SWMU interferences and to assess worker protection.	Pantex	None	August 2014
Establish criteria for ceasing SVE system operations.	Develop SVE Performance Monitoring Plan.	Pantex	EPA/TCEQ	December 2014
Groundwater Remedies				
Ensure PTS operational priorities focus on reducing reliance on injection of treated water back into the perched aquifer.	Revise O&M metrics for PTS to emphasize focus on beneficial use and eventual elimination of injection.	Pantex	EPA/TCEQ	July 2014
Evaluate addition of another extraction well (or two) to improve consistency of achieving throughput goals at the P1PTS.	Select two potential locations and plan P1PTS modification.	Pantex	EPA/TCEQ	October 2013
Shorten time between amendment injections for the SEISB; monitoring data indicate that two years is too long.	• Schedule amendment injection frequency at the SEISB for approximately every 18 months. • Evaluate data annually and during the next FYR period to determine effects.	Pantex	EPA/TCEQ	November 2013 (18 months after the last event)

Recommendation	Follow-up Action	Party Responsible	Oversight Agency	Milestone Date
LTM Network				
Consider recommendations for improving early detection monitoring of the Ogallala Aquifer.	Develop improvement plan for sampling Ogallala aquifer wells for early detection of perched groundwater COCs.	Pantex	EPA/TCEQ	October 2013
Update LTM Network design and SAP documents to capture changes approved and implemented in 2012 and recommendations from this FYR to be implemented.	LTM Network and SAP documents need to be updated to reflect new wells installed in 2012 and revised ISB sampling frequency already approved by TCEQ & EPA. Other needed revisions resulting from this FYR should be incorporated in this effort.	Pantex	EPA/TCEQ	January 2014
ICs				
Finalize Well Maintenance Plan to ensure continued inspection, maintenance and repair of system and monitoring wells.	Finalize Well Maintenance Plan and ensure implementation of inspection, maintenance and repairs needed to keep components of the RA systems functioning and free from damage. This is a key requirement of the deed restrictions for perched groundwater.	Pantex	EPA/TCEQ	December 2013
Community Involvement				
Implement measures to better inform neighbors of the RA.	Update Community Involvement Plan, neighbor mailing lists, and provide an annual newsletter to neighbors.	Pantex	EPA/TCEQ	December 2013

This page left intentionally blank.

10 Protectiveness Statements

The remedy at the Pantex Plant currently protects human health and the environment because:

- All soil remedies are functioning as designed and performing as expected.
- Risk of exposure to contaminated soils and affected perched groundwater is being minimized through contact prevention (maintenance and enforcement of ICs).
    - Access to contaminated surface soil is prevented through a combination of protective covers, fencing, and other access controls associated with the active mission of the site.
    - Access to contaminated perched groundwater is prevented through a combination of use, drilling, and access restrictions.
- The pump and treat systems continue to reduce saturated thickness of the perched aquifer, thus reducing vertical movement of affected groundwater and protecting the underlying Ogallala Aquifer.
- The SEISB system is reducing COC concentrations below GWPS in an area sensitive to vertical movement of affected perched groundwater, thus protecting the underlying Ogallala aquifer.
- The ZN11ISB has currently established a reducing zone in the perched groundwater, has treated perchlorate to concentrations below the GWPS, and appears to be reducing TCE concentrations downgradient of the treatment zone.

However, in order for the remedy to be protective in the long-term, the following actions need to be taken:

- Continue operation and maintenance of the soil remedies.
- Continue operation of the groundwater remedies to achieve cleanup standards in the perched aquifer.
- Continue to maintain and enforce the established ICs.
- Address the issues identified in Chapter 8 by implementing follow-up actions described in Table 9-1.

This page left intentionally blank.

11 Next Review

The next FYR will be conducted in 2017. The final report will be completed in 2018, with concurrence by regulatory agencies no later than five years after concurrence with this report.

This page left intentionally blank.

Attachments 1-15

Please request attachments through the Pantex webmaster or Greg Cunningham at webmaster@pantex.com or gcunning@pantex.com