



**SURFICIAL GEOLOGY ALONG THE SPOKANE
RIVER, WASHINGTON
AND ITS RELATIONSHIP TO
THE METAL CONTENT OF SEDIMENTS
(IDAHO-WASHINGTON STATELINE
TO LATAH CREEK CONFLUENCE)**

by Stephen E. Box¹ and John C. Wallis²

Prepared in cooperation with the Washington Department of Ecology
and the Environmental Protection Agency

Open-File Report 02-126

2002

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards or with the North American Stratigraphic Code. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

**U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY**

¹ U.S. Geological Survey, 904 West Riverside Avenue, Room 202, Spokane, WA 99201; sbox@usgs.gov

² Information Systems Support, Inc., Spokane, WA

TABLE OF CONTENTS

| | |
|---|-----------|
| INTRODUCTION | 4 |
| METHODOLOGY | 4 |
| GEOLOGIC BACKGROUND..... | 5 |
| GEOMORPHOLOGY OF THE SPOKANE RIVER VALLEY | 5 |
| FLOW OF THE SPOKANE RIVER | 6 |
| SURFICIAL DEPOSITS ALONG THE SPOKANE RIVER | 7 |
| GEOCHEMISTRY OF THE SURFICIAL SEDIMENTS..... | 8 |
| SAMPLING METHODOLOGY | 8 |
| VARIATIONS IN SEDIMENT TRACE ELEMENT GEOCHEMISTRY | 9 |
| CONCLUSIONS..... | 12 |
| DESCRIPTION OF MAP UNITS..... | 13 |
| RATIONALE FOR DIVISION OF SURFICIAL MAP UNITS..... | 13 |
| ACKNOWLEDGEMENTS | 16 |
| REFERENCES | 16 |

(Material following text)

TABLES

- Table 1:** Geochemical analytical data for sediment samples from the Spokane River channel and margins in the map area in eastern Washington.
- Table 2:** Average Pb and Zn contents of samples upstream and downstream of Upriver Dam, separated by lithologic unit.

FIGURES

- Figure 1:** Regional map of Spokane River drainage basin in eastern Washington and northern Idaho.
- Figure 2:** Map of the Spokane River valley showing location of features mentioned in text.
- Figure 3:** Map of the geomorphological features of the floodway of the last few late Pleistocene glacial outburst floods through the Spokane Valley, with the location of the mapped Holocene deposits.
- Figure 4:** Generalized stratigraphic section of the outburst flood thalweg deposits exposed in the highwall of the Sullivan Road gravel pit.
- Figure 5:** Annual hydrographs for the Spokane River at Spokane for Water Years 1997 and 1998.
- Figure 6:** Annual peakflows on the Spokane River at Spokane from 1891 to 2000.
- Figure 7:** Lead content of various grain size fractions of coarse cobble gravels along the Spokane River plotted by geologic map unit against downriver position.
- Figure 8:** Lead content of various grain size fractions of deposits of pebble gravel and sand along the Spokane River plotted by geologic map unit against downriver position.
- Figure 9:** Zinc content of various grain size fractions of coarse cobble gravels along the Spokane River plotted by geologic map unit against downriver position.

- Figure 10:** Zinc content of various grain size fractions of deposits of pebble gravel and sand along the Spokane River plotted by geologic map unit against downriver position.
- Figure 11:** Mean lead and zinc contents of fine-grained fractions of samples by surficial geologic map unit.
- Figure 12:** XY plot of lead versus zinc content of fine fractions of Spokane River bed sediment and of Spokane River suspended sediment collected in May, 1997.
- Figure 13:** XY plot of lead content versus zinc-to-lead ratio of Spokane River samples by geologic map unit along with calculated mixing lines of three postulated detrital end-members.

PLATES

- Plate 1:** Spokane River surficial geology: east half of Liberty Lake quadrangle, WA (scale 1:24,000).
- Plate 2:** Spokane River surficial geology: west half of Liberty Lake quadrangle, WA (scale 1:24,000).
- Plate 3:** Spokane River surficial geology: east half of Greenacres quadrangle, WA (scale 1:24,000).
- Plate 4:** Spokane River surficial geology: west half of Greenacres quadrangle, WA (scale 1:24,000).
- Plate 5:** Spokane River surficial geology: east half of Spokane NE quadrangle, WA (scale 1:24,000).
- Plate 6:** Spokane River surficial geology: west half of Spokane NE quadrangle, WA (scale 1:24,000).
- Plate 7:** Spokane River surficial geology: east half of Spokane NW quadrangle, WA (scale 1:24,000).
- Plate 8:** Spokane River surficial geology: west half of Spokane NW quadrangle, WA (scale 1:24,000).

APPENDICES

- Appendix A:** List of digital files associated with this report and how to obtain them.
- Appendix B:** Metadata for srgeounits.shp(srgeounits.met)
- Appendix C:** Metadata for srsedchem.dbf (srsedchem.met)

INTRODUCTION

The Spokane River flows westward into eastern Washington out of the northern end of Lake Coeur d'Alene in northern Idaho ([figure 1](#)). The river and lake lie downstream of the Coeur d'Alene mining district, where over 56 million metric tonnes of metal-enriched tailings were disposed into the Coeur d'Alene River between 1886 and 1968 (Long, 1998). Geochemical analyses of riverine sediments in the Spokane River by the Washington Department of Ecology (Johnson, 1999), the US Geological Survey (Grosbois and others, 2001; Box and others, in prep.) and a contractor for the Environmental Protection Agency (URS Greiner, 2000, 2001) have indicated that Spokane River sediments are variably enriched in metals derived from those tailings. In order to give some geologic context to this variable enrichment, we mapped the distribution and characteristics of unconsolidated deposits within and along the Spokane River in eastern Washington between the Idaho stateline and the confluence with Latah Creek about 32 km (20 miles) downstream and prepared a surficial geologic map ([plates 1 through 8](#)). Existing sample datasets for sediments and soils in and along the Spokane River are also located on the map and the surficial geologic unit that was sampled is noted in [table 1](#).

The purpose of this study is (1) to document the geographic distribution of Holocene (deposited in the last 11,000 years) sedimentary lithologies in and along the Spokane River, (2) to document the downstream variation of metal contents (especially lead [Pb] and zinc [Zn]) by sedimentary lithology, and (3) to compare the metal contents of different sedimentary lithologies. This data is used to gain some understanding of the physical and chemical processes that control those metal contents. It is hoped this study can be used to guide potential future remedial actions aimed at reducing the biologic impact of metal-enriched sediments in this area. This work was undertaken in cooperation with the Washington Department of Ecology and the Environmental Protection Agency.

Methodology

Field work along the Spokane River corridor was undertaken between August 21 and September 1, 2000, when flow of the river was at its annual minimum (600-800 cfs). Page-size, 1:3000 scale, black-and-white prints made from the USGS digital orthophoto quarter-quadrangles (DOQQs; nominal scale 1:12000) were used as field sheets for mapping. One or both banks of the river were walked for most of the map area and the character of the surficial deposits was studied. Mappable units were defined based primarily on lithologic character and position relative to the inundated low-flow channel. The map area was subdivided into map units based on consistency and continuity of the lithologic character of the subareas, with a minimum polygon size of 50 square meters. Typically the area of a mapped unit may include patches of up to 20% of other lithologies than that in the unit description. Map units were transferred to the field sheets by inspection. Following the field work, the linework from the field sheets was used to draw attributed polygons in a shapefile (srgeounits.shp) on the DOQQ base (UTM, NAD27) in ArcView 3.1. Some of the linework was later revised after subsequent spot field visits.

The report begins with the presentation of the geologic setting of the Spokane River valley, especially the importance of its late Pleistocene history, deposits, and landforms. This is followed by a discussion of the hydrology of the river system and the effects of the several dams

in and upstream of the map area. The Recent (last 11,000 years) and historic sedimentary deposits in and along the Spokane River (the main focus of this report) are then broadly discussed. The discussion then moves to the geochemistry of the Recent sedimentary deposits based on sampling for this report and on several other sample datasets. We first present relevant information about sampling methodologies, followed by a discussion of the variations of sediment trace element geochemistry and the relevance of interelement correlations. Finally, the more detailed descriptions of the individual surficial geologic map units are given. The [three appendices](#) give more information about the digital data available with this report.

GEOLOGIC BACKGROUND

Geomorphology of the Spokane River valley

The Spokane River flows into a wide alluvium-covered valley out of the north end of Lake Coeur d'Alene, a relatively narrow, bedrock-flanked, backflooded stream valley. Between the Washington-Idaho stateline and downtown Spokane, the Spokane River flows in a shallow (10-20 m, or 30-60 feet deep), incised inner valley within the wide (3-4 km, or 2-3 mile wide) flat alluvium-covered valley ([figure 2](#)). At Spokane Falls in downtown Spokane, the river plunges over a series of basaltic ledges (Miocene Columbia River basalts: Joseph, 1990), falling about 40 m (130 feet) in 0.8 km (0.5 mile). Between the base of Spokane Falls and the confluence with Latah Creek, the Spokane River cuts a 60 m (200 foot) deep valley through unconsolidated gravels. Latah Creek joins the river from the south, the first perennially flowing tributary downstream of Lake Coeur d'Alene.

The wide Spokane valley is underlain by coarse, late Pleistocene glacial outburst flood gravels that are as thick as 200 m (650 feet) and constitute the matrix of the Spokane Aquifer (Molenaar, 1988). Deposition of these gravels in the Rathdrum Prairie-Spokane valley resulted from huge, repeated glacial outburst floods emanating southward from the present location of Pend Oreille Lake ([figure 1](#)). A tongue of the continental ice sheet would advance southward into the valley of present-day Pend Oreille Lake, effectively damming the Clark Fork valley. Failure of the glacial ice dam caused catastrophic draining of the impounded lake waters in the Clark Fork valley. Repeated re-advance of the glacial tongue and failure of the glacial dams led to dozens of these glacial outburst floods. These massive floods (maximum flood discharge estimated to be about 600 million cubic feet per second [cfs] or over 100 times larger than the floodstage Amazon River at its mouth; O'Connor and Baker, 1992) repeatedly deposited coarse gravels in the Rathdrum Prairie-Spokane valley, building up the valley floor and damming all the tributary valleys to form lakes, the largest of which is Lake Coeur d'Alene. Only Lake Coeur d'Alene has perennial surface water outflow. All the other tributary lakes have surface outflow only at the highest water levels because of the permeable nature of the gravel dams.

The Spokane valley, generally devoid of surface drainage because of the permeable character of these glacial outburst flood deposits, preserves bedforms developed during the repeated late Pleistocene catastrophic glacial outburst floods ([figure 3](#)). These bedforms include the primary deepest channel (thalweg), interconnected secondary channels, intrachannel bars, channel margin bars, eddy bars, and erosional bedforms. The present surface features developed during the last (few?) outburst flood(s) between 13,000 and 11,000 years ago (Waitt, 1985). The outburst flood deposits in the thalweg consist of 3-5 m (10-16 foot) thick layers of cobble to boulder gravel with foreset layering inclined downstream ([figure 4](#)). Large-boulder lag horizons

(1-3 m diameter boulders) occur at the base of some of the layers. The Spokane River outflow from Lake Coeur d'Alene follows a secondary outburst flood channel until it intersects the primary thalweg channel west of the Idaho-Washington stateline. Further west the river mostly follows the outburst flood thalweg through the Spokane Valley, except for a segment above Upriver Reservoir where it follows a secondary outburst flood channel.

The incised inner valley within the wide Spokane valley was eroded by the Spokane River into the landscape left by the last of the glacial outburst floods. This incised inner valley consists of stream deposits within the active floodplain of the Spokane River, as well as two terrace levels above the present floodplain (three terrace levels between Spokane Falls and Latah Creek). The terraces represent earlier floodplain levels that were stranded by continued downcutting of the river channel. The surficial deposits of this incised inner valley, including the abandoned floodplain terraces, are the subject of this report and are mapped in [plates 1 through 8](#).

Flow of the Spokane River

The Spokane River flows out of the northern end of Lake Coeur d'Alene. The flow rate of the Spokane River out of the lake is controlled by a bedrock-incised reach of the river at Post Falls, Idaho ([figure 1](#)). Unrestricted flow on the river closely correlates with the height of the water surface of Lake Coeur d'Alene. Three natural channels are cut through the bedrock at Post Falls. Since 1906 the three channels have been blocked by dams; the northern and southern dams are gated to allow for control of the lake elevation at selected heights (partially closed) or for free flow (open), while the middle dam is equipped with flow-through power turbines (maximum flow rate through turbines is 5000 cfs). Typically the dam gates are completely opened from December through early June and the lake level and Spokane River flow fluctuate, depending on the inflow rate to the lake. Lake levels and Spokane River flows typically rise due to spring snowmelt in April and May, and begin subsiding by early June. From early June to early September, the dam gates are fixed to control the lake elevation at 2125 feet (647.7 m) above sea level, causing the Spokane River outflow to gradually decline through the summer to annual minimum levels in late August and early September. From early September to early December the lake level is gradually lowered (and the Spokane River outflow rate increased) until the dam gates are completely opened and the lake adjusts to its natural level (where inflow to the lake equals outflow from the lake). Between December and March, it is not unusual for several winter-warming events to push the lake level and Spokane River flow up to spring-like levels for short periods. The annual hydrographs for Water Years 1997 and 1998 (relative high and low flow years, respectively) are shown for the Spokane River at Spokane in [figure 5](#).

The USGS has operated the gage on the Spokane River at Spokane since 1891. A plot of the annual flow peaks since establishment of the gage in 1891 is shown in [figure 6](#). The highest flow (49,000 cfs) was recorded in May of 1894 (prior to Post Falls dam) when the lake level was at 2134.6 feet (650.6 m). The next highest flow (47,100 cfs) occurred in December of 1933 (after Post Falls dam was constructed) when the lake level reached 2136 feet (651.1 m). The third and fourth highest flows occurred in January, 1974 (45,600 cfs) and in May of 1997 (42,600 cfs), respectively. Peak flow in the spring of 2000 was 27,500 cfs, slightly above the median value of 25,000 cfs and the highest since 1997. During the August, 2000 fieldwork, the

high water marks of spring, 2000 and May, 1997 were readily identified in most locations. At a few places just east of Sullivan Road, the high water mark of January 1974 is still recognizable.

The Spokane River significantly interchanges water with the groundwater of the Spokane Aquifer (Molenaar, 1988). During intermediate to low flows on the river, the water is lost downward through the bed of the river into the underlying aquifer from the stateline to about Sullivan Rd. (figure 2), while water is gained into the river from the aquifer below Sullivan Rd. During low-flow periods, stream flow can triple between Post Falls and downtown Spokane due to inflow of groundwater to the river. When stream flow is increasing to high flow conditions, water percolates into the aquifer along the whole length of the river.

Three dams on the Spokane River are located within the map area: Upriver dam, Havermale Island (or Upper Falls) dam, and Monroe Street dam (figure 2). At each dam the reservoir height is controlled at an approximately fixed height by release of water through the associated power-generating turbines and either through a gated dam (Upriver and Havermale Island dams) or over a fixed dam (Monroe Street). At high flows the water surface elevation at the upstream end of the low-flow reservoirs rises because of increased inflow.

Surficial deposits along the Spokane River

The Spokane River flows over a cobble to boulder bed for most of its course between the Idaho stateline and its confluence with Latah Creek, except for a 0.8 km (0.5 mile) reach through downtown Spokane, where it flows over bedrock. As mentioned above, the channel is incised into a thick sequence of Pleistocene outburst flood gravels and the cobble-boulder bed is derived primarily from erosion of the flood gravel deposits. These flood gravels (especially the thalweg and secondary channel deposits) consist predominately of well-rounded, cobble-size materials, but clast sizes range from sand to 3 m (10 foot) diameter boulders. Silt and finer grain size material is scarce in the Pleistocene flood channel deposits. In general, boulders with diameters greater than about 0.3 m (one foot) are too large to be moved by the present stream and remain as a lag deposit on the stream bed and banks as smaller clasts are moved around them. Where boulders greater than 0.3 m diameter are exposed, the environment is generally erosive, since deposition of smaller clasts would bury them. Conversely, areas of the river channel and floodplain with maximum clast size of less than one foot have been built up by riverine deposition of those clasts.

The river moves, sorts, and redeposits sediment in cycles ranging from one year to hundreds and even thousands of years. For the coarse bedload (coarse cobbles), movement and redeposition occurs during infrequent high flow events (10s to 100s of years between recurrence). Finer materials also move in more frequent, lower flow events (semi-annually to every few years) and are deposited over the bedforms constructed of coarser materials during the infrequent high flow events. At the finest grain sizes (clays), chemical and biologic precipitation, sorption, and flocculation play important roles in the creation of sedimentary particles and creation, transportation, and deposition of these particles can occur even at the lowest flows.

Excluding the lag deposits, the coarsest depositional materials on bars in the Spokane River are coarse cobbles (125-250 mm diameter clasts). In the high flow channel upstream of Harvard Road (figure 2; plates 1, 2), accumulations (“bars”) of coarse cobbles generally are

present along the inside of gentle to sharp river bends. They are much less common but are locally present between Harvard Road and Upriver Reservoir; they are rare between the reservoir and the confluence with Latah Creek. Where bars are lacking, the erosional channel flanks are draped with a thin veneer of cobbles and/or finer deposits. Upstream of Harvard Road, the depositional bars consist of wide areas of deposited cobbles that are completely submerged at high flow and exposed at low flow. The channelward flank of each bar consists of recently rolled cobbles, and a cobble riffle occurs along part of the bar in the low flow channel.

The gravel bar deposits grow laterally as the channel migrates toward the opposite bank. The channel erodes the opposite bank as the bar grows, maintaining the channel cross-section. As the bar grows, the bar top away from the channelward flank begins to accumulate a thin veneer of sand ("floodplain sand") during high flow events (generally less than 0.6 m, or 2 feet, thick). Further lateral bar growth leads to the erosion of a shallow bar-top channel along the inner edge (distal from channel) of the sand-capped bar. Preserved terraces along the river channel represent older, sand-capped coarse-cobble bars that became stranded above flood level after renewed downcutting of the river channel. In a few places bars composed of gravels finer than coarse cobbles are present along the flanks of the river channel.

Sand deposits are not extensively present within or along the channel of the Spokane River. Sand deposits occur in three settings within the active floodplain of the Spokane River: (1) capping the flat top of coarse cobble, river margin bars (discussed above), (2) as a narrow, channelward-sloping band of beach sand near the high water line on one or both margins of the river, and (3) as smaller pockets of sand behind natural or manmade obstacles along the flank of the channel. Only a few deposits of sand in the third setting above extend down into the low flow channel; all other sand deposits are separated from the low-flow channel by gravel deposits.

The fine-grained fraction (fine sand-, silt-, and clay-sized fractions) of the sediment deposits in and along the Spokane River (the fractions analyzed for metal contents discussed subsequently) make up a small percentage of the total weight of most of the sample units in the map area (URS Greiner, 2000; Grosbois and others, 2001). This size fraction of the cobble and pebble units was generally not deposited during the peak flows that deposited the coarse framework grains but was deposited on the surface of that unit during the waning of the peak flows or even later. In some cases the fine fraction is scoured away from the surface of the cobble and pebble units during high velocity runoff flows and a new layer deposited as flow velocities diminish. Fine-grained material that has worked itself below the surface into the interstitial spaces between the cobbles or pebbles can be preserved, at least until the framework grains are mobilized. The silt and clay fraction of the sand deposits is generally deposited at the same time as the sand.

GEOCHEMISTRY OF THE SURFICIAL SEDIMENTS

Sampling methodology

During the field work, we collected grab samples of sand or finer material from 51 sites in the map area in sandwich-size (10 cm by 10 cm) Ziploc bags. These sample bags were shaken to allow the finer fraction to move to the bottom of the bag and that part of the sample was analyzed with a portable X-Ray Fluorescence (XRF) instrument by personnel from URS Corp,

under contract with the Environmental Protection Agency (dataset URS-00 in [table 1](#); URS Greiner, 2001). The rough size sorting within the sample bag prior to analysis leads us to approximate the analyzed size fraction in [table 1](#) as less than 500 microns (medium-grained sand and finer). A subset of these locations was resampled by the URS personnel after gridding of the sample site, selecting 7 random sample points from the grid, and field sieving the sample to less than 175 microns (fine-grained sand and finer; dataset URS-01 in [table 1](#); URS Greiner, 2001). About 10% of these samples were reanalyzed in the lab using EPA methods and protocols, which showed good agreement with the XRF data.

Two other sample datasets are included in [table 1](#) and are briefly described here. The first consists of 35 samples collected by the USGS (dataset USGS-99 in [table 1](#); A. Horowitz, USGS, written communication, 1999; Grosbois and others, 2001). Samples labeled “SRG-xx” were collected with a small dredge bucket from the submerged channel bottom using a small boat in October, 1998. Samples labeled “SRH-xx” were collected along the shoreline using a plastic trowel in October, 1998 and February, 1999. Two subsamples of these samples were analyzed: the less than 2000 micron fraction (very coarse sand and finer), and the less than 63 micron fraction (silt-sized and finer). Samples were analyzed using ICP-AES and AAS methodologies and instrumentation (Grosbois and others, 2001). The second dataset consists of 56 samples from 8 public recreation sites collected in the summer of 1999 by a contractor for the EPA (dataset URS-99 in [table 1](#); URS Greiner, 2000). Samples were collected above the waterline from 0 to 12 inches depth and sieved to less than 175 microns for analysis. Samples were analyzed using EPA methods and protocols (URS Greiner, 2000).

Sample locations were derived by a variety of methods and are given in UTM, zone 11 coordinates (meters) relative to the North American datum of 1927 (NAD1927). For dataset URS-00, the locations were marked directly on 1:3000 scale prints of the DOQQs and subsequently digitized in ArcView 3.1. For dataset URS-01, sample locations were located using differential GPS instrumentation (URS Greiner, 2001). For dataset USGS-99, sample locations were digitized in ArcView from copies of the 1:24,000 US Geological Survey topographic maps used as field sheets (A. Horowitz, written communication, 2000; M. Beckwith, written communication, 2000). For dataset URS-99, sample locations were transferred by inspection from field sketches (URS Greiner, 2000) to the DOQQs in ArcView.

The surficial map unit from which each sample was taken is listed in [table 1](#). For those samples that we collected, the map unit was noted during sample collection. For all other samples the map unit was determined by plotting the sample locations on the surficial geologic map of [plates 1-8](#) in ArcView 3.1 (associated ArcView shapefile `srgeounits.shp` is available on our website at <http://geopubs.wr.usgs.gov/open-file/of02-xxx>).

Variations in sediment trace element geochemistry

The metal contents of the fine fractions of sediment samples from the map area are quite variable ([table 1](#)). To illustrate this variability, the lead (Pb) and zinc (Zn) contents (in parts per million [ppm] dry weight) of samples are plotted separately by map unit against downstream position in [figures 7 through 10](#). The grain size fraction of the sample that was analyzed is also indicated on the plots. The average Pb and Zn content of the fine fraction (the <175 micron fraction, and in some cases the <63 micron fraction) of each unit is illustrated in [figure 11](#), which also lists the percentage of samples by unit which have Pb contents greater than 700 ppm.

A comparison of the Pb and Zn content of samples upstream and downstream of Upriver Dam is given in [table 2](#).

The Pb contents of the finer fractions of the four coarse cobble gravel units are plotted against downstream position in [figure 7](#). The vertical axis of Pb content in [figures 7 and 8](#) is scaled in increments of 700 ppm because the human health risk assessment for the Spokane River in Washington (URS Greiner, 2000) used 700 ppm Pb in the fine fraction of sediment as the lower limit of concern. Pb contents of the fine fraction of silty cobble gravels (Qgcc3; [figure 7d](#)) are the highest of the cobble lithologies, with 61% of the less than 175 micron sample fractions having values above 700 ppm, with a mean concentration of 1021 ppm Pb. All but two of all the Spokane River sediment samples with Pb greater than 1400 ppm come from unit Qgcc3. This depositional unit is only present upstream of Sullivan Road (east of UTM East 486,000). By comparison the fine fraction of samples of the sandy cobble gravel unit (Qgcc2) have a mean concentration of 501 ppm Pb with 14% of the samples having values above 700 ppm ([figure 11](#)), all occurring upstream of Upriver dam. The average Pb and Zn content of samples of Qgcc2 downstream of Upriver Dam is 61-65% of samples upstream ([table 2](#)).

The Pb contents of the finer fractions of the four sand and pebble gravel units are plotted against downstream position in [figure 8](#). Of the samples sieved to less than 175 micron, none of the coarse pebble gravel unit (Qgpc) samples have Pb above 700 ppm (although two of the <63 micron samples do), while a few samples (12%) of the fine pebble gravel (Qgpf) do ([figure 11](#)). Only 2% of the channel flank sand beach samples (unit Qsc) have fine fraction Pb content greater than 700 ppm (mean = 378 ppm), while 25% of the floodplain sand (Qsf) fine fraction samples have Pb content greater than 700 ppm (mean = 512 ppm). Again all of the sand and pebble gravel samples with more than 700 ppm Pb were recovered upstream of Upriver dam. However for the channel flank beach sand unit (Qsc), Pb and Zn contents of samples downstream from Upriver dam are not significantly lower than those upstream of the dam (91-92% of the upstream values; [table 2](#)). The mean Pb content of the fine fractions of 11 samples of terrace sand, vertically above the level of historic sand deposition (and downstream of Upriver Dam), is 25 ppm.

The Zn contents of the finer fractions of the four coarse cobble gravel units and the four sand and pebble gravel units are plotted against downstream position in [figures 9 and 10](#), respectively. Zn contents of the finer fractions of the samples are considerably higher than Pb contents and range up to nearly 7000 ppm. All but a few samples with Zn greater than 2000 ppm were recovered from upstream of Upriver dam. Typically the fine fractions of the coarse cobble samples are higher in zinc than the fine fractions of the sand units ([figure 11](#)). By comparison the mean Zn content of the fine fractions of 12 samples of terrace sand, vertically above the level of historic sand deposition (and downstream of Upriver Dam), is 91 ppm.

Correlation of the Pb and Zn contents of the fine fractions of all the bed sediment samples is crude ([figure 12](#)). Also plotted on this diagram are samples of suspended sediment collected from the Spokane River during high flow conditions in May of 1997 (Box and others, in prep.). The compositions of these suspended sediment samples overlap with those of the higher Pb and Zn bed sediment samples. Much of the variation seen in [figure 12](#) could result from mixing of sediment with composition similar to the suspended sediment with sediment with low Pb and Zn (like the terrace sand samples). The spread of sample compositions that fall below that two-component trend would require an additional component with high Zn but low Pb contents.

Detrital mixing of varying proportions of three such components could explain the spread of Pb and Zn compositions of the bed sediment samples.

To test the utility of such a mixing scenario, a 3-component mixing model was developed and is illustrated in [figure 13](#) on a plot of Pb content against Zn/Pb ratio of the bed sediment samples. Three end-members (EM) are hypothesized: (1) a high Pb-high Zn end-member (EM1), similar to the most metal-enriched suspended sediment sample from spring of 1997 (Pb = 2500 ppm, Zn = 4000 ppm), (2) a low Pb-low Zn end-member (EM2), representative of background sediment exposed on the flanks of the Spokane River channel and similar to the mean of our analyses of Spokane River terrace sand (Pb = 25 ppm, Zn = 100 ppm), and (3) a high Zn-low Pb end-member (EM3), which, based on [figure 12](#), must have a Zn content of at least 7000 ppm and a low Pb content (50 ppm). The high Zn-low Pb end-member may represent metals precipitated or flocculated from the dissolved state in the river water or upstream lake, either inorganically or biologically mediated, as has been shown to occur in the lower Coeur d'Alene River (Paulson, 1996) and in Lake Coeur d'Alene (Laurie Balistrieri, written communication, 2001). On [figure 13](#) two example mixing lines of these three components are shown with the mixture percentages for several points noted along each line.

The compositional variation of the fine fraction of some of the surficial map units may be explained by their positions along these theoretical mixing lines. For instance, the fine fraction of the silty coarse cobble unit (Qgcc3: open circle symbol on [figure 13](#)), deposited during high-water in eddies along the high-water channel, has the highest percentage of the high-flow, suspended sediment end-member (ranging from 20-100%), which is metal-rich and derived primarily from the Coeur d'Alene River above Lake Coeur d'Alene (Box and others, in prep.). Conversely the fine fraction of the coarse cobble unit with little fines (Qgcc1: blackened circle symbol on [figure 13](#)), which generally occupies the lower elevation band just above the late summer, inundated low-flow channel, falls along two separate mixing lines on [figure 13](#): (1) a mixing line with a decreasing metal-rich, high-flow suspended sediment component (5-50%) and an increasing components of background sediment and of the high-Zn end-member, and (2) mixing between the background sediment end-member (70-100%) and the high Zn end-member, with less than 5% of the metal-rich high flow suspended sediment end-member. These two mixing trends may represent sedimentation of fines on and between the cobbles (1) during waning spring flows when detrital metal-rich fines are still traversing Lake Coeur d'Alene from input by the Coeur d'Alene River, and (2) during summer flows when little detrital sediment is input into the lake by the Coeur d'Alene River, and fine suspended sediment derived from biologic or inorganic flocculation of metals dissolved in the water is generated either in Lake Coeur d'Alene or in the Spokane River and mixes with detrital background sediment in the Spokane River.

Although the two metal-rich sediment components (EM-1 and EM-3) are hypothesized ultimately to arrive in the Spokane River via the outflow from Lake Coeur d'Alene, these components can be deposited and remobilized a number of times in and along the Spokane River channel before arriving in a particular sediment deposit. How much of the enriched metal component of any sediment sample was derived directly from suspended sediment exiting Lake Coeur d'Alene immediately prior to deposition versus from sediment previously deposited in the Spokane River channel is not known. It is presumed that repeated recycling leads to more thorough mixing of the 3 sediment components toward some average mixture. The median Pb and Zn contents of all the samples in [table 1](#) are 350 ppm Pb and 1400 ppm Zn, similar to the

median of the channel margin sand unit (Qsc) samples. This median point would be produced by the following mixture of the three end-members: % EM1-%EM2-%EM3= 13-75-12.

CONCLUSIONS

For most of its course from the Idaho stateline to its confluence with Latah Creek, the Spokane River channel is incised into a thick sequence of Pleistocene outburst flood gravels and flows over a bed of cobbles to boulders recycled from the Pleistocene deposits. Within this incised valley set in the broader Spokane valley, mappable, surficial lithological units underlie the active channel and floodplain and inactive Recent terraces. Metal concentrations in the fine fraction of sediments that are exposed in the active channel and floodplain are considerably higher than in sediments exposed on the inactive recent terraces (up to 100 times higher in Pb). The high metal concentrations are derived from metal-enriched sediment from historic mining and milling activities in the Coeur d'Alene drainage basin upstream (Grosbois et al, 2001).

Each Spokane River lithologic unit has a distinct range of metal contents. The highest Pb and Zn contents are found in a silty cobble gravel unit (Qgcc1), found only upstream of Sullivan Road; 61% of the samples have more than 700 ppm Pb, the level of concern in the Spokane River human health risk assessment (URS Greiner, 2000). In contrast the lowest Pb and Zn contents within the active floodplain are found in the channel margin beach sand unit (Qsc), with only 2% of the samples exceeding 700 ppm Pb. For most of the units, a weak trend of decreasing Pb and Zn content downstream versus upstream of Upriver dam is suggested by the plots of [figures 7-10](#). However for the unit with the most samples for comparison (Qsc), samples downstream of the dam average 91-92% of the Pb and Zn content of those upstream ([table 2](#)).

The variation in metal content in the Spokane River sediment samples can be modeled as resulting from the detrital mixing of 3 components: (1) metal-enriched suspended sediment derived from the Coeur d'Alene River basin after transiting Lake Coeur d'Alene, (2) erosion of sediments deposited before upstream mining from the banks of the Spokane River, and (3) biologically or inorganically flocculated sediment with metals precipitated from solution either in Lake Coeur d'Alene or the Spokane River. It is presumed that the composition of a particular sediment results both from recycling of previously deposited detrital mixtures, as well as from input of new end-member components.

DESCRIPTION OF MAP UNITS

UNCONSOLIDATED DEPOSITS

Rationale for division of surficial map units

On the surficial geologic map of plates 1 through 8, surficial deposits along the Spokane River are broadly divided into 3 categories: (1) deposits submerged within the low-flow channel (units beginning with “Qc-”), and (2) gravel and sand deposits above the low-flow channel that are within the active (last few hundred years) high-water floodway (units beginning with “Qg-” and “Qs-”, respectively), and (3) terrace deposits above the level of active flooding (units beginning with “Qt-”). Deposits within the submerged low-flow channel were not directly mapped but are subdivided based on whether the reach is pooled (“Qcp”) or is riffled (“Qcr”) or is inundated by damming (“Qci”). If boulders or cobbles are emergent across the low-flow channel, a “b” or a “c” is added to the pooled or riffled designation. Gravel deposits above the low-flow channel are designated “Qg-” and followed by modifying initials to denote clast size and variations in the fine fraction. Sand deposits are designated “Qs” and modified by their position relative to the sloping channel (“Qsc” for channel flank and “Qsf” for floodplain bench). Finally terrace deposits (generally capped by sand) are correlated with elevation above maximum flood level and numbered from lowest to highest (Qts1, Qts2, etc.). As is the convention with geologic map units, the first letter of the unit abbreviation (“Q”) indicates the age of the unit, which in this case is Quaternary.

Qsc Sand, sloping channel flank beach deposit Coarse to fine sand underlying a gently channelward sloping surface. Where separated from the low-flow channel by a coarse cobble unit, the surface may support grass, brush, or Ponderosa pines. Up to 50% of the surface area of unit may be coarse cobbles. Percentage of interstitial silt and finer material varies from 0 to 20%. Thickness is variable, but is generally less than 30 cm. A small portion of this map unit may not have been inundated since the onset of mining in the Coeur d’Alene mining district in 1886.

Qsf Sand, floodplain bench deposit Coarse to fine sand underlying a generally horizontal surface adjacent to the channelward sloping surface adjacent to the low-flow channel. Unit typically supports a growth of grass. Up to 50% of the surface area may consist of coarse cobbles. Percentage of interstitial silt and finer material varies from 0 to 20%. Thickness is variable, but is generally less than 30 cm. A small portion of this map unit may not have been inundated since the onset of mining in the Coeur d’Alene mining district in 1886.

Qgpf Gravel, fine pebble (2-20 mm) Fine pebble gravel forming bars or in sloping channel flank deposits. Commonly grades into or is intermixed with coarse pebble gravel. Percentage of interstitial silt and finer material varies from 0 to 10%. Channel flank deposits between Myrtle Pt. and Argonne St. and between Greene St. and Division St.

have 10-50% coarse cobble to boulders. Those particular deposits are localized just upstream of the low-flow slackwater pools behind the in-channel dams at Upriver dam and at Havermale Island, respectively, where backwater effects reduce current velocities during high flow.

- Qgpc Gravel, coarse pebble (20-64 mm)** Coarse pebble gravel forming bars or in sloping channel flank deposits. Commonly grades into or is intermixed with fine pebble gravel. Percentage of interstitial silt and finer material varies from 0 to 10%.
- Qgcf Gravel, fine cobble (64-125 mm)** Fine cobble gravel forming unvegetated bars in or along the low-flow channel. Moderately to well-sorted with <5% silt and finer material. In-channel bars of this unit near Myrtle Pt. are vegetated and probably inactive.
- Qgcc1 Gravel, coarse cobble and boulder (>125 mm), with little fines** Coarse cobble gravel and intermixed boulders with less than 15% of surface area covered by sand and finer sediment. This unit typically flanks the low-flow inundated channel.
- Qgcc2 Gravel, coarse cobble and boulder (>125 mm), with patches of sand** Coarse cobble gravel and intermixed boulders with greater than 15% but less than 50 % of the surface area covered by sand, which contains little (<10%?) silt and finer sediment. Identified in the field by the sandy character of the intercobble surface and by the lack of a “flag” of visible dust that settles slowly when a shovelful of dry sand is tossed in the air.
- Qgcc3 Gravel, coarse cobble and boulder (>125 mm), with patches of silt** Coarse cobble gravel and intermixed boulders with greater than 15% but less than 50 % surface area covered by sand, which contains a significant component (>10%) of silt and finer sediment. Identified in the field by the silty character of the intercobble surface and by the “flag” of visible dust that settles slowly when a shovelful of dry sand is tossed in the air. Only present upstream of Sullivan Road.
- Qcrc Cobble riffle in low-flow channel** Submerged cobble bar in low-flow channel over which the river gradient increases to form a riffle.
- Qcrb Boulder riffle in low-flow channel** Channel bed with emergent boulders occurring irregularly across a riffled reach of the low-flow channel.
- Qcpb Low-flow channel pool with emergent boulders** Channel bed with emergent boulders occurring irregularly across a pooled reach of the low-flow channel.
- Qcp Low-flow channel pool** Submerged channel bed in pooled (non-riffled) reaches of the low-flow channel, generally underlain by coarse cobble and boulder gravel with little interstitial sand and finer sediment.
- Qci Channel bed beneath impounded reservoirs** Submerged channel bed beneath the reservoir waters in impounded reaches of the channel behind dams across the Spokane River (as observed in low-flow periods). Impounding dams include Monroe Street

dam, Havermale Island dam, and Upriver dam. Character of bed sediment probably similar to that of Qcp but with more fines.

- Qcb Channel, scoured bedrock** High water channel bed underlain by scoured bedrock surface.
- Qts1 Sand and gravel deposits of the first (lowest) terrace** Coarse to fine sand overlying coarse cobbles and underlying a generally horizontal surface 5-10 feet above the active floodplain bench. Surface is typically covered by grass. Up to 50% of the surface area may consist of coarse cobbles. Percentage of interstitial silt and finer material in the surficial sand deposit varies from 0 to 20%. Sand thickness is variable, but is generally less than 30 cm.
- Qts2 Sand and gravel deposits of the second terrace** Coarse to fine sand overlying coarse cobbles and underlying a generally horizontal surface 15-25 feet above the active floodplain bench. Surface is typically covered by grass. Up to 50% of the surface area may consist of coarse cobbles. Percentage of interstitial silt and finer material in the surficial sand deposit varies from 0 to 20%. Sand thickness is variable, but is generally less than 30 cm.
- Qts3 Sand and gravel deposits of the third terrace** Coarse to fine sand overlying coarse cobbles and underlying a generally horizontal surface 40-50 feet above the active floodplain bench. Only present downstream of Spokane Falls. Surface is typically covered by grass. Up to 50% of the surface area may consist of coarse cobbles. Percentage of interstitial silt and finer material in the surficial sand deposit varies from 0 to 20%. Sand thickness is variable, but is generally less than 30 cm.
- Qaf Artificial fill rock** Artificially placed rock aggregate comprising road embankments, bridge abutments, and streambank riprap.

Acknowledgements

This work was partially funded by a cooperative agreement with the Washington Department of Ecology and by an interagency agreement with the Environmental Protection Agency. Discussions with John Roland of the Washington Department of Ecology were important in initiating this project and in refining the scope and approach of the study. Mary Jane Nearman of the Environmental Protection Agency is thanked for instigating an additional geochemical sampling program in coordination with our field work. Kara Steward and Jeff Franklin of URS Greiner, Inc. are thanked for their help and coordination in the field. We thank Arthur Horowitz and Mike Beckwith of the US Geological Survey for clarifications in response to our queries about their earlier geochemical sampling program.

REFERENCES

- Box, Stephen E., Bookstrom, Arthur A., and Ikramuddin, Mohammed, in preparation, Metal-enriched sediments mobilized by the floods of 1995, 1996, and 1997 in the Coeur d'Alene-Spokane River system, Idaho and Washington: U.S. Geological Survey Open-File Report.
- Groisbois, Cecile A., Horowitz, Arthur J., Smith, James J., and Elrick, Kent A., 2001, The effect of mining and related activities on the sediment-trace element geochemistry of Lake Coeur d'Alene, Idaho, U.S.A. – Part III: Downstream effects: The Spokane River basin: Hydrological Processes, vol. 15, no. 5, p. 855-875
- Johnson, Art, 1999, Metal concentrations in Spokane River sediments collected with USGS in 1998: Washington Dept. of Ecology Report 99-330, 16 p.
- Joseph, Nancy L., 1990, Geologic map of the Spokane 1:100,000 quadrangle, Washington-Idaho: Washington Division of Geology and Earth Resources Open File Report 90-17, 29 p.
- Long, Keith R., 1998, Production and disposal of mill tailings in the Coeur d'Alene mining region, Shoshone County, Idaho; Preliminary estimates: U.S. Geological Survey Open-File Report 98-595, 14 p.
- Molenaar, D., 1988, The Spokane Aquifer, Washington: Its geologic origin and water-bearing and water-quality characteristics: U.S. Geological Survey Water Supply Paper 2265, 74 p.
- O'Connor, Jim E., and Baker, Victor R., 1992, Magnitudes and implications of peak discharges from glacial Lake Missoula: Geological Society of America Bulletin, vol. 104, no. 3, p. 267-279.

- US Geological Survey, 1999, Geochemical analyses of Spokane River sediment samples: written communication from Arthur Horowitz to Environmental Protection Agency, Region X.
- URS Greiner, 2000, Draft Final Screening level human health risk assessment for nonresidential receptors, Spokane River, Washington: Coeur d'Alene basin RI/FS: consultant report URS DCN 4162500.5843.05.a to Environmental Protection Agency, Region X, 113 p.
- URS Greiner, 2001, Final Field sampling plan, addendum no. 18, Fall 2000 field screening of sediment in Spokane River depositional areas, summary of results (Revision 1): consultant report URS DCN 4162500.06116.05.a to Environmental Protection Agency, Region X, 61 p.
- Waite, Richard B., Jr., 1985, Case for periodic, colossal jokulhlaups from Pleistocene glacial Lake Missoula: Geological Society of America Bulletin, vol. 96, no. 10, p. 1271-1286.

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | DATASET | UTM27E | UTM27N | MAP_UNIT | Pb_ppm | Zn_ppm |
|-----------|-----------|---------|--------|---------|----------|--------|--------|
| SRG-37 | <2000 um | USGS-99 | 484785 | 5280161 | Qcp | 100 | 510 |
| SRG-38 | <2000 um | USGS-99 | 483855 | 5280508 | Qcp | 150 | 730 |
| SRG-39 | <2000 um | USGS-99 | 483482 | 5280786 | Qcp | 160 | 730 |
| SRG-40 | <2000 um | USGS-99 | 481653 | 5282490 | Qcp | 170 | 1200 |
| SRG-41 | <2000 um | USGS-99 | 479988 | 5281631 | Qcp | 350 | 900 |
| SRG-42 | <2000 um | USGS-99 | 477446 | 5282048 | Qci | 360 | 2300 |
| SRG-43 | <2000 um | USGS-99 | 476717 | 5282137 | Qci | 21 | 650 |
| SRG-44 | <2000 um | USGS-99 | 475482 | 5281092 | Qci | 200 | 970 |
| SRG-45 | <2000 um | USGS-99 | 475753 | 5281184 | Qci | 130 | 1200 |
| SRG-46 | <2000 um | USGS-99 | 471643 | 5280276 | Qcp | 110 | 800 |
| SRH-02 | <2000 um | USGS-99 | 491723 | 5280890 | Qgcc1 | 1200 | 1700 |
| SRH-03 | <2000 um | USGS-99 | 488532 | 5280365 | Qgcc1 | 420 | 1200 |
| SRH-04 | <2000 um | USGS-99 | 485311 | 5279750 | Qgcc1 | 200 | 870 |
| SRH-05 | <2000 um | USGS-99 | 496295 | 5282510 | Qgcc1 | 430 | 2800 |
| SRH-06 | <2000 um | USGS-99 | 466296 | 5277588 | Qgcc1 | 33 | 64 |
| SRH-14 | <2000 um | USGS-99 | 496145 | 5282487 | Qgcc1 | 210 | 960 |
| SRH-15 | <2000 um | USGS-99 | 495878 | 5282393 | Qgcc1 | 760 | 2000 |
| SRH-15a | <2000 um | USGS-99 | 495878 | 5282393 | Qgcc1 | 760 | 1900 |
| SRH-16 | <2000 um | USGS-99 | 494870 | 5281728 | Qgcc3 | 1500 | 2000 |
| SRH-17 | <2000 um | USGS-99 | 493021 | 5280832 | Qsc | 370 | 2000 |
| SRH-18 | <2000 um | USGS-99 | 491961 | 5280963 | Qsc | 250 | 1000 |
| SRH-19 | <2000 um | USGS-99 | 491830 | 5280976 | Qgcc1 | 500 | 1200 |
| SRH-20 | <2000 um | USGS-99 | 489648 | 5280760 | Qgcc1 | 460 | 1700 |
| SRH-21 | <2000 um | USGS-99 | 488609 | 5280275 | Qgpc | 410 | 1600 |
| SRH-21a | <2000 um | USGS-99 | 488609 | 5280275 | Qgpc | 1100 | 2700 |
| SRH-22 | <2000 um | USGS-99 | 488554 | 5280366 | Qgcc1 | 510 | 3200 |
| SRH-23 | <2000 um | USGS-99 | 486973 | 5280376 | Qgcc3 | 330 | 1300 |
| SRH-24 | <2000 um | USGS-99 | 486864 | 5280410 | Qgcc1 | 430 | 1600 |
| SRH-25 | <2000 um | USGS-99 | 485487 | 5279627 | Qgcc1 | 170 | 840 |
| SRH-26 | <2000 um | USGS-99 | 485349 | 5279729 | Qgcc1 | 150 | 730 |
| SRH-26a | <2000 um | USGS-99 | 485349 | 5279729 | Qgcc1 | 140 | 720 |
| SRH-27 | <2000 um | USGS-99 | 484655 | 5280255 | Qgcc1 | 200 | 990 |
| SRH-28 | <2000 um | USGS-99 | 483416 | 5280963 | Qgcc1 | 150 | 810 |
| SRH-29 | <2000 um | USGS-99 | 482410 | 5281855 | Qgcc1 | 370 | 1600 |
| SRH-30 | <2000 um | USGS-99 | 482174 | 5282192 | Qgcc1 | 230 | 750 |
| SRG-38 | <63 um | USGS-99 | 483855 | 5280508 | Qcp | 770 | 2400 |
| SRG-39 | <63 um | USGS-99 | 483482 | 5280786 | Qcp | 750 | 2800 |
| SRG-40 | <63 um | USGS-99 | 481653 | 5282490 | Qcp | 470 | 3600 |
| SRG-41 | <63 um | USGS-99 | 479988 | 5281631 | Qcp | 2200 | 5300 |
| SRG-42 | <63 um | USGS-99 | 477446 | 5282048 | Qci | 320 | 2100 |
| SRG-43 | <63 um | USGS-99 | 476717 | 5282137 | Qci | 36 | 1900 |
| SRG-44 | <63 um | USGS-99 | 475482 | 5281092 | Qci | 1100 | 3400 |
| SRG-45 | <63 um | USGS-99 | 475753 | 5281184 | Qci | 460 | 2800 |
| SRG-46 | <63 um | USGS-99 | 471643 | 5280276 | Qcp | 550 | 3000 |
| SRH-02 | <63 um | USGS-99 | 491723 | 5280890 | Qgcc1 | 2900 | 4800 |
| SRH-03 | <63 um | USGS-99 | 488532 | 5280365 | Qgcc1 | 1300 | 3400 |
| SRH-04 | <63 um | USGS-99 | 485311 | 5279750 | Qgcc1 | 1100 | 3200 |
| SRH-05 | <63 um | USGS-99 | 496295 | 5282510 | Qgcc1 | 540 | 6400 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | DATASET | UTM27E | UTM27N | MAP_UNIT | Pb_ppm | Zn_ppm |
|------------|-----------|---------|--------|---------|----------|--------|--------|
| SRH-06 | <63 um | USGS-99 | 466296 | 5277588 | Qgcc1 | 30 | 100 |
| SRH-14 | <63 um | USGS-99 | 496145 | 5282487 | Qgcc1 | 690 | 2100 |
| SRH-15 | <63 um | USGS-99 | 495878 | 5282393 | Qgcc1 | 690 | 1800 |
| SRH-15a | <63 um | USGS-99 | 495878 | 5282393 | Qgcc1 | 650 | 1700 |
| SRH-16 | <63 um | USGS-99 | 494870 | 5281728 | Qgcc3 | 3500 | 4200 |
| SRH-17 | <63 um | USGS-99 | 493021 | 5280832 | Qsc | 1100 | 5500 |
| SRH-18 | <63 um | USGS-99 | 491961 | 5280963 | Qsc | 930 | 2300 |
| SRH-19 | <63 um | USGS-99 | 491830 | 5280976 | Qgcc1 | 1300 | 2800 |
| SRH-20 | <63 um | USGS-99 | 489648 | 5280760 | Qgcc1 | 580 | 2200 |
| SRH-21 | <63 um | USGS-99 | 488609 | 5280275 | Qgpc | 720 | 2700 |
| SRH-21a | <63 um | USGS-99 | 488609 | 5280275 | Qgpc | 1400 | |
| SRH-22 | <63 um | USGS-99 | 488554 | 5280366 | Qgcc1 | 830 | 3100 |
| SRH-23 | <63 um | USGS-99 | 486973 | 5280376 | Qgcc3 | 530 | 1600 |
| SRH-24 | <63 um | USGS-99 | 486864 | 5280410 | Qgcc1 | 1040 | 3800 |
| SRH-25 | <63 um | USGS-99 | 485487 | 5279627 | Qgcc1 | 770 | 2600 |
| SRH-26 | <63 um | USGS-99 | 485349 | 5279729 | Qgcc1 | 700 | 3600 |
| SRH-26a | <63 um | USGS-99 | 485349 | 5279729 | Qgcc1 | 730 | 3300 |
| SRH-27 | <63 um | USGS-99 | 484655 | 5280255 | Qgcc1 | 730 | 2700 |
| SRH-28 | <63 um | USGS-99 | 483416 | 5280963 | Qgcc1 | 820 | 3000 |
| SRH-29 | <63 um | USGS-99 | 482410 | 5281855 | Qgcc1 | 770 | 3200 |
| SRH-30 | <63 um | USGS-99 | 482174 | 5282192 | Qgcc1 | 930 | 2200 |
| CUA201-101 | <175 um | URS-99 | 494946 | 5281710 | Qgcc3 | 719 | 2190 |
| CUA201-102 | <175 um | URS-99 | 494901 | 5281661 | Qgcc1 | 1310 | 2420 |
| CUA201-103 | <175 um | URS-99 | 494964 | 5281755 | Qgcc3 | 2360 | 3230 |
| CUA201-104 | <175 um | URS-99 | 494885 | 5281710 | Qgcc3 | 656 | 2040 |
| CUA201-105 | <175 um | URS-99 | 494954 | 5281782 | Qgcc3 | 2350 | 3320 |
| CUA201-106 | <175 um | URS-99 | 494909 | 5281725 | Qgcc3 | 867 | 2490 |
| CUA201-107 | <175 um | URS-99 | 494931 | 5281760 | Qgcc3 | 1590 | 3270 |
| CUA202-101 | <175 um | URS-99 | 491640 | 5280884 | Qgcc1 | 479 | 2020 |
| CUA202-102 | <175 um | URS-99 | 491648 | 5280889 | Qgcc1 | 328 | 1880 |
| CUA202-103 | <175 um | URS-99 | 491647 | 5280897 | Qgcc1 | 484 | 2340 |
| CUA202-104 | <175 um | URS-99 | 491647 | 5280904 | Qgpf | 379 | 2090 |
| CUA202-105 | <175 um | URS-99 | 491647 | 5280911 | Qgpf | 503 | 2140 |
| CUA202-106 | <175 um | URS-99 | 491647 | 5280918 | Qgpf | 534 | 2480 |
| CUA202-107 | <175 um | URS-99 | 491647 | 5280924 | Qgpf | 261 | 1430 |
| CUA203-101 | <175 um | URS-99 | 491690 | 5280805 | Qgcc1 | 1070 | 2640 |
| CUA203-102 | <175 um | URS-99 | 491690 | 5280799 | Qsc | 234 | 2180 |
| CUA203-103 | <175 um | URS-99 | 491690 | 5280795 | Qsc | 146 | 1570 |
| CUA203-104 | <175 um | URS-99 | 491690 | 5280791 | Qsc | 154 | 1180 |
| CUA203-105 | <175 um | URS-99 | 491690 | 5280788 | Qsc | 306 | 1770 |
| CUA203-106 | <175 um | URS-99 | 491690 | 5280784 | Qsc | 326 | 1360 |
| CUA203-107 | <175 um | URS-99 | 491690 | 5280780 | Qsc | 335 | 1500 |
| CUA204-101 | <175 um | URS-99 | 488531 | 5280368 | Qgcc1 | 116 | 1990 |
| CUA204-102 | <175 um | URS-99 | 488537 | 5280378 | Qgcc1 | 106 | 1360 |
| CUA204-103 | <175 um | URS-99 | 488546 | 5280380 | Qgcc2 | 822 | 2590 |
| CUA204-104 | <175 um | URS-99 | 488552 | 5280377 | Qgcc2 | 647 | 2610 |
| CUA204-105 | <175 um | URS-99 | 488557 | 5280375 | Qgcc2 | 714 | 2490 |
| CUA204-106 | <175 um | URS-99 | 488562 | 5280373 | Qgcc2 | 537 | 3470 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | DATASET | UTM27E | UTM27N | MAP_UNIT | Pb_ppm | Zn_ppm |
|------------|-----------|---------|--------|---------|----------|--------|--------|
| CUA204-107 | <175 um | URS-99 | 488563 | 5280356 | Qgcc1 | 404 | 4880 |
| CUA205-101 | <175 um | URS-99 | 486920 | 5280371 | Qgcc1 | 799 | 2440 |
| CUA205-102 | <175 um | URS-99 | 486920 | 5280369 | Qgpf | 529 | 4020 |
| CUA205-103 | <175 um | URS-99 | 486920 | 5280367 | Qgpf | 771 | 4450 |
| CUA205-104 | <175 um | URS-99 | 486920 | 5280365 | Qgpf | 531 | 3860 |
| CUA205-105 | <175 um | URS-99 | 486919 | 5280363 | Qgpf | 1040 | 2930 |
| CUA205-106 | <175 um | URS-99 | 486920 | 5280360 | Qgpf | 498 | 3030 |
| CUA205-107 | <175 um | URS-99 | 486919 | 5280358 | Qgpf | 772 | 2990 |
| CUA206-101 | <175 um | URS-99 | 481805 | 5282567 | Qgcc1 | 88 | 266 |
| CUA206-102 | <175 um | URS-99 | 481801 | 5282559 | Qgcc1 | 73 | 365 |
| CUA206-103 | <175 um | URS-99 | 481813 | 5282556 | Qgcc1 | 173 | 592 |
| CUA206-104 | <175 um | URS-99 | 481810 | 5282563 | Qgcc1 | 174 | 614 |
| CUA206-105 | <175 um | URS-99 | 481814 | 5282563 | Qgcc1 | 98 | 228 |
| CUA206-106 | <175 um | URS-99 | 481801 | 5282565 | Qgcc1 | 34 | 119 |
| CUA206-107 | <175 um | URS-99 | 481809 | 5282560 | Qgcc1 | 112 | 254 |
| CUA208-101 | <175 um | URS-99 | 476892 | 5282168 | Qts2 | 30 | 100 |
| CUA208-102 | <175 um | URS-99 | 476891 | 5282170 | Qts2 | 25 | 74 |
| CUA208-103 | <175 um | URS-99 | 476890 | 5282173 | Qts2 | 25 | 88 |
| CUA208-104 | <175 um | URS-99 | 476888 | 5282176 | Qts2 | 55 | 172 |
| CUA208-105 | <175 um | URS-99 | 476887 | 5282179 | Qts2 | 40 | 82 |
| CUA208-106 | <175 um | URS-99 | 476886 | 5282182 | Qts2 | 18 | 51 |
| CUA208-107 | <175 um | URS-99 | 476885 | 5282184 | Qts2 | 21 | 49 |
| CUA209-101 | <175 um | URS-99 | 465731 | 5278318 | Qgcc1 | 15 | 69 |
| CUA209-102 | <175 um | URS-99 | 465725 | 5278326 | Qts1 | 15 | 78 |
| CUA209-103 | <175 um | URS-99 | 465726 | 5278321 | Qts1 | 19 | 91 |
| CUA209-104 | <175 um | URS-99 | 465735 | 5278324 | Qgcc1 | 13 | 78 |
| CUA209-105 | <175 um | URS-99 | 465716 | 5278334 | Qts1 | 16 | 78 |
| CUA209-106 | <175 um | URS-99 | 465736 | 5278315 | Qgcc1 | 27 | 142 |
| CUA209-107 | <175 um | URS-99 | 465710 | 5278332 | Qts1 | 13 | 66 |
| JR1 | <500 um | URS-00 | 495294 | 5281740 | Qgcc1 | -39 | 224 |
| JR2 | <500 um | URS-00 | 495310 | 5281777 | Qsf | 500 | 1600 |
| JW01 | <500 um | URS-00 | 495605 | 5282056 | Qsf | 444 | 1510 |
| JW02 | <500 um | URS-00 | 495555 | 5282048 | Qsf | -63 | 106 |
| JW03 | <500 um | URS-00 | 495316 | 5281820 | Qsf | 282 | 944 |
| JW04 | <500 um | URS-00 | 494247 | 5281484 | Qts2 | 61 | 126 |
| JW06 | <500 um | URS-00 | 488722 | 5280360 | Qgcc2 | 426 | 1600 |
| JW07 | <500 um | URS-00 | 488793 | 5280398 | Qts1 | -54 | 628 |
| JW09 | <500 um | URS-00 | 487268 | 5280467 | Qsc | 188 | 680 |
| JW10 | <500 um | URS-00 | 495276 | 5281807 | Qsf | 122 | 1580 |
| JW11 | <500 um | URS-00 | 495751 | 5282237 | Qsf | 77 | -78 |
| JW12 | <500 um | URS-00 | 486399 | 5279593 | Qsf | 173 | 444 |
| JW13 | <500 um | URS-00 | 486191 | 5279462 | Qsf | 101 | 532 |
| JW14 | <500 um | URS-00 | 486172 | 5279479 | Qsf | -62 | 253 |
| JW15 | <500 um | URS-00 | 486449 | 5279956 | Qgcc1 | 182 | 682 |
| JW16 | <500 um | URS-00 | 486431 | 5279964 | Qsf | 122 | 405 |
| JW17 | <500 um | URS-00 | 486425 | 5279979 | Qsf | 281 | 556 |
| JW18 | <500 um | URS-00 | 486414 | 5279986 | Qsf | -59 | 71 |
| JW19 | <500 um | URS-00 | 486194 | 5279449 | Qsf | -58 | 238 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | DATASET | UTM27E | UTM27N | MAP_UNIT | Pb_ppm | Zn_ppm |
|--------------|-----------|---------|--------|---------|----------|--------|--------|
| JW20 | <500 um | URS-00 | 484263 | 5280403 | Qsf | -62 | 170 |
| JW21 | <500 um | URS-00 | 481832 | 5282445 | Qsc | 492 | 1560 |
| JW22 | <500 um | URS-00 | 481669 | 5282429 | Qgpf | 85 | 437 |
| JW23 | <500 um | URS-00 | 481502 | 5282061 | Qsc | 480 | 1310 |
| JW24 | <500 um | URS-00 | 481343 | 5282004 | Qgpf | -60 | 595 |
| JW25 | <500 um | URS-00 | 481284 | 5281932 | Qgpf | 74 | 374 |
| JW26 | <500 um | URS-00 | 480200 | 5281612 | Qsf | 159 | 700 |
| JW27 | <500 um | URS-00 | 480120 | 5281629 | Qsf | 502 | 1440 |
| JW28 | <500 um | URS-00 | 480523 | 5281752 | Qsf | 114 | 728 |
| JW29 | <500 um | URS-00 | 480095 | 5281678 | Qgpf | 537 | 2000 |
| JW30 | <500 um | URS-00 | 480015 | 5281662 | Qgpf | 528 | 1830 |
| JW31 | <500 um | URS-00 | 474974 | 5280719 | Qgcc1 | 99 | 458 |
| JW32 | <500 um | URS-00 | 474751 | 5280482 | Qsc | 383 | 1890 |
| JW33 | <500 um | URS-00 | 473874 | 5280192 | Qsc | 372 | 1520 |
| JW34 | <500 um | URS-00 | 473071 | 5280302 | Qsc | 91 | 665 |
| JW35 | <500 um | URS-00 | 472174 | 5280548 | Qgpf | 109 | 866 |
| JW36 | <500 um | URS-00 | 471680 | 5280343 | Qgpf | 132 | 1050 |
| JW37 | <500 um | URS-00 | 471014 | 5279657 | Qsc | 120 | 847 |
| JW38 | <500 um | URS-00 | 470784 | 5279114 | Qgpf | 158 | 992 |
| JW39 | <500 um | URS-00 | 471456 | 5280187 | Qgpf | 107 | 769 |
| JW40 | <500 um | URS-00 | 471739 | 5280303 | Qgpf | 229 | 1150 |
| JW41 | <500 um | URS-00 | 472258 | 5280490 | Qgpf | 147 | 748 |
| JW42 | <500 um | URS-00 | 473448 | 5280157 | Qgcc2 | 206 | 981 |
| JW43 | <500 um | URS-00 | 466845 | 5278337 | Qsc | -58 | 930 |
| JW44 | <500 um | URS-00 | 467401 | 5278441 | Qsc | 78 | 298 |
| JW45 | <500 um | URS-00 | 467120 | 5278329 | Qsc | 99 | 848 |
| JW46 | <500 um | URS-00 | 466365 | 5278285 | Qgcc2 | 148 | 712 |
| JW48 | <500 um | URS-00 | 496215 | 5282573 | Qgcc3 | 504 | 1760 |
| JW49 | <500 um | URS-00 | 496234 | 5282567 | Qsc | 182 | 1000 |
| JW50 | <500 um | URS-00 | 465839 | 5279957 | Qsc | -67 | 252 |
| SB7B 130-165 | <500 um | URS-00 | 495291 | 5281747 | Qgpc | 163 | 690 |
| SB7B 165-200 | <500 um | URS-00 | 495291 | 5281747 | Qgpc | -43 | 278 |
| CUA203-01 | <175 um | URS-01 | 491647 | 5280754 | Qsc | 535 | 1990 |
| CUA203-01 | <175 um | URS-01 | 491647 | 5280754 | Qsc | 513 | 2100 |
| CUA203-02 | <175 um | URS-01 | 491624 | 5280748 | Qsc | 210 | 491 |
| CUA203-03 | <175 um | URS-01 | 491675 | 5280785 | Qsc | 433 | 2770 |
| CUA203-04 | <175 um | URS-01 | 491629 | 5280767 | Qgcc1 | 580 | 2210 |
| CUA203-05 | <175 um | URS-01 | 491690 | 5280789 | Qsc | 91 | 834 |
| CUA203-06 | <175 um | URS-01 | 491611 | 5280736 | Qsc | 161 | 718 |
| CUA203-07 | <175 um | URS-01 | 491668 | 5280771 | Qsc | 489 | 1300 |
| CUA204-01 | <175 um | URS-01 | 488559 | 5280364 | Qgcc1 | 77 | 4850 |
| CUA204-02 | <175 um | URS-01 | 488561 | 5280369 | Qgcc2 | 570 | 3190 |
| CUA204-03 | <175 um | URS-01 | 488549 | 5280370 | Qgcc1 | 137 | 3420 |
| CUA204-04 | <175 um | URS-01 | 488540 | 5280376 | Qgcc1 | 501 | 2210 |
| CUA204-05 | <175 um | URS-01 | 488547 | 5280382 | Qgcc2 | 377 | 1310 |
| CUA204-06 | <175 um | URS-01 | 488531 | 5280381 | Qgcc1 | 159 | 1240 |
| CUA204-07 | <175 um | URS-01 | 488557 | 5280372 | Qgcc2 | 463 | 1870 |
| DA01-01 | <175 um | URS-01 | 496930 | 5282436 | Qsc | -56 | 2730 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | DATASET | UTM27E | UTM27N | MAP_UNIT | Pb_ppm | Zn_ppm |
|------------|-----------|---------|--------|---------|----------|--------|--------|
| DA01-02 | <175 um | URS-01 | 496923 | 5282442 | Qsc | 339 | 1860 |
| DA01-03 | <175 um | URS-01 | 496913 | 5282458 | Qsc | 123 | 5480 |
| DA01-04 | <175 um | URS-01 | 496912 | 5282440 | Qsc | 205 | 955 |
| DA01-05 | <175 um | URS-01 | 496923 | 5282444 | Qsc | 230 | 2020 |
| DA01-05 | <175 um | URS-01 | 496923 | 5282444 | Qsc | 300 | 2040 |
| DA01-06 | <175 um | URS-01 | 496911 | 5282437 | Qsc | 201 | 748 |
| DA01-07 | <175 um | URS-01 | 496907 | 5282448 | Qsc | 393 | 1440 |
| DA03-01 | <175 um | URS-01 | 496217 | 5282566 | Qgcc3 | 546 | 1490 |
| DA03-02 | <175 um | URS-01 | 496224 | 5282565 | Qgcc3 | 744 | 1990 |
| DA03-03 | <175 um | URS-01 | 496236 | 5282567 | Qsc | 396 | 1440 |
| DA03-04 | <175 um | URS-01 | 496215 | 5282574 | Qgcc3 | 506 | 1910 |
| DA03-05 | <175 um | URS-01 | 496231 | 5282567 | Qsc | 410 | 1980 |
| DA03-06 | <175 um | URS-01 | 496223 | 5282570 | Qsc | 417 | 1810 |
| DA03-06 | <175 um | URS-01 | 496223 | 5282570 | Qsc | 369 | 1790 |
| DA03-07 | <175 um | URS-01 | 496225 | 5282578 | Qsc | 312 | 1460 |
| DA04-01 | <175 um | URS-01 | 495485 | 5281945 | Qsc | -46 | 155 |
| DA04-02 | <175 um | URS-01 | 495494 | 5281942 | Qsc | -50 | 180 |
| DA04-03 | <175 um | URS-01 | 495501 | 5281961 | Qsc | 168 | 805 |
| DA04-03 | <175 um | URS-01 | 495501 | 5281961 | Qsc | 168 | 786 |
| DA04-04 | <175 um | URS-01 | 495503 | 5281952 | Qsc | -44 | 147 |
| DA04-05 | <175 um | URS-01 | 495493 | 5281953 | Qsc | 46 | 143 |
| DA04-06 | <175 um | URS-01 | 495488 | 5281954 | Qsc | 105 | 624 |
| DA04-07 | <175 um | URS-01 | 495484 | 5281949 | Qsc | 102 | 468 |
| DA05 0-2 | <175 um | URS-01 | 495498 | 5281910 | Qsc | 191 | 631 |
| DA05 11-14 | <175 um | URS-01 | 495498 | 5281910 | Qsc | -43 | 455 |
| DA05 14-17 | <175 um | URS-01 | 495498 | 5281910 | Qsc | -43 | 437 |
| DA05 24-27 | <175 um | URS-01 | 495498 | 5281910 | Qsc | -43 | 244 |
| DA05 4-7 | <175 um | URS-01 | 495498 | 5281910 | Qsc | 536 | 1320 |
| DA06-01 | <175 um | URS-01 | 495275 | 5281830 | Qsf | 751 | 1740 |
| DA06-02 | <175 um | URS-01 | 495276 | 5281828 | Qsf | 938 | 4580 |
| DA06-03 | <175 um | URS-01 | 495276 | 5281826 | Qsf | 652 | 1710 |
| DA06-04 | <175 um | URS-01 | 495278 | 5281828 | Qsf | 1030 | 2310 |
| DA06-05 | <175 um | URS-01 | 495267 | 5281826 | Qsf | 517 | 1660 |
| DA06-06 | <175 um | URS-01 | 495279 | 5281827 | Qsf | 690 | 1730 |
| DA06-06 | <175 um | URS-01 | 495279 | 5281827 | Qsf | 704 | 1680 |
| DA06-07 | <175 um | URS-01 | 495273 | 5281826 | Qsf | 730 | 2150 |
| DA07 0-3 | <175 um | URS-01 | 495274 | 5281803 | Qsf | 440 | 1660 |
| DA07 19-23 | <175 um | URS-01 | 495274 | 5281803 | Qsf | 241 | 2620 |
| DA07 23-40 | <175 um | URS-01 | 495274 | 5281803 | Qsf | 56 | 842 |
| DA07 48-73 | <175 um | URS-01 | 495274 | 5281803 | Qsf | -45 | 273 |
| DA07 5-8 | <175 um | URS-01 | 495274 | 5281803 | Qsf | 2280 | 4210 |
| DA07 70-98 | <175 um | URS-01 | 495274 | 5281803 | Qsf | -45 | 258 |
| DA08-01 | <175 um | URS-01 | 495238 | 5281833 | Qgpc | 304 | 1120 |
| DA08-01 | <175 um | URS-01 | 495238 | 5281833 | Qgpc | 265 | 1120 |
| DA08-02 | <175 um | URS-01 | 495232 | 5281815 | Qgpc | 312 | 1180 |
| DA08-03 | <175 um | URS-01 | 495235 | 5281803 | Qgpc | 293 | 1080 |
| DA08-04 | <175 um | URS-01 | 495235 | 5281789 | Qgpc | 376 | 1430 |
| DA08-05 | <175 um | URS-01 | 495232 | 5281776 | Qgpc | 268 | 1050 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | DATASET | UTM27E | UTM27N | MAP_UNIT | Pb_ppm | Zn_ppm |
|-----------|-----------|---------|--------|---------|----------|--------|--------|
| DA08-06 | <175 um | URS-01 | 495235 | 5281758 | Qgpc | 279 | 1120 |
| DA08-07 | <175 um | URS-01 | 495242 | 5281763 | Qgpc | 533 | 1890 |
| DA09-01 | <175 um | URS-01 | 494303 | 5281450 | Qgcc2 | 445 | 1740 |
| DA09-02 | <175 um | URS-01 | 494294 | 5281450 | Qgcc2 | 526 | 1650 |
| DA09-03 | <175 um | URS-01 | 494294 | 5281465 | Qgcc2 | 586 | 1920 |
| DA09-04 | <175 um | URS-01 | 494298 | 5281458 | Qgcc2 | 502 | 1490 |
| DA09-04 | <175 um | URS-01 | 494298 | 5281458 | Qgcc2 | 499 | 1510 |
| DA09-05 | <175 um | URS-01 | 494315 | 5281454 | Qgcc1 | 381 | 3660 |
| DA09-06 | <175 um | URS-01 | 494285 | 5281460 | Qgcc2 | 700 | 1730 |
| DA09-07 | <175 um | URS-01 | 494305 | 5281461 | Qgcc2 | 656 | 2000 |
| DA10-01 | <175 um | URS-01 | 494083 | 5281261 | Qgcc3 | 1810 | 3540 |
| DA10-02 | <175 um | URS-01 | 494059 | 5281268 | Qgcc3 | 626 | 1570 |
| DA10-03 | <175 um | URS-01 | 494024 | 5281237 | Qgcc3 | 861 | 2410 |
| DA10-03 | <175 um | URS-01 | 494024 | 5281237 | Qgcc3 | 762 | 2390 |
| DA10-04 | <175 um | URS-01 | 494098 | 5281265 | Qgcc3 | 956 | 2340 |
| DA10-05 | <175 um | URS-01 | 494087 | 5281292 | Qgcc3 | 903 | 1940 |
| DA10-06 | <175 um | URS-01 | 494062 | 5281242 | Qgcc3 | 1530 | 3130 |
| DA10-07 | <175 um | URS-01 | 494075 | 5281242 | Qgcc3 | 1290 | 2640 |
| DA12-01 | <175 um | URS-01 | 492480 | 5280986 | Qgcc3 | 385 | 1420 |
| DA12-02 | <175 um | URS-01 | 492481 | 5280985 | Qgcc3 | 534 | 2500 |
| DA12-03 | <175 um | URS-01 | 492474 | 5280988 | Qgcc3 | 561 | 1590 |
| DA12-03 | <175 um | URS-01 | 492474 | 5280988 | Qgcc3 | 592 | 1590 |
| DA12-04 | <175 um | URS-01 | 492484 | 5280988 | Qgcc3 | 1950 | 3960 |
| DA12-05 | <175 um | URS-01 | 492469 | 5280984 | Qsc | 430 | 2010 |
| DA12-06 | <175 um | URS-01 | 492480 | 5280977 | Qsc | 580 | 2570 |
| DA12-07 | <175 um | URS-01 | 492472 | 5280982 | Qsc | 451 | 1750 |
| DA12-08 | <175 um | URS-01 | 492481 | 5280986 | Qgcc3 | 352 | 1520 |
| DA12-09 | <175 um | URS-01 | 492474 | 5280981 | Qsc | 269 | 1220 |
| DA12-10 | <175 um | URS-01 | 492468 | 5280975 | Qsc | 467 | 1430 |
| DA12-11 | <175 um | URS-01 | 492466 | 5280969 | Qsc | 166 | 942 |
| DA12-12 | <175 um | URS-01 | 492462 | 5280961 | Qts1 | 201 | 774 |
| DA12-13 | <175 um | URS-01 | 492460 | 5280954 | Qts1 | -64 | 167 |
| DA12-14 | <175 um | URS-01 | 492457 | 5280945 | Qts1 | -63 | -60 |
| DA15-01 | <175 um | URS-01 | 488375 | 5280349 | Qgpf | 286 | 1760 |
| DA15-02 | <175 um | URS-01 | 488395 | 5280337 | Qgpf | 446 | 1480 |
| DA15-03 | <175 um | URS-01 | 488374 | 5280342 | Qgpf | 114 | 510 |
| DA15-04 | <175 um | URS-01 | 488361 | 5280355 | Qgpf | 279 | 1110 |
| DA15-04 | <175 um | URS-01 | 488361 | 5280355 | Qgpf | 247 | 1070 |
| DA15-05 | <175 um | URS-01 | 488392 | 5280334 | Qgpf | 167 | 885 |
| DA15-06 | <175 um | URS-01 | 488366 | 5280356 | Qgpf | 260 | 1010 |
| DA15-07 | <175 um | URS-01 | 488390 | 5280339 | Qgpf | 368 | 1590 |
| DA16-01 | <175 um | URS-01 | 488621 | 5280273 | Qgpc | 170 | 679 |
| DA16-02 | <175 um | URS-01 | 488604 | 5280276 | Qgpc | 252 | 1080 |
| DA16-03 | <175 um | URS-01 | 488625 | 5280277 | Qgcc1 | 1310 | 3810 |
| DA16-04 | <175 um | URS-01 | 488598 | 5280272 | Qgpc | 289 | 2840 |
| DA16-05 | <175 um | URS-01 | 488612 | 5280272 | Qgpc | 297 | 1200 |
| DA16-05 | <175 um | URS-01 | 488612 | 5280272 | Qgpc | 243 | 1180 |
| DA16-06 | <175 um | URS-01 | 488618 | 5280276 | Qgpc | 102 | 984 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | DATASET | UTM27E | UTM27N | MAP_UNIT | Pb_ppm | Zn_ppm |
|-----------|-----------|---------|--------|---------|----------|--------|--------|
| DA16-07 | <175 um | URS-01 | 488599 | 5280276 | Qgpc | 69 | 818 |
| DA17-01 | <175 um | URS-01 | 486189 | 5279469 | Qsf | 129 | 541 |
| DA17-02 | <175 um | URS-01 | 486184 | 5279457 | Qsf | 216 | 948 |
| DA17-03 | <175 um | URS-01 | 486181 | 5279483 | Qsf | -52 | 162 |
| DA17-04 | <175 um | URS-01 | 486176 | 5279503 | Qgcc1 | 730 | 3730 |
| DA17-05 | <175 um | URS-01 | 486164 | 5279486 | Qsf | 137 | 1050 |
| DA17-06 | <175 um | URS-01 | 486181 | 5279472 | Qsf | 119 | 470 |
| DA17-07 | <175 um | URS-01 | 486171 | 5279457 | Qsf | 93 | 252 |
| DA17-07 | <175 um | URS-01 | 486171 | 5279457 | Qsf | 68 | 182 |
| DA17-08 | <175 um | URS-01 | 486171 | 5279501 | Qgcc1 | 138 | 989 |
| DA17-09 | <175 um | URS-01 | 486173 | 5279483 | Qsf | 79 | 855 |
| DA17-10 | <175 um | URS-01 | 486175 | 5279476 | Qsf | 114 | 411 |
| DA17-11 | <175 um | URS-01 | 486176 | 5279470 | Qsf | -59 | 299 |
| DA17-12 | <175 um | URS-01 | 486177 | 5279464 | Qsf | -57 | 193 |
| DA17-13 | <175 um | URS-01 | 486180 | 5279458 | Qsf | -62 | 146 |
| DA17-14 | <175 um | URS-01 | 486181 | 5279451 | Qsf | 132 | 262 |
| DA18-01 | <175 um | URS-01 | 484971 | 5280020 | Qsc | 95 | 418 |
| DA18-02 | <175 um | URS-01 | 484961 | 5280021 | Qsc | 479 | 2030 |
| DA18-03 | <175 um | URS-01 | 484962 | 5280026 | Qsc | 361 | 1920 |
| DA18-03 | <175 um | URS-01 | 484962 | 5280026 | Qsc | 348 | 1880 |
| DA18-04 | <175 um | URS-01 | 484961 | 5280005 | Qsc | 144 | 1090 |
| DA18-05 | <175 um | URS-01 | 484972 | 5280006 | Qsc | 358 | 1610 |
| DA18-06 | <175 um | URS-01 | 484963 | 5280008 | Qsc | 398 | 1920 |
| DA18-07 | <175 um | URS-01 | 484951 | 5280024 | Qsc | 246 | 1240 |
| DA20-01 | <175 um | URS-01 | 483427 | 5280750 | Qsc | 175 | 859 |
| DA20-02 | <175 um | URS-01 | 483432 | 5280749 | Qsc | 343 | 964 |
| DA20-03 | <175 um | URS-01 | 483431 | 5280744 | Qsc | 296 | 1110 |
| DA20-04 | <175 um | URS-01 | 483432 | 5280752 | Qsc | 362 | 1460 |
| DA20-05 | <175 um | URS-01 | 483430 | 5280751 | Qsc | 239 | 1000 |
| DA20-06 | <175 um | URS-01 | 483428 | 5280755 | Qsc | 168 | 941 |
| DA20-07 | <175 um | URS-01 | 483425 | 5280757 | Qsc | 156 | 578 |
| DA20-07 | <175 um | URS-01 | 483425 | 5280757 | Qsc | 162 | 552 |
| DA21-01 | <175 um | URS-01 | 481827 | 5282445 | Qsc | 479 | 1620 |
| DA21-02 | <175 um | URS-01 | 481826 | 5282442 | Qsc | 696 | 2020 |
| DA21-03 | <175 um | URS-01 | 481826 | 5282444 | Qsc | 451 | 1750 |
| DA21-04 | <175 um | URS-01 | 481832 | 5282448 | Qsc | 642 | 1970 |
| DA21-05 | <175 um | URS-01 | 481832 | 5282446 | Qsc | 774 | 2080 |
| DA21-06 | <175 um | URS-01 | 481826 | 5282446 | Qsc | 411 | 1520 |
| DA21-07 | <175 um | URS-01 | 481830 | 5282445 | Qsc | 552 | 1770 |
| DA21-07 | <175 um | URS-01 | 481830 | 5282445 | Qsc | 522 | 1780 |
| DA23-01 | <175 um | URS-01 | 481539 | 5282101 | Qsc | 423 | 1770 |
| DA23-02 | <175 um | URS-01 | 481520 | 5282062 | Qsc | 416 | 1270 |
| DA23-03 | <175 um | URS-01 | 481534 | 5282077 | Qsc | 489 | 1740 |
| DA23-04 | <175 um | URS-01 | 481501 | 5282063 | Qsc | 918 | 2970 |
| DA23-05 | <175 um | URS-01 | 481511 | 5282054 | Qsc | 452 | 1550 |
| DA23-05 | <175 um | URS-01 | 481511 | 5282054 | Qsc | 436 | 1440 |
| DA23-06 | <175 um | URS-01 | 481536 | 5282069 | Qsc | 124 | 544 |
| DA23-07 | <175 um | URS-01 | 481543 | 5282084 | Qsc | 476 | 1870 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | DATASET | UTM27E | UTM27N | MAP_UNIT | Pb_ppm | Zn_ppm |
|-----------|-----------|---------|--------|---------|----------|--------|--------|
| DA24-01 | <175 um | URS-01 | 480151 | 5281633 | Qsf | 629 | 2200 |
| DA24-02 | <175 um | URS-01 | 480141 | 5281636 | Qsf | 846 | 2130 |
| DA24-03 | <175 um | URS-01 | 480128 | 5281616 | Qsf | 657 | 2000 |
| DA24-03 | <175 um | URS-01 | 480128 | 5281616 | Qsf | 640 | 2160 |
| DA24-04 | <175 um | URS-01 | 480120 | 5281628 | Qsf | 580 | 1790 |
| DA24-05 | <175 um | URS-01 | 480142 | 5281605 | Qgcc1 | 177 | 1010 |
| DA24-06 | <175 um | URS-01 | 480144 | 5281620 | Qsf | 634 | 1930 |
| DA24-07 | <175 um | URS-01 | 480165 | 5281612 | Qsf | 242 | 1380 |
| DA25-01 | <175 um | URS-01 | 471718 | 5280366 | Qgpf | 195 | 1370 |
| DA25-02 | <175 um | URS-01 | 471678 | 5280346 | Qgpf | 200 | 1100 |
| DA25-03 | <175 um | URS-01 | 471700 | 5280348 | Qgpf | 172 | 1210 |
| DA25-04 | <175 um | URS-01 | 471662 | 5280334 | Qgpf | 501 | 1660 |
| DA25-05 | <175 um | URS-01 | 471731 | 5280364 | Qgpf | 141 | 3510 |
| DA25-05 | <175 um | URS-01 | 471731 | 5280364 | Qgpf | 145 | 3590 |
| DA25-06 | <175 um | URS-01 | 471743 | 5280377 | Qgpf | 273 | 1700 |
| DA25-07 | <175 um | URS-01 | 471705 | 5280360 | Qgpf | 207 | 1520 |
| DA26-01 | <175 um | URS-01 | 471016 | 5279649 | Qsc | 213 | 1230 |
| DA26-02 | <175 um | URS-01 | 471013 | 5279641 | Qsc | 305 | 1850 |
| DA26-03 | <175 um | URS-01 | 471010 | 5279638 | Qsc | 353 | 1620 |
| DA26-03 | <175 um | URS-01 | 471010 | 5279638 | Qsc | 330 | 1410 |
| DA26-04 | <175 um | URS-01 | 471018 | 5279645 | Qsc | 167 | 1250 |
| DA26-05 | <175 um | URS-01 | 471022 | 5279660 | Qsc | 241 | 989 |
| DA26-06 | <175 um | URS-01 | 471016 | 5279654 | Qsc | 311 | 1520 |
| DA26-07 | <175 um | URS-01 | 471013 | 5279636 | Qsc | 230 | 1090 |
| DA27-01 | <175 um | URS-01 | 467128 | 5278360 | Qgcc1 | 533 | 1900 |
| DA27-02 | <175 um | URS-01 | 467120 | 5278330 | Qsc | 379 | 1620 |
| DA27-03 | <175 um | URS-01 | 467143 | 5278348 | Qsc | 398 | 1400 |
| DA27-03 | <175 um | URS-01 | 467143 | 5278348 | Qsc | 435 | 1410 |
| DA27-04 | <175 um | URS-01 | 467118 | 5278319 | Qsc | 194 | 850 |
| DA27-05 | <175 um | URS-01 | 467138 | 5278334 | Qsc | 219 | 990 |
| DA27-06 | <175 um | URS-01 | 467103 | 5278316 | Qsc | 690 | 2390 |
| DA27-07 | <175 um | URS-01 | 467120 | 5278338 | Qsc | 477 | 2230 |
| DA28-01 | <175 um | URS-01 | 466261 | 5278180 | Qgcc2 | 361 | 1140 |
| DA28-02 | <175 um | URS-01 | 466267 | 5278182 | Qgcc2 | 442 | 1420 |
| DA28-03 | <175 um | URS-01 | 466275 | 5278188 | Qgcc2 | 396 | 1680 |
| DA28-04 | <175 um | URS-01 | 466258 | 5278186 | Qgcc2 | 313 | 1020 |
| DA28-04 | <175 um | URS-01 | 466258 | 5278186 | Qgcc2 | 331 | 1020 |
| DA28-05 | <175 um | URS-01 | 466274 | 5278196 | Qgcc2 | 400 | 1830 |
| DA28-06 | <175 um | URS-01 | 466273 | 5278201 | Qgcc2 | 295 | 995 |
| DA28-07 | <175 um | URS-01 | 466268 | 5278187 | Qgcc2 | 434 | 1210 |
| DA29-01 | <175 um | URS-01 | 465922 | 5278110 | Qsc | 182 | 928 |
| DA29-02 | <175 um | URS-01 | 465929 | 5278119 | Qsc | 110 | 773 |
| DA29-03 | <175 um | URS-01 | 465923 | 5278120 | Qsc | 192 | 806 |
| DA29-03 | <175 um | URS-01 | 465923 | 5278120 | Qsc | 138 | 771 |
| DA29-04 | <175 um | URS-01 | 465941 | 5278110 | Qsc | 442 | 1720 |
| DA29-05 | <175 um | URS-01 | 465927 | 5278106 | Qsc | 202 | 867 |
| DA29-06 | <175 um | URS-01 | 465937 | 5278100 | Qsc | 116 | 610 |
| DA29-07 | <175 um | URS-01 | 465922 | 5278115 | Qsc | 291 | 1300 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | As_ppm | Cd_ppm | Fe_% | Hg_ppm | Mn_ppm | Sb_ppm | Al_% |
|-----------|-----------|--------|--------|------|--------|--------|--------|------|
| SRG-37 | <2000 um | 11 | 0.8 | 2.7 | 0.02 | 490 | 1.6 | 6.1 |
| SRG-38 | <2000 um | 12 | 2.8 | 2.4 | 0.02 | 710 | 2.0 | 6.4 |
| SRG-39 | <2000 um | 13 | 1.3 | 2.8 | 0.03 | 720 | 1.8 | 6.4 |
| SRG-40 | <2000 um | 9.6 | 13 | 2.0 | 0.05 | 910 | 2.1 | 5.5 |
| SRG-41 | <2000 um | 9.9 | 2.2 | 2.4 | 0.02 | 770 | 2.2 | 6.2 |
| SRG-42 | <2000 um | 12 | 23 | 2.6 | 0.20 | 350 | 6.5 | 6.1 |
| SRG-43 | <2000 um | 9.7 | 1.7 | 2.6 | 0.03 | 500 | 1.9 | 6.6 |
| SRG-44 | <2000 um | 6.5 | 2.5 | 2.7 | 0.03 | 550 | 2.1 | 6.5 |
| SRG-45 | <2000 um | 6.2 | 3.2 | 2.3 | 0.03 | 340 | 2.3 | 6.3 |
| SRG-46 | <2000 um | 6.8 | 1.6 | 2.5 | 0.01 | 430 | 1.5 | 6.5 |
| SRH-02 | <2000 um | 28 | 9.0 | 3.0 | 0.33 | 2300 | 9.2 | 7.1 |
| SRH-03 | <2000 um | 16 | 5.3 | 3.2 | 0.13 | 1400 | 3.4 | 6.5 |
| SRH-04 | <2000 um | 15 | 4.5 | 2.8 | 0.08 | 1100 | 2.5 | 6.8 |
| SRH-05 | <2000 um | 30 | 6.8 | 3.6 | 0.15 | 1800 | 5.4 | 6.7 |
| SRH-06 | <2000 um | 8.3 | -0.1 | 2.9 | 0.01 | 700 | 1.3 | 6.0 |
| SRH-14 | <2000 um | 12 | 3.8 | 3.1 | 0.07 | 990 | 2.2 | 6.6 |
| SRH-15 | <2000 um | 18 | 9.6 | 3.4 | 0.23 | 1300 | 4.8 | 5.9 |
| SRH-15a | <2000 um | 19 | 9.1 | 3.2 | 0.26 | 1200 | 4.8 | 5.8 |
| SRH-16 | <2000 um | 21 | 8.8 | 3.2 | 0.23 | 2100 | 8.3 | 7.0 |
| SRH-17 | <2000 um | 17 | 3.0 | 3.4 | 0.08 | 780 | 3.7 | 7.3 |
| SRH-18 | <2000 um | 10 | 3.3 | 2.7 | 0.04 | 810 | 2.3 | 6.6 |
| SRH-19 | <2000 um | 14 | 4.6 | 2.9 | 0.08 | 1300 | 3.6 | 6.7 |
| SRH-20 | <2000 um | 16 | 18 | 2.8 | 0.04 | 1500 | 3.9 | 5.6 |
| SRH-21 | <2000 um | 17 | 6.2 | 3.4 | 0.12 | 1500 | 3.8 | 6.6 |
| SRH-21a | <2000 um | 36 | 12 | 3.8 | 9.20 | 3000 | 8.2 | 7.1 |
| SRH-22 | <2000 um | 26 | 7.7 | 6.2 | 0.03 | 1900 | 4.9 | 14.7 |
| SRH-23 | <2000 um | 16 | 3.2 | 3.0 | 0.10 | 1100 | 3.1 | 6.6 |
| SRH-24 | <2000 um | 19 | 6.2 | 3.2 | 0.17 | 1700 | 4.5 | 6.8 |
| SRH-25 | <2000 um | 13 | 3.4 | 2.6 | 0.03 | 810 | 2.2 | 6.4 |
| SRH-26 | <2000 um | 8.9 | 2.0 | 3.0 | 0.01 | 650 | 1.8 | 6.6 |
| SRH-26a | <2000 um | 9.4 | 1.9 | 2.6 | 0.01 | 590 | 1.6 | 6.4 |
| SRH-27 | <2000 um | 13 | 4.7 | 2.8 | 0.03 | 890 | 2.3 | 6.4 |
| SRH-28 | <2000 um | 15 | 2.7 | 2.5 | 0.03 | 820 | 2.0 | 6.3 |
| SRH-29 | <2000 um | 14 | 5.1 | 3.3 | 0.06 | 980 | 3.4 | 6.8 |
| SRH-30 | <2000 um | 11 | 1.8 | 2.6 | 0.01 | 490 | 1.7 | 6.5 |
| SRG-38 | <63 um | 43 | 15 | 3.9 | 0.15 | 2400 | 5.8 | 6.3 |
| SRG-39 | <63 um | 53 | 19 | 3.9 | 0.10 | 2200 | 4.9 | 6.3 |
| SRG-40 | <63 um | 11 | 38 | 1.9 | 0.15 | 2100 | 2.7 | 3.0 |
| SRG-41 | <63 um | 32 | 37 | 3.5 | 0.27 | 3600 | 11.0 | 6.2 |
| SRG-42 | <63 um | 11 | 17 | 2.6 | 0.17 | 320 | 5.0 | 7.0 |
| SRG-43 | <63 um | 19 | 5.9 | 3.7 | 0.05 | 1100 | 4.0 | 8.1 |
| SRG-44 | <63 um | 20 | 36 | 3.4 | 0.25 | 1300 | 5.5 | 5.3 |
| SRG-45 | <63 um | 11 | 20 | 2.8 | 0.25 | 520 | 4.9 | 5.3 |
| SRG-46 | <63 um | 20 | 20 | 3.5 | 0.20 | 840 | 4.5 | 6.6 |
| SRH-02 | <63 um | 60 | 28 | 4.7 | 0.99 | 4900 | 21.0 | 7.9 |
| SRH-03 | <63 um | 38 | 19 | 4.1 | 0.54 | 3600 | 8.3 | 7.5 |
| SRH-04 | <63 um | 50 | 20 | 4.4 | 0.53 | 3800 | 7.5 | 7.6 |
| SRH-05 | <63 um | 39 | 7.9 | 4.2 | 0.26 | 1600 | 7.9 | 7.1 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | As_ppm | Cd_ppm | Fe_% | Hg_ppm | Mn_ppm | Sb_ppm | Al_% |
|------------|-----------|--------|--------|------|--------|--------|--------|------|
| SRH-06 | <63 um | 9.6 | 0.2 | 2.4 | 0.02 | 1100 | 0.8 | 5.1 |
| SRH-14 | <63 um | | 15 | 4.0 | 0.33 | 2300 | 3.7 | 6.7 |
| SRH-15 | <63 um | 18 | 8.4 | 3.0 | 0.27 | 1100 | 4.8 | 5.5 |
| SRH-15a | <63 um | 17 | 7.2 | 3.1 | 0.27 | 1000 | 4.6 | 5.8 |
| SRH-16 | <63 um | 51 | 19 | 4.6 | 0.73 | 4200 | 11.0 | 7.1 |
| SRH-17 | <63 um | 18 | 8.6 | 5.5 | 0.36 | 1400 | 10.0 | 8.7 |
| SRH-18 | <63 um | 24 | 14 | 3.7 | 0.29 | 2400 | 5.8 | 6.3 |
| SRH-19 | <63 um | 41 | 14 | 4.1 | 0.60 | 3100 | 9.0 | 6.6 |
| SRH-20 | <63 um | 20 | 25 | 2.9 | 0.29 | 1700 | 4.9 | 5.2 |
| SRH-21 | <63 um | 33 | 9.6 | 4.0 | 0.38 | 1800 | 6.8 | 6.8 |
| SRH-21a | <63 um | 32 | 14 | 4.5 | 0.76 | 2600 | 15.0 | 7.3 |
| SRH-22 | <63 um | 30 | 18 | 4.1 | 0.33 | 2400 | 6.3 | 6.5 |
| SRH-23 | <63 um | 19 | 7.3 | 3.5 | 0.26 | 1600 | 4.2 | 5.8 |
| SRH-24 | <63 um | 46 | 12 | 4.1 | 0.62 | 3100 | 11.0 | 7.0 |
| SRH-25 | <63 um | 32 | 28 | 3.8 | 0.35 | 2800 | 6.4 | 6.3 |
| SRH-26 | <63 um | 45 | 16 | 4.7 | 0.42 | 2200 | 8.5 | 7.5 |
| SRH-26a | <63 um | 43 | 20 | 4.4 | 0.32 | 2400 | 7.5 | 6.9 |
| SRH-27 | <63 um | 29 | 27 | 3.5 | 0.26 | 2700 | 5.3 | 5.9 |
| SRH-28 | <63 um | 34 | 23 | 3.9 | 0.29 | 3500 | 5.9 | 6.5 |
| SRH-29 | <63 um | 26 | 11 | 4.0 | 0.21 | 1600 | 6.5 | 7.1 |
| SRH-30 | <63 um | 27 | 15 | 3.6 | 0.18 | 1200 | 5.2 | 5.9 |
| CUA201-101 | <175 um | 21.4 | 1.2 | 2.8 | 0.15 | 1650 | 1.2 | |
| CUA201-102 | <175 um | 23.4 | 2.7 | 2.5 | 0.23 | 1880 | 2.7 | |
| CUA201-103 | <175 um | 28.4 | 2.8 | 2.8 | 0.28 | 2820 | 2.8 | |
| CUA201-104 | <175 um | 21.6 | 2.2 | 2.3 | 0.22 | 1740 | 2.2 | |
| CUA201-105 | <175 um | 35.1 | 4.1 | 2.8 | 0.45 | 2890 | 4.1 | |
| CUA201-106 | <175 um | 21.8 | 1.6 | 2.5 | 0.16 | 1710 | 1.6 | |
| CUA201-107 | <175 um | 31.7 | 3.7 | 2.7 | 0.55 | 2810 | 3.7 | |
| CUA202-101 | <175 um | 15.3 | 9.3 | 2.4 | 0.18 | 1520 | 0.5 | |
| CUA202-102 | <175 um | 15.1 | 6.4 | 2.4 | 0.17 | 1260 | 0.5 | |
| CUA202-103 | <175 um | 21.6 | 9.9 | 3.0 | 0.28 | 1970 | 1.9 | |
| CUA202-104 | <175 um | 17.0 | 9.1 | 2.7 | 0.18 | 1470 | 1.5 | |
| CUA202-105 | <175 um | 15.8 | 10.1 | 2.8 | 0.18 | 944 | 1.6 | |
| CUA202-106 | <175 um | 23.6 | 13.6 | 2.9 | 0.29 | 1270 | 3.1 | |
| CUA202-107 | <175 um | 19.1 | 7.0 | 3.0 | 0.18 | 970 | 2.0 | |
| CUA203-101 | <175 um | 31.7 | 11.4 | 2.6 | 0.24 | 2850 | 0.9 | |
| CUA203-102 | <175 um | 16.2 | 4.1 | 2.1 | 0.03 | 1150 | 1.1 | |
| CUA203-103 | <175 um | 13.9 | 4.0 | 2.2 | 0.03 | 879 | 0.7 | |
| CUA203-104 | <175 um | 13.2 | 4.2 | 2.1 | 0.03 | 882 | | |
| CUA203-105 | <175 um | 16.4 | 7.8 | 2.2 | 0.08 | 1180 | | |
| CUA203-106 | <175 um | 13.5 | 5.7 | 2.0 | 0.06 | 978 | | |
| CUA203-107 | <175 um | 13.6 | 5.3 | 2.0 | 0.06 | 1110 | | |
| CUA204-101 | <175 um | 13.0 | 3.5 | 2.6 | 0.05 | 687 | 0.5 | |
| CUA204-102 | <175 um | 22.3 | 6.5 | 3.8 | 0.05 | 909 | 1.9 | |
| CUA204-103 | <175 um | 29.8 | 15.5 | 3.0 | 0.38 | 1720 | 3.0 | |
| CUA204-104 | <175 um | 28.5 | 12.6 | 3.2 | 0.28 | 1480 | 2.5 | |
| CUA204-105 | <175 um | 30.8 | 13.3 | 3.4 | 0.34 | 1610 | 2.8 | |
| CUA204-106 | <175 um | 43.8 | 13.0 | 4.9 | 0.18 | 1310 | 2.9 | |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | As_ppm | Cd_ppm | Fe_% | Hg_ppm | Mn_ppm | Sb_ppm | Al_% |
|------------|-----------|--------|--------|------|--------|--------|--------|------|
| CUA204-107 | <175 um | 45.6 | 11.1 | 4.4 | 0.17 | 1660 | 2.0 | |
| CUA205-101 | <175 um | 15.9 | 5.4 | 2.4 | 0.11 | 1770 | 1.2 | |
| CUA205-102 | <175 um | 16.4 | 5.2 | 2.8 | 0.06 | 1340 | 1.4 | |
| CUA205-103 | <175 um | 19.8 | 5.5 | 2.7 | 0.08 | 1390 | 0.7 | |
| CUA205-104 | <175 um | 17.6 | 7.3 | 2.5 | 0.03 | 1300 | 0.9 | |
| CUA205-105 | <175 um | 22.5 | 10.1 | 2.5 | 0.16 | 2110 | 1.7 | |
| CUA205-106 | <175 um | 20.3 | 9.4 | 2.7 | 0.19 | 1420 | 1.4 | |
| CUA205-107 | <175 um | 24.8 | 10.1 | 2.9 | 0.11 | 1650 | 1.7 | |
| CUA206-101 | <175 um | 16.5 | 0.6 | 2.8 | 0.18 | 503 | 0.5 | |
| CUA206-102 | <175 um | 15.2 | 1.3 | 4.3 | 0.05 | 286 | 1.6 | |
| CUA206-103 | <175 um | 14.2 | 2.5 | 2.4 | 0.05 | 673 | 0.5 | |
| CUA206-104 | <175 um | 14.0 | 2.4 | 2.4 | 0.05 | 704 | 1.2 | |
| CUA206-105 | <175 um | 12.1 | 0.1 | 2.8 | 0.05 | 645 | 0.5 | |
| CUA206-106 | <175 um | 5.2 | 0.1 | 1.4 | 0.05 | 129 | 0.5 | |
| CUA206-107 | <175 um | 7.6 | 0.1 | 2.1 | 0.05 | 321 | 0.5 | |
| CUA208-101 | <175 um | 7.7 | | 2.3 | | 507 | | |
| CUA208-102 | <175 um | 5.5 | | 1.6 | | 395 | | |
| CUA208-103 | <175 um | 5.6 | | 1.9 | | 633 | | |
| CUA208-104 | <175 um | 6.9 | | 1.8 | | 526 | | |
| CUA208-105 | <175 um | 5.1 | | 1.4 | | 416 | | |
| CUA208-106 | <175 um | 3.8 | | 0.9 | | 300 | | |
| CUA208-107 | <175 um | 3.1 | | 0.8 | | 281 | | |
| CUA209-101 | <175 um | 10.2 | 0.1 | 2.0 | | 331 | 0.5 | |
| CUA209-102 | <175 um | 8.7 | 0.1 | 2.0 | | 293 | 0.5 | |
| CUA209-103 | <175 um | 11.9 | 0.1 | 2.6 | | 423 | 0.5 | |
| CUA209-104 | <175 um | 25.2 | 0.1 | 2.8 | | 390 | 0.5 | |
| CUA209-105 | <175 um | 10.3 | 0.1 | 2.2 | | 469 | 0.5 | |
| CUA209-106 | <175 um | 8.8 | 0.1 | 2.0 | | 414 | 0.5 | |
| CUA209-107 | <175 um | 14.6 | 0.1 | 2.6 | | 489 | 0.5 | |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | Ag_ppm | Ba_ppm | Be_ppm | C_Tot_% | TOC_% | Co_ppm | Cr_ppm |
|-----------|-----------|--------|--------|--------|---------|-------|--------|--------|
| SRG-37 | <2000 um | -0.5 | 650 | 1.8 | -0.1 | 0.3 | 5 | 26 |
| SRG-38 | <2000 um | -0.5 | 680 | 1.9 | 0.9 | 0.8 | 7 | 34 |
| SRG-39 | <2000 um | -0.5 | 670 | 1.9 | 0.2 | 0.2 | 8 | 35 |
| SRG-40 | <2000 um | -0.5 | 480 | 1.7 | 11.0 | 5.3 | 7 | 25 |
| SRG-41 | <2000 um | -0.5 | 670 | 2.0 | 0.3 | 0.3 | 9 | 33 |
| SRG-42 | <2000 um | 0.7 | 520 | 1.6 | 7.7 | 7.2 | 11 | 43 |
| SRG-43 | <2000 um | -0.5 | 660 | 1.9 | 0.3 | 0.2 | 7 | 38 |
| SRG-44 | <2000 um | -0.5 | 640 | 1.9 | 1.1 | 1.0 | 8 | 36 |
| SRG-45 | <2000 um | -0.5 | 600 | 1.8 | 1.4 | 1.4 | 7 | 37 |
| SRG-46 | <2000 um | -0.5 | 710 | 2.0 | 0.4 | 0.4 | 7 | 36 |
| SRH-02 | <2000 um | 1.6 | 660 | 2.1 | 1.2 | 1.1 | 12 | 37 |
| SRH-03 | <2000 um | 0.5 | 630 | 1.9 | 1.4 | 1.4 | 10 | 34 |
| SRH-04 | <2000 um | -0.5 | 670 | 2.0 | 0.9 | 0.7 | 9 | 34 |
| SRH-05 | <2000 um | 0.7 | 630 | 1.9 | 1.5 | 1.5 | 13 | 39 |
| SRH-06 | <2000 um | -0.5 | 610 | 1.6 | 2.7 | 1.4 | 8 | 37 |
| SRH-14 | <2000 um | 0.5 | 610 | 1.9 | 1.4 | 1.4 | 11 | 39 |
| SRH-15 | <2000 um | 1.4 | 500 | 1.6 | 6.1 | 6.1 | 14 | 37 |
| SRH-15a | <2000 um | 1.4 | 480 | 1.5 | 5.9 | 5.9 | 13 | 36 |
| SRH-16 | <2000 um | 1.4 | 640 | 2.0 | 1.0 | 1.0 | 16 | 38 |
| SRH-17 | <2000 um | 0.5 | 660 | 2.0 | 0.8 | 0.9 | 9 | 38 |
| SRH-18 | <2000 um | -0.5 | 670 | 1.5 | 1.6 | 1.7 | 9 | 37 |
| SRH-19 | <2000 um | 0.6 | 610 | 1.9 | 1.2 | 1.3 | 10 | 35 |
| SRH-20 | <2000 um | 0.9 | 550 | 1.5 | 5.2 | 5.6 | 12 | 32 |
| SRH-21 | <2000 um | 0.7 | 640 | 1.8 | 2.0 | 2.1 | 13 | 38 |
| SRH-21a | <2000 um | 1.6 | 700 | 1.9 | 1.9 | 1.9 | 19 | 40 |
| SRH-22 | <2000 um | 0.9 | 1400 | 3.3 | 0.5 | 0.5 | 20 | 65 |
| SRH-23 | <2000 um | 0.8 | 610 | 1.7 | 2.5 | 2.6 | 12 | 33 |
| SRH-24 | <2000 um | 0.8 | 630 | 2.0 | 0.9 | 1.0 | 13 | 36 |
| SRH-25 | <2000 um | -0.5 | 610 | 1.8 | 0.7 | 0.8 | 10 | 31 |
| SRH-26 | <2000 um | -0.5 | 630 | 1.9 | 0.1 | 0.2 | 9 | 35 |
| SRH-26a | <2000 um | -0.5 | 650 | 1.8 | 0.1 | 0.1 | 9 | 34 |
| SRH-27 | <2000 um | -0.5 | 650 | 1.8 | 1.3 | 1.4 | 10 | 36 |
| SRH-28 | <2000 um | -0.5 | 630 | 2.8 | 0.5 | 0.6 | 8 | 31 |
| SRH-29 | <2000 um | 0.5 | 620 | 1.9 | 1.9 | 1.9 | 11 | 38 |
| SRH-30 | <2000 um | -0.5 | 680 | 1.8 | 0.6 | 0.4 | 10 | 35 |
| SRG-38 | <63 um | -0.5 | | 2.0 | 1.1 | 6.4 | 18 | 51 |
| SRG-39 | <63 um | -0.5 | 540 | 1.9 | | 5.1 | 17 | 60 |
| SRG-40 | <63 um | -0.5 | 510 | 1.0 | 0.3 | 10.2 | 9 | 20 |
| SRG-41 | <63 um | -0.5 | 270 | 1.8 | 0.2 | 6.1 | 25 | 50 |
| SRG-42 | <63 um | -0.5 | 530 | 1.6 | 0.3 | 3.7 | 9 | 43 |
| SRG-43 | <63 um | -0.5 | 530 | 1.9 | -0.1 | 1.6 | 11 | 56 |
| SRG-44 | <63 um | -0.5 | 610 | 1.8 | 0.4 | 7.4 | 12 | 41 |
| SRG-45 | <63 um | -0.5 | 500 | 1.4 | 0.3 | 6.4 | 8 | 57 |
| SRG-46 | <63 um | -0.5 | 400 | 1.9 | 4.6 | 4.6 | 14 | 68 |
| SRH-02 | <63 um | 6.2 | 520 | 2.1 | 4.6 | 4.4 | 23 | 47 |
| SRH-03 | <63 um | 2.9 | 600 | 1.9 | 5.8 | 5.6 | 19 | 45 |
| SRH-04 | <63 um | 2.5 | 540 | 2.0 | 5.5 | 5.3 | 20 | 49 |
| SRH-05 | <63 um | 0.9 | 560 | 1.8 | 2.4 | 2.4 | 14 | 48 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | Ag_ppm | Ba_ppm | Be_ppm | C_Tot_% | TOC_% | Co_ppm | Cr_ppm |
|-----------|-----------|--------|--------|--------|---------|-------|--------|--------|
| SRH-06 | <63 um | -0.5 | 570 | 1.1 | 6.9 | 3.9 | 9 | 31 |
| SRH-14 | <63 um | 1.6 | 520 | 1.9 | | 3.0 | 17 | 44 |
| SRH-15 | <63 um | 1.6 | 560 | 1.5 | 4.4 | 4.2 | 12 | 35 |
| SRH-15a | <63 um | 1.6 | 430 | 1.6 | 4.0 | 4.0 | 11 | 36 |
| SRH-16 | <63 um | 4.7 | 460 | 2.1 | 3.0 | 0.0 | 23 | 46 |
| SRH-17 | <63 um | 2.2 | 630 | 2.0 | 3.3 | 0.2 | 12 | 56 |
| SRH-18 | <63 um | 1.6 | 570 | 1.8 | 5.8 | 5.6 | 17 | 42 |
| SRH-19 | <63 um | 2.8 | 500 | 1.9 | 4.9 | 4.7 | 16 | 41 |
| SRH-20 | <63 um | 2.6 | 550 | 1.4 | 5.9 | 5.9 | 11 | 32 |
| SRH-21 | <63 um | 1.9 | 450 | 1.8 | 3.7 | 3.6 | 13 | 42 |
| SRH-21a | <63 um | 3.7 | 560 | 2.0 | 3.4 | 3.4 | 15 | 46 |
| SRH-22 | <63 um | 1.9 | 620 | 1.9 | 5.3 | 5.3 | 16 | 44 |
| SRH-23 | <63 um | 1.2 | 560 | 1.4 | 3.2 | 3.2 | 14 | 29 |
| SRH-24 | <63 um | 2.8 | 440 | 2.1 | 2.7 | 2.7 | 16 | 45 |
| SRH-25 | <63 um | 1.7 | 610 | 1.8 | 6.0 | 5.9 | 17 | 44 |
| SRH-26 | <63 um | 1.6 | 550 | 2.2 | 3.2 | 3.1 | 17 | 70 |
| SRH-26a | <63 um | 1.5 | 600 | 2.1 | 3.4 | 3.8 | 17 | 69 |
| SRH-27 | <63 um | 1.8 | 380 | 1.7 | 6.6 | 6.5 | 16 | 40 |
| SRH-28 | <63 um | 2.2 | 540 | 1.9 | 5.4 | 6.1 | 18 | 40 |
| SRH-29 | <63 um | 1.5 | 610 | 1.8 | 3.9 | 4.0 | 13 | 47 |
| SRH-30 | <63 um | 1.1 | 540 | 1.8 | 3.8 | 3.5 | 19 | 49 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | Cu_ppm | Ni_ppm | P_ppm | S_Tot_% | Se_ppm | Sr_ppm | Ti_% | V_ppm |
|-----------|-----------|--------|--------|-------|---------|--------|--------|------|-------|
| SRG-37 | <2000 um | 7 | 11 | 350 | -0.1 | -0.1 | 200 | 0.22 | 43 |
| SRG-38 | <2000 um | 10 | 14 | 450 | -0.1 | 0.1 | 550 | 0.28 | 54 |
| SRG-39 | <2000 um | 9 | 14 | 510 | -0.1 | 0.1 | 260 | 0.32 | 67 |
| SRG-40 | <2000 um | 13 | 13 | 700 | 0.3 | 0.3 | 150 | 0.18 | 36 |
| SRG-41 | <2000 um | 9 | 14 | 500 | -0.1 | 0.1 | 240 | 0.27 | 58 |
| SRG-42 | <2000 um | 45 | 22 | 730 | -0.1 | 0.5 | 170 | 0.34 | 57 |
| SRG-43 | <2000 um | 11 | 14 | 510 | -0.1 | 0.1 | 220 | 0.31 | 63 |
| SRG-44 | <2000 um | 10 | 13 | 660 | -0.1 | 0.2 | 240 | 0.34 | 69 |
| SRG-45 | <2000 um | 9 | 14 | 520 | -0.1 | 0.1 | 200 | 0.29 | 56 |
| SRG-46 | <2000 um | 9 | 12 | 510 | -0.1 | 0.1 | 280 | 0.30 | 64 |
| SRH-02 | <2000 um | 27 | 19 | 750 | -0.1 | 0.2 | 160 | 0.29 | 64 |
| SRH-03 | <2000 um | 18 | 17 | 690 | -0.1 | 0.2 | 190 | 0.27 | 69 |
| SRH-04 | <2000 um | 14 | 15 | 560 | -0.1 | 0.1 | 200 | 0.28 | 61 |
| SRH-05 | <2000 um | 27 | 24 | 810 | -0.1 | 0.3 | 170 | 0.33 | 72 |
| SRH-06 | <2000 um | 13 | 13 | 690 | -0.1 | 0.2 | 220 | 0.34 | 71 |
| SRH-14 | <2000 um | 14 | 17 | | -0.1 | 0.1 | | 0.35 | 71 |
| SRH-15 | <2000 um | 32 | 274 | | 0.1 | -0.1 | | 0.33 | 68 |
| SRH-15a | <2000 um | 32 | 23 | | 0.1 | -0.1 | | 0.32 | 63 |
| SRH-16 | <2000 um | 24 | 18 | | -0.1 | 0.1 | | 0.34 | 70 |
| SRH-17 | <2000 um | 20 | 19 | | -0.1 | 0.1 | | 0.26 | 75 |
| SRH-18 | <2000 um | 13 | 14 | | -0.1 | -0.1 | | 0.30 | 62 |
| SRH-19 | <2000 um | 18 | 15 | | -0.1 | -0.1 | | 0.29 | 62 |
| SRH-20 | <2000 um | 22 | 18 | | 0.1 | 0.2 | | 0.27 | 56 |
| SRH-21 | <2000 um | 19 | 19 | | -0.1 | 0.2 | | 0.14 | 73 |
| SRH-21a | <2000 um | 31 | 27 | | -0.1 | 0.2 | | 0.34 | 77 |
| SRH-22 | <2000 um | 34 | 26 | | -0.1 | 0.2 | | 0.66 | 110 |
| SRH-23 | <2000 um | 19 | 16 | | -0.1 | 0.1 | | 0.33 | 65 |
| SRH-24 | <2000 um | 18 | 17 | | -0.1 | -0.1 | | 0.32 | 69 |
| SRH-25 | <2000 um | 10 | 13 | | -0.1 | -0.1 | | 0.26 | 54 |
| SRH-26 | <2000 um | 8 | 12 | | -0.1 | -0.1 | | 0.30 | 72 |
| SRH-26a | <2000 um | 8 | 11 | | -0.1 | -0.1 | | 0.29 | 61 |
| SRH-27 | <2000 um | 13 | 14 | | -0.1 | -0.1 | | 0.30 | 62 |
| SRH-28 | <2000 um | 11 | 13 | | -0.1 | -0.1 | | 0.26 | 54 |
| SRH-29 | <2000 um | 18 | 17 | | -0.1 | 0.1 | | 0.35 | 72 |
| SRH-30 | <2000 um | 9 | 11 | | -0.1 | -0.1 | | 0.30 | 60 |
| SRG-38 | <63 um | 43 | 35 | 1500 | 0.1 | 0.4 | 160 | 0.38 | 74 |
| SRG-39 | <63 um | 44 | 32 | 1600 | | 0.5 | 130 | 0.35 | 70 |
| SRG-40 | <63 um | 32 | 19 | 2000 | 0.3 | 0.9 | 69 | 0.15 | 32 |
| SRG-41 | <63 um | 59 | 37 | 1600 | 0.2 | 1.2 | 120 | 0.33 | 68 |
| SRG-42 | <63 um | 43 | 19 | 810 | 0.3 | 0.4 | 190 | 0.37 | 59 |
| SRG-43 | <63 um | 43 | 28 | 960 | -0.1 | 0.4 | 210 | 0.47 | 79 |
| SRG-44 | <63 um | 52 | 29 | 1500 | 0.4 | 1.5 | 100 | 0.36 | 66 |
| SRG-45 | <63 um | 38 | 26 | 1300 | 0.3 | 0.6 | 130 | 0.34 | 57 |
| SRG-46 | <63 um | 51 | 28 | 1500 | 0.1 | 0.7 | 150 | 0.41 | 76 |
| SRH-02 | <63 um | 82 | 36 | 1700 | 0.1 | 0.9 | 100 | 0.33 | 78 |
| SRH-03 | <63 um | 68 | 34 | 1700 | 0.2 | 0.9 | 99 | 0.32 | 72 |
| SRH-04 | <63 um | 71 | 34 | 1600 | 0.1 | 1.1 | 110 | 0.33 | 73 |
| SRH-05 | <63 um | 45 | 33 | 1000 | 0.1 | 0.6 | 89 | 0.34 | 73 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 1: Geochemical data for sediment samples from the Spokane River in the map area.

| SAMPLE_ID | GRAINSIZE | Cu_ppm | Ni_ppm | P_ppm | S_Tot_% | Se_ppm | Sr_ppm | Ti_% | V_ppm |
|-----------|-----------|--------|--------|-------|---------|--------|--------|------|-------|
| SRH-06 | <63 um | 22 | 14 | 1200 | 0.1 | 0.6 | 290 | 0.34 | 62 |
| SRH-14 | <63 um | 43 | 28 | | 0.1 | 0.4 | | 0.34 | 41 |
| SRH-15 | <63 um | 33 | 21 | | 0.1 | 0.3 | | 0.31 | 62 |
| SRH-15a | <63 um | 31 | 22 | | 0.1 | 0.2 | | 0.34 | 65 |
| SRH-16 | <63 um | 66 | 30 | | 0.1 | 0.2 | | 0.38 | 84 |
| SRH-17 | <63 um | 68 | 42 | | 0.1 | 0.5 | | 0.40 | 93 |
| SRH-18 | <63 um | 40 | 27 | | 0.1 | 0.4 | | 0.32 | 71 |
| SRH-19 | <63 um | 31 | 29 | | 0.1 | 0.4 | | 0.33 | 73 |
| SRH-20 | <63 um | 33 | 22 | | 0.1 | 0.3 | | 0.28 | 58 |
| SRH-21 | <63 um | 39 | 26 | | 0.1 | 0.4 | | 0.34 | 73 |
| SRH-21a | <63 um | 54 | 31 | | 0.1 | 0.4 | | 0.33 | 78 |
| SRH-22 | <63 um | 48 | 30 | | 0.1 | 0.4 | | 0.30 | 70 |
| SRH-23 | <63 um | 32 | 19 | | 0.1 | 0.2 | | 0.36 | 71 |
| SRH-24 | <63 um | 45 | 28 | | 0.1 | 0.3 | | 0.33 | 69 |
| SRH-25 | <63 um | 43 | 28 | | 0.1 | 0.3 | | 0.34 | 72 |
| SRH-26 | <63 um | 48 | 38 | | 0.1 | 0.4 | | 0.37 | 83 |
| SRH-26a | <63 um | 48 | 38 | | 0.1 | 0.4 | | 0.37 | 79 |
| SRH-27 | <63 um | 49 | 25 | | 0.2 | 0.4 | | 0.30 | 66 |
| SRH-28 | <63 um | 54 | 30 | | 0.1 | 0.7 | | 0.30 | 68 |
| SRH-29 | <63 um | 44 | 29 | | 0.1 | 0.4 | | 0.36 | 75 |
| SRH-30 | <63 um | 43 | 26 | | 0.1 | 0.3 | | 0.38 | 75 |

("-" sign before value indicates element concentration in sample is less than that value).

Table 2. Average Pb and Zn contents of samples upstream and downstream of Upriver Dam, separated by lithologic unit.

| | upstream of Upriver Dam | | downstream of Upriver Dam | | downstream as % of upstream | |
|--------------|-------------------------|------------------|---------------------------|------------------|-----------------------------|-------------|
| | Pb (<175um) | Zn (<175um) | Pb (<175um) | Zn (<175um) | Pb (<175um) | Zn (<175um) |
| Qgcc1 | 386 | 1982 | 147 | 547 | 38% | 28% |
| <i>n</i> | <i>avg of 26</i> | <i>avg of 26</i> | <i>avg of 4</i> | <i>avg of 4</i> | | |
| Qgcc2 | 575 | 2112 | 372 | 1289 | 65% | 61% |
| <i>n</i> | <i>avg of 14</i> | <i>avg of 14</i> | <i>avg of 8</i> | <i>avg of 8</i> | | |
| Qgpf | 444 | 2158 | 229 | 1958 | 52% | 91% |
| <i>n</i> | <i>avg of 18</i> | <i>avg of 18</i> | <i>avg of 8</i> | <i>avg of 8</i> | | |
| Qsc | 313 | 1408 | 288 | 1288 | 92% | 91% |
| <i>n</i> | <i>avg of 78</i> | <i>avg of 78</i> | <i>avg of 23</i> | <i>avg of 23</i> | | |

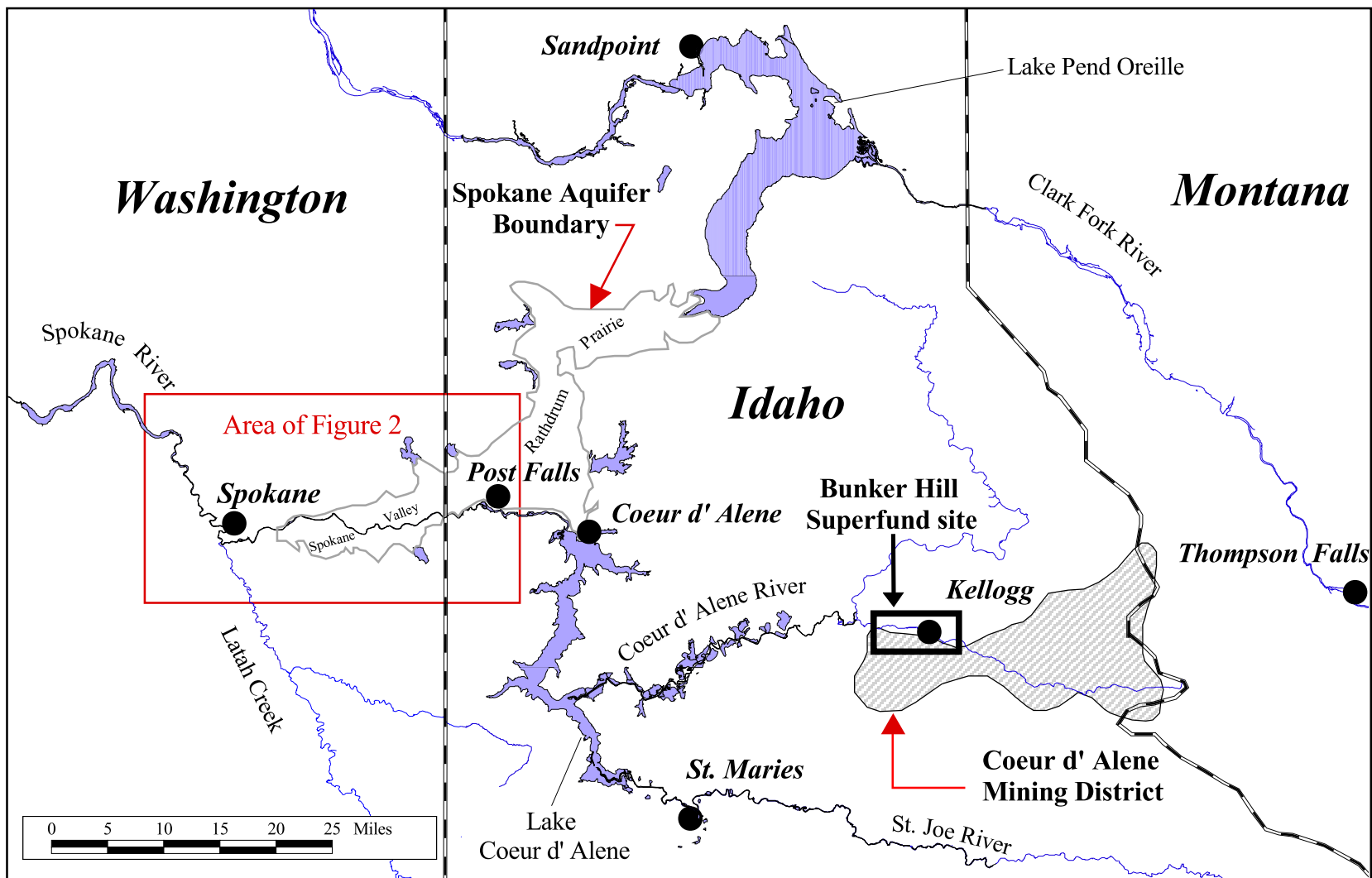


Figure 1. Regional map of the Spokane River drainage basin and surrounding region in eastern Washington, northern Idaho, and western Montana. The area of figure 2 is shown.

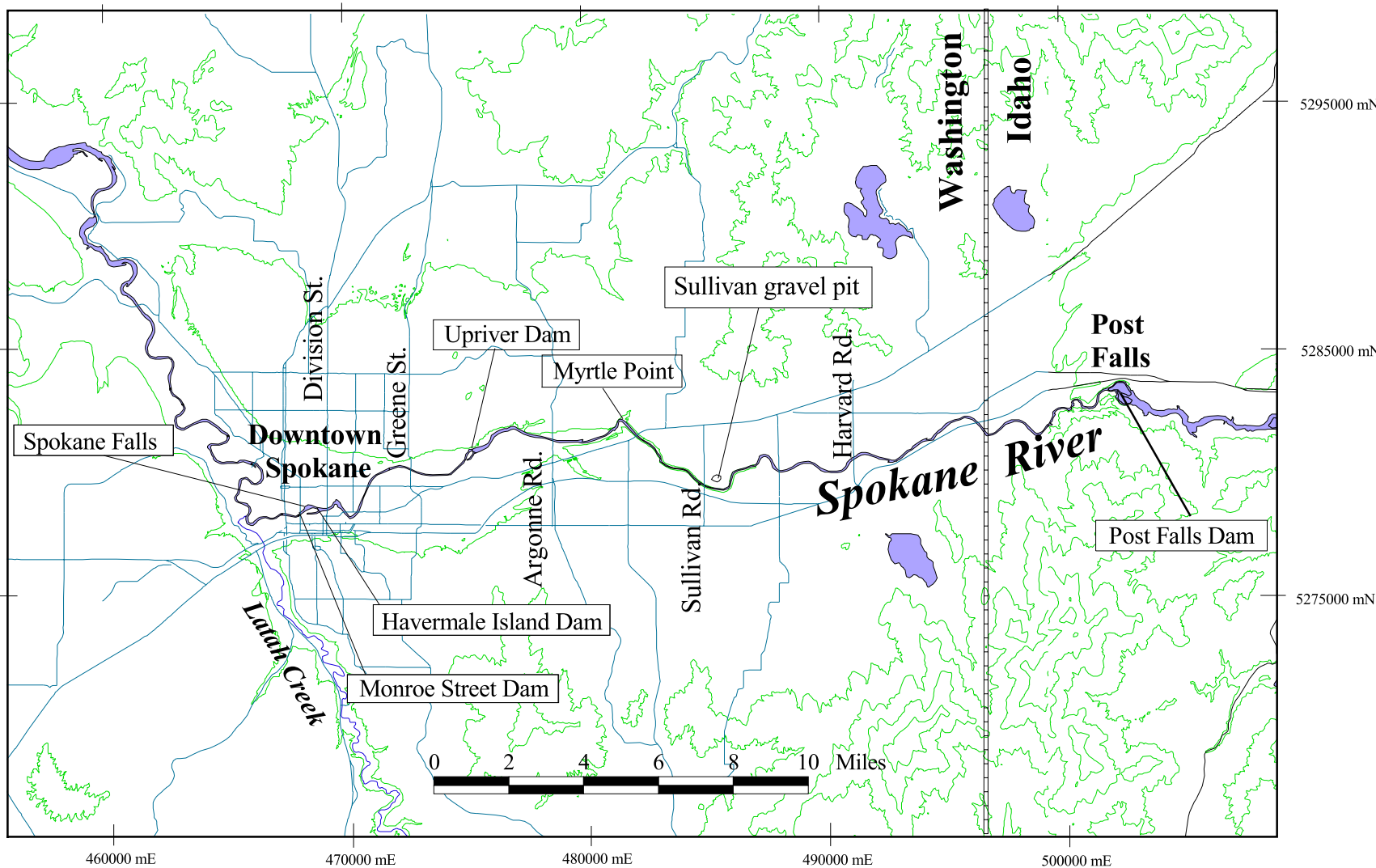


Figure 2. Map of the Spokane River valley showing locations of the features mentioned in text (grid ticks are in Universal Transverse Mercator Zone 11, NAD27).

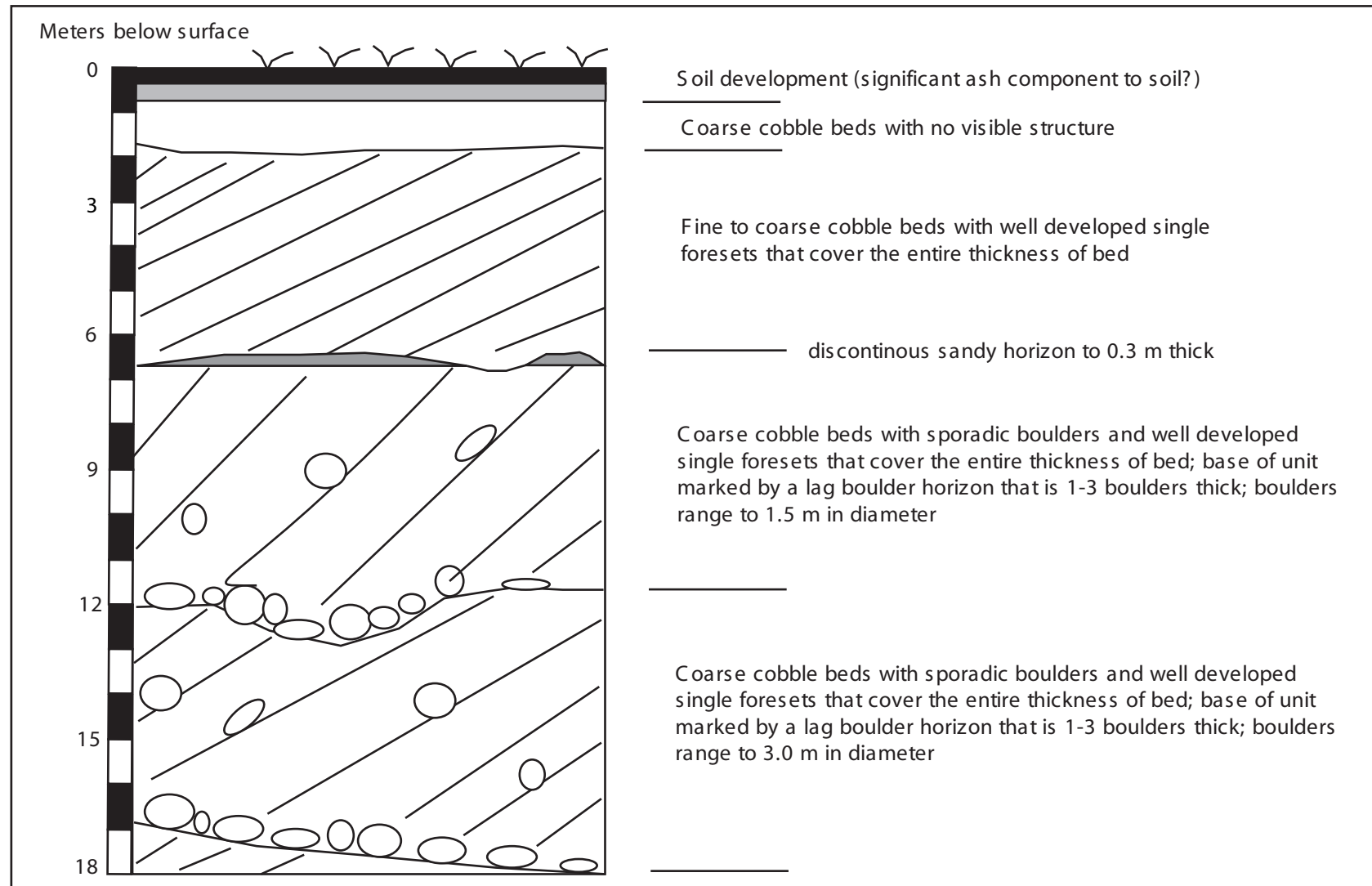


Figure 4. Generalized stratigraphic section of outburst flood thalweg deposits exposed in highwall of Sullivan Rd gravel pit. The giant 3-6 m (10-20 foot) high foresets and the basal boulder lag deposits are characteristic of the thalweg deposits in the Spokane Valley.

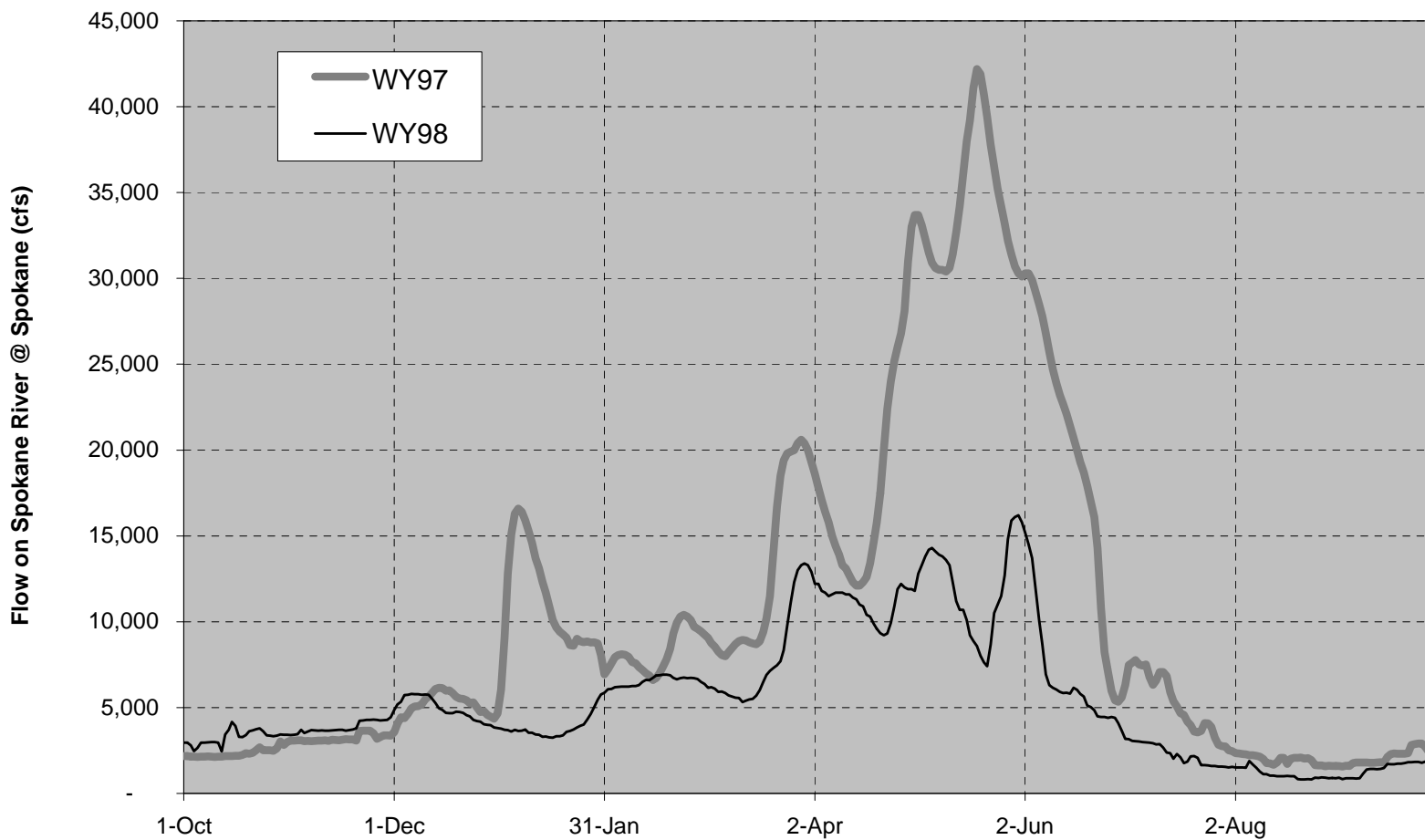


Figure 5. Annual hydrographs for the Spokane River at Spokane (USGS gage 12422500) for Water Years 1997 and 1998.

Spokane River 1891-2000
Annual peakflow by Water Year

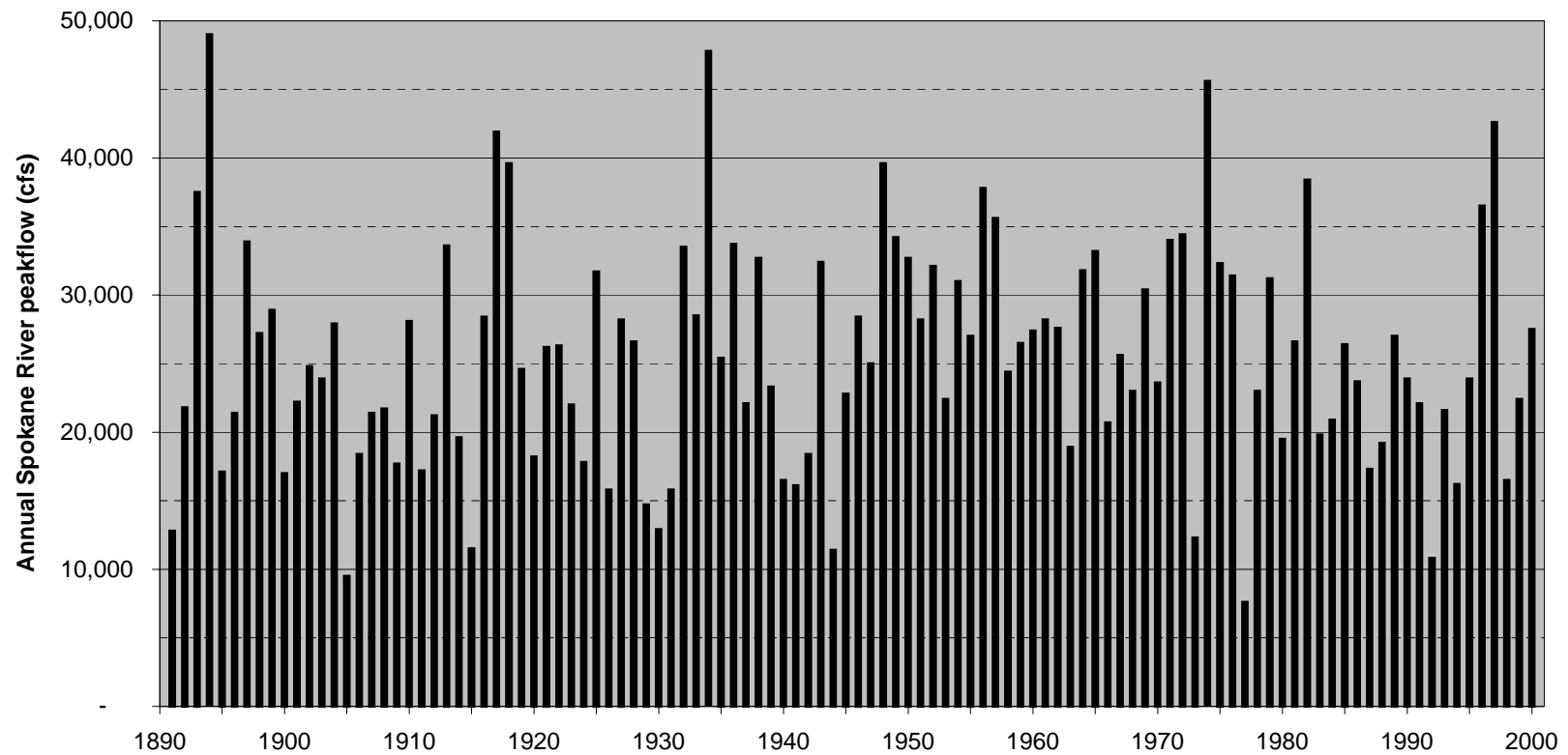


Figure 6. Annual peakflows on the Spokane River (by October 1 to September 30 water year) from 1891 to 2000.

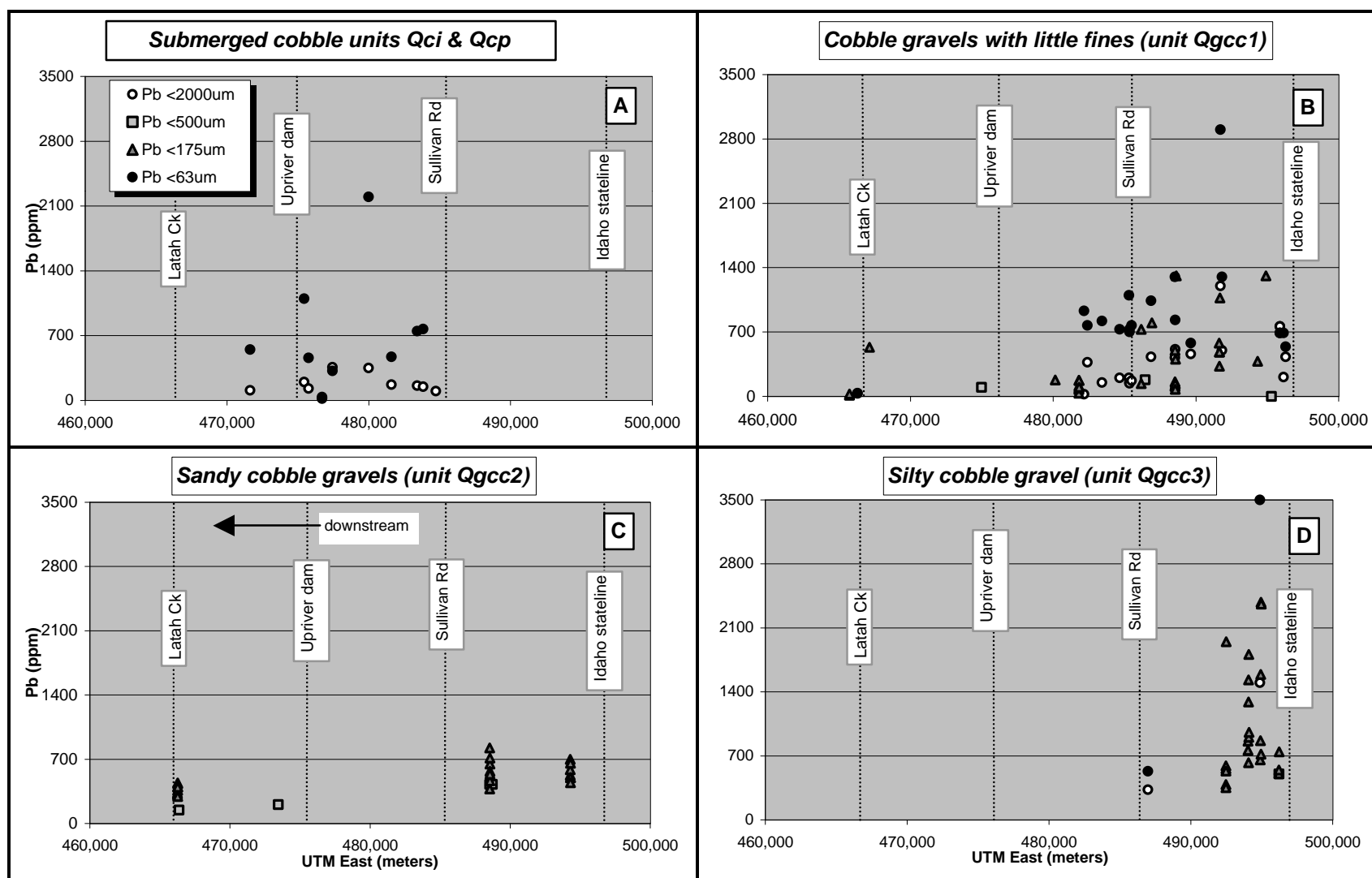


Figure 7. Lead (Pb) content of various grain size fractions of coarse cobble gravels along the Spokane River plotted by geologic map unit against downriver position using UTM east coordinate of sample site. (A) deposits in low water channel (Qci & Qcp), (B) cobble gravels with little fines (Qgcc1), (C) sandy cobble gravels (Qgcc2), and (D) silty cobble gravels (Qgcc3).

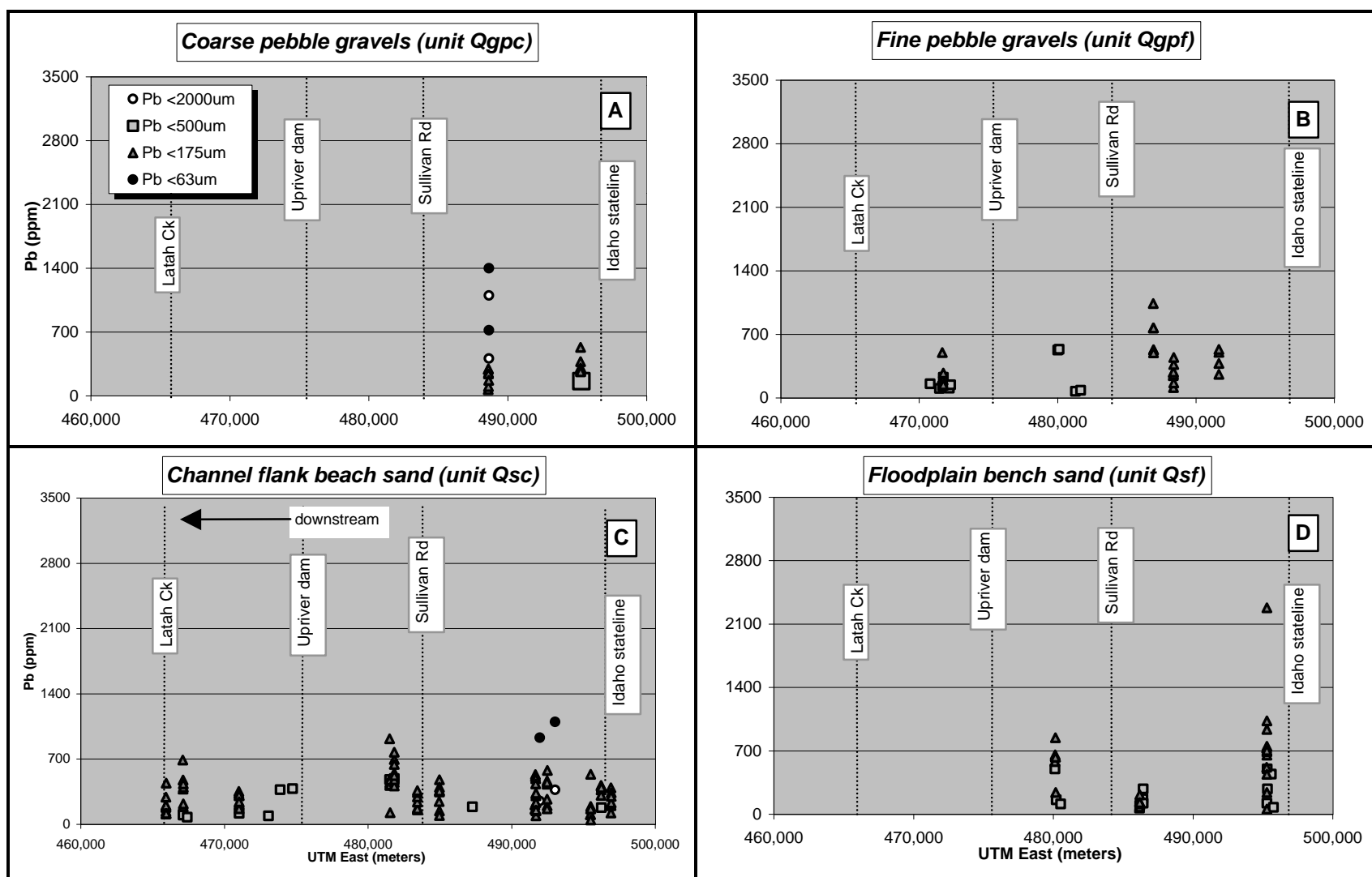


Figure 8. Lead (Pb) content of various grain size fractions of deposits of pebble gravel and sand along the Spokane River plotted by geologic map unit against downriver position using UTM east coordinate of sample site. (A) coarse pebble gravels (Qgpc) (B) fine pebble gravels (Qgpf), (C) sand along channel flank (Qsc), and (D) sand on floodplain bench (Qsf).

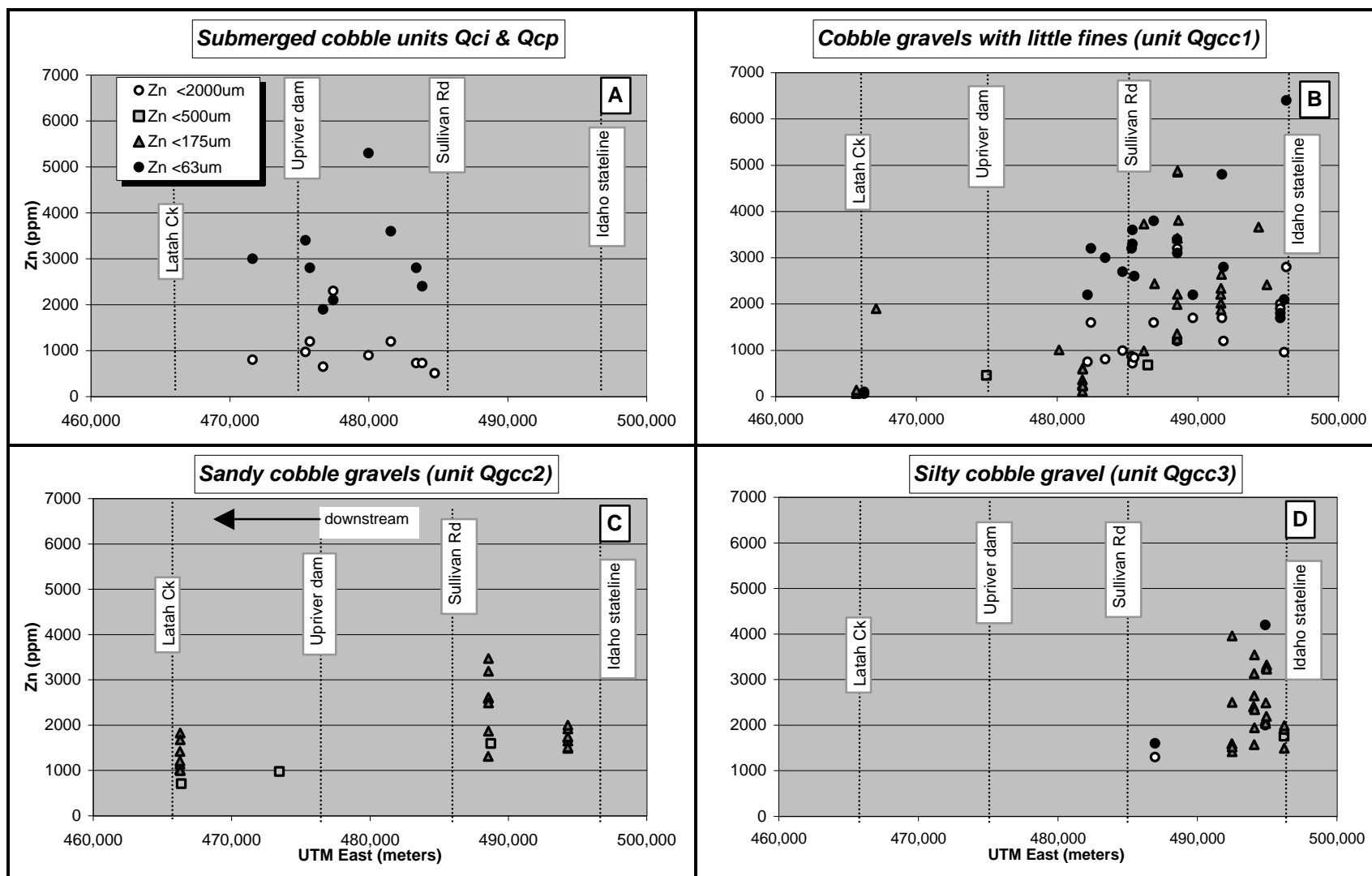


Figure 9. Zinc (Zn) content of various grain size fractions of coarse cobble gravels along the Spokane River plotted by geologic map unit against downriver position using UTM east coordinate of sample site. (A) deposits in low water channel (Qci & Qcp), (B) cobble gravels with few fines (Qgcc1), (C) sandy cobble gravels (Qgcc2), and (D) silty cobble gravels (Qgcc3).

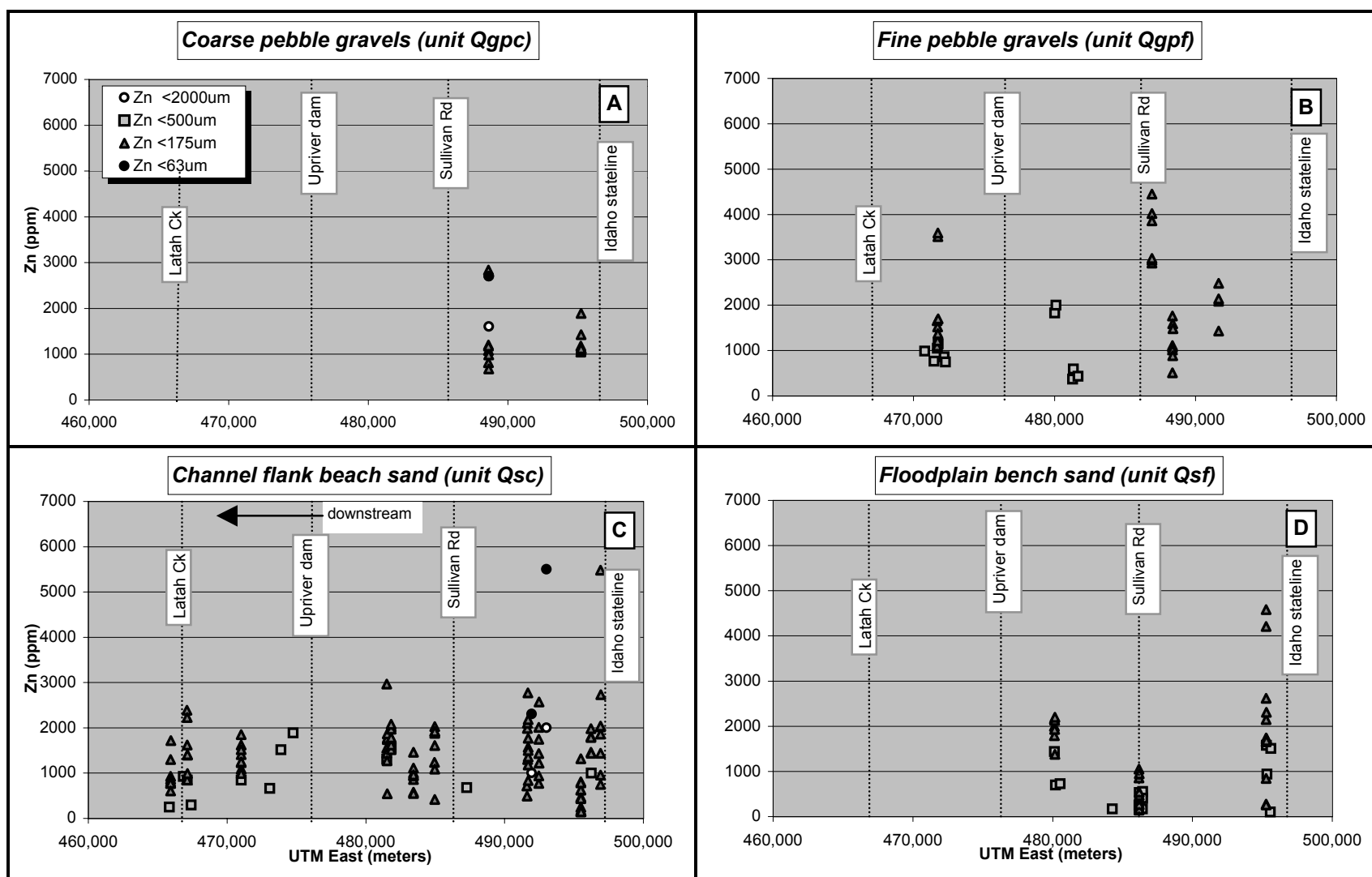


Figure 10. Zinc (Zn) content of various grain size fractions of deposits of pebble gravel and sand along the Spokane River plotted by geologic map unit against downriver position using UTM east coordinate of sample site. (A) coarse pebble gravels (Qgpc) (B) fine pebble gravels (Qgpf), (C) sand along channel flank (Qsc), and (D) sand on floodplain bench (Qsf).

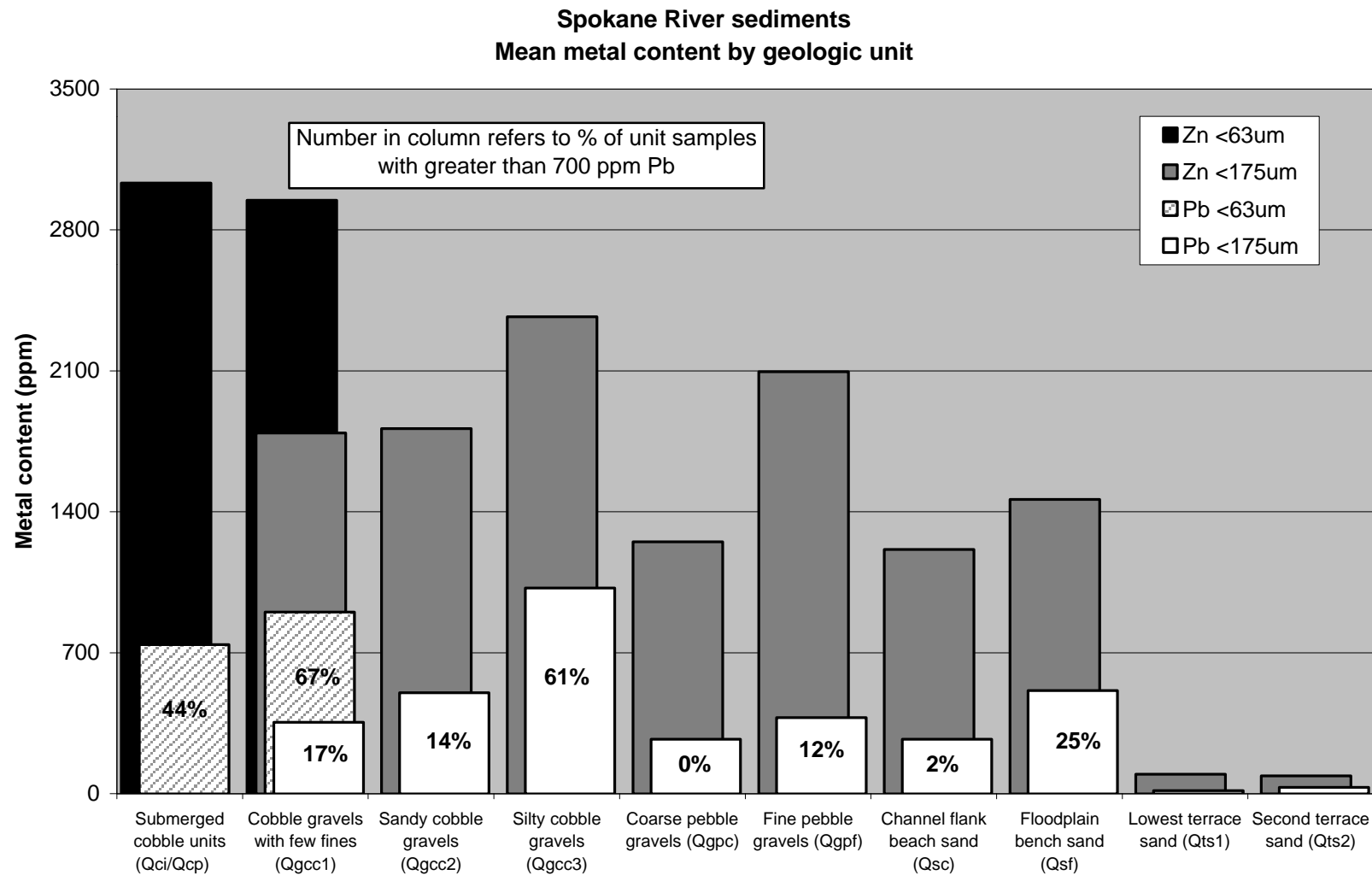


Figure 11. Mean Pb and Zn contents of fine-grained fractions of samples by surficial geologic unit and grain size; percent in column refers to the percent of unit samples with Pb greater than 700 ppm.

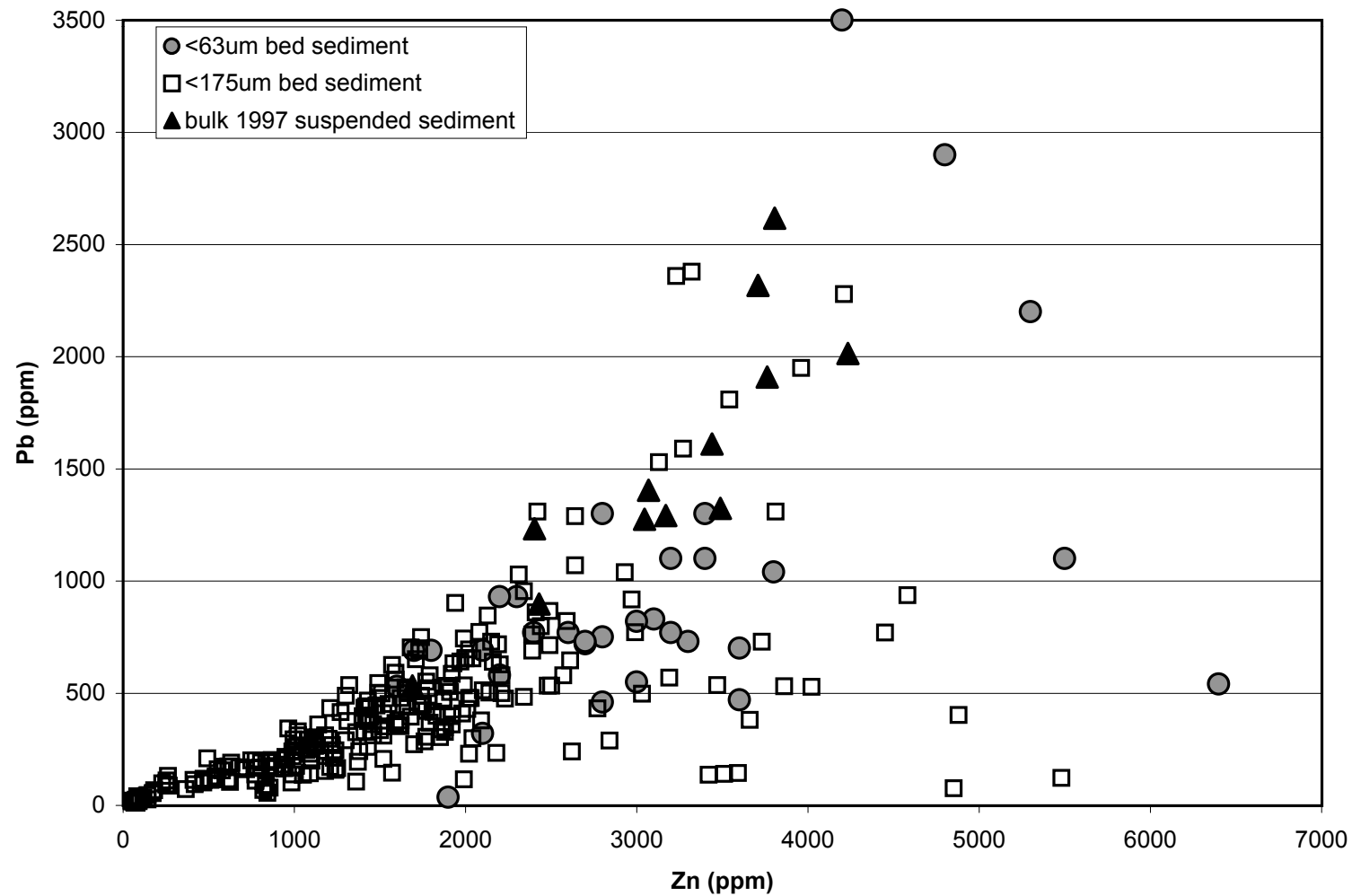


Figure 12. Lead (Pb) versus zinc (Zn) content of fine fractions of Spokane River bed sediment and of Spokane River suspended sediment collected in May, 1997 (Box and others, in prep.); see text for discussion.

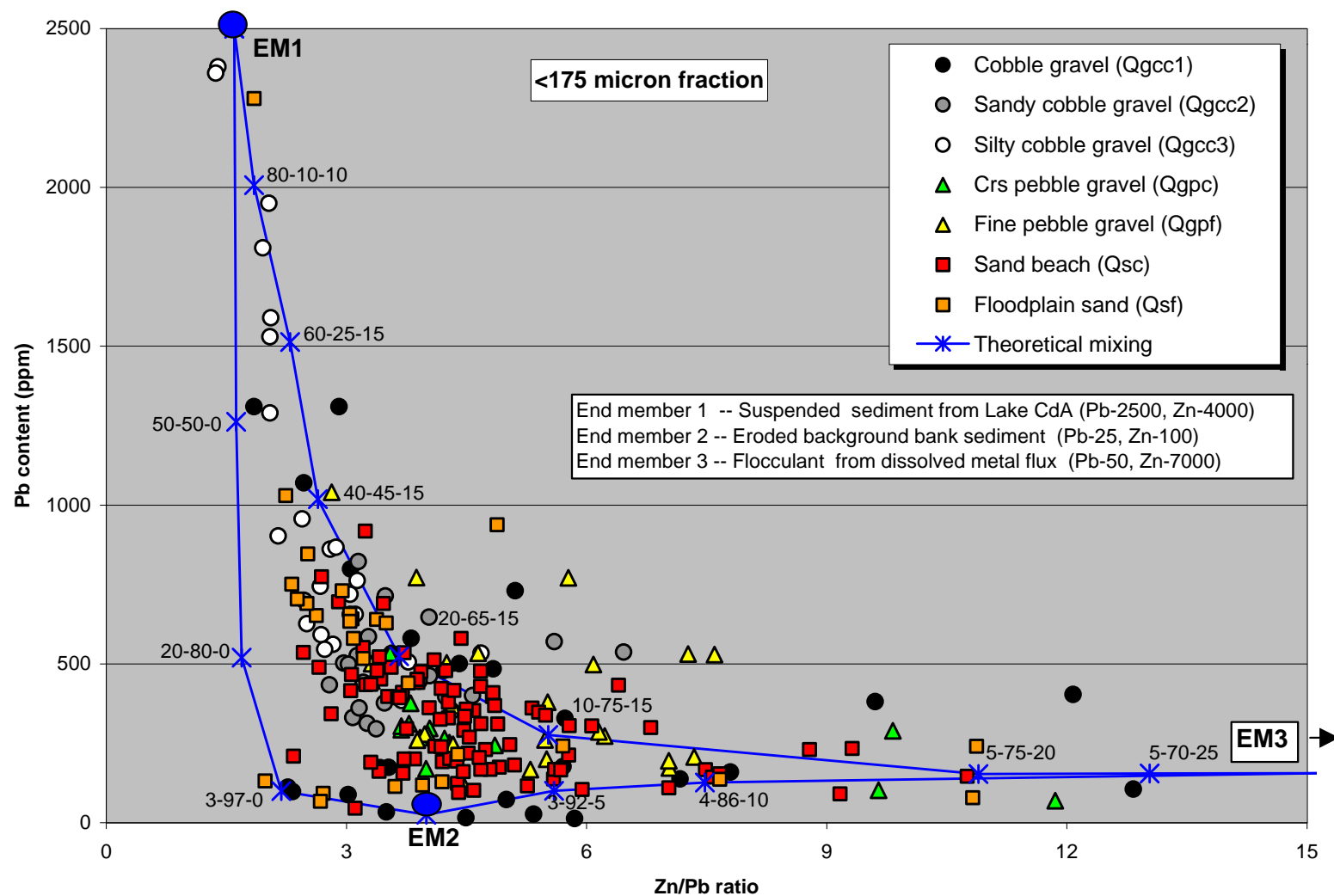


Figure 13. Lead (Pb) content plotted against the ratio of zinc to lead (Zn/Pb) of the less than 175 micron fraction of Spokane River sediment samples from several geologic map units; black line shows calculated mixture of three end members (EM), and mixture percentages (% of EM1 - % of EM2 - % of EM3) shown for several points along mixing line. See text for discussion.

Map Legend

Srgeounits.shp

- Qsc - Sand, channel flank
- Qsf - Sand, floodplain
- Qgpf - Gravel, pebble, fine
- Qgpc - Gravel, pebble, coarse
- Qgcf - Gravel, cobble, fine
- Qgcc1 - Gravel, coarse cobble, little fines
- Qgcc2 - Gravel, coarse cobble, sandy
- Qgcc3 - Gravel, coarse cobble, silty
- Qcrc - Channel riffle, cobbles
- Qcrb - Channel riffle, boulders
- Qcpb - Channel pool, emergent boulders
- Qcp - Channel pool, submerged
- Qci - Channel, impounded
- Qcb - Channel, scoured bedrock
- Qts1 - 1st terrace, sand
- Qts2 - 2nd terrace, sand
- Qts3 - 3rd terrace, sand
- Qaf - Artificial fill
- Sediment sample site

Area of Study

Scale: 0 to 1 Mile

USGS OF 02-XXX

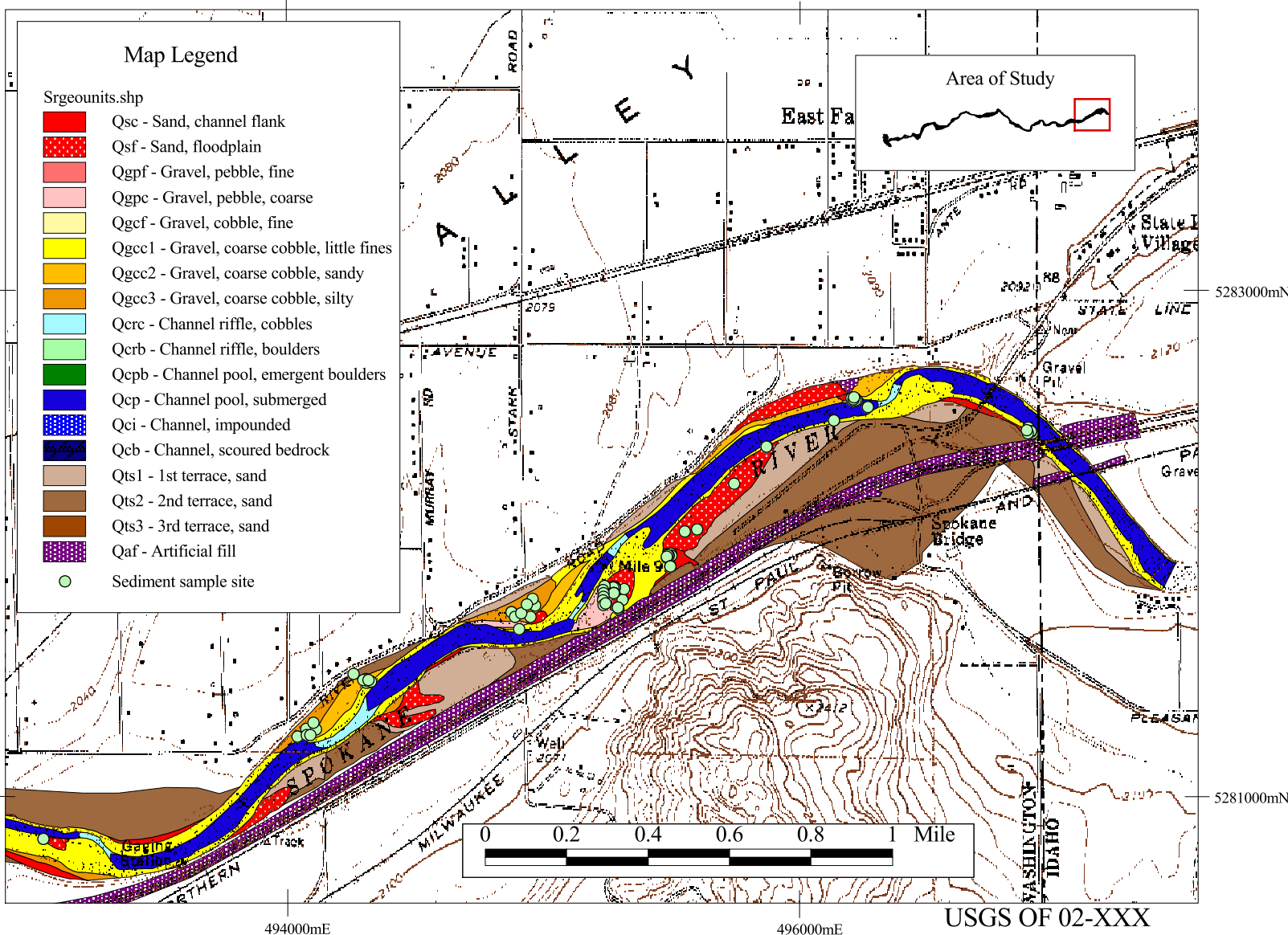


Plate 2. Spokane River surficial geology: west half of Liberty Lake quadrangle, WA (scale 1:24,000).

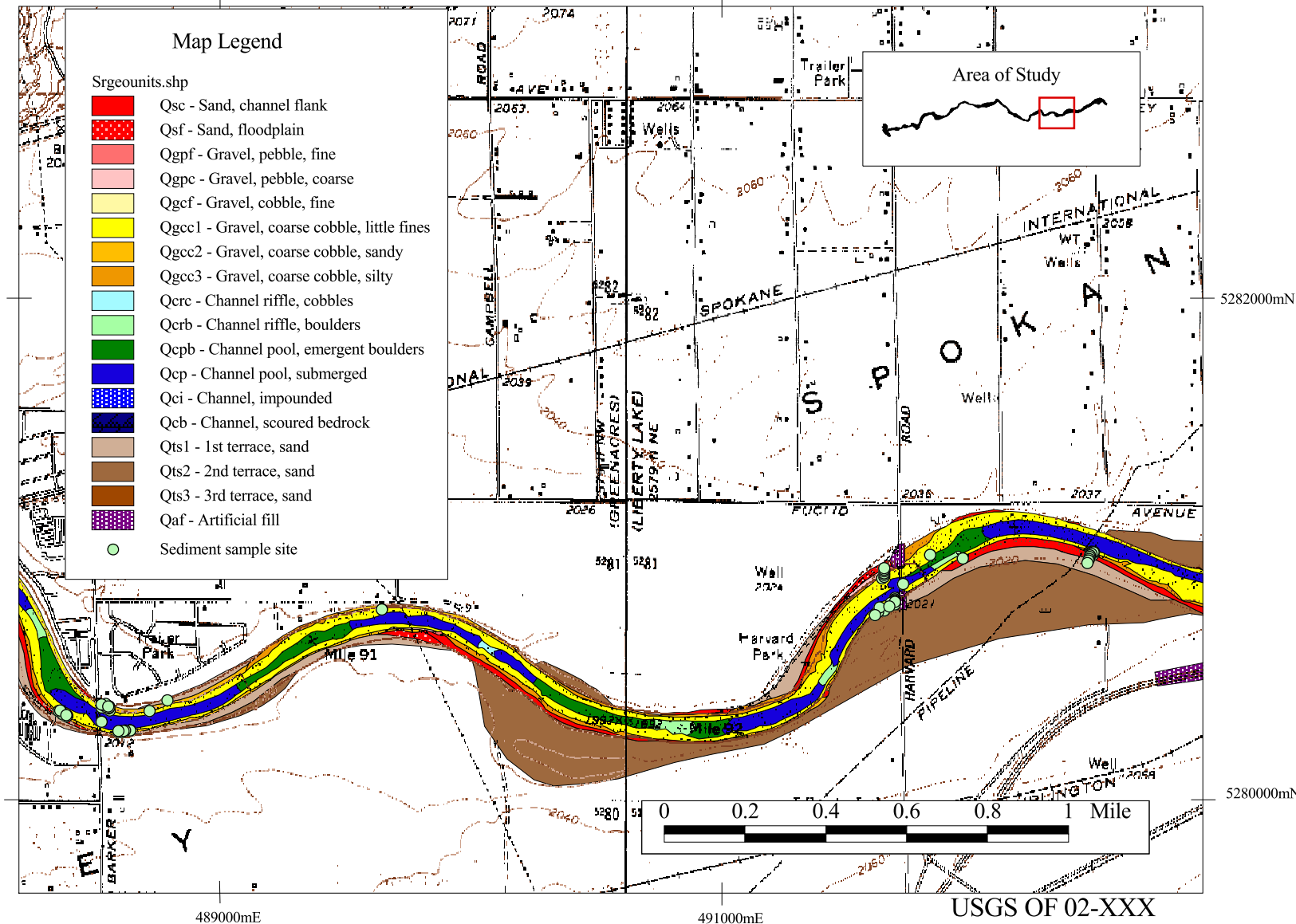


Plate 3. Spokane River surficial geology: east half of Greenacres quadrangle, WA (scale 1:24,000).

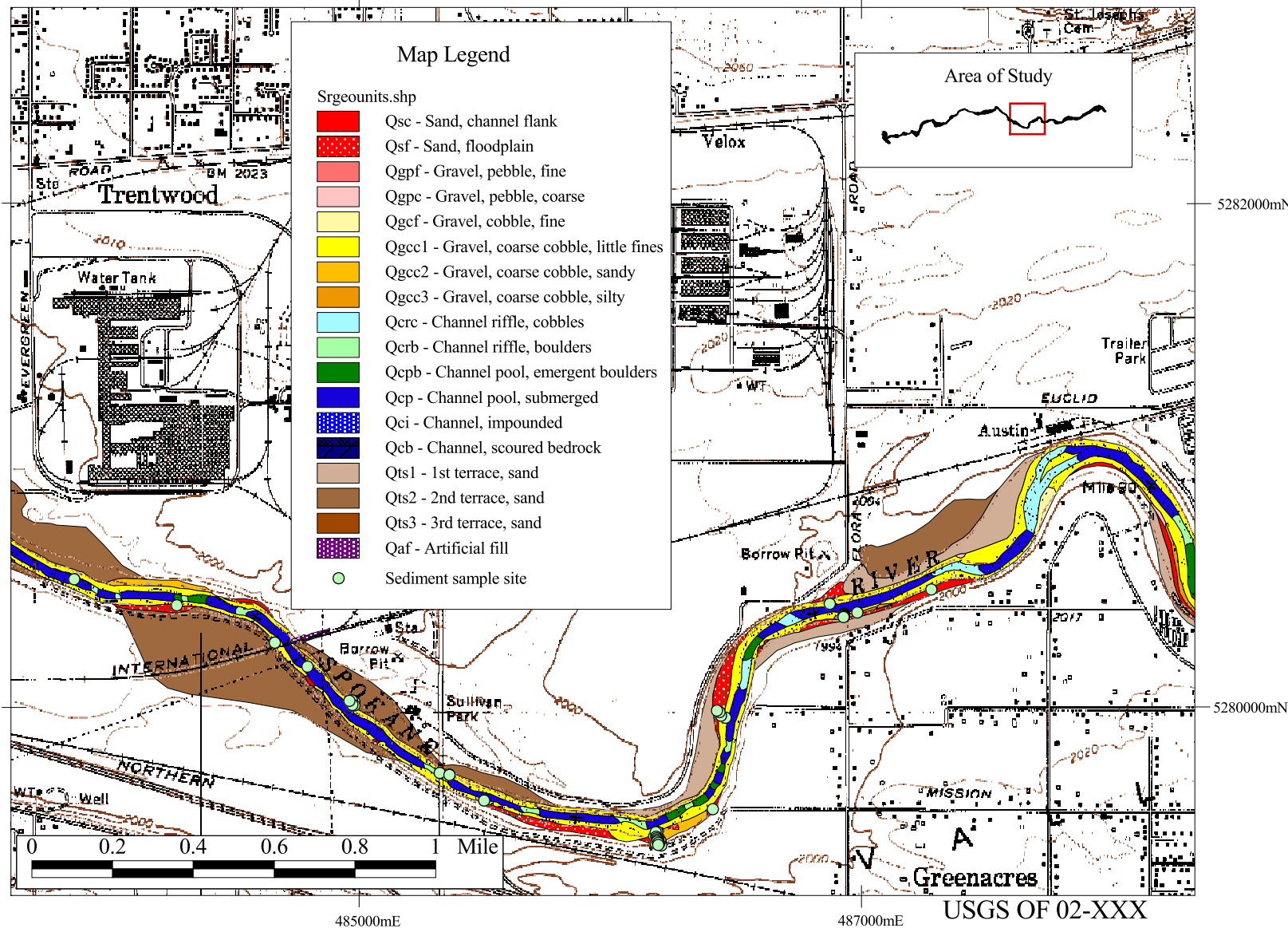


Plate 4. Spokane River surficial geology: west half of Greenacres quadrangle, WA (scale 1:24,000).

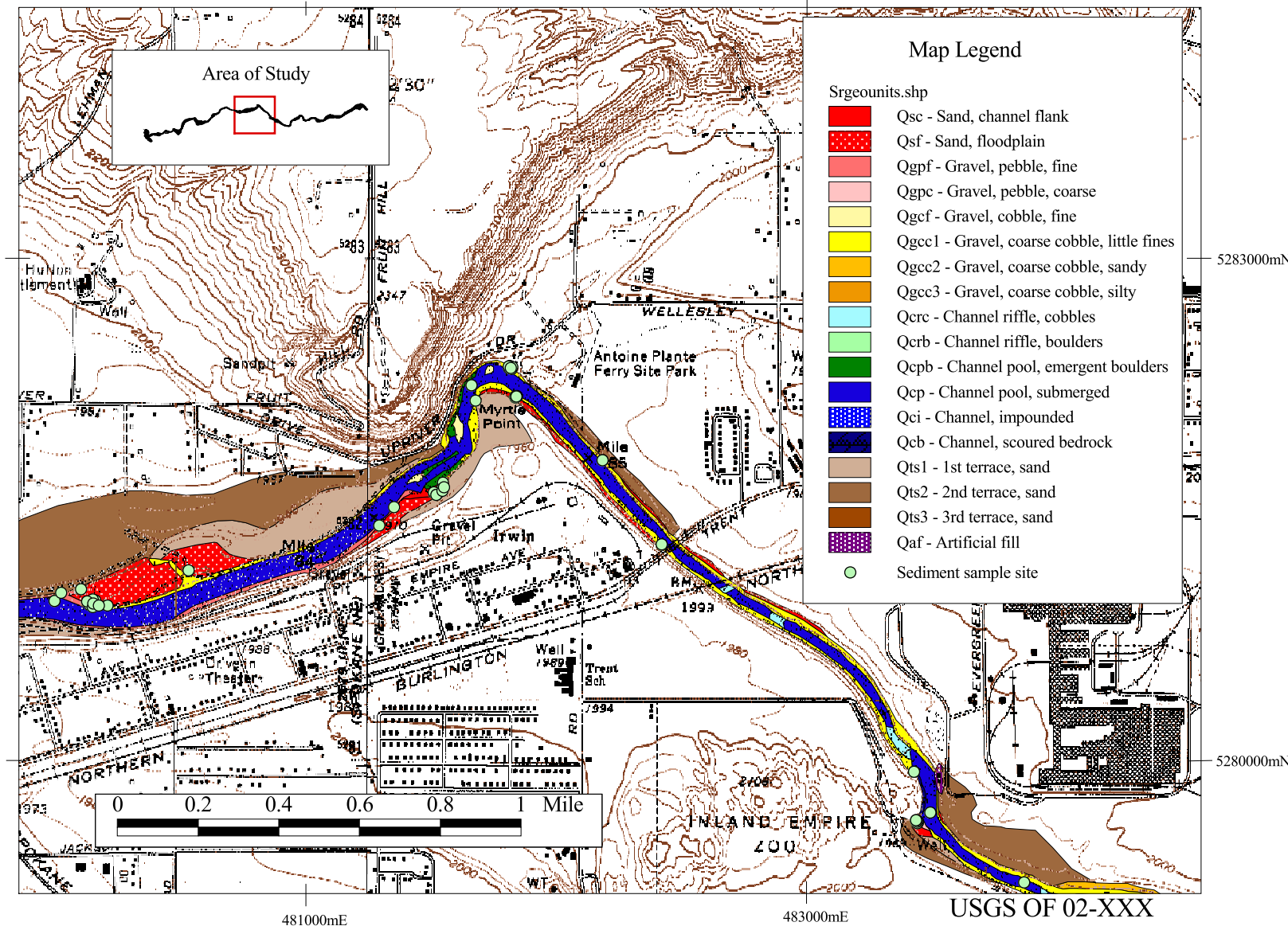


Plate 5. Spokane River surficial geology: east half of Spokane NE quadrangle, WA (scale 1:24,000).

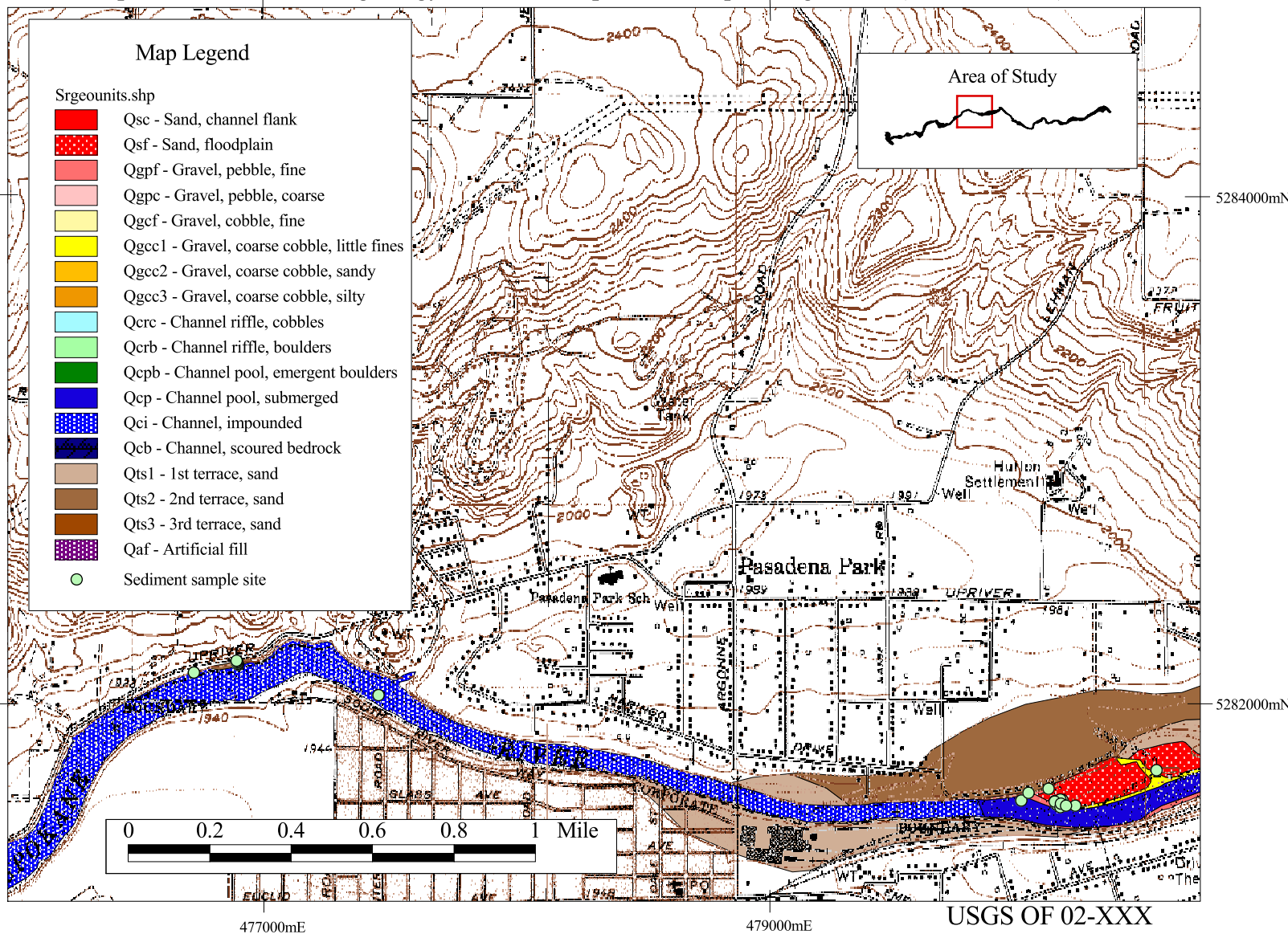


Plate 6. Spokane River surficial geology: west half of Spokane NE quadrangle, WA (scale 1:24,000).

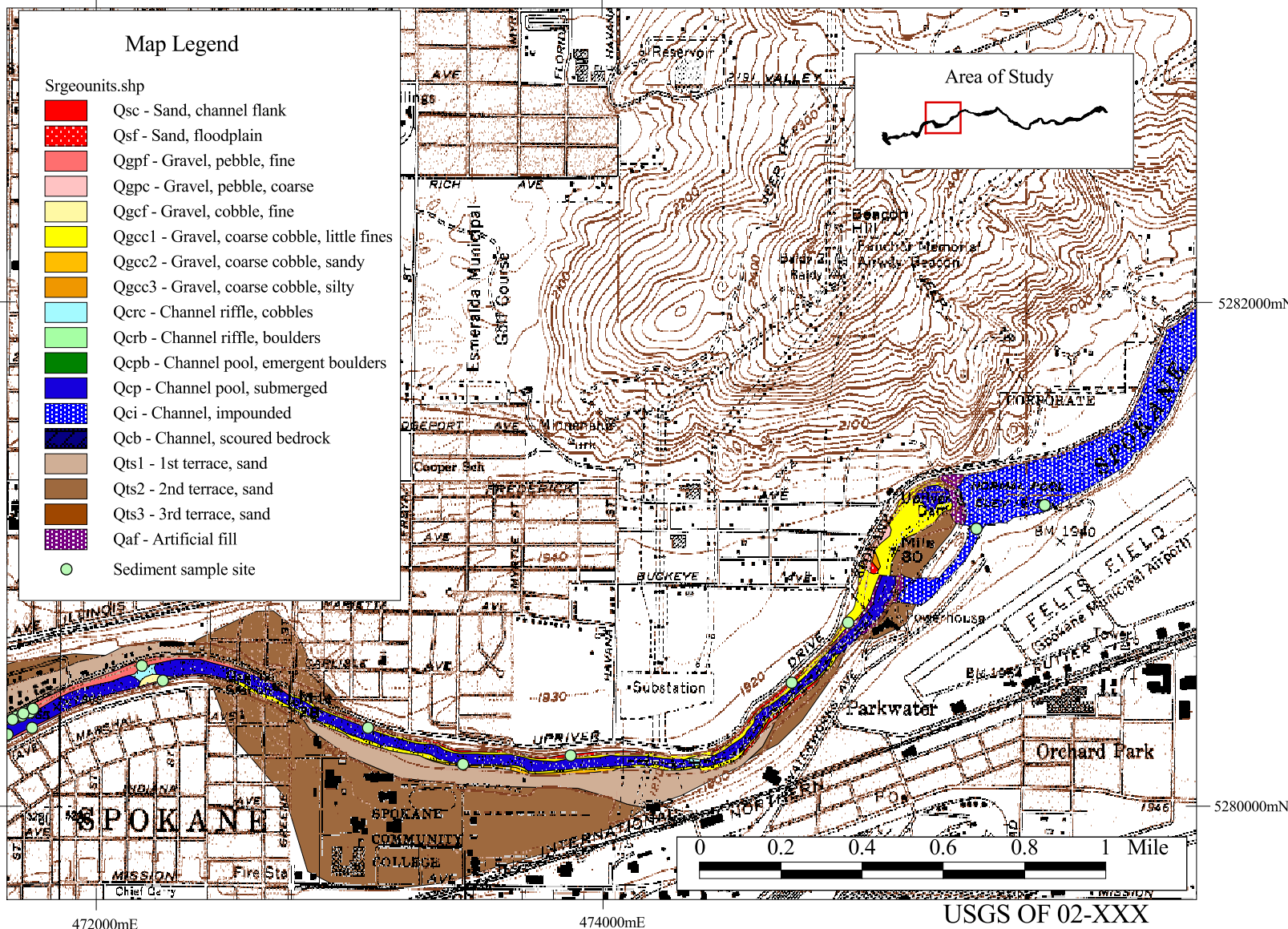


Plate 7. Spokane River surficial geology: east half of Spokane NW quadrangle, WA (scale 1:24,000).

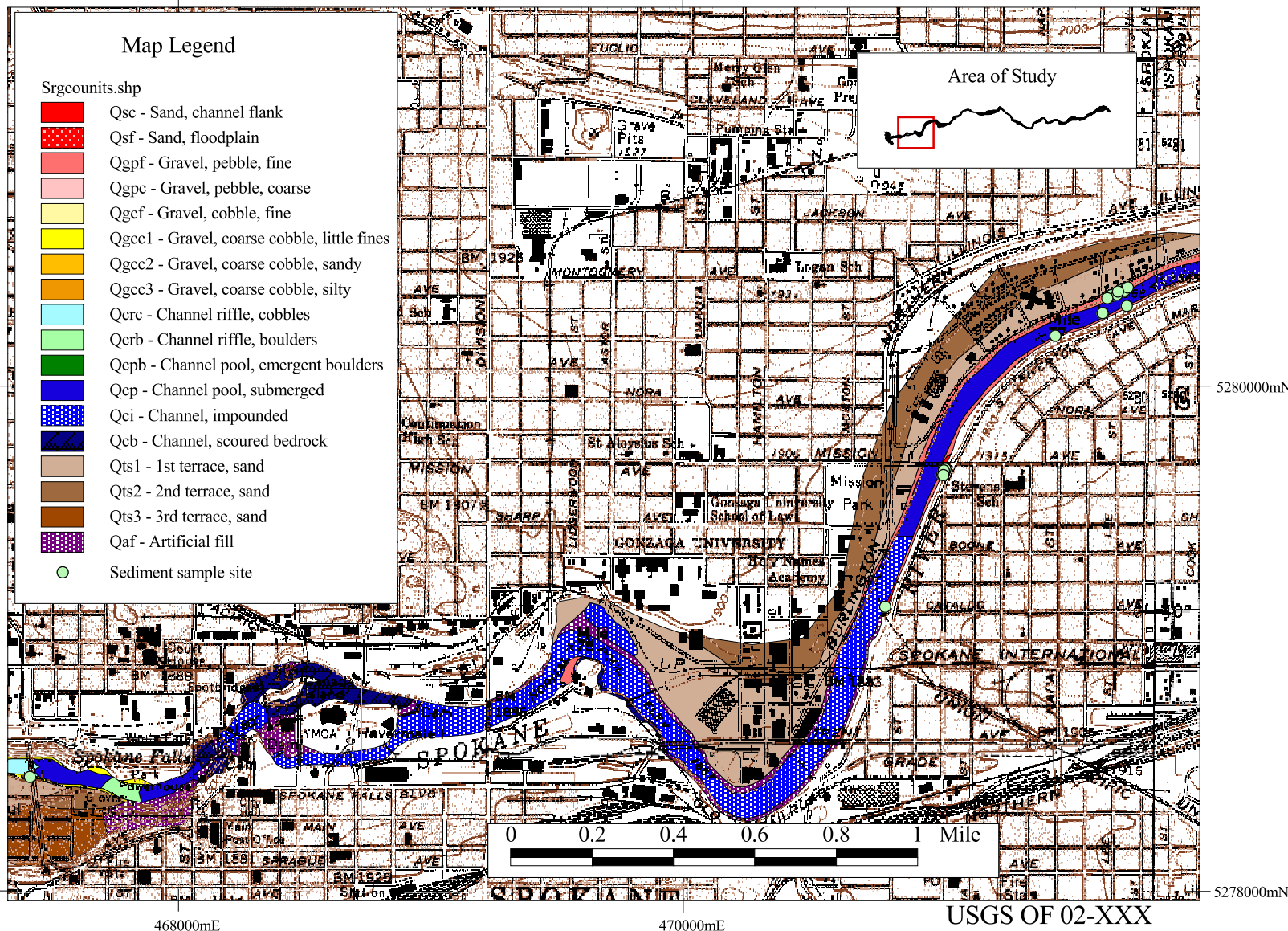
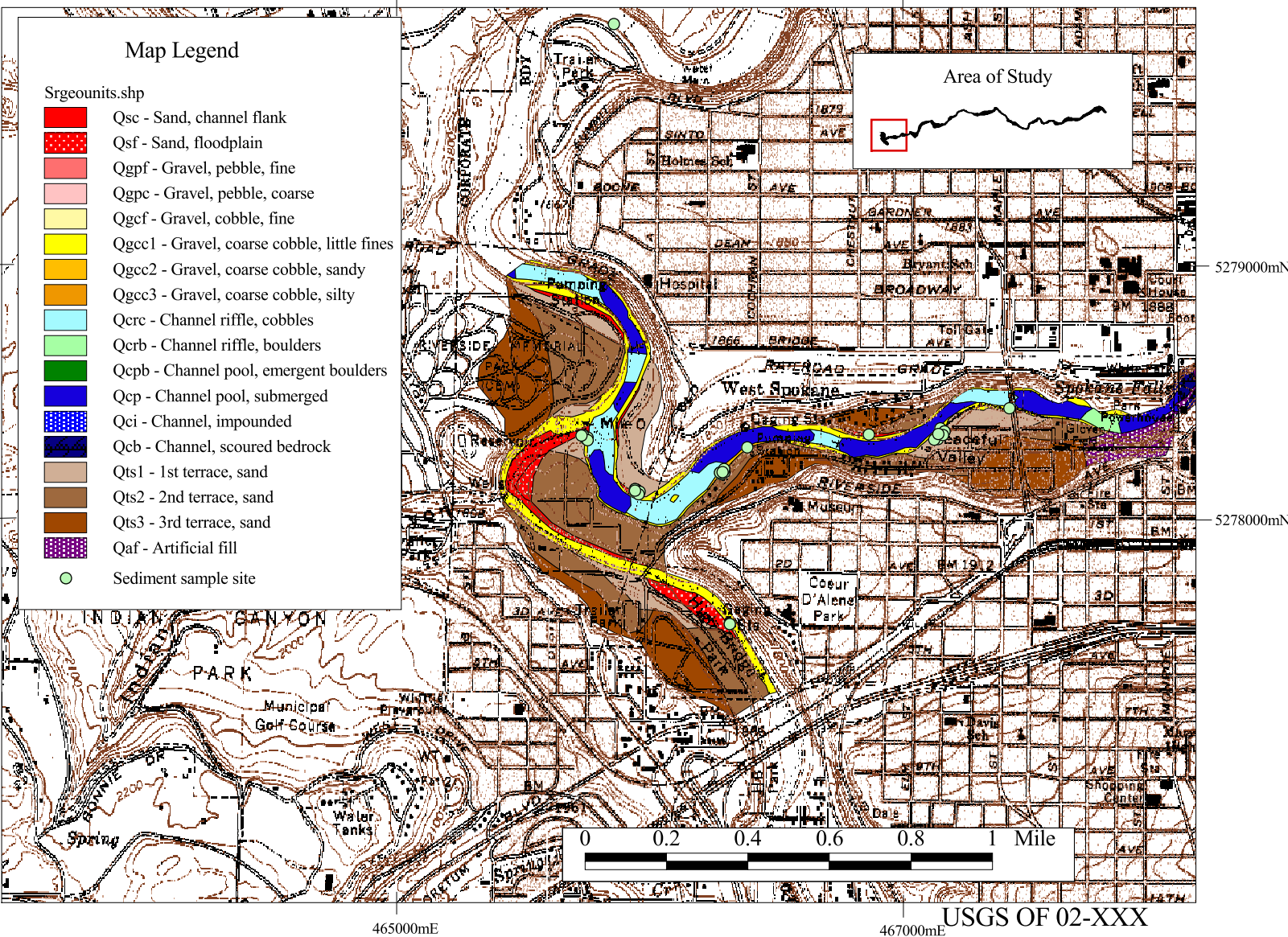


Plate 8. Spokane River surficial geology: west half of Spokane NW quadrangle, WA (scale 1:24,000).



Appendix A – List of digital files associated with this report

Text, figures and table of this report in PDF format

- of02-126.pdf Open-file report in PDF format.

ArcView shapefile and legend files for surficial geologic map unit polygons from plates 1-8 of this report

- srgeounits.shp/.sbx/.sbn/.shx/.dbf
- srgeounits.avl ArcView legend file

Table 1 from this report in Dbase4 format

- srsedchem.dbf geochemical data

Metadata for srgeounits.shp and for srsedchem.dbf

- srgeounits.txt see Appendix B
- srsedchem.txt see Appendix C

Obtaining Digital Data

The above digital files can be downloaded from the US Geological Survey public access World Wide Web site on the Internet:

URL = <http://geopubs.wr.usgs.gov/open-file/of02-126/>

APPENDIX B. Metadata for srgeounits.shp(srgeounits.met)

Identification_Information:

Citation:

Citation_Information:

Originator: Stephen E. Box

Originator: John C. Wallis

Publication_Date: 2001

Title:

Surficial geology along the Spokane River, Washington and its relationship to the metal content of sediments (Idaho-Washington stateline to Latah Creek confluence).

Edition: 1.0

Geospatial_Data_Presentation_Form: map

Series_Information:

Series_Name: Open File Report

Issue_Identification: OF-01-XXX

Publication_Information:

Publication_Place: Menlo Park, CA

Publisher: U.S. Geological Survey

Online_Linkage: <http://geopubs.wr.usgs.gov/open-file/of02-126>

Description:

Abstract:

The Spokane River flows westward into eastern Washington out of the northern end of Lake Coeur d'Alene in northern Idaho (figure 1). The river and lake lie downstream of the Coeur d'Alene mining district, where over 56 million metric tonnes of metal-enriched tailings were disposed into the Coeur d'Alene River between 1886 and 1968 (Long, 1998). Geochemical analyses of riverine sediments in the Spokane River by the Washington Dept of Ecology (Johnson, 1999), the US Geological Survey (Grosbois and others, 2001; Box and others, in prep.) and an EPA contractor (URS Greiner, 2000, 2001) have indicated that Spokane River sediments are variably enriched in metals derived from those tailings. In this report we present a surficial geologic map (plates 1 through 8) of the unconsolidated deposits within and along the Spokane River in eastern Washington between the Idaho stateline and the confluence with Latah Creek about 20 miles downstream. Existing sample datasets for sediments and soils in and along the Spokane River are also located on the map and the surficial geologic unit that was sampled is noted. This work was undertaken in cooperation with the Washington Department of Ecology and the Environmental Protection Agency.

Purpose:

The digital map was prepared in cooperation with the Department of Ecology and the Environmental Protection Agency to aid in the interpretation of the distribution, sources, and transport processes of metal-enriched sediment in and along the Spokane River. These agencies are evaluating the relative metal enrichment in the riverine sediments due to concerns of potential health impacts to humans, waterfowl, and aquatic organisms.

Supplemental _Information:

The digital surficial geologic map of the Spokane River channel and its margins in Washington between the Idaho state line and the confluence of Latah Creek was compiled on a base of 1:12,000 scale Digital Orthophoto Quarter Quadrangles (DOQQs) from field maps prepared on 1:3,000 scale paper printouts of the DOQQs in August and September of 2000. The units are defined by the lithologic character of the surficial sediment and by their geomorphological settings. The digital dataset discussed in this, Appendix C, Metadata (srgeounits.met) consist of one ArcView shape file (srgeounits.shp/.sbn/.sbx/.shx/.dbf/.avl) that provide the polygon outlines and identify the underlying lithologic units, projected in UTM zone 11, North American Datum of 1927 (NAD27).

The Metadata for this Open-File report consists of two separate Metadata files, Appendix B (srgeounits.met) described here and Appendix C (srsedchem.met) that discusses the dBase4 file srsedchem.dbf.

Time_Period_of_Content:
 Time_Period_Information:
 Single_Date/Time:
 Calendar_Date: 2000
 Currentness_Reference:
 Publication date
Status:
 Progress: Complete
 Maintenance_and_Update_Frequency: None planned

Spatial_Domain:
 Bounding_Coordinates:
 West_Bounding_Coordinate: -117 30 00
 East_Bounding_Coordinate: -117 00 00
 North_Bounding_Coordinate: 47 45 00
 South_Bounding_Coordinate: 47 35 00

Keywords:
 Theme:
 Theme_Keyword_Thesaurus: None
 Theme_Keyword: Geology
 Theme_Keyword: Surficial
 Theme_Keyword: Quaternary
 Theme_Keyword: Metals
 Theme_Keyword: Geochemistry
 Theme_Keyword: Mining
 Theme_Keyword: Environment
 Theme_Keyword: Sediment
 Theme_Keyword: River
 Theme_Keyword: Aquifer
 Theme_Keyword: Pollution
 Theme_Keyword: EPA
 Theme_Keyword: USGS
 Theme_Keyword: URS Greiner
 Theme_Keyword: Lead
 Theme_Keyword: Zinc
 Theme_Keyword: RI/FS
 Theme_Keyword: Superfund

Place:

Place_Keyword_Thesaurus: None
Place_Keyword: USA
Place_Keyword: Washington
Place_Keyword: Spokane
Place_Keyword: Spokane County
Place_Keyword: Spokane River
Place_Keyword: Liberty Lake
Place_Keyword: Green Acres
Place_Keyword: Spokane NE
Place_Keyword: Spokane NW
Place_Keyword: Idaho
Place_Keyword: Coeur d'Alene
Place_Keyword: Coeur d'Alene Lake

Access_Constraints: This digital dataset is not to be used or displayed at any scale larger than 1:12,000 (e.g., 1:6,000).

Use_Constraints:

Any hardcopies utilizing this data set shall clearly indicate its source. If the users have modified the data in any way, they are obliged to describe the types of modifications they have performed. The user specifically agrees not to misrepresent this data set, nor to imply that changes they made were approved by the U.S. Geological Survey.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Stephen E. Box

Contact_Organization: U.S. Geological Survey

Contact_Position: Geologist

Contact_Address:

Address_Type: mailing and physical address

Address: 904 W. Riverside Ave., Rm 202

City: Spokane

State_or_Province: WA

Postal_Code: 99201

Country: USA

Contact_Voice_Telephone: 509-368-3106

Contact_Facsimile_Telephone: 509-368-3199

Contact_Electronic_Mail_Address: sbox@usgs.gov

Hours_of_Service: 9 - 5 Pacific Time Zone

Native_Data_Set_Environment:

Windows NT ArcView 3.1

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

Attribute accuracy was verified by manual comparison of source data with hard-copy printouts, plots, and on-screen evaluations.

Logical_Consistency_Report:

These data are believed to be logically consistent, though no tests were performed.

Completeness_Report:

The minimum mapped polygon size is approximately 50 square meters. Polygon data is based on the geologic interpretation of the lithology and surficial features observed in and along the Spokane River channel.

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:
The horizontal positional accuracy for the digital data is accurate
To within +/- 15 meters based on digitizing RMS error.
Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report:
No vertical data

Lineage:

Source_Information:
Source_Citation:
Citation_Information:
Originator: U.S. Geological Survey
Publication_Date: 1997
Title:
Digital Raster Graphic (DRG)
Geospatial_Data_Presentation_Form: map
Series_Information:
Series_Name: Spokane West
Issue_Identification: 47117f1 (1973), 47117f2 (1986), 47117f3
(1986), 47117f4 (1986).
Publication_Information:
Publication_Place: Reston, VA
Publisher: U.S. Geological Survey
Online_Linkage: <http://mcmcweb.er.usgs.gov/drg/>
Source_Scale_Denominator: 24000
Type_of_Source_Media: CD-ROM
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 1973
Ending_Date: 1986
Source_Currentness_Reference:
ground condition
Source_Citation_Abbreviation:
DRG (USGS)
Source_Contribution:
DRGs were used in conjunction with DOQQs to digitize surficial
geologic features that were mapped in the field.

Source_Information:
Source_Citation:
Citation_Information:
Originator: U.S. Geological Survey
Publication_Date: 1992 and 1995
Title:
Digital Orthophoto Quarter Quadrangles (DOQQs)
Geospatial_Data_Presentation_Form: remote-sensing image
Series_Information:
Series_Name: None
Issue_Identification: 47117F11 (1992), 47117F12(1992),
47117F13 (1992), 47117F14 (1992), 47117F21 (1995), 47117F22
(1995), 47117F23 (1995), 47117F24 (1995), 47117F31 (1995),
47117F32 (1995), 47117F33 (1995), 47117F34 (1995), 47117F41
(1995), 47117F42 (1995), 47117F43 (1995), 47117F44 (1995).
Publication_Information:
Publication_Place: Reston, VA
Publisher: U.S. Geological Survey

Online_Linkage:
<http://rmmcweb.cr.usgs.gov/public/nmpstds/dogstds.html>
Source_Scale_Denominator: 12000
Type_of_Source_Media: online
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 5/22/1992
Ending_Date: 7/16/1995
Source_Currentness_Reference:
ground condition
Source_Citation_Abbreviation:
DOQQ (USGS)
Source_Contribution:
DOQQs were used as the geographic base map onto which the surficial geologic features, mapped in the field, were digitized.

Process_Step:

Process_Description:
DOQQs were used in ArcView 3.1 to transfer the field notes, drawings, and map interpretations of Spokane River lithology into a GIS layer where polygons were digitized. Polygons were hand digitized on screen using DOQQs as theme overlays at scales of 1:12,000 and larger with a hand operated mouse in ArcView 3.1. Polygon line work was based on geologic mapping on 1:3,000 scale DOQQs printouts that were used for field maps.

The ArcView script calcacre.ave was used to calculate the area (in square meters), the area in acres, and the perimeter (in meters) of all polygons in srgeounits.shp while projected in UTM NAD27.

Process_Date: 2000

Process_Contact:

Contact_Information:
Contact_Person_Primary:
Contact_Person: Stephen E. Box
Contact_Organization: U.S. Geological Survey
Contact_Position: Geologist
Contact_Address:
Address_Type: mailing and physical address
Address: 904 W. Riverside Ave., Rm 202
City: Spokane
State_or_Province: WA
Postal_Code: 99201
Country: USA
Contact_Voice_Telephone: 509-368-3108
Contact_Facsimile_Telephone: 509-368-3199
Contact_Electronic_Mail_Address: sbox@usgs.gov
Hours_of_Service: 9 - 5 Pacific Time Zone

SPATIAL_DATA_ORGANIZATION_INFORMATION

Direct_Spatial_Reference_Method: Vector

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: GT-polygon composed of chains

Point_and_Vector_Object_Count: 359

SPATIAL_REFERENCE_INFORMATION

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator

Universal_Transverse_Mercator:

UTM_zone_Number: 11

Transverse_Mercator:

Scale_Factor_at_Central_Meridian: 0.999600

Longitude_of_Central_Meridian: -117.000000

Latitude_of_Projection-Origin: 0.000000

False_Easting: 500000.000000

False_Northing: 0.000000

Planar_Coordinate_Information:

Planar_Coordinate_Encoding_Method: Coordinate pair

Coordinate_Representation:

Abscissa_Resolution:

Ordinate_Resolution:

Planar_Distance_Units: Meters

Geodetic_Model:

Horizontal_Datum_Name: North American Datum of 1927

Ellipsoid_Name: Clarke 1866

Semi-major_Axis: 6378206.4000000

Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:

Detailed_Description:

Entity_Type:

Entity_Type_Label: srgeounits.shp

Entity_Type_Definition: These polygon data represent the distribution of surficial geologic units in and along the Spokane River channel.

Entity_Type_Definition_Source: User defined

Entity_and_Attribute_Detail_Citation:

Attribute:

Attribute_Label: SHAPE

Attribute_Definition: Polygon

Attribute_Definition_Source: ArcView assigned

Attribute:

Attribute_Label: UNIT

Attribute_Definition: Surficial geologic map unit designation of the polygon.

Attribute_Definition_Source: User defined

Attribute:

Attribute_Label: UNIT_DESC

Attribute_Definition: A brief lithologic description of surficial geologic map unit.

Attribute_Definition_Source: User defined

Attribute:

Attribute_Label: AREA

Attribute_Definition: Area of the polygon (in square meters).
Attribute_Definition_Source: ArcView script

Attribute:

Attribute_Label: ACRES
Attribute_Definition: Number of acres contained within the polygon.
Attribute_Definition_Source: ArcView script

Attribute:

Attribute_Label: PERIMETER
Attribute_Definition: The length of the polygon perimeter in meters.
Attribute_Definition_Source: ArcView script

Attribute:

Attribute_Label: ID
Attribute_Definition: Unique numerical polygon identifier.
Attribute_Definition_Source: User defined

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:
Contact_Organization: U.S. Geological Survey

Contact_Instructions:

This report is only available in an electronic format at the following URL= <http://geopubs.wr.usgs.gov/OF02-126> or via anonymous FTP from [geopubs.wr.usgs.gov](http://geopubs.wr.usgs.gov/pub/OF02-126), in the directory pub/OF02-126

Resource_Description: Open-File Report OF02-126

Distribution_Liability:

The U.S. Geological Survey (USGS) provides these data "as is". The USGS makes no guarantee or warranty concerning the accuracy of the information contained in the data set. The USGS further makes no warranties, either expressed or implied as to any other matter whatsoever, including, without limitation, the condition of the product, or its fitness for any particular purpose. The burden for determining fitness for use lies entirely with the user. Although this data has been processed successfully on computers at the USGS, no warranty, expressed or implied, is made by the USGS regarding the use of this data on any other system, nor does the fact of distribution constitute or imply any such warranty. In no event shall the USGS have any liability whatsoever for payment of any consequential, incidental, indirect, special, or tort damages of any kind, including but not limited to, any loss of profits arising out of use or reliance on the geographic data or arising out of the delivery, installation, operation, or support by the USGS.

Metadata_Reference_Information:

Metadata_Date: 20020320

Metadata_Contact:

Contact_Information:

Contact_Person_Primary:
Contact_Person: John C. Wallis
Contact_Organization: U.S. Geological Survey
Contact_Position: Contractor
Contact_Address:
Address_Type: mailing and physical address

Address: 904 W. Riverside Ave., Rm 202
City: Spokane
State_or_Province: WA
Postal_Code: 99201
Country: USA
Contact_Voice_Telephone: 509-368-3108
Contact_Facsimile_Telephone: 509-368-3199
Contact_Electronic_Mail_Address: jwallis@usgs.gov
Hours_of_Service: 8:00 - 4:00 Pacific Time Zone
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Access_Constraints: none
Metadata_Use_Constraints: none

APPENDIX C. Metadata for srsedchem.dbf (srsedchem.met)

Identification_Information:

Citation:

Citation_Information:

Originator: Stephen E. Box

Originator: John C. Wallis

Publication_Date: 2001

Title:

Surficial geology along the Spokane River, Washington and its relationship to the metal content of sediments (Idaho-Washington stateline to Latah Creek confluence).

Edition: 1.0

Geospatial_Data_Presentation_Form: MS Excel DBF4 Table

Series_Information:

Series_Name: Open-File Report

Issue_Identification: OF01-XXX

Publication_Information:

Publication_Place: Menlo Park, CA

Publisher: U.S. Geological Survey

Online_Linkage: <http://geopubs.wr.usgs.gov/open-file/of02-126>

Description:

Abstract:

The Spokane River flows westward into eastern Washington out of the northern end of Lake Coeur d'Alene in northern Idaho (figure 1). The river and lake lie downstream of the Coeur d'Alene mining district, where over 56 million metric tonnes of metal-enriched tailings were disposed into the Coeur d'Alene River between 1886 and 1968 (Long, 1998). Geochemical analyses of riverine sediments in the Spokane River by the Washington Dept of Ecology (Johnson, 1999), the US Geological Survey (Grosbois and others, 2001; Box and others, in prep.) and an EPA contractor (URS Greiner, 2000, 2001) have indicated that Spokane River sediments are variably enriched in metals derived from those tailings. In this report we present a surficial geologic map (plates 1 through 8) of the unconsolidated deposits within and along the Spokane River in eastern Washington between the Idaho stateline and the confluence with Latah Creek about 20 miles downstream. Existing sample datasets for sediments and soils in and along the Spokane River are also located on the map and the surficial geologic unit that was sampled is noted. This work was undertaken in cooperation with the Washington Department of Ecology and the Environmental Protection Agency.

Purpose:

The data were prepared in cooperation with the Department of Ecology and the Environmental Protection Agency to aid in the interpretation of the distribution, sources, and transport processes of metal-enriched sediment in and along the Spokane River. These agencies are evaluating the relative metal enrichment in the riverine sediments due to concerns of potential health impacts to humans, waterfowl, and aquatic organisms.

Supplemental_Information:

The digital surficial geologic map of the Spokane River and its

margins in Washington between the Idaho stateline and the confluence of Latah Creek was compiled on a base of 1:12,000 scale Digital Orthophoto Quarter Quadrangles (DOQQs) from field maps prepared on 1:3,000 scale paper printouts of the DOQQs in August and September of 2000. The units are defined by the lithologic character of the surficial sediment and by their geomorphological settings. The dBase dataset (srsedchem.dbf) discussed in this Metadata contain analytical geochemistry data and sediment sample locations projected in UTM zone 11, North American Datum of 1927 (NAD27).

The Metadata for this Open-File report consists of two separate Metadata files. Appendix B (srgeounits.met) discusses the ArcView shape file srgeounits.shp. The sample geochemistry table (srsedchem.dbf) in dBase4 format is described here in Appendix C.

Time_Period_of_Content:

Time_Period_Information:

Multiple_Dates/Times:

Single_Date/Time:

Calendar_Date: 1999

Single_Date/Time:

Calendar_Date: 2000

Currentness_Reference:

publication date

Status:

Progress: Complete

Maintenance_and_Update_Frequency: None planned

Spatial_Domain:

Bounding_Coordinates:

West_Bounding_Coordinate: -117 30 00

East_Bounding_Coordinate: -117 00 00

North_Bounding_Coordinate: 47 45 00

South_Bounding_Coordinate: 47 35 00

Keywords:

Theme:

Theme_Keyword_Thesaurus: none

Theme_Keyword: Geology

Theme_Keyword: Surficial

Theme_Keyword: Quaternary

Theme_Keyword: Metals

Theme_Keyword: Geochemistry

Theme_Keyword: Mining

Theme_Keyword: Environment

Theme_Keyword: Sediment

Theme_Keyword: River

Theme_Keyword: Aquifer

Theme_Keyword: Pollution

Theme_Keyword: EPA

Theme_Keyword: USGS

Theme_Keyword: URS Greiner

Theme_Keyword: Lead

Theme_Keyword: Zinc

Theme_Keyword: RI/FS

Theme_Keyword: Superfund

Place:

Place_Keyword_Thesaurus: none
Place_Keyword: USA
Place_Keyword: Washington
Place_Keyword: Spokane
Place_Keyword: Spokane County
Place_Keyword: Spokane River
Place_Keyword: Liberty Lake
Place_Keyword: Green Acres
Place_Keyword: Spokane NE
Place_Keyword: Spokane NW
Place_Keyword: Idaho
Place_Keyword: Coeur d' Alene
Place_Keyword: Coeur d' Alene Lake

Access_Constraints: This digital dataset is not to be used or displayed at any scale larger than 1:12,000 (e.g., 1: 6,000).

Use_Constraints:

Any hardcopies utilizing this data set shall clearly indicate its source. If the users have modified the data in any way, they are obliged to describe the types of modifications they have performed. The user specifically agrees not to misrepresent this data set, nor to imply that changes they made were approved by the U.S. Geological Survey.

Point_of_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Stephen E. Box
Contact_Organization: U.S. Geological Survey

Contact_Position: Geologist

Contact_Address:

Address_Type: mailing and physical address
Address: 904 W. Riverside Ave., Rm 202
City: Spokane
State_or_Province: WA
Postal_Code: 99201
Country: USA

Contact_Voice_Telephone: 509-368-3106

Contact_Facsimile_Telephone: 509-368-3199

Contact_Electronic_Mail_Address: sbox@usgs.gov

Hours_of_Service: 9 - 5 Pacific Time Zone

Native_Data_Set_Environment:

MS Excel 2000 for Windows NT

Data_Quality_Information:

Attribute_Accuracy:

Attribute_Accuracy_Report:

Attribute accuracy of geospatial data was verified by manual comparison of the source field data with hardcopy printouts, and on screen evaluations. 100% of tabulated data for lead (Pb) and zinc (Zn) was verified between digital tables and the hardcopy sources from which they were derived.

Logical_Consistency_Report:

Point data is given in UTM NAD27

Positional_Accuracy:

Horizontal_Positional_Accuracy:

Horizontal_Positional_Accuracy_Report:

Sample location data came from several sources, and were tested by comparing source data to how they plotted on DRGs and DOQQs. Some data point locations, from source materials, were modified after on-screen evaluations showed errors in their plotted locations. After verbal discussions and written communications with the authors of the source data, our data now reflect the most accurate geospatial data we are able to produce. These data are therefore considered to be accurate to within +/- 25 meters depending on distinctiveness of the site and/or its distance from features both on the ground and on field maps.

Lineage:

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S. Geological Survey

Publication_Date: 1997

Title:

Digital Raster Graphic (DRG)

Geospatial_Data_Presentation_Form: map

Series_Information:

Series_Name: Spokane West

Issue_Identification: 47117f1 (1973), 47117f2 (1986), 47117f3 (1986), 47117f4 (1986).

Publication_Information:

Publication_Place: Reston, VA

Publisher: U.S. Geological Survey

Online_Linkage: <http://mcmcweb.er.usgs.gov/drg/>

Source_Scale_Denominator: 24000

Type_of_Source_Media: CD-ROM

Source_Time_Period_of_Content:

Time_Period_Information:

Range_of_Dates/Times:

Beginning_Date: 1973

Ending_Date: 1986

Source_Currentness_Reference:

ground condition

Source_Citation_Abbreviation:

DRG

Source_Contribution:

DRG's were used in conjunction with DOQQ's to verify all sample site locations that were identified in this report. They were also used to correct some of the source data (point locations) that may have been originally in error.

Source_Information:

Source_Citation:

Citation_Information:

Originator: U.S. Geological Survey

Publication_Date: 1992 and 1995

Title:

Digital Orthophoto Quarter Quadrangles (DOQQ)

Geospatial_Data_Presentation_Form: remote-sensing image

Series_Information:

Series_Name: None

Issue_Identification: 47117F11 (1992), 47117F12(1992),
47117F13 (1992), 47117F14 (1992), 47117F21 (1995), 47117F22
(1995), 47117F23 (1995), 47117F24 (1995), 47117F31 (1995),
47117F32 (1995), 47117F33 (1995), 47117F34 (1995), 47117F41
(1995), 47117F42 (1995), 47117F43 (1995), 47117F44 (1995).
Publication_Information:
Publication_Place: Reston, VA
Publisher: U.S. Geological Survey
Online_Linkage:
<http://rmmcweb.cr.usgs.gov/public/nmpstds/dogstds.html>
Source_Scale_Denominator: 12000
Type_of_Source_Media: online
Source_Time_Period_of_Content:
Time_Period_Information:
Range_of_Dates/Times:
Beginning_Date: 5/22/1992
Ending_Date: 7/16/1995
Source_Currentness_Reference:
ground condition
Source_Citation_Abbreviation:
DOQQ
Source_Contribution:
DOQQ's were used in conjunction with DRG's to verify all sample site
locations that were identified in this report. They were also used to
correct some of the source data (point locations) that may have been
originally in error.

Source_Information:
Source_Citation:
Citation_Information:
Publication_Date: Unpublished Material
Originator: USGS
Title: none
Geospatial_Data_Presentation_Form: Document with tabular data.
Type_of_Source_Media: paper
Source_Time_Period_of_Content:
Time_Period_Information:
Multiple_Dates/Times:
Single_Date/Time:
Calendar_Date: 1998
Single_Date/Time:
Calendar_Date: 1999
Source_Citation_Abbreviation: USGS-99
Source_Contribution: Written communication from Art Horowitz(USGS)
containing sample site geochemistry and sample locations
from Spokane River channel. These data were used to
compile the database (srsedchem.dbf).

Source_Information:
Source_Citation:
Citation_Information:
Originator: URS Greiner, Inc.
Publication_Date: 2000
Title: Draft Final Screening Level Human Health Risk Assessment
for Nonresidential Receptors Spokane River, Washington.

Coeur d'Alene Basin RI/FS.
Geospatial_Data_Presentation_Form: Document with tabular data.
Series_Information:
 Series_Name: Coeur d'Alene Basin RI/FS
Type_of_Source_Media: paper
Source_Time_Period_of_Content:
 Time_Period_Information:
 Single_Date/Time:
 Calendar_Date: 1999
Source_Citation_Abbreviation: URS-99
Source_Contribution: These data were used to compile a database
 (srsedchem.dbf) contain sediment sample locations and
 geochemistry from the Spokane River.

Source_Information:
 Source_Citation:
 Citation_Information:
 Originator: URS Greiner
 Publication_Date: Unpublished Material
 Title: none
 Geospatial_Data_Presentation_Form: Document with tabular data.
 Other_Citation_Details: written communication from URS Greiner.
Type_of_Source_Media: paper
Source_Time_Period_of_Content:
 Time_Period_Information:
 Single_Date/Time:
 Calendar_Date: 2000
Source_Citation_Abbreviation: URS-00
Source_Contribution: These field notes were used to compile the
 database (srsedchem.dbf) containing sediment sample locations
 and geochemistry from the Spokane River.

Source_Information:
 Source_Citation:
 Citation_Information:
 Originator: URS Greiner, Inc.
 Publication_Date: 2001
 Title: Draft Field Sampling Plan Addendum 18 - Fall 2000 Field
 Screening of Sediment in Spokane River Depositional
 Areas. Coeur d'Alene Basin RI/FS.
 Geospatial_Data_Presentation_Form: Document with tabular data.
 Series_Information:
 Series_Name: Coeur d'Alene Basin RI/FS
Type_of_Source_Media: paper
Source_Time_Period_of_Content:
 Time_Period_Information:
 Single_Date/Time:
 Calendar_Date: 2000
Source_Citation_Abbreviation: URS-01
Source_Contribution: These data were used to compile the database
 (srsedchem.dbf) containing sediment sample locations and
 geochemistry from the Spokane River.

Process_Step:

Process_Description:

This table (srsedchem.dbf) was originally compiled in MS excel 2000. It was then converted to dBase4 format and imported to ArcView 3.1 as an Event Theme.

This dBase4 table contains data from USGS-99, URS-99, URS-00, and URS-01, data sources. Point locations are presented in UTM zone 11 North American Datum of 1927 (NAD27). To verify sample site coordinates we plotted sample sites onto DRGs and/or DOQQs in ArcView 3.1. Some plotted locations did not match field descriptions or locations noted in source field notes or sketch maps. In some cases we were able to correct misfit locations by matching them to the locations noted on the original field maps. In other cases we moved misfit sample locations to an area that closely matched the description in the field notes of our source materials. These data are therefore considered to be accurate to within +/-10 meters depending on distinctiveness of the site and/or its distance from features both on the ground and on field maps.

Some of the geospatial source material was provided in geographic projection. These data had to be converted from latitude/longitude to UTM NAD27 using an ArcView script addxycoo.ave or an MS Excel Lat/Lon to UTM27 conversion table (written communication).

Process_Step:

Process_Description:

Process_Date: 2001

Process_Contact:

Contact_Information:

Contact_Person_Primary:

Contact_Person: Stephen E. Box

Contact_Organization: U.S. Geological Survey

Contact_Position: Geologist

Contact_Address:

Address_Type: mailing and physical address

Address: 904 W. Riverside Ave., Rm 202

City: Spokane

State_or_Province: WA

Postal_Code: 99201

Country: USA

Contact_Voice_Telephone: 509-368-3106

Contact_Facsimile_Telephone: 509-368-3199

Contact_Electronic_Mail_Address: sbox@usgs.gov

Hours_of_Service: 9 - 5 Pacific Time Zone

Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Point

Point_and_Vector_Object_Information:

SDTS_Terms_Description:

SDTS_Point_and_Vector_Object_Type: Entity point

Point_and_Vector_Object_Count: 350

Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:

Planar:

Grid_Coordinate_System:

Grid_Coordinate_System_Name: Universal Transverse Mercator

```

Universal_Transverse_Mercator:
  UTM_zone_Number: 11
  Transverse_Mercator:
    Scale_Factor_at_Central_Meridian: 0.999600
    Longitude_of_Central_Meridian: -117.000000
    Latitude_of_Projection-Origin: 0.000000
    False_Easting: 500000.000000
    False_Northing: 0.000000
Planar_Coordinate_Information:
  Planar_Coordinate_Encoding_Method: Row and column
  Coordinate_Representation:
    Abscissa_Resolution:
    Ordinate_Resolution:
  Planar_Distance_Units: Meters
Geodetic_Model:
  Horizontal_Datum_Name: North American Datum of 1927
  Ellipsoid_Name: Clarke 1866
  Semi-major_Axis: 6378206.4000000
  Denominator_of_Flattening_Ratio: 294.98

Entity_and_Attribute_Information:
  Detailed_Description:
    Entity_Type:
    Entity_Type_Label: srsedchem.dbf
Entity_Type_Definition:
  This dBase4 table contains sample point locations (UTM NAD27) and
  geochemical analyses.
Entity_Type_Definition_Source: User defined

Entity_and_Attribute_Detail_Citation:
  Attribute:
    Attribute_Label: SAMPLE_ID
    Attribute_Definition:
    Sample identifier
    Attribute_Definition_Source: from source reference

  Attribute:
    Attribute_Label: GRAINSIZE
    Attribute_Definition:
    Size fraction of analyzed sample (<2000 microns (um), <500 um,
    175 um, or <63 um).
    Attribute_Definition_Source: from source reference.

  Attribute:
    Attribute_Label: DATASET
    Attribute_Definition:
    Source of sample data USGS-99, URS-99, URS-00, URS-01.
    Attribute_Definition_Source: user defined

  Attribute:
    Attribute_Label: UTM27E
    Attribute_Definition:
    location of sample (UTM East, zone 11 NAD 27)
    Attribute_Definition_Source: computed

  Attribute:

```

Attribute_Label: UTM27N
Attribute_Definition:
location of sample (UTM North, zone 11 NAD 27)
Attribute_Definition_Source: computed

Attribute:

Attribute_Label: MAP_UNIT
Attribute_Definition:
Surficial geologic map unit of sediment sample. Can be one
of the following units:

| | |
|-------|--|
| Qsc | Sand, sloping channel flank deposit |
| Qsf | Sand, floodplain bench deposit |
| Qgpf | Gravel, fine pebble (2-20 mm) |
| Qgpc | Gravel, coarse pebble (20-64 mm) |
| Qgcf | Gravel, fine cobble (64-125 mm) |
| Qgcc1 | Gravel, coarse cobble and boulder (>125 mm), with little fines |
| Qgcc2 | Gravel, coarse cobble and boulder (>125 mm), with patches of sand |
| Qgcc3 | Gravel, coarse cobble and boulder (>125 mm), with patches of silt |
| Qcrc | Cobble riffle in low-flow channel |
| Qcrb | Boulder riffle in low-flow channel |
| Qcpb | Low-flow channel pool with emergent boulders |
| Qcp | Low-flow channel pool |
| Qci | Channel bed beneath impounded reservoirs |
| Qcb | Channel, scoured bedrock |
| Qts1 | Sand and gravel deposits of the first (lowest) terrace |
| Qts2 | Sand and gravel deposits of the second terrace |
| Qts3 | Sand and gravel deposits of the third terrace |
| Qaf | Artificial fill rock |

Attribute_Definition_Source: user defined

Attribute:

Attribute_Label: PB_PPM
Attribute_Definition:
The amount of lead detected in sample in parts per million (ppm) by
weight.
Attribute_Definition_Source: from source reference.

Attribute:

Attribute_Label: ZN_PPM
Attribute_Definition:
The amount of zinc detected in sample in parts per million (ppm) by
weight.
Attribute_Definition_Source: from source reference.

Attribute:

Attribute_Label: AS_PPM
Attribute_Definition:
The amount of arsenic detected in sample in parts per million (ppm)
by weight.
Attribute_Definition_Source: from source reference.

Attribute:

Attribute_Label: CD_PPM
Attribute_Definition:
The amount of cadmium detected in sample in parts per million (ppm)
by weight.
Attribute_Definition_Source: From source reference.

Attribute:
Attribute_Label: FE_%
Attribute_Definition:
The amount of iron detected in sample in percent (%) by weight
Attribute_Definition_Source: From source reference.

Attribute:
Attribute_Label: HG_PPM
Attribute_Definition:
The amount of mercury detected in sample in parts per million (ppm)
by weight.
Attribute_Definition_Source: From source reference.

Attribute:
Attribute_Label: MN_PPM
Attribute_Definition:
The amount of manganese detected in sample in parts per million (ppm)
by weight.
Attribute_Definition_Source: From source reference.

Attribute:
Attribute_Label: SB_PPM
Attribute_Definition:
The amount of antimony detected in sample in parts per million (ppm)
by weight.
Attribute_Definition_Source: Lab results

Attribute:
Attribute_Label: AL_%
Attribute_Definition:
The amount of aluminum detected in sample in percent (%) by weight.
Attribute_Definition_Source: From source reference.

Attribute:
Attribute_Label: AG_PPM
Attribute_Definition:
The amount of silver detected in sample in parts per million (ppm) by
weight.
Attribute_Definition_Source: From source reference.

Attribute:
Attribute_Label: BA_PPM
Attribute_Definition:
The amount of barium detected in sample in parts per million (ppm) by
weight.
Attribute_Definition_Source: From source reference.

Attribute:
Attribute_Label: BE_PPM
Attribute_Definition:
The amount of beryllium detected in sample in parts per million (ppm)
by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: C_TOT_%

Attribute_Definition:

The total amount of carbon detected in sample in percent (%) by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: TOC_%

Attribute_Definition:

The total amount of organic carbon detected in sample in percent (%) by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: CO_PPM

Attribute_Definition:

The amount of cobalt detected in sample in parts per million (ppm) by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: CR_PPM

Attribute_Definition:

The amount of chromium detected in sample in parts per million (ppm) by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: CU_PPM

Attribute_Definition:

The amount of copper detected in sample in parts per million (ppm) by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: NI_PPM

Attribute_Definition:

The amount of nickel detected in sample in parts per million (ppm) by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: P_PPM

Attribute_Definition:

The amount of phosphorus detected in sample in parts per million (ppm) by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: S_TOT_%

Attribute_Definition:

The total amount of sulfur detected in sample in percent (%) by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: SE_PPM

Attribute_Definition:

The amount of selenium detected in sample in parts per million (ppm) by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: SR_PPM

Attribute_Definition:

The amount of strontium detected in sample in parts per million (ppm) by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: TI_%

Attribute_Definition:

The amount of titanium detected in sample in percent (%) by weight.

Attribute_Definition_Source: From source reference.

Attribute:

Attribute_Label: V_PPM

Attribute_Definition:

The amount of vanadium detected in sample in parts per million (ppm) by weight.

Attribute_Definition_Source: From source reference.

Distribution_Information:

Distributor:

Contact_Information:

Contact_Organization_Primary:

Contact_Organization: U.S. Geological Survey

Contact_Instructions:

This report is only available in an electronic format at the following URL= <http://geopubs.wr.usgs.gov/OF02-126> or via anonymous FTP from geopubs.wr.usgs.gov, in the directory pub/OF02-126

Resource_Description: Open-File Report OF02-126

Distribution_Liability:

The U.S. Geological Survey (USGS) provides these data "as is". The USGS makes no guarantee or warranty concerning the accuracy of the information contained in the data set. The USGS further makes no warranties, either expressed or implied as to any other matter whatsoever, including, without limitation, the condition of the product, or its fitness for any particular purpose. The burden for determining fitness for use lies entirely with the user. Although this data has been processed successfully on computers at the USGS, no warranty, expressed or implied, is made by the USGS regarding the use of this data on any other system, nor does the fact of distribution constitute or imply any such warranty. In no event shall the USGS have any liability whatsoever for payment of any consequential, incidental, indirect, special, or tort damages of any kind, including but not limited to, any loss of profits arising out of use or reliance on the geographic data or arising out of the delivery, installation, operation, or support by the USGS.

Metadata_Reference_Information:
Metadata_Date: 20020320
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: John C. Wallis
Contact_Organization: U.S. Geological Survey
Contact_Position: Contractor
Contact_Address:
Address_Type: mailing and physical address
Address: 904 W. Riverside Ave., Rm 202
City: Spokane
State_or_Province: WA
Postal_Code: 99201
Country: USA
Contact_Voice_Telephone: 509-368-3108
Contact_Facsimile_Telephone: 509-368-3199
Contact_Electronic_Mail_Address: jwallis@usgs.gov
Hours_of_Service: 8:00 - 4:00 Pacific Time Zone
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Access_Constraints: none
Metadata_Use_Constraints: none