DOE/RL-96-16-c
Revision 0, Volume I
UC-630
Draft

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Data for the Screening Assessment
Volume I: Text
Columbia River Comprehensive Impact Assessment

T. B. Miley
T. K. O'Neil
R. O. Gilbert
L. A. Klevgard
T. B. Walters

June 1996

MASTER

Prepared by the Pacific Northwest National Laboratory
In Consultation with Representatives of

U.S. Department of Energy	Confederated Tribes of the Umatilla Indian Reservation
U.S. Environmental Protection Agency	Hanford Advisory Board
Washington State Department of Ecology	Nez Perce Tribe ERWM
Bechtel Hanford, Inc.	Oregon State Department of Energy
Dames & Moore	Yakama Indian Nation

United States
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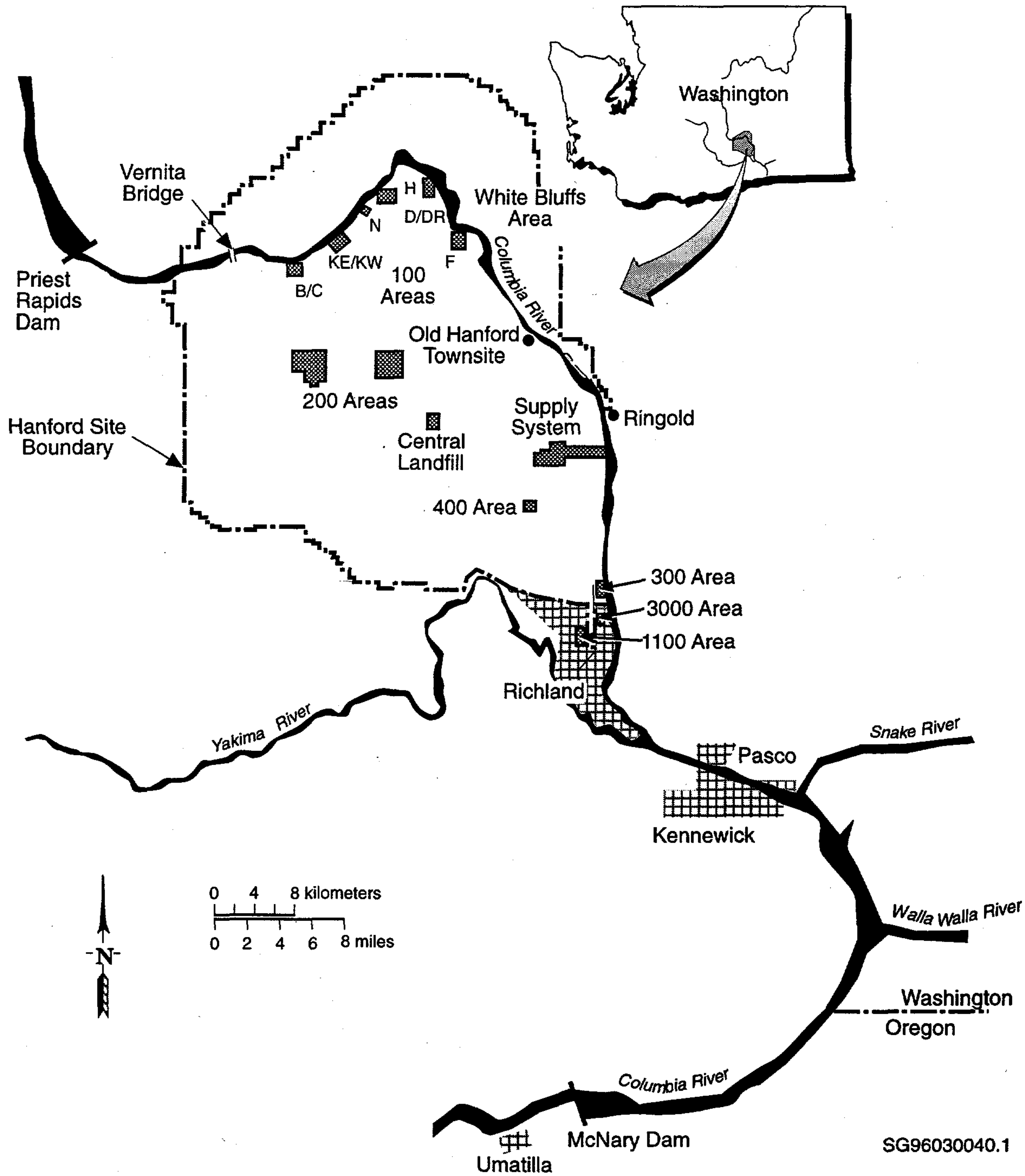

Figure P.1. Map of Screening Assessment Study Area: Vicinity of Priest Rapids Dam - McNary Dam

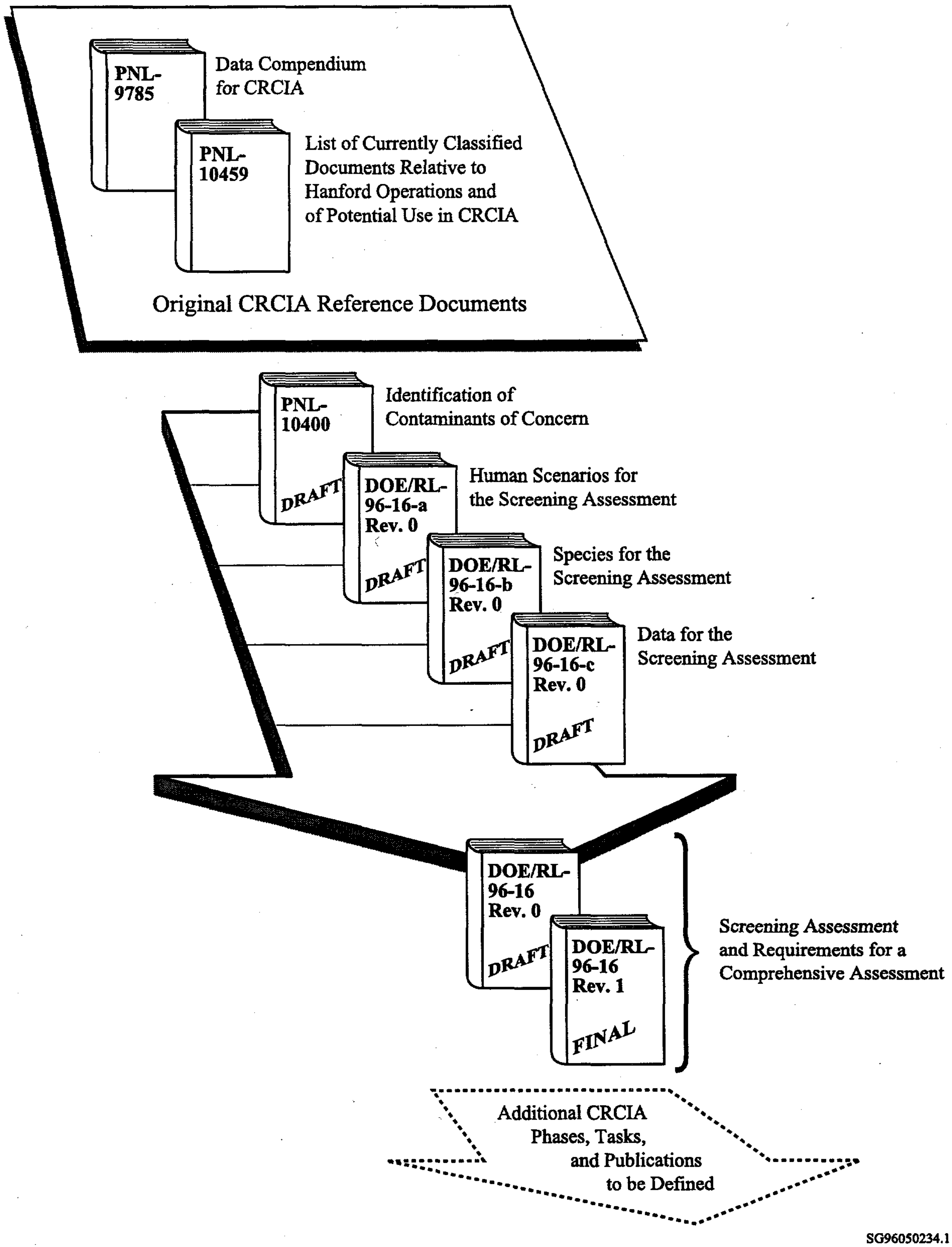

Figure P.2. Publications in the Initial Phase of the Columbia River Comprehensive Impact Assessment

Preface

The Columbia River is a critical resource for residents of the Pacific Northwest. It provides for basic needs and is interrelated with the life style and quality of life for Columbia Basin's many human and non-human residents. This resource drew the Manhattan Project's planners to the site now called Hanford to produce nuclear weapon materials. Production of those materials has left behind a legacy of chemical and radioactive contamination and materials that have, are, and will continue to pose a threat to the Columbia River for the foreseeable future.

To evaluate the impact to the river from this Hanford-derived contamination, the U.S. Department of Energy, U.S. Environmental Protection Agency, and State of Washington Department of Ecology (the Tri-Party agencies) initiated a study referred to as the Columbia River Comprehensive Impact Assessment (CRCIA). To address concerns about the scope and direction of CRCIA as well as enhance regulator, stakeholder, tribal, and public involvement, the CRCIA Management Team was formed in August 1995. The CRCIA Team meets to share information and provide input to decisions made by the Tri-Party agencies concerning CRCIA. Representatives from the Confederated Tribes of the Umatilla Indian Reservation, Hanford Advisory Board, Nez Perce Tribe, Oregon State Department of Energy, Yakama Indian Nation, Tri-Party agencies, and contractors are active participants on the team.

A major CRCIA Team decision was to organize CRCIA into phases, with additional phases to be identified as warranted after completion of the initial phase. The initial phase is comprised of two parts: 1) a screening assessment to evaluate the current impact to the river resulting from Hanford-derived contamination (see Figure P.1 for map of screening assessment area) and 2) identification of requirements considered necessary by the CRCIA Management Team for a comprehensive assessment of impact to the river.

This *Data for the Screening Assessment* report is the fourth in a series of reports which have been issued as part of the initial phase. Figure P.2 depicts the documents which have been and will be issued in the initial phase. After the data report and three previously published reports have been revised, they will be incorporated into a two-part report which will document the results of the two parts of the initial phase of CRCIA: the screening assessment results and the requirements for a comprehensive assessment.

Background

The Hanford Site occupies 1456 square kilometers (560 square miles) in the south central portion of the State of Washington. It is located northeast of the Tri-Cities of Richland, Kennewick, and Pasco. The site is partially bordered on the north and east by the Columbia River and includes a relatively narrow buffer zone north of the river referred to as the Wahluke or North Slope. The Hanford Site is located on land ceded in 1855 by treaties with the Confederated Tribes of the Umatilla Indian Reservation and the Yakama Indian Nation. The Nez Perce Tribe has treaty rights on the Columbia River. The tribes were guaranteed the right to fish at all usual and accustomed places and the privilege to hunt, gather roots and berries, and pasture horses and cattle on open and unclaimed land.

From 1944-1987, the U.S. Department of Energy (DOE) conducted nuclear production operations at the Hanford Site along the Hanford Reach of the Columbia River. The Hanford Reach extends 85 kilometers (51 miles) downstream from Priest Rapids Dam to the head of the McNary Pool near the city of Richland, Washington. These past nuclear operations resulted in the release of hazardous chemicals and radionuclides to the Columbia River and into the soil. These operations also resulted in the storage of wastes and nuclear materials, some of which have escaped containment or have the potential for doing so. Current conditions of the Columbia River reflect that contamination is reaching the river primarily via the groundwater pathway.

In addition to contamination resulting from past and present Hanford operations, there is the potential for more contamination because the Hanford Site is being used for storage and disposal of nuclear materials, radioactive waste, chemically hazardous waste, and mixed waste (nuclear materials mixed with hazardous chemicals). For example, presently two-thirds of the nation's high-level defense nuclear waste is being stored at the Hanford Site with continuing shipments of nuclear waste being received (DOE 1992). Much of this nuclear waste may remain at the Hanford Site. The storage of these nuclear wastes could potentially contribute to the contamination of the Columbia River (depending on the performance of the chosen isolation solution) for thousands of years.

As a result of the known contamination, four areas of the Hanford Site (the 100, 200, 300, and 1100 Areas) have been placed by the U.S. Environmental Protection Agency (EPA) on the national priorities list for cleanup. The national priorities list is a component of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) (42 USC 9601) enacted by the U.S. Congress.

To address the cleanup needs mandated by CERCLA and to address the requirements for handling currently stored/generated wastes as mandated by the Resources Conservation and Recovery Act (RCRA) (42 USC 6901), DOE entered into a *Federal Facility Agreement and Compliance Order* (unofficially known as the Tri-Party Agreement) (Ecology et al. 1994) in 1989 with EPA and the State of Washington. Milestones have been adopted for the Tri-Party Agreement that identify actions needed to ensure acceptable progress toward Hanford Site compliance with CERCLA, RCRA, and the *Washington State Hazardous Waste Management Act* (RCW 1985).

During 1993, the Tri-Party agencies began work toward a comprehensive assessment of the impact of Hanford operations (past and present) on the current conditions of the Columbia River (DOE 1994). In January 1994, the Tri-Party Agreement was revised to reflect this project. This revision included a new Milestone, M-13-80B (later changed to M-15-80), that established CRCIA. In December 1995, the CRCIA milestone was revised, enhancing the review process and specifying target dates. In April 1996, another change to the Tri-Party Agreement provided additional time to perform the work in the initial phase.

Purpose and Scope of the Screening Assessment

The purpose of the screening assessment is to support cleanup decisions. The scope of the screening assessment is to evaluate the current risk to humans and the environment resulting from Hanford-derived contaminants. The screening assessment has the primary components of:

- identifying contaminants to be assessed
- identifying a variety of exposure scenarios to evaluate human contaminant exposure
- identifying a variety of other species to evaluate ecological contaminant exposure
- assessing risks posed by exposure of humans and other species to the contaminants

The study area for the screening assessment (see Figure P.1) was defined to extend from upstream of the Hanford Site in areas unaffected by Hanford Site operations down to McNary Dam, which is the first dam downstream of the Hanford Site. Historical data indicate that the concentrations of contaminants are as high or higher in this reach of the Columbia River than in areas downstream of McNary Dam. Other factors determining the study area include the availability of appropriate environmental data to conduct the screening assessment, the lack of such data downstream of McNary Dam, the known discharge of contaminants into the river (primarily via groundwater seepage) along the Hanford Site, and the resource constraints (time and dollars) originally imposed on the screening assessment. The parameters of the scope are:

Area:	Columbia River (vicinity of Priest Rapids Dam to McNary Dam), groundwater (up to 0.8 kilometer/0.5 mile in from the river), and adjacent riparian zone
Time:	January 1990 - present (date data were received for use in the screening assessment) with data gaps filled by earlier data where available
Contaminants:	Published in Napier et al. (1995) (to be modified in screening assessment report)
Scenarios:	Published in Napier et al. (1996) (to be modified in screening assessment report)
Receptor Species:	Published in Becker et al. (1996) (to be modified in screening assessment report)
Measured Media:	Groundwater, sediment, seeps, surface water, external radiation, biota, cobalt-60 particles, drive point groundwater, N Springs punch point water, and pore water

The primary contractor conducting the screening assessment is the Pacific Northwest National Laboratory. Bechtel Hanford, Inc. provides technical and public involvement coordination with environmental restoration activities. Technical peer reviewers are evaluating the work under the guidance of the Directors of the Oregon Water Resources Research Institute and State of Washington Water Research Center.

Work Integration and Documentation

The results of the initial phase of CRCIA are reported in a series of reports (see Figure P.2 and Table P.1). These reports reflect the process involved in the screening assessment of current risk. The reports published first as drafts will be compiled into one document on the screening assessment and requirements for a comprehensive assessment.

The process involved in the screening assessment was to first identify the documents containing pertinent data. That information was published in two reports (Eslinger et al. 1994 and Miley and Huesties 1995), which were issued as final reports.

The data documents listed in Eslinger et al. (1994) and Miley and Huesties (1995) helped to identify the most significant Hanford Site contaminants that affect the Columbia River. The winnowing process used to determine which of those contaminants should be evaluated in the screening assessment of risk was published in Napier et al. (1995) as a draft. The comments on the draft are being incorporated, and the contaminants information will appear as a section in the draft of the report on the screening assessment and requirements for a comprehensive assessment.

Next, groups of people with potentially different exposures to the Columbia River were identified. With information from the Hanford Site Risk Assessment Methodology (DOE 1995) and with input from the CRCIA Team, scenarios were written defining the potential pathways and exposures for the various groups. Input from the scenarios will be used in the screening assessment of human risk. The scenarios are described in Napier et al. (1996), which was published as a draft. The comments on the draft are being incorporated, and the scenarios information will appear as a section in the draft of the report on the screening assessment and requirements for a comprehensive assessment.

Simultaneously, the most significant species were identified and those to be evaluated in the screening assessment of ecological risk were selected. The species to be used in the screening assessment and the process used to select them are described in Becker et al. (1996), which was published as a draft. The comments on the draft are being incorporated, and the species information will appear as a section in the draft of the report on the screening assessment and requirements for a comprehensive assessment.

The monitoring data available, the lists of contaminants and species to be evaluated, and the selection rules developed by the CRCIA Team determined which data were selected for use in the screening assessment of human and ecological risk. The data to be used in the screening assessment and the process used to select them are presented in this draft report. The comments on the draft will be incorporated, and the data information will appear as a section in the draft of the report on the screening assessment and requirements for a comprehensive assessment.

The draft report on the screening assessment and requirements for a comprehensive assessment will provide the results of the screening assessment and a definition of the essential work remaining to provide an acceptable comprehensive river impact assessment. The comments on the draft will be incorporated and the screening assessment and requirements for a comprehensive assessment will be published as a final report.

Table P.1. Documents in Initial Phase of Columbia River Comprehensive Impact Assessment

Title	Document No.	Publication Date	Status
Data Compendium for the Columbia River Comprehensive Impact Assessment (Eslinger et al. 1994)	PNL-9785	April 1994	Final publication
List of Currently Classified Documents Relative to Hanford Operations and of Potential Use in the Columbia River Comprehensive Impact Assessment January 1, 1973 - June 20, 1994 (Miley and Huesties 1995)	PNL-10459	February 1995	Final publication
Identification of Contaminants of Concern (Napier et al. 1995)	PNL-10400	January 1995	Published as a draft - Issued first in January 1995 for review, then again in January 1996; comments from both review periods will be addressed and report will be a section in the *Screening Assessment and Requirements for a Comprehensive Assessment* report
Human Scenarios for the Screening Assessment: Columbia River Comprehensive Impact Assessment (Napier et al. 1996)	DOE/RL-96-16-a Rev.0	March 1996	Published as a draft - Then comments will be addressed and report will be a section in the *Screening Assessment and Requirements for a Comprehensive Assessment* report
Species for the Screening Assessment: Columbia River Comprehensive Impact Assessment (Becker et al. 1996)	DOE/RL-96-16-b Rev. 0	March 1996	Published as a draft - Then comments will be addressed and report will be a section in the *Screening Assessment and Requirements for a Comprehensive Assessment* report
***Data for the Screening Assessment: Columbia River Comprehensive Impact Assessment* (Miley et al. 1996)**	**DOE/RL-96-16-c Rev.0**	**June 1996**	**Published as a draft - Then comments will be addressed and report will be a section in the *Screening Assessment and Requirements for a Comprehensive Assessment* report**
Screening Assessment and Requirements for a Comprehensive Assessment: Columbia River Comprehensive Impact Assessment	DOE/RL-96-16 Rev.0	December 1996	To be published as a draft - Will incorporate all previous draft publications (not those published as final) plus sections on site characterization, screening assessment of risk, and CRCIA Team statement of work to be done after the initial phase
Screening Assessment and Requirements for a Comprehensive Assessment: Columbia River Comprehensive Impact Assessment	DOE/RL-96-16 Rev.1	April 1997	To be published final - Will incorporate responses to comments and minority opinions should any comments not be reconciled

032580

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

JUN 18 1996

Those on the Attached List:

REQUEST FOR COMMENTS ON THE DRAFT DATA FOR THE SCREENING ASSESSMENT, VOLUME I: TEXT, COLUMBIA RIVER COMPREHENSIVE IMPACT ASSESSMENT (CRCIA), DOE/RL-96-16-c, REVISION 0, UC-630, JUNE 1996

The U.S. Department of Energy, Richland Operations Office (RL), is pleased to provide the subject document for your review. Volume I (Attachment 1) describes how the data were selected and processed, and should be the focus of your review. Volume II (Attachment 2) is being provided as a reference and contains the raw data files, maps of sampling locations with coordinates, plots of raw data which also show the maximum representative values, and media files of data that will be used in the screening assessments of risk to human health and the environment. The CRCIA is now located on the Internet. All of the reports produced to date, including Volumes I and II of the subject document, are available through the CRCIA home page at http://crcia.pnl.gov:2080/crcia/.

This report is the fourth in a series, following the draft "Species for the Screening Assessment: Columbia River Comprehensive Impact Assessment," DOE/RL-96-16-b, Revision 0, UC-630, March 1996. Like the aforementioned report, this report will become part of the final document for the initial phase of the CRCIA, entitled "Screening Assessment and Requirements for a Comprehensive Assessment: Columbia River Comprehensive Impact Assessment." RL is planning to send the draft final document to you for review in December 1996.

Please provide written comments to me by July 12, 1996, at the U.S. Department of Energy, Richland Operations Office, P.O. Box 550, MSIN HO-12, Richland, Washington, 99352-0539. If you have any questions, please contact me at (509) 376-6192.

Sincerely,

Robert K Stewart

Robert K. Stewart, Project Manager
Groundwater Project

GWP:RKS

Enclosures: As stated

cc: See page 2

cc w/encls 1 & 2:
A. Bunn, Dames & Moore
S. Cannon, PNNL
P. Danielson, NPT
G. de Bruler, HAB
R. Dirkes, PNNL
S. Finch, PNNL
M. Freshley, PNNL
L. Gadbois, EPA
R. Gilbert, PNNL
S. Harris, CTUIR
D. Holland, Ecology
L. Klevgard, PNNL
A. Knepp, BHI
T. Miley, PNNL
T. O'Neil, PNNL
R. Patt, Oregon DOE
T. Walters, PNNL
T. Woods, YIN

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Addressees - Letter dated: JUN 18 [illegible]

Ms. E. Buffum, Director
U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, Tennessee 37831

Mr. J. Carleton
State of Washington
Department of Fish and Wildlife
600 Capitol Way North
Olympia, Washington 98501-1091

Mr. J. Jakabosky
Bureau of Land Management
Spokane District Office
1103 N. Fancher
Spokane, Washington 99212

Ms. V. Peery
State of Washington
Department of Ecology
1315 W. Fourth Avenue
Kennewick, Washington 99336-6018

Mr. P. Sleeger
U.S. Department of the Interior
500 NE Multnomah Street
Suite 600
Portland, Oregon 97232

Mr. G. Tallent
State of Washington
Department of Ecology
P.O. Box 47600
Olympia, Washington 98504-7600

Mr. A. Thatcher
State of Washington
Department of Health
Division of Radiation Protection
P.O. Box 47827
Olympia, Washington 98504-7827

Summary

The initial phase of the Columbia River Comprehensive Impact Assessment (CRCIA) is a screening assessment of risk to humans and the environment. To assess risk, monitoring data of contaminant concentrations are needed. The data task provides measurements of contaminant concentrations in various media for use in the human health and ecological screening assessments. This report is divided into two volumes. *Volume I: Text* describes the data gathering and data selection processes. *Volume II: Appendices* presents the 1) final data sets (media files) to be used in the screening assessments, 2) the raw data from which the data sets were derived, and 3) the raw data values for media for which other calculation methods will be used. (For a copy of Volume II with 500 pages plus 9 diskettes, contact S. D. Cannon at 509-372-6210.) The data task for CRCIA is being conducted under the guidance of the CRCIA Management Team. All defining decisions for the task were made with CRCIA Team concurrence

The scope of the data task is to compile data collected since January 1990 by the various monitoring programs for the contaminants of interest. The contaminants of interest for the screening assessment were originally defined in Napier et al. (1995) and have been revised based on comments received on that draft document.

The media for which concentration data are needed for the human health and ecological screening assessment calculations are groundwater, sediment, seeps, surface water, and external radiation. These media files along with the original raw data files are presented in this report. In addition, contaminant concentrations in biota, cobalt-60 particles, drive point groundwater data for chromium, N Springs punch point water data, and pore water data for chromium will be evaluated in the screening assessment. These raw data values are also presented in this report. However, because the availability of data applicable to the screening assessment is limited, other calculation methods will be used in the screening assessment for biota, cobalt-60 particles, drive point groundwater, N Springs punch point water, and pore water. Therefore, no media files needed to be prepared for these data.

The first step in the data gathering process was to identify sources of environmental data. A data compendium (Eslinger et al. 1994) provided a collection of references. Other sources of environmental data were identified by the CRCIA Team. In addition, a meeting was called with data managers and environmental leads at the Hanford Site who are familiar with river sampling activities. The purpose of this meeting was to summarize the data that had been gathered and to identify additional sources of data. This meeting was also used to determine which programs' data were stored in the Hanford Environmental Information System (HEIS).

Data for all media were initially gathered from a corridor up to 0.8 kilometer (½ mile) on either side of the Columbia River. For sediment, seeps, surface water, and external radiation, all data within 0.8 kilometer of the river were used. For the groundwater data, it was necessary to use only the portion of these data that would be relevant to estimating the contaminant concentrations entering the Columbia River from the Hanford Site. This was done by assigning a groundwater corridor width to

the Hanford side of each segment. The corridor width was based on having sufficient groundwater data to characterize the contamination within a segment. These corridor width decisions were made by staff from Pacific Northwest National Laboratory, U.S. Environmental Protection Agency, Washington State Department of Ecology, with concurrence by the CRCIA Team.

Once the sources of environmental data were identified, data were collected for January 1990 to the date the data were received. The data were reviewed with the environmental leads for the respective data sources to categorize the data appropriate for the media of interest. The data were then cross referenced with the contaminants of interest. After the data of the independent programs had been selected as appropriate for use within the scope of the screening assessment, the various data sets within a medium were combined into a single database.

The human health and ecological screening assessments calculate risk based on contributions from multiple pathways affected by contaminant concentrations in multiple media. These contaminant concentrations were not usually measured in a fashion that would allow a complete assessment at every sampling site. To provide data for the assessments, it was necessary to aggregate data to represent concentrations in areas rather than at points. This was done through the technique of river segmentation, resulting in 27 segments being identified.

The purpose of the data analysis process was to obtain concentration inputs to the screening assessment models from the raw concentration data. This process was repeated for each segment and for each contaminant being evaluated. The process involved choosing a maximum representative value for the concentration of each contaminant for a deterministic run and calculating the parameters that define the concentration probability density function needed for the stochastic runs.

The final data sets (media files) will be used in the human health and ecological screening assessments of risk. The work of the data task did not include analyzing the quality of the data. Data quality objectives will be discussed in the report on the screening assessment and requirements for a comprehensive assessment. Once comments are received, this data report will be revised and published as a section in the screening assessment report.

Glossary

100 Areas	site of the Hanford production reactors, which include B, C, D, DR, F, H, KE, KW, and N Reactors; see Figure P.1
300 Area	site of the research, development and fuel-fabrication operations; see Figure P.1
biota	plants and animals
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980 as Amended* (42 USC 9601 et seq. as amended)
concentration	amount of substance in a given quantity of material (for example, micrograms of chromium per liter of groundwater)
CRCIA	Columbia River Comprehensive Impact Assessment
CRCIA Team	Columbia River Comprehensive Impact Assessment Management Team
deterministic analysis	single calculation performed with a single value selected for each parameter, such as the concentrations of contaminants entering the river; see stochastic analysis
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERC	Environmental Restoration Contractor (Bechtel Hanford, Inc.; CH2M Hill Hanford, Inc.; IT Hanford, Inc.; Thermo Hanford, Inc.)
Geographic Information System	computerized system designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information
geometric mean	see "mean" for definition.

geometric standard deviation — measure of dispersion (variability) for lognormally distributed data; one of the stochastic parameters calculated from the set of median (best-estimate) well values in each segment; see also "geometric mean" under "mean".

GW — groundwater

Hanford Reach — segment of the Columbia River that extends 85 kilometers (51 miles) downstream from Priest Rapids Dam to the head of the McNary Pool near the city of Richland, Washington

HEIS — Hanford Environmental Information System; an electronic database that consolidates the data gathered during environmental monitoring and restoration of the Hanford Site

irradiation — exposure of an object to radiation

lognormal distribution — data distribution such that the logarithms of the data form a normal distribution

maximum representative value — highest concentration value that is considered representative of the sampling location

mean — average value of a set of numbers

- **geometric mean** — central value of a set of lognormal data; one of the stochastic parameters calculated from the set of median (best-estimate) well values in each segment; see also "geometric standard deviation"

- **winsorized mean** — way of approximating the average for a set of measurements when some are below the level of detection; evaluated by leaving out as many of the highest results as there are non-detectable results

median — middle value in a series of values arranged in order of size

model — representation of a process or entity; the representation may be graphical or a set of mathematical equations that simulate the process or entity being modeled

outlier — data value determined by a statistical test to be outside the range of possible values in the given distribution

pdf	probability density function; set of all possible values of a parameter and their associated likelihoods
plume	volume of air, water, or soil containing contaminants released from a contaminant source
PNNL	Pacific Northwest National Laboratory
production operations	activities connected with the production reactors in the 100 Areas (B, C, D, DR, F, H, KE, KW, or N reactors) in which uranium or other fuel was irradiated with neutrons to produce radioactive materials; used primarily at Hanford to produce plutonium for weapons; used also for research
radionuclide	radioactive isotope of an element
RCRA	*Resource Conservation and Recovery Act of 1976* (42 USC 6901 et seq. as amended)
risk assessment	estimation of the severity and likelihood of harm to human health or the environment occurring from exposure to a particular substance or activity
screening assessment of risk	risk assessment with limited scope; for example, the initial phase of CRCIA is a screening assessment of risk because it is restricted to 1) current conditions, 2) the area between Priest Rapids Dam and McNary Dam, 3) a limited number of contaminants, 4) a few selected receptor species, and 5) a limited amount of monitoring data; the objective of the screening assessment of risk is to identify areas where significant potential exists for adverse effects on humans or the environment
SD	sediment
seeps	locations where groundwater oozes to the surface
SESP	Surface Environmental Surveillance Project
SP	seeps
stochastic analysis	set of calculations performed over the range of some of the input parameters; see deterministic analysis

SW	surface water
TLD	thermoluminescent dosimeter; identified as "external radiation" in the text of this report
TPA	Tri-Party Agreement (officially, *Hanford Federal Facility Agreement and Consent Order*)
Tri-Party agencies	Three government agencies (U.S. Department of Energy, U.S. Environmental Protection Agency, and the Washington State Department of Ecology) responsible for the cleanup of the Hanford Site
USGS	United States Geological Survey
WHC	Westinghouse Hanford Company
WPPSS	Washington Public Power Supply System

Contents

Figures

Tables

1.0 Introduction

The initial phase of the Columbia River Comprehensive Impact Assessment (CRCIA) is a screening assessment of risk to humans and the environment. To assess risk, monitoring data of contaminant concentrations are needed. The data task provides measurements of contaminant concentrations in various media for use in the human health and ecological screening assessments. This report is divided into two volumes. *Volume I: Text* describes the data gathering and data selection processes. *Volume II: Appendices* presents the 1) final data sets (media files) to be used in the screening assessments, 2) the raw data from which the data sets were derived, and 3) the raw data values for media for which other calculation methods will be used. (For a copy of Volume II with 500 pages plus 9 diskettes, contact S. D. Cannon at 509-372-6210.)

1.1 Scope

The Columbia River has been the focus of environmental monitoring programs over the years. The scope of the data task is to compile data collected since January 1990 by the various monitoring programs for the contaminants of interest. The contaminants of interest for the screening assessment were originally defined in Napier et al. (1995) and have been revised based on comments received on that draft document. The revised list of contaminants is given in Table 1.1.

Table 1.1. List of Identified Contaminants of Interest[a]

Radionuclides	Metals	Other Compounds
Carbon-14	Chromium	Ammonia
Cesium-137	Copper	Benzene
Cobalt-60	Lead	Cyanide
Europium-152	Mercury	Diesel oil
Europium-154	Nickel	Kerosene
Iodine-129	Zinc	Nitrate
Neptunium-237		Nitrite
Strontium-90		Phosphates
Technetium-99		Sulfates
Tritium		Xylenes
Uranium-234		
Uranium-238		

(a) Direct irradiation and discrete radioactive particles will also be evaluated.

The media for which concentration data are needed for the human health and ecological screening assessment calculations are groundwater, sediment, seeps, surface water, and external radiation. These media files along with the original raw data files are presented in this report. In addition, contaminant concentrations in biota, cobalt-60 particles, drive point groundwater data for chromium, N Springs punch point water data, and pore water data for chromium will be evaluated in the screening assessment. These raw data values are also presented in this report. However, because the availability of data applicable to the screening assessment is limited, other calculation methods will be used in the screening assessment for biota, cobalt-60 particles, drive point groundwater, N Springs punch point water, and pore water. Therefore, no media files needed to be prepared for these data.

1.2 Approach

The data task for CRCIA is being conducted under the guidance of the CRCIA Management Team. All defining decisions for the task were made with CRCIA Team concurrence. All team decisions relating to the efforts of the data task are presented in Table 1.2.

Table 1.2. Data Decisions by the CRCIA Team

Date	Decision
1/30/96	Agreement was reached to collect data from January 1, 1990 to present and fill data gaps with older data where it is available for the initial phase of the screening assessment.
1/30/96	The primary geographic focus area for the screening assessment is from Priest Rapids Dam to McNary Dam. A radionale will be provided justifying this area by including in the report a discussion of historical levels/trends in contaminant data over time showing levels typically upstream of McNary, including Hanford data, Oregon data, and Washington data were available.
2/13/96	All data will be provided on a diskette in the final report.
2/13/96	There will be no soil medium. There are no soil samples associated with the outfall pipe locations, and no other soil data were requested by the human health and ecological task leads.
2/13/96	The river (between Priest Rapids and McNary) will be broken into 27 segments. This partially defines the spatial aggregation of the data.
2/13/96	Corridor widths were chosen by segment based on sampling sites available to characterize contamination. Reactor areas 100 B/C, D, F, H, K, N and the 300 Area have 0.4-kilometer (1/4-mile) corridor widths. (N Reactor width was changed from 0.8 kilometer to 0.4 kilometer at 3/5/96 CRCIA Team meeting.) The non-trench portion of the 100-K Area has a 0.6-kilometer (3/8-mile) corridor width. All other segments have a 0.8-kilometer (1/2-mile) width. This completes the definition of the spatial aggregation of the data.
2/13/96	A representative value for each groundwater well in each segment will be chosen. A mechanized process needs to be developed to choose the representative value. It is expected that the mechanized process will be adequate for about 80 percent of the values. Remaining values will need to be looked at by hand. A team was formed to develop the algorithm.
2/20/96	Where there is a clear upward or downward trend, a representative value will be chosen from the most recent data.
2/20/96	The maximum representative value for each data set should be an observed data point.

Table 1.2. (contd)

Date	Decision
2/20/96	The set of representative data in each segment for each medium will be assumed to be lognormally distributed. The parameters for the lognormal distribution will be estimated from the representative data. Log-probability plots will be provided.
2/20/96	Both filtered and unfiltered data will be used in the identification of representative data and in determining the parameters for the lognormal distribution.
2/27/96	Dixon's test will be used to eliminate, at most, a single outlier data point in each data set. In the data section of the final report, every data point that is eliminated will be explained.
2/27/96	For the elimination of outliers, log transformation of the data will be used.

A Geographic Information System was used to assist in implementing the processing of the data for the screening assessment. The Geographic Information System is a computerized system designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information. Many software packages exist that perform basic Geographic Information System functions. Arc/Info Rev. 7.0.2 was used for the data task (ESRI 1994).

1.2.1 Segmentation

The human health and ecological screening assessments calculate risk based on contributions from multiple pathways affected by contaminant concentrations in multiple media. These contaminant concentrations were not usually measured in a fashion that would allow a complete assessment at every sampling site. To provide data for the assessments, it was necessary to aggregate data to represent concentrations in areas rather than at points. This was done through the technique of river segmentation.

Staff from the Pacific Northwest National Laboratory (PNNL), U.S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology) defined 27 segments within the study area from Priest Rapids Dam down to McNary Dam (see Figure 1.1). A segment is a section of the river over which contaminant conditions can be expected to be similar and which captures the major influences to the Columbia River. The major resources used to decide how to most appropriately segment the river were a groundwater well location map (Dresel et al. 1995), the radiological and chemical contaminant plume maps from the 1994 Hanford Site groundwater monitoring report (Dresel et al. 1995), the Surface Environmental Surveillance Project spring monitoring locations information, the maps of sampling locations for the special chromium studies being conducted by the Environmental Restoration Contractor at the 100-H Area (Hope and Peterson 1995) and 100-D Area (from an unpublished document by S. J. Hope and R. E. Peterson), and the Ecology and EPA staff knowledge of the contaminant sources.

Because many contaminant sources are located in the reactor areas, each reactor area was examined to determine if a single segment could be designed around it or whether it should be further divided. When this decision was made, the resources listed above were used to determine the upstream and

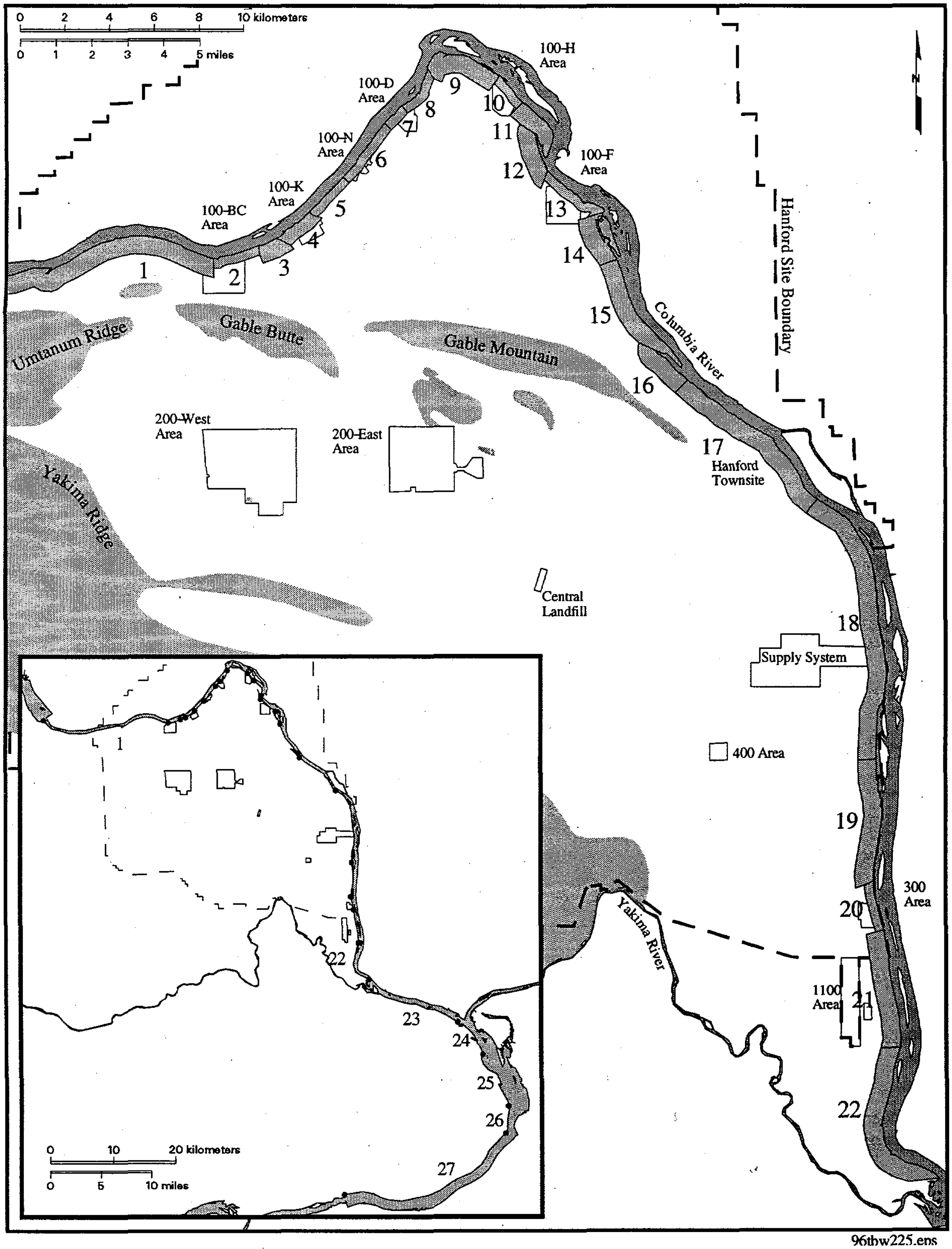

Figure 1.1. Segmentation of the Columbia River

downstream cutoff points for these segments. This process was continued for other major features of the river, such as the sloughs and the confluence points of the Yakima, Snake, and Walla Walla Rivers. The final step in the segmentation process was to look at the areas between known areas of interest and determine how to define segments in these generally data sparse areas.

1.2.2 Thiessen Polygon Analysis

A Thiessen polygon analysis was used to define the area of influence of the data from a groundwater well and, thereby, refine the segmentation of the river. Thiessen analyses apportion points into polygonal regions such that each region contains only one point. Each region has the unique property that any location within a region is closer to the region's point than to any other point (Thiessen and Alter 1911). In this study, the points used for the analysis are the groundwater well locations. An example of the results of the Thiessen analysis are shown in Figure 1.2. The example shows a portion of the study area where segment boundaries were adjusted based on the Thiessen results.

Adjustments to segment boundaries were based on the Thiessen analysis for two reasons. First, it was desirable for the polygons within a segment to be of similar size so that each well is used to represent the contaminant concentration over an area of similar size. When polygon sizes became large relative to the other polygons in the segment, then the large polygon was clipped and the space was added to neighboring segments. This phenomenon occurs with the outer most wells in a data dense area when the data dense area borders an area with few or no wells. Therefore, the additional space was added to a data sparse segment. Second, the original segment boundaries were drawn perpendicular to the river shore. To better reflect the areas of well influence, the polygon lines were used to represent the segment boundaries. Examples of this type of adjustment can be seen on Figure 1.2 for both the upstream and downstream boundaries of segment 3.

1.2.3 Corridor

Data for all media were initially gathered from a corridor up to 0.8 kilometer (½ mile) on either side of the Columbia River. For sediment, seeps, surface water, and external radiation, all data within 0.8 kilometer of the river were used. For the groundwater data, it was necessary to use only the portion of these data that would be relevant to estimating the contaminant concentrations entering the Columbia River from the Hanford Site. This was done by assigning a groundwater corridor width to the Hanford side of each segment. The corridor width was based on having sufficient groundwater data to characterize the contamination within a segment. These corridor width decisions were made by staff from Ecology, EPA, and PNNL with concurrence by the CRCIA Team. The corridor widths for groundwater data are as follows. Segments 2 (100-B/C Area), 5 (116-K-2 trench in 100-K Area), 6 (100-N Area), 7 and 8 (100-D Area), 10 (100-H Area), 13 (100-F Area), and 20 (300 Area) have a 0.8-kilometer (1/4-mile) corridor width. Segment 4 (100-K Area) has a 0.6-kilometer (3/8-mile) corridor width. All other segments have a 0.8-kilometer (1/2-mile) width (Figure 1.1). These groundwater corridor widths are measured from the Columbia River shoreline inland onto the Hanford Site.

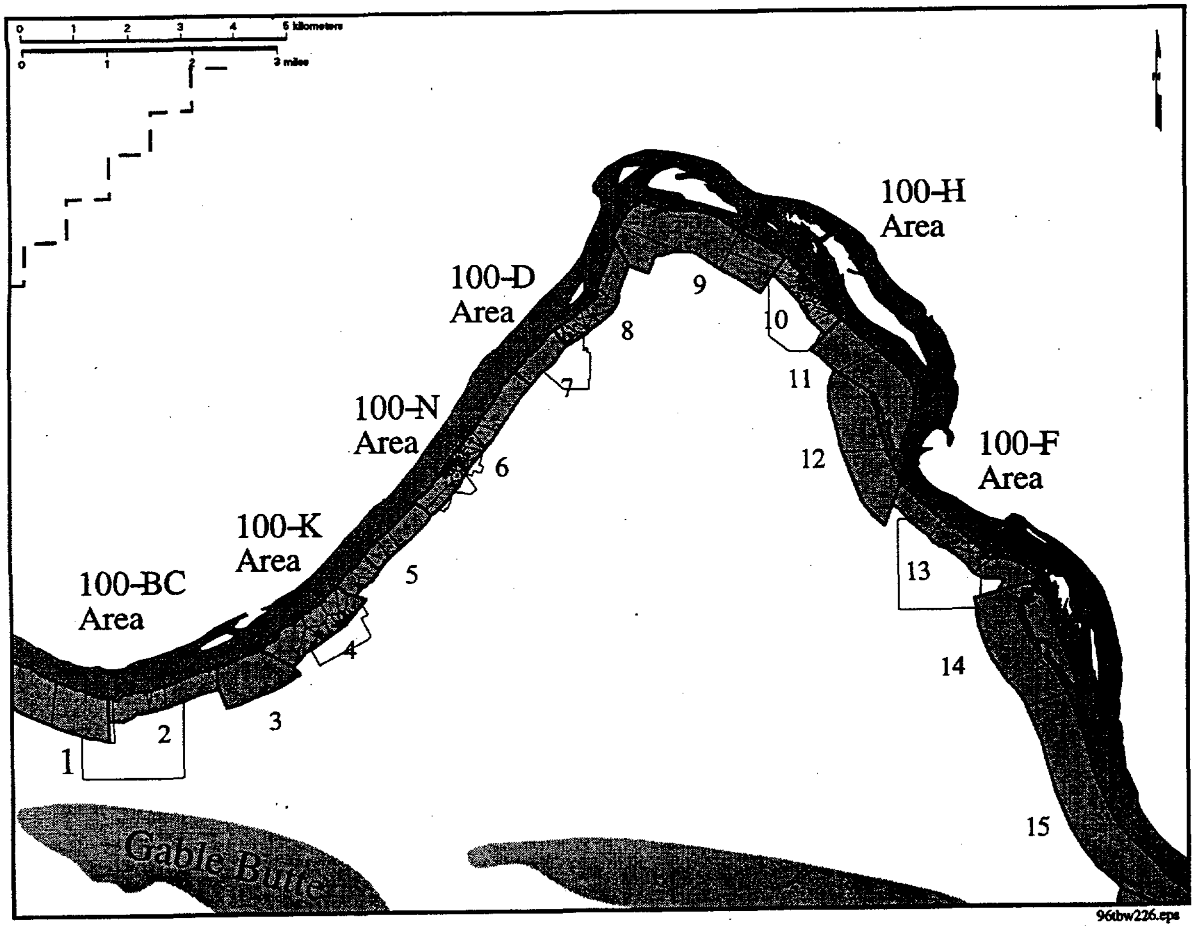

Figure 1.2. Example of the Results of the Thiessen Analysis on Segmentation of the Columbia River

2.0 Data Gathering

Many data have been collected that are relevant to the Columbia River environment and the CRCIA. The data task gathered the existing data that fell within the scope of the geographical area and time period of the screening assessment.

2.1 Description of the Data Gathering Process

The data gathering process involved identifying sources of environmental data, assimilating that data, and identifying the appropriate river segment to which the data applied.

2.1.1 Identification of Data Sources

The first step of the data gathering process was to identify sources of environmental data. A data compendium (Eslinger et al. 1994) was produced for CRCIA and was the initial step to identify existing environmental data sources associated with the Columbia River that may be of potential interest to CRCIA. The data compendium provides a collection of references as well as a discussion of data sources, descriptions of the physical format of the data, and descriptions of the search process used to identify data. Other sources of environmental data were identified by the CRCIA Team. In addition, a meeting was called with data managers and environmental leads at the Hanford Site who are familiar with river sampling activities. The purpose of this meeting was to summarize the data that had been gathered and to identify additional sources of data. This meeting was also used to determine which programs' data were stored in the Hanford Environmental Information System (HEIS).

2.1.2 Data Assimilation

Once the sources of environmental data were identified, data were collected for January 1990 to the date the data were received. The data were reviewed with the environmental leads for the respective data sources to categorize the data appropriate for the media of interest. The data were then cross referenced with the contaminants of interest. Once the data of the independent programs had been selected as appropriate for use within the scope of the screening assessment, the various data sets within a medium were combined into a single database.

2.1.3 Identification of Sampling Locations and Their Segments

Before the data can be processed by segment into usable input files for the human health and ecological screening assessments, the coordinates of the sampling location must be identified and accurate. Many environmental sampling projects on the Hanford Site identify their sampling locations in the Geographic Information System. Other programs document their sampling locations on a map in a report but do not provide coordinates. Data received from HEIS generally had coordinates associated with the data and were easily downloaded into the Geographic Information System. Downloading data into the Geographic Information System received from other sources that did not have coordinates for sample locations was a two-step process. The first step was to meet with the environmental leads to identify the sample location on a map. The second step was to digitize the coordinates of the sample locations using the Geographic Information System.

The Geographic Information System was used to identify sampling locations that fell within the study area corridor and to identify the segment numbers of those locations. This was done using a point in polygon intersection selection process in Arc/Info (ESRI 1994). The accuracy of the coordinates assigned to a sample location varied depending on how coordinates were derived. If the coordinates were gathered through use of a global positioning system, the locations can be accurate down to a meter. If locations were digitized based on a map, the coordinates are representative of the general location only. For the sample locations that were digitized, environmental leads were consulted to confirm that the segment identified was appropriate.

2.2 Non-Hanford Data Sources Contacted

The following non-Hanford agencies were contacted for environmental sampling data along the Columbia River for input into the screening assessment. The sources were contacted because they were identified in the data compendium (Eslinger et al. 1994) as data collectors or because they were identified by the CRCIA Team or other data source as potentially having pertinent data.

2.2.1 City of Richland

The City of Richland conducts surface water sampling only after the City has treated the water for human consumption. This sampling is part of a monitoring program which allows the City to be in compliance with Washington State laws that mandate contaminant levels in drinking water. No contaminant data were available from the City of Richland for input into the screening assessment.

2.2.2 City of Umatilla

The City of Umatilla does not have an environmental sampling program and relies on the Washington and Oregon departments of health for information. The City of Umatilla takes its municipal water from deep basalt wells not from the Columbia River. No data were collected from the City of Umatilla for input into the screening assessment.

2.2.3 City of Hermiston

The City of Hermiston does not have an environmental sampling program and relies on the Washington and Oregon departments of health for information. At this time, the City of Hermiston takes its municipal water from wells not from the Columbia River. No data were collected from the City of Hermiston for input into the screening assessment.

2.2.4 Port of Umatilla

The Port of Umatilla does not have an environmental sampling program and relies on the U.S. Army Corp of Engineers in Walla Walla for information. No data were collected from the Port of Umatilla for input into the screening assessment.

2.2.5 Washington Public Power Supply System

The Washington Public Power Supply System (WPPSS) has an environmental monitoring program which consists of the 1) Radiological Environmental Monitoring Program and 2) Non-Radiological Environmental Monitoring Program. Both of these programs produce annual reports. The data are collected quarterly, and the constituents analyzed for are limited to those of interest to WPPSS. The Radiological Environmental Monitoring Program provided data collected from 1990-1994 for use in the current screening assessment for radionuclides in the following media:

- External radiation
- Fish
- Plants/vegetables
- Sediment
- Surface water

WPPSS is no longer required to monitor for non-radiological contaminants, and the data from previous years when monitoring was required have not been maintained in a database. Non-radiological monitoring reports for 1990-1995 were provided by WPPSS for data input into the screening assessment.

2.2.6 Oregon Department of Energy

The Oregon Department of Energy had no environmental sampling data along the Columbia River within the scope of the screening assessment (Priest Rapids to McNary Dams and 1990-present). No data were collected from the Oregon Department of Energy for input into the screening assessment.

2.2.7 U.S. Army Corps of Engineers - Walla Walla and Seattle

The Corps of Engineers conducted sediment sampling along the Columbia River in the early 1980s. The purpose of the sampling was to analyze grain size. Contaminant concentrations were not measured. Currently, the Army Corps is not conducting environmental sampling within the scope of the current study area for the screening assessment from the vicinity of Priest Rapids Dam to McNary Dam.

2.2.8 Washington Department of Health

The Environmental Radiation Program within the Washington Department of Health collects environmental data and produces annual reports containing that data. Data were requested from the

Washington Department of Health for input into the screening assessment. No data were received from the Washington Department of Health at the time of this publication. Data received subsequent to this effort will be reviewed for impact on the screening assessment. Because data reported by the Washington Department of Health have been collected in tandem with the data collected by PNNL's Surface Environmental Surveillance Program, it is assumed the PNNL data reflect the Washington Department of Health data. If the Department of Health data is received and would increase concentration estimates, then the data will be revised for the final report.

2.2.9 Department of Environmental Quality - Portland

The Department of Environmental Quality is currently coordinating the bi-state estuary study. The Department is only familiar with Oregon sampling along the Columbia River, which has been conducted from the Bonneville Dam down river. For information above the Bonneville Dam, the Department refers to the Washington Department of Health. No data were collected from the Department of Environmental Quality for input into the screening assessment.

2.2.10 Oregon Health Division - Portland

The Oregon Health Division concurred with the Department of Environmental Quality. The Division is only familiar with Oregon sampling along the Columbia River, which has been conducted from the Bonneville Dam down river. Anything above the Bonneville Dam the Department refers to the Washington Department of Health for information. No data were collected from the Oregon Health Division for input into the screening assessment.

2.2.11 Boise Cascade Corporation - Wallula

Boise Cascade Corporation currently monitors effluents for acidity/alkalinity and sediment accumulation in the Wallula Lake area of the Columbia River as required for the National Pollutant Discharge Elimination System permits. This information is reported to the Department of Ecology in Olympia. Contaminant concentrations are not measured in the Boise Cascade samples. No data were collected from the Boise Cascade Corporation for input into the screening assessment.

2.2.12 Department of Ecology - Olympia

The Washington Department of Ecology in Olympia was consulted for possible sources of data. No data were collected from the Washington Department of Ecology for input into the screening assessment, and no additional sources of information were provided.

2.2.13 United States Geological Survey - Pasco and Portland

The United States Geological Survey (USGS) conducts environmental sampling along the Columbia River at the Vernita Bridge and the City of Richland only. Monitoring reports for 1989-1994 were collected from USGS for data input into the screening assessment.

2.3 Hanford Data Sources

The following Hanford resources were contacted to obtain environmental sampling data along the Columbia River for input into the screening assessment.

2.3.1 Environmental Restoration Contractors

The Environmental Restoration Contractors (ERC - Bechtel Hanford, Inc.; CH2M Hill Hanford, Inc.; IT Hanford, Inc.; Thermo Hanford, Inc.) queried the HEIS database for environmental data relevant to the screening assessment. ERC also provided environmental data from a special chromium study along the 100-D (unpublished report by S. J. Hope and R. E. Peterson) and 100-H (Hope and Peterson 1995) Areas of the Hanford Site.

2.3.2 Hanford Environmental Information System

The purpose of HEIS is to provide computer-based access to Hanford Site environmental sample data (Brulotte 1994). Some of the programs that store data in HEIS are the PNNL Groundwater Monitoring Program, ERC's CERCLA remedial investigation/feasibility study programs, and the Westinghouse Hanford Company (WHC) Environmental Monitoring program. Many special studies also place their data in the HEIS system.

The functions of HEIS are the following:

- Assignment of sample numbers
- Scheduling and tracking samples
- Data storage
- Database query and report generation

The types of data found in HEIS are:

- Atmospheric
- Biota
- Constituents
- Groundwater
- Locations
- Samples
- Soils (surface and geologic)
- Waste site
- Water levels
- Wells

The procedures for computer access to HEIS are found in Schreck (1993). There are nine volumes organized by subject and area.

2.3.3 Pacific Northwest National Laboratory

Data collected by PNNL through the Ground Water Surveillance Project and the Surface Environmental Surveillance Project (SESP) were provided for the screening assessment. In addition to the ongoing monitoring data provided by SESP, environmental data from special studies were provided for the screening assessment.

The CRCIA Project conducted sediment sampling of the Columbia River from Priest Rapids down to Bonneville Reservoir. This sampling was done in conjunction with the SESP Project. For some locations, the data are reported as SESP monitoring data. All of the CRCIA data for sediment sampled in the study area of the screening assessment are being used.

2.3.4 Westinghouse Hanford Company

Environmental monitoring data collected by WHC are maintained in the HEIS database and were contained within the HEIS query ERC conducted for the screening assessment.

2.4 Summary of Data Gathered

Environmental data collected for the screening assessment originated from the following sources by media:

- Groundwater (GW)
  HEIS
- Sediment (SD)
  HEIS, PNNL, WPPSS
- Seeps (SP)
  ERC, HEIS, PNNL
- Surface Water (SW)
  ERC, HEIS, PNNL, WPPSS, USGS
- External Radiation (TLD)
  PNNL, WPPSS

The abbreviations given in parentheses following the media names are used throughout this report and in naming data files. These data were processed into concentration input files (media files) that will be used in the human health and ecological screening assessments.

There were additional data sets that will be used for model validation, comparison to other media, and/or special analyses that are limited in scope. The type of data and the data source are as follows:

- Biota
  HEIS, PNNL, WPPSS
- Cobalt-60 Particles
  PNNL
- Drive Point Groundwater and Pore Water (Chromium Data)
  ERC
- N Springs Punch Point Water
  WHC

2.4.1 Raw Data Files

The raw data from all sources were combined into a single Microsoft Access database for each medium. Access is a Windows™-based database management system that stores and retrieves data, presents information, and automates repetitive tasks. Diskettes of the raw data are included as part of Appendix A in Volume II of this report. The content of the raw data is described in Appendix A. Volume II (over 500 pages plus 9 diskettes) is available by calling S. D. Cannon at 509-372-6210.

2.4.2 Raw Data Summary

The raw data are summarized by segment to show the sample coverage across the media. This summary is presented in Table 2.1. For each segment, the major feature of the segment is identified, and the number of samples for each medium is given. For the groundwater, the corridor width and the number of wells used are also presented.

Table 2.2 presents a further breakdown of the sample counts by media into the number of analyses in each medium by contaminant of interest.

2.4.3 Data Sampling Locations

Each media database was queried to identify the set of unique sample locations for the data used for that medium. The coordinates for these sample locations were fed into the Geographic Information System for plotting on a map. Figure 2.1 shows all of the sampling locations used in the screening assessment for all of the media. Because of concurrent sampling (for example, for seeps and sediment) in some of the locations, not all locations are visible on the map. The media are listed in the legend in the order of plotting. The number of locations on the map is given in the legend for each medium. A map for each of the media sampling locations is also provided. These are Figure 2.2 for groundwater, Figure 2.3 for sediment, Figure 2.4 for seeps, Figure 2.5 for surface water, and Figure 2.6 for external radiation. Detailed maps with coordinate grids are provided in Appendix B of Volume II. Each map shows a single segment and the sample locations for all media in that segment. The coordinate grid is provided so that samples may be tracked from the coordinates provided in the raw data. For a copy of Volume II (over 500 pages plus 9 diskettes), call S. D. Cannon at 509-372-6210.

Table 2.1. Number of Raw Data Samples per Medium and Segment

Segment	Segment Description	Groundwater			Sediment	Seeps	Surface Water	External Radiation
		Corridor Width(a)	Number of Wells	Number of Samples	Number of Samples	Number of Samples	Number of Samples	Number of Samples
1	Priest Rapids Dam	0.8 km	3	265	324	0	1723	35
2	B/C Area	0.4 km	3	600	74	104	242	23
3	Between B/C and K Areas	0.8 km	1	292	7	16	32	10
4	K Reactor Area	0.6 km	16	3574	64	55	24	23
5	116-K-2 trench	0.4 km	6	1515	20	17	82	0
6	N Area	0.4 km	32	4422	38	117	764	278
7	Upstream D Area	0.4 km	1	199	0	0	200	0
8	D Area	0.4 km	9	1957	134	148	158	61
9	The Horn	0.8 km	2	70	59	0	118	0
10	H Area	0.4 km	20	4816	141	157	154	0
11	Between H and White Bluffs Slough	0.8 km	0	0	0	0	0	0
12	White Bluffs Slough	0.8 km	2	85	70	0	0	69
13	F Area	0.4 km	9	1639	27	61	478	46
14	F Slough	0.8 km	0	0	207	32	63	0
15	Between F and Hanford sloughs	0.8 km	1	65	32	68	128	46
16	Hanford Slough	0.8 km	0	0	85	32	96	0
17	Hanford Townsite	0.8 km	7	334	92	58	578	114
18	WPPSS	0.8 km	0	0	78	0	1830	153
19	Between WPPSS and 300 Area	0.8 km	6	701	18	0	192	23
20	300 Area	0.4 km	34	5094	39	42	807	110
21	1100 Area to Richland pumphouse	0.8 km	5	550	69	0	3009	110
22	Pumphouse to Columbia Point	0.8 km	0	0	34	0	0	0
23	Yakima River influence	NA	NA	NA	106	0	0	22
24	Snake River influence	NA	NA	NA	89	0	0	0
25	Boise Cascade	NA	NA	NA	34	0	0	0
26	Walla Walla River influence	NA	NA	NA	51	0	0	0
27	McNary Dam	NA	NA	NA	365	0	0	4
	Total		157	26178	2257	907	10678	1127

(a) 0.8 km = 1/2 mile 0.4 km = 1/4 mile 0.6 km = 3/8 mile

Table 2.2. Number of Raw Data Samples per Contaminant, Medium, and Segment

Segment	Medium	Ammonia	Benzene	Carbon-14	Cesium-137	Chromium	Cobalt-60	Copper	Cyanide	Diesel oil	Europium-152	Europium-154	Iodine-129	Kerosene	Lead	Mercury	Neptunium-237	Nickel	Nitrate	Nitrite	Phosphate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium-234	Uranium-238	Xylenes (total)	Zinc
1	GW	4	15	8	6	22	6	22	5	0	4	5	0	0	17	16	0	22	17	7	11	7	0	10	20	0	4	15	22
	SD	0	5	0	35	21	35	17	0	0	3	35	0	0	17	9	0	21	5	5	5	36	0	0	0	13	36	5	21
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	0	34	0	202	42	202	42	4	0	0	175	16	0	20	22	0	54	30	57	30	152	45	74	157	153	153	18	41
2	GW	12	28	26	16	51	16	51	12	0	12	12	1	0	48	47	0	51	30	3	12	23	0	31	27	0	12	28	51
	SD	0	0	0	7	8	7	8	0	0	3	4	0	0	5	5	0	8	0	0	0	7	0	0	0	0	4	0	8
	SP	0	0	0	8	8	8	8	0	0	0	5	0	0	2	2	0	8	3	3	4	9	4	5	9	5	5	0	8
	SW	5	0	0	34	10	34	10	0	0	0	28	0	0	2	2	0	10	4	4	5	34	0	5	35	5	5	0	10
3	GW	5	14	13	6	27	6	27	5	0	5	5	1	0	25	24	0	27	12	2	5	8	0	14	15	0	5	14	27
	SD	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	1
	SP	0	0	0	1	2	1	2	0	0	0	0	0	0	0	0	0	2	1	1	1	1	1	0	1	0	0	0	2
	SW	2	0	0	2	4	2	4	0	0	0	0	0	0	0	0	0	4	2	2	2	2	0	0	2	0	0	0	4
4	GW	39	91	159	160	285	160	285	50	0	41	54	16	0	142	134	0	285	247	180	232	98	0	55	370	37	78	91	285
	SD	0	0	0	5	6	6	6	0	0	5	5	0	0	4	4	0	6	0	0	0	6	0	0	0	0	5	0	6
	SP	0	0	0	4	4	4	4	0	0	0	3	0	0	2	2	0	4	1	1	1	5	1	4	5	3	3	0	4
	SW	0	0	0	3	0	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	3	3	3	3	0	0
5	GW	28	55	58	46	129	46	129	31	0	33	34	4	0	99	99	0	129	61	24	55	53	0	34	107	24	53	55	129
	SD	0	0	0	2	2	2	2	0	0	2	1	0	0	1	1	0	2	0	0	0	2	0	0	0	0	1	0	2
	SP	0	0	0	1	2	1	2	0	0	0	0	0	0	0	0	0	2	1	1	1	1	1	1	1	0	0	0	2
	SW	4	0	0	4	10	4	10	0	0	0	0	0	0	2	2	0	10	4	4	4	5	0	4	5	0	0	0	10
6	GW	74	39	4	193	464	194	464	1	7	25	33	7	4	340	297	0	464	298	261	277	210	0	8	235	10	10	39	464
	SD	0	0	0	5	5	5	5	0	0	3	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	0	0	5
	SP	0	0	0	9	10	9	10	0	0	0	4	0	0	0	0	0	10	5	5	5	9	5	9	9	4	4	0	10
	SW	10	30	0	54	39	54	39	0	0	0	44	0	0	10	0	0	39	30	30	30	64	10	54	64	52	52	20	39
7	GW	8	7	2	4	20	4	20	4	0	3	3	0	0	14	14	0	20	17	3	8	6	0	4	9	0	3	7	19
	SD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	0	0	0	24	44	24	0	0	0	0	22	0	0	0	0	0	0	39	0	0	23	0	0	24	0	0	0	0

Table 2.2. (contd)

Segment	Medium	Ammonia	Benzene	Carbon-14	Cesium-137	Chromium	Cobalt-60	Copper	Cyanide	Diesel oil	Europium-152	Europium-154	Iodine-129	Kerosene	Lead	Mercury	Neptunium-237	Nickel	Nitrate	Nitrite	Phosphate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium-234	Uranium-238	Xylenes (total)	Zinc
8	GW	39	63	29	36	207	36	207	34	0	11	12	2	9	121	153	0	207	146	76	91	48	0	37	98	9	25	55	206
	SD	0	0	0	11	12	11	12	0	0	10	9	0	0	11	11	1	12	0	0	0	11	0	2	0	0	9	0	12
	SP	0	0	0	8	18	8	14	0	0	0	6	0	0	2	2	0	14	6	6	6	9	6	8	9	6	6	0	14
	SW	1	1	0	7	42	7	4	0	0	0	6	0	0	2	3	0	4	39	1	1	8	0	7	8	6	6	1	4
9	GW	1	2	1	1	8	1	8	1	0	0	0	1	0	3	2	0	8	5	4	4	2	0	3	4	0	1	2	8
	SD	0	0	0	5	5	5	5	0	0	5	4	0	0	5	5	0	5	0	0	0	5	0	0	0	0	5	0	5
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	7	0	0	6	14	6	14	0	0	0	0	0	0	2	2	0	14	6	6	7	7	0	6	7	0	0	0	14
10	GW	47	38	42	65	612	65	612	47	0	7	12	6	0	65	63	0	612	485	366	413	83	0	260	182	35	50	38	611
	SD	0	0	0	13	13	13	13	0	0	10	9	0	0	8	8	1	13	0	0	0	13	0	5	0	0	9	0	13
	SP	0	0	0	10	14	10	14	0	0	0	5	0	0	4	4	0	14	5	5	6	14	6	10	12	5	5	0	14
	SW	4	0	0	9	10	9	10	0	0	0	5	0	0	2	2	0	10	4	4	4	18	0	15	16	11	11	0	10
11	GW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	GW	0	6	0	2	8	2	8	0	0	0	0	0	0	0	0	0	8	8	8	8	0	0	5	8	0	0	6	8
	SD	0	1	0	8	4	8	3	0	0	4	8	0	0	3	1	0	4	1	1	1	8	0	0	0	3	7	1	4
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	GW	48	90	56	41	140	41	140	52	0	36	36	1	0	136	100	0	140	105	8	38	44	0	45	67	11	38	86	140
	SD	0	0	0	4	3	3	3	0	0	2	1	0	0	1	0	0	3	0	0	0	3	0	0	0	0	1	0	3
	SP	0	0	0	4	6	4	6	0	0	0	2	0	0	2	2	0	6	2	2	2	5	2	1	5	2	2	0	6
	SW	4	29	0	4	39	4	39	0	0	0	0	0	0	12	2	0	39	33	33	33	35	19	0	35	30	30	19	39
14	GW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SD	0	2	0	19	16	19	15	0	0	12	17	0	0	14	12	0	16	2	2	2	19	0	2	0	4	16	2	16
	SP	0	0	0	1	4	1	4	0	0	0	0	0	0	2	2	0	4	1	1	2	2	2	0	2	0	0	0	4
	SW	3	0	0	4	6	4	6	0	0	0	2	0	0	2	2	0	6	2	2	3	5	0	1	5	2	2	0	6

Table 2.2. (contd)

	Medium	Ammonia	Benzene	Carbon-14	Cesium-137	Chromium	Cobalt-60	Copper	Cyanide	Diesel oil	Europium-152	Europium-154	Iodine-129	Kerosene	Lead	Mercury	Neptunium-237	Nickel	Nitrate	Nitrite	Phosphate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium-234	Uranium-238	Xylenes (total)	Zinc
15	GW	0	6	0	1	6	1	6	0	0	0	1	0	0	1	0	0	6	6	5	6	0	0	1	7	0	0	6	6
	SD	0	0	0	4	4	4	4	0	0	4	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	4
	SP	0	0	0	4	9	4	9	0	0	0	0	0	0	0	0	0	9	4	4	4	4	4	0	4	0	0	0	9
	SW	8	0	0	8	16	8	16	0	0	0	0	0	0	0	0	0	16	8	8	8	8	0	0	8	0	0	0	16
16	GW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SD	0	1	0	10	6	10	5	0	0	5	8	0	0	3	1	0	6	1	1	1	10	0	0	0	3	7	1	6
	SP	0	0	0	2	4	2	4	0	0	0	0	0	0	0	0	0	4	2	2	2	2	2	0	2	0	0	0	4
	SW	6	0	0	6	12	6	12	0	0	0	0	0	0	0	0	0	12	6	6	6	6	0	0	6	0	0	0	12
17	GW	0	20	0	8	19	8	19	0	0	0	5	8	0	6	0	0	19	29	22	29	0	0	34	69	0	0	20	19
	SD	0	1	0	8	8	8	8	0	0	7	7	0	0	5	5	0	8	1	1	1	8	0	0	0	1	6	1	8
	SP	0	0	0	6	2	6	2	0	0	0	5	2	0	0	0	0	2	1	1	1	6	1	5	6	5	5	0	2
	SW	0	30	0	31	20	31	20	0	0	0	31	3	0	10	0	0	20	20	20	20	35	10	53	63	60	61	20	20
18	GW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SD	0	1	0	21	1	21	1	0	0	21	1	0	0	1	1	0	1	1	1	1	1	0	0	0	1	1	1	1
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	108	0	0	0	223	0	331	0	0	0	0	0	0	230	4	0	231	104	0	123	0	226	0	20	0	0	0	230
19	GW	13	31	0	32	54	32	54	3	0	3	7	7	1	49	44	0	54	49	39	38	12	0	19	50	9	16	31	54
	SD	0	1	0	1	1	1	1	0	0	1	1	0	0	1	1	0	1	1	1	1	1	0	0	0	1	1	1	1
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	8	8	0	8	16	8	16	0	0	8	8	0	0	16	16	0	16	0	0	8	8	0	8	8	0	8	8	16
20	GW	78	420	0	170	396	170	396	14	0	28	45	17	2	343	361	0	396	290	238	227	147	0	52	194	114	186	414	396
	SD	0	1	0	4	3	4	3	0	0	1	4	0	0	1	1	0	3	1	1	1	4	0	0	0	0	3	1	3
	SP	0	0	0	5	0	5	0	0	0	0	5	2	0	0	0	0	0	0	0	0	5	0	5	5	5	5	0	0
	SW	10	10	0	101	52	101	52	0	0	10	78	10	0	20	20	0	52	0	0	10	40	0	41	62	33	43	10	52
21	GW	10	29	0	30	38	30	38	7	0	4	9	4	0	25	23	0	38	43	31	37	10	0	21	36	7	13	29	38
	SD	0	1	0	8	4	8	3	0	0	1	8	0	0	3	1	0	4	1	1	1	8	0	0	0	4	8	1	4
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	0	111	0	188	131	188	111	20	0	0	161	16	0	40	39	0	111	121	141	121	291	77	74	313	291	292	61	111

Table 2.2. (contd)

Segment	Medium	Ammonia	Benzene	Carbon-14	Cesium-137	Chromium	Cobalt-60	Copper	Cyanide	Diesel oil	Europium-152	Europium-154	Iodine-129	Kerosene	Lead	Mercury	Neptunium-237	Nickel	Nitrate	Nitrite	Phosphate	Strontium-90	Sulfate	Technetium-99	Tritium	Uranium-234	Uranium-238	Xylenes (total)	Zinc
22	GW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SD	0	2	0	2	2	2	2	0	0	2	2	0	0	2	2	0	2	2	2	2	2	0	0	0	1	1	2	2
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	GW	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	SD	0	6	0	6	6	6	6	0	0	4	6	0	0	6	6	0	6	6	6	6	6	0	0	0	6	6	6	6
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	GW	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	SD	0	4	0	7	4	7	4	0	0	6	7	0	0	4	4	0	4	4	4	4	7	0	0	0	4	7	4	4
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	GW	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	SD	0	2	0	2	2	2	2	0	0	0	2	0	0	2	2	0	2	2	2	2	2	0	0	0	2	2	2	2
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	GW	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	SD	0	3	0	3	3	3	3	0	0	0	3	0	0	3	3	0	3	3	3	3	3	0	0	0	3	3	3	3
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	GW	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	SD	0	9	0	37	22	37	17	0	0	13	37	0	0	18	9	0	22	8	8	8	37	0	0	0	16	36	9	22
	SP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	SW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

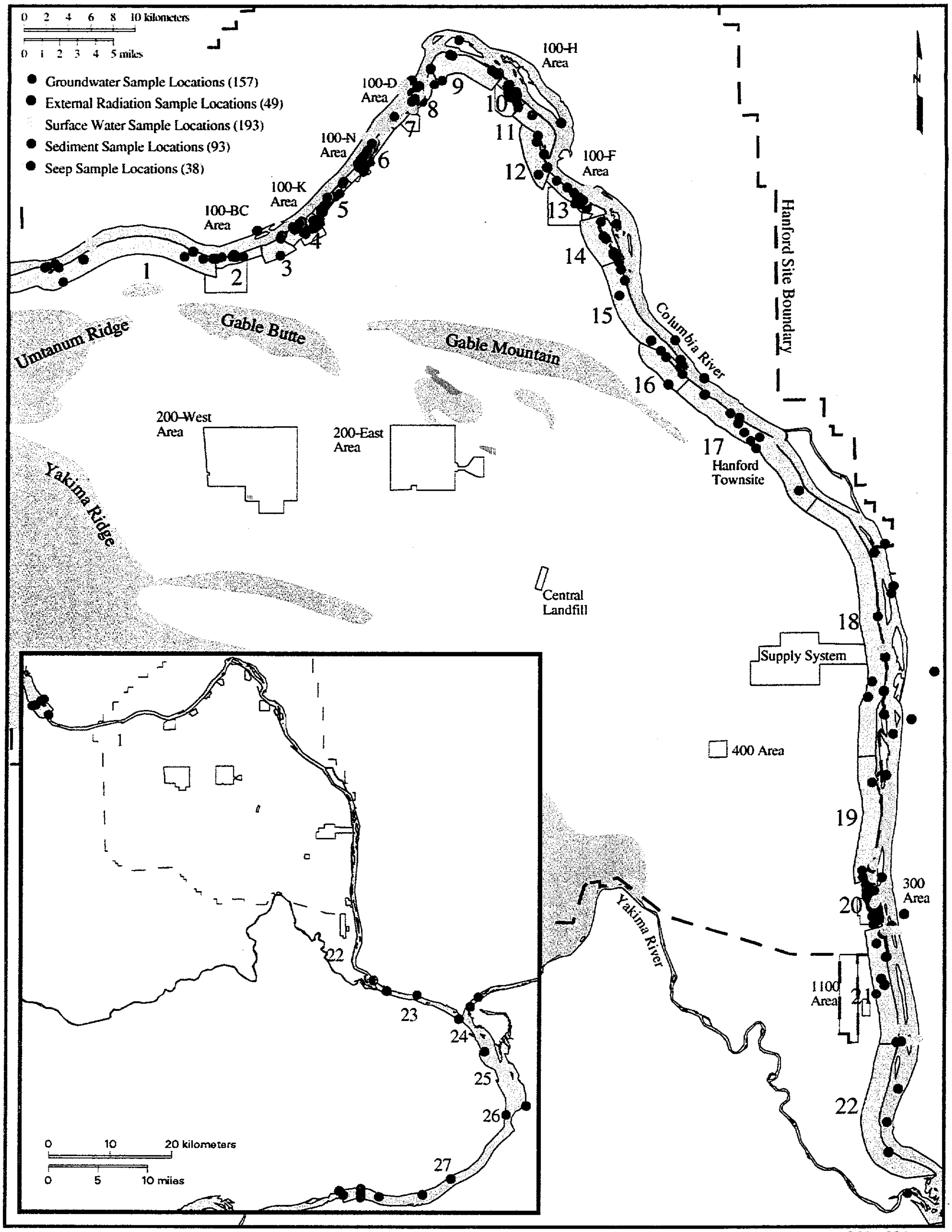

Figure 2.1. Sampling Locations for All Data Used in the Screening Assessment

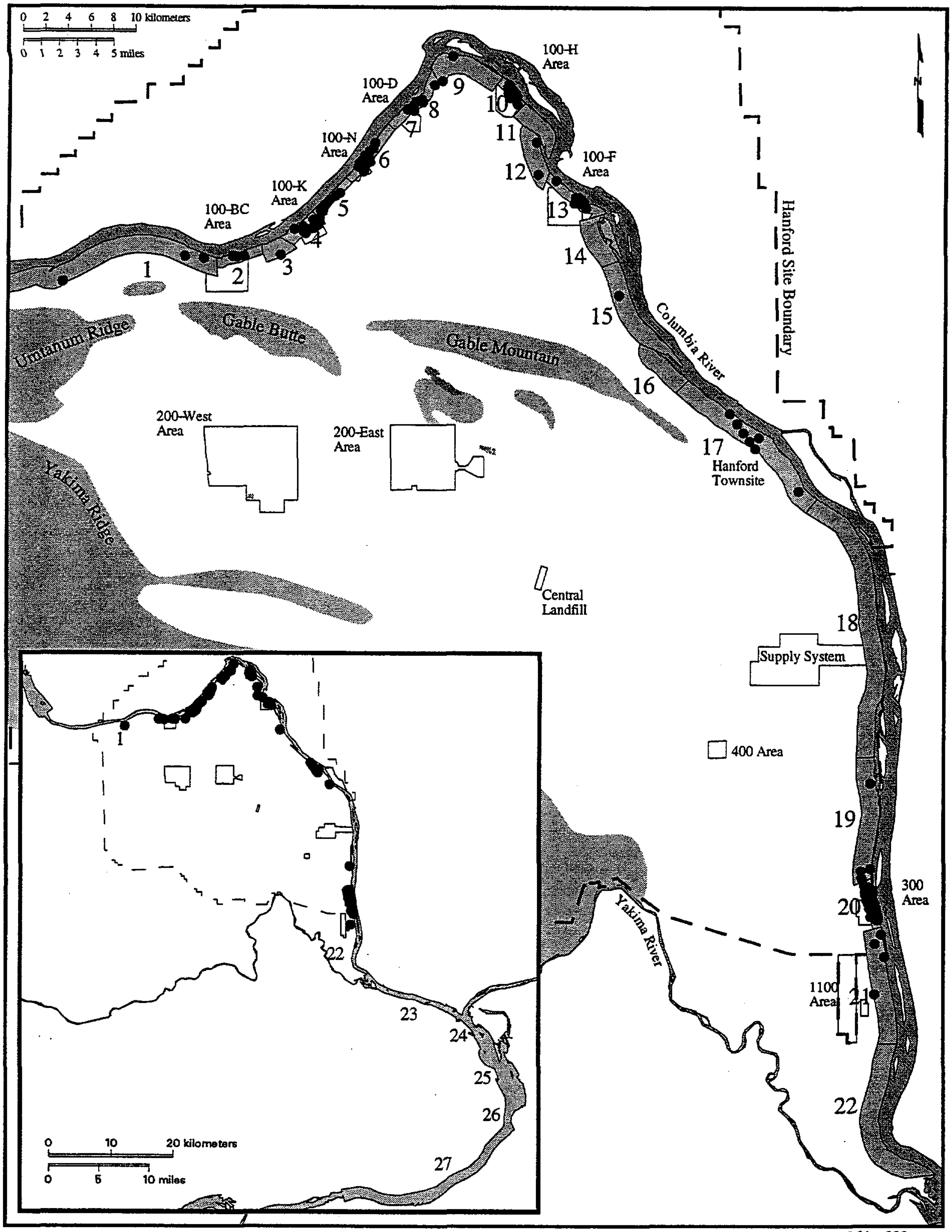

Figure 2.2. Sampling Locations for Groundwater Data Used in the Screening Assessment

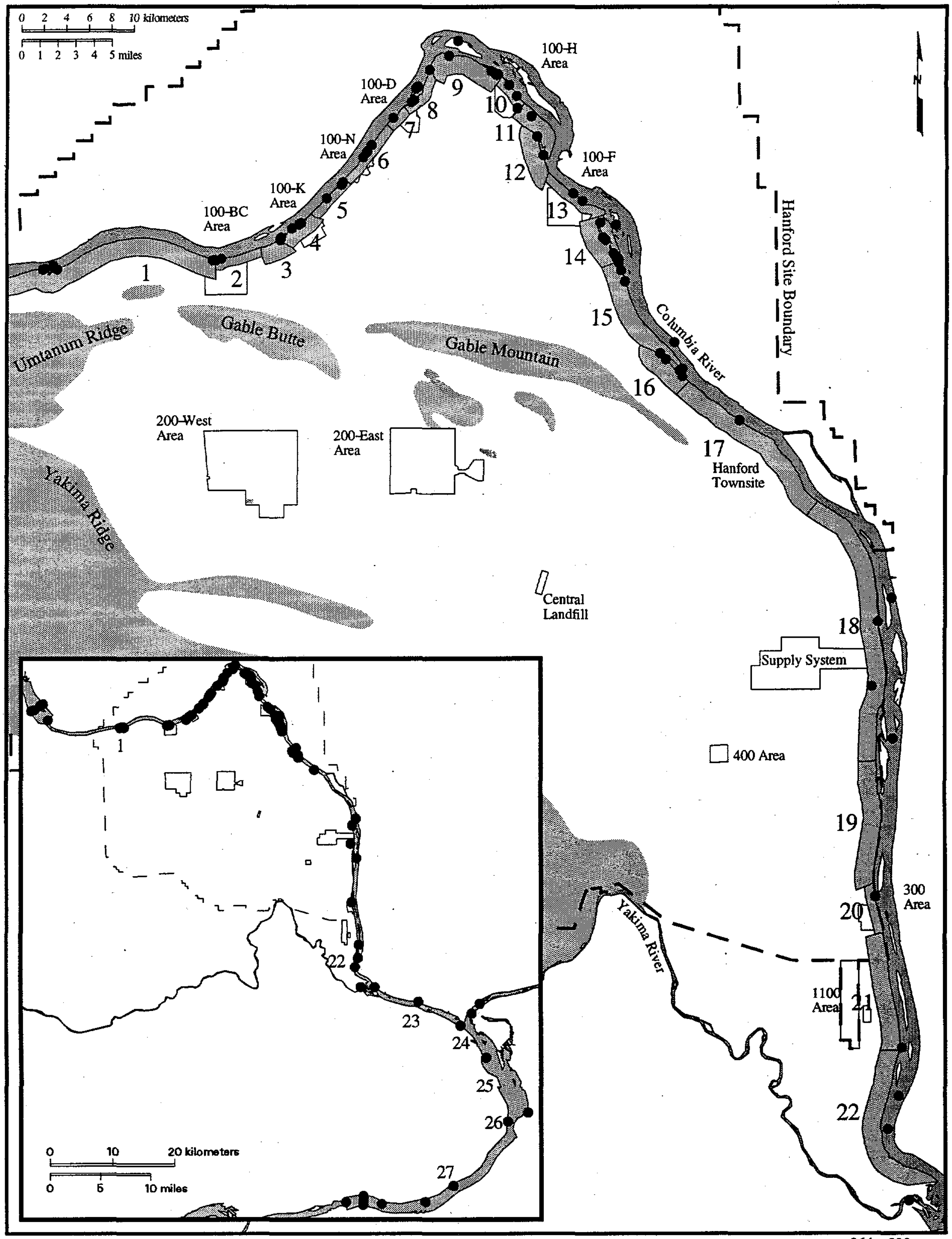

Figure 2.3. Sampling Locations for Sediment Data Used in the Screening Assessment

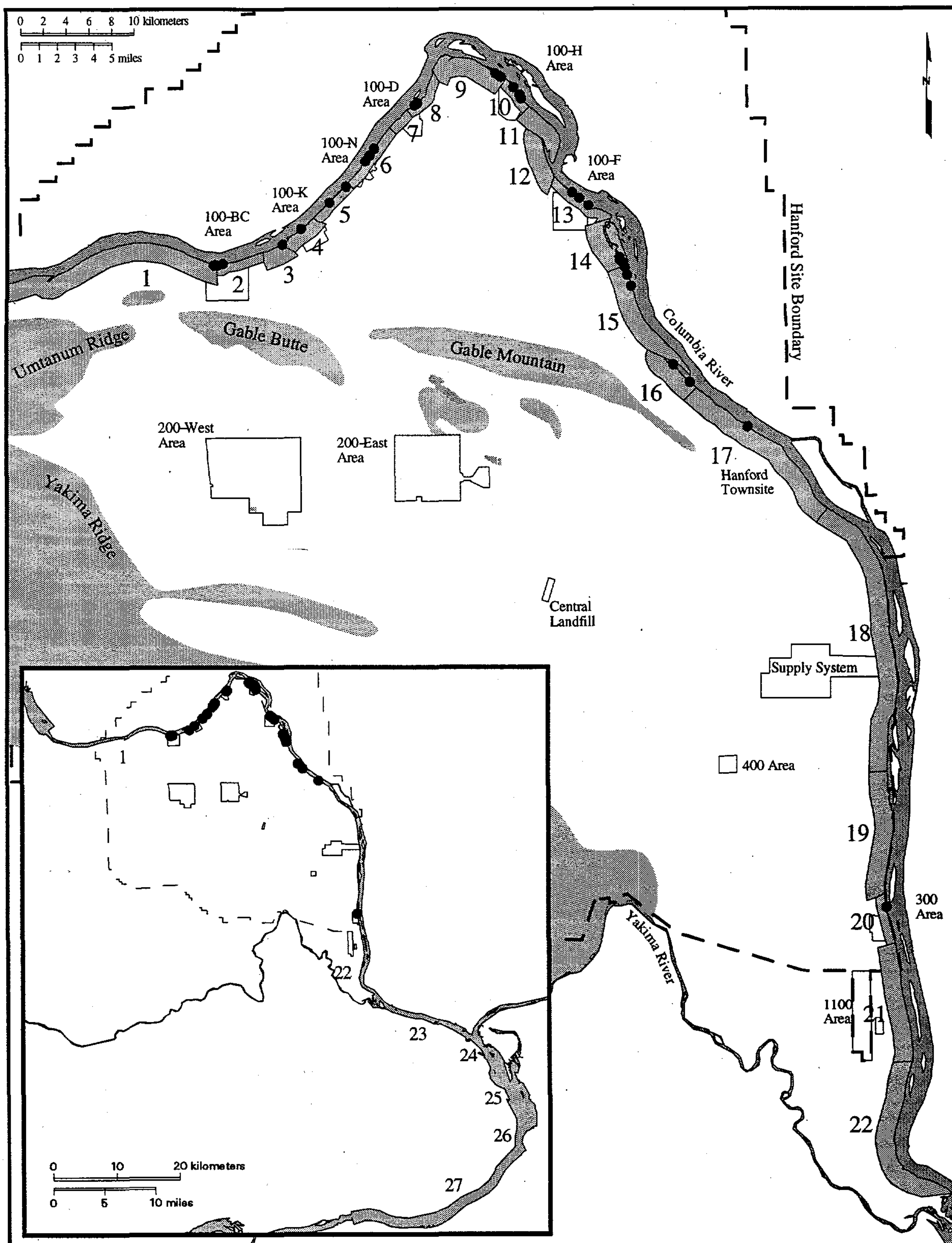

Figure 2.4. Sampling Locations for Seep Data Used in the Screening Assessment

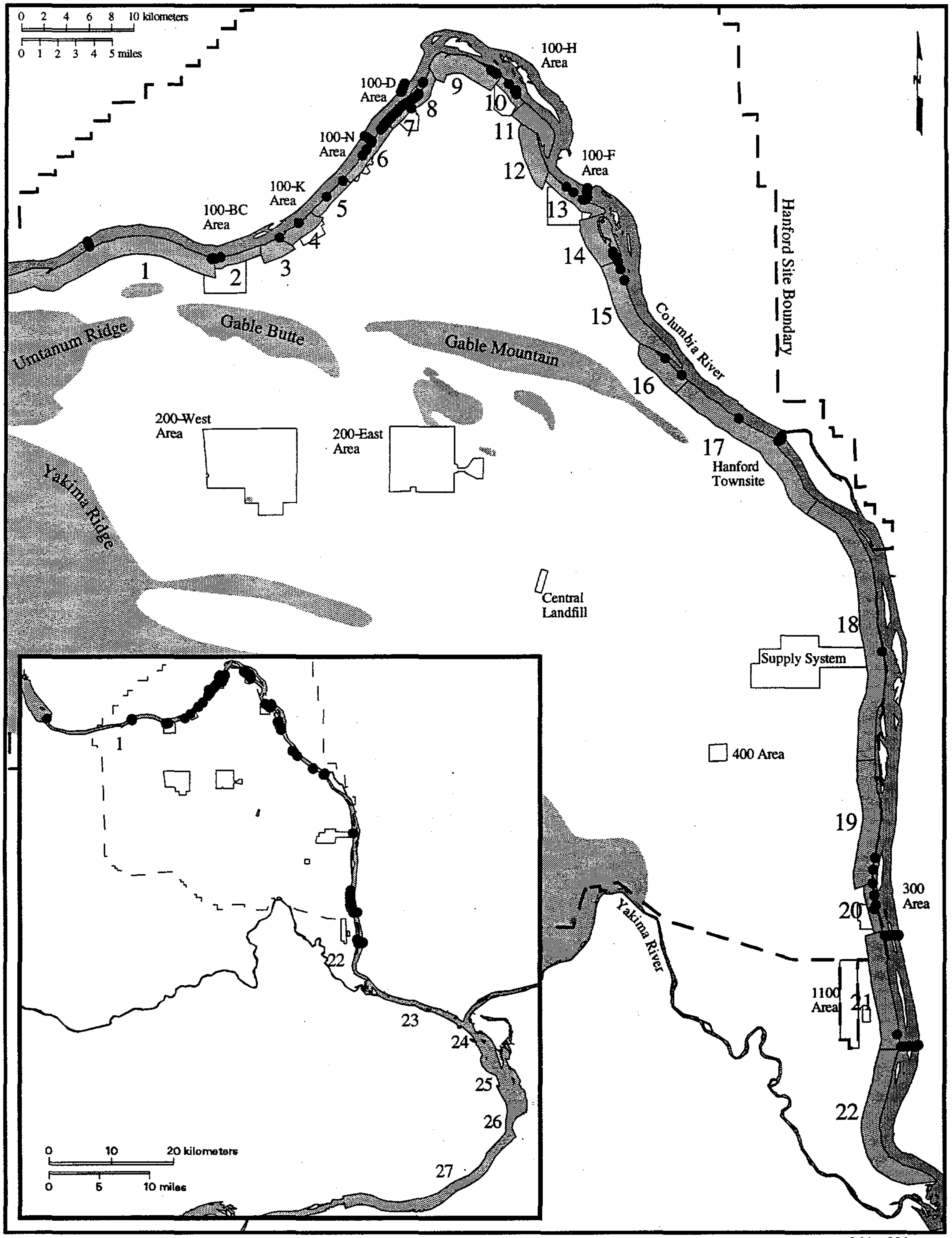

Figure 2.5. Sampling Locations for Surface Water Data Used in the Screening Assessment

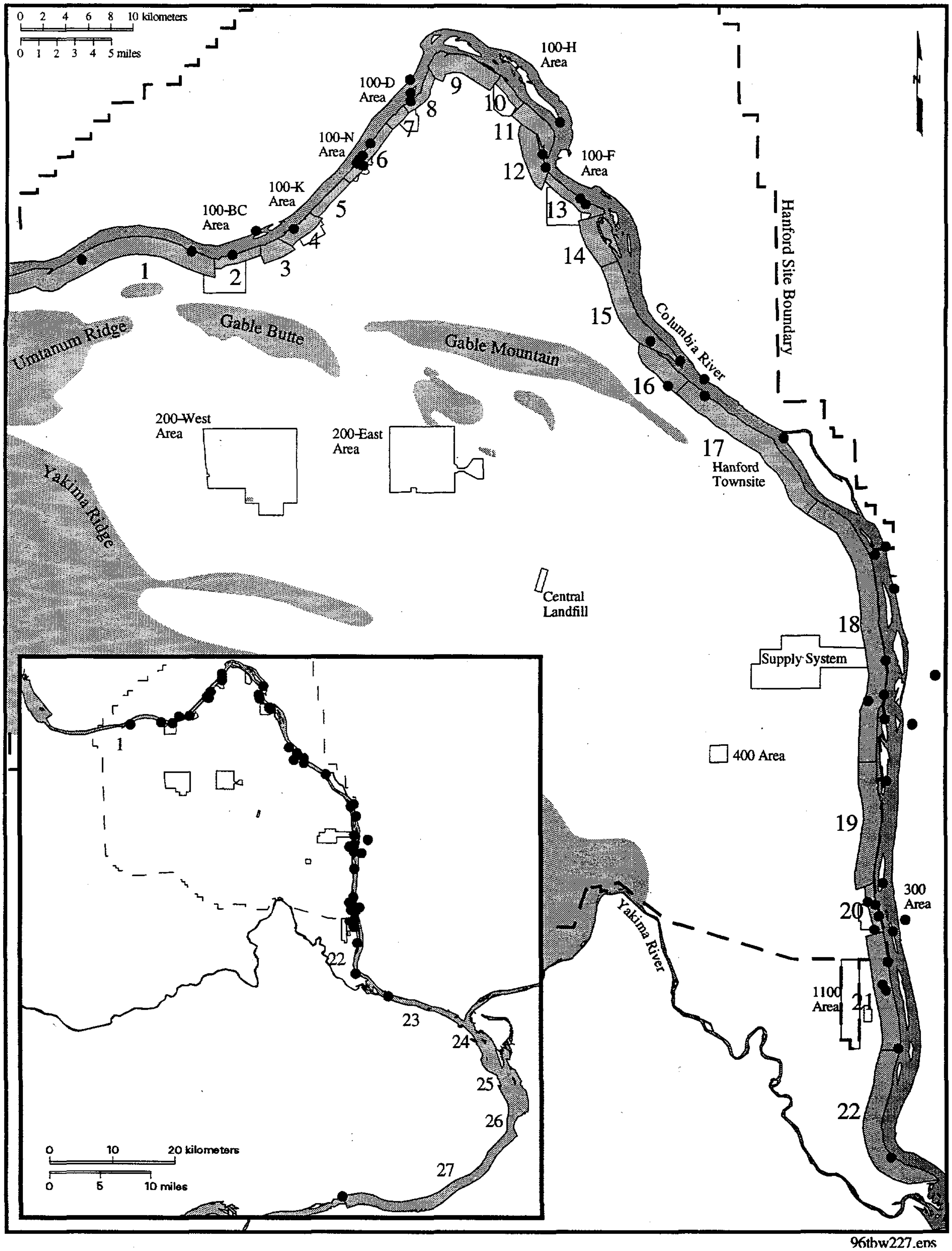

Figure 2.6. Sampling Locations for External Radiation Data Used in the Screening Assessment

3.0 Data Selection Process

This section describes the data analysis process used to obtain concentration inputs to the screening assessment models from the raw concentration data. This process was repeated for each segment and for each contaminant being evaluated. The process involved choosing a maximum representative value for the concentration of each contaminant for a deterministic run and calculating the parameters that define the concentration probability density function needed for the stochastic runs. The term "maximum representative value" is used to mean the highest concentration value that is considered representative of the sampling location.

Because of the volume of data, it was desirable to keep human intervention in the data selection process to a minimum. PNNL guided the development of computational techniques to select the data values to be used in the screening assessment. Graphical displays of the raw data were used to track the results of the computational techniques and identify needed modifications to final data files. The data plots are included as Appendix C in Volume II. For a copy of Volume II (over 500 pages plus 9 diskettes), contact S. D. Cannon at 509-372-6210.

The work of the data task did not include analyzing the quality of the data. Data quality objectives will be discussed in the report on the screening assessment and requirements for a comprehensive assessment.

3.1 Deterministic and Stochastic Analyses

To meet the needs of the screening assessment, data were prepared to support two types of analyses:

- A **deterministic analysis** wherein a single calculation is performed with a single value selected for each parameter, such as the concentrations of contaminants entering the river.

- A **stochastic analysis** wherein a set of calculations is performed over the range of some of the input parameters.

For the deterministic analysis, the maximum representative concentrations for each contaminant in each medium were used to represent the segment. For the stochastic analysis, a probability density function of the concentration parameter will be assumed to be a lognormal distribution truncated at the 99.9th percentile. The probability density function expresses the state of knowledge about alternative values for the parameter. The particular lognormal distribution assumed will be determined by specifying the geometric mean and geometric standard deviation that represents concentration data for each river segment for which impacts will be computed.

3.2 Data Evaluation Conventions

Some general data evaluation conventions were applied in the course of selecting the data and preparing it for the automated processing. These conventions are the result of CRCIA Team decisions and EPA risk assessment guidance (EPA 1990).

- Both filtered and unfiltered data were used in the data selection process.

- If any datum was reported by the laboratory as "less than" the equipment detection limit, then the data value (which is the equipment detection limit) was replaced with half the reporting limit for that datum.

- Any data value labeled with a laboratory qualifier of "R" for "rejected" was removed from the data set. These data values were marked for rejection by the laboratories for reasons such as exceeding the holding times.

- If no detection limit information was provided, any data value labeled with a laboratory qualifier of "U" was removed from the data set. Data values labeled "U" by the laboratory were below the reporting limit for the constituent.

- Data values labeled with a laboratory qualifier of "U" were not used when choosing maximum values.

3.3 Process Used to Select Groundwater Data

One of the key parameters in the screening assessment calculations is the concentration of the contaminants in the groundwater entering the Columbia River from the Hanford Site. For the purpose of the screening assessment, Hanford groundwater data have been compiled that represent water quality in the upper part of the unconfined aquifer. This hydrologic unit offers the most direct pathway for contaminants to reach humans and environmental receptors. It also is believed to contain the majority of contaminants. Where data exist for wells that monitor deeper zones, the general pattern is lower concentrations or nonexistent contamination with increasing depth in the aquifer (e-mail message from R.E. Peterson, ERC, to T.B. Miley, PNNL, March 20, 1996).

3.3.1 Selection of Groundwater Wells

The first step in selecting the set of groundwater wells as sources of data for the screening assessment was to identify all wells that have been sampled over the time period of interest. The next step was to use the Geographic Information System to determine which of these wells fell within the groundwater corridors specified for study. The well drilling information was then examined to determine the screening depth of the wells. Groundwater data from wells that monitor zones deeper than the upper unconfined aquifer were not included in the data compilation. Table 3.1 gives the list of wells by segment that were eliminated because they monitor at depths below the upper unconfined aquifer.

Table 3.1. Groundwater Wells Eliminated as Sources of Data for the Screening Assessment

Segment	Well Name
2	199-B2-12
2	199-B3-2P
4	199-K-32B
6	199-N-69
6	199-N-80
6	199-N-8P
8	199-D8-54B
8	199-D8-54B
10	199-H4-12C
10	199-H4-15C
10	199-H4-2
13	199-F5-43B
13	199-F5-43B
20	399-1-16C
20	399-1-17C
20	399-1-9
21	699-S29-E16C

3.3.2 Selection of Data

This section presents the data selection process for groundwater data. The process was followed for each contaminant and river segment.

3.3.2.1 Process the Raw Data for Inconsistencies

All groundwater data used in the assessment were from HEIS. ERC supplied a Microsoft Access macro to process the data for inconsistencies. The macro performed a series of queries designed to implement data standardization and to correct known errors. Soil results that reside in the groundwater area of HEIS were removed. Units of measurement were standardized for various contaminants. Known errors in constituent identification codes were corrected. Constituent names were standardized. Known errors in some of the nitrate analyses were corrected.

3.3.2.2 Identify at Most One Outlier

For each well, Dixon's test (Barnett and Lewis 1994) was conducted to decide if the largest data value is an outlier. The test assumes that the distribution (probability density function) of the data is normal except possibly for the potential single outlier. Because the groundwater data are assumed to be log-normally distributed, the data were log-transformed before this test was applied. If the data are lognormal, the log-transformed data will be normal as required by the test. When the data values were zero or negative, they were replaced with a small positive value for the log transformation.

The Dixon test examines the ratio between the difference in the largest and second largest data values and the range of the data. If this ratio is large, then the largest point is declared to be an outlier. The confidence level used for the test was 0.05. Any data identified as an outlier by the Dixon test received individual attention to determine whether they should indeed be deleted from the data set. This was done through a review of the data plots in Appendix C of Volume II. For a copy of Volume II (over 500 pages plus 9 diskettes), contact S. D. Cannon at 509-372-6210.

3.3.2.3 Test for a Trend Over Time

After any outlier was removed, the concentration data were tested for an upward or downward trend over time using the Mann-Kendall test (Gilbert 1987). To determine what data value is representative of current conditions in a well, it was necessary to know if the well data were trending over time. The Mann-Kendall test can be used regardless of the underlying data distribution. To perform the test, the data were ordered by sample date, then the sign of the difference (plus or minus) between each measurement and all subsequent measurements were calculated. The Mann-Kendall statistic is the number of positive differences minus the number of negative differences. If the test statistic was a large positive number, then measurements taken later in time were larger than those taken earlier, and an upward trend was present. If the test statistic was a large negative number, then the measurements taken later in time were smaller than those taken earlier, and a downward trend was present. A significance level of 0.01 was used in testing for an upward or downward trend in the concentration data. That is, if in fact there was no underlying trend in the data, 1 percent of the time the test would incorrectly indicate that a trend did exist.

3.3.2.4 Choose Representative Well Data

To support the deterministic and stochastic analyses, two representative values were selected for each well. These were a representative maximum and a representative median. Representative well data are selected after any outlier is removed. For a well that had no trend in its data, no data value is considered more representative than any other data value, so the representative values were selected based on all of the data values. For a well with a trend in the data values, the most recent data were considered most representative of the current conditions in the well.

3.3.2.5 Choose a Representative Well Maximum

A representative maximum value is used for the deterministic analysis because the goal is to produce a conservative or worst case estimate of risk. For each groundwater well with non-trending data, the maximum concentration detected in the well is chosen for the representative maximum value. For upward trending data, the maximum concentration was more conservative than the maximum of the current time period, so the overall maximum was used. For downward trending data, the most recent detected measurement was used. If there is more than one detected measurement in the most recent sampling period (as in one filtered and one unfiltered), then the maximum of the measurements is chosen as the representative maximum value.

3.3.2.6 Choose a Representative Well Median

A representative median value was used in the calculation of stochastic parameters because the stochastic process requires that attention be focused on best-estimate parameter values rather than conservative (maximal) values. If an upward or downward trend was detected, the median of the most recent groundwater concentration measurements was used to represent the well. If a well does not have a trend, then no single data point is considered more representative of the well than any other point. In that case, the median of the data is the single most representative concentration value for the well. This approach leads to the most representative probability density function to describe the uncertainty about the concentration data for the river segment being studied.

3.3.2.7 Compute Segment Parameters

For the groundwater medium, the representative values for individual wells must be combined into parameters that are representative of the river segment because no single well is representative of the segment. Whereas the process for the wells combines the data over time into a single value at the various well locations, the segment process combines the values over space into representative data for the segment.

3.3.2.8 Compute the Segment Maximum

The segment maximum is the highest of the well representative maximum values. This value is the maximum of all the observed concentrations in any well in the segment. This value is used to represent the segment in the deterministic risk calculations.

3.3.2.9 Compute Stochastic Parameters

The stochastic parameters (the geometric mean and geometric standard deviation) were calculated from the set of median (best-estimate) well values in the segment. The first step in calculating the geometric mean and geometric standard deviation was to take the natural logarithm of the median well values. The arithmetic mean of the log-transformed median values was calculated and then exponentiated to obtain the geometric mean. To calculate the geometric standard deviation, the standard deviation of the log-transformed median values was calculated and then exponentiated.

When some of the data are less than or equal to zero, the winsorized mean and standard deviation are computed (Dixon and Tukey 1968). Winsorizing is used to estimate the mean and standard deviation of a symmetric distribution even though the data set has a few missing or unreliable values at either or both ends of the ordered data set. The unreliable data at the lower end of the data set are replaced with the next largest data value, and an equal number of data are replaced at the upper end of the data set with the next smallest data value.

3.4 Process Used to Select Data for Other Media

For the sediment, seeps, surface water, and external radiation media, sampling locations within a segment cannot be easily pinpointed. Sampling locations tend to be regions rather than distinct locations such as a well. Also, in any one sampling period, there are few sampling events within a segment. Because the sampling does not occur at discrete locations for multiple times, it is not necessary to combine the data for a sampling location over time before calculating segment values.

3.4.1 Process the Raw Data for Inconsistencies

The data for all media other than groundwater were processed to remove inconsistencies. Units were standardized for various contaminants, and constituent names were standardized.

3.4.2 Identify at Most One Outlier

For each segment, Dixon's test (Barnett and Lewis 1994) was conducted to decide if the largest datum was an outlier. This test was applied to the set of all data over all sampling locations in the segment. As with the groundwater data, the data were log-transformed before this test was applied. The Dixon test used was described in the groundwater processing section above. When the data values were zero of negative, they were replaced with a small positive value for the log transformation. Any data identified as an outlier by the Dixon test received individual attention to determine whether they should indeed be deleted from the data set. This was done through a review of the data plots in Appendix C of Volume II. For a copy of Volume II (over 500 pages plus 9 diskettes), contact S. D. Cannon at 509-372-6210.

3.4.3 Compute the Segment Maximum

After removing at most one outlier, the maximum detected concentration was selected as the segment maximum. This value will be used for the deterministic screening assessment calculations.

3.4.4 Compute Stochastic Parameters

Calculate the geometric mean and geometric standard deviation of all measurements for the segment after outliers for the segment have been removed. The calculation of the geometric mean and geometric standard deviation are as described in section 3.3.2.5.2 in the groundwater process using winsorized data. The geometric mean and geometric standard deviation define the specific two-parameter lognormal distribution that will be used for the stochastic risk assessment calculations for the segment.

4.0 Final Data Sets

The final data sets produced for input to the human health and ecological screening assessments are the media files. The media files were derived from the Microsoft Access database of raw files (see Appendix A in Volume II). The media files are provided on diskette as Appendix D in Volume II. (For a copy of Volume II containing over 500 pages plus 9 diskettes, contact S. D. Cannon at 509-372-6210.) The media files are comma separated files that can be opened and read by Excel 5.0. Each medium is provided in a separate file. The media are groundwater (GW), sediment (SD), seeps (SP), surface water (SW), and external radiation (TLD).

Each media file contains a record for each contaminant in each segment. The records are sorted by contaminant first, then segment. For each medium, a file is constructed that contains the following information:

Media	Medium name
Segment_No	Segment number
Contaminant	Contaminant name
Units	Units of measurement
Max_Value	Maximum concentration
NA	Not available
Max_Samp_Num	Identifying number for the sample with the maximum concentration
Max_Samp_Date	Date of the sample with the maximum concentration
Max_Samp_Owner	Organization that has responsibility for the sample with the maximum concentration
GM	Geometric mean
GSD	Geometric standard deviation
Num_Obs	Number of records for that contaminant/medium combination

If there were no data for a contaminant and segment combination, there will be an "NA" in the media file for the pertinent record. This will be the case for the maximum and its associated information and for the geometric mean and geometric standard deviation. If data are marked as undetected (qualifier of "u") in segments with no detected values for the particular contaminant in question, a geometric mean and geometric standard deviation will be calculated on the detection limits reported (see Section 3.2), but the maximum value and its associated information will be reported as not available (NA).

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