Comments on Appendix A: Part II – Requirements for a Columbia River Comprehensive Impact Assessment (CRCIA: Part II)

The Department of Energy (DOE) requested the Groundwater/Vadose Integration Project (Project) to use the CRCIA: Part II Requirements document as a template for the development of a capability to conduct site wide impact assessments. The Project, working in collaboration with representatives of the CRCIA working group, developed a proposed statement of guidelines and principles to conduct a sitewide evaluation of cumulative effects based on the original CRCIA: Part II requirements and principles. This information is found in Appendix F of the *Groundwater/Vadose Zone Integration Project Specification (DOE/RL-98-48 Draft C)*. The Project recognized that it was important to go beyond general principles to better understand the many detailed requirements compiled by the CRCIA board. A systematic review of Appendix A – *What the Assessment Must Include* - of the CRCIA: Part II requirements document was thus initiated in October of 1998.

The review of Appendix A was conducted by the Project in a public forum and met 3 times a week until the review was completed. Participants included members of the Project, Indian Nations, Environmental Protection Agency, Washington Dept. of Ecology, State of Oregon, and the Hanford Advisory Board. After some initial discussions, the group agreed upon a detailed approach and each requirement was evaluated and discussed in turn. Minutes of each meeting were taken and are available from the Project. Key elements of the approach included:

- Development of the types of information to be recorded during their review of each requirement.
- Assignment of a lead individual and team members to provide an initial evaluation of each requirement.
- Open discussion of each requirement and an update to the initial evaluation.
- Publishing of the entire collection of comments and evaluations and the solicitation of final comments.
- Finalization of the document with the incorporation of comments. (This last step has not been completed as of February 18, 1999)

The development of candidate and study sets will use this material to guide their respective development.

The attachment contains the results of the above process. Working definitions of the column headings are provided below to help readers better understand the approach and more effectively review the material.

Column	Title	Meaning
1	**None**	Original CRCRIA number used to organize requirements in Appendix A of the CRCIA Part II Requirements Document.
2	**None**	Exact statement of the requirement. With very few exceptions, the wording of the requirement is identical to the original wording.
3	**Category**	Used to link requirements to technical element within the Project.
4	**S&T Project(s)**	Used to indicate whether the requirement would likely require substantial science and technology development work. (Y – yes, blank – no)
5	**Other Project(s)**	Identification of responsible group for completing or meeting the requirement.
6	**Numerical Code (Hi, Med, Low)**	Assessment of the likelihood that a numerical analysis would be needed to meet the requirement. A numerical analysis here means an analytical effort based on the solution of a set of differential equations.
7	**Qualitative ((Hi, Med, Low)**	Assessment of the likelihood that a more qualitative effort would likely be used to satisfy the requirement (at least initially)
8	**Comments**	Collection of all significant comments agreed to by the group to demonstrate or refine the understanding of the requirement. Comments on individual opinions from group members and approaches were also included.

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
A.1 Hanford Materials and Contaminants (Sources and Inventories)							
(A1.0-1)	All existing and potential contaminants and contaminant sources shall be identified, characterized, and ranked for significance of potential impact. The characterization shall include atomic or molecular composition, mass, and location. It also shall include reactivity, solubility, and mobility. Materials shall be defined explicitly enough to support tracing their movement through the media along their pathway to the Columbia River.	Inventory	Y	Core Projects SAC Work Group	High	High	"All" will be defined by criteria developed under A1.0-2. The information needed includes Hanford site inventories and other source terms needed to make the assessment meaningful (e.g. Siemens, WPPSS). The product is a database generated using models, monitoring data, and historical records. The "Process" is important to public and stakeholder acceptance. Completeness is important. The results may have wider applicability than just the SAC. Data sources include Aggregate Area Management Reports as a starting point. Will need to review documents in DOE storage areas (Seattle, etc.) Do not overlook documents at other sites discussing Hanford activities. Ranking of contaminants will involve not just the Inventory element, but all of the components of the SAC. In the Inventory determination, reactivity, solubility, and mobility are only characterized for the source region (i.e., point of discharge). The role of past contaminant sources and existing contamination in media shall be developed later in the process and may be different in each case. The inventory should include baseline concentrations of contaminants in surface soil from reprocessing facilities and from atomic detonation yield. The inventory shall include a description of existing and potential contaminant sources that have been identified beyond the DOE's source term data. "High/High" indicates that considerable modeling may be required, but that the ranking systems (and some data interpretation) may be very qualitative. Modeling may include ORIGEN2 simulations of fuel irradiation and process knowledge to estimate bounding inventories. Reactor discharges to Columbia River may need to be reconstructed (but see HEDR River source term).
(A1.0-2)	A method shall be developed to demonstrate and document completeness of the lists of inventory sources and their compositions used in the assessment.	Inventory		SAC Work Group	Low	High	The initial assessment must rely on existing knowledge. Ultimately, something approaching the HEDR data search technique may be required. This documented, Qaed, reference tree technique is labor intensive but ultimately reproducible. The data searching process may need to be automated. "Low/High": Some numerical modeling will be required, but the demonstration of completeness may be done with qualitative information.
A.1.1 Required Candidate Contaminants Set							

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A1.1-1)	The Candidate Contaminants Set shall be formed by identifying all the radioisotopes and chemicals that are known to have a harmful impact on humans, cultures, or ecosystems and are known to be on the Hanford Site, as determined by established criteria.	Inventory		SAC Work Group	Medium	Medium	Completeness for the initial assessments will rely mostly on existing knowledge. "All" will be defined by "Established criteria" established as part of A1.0-2 and A1.1-2. Beware of instances where past national security issues may have resulted in obscuring actual inventories. This reinforces the use of primary records rather than compilations or existing databases. "Medium/Medium" implies that both numerical simulations/records searches are needed, and qualitative screening criteria must be developed. SCOPING STUDY REQUIRED – Define criteria for inclusion. SCOPING STUDY REQUIRED – Develop Candidate Set/winnow to Study Set.
(A1.1-2)	Criteria for the completeness of the range of contaminants to be included in the Candidate Contaminants Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Inventory		SAC Work Group	Low	High	An integration project management decision is needed to define an appropriate approval group. To determine the candidate set for radionuclides, a half-life criteria may be used, but some radionuclides may be included for model validation (e.g. Ru-106). For chemicals, a screen of "quantity x nastiness" should be developed. "Low/High": Some numerical modeling will be required, but the demonstration of completeness may be done with qualitative information
(A1.1-3)	Chemicals that mobilize contaminants shall be included in the Candidate Contaminants Set. An example is ethylenediamine-N,N,N',N'-tetra acetic acid (EDTA).	Inventory		SAC Work Group	Medium	Medium	Should also include chemicals that fix, alter hydrology, major cations and anions. Chemicals that potentially may retard migration should also be included. Materials that enhance microbial or biotic actions should be included. A physical description of the sources shall be included: temperature, pressure, etc. "Medium/Medium" implies that modeling may be required for inventories and interpretations may be needed for the physical descriptions.
A.1.2 Required Candidate Inventories Set							
(A1.2-1)	The Candidate Inventories Set shall be formed by identifying all the inventories that contain any contaminants belonging to the Candidate Contaminants Set, as determined by established criteria.	Inventory		SAC Work Group Core Projects	Medium	Medium	"Holistic" inventories require uncertainty; they should be developed with constraints so that individual realizations are bounded by the Hanford total. When reduced to study set, the lists may be different for different waste site categories (e.g. 100 vs 200 areas). Criteria need to be developed. "Medium/Medium" implies that both numerical simulations/records searches are needed, and qualitative screening criteria must be developed. SCOPING STUDY REQUIRED – Develop criteria for inclusion (See A1.2-1b) SCOPING STUDY REQUIRED – Develop Candidate Set, winnow to Study Set
	a. Present inventories and those to be added by future missions shall be included.	Inventory			Medium	Medium	"Medium/Medium" implies that numerical simulations must be applied to potential future states that must be qualitatively defined.
	b. All inventories on the Hanford Site shall be included regardless of who owns or is responsible for them. Although not complete, the following are examples of inventories that shall be included:	Inventory			High	Low	"High/Low" implies that the bulk of the work will be in defining numerical entries for the database. SCOPING STUDY REQUIRED – Develop inventory framework; define categories. This issue arises from the S&T recommendations from the National Lab Inventory Group.

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	residual pre-1970 transuranic solid waste	Inventory			N/A	N/A	Example
	burial grounds waste, such as that contained at 618-10 and 618-11	Inventory			N/A	N/A	Example
	Non-Radioactive Dangerous Waste Landfill	Inventory			N/A	N/A	Example
	projected mass of contaminants from the Environmental Restoration Disposal Facility	Inventory			N/A	N/A	Example
	submarine reactor cores	Inventory			N/A	N/A	Example
	Resource Conservation and Recovery Act (RCRA) storage and disposal sites	Inventory			N/A	N/A	Example
	U.S. Ecology Incorporated site	Inventory			N/A	N/A	Example
	Advanced Nuclear Fuels at the Siemens Power Corporation site	Inventory			N/A	N/A	Example
	Washington Public Power Supply System materials and contaminants	Inventory			N/A	N/A	Example
	laundries handling anti-contamination clothing	Inventory			N/A	N/A	Example
	residual waste inventory from the Liquid Effluent Retention Facility and similar treatment facilities	Inventory			N/A	N/A	Example
	routine permitted releases, such as National Pollution Discharge Elimination System (NPDES) or National Emission Standards for Hazardous Air Pollutants (NESHAP)	Inventory			N/A	N/A	Example
	spent nuclear fuel storage sites, such as K Basins, including water, sludge, and structure	Inventory			N/A	N/A	Example
	inventories associated with retention basins	Inventory			N/A	N/A	Example
	inventories associated with 100 Area reactors, including reactor cores	Inventory			N/A	N/A	Example
	inventories associated with T-Plant facilities	Inventory			N/A	N/A	Example
	inventories associated with B-Plant facilities and cesium capsules	Inventory			N/A	N/A	Example
	inventories associated with Plutonium Uranium Extraction (PUREX) facilities	Inventory			N/A	N/A	Example
	inventories associated with Fast Flux Test Facility (FFTF) facilities	Inventory			N/A	N/A	Example
	special nuclear materials inventories, including N Reactor spent fuel and the proposed spent nuclear fuel inventory for the Containment Storage Building	Inventory			N/A	N/A	Example
	groundwater inventories, for example, dense and light phase non-aqueous liquid inventories	Inventory			N/A	N/A	Example
	saturated zone inventories on soils	Inventory			N/A	N/A	Example
	contaminants inventories in liquid effluent disposal facilities, such as cribs and French drains	Inventory			N/A	N/A	Example
	inventories associated with decontaminated and decommissioned facilities	Inventory			N/A	N/A	Example
	inventories associated with interim stabilized	Inventory			N/A	N/A	Example

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	facilities						
	c. Residual materials (contaminants) expected to remain on the Hanford Site after retrieval and after remedial goals have been met shall be included. Although not complete, the following are examples of inventories that shall be included:	Inventory		SAC Work Group	High	Low	There may be different sets for each of the Hanford Site end states that are ultimately defined. "High/Low" implies that the bulk of the work will be in defining numerical entries for the database
	contaminant inventories expected to remain in the saturated zone	Inventory			N/A	N/A	Example
	material inventories expected to remain in tank structures	Inventory			N/A	N/A	Example
	contaminant inventories expected to remain in the vadose zone, including those located below excavation depth	Inventory			N/A	N/A	Example
	contaminated sediment inventories expected to remain in the Hanford Reach, including sloughs	Inventory			N/A	N/A	Example
	parent contaminants and their degradation and reaction products, such as chromium (including Cr III and Cr VI), carbon tetrachloride, trichloroethylene (TCE), and TCE degradation products	Inventory			N/A	N/A	Example
	materials known to have been produced but lost to the accessible environment	Inventory			N/A	N/A	Example
	d. Inventories that contaminate the following locations shall be included:	Inventory and River		SAC Work Group	Medium	Medium	This requires additional monitoring efforts. "Medium/Medium" indicates that the numerical database must be supplemented with measurements. Dominance principle will define level of effort expended in this area. Other potential sites will be identified by the Risk subtask.
	lower Columbia River shoreline and sediment from McNary Dam to the Pacific Ocean	Inventory and River			N/A	N/A	Example
	McNary Pool shoreline and sediment	Inventory and River			N/A	N/A	Example
	lower Columbia River dams pool sediment	Inventory and River			N/A	N/A	Example
	tidal area sediment at the mouth of the Columbia River	Inventory and River			N/A	N/A	Example
	Port of Pasco and Kennewick sediment	Inventory and River			N/A	N/A	Example
	shoreline at the 300 Area	Inventory and River			N/A	N/A	Example
	shoreline between the Hanford town site and land leased by the Washington Public Power Supply System	Inventory and River			N/A	N/A	Example
	shoreline at the Hanford town site	Inventory and River			N/A	N/A	Example
	shoreline at the 100 Area	Inventory and River			N/A	N/A	Example

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	North Slope shoreline	Inventory and River			N/A	N/A	Example
	upstream of the 100 Area	Inventory and River			N/A	N/A	Example
	e. Inventories created by hazardous materials introduced in the course of cleanup activities shall be included. An example is the material inventories accumulated from in-situ REDOX projects and that might be released at undesirable concentrations in the future, such as uranium at breakdown of the REDOX barrier.	Inventory					Accepted
(A1.2-2)	Criteria for determining the completeness of the range of inventories to be included in the Candidate Inventories Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Inventory		SAC Work Group	Medium	Medium	An integration project management decision is needed to define an appropriate approval group. "Medium/Medium" implies that numerical simulations must be applied to potential future states that must be qualitatively defined. See scoping study proposed for A1.2-1b.
(A1.2-3)	Inventory masses shall be established and reconciled with known reactor production quantities and chemical input to the Hanford Site. Estimates of lost materials that may remain in the local environment shall be included in the reconciliation.	Inventory		SAC Work Group	High	High	"Holistic" inventories require uncertainty; they should be developed with constraints so that individual realizations are bounded by the Hanford total. When reduced to study set, the lists may be different for different waste site categories (e.g. 100 vs 200 areas). "High/High" indicates that a large effort is required both on simulations of inventory production and on reconstruction of historical purchases by evaluating records.
(A1.2-4)	Decay of radionuclides and production of radioactive daughters shall be accounted for in inventories and throughout their transport to the Columbia River and uptake by receptors.	All			Medium	Low	Accepted
A.2 Containment Failure and Contaminant Release							
A2.0-1	A projected time of containment failure for each isolation form shall be determined based on the method of containment selected in the approved disposal plan. If disposal plans (see Section II-A.11) include defensible estimates of containment durability, these will be used. It is anticipated that uncertainties in time to contaminant failure for a disposal form will require representation in terms of statistical distributions. Distributions may need to be parameterized on isolation form attributes , depending on the specificity of isolation form definitions. Examples of attributes are the type of barrier and glass formulation applied.	Inventory		Core Project	Low	High	Times and modes of failure are interrelated and need to be considered. Selection of a single non distributed failure mode is a likely option to be taken because of insufficient data to support estimates of distributed failure. Initial estimates will be provided by core projects and will be site specific. More than one type of failure is likely. The product of this requirement will be generally quantitative and used as input to numerical models. However, this information is defined as qualitative because it is not likely to be developed as a result of numerical modeling and in many cases will be determined through a consensus of expert opinion (e.g., a data base of measurements on distributed failure will be extremely limited). Having determined a failure mode, radionuclide flux estimates will be based on the selected mode. Numerical codes may be used to calculate fluxes from the facility into the vadose zone
A2.0-2	The projected rates of release from each form of isolation after containment failure (progression of containment deterioration) shall be determined based on approved disposal plans, where		Y	SAC Work Group	Low (high for ILAW PA)	High	Each form of isolation pertains to various features of the engineered system at a given location (e.g., waste form, containers, design features). S&T activities completed to estimate or measure release rates and core projects efforts need to be integrated. The ILAW PA relies heavily on modeling to calculate contaminant fluxes from the disposal

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	available,according to Section II-A.11.						facility.
A2.0-3	Determination of release rates shall be consistent with external migration rates in adjacent soils.				Low	High	The concept is not understood, but we believe the concern is handled under A2.0-2. For any modular flow and transport modeling approach taken, mass balance will be maintained from module to module.
A2.04 The following shall be included in formulating shallow land burial site evaluations:		Vadose Zone/Remedial Options			Low	High	
A2.0-4(a).	The engineered barrier description used in the assessment shall be the "Hanford Site Disposition Baseline" (see Section II-A.11) as approved by the responsible regulatory agency. Where no baseline exists, the guidance of the responsible agency shall be used with regulator concurrence.			SAC Work Group Core Projects	Low	High	Regulator concurrence is assumed to be active input from the regulators during the assessment. Regulatory decisions on engineered barriers are unlikely to be final prior to the assessment, at least the initial one. Selection of the assumed engineered barrier system is part the selected end state condition (Section A.11) and will be site specific. Some contaminant isolating performance will be associated with the engineered barrier description. Note: Section II-A.11 refers to the section number, not the page number (II-A.37 &37). In this section, numerical would have to be applied to code inputs instead of outputs
A2.0-4 (b).	Approved barriers and other mobility inhibiting actions, as well as barrier failure scenarios, shall be included.			SAC Work Group	Low	High	See A2.0-4(a) for discussion of "regulatory approval". It is assumed that the candidate scenario sets defined per Section A.10 will include barrier failure events.
A2.0-4 (c).	Migration of Hanford contaminants under all applicable types of barriers in non-uniform geologic media shall be included. An example of this is accelerated lateral dispersion due to caliche layers.			Core Projects		High	This is largely the responsibility of the vadose zone migration module (A.3.0-1). This item is understood to focus on horizontal contaminant movement that could result in accelerated contaminant movement outside the infiltration controlling influence of the barrier. Migration of Hanford contaminants also includes migration of liquids. It is also important to consider the interaction of contaminants on release rates (e.g., hexone, carbon tetrachloride interaction with other waste forms).
A2.1-1	The candidate Containment Failure Scenarios Set shall be formed by identifying all the individual containment failure scenarios, both those with high likelihood and those that possibly could lead to the shortest containment release following containment failure.			Core Projects		High	See A2.0-1. The scenarios will defined in work completed to satisfy A.10 (both criteria for defining the candidate set and the candidate set will be identified).
A2.1-2	Criteria for determining the completeness of the range of containment failure scenarios to be included in the Candidate Containment Failure Scenarios Set shall be established in consultation with the Systems Assessment Capability Team and shall be subject to its approval.			SAC Work Group		High	Agreed. An integration project management decision is needed to define an appropriate approval group.
A.3 Transport Mechanisms and Pathways to the Columbia River							
(A3.0-1)	Contaminant transport through the vadose zone to groundwater shall be assessed.	Vadose Zone					

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A3.0-2)	Contaminant transport through the groundwater to the Columbia River shall be assessed.	Groundwater					
(A3.0-3)	Transport characteristics of geologic formations, such as the Hanford formation and Ringold formation, shall be established to the degree needed to support the assessment.	Vadose Zone/Ground water					Comment 1: The CRCIA requirement should to include flow characteristics as well. **(GW)** Agree. **(GW)**
(A3.04)	All other paths of Hanford-derived contaminants to the Columbia River shall be considered. This shall include but not be limited to atmospheric transport, direct discharges, and transport of contaminants to the Columbia River by humans, either via personal contamination or intentional transport of materials, or by contaminated plants and animals.	Risk					
(A3.0-5)	Migration rates to and concentrations in the Columbia River of all contaminants shall be determined, including estimates of holdup periods in travel time calculations.	Vadose Zone/Ground water/Columbia River			High	Medium	Comment 1: The CRCIA requirement should be amended by changing **all contaminants** to **all contaminants determined in inventory and effects candidate set. (GW)** Comment 2: Agree with modified requirement, details of approach identified below. **(GW)**
(A3.0-6)	Chemical forms and physical characteristics of radionuclides, such as solubility and sorption rates, shall be considered to the extent that migration rates are affected. This consideration shall include probable modifications of the original contaminants' characteristics as contact is made with soils, groundwater chemistry, and other contaminants.	Vadose Zone/Ground water/Columbia River					Comment 1: Agree details of approach identified below. **(GW)**
(A3.0-7)	Decay of radionuclides during transport shall be evaluated.	Vadose Zone/Ground water/Columbia River			High		Comment 1: Agree, no clarification needed. **(GW)**
A.3.1 Required Candidate Transport Paths Set							
(A3.1-1)	The Candidate Transport Paths Set shall be formed by identifying all potential paths for contaminant migration from existing and projected inventories to the Columbia river.	Vadose Zone/Ground water/Columbia River		SAC Work Group	High	Medium	Comment 1: **(GW)** A small working group team should be created to define to the degree possible all potential groundwater pathways of significance. The following is a list of pathways discussed in preparing these comments: **Standard Pathway** – Standard stratigraphy influenced saturated water flow and transport where migrating waste doesn't appreciably affect media or transport properties. For completeness the following should be included in the candidate set.

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
							Chemically Influenced Pathway – Stratigraphy influenced saturated water flow and transport where waste soil interactions should affect both the soil/hydrologic properties and the transport properties. **Pathways with Enhanced Driving Forces** - Standard stratigraphy influenced saturated water flow and with and without chemical influences (above) and as appropriate and also including as appropriate: • Unstable Flow – as it arises because of fluid -fluid interfaces (e.g., waste and water) and also because of differences in wetting properties (e.g., DNAPLS): • Preferential Flow **(GW)** Comment 2: **(GW)** Numerical models should be used for most pathways but there should be some qualitative assessment required to develop the simplified models for some of the more complex pathway models if they are determined to be significant. **(GW)** Comment 1: **(VZ)** A small working group team should be created to define to the degree possible all potential pathways of significance. The following is a list of pathways discussed in preparing these comments: **Standard Pathway** – Standard stratigraphy influenced unsaturated water flow and transport as appropriate for the soil structure underlying the disposal area where waste doesn't appreciably affect media or transport properties. **Chemically Influenced Pathway** - Stratigraphy influenced unsaturated water flow and transport as appropriate for the soil structure underlying the disposal area where waste soil interactions affect both the soil/hydrologic properties and the transport properties. **Pathways with Enhanced Driving Forces** - Standard stratigraphy influenced unsaturated water flow and transport as appropriate for the soil structure underlying the disposal area with and without chemical influences (above) and heat influences as appropriate and also including as appropriate: • Unstable Flow – as it arises because of fluid -fluid interfaces (e.g., waste and air, water and air, and waste and water) and also because of differences in wetting properties (e.g., DNAPLS): • Preferential Flow – related to features such as clastic dikes, boreholes, and artifical structures or even pathways created by the chemical properties of the waste or alterations related to the leak (e.g., the flashing to steam events discussed by the SX expert panel). • Need to examine various water content formulations and the recommendations from the vadose zone (Van Genechten) working group on property representations. **Additional Pathways** – 1) New contaminated vadose zones created from falling water table in contaminated groundwater areas. 2) In the groundwater, an up-the-groundwater-gradient moving plume is created because DNAPL is moving up-the-groundwater gradient because of the slope of the sedimentary or rock structures. Vapor from dissolution of migrating DNAPL re-entering vadose zone (complicated by the upgradient DNAPL movement) could result in pathway for contaminants to Vernita Bridge. 3) What new pathways and mechanisms develop and need to be considered as a result of interactions between sources (e.g., trenches, tank leaks, reverse wells, and other sources such as water leaks and hydrant flushing) and as a result of future scenarios or other changes (e.g., irrigation). **(VZ)** Comment 2

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
							S&T Needs – 1) How do we determine, for each disposal location, which of the pathways (really the pathways and mechanisms) apply. 2) Determine under what conditions (e.g., fluid properties, degrees of saturation, and soil types and structure) fingering can occur at scales important to assessment. Also identify how we find evidence to support this in field. (Perhaps fractal modeling of heterogeneity may be appropriate to identify what scales of heterogeneity are important to to the prediction of waste movement.) **(VZ)** Comment 3 Numerical models should be used for most pathways but there will be some qualitative assessment required to develop the simplified models for some of the more complex pathways. **(VZ)**
(A3.1-2)	Criteria for determining the completeness of the range of transport paths to be included in the Candidate Transport Paths Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Vadose Zone/Ground water/Columbia River		SAC WG Ground-water			Comment 1: An integration project management decision is needed to define an appropriate approval group.**)** Comment 2: A small working group team should be created to draft completeness criteria. Approach for approval to be defined by the policy group. **(GW)**
(A3.1-3)	Geologic features associated with each path shall be identified. An example is an aquifer.	Vadose Zone/Ground water		SAC Work Group			Comment 1: **GW)** A small working group team should be created to define to the important geological features associated with each potential groundwater pathway of significance. The following is a list of potential characterization needs and ideas: Major stratigraphic structure (e.g., mud and aquifer units) and a quantative/qualitative assessment of the nature of the fine structure of these major stratigraphic units that should affect flow and transport. This includes the physical and mineralogical or chemical character. Additionally the general nature and character of any potential preferential pathways or blockers (e.g. clastic dikes and faults) and their characteristics should be identified. Comment 1 **(VZ)** A small working group team will be created to define to the important geological features associated with each potential pathway of significance. The following is a list of potential characterization needs and ideas that were discussed in preparing these comments: Major stratigraphic structure and slopes of the interfaces along with a quantative/qualitative assessment of the nature of: • these interfaces that could affect flow and transport; • the fine structure of these major stratigraphic units that could affect flow and transport. This includes the physical and mineralogical or chemical character. Additionally the general nature and character of clastic dikes (e.g., spacing, vertical extents, and widths) shall be identified. Perhaps numerical sensitivity studies (the idea of synthetic data sets) could be undertaken as a supportive effort to account for effects of the fine scale structure on routing, flow and transport and to define the response function that must be implemented in a simpler assessment model implementation. These studies coupled with empirical field experiments might be used to verify the selected simplifications and demonstrate that we understand the

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
							effect of these features on the larger scale movement and transport important for assessing risk.
(A3.1-4)	Both confined and unconfined aquifers shall be included in the Candidate Transport Paths Set.	Groundwater			High	Medium	Comment 1: Agree **(GW)**
(A3.1-5)	Transport mechanisms associated with each path shall be identified.	Groundwater/ Columbia River Vadose	Y	SAC Work Group	High	Medium	Comment 1: **(GW)** The CRCIA requirement should be amended to include flow mechanisms as well. Comment 2: **(GW)** A small working group team should be created to define the important transport mechanisms associated with each potential groundwater pathway of significance. The following is a list of potential transport mechanisms and ideas: Pathways – Mechanism Associations (see A3 1-1 above). An enumeration of the mechanisms follows: • Standard saturated flow and dispersive transport equation for saturated water flow and conservative and retardation teansport. Preferential flow can be included by characterizing the high permeability or low Kd pathways. • Density dependent saturated water flow Preferential flow can be included by characterizing the high permeability or low Kd pathways. • Multiphase density dependent saturated flow for DNAPLS. • Reactive chemical transport Consider the processes associated with short term mitigation,containment and remediation alternatives? Numerical models should be used for most mechanisms but there should be some qualitative assessment required developing the simplified models for some of the more complex mechanisms. Comment 1: **(VZ)** A small working group team should be created to define the important transport mechanisms associated with each potential pathway of significance. The following is a list of potential transport mechanisms and ideas that were discussed in preparing these comments: Pathways – Mechanism Associations (see A3 1-1 above). An enumeration of the mechanisms follows: • Richard's equation for unsaturated water flow (stagnant air). Includes preferential flow. • Density dependent unsaturated water flow (stagnant air). Includes preferential and unstable flow. • Multiphase density dependent unsaturated flow with heat. • Standard Kd transport (must validate that the concept is valid where used) • Reactive chemical transport with/without porous media alterations ▪ Ion exchange and ion exchange like (e.g., zeolites) ▪ Sorption (e.g., adsorption, absorbtion, desorption, chemisorbtion, Van der Waals forces) ▪ Binding and transport (zeta effects etc) ▪ Oxidation/reduction ▪ pH and other chemistry effects ▪ Precipitation/dissolution

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
							▪ Specific modeling challenges (e.g., goethite, clays, zeolite, …) ▪ Reactions that affect the porous media ▪ Effects of degradation products on mobility ▪ Effects of organic acids (humic and fulvic) ▪ Creation of new contaminants by degradation ▪ Radiolytic chemistry (radiolysis) ▪ Gas chromatographic effects resulting from solvents coating soils and driven by barometric pumping and or radiolytic heat generation. • Degradation reactions (nitrate, DNAPL) including chemical and microcobial. • Shifting transport mechanisms related to nuclides whose valence state is easily shifted by subtle changes in other soil and water properties (e.g., redox shifting) or the inherent nature of the material (e.g., Pu). What are the processes associated with containment and remediation? Perhaps as discussed in (A3.1-3) numerical sensitivity studies (the idea of synthetic data sets) could be undertaken as a supportive effort or S&T activity to define the response function that must be implemented in a simpler assessment model implementation to account for these more complex transport mechanisms. These studies coupled with empirical lab or field experiments might be used to verify the selected simplifications and demonstrate that we understand these mechanisms to the degree necessary for assessing risk. Numerical models will be used for most mechanisms but there will be some qualitative assessment required to develop the simplified models for some of the more complex mechanisms. **S&T Needs** – 1) How do we determine, for each disposal location, which of the mechanisms apply through time? **(VZ)**
A.3.2 Hydrogeologic Characterization							Comment 1: The CRCIA requirement should be amended to read "Characterization of the Hydrologeologic, Geochemical, and Thermal Properties along the Transport Pathways". **(GW)**
(A3.2-1)	Stratigraphy, including thickness, lateral extent, continuity of units, and pathways, shall be established.	Vadose Zone/Ground water		SAC Work Ggroup Ground-water			Comment 2: This requirement duplicates some aspects discussed under the geologic features requirement (A.3 1.3) as they really apply to stratigraphy and thickness, and continuity of units. It also duplicates the pathways requirement (A.3 1-1) so these are not addressed here except to reference the information presented in requirements (A.3 1-1) and (A.3 1-3) above. **(GW)** Comment 3: A small working group team should be created to define any additional needs beyond those covered in (A.3 1-1) and (A.3 1-3) above. The following is a list of potential transport mechanisms and ideas that were discussed in preparing these comments: • domain size and resolution necessary to properly model the confined and unconfined systems and their interaction with each other and the Columbia River. **(GW)** Comment 2: A small working group team will be created to define any additional needs beyond those covered in (A.3 1-1) and (A.3 1-3) above. The following is a list of potential

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
							transport mechanisms and ideas that were discussed in preparing these comments: • domain size necessary to properly account for down slope transport and interactions with other sources, • qualitative data on breaks in large scale features: The use of the synthetic data set/empirical study approach to achieve simplification. **(VZ)**
(A3.2-2)	The effect of geochemistry on migration rates shall be identified. An example is the retardation of the rate of contaminant migration.	Vadose Zone/Ground water		SAC Work Group Ground-water			Comment 1: The CRCIA requirement is duplicative of requirement A.3 1-5 above which reads "Transport mechanisms associated with each path shall be identified". Suggest that it be ignored in favor of requirement A.3 1.5 above as it is not a characterization need. **(GW)**
(A3.2-3)	Hydraulic conductivity, storage coefficient, and effective porosity shall be established.	Vadose Zone/Ground water	Y	SAC Work Group Ground-water			Comment 1: **(GW)** A small working group team should be created to define any important hydrologic parameter needs beyond those identified in the requirement associated with each potential pathway of significance. Comment 1: **(VZ)** A small working group team should be created to define the important hydrologic parameter needs associated with each potential pathway of significance. The following is a list of potential characterization parameter need and ideas that were discussed in preparing these comments: We recognize that much of the vadose zone data is from disturbed samples and that this is a potential problem. **S&T Need** – How do we get from the measurable items (i.e., typically on disturbed samples) to properties that reflect the effects of the fine structure under the different flow states (e. g., from the very dry to very wet).
(A3.2-4)	Geochemical characterization shall include identifying the following:	Vadose Zone/Ground water		SAC Work Group Ground-water			Comment 1: The CRCIA requirement should be amended to read "Geochemical and thermal property characterization shall be include those properties needed to address each transport mechanisms identified by CRCIA requirement (A.3 1-5)". **(VZ)** Comment 2: Suggest examples be ignored for the purpose of this requirement since they are really geochemical process and mechanism identification requirements. Suggest that the mechanisms and processes identified in (A.3 1-5) be used to identify the geochemical and thermal property characterization needs to address this requirement. **(VZ)** Comment 3: The small working group team created to define the important transport mechanisms associated with each potential pathway (CRCIA requirement A.3 1-5 above) should also be the group to identify these needs. **(VZ)** The following is a list of ideas that were discussed in preparing these comments: • Characterize those geochemical properties of the water and sediment important to understanding the reactions and mechanisms identified above that affect mobility or are reactable with wastes and contaminants • Characterize the thermal properties of the porous media, • Characterize the initial distribution of waste materials and thermal loading. Identify those components in the sediments that through re-exposure to the migrating wastes (see processes above) would result in additional degradation (e.g., migrating organic acids). **(VZ)**

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	a. changes in mobility brought about by remediation and technical development	Vadose Zone					Comment 1 This is not a geochemical characterization need but a process or mechanism identification need. This need should be considered by the SAC WG convened to address A.3 1.5 **(GW)**
	b. the effects of chelating agents, such as EDTA	Vadose Zone					Same comment as for (a) above.
	c.the long-term effects of chemicals introduced in connection with or as a part of remediation. An example is sodium dithionate weathering in contact with groundwater whose pH and dissolved oxygen change.	Vadose Zone					Same comment as for (a) above.
A.3.3	Contaminant Migration in the Vadose Zone			SAC Work Group Vadose Zone	High	Med	Comment 1: The CRCIA requirement is attempting to define the interface requirements between the various modules (e.g., land-vadose, source term module-vadose, vadose-groundwater) If this is the case then additional items (i.e., row) need to be added to the CRCIA requirements. The additional rows/ new requirements would be (A.3 3-3) that should read: • "Assessment of the interface of the vadose zone with the source term/containment". and this row would replace (A3.3-2 a) • "Assessment of the interface of the vadose zone with the river term/containment". and this row would be a new row Our suggested solution is to select a small working group team to define both the module interface requirements as well as the vadose zone model assessment needs, thereby addressing both potential issues. **(VZ)**
(A3.3-1)	Assessment of the interface of the vadose zone with the land surface shall identify the following:	Vadose Zone					See comments made for A.3.3
	a. effects of infiltration on vadose contaminant migration rates	Vadose Zone					Same as above. **(VZ)**
	b. effects of permitted discharges on vadose contaminant migration rates	Vadose Zone					Same as above **(VZ)**
	c. effects of discharged chemicals on mobilization of contaminants and consequent vadose contaminant migration rates	Vadose Zone					Same as above **(VZ)**
(A3.3-2)	In assessing the interface of the vadose zone with the groundwater zone, the following shall be represented:	Vadose Zone					See comments made for A.3.3
	a. migration of contaminants to soils immediately adjacent to containment packages, especially as saturated with escaped effluents	Vadose Zone					Same as above. **(VZ)**
	b. migration from vadose zone to saturated zone groundwater	Vadose Zone					Same as above **(VZ)**
	c. mixing of contaminants from vadose zone with saturated zone groundwater	Vadose Zone					Same as above **(VZ)**
A.3.4 Contaminant Migration in Groundwater							

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A3.4-1)	Contaminant migration rates in groundwater from its source at the interface with the vadose zone to the river shall be identified.	Groundwater		SAC Work Group	High	Med	Comment 1: We are assuming this CRCIA requirement addresses the interface requirements between the various modules that link to groundwater (e.g., vadose-groundwater and groundwater-river) Our suggested solution is to select a small working group team to define the groundwater module interface requirements for groundwater-vadose, and groundwater-river. **(GW)**
(A3.4-2)	Interaction between confined and unconfined aquifers and contamination transport shall be identified.	Groundwater		SAC Work Group	High	Medium	Comment 1: We are assuming this CRCIA requirement addresses the interface requirements that links unconfined groundwater to confined groundwater. Our suggested solution is to use the same working group team (A3.4-1) above to define the groundwater module interface requirements that links unconfined groundwater to confined groundwater. **(GW)**
A.3.6 Contaminant Migration in Air							
(A3.6-1)	Wind patterns within the Columbia River watershed shall be assessed and documented. Wind pattern data provided by the State of Oregon shall be evaluated.			SAC Work Group	High	Low	Accepted. Data from a number of sources throughout the Columbia Basin can be used to develop annual average wind fields – HMS, airport observations, weather service, etc.
(A3.6-2)	The effects on the Columbia River from deposition and redeposition of airborne contaminants from the Hanford Site shall be identified.			SAC Work Group	Medium	Low	This should be expanded to include impacts on other areas, including locations outside of Hanford operating areas within the Project scope. Potential scoping study to identify magnitude of issue.
A.4 Contaminant Entry into the Columbia River							
(A.4.0-1)	Groundwater and surface water interactions shall be identified.	Groundwater/ Columbia River			Low	High	Agree. Comment 1: Interactions include physical, chemical, and biological processes that occur within the zone where groundwater meets surface water. The dimensions of this zone are variable for the different types of processes. Understanding how representative observational data from the zone are of actual conditions is important for reducing uncertainty in assessing impacts.
(A.4.0-2)	The interface with the Columbia River, including seeps, springs, and sub-surface influx into the river, shall be identified to support the assessment of biota exposures in the riparian zone and near the river bottom as required in Section II-A.8.	Groundwater/ Columbia River			Low	High	Agree. Comment 1: Contaminant characteristics, including constituents, concentrations, and changes with time need to be known at potential exposure locations in the riparian zone and river substrate, to support dose assessment activities.
(A.4.0-3)	The groundwater interface with the Columbia River, seeps, springs, and sub-surface influx shall be identified to support assessment of contaminant distribution in the river.	Groundwater/ Columbia River			Low	High	Agree. Comment 1: Contaminant characteristics at the point of introduction into the free stream of the river need to be known to help anticipate the distribution of contaminants by the flowing river.
(A.4.0-4)	Valid interfaces shall be defined between groundwater transport assessment and the assessment of groundwater introduction into the Columbia River.	Groundwater/ Columbia River	Y		High	High	Agree. Comment 1: A means to connect the numerical modeling methods used for groundwater movement across the Site with the (a) movement and mixing within the zone of interaction, and (b) release from the zone of interaction into the free stream of the river, is needed. Comment 2: There is a need to identify the interface between these two models recognizing the potential significance of the groundwater/river interface.
A.4.1 Required Candidate River Entry Location Set							

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A.4.1-1)	The Candidate River Entry Location Set shall be formed by identifying all potential river entry locations.	Groundwater/ Columbia River		SAC Work Group	Medium	High	Comment 1: There will always be some degree of uncertainty associated with identifying " "all" potential locations of entry. It will not be possible to provide observational data on all horizontal and vertical locations within the zone of interaction between the Hanford Site aquifer and the river channel. Comment 2: The term "all" will be related to WEB dependencies; the purpose for their identification is for evaluation of effects.
(A.4.1-2)	Criteria for determining the completeness of the range of river entry locations to be included in the Candidate River Entry Location Set shall be established in consultation with the CRCIA Board and shall be subject to its approval.	Groundwater/ Columbia River		CRICA Group	Low	High	An integration project management decision is needed to define an appropriate approval group. Comment 1: Criteria for completeness will initially be applied to create the base case for the candidate set.
A4.2 River/Groundwater Interface Description							
(A4.2-1)	The data, models, and parameters developed shall support the assessment of the exposures (see requirements in Section II-A.8) over the required period of time (see the "Principles and General Requirements" Section).	Groundwater/ Columbia River					Agree.
(A4.2-2)	Models and data that represent the mixing of groundwater with surface water shall support the assessments related to the exposures and impact to aquatic species specified in Sections II-A.8 through II-A.9, for example, the effectiveness of salmon reproduction.	Groundwater/ Columbia River	Y		High	High	Agree. Comment 1: The design of numerical models, and the collection of field data, should both be influenced by the intended use of the results. Following the EPA's data quality objectives process for collecting new environmental data helps ensure that the appropriate type and amount of data are obtained to provide knowledge that will support environmental restoration decisions and environmental impact assessments.
(A4.2-3)	Future location and mass flux of contaminants into the Columbia River shall be evaluated.	Groundwater/ Columbia River			High	High	Agree. Comment 1: The DOE needs to provide the public with information on expected future conditions, given a variety of scenarios for Hanford Site cleanup and reconfiguration for future uses. That information should be focused during the near-term on giving the public confidence that DOE knows whether contamination conditions near the river are likely to continue to improve, or potentially become worse.
(A4.2-4)	Future contaminant concentrations near the river bottom shall be assessed, both in mixtures of groundwater and river water beneath the river bottom (pore water) and at the river bottom, where the pore water enters into the main body of river water.	Groundwater/ Columbia River	Y		High	High	Agree. Comment 1: Methods need to be developed to anticipate future contamination conditions in the riverbed substrate. Understanding the present conditions and the processes that control them is key to anticipating future conditions.
(A4.2-5)	Future contamination of other media and contaminant holdup in other media, such as sediment, which are in contact with groundwater and pore water shall be evaluated.	Groundwater/ Columbia River	Y		High	High	Comment 1: Knowledge of the interaction between (a) typical Hanford Site contaminants that are transported by groundwater flow and (b) the various media that contact the contaminated groundwater, needs to exist, if credible predictions are to be made.
A.4.3 Groundwater Influx into the River							
(A.4.3-1)	To quantify the variety and amount of contaminants currently reaching the Columbia River, groundwater entering the river shall be characterized.	Groundwater/ Monitoring			Low	High	Agree. Comment 1: The locations and characteristics of contamination entering the river need to be monitored, using methods that provide representative samples. A substantial body of knowledge currently exists regarding the entry of groundwater into the river. Uncertainty associated with this knowledge shall be monitored.
(A.4.3-2)	Measurements shall be coordinated with model development to describe mixing between	Groundwater/ Columbia			High	Medium	Agree. Comment 1: A numerical model that shows how groundwater and river water intermix

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	groundwater and surface water over the transition zone between them.	River/Monitoring					near the river will provide important information for decision making. Model codes currently exist to accomplish this.
(A.4.3-3)	Maps of groundwater influx into the Columbia River from contaminated regions of the Hanford Site shall be provided. Volumetric flux contours over the Hanford Reach shall be provided.	Groundwater/ Columbia River/Monitoring			Low	High	Agree. Comment 1: Estimates for rates of (a) groundwater entry into the river and (b) mass flux of contamination into the river via groundwater movement, are needed at a scale that allows differentiation of individual plumes. Comment 2: Descriptions for the geometry of the aquifer and river channel are currently limited by the absence of a detailed bathymetric chart for the river channel; this is a major data gap for performing the type or work implied by the requirement. Comment 3: An additional aspect of this requirement is to map areas of the riverbed that are potentially exposed to contaminated groundwater that upwells into the channel.
(A.4.3-4)	Semi-permanent shoreline groundwater access structures (that is, drive points) shall be established at various distances along the Hanford shoreline. The distance separating structure locations shall be determined by potential contaminant influx, within the following limits:	Groundwater/ Monitoring			Low	High	Agree. Comment 1: Approximately 80 locations at 1,000 to 2,000-ft intervals along the 100 Areas shoreline were equipped with from 1 to 3 aquifer sampling tubes during fall 1997. These tubes supplement tubes installed at much closer intervals in the 100-D/DR Area during fall 1996. Water quality results for the initial sampling conducted during the installation project in fall 1997 are presented in BHI-01153, Rev. 0, February 1998. Comment 2: Aquifer sampling tube methodology has proven itself for obtaining water quality data from the aquifer near the river for several reasons: (a) proximity to points of exposure, which can't be achieved with drill rigs, (b) useable in culturally sensitive areas (e.g., 100-K shoreline along trench), (c) considerably lower cost per location monitored. Comment 3: Frequent monitoring of water quality in samples from the tubes will provide important information on the variability of contaminant concentrations near the river, which is primarily caused by the fluctuating river stage.
	a. Each river mile within the Hanford Site shall have a minimum of four structures. The structures shall be used to assess contaminant influx by sampling groundwater entering the Columbia River. More structures should be added in known zones of greater groundwater or contaminant influx.	Groundwater/ Monitoring			Low	High	Comment 1: Design of monitoring programs needs to take full advantage of the EPA's data quality objectives process to specify locations, spacings, analysis suites, and frequency of sampling for monitoring along the river.
	b. The interval between structures shall not exceed 0.8 kilometers (0.5 miles).	Groundwater/ Monitoring			Low	High	Comment: Objectives of this monitoring need to be determined to set spacing intervals.
	c. The required intervals may be waived with agreement by the System Assessment Capability Team.	N/A		SAC Work Group	Low	Low	An integration project management decision is needed to define an appropriate approval group.
(A.4.3-5)	Subsurface stratigraphy changes shall be noted during establishment of semi-permanent shoreline groundwater access structures, such as wells. This information will be valuable in estimating the hydraulic conductivity of the groundwater path at the sample location.	Groundwater			Low	Medium	Comment 1: Attempts were made to record stratigraphic information during the installation of the aquifer sampling tubes in fall 1997. It was not possible to obtain detailed information as the casing was driven. However, at nearly all locations, further penetration stopped at depths of approximately 30 feet, when the casing encountered dense sediment that yielded no water. This horizon has been presumed to be the top of the Ringold Mud Unit, which underlies the transmissive Ringold Unit E.
(A.4.3-6)	The amount of groundwater entering the Columbia River at each sampling location shall be estimated from the stratigraphy.	Groundwater	Y		Low	High	Disagree. Comment 1: There is currently no known practical way of doing this with the aquifer sampling tubes.
(A.4.3-7)	Groundwater sampling at the river shall be conducted to meet the following criteria:	Groundwater/ Columbia River					Comment 1: This requirement is interpreted to mean groundwater sampling at locations as close to the river as logistically possible, i.e., by the use of aquifer sampling tubes near the low river-stage shoreline.

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	a. Pore water on the Hanford shoreline at 30-300 centimeters (1-10 feet) below the unconfined groundwater table elevation shall be analyzed throughout the entire Hanford Reach.	Groundwater/ Columbia River			Low	High	Comment 1: The fall 1997 installation project generally meets this requirement, although coverage downstream of the 100 Area ends at the Hanford townsite. There is no coverage by aquifer sampling tubes for the stretch between the townsite and the 300 Area, creating a major data gap in monitoring coverage for the plumes from the 200 Areas that have reached the river.
	b. Groundwater influx to the Columbia River shall be analyzed at the Hanford shoreline throughout the entire Hanford Reach.	Groundwater/ Columbia River			Low	High	Comment 1: (see comments for Requirement A4.3-3)
	c. A pore water sampling plan shall be developed, including a standard suite of chemicals to be analyzed in addition to suspected contaminants.	Groundwater/ Columbia River			Low	High	Comment 1: An integrated plan to monitor water quality near the Columbia River needs to be developed that would integrate sampling of near-river wells, riverbank seepage, aquifer sampling tubes, and near-shore river water into an efficient, cost-effective program. Currently, multiple contractors perform sampling of these locations in a somewhat fragmented manner. The EPA's data quality objectives process should be followed in developing this plan. Comment 2: Samples collected from aquifer sampling tubes located at the low river-stage shoreline are collected annually during the seasonal low in river discharge. They are analyzed for metals, anions, radiological indicators (gross beta, tritium), specific radionuclides in areas of known plumes, and physical parameters (pH, temperature, and specific conductance). Typical Hanford contaminants in groundwater should be detected by this suite of analyses..
	d. A groundwater sampling plan shall be developed, including a standard suite of chemicals to be analyzed, both radioactive and chemical contaminants, in addition to suspected contaminants and physical parameters.	Groundwater/ Columbia River			Low	High	(See Comment 1 for Requirement A4.3-7c) Comment 1: Lists of wells, frequency of sampling, and analytical suites have been developed for the various groundwater operable units. These sampling and analysis schedules represent a consensus of Site investigators, DOE, and the regulators (EPA and Ecology). The consensus is documented via Tri-Party Agreement Change Control Forms.
	e. A stratigraphic section of soil samples shall be taken at each groundwater sampling location to correlate groundwater contaminant impact with the degree of soil impact at that given location.	Groundwater/ Columbia River			Low	Medium	Disagree. Comment 1: As a general rule, this requirement is excessive. However, in areas of known or suspected soil contamination (e.g., liquid waste disposal sites; sites of significant pipeline or reservoir leakage), soil samples should be collected and analyzed for contamination whenever new groundwater wells are installed. Recent new knowledge regarding the remobilization of strontium-90 from the soil column at 100-N, in response to an elevated water table, provides strength for this argument.
	f. Concentration gradients in the ground near the Columbia River bottom shall be measured.	Groundwater/ Columbia River			Low	Medium	Comment 1: The requirement is unclear. The mixture of river water and groundwater in river bottom sediment pore water probably changes with depth in the sediment. At some depth, pure groundwater is encountered beneath the entire channel. Above this depth, pore water composition is highly variable, depending on the degree of infiltration by river water and the hydraulic gradient associated with upwelling groundwater. At shallow depths in the riverbed sediment, flow may be dominated by horizontal flow of primarily river water, as David Geist of PNNL has suggested in his study of salmon redds.
(A.4.3-8)	The quantity of radioactive materials currently in the Columbia River shall be estimated by an aerial geophysical survey of the river and surrounding locations.	Columbia River			Low	High	Agree.
	a. Shoreline and island areas identified to have the highest relative radioactivity shall have ground level and/or benthic surveys.	Columbia River			Low	High	Agree
	b. The geophysical survey of the Columbia River and surrounding locations shall be timed to coincide with the yearly low water cycle of the Columbia River to characterize the radioactive contamination with the effect of shielding	Columbia River			Low	High	Agree

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	minimized.						
(A.4.3-9)	Benthic groundwater influx surveys shall be completed to provide input into the decision making process whereby the number of shoreline groundwater sampling structures per mile are considered. Areas of greater groundwater influx to the river shall have more sampling structures.	Groundwater/ Columbia River/Monitoring			Low	High	Comment 1: Methods exist to survey/sample/monitor the influx of groundwater through the riverbed sediment, but the logistics to do so are complex and not without a certain degree of worker risk. With this in mind, requirements/demands for observational data on riverbed sediment pore water need to be carefully thought out. Consideration of how the data would be used to support decisions and future regulatory requirements (i.e., those in records-of-decision) must precede implementing field programs. Comment 2: (see response to Requirement A4.3-4) Shorter intervals between locations were established along segments of shoreline adjacent to known contaminant plumes.
A.5 Fate and Transport of Columbia River-Borne Contaminants							
(A.5.0-1)	The fate assessment of river-borne contaminants (to include locations of sediment deposits) shall support exposure and dose assessment.	Columbia River		SAC Work Group	High	Medium	The fate and transport assessment should include hydrodynamic, sediment, biological, and contaminant transport models. Fate and transport assessment results should be evaluated relative to critical habitat and uptake locations. In addition, modeling should be performed to endpoints consistent with exposure and dose assessment criteria as defined by the SAC. **(RD)**
(A.5.0-2)	The transport assessment of river-borne contaminants shall support exposure and dose assessment.	Columbia River		SAC Work Group	High	Medium	The fate and transport assessment should include hydrodynamic, sediment, biological, and contaminant transport models. Fate and transport assessment results should be evaluated relative to critical habitat and uptake locations. In addition, modeling should be performed to endpoints consistent with exposure and dose assessment criteria as defined by the SAC. (RD)
(A.5.0-3)	Hot spots (contaminant concentrations) in the Columbia River that result from slow mixing of high concentration contamination sources with river water and suspended solids shall be assessed.	Columbia River		SAC Work Group	High	Medium	"Hot spots" in the Columbia River that result from slow mixing of high concentration contamination sources with river water and suspended solids should be accounted for within the GW/River Interface numerical model (determining source term), critical uptake location identification, river fate and transport models, river impacts evaluation, and exposure and dose assessment criteria as defined by the SAC. Indeed, by definition, such sites are included in the assessment as critical locations. **(RD)**
(A.5.0-4)	All Hanford contamination in the Columbia River environment that has the potential to contribute to habitat or drinking water contamination shall be identified.	Columbia River		SAC Work Group	Low	High	Consistent with the SAC contaminant candidate and study set criteria and critical habitat and uptake locations candidate and study set criteria, contamination in the Columbia River environment that has the potential to contribute to critical habitat or drinking water contamination should be identified. Significant characterization efforts, the design based on existing observational data and model predictions, would be necessary. A major challenge here (and identified in the RTE) is the differentiation between Hanford and non-Hanford contamination. **(RD)**
A.5.1 Required Candidate River Holdup Location Set							
(A.5.1-1)	The Candidate River Holdup Location Set shall be formed by identifying contaminant holdup locations in the river with the potential to harm humans, cultures, or biota.	Columbia River			Low	High	The candidate River Holdup Location Set should be determined consistent with river fate and transport modeling results coupled with the SAC critical habitat and uptake locations criteria – be it human, cultural, socio-economic, or ecological endpoints. Critical in this process is the need for the identification of these endpoints and definition of impact criteria for them in order to evaluate the "potential to harm…". **(RD)**
(A.5.1-2)	Criteria for the completeness of the holdup locations to be included in the Candidate River	N/A					

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	Holdup Location Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.						
A.5.2 Contaminant Redistribution to Habitat							
(A.5.2-1)	Groundwater mixing with surface water and flow representation shall support valid assessment of contact between receptors and contaminants in the Columbia River. An example is the exposure of bottom fish.	Columbia River		SAC Work Group	Low	High	While complex, this phenomena should be addressed across/within the GW/river interface and river fate and transport modeling (hydrodynamic, sediment, contaminant, and biological) capabilities. In addition, this component should be accounted for consistent with SAC candidate and study set criteria developed for contaminants, critical habitat, locations, and species of interest. **(RD)**
(A.5.2-2)	Hanford contamination that may have the potential to significantly affect the creation or mitigation of present or future critical locations (defined in Section II-A.6.3) in the Columbia River environment shall be identified.	Columbia River		SAC Work Group	Low	High	Consistent with the SAC contaminant candidate and study set criteria and critical habitat and uptake locations candidate and study set criteria, contamination in the Columbia River environment that has the potential to contribute to critical habitat or drinking water contamination should be identified. Significant characterization efforts, the design based on existing observational data and model predictions, would be necessary. A major challenge here (and identified in the RTE) is the differentiation between Hanford and non-Hanford contamination. **(RD)**
(A.5.2-3)	Columbia River chemical and physical environment with the potential for precipitating out Hanford chemicals shall be identified.	Columbia River			High	Medium	The chemical and physical environment within the Columbia River with the potential for precipitating out Hanford chemicals is accounted for in the fate and transport models (hydrodynamic, sediment, and contaminant). In addition, biological fate and transport is also accounted for the in the current assessment plan. **(RD)**
(A.5.2-4)	Local contamination of drinking water in the study area shall be assessed.	Columbia River			High	Medium	Drinking water systems within the study area are currently included by definition as a critical location. The potential to redistribute and concentrate contaminants outside of the river environment through this pathway should be considered. (**RD)**
(A.5.2-5)	Columbia River changes that affect habitat and species changes shall be identified for inclusion in the contaminant redistribution assessment.	Columbia River		SAC Work Group	High	Medium	Fate and transport modeling should account for changes in the Columbia River to the extent practical and agreed upon through the SAC. This may be in the form of alternative scenarios upon which to apply the fate and transport model or adjustments to the fate and transport model as a result of significant changes in the Columbia River that render current fate and transport models obsolete. It is anticipated that the SAC, river impacts evaluation, and risk assessment criteria will remain representative of environmental conditions (current, anticipated, or theoretical). **(RD)**
(A.5.2-6)	Peak contaminant concentrations in habitat shall be assessed.	Risk		SAC Work Group	Medium	Medium	All contaminant concentrations (observed or predicted) should be used as agreed upon through the SAC and as appropriate given known limitations of data and objectives of assessment. It would appear likely that the use of maximum contaminant concentrations would be appropriate under some circumstances. (RD)
(A.5.2-7)	Biotic redistribution and concentration of contaminants in habitat shall be identified.	Columbia River			High	Medium	Redistribution of contaminants through biological uptake, transport, and degradation should be accounted for through the fate and transport modeling (hydrodynamic, sediment, biological, contaminant) capability. See A5.0-4 and A5.2-3. **(RD)**
A.5.3 Contaminant Transport in the River							

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A.5.3-1)	Contaminant dilution and reconcentration (contaminant concentration) shall be identified.	Columbia River			High	Low	Contaminant dilution and potential reconcentration is included in the current river fate and transport models (hydrodynamic, sediment, contaminant, and biological). **(RD)**
(A.5.3-2)	Non-uniform distribution of contaminants in the Columbia River shall be considered. Examples are near sources of contaminated groundwater and locations where contaminants concentrate or local inventories accumulate.	Columbia River			High	Low	The fate and transport models should account for non-uniform distribution of contaminants in the Columbia River. Pasts studies have indicated the need for evaluations of localized effects attributable to contaminated groundwater entry, areas of significant sedimentation, and/or areas of potential contaminant reconcentration. **(RD)**
(A.5.3-3)	Hydrodynamic behavior that affects habitat contamination shall be represented. Examples are laminar flow and weak turbulence.	Columbia River			High	Low	Current fate and transport modeling plans call for the development of a hydrodynamic model that is representative of the river, to include laminar flow or weak turbulence (?) as appropriate. **(RD)**
(A.5.3-4)	The interactions of multiple phases shall be identified. Examples are water solution, settled sediment, organic sediment, and suspended particulates in the water column.	Columbia River			High	Low	Fate and transport models should account for multiple phases. In addition to soluble contaminants, settled sediment, organic sediment, and suspended sediment, the biological component should also be considered. **(RD)**
(A.5.3-5)	Mapping of current contaminant inventories at intermediate locations within the study region shall be performed.	Columbia River			Low	High	Current environmental conditions and those observed as a result of additional characterization activities should be presented in a manner consistent with the intended uses and objectives of the assessment activity as defined through the SAC. Presently there is no definition of "intermediate" locations or "intermediate" contaminant levels. It is currently anticipated that contaminant entry locations/areas, critical habitat, critical uptake locations, species of interest distributions, and significant contamination deposits, should be mapped. **(RD)**
(A.5.3-6)	Future contaminant inventories at Columbia River locations, particularly in habitat, shall be identified.	Columbia River	Y		High	Low	development of fate and transport modeling capabilities provides the ability to predict future contaminant concentrations and inventories. Combined with the identification of critical habitat, critical uptake locations, and species of interest distributions, this allows for significant future contaminant inventories to be predicted, consistent with the SAC. **(RD)**
(A.5.3-7)	Effects of natural phenomena (such as reduction of Columbia River water oxygen and pH as a result of organics decomposition) on Hanford contaminants shall be identified.	Columbia River			Medium	Medium	Effects of changing pH, oxygen content, and organic content and other physical, chemical, and/or biological conditions in the river should be accounted for in the parameterization of the fate and transport models. **(RD)**
(A.5.3-8)	Physical changes in the Columbia River causing remobilization of contaminants shall be considered.	Columbia River	Y		Medium	Medium	Physical changes in the Columbia River that result in the remobilization of contaminants should be accounted for in the fate and transport models, either through changing input parameters/scenarios in the predictive mode or in modifications to the model should such physical changes occur.**(RD)**
(A.5.3-9)	The effects of Columbia River water interaction with groundwater shall be identified. An example is the change in solubility of contaminants.	Columbia River			Medium	Medium	The groundwater/river interface models should account for the effects of the interaction of river water with groundwater. Changes in and effects of the physical, chemical, and biological conditions within the GW/River interface are currently included. **(RD)**
(A.5.3-10)	Annual and diurnal variations in river flow and conditions, such as temperature, salinity, and pH, shall be identified to establish limiting dose conditions. Effects on bank storage and upwelling and on influx shall be identified.	Columbia River	Y		High	Medium	Fate and transport models should be developed that are representative of river conditions, including annual and diurnal variations in river flow and water quality as appropriate. Effects of changing water levels on bank storage, upwelling, and contaminant influx should be considered and accounted for in the groundwater/river interface numerical model.**(RD)**
(A.5.3-11)	Interactions of seasonal peaks with biota shall be identified. An example is the effects of organic contaminants load on biological processes, such as birth.	Columbia River		SAC Work Goup	Low	High	Critical life stages and other sensitive endpoints as defined via the SAC, risk assessment, and impact evaluation endpoints, should be identified. Maximum contaminant concentrations (modeled or observed) should be evaluated against these endpoints as appropriate and agreed upon through the SAC. **(RD)**
(A.5.3-12)	Transport of contamination in the river shall be evaluated.	Columbia River			High	Low	This is a given, through the various fate and transport models. **(RD)**

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A.5.3-13)	Biota-driven redistribution of contaminants (mixing and relocation) shall be identified.	Columbia River			High	Low	Biota-driven redistribution of contaminants should be accounted for through the application of hydrodynamic, sediment, biological, and contaminant transport models. **(RD)**
(A.5.3-14)	The effects of dams, turbine repairs, or construction shall be identified.	Columbia River			High	Low	The effects of dams, turbine repairs, or construction can be identified and accounted for through the use of various scenarios and changing fate and transport model input parameters. The effects of these activities relative to the redistribution of Hanford contaminants should be accounted for through predictive modeling and/of observational data prior to, during, or following such events. **(RD)**
(A.5.3-15)	Scouring of Columbia River banks during periods of high river flow shall be identified.	Columbia River			Medium	Medium	Scouring of river banks during periods of high flow, as well as the influx of sediment during sloughing events, should be identified and accounted for through the modeling and observational data. To the extent possible, potential future scouring of known areas of contamination should be minimized and appropriate monitoring schemes established to document river conditions and potential impacts. **(RD)**
(A.5.3-16)	The effects of treated effluent discharged from Hanford remediation processes into the Columbia River shall be identified.	Columbia River			Low	High	Treated effluent discharges from Hanford remediation processes into the Columbia River are included in the Contaminant Entry component of the River Technical Element. Similarly, effluent discharges from non-Hanford entities are also included. **(RD)**
(A.5.3-17)	Effects of Hanford remedial actions on hydrological characteristics of the Columbia River shall be identified.	Columbia River			High	Low	While it is not likely that Hanford remedial actions will be of the magnitude to influence the hydrological characteristics of the Columbia River, such effects would be accounted for in the fate and transport models. **(RD)**
(A.5.3-18)	Interaction of Hanford contaminants with other materials in the river shall be identified. Examples are CrVI ? CrIII; pH, etc., at the river.	Columbia River	Y		Medium	Medium	See A5.3-4,7,10.**(RD)**
(A.5.3-19)	The effects of contaminant chemical changes along the transport path, such as changes in the transport medium, shall be identified. An example is groundwater to river water.	Columbia River/Ground water			High	Low	The effects of changing physical, chemical, and biological conditions through the transport path of specific contaminants of interest should be accounted for in the groundwater/river interface numerical model and the river fate and transport models. **(RD)**
(A.5.3-20)	Interaction of Hanford contaminants with offsite river impacts, such as agricultural sedimentation, shall be identified.	Columbia River			High	Low	Interaction of Hanford contaminants with offsite contaminant sources are accounted for in the Contaminant Entry component of the River Technical Element and carried through the fate and transport models. Sedimentation, suspended load and resuspension, resulting from agricultural practices would be accounted for in the sediment and contaminant transport models. **(RD)**
(A.5.3-21)	The effects of changes in the Columbia River from sources other than Hanford shall be identified when they contribute to Hanford-derived impacts. An example is additional non-Hanford pollutants interacting with Hanford contaminants.	Columbia River			High	Low	Ditto A5.3-7,8,19,20 **(RD)**
(A.5.3-22)	The effects of river conditions on chemical mobility shall be identified.	Columbia River			High	Low	Chemical mobility and changes therein due to changes in the river environment are accounted for as appropriate in the river fate and transport models. **(RD)**
(A.5.3-23)	Hanford thermal pollution shall be identified.	Columbia River		SAC Work Group	High	Low	The effect of thermal pollution from Hanford, should it occur, would be included in the river fate and transport modeling activity consistent with the need to include this contaminant in the SAC, risk assessment, and/or river impact evaluation. **(RD)**
A.5.4. Contaminant Transport by Sediments in the River							
(A.5.4.-1)	Transport of sediment by river water flow shall be explicitly represented.	Columbia River	Y	SAC Work Group	High	Low	Current plans call for a sediment transport model that will represent the transport of sediment in the river environment. **(RD)**

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A.5.4.-2)	Contaminant transport by moving sediments shall be evaluated.	Columbia River	Y	SAC Work Group	High	Low	A contaminant transport model, which couples the hydrodynamic, sediment and biological transport models is identified in the current plans for the River Technical Element. **(RD)**
(A.5.4.-3)	The representation of contaminant transport and accumulation by sediment shall support valid assessment of habitat contamination.	Columbia River			High	High	See A5.0-1,4; A5.3-3,4,5. **(RD)**
(A.5.4.-4)	Potential movement of disturbed sediment shall be evaluated. Hazards that could arise from sediment movement shall be identified.	Columbia River			High	Low	See A5.3-8,15; A5.4-1. Hazards that could arise from sediment movement should be identified through exposure models (Risk Element) and the SAC. **(RD)**
(A.5.4.-5)	Conditions leading to sediment resuspension shall be identified. Examples are the role of Hanford remediation activities on sediment resuspension and the effects of dredging.	Columbia River		SAC Work Group	Low	High	See A5.3-8,15; A5.4-1,2. Potential mechanisms for the movement of sediment should be accounted for within the SAC process and associated candidate and study set criteria for the inclusion of exposure mechanisms. **(RD)**
A.5.5 Contaminant Deposition and Accumulation							
(A5.5-1)	Contaminant reservoirs/sinks in the river shall be identified.	Columbia River			High	Low	See A5.0-1,4. Sediment and contaminant transport models should be capable of identifying probable areas of sedimentation (sinks). Continued characterization and monitoring activities should verify such areas. **(RD)**
(A5.5-2)	Initial contamination of sediment shall be evaluated.	Columbia River			Low	High	The need for additional characterization of sediment in the study area has been identified. Current monitoring programs are obtaining additional observational data relative to contaminants associated with sediment, within current funding limitations. **(RD)**
(A5.5-3)	Present and future peak sediment concentrations shall be evaluated.	Columbia River		SAC Work Group	Medium	Medium	Ditto A5.2-6. Current and predicted concentrations of contaminants in river sediments will be used as agreed upon through the SAC process. **(RD)**
(A5.5-4)	Contaminant accumulation and concentration by plants and algae at the Columbia River shall be identified.	Columbia River			High	Medium	Ditto A5.2-7 **(RD)**.
(A5.5-5)	Contaminated sediment accumulation in low velocity regions that are used as habitat shall be identified. Examples are fish habitat in regions behind large boulders, holes, sloughs, and large, down-stream pools.	Columbia River		SAC Work Group	Medium	Medium	Ditto A5.4-3. See A5.0-1,4; A5.3-3,4,5.**(RD)**
(A5.5-6)	Conditions affecting release of held-up contaminants shall be identified.	Columbia River			High	Medium	Ditto A5.2-3; A5.3-7,8,10,19,22. **(RD)**
(A5.5-7)	Conditions under which sediment or biota release contaminants to river water in response to physical or chemical river changes shall be identified.	Columbia River			High	Medium	Ditto A5.5-6 **(RD)**
(A5.5-8)	Future accumulation of contamination in sediment near contamination currently buried in sediment shall be evaluated.	Columbia River		SAC Work Group	High	Medium	Areas of contaminated sediment accumulation, current and predicted, should be accounted for within the sediment and contaminant transport models. See A5.0-1, A5.5-1, and A5.5-2. Need clarification as to rationale for evaluating future areas of contaminant accumulation near areas of current contaminated sediment accumulation. Why would this be handled differently than other conditions. Bottom line is the assessment must account for past, present, and potential future contaminants and evaluate impacts or assess risk per agreed upon endpoint criteria. **(RD)**
(A5.5-9)	Opportunities for microscale sorbtion shall be identified.	Columbia River	Y		High	High	The current plans for fate and transport model development include sorbtion to sediment as one of the critical physical-chemical-biological processes that must be considered in the models. There will be a need to collaborate and clarify “microscale sorbtion” during the development of these models. **(RD)**

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A5.5-10)	Locations of contaminant accumulations shall be mapped.	Columbia River			Low	High	Ditto A5.3-5. **(RD)**
(A5.5-11)	Bathymetric maps shall be developed in regions of the river where sediment settling could potentially occur.	Columbia River	Y		High	Low	Bathymetric maps have been identified as critical components for several activities relative to the River Technical Element including the development of the fate and transport models that would predict areas of sediment deposition and accumulation. **(RD)**
(A5.5-12)	Short-term and long-term hazards from buried sediment shall be identified, for example, at McNary Pool.	Columbia River		SAC Work Group	Low	High	Consistent with the SAC, risk technical element, and river impact evaluation criteria, potential short term hazards and potential long term hazards due to buried contaminated sediments will be evaluated as appropriate. **(RD)**
A.6 Critical Habitat and Uptake Locations							
(A6.0-1)	Candidate habitat locations within the study area shall be identified.	Vadose Zone/ Columbia River		SAC	Low	High	Agree. Candidate habitat locations will be developed as part of the dependency webs - see Item A7.0-1. It is the intent to identify candidate habitat locations within the study area. Current SAC working group activities are attempting to define criteria to select candidate sets. **(RD)**
(A6.0-2)	Cleanup impact on critical locations shall be assessed. (See Section II-A.11.)	Risk		SAC	Low	High	Agree. Critical locations are those where the contaminants and receptors intersect. While the contaminant flow will likely be modeled, the intersection will more likely qualitative. See A5.3-16&17, A5.4-5. The potential impacts of remedial actions themselves on critical habitat and uptake locations will be considered as any other potential impact through the SAC, risk technical element, and river impacts evaluations **(RD)**
(A6.0-3)	The spatial representation scheme shall support realistic representation of exposure to contaminants that occur at critical locations.	Risk		SAC (Risk Issue	Low	High	Agree. This ties to Section A7 - issues of scale Spatial scales necessary to perform the assessment should be determined to a large degree on the type and extent of areas of contaminant entry into and/or accumulation within the river environment and the characteristics of the specific exposure endpoint of interest. The groundwater/river interface component of the River Technical Element calls for the merging of spatial scales in the groundwater transport model to the scale necessary to evaluate the ecological impacts in the groundwater/river interface and/or the river itself. **(RD)**.
(A6.0-4)	Any habitats within the study area that are considered high priority or sensitive by the State of Washington shall be accounted for. To be identified are habitats critical to the well being of plant and animal species that are classified as threatened, endangered, or sensitive by the State of Washington, the State of Oregon, the federal government, and/or the Indian Nations.	Risk			Low	High	Agree. Webs should address this. Agree. In fact these would be good words to incorporate into the River Technical Element plan as at least partial definition of critical habitats. **(RD)**
(A6.0-5)	Suspect areas with unknown characteristics shall be identified.	Risk			Low	High	This item requires more clarification on what is meant by suspect areas. Identification of data gaps (areas on unknown characteristics) is included in the initial data gathering and evaluation activity included in the Information Management and Utilization component of the River Technical Element. Once identified, efforts will be made to fill the gaps to the extent practical consistent with the needs of the SAC, risk assessment, and river impacts evaluation. **(RD)**
(A6.0-6)	All available sources of information shall be catalogued and included in databases to the extent needed to meet assessment objectives.	River			Low	High	This will require agreement on the objectives from SAC and others. The River Technical Element includes a component aimed at exactly this issue. The Information Management and Utilization component will provide the means through which available sources of relevant data will be queried, mined as appropriate, evaluated, utilized

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
							in the risk assessment and river impacts evaluation, and archived. **(RD)**
A.6.1 Required Candidate Habitat Location Set							
(A6.1-1)	The Candidate Habitat Location Set shall identify all habitat with the potential to expose humans and biota to contaminants.	River			Low	High	Agree. Maps of the categories of habitat types should demonstrate Ditto A5.0-4. In addition, this element must be consistent with the exposure model/scenario candidate and study set criteria **(RD)**
(A6.1-2)	Criteria for determining the completeness of the range of habitat locations to be included in the Candidate Habitat Location Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	N/A			Low	High	An integration project management decision is needed to define an appropriate approval group.
(A6.1-3)	Locations of aquatic habitat regions shall be identified.	River			Low	High	Agree. Terrestrial habitat regions are also included in this study for completeness Locations of critical aquatic habitat regions, consistent with criteria for selection of candidate habitats should be identified. **(RD)** .
(A6.1-4)	Locations of salmon redds nesting habitat, where juvenile impacts occur, shall be identified.	River			Low	High	Specific subset of A6.1-1. Clearly, locations of salmon spawning activities fall into the critical habitat classification and will be included in the assessment. It should be noted that the qualifier "where juvenile impacts occur" is both presumptive that impacts are occurring and, more importantly, limiting in that only those spawning locations where impacts are occurring would be included in the assessment. **(RD)**
(A6.1-5)	All available data shall be considered in establishing candidate habitat locations. In particular, sampling and analysis done by the State of Oregon and also work done by the Bi-State Water Quality Commission shall be considered.	Vadose Zone/ River					Agree. These sources of information should be included in the development of the webs. Ditto A6.0-6 **(RD)**.
(A6.1-6)	Locations of geochemical and groundwater impacts stemming from cleanup actions shall be identified.	Groundwater/ River			Medium	Medium	Agreed. An example of this is 183-H. SAC will need to provide other groups with their needs for data (e.g. NRDA, Feasibility Studies, Monitoring Post Cleanup, Cleanup Actions) Groundwater Technical Element requirement. Key in the River Technical Element is how these changes may result in changes in the point of entry or magnitude of contaminants of interest and , ultimately, some potential impact to the river environment. **(RD)**
(A6.1-7)	Bottom-feeding fish habitat locations shall be identified. An example is the habitat of sturgeon, a long-lived species.	River			Low	High	Specific subset of A6.1-1 Consistent with SAC, risk assessment, river impact evaluation, candidate species of interest criteria, and candidate set critical habitat and uptake locations criteria, bottom feeding fish habitat should be identified. It is anticipated, based on experience and past assessment results, that habitat favorable to bottom feeding fish will be included in the candidate study set. **(RD)**
(A6.1-8)	Habitat located near outfall pipes shall be identified.	River			Low	High	Specific subset of A6.1-1 Are the authors stating that any habitat near the outfall pipes is defined to be critical? Critical habitat will be identified consistent with the agreed upon definition of, and candidate set criteria for, critical habitat and critical uptake locations. The habitat near

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
							outfall pipes should be included in the characterization of habitat within the study area and in the determination of "critical habitat" per the candidate set criteria. **(RD)**
(A6.1-9)	Habitat located where groundwater enters the river shall be identified.	Groundwater/ River			Medium	Medium	Specific subset of A6.1-1 Are the authors stating that any habitat where groundwater enters the river is defined to be critical? Groundwater enters the Columbia River essentially all along the Hanford Reach, much of this is not contaminated as a result of Hanford operations. Critical habitat should be identified consistent with the agreed upon definition of, and candidate set criteria for, critical habitat and critical uptake locations. The habitat where groundwater enters the river will be included in the characterization of habitat within the study area and in the determination of "critical habitat and uptake locations" per the candidate set criteria. **(RD)**
(A6.1-10)	Bank storage, recharge, and discharge of groundwater near the river due to varying river levels shall be identified.	River			Medium	Medium	Specific subset of A6.1-1 Agreed, however, consistent with SAC, risk assessment, river impacts evaluation, and candidate set criteria for critical habitat and uptake locations, it is anticipated that the focus will be placed on those areas where contaminated groundwater enters or is near the river. Consideration of variable river levels is a key factor in understanding the relationships and dynamics of the groundwater/river interface **(RD)**
(A6.1-11)	Locations on the Hanford Site that are related to Columbia River use shall be identified, including the Hanford reach as a whole, but particular noting the following:	River			Low	High	Specific subset of A6.1-1 Consistent with SAC, risk assessment, river impact evaluation, candidate species of interest criteria, and candidate set critical habitat and uptake locations criteria, locations that are used along the Hanford Reach should be identified. It is plausible that some of the "locations" described here will be established as part of the candidate set criteria for identifying the critical habitat and uptake locations. **(RD)**
	B Reactor (mile 384.1 - 383.9)	River			Low	High	Specific subset of A6.1-1
	K Reactor (mile 381.8 - 380.9)	River			Low	High	Specific subset of A6.1-1
	N Reactor (mile 379.4 - 378.5)	River			Low	High	Specific subset of A6.1-1
	islands: D Island (mile 376.9 - 376.5)	River			Low	High	Specific subset of A6.1-1
	H Reactor (mile 372.7 - 372.3)	River			Low	High	Specific subset of A6.1-1
	sturgeon habitat in river bottom holes near F reactor (mile 367.6 - 367.0)	River			Low	High	Specific subset of A6.1-1
	sloughs and backwaters: F Slough, H Slough, White Bluffs Slough, Hanford Slough (mile 372.7 - 372.3), below the Washington Public Power Supply system	River			Low	High	Specific subset of A6.1-1

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	springs below Hanford town site (mile 372.7 - 372.3)	River			Low	High	Specific subset of A6.1-1
	known areas of past or present contaminant influx, or culturally or ecologically sensitive areas, such as: marshy areas: tules; 300 Area shore; outfalls; and, foods and medicines in riparian region.	River			Low	High	Specific subset of A6.1-1
A.6.2 Required Candidate Habitat Features Set							It is not real clear what the differences are in this section (A6.2), Required Habitat Features Set, and section A6.1, Required Candidate Habitat Location Set. Clearly, once critical habitat and uptake locations are identified they will be described (including "land features") and characterized to the extent appropriate. **(RD)**
(A6.2-1)	The Candidate Habitat Features Set shall identify Columbia River and land features needed to support realistic representation of contact between receptors and contaminants.	River					Please clarify habitat features. Does this mean to include the ability to evaluate landscape or watershed impacts? We think this ties to risk characterization. Agreed. Physical features may be appropriate as candidate set criteria for determining critical habitat and uptake locations??? **(RD)**
(A6.2-2)	Criteria for the completeness of the range of habitat features to be included in the Candidate Habitat Features Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	N/A					An integration project management decision is needed to difine an appropriate approval group. Accepted.
(A6.2-3)	Columbia River and land features that contribute to selected impacts shall be identified.	River					Please clarify habitat features. Does this mean slopes which would funnel water, features that would cause concentration? It is not clear how one is to "select impacts" for which Columbia River and land features are to be identified. Clearly, if potential impacts are observed along the study area and they are attributed to land features as opposed to Hanford contaminants this will be identified. Also, if unique features (river or land) tend to concentrate contaminants or are associated with critical habitat, this also will be identified and considered as appropriate for interpretation of predictive assessment results. **(RD)**
(A6.2-4)	Land features that support evaluation of stream-side habitat shall be identified.	River					Agree. Input from Fish & Wildlife would be used here. Habitat should be characterized throughout the study area. Relationships between a specific habitat type and land or river features should be defined. **(RD)**
(A6.2-5)	Salmon redds shall be characterized to support assessment of current and future impact to salmon reproduction.	River					It is not clear if this is referring to sedimentation. Characterization necessary for the conduct of the assessment, consistent with the needs of the SAC, risk assessment, fate and transport model development, critical habitat definition, species of interest identification, and river impacts evaluation is currently included in the River Technical Element. It is anticipated that there is a need for further characterization of salmon redds relative to location with respect to contaminated groundwater plumes and contaminant concentrations in the hyporheic zone. **(RD)**
(A6.2-6)	Habitat for candidate species shall be identified, both as a receptor for contamination and as a supporting environment for the candidate receptors. (See Section II-A.7.)	River					Agree. Also, certain species may act as stressors to species of interest. Habitat within the study area for candidate species should be identified. It is anticipated that the identification of critical habitat and candidate species, and the criteria for determining the same, will be linked to some extent. **(RD)**

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
A.7 Receptors and Exposure Pathways							
(A7.0-1)	An all-inclusive, internally consistent set of receptors shall be identified to include river-dependent humans, plants, animals, and groups whose activities bring them into contact with river corridor resources. These activities include, but are not limited to, sustenance, recreational, commercial, religious, and cultural practices. The term "receptor" also includes the culture of affected population groups (for example, the Yakama Indian Nation and Hispanic migrant farm workers) as well as the economic viability of commercial groups (for example, agriculture and river barge transportation). This requirement includes those candidate receptors who come into contact with river resources even though they may be a considerable distance from the river corridor under study. Examples include those coming into contact with commercially marketed fish, wide-ranging animals that drink at the river, water fowl, distributed municipal water, irrigation water, wind-blown sediments, and hydroelectric parts or equipment	Risk		SAC Work Group	Low	High	Receptor inputs to the webs. Also includes potential future uses.
(A7.0-2)	All interactions with river resources that may lead to contaminated habitat, food, or receptors and that contribute to exposure levels shall be identified.	Risk			Low	High	Webs are intended to illustrate interactions between receptors and contaminants.
(A7.0-3)	All humans, animals, and plants that use habitat in the study area shall be considered as candidate receptors.	Risk			Low	High	Receptor inputs to the webs
(A7.0-4)	Pathway webs shall be developed that capture the relationships of the candidate receptors to river resources. Different relationship webs may be needed for each type of potential impact such as health effects, economic effects, and cultural practices. All such webs are expected to embody many of the river ecosystem relationships.	Risk			Low	High	Webs to be considered are cultural, health, economic
(A7.0-5)	Intrusion scenarios that result in potential contaminant transport into the river corridor shall be identified for both humans and biota.	Risk			Low	High	Please clarify intrusion scenarios. Give examples.
(A7.0-6)	Exposure mechanisms related to airborne contaminants shall be identified for both humans and biota.	Risk			Low	High	Pathway input for the webs.
A.7.1 Required Candidate Receptors Set							
(A7.1-1)	The Candidate Receptors Set shall include all species that could potentially be subjects of harm from Hanford contaminants at any time within	Risk		SAC Work Group	Low	High	Traditionally children and older people are more sensitive. Some ethnic groups have certain genetic suceptabilities.

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	the period covered by the assessment.						
(A7.1-2)	Criteria for determining the completeness of the range of species to be included in the Candidate Receptors Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Risk		SAC Work Group and Policy			Webs should identify these groups.
(A7.1-3)	All species that enter into the representation of ecosytem structure and ecosystem dynamics shall be included in the Candidate Receptors Set.	Risk		SAC Work Group	Medium	Medium	Specific subset of A7.1-1
(A7.1-4)	All species that enter into the representation of ecosystem functions and services to stakeholders shall be included in the Candidate Receptors Set.	Risk			Low	High	Specific subset of A7.1-1
(A7.1-5)	All new competing species that have been introduced in, or could spread into, the study area, particularly those that could affect ecosystem robustness and stability, shall be included in the Candidate Receptors Set.	Risk			Low	High	Specific subset of A7.1-1
(A7.1-6)	All species that contribute to sustaining the existing trophic structure shall be included in the Candidate Receptors Set.	Risk			Medium	High	Specific subset of A7.1-1
(A7.1-7)	All species that compete with species included in the Candidate Receptors Set or that have the potential to alter the trophic structure by eliminating any included species shall also be included in the Candidate Receptors Set.	Risk					Specific subset of A7.1-1
(A7.1-8)	Particular attention shall be given to including all species at lower trophic levels in the Candidate Receptors Set to support assessment of biological contamination pathways. (See Section II-A.7.3.)	Risk					Specific subset of A7.1-1
(A7.1-9)	All species that entering into cultural dependency webs shall be included in the Candidate Receptors Set. (See Section II-A.7.4.)	Risk			Low	High	Specific subset of A7.1-1
(A7.1-10)	All species that carry contaminants between the riparian region and the terrestrial zone on the Hanford Site shall be included in the Candidate Receptors Set.	Risk					Specific subset of A7.1-1
(A7.1-11)	All edible plants, or classes of edible plants, shall be included in the Candidate Receptors Set. Examples are asparagus, wild onions, mule deer, fish, and herons.	Risk					Specific subset of A7.1-1
(A7.1-12)	All biota or socio-economic entities introduced as "Receptors of Concern" in Section II-A.7.5 shall be included in the Candidate Receptors Set.	Risk			Medium	Medium	Specific subset of A7.1-1
(A7.1-13)	All game animals shall be included in the Candidate Receptors Set.	Risk					Specific subset of A7.1-1
(A7.1-14)	All species considered to be indicators of environmental quality shall be identified and included in the Candidate Receptors Set. An	Risk			Medium	Medium	Agree.

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	example is the presence or absence of freshwater mollusks, which may be an excellent indicator of river dynamics.						
(A7.1-15)	All species classified as threatened, endangered, candidate, or sensitive species by the states, federal agencies, or Indian Nations and that depend on the Columbia River for survival, directly or indirectly, shall be included in the Candidate Receptors Set. Examples are the Great Blue heron, Columbia River limpet, Columbia River pebble snail, and salmon.	Risk			Low	High	A literature search will be needed.
(A7.1-16)	Species that bioconcentrate contaminants and/or their effects and pass them on to their offspring shall be included in the Candidate Receptors Set.	Risk					Food chain models exist, but will need to be modified to deal with multigenerational effects.
A.7.1.1 Required Human Populations to be Included in the Candidate Receptors Set							
(A7.1.1-1)	The most impacted human populations that can be identified shall be included in the Candidate Receptors Set.	Risk		SAC Work Group	Low	High	Traditionally children and older people are more sensitive. Some ethnic groups have certain genetic suceptabilities.
(A7.1.1-2)	The human populations needed to evaluate equity and fractional impact to (the most impacted) groups shall be included in the Candidate Receptors Set.	Risk		SAC Work Group	Low	High	Webs should identify these groups.
(A7.1.1-3)	The following populations shall be included in the Candidate Receptors Set:	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
	a. Tri-Cities residents	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
	b. agricultural residents	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
	c. wildlife refuge and wild and scenic river rangers	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
	d. hunters and fishers	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
	e. recreational users	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
	f. industrial workers	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
	g. fish hatchery workers	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
(A7.1.1-4)	The following Native American populations shall be included in the Candidate Receptors Set:	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	a. subsistence residents living a traditional life style (unrestricted use)	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
	b. hunter/gatherers	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
	c. cultural activities visitors	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
	d. Columbia River island users	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
(A7.1.1-5)	Populations, in some cases related to cultural affinity, which depend on the Columbia River shall be included in the Candidate Receptors Set. An example is Southeast Asians with their fish-oriented culture.	Risk		SAC Work Group	Low	High	Specific subset of A7.1-1
A.7.2 Required Candidate Exposure Mechanisms Set							
(A7.2-1)	The Candidate Exposure Mechanisms Set shall include all the exposure mechanisms that potentially result in contact between harmful contaminants and receptors.	Risk			Low	High	Agree. The direct and indirect mechanisms for exposure of receptors to contaminants will be identified here.
(A7.2-2)	Criteria for determining the completeness of the range of exposure mechanisms to be included in the Candidate Exposure Mechanisms Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Risk					Accept. An integration project management decision is needed to define an appropriate approval group.
(A7.2-3)	All forms of proximity or contact leading to ingestion, inhalation, dermal exposure, or external radiation exposure shall be included in the Candidate Exposure Mechanisms Set.	Risk					Subset of A7.2-1
(A7.2-4)	Exposure mechanisms resulting in uptake of contaminants by contaminated humans, plants, and animals transporting contaminants offsite shall be included in the Candidate Exposure Mechanisms Set.	Risk					Subset of A7.2-1
(A7.2-5)	Exposure mechanisms associated with collecting, eating, and using edible plants and medicines shall be included in the Candidate Exposure Mechanisms Set.	Risk					Subset of A7.2-1
(A7.2-6)	Exposure mechanisms resulting in uptake of contaminants by threatened, endangered, candidate, and sensitive species shall be included in the Candidate Exposure Mechanisms Set.	Risk					Subset of A7.2-1
(A7.2-7)	Exposure mechanisms that result in uptake of contaminants by game animals shall be included in the Candidate Exposure Mechanisms Set.	Risk					Subset of A7.2-1

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A7.2-8)	Exposure mechanisms that result in uptake of contaminants by indictor species shall be included in the Candidate Exposure Mechanisms Set.	Risk					Subset of A7.2-1
(A7.2-9)	Exposure mechanisms that involve contact between receptors and contaminants transported by intruders to the Columbia River species shall be included in the Candidate Exposure Mechanisms Set.	Risk					Subset of A7.2-1 Development of these scenarios will require a literature search and consultation with stakeholder groups.
(A7.2-10)	Exposure mechanisms associated with inhalation of volatized contaminants, including aerosols, shall be included in the Candidate Exposure Mechanisms Set.	Risk					Subset of A7.2-1
(A7.2-11)	Inhalation of surface contamination shall be included in the Candidate Exposure Mechanisms Set.	Risk					Subset of A7.2-1
A.7.3 Required Candidate Pathways Set							
(A7.3-1)	The Candidate Pathways Set shall be formed by including all biological interactions that result in transfer of harmful contaminants between receptors.	Risk		SAC	Medium	Medium	Agree. Webs and transport should cover these.
(A7.3-2)	Criteria for determining the completeness of the range of pathways to be included in the Candidate Pathways Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Risk					Agree. An integration project management decision is needed to define an appropriate approval group.
(A7.3-3)	Direct human exposure pathways shall be included in the Candidate Pathways Set.	Risk		SAC Work Group	Low	High	Agree.
(A7.3-4)	Food web pathways accounting for indirect human exposure shall be included in the Candidate Pathways Set. Examples are transmission of hazardous materials to humans from contaminated fish and game.	Risk		SAC Work Group	Low	High	Specific subset of A7.3-1
(A7.3-5)	Hazardous materials transmission from prey to predator shall be included in the Candidate Pathways Set.	Risk		SAC Work Group	Low	High	Specific subset of A7.3-1
(A7.3-6)	Hazardous materials transmission from environmental media to plants shall be included in the Candidate Pathways Set.	Risk		SAC Work Group	Low	High	Specific subset of A7.3-1
(A7.3-7)	Pathway/dose analysis shall not be over generalized by dependency on surrogate equivalency assumptions.	Risk		SAC Work Group	Low	High	This is a value judgement and will require feedback
A.7.4 Required Candidate Cultural Dependency Webs							
(A7.4-1)	The Candidate Cultural Dependency Webs Set shall be formed by including all dependency	Risk		SAC Work Group	Low	High	Agree.

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	webs that result in damage to cultural practices and institutions.						
(A7.4-2)	Criteria for determining the completeness of the range of cultural dependency webs to be included in the Candidate Cultural Dependency Webs Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Risk					Agree. An integration project management decision is needed to define an appropriate approval group.
(A7.4-3)	Cultural dependency webs associated with minority cultures located in the vicinity of the study area shall be defined and included in the Candidate Cultural Dependency Webs Set. Examples are cultures of Native American Nations and Hispanic farm workers.	Risk		SAC Work Group	Low	High	Agree. Subpopulations such as Hispanic farm workers needs to be included in the development of the webs.
(A7.4-4)	Hanford-related contamination that affects Native American cultures, in particular the cultures of the Nez Perce, Umatilla and Yakama tribes, shall be incorporated in the appropriate cultural dependency webs. Contamination of the following shall be included:	Risk					Agree. Need to include Wanapum Band.
	a. contamination of ceremonial and religious areas	Risk					
	b. contamination of artifacts	Risk					
	c. contamination of traditional foods and medicines	Risk					
	d. role of Hanford contaminants in the degradation or destruction of the Columbia River ecosystem	Risk					
(A7.4-5)	Dependency webs for agriculture and tourism shall be defined and included in the Candidate Cultural Dependency Webs Set.	Risk					Agree. Other commericial practices need to be included in the dependency webs.
(A7.4-6)	Probable cultural and life style changes shall be considered as they alter pathways and cultural dependency webs.	Risk					Agree. This information should be developed as part of the webs.
A.7.6 Required Quantification of Human Exposures							
(A.7.6-1)	Evaluation of the Native American subsistence scenario shall include the following effects:	Risk					Agree. Same as A7.3-1
	a. differential patterns of consumption, especially consumption of natural foods and medicines, plus additional exposures due to cultural practices	Risk					Agree. This will require close interaction with potentially affected groups to provide the information.
	b. differences in sensitivity due to age, gender, activity clusters, physiology, and background	Risk					Agree.

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	nutritional factors						
(A.7.6-2)	Social activities that focus on the Columbia River and its resources or environs shall be considered.	Risk					Agree. Information will be developed as part of the webs.
(A.7.6-3)	Native American religious activities that focus on the Columbia River, its resources, and its sacred geography that are vulnerable to Hanford contaminants shall be included in exposure quantification. These activities shall be defined only as permitted and approved through tribal consultation.	Risk					Agree.
A.8 Dose Assessment							
(A8.0-1)	Dose measures and attributes identified shall be sufficient to correlate with all candidate impacts identified in Section II-A.9.	Risk		SAC Work Group			Agree. Note dose includes exposure to radionuclides and hazardous chemicals.
(A8.0-2)	Dose transfer or uptake effectiveness for the activities included in the exposure scenarios defined in Section II-A.7 shall be defined for each receptor group having different activities in relationship to river resources and potential exposure. Examples include contacted contaminant mass taken up and bioaccumulation in the different scenarios for fishery and related river workers, farm workers where irrigation water is used, Native Americans, Tri-Cities residents, and metropolitan area industrial and office workers.	Risk		SAC Work Group			Input from Natural Resource Trustees on their ongoing activities addressing bioaccumulation issues.
A.8.1 Required Candidate Dose Measures Set							
(A8.1-1)	The Candidate Dose Measures Set shall be formed by including all dose measures that might be needed to provide an basis for impact quantification.	Risk		SAC Work Group			Agree.
(A8.1-2)	Criteria for determining the completeness of the range of dose measures to be included in the Candidate Dose Measures Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Risk		SAC Work Group			Agree. An integration project management decision is needed to define an appropriate approval group.
(A8.1-3)	Dose measures in the Candidate Dose Measures Set shall support assessment of the impacts and tolerance (vitality) identified in the "Candidate Impacts Set" required in Section II-A.9.1.	Risk		SAC Work Group			S&T may be needed to define measures of tolerance.
(A8.1-4)	Measures of short-term, acute exposures and long-term, chronic exposures of receptors to hazardous contaminants shall be included in the	Risk					Subset of A8.1-1. Possibly create a matrix of webs, receptors, exposure. The duration of exposure is characterized by longevity of contact, rate, amount, and lifestyle activity.

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	Candidate Dose Measures Set.						
(A8.1-5)	Dose measures shall support characterization of the effects of dose duration/intensity, including multi-generational doses, and shall support correlation with impacts included in the Candidate Impact Set.	Risk					Literature search will be needed.
(A8.1-6)	Dose measures that support evaluation of combined and synergistic effects of multiple contaminants, including background and exposures from non-Hanford sources, shall be included in the Candidate Dose Measures Set.	Risk			Low	High	Initial pass would be a literature search for relevant synergistic effects, perhaps using the QSAR (quantitative structure activity relationship) methodology.
(A8.1-7)	Measures of chemical concentration in body tissue shall be included in the Candidate Dose Measures Set.	Risk			Rad - High	Haz Chem - High	This may require studies to determine tissue distributions for certain chemicals.
A.8.2 Required Candidate Dose Attributes Set							
(A8.2-1)	The Candidate Dose Attributes Set shall be formed by including all dose attributes that might be needed to provide a basis for impact quantification.	Risk		SAC Work Group			Agree.
(A8.2-2)	Criteria for determining the completeness of the range of dose attributes to be included in the Candidate Dose Attributes Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Risk		SAC Work Group			Agree. An integration project management decision is needed to define an appropriate approval group.
(A8.2-3)	Association of dose measures with body organs shall be specified in the Candidate Dose Attributes Set.	Risk		SAC Work Group			Subset of A8.1-7.
(A8.2-4)	The statistical properties of dose relevant to assessing dose to a given, most exposed fraction of a population shall be identified and included in the Candidate Dose Attributes Set in consultation with the System Assessment Capability Team and shall be subject to its approval.	Risk					Agree. The webs should identify the most exposed subpopulations. Standard change.
A.8.3 Required Quantification of Relationships Between Exposure and Doses							
(A8.3-1)	Age and gender shall be considered in establishing humans absorption or uptake efficiency.	Risk					Agree. These identify receptor types
(A8.3-2)	Small gene pools shall be included in relations between long term, cumulative exposures and doses. Examples are small Native American tribal gene pools and salmon gene pools.	Risk					A literature search should be done to determine if there is a S&T need.
A.9 Receptor Impact and Tolerance Assessment							

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A9.0-1)	Acute health effects shall be assessed. An example is subchronic effects from various exposures at fluctuating seasonal or peak exposure conditions.	Risk		SAC Work Group	High	Low	Agree. Both effects shall be included in the candidate set.
(A9.0-2)	Chronic health effects including delayed health effects and cumulative effects from long-term, including multi-generational, doses shall be assessed.	Risk	See comment	SAC Work Group	High	Low	Dose response information must be developed as appropriate. (may not be acheivable)
(A9.0-3)	The full range of genetic effects shall be assessed in all affected populations.	Risk	See comment	SAC Work Group	Low	High	Genetic response information must be developed as appropriate. (may not be acheivable) Some effects assessed initially for some populations
(A9.0-4)	The impact to community, tribal, and other populations' quality of life shall be assessed. This includes impact to jobs, housing, produce markets, and recreational opportunities.	Risk	Metrics needed for some	SAC Work Group	Low	High	Initial assessment at high level
(A9.0-5)	The impact to tribal quality of life shall be assessed and include, but not be limited to, the following:	Risk					This will be developed through the web process.
	a. restrictions on access to ancestral lands and heritage resources	Risk			Low	High	Surrogate or proxy scale (e.g. acreage)
	b. interruption of transfer of educational and spiritual knowledge within the community and between generations	Risk			Low	High	Metrics need definition.
	c. damage to cultural and religious values and sacred landscapes	Risk			Low	High	Metrics need definition.
	d. culturally important sites and resources lost/restored within the study area	Risk			Low	High	Metrics need definition.
	e. loss of sustainability for economic and environmental practices	Risk			Low	High	Metrics need definition.
	f. lost/gained access to open spaces	Risk			Low	High	Metrics need definition.
	g. visual and aesthetic impact to landscape	Risk			Low	High	Metrics need definition.
	h. lost/gained trust in governing institutions	Risk				High	Metrics need definition.
	I. cost of avoiding exposure and illness	Risk			Low	High	Metrics need definition.
(A9.0-6)	Impact measures that quantify all impacts assessed shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Risk		Policy Work Group			Std change.
A.9.1 Required Candidate Impact Set							

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A9.1-1)	The Candidate Impact Set shall be formed by including all of the known impacts that may be related to Hanford contaminants of concern.	Risk		SAC Work Group		High	Agree.
(A9.1-2)	Criteria for determining the completeness of the range of impacts to be included in the Candidate Impact Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Risk				High	SAC Working group will establish criteria
(A9.1-3)	Dependencies between impacts shall be documented in the Candidate Impact Set.	Risk		SAC Work Group		High	These dependencies will be addressed by the development of webs
A.9.1.1 Environmental Impacts to be Included							
(A9.1.1-1)	Direct harm to the ecosystem and damage to ecosystem robustness, resiliency, viability, and sustainability shall be included in the Candidate Impact Set.	Risk	to develop measures	SAC Work Group	Low	High	Functions need to be developed/selected
(A9.1.1-2)	Impacts of exposures on populations in terms of growth, maintenance, and reproduction shall be included in the Candidate Impact Set.	Risk		SAC Work Group	Medium	High	May best be known for dose to humans from radionuclides
(A9.1.1-3)	Impacts of Hanford contaminants on endangered species and migratory birds shall be included in the Candidate Impact Set.	Risk		SAC Work Group	Medium	High	Foodweb models exist; Data may not be adequate for species of interest
(A9.1.1-4)	Impacts on the ability of the ecosystem to support cultures without damage to itself shall be included in the Candidate Impact Set.	Risk			Medium	High	Literature search may be needed to define the metrics;
(A9.1.1-5)	Direct mortality in animal populations shall be included in the Candidate Impact Set.	Risk			Medium	High	Difficult to assess for mixtures of contaminants and populations
(A9.1.1-6)	Ecotoxicity to individual members of key species exposed through a food web shall be included in the Candidate Impact Set.	Risk			Medium	High	See A.9.1.1-3
(A9.1.1-7)	Reversible and irreversible damage to species shall be included in the Candidate Impact Set. An example of irreversible harm is mutagenic effects on salmon.	Risk			Low	High	Metrics need definition
(A9.1.1-8)	Impacts on population size in animal species shall be included in the Candidate Impact Set.	Risk			Medium	High	Population size not known for some species
(A9.1.1-9)	Cumulative impacts to a species from multi-generational exposures shall be included in the Candidate Impact Set.	Risk	Need metrics			High	Models will need to be developed
(A9.1.1-10)	Damage at levels that could potentially impact the gene pool of any species shall be included in the Candidate Impact Set.	Risk			Low	High	Subset of A.9.1.1-7; Genetic impacts of contamination
(A9.1.1-11)	Loss or restoration of all species population stability shall be included in the Candidate Impact Set.	Risk			Low	High	Literature search may be needed to define the metrics.

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A9.1.1-12)	Loss of reproductive effectiveness shall be included in the Candidate Impact Set.	Risk			Low	High	Data may be lacking
(A9.1.1-13)	Effects from genetic changes shall be included in the Candidate Impact Set.	Risk			Low	High	Data may be lacking
(A9.1.1-14)	Changes to locally threatened species population or viability from competition between species shall be included in the Candidate Impact Set. An example is locally threatened bottom fish species.	Risk			Low	High	Competition models
(A9.1.1-15)	Impacts of contaminants on competition between species shall be included in the Candidate Impact Set. An example is competition between pike and salmon.	Risk			Low	High	Competition models likely not well defined for contaminant impact
A.9.1.2 Impacts on Humans to be Included							
(A9.1.2-1)	All adverse effects at the individual level and over multiple generations shall be included in the Candidate Impact Set.	Risk			Medium	High	Existing models for individual impacts can be segmented into generations, with the exception of assessment models used in MTCA, CERCLA which generally focus on 30 years.
(A9.1.2-2)	All adverse effects from actions to avoid exposure shall be included in the Candidate Impact Set.	Risk	Yes			High	Need an example of what was intended, but is thought to be not addressed by current techniques
(A9.1.2-3)	All impacts from enforced cultural changes shall be included in the Candidate Impact Set.	Risk		SAC Work Group	Low	High	Part of Web work; Socio-cultural
(A9.1.2-4)	All known effects on humans that could occur over the time period of the assessment shall be included in the Candidate Impact Set.	Risk	All known effects		Time-High	All known effects- High	Time periods (generations, length of existence of hazard)
(A9.1.2-5)	Impacts of concern to vulnerable populations shall be included in the Candidate Impact Set.	Risk	Peer review				Needs identification of vulnerable populations for webs
(A9.1.2-6)	Cancer risk to populations over the duration of contamination shall be included in the Candidate Impact Set.	Risk	Peer review		High	Low	Accuracy may diminish over longer times, will require some modifications but is doable
(A9.1.2-7)	Mutagenic and clastogenic effects on humans shall be included in the Candidate Impact Set.	Risk	Peer review		Rad-High HazChem-Medium	HazChem-Medium	Literature search may be needed.
(A9.1.2-8)	Overt teratogenic effects on humans due to structural or chromosomal factors, as well as fetal loss and spontaneous abortion, shall be included in the Candidate Impact Set.	Risk	Possibly		Medium	Medium	Needs literature search for information on known teratogens
(A9.1.2-9)	Developmental effects on humans shall be included in the Candidate Impact Set. Examples are failure to thrive, developmental delays, and learning and behavioral deficits.	Risk	Possibly		Medium	Medium	Needs literature search
(A9.1.2-10)	Reduced human birth rates and weights shall be included in the Candidate Impact Set.	Risk	Yes			High	Linkage to specific chemicals or mixtures will be difficult to find for humans--likely some laboratory data on some chemicals which would require extrapolation

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
(A9.1.2-11)	Specific effects on human organ systems shall be included in the Candidate Impact Set. Examples are neurological, immunological, and metabolic effects.	Risk	Yes			High	Some known for radionuclides and chemicals with exposure via inhalation; will require literature search
(A9.1.2-12)	Neuro-behavioral effects on humans shall be included in the Candidate Impact Set. Examples are peripheral neuropathy, effects on memory and cognition, biochemical neurotransmitter alterations that affect psychological function, and direct neurotoxicity.	Risk	Possibly		High	High	Heavy metals, PCBs, and organochlorines are known to have neurotoxic effects. Some literature search needed; assessment input will be dependent on information available
(A9.1.2-13)	The freedom of individuals to use the Columbia River without a resulting health impact shall be included in the Candidate Impact Set.	Risk					Clarification is needed. Please provide an example
(A9.1.2-14)	Impacts on community well-being and community health shall be included in the Candidate Impact Set.	Risk	Yes				Dept of Health monitors community health, will need to review information, indicators, develop metrics
(A9.1.2-15)	Impacts to intra- and inter-generational equity shall be included in the Candidate Impact Set, including the following:	Risk	Peer review	TBD	Medium	High	Need web for each current and future group; would model future
	a. effects on groups at highest risk due to exposure and/or sensitivity	Risk	Peer review				Population genetics questions which could likely be extrapolated to humans
	b. disproportional impacts on human and environmental health of minority and low income, such as social and economic impact	Risk	Peer review				Some measures exist.
	c. monitoring and surveillance burdens for present and future generations	Risk	Peer review				Acknowledged. It is not clear if monitoring burdens for future generations can be defined at this point.
(A9.1.2-16)	Impacts of current and future conditions on land use options shall be included in the Candidate Impact Set.	Risk					Needs clarification. Fits with socio-cultural and risk characterization, but also seems to be use of the tool to make a decision
(A9.1.2-17)	Impacts on degradation of values shall be included in the Candidate Impact Set.	Risk	Peer review	SAC Work Group		High	Proxy scales and interviews to be done: There is an example study for K-basins
(A9.1.2-18)	Impacts on usability of resources on and adjacent to the Hanford Site shall be included in the Candidate Impact Set.	Risk	Peer review	SAC Work Group		High	Needs resources and users identified for web
(A9.1.2-19)	Impacts to a people from the availability of an individual species that they depend on shall be included in the Candidate Impact Set.	Risk	Peer review	SAC Work Group		High	Needs species and peoples identified for web
(A9.1.2-20)	All the impacts on land development shall be included in the Candidate Impact Set.	Risk					This appears to be similar to A.1.1.2-16.
(A9.1.2-21)	All the impacts on recreation services and tourism shall be included in the Candidate Impact Set.	Risk					Socio-Economic
(A9.1.2-22)	Costs of non-involvement or counter-involvement by affected people shall be included in the Candidate Impact Set.	Risk					Needs clarification

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
A.9.1.3 Impacts on Native American Traditional Culture and Values to be Included							
(A9.1.3-1)	Dependencies between health impacts and cultural impacts on individuals practicing a Native American life style shall be documented in the Candidate Impact Set.	Risk	Peer review	SAC Work Group			Web development for Native American Lifestyle(s); Risk characterization
(A9.1.3-2)	Lost use of resources critical to Native American cultures shall be included in the Candidate Impact Set. An example is lost use due to contamination hazards.	Risk	Peer review	SAC Work Group			Overlaps with A.9.1.2-13; A.9.1.2-18, A.9.1.1-18; Needs Survey & Scale development; Risk characterization
(A9.1.3-3)	Lost access to resources critical to Native American cultures of shall be included in the Candidate Impact Set. An example is administrative restrictions.	Risk	Peer review	SAC Work Group			Overlaps with A.9.1.2-13; A.9.1.2-18, A.9.1.1-18; Needs Survey & Scale development; Risk characterization
(A9.1.3-4)	Cultural harm, particularly the following aspects, shall be included in the Candidate Impact Set:	Risk	Peer review	SAC Work Group			Agree.
	a. loss of cultural viability/continuity	Risk	Peer review	SAC Work Group			Scale development; Risk characterization
	b. loss of traditions	Risk	Peer review	SAC Work Group			Scale development; Risk characterization
	c. loss of language	Risk	Peer review	SAC Work Group			Scale development; Risk characterization
	d. loss of traditional religion	Risk	Peer review	SAC Work Group			Scale development; Risk characterization
	e. loss of traditional disciplines and values	Risk	Peer review	SAC Work Group			Scale development; Risk characterization
	f. loss of access to teaching sites, with consequent loss of teaching opportunities	Risk	Peer review	SAC Work Group			Scale development; Risk characterization
	g. loss of use of traditional materials, with consequent loss of traditional activities	Risk	Peer review	SAC Work Group			Scale development; Risk characterization
A.10 Assessment Scenarios: Columbia River, Climate, Geological, and Political Changes							Comment 1. 'Scenarios' in A.10 refer to 'regional scale' scenarios and generally long time scales (>50 years). Examples of scenarios included are persistent climatic changes (shifts in recharge and vegetation), extreme hydrologic events (floods), geomorphic evolution (changes in river channel), changes in Columbia River system (removal of dams), political changes (loss of institutional control, loss of cleanup funding), demographic changes (regional population growth), ecosystem changes (Northern Pike). Examples of scenarios not included are moving waste from Site A to Site B, installing barrier on Site X, exposure scenarios. Are scenarios not included adequately addressed in other sections?
(A10.0-1)	A set of scenarios that depict the maximum credible impact from Hanford shall be defined.	Risk					Comment 1. 'Maximum credible impacts' implies the maximum impact that is credible, as opposed to, the impact that is most credible. Comment 2. "Scenarios' are sensitivity analyses, in as much as they are pertubations on the

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
							base case. The base case is defined in the Risk element. Comment 3. 'Credible' will be defined by criteria established in small working group. See A10.1-1 Comment 4. If dependency webs result in non-quantifiable impacts, how will 'maximum' be assessed.
(A10.0-2)	Credible scenarios with parameters that depict increased consequences from Hanford contaminants shall be identified to establish a set of scenarios for use in a comprehensive assessment.	Risk			Low	High	Comment 1. . "Scenarios' are sensitivity analyses, in as much as they are pertubations on the base case. The base case is defined in the Risk element.
(A10.0-3)	The limited set of scenarios to be evaluated shall include waste containment performance corresponding to the current Hanford Site disposition baseline for cleanup. (See Section II-A.11.)	Risk/Remediation			Low	High	Comment 1. This subset of scenarios will be used for comparison with existing PA s.
(A10.0-4)	The set of scenarios to be evaluated include potential demographic changes for the river corridor area under study.	Risk					Comment 1. Accepted
(A10.0-5)	Scenarios to be assessed shall include, but not be limited to, the following:	Risk			Low	High	Comment 1. Clarify "assessed". Does "assessed" refer to those included in Candidate Set or Study Set? Note similar wording of 10.0-6.
	a. Scenarios that depict the groundwater recharge rate in a way that the maximum credible impact from Hanford is assessed. Examples are climate change, future site uses including irrigated agriculture, and river channel changes.	Risk					
	b. Scenarios that depict contaminant dilution by groundwater or Columbia River water in a way that the maximum impact from Hanford is assessed. Examples are flood and drought scenarios, upgradient injection or extraction, disposition of present or new dams, and geologic events.	Risk					
	c. Scenarios that depict enhanced remobilization of sediment in a way that the maximum impact from Hanford is assessed. Examples are future dredging, disposition of present or new dams, and river channel changes.	Risk					
	d. Scenarios that depict potential changes in receptors. Examples are future Hanford land-use scenarios, Hanford Site accident scenarios, transportation accident scenarios, demographic scenarios, economic scenarios, institutional evolution scenarios, and cultural evolution scenarios.	Risk					
(A10.0-6)	Scenarios to be identified shall include, but not be limited to, the following:	Risk					

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
	a. scenarios involving increased inventories of dangerous materials at Hanford, such as a projected future plutonium repository	Risk					Comment 1. "Dangerous materials' refers to any 'resource or product' that if released to the environment would be considered a waste or contaminant.
	b. scenarios depicting the impact of newly introduced foreign species, such as the introduction of Northern Pike	Risk					Comment 1. Combine with 10.0-6f
	c. scenarios depicting loss of institutional control over the Hanford Site after various time periods; the full range of probable times for loss of institutional control shall be evaluated.	Risk					Comment 1. Accepted
	d. scenarios depicting loss of cleanup funding	Risk					Comment 1. Accepted
	e. scenarios depicting the future production of radionuclides and other new missions for the Hanford Site	Risk					Comment 1. Accepted
	f. scenarios depicting ecosystem changes	Risk					Comment 1. Combine with 10.0-6b
A.10.1 Required Candidate Scenarios Set							
(A.10.1-1)	The Candidate Scenarios Set shall be formed by including all the scenarios of potential concern.	Risk			Low	High	Comment 1. Add "credible" to maximum impact.
(A.10.1-2)	Criteria for completeness of the range of scenarios to be included in the Candidate Scenarios Set shall be established in consultation with the System Assessment Capability Team and shall be subject to its approval.	Risk					Comment 1. Agreed upon standard break up and assignments. See instruction 2 of instructions for preparation of Draft Matrices (October 21, 1998). Comment 2. A small working group will be created to draft completeness criteria. Approach for approval to be defined by the policy group. Comment 3. Criteria for "credible" and "maximum" will be drafted by small working group.
A.11 Hanford Site Disposition							
A.11.0-1	A complete disposition baseline shall be documented for the assessment.	SAC		SAC Work Group	Low	High	Accepted
A.ll.0-2	The assessment shall be consistent with the current revisions of the Hanford disposition baseline.	SAC		SAC Work Group	Low	High	Accepted
A.ll.0-3	The impact from actual and proposed remedial actions shall be assessed for compatibility with target, end-state conditions.	SAC		SAC Work Group	Low	High	Accepted
A.ll.0-4	The retrieveability of new waste forms that are part of either interim or permanent remedies and that affect the Columbia River shall be assessed.	SAC		SAC Work Group	Low	High	Comment 1: New waste forms that are part of permanent remedies should be assessed. Comment 2: Retrievability is an engineering study and the responsibility of the specific project.
A.ll.0-5	Corresponding end-state conditions shall be identified for each item in the Candidate Inventories Set.	SAC		SAC Work Group	Low	High	Comment 1: The end-state condition of the Candidate Inventory Set will be sufficiently well known to apply criteria for the selection of the study set. Comment 2: The end-state conditions should be identified for each item in the Inventory Study Set.

CRCIA Requirement		Category	S&T Project(s)	Other Project(s)	Numerical Code (Portion of Assessment high medium low)	Qualitative (Portion of Assessment high medium low)	Comments
A.ll.0-6	End-state conditions, including disposal forms, shall be defined sufficiently to enable risk evaluation.	SAC		SAC Work Group	Low	High	Accepted