

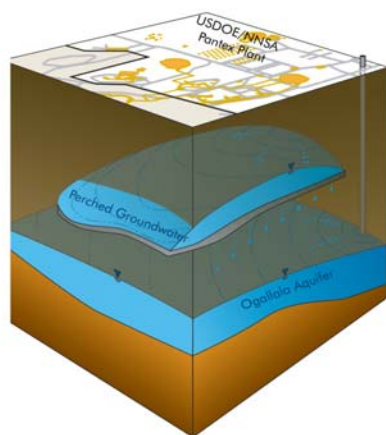
PANTEX ENVIRONMENTAL RESTORATION



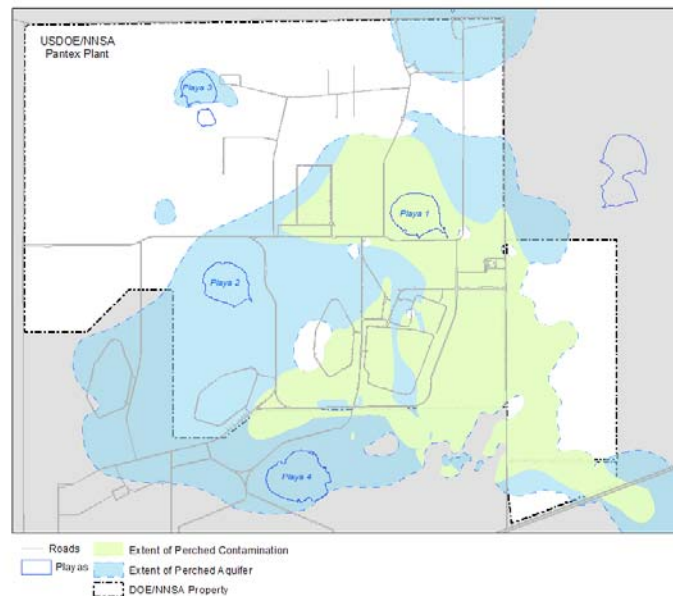
Groundwater Monitoring

The Pantex Remedial Action established in the Record of Decision and the Compliance Plan in the Hazardous Waste Permit (HW-50284) includes two pump and treat systems and in situ bioremediation systems for the cleanup of perched groundwater. Groundwater monitoring is conducted as part of the Remedial Action to evaluate the effectiveness and protectiveness of the actions and for early detection of potential breakthrough to the underlying drinking water aquifer (commonly referred to as the Ogallala Aquifer).

Groundwater beneath the Pantex Plant and vicinity occurs in the Ogallala and Dockum Formations at two intervals. 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 is found between the perched groundwater and the underlying drinking water aquifer. The fine-grained zone acts as a significant barrier to downward migration of contaminated water.



Groundwater Beneath Pantex



Extent of Perched Groundwater and Plumes (2018)

The perched groundwater ranges in saturated thickness from less than a foot at the margins to more than 50 feet beneath Playa 1. Perched groundwater is formed by surface water in the playas that initially infiltrates down to the fine-grained zone. It then flows outward in a radial manner away from the playa lakes and is then influenced by the regional gradient. 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.

Pantex has developed cleanup goals for the perched groundwater which include cleanup of groundwater to

protection standards and reduction of perched water levels to protect the underlying Ogallala Aquifer and to prevent growth of the plumes. Pantex monitors the perched groundwater and the Ogallala Aquifer to determine if the established objectives are met. The monitoring system was established to evaluate the following objectives:

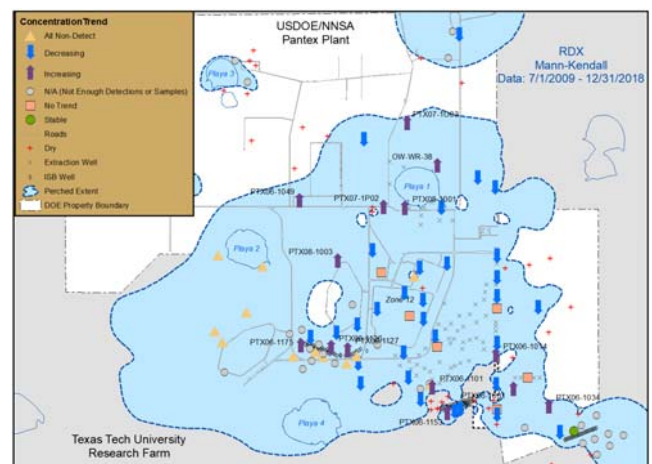
- **Plume stability** – Pantex evaluates the plumes to determine if they are stabilizing and being treated or continuing to spread.
- **Corrective Action effectiveness** – Pantex evaluates the concentrations in and downgradient of the treatment system to determine if the systems are effectively treating or removing contaminants as expected. Pantex also evaluates whether water levels are declining as expected to prevent the movement of contaminated groundwater to areas that could allow migration to the Ogallala Aquifer.
- **Uncertainty management at the source areas** – Pantex evaluates data to determine if the source areas are depleting as expected and verify that no new contamination has moved into the perched groundwater or the Ogallala Aquifer.
- **Early detection in the Ogallala Aquifer** – Pantex evaluates Ogallala wells at points where breakthrough from impacted perched groundwater could occur and upgradient of water sources.
- **Natural attenuation of contaminants** - This process is monitored at Pantex to help determine where natural attenuation is occurring, under what conditions it is occurring, and to possibly determine a rate of attenuation. Natural attenuation is evaluated to determine if it is a viable remedial option in areas that are difficult to treat.

The long-term monitoring system was designed in conjunction with the Texas Commission on Environmental Quality and the US Environmental Protection Agency. The design was documented in the *Long-Term Monitoring Design* and the detailed sampling and analysis requirements are provided in the *Sampling and Analysis Plan (SAP)*. The SAP is incorporated into the Compliance Plan and is submitted to regulatory agencies for approval.

October 2019

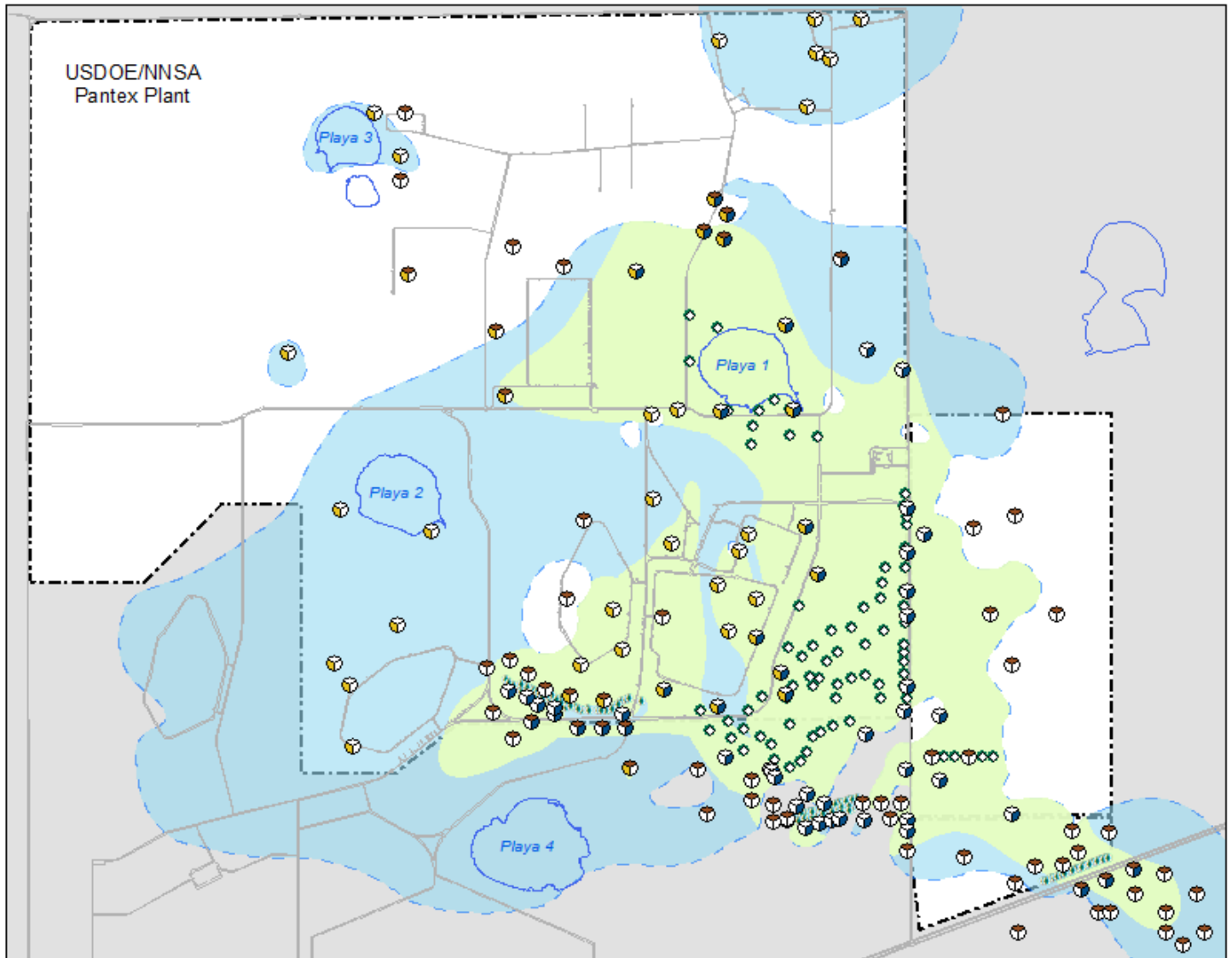
Pantex monitors 128 perched groundwater wells for contaminants or continued dry conditions. Pantex also evaluates an additional 42 wells for water levels. Pump and treat extraction wells are monitored to gather additional data about the contaminant plumes. Pantex also monitors wells inside the in situ bioremediation system to evaluate reducing conditions. In an average year, Pantex analyzes for over 9,000 constituents in perched groundwater.

Pantex monitors 28 wells in the Ogallala Aquifer for contaminants and water levels. Seven of the wells are sampled at multiple depths. In an average year, Pantex analyzes over 1,500 constituents in Ogallala groundwater. Results of the monitoring are evaluated and provided in quarterly and annual progress reports. Pantex also conducts a five-year review to evaluate the protectiveness of the remedies and determine if changes to the remedy are required to meet the cleanup goals and short-term and long-term



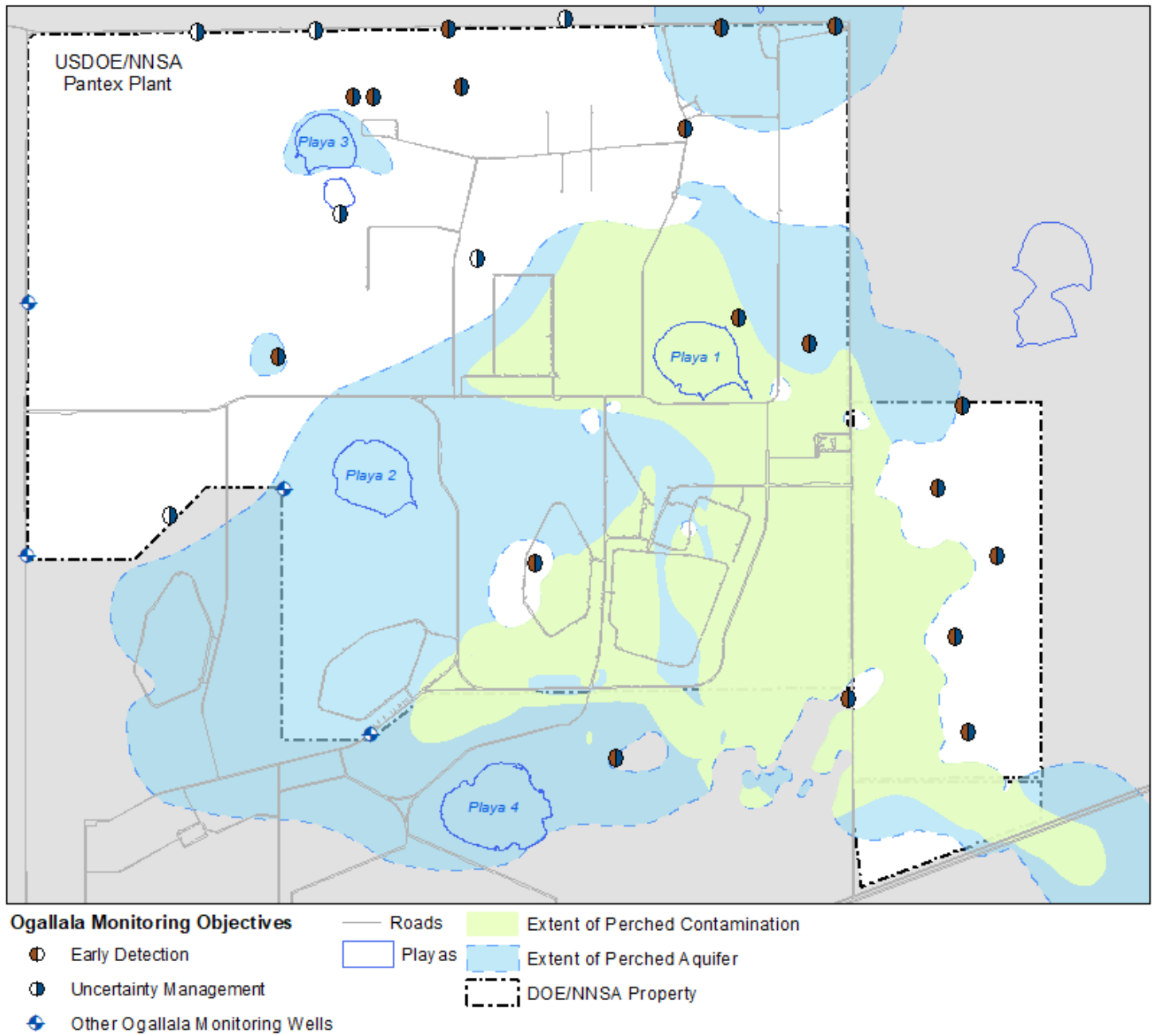
2018 Evaluation of RDX concentration trends based on monitoring data collected at perched groundwater wells

protectiveness of people and the environment. Pantex has also developed a groundwater contingency plan, approved by regulatory agencies, to quickly and efficiently respond to unexpected results in perched groundwater and the Ogallala Aquifer. It is expected to take many years of treatment to remedy the plumes. Pantex will continue to monitor the Remedial Action and provide results in progress reports at pantex.energy.gov on the Environmental Cleanup Documents web page.



- | | | | |
|--------------------------------------|-------------------------------|-----------------------|-----------------------------------|
| Perched Monitoring Objectives | ◆ Extraction Well | — Roads | ■ Extent of Perched Contamination |
| ● Plume Stability | ◆ In Situ Bioremediation Well | □ Playas | ■ Extent of Perched Aquifer |
| ● Uncertainty Management | | --- DOE/NNSA Property | |
| ● Corrective Action | | | |

Perched Monitoring Wells and Monitoring Objectives



Ogallala Monitoring Wells and Monitoring Objectives