

0075938

The Health Status of Fish in the  
Hanford Reach of the Columbia River, Washington

Submitted by:

Aida Farag  
USGS - Columbia Environmental Research Center  
Jackson Field Research Station  
P.O. Box 1089  
Jackson, Wyoming

November 2003

USGS Proposal  
9/2003  
11/2003

**RECEIVED**  
FEB 06 2008  
**EDMC**

Multiple parameters were used to define the health of fish during the laboratory study and the same approach will be used in the proposed field study. Therefore, the health of fish collected in the Reach will be defined with a weight-of-evidence approach, where all information will be gathered and an overall health assessment will be defined. It is only with this weight-of-evidence approach that we can define the health status of fish and minimize uncertainty of the assessment.

We propose to study the health status of resident fish in the Hanford Reach of the Columbia River, Washington. We will study resident fish rather than chinook salmon for two reasons. First, by studying resident fish we alleviate any need to sacrifice chinook salmon in the Reach. Second, resident fish may provide a more true representation of exposure to contaminants in the Hanford Reach. Their exposure history is longer and some species (e.g. sculpin) may spend more time in closer proximity to the sediment, where concentrations of contaminants might be greatest.

To provide a more complete assessment, we believe that multiple species of fish should be studied. We will attempt to study one species of non-game fish, such as sculpin. Woodling et al. 2002 documented that sculpin are sensitive to some metals and Farag et al. (2002) noted that sculpin were no longer present in some sections of stream affected by abandoned mine lands. The second species of fish studied may be a game species that is used as a food source for Native Americans and others.

In summary, the proposed study of field fish health is a natural progression of earlier work performed by USGS. The proposed study would utilize information gained during previous laboratory experiments and would provide a useful assessment of the health of fish in the Hanford Reach of the Columbia River. This weight-of-evidence approach based on parameters associated with population level effects can provide a comprehensive assessment of fish health in the Hanford Reach.

**BUDGET:**

4 sites x 30 fish per site x 2 species = 240 fish  
6 tissue types (gill, liver, kidney, muscle, intestine, and whole fish)

Measurements

Chromium residues: (240 fish x 5 organs and whole fish = 1440 samples)	108,000
Histology and Lipid peroxidation: (240 fish x 5 organs (no whole fish) = 1200 samples)	132,000
Immunohistochemistry: (240 fish x 2 organs (kidney and gill) = 480 samples)	14,400
DNA: (240 fish x 2 organs (kidney and blood) = 480 samples)	48,000

Salaries:

Fishery Biologist GS 11, 7 mths	41,637
Biological Technician GS 9, 5 mths	25,166

Supplies, Training, Safety 5,000

Travel 4,000

CERC Common Services 15,128

Subtotal 393,331

Bureau Assessment (11%) 43,266

**TOTAL** **436,597**

**FINANCING:** The charge for goods and/or services shall include both direct and prevailing indirect costs applicable to this agreement.



# United States Department of the Interior

U.S. Geological Survey

Columbia Environmental Research Center

Jackson Field Research Station

P.O. Box 1089

Jackson, WY 83001

Commercial and FTS No: 307-733-2314 FAX No: 307-739-9268

September 10, 2003

Don Steffek  
Chief, Environmental Contaminants  
911 NE 11<sup>th</sup> Avenue  
Portland, OR 97232-4181

On January 14, 2003 a letter was provided to the USFWS by the USGS – Columbia Environmental Research Center that described general comments about the DOE/PNNL Report, and recommendations for further research were also provided by the USGS in this letter. Some statements below are quoted directly from that letter:

"General Comments:

1. Chromium in groundwater issue. Only one water source at one point in time was used in the PNNL studies. A huge area of the Hanford site was not considered or monitored at all. Is the 199-D5-43 the best representation of water that will mix with water at the 100-DR site, and is this the only water that is of importance to the fish species that spawn in this reach of the Columbia River?
2. No biological effects demonstrated. The DOE/PNNL report states that all results from the USGS and PNNL studies resulted in no aberrant effects to the fish species at any age and concluded that this means further studies do not need to be conducted. USGS clearly demonstrated physiological effects from Cr exposure in parr. Histological lesions in kidney, for example, were observed and associated with elevated doses of Cr in the kidney and reduced growth and survival. Impaired growth and reduced survival are effects that clearly impact fish populations. It appears that the DOE/PNNL report ignored USGS information. In addition, while all these studies were laboratory studies, thus far, there have been no studies to examine the physiological status of fish from the field.
3. One species/no effect on aquatic organisms. In this preliminary assessment, the USGS studied only one species of fish and clearly demonstrated physiological effects brought about by chromium exposure. Further studies with additional species are needed to provide a thorough assessment of chromium-induced biological effects in aquatic organisms in the Hanford Reach.

- we took most sensitive species + most toxic contaminant - cleanup level adequate
- we have not done resident species starting to do some monitoring

also K+H  
3 reactor areas w/ chrome  
Only really concerned @ DR  
used worst case

Don't see these effects in river  
There was injury in lab - limited area of concentration  
limited injury

} true  
- no identical of exposure in river  
- need to do path way first  
not injury

check with Battelle

...Recommended Future Research

The series of studies conducted by USGS, under the auspices of the Trustees and U.S. Fish and Wildlife Service, were designed to assess the effects of chromium (Cr) on chinook salmon under exposure conditions similar to those of the Hanford Reach of the Columbia River. The intent was to develop exposure assessment tools that could then be used in field studies. The focus of the DOE/PNNL report was to examine potential effects of Hanford groundwater on early life stage chinook salmon. Based on the results of these initial studies, it is our suggestion that further studies be conducted using the laboratory assessment tools to address effects of Hanford water on organisms in the field. We suggest the following uncertainties be addressed:

- correct  
- found limited exposure + limited affected habitat

1. Field studies involving more extensive water and sediment sampling would add greatly to the understanding of potential chromium exposure in the Hanford Reach. *River bottom? we already have tons of data @ shoreline*
2. Field studies on physiological effects of chromium on fish should be conducted keeping in mind that kidney tissue may be particularly sensitive. We suggest that studying effects on other species would also be useful. *Additional studies by AMRC / Natl. did not see increased chrom uptake in tissue → not in kidney*
3. Fish spawn on only one side of Hanford Reach, but not on the other. Studies addressing this pattern of behavior are needed. Whether or not the selection is chromium-related is unknown. If chromium is involved, avoidance behavior could be responsible for the spawning pattern. This is a testable issue that would provide meaningful information. *was done by USGS already - possibly check habitat suitability*
4. Studies of the effects of chromium or that of Hanford water on other species of fish (or potentially other aquatic organisms) should be conducted to conclude no effects. Basing these conclusions on one species is not valid." *already used most sensitive species related to #2 - need to document exposure in other species just to do injury study*

→ true - need to document exposure

No data have been introduced to date that would suggest the recommendations of the USGS - Columbia Environmental Research Center differ from what was suggested in January 2003. Three important issues still remain. First, more field data should be collected to determine the extent of conditions that could affect chinook salmon and resident species in the Hanford Reach of the Columbia River. More extensive water and sediment sampling efforts along with sampling efforts of resident fish (focusing investigation on effects at the kidney defined as target organ for chromium) in addition to salmon could address this concern (see recommendations 1 and 2). Second, questions about the spawning patterns of chinook salmon are still unaddressed (see recommendation 3). Third, it is important to address injury potential to additional fish species and aquatic organisms (see recommendation 4) in an effort to understand potential effects on the aquatic communities in the Hanford Reach. We understand that divisions of administrative responsibilities for the Hanford Reach may have led to compartmentalizing data collections for various fish species. However, to adequately define the effects of chromium and other contaminants on the aquatic community in the Hanford Reach, data on multiple species and levels of biology must be considered.

agree but would focus on kidney until exposure documents

43 CFR 11.63 - pathway determination

Pathway studies is key  
describe chunk aquifer tube water samples in annual report for chrome values

Finally, an issue that is yet unexplored by the Trustee Council is the potential threat of contaminants in the Hanford Reach to humans via consumption of exposed fish. This is currently being explored by EPA (e.g. e-mail provided by Don Steffeck on 9/08/03), but the Council may wish to keep informed about the findings as it impacts the management of the Hanford Reach. Furthermore, this provides an opportunity for data to be shared between EPA and the Trustee Council. For example, collection efforts of water, sediment, and resident fish may not be duplicated if EPA sampling plans were coordinated with researchers for the Trustee Council. In particular, water and sediment samples collected by EPA might supplement data needs for the Trustee Council. Furthermore, samples of fish tissues used to study human consumption issues could be collected simultaneously with samples collected for field fish health studies (e.g. samples of muscle collected by EPA for human consumption issues, samples of kidney collected for Trustee Council for fish health issues).

In conclusion, the Trustee Council has supported research efforts to define the effects of chromium on chinook salmon. However, as USGS recommended in January 2003, some data gaps exist. Studies to further document the distribution of chromium (and other contaminants) in water and sediment, define factors that contribute to the spawning distribution of salmon in the Hanford Reach, and characterize the health of resident fish in addition to salmon from the Hanford Reach could help answer these questions.

I hope that this information provides insight for the Trustee Council and please contact me if you need additional information.

Sincerely,

Aida Farag  
Station Leader

## Summary of USGS Study Proposal

Dated November 2003

“The Health status of Fish in the Hanford Reach, of the Columbia River, Washington”

### Background:

See Jamie Zeisloft presentation. Under the direction of the Trustees Council, the USGS completed 2 studies (in 2000 and 2001) designed to assess the potential for chromium to affect Chinook salmon in the Hanford Reach. These were laboratory studies on early life stages and avoidance.

### Current Scope of Draft Proposal to USFWS:

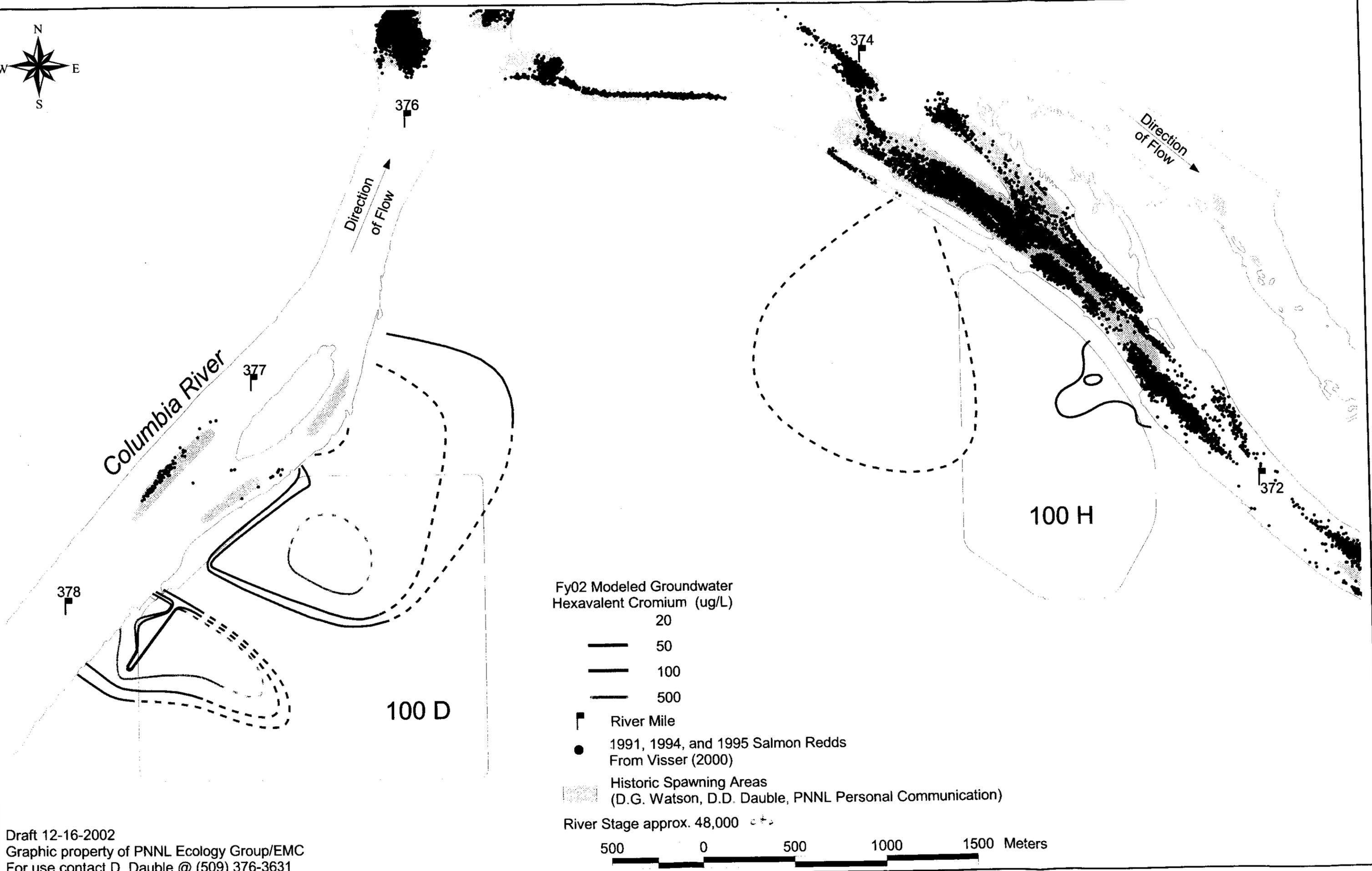
USGS is proposing continue from the previous studies to sample resident fish in the river and look for similar affects that were documented in the laboratory to provide a comprehensive assessment of fish health in the Hanford Reach.

### Issues:

- PNNL in their most recent study has already performed some of this statement of work (residue, histology, physiology, morphology)
- This study assumes that exposure warrants these affect studies (i.e. assumes residue is present in toxic concentrations).
- The earlier studies studied early life state salmon with pore water exposure. We should only study other species that spend their early life stage in chromium contaminated porewater. This proposal studies other fish that probably do not see this type of early exposure. It cannot be assumed that the earlier results apply to other fish species:
- The recent PNNL study suggests that the chromium uptake is through ingestion. The proposal does not address ingestion issues.
- The DNA method that USGS is proposing to use was developed by USGS but has not undergone rigorous peer review as a bona fide test method. Peer reviews for the earlier studies indicated some deficiencies with the method.
- The cost of the study is \$437,000 which may not include sampling. The Proposal has a budget for 240 fish samples. There may be additional overhead expenses (>30%) if USFWS manages the project similar to the previous studies.

### Recommendation:

- Collect samples of multiple fish species as required by the River Corridor Risk Assessment and analyze for applicable contaminants.
- If contaminant residues exceed “action levels”, proceed with affects studies for that particular species and contaminant.



Fy02 Modeled Groundwater  
Hexavalent Chromium (ug/L)

- 20
- 50
- 100
- 500

- ▣ River Mile
- 1991, 1994, and 1995 Salmon Redds  
From Visser (2000)
- ▨ Historic Spawning Areas  
(D.G. Watson, D.D. Dauble, PNNL Personal Communication)

River Stage approx. 48,000 cfs

