Establishing Final Cleanup Decisions for the Hanford Site River Corridor

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ABSTRACT

A major challenge in the River Corridor Closure Contract is establishing final cleanup decisions for the source operable units in the Hanford Site river corridor. Cleanup actions in the river corridor began in 1994 and have been performed in accordance with a "bias for action" approach adopted by the Tri-Parties – the U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology. This approach enabled early application of cleanup dollars on actual remediation of contaminated waste sites. Consequently, the regulatory framework authorizing cleanup actions at source operable units in the river corridor consists largely of interim action records of decision, which were supported by qualitative risk assessments. Obtaining final cleanup decisions for the source operable units is necessary to determine whether past cleanup actions in the river corridor are protective of human health and the environment and to identify any course corrections that may be needed to ensure that ongoing and future cleanup actions are protective. Because the cleanup actions are ongoing, it is desirable to establish the final cleanup decisions as early as possible to minimize the impacts of any identified course corrections to the present cleanup approach.

Development of a strategy to obtain final cleanup decisions for the source operable units in a manner that is responsive to desires for an integrated approach with the groundwater and Columbia River components while maintaining the ability to evaluate each component on its own merit represents a significant challenge. There are many different options for grouping final cleanup decisions, and each involved party or stakeholder brings slightly different interests that shape the approach. Regardless of the selected approach, there are several specific challenges and issues to be addressed before making final cleanup decisions. A multi-agency and contractor working group has been established to address these issues and develop an endorsed strategy. Ultimately, it is anticipated that the Tri-Parties will establish a set of milestones to document pathway selection and define schedule requirements.

INTRODUCTION

In 1989, the U.S. Department of Energy (DOE) entered into the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) [1] with the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology), thereby establishing the legal framework and schedule for cleanup of the Hanford Site. The Hanford Site

was placed on the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) [2] National Priorities List (NPL) and was divided into four NPL sites: 100 Area, 200 Area, 300 Area, and 1100 Area.

The Hanford Site river corridor, which includes the 100 Area and 300 Area NPL sites, consists of 565 km^2 (218 mi^2) adjacent to the Columbia River (Figure 1). Portions of the river corridor are contaminated as a result of over 50 years of nuclear defense production activities. Cleanup actions within NPL sites are organized into source operable units (OUs) and groundwater OUs. The 100 Area and 300 Area source OUs address soil cleanup in the river corridor associated with liquid effluent disposal sites, solid waste burial grounds and landfills, nine former nuclear reactors, and former fuel fabrication and research facilities (Figure 1). Underlying the source OUs, the groundwater OUs address groundwater cleanup actions. Identification of associated source and groundwater OUs within the river corridor is shown in Table I. The Columbia River represents a third component that must be assessed for potential contributions from the migration of contaminants within source and groundwater OUs.

Table I. River Corridor Source and Groundwater Operable Units

National Priorities List Area	Source Operable Units[a]	Groundwater Operable Units
100	100-BC-1	100-BC-5
	100-BC-2	
	100-KR-1	100-KR-4
	100-KR-2	
	100-NR-1	100-NR-2
	100-DR-1	100-HR-3
	100-DR-2	
	100-HR-1	100-HR-3
	100-HR-2	
	100-FR-1	100-FR-3
	100-FR-2	
	100-IU-2	100-FR-3
	100-IU-6	100-FR-3/200-PO-1
300	300-FF-1	300-FF-5
	300-FF-2	

[a] Source Operable Units 100-IU-1, 100-IU-3, 100-IU-4, and 100-IU-5 have been either removed from the 100 National Priorities List site or require no further actions.

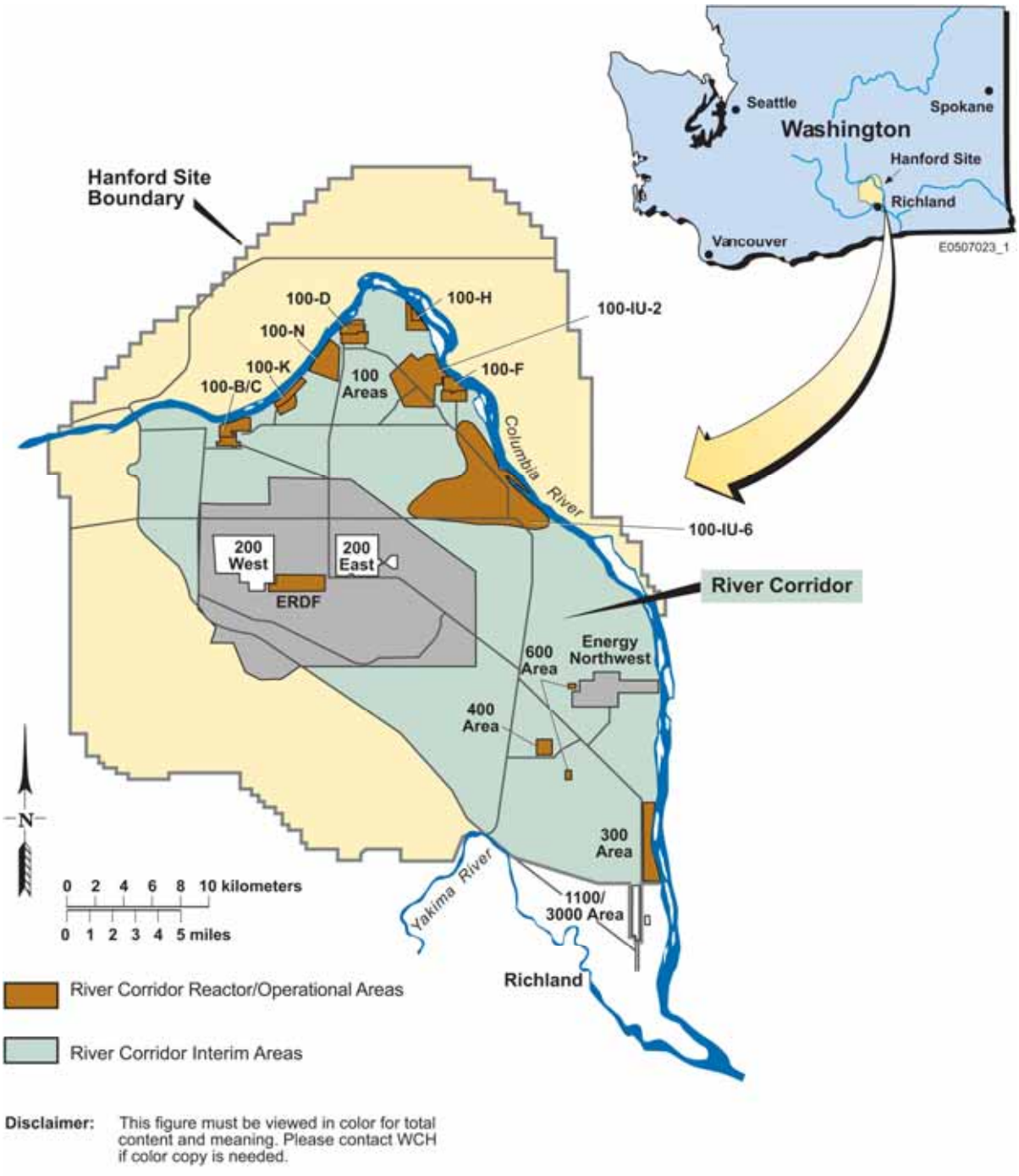

Fig. 1. River corridor boundary and associated source operable unit areas

History of Cleanup Actions in the River Corridor

Cleanup actions in the river corridor were initiated in 1994 under the Environmental Restoration Contract (ERC) including actions at both source and groundwater OUs. Midway through the ERC, source unit cleanup actions were programmatically separated from the groundwater OUs. In August 2005, the ERC transitioned to the River Corridor Closure Contract (RCCC) for

completion of source unit cleanup actions under the direction of Washington Closure Hanford (WCH), a limited liability company owned by Washington Group International, Bechtel National, and CH2M HILL.

CERCLA remedial actions at source OUs in the river corridor are expected to be completed through the RCCC. As part of its obligations for cleanup and closure of the river corridor as defined by the RCCC, WCH must ensure that no further action is required to protect human health and the environment. The ability for WCH to perform and complete its work in a manner that is integrated with the cleanup and assessment actions for the groundwater and Columbia River components is a key to success under the RCCC. The groundwater work scope supporting river corridor cleanup and closure currently is assigned to other Hanford Site contractors. Compilation and evaluation of historical data to begin assessment of potential impacts to the Columbia River from Hanford Site contaminants has been completed, but the path forward for continued assessment is presently under development.

Hanford Past-Practice Strategy and the Need for Final Cleanup Decisions

Cleanup actions in the river corridor, to date, have been performed in accordance with a "bias for action" approach to the CERCLA process agreed to in 1991 by the Tri-Parties. This approach, known as the *Hanford Past-Practice Strategy* (HPPS) [3], streamlined the remedial investigation/feasibility study (RI/FS) process to enable early application of cleanup dollars on actual remediation of contaminated waste sites. The HPPS approach is consistent with later EPA initiatives implemented to expedite cleanups, such as the *Superfund Accelerated Cleanup Model* [4] and the *RCRA Facility Stabilization Initiative*. [5] Because of the HPPS objectives, the regulatory framework authorizing cleanup actions at source OUs in the river corridor (i.e., 100 and 300 Area OUs) consists largely of interim action records of decision (RODs), which were supported by qualitative risk assessments.

Obtaining final cleanup decisions for the source OUs is necessary to determine whether past cleanup actions in the river corridor are protective of human health and the environment and to identify any course corrections that may be needed to ensure that ongoing and future cleanup actions are protective. Because the cleanup actions are ongoing, it is desirable to establish the final cleanup decisions as early as possible to minimize the impacts of any identified course corrections to the cleanup approach.

A key element to establishing final cleanup decisions for the river corridor is the completion of baseline risk assessment activities. Results of the baseline risk assessment will be used to support development of a proposed plan(s) and final ROD(s), which will establish the final cleanup objectives and any associated actions required to complete the CERCLA process for the river corridor. Given the size and complexity of the Hanford Site, it is desirable to obtain and analyze data in manageable segments while also providing a means for the DOE to acknowledge all of the data necessary for an overall Hanford Site risk assessment. The river corridor source OUs are the first segment to undergo this process as part of the objectives established by the RCCC.

Natural Resources Damage Assessment Integration

The Hanford Natural Resource Trustee Council was established in 1993 to help ensure that natural resource values are considered in decision making and to integrate natural resource considerations into remedial actions, including the prevention of the loss of habitat and the enhancement of habitat after remedial actions are complete. The trustees have been involved in the development of many mitigation action plans for CERCLA activities, as well as the development of the *Hanford Site Biological Resources Management Plan* [6], among other work. The trustees have also provided technical assistance in development of the CERCLA baseline risk assessments across the Hanford Site.

Integration and Organization of Cleanup Activities

The objective of cleanup actions and the culmination of the CERCLA process for the river corridor is NPL site deletion of the 100 and 300 Areas of the Hanford Site (Figure 2). Achievement of this objective requires integration of final cleanup decisions associated with the source OUs, groundwater OUs, and the Columbia River. Assessment and cleanup actions associated with each of the three components have unique cost and schedule considerations that led the DOE to separate the work into manageable pieces through multiple contracts. This contracting strategy drives a need to perform the work in a manner that allows final cleanup decisions associated with each of the three components to be evaluated independently on their own merits, while maintaining an integrated approach to ultimately support 100 Area and 300 Area NPL site deletion as well as broader Hanford Site cleanup efforts. In this sense, each risk assessment builds a foundation for those that follow it, and each OU cleanup decision must recognize the potential for modification based on future component risk assessments.

SOURCE OPERABLE UNIT ACTIONS

Cleanup and assessment actions at source OUs in the river corridor are performed under the direction of WCH through the RCCC as depicted in Figure 2. WCH will continue to implement interim remedial actions at source sites within the river corridor in accordance with the applicable RODs. Selected remedies dictate that waste sites will be removed, treated (as necessary), and disposed at an appropriate facility. These cleanup actions are intended to address all of the potential contaminants that may have been released to a given waste site (i.e., source removal), and established cleanup levels were developed to be protective with respect to human exposure, groundwater, and the Columbia River. Because source OUs will be cleaned up such that any residual contamination will not adversely impact underlying groundwater or surface water (based on predictive modeling), it is technically possible to evaluate the cleanup actions at source OUs separately from the groundwater OUs and the Columbia River.

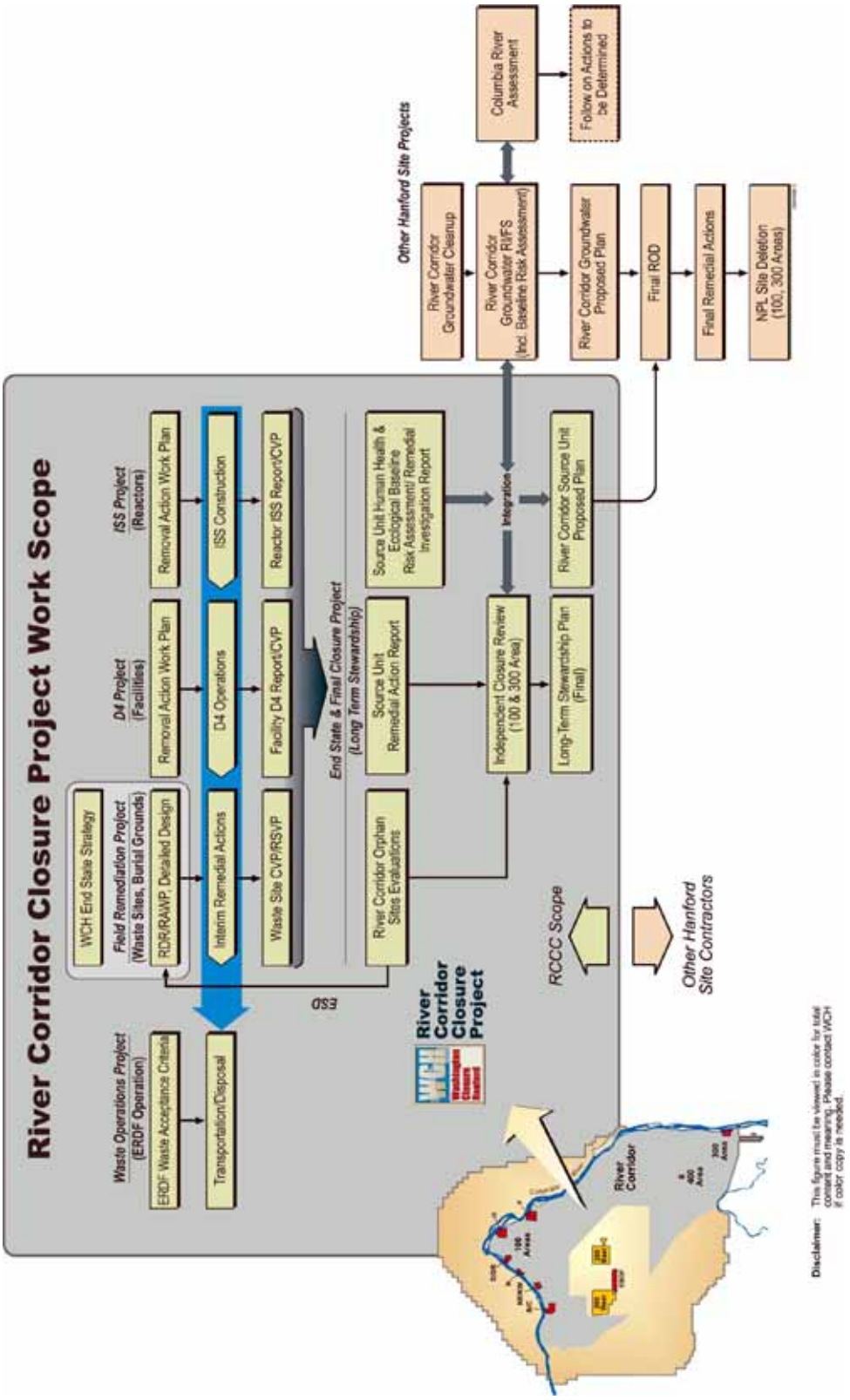

Fig. 2. RCCC scope and process elements for achieving closure

In parallel with continuing implementation of interim remedial actions, WCH will work to establish the infrastructure to support final cleanup decisions for source OUs in the river corridor. The WCH objective is to establish early final cleanup decisions for the source OUs in a manner that is integrated with, but not dependent on, the schedule for associated groundwater cleanup actions and the Columbia River assessment activities. The approach is integrated with the other components because all source unit cleanup actions within the river corridor are designed, implemented, and evaluated from a standpoint of protecting groundwater as a future drinking water source and meeting ambient water quality requirements for the Columbia River. The objective to establish early cleanup decisions for the source OUs calls for acceleration of RCCC work scope items that are viewed as critical path, with a completion target of mid-2008. These critical path items include a baseline risk assessment, an RI report, and a proposed plan.

Source Unit Baseline Risk Assessment

A comprehensive baseline risk assessment is being conducted to characterize risk in the river corridor. This effort consists of the 100/300 Area component and a shoreline inter-areas evaluation. Because of the bias for action decisions made early in the Hanford Site cleanup process and the resulting interim action RODs, one of the key outcomes of these activities will be characterization of risk to ecological receptors. Figure 3 presents a portrayal of a Hanford Site conceptual site model to demonstrate how the river corridor risk assessment scope fits into the overall Hanford Site approach.

The 100/300 Area component of the baseline risk assessment is designed to assess the risks to terrestrial, riparian, and near-shore receptors throughout the reactor/operational areas of the river corridor. The geographical scope of this assessment is bounded in the upland by the OU boundaries (including any outlying waste sites) and in the shoreline by emerging plumes that originate in the 100 or 300 Areas. This work is being conducted in accordance with a work plan [7] and a sampling and analysis plan (SAP) [8] that was developed through a data quality objective (DQO) process involving the Tri-Parties and stakeholder groups. Sample collection and analysis activities for the 100/300 Area component were initiated in September 2005 and completed in September 2006. The draft report for the 100/300 Area component of the risk assessment is scheduled to be completed in June 2007, as fulfillment of Tri-Party Agreement Milestone M-016-72.

The inter-areas shoreline assessment is being conducted to evaluate potential human health and ecological risks for the riparian and near-shore areas outside of the scope of the 100/300 Area component of the river corridor baseline risk assessment. This assessment allows an opportunity to assess potential risk from Hanford Site contaminants in areas of emergent 200 Area groundwater plumes (under current conditions), slough and backwater areas, and in habitats found predominantly in areas between reactor/operational areas. The approach for sampling and assessment in the inter-areas expands on the assessment design used for the 100/300 Area component in order to form a consistent evaluation of the Hanford Site shoreline and facilitate integration of the data sets. Sampling associated with this assessment was initiated in November 2006 in accordance with the approved SAP [8].

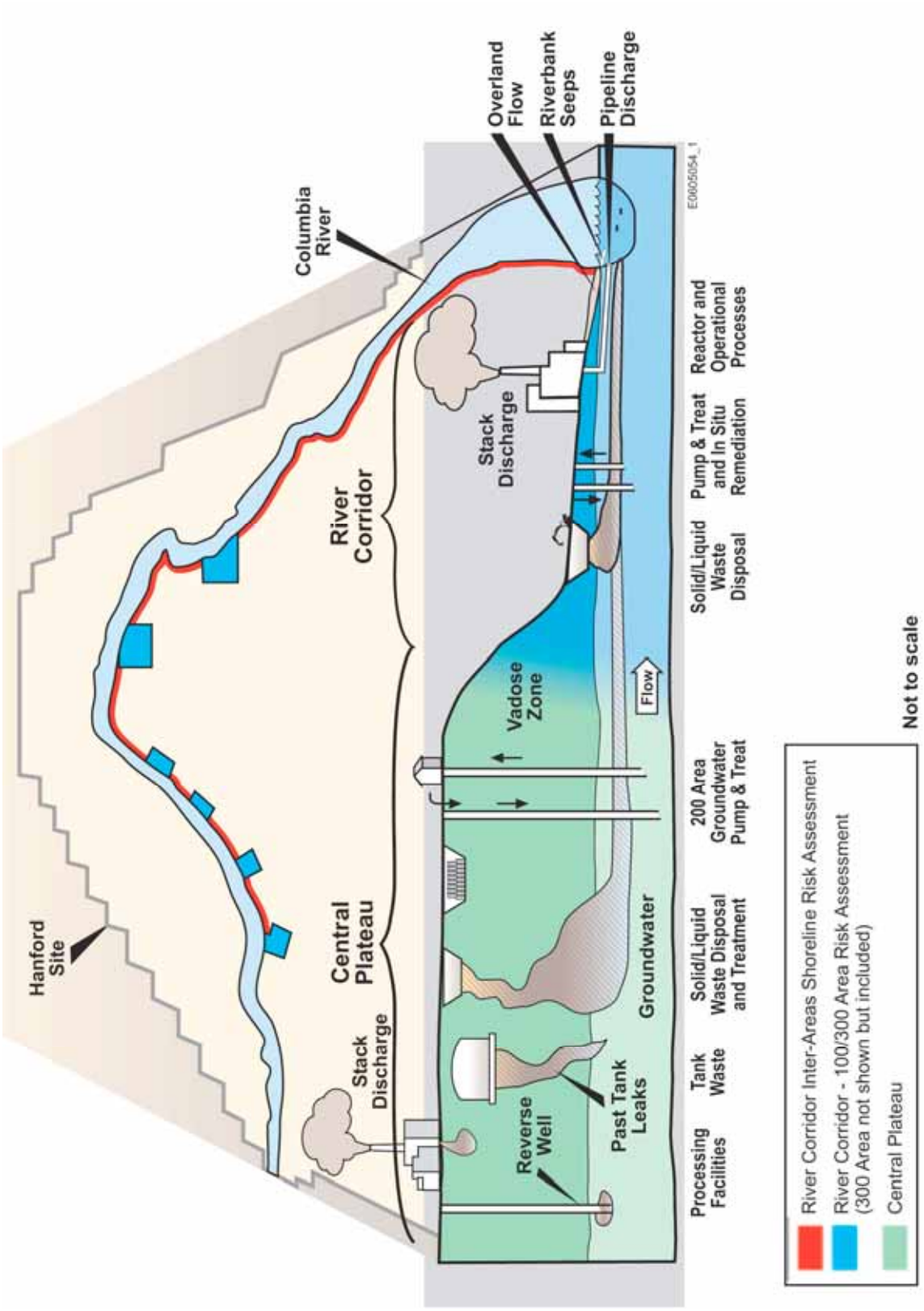

Fig. 3. Hanford Site conceptual model river corridor baseline risk assessment scope

Remedial Investigation Report

Near the end of baseline risk assessment activities, preparation of a cumulative source unit RI report will begin to evaluate the performance of the remedial action objectives (RAOs) and remedial action goals (RAGs) in the interim action RODs. Using the baseline risk assessment results (100/300 Area component and inter-areas), the RI report will evaluate whether remedial actions at source OUs (1994 to present) are protective of human and ecological receptors under the exposure scenarios evaluated and identify final cleanup level recommendations. If any modifications are required to ensure that future source cleanup actions are protective, they will be evaluated with respect to the RCCC scope and factored into subsequent remedial action design activities and operations. Modifications to the existing interim RODs, through a ROD amendment or Explanation of Significant Differences, may be pursued if risk levels identified in the risk assessment dictate immediate actions. WCH has established an accelerated schedule to complete the RI report in 2008.

River Corridor Source Unit Proposed Plan

Building on the baseline risk assessment activities and RI report, a proposed plan will be prepared to summarize the final cleanup levels and exposure scenarios proposed for source OUs within the river corridor. Because the risk assessment results and conclusions presented in the RI report will apply throughout the river corridor, WCH anticipates development of a single comprehensive source unit proposed plan. Development of the proposed plan will begin when the final cleanup level recommendations are established midway through the scheduled period for the RI report. The proposed plan would be finalized to reflect disposition of comments received during review of the RI report and will be submitted for public review, establishing the path forward for development of a final ROD for source units within the river corridor.

GROUNDWATER OPERABLE UNIT ACTIONS

The groundwater work scope supporting river corridor cleanup and closure is currently assigned to Fluor Hanford (FH). The primary goal for groundwater cleanup is to restore groundwater to the highest beneficial use, which in most cases means as a potential drinking water source. Unlike the source OUs, where interim actions address a broad range of contaminants and apply to each waste site within a given source area, interim actions addressing existing groundwater plumes in the river corridor are focused on single contaminants that present a near-term risk to human health and the environment. Consequently, completion of the associated actions will not always represent "completion" of remediation. In some instances, additional remedies will be needed, such as a final active remedy or selection of alternate concentration limits or technical impracticability waivers.

Groundwater Remedial Investigation/Feasibility Study

Supplemental RI/FS activities, including baseline risk assessments, for completion of the CERCLA process for the 100 Area have yet to be completed. Supplemental RI/FS information for the 300-FF-5 OU is currently being developed. The primary tasks left to be addressed in these supplemental RI/FS activities include developing the RI (including the DQO process),

developing a final set of remedial alternatives for groundwater, establishing goals for groundwater restoration and protection, and (if necessary) identifying those areas where groundwater restrictions may be required. Evaluation of potential remedial alternatives for these secondary contaminants of concern will be needed. The primary emphasis of these evaluations will focus on those secondary contaminants that were not the subject of the ongoing interim remedial actions. Baseline schedules for these activities are currently being revised. The anticipated schedules for RI/FS activities at groundwater OUs in the river corridor range from 2008 to 2013.

Groundwater Proposed Plans

Following completion of the supplemental RI/FS documentation, proposed plans for the final CERCLA groundwater remedy selection will be prepared. These proposed plans will address the final remedies for all areas and all contaminants of concern. As in the case of the supplemental RI/FS activities, the schedules for these activities are presently being updated.

COLUMBIA RIVER ASSESSMENT

The objective of the Columbia River component is to assess potential impacts associated with contaminant migration from the source and groundwater OUs. An extensive data compilation effort was initiated in 2004 under the ERC and completed by WCH in 2006 following transition to the RCCC. When originally scoped, it was anticipated that the historical data (sediment, water, and biota) would be adequate to delineate a boundary for potential Hanford Site contaminant impacts. After assessment of the compiled data, however, a clear boundary was not evident. Consequently, the Tri-Parties are working to establish a path forward for continued assessment of the Columbia River.

The anticipated path forward involves development of a work plan to outline the approach for a scoping study, a subsequent risk assessment DQO, risk assessment SAP, and risk assessment report for the Columbia River. The scoping study, with collection of new sediment data to fill gaps in the historical data set, would be the fist step in implementing the work plan It is hoped that results from an assessment of potential impacts to the Columbia River based on the two data sets would be adequate to establish a boundary for the Columbia River component. The sediment sampling effort will be preceded by a DQO process and development of a sampling plan in order to ensure that the appropriate design is implemented to fill the data gaps.

Execution of tasks identified in a Columbia River work plan would have two likely outcomes. In the event that the scoping study results do not indicate a potential for offsite risks from Hanford Site contamination, the study conclusions would be summarized in a report and a risk assessment would not be performed. Should the scoping study indicate the potential for offsite risk from Hanford Site contamination, the remaining steps outlined in the work plan (risk assessment DQO, risk assessment SAP, and risk assessment) would likely be performed. Follow-on activities would be conducted in accordance with the CERCLA process to evaluate options, establish a remedy, and execute any cleanup actions, as appropriate.

The DOE, Richland Operations Office (DOE-RL) has asked WCH to prepare a schedule and budget for development of the work plan and implementation of a scoping study, but the scope has not yet been added to the RCCC. Responsibility for any follow on work, as needed, would be assigned separately by DOE-RL.

FINAL RECORD(S) OF DECISION AND POTENTIAL GROUPING OPTIONS

Development of the final ROD(s) is a regulatory agency responsibility and is not required to complete the RCCC. The anticipated availability of key elements supporting the framework for final cleanup decisions is summarized in Table II. Once proposed plans for source OUs or groundwater OUs have been prepared, the regulatory agencies have multiple options for development of final RODs. It is possible to issue a final ROD corresponding to each individual proposed plan or to join various combinations of proposed plans into one or more final RODs for the river corridor source and groundwater OUs. In the event that risk is identified and the Columbia River becomes part of a CERCLA cleanup action, it too could be packaged with source and/or groundwater OU decision making as determined by the regulatory agencies.

Table II. Baseline Schedule of Key Final Decision-Making Elements

Component	Operable Unit	Baseline Risk Assessment	Remedial Investigation/ Feasibility Study	Proposed Plan
Source	All	October 2007	October 2008	March 2009
Groundwater	100-BC-5	[b]	September 2012	July 2011
	100-FR-3	[b]	September 2012	July 2013
	100-HR-3[a]	[b]	April 2012	December 2011
	100-KR-4	[b]	September 2013	September 2012
	100-NR-2	[b]	June 2011	January 2013
	300-FF-5	[c]	July 2008	[c]
Columbia River	No operable unit established	Not scheduled	Not scheduled	Not scheduled

[a] The 100-HR-3 groundwater operable unit includes contaminated groundwater beneath 100-D and 100-H Areas.
[b] Specific dates have not yet been established for this item but are presumed to be equivalent to or precede the RI/FS completion dates.
[c] Subject to ongoing work defined in the *300-FF-5 Operable Unit Limited Field Investigation* [9].

From a RCCC perspective, WCH would like the regulatory agencies to immediately pursue a final ROD for the river corridor source OUs following public review of the WCH-prepared proposed plan. This preferred course of action could result in a final source unit ROD within the anticipated time frame of the RCCC. However, the Tri-Parties have yet to agree on the approach for final CERCLA decision making and closure of the river corridor. Furthermore, the regulatory agencies have expressed their preference that final cleanup decisions address all pathways to include both source and groundwater OUs, as well as the Columbia River. This approach would result in a final ROD(s) addressing both the source and groundwater OUs within the river corridor but would be dependant on schedules for groundwater actions and, potentially, the Columbia River assessment. Consequently, an effort has been made to identify other potential grouping options as presented in the following subsections.

Reactor/Operational Areas

The stated regulatory agency preference for assessment of all pathways suggests that the smallest unit for decision making in the 100 Areas would be on an area-by-area basis for the six reactor operations areas. For the 300 Area, it might be appropriate to consider subdividing this NPL site into the industrial area and an outlying area. Cleanup actions for the outlying areas are based on an unrestricted-use exposure scenario, while cleanup actions for the industrial area and the 618-11 Burial Ground are currently based on an industrial-use exposure scenario.

NPL Sites Grouping

As discussed previously, the area defined as the Hanford Site river corridor includes two NPL sites: the 100 Area and 300 Area. Organization of the OUs into these two groups based on the NPL site affiliation is presented in Table III.

Table III. Summary of Operable Units by NPL Site

NPL Site	Source Operable Unit	Groundwater Operable Unit
100 Area	100-BC-1, 100-BC-2	100-BC-5
	100-DR-1, 100-DR-2	100-HR-3
	100-FR-1, 100-FR-2	100-FR-3
	100-HR-1, 100-HR-2	100-HR-3
	100-IU-2, 100-IU-6	100-FR-3
	100-KR-1, 100-KR-2	100-KR-4
	100-NR-1	100-NR-2
300 Area[a]	300-FF-2	300-FF-5

[a] Cleanup decisions for the 300-FF-1 Operable Unit have been established in a final Record of Decision.
NPL = National Priorities List

Lead Regulatory Agency Based Grouping

In accordance with provisions of the Tri-Party Agreement, legal authority for regulatory oversight of DOE actions rests with either EPA or Ecology on an OU basis. A potential option for obtaining final cleanup decisions is to align the OUs according to the assigned lead regulatory agency. For the OUs in the river corridor, the lead regulatory authority assignments are summarized in Table IV.

Table IV. Summary of Regulatory Lead Assignments

Regulatory Lead	Source Operable Unit	Groundwater Operable Unit
EPA	100-BC-1, 100-BC-2	100-BC-5
	100-FR-1, 100-FR-2	100-FR-3
	100-IU-2, 100-IU-6	100-FR-3
	100-KR-1, 100-KR-2	100-KR-4
	300-FF-2	300-FF-5
Ecology	100-DR-1, 100-DR-2	100-HR-3
	100-HR-1, 100-HR-2	100-HR-3
	100-NR-1	100-NR-2

Attribute-Based Source Operable Unit Groupings

Final cleanup decisions in the river corridor could be organized based on anticipated potential future use, groundwater restoration goals or the likelihood of reaching those goals, and predicted residual risk. Table V assigns source OUs within the river corridor to one of three groupings that consist of achieving 1) unrestricted land use and restoring groundwater to its highest potential beneficial use, 2) unrestricted surface use and some restrictions on groundwater use to prevent unacceptable risk, and 3) restricted use of both land use and groundwater. These preliminary groupings are based on initial reviews of contaminant levels and the relative lack of viable technologies to recover specific radiological contaminants from groundwater and aquifer sediments. A full CERCLA evaluation of remedial alternatives has not been conducted and would be required before any final decisions are made.

Table V. Attribute Groupings for Completing the CERCLA Process

Source Units Exposure Scenarios	Groundwater Use	Source Operable Units	Groundwater Operable Units
Unrestricted	Unrestricted	100-BC-1 and 100-BC-2 100-DR-1 and 100-DR-2 100-FR-1 and 100-FR-2 100-HR-1 and 100-HR-2 100-IU-2 and 100-IU-6	100-BC-5 100-HR-3 100-FR-3
Unrestricted	Restricted	100-KR-1 and 100-KR-2 300-FF-2 (outlying sites)	100-KR-4 300-FF-5
Restricted	Restricted	100-NR-1 300-FF-2 (300 Area complex, 618-11)	100-NR-2 300-FF-5

ISSUES AND CHALLENGES

Many issues and challenges must be addressed to establish final cleanup decisions and complete the CERCLA process for the river corridor, regardless of the approach that is selected. These issues and challenges are summarized in the following subsections.

Program Integration

Cleanup actions at source and groundwater OUs are programmatically separated within DOE and implemented through multiple Hanford Site contractors. A path forward for the Columbia River is under development. Integrating the assessment and cleanup actions of these three components is a fundamental challenge and is of high importance to the regulatory and stakeholder communities. The DOE-RL is presently responsible for ensuring integration of contractor cleanup activities within the river corridor and Hanford Site. In June 2006, DOE-RL issued a Plan of Action and Milestones document [10] to respond to commitments made to Congress in March 2006 to improve integration.

As part of the commitments to address these concerns, integrated project teams are being chartered to propose resolutions to some of these issues. The teams consist of DOE and contractor staff from all programs on the Hanford Site that could be affected (e.g., Central

Plateau, River Corridor, and Tank Farms). One such team has been established to develop and maintain an integrated approach to assessment and decision making for the river corridor project. This team will ensure that all assessment and remediation decisions are coordinated between the river corridor and the balance of the Hanford Site.

Deep Vadose Zone Contaminants

There are several interpretations of deep vadose zone contamination and an inconsistent use of terms to describe various conceptual site model zones. In addition, the transition of responsibility between source and groundwater cleanup actions has not been formally established. Figure 4 represents a simple depiction of the zones, assigns initial terms to the layers for discussion purposes, and identifies the area of responsibility based on current understanding. Use of consistent terms and assignment of responsibility are critical to support final cleanup decision making in the river corridor.

The cleanup packages for source waste sites evaluate completed actions in the 100 and 300 Areas to ensure that the waste site has been remediated in accordance with the ROD. As identified in the RODs, cleanup levels for direct exposure, groundwater, and subsequent Columbia River protection apply to the upper 4.6 m (15 ft) of the soil column, commonly referred to as shallow zone soils. At depths greater than 4.6 m (15 ft), commonly referred to as the deep vadose zone, only groundwater and river protection cleanup levels apply.

A portion of the deep vadose zone contamination can also be interpreted as contaminants in groundwater that are resuspended in a "periodically rewetted zone" due to fluctuations in water levels. This zone is defined by the minimum and maximum elevations of the current water table. During periods of unusually high water table elevations (associated with high river stage), contaminated groundwater can move up into the lower vadose zone, into areas that represent the historic groundwater mound that may have been created by artificial recharge from past operations. When the water table returns to normal, some contaminants may be left behind in the pore fluid or retained on particles. This in turn represents a potential source to be released when high water tables return. These deep vadose zone issues are the programmatic responsibility of the Groundwater Remediation Program and are part of the remedy for cleanup of groundwater OUs based on current understanding.

Modeling Contaminant Migration

Prediction of contaminant migration from the vadose zone to groundwater, and subsequently the Columbia River, continues to be an issue with the regulators. Acceptance of the model and associated results for prediction of future contaminant migration is critical to support conclusions that cleanup actions at source waste sites are complete and protective. Consistent application of input parameters used for modeling by the various contractors involved can also be an issue.

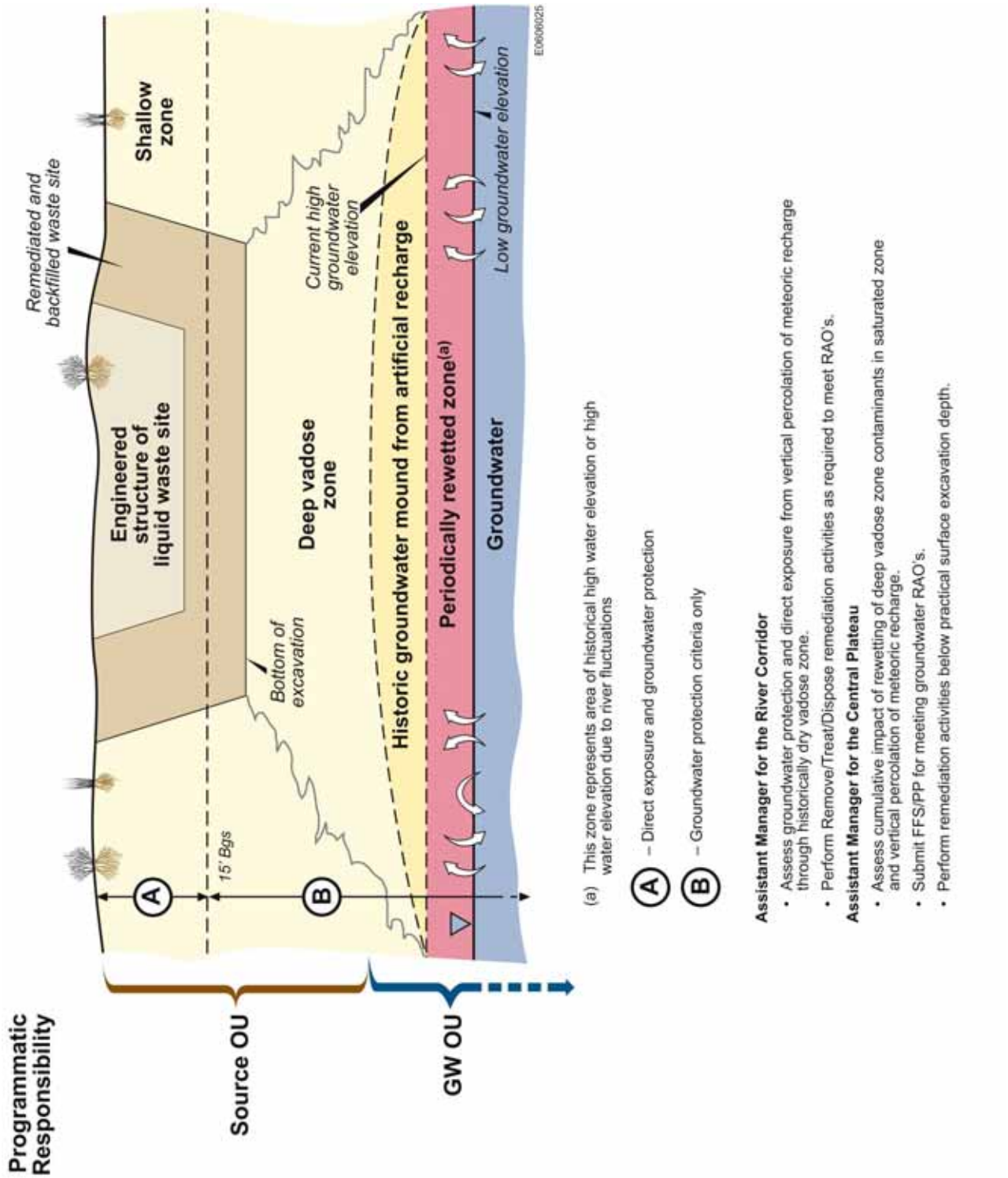

Fig. 4. Contamination distribution model and program responsibility

The RESidual RADioactivity dose model (RESRAD) is the tool currently being used to model residual contamination in the vadose zone for the river corridor. Recent discussions have focused on use of the code for modeling movement of contaminants through the vadose zone to groundwater and the levels and timing of those impacts. Use of the Surface-Transport Over Multiple Phases (STOMP) code has been suggested as a more appropriate tool for these analyses and it has been suggested that the RESRAD code could be retained as a screening tool. Additional discussions suggest that modeling based on a U.S. Geological Survey Modular Three-Dimensional Groundwater Flow Model[1] (MODFLOW) will provide an updated comprehensive analysis that could be utilized to support future cleanup decisions.

Mandated use of a particular model leaves open the possibility that source unit cleanup activities completed based on other models could be questioned or rejected unless reevaluated. A recent letter from DOE-RL [11] directs Hanford Site contractors to use specific models for modeling purposes. This includes specifying STOMP for contaminant transport predictions through the vadose zone and near-field groundwater impacts. In addition, RESRAD will be used as a screening tool. This letter also described the formulation of the Tank Closure and Waste Management Environmental Impact Statement Team whose focus is related to activities associated with the Hanford Site Central Plateau. The Plan of Action [10] issued in June 2006 goes further and identifies an objective to consolidate modeling and risk assessment work for the Hanford Site. The Groundwater Remediation Project has been given the responsibility to oversee overall groundwater and vadose zone modeling and applications at the Hanford Site.

Exposure Scenarios

Exposure scenarios being used by different contractors need to be discussed to the degree necessary to ensure consistency. Agreement needs to be reached on an appropriate set of parameters for each scenario among DOE-RL and the regulators. This includes any additional scenarios (e.g., Tribal Use or Native American) that might be considered. Once established there will be an element of configuration management control that will need to be maintained.

Cumulative Risk

Cumulative risk can be interpreted as the risk posed by contaminants released from the Hanford Site in addition to risk posed by offsite contaminant sources and where they have come to be located (such as contaminants coming down the Columbia River). Cumulative risk could include physical impacts as well as synergistic or additive effects and interactions of contaminants. Cumulative risk could be defined as the assessment of multi-contaminant, multi-pathway and multiple stressors, both site related and offsite related and could include integration across space and time. In the *Framework for Cumulative Risk Assessment* [12] a cumulative risk assessment is defined as an analysis, characterization, and possible quantification of the combined risks to health or the environment from multiple agents or stressors. The components of the baseline risk assessment for the river corridor form a portion of the work that collectively will address the cumulative risk associated with all of the discharges of contaminants at the Hanford Site. In this sense, culmination of the various components will result in a cumulative risk assessment. Given

[1] http://www.modflow.com/modflow/modflow.html

the potential impacts of the cumulative risk concept, it is important to have a clear definition so that all parties have a common understanding.

Risk Assessment Integration

The Hanford Site Risk Assessment Working Group was established in fiscal year 2004 with the purpose of improving coordination and consistency between risk assessments performed across the Hanford Site. A Configuration Management Group (CMG) was established at the Hanford Site to provide consistency and configuration control on key parameters and reference documents related to risk assessments, waste inventory, vadose zone and groundwater transport, and other activities. The CMG has recently been reconstituted into another team whose focus is related to activities associated with the Hanford Site Central Plateau. The Plan of Action [10] issued in June 2006 by DOE-RL identifies an objective to consolidate modeling and risk assessment work for the Hanford Site.

Ongoing efforts are needed to work with the regulators and stakeholders to openly discuss and further develop the common set of parameters and assumptions for human health and ecological risk assessments. It appears that the initial path forward in this process will involve 1) a risk integration technical working group evaluating the risk assessment requirements (i.e., schedules, linkages, and gaps) and alignment with closure decision requirements across the site; and 2) a series of workshops with regulatory agencies, stakeholders, Tribes, and the Natural Resource Trustee Council to obtain their interests and discuss the integration of site decisions, cumulative analyses, and risk assessment parameters and assumptions.

Groundwater and Source Operable Unit Schedules

Groundwater schedules are not currently aligned with source action schedules. The FH Groundwater Protection Program is currently in the process of updating schedules identified in the *Hanford Groundwater Management Plan: Accelerated Cleanup and Protection* [13] that was issued in 2003. WCH provided its integrated baseline schedule information for the RCCC for the consideration of schedule development to support the groundwater program. Groundwater program schedule and funding considerations need to be reflected in its baseline planning process and supported by DOE to effectively align groundwater and source OU cleanup actions. Based on the WCH objectives to provide the framework for early final cleanup decisions, the source unit RI report could be completed in 2008, while the baseline schedules for completion of the RI/FS process for groundwater OUs ranges from 2010 to 2012 or beyond.

Columbia River Assessment

The role of the Columbia River assessment activities in obtaining final cleanup decisions for the river corridor has not been defined. Futhermore, implementation of the Columbia River component has not been assigned to a contractor and the exact scope of this assessment has yet to be determined. Development of a path forward regarding this scope, based on findings from the existing data evaluation, is currently taking place. The regulatory agencies have recently expressed concerns that a final source OU ROD cannot be supported without the performance of the Columbia River component risk assessment.

TRI-PARTY AND WCH INTERESTS

Before beginning a process to determine the requirements and select an approach for obtaining final cleanup decisions in the river corridor, better understanding the interests of the Tri-Parties and WCH was needed. All parties share a common goal of cleaning up the river corridor to protect human health and the environment but have some degree of varied interests based on consideration of contractual obligations, legal positions, regulatory requirements, stakeholder input, and public interactions. The interests of each party are presented in Table VI as identified through a series of discussions between WCH, DOE-RL, EPA, and Ecology.

Table VI. Summary of Interests in Final Cleanup Decisions for the River Corridor

Party	Interests
WCH	• Determine whether past remedial actions (1994 – present) are protective of human health and the environment. Identify and implement any modifications to the current cleanup approach, if needed, to ensure that ongoing and future remedial actions at source operable units will be protective. Sooner is better than later. • Ensure that implemented remedies for the source operable units meet the required action objectives and goals in the RODS and that no further action is needed to protect human health and the environment through closure review with independent experts. • Ensure that results from cleanup and risk assessment activities for the source operable units in the river corridor are integrated with groundwater actions and the Columbia River to the extent that they will support the overall Hanford Site cleanup mission and CERCLA process through eventual NPL site deletion for the 100 and 300 Areas. • To the extent possible, execute the contracted work scope for cleanup of the river corridor source operable units without having other site contractors in the WCH performance path (i.e., complete control of its own schedule).
DOE-RL	• Establish the process and requirements to complete CERCLA closure of the river corridor that is endorsed by the Tri-Parties. DOE-RL can then direct its contractors and validate or develop baseline scope and budget. • Separate Natural Resource Damage Assessment issues from river corridor work activities.
EPA	• Regardless of decisions for grouping operable units, tell an integrated story with each package to include source sites, deep vadose zone, and groundwater. • Complete the river corridor risk assessment to include the Columbia River component. While technically possible to separate the river component, there is no compelling reason to separate and it is viewed as being difficult to go to the public without it. • Determine how the reactor blocks fit into final decision making. • Ensure that work is completed at the 618-10 and 618-11 Burial Grounds. • Establish final decisions sooner that later to determine whether completed actions are protective.
Ecology	• Complete the river corridor risk assessment to include the Columbia River component. • Obtain a fully integrated schedule of source unit, groundwater, and river component work scope to help make decisions about operable unit grouping. • Ensure that RCRA [14] corrective action requirements are addressed. • Ensure that potential airborne deposition (e.g., 200 Area emissions, tumbleweeds) are addressed in an RI report. • Align final decisions by lead regulator responsibility. The Tri-Party Agreement identifies that final RODs are to be written by the lead regulatory agency. • Consider "sticker shock" potential with constituents as scope of final RODs get larger (e.g., to include more operable units).

CONCLUSIONS AND PATH FORWARD

An approach for obtaining early final cleanup decisions for source OUs in the river corridor that can be evaluated on its own merit has been prepared by WCH in a manner that is integrated with, but not dependent on, the anticipated schedule for completion of remedial actions at groundwater OUs within the river corridor and assessment of the Columbia River. This approach focuses on accelerating work scope items viewed as critical path, resulting in development of a single source unit proposed plan for the river corridor. At the same time, it is recognized that evaluation of and decisions for the 100 Area and 300 Area source OUs are part of a bigger picture that includes groundwater OUs, the Columbia River, and the Hanford Site 200 Area.

The Tri-Parties have yet to agree on the approach for final CERCLA decision making and closure of the river corridor. Consequently, potential alternative approaches to achieving final cleanup decisions have been identified. In this case, groups of OUs would be available for final decision making at different times during the overall cleanup process for the river corridor.

Regardless of the selected approach, there are a number of challenges and issues that need to be addressed before making final cleanup decisions. Ongoing integration activities among the various contractors working within the river corridor and across the Hanford Site need to continue. This will ensure that consistency is achieved in approaches to risk assessment and modeling activities. The DOE-RL is presently responsible for the coordination of these contractor efforts, and has recently established an integrated project team to develop and maintain an integrated approach to assessment and decision making for the river corridor. Another important element is identification and understanding of the "interests" of each of the parties in pursuing final cleanup decisions for the river corridor. All parties share a common goal of cleaning up the river corridor to protect human health and the environment but have some degree of varied interests based on consideration of contractual obligations, legal positions, regulatory requirements, stakeholder input, and public interactions.

The Tri-Parties agreed to form a working group to establish requirements, evaluate options, and select a pathway to obtain final decisions for the river corridor. The working group will include representation from WCH, FH, DOE-RL (source and groundwater programs), EPA, and Ecology. The working group will use the issues, challenges, and interests of the parties as a foundation to kick-off its efforts. It is anticipated that results from the working group discussions will be reflected in a separate strategy document that is endorsed by the Tri-Parties and a subsequent Tri-Party Agreement change package with associated milestones.

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