SGW-59936
Revision 0

FY2017 Plume Containment and Remediation Utilization Plan

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

P.O. Box 1600
Richland, Washington 99352

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1 Introduction

This plan was prepared for Performance Measure PM-30-1-17 to identify the fiscal year (FY) 2017 field activities to maximize plume containment and remediation utilization. This *FY2017 Plume Containment and Remediation Utilization Plan* was prepared for the active pump and treat (P&T) systems with the objectives to maximize contaminant removal during the FY, utilize the full treatment capacity, and optimize groundwater remediation. It provides the technical basis to achieve these objectives based on data inputs from the following previous year(s) reports:

- Annual groundwater report
- P&T operations reports
- Plume maps
- Drilling priority list
- Well realignment priorities
- Operations team input

The scope of this Performance Measure includes the following operable units' (OUs) active P&T systems:

- 100-HR-3 OU (DX and HX)
- 100-KR-4 OU (KR4, KW, and KX)
- 200-ZP-1, 200-UP-1, and 200-BP-5 (200 West)

Recommendations for additional field activities and system modifications proposed for these systems are based on an evaluation of the previous year's performance. Discussion and recommendations for potential scope for these three 200 Area OUs are included in Section 5 as part of the 200 West P&T operations.

Implementation of these recommendations during FY2017 is dependent upon agreement with the U.S. Department of Energy (DOE) Richland Operations Office (RL) and sufficient funding. Therefore, agreement needs to be reached with RL on what activities will be funded in FY2017 and included as part of the FY2017 Performance Measure activities identified in the *Final FY2017 Plume Containment and Remediation Utilization Plan*. Following this determination, CH2M HILL Plateau Remediation Company (CHPRC) can implement the Performance Measure to accomplish the following:

- Execute the approved yearly plume containment and remediation utilization plan
- Provide documentation substantiating that the actions were completed by September 30 of each FY

Groundwater remediation at the Hanford Site involves integration of the engineered systems into the subsurface environment to depths ranging from tens to hundreds of feet below ground surface. Subsurface conditions provide a large portion of the overall remedial uncertainty at each of the P&T systems, including contaminant concentration and aquifer yield. Additionally, meteorological conditions and cultural resources can influence the location, timing and performance of work. This plan uses the best information available to reduce the amount of uncertainty associated with the work; however, various contributors to the uncertainty may affect implementation and outcome of the proposed activities.

1.1 Optimization Approach

An objective of this plan is identify approaches for groundwater remediation through ongoing assessment of the systems operation and performance. Optimization refers to efforts associated with improving the remedy's

effectiveness in protecting human health and the environment, improving efficiency, and speeding the process toward site closure. Specific objectives for each OU include;

- River protection and hydraulic containment
- Mass removal and plume reduction
- System operation and maintenance updates
- Conceptual site model refinement

Remedial process optimization (RPO) is a systematic evaluation of the inputs, system components, and conditions against specific metrics, followed by a set of recommendations for modifications to improve system performance. While each of the P&T systems contains similar elements (e.g., extraction wells, injection wells, treatment process, and pipeline conveyance), contaminants, hydraulic performance and contaminant plume response to each individual system are unique. These elements can be optimized individually or in aggregate to enhance hydraulic capture, contaminant mass removal, and treatment system throughput, resulting in more efficient P&T system operations. Evaluation of each element within the context of the whole system provides the basis for modifications to accelerate remediation progress. Table 1 summarizes the inputs for periodic RPO evaluations.

Table 1. Inputs for Annual RPO Evaluations

System Element	Metric Evaluated	Input		
		Data	Tools	Reports
Groundwater contaminant plume geometry - Concentrations and spatial/vertical distribution.	Change since previous year, progress toward closure.	Water level data, groundwater chemical concentrations.	AWLN, groundwater monitoring, groundwater modeling.	Annual groundwater monitoring and P&T reports
Extraction wells - Number and location of extraction wells and well configuration (size, depth, screen, pump, and riser).	Well and screen placement relative to plume location. Well specific capacity. Pump capacity and sizing.	Water level data, aquifer capacity, well construction drawings, daily system monitoring data, well assessment	AWLN, aquifer testing, groundwater monitoring, groundwater modeling, pumping optimization model screening level tool, camera surveys	Annual groundwater monitoring and P&T reports, plume maps, hydraulic containment maps, water table maps. System design records, ECRs.
Extracted water conveyance - Sizing, routing, and materials of the conveyance, including intermediate transfer stations.	Head loss, potential to increase pumping rate and/or adjust for fewer or more wells. Materials performance. Fouling potential.	N/A	N/A	System design records, ECRs.
Treatment Process - Treatment technology, system sizing and configuration, capacity, contaminant removal efficiency, instrumentation and	Treatment process removal efficiency. Repair and maintenance experience. Fouling. Production of	System monitoring data, periodic sampling and analysis of influent and effluent streams.	N/A	System design records, ECRs

Table 1. Inputs for Annual RPO Evaluations

System Element	Metric Evaluated	Input		
		Data	Tools	Reports
controls. Process effluent water quality.	secondary waste streams. Effluent effects on aquifer.			
Treated water conveyance – Sizing, routing, and materials of the conveyance, including intermediate transfer stations.	Head loss. Potential to adjust for fewer or more wells. Materials performance. Fouling potential.	Design information	N/A	System design records ECRs
Injection wells - Number and location of injection wells and well configuration (size, depth, screen, and riser).	Well and screen placement relative to plume location. Well specific capacity. Pump capacity and sizing.	Water levels, aquifer capacity, well construction drawings, daily system monitoring data	AWLN, aquifer testing, groundwater monitoring, groundwater modeling, pumping optimization model screening level tool, camera surveys	Annual monitoring reports, plume maps, hydraulic containment maps, water table maps. System design records, ECRs
Injected water conveyance – Sizing, routing, and materials of the conveyance,	Head loss, potential to increase pumping rate and/or adjust for fewer or more wells. Materials performance. Fouling potential.	N/A	N/A	System design records, ECRs.

AWLN = automated water level network
ECR = engineering change request
N/A = not applicable
P&T = pump and treat

Key elements of a successful RPO program are timely evaluation and reporting of system performance monitoring data, and timely implementation of modifications. Monitoring programs for each of the P&Ts include the following elements:

- **Operational monitoring:** evaluates how well the treatment process functions and facilitates operation of the system. Operational monitoring includes P&T process monitoring, and treatment process water monitoring. P&T process monitoring includes collection and evaluation of data on the operational components of the treatment system. Treatment process water monitoring includes collection and analysis of samples from extraction wells, influent tanks, and effluent tanks to evaluate the removal of Cr(VI) and/or other contaminants by the system.
- **Performance monitoring**: assesses remedy performance and determine progress toward achieving the RAOs. Performance monitoring includes collection and evaluation of groundwater quality and groundwater elevation data. The assessment of performance includes evaluating how well the remedial action complies with the river protection objective and quantifies mass removal of Cr(VI) and/or other

contaminants. Performance monitoring data and operational monitoring data are used for remedial process optimization.

- **Compliance monitoring**: is conducted at the end of the remedial action to demonstrate achievement of cleanup.

Timely radiological, chemical, and water level data allow for development of accurate plume and hydraulic containment maps. Based on this information, together with well assessment and operations data, RPO evaluates each remediation system and target area, and recommends modifications to improve performance, thus enhancing progress toward remedy completion. Recommendations commonly address:

- Addition of new extraction and injection wells or repurposing of existing wells
- Well maintenance and rehabilitation
- Modification of pumping rates at extraction and/or injection wells
- Treatment system modifications and change management
- Alternate sampling parameters and frequencies

2 Pump and Treat Strategy

This section provides a summary of the objectives and priorities for the pump and treat strategy for each OU. It includes strategies to achieve both long-term and short-term objectives.

2.1 Objectives

The overall operational strategy for the P&T systems is to implement effective groundwater remedies that will progress toward final cleanup of contaminated groundwater plumes in as short amount of time as practical. The strategy includes both long-term and short-term objectives. The key long-term objective is to achieve the remedial action objectives (RAOs) established in the interim or final Record of Decisions (ROD) in accordance with Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) (Ecology et al., 1989) target milestones. The primary short-term objectives are to design and operate the systems, including any design modifications as necessary, to achieve performance criteria.

2.1.1 Long-Term Objectives (100-HR-3 and 100-KR-4 Operable Units)

The long-term objectives for the 100-HR-3 and 100-KR-4 P&T systems are identified in the RAOs of the interim ROD (EPA/ROD/R10-96/134, *Record of Decision for the 100-HR-3 and 100-KR-4 Operable Units Interim Remedial Actions, Hanford Site, Benton County, Washington*):

- Protect aquatic receptors in the river bottom substrate from contaminants in groundwater entering the Columbia River.
- Protect human health by preventing exposure to contaminants in the groundwater.
- Provide information that will lead to a final remedy.

Consistent with these RAOs, the following Tri-Party Agreement (Ecology et al., 1989) target milestones were established for the 100 Area OUs:

- **Milestone M-016-110-T01 (December 31, 2012):** DOE shall take actions necessary to contain or remediate hexavalent chromium groundwater plumes in all 100 Area NPL [National Priorities List] Operable Units such that ambient water quality standards for hexavalent chromium are achieved in the hyporheic zone and river water column.

Milestone M-016-110-T01 was completed in November 2012 (12-AMRP-0172, *Completion of Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) Target Milestone M-016-110-T01, 'DOE Shall Take Actions Necessary to Contain or Remediate Hexavalent Chromium Groundwater Plumes in Each of the 100 Area National Priority List Operable Units Such That Ambient Water Quality Standards for Hexavalent Chromium are Achieved in the Hyporheic Zone and River Water Column'*).

- **Milestone M-016-110-T04 (December 31, 2016):** DOE shall implement remedial actions selected in all 100 Area Records of Decision for Groundwater Operable Units so that no contamination above drinking water standards or ambient water quality standards enters the Columbia River unless otherwise specified in a CERCLA decision.
- **Milestone M-016-110-T02 (December 31, 2020):** DOE shall take actions necessary to remediate hexavalent chromium groundwater plumes such that hexavalent chromium will meet drinking water standards in each of the 100 Area NPL operable units.

2.1.2 Long-Term Objectives (200 West P&T)

Long-term objectives for the 200 West P&T system are identified in the RAOs of the final 200-ZP-1 OU ROD (EPA et al., 2008, *Record of Decision, Hanford 200 Area, 200-ZP-1 Operable Unit Superfund Site, Benton County, Washington*) and are site-specific goals that define the extent of cleanup necessary to achieve the specific level of remediation at the site. The following RAOs are defined in the final ROD:

- Return the 200-ZP-1 OU groundwater to beneficial use (restore groundwater to achieve domestic drinking water levels) by achieving the cleanup levels.
- Apply institutional controls to prevent the use of groundwater until the cleanup levels have been achieved.
- Protect the Columbia River and its ecological resources from degradation and unacceptable impact caused by contaminants originating from the 200-ZP-1 OU.

In addition, the long-term objectives for the 200 West P&T also includes optimization of the groundwater remediation activities associated with the 200-UP-1, 200-BP-5, and 200-DV-1 OU. This includes improvements to remedial actions that will help to expedite groundwater remediation. The FY17 activities will focus on work plan updates, 200 Area evaluations, and studies to evaluate current 200 West P&T system modifications and performance. Updating the conceptual site model, including tracer studies for groundwater flow, and an improved understanding of aquifer characteristics and remediation have also been identified for these 200 Area OUs.

2.1.3 Short-term Objectives (Fiscal Year 2017)

In addition to long-term objectives, short-term objectives for the P&T systems have been provided for in the FY annual performance measurement baseline (PMB) update. The following items are directly applicable to P&T operations:

- Maintain safe and compliant operations.
- Operate and maintain groundwater and vadose treatment systems with appropriate well network adjustments to accomplish the following:
  - Efficiently utilize treatment capacity.
  - Maximize contaminant mass removal.
  - Minimize contaminants from reaching the river.
  - Install and connect new and existing wells to improve remediation effectiveness.

2.2 Optimization Priorities

Based on the objectives outlined in the previous subsections, the following priorities have been established to guide system operations, data evaluation, and design modifications:

1. River protection (100-HR-3 and 100-KR-4 only)

   Minimize Cr(VI) from reaching the river through hydraulic containment in areas in close proximity to the river. This includes realigning wells and adjusting pumping rates to optimize river protection.

2. Mass removal and plume reduction

   Installation and connection of new and existing wells to maximize remediation effectiveness by removing groundwater containing high-concentration contaminants.

3. System operations and maintenance

   a. Fully utilize treatment capacity to ensure hydraulic containment and plume reduction.

   b. Perform required maintenance on system components to maintain system operation.

4. Conceptual site model (CSM) refinements

   a. Periodic groundwater monitoring and data evaluation to further the understanding of contaminant distribution and aquifer response to P&T remediation.

Each of these priorities is discussed in the following subsections, with OU-specific information, and the associated recommendations that support these priorities are identified in the subsequent sections.

2.2.1 River Protection and Hydraulic Containment

The highest priority for the 100-HR-3 and 100-KR-4 groundwater P&T systems is river protection. The expanded systems were designed to protect the Columbia River from discharges of Cr(VI) at concentrations greater than the state surface water quality standard of 10 µg/L (EPA/ROD/R10-96/134 and Milestone M-016-110-T01). Upgrades and optimization activities at the HX, DX, KR4, KW, and KX systems control discharge of groundwater containing Cr(VI) by plume capture and creation of hydraulic boundaries. This is consistent with Milestones M-016-110-T01 and M-016-110-T04. Monitoring of system performance and adjustments to systems will be performed as needed to maintain river protection.

2.2.2 Mass Removal and Plume Reduction

Restoration of groundwater quality to applicable standards is the long-term objective for all the P&Ts. The strategy for mass removal is similar to that for river protection: focus on the extraction well-field configuration and individual well extraction rate capacity to maximize contaminant mass removal. The primary decision criteria for locating mass removal extraction wells are contaminant concentration, well and aquifer yield, and proximity to continuing contaminant sources (where applicable).

2.2.3 System Operations and Maintenance

Routine P&T system operations and maintenance (O&M) is another key RPO element. Proper maintenance of system components, in accordance with the O&M plan, assures that all remedial systems achieve a high level of uptime, hydraulic performance, and treatment system effectiveness. Extraction well hydraulics and pipeline conveyance capacity, treatment system throughput, and injection conveyance and hydraulic capacity must be in balance to achieve optimum performance. Effective preventative maintenance minimizes system downtime and maximizes remedial effects during periods of highest potential for exposure (e.g., the transition from high river stage to low river stage).

The treatment system is a critical component in P&T system optimization. As extraction rates are increased, the system capacity must increase to meet the demand. Additionally, as the remediation advances and the

plumes contract, perimeter extraction wells may be shut down and treatment system throughput rates may decrease accordingly. These modifications can be achieved by reconfiguring treatment trains to take one or more vessels offline.

2.2.4 Conceptual Site Model Refinement

The RPO framework provides a systematic approach for evaluating and improving site remediation system performance. CSM refinement is an important component of RPO. The CSM is a dynamic tool that continually evolves as data are collected and evaluated regarding the P&T systems, aquifer hydraulics, and contaminant plume response to P&T. Periodic CSM updates help ensure that river protection and mass removal goals are achieved as efficiently as possible.

3 100-HR-3 Optimization Recommendations

The interim remedy at the 100-HR-3 Groundwater OU consists of two P&T systems (DX and HX) for the remediation of Cr(VI). These interim remedies are providing protection to the Columbia River and removing contaminant mass from the aquifer in most areas. To meet the optimization priorities for river protection, mass removal, system operations and maintenance, and refine the conceptual site model, the current systems have been evaluated following the optimization approach described in Section 2.

The optimization recommendations for the 100-HR-3 OU (Table 2 and Figure 1) are designed to maintain river protection, advance aquifer restoration progress, optimize P&T system operations, and refine the overall CSM. Following implementation of these actions, sufficient time is required for proper evaluation of the effectiveness of the optimization in meeting the strategy goals described in Section 2.

Continued evaluation of remedy performance and effectiveness provides information on the CSM and more clearly delineates the extent of groundwater plumes of Cr(VI) and other co-contaminants. To ensure capture assessment is accurate and reflects current plume configuration, additional wells may be connected to the Automated Water Level Network (AWLN) system.

4 100-KR-4 Optimization Recommendations

The interim remedy at the 100-KR-4 Groundwater OU consists of three P&T systems (KR4, KW, and KX) that capture contaminated groundwater, treat it to remove Cr(VI), and inject the treated water back into the aquifer. The interim remedy is currently capturing the Cr(VI) plumes, however, additional activities can increase contaminant removal for aquifer restoration, refine the area CSM, and optimize the effectiveness of P&T systems.

The optimization recommendations for the 100-KR-4 OU (Table 3 and Figure 2) are designed to maintain river protection, advance aquifer restoration progress, optimize P&T system operations and refine the overall site CSM. Following implementation of these actions, sufficient time is required to properly evaluate the effectiveness of the optimization in meeting the strategy goals described in Section 2.

Continued evaluation of remedy performance and effectiveness provides information on the CSM and more clearly delineates the extent of groundwater plumes of Cr(VI) and other identified co-contaminants.

5 200 West P&T Optimization Recommendations

The final remedy for the 200-ZP-1 Groundwater OU consists of a single treatment system (200 West P&T) for the capture and remediation of carbon tetrachloride, total chromium, Cr(VI), iodine-129, nitrate, technetium-99, and trichloroethene. This final remedy is intended to remove contaminant mass from the

aquifer and keep plumes from moving to the Columbia River. The 200 West P&T system has also recently been expanded to remediate groundwater from the 200-UP-1, 200-BP-5, and 200-DV-1 OUs. Table 4 identifies the FY17 optimization recommendations for the 200 West P&T system. Figure 3 shows planned FY17 optimization activities for 200-ZP-1 OU. Following implementation of the proposed actions, sufficient time is required to properly evaluate the effectiveness of the optimization in meeting the strategy goals described in Section 2.

Table 2. 100-HR-3 Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well/Location Identification	P&T Optimization Priority (Section 2.2)	100-HR-3 Priority	In PMB?
Increase extraction near ISRM to improve river protection	Connect existing well to DX extraction if flow rates are greater than 10 gpm, otherwise evaluate whether to restart ISRM extractions or install new extraction well.	100-D Area near ISRM barrier	Additional extraction capacity is needed to improve river protection near the ISRM barrier. This well improves capture upgradient of the ISRM and intercepts contamination that is currently following a channel to the river.	199-D4-102	1. River Protection	1	Yes
Increase extraction near ISRM to improve river protection	Connect existing well to DX extraction if flow rates are greater than 10 gpm, otherwise evaluate whether to restart ISRM extractions or install new extraction well.	100-D Area near ISRM barrier	Additional extraction capacity is needed to improve river protection near the ISRM barrier. This well improves capture upgradient of the ISRM and intercepts contamination that is currently following a channel to the river.	199-D4-103	1. River Protection	2	Yes
Increase extraction near ISRM to improve river protection	Convert existing monitoring well to DX extraction	100-D Area near ISRM barrier	Additional extraction capacity is needed to improve river protection near the ISRM barrier. Contamination migrating south of the ISRM barrier would be intercepted by adding this well. Cultural approval needed by March 31st.	199-D3-2	1. River Protection	3	No
Increase extraction near ISRM to improve river protection	Convert existing monitoring well to DX extraction	100-D Area near ISRM barrier	Additional extraction capacity is needed to improve river protection near the ISRM barrier. Contamination migrating south of the ISRM barrier would be	199-D4-77	1. River Protection	4	No

Table 2. 100-HR-3 Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well/Location Identification	P&T Optimization Priority (Section 2.2)	100-HR-3 Priority	In PMB?
			intercepted by adding this well. Cultural approval needed by March 31st.				
Evaluate alternative to improve river protection	Evaluate feasibility of installing horizontal extraction well at HX	100-H Area	Contamination in the area between 199-H1-43 and 199-H1-45 is increasing. Additional capture is needed in this area which is dominated by a thin aquifer. A horizontal well is recommended to allow for low river stage capture. This evaluation will support selection and implementation of installation method.	Between 199-H1-43 and 199-H1-45	1. River Protection	5	Yes
Increase extraction along the eastern edge of 100-H	Drill 3 new wells; connect to HX extraction	100-H plume eastern edge	River protection in the horizontal well evaluation area. Contamination levels are increasing in this area. Additional vertical wells would be installed, however the effectiveness of the wells may be limited due to the geology of the area and thin aquifer.	199-H1-47, 199-H1-48, and 199-H1-49	1. River Protection	6, 7, 8	No
Improve communications between P&T system and extraction and injection wells	Upgrade existing communications to fiber optic cable	100-D Area, DX P&T facility	Increased reliability/communication between P&T facility and existing extraction and injection wells.	Multiple	3. Operations	9	No
Increase system capacity and mass removal	Install new booster pump	100-D Area; DX P&T facility	Increased mass removal and process reliability by installing an	Building M5	2. Mass Removal 3. Operations	10	Yes

Table 2. 100-HR-3 Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well/Location Identification	P&T Optimization Priority (Section 2.2)	100-HR-3 Priority	In PMB?
			additional booster pump at building M5.				
Improve understanding of communication between RUM, river and unconfined aquifer	RUM step/constant rate test report	100-H Area	Reduction and analyses of data collected in CY2016 to assess interconnection between RUM, unconfined aquifer and river.	Multiple	4. Conceptual Site Model	11	No
Increase extraction from H-Area RUM	Drill new well; Connect to HX extraction	100-H Area RUM	Pending results of the FY2016 step/constant rate testing, additional extraction may be needed to increase mass removal. Preliminary results indicate that the RUM unit is connected across a portion of 100-H.	New (TBD)	2. Mass Removal	12	No
Increase extraction from H-Area RUM	Drill new well; Connect to HX extraction	100-H Area RUM	Pending results of the FY2016 step/constant rate testing, additional extraction may be needed to increase mass removal. Preliminary results indicate that the RUM unit is connected across a portion of 100-H.	New (TBD)	2. Mass Removal	13	No
Increase extraction from H-Area RUM	Drill new well; Connect to HX extraction	100-H Area RUM	Pending results of the FY2016 step/constant rate testing, additional extraction may be needed to increase mass removal. Preliminary results indicate that the RUM unit is connected across a portion of 100-H.	New (TBD)	2. Mass Removal	14	No

Table 2. 100-HR-3 Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well/Location Identification	P&T Optimization Priority (Section 2.2)	100-HR-3 Priority	In PMB?
AWLN system improvement	Connect additional wells to AWLN	100-D Area	AWLN data are needed to ensure capture assessment is accurate and reflects current plume configuration (near-optimal configuration).	199-D3-5, 199-D5-13, 199-D6-3, 199-D8-101, and 699-98-49A	4. Conceptual Site Model	15	No
AWLN system improvement	Connect additional wells to AWLN	100-H Area	AWLN data are needed to ensure capture assessment is accurate and reflects current plume configuration (near-optimal configuration).	199-H4-47, 199-H6-3, 699-94-41, 699-94-43, 699-96-44, 699-88-41A, and 699-93-37A	4. Conceptual Site Model	16	No
Increase extraction along the eastern edge of 100-H	Replace existing 2" conveyance pipe with new 3" pipe	100-H Area	Additional capture is needed in this area.	199-H1-45	1. River Protection 2. Mass Removal	17	
Groundwater plume monitoring	Convert existing injection wells to monitoring. Cap ends and leave piping.	100-D North Area	Wells are configured for injection, but are inoperable for the majority of the year due to high water levels. Additional sampling locations are needed in the 100-D north area to track plume movements.	199-D2-10, 199-D2-12, 199-D8-93, and 199-D8-94	3. Operations 4. Conceptual Site Model	18	No
Groundwater plume monitoring	Convert existing extraction well to monitoring. Cap ends and leave piping.	100-D North Area	Well is configured for extraction, but is inoperable for the majority of the year due to the lack of water in the area. Additional sampling locations are needed in the 100-D north area to track plume movements.	199-H1-3	3. Operations 4. Conceptual Site Model	19	No

Table 2. 100-HR-3 Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well/Location Identification	P&T Optimization Priority (Section 2.2)	100-HR-3 Priority	In PMB?
N/A	Complete Phase 1 Tracer Study Report	100 HR-3 100 KR-4	Reduction and analysis of data to determine and increase confidence in modeling.	N/A	4. Conceptual Site Model	20	No
Groundwater plume monitoring	Annual groundwater and P&T Reporting	All P&T's	Submit draft Annual groundwater report by April 15th and draft Annual P&T reports by May 15th.	N/A	3. Operations 4. Conceptual Site Model	21	Yes
Groundwater plume monitoring	Well Identification	All P&T's	Verify that monitoring wells identified in Annual groundwater and P&T reports are included in current M-24 well list.	N/A	3. Operations 4. Conceptual Site Model	22	Yes
Process Improvement	Technology Assessment	100 HR-3 100 KR-4	Evaluate chromium sensor technology test progress for inclusion in FY 2018 P&T Optimizaiton Plan.	N/A	3. Operatons	23	Yes

AWLN = automated water level network
CY = calendar year
ISRM = in situ redox manipulation
N/A = not applicable
P&T = pump and treat
PMB = performance measurement baseline
RUM = Ringold Formation upper mud
TBD = to be determined

Table 3. 100-KR-4 Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well Identification	P&T Optimization Priority (Section 2.2)	100-KR-4 Priority	In PMB?
Enhance Cr(VI) plume capture	Convert existing monitoring well to extraction well - KX (K-131 taken off line)	Between 100-K and 100-N Areas	Enhance extraction, increase potential mass removal, and increase capture of Cr(VI) plume between 100-K and 100-N. Cultural approval needed by April 1st.	199-N-189 (XE15)	2. Mass Removal	1	No
Enhance near-river Cr(VI) monitoring	Convert existing extraction well to monitoring well - remove rack, pump and downhole pipe	100-K Area, distal end of 116-K-2 Trench	Provide process space for Well 199-N-189 and will also allow for near-river monitoring between newly established injection Well 199-K-149 and extraction Well 199-K-147. Concurrent with actions at Well 199-N-189. Cultural approval needed by April 1st.	199-K-131	3. Operations 4. Conceptual Site Model	2	No
Enhance system throughput	Convert existing monitoring well to Injection - KX (199-K-160 taken off line)	100-KX P&T system distal injection capacity	Enhance throughput of KX system by shortening injection pipe run to the well, reducing head loss, and increasing injection capacity. Also brings the injection mound closer to 100-K and provides additional plume containment. Cultural approval needed by April 1st.	199-K-149 (XJ2)	2. Mass Removal 3. Operations	3	No
Enhance distal plume monitoring	Convert existing injection to monitoring well - remove rack and downhole piping	100-K Area distal plume	Provides monitoring downgradient of current injection field (Well 199-K-164). Process improvement, concurrent with 199-K-149. Cultural approval needed by April 1st.	199-K-160	3. Operations 4. Conceptual Site Model	4	No
Enhance system throughput	Convert existing monitoring well to injection well -	100-KX P&T system distal injection capacity	Enhance throughput of KX system by shortening injection pipe run to the well, reducing head loss, and increasing injection capacity. Also	199-K-151 (XJ1)	2. Mass Removal 3. Operations	5	No

Table 3. 100-KR-4 Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well Identification	P&T Optimization Priority (Section 2.2)	100-KR-4 Priority	In PMB?
	KX (K-159 taken off line)		brings the injection mound closer to 100-K and provides additional plume containment. Cultural approval needed by April 1st.				
Enhance distal plume monitoring	Convert existing injection to monitoring well - remove rack and downhole piping	100-K Area distal plume	Provides monitoring downgradient of current injection field (Well 199-K-164). Process improvement, concurrent with 199-K-151. Cultural approval needed by April 1st.	199-K-159	3. Operations 4. Conceptual Site Model	6	No
Enhance Cr(VI) plume capture	Convert existing monitoring well to extraction well - KX	Cr(VI) plume inland of 116-K-2 Trench	Enhance extraction, increase potential mass removal, and increase capture of Cr(VI) plume segment in an area of potential flow stagnation. Cultural approval needed by April 1st.	199-K-193 (XE36)	2. Mass Removal	7	No
Enhance system throughput	Install additional feed pump at KX	K Area, KX P&T system	Increase the operational capacity of the KX P&T system.	KX P&T	3. Operations	8	Yes
Enhance Cr(VI) plume delineation	Install new monitoring well between KE Headhouse and Well K-111A	105-KE Reactor vicinity	Help define the current high-concentration Cr(VI) plume near the 105-KE Reactor. No monitoring wells exists between the 183 KE Headhouse, 118-K-1 Burial Ground, and the 105-KE Reactor.	TBD	4. Conceptual Site Model	9	Yes
Enhance Cr(VI) and Tritium plume delineation	Install new monitoring well at K-1 Burial Ground	118-K-1 Burial Ground	Adds plume definition to the southern end of the 118-K-1 Burial Ground and evaluation of potential tritium source.	TBD	4. Conceptual Site Model	10	Yes
N/A	Evaluate changing out	K-Area P&T systems	Measurements during system operation indicate that SIR-700	N/A	3. Operations	11	No

Table 3. 100-KR-4 Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well Identification	P&T Optimization Priority (Section 2.2)	100-KR-4 Priority	In PMB?
	SIR-700 resins more frequently based on observed buffering capacity.		resin exhibits measureable alkaline buffering capacity. This capacity is gradually consumed during prolonged operation. This evaluation will provide information regarding feasibility of relying on the resin buffering for effluent pH control as an alternative to an engineered alkaline adjustment system.				
N/A	KW Rebound Study continuation/ reporting	KW P&T Affected Area	Groundwater monitoring at the KW system will continue through the end of FY16 under current funding. Validate effectiveness of KW groundwater cleanup and potential for secondary sources. Assumes reporting on activities with data through March 31, 2017.	N/A	4. Conceptual Site Model	12	No
Enhance Cr(VI) plume capture	Convert existing monitoring well to extraction well downgradient of 118-K-1 Burial Ground	105-KE Reactor vicinity	Mass reduction from high Cr(VI) plume downgradient from 118-K-1 Burial Ground.	199-K-226	2. Mass Removal	13	No
Enhance Cr(VI) plume delineation	Install new monitoring well downgradient of the KW Head House and south of the KW Switch Yard.	K Area	Conceptual site model update and plume delineation.	TBD	4. Conceptual Site Model	14	No

Table 3. 100-KR-4 Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well Identification	P&T Optimization Priority (Section 2.2)	100-KR-4 Priority	In PMB?
Enhance Cr(VI) plume delineation	Install new monitoring well between the KW and KE reactors.	K Area	Conceptual site model update and plume delineation.	TBD	4. Conceptual Site Model	15	No
N/A	Complete K Area Phase 2 tracer study and prepare Tracer Study Report	K Area	Reduction and analysis of data to determine and increase confidence in modeling.	TBD	4. Conceptual Site Model	16	No

N/A = not applicable
P&T = pump and treat
PMB = performance measurement baseline
TBD = to be determined

Table 4. 200 West Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well/Location Identification	P&T Optimization Priority (Section 2.2)	200 West Priority	In PMB?
Mass reduction	Install four (4) new injection wells - 200 West area	200-ZP-1	Mass reduction.	TBD	2. Mass removal	1, 2, 3, 4	No
Process improvement	Realign IMB lines in ITB-2 to stainless header	200 West P&T	Process improvement.	N/A	3. 200 West Operations	5	Yes
Source control	Submit Surface Infiltration Evaluation Report	200-ZP-1	Reduce issues associated with injection water disposal.	N/A	3. 200 West Operations	6	Yes
Process improvement	Evaluate injection water process improvements	200 West P&T	Optimize 200 West injection well development techniques with the objective to improve the overall performance of the injection well field. CHPRC will perform a review of the current well development techniques. Review results will be included in a report to DOE that summarizes the observation of techniques previously implemented, documents recommended changes to the well development techniques, and results of implemented changes.	N/A	2. Mass removal 3. 200 West Operations	7	Yes
Process improvement	Evaluate process improvements to minimize fouling	200 West P&T	Evaluate system improvements to minimize fouling of injection wells and aquifer resulting from currently used materials. CHPRC will review current material usage and options for improving system performance.	N/A	3. 200 West Operations	8	Yes

Table 4. 200 West Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well/Location Identification	P&T Optimization Priority (Section 2.2)	200 West Priority	In PMB?
Process improvement	Purchase six LEAP cassettes for next MBR for installation in FY2018	200 West P&T	Increased reliability and flexibility for 200 W P&T. Dependent on funding available. LEAP cassettes are a long lead procurement item (12 months).	N/A	3. 200 West Operations	9	No
N/A	Submit Central Plateau Vadose Zone – Groundwater Integration Schedule	200 Area OUs	Integrate source control and removal with groundwater treatment for process improvement.	N/A	2. Mass Removal 3. 200 West Operations	10	No
N/A	Submit Decisional Draft 200-BP-5 RAWP	200-BP-5	Integrate source control and removal with groundwater treatment for process improvement.	N/A	2. Mass removal 3. 200 West Operations	11	Yes
N/A	Submit Central Plateau Tracer Study Work Plan and Initiate 1 tracer study in FY2017	200 Area OUs	Improve hydrogeologic understanding of Central Plateau/200 Area groundwater OUs	N/A	4. Conceptual Site Model	12	No
N/A	Submit a white paper evaluating treating higher capacity flows from 200 East Area groundwater	200 Area OUs	Process improvement. Evaluation will identify current system limitations and recommendations to achieve higher capacity flow rates.	N/A	2. Mass removal 3. 200 West Operations	13	No
N/A	Submit Revised Decisional Draft 200-UP-1 RD/RAWP and	200-UP-1	Complete 200-UP-1 ROD requirements crosswalk against existing documents. Revised document will have consistent format to the 200-ZP-1 RD/RAWP and include; 1) approach to meeting	N/A	2. Mass removal 3. 200 West Operations	14	No

Table 4. 200 West Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well/Location Identification	P&T Optimization Priority (Section 2.2)	200 West Priority	In PMB?
	Characterization SAP		M-016-193 milestone, 2) I-129 implementation approach, 3) changes in remedy implementation, 4) updated groundwater modeling and 5) MNA evaluation.				
N/A	Submit Revised Decisional Draft 200-ZP-1 RD/RAWP	200-ZP-1	Complete 200-ZP-1 ROD requirements crosswalk against existing documents. Revised document will consistent format to the 200-UP-1 RD/RAWP. Document to update cleanup predictions based on the updated groundwater model and progress made to date.	N/A	2. Mass removal 3. 200 West Operations	15	No
Process improvement	Prepare the Baseline P&T Extraction/ Injection Well Database for the 200 Area wells.	200 Area OUs	Process improvement.	N/A	3. 200 West Operations 4. Conceptual Site Model	16	No
N/A	Update the CSM and groundwater models to reflect current conditions, capture zone, and improve cleanup predictions.	200-UP-1 and 200-ZP-1	Improve hydrogeologic understanding of Central Plateau/200 Area groundwater OUs	N/A	4. Conceptual Site Model	17	No
Process improvement	Operate 200 W P&T at an annual flow rate of 2000 gpm. Demonstrate 2500 gpm recipe at	200 West P&T	Exceptions are allowed for preventative and corrective maintenance.	N/A	3. 200 West Operations	18	Yes

Table 4. 200 West Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well/Location Identification	P&T Optimization Priority (Section 2.2)	200 West Priority	In PMB?
	200 W P&T for a 2-month period.						
Process improvement	Evaluate process chemicals	200 West P&T	Evaluate impacts from implementation of a national certification pedigree for chemicals.	N/A	3. 200 West Operations	19	Yes
Process improvement	200 West P&T Annual Plans	200 West P&T	Submit Annual System Maintenance, Annual Treatment System Upgrades/Modifications Plan and Treatment Process Recipe Modifications and Logic/Procedure Demonstration for the 200W P&T.	N/A	3. 200 West Operations	20	Yes
Process improvement	Uranium well realignment	200-UP-1	Perform an evaluation of the uranium capture and connect an additional extraction well based on the evaluation.	299-W19-123 or 299-W19-125	2. Mass removal	21	No
Process improvement	Assessment of chemicals used at P&T facilities	100-HR3 P&T's 100-KR4 P&T's 200 W P&T	Evaluate impacts from implementation of a national certification pedigree for chemicals.	N/A	3. Operations	22	Yes

* Includes annual system maintenance plan and treatment system upgrade/modifications plan, treatment process recipe modifications, and logic/procedure demonstration.

IMB = injection manifold building
ITB = injection transfer building
LEAP = low energy advanced performance
MBR = membrane bioreactor
MNA = monitored natural attenuation
N/A = not applicable
OU = operable unit
P&T = pump and treat
PMB = performance measurement baseline

Table 4. 200 West Pump and Treat Optimization Priorities for FY2017

Well Use/Function	Proposed Action	Area of Concern/Location	Technical Justification	Well/Location Identification	P&T Optimization Priority (Section 2.2)	200 West Priority	In PMB?

RAWP = removal action work plan

RD/RAWP = remedial design/remedial action work plan

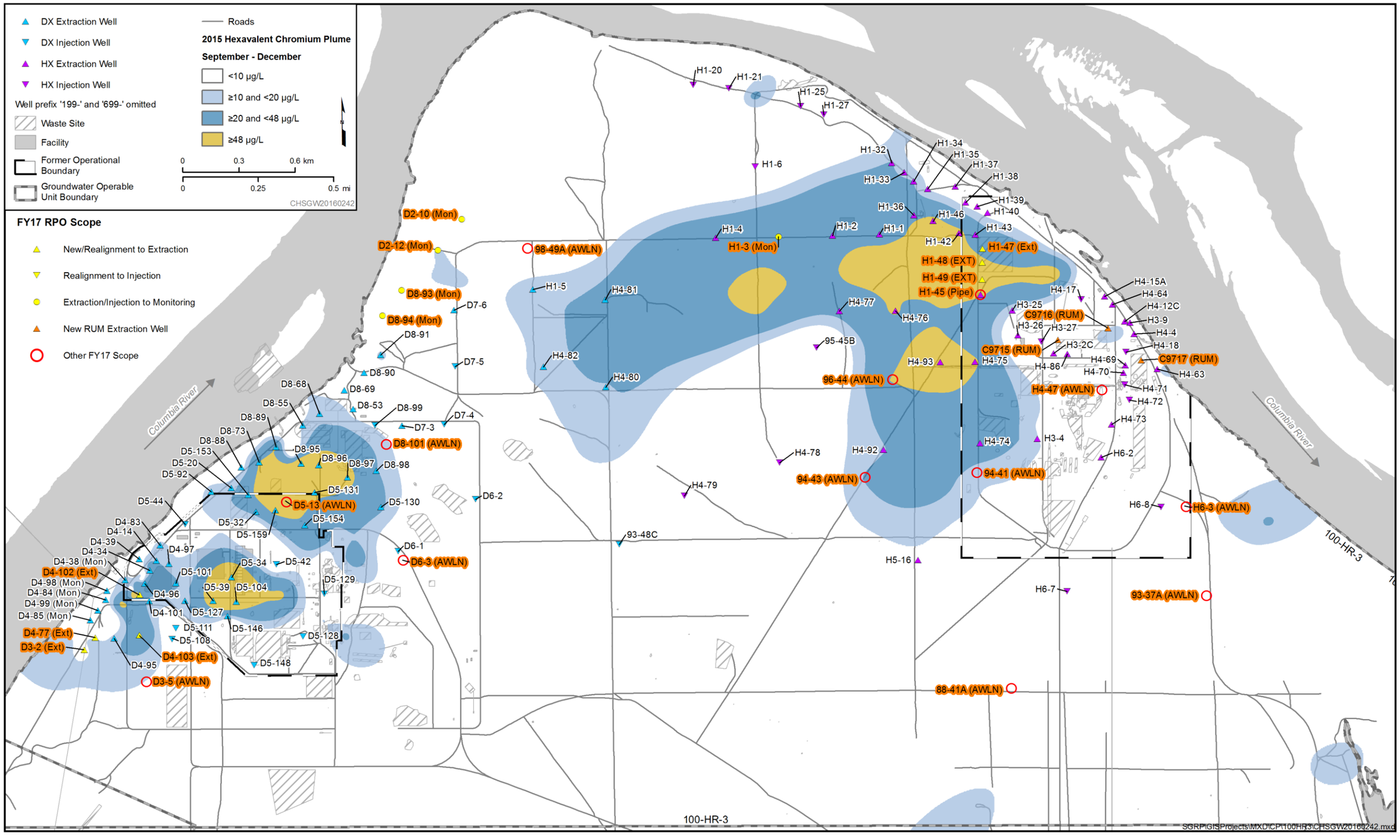

Figure 1. 100-HR-3 Optimization Locations

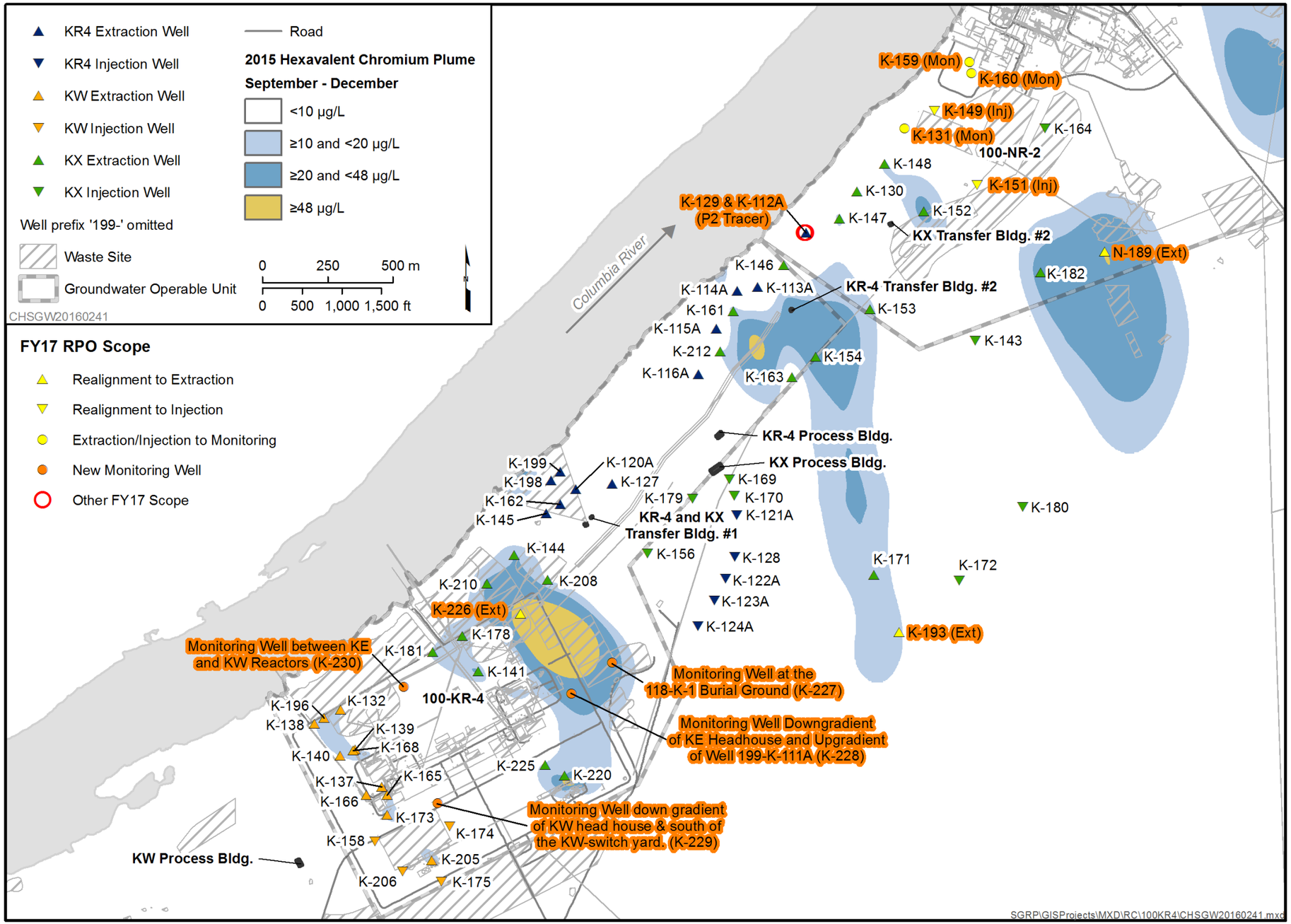

Figure 2. 100-KR-4 Optimization Location

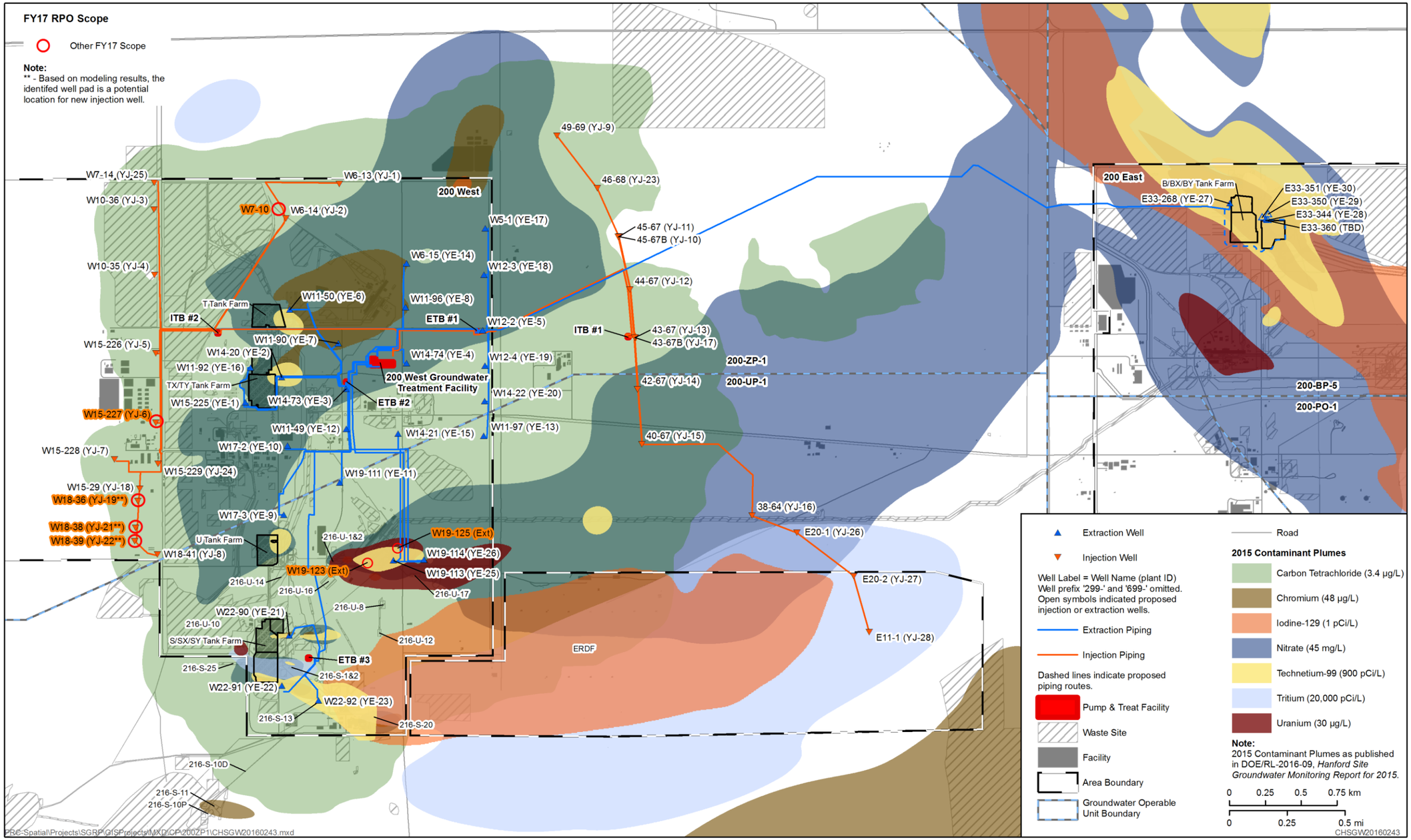

Figure 3. 200-ZP-1 Optimization Locations

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6 Fiscal Year 2017 P&T Optimization Activities

The P&T optimization activities listed in Table 5 are included in the Performance Measure (PM-30-1-17) for FY2017. These activities are included in the Plateau Remediation Contract (PRC) and sufficient funding will be provided to complete this work scope in FY2017. Completion of these activities is based on receipt of RL-approved cultural reviews by April 1, 2017.

Table 5. Proposed Fiscal Year 2017 Pump and Treat Optimization Activities (included in Performance Measure PM-30-1-17

Activity Number	Area	Activity Description
1	All	Complete groundwater protection FY 2017 key performance goals for P&T operations.
2	All	Submit the draft Annual Groundwater Report to DOE for review by April 15th and the draft Annual Pump and Treat Reports to DOE for review by May 15th.
3	All	Verify that the monitoring wells recommended in the draft Annual Groundwater Monitoring Report and Pump and Treat reports have been added to the current M-24 well list by May 15, 2017.
4	All	Prepare Integrated Schedule for the Central Plateau Vadose Zone/Groundwater Characterization focusing on geoframework development and real-time integration of data into the conceptual site model, such as hydrologic testing, leaching studies, MNA evaluations, tracer studies, etc.
5	All	Evaluate chromium sensor technology scope for inclusion in the FY18 P&T Optimization Plan by April 30, 2017.
6	200 West P&T	Realign IMB lines in ITB-2 to stainless header.
7	200 West P&T	Evaluate process improvements for injection well development techniques for the 200W P&T.
8	200 West P&T	Evaluate process improvements to minimize the injection materials causing fouling of the well and aquifer.
9	200 West P&T	Submit Surface Infiltration Evaluation Report for the 200W P&T.
10	200 West P&T	Evaluate impacts from implementation of a national certification pedigree for chemicals.
11	200 West P&T	Submit Annual System Maintenance, Annual Treatment System Upgrades/Modifications Plan and Treatment Process Recipe Modifications and Logic/Procedure Demonstration for the 200W P&T.
12	200 West P&T	Operate 200 West P&T at an annual flow rate of 2,000 gpm. Demonstrate 2,500 gpm recipe at 200W P&T using all four MBRs for a two month period. Exceptions are allowed for preventative and corrective maintenance.
13	200-BP-5	Prepare Decisional Draft 200-BP-5 Removal Action Work Plan.

Table 5. Proposed Fiscal Year 2017 Pump and Treat Optimization Activities (included in Performance Measure PM-30-1-17

Activity Number	Area	Activity Description
14	100-HR-3	Connect existing well 199-D4-102 to DX extraction if flow rates are greater than 10 gpm, otherwise evaluate whether to restart ISRM wells or install new extraction well by November 30, 2016.
15	100-HR-3	Connect existing well 199-D4-103 to DX extraction if flow rates are greater than 10 gpm, otherwise evaluate whether to restart ISRM wells or install new extraction well by November 30, 2016.
16	100-HR-3	Evaluate feasibility of installing horizontal extraction well at HX.
17	100-HR-3	Add new booster pump at M5 building.
18	100-KR-4	Install additional feed pump at KX P&T.
19	100-KR-4	Install new monitoring well downgradient of KE Head House and 199-K-111A.
20	100-KR-4	Install new monitoring well at K-1 Burial Ground.
21	100-KR-4	Install new monitoring well downgradient of the KW Head House and south of the KW Switch Yard.
22	100-KR-4	Install new monitoring well between the KW and KE reactors.

IMB = injection manifold building
ITB = injection transfer building
MNA = monitored natural attenuation
P&T = pump and treat

Final completion of activities described in Table 5 will be documented in a letter to RL that is submitted no later than 60-days after the end of FY2017.

The P&T optimization activities listed in Table 6 are not included in Performance Measure (PM-30-1-17) for FY2017. These activities were either not included in the PRC and/or were not identified by RL as high priority at the beginning of the fiscal year. Initiation of these activities is contingent upon: 1) RL issuing a directed change to add this work scope to the PRC; 2) RL providing adequate funding; and/or 3) RL approved cultural reviews. Completion of these activities will then be dependent upon the timing of the above identified actions. These activities were prioritized based on discussions and agreement with RL.

Table 6. Additional Fiscal Year 2017 Pump and Treat Optimization Activities (not in PRC or PM)

Activity Number	Area	Activity Description
1	200 West P&T	Install new injection well - 200 Area.
2	200 West P&T	Install new injection well - 200 Area.
3	200 West P&T	Install new injection well - 200 Area.

Table 6. Additional Fiscal Year 2017 Pump and Treat Optimization Activities (not in PRC or PM)

Activity Number	Area	Activity Description
4	200 West P&T	Install new injection well - 200 Area.
5	200 West P&T	Purchase six LEAP cassettes for next MBR for installation in FY18.
6	200 West P&T	Prepare white paper that evaluates treating higher capacity flows from 200 East Area groundwater at the 200W P&T. Evaluation will identify current system limitations and recommendations to achieve higher capacity flowrates.
7	200-ZP-1 and 200-UP-1	Update the 200 West conceptual site model and groundwater models to reflect current conditions, capture zone analysis, and improve cleanup predictions.
8	200-UP-1	Complete 200-UP-1 ROD requirements crosswalk against existing documents. Prepare revised Decisional Draft 200-UP-1 RD/RAWP and Characterization SAP to include 1) approach to meeting M-016-193 milestone, 2) I-129 implementation approach, 3) changes in remedy implementation, 4) updated groundwater modeling, and 5) MNA evaluations. Revised document will have consistent format to the 200-ZP-1 RD/RAWP. Does not include an update to the Performance Monitoring Plan.
9	200-ZP-1	Complete 200-ZP-1 ROD requirements crosswalk against existing documents. Prepare revised Decisional Draft 200-ZP-1 RD/RAWP to update the cleanup predictions based on the updated groundwater model and progress made to date. Revised document will have consistent format to the 200-UP-1 RD/RAWP. Does not include an update to the Performance Monitoring Plan based on new model predictions.
10	200 Area	Prepare the Baseline P&T Extraction/Injection Well Database for the 200 Area wells.
11	200 Area	Prepare Central Plateau Tracer Study Work Plan and initiate one tracer study in FY17.
12	200-UP-1	Perform an evaluation of the uranium capture and connect an additional extraction well based on the evaluation. New extraction well may replace an existing extraction well based, depending on the evaluation.
13	100-HR-3	Convert existing monitoring well to extraction well– DX (199-D3-2). Work inside TCP; requires RL-approved CRR by April 1, 2017 in order to complete scope in FY17.
14	100-HR-3	Convert existing monitoring well to extraction well – DX (199-D4-77). Work inside TCP; requires RL-approved CRR by April 1, 2017 in order to complete scope in FY17.
15	100-HR-3	Install new extraction well for river protection.
16	100-HR-3	Install new extraction well for river protection.
17	100-HR-3	Install new extraction well for river protection.
18	100-HR-3	Upgrade Communications to Fiber Optic Cable at DX.

Table 6. Additional Fiscal Year 2017 Pump and Treat Optimization Activities (not in PRC or PM)

Activity Number	Area	Activity Description
19	100-HR-3	Prepare RUM Step/Constant Rate Pumping Test Report.
20	100-HR-3	Prepare Phase 1 Tracer Study Report
21	100-HR-3	Install new RUM extraction well.
22	100-HR-3	Install new RUM extraction well.
23	100-HR-3	Install new RUM extraction well.
24	100-HR-3	Purchase, install and hookup five (5) new AWLN units in 100 D Area.
25	100-HR-3	Purchase, install and hookup seven (7) new AWLN units in 100 H Area.
26	100-HR-3	Convert existing injection wells to monitoring wells (199-D2-10, 199-D2-12, 199-D8-93 and 199-D8-94); leave HDPE pipe.
27	100-HR-3	Convert existing extraction well 199-H1-3 to monitoring well; leave HDPE pipe and electrical cables.
28	100-HR-3	Replace existing 2" conveyance pipe with new 3" pipe for well 199-H1-45.
29	100-KR-4	Convert existing monitoring well 199-N-189 (XE15) to extraction well - KX pump and treat system (199-K-131 taken off line). Work inside TCP; requires RL-approved CRR by April 1, 2017 in order to complete scope in FY17.
30	100-KR-4	Convert existing extraction well 199-K-131 to monitoring well; leave HDPE pipe and electrical cables. Work inside TCP; requires RL-approved CRR by April 1, 2017 in order to complete scope in FY17.
31	100-KR-4	Convert existing monitoring well 199-K-149 (XJ2) to injection well - KX pump and treat system (199-K-160 taken off line). Work inside TCP; requires RL-approved CRR by April 1, 2017 in order to complete scope in FY17.
32	100-KR-4	Convert existing injection well (199-K-160) to monitoring well; leave HDPE pipe. Work inside TCP; requires RL-approved CRR by April 1, 2017 in order to complete scope in FY17.
33	100-KR-4	Convert existing monitoring well 199-K-151 (XJ1) to injection well – enhance throughput at KX. (199-K-159 taken off line). Work inside TCP; requires RL-approved CRR by April 1, 2017 in order to complete scope in FY17.
34	100-KR-4	Convert existing injection well 199-K-159 to monitoring well; leave HDPE pipe. Work inside TCP; requires RL-approved CRR by April 1, 2017 in order to complete scope in FY17.
35	100-KR-4	Convert existing monitoring well 199-K-193 (XE36) to extraction well – enhance extraction and shorten remediation time frame. Work inside TCP; requires RL-approved CRR by April 1, 2017 in order to complete scope in FY17.

Table 6. Additional Fiscal Year 2017 Pump and Treat Optimization Activities (not in PRC or PM)

Activity Number	Area	Activity Description
36	100-KR-4	Evaluate changing out SIR-700 resins more frequently based on observed buffering capacity.
37	100-KR-4	Continue KW rebound study and prepare Rebound Study Report that evaluates data through March 31, 2017.
38	100-KR-4	Complete K Area tracer study and prepare Tracer Study Report.
39	100-KR-4	Install new extraction well (199-K-226) downgradient of 118-K-1 Burial Ground.

AWLN = automated water level network
CRR = Cultural Resource Review
Cr(VI) = hexavalent chromium
CSM = conceptual site model
LEAP = low energy advanced performance
MBR = membrane bioreactor
RD/RAWP = remedial design/remedial action work plan
RUM = Ringold Formation upper mud
TCP = Traditional Cultural Property

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