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Confederated Tribes and Bands of the Yakama Nation

Established by the Treaty of June 9, 1855

August 22, 2008

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EDMC

Mr. David Brockman, Manager
Richland Operations Office
P.O. Box 550 MSIN: A7-50
Richland, WA 99352

Re: Yakama Nation Comments –
Remedial Investigation Work Plan for Hanford Site Releases to the Columbia River

Dear Dave,

Attached please find the Yakama Nation's Comments to the Department of Energy's (DOE) draft *Remedial Investigation Work Plan for Hanford Site Releases to the Columbia River* ("Draft Columbia River Work Plan" or "Plan").

The Yakama Nation's involvement in the Hanford cleanup is grounded in the Treaty of June 9, 1855 and federal statutes such as CERCLA. This involvement concerns rights guaranteed in the Treaty, the protection of the Yakama people and the Nation's natural resources. The Yakama Nation's Comments reflect its role both as a cooperating government commenting on proposed Hanford Response activities, and its role as a Natural Resource Trustee commenting on natural resource impacts of proposed Response activities.

Recently you expressed your hope that the Yakama Nation would be able to stand side-by-side with DOE in support of DOE's cleanup decision (Records of Decisions or RODs) regarding the Columbia River and the River Corridor. The Yakama Nation shares that hope. Unfortunately the Draft Columbia River Work Plan, in its present draft form, does not bode well for such future support and cooperation.

For the reasons outlined below and detailed in the attached Comments, the Yakama Nation views DOE's Draft Columbia River Work Plan as fatally flawed. We ask that it be withdrawn and redrafted, with substantial initial consultation and input from not only the regulating governmental agencies (EPA and Washington), but also from the other cooperating governmental entities such as the Yakama Nation.

Such a collaborative approach has been used productively at the Portland Harbor Superfund cleanup, as we have previously discussed. The complexities presented by Hanford call for more, not less collaboration. Such collaboration will not only produce a

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better decision process based on partnership, but will increase efficiency in applying limited budget resources.

Working together from the beginning can avoid delay and multi-million dollar fiascos such as the Vitrification Plant design, allowed to proceed without adequate seismic studies. As another instance, the "road to nowhere" at the base of Rattlesnake Mountain was built to haul capping soil before testing revealed that soil at the proposed mining site was inadequate for capping. Such planning deficiencies are consistently identified by participating governments when allowed adequate opportunity for review, which can result in significant cost savings. After-the-fact comments, even with a longer comment period than allowed here, seldom results in final document that reflects the collective wisdom of all involved.

The reasons the Yakama Nation feels the Draft Columbia River Work Plan is fatally flawed and should be withdrawn and redone are concisely set out in the formal Comments. In general terms, the flaws include:

1. **EPA Guidance Noncompliance** - The draft Plan does not comply with applicable EPA Guidance, nor does it constitute a reasonable alternative approach to achieve the same result.
2. **Lack of Contemplated Response Action** - No response action appears to be contemplated to remedy any problems identified by the Plan's work.
3. **Flaws in Contemplated Work** - There are various flaws in specific work contemplated in the draft Plan.

Not only is the Draft Columbia River Work Plan out of compliance with applicable EPA Guidance, but the specific shortcomings of the draft Plan build on one another in such a way to render the draft Plan's end result essentially useless in determining risks posed to human health and the environment and in evaluating possible response actions. Specific areas of non-compliance and failings include:

1. **Conceptual Site Model** - A complete Conceptual Site model was not developed prior to drafting the Plan. As a result the draft Plan does not reflect a holistic approach to the risks posed regarding the Columbia River.
2. **Extent of Contamination Impacts** – The draft Plan does not propose to determine the longitudinal, lateral or vertical extent of the contamination potentially posing human health and ecological risk relating to the Columbia River.
3. **Time of Contamination Impacts & Pathways** – The draft Plan does not propose to determine current and future pathways and risks posed by past and future contaminate releases.
4. **Level of Risk** - The draft Plan's failure to adequately evaluate the various factors regarding the extent of past, present and future contamination results in the draft Plan's inability to properly assess the level of risk posed to both human health and the environment.

5. **Remedial Response** – The draft Plan's failure to adequately evaluate the level of human health and ecological risk posed regarding the Columbia River results in the draft Plan's inability to provide information needed to assess appropriate remedial actions.

The Yakama Nation's attached Comments explain in detail the flaws in the draft Plan outlined above. This Columbia River Work Plan is of special concern to the Yakama Nation because the Columbia River's salmon and the other Columbia River fisheries are so fundamental to the very being of the Yakama people.

A recent EPA study found that Yakama people had a 1 in 50 chance of contracting fatal cancer from eating Columbia River salmon. The portion of that risk that is attributable to past, present and future contaminant releases from Hanford that must be identified by the Columbia River Work Plan and eliminated by the resulting Hanford remedial actions. As currently drafted, the Plan will fail to identify that risk and will fail to inform needed remedial actions. This is the reason the draft Plan is fatally flawed.

The Yakama Nation asks that 1) the current Draft Columbia River Work Plan be withdrawn, and 2) the Plan be redrafted with substantial initial consultation and input from not only the regulating governmental agencies (EPA and Washington), but also from the other cooperating governmental entities such as the Yakama Nation.

Thank you for your consideration. The Yakama Nation and its ERWM program look forward to working collaboratively with DOE to develop a proper Columbia River Work Plan.

Sincerely,

Russell Jim, Manager
Yakama Nation ERWM Program

Cc: Moses Squeochs, Chairman,
Radioactive/Hazardous Waste Committee

Phil Rigdon, Deputy Director,
Natural Resources Department

Francis SiJohn, Program Specialist,
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Nick Ceto, Hanford Project Manager
Environmental Protection Agency

Jane Hedges, Manager
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Remedial Investigation Work Plan for Hanford Site Releases to the Columbia River

We have reviewed the July 2008 *Remedial Investigation Work Plan for Hanford Site Releases to the Columbia River* (DOE/RL-2008-11 Revised Draft A) prepared by U.S. Department of Energy (herein after referred to as "Work Plan"). Contamination from unremediated upland sources, upland and shoreline soils, and groundwater releases from Hanford are not addressed by the proposal. Potentially affected plants, birds, mammals, and aquatic life (other than fish) in the river corridor are not addressed by the Work Plan. A full analysis of risk to Yakama Treaty resources and the peoples' health from the Hanford Site has yet to be performed. The risk assessments performed to date for different parts of the site, including those proposed for the Columbia River, are deficient without sufficient site characterization information and an evaluation of cumulative risk to a maximum exposed individual.

Our comments on the Work Plan are presented below, and fall into the following categories:

A. Failure to follow the EPA Guidance for conducting remedial investigations with regard to development or acquisition of the necessary data for:

1. Conceptual site model
2. Determining nature and extent of contamination
3. Spatial and temporal trends and determining transport pathways
4. Determining the level of risk presented by the site
5. Determining appropriate types of remedial response

B. No remedial responses are planned for the Columbia River, although cleanup may be required based on the results of an objective and complete remedial investigation.

C. Deficiencies in and Considerations for the Efforts Proposed

1. Consultation on Cultural Issues
2. Interactions between Ground Water and Surface Water of the Columbia River
3. River Sediment Characterization
4. Background/Reference Issues
5. Cumulative Comprehensive Risk Assessment Needed
6. Risk "Integration" to Address Totality of Hazards
7. Human Health Risk Assessment
8. Ecological Risk Assessment

D. Detailed Work Plan Comments

To begin, we note that the Treaty of 1855 between the Yakama Nation and the United States of America reserved specific rights and resources. These rights listed in Article 3 of Stat. 951 include "...the right of taking fish at all usual and accustomed places...together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land." The U.S. Constitution in Article VI states, "...all Treaties made, or which shall be made, under the Authority of the United States, shall be the supreme Law of the Land..." The U.S. government has a fiduciary responsibility to the Yakama Nation to protect its Treaty rights and resources and our culture, and health and welfare. And the Hanford Site is a portion of the Yakama Nation's homeland. In light of these facts, Stat. 951 must, at a minimum, be identified as an applicable or relevant and appropriate requirement (ARAR) of the CERCLA Remedial Investigation/Feasibility Study process (40 CFR § 300.430(b)(9) and at (d)(3)). It has not been recognized as such in this effort or under other CERCLA actions undertaken at the Hanford Site.

A. EPA Guidance and Failure of Work Plan to follow the Guidance

As stated in Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (PB-89-184626 and OSWER Directive 9355.3-01, 1988):

"Information on the waste sources, pathways, and receptors at a site is used to develop a conceptual understanding of the site to evaluate potential risks to human health and the environment. The conceptual site model should include known and suspected sources of contamination, types of contaminants and affected media, known and potential routes of migration, and known or potential human and environmental receptors. "

As to remedial investigations, the Guidance cited above states that "Analysis that are important to the subsequent risk assessment and subsequent development of remedial alternatives include the horizontal and vertical extent of contamination in soil, groundwater, surface water, sediment, air, biota, and facilities. Spatial and temporal trends in contamination may be important in evaluating transport pathways." Also, "The final objective of the field investigations is to characterize the nature and extent of contamination such that informed decisions can be made as to the level of risk presented by the site and the appropriate type(s) of remedial response." In describing the RI/FS process under CERCLA, the Guidance states "The RI continues to serve as the mechanism for collecting data to characterize site conditions; determine the nature of the waste; assess risk to human health and the environment; and conduct treatability testing as necessary to evaluate the potential performance and cost of the treatment technologies that are being considered."

1. Conceptual site model

A complete conceptual site model is critical to scoping, but was not developed prior to planning this remedial investigation project. As a result, the Work Plan fails to investigate critical data gaps. Known and potential routes of migration include river transport of long-lived radionuclides from the Hanford Site downstream to the mouth of the Columbia River, past emissions from operational facilities migrating by air pathways, and groundwater contaminant plumes heading toward and releasing contaminants to the Columbia River in the future.

Developing a conceptual site model for the Hanford facility which accurately takes into account all media and exposure pathways for Hanford contaminants is a key step in understanding the scope of the problem and what data must be collected as part of the remedial investigation. The failure to develop a comprehensive model that describes the conditions at the site and links sources of contaminants to pathways, exposure points, and receptors, and shows how they interrelate site-

wide has resulted in a Work Plan that fails to fill data gaps. There are many unanswered questions, including but not limited to:

How and where will the contaminant plumes moving toward the river express themselves? What risk will future releases of high level and toxic contaminants pose to humans and the environment? How will risks from releases that have or will come to be located in the river be addressed?

How can the contaminated groundwater plumes, springs, and sediment deposits be remediated and what information is needed to evaluate appropriate technologies for performance and cost?

Where are the plutonium and ruptured fuel elements released during reactor operations now located? What is the extent and nature of contaminated sediments behind McNary and Bonneville Dams? What will happen to those toxic sediments when the dams are no longer there?

How do the contaminants in and around the river move through the water and sediments through the aquatic food chain? What risks are posed to human and ecological receptors now and in the future?

2. Determining nature and extent of contamination

The Work Plan should, but does not, describe a proposal to determine the horizontal and vertical extent of contamination in soil, groundwater, surface water, sediment, and biota. As to the horizontal extent of the study area, the longitudinal boundaries should include wherever the hazardous substances released from Hanford have come to reside. This includes the entire river, from the Hanford Reach to the Pacific Ocean, where contaminants released from Hanford have come to be located.

We note that U-234 and U-238 were found in grab sediment samples on both the OR and WA shores of McNary Dam that exceed the human health benchmark of 1.1 pCi/g. Department of Health found elevated Pu-239/240 at OR shore of Bonneville Dam and on WA shore at Dalles Dam. Recent tests found concentrations of U-234 over the human health benchmark at Bonneville Beach, the Shores of Dalles Dam and John Day Dam, and the OR shore of McNary (PNNL-14878, 2003).

In addition, the lateral study area boundaries should incorporate the areas of the Hanford Site where contaminants have, are now, or will, be released into the river. As the Work Plan stands, the lateral study area boundaries have the effect of disengaging the riparian and near shore aquatic zones from the Columbia River for the Remedial Investigation. People and the ecology of the shoreline and river systems are connected. For example, see Figure 4.2 Aquatic Food Web for the Ecological Risk Screening Assessment of the Columbia River, from the CRCIA Screening Assessment (DOE/RL-96-16). Cutting off the Hanford Reach of the Columbia River from the uplands, shoreline, riparian, and nearshore aquatic zones at an artificial "boundary" 6-feet below the low water mark defies ecologic and hydrologic principles. By establishing such a lateral study area boundary, a complete understanding of the effects of Hanford Site releases to the River is not possible.

As to the vertical extent, sediment cores to determine where Hanford contaminants have come to be located should be included in the Work Plan. For example, a buildup of sediments containing long-lived radionuclides was demonstrated in the 1960's by core sampling of the sediments at McNary Dam and in slack areas of the river (Nelson et al, 1964). Long-lived radionuclides remain buried in sediment deposits behind McNary Dam (BNWL-2305). Based on sediment flux and deposition estimates, plutonium from the reactor operations could be buried 20 feet deep. At present, no radionuclide data from sediment cores behind Bonneville Dam or in areas downstream of Bonneville exists, and thus, should be included in the Work Plan and resulting risk assessment.

PNNL has estimated the suspended sediment load in the river at 1,188 tons per day. Based on estimates done during the 1970s, there were 80 cm of sediment deposited at McNary Dam during a 5 year period. Thus, the reservoir of radionuclides may be buried under several feet of cleaner sediment. What is the nature and extent of contamination behind the dams? And what will happen to those materials when the dams no longer exist? Could they become remobilized in the future and if so, shouldn't potential remedies be evaluated?

Characterization of biota in the Work Plan is limited to a few species of fish in the Hanford Reach. This is unacceptable given the complex ecology and variety of plants and animals that inhabit the Columbia River. For example, refer to the attached Figure 4.2 from the CRCIA-Screening Assessment. Periphyton, phytoplankton, amphibians, ducks, heron, otter, eagle, and coyote are some of the biota potentially affected by Hanford contaminant releases. How do contaminants move through the food chain to aquatic and human receptors? What are the risks posed now and in the future to the environment?

The DOE should determine and consider the total extent of contamination in and across all media for the site, according to the Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, EPA/540/G-89/004, October 1998.

3. Spatial and temporal trends and determining transport pathways

The Work Plan should, but does not, describe how the spatial and temporal trends in contamination will be determined in order to completely evaluate transport pathways. Past and future releases to the river should be considered in development of the Work Plan. These releases resulted in Hanford contaminants hundreds of miles downstream beyond the mouth of the Columbia River, as far as the Pacific coastal areas of Washington State. The Work Plan should, but does not, evaluate where the key mobile radionuclides and other hazardous releases have come to be located in the river system.

Releases from the Hanford reactors and other operations included long-lived radionuclides such as Iodine-129, plutonium, and uranium isotopes (such as uranium-234, 236 and 232) that were present in higher ratios due to recycling. Also large amounts of hexavalent chromium, cadmium, and other metals were discharged directly into the river or into soil that percolated into the river. (DOE-2004, Hanford Waste Management Units Report, DOR-R-88-30) The single pass cooling reactors at Hanford operated from September 1944 through January 1971. The releases from these reactors included:

- Reactor cooling water
- Operational outfall effluent
- Nuclear fuel element ruptures
- Purging reactor process tubes
- Reactor basin overflows

For example, fission products from the reactors were released from "tramp" uranium in cooling water that had passed through the reactor core, and from fuel-element rupture events when pieces of fuel escaped into the Columbia River (Foster, 1972). Reactor effluent pipelines contaminated with radionuclides, and non-radioactive hazardous substances remain in the river. (DOE-2004, Hanford Waste Management Units Report, DOR-R-88-30) How will these materials be recovered, remediated, and disposed?

Additionally, radioactive and non-radioactive hazardous wastes were discharged into the Columbia River from operations in the Hanford 300-Area. Millions of gallons of wastes containing tens of tons of non-recoverable of uranium, thorium, acids, ammonium, solvents, tons of lead, and thousands of pounds of hexavalent chromium were discharged from 300-area facilities into soils that percolated into the river. (Gerber, M.S., Multiple Missions: The 300-Area in the Hanford Site History, WHC-MR-0440, September 1993)

As noted in the early 1960s, the greatest source of radioactivity in the river came from reactor effluent, which contained over one hundred different radionuclides. As far downstream as Vancouver, WA, chromium-51 and zinc-65 and other nuclides were sampled routinely by the Hanford Laboratories and were found to be transported past Vancouver at a rate of 980 curies per day in 1961. Below Vancouver there was a reservoir of radionuclides in the river of 34,350 to 47,820 curies annually. From 1961 to 1963, Zn-65 was found in plankton samples off the coast of WA and OR. In 1962, Cr-51 and Zn-65 were found in soft parts of mussel, razor clam, and sea anemone and elevated Zn-65 concentrations were found in sole, flounder, and sculpin at North Head. In 1963, Zn-65 was found in Willapa Bay water and oysters, where contributions of Zn-65 from nuclear fallout was minimal (Lewis and Seymour, 1964).

The downstream boundary of the characterization should include, but does not, wherever the Hanford released hazardous substances have come to be located. Radionuclide inventory, flux, and depletion were estimated for the river from Pasco to Vancouver, WA by PNL scientists in the 1960's (Perkins, Nelson, and Haushild; 1966). The primary depletion mechanism for most of the long- and intermediate-lived nuclides was deposition on the river bottom (Foster, 1972).

Current and future ground water releases to surface water should be included in the development of the Work Plan. Recommendations from the recent expert panel regarding characterization of groundwater flux and upwelling of contaminated water to the river should be incorporated into the Work Plan (see related additional comments below).

Aquifer tube sampling in the river corridor indicates current releases of U and TCE from the 300 Area. In the 100 Areas aquifer tube results show hexavalent chromuim, nitrate, Sr-90, Tc-99 and tritium exceeding drinking water or aquatic standards with associated releases to the Hanford Reach of the Columbia River. Based on groundwater monitoring information, future releases of Iodine-129 to the river are likely to occur (Hartman et al., 2006).

As to transport pathways, USGS staff have proposed "to refine the models that simulate the flux of contaminants from the Hanford Site to the Columbia River by doing detailed analyses of contaminant chemistry including speciation and interactions with other inorganic and organic compounds that influence contaminant mobility, uptake, and toxicity. The rate at which a contaminant is transported from ground water underlying the Hanford Site through the hyporheic zone to the Columbia River is influenced by its chemical form as defined by its interactions with other inorganic and organic compounds. For example, the transport of uranium through ground water systems is enhanced by complexation of the aqueous U (VI) oxyanion by carbonate. The hyporheic zone is a transition zone between ground water and river water, where there is a high probability that large gradients in ionic strength, pH, oxidation-reduction potential, total carbon dioxide, and other interactions affect contaminant movement. Understanding the speciation of contaminants in the hyporheic zone is particularly important to understanding the flux of contaminants in ground water to the river as well as understanding the toxicological effects of contaminants on organisms living within the hyporheric zone, especially salmon redds."

Furthermore, their suggested studies included "Construct of a 3-dimensional hydrodynamic model of the Hanford Reach to identify areas of sediment deposition and removal, simulate the movement of contaminants, and assess the velocity structure in relation to fish habitat
The flow model will be a fully 3-dimensional hydrodynamic model that will allow for a detailed assessment of the velocity structure throughout the reach. Use of such a model in the San Joaquin Delta complex in California provided valuable information on the movement of sediment and contaminants in addition to information on fish habitat. The model will be calibrated using Acoustic Doppler Current Profiler (ADCP) technology integrated with differential GPS to map both water velocity profiles as well as channel bathymetry. A series of transects located throughout the reach will be measured over time and under a range of hydraulic conditions." (USGS, 2005)

Cleanup and protection of the river must consider and the Work Plan should include projections of contamination from the Hanford Site, such as known groundwater plumes that are migrating to the river. The Work Plan does not include, but should address, future anticipated releases to the river from the 100, 200, and 300 Areas.

4. Determining the level of risk presented by the site

The Work Plan should, but does not, plan to characterize the nature and extent of contamination such that informed decisions can be made as to the level of risk presented by the site. An assessment of the risks posed by contaminant sources and releases from the Hanford site should be evaluated in a systematic way according to the CERCLA guidance. The investigation and analysis of data regarding the nature and extent of contamination is critical to the remedial investigation in order to conduct an adequate risk assessment (see EPA/540/G-89/004). Cumulative risks from radiological and non-radiological contaminants at the site should address contaminants of concern in all media and should combine risks from multiple pathways of exposure and various areas of the Hanford Site.

The Work Plan will not result in a cumulative risk assessment for comprehensive evaluation to make cleanup decisions. As an example, Bonneville accumulations are proposed to be characterized by only 2 core sites drilled to refusal, and the Work Plan states that the resulting data are not to be used in the subsequent risk assessment.

The Yakama Nation continues to have significant concerns with the reference sites used for risk assessment purposes at Hanford. Past air releases occurred during the operations period and nearly all reference sites used in this assessment were within 1-5 miles of operational areas and likely to be within the zone of deposition from these past releases. Strontium-90 has been detected in plants on the Arid Lands Ecology Reserve, and some media sample results from reference sites as part of this risk assessment showed detections of contaminants of potential concern (COPCs) of Hanford origin which calls into question the validity of the reference sites for comparison purposes.

Air emissions and pathway should be, but is not, included in the human health and ecological exposure models in the Work Plan and incorporated into the sampling plan. Emissions from Hanford operations released contaminants that have likely come to be located in soils and waters of the region. The conceptual site model for both human health and ecological risk assessment should include the "past operational emissions" as a source of contamination, and "air transport" as a pathway for those Hanford releases.

Based on the HEDR Project, the main contributors to offsite dose from the air pathway were iodine-131, Cerium-144, plutonium-239, ruthenium-103, ruthenium-106, and strontium-90. Some 1.78

curies of plutonium were released to the air, a fraction of which may have been in an insoluble form (HHIN, 1994).

As stated in USDOE's Basis and Assumptions on Project Scope (DOE/RL-2004-49), "Media of concern that will be evaluated under the Columbia River Component include, but are not limited to:

Air-deposited contaminated media

--Stack emissions

--Fallout

--Fugitive dust (winds carrying contamination from sediments)."

The risk assessment for the river corridor relies primarily on information collected for the source and groundwater and inter-area (100/300 Area) RCBRA – this is problematic based on past Trustee (including YN) comments related to the inadequacy of data collection, inappropriate background, etc. for the 100 B/C Risk Assessment and the 100/300 Area Risk Assessment.

Potential risks include those from radionuclides in food items. Strontium-90 was found in three samples of fish in the Hanford Reach area. Wholebody largescale sucker samples taken from the Hanford Reach had the highest concentrations of barium, cadmium, and manganese in the study. Up to 1 in 50 cancer risk was found for consuming white sturgeon and mountain whitefish. Adult cancer risks are highest for Tribes that consume fish from the Columbia River at a rate much higher than the general public (EPA 910/R-02-006, 2002).

The human health and ecological exposure assessments rely on information related to chemical concentrations in plants and other biota. Plants of concern to Native Americans are not being tested under the proposed Work Plan, and neither are plants or animals for purposes of conducting an ecological risk assessment.

The Work Plan will not result in adequate data to conduct a baseline ecological risk assessment for the river. There is no biota sampling proposed in the work plan to support a complete ecological risk assessment.

5. Determining appropriate types of remedial response

The Work Plan should, but does not, propose a field investigation that characterizes the contamination such that informed decisions can be made as to the appropriate type(s) of remedial response. The Work Plan should, but does not, propose to gather sufficient information to make an informed remedial decision for the river nor will the work fully characterize the nature and extent of Hanford contamination in the Columbia River. It fails to identify potential treatability testing to evaluate solutions.

As expressed by the Hanford Advisory Board (HAB) cleanup values #1. "Columbia River should be the highest priority. The river is a vital resource in the Northwest." A September 10, 2004 letter from the HAB provided "input to final remedial decisions in the river corridor". The HAB's advice:

- DOE should outline how Hanford's risk assessments will provide an integrated, comprehensive view of risk.
- The 100 and 300 Areas RCBRA should consider the arrival of groundwater plumes from the 200 Area.

- The river corridor risk assessment exposure scenarios should include groundwater consumption in both the 100 and 300 Areas.

Issues raised related to remedial responses in the May 8, 2006 CERCLA Five-Year Review for Hanford include, but are not limited to:

- A strategy to obtain the final records of decisions and integrate the waste sites, deep vadose zone and groundwater has not been developed and agreed upon with the regulator agencies.
- The pump-and-treat system is inefficient in reducing the flux of strontium-90 to the Columbia River, providing only a fraction (1:10) of the protection provided by natural radioactive decay
- Additional ecological data are needed to assess the interim actions prescribed within the record of decisions and to develop final cleanup standard.
- Predicted attenuation of uranium contaminant concentrations in the groundwater under the 300 Area has not occurred.

The remedial investigation phase of the CERCLA process provides the opportunity to collect data needed to evaluate the feasibility of technologies to cleanup the river and the releases to it.

B. No remedial responses are planned for the Columbia River, although cleanup may be required based on the results of an objective and complete remedial investigation.

Columbia River sediments retain hazardous waste discharged during Hanford Site operations. Despite the enormous volumes of waste discharged (over 100 million curies of radioactive waste and thousands of tons of hazardous chemical waste), the inventory of this waste remaining in the Columbia River is as yet unknown, and mechanisms for future human and ecological exposure are unknown. Thorough characterization of the nature and extent of contamination in the Columbia River and assessment of exposure pathways are necessary to evaluate human and ecological risk for this remedial investigation.

The Work Plan points out that six (6) final remedy Records of Decision (RODs) will be prepared for the River Corridor areas in the 100 Area (5) and 300 Area (1). The Columbia River is not included in the list of forthcoming RODs for the River Corridor. This raises the concern that this Work Plan is nothing more than a proposal for superficial studies to justify a "no further action" response for the river rather than an objective analysis of the environmental conditions to be rectified by remedial actions. This concern is bolstered by the fact that collection of data to support evaluation of appropriate responses (such as treatment of seeps, groundwater upwelling, or removal and treatment of river sediment) is not included in the Work Plan. Normally, data is collected during a remedial investigation to support subsequent feasibility evaluations of remedial alternatives.

We commend the USDOE for attempting to study the river even though there is no Tri-Party Agreement milestone calling for such a Work Plan. However, the attempt should result in a comprehensive study that provides the data needed to make an informed decision about remedy. The remedial investigation step provides an opportunity to take a thorough look at the Columbia River to assess the Hanford releases, which are indisputable, and risks posed to human health and the environment. Conclusions regarding the level of risk presented by the site should not be pre-supposed. An objective and thorough investigation should be planned for and conducted, and the potential that cleanup actions in the river may be required should be accommodated based on the

results of a complete remedial investigation. In fact, cleanup of the river portion of the facility may be required, even though a ROD is not planned nor is there a related USDOE milestone.

C. Deficiencies in and Considerations for the Efforts Proposed

1. Cultural Issues

Locke Island has a sample grid with 10 sample sites identified in the Work Plan. Unfortunately, the ERWM Program cultural representatives were not contacted and those selected sites may be in areas where there are cemetery or village sites. Better coordination needs to be established for this remedial investigation project and should be worked into all future study plans. Close consultation with the Yakama Nation is needed ahead of time to ensure that none of the proposed work will adversely impact cultural sites or resources.

2. Interactions between Ground Water and Surface Water of the Columbia River

Ground water/river water expert panel findings, data gaps and implications to remediation:
USDOE held a three day workshop with an outside expert panel having expertise in hydrology and large rivers to seek input on interactions of ground water with river water. The panel offered many suggestions and recommendations that are still unavailable to governments and interested parties who have a vested interest in the health of the Columbia River.

Findings reported during the closeout presentation included:

- There is not much ground water information for under river
- Conditions are not static
- If river bed is armored then ground water will seek area where it can get out
- Windows may exist in the river bed where ground water can come out
- Need to determine what effect occurs to ecological receptors
- Need to determine what is the deepest flow path
- Need to understand water balance, both sides of the river, for evaluation of hydrologic divide in river
- Consider alternative hydrogeologic models that include armor and windows
- Armoring may affect flow patterns in the river
- Improvements to ground water models should consider 3-D
- Need for bathymetry of river bottom
- Surveys of river bottom using different techniques such as electromagnetic survey
- Need to know temporal and spatial concentrations of Cr entering river [This point is applicable to all plumes entering river]
- Ground water could be seeking discharge to deep holes that create crosscuts in river bed, such as, sturgeon holes

- Revise/re-examine "mixing" mechanisms within the bank and beneath the channel

Data gaps mentioned by expert panel included:

- Map extent of plume underneath river
- Continue mapping preferential discharge locations at river bank
- Estimate hydraulic conductivity of the river bed
- Map Ringold mud as possible source (diffusion)
- Characterize vertical distribution of contaminants in unconsolidated materials adjacent and beneath the river
- Evaluate existing models –consider alternative conceptual models- "Get that complexity in there"
- What can you afford to miss out there; example 40,000 v 5,000 v 100 feet away
- Use temperature techniques to better constrain flow and mass transport modeling
- Instrument bottom of river-geophysical and remote-sensing surveys
- Cross sections of river

The expert panel recognized the following implications for remediation:

- How does river flow function in controlling ground water flow?
- Transient data set becomes very important to calculating compliance concentration. Considering variability of discharge; transient data becomes critical.

The expert panel report was due to Fluor on June 5th and to be released on June 30th. To our knowledge, no findings, recommendations, or reporting has occurred although clearly the ground water upwelling and contaminant flux to the Columbia River are key elements of current releases. USDOE staff informed trustees at the July HNRTC meeting that the report would be released in August, and now we are told by an agency source that the report won't be available until September. It is unfortunate that USDOE cannot synchronize activities to ensure products can be used in other investigation planning such as this Work Plan. As it stands, the Work Plan lacks the specificity mentioned by the expert panel as it relates to chromium but that could also apply to other plumes such as strontium-90 at N Area and the uranium plume at the 300 Area and other contaminants entering the river.

3-D Bathymetry model: USDOE should develop a 3-D bathymetry model to assist in understanding the movements of Hanford contaminants away from the site. The document indicates that a one-dimensional model is being used for the Hanford Reach (p.A2-4). This is one of the suggestions made by the expert panel that USDOE convened to address ground water/ river water issues.

3. River Sediment Characterization

The Work Plan emphasizes information gathering for additional sediment areas not addressed by previous environmental monitoring, augmenting previous core data behind downstream dams, and sampling of fish species.

Unfortunately, a number of the additional locations picked for the expanded sampling program were left out of the Work Plan. Sediment sampling should be conducted at:

- The backwater area across from the White Bluffs boat launch, and
- The backwater area of Savage Island located just north of Ringold Springs.

An expanded sediment sampling program needs to be conducted to determine background concentrations or non-Hanford related contamination at these areas:

- Yakima River Confluence/Delta (needs an expanded sampling at the confluence),
- Up gradient of the Hanford site on the Columbia River,
- The Snake River Confluence, and
- The Walla Walla River Confluence .

Another issue is the lack of a consistent sampling approach for the islands in the Columbia River. Some of the large islands have an extensive sampling grid laid out for sample areas yet others were ignored all together. Missing from the sampling is Coyote Island, White Bluffs Townsite Island, 100-F Island, Hanford Townsite Island, Savage Island, 300 Area Island, Richland City Islands, and Bateman Island.

Depths of sediment contaminants in the river system should be characterized—where and in what form are the long-lived radionuclides residing? Deep sediment cores and vertical profiles should be analyzed for radionuclides as a priority and if enough sediment is not collected for analysis, take more samples at new locations.

4. Background/Reference Issues

We disagree with DOE's premise that Vernita bridge area samples are reflective of background conditions (page 4-34). Reference sites should match the Superfund site in all aspects except contamination (EPA-F-94-050). The "upriver sub-area" proposed to characterize non-Hanford influence is most likely impacted by air releases from Hanford operations. The area contains chemical concentrations in soil that are greater than statewide background and EPA radiological PRG values. The Data Summary for 2003 and 2004 (BHI-01724) shows that both the "upland reference soils" and the 100 B/C area soils contain Cesium-137 and Strontium-90 in concentrations that exceed EPA risk-based PRGs. Cheatgrass roots and shoots from both areas contain Strontium-90, and chromium from both areas exceeds statewide soil concentration background values (Ecology Publication 94-115). Furthermore, invertebrate samples from the upstream reference location had higher concentrations of chromium, barium, thorium, and uranium than the samples collected at the 100-B/C area. It appears highly likely that the "upriver sub-area" is impacted by releases from Hanford operations.

In addition, fish clearly migrate throughout the Hanford Reach from Richland to above the Vernita Bridge and beyond to Priest Rapids Dam. Vernita Bridge fish are likely impacted by releases from the Hanford Site and thus, are not reflective of background, reference, or control samples for the RI.

Several EPA guidance documents emphasize locating reference sites in areas absent of contaminants as in the following guidance document wherein it states,

"...Reference data are baseline values or characteristics that should represent the site in the absence of contaminants released from the site. Reference data might be data collected from the site before contamination occurred or new data collected from the reference site."(Source: USEPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final, EPA 540-R-97-006, OSWER Directive #9285.7-25).

And another states,"...Reference sites should match the Superfund site in all aspects except contamination: the former should be upstream, upwind, or higher in the drainage system but otherwise located as close as possible to the latter..."(Source: U.S. EPA 1994. Selecting and Using Reference Information in Superfund Ecological Risk Assessments. Eco Update, Intermittent Bulletin, Volume 2, Number 4. Washington D.C. Office of Emergency and Remedial Response, Hazardous Site Evaluation Division. Publication 9345.0-10I. EPA 540-F-94-050. NTIS PB94-963319). Although Vernita Bridge may be upstream, the area most likely has been impacted by wind and biological transport of Hanford contaminants.

And another states,"...an investigator selects a reference site that as closely as possible mirrors the characteristics of the site medium being analyzed but is unaffected by site contamination. Analyzing a sample from the reference site allows the investigator to measure background conditions. The investigator should try to locate the reference as close as possible to the Superfund site so that the reference site will accurately reflect the site's conditions. Yet the reference site should lie at a great enough distance from the Superfund site to be unaffected by site contamination. Provided that pollutant loading from other sources does not occur upstream, an upstream location may provide an appropriate reference site for a Superfund site with contaminated surface water. Soil type and texture, vegetation, and slope are important considerations in selecting a reference site with the appropriate terrestrial characteristics."(Source: U.S. EPA, 1994. Using Toxicity Tests in Ecological Risk Assessment. Eco Update, Intermittent Bulletin, Volume 2, Number 1. Washington D.C. Office of Emergency and Remedial Response, Hazardous Site Evaluation Division. Publication 9345.05I. EPA/540/F-94/012. NTIS PB94-963303).

5. Cumulative Comprehensive Risk Assessment Needed

As to risk to the public from Hanford, the Agency for Toxic Substance and Disease Registry's November 30, 2006 Public Health Assessment for the Hanford Site concludes that "Although there have been past releases and exposures, substantial controversy remains over the actual doses individuals received and the potential health effects at those doses. Given the uncertainties, ATSDR could not determine conclusively whether exposures to radioactive substances occurred off the Hanford Property at levels sufficient to cause harmful health effects." U.S. DOE has refused to fund the ATSDR to complete its work and finalize the Public Health Assessment Report.

The Yakama Nation has asked for a cumulative risk assessment of the Hanford Site, i.e. one human health and one ecological risk assessment, for several years now. The issue remains unresolved to date. When will USDOE begin this needed cumulative assessment? Hopefully before any final RODs are written and signed.

The March 2008 CRESP Status Report on the *The Participatory Process on Risk at Hanford* concludes

that the "fact that the Department is now committed to doing a full Baseline Risk Assessment for the River Component while maintaining schedule is an important step in resolving some of the outstanding concerns, and its execution will lend credibility, clarity and transparency to the process." The Work Plan presented does not include sufficient biological characterization nor does it include a sufficient geographic area in order to adequately develop a full Baseline Risk Assessment.

Ecological risk assessment scope was discussed in the USDOE's Basis and Assumptions on Project Scope document (DOE/RL-2004-49). "All federal and state endangered, threatened, and candidate species will be evaluated. A trophic-level approach to sampling will continue to be used as specified in EPA guidance. Where appropriate, additional receptor species or trophic levels will be evaluated to assess contaminant transfer and magnification through the ecosystem. For example, smallmouth bass may be sampled because they consume (among other food sources) snails, crayfish, and sculpin. ...In addition, culturally significant plants that are identified in collaboration with the Tribes will also be evaluated." No fish or plant testing for purposes of ecological risk assessment is proposed in the Work Plan, although it should be addressed in the scope of such a Remedial Investigation.

6. Risk "Integration" to Address Totality of Hazards

A process endorsed in the July 6, 2005 Hanford Site Risk Assessment Integration Charter, signed by the Tri-Parties states, "The integrated risk assessment process must be comprehensive, cumulative, efficient, provide adequate geographic coverage, be both enduring and flexible, and able to be implemented." The integrated process has not been adopted.

Oregon and Washington State representatives documented their concerns in an October 12, 2006 letter. "The need to bring together four components of risk assessment findings (surface, vadose zone, groundwater, and Columbia River) has been a topic of discussion for years at Hanford." ..."Accelerated closure cannot be achieved without an agreed upon framework and approach, especially at a site as complex as Hanford."...Hanford cleanup cannot succeed, no matter the size of the budget, unless we have:

1. A comprehensive strategy for the complete Comprehensive Environmental Response, Compensation and Liability Act process, including Natural Resource Damage Assessment

2. A complete picture of the risks and injury in surface, vadose zone, groundwater, and the Columbia River. At this time, those do not appear to exist."

The Columbia River Comprehensive Impact Assessment Project during the early 1990's was to "evaluate the current human and ecological risks from the Columbia Ricer attributable to past and present activities on the Hanford Site. ... A multi-stage screening process was developed to prioritize these various contaminants in terms of human health risk and ecosystem risk." It was recognized that "Contaminants in Hanford waste sites or other sites adjacent to the Columbia River (e.g., operating facilities, spills, etc.) may pose a threat of future contamination of the river." The screening process resulted in a list of 20 contaminants of concern, in addition to direct irradiation. Some of these contaminants of concern are not included, but should be, in the lists of target analytes presented in the Work Plan.

Future risk: Currently, this Work Plan is silent on future risk and yet, we know there are plumes of Strontium-90 (half-life 29 years) and Uranium discharging to the river, and ground water plumes that are moving toward the river that will affect future risk to the environment and human health.

These future plumes include Technetium-99 (half-life 213,000 years) and Iodine-129 (half-life 16,000,000 years). A thorough understanding of contaminants in the soil column (vadose zone) and ground water is needed to adequately assess risk to the Columbia River. In a 2006 GAO report[1] the auditors state, "DOE knows less about the extent and location of contaminants in the vadose zone above the groundwater", and further states, "Once DOE understands the nature and extent of contamination in the vadose zone and groundwater, it *must [emphasis added]* assess the risk to the public in future years by estimating how, and where, the contamination will migrate over time."

Air emissions: USDOE has omitted past air emissions as part of the remedial investigation and risk analysis. GAO auditors acknowledged these releases in their 2006 report[2] wherein they state, "Operations also resulted in air emissions of about 20 million curies from 1944 to 1972. The portion that went to the river is unknown." C. D. Becker (1990)[3] provides a chronology of major milestones related to operations wherein he cites, "About 340,000 curies of radioactivity were released to the air at Hanford during the year [1945]...December 1-3, 1949. An estimated 5000 to 7000 curies of radioiodine were released to the atmosphere...Year 1951. Air filters failed at Hanford plants, inadvertently releasing about 19,000 curies of radioiodine to the atmosphere."

Erroneous assumptions: We have noted that this investigation and risk analysis are limited in scope (spatially and geographically) and that USDOE assumes (p. A2-40) residual contaminants behind the dams are safe given that they lie beneath several feet of "clean sediment". USDOE fails to assess future risk from these sources, and some of those contaminants (ruptured fuel rods and pieces) may have half-lives well beyond the life expectancy of the dams and at some future date may be remobilized and pose a threat to humans and the environment since they can be consider spent nuclear fuel. What is the future risk from these sources? Where are these sources? How much mass of ruptured fuel rods was flushed into the river? The Work Plan fails to address locating these sources throughout the river below the reactor outfalls. The effort to date fails to account for how much was flushed to the river by performing a mass balance analysis.

Have aerial radiological surveys been performed to determine if any of these sources were washed above the high water mark from past floods? Have any underwater surveys been performed behind the reservoirs to locate any radioactive materials or ruptured fuel rods?

7. Human Health Risk Assessment

As to Human health risk—there is insufficient data, species types (plants & animals), and sampling proposed to provide statistical certainty. High risk to Native Americans already exists based on EPA's *Columbia River Basin Fish Contaminant Survey 1996-1998* study. Recreational species of fish such as bass, catfish should also be evaluated for potential human health risk.

A baseline risk assessment must be performed to assess risk to the reasonable maximum exposed individual, in addition to the unique risk only tribal people are exposed to at reasonable maximum exposure. Risk should drive cleanup decisions that allow for unrestricted use thus allowing multiple uses including the use of tribal members gathering native plants and medicines that are safe for consumptive or medicinal use. This would be consistent with the conclusions of the Hanford Site

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[1] GAO-06-1018 Report to the Chairman and Ranking Minority Member, Subcommittee on Energy and Water Development and Related Agencies, Committee on Appropriations, House of Representatives: Nuclear Waste, DOE's Efforts to Protect the Columbia River from Contamination Could Be Further Strengthened.

[2] ibid

[3] Becker, C. Dale. Aquatic bioenvironmental studies: the Hanford experience, 1944-84.

Future Uses Working Group which emphasized that cleanup should occur to a level that allows multiples uses of the site once remedial actions are finished.

The approach used by DOE for the human health risk assessment is portioned into separate risk calculations for each geographic zone, project, and type of effect (cancer and non-cancer) such that total risk to the receptor populations from the various media and effects are not determined.

The EPA's *Columbia River Basin Fish Contaminant Survey 1996-1998*, contains relevant data regarding contaminants found in fish near the Hanford site and potential human risks from consuming these fish. The study was released in August 2002 and took eight years to complete. The study found that tribal people eat five to 10 times more fish than the general public. As a result the risks of tribal people contracting cancer and non-malignant disorders among our children from contaminants in the Columbia River Basin are 10 to 200 times higher than for the general public. The study concluded that:

- The highest levels of some non-radioactive hazardous contaminants in the Columbia River Basin are found in the fish of the Hanford Reach; and

- Tribal people who eat fish from the Columbia River have a risk as high as one in fifty of contracting cancer; and tribal children were shown to have risks of contracting central nervous system disorders that are hundreds of times greater than for non tribal children

Regulatory actions are generally taken by the EPA when risks exceed one in ten thousand to one in a million.

Specific findings of the EPA survey that should be taken into account include:

- Dozens of waste sites in the 100 and 300 areas contain contaminants found by the EPA in fish near the Hanford site to be among the highest in the Columbia River. These EPA survey data should be factored into the Work Plan for the Remedial Investigation.

- Several types of fish (Mountain Whitefish, Large Scale Sucker, and White Sturgeon) sampled from the Hanford Reach have some of the highest concentrations of contaminants (Aroclor, Cadmium) found in the EPA Columbia River Fish Contaminant Survey.

Risk estimates by the EPA indicate that adults eating contaminated fish from the Hanford Reach have risk of contracting fatal disease; and children are at risk of contracting Central Nervous System and immunological disorders.

In *A Risk-Based Screening Analysis for Radionuclides to the Columbia River* conducted for the Center for Disease Control (Risk Assessment Corporation, 2002), a median annual fish consumption rate of 109 kg was assumed for Native Americans (compared to the HEDR Project annual maximum consumption rate of 42.1 kg). The conclusion was:

> " The total screening risk for the Native American scenario at Richland for exposures from 1944 to 1972 was 1.7×10^{-2}. This is roughly a factor of 10 higher than the median risk to the maximum representative individual in the HEDR Project. Most of the difference was attributed to the fish consumption rates."

Our Yakama Nation Exposure Scenario for the Hanford Site proposes a fish ingestion rate of 519 g/day, or about 189 kg per year, significantly greater than those assumed for the above analysis.

EPA guidance for Superfund Risk Assessment (Publication 9285.7-47, RAGS) requires that populations be identified for the evaluation of risk to reasonable maximum exposed (RME) individual. DOE should consider a maximum exposed population with individual exposures including pathways from surface water, groundwater, soils, fish, wildlife, and plants by various intake routes. Combined risk to an individual from eating fish, drinking water, ingesting soils, etc. should be assessed.

The exposure assessment should address risks to humans from consumption of biota with exposure limits set to protect ecological endpoints. For instance, in the Ecological Risk Section of the draft (p.5-76), it states: "When nondetected radionuclides were excluded, the potential dose estimates decreased to less than 0.001 rad/day, which is attributable to detected concentrations of strontium-90 and tritium. This level is well below the IAEA threshold screening value (1 rad/day) and the lowest radiation effect NOAEL for fish (0.06 rad/day)."

As the following calculations based on Tc-99 contamination indicate, the exposure limits to fish cited in the draft risk assessment imply potentially large radiological doses to tribal people eating fish so exposed.

- Dose to fish: 1 rad/day. Corresponding activity in fish: ~2x10E+6 Bq/kg, Eating 389 g/d of fish with 2x10E+6 Bq/kg for one year results in an effective dose of 0.0828 Sv or 8.28 rems.
- Dose NOAEL to fish: 0.06 rad/day. Corresponding activity in fish 1.2xE+6 Bq/g activity in fish: Eating 389g/d of fish with 1.2xE+6 for one year results in 0.04968 Sv or 4.97 rems.

In each instance, these limits indicate that a tribal person would receive doses substantially higher than the 15 millirem limit derived in this assessment.

According to a 2005 paper by IAEA-sponsored researchers, the IAEA has <u>not</u> adopted the DOE standard.[4] The IAEA has held several conferences to address this issue and:

"...the IAEA is currently developing an International Action Plan on the protection of the environment from the effects of ionizing radiation with the main focus on the possible form of future regulatory criteria, the application of biota effect data, and their relationship to discharge regulation."[5]

Furthermore, according to a 2005 paper by IAEA-sponsored researchers, the IAEA has <u>not</u> adopted the DOE standard of 15-millirem. The IAEA has held several conferences to address this issue and as of 2005 (from The IAEA standards for the radioactive discharge control: Present status and future development):

"...the IAEA is currently developing an International Action Plan on the protection of the environment from the effects of ionizing radiation with the main focus on the possible form of future regulatory criteria, the application of biota effect data, and their relationship to discharge regulation."

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[4] M. Balonov, G. Linsley, D. Louvat, C. Robinson and T. Cabianca, The IAEA standards for the radioactive discharge control: Present status and future development, *Radioprotection, Suppl. 1, vol. **40** (2005) S721-S726,* http://www.edpsciences.org/articles/radiopro/pdf/2005/02/o505.pdf?access=ok

[5] ibid.

The National Contingency Plan (See 40 CFR § 300.430(e)(2)(i)(A)(2)) identifies an upper bound lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} for known or suspected carcinogens. In the *Remedial Investigation Work Plan for the Hanford Site releases to the Columbia River*, USDOE cites 15 mrem/yr as the target dose rate that meets the upper target risk threshold of 1×10^{-4}. This 15 mrem/yr threshold equates to approximately 3×10^{-4} increased lifetime risk. It is three times higher than 1×10^{-4} or 5mrem/yr. The Yakama people are already exposed to a 1 in 50 risk of cancer from non-radiological contaminants present in the Hanford Reach of the Columbia River. In light of this information, a more protective level needs to be negotiated between our governments. More stringent levels between 1×10^{-5} and 1×10^{-6} have been selected at other CERCLA sites in NJ, OH, SC, and CA.

8. Ecological Risk Assessment

Major omission: The document fails to propose collecting biological information for preliminary steps of an ecological risk assessment. Furthermore, historical biological data is not presented in this remedial investigation Work Plan. This is a glaring omission given that the NCP requires a baseline risk assessment that is not limited to only sediment and surface water.

Based on discussions held with the Yakama Nation, USGS recommended the proposal described below to assess biological impacts from Hanford. These recommendations should be factored into the Work Plan.

Determine the status of resident fish and invertebrate populations and construct population models for resident fish and their prey items. In order to fully understand the biological significance of contaminant residues in the biota and media, it is useful to conduct holistic studies that focus on the general quality of the habitat relative to development, survival and reproduction of the resident biota. This is especially critical to the development of an ecological risk assessment for the Hanford Reach, as discussed below. Using the habitat information developed ... and information from the retrospective study, population models will be constructed for key aquatic species, namely salmon, their predators, and their prey. These models will be developed in conjunction with a Hanford Reach food-web model, which will address trophic transfer, and the contaminant biomagification study discussed below.

Conduct toxicity testing and toxicity assessments from single and complex mixtures of contaminants with key species of concern. Two phases of investigation are anticipated. The first phase is the collection of data on the toxicity and bioaccumulation potential of specific chemicals presently being released or anticipated to be released in the future. Relatively little toxicological work has been conducted on aquatic organisms with radioactive compounds. A basic understanding of lethal and sub-lethal toxicity and bioaccumulation of these unusual compounds will be required prior to completion of a thorough ecological risk assessment.
The second phase is determining the impact of complex mixtures present in sediment, water and biota. Cumulative impact assessment of complex mixtures of contaminants present in the Hanford Reach will require integrative investigations such as *in-situ* toxicity (survival and development of fish in artificial redds), the sediment quality triad approach (sediment chemical concentrations, toxicity, and benthic invertebrate abundance and diversity), sediment bioaccumulation studies, and assessment of toxicity and bioaccumulation of environmental extracts derived from chemical sequestration devices such as semipermeable membranes, and measures of biomarkers for health and reproductive success. Such information will be necessary for an accurate assessment of risks in the Hanford Reach.

Determine the trophic ecology of contaminants within the food web of the Hanford Reach.
Capitalizing on the habitat assessment and population models discussed above, this project will utilize that information along with in-tissue measurements, to assess the extent of biomagnification of contaminants. The study will identify where contaminants are entering the food web, what compounds are being biomagnified, and what factors may be controlling such dynamics. Avian and mammalian organisms that feed upon Columbia River biota represent the upper tier of the food chain and are likely to exhibit biochemical, reproductive, and developmental responses indicative of human health impacts. Contaminant loading information for other mammalian predators in the Hanford Reach will be useful in the ecological risk assessment, as well as providing critical information to the human health Risk assessment.

Perform an ecological risk assessment of cumulative effects associated with complex chemical mixture exposures in fishes and aquatic invertebrates of the Hanford Reach.
Utilizing the information gained in the physical and biological studies proposed above, an ecological risk assessment will be conducted. Ecological risk assessments are most commonly conducted on specific stressors, however, such assessments fail to consider the cumulative impact to the biota that multiple chemical and radionuclide contaminants may have. The physical habitat information, population models of key resident species, and the field and laboratory assessments discussed above will all be used to characterize risks from multiple stressors. Given an upstream-downstream context for evaluating risks and the incorporation of information from the groundwater study discussed above, potential risks to fish and aquatic invertebrates can be evaluated from exposures to surface waters and ground water seeps of the Hanford reach.

D. Detailed Work Plan Comments

The Work Plan presents an incomplete list of target analytes. Target analytes for water, soil and sediment in Appendix A Table 3-2 and for the Remedial Investigation should include Hanford contaminants such as, but not limited to: P-238,239/240,241; Carbon tetrachloride; Trichloroethene; Iodine-129; Thorium-222 & 230; Tritium; and Total PCBs.

Page ES-13, Table ES-2: Co-located pore water samples should be collected with the surface water samples in ground water upwelling areas. In Appendix A, Section 2.5.1, it appears that surface water samples will be collected no closer to the bottom that 1 foot, which will not provide information on potential impacts from upwelling ground water to bottom organisms or fish using the river bottom at various life stages.

Page 4-17, 4.3.8.2: Co-located pore water samples should be collected with the surface water samples in ground water upwelling areas (see first comment).

Page 4-34, 4.4.2, 2nd ¶: Hanford contaminants are likely upriver of Vernita Bridge.

Page 4-36, 4.4.2.1: Upwelling ground water is not limited to the shoreline seeps and springs. Release of contaminated ground water from the hyporheic zone is occurring offshore as well.

Page 4-47, 4.5.1, 1st ¶: Upwelling ground water is not limited to the shoreline seeps and springs along the right shore. Also, co-located pore water samples should be collected with the surface water samples in ground water upwelling areas since ground water upwelling is being investigated to support the BERA (see first comment).

Page 4-53, 4.5.4.4, 1st ¶: Are tissue SRMs being analyzed as quality control samples? If not, they should be analyzed for each extraction/preparation batch for methods with available SRMs.

Page 4-56, 4.5.6.2, 1st ¶: Please discuss the drilling technology and sample recovery methodology for the deep cores.

Page 4-68, 4.6.3.1.5 Table: Since the aquatic habitat endpoint is survival, growth and reproduction of fish, pore water should be sampled in ground water upwelling areas as well as surface water and sediment. In Appendix A, Section 2.5.1, it appears that surface water samples will be collected no closer to the bottom that 1 foot, which will not provide information on potential impacts from upwelling ground water to bottom organisms or fish using the river bottom at various life stages.

Page 5-4, 5.1.7, 1st bullet: The purpose of the RI is in part to "Characterize the nature and extent of Hanford Site-related contaminants that have come to be located within the Columbia River." This goal cannot be met by limiting sampling to the river above McNary Dam and two deep cores above Bonneville Dam. The investigation should be expanded to determine where the contaminants are located.

General Comments of the Baseline Risk Assessment Work Plan Elements

The purpose of the risk assessment as stated in the Work Plan is to "evaluate whether current conditions pose a significant risk to ecological or human receptors that may require additional study or response actions under CERCLA." Evaluating current conditions indicates an assessment for an isolated point in time, which is too restrictive for a complete Remedial Investigation.

We noted that the risk assessment intends to consider cumulative effects of Hanford and non-Hanford contaminants (as well as the incremental risk of differentiated Hanford-only effects), and that the methodologies described in the Work Plan will be followed to complete the RCBRA. The assessments have already begun, so we can only assume that there is no conflict between previous plans (and associated work conducted) and the appropriate EPA methodology described here (e.g., EPA's eight-step process for ecological risk assessments and five-component process for human health assessments). The methodologies proposed appear sound; however, a further "step back" should be taken to consider all data potentially needed for a complete RI, not simply what data are missing based upon previous work and data gaps analysis. Similar to previous comments, there should be a clear method proposed for integrating the assessment of potential risk site-wide for all scenarios now and in the future.

We noted that results of the sampling described in this Work Plan will be combined with existing data to perform the RCBRA. Unfortunately, to discern whether the initial scoping steps of the RI were accurate and the characterization adequate, we would also have to review the Data Evaluation Summary, Data Gaps Analysis, Data Quality Objectives reports, and CRC database.

Detailed Comments on Section 4.6

1. The boundary of the study area is too restrictive, parceling out the Hanford Site in a way that does not account for the movement of ecological receptors between upland, riparian, nearshore, and in-water habitats.

2. During the pre-screen exclusion of COPECs (p. 4-62), it may be more appropriate to refer to "background radionuclides" as "naturally occurring radionuclides" so as to avoid confusion with background concentrations.

3. Although various sources of screening values are identified and used to select ecological benchmarks (Table 4-10/Table 4-8 on pages 4-69 to 4-73), it does not appear that the most conservative values were necessarily selected for the final benchmarks. For example, for screening benzo(a)pyrene in sediment, an Apparent Effects Threshold value of 3.3 mg/kg or 3300 ppb (Michelsen 2003) is selected, rather than 31.9 ppb Threshold Effect Level (MacDonald et al. 2000) or even 350 ppb toxicity-based sediment quality benchmark (ORNL 1997). The lowest value should be used for screening, and the process/rationale for benchmark selection should be clarified.

Detailed Comments on Section 4.7

1. Upland, riparian, and nearshore areas located near former reactors are not scheduled to be evaluated in this RI, but in the separate "source and groundwater component" risk assessment. This RI clearly aims to dissect the Hanford Site once again, focusing on a very narrow spatial corridor and ignoring the larger issue of multiple contaminant sources, fate and transport mechanisms, exposure pathways, and their cumulative effects. Groundwater transport to the surface waters of the Columbia River is a critical issue, and the two media cannot be evaluated separately. Also, previous studies have indicated that Hanford contamination has traveled downstream well beyond McNary Dam, which is the current, albeit inadequate, study boundary proposed in the Work Plan.

   As mentioned during previous review opportunities, multiple assessments continue to be conducted with little plan for a cumulative analysis of risk to humans or the environment. Although this RI claims to represent the culmination of existing data evaluation, CSM development, and DQO identification, it remains spatially (and temporally) limited, perhaps intending to simply fill certain data gaps or address specific concerns not covered in previous work, all the while avoiding the critical need for a site-wide remedial investigation. This is particularly relevant for risk assessment.

2. The plan states that sampling of surface water, soils, sediment, and fish influenced by contamination from upwelling groundwater will be considered upon evaluation of the groundwater plume upwelling survey results. How can the current sampling plan be proposed without such information being yet available? All steps of the phased approach, if that is indeed the process, should be clarified, including adequate field collection and lab control details in this sampling plan, with the same intention for future sampling plans to be developed for additional data needs.

3. Page 4-81 refers to risk-based benchmarks that can be found in Section 4.6.10, which is a section that does not exist. We assume Tables 4-11 through 4-13 should be referenced. P. 4-87 refers to the statistical comparison procedures discussed in Section 4.6.4.4, which also does not exist in the Work Plan.

4. Surface water benchmarks for human health include addressing both the drinking water pathway and the fish ingestion pathway. Proposed values are generally appropriate with

the exception of the National Recommended Water Quality Criteria (NRWQC). While the NRWQC values address both the drinking water and the fish ingestion pathways (consumption of water and organisms), the fish ingestion rates are only 17.5 g/d, which does not adequately account for tribal cultural and subsistence consumption. The NRWQC criteria should be modified based on an appropriate consumption rate (perhaps highest of Yakama and CTUIR).

Fish tissue benchmarks are based on modified EPA Region 3 RBC values (modified based on 620 g/d CTUIR rate). However, only the ingestion rate has been modified from the Region 3 RBC, and not other exposure parameters appropriate to a tribal scenario. Region 3 uses an exposure frequency of 350 d/y (should be changed to 365 d/y) and an exposure duration of 30 years (should be changed to a 70-year lifetime exposure).

5. The Work Plan states that soil values will be used for sediment screening (since freshwater sediment values include protecting aquatic organisms). However, p. 4-102 states that if no benchmark or reasonable surrogate benchmark is available, that compound will be excluded as a COPC. We recommend that in these cases, if there is a freshwater sediment value is available, that it be used.

6. For screening fish tissue, the Work Plan states on p. 4-102 that if a compound is not detected in any other media, it will be excluded as a COPC for fish, whether or not it is detected in fish. We disagree with this approach. Despite whether Hanford COPCs are "known biomagnifiers" or not, compounds may remain present in fish after they have attenuated to non-detectable levels in other media.

7. Retaining compounds identified as potentially "background" is appropriate (although there is mention again of the statistical comparisons described in the non-existent Section 4.6.10.1 on p.4-103). However, we continue to disagree with the location of the background samples because of data that indicates the sampling locations are within the radius of influence for Hanford contaminants.

8. The Work Plan proposes to not include an avid hunter scenario because only a fraction of migratory birds' time is likely spent on the river. We disagree with this approach. If previous work has found that waterfowl spend a percentage of their time in the area, that percentage may be applied to the exposure scenario. We recognize the extent of previous work, however, the purpose of an RI is to present an approach for evaluating every possibility for exposure to Hanford contaminants. Similarly, workers (industrial, fish hatchery, etc.) should be considered.

9. Tables 4-15 through 4-17 list the proposed exposure parameters. In all cases, the exposure frequency (150 days/year for adults) is less than half of the value recommended in the Yakama Exposure Scenario (365 d/y). Ensure all parameters for all scenarios are correct.

10. Table 4-15 indicates footnotes 1 through 12, but only nine footnotes are listed at the end of the table.

11. Fish sampling should not be limited to support only the human health assessment and not the ecological assessment. The opportunity exists to collect fish for both purposes during the proposed sampling events.

Comments on Appendix A Sampling and Analysis Plan

Page A2-2, 2.2.2 (also page A2-41): Insufficient detail is provided on the methodologies that will be used to determine the ground water upwelling areas. This discussion should be expanded so that it is clear that the approach will provide the necessary information. As described here, the sampling approach is not adequately developed.

Section 2.4, Tables 2-2 through 2-6: A footnote in each of these tables states that "Inclusion in this table is not a commitment to sample analyze for all of these compounds." However, in tables 3-1 thru 3-4 it is implied samples will be analyzed for all the analytes associated with these methods. Please explain the footnote.

Page A2-40, last bullet:Limiting sampling to two cores is unlikely to provide sufficient information to decide if Hanford contaminants are present in the Bonneville Dam pool. Depositional areas located closer to the dam should also be sampled.

Page A2-42, 2.5.1, 2nd ¶: What is the rationale behind sampling at two-thirds the depth of the water column. Why not use depth-integrated sampling? Also, peristaltic pumps have limited lift capacity (33 feet or less at sea level).

Page A2-42, 2.5.1, 3rd ¶: It appears that surface water samples in ground water upwelling areas will be collected no closer to the bottom that 1 foot, which will not provide information on potential impacts from upwelling ground water to bottom organisms or fish using the river bottom at various life stages. Pore water samples should also be collected at these locations.

Page A2-45 , last ¶: Please discuss the drilling technology and sample recovery methodology for the deep cores.

Tables 3-1 through 3-4: Attainable reporting limits for metals (ICP-MS and CVAA Mercury) are considerably lower than listed.

Page A3-67, 3.12.2, 2nd ¶: A frequency of validation of 10% of data packages is preferrable, with provisions for greater frequency if problems are encountered.

Page A3-68, 3.12.3 1st ¶: The referenced documents are not readily available for review.

Summary of Fish Sampling and Analysis Plan (in Appendix A)

As part of the RI, DOE proposes to conduct a fish tissue study within the Hanford Reach area of the Columbia River and downstream to McNary Dam. Fish will be taken from four sub-areas including: Upriver Sub-Area (Upriver of Priest Rapids Dam and RM 388 to RM 401); 100 Area Sub-

Area (RM 388 downstream to RM 365); 300 Area Sub-Area (RM 365 downstream to RM 339); and Lake Wallula Sub-Area (RM 339 downstream to McNary dam at RM 292). The Bonneville Dam Pool Sub-Area will not be sampled.

The study will target six resident fish species including: white sturgeon (*Acipensertransmontanus*); common carp (*Cyprinuscarpio*); largescale sucker (*Catostomusmacocheilus*); bridgelip sucker (*Catostomuscolumbianus*); mountain whitefish (*Prosopiumwilliamsoni*), and walleye (*Stizostedionvitreum*). The fishing effort will be conducted in late summer to early fall. Fishing methods will include electrofishing, hook and line, and seining. Fish may be taken from any location with in a sub-area. However, fishing crews will focus on traditional recreational and subsistence fishing spots. Information on these locations was obtained from local fishermen.

Five composite samples of carp, suckers, whitefish, and walleye will be collected for each of the sub-areas. Each composite will be comprised of 3 to 5 fish depending on the species. Because of their large size and intense fishing pressure on the species, only one white sturgeon per sub-area will be taken. Analysis will be conducted separately on muscle tissue (fillets), combined organs (stomach, liver, and heart), and skeletal system (bones). Analyses will not be conducted on any whole fish. The Work Plan states that results from the muscle, organ, and bone analysis can added together to provide total contaminants for the whole fish. The fish tissue will be analyzed for pesticides, PCBs, radionuclides, target analyte list metals, and methyl mercury.

The results of the study will be used to conduct a human health risk assessment only.

Comments on Fish Sampling and Analysis Plan (in Appendix A)

Sturgeon Studies: We note that Yakama Nation has proposed to conduct sturgeon studies, which may be developed through a coordinated approach with USDOE. The comments presented below are based on a brief review of the limited information presented in the Work Plan only and do not constitute all of our concerns regarding sturgeon studies.

Lamprey issues: It is our understanding that efforts to restore the lamprey in the middle reach of the Columbia River are underway. In the future, lamprey may be reintroduced to areas where they traditionally existed. The implications are that contaminants in sediments, in particular, may affect lamprey, and since lamprey will be eaten by Tribal members, the Work Plan should include studies (such as sediment toxicity) to determine risk to lamprey and to humans who consume them.

Fish reference areas for BHHRA: Past studies performed at Hanford documented radiotagged fish movements from the Hanford Reach into the Yakima River as well as above Vernita Bridge. A study by Cushing and Watson (1966)[6] documents Zn-65 values similar or higher for whitefish taken below Priest Rapids dam 1060 (eye) and 1400 (GI tract) than Hanford Reach specimens that had values of 540 (eye) and 1200 (GI tract). Based on this past study it appears that the use of the area between Priest Rapids dam and the Vernita Bridge as a reference site is inappropriate.

Detailed Comments on Appendix A Fish Sampling and Analysis

1. The Bonneville Dam Pool Sub-Area should be included in the fish tissue study. This information will provide insight about the downriver extent of contamination from the

[6] Cushing, C.E., and D.G. Watson. 1966. "Accumulation and Transport of Radionuclides by Columbia River Biota" In: Disposal of Radioactive Waste Into Seas, Oceans and Surface Waters, ed. A. Guillon, pp 551-570. International Atomic Energy Agency, Vienna, Austria.

Hanford site. Results from a fish tissue study in this sub-area should be compared to the sediment sampling that is proposed to occur in the sub-area.

2. Sediment sampling and fish tissue sampling should be co-located throughout all of the sub-areas. To achieve this, some of the proposed sediment sampling locations may need to be altered depending on where fish are caught in the sub-areas.

3. Salmon are excluded from the study because they are not resident fish. However, they should be included in the study because they are a critical subsistence and recreational fish species. The local population is more apt to consume salmon than suckers. Salmon should be fairly easy to collect in the sub-areas during late summer and early fall when the study will occur. In fact they may well be taken incidentally by any one if not all of the proposed fishing methods.

4. Bass, catfish, or trout are not discussed as target or alternative species. They should be included in the study. Local fishermen are likely to consume bass, catfish, and trout caught in the study area.

5. No analysis will be conducted on whole body fish tissue. The Work Plan states that results from the muscle, organ, and bone analysis can added together to provide total contaminants for the whole fish. It should be assumed that local fishermen are consuming whole fish from the study area. Recreational or subsistence fishermen may in fact can fish as a method of preserving them or they may consume whole fish in a stew. If this is the case, the whole fish may be used. Whole body fish analysis would also pick up contaminants that may be present in other organs such as eyes, kidneys, skin, and spleens, none of which were mentioned in the Work Plan. Whole body fish tissue analysis should be considered.

6. The Work Plan does not mention conducting analysis on eggs (roe) that may be present in female sturgeon. It should be assumed that roe will be consumed as caviar by recreational and subsistence fishermen. If egg-bearing female sturgeon are caught during the study, the eggs should be collected and analyzed for the same target analytes that will be analyzed for in muscle, organs, and bones.

7. The Work Plan does not mention whether or not a set of fish tissue samples will be collected and held as archives. This should be considered in the event additional tissue is needed for further analysis.

8. The study area is large, encompassing over 50 miles of river habitat. A maximum of five composite samples per sub-area are proposed. One composite sample will be comprised of one to five individual fish. Given the size of the study area, individual fish sample size and the number of composites per sub-area may need to be increased to provide a statistically robust data package.

9. Page A2-48 of the work states that one sturgeon from each sub-area will be collected, a total of four fish. Table 2-8 of the Work Plan states that one sturgeon will be collected for each "composite". It also states that five sturgeon will be collected in each sub-area, for a total of 20 fish. To avoid confusion, it should be clearly stated how many sturgeon are proposed to be collected and analyzed during the study.

10. While it is important to sample fish from known recreational and subsistence hot spots, it is equally important to sample fish from areas that may have high levels of contamination in the sediments. There appears to be no proposed fish sampling areas adjacent to several of the reactors or their discharge pipes in the 100 area (Appendix A Sampling and Analysis Plan [SAP], Figures 2-3, 2-7, and 2-8). Additionally, the Lake Wallula subarea (Appendix A SAP, Figures 2-14 through 2-18) appears to have no proposed fish sampling at many of the numerous parks and boat launches that are present in the area. Most sampling in this subarea appears to be concentrated at the Yakima River confluence. While avid fishermen may not have provided information for these parks and boat launches, it should be assumed that people will fish from these recreational areas or any other areas that provide public access to the river and its banks.

11. Sediment, soil, and surface water samples will be analyzed for hexavalent chromium (Cr+6). Fish tissue will not be analyzed for Cr+6. The fish tissue study should include analysis of Cr+6, as it is known to accumulate in fish body tissue and organs (livers, kidneys, spleens). From past USGS work, we know that the kidney of fish has an affinity for chromium, and the kidney should be analyzed separately to determine the highest concentration in the fish. This type of sampling should be part of an ecological risk assessment, which is not included in this Work Plan.

12. Table 3-4 of the Appendix A SAP presents the analytical performance requirements of contaminants in tissue. Many of the fish tissue benchmark concentrations are lower than the laboratory detection limit requirements. Other analytical methodologies should be considered to attain lower detection limits.

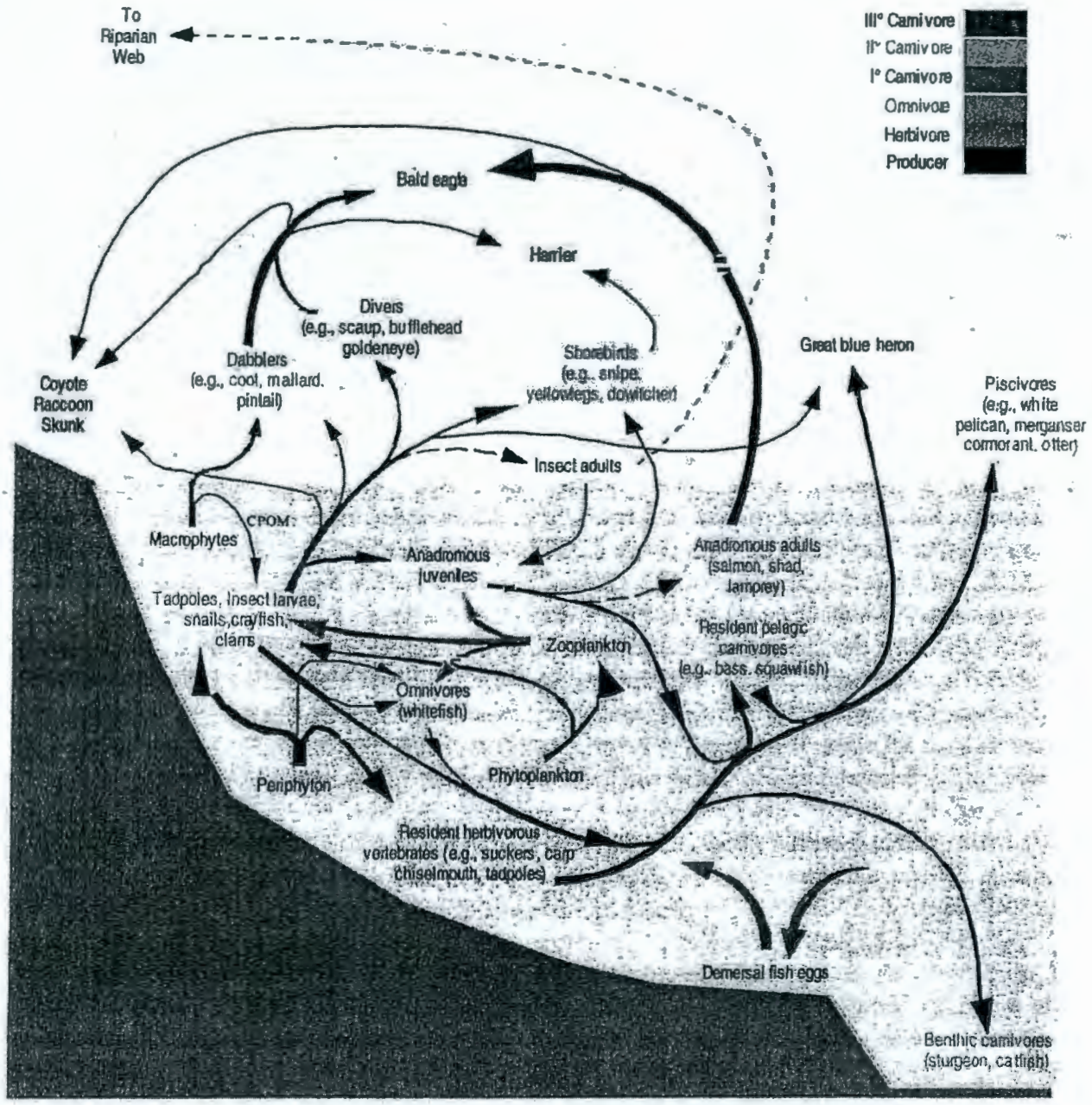

Figure 4.2. Aquatic Food Web for the Ecological Risk Screening Assessment of the Columbia River (Detrital/decomposing components are not represented. Line widths represent the approximate level of biomass flow. Dashed lines indicate developmental transformation to a different life style. Legend colors apply only to organisms' names, not to the arrows.)