TRI-PARTY AGREEMENT

Change Notice Number TPA-CN- 1102	TPA CHANGE NOTICE FORM	Date: September 29, 2020
Document Number, Title, and Revision: DOE/RL-2019-38, *200-ZP-1 Operable Unit Optimization Study Plan*, Rev. 0		Date Document Last Issued: September 30, 2019
Approved Change Notices Against this Document: N/A		
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Description of Change:

DOE/RL-2019-38, Rev. 0 is revised to update some references, revise the schedule, and revise text associated with the duration of the optimization plan.

M. W. Cline (**DOE**) and E. Laija (**Lead Regulatory Agency**) agree that the proposed change modifies an approved workplan/document and will be processed in accordance with the Tri-Party Agreement Action Plan, Section 9.0, *Documentation and Records,* and not Chapter 12.0, *Changes to the Agreement*.

DOE/RL-2019-38, Rev 0 is revised to update references and revise text concerning the schedule and duration of planned activities. Section 11 contains several changes to the study schedule due to delays associated with the COVID-19 epidemic and related shutdowns.

Additions are shown using <u>double underline</u>. Deletions are shown using ~~strikeout~~.

Note: Include affected page number(s): iii, vi, 1, 2, 15, 22, 23, 30, 36, 45, 46, 47, 49, 50, 51, 52, 53, 55

Justification and Impacts of Change:

DOE/RL-2019-38, *200-ZP-1 Operable Unit Optimization Study*, is being revised to update references, revise the schedule, and revise text associated with the duration of the optimization plan. The study has a duration 5 years with an option of 2 additional years if needed. In parallel, the Ringold A characterization activities are being performed so that within 3 years the Ringold A data could be evaluated and some decisions made regarding the remedy modification(s). Due to delays associated with the COVID-19 epidemic and related shutdowns, all the FY 2021 work planned in the OSP now gets pushed into FY2022, FY2023 and potentially FY2024.

Approvals:

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Executive Summary

Based on U.S. Environmental Protection Agency guidance,[1] an optimization study is being performed to generate information to evaluate potential remedy configuration modifications for the 200-ZP-1 Groundwater Operable Unit (OU) and the 200 West pump and treat facility (hereinafter referred to as 200 West pump and treat [P&T]). The optimization study consists of four tasks conducted over a minimum of 6 years. (The work was initially planned for fiscal years 2020 through 2025). but was delayed due to work stoppages and facility shutdowns in response to the COVID-19 epidemic. The revised schedule is fiscal years 2021 through 2026. The schedule for work performed may be impacted based on prioritization of Hanford Site work activities and available funding each fiscal year. Changes to the schedule will be made in accordance with the Tri-Party Agreement.

Groundwater remediation at the 200-ZP-1 OU is currently in progress in accordance with the Record of Decision (ROD) issued in 20082 (hereinafter referred to as the 200-ZP-1 OU ROD). The groundwater remedy detailed in the 200-ZP-1 OU ROD is comprised of P&T and flow-path control, followed by monitored natural attenuation (MNA). The ROD estimates that remediation will require 125 years to achieve final cleanup levels for eight contaminants of concern, with carbon tetrachloride taking the longest time to achieve the cleanup level. The remedy is designed so MNA and P&T will occur concurrently during the 25-year period of active P&T to reduce contaminant concentrations, and then MNA alone will further reduce concentrations to final cleanup levels.

Operations began at the 200 West P&T in July 2012, and remedy performance has been evaluated annually since that time. The results of the evaluations are documented in annual 200 West Area P&T reports. The evaluations have demonstrated that system-wide flow rates, plume hydraulic containment, and mass recovery rates are following the

[1] EPA 542-R-13-008, 2013, *Remediation Optimization: Definition, Scope and Approach*, Office of Solid Waste and Emergency Response and Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/production/files/2015-08/documents/optimizationprimer_final_june2013.pdf.

[2] EPA, Ecology, and DOE, 2008, *Record of Decision Hanford 200 Area 200-ZP-1 Superfund Site, Benton County, Washington*, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington. Available at: https://pdw.hanford.gov/document/00098825.

targets established in Rev. 0 of the 200-ZP-1 P&T remedial design/remedial action work plan (RD/RAWP).[3] However, data and information acquired following issuance of the 200-ZP-1 OU ROD[2] suggest that conditions are less favorable and highly unlikely to

[3] DOE/RL-2008-78, 2009, *200 West Area 200-ZP-1 Pump-and-Treat Remedial Design/Remedial Action Work Plan*, Rev. 0 REISSUE, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: https://pdw.hanford.gov/document/0096137.

throughput capacity with the installation of a third air stripper and additional extraction and injection wells.

To evaluate a basis for modifying the current remedy configuration, a formal remedy optimization study is needed to evaluate alternative remedy reconfigurations, in particular regarding increased treatment capacity for carbon tetrachloride, as well as optimizing locations and rates of additional extraction and injection wells. The need for continued nitrate treatment will also be evaluated under this optimization study.

This optimization study plan provides the basis and approach for conducting the optimization study to meet the needs summarized herein and detailed in ~~Rev. 1, Draft A of~~ the 200-ZP-1 P&T RD/RAWP[7], emphasizing configuration changes and data collection for the Rwie. This optimization study plan summarizes the results of previous analyses and provides an overall approach to optimizing carbon tetrachloride treatment while transitioning from biological treatment to MNA for nitrate. The purpose of the optimization study is to collect and interpret data to evaluate remedy performance enhancements and remedy configuration changes associated with P&T operations. It is anticipated that remedy configuration changes will focus on increasing carbon tetrachloride treatment capacity for the Rwie to diminish the plume and help achieve remediation goals as identified in the 200-ZP-1 OU ROD.[2] The intent of these and other concurrent remedy evaluation and optimization efforts is to identify opportunities to improve remedy protectiveness, effectiveness, and cost efficiency, and to facilitate progress toward completion of site work.

This optimization study plan provides an overall approach to conduct well network optimization to increase carbon tetrachloride treatment capacity and perform necessary changes at the treatment facility. A focused sampling and analysis plan will be developed at the onset of the study to specify the data that will be collected to meet the study objectives. The optimization study focuses on the Rwie and is anticipated to have minimal impact on contamination in the Rwia. A separate investigation is being performed to better understand the nature and extent of contamination in the Rwia, which will then be used to determine the treatment needs. A comprehensive evaluation to further evaluate the cleanup potential for other COCs is planned as a separate activity to

[7] DOE/RL-2008-78, 2019, *200 West Area 200-ZP-1 Pump-and-Treat Remedial Design/Remedial Action Work Plan*, Rev. 1, ~~Draft A,~~ U.S. Department of Energy, Richland Operations Office, Richland, Washington.

take place concurrently with this optimization study which has been initiated in FY2020 and will continue through FY2021.

1 Introduction

This document describes the optimization study plan to evaluate the remedy for the 200-ZP-1 Groundwater Operable Unit (OU). The optimization study plan consists of four tasks that include modifying the configuration of the 200 West pump and treat (P&T) facility and associated well network (hereinafter collectively referred to as the 200 West P&T) to improve contaminant capture and containment. The optimization study will be conducted in conjunction with the activities identified in DOE/RL-2008-78, Rev. 1~~, Draft A~~, *200 West Area 200-ZP-1 Pump-and-Treat Remedial Design/Remedial Action Work Plan* (hereinafter referred to as the 200-ZP-1 P&T remedial action/remedial design work plan [RD/RAWP])~~ (which will be finalized in a Rev. 1)~~. This optimization study plan provides the approach to increase contaminant removal from the Ringold Formation member of Wooded Island – unit E (Rwie).

The 200-ZP-1 OU has multiple contaminant plumes that require remediation in accordance with EPA et al., 2008, *Record of Decision Hanford 200 Area 200-ZP-1 Superfund Site, Benton County, Washington* (hereinafter referred to as the 200-ZP-1 OU Record of Decision [ROD]). The groundwater remedy detailed in the 200-ZP-1 OU ROD is comprised of 25 years of P&T and flow-path control, followed by 100 years of monitored natural attenuation (MNA), for a total remedy duration of 125 years to achieve the final cleanup levels for the contaminants of concern (COCs). Except for tritium, all of the other groundwater COCs reside within the boundaries of the carbon tetrachloride contamination and will be addressed concurrently with the P&T component designed for carbon tetrachloride until cleanup levels are achieved.

The 200-ZP-1 OU remedy began in 2012 using the 200 West P&T. Overall performance of 200-ZP-1 OU P&T activities through the initial 6 years of operation has demonstrated that flow rates, plume containment, and mass extraction performance are consistent with the targets established in the 200-ZP-1 P&T RD/RAWP (DOE/RL-2008-78~~, Rev. 0~~). However, data and information obtained following issuance of the 200-ZP-1 OU ROD (EPA et al., 2008) suggest that conditions are less favorable for attaining the carbon tetrachloride cleanup level with the current remedy configuration in the timeframe specified in the ROD. The new data and information include the following:

- The site-specific abiotic degradation rate of carbon tetrachloride, as presented in PNNL-22062, *Abiotic Degradation Rates for Carbon Tetrachloride and Chloroform: Final Report*, has been determined to be about an order of magnitude slower than the degradation rate assumed in DOE/RL-2007-28, Rev 0, *Feasibility Study Report for the 200-ZP-1 Groundwater Operable Unit* (hereinafter referred to as the 200-ZP-1 OU feasibility study [FS]). As a result of the slower natural degradation rate, more intensive P&T efforts and/or a longer cleanup duration is needed to achieve the carbon tetrachloride cleanup levels specified in the 200-ZP-1 OU ROD (EPA et al., 2008).

- New data show that more carbon tetrachloride contamination is present in Rwie than was identified in the 200-ZP-1 OU FS (Section 2.4 in DOE/RL-2007-28). Current estimates indicate that over a third more carbon tetrachloride mass resides within the Rwie than was assumed in the 200-ZP-1 OU FS.

A predictive analysis was conducted using this new information to evaluate whether the current remedy configuration could meet the remedial action objectives (RAOs) for carbon tetrachloride, which is the primary risk driver due to its high concentration relative to the cleanup level and corresponding large mass within the aquifer. The analysis indicated that without modification, carbon tetrachloride remediation would not meet cleanup levels within the 125-year timeframe. The analysis also suggested that sufficient nitrate treatment may have occurred to transition to MNA, since nitrate concentrations are less than an order of magnitude above the cleanup level.

The predictive analysis resulted in an evaluation of remedy configuration changes to focus on increasing the carbon tetrachloride treatment capacity of the 200 West P&T to diminish the plume in the Rwie. To improve carbon tetrachloride cleanup, a third air stripper and additional extraction and injection wells are necessary to accommodate greater total overall operating capacity for the 200 West P&T. The 200 West P&T is currently operating at its original design capacity of 9,500 L/min (2,500 gal/min), but only 6,800 L/min (1,800 gal/min) is available for the 200-ZP-1 OU due to water being treated from other feed streams. Suspension of biological treatment will allow treatment capacity for carbon tetrachloride to increase up to approximately 14,200 L/min (3,750 gal/min) maximum throughput capacity with the installation of a third air stripper and the additional extraction and injection wells.

In addition, new data show that more carbon tetrachloride contamination is present in the lower Ringold Formation member of Wooded Island – unit A (Rwia) portion of the aquifer than was identified in the 200-ZP-1 OU FS (Section 2.4 in DOE/RL-2007-28). Current estimates indicate that approximately 25% of the remaining carbon tetrachloride mass resides within the Rwia compared to approximately 12% assumed in the 200-ZP-1 OU FS. The data also indicate lower hydraulic conductivity in the Rwia aquifer when compared to the Rwie, causing additional remediation difficulties. A sampling and analysis plan (SAP) is being developed to better characterize the Rwia (DOE/RL-2019-23, Rev 0, ~~Draft A,~~ *200-ZP-1 Operable Unit Ringold Formation Unit A Characterization Sampling and Analysis Plan* [hereinafter referred to as the Ringold A SAP]), which is planned to be finalized and performed concurrently with this optimization study. Treatment needs for the Rwia will be further evaluated following completion of the Ringold A SAP. The optimization study will have minimal impact on the Rwia because the Ringold Formation member of Wooded Island – lower mud unit (Rlm) separates the Rwia and the Rwie over most of the 200-ZP-1 OU. The information resulting from the Rwia study will be combined with the data from the optimization study results to help evaluate remedy performance.

A comprehensive evaluation to further evaluate the cleanup potential for other COCs is planned as a separate activity to take place concurrently with the optimization study. In FY2020 and FY2021, CH2M Hill Plateau Remediation Company will be determining whether additional COC/constituents of potential concern data are needed. In accordance with Ecology et al., 1989b, *Hanford Federal Facility Agreement Consent Order Action Plan* (hereinafter referred to as the Tri-Party Agreement Action Plan), a change notice mechanism will be used if additional near-term monitoring data are needed. Concurrently, a comprehensive plume evaluation to evaluate more effective treatment for other plumes and continuing sources was initiated in FY2020 (and continuing into FY2021). Integrating the results of the comprehensive plume evaluation into the overall remedy optimization is planned for FY2021 and FY2022. An initial summary of these activities is presented in SGW-65172-VA, Rev 0, *200-ZP-1 Optimization Study-Resolution of RL Comments Regarding Integration of a Comprehensive Remediation Evaluation of Groundwater Plumes and Well Networks.*

Furthermore, biological treatment processes contribute to injection well fouling that diminishes injection well capacity, which has necessitated frequent well cleaning, constructing new injection wells, installing an effluent chlorination system, and making changes to facility amendments and operational conditions. The diminished well capacity due to well fouling limits flow through the treatment plant and increases operational costs.

This optimization plan is organized as follows:

- Chapter 1 describes the purpose and scope of the study and summarizes the site setting and background for the 200-ZP-1 OU.
- Chapter 2 provides background information about the current 200-ZP-1 OU remedy and 200 West P&T requirements.

- Chapter 3 provides the objectives for the optimization study.
- Chapter 4 discusses operational constraints and compliance during implementation of the optimization study.
- Chapter 5 describes the conceptual facility design.
- Chapter 6 describes the well network design to meet study objectives.
- Chapter 7 outlines the approach to be used to develop the sampling and modeling activities for implementing the study.
- Chapter 8 discusses data management.

2.1.1 Remedy Documentation

The 200-ZP-1 OU remedy is implemented through multiple remedy implementation documents, including the following:

- 200-ZP-1 P&T RD/RAWP (DOE/RL-2008-78, Rev. 1~~, Draft A~~)
- 200 West P&T operations and maintenance (O&M) plan (DOE/RL-2009-124, Rev. 5, *200 West Pump and Treat Operations and Maintenance Plan*)
- 200-ZP-1 OU performance monitoring plan (PMP) (DOE/RL-2009-115, Rev. 3, ~~Draft A,~~ *Performance Monitoring Plan for the 200-ZP-1 Groundwater Operable Unit Remedial Action*)
- Ringold A SAP (DOE/RL-2019-23, ~~Draft A~~Rev. 0)
- This optimization study plan

Reporting activities are provided through annual P&T reports, quarterly regulatory briefings, and an annual P&T remedy progress assessment report. Changes to the remedy configuration performed as part of this optimization study may require revisions to the 200-ZP-1 OU PMP (DOE/RL-2009-115~~, Rev. 2~~) and the 200 West P&T O&M plan (DOE/RL-2009-124).

Figure 8 shows the relationship between 200-ZP-1 OU remedy implementation documents and remedy reporting, optimization, decisions, and management. As shown in Figure 8, the 200-ZP-1 P&T RD/RAWP (DOE/RL-2008-78~~, Rev. 1, Draft A~~) is the overarching enforceable document that describes the remedy tasks and provides the overall direction for remedy implementation to meet 200-ZP-1 OU ROD (EPA et al., 2008) requirements. The 200-ZP-1 OU PMP (DOE/RL-2009-115~~, Rev. 23~~) and the 200 West P&T O&M plan (DOE/RL-2009-124) guide the approach for remedy implementation. Specifically, the PMP describes data collection and interpretation to conduct remedy performance assessment and support remedy implementation decisions. The O&M plan guides operation and data collection for the 200 West P&T, as well as the injection and extraction well networks. The PMP provides the requirements that the O&M plan must incorporate to meet plume remediation needs. The O&M plan activities provide data to the PMP for use in performance assessment.

2.2 200-ZP-1 Operable Unit Record of Decision Requirements

This section describes the RAOs and other requirements specified in the 200-ZP-1 OU ROD (EPA et al., 2008).

2.2.1 Remedial Action Objectives

The RAOs are site-specific objectives that define the extent of cleanup necessary to achieve cleanup goals for the 200-ZP-1 OU, including the following, as stated in the 200-ZP-1 OU ROD (EPA et al., 2008):

- **RAO #1:** Return 200-ZP-1 OU groundwater to beneficial use (restore groundwater to achieve domestic drinking water levels) by achieving cleanup levels (provided in Table 11 of the 200-ZP-1 OU ROD and Table 1 of this optimization study plan). This objective is to be achieved within the entire 200-ZP-1 OU groundwater plumes. The estimated timeframe to achieve cleanup levels is within 150 years.
- **RAO #2:** Apply ICs to prevent the use of groundwater until cleanup levels (provided in Table 11 of the 200-ZP-1 OU ROD) have been achieved. Within the entire OU groundwater plumes, ICs must be maintained and enforced until cleanup levels are achieved, which is estimated to be within 150 years.

4.1 Study Approach

The optimization study will be implemented under four tasks. Chapters 5 through 10 provide additional details for the activities associated with each task, and Chapter 11 provides a proposed schedule.

4.1.1 Task 1 – Suspension of Biological Treatment

During Task 1, biological treatment will be suspended at the 200 West P&T to allow an increase in carbon tetrachloride treatment capacity and to facilitate more efficient additional modifications of the 200 West P&T (Task 2). Initially during Task 1, performance monitoring (described in Chapter 7) will be implemented until the optimization study SAP is finalized. Chapter 5 provides additional information regarding the facility configuration. Additional extraction and injection wells (if needed) will be installed during Task 1 to allow the 200 West P&T to incrementally add capacity during Task 2 activities (see Section 4.1.2). Extraction wells will be installed in accordance with the 200-ZP-1 OU remediation well installation SAP, which is provided in Appendix G of the 200-ZP-1 OU PMP (DOE/RL-2009-115~~, Rev. 3, Draft A~~).

In parallel with Task 1, efforts will include conducting data quality objective (DQO) processes and developing a SAP to guide continued sampling and analysis actions needed to collect and evaluate data identified in this optimization study plan. Predictive fate and transport (F&T) modeling will be conducted to provide input to facility and well network design upgrades, as well as to support the DQO and SAP processes (see Chapter 6). The well network upgrade design to meet the optimization study objectives will be completed and will support necessary well installation planning and implementation. Work will also include completing facility design modifications to increase the 200 West P&T treatment capacity. Cost and operational data and information for Task 1 activities will be collected as input to evaluate the optimization study results.

The following activities will be implemented during Task 1 of the optimization study to lay the foundation for the main study activities:

- Monitor performance of the modified system in accordance with the optimization study plan once biological treatment has ceased.
- Use the DQO process to support development of a SAP for collecting data needed to support the optimization study (see Chapter 7).
- Develop engineering documents and procedures describing the details for implementing 200 West P&T modifications (see Chapter 5).
- Conduct groundwater contaminant F&T modeling to support optimization of the well network and to provide input to the DQO and data evaluation processes.

4.1.2 Task 2 – Facility and Well-Network Modifications to Increase Carbon Tetrachloride Treatment Capacity

Design and modeling data from Task 1 will be used to implement facility and well network upgrades in Task 2. The facility treatment capacity will be increased to reach a total maximum capacity of approximately 14,200 L/min (3,750 gal/min). Current estimates indicate that of the 14,200 L/min (3,750 gal/min) design capacity, approximately 11,600 L/min (3,070 gal/min) will be available for the 200-ZP-1 OU (an increase from the current capacity of 6,800 L/min [1,800 gal/min]). Facility modifications primarily associated with installing a third air stripper tower and associated facility and well network plumbing will proceed in parallel with well installation. Section 5.2.2 provides further details regarding facility modifications.

The well network expansion will initially focus on installing extraction wells needed to increase capacity and then installing monitoring wells and injection wells as needed to meet the overall needs of the optimization study. Installation of some new extraction wells will occur during Task 1 (Section 4.1.1). Additional well installations (beyond the initially installed extraction wells) will begin after completion of the optimization study SAP, which will be developed to meet the optimization study needs as part of the Task 1 DQO and SAP processes. The well locations will be identified using the processes presented in Chapter 6 of this optimization study plan and will be installed under the 200-ZP-1 OU remediation well installation SAP (Appendix G of the 200-ZP-1 OU PMP [DOE/RL-2009-115~~, Rev. 3, Draft A~~]). Section 6.1 provides further details on the injection/extraction well network configuration.

4.1.3 Task 3 – Data Collection and Monitoring

Task 3 represents the period of data collection and monitoring for the optimization study, beginning with suspension of biological treatment. Data collection includes both the effect of biological treatment suspension and the effect of increased carbon tetrachloride treatment capacity. Primary data collection elements will include information from the 200 West P&T (influent and effluent COC concentrations, as well as additional process operational monitoring data), COC mass recovery data, aquifer hydraulic head data, and COC concentrations at monitoring wells over the period of data collection.

The optimization study duration is controlled by (1) the need to operate at an increased treatment capacity for carbon tetrachloride for a timeframe sufficient to collect data that provide a foundation for evaluating potential remedy modifications, and (2) the need to operate without biological treatment for a timeframe sufficient to collect data that provide a foundation for evaluating whether biological treatment can be permanently terminated. Some of the supporting data for these objectives can be collected within about one year of reaching the targeted treatment flow rate. These data include verifying hydraulic containment and that effluent concentrations for COCs (except nitrate) meet effluent requirements. Data to evaluate how the injection well performance is enhanced under the optimized configuration will require a few years in order to assess the sustainability of injection operations after terminating biological treatment. However, quantification of two key plume remediation performance elements is needed to meet the objectives, which may require additional time for data collection. Data are needed to quantify the extent to which carbon tetrachloride mass extraction and associated plume shrinkage are enhanced by the increased treatment flow rate and to quantify nitrate plume behavior without biological treatment.

Groundwater F&T modeling was used to perform scoping simulations to estimate the timeframe needed to demonstrate how plume remediation performance is affected by the revised optimization study operational configuration. These simulations provided estimated trends in mass removal rate, concentration of nitrate in facility effluent, and monitoring well concentrations. Scoping simulations showed that the optimization study operational changes will result in mass removal and concentration differences that will become substantial (in comparison to what would occur under current operating conditions) within a period of about 3 years after the facility treatment flow rates are increased to the value targeted by the optimization study. While simulation results show obvious positive changes in the key performance elements within 3 years, field data to be collected during the optimization study are subject to variability, and statistical methods will need to be applied to quantify the performance trends. Depending on the level of variability, the 3 year operational timeframe may be sufficient to quantify the performance trends for comparison to trends under current operating conditions and to defensibly support the future predictive modeling need for remedy decisions. However, an evaluation of the field data after 3 years of operation at the full treatment flow may necessitate continuing optimization study operations and data collection for a total of 5 years to meet data quality needs. The operational durations discussed above are for the period after the facility has been modified (completion of Task 2, which

wells in areas that help maintain hydraulic containment and accelerate contaminant flushing, thereby accelerating mass removal and concentration reductions.

Figure 10 shows the layout of the current injection and extraction well network, as well as the mapped carbon tetrachloride plume and preliminary candidate areas for installing initial extraction wells to enhance the carbon tetrachloride extraction rate. The preliminary proposed well locations were derived from previously completed studies. Installation of new extraction wells will be initiated during Task 1 to allow the 200 West P&T to incrementally reach full capacity by the end of Task 2 (Section 4.1.2). The plan for installing the initial extraction wells will be incorporated into the 200-ZP-1 OU remediation well installation SAP (Appendix G of the 200-ZP-1 OU PMP [DOE/RL-2009-115~~, Rev. 3, Draft A~~]).

The injection and extraction well network design approach will be based on methods previously used to analyze the 200-ZP-1 OU P&T remedy (and other Hanford Site groundwater OU P&T remedies). These analyses use multiple lines of evidence to prioritize areas where additional extraction or injection wells have high potential to improve remedy performance for carbon tetrachloride:

- P&T performance analysis methods use empirical data analysis and the CPGWM to evaluate and predict groundwater flow, contaminant distribution, and contaminant transport to delineate areas where hydraulic containment is incomplete, concentration reductions and mass recovery are not in line with goals, and contaminant concentrations are unlikely to meet RAOs.

- Derived analysis methods use particle-tracking calculations to depict regions of the aquifer that will be recovered by the extraction wells over prescribed time intervals and use the CPGWM to identify areas that have been flushed or diluted by treated water via the injection wells.

- Predictive F&T modeling uses the CPGWM to analyze candidate well network configurations to assess their predicted performance over time in diminishing the carbon tetrachloride plume.

- Formal optimization techniques use numerical methods, combined with the CPGWM, to search for a best design by evaluating multiple combinations of pumping rates and candidate well networks.

These analysis methods are further discussed in Section 7.2, where the relationships between the different methods are shown.

described in the data gap study performed in 2017 (SGW-61350, *Data Gaps Evaluation in Groundwater Monitoring at the Hanford 200-ZP-1 Groundwater Operable Unit*) and the data quality objectives established during preparation of the optimization study SAP. The data gap study will be revisited with the specific objectives of this optimization study plan as part of evaluating the monitoring well network during preparation of the optimization study SAP. Selected well locations will be prioritized, with emphasis placed on either existing wells or installation of new wells that are anticipated (based primarily on the predictive F&T modeling) to show near-term hydraulic and chemical water quality responses to the reconfigured extraction/injection well network and P&T operations in order to support this optimization study. Prior to completion of the optimization study SAP, the monitoring well network will be sampled as described in Section 7.1.2.

Monitoring well locations and sampling frequencies will be updated based on the analysis described in this section and will be incorporated into the optimization study SAP. Existing monitoring wells from the 200-ZP-1 OU PMP (DOE/RL-2009-115~~, Rev. 2~~) or in use by other monitoring programs will be candidates for inclusion in the monitoring well network for the optimization study. New monitoring wells that are identified in the optimization study SAP will be installed during Task 2 under the 200-ZP-1 OU remediation well installation SAP (Appendix G of the 200-ZP-1 OU PMP [DOE/RL-2009-115~~, Rev. 3, Draft A~~]) by adhering to the document change control process described in the well installation SAP. The monitoring well locations and sampling frequencies will account for expected plume dynamics based on groundwater flow and contaminant migration velocities, as well as the proximity of monitoring locations to the injection and extraction wells. For example, Figure 12 shows the current PMP monitoring wells that lie within a conservative 5-year travel time from an injection well. These wells would be priority locations for monitoring changes in nitrate concentrations while operating the reconfigured 200 West P&T for the optimization study.

Data obtained from the monitoring network will be used to interpret remedy performance and optimization study results using the methods discussed in Section 6.1. The data will also be incorporated into the updated groundwater flow and contaminant transport components of the CPGWM to update predictions of overall remedy performance for carbon tetrachloride using the optimized remedy configuration.

7 Performance Monitoring Activities

This chapter outlines the performance monitoring activities that will be implemented to ensure that the operational and analytical data collected are acceptable and useful for decision making. The DQOs for the 200-ZP-1 OU optimization study plan will be developed in accordance with EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA QA/G-4). The DQOs serve as the basis for designing the sampling and modeling activities to collect data of sufficient quality and quantity to support performance monitoring goals and objectives. The supplemental data gathered under this optimization study will address the additional data needs not already covered in the 200-ZP-1 OU PMP (DOE/RL-2009-115~~, Rev. 2~~). Section 9.2 discusses the initial goals to support the needs of this optimization study. The DQOs will be developed during Task 1 of the optimization study.

In addition to data collected in accordance with the optimization study SAP, data collected as described in the 200-ZP-1 OU PMP (DOE/RL-2009-115~~, Rev. 2~~) and the Ringold A SAP (DOE/RL-2019-23) will be used to evaluate modifications to the remedy configuration and to support future remedy decisions.

At the start of Task 1 (which begins when the FBRs are restarted after the GAC has been removed), treatment effectiveness of the air strippers will be monitored by comparing the carbon tetrachloride concentrations of the water prior to entering and after exiting the air strippers. The inlet concentrations to the air strippers are calculated from water sample results of existing air stripper inlet (location 10) and ETB-2 (location 11) well concentrations. Water samples collected from the effluent tank (location 12) provide the air stripper effluent concentrations. Additionally, the effluent tank (location 12) samples will be analyzed for all COCs to verify that injection water meets the cleanup levels identified for the optimization study. Depending on the interim piping configuration from the equalization tank to the existing air stripper during Task 2, water sampling may not be needed at the equalization tank (location 7), the recycle tank (location 8), and the FBR effluent (location 9).

At the completion of Task 2 (when the new air strippers are brought into service), treatment effectiveness of the new and existing air strippers will be monitored by comparing carbon tetrachloride concentrations of the water prior to entering and after exiting the air strippers. Water samples will be collected at the existing air stripper inlet (location 10) and the effluent tank (location 12) for the existing air strippers and at the new air stripper inlet (location 11) and new air stripper effluent (location 13) for the new air strippers. Additionally, the effluent tank (location 12) and new air stripper effluent (location 13) water samples will be analyzed for all COCs to verify that injection water meets the injection criteria. Depending on the final piping configuration from the equalization tank to the existing air stripper following completion of Task 2, water sampling may not be needed at the equalization tank (location 7), the recycle tank (location 8), and the FBR effluent (location 9).

At the start of Task 1, vapor samples will be collected weekly for one month from the existing GAC vapor off-gas vessels (location 14) and monthly for one quarter from the treated off-gas stack (location 15). At the completion of Task 2, vapor samples will be collected weekly for one month from the new GAC vapor off-gas vessels (location 14) and monthly for one quarter from the treated off-gas stack (location 15). As with the increased water sampling frequencies, the increased vapor sampling frequencies following the start of Task 1 and at the completion of Task 2 will be evaluated for possible extension if the data show that steady-state conditions for 200 West P&T operations have not been achieved.

7.1.1.3 Coordination of Existing Sample Requirements

Sampling for compliance is documented in the 200 West P&T O&M plan (DOE/RL-2009-124). All compliance samples will continue to be collected and will augment the sampling detailed in this optimization study plan. Likewise, the sampling associated with ERDF and the MSUs will continue as described in the applicable documents. The sampling requirements are described in the 200-DV-1 OU action memorandum (DOE/RL-2014-34), the 200-BP-5 OU action memorandum (DOE/RL-2016-41), the 200-ZP-1 OU ROD (EPA et al., 2008), and the 200-UP-1 OU interim ROD (EPA et al., 2012)

The documents that describe the samples augmenting those outlined in this section include DOE/RL-2009-124, Appendix D (which provides the 200 West P&T SAP); DOE/RL-2018-70, *Optimization Pilot Test Results of Treating Water from Modular Storage Units at 200 West Pump & Treat Facility*; and CP-60072, *Environmental Restoration Disposal Facility Leachate and Washwater Management Plan, Formerly WCH-182, Revision 3*.

7.1.2 Plume Performance Sampling Activities

Plume performance monitoring is generally guided by the requirements of the 200-ZP-1 OU PMP (DOE/RL-2009-115~~, Rev. 2~~). The hydraulic and contaminant-specific monitoring well networks established in the performance monitoring SAP (Appendix B of the PMP, Figures B-8 through B-15) will

be used to support this optimization study. The list of COCs and other constituents of interest for the 200-ZP-1 OU (Table B-6 in Appendix B of the PMP) will be used as the basis for the initial monitoring program for this optimization study. The initial sampling and analysis frequencies for Task 1 will be governed by the sampling schedule specified in Appendix B, Table B-14 of the PMP. The first year of the optimization study will be adequately monitored under the existing performance monitoring SAP (Appendix B of the PMP) since the travel time from the injection wells to the nearest 200-ZP-1 OU monitoring wells exceeds one year; therefore, plume changes will not be observable during the first year of the study (see Section 4.1.3). In addition, the wells to be monitored for nitrate and sulfate at a minimum during the first year of this optimization study will be determined based on a combination of modeling analysis. Additional monitoring wells will be evaluated to support FY 2020 sampling. Other plume performance monitoring needs (e.g., extraction well data) will initially be satisfied by the existing monitoring requirements for the 200-ZP-1 OU P&T (extraction and injection) well network, as specified in the 200 West P&T O&M plan (DOE/RL-2009-124). After the first year of the study, the optimization study performance monitoring will be governed by the new optimization study SAP (DOE/RL-2019-76, Rev 0, *200-ZP-1 Operable Unit Optimization Study Sampling and Analysis Plan*), the performance monitoring SAP (Appendix B of the PMP), and the 200 West P&T SAP (Appendix D of the O&M plan). The SAPs provided in the PMP and the O&M plan may be modified following completion of the optimization study, as further discussed in Chapter 10.

The monitoring frequency specified in the 200-ZP-1 OU PMP (DOE/RL-2009-115~~, Rev. 2~~) is expected to be sufficient for the approximate 1-year timeframe of Task 1 monitoring because significant changes in plume dynamics are not expected to be observed during the Task 1 monitoring period. The optimization study SAP will be used to guide data collection during Task 3 after the 200 West P&T has been modified to increase flow rates to approximately 11,600 L/min (3,070 gal/min) for the 200-ZP-1 OU.

The following plume performance monitoring data and information will initially be collected during implementation of Task 1 to evaluate plume behavior under the modified 200 West P&T configuration:

- Hydraulic head and flow rate data for the P&T (extraction and injection) well network (the same as required by the 200 West P&T O&M plan [DOE/RL-2009-124] and identified in the 200-ZP-1 OU PMP [DOE/RL-2009-115~~, Rev. 2~~])
- Rehabilitation information for injection wells (the same as required by the 200 West P&T O&M plan and identified in the 200-ZP-1 OU PMP)
- Monitoring well network hydraulic head data (the same as required by the 200-ZP-1 OU PMP)
- COC data in monitoring well networks (the same as required by the 200-ZP-1 OU PMP)

Any additional sampling needs identified during the DQO process for this optimization study conducted during Task 1 will be documented in the optimization study SAP (DOE/RL-2019-76).

Additional sampling needs may include the need to expand and/or reconfigure the monitoring well network to sufficiently evaluate plume performance over the duration of the optimization study. This may include identifying a need for more optimally located monitoring wells. If needed, the additional monitoring well locations will be selected using the monitoring well network evaluation and reconfiguration processes discussed in Section 6.2.

7.2 Modeling Activities

Chapter 6 describes the empirical monitoring data analyses, groundwater flow and contaminant transport modeling, mathematical optimization methods, and other calculations that will be used during the optimization study to monitor performance toward meeting near- and long-term targets and goals, to

project and contrast the likely performance of the remedy over the near- and long-term timeframes, and to support attaining the goals and objectives of the optimization study.

Modeling will be integrated with data collection during the optimization study to (1) support well network adjustments; (2) provide predictions of plume remediation performance for comparison to the data collected; and (3) evaluate remedy configuration scenarios for the injection/extraction well network, pumping rates, and natural attenuation timeframe as input to subsequent consideration of remedy modifications. The primary modeling activities are summarized as follows:

- In FY ~~2020~~2021, using the data obtained from installation of the first set of extraction wells, well network optimization will be conducted with the model to determine if any adjustments are needed for the next set of extraction wells to be installed.
- After all of the planned extraction wells are installed (FY ~~2021~~2022), modeling will be conducted to provide predictions of plume remediation performance for comparison to the data to be collected during the optimization study and as input to pumping rates used in the well network. This effort will be integrated with the annual reporting analyses for the optimization study as part of the annual P&T report.
- To support the final optimization study report, modeling will consider the data collected during the optimization study and provide predictions of plume remediation performance for a range of scenarios that interpret the study results in terms of remedy configurations that can be considered as input to subsequent evaluation of remedy modifications (e.g., within subsequent RD/RAWP activities, such as the focused FS).

The implementation approach for the modeling activities will be performed in a stepwise manner and integrated with data collection and interpretation following a sequence of analyses and applications developed in recent years to evaluate and optimize the performance of the 200-ZP-1 OU remedy. Chapters 4, 5, and 6 provide an overview of the particular methods. Figure 14 identifies these activities and shows the general sequence of application. The left side of Figure 14 shows a combination of empirical data analyses and the groundwater flow and contaminant F&T analyses. These activities are performed annually at a minimum as part of the annual groundwater P&T reporting, but components of these analyses are also performed on a more frequent basis to support remedy decision making. The right side of Figure 14 presents a sequence of modeling-based predictive analyses, trial-and-error, and formal mathematical optimization analyses that will be instrumental to this optimization study. Completion of these predictive and optimization analyses (the right side of Figure 14) is predicated on completion of the empirical data and modeling analyses presented on the left side of Figure 14, which provides a foundation and ensures that the data, models, and tools are sufficiently complete, current, and reliable.

The empirical data analyses and associated modeling activities are intended to support the sampling locations, injection rate evaluations, extraction and monitoring well networks, associated timeframes to evaluate changes in plume extents and concentrations, and evaluation of P&T facility modifications. The modeling activities needed to monitor performance of the optimization study will be further developed during Task 1 as needed.

8 Data Management

Data will be managed in accordance with to the quality assurance project plan provided in Appendix B, Section B2 of the 200-ZP-1 OU PMP (DOE/RL-2009-115~~, Rev. 2~~). Any additional data management needs that may be identified during the DQO process for this optimization study (conducted during Task 1) will be documented in the optimization study SAP.

9 Optimization Study Reporting

This chapter describes reporting activities and data evaluation for the optimization study.

9.1 Interim Optimization Study Reporting

The 200-ZP-1 P&T RD/RAWP (DOE/RL-2008-78~~, Rev. 1, Draft A~~), the 200-ZP-1 OU PMP (DOE/RL-2009-115~~, Rev. 2~~), and the 200 West P&T O&M plan (DOE/RL-2009-124) include reporting requirements that are documented in annual P&T reports, which include analyses of remedy performance and costs. During Tasks 1, 2, and 3 of the optimization study, interim reporting of optimization study progress, annual operational costs, and remedy performance will be incorporated in annual 200 West P&T reports.

9.2 Final Optimization Study Report

A final optimization study report will be prepared to summarize the results of the optimization study, including the following:

- Summarize changes to the remedy configuration implemented during Tasks 1 and 2 and subsequent optimizations made during Task 3.
- Summarize performance monitoring data collected during Task 3.
- Evaluate 200 West P&T performance in regard to treating influent streams, including feed streams other than those from the 200-ZP-1 OU (e.g., extracted groundwater from other OUs and feed streams such as ERDF leachate and MSU purgewater), for injection in the 200-ZP-1 and 200-UP-1 OUs.
- Evaluate the performance of the optimization study remedy configuration against the RAOs and other 200-ZP-1 OU ROD (EPA et al., 2008) requirements.
- Provide operational cost information for use in remedy lifecycle cost estimates for Rwie cleanup as part of the remedy modification process discussed in Chapter 10. The cost data will be based on annual cost data collected during the study.
- Provide recommendations for treatment facility and well network configurations for consideration in subsequent efforts to evaluate potential remedy modifications.

10 Permanent Remedy Modifications

When the objectives of the optimization study are successfully achieved, and in conjunction with the outcome of other activities identified in Chapter 4 of the 200-ZP-1 P&T RD/RAWP (DOE/RL-2008-78~~, Rev. 1, Draft A~~), changes to the remedy configuration may require modifications to remedy decision documents to permanently adopt these changes. These changes to the 200-ZP-1 OU remedy configuration may be considered as (1) a nonsignificant or minor change, (2) a significant change to a component of the remedy, or (3) a fundamental change to the overall remedy. EPA 540-R-98-031, *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents*, provides guidance for defining minor, significant, and fundamental changes to a remedy.

If a remedy modification is needed, EPA and DOE will follow the appropriate CERCLA process to modify the remedy identified in the 200-ZP-1 ROD, and the associated documents (e.g., the 200-ZP-1 P&T RD/RAWP [DOE/RL-2008-78~~, Rev. 1, Draft A~~], the 200 West P&T O&M plan

[DOE/RL-2009-124], and the 200-ZP-1 OU PMP [DOE/RL-2009-115~~, Rev. 2~~]) will be revised accordingly.

10.1 Remedy Optimization Decision Logic

The optimization study objectives identified in Chapter 3 will be used to identify the appropriate data analysis and interpretation approaches (e.g., predictive modeling and development of cost metrics) for reporting the study results and for subsequent decision-making processes. The decision-making process will consider the following criteria:

- Changes in carbon tetrachloride mass removal rates
- Capture effectiveness for carbon tetrachloride plume containment
- Injection well performance (e.g., specific injection capacity) compared to pre-optimization study well performance
- Remedy performance for carbon tetrachloride compared to the predicted pre-optimization study performance
- Operational cost changes compared to pre-optimization study performance
- Changes in nitrate concentrations in the aquifer, extraction well influent, and 200 West P&T effluent, and whether predictive modeling indicates that RAOs for nitrate are likely to be met
- Discussion of 200 West P&T effluent quality and whether it meets reinjection criteria for the 200-ZP-1 OU aquifer for all COCs in the 200 West P&T influent streams (except nitrate) without biological treatment
- Capture and removal effectiveness for the 200-ZP-1 OU COCs and whether predictive modeling indicates that RAOs are likely to be achieved under the optimization study remedy configuration
- Performance of the off-gas treatment equipment with increased contaminant concentrations sent to the air stripper after suspension of biological treatment

The DQO process outlined in EPA/240/B-06/001 will be used during Task 1 of the optimization study to develop principal study questions, decision statements, decision rules, and data needs and inputs.

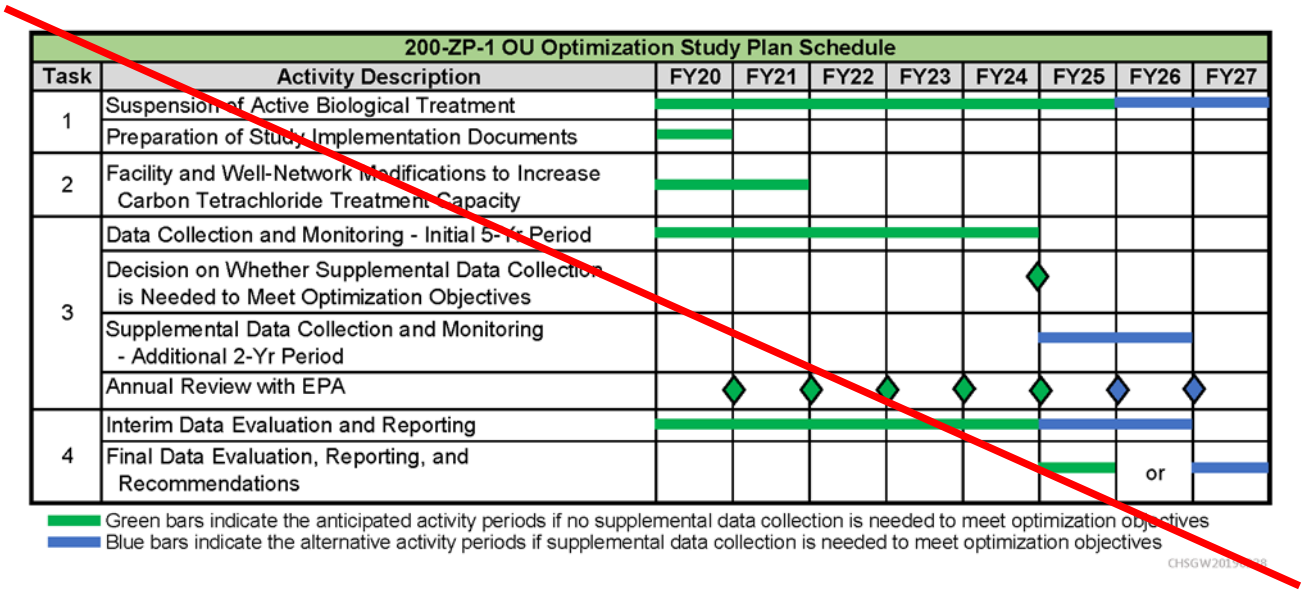
10.1.1 Long-Term Biological Treatment Decision Logic

Remedy performance will be evaluated during the optimization study to determine the effects of suspending biological treatment. At the conclusion of the study, a decision will be made whether to continue operation of the remedy without biological treatment. The F&T modeling conducted in conjunction with the remedy evaluation elements identified in the 200-ZP-1 P&T RD/RAWP (DOE/RL-2008-78~~, Rev. 1, Draft A~~) will be used to evaluate configurations for addressing carbon tetrachloride and nitrate contamination following the optimization study, including the option to restart biological treatment at the 200 West P&T for a portion of the influent with high nitrate concentrations.

11 Proposed Schedule

A described in Section 4.1, the study approach consists of four primary tasks (Tasks 1 through 4). Figure 15 summarizes the optimization study plan proposed schedule. The study is currently expected to be completed in ~~6~~7 years (through FY ~~2025~~2026, as detailed in the 200-ZP-1 P&T RD/RAWP [DOE/RL-2008-78~~, Rev. 1, Draft A~~]). However, as discussed in Section 4.1.3, additional time may be needed to collect sufficient data to meet study objectives, which could result in the optimization study continuing for an additional 2 years (through FY ~~2027~~2028). The optimization study schedule is integrated with the overarching 200-ZP-1 OU remedy schedule provided in Chapter 8 of the 200-ZP-1 P&T RD/RAWP (DOE/RL-2008-78~~, Rev. 1, Draft A~~) and is intended to support the potential remedy modification process described in Chapter 10 of this optimization study plan. The schedule for implementing the optimization study is based on the logical progression and anticipated durations of the four tasks:

- **Task 1:** After approval of this optimization study plan, the initial step for implementing the optimization study is suspension of biological treatment, which is expected to begin in the first quarter of FY 2020 and will continue throughout the duration of the optimization study. The second activity for Task 1 is preparation of study implementation documents (described in Section 4.1.1). Lastly, extraction well drilling will begin during Task 1. The documentation and some of the initial extraction well installation activities are expected to be completed during FY ~~2020~~2022.
- **Task 2:** The second task of the optimization study involves facility and well network upgrades to allow for increases to the 200 West P&T treatment capacity to target carbon tetrachloride remediation. These upgrades are expected to begin in FY 2020 and be completed in FY ~~2021~~2022.
- **Task 3:** Data collection and monitoring will begin at the start of Task 1 with the suspension of biological treatment and will continue in Task 3 for the duration the optimization study. Task 3 is anticipated to begin in FY 2020 and continue through the end of the FY ~~2024~~2025, allowing for the collection of up to 5 years of data (Section 4.1.3), with three of those years covering the period following completion of the Task 2 facility and well network upgrades. Field data will be evaluated and reviewed each year by EPA and DOE, in conjunction with the 200 West annual P&T report. However, an evaluation of field data after 3 years of operation at the full treatment flow (following the completion of Task 2) may necessitate continuing optimization study operations and data collection for a total of 7 years to meet data quality needs (through FY ~~2026~~2027), as discussed Section 4.1.3. Therefore, the total duration of the data collection and monitoring task will be 5 years at a minimum and, after the mid-study evaluation, may be extended to a total duration of 7 years.
- **Task 4:** The reporting task of the optimization study, Task 4, is anticipated to begin in FY 2020 following ~~completion of the first year of~~ data collection under Task 3. Initial reporting will be provided as annual interim reports through the end of Task 3 as part of current P&T annual reporting. The final report for the optimization study is expected to be completed in the year following completion of Task 3.



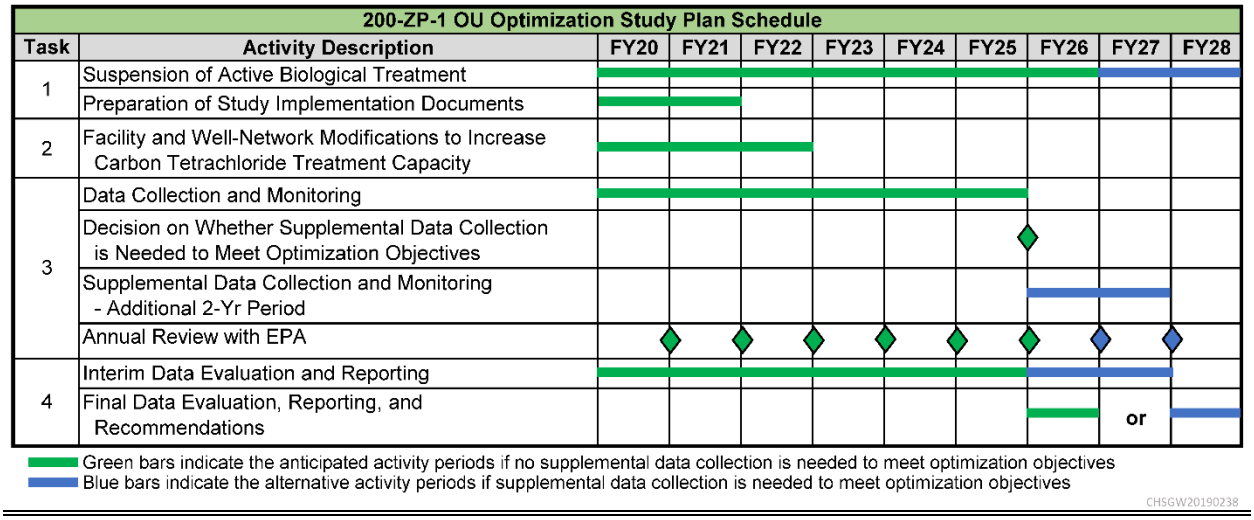


Figure 15. Summary of the 200-ZP-1 OU Optimization Study Plan Schedule

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