4.0 BASIN-WIDE ENVIRONMENTAL MONITORING PROGRAM

4.1 MONITORING PROGRAM DESIGN

Design of the BEMP implements the monitoring approach and principles discussed in Section 3.2 and will be used to evaluate the monitoring hypotheses presented in Section 3.3. The design intent is to develop sampling designs that provide the monitoring information needed for remedy documentation and evaluation consistent with the mandates of the ROD. Consistent with this monitoring mandate, the BEMP sampling designs represent observational studies not experimental studies, as the BEMP does not implement designed experiments.

Many trade-offs were made during the development of this monitoring plan. These trade-offs were necessary in order to keep the monitoring plan realistically achievable in terms of schedule, budget, and evaluation and interpretation of results. Within the anticipated limits of available funding, the sampling designs aim to provide sufficient information to assess Basin environmental conditions and measure progress toward and attainment of the ecological benchmarks identified in the ROD.

The sampling designs were developed using an iterative process where candidate designs are proposed and then analyzed, evaluated, and refined with the aim of reasonably optimizing performance, cost-effectiveness, and practicality. Performance means a sampling design's ability or effectiveness at providing information to assess Basin environmental conditions and measure progress toward and attainment of the ecological benchmarks identified in the ROD. Cost-effectiveness means that the sampling design provides adequate performance at minimum cost. Practicality means that the sampling design can be reasonably implemented in the field and that "adequate performance and cost-effectiveness" considers real or potential practical constraints and opportunities, including funding. Achieving adequate performance, cost-effectiveness, and practicality are utilitarian aims that require scientific and engineering knowledge and judgment.

Performance and relative cost-effectiveness can be quantified. Performance is quantified by subjecting candidate sampling designs to statistical power analyses. The power analyses quantify the statistical effectiveness of a given sampling design for hypothesis testing, characterizing uncertainty in true values, and establishing DQOs. Relative cost-effectiveness is quantified by comparing statistical effectiveness with the number of samples defined by the sampling design. It should be noted that both statistical effectiveness and the number of samples in a given sampling design will vary over time during the implementation period of the monitoring program. Results of the power analyses for candidate sampling designs are interpreted and evaluated in terms of performance, cost-effectiveness, and practicality, as discussed in the previous paragraph. The statistical power analyses are documented in Appendix D.

One very important implication from the statistical power analyses documented in Appendix D is the diminishing increase in statistical power resulting from increasing sampling frequency. The power analyses indicated that surface water and sediment sampling significantly more frequent than called for in this section would provide only a relatively modest (and not cost-effective) increase in the capability to detect subtle changes or trends in measured monitoring parameters at a given monitoring location or area. This implication applies generally to metal concentrations, loads, AWQC ratios, or the like. Very simply, increased sampling frequency cannot compensate for the time period (duration) of monitoring needed to reliably detect subtle effects that manifest slowly over time.

Furthermore, the power analyses indicated that for detecting long-term changes and trends with a given total sampling effort, cost-effectiveness and statistical power generally increase with the time between sampling events. While timely results over the 30-year monitoring period is required, the most cost-effective monitoring having the greatest statistical power will likely occur towards the end of the 30-year monitoring period. However, if at any time results from the BEMP suggest modifications should be made to the sampling plans identified in this section, the BEMP can be modified, consistent with a strategy of adaptive management.

4.2 MEDIA-SPECIFIC MONITORING PROGRAMS

This section describes the media-specific monitoring programs for surface water, soil and sediment, and biological resources. Where appropriate, monitoring activities for the various media will be co-located (for example, at locations with selected remedy benchmarks or surface water "sentinel" locations) to aid in data interpretation, minimize redundancy, and maximize information generated. Monitoring programs for surface water, soil and sediment, and biological resources are presented in Tables 4-1, 4-2, and 4-3, respectively. The following sections describe the specific monitoring programs for each medium. Tables 4-4 and 4-5 summarize the BEMP and schedule for implementation over the next 30 years. Sampling, data collection, and analytical methods for the monitoring programs are discussed in Section 5.

4.2.1 Surface Water

The surface water-monitoring program is designed to evaluate six of the BEMP monitoring hypotheses discussed in Section 3.3.

- **Monitoring Hypothesis 1.** There is a decrease in dissolved zinc and cadmium concentrations in surface water from the recent historic trend or pre-remediation condition.
- **Monitoring Hypothesis 3.** There is a decrease in particulate lead loads and concentrations in surface water from the recent historic trend or pre-remediation condition.

- **Monitoring Hypothesis 4.** There is a decrease in zinc AWQC ratios (dissolved metal concentration divided by AWQC) from the recent historic trend or pre-remediation condition.
- **Monitoring Hypothesis 6.** There is an improvement in metals retention in Coeur d'Alene Lake from the recent historic pre-remediation condition.
- **Monitoring Hypothesis 7.** Implementation of the remedy has resulted in "unwanted" impacts to the system such as recontamination, nutrient loading, excess sedimentation, etc.
- **Monitoring Hypothesis 8.** There has been progress toward achieving benchmarks of selected remedy.

Surface water monitoring data will also aid in interpretation of biological resources (specifically with respect to fisheries by providing information on the AWQC ratio) and understanding groundwater processes.

Monitoring locations were selected based on relevance to the above monitoring hypotheses. The selected remedy includes surface water benchmarks for AWQC ratios, dissolved metals loading, and/or particulate metals loading in the Canyon Creek, Ninemile Creek, Pine Creek, and South Fork watersheds, as well as in the Lower Basin.

A combination of surface water sampling frequencies is employed to obtain the required data in a cost-effective manner. Given the large area of the Basin and the pace of remedy implementation over the 30-year time frame, relevant changes in environmental media may occur relatively slowly. Consequently, monitoring at some stations may be conducted at a relatively long interval (e.g., five years) without compromising the ability to detect changes over time. Monitoring frequency designs include a combination of both fixed-interval sampling events and event-triggered sampling (such as rain on snow events). The fixed-interval monitoring frequencies are designed to evaluate Basin-wide conditions during both stable and transient periods of the Basin and lake hydrographs. This approach provides data to evaluate the monitoring hypotheses and improves the understanding of concentration and load versus discharge relationships in the Basin. The frequency designs are based on the Basin conceptual model, the benchmarks of the selected remedy, and the results of the statistical power analyses presented in Appendix D.

The surface water monitoring program includes annual sampling at key "sentinel" locations within the Basin. These "sentinel" locations will provide data on potential short-term trends or "trend discontinuities" in the longer-term trends. The seven locations identified as "sentinel" monitoring locations (Elizabeth Park, Smelterville, South Fork at Pinehurst, North Fork at Enaville, Harrison, St. Joe River at mouth, and Spokane River at Lake outlet) will be monitored eight times annually to provide information relative to Basin-wide conditions and mass balances of metals, nutrient, and sediment loading. The eight sampling events are based on the respective

hydrographs for the Basin and lake and are summarized on Table 4-1. Surface water samples collected eight times per year at sentinel stations will be analyzed for total and dissolved metals, hardness, suspended sediment, and nutrients. Total and dissolved metals analyses will include the chemicals of environmental concern (COECs) cadmium, lead, and zinc (ROD Section 5.2.2). Nutrient analysis will include total and dissolved nitrogen, and total and dissolved phosphorus.

The sentinel data also will be used to aid interpretation of data from the more spatially comprehensive, but less frequent, sampling events. This approach is anticipated to reduce the expense associated with sample collection and analysis while maintaining adequate monitoring effectiveness in terms of sensitivity and responsiveness.

Other locations in the Basin will be sampled less frequently (at 5-year intervals) to support ROD benchmark evaluation for the 5-year review process. "Benchmark" locations will be monitored eight times a year every five years to evaluate progress toward the benchmarks of the selected remedy (see Table 3-2). Benchmark locations include South Fork above Canyon Creek, Canyon Creek at mouth, upper East Fork Ninemile Creek, lower East Fork Ninemile Creek, Ninemile Creek at mouth, Pine Creek below Amy Gulch, Cataldo, and Spokane River at the Washington state line. Samples collected eight times a year every fifth year at Benchmark stations will be analyzed for the same suite of parameters as the sentinel station samples.

The 5-year monitoring at benchmark stations will be supplemented with an annual low-flow sampling event. The low-flow sampling event will be conducted every year at all monitoring stations (sentinel and benchmark) to provide information on trends of dissolved metals concentrations and loads and inter-annual variability within the Basin. Dissolved metals concentrations and loads typically exhibit the least variability during low-flow conditions, and trends in these parameters should be easier to detect using monitoring data collected during these relatively stable conditions. Surface water samples collected once per year during low-flow at benchmark stations will be analyzed for dissolved cadmium, lead, zinc, and hardness only.

Water samples collected during high flows (i.e., during peak snowmelt runoff or during rain-on-snow events) will be analyzed for total metals content of suspended sediment if sufficient suspended sediment is present in the water. Suspended sediment metals analyses will be performed on the filter residue from a 0.45 μm filter and the analytes will include the COECs for sediment: arsenic, cadmium, copper, lead, mercury, silver, and zinc (ROD Section 5.2.2). Sample preparation and analysis of the suspended sediment will be consistent with the soil/sediment preparation and analytical methods described in Section 5.2.

Metals and nutrient retention in Coeur d'Alene Lake will be evaluated based on mass balance results of loads measured at monitoring stations at the mouth of the St. Joe River, the Coeur d'Alene River at Harrison, and the Spokane River at the lake outlet. Monitoring at the lake outlet assumes discharge measurements from the existing USGS gauging station at Post Falls coupled with surface water sampling at the outlet, upstream of metals and nutrients inputs from

the City of Post Falls wastewater treatment plant and other urban sources. Changes to discharge as a result of groundwater/surface water interaction along the Spokane River between the lake outlet and Post Falls have not been quantified at this time. However, the largest loadings occur with high flow, and surface water/groundwater interaction differences are expected to be negligible compared to the total discharges at these times when most of the annual load passes these two stations. Future studies planned by USGS are aimed at quantifying flow relationships between the two locations. Evaluation of Lake Coeur d'Alene data collected under the BEMP will be coordinated with data collected under the Lake Management Plan.

The surface water-monitoring program is summarized in Table 4-1. Surface water monitoring locations are shown in Figure 4-1. Surface water sample collection and analytical methods are discussed in Section 5.

4.2.2 Soil and Sediment

The soil and sediment-monitoring program is designed to evaluate three of the BEMP monitoring hypotheses discussed in Section 3.3.

- **Monitoring Hypothesis 2.** There is a decrease in particulate lead concentrations in the flood plain soils/sediment, levees, and riverbed sediments from the recent historic trend or pre-remediation condition.
- **Monitoring Hypothesis 7**. Implementation of the remedy has resulted in "unwanted" impacts to the system such as recontamination or excess sedimentation.
- **Monitoring Hypothesis 8**. There has been progress toward achieving benchmarks of selected remedy.

The benchmarks evaluated by the soil and sediment monitoring program include those related to improvements in soil and sediment quality in the Ninemile Creek, Pine Creek, and South Fork watersheds, the Lower Basin, and the Spokane River above Upriver Dam.

The monitoring hypotheses and benchmarks will be evaluated primarily using comprehensive "snapshots" of Basin soil and sediment conditions at 10, 20, and 30 years from the date of the ROD. Samples will be collected from Upper Basin in-channel and floodplain (riparian) depositional areas, Lower Basin floodplains, and selected Spokane River in-channel or near-shore depositional areas. In the Upper Basin, samples will be collected from areas potentially affected by remedial actions selected in the ROD (Ninemile Creek, Pine Creek, and the South Fork). Composite samples will be collected at all locations to increase statistical power and reduce monitoring costs. In addition to BEMP sediment sampling, remedial action effectiveness monitoring is expected to occur in areas where sediment-focused remedial action is planned. The ROD includes sediment-related remedial actions at several locations, including Upriver Dam and selected Spokane River beaches. It is anticipated that performance monitoring will be an

important component of remedial action sediment or shoreline effectiveness monitoring associated with these actions.

In addition to the in-channel, shoreline and floodplain depositional sampling, core samples will be collected from mid-Long Lake and lower Long Lake along the Spokane River and near the Harrison Delta in Coeur d'Alene Lake every 10 years. At each location, the three cores will be located in the same general area (representing a potential geologic substratum of the lake) but no less than approximately 100 meters from each other (i.e., outside the range of potential short-range autocorrelations). Each core will be subjected to stratigraphic analysis that may include age dating, with details to be determined at the time the coring is planned. The sampling locations and three sampling points will be determined at the time the coring is planned. For the purpose of the BEMP, it is anticipated that results from the Long Lake coring will be pooled to represent the lake statistical sample, but that potential differences between the two locations will be analyzed and evaluated.

The 10-year comprehensive sampling programs will be augmented by annual "sentinel" sampling at key Basin locations. These sentinel samples will provide information on the inter-annual variability of sediment transported to and within the Lower Basin and provide valuable information for evaluation of potential unwanted impacts of remedy implementation (monitoring hypothesis 7). The sentinel locations will include in-channel and floodplain locations (sampling of the floodplain locations would be triggered by flood events). If practical, sediment traps will be used to collect sediment from the current year or flood event.

In addition to the comprehensive (10-year) and annual sediment sampling programs, sediment transport within the basin by surface water will be evaluated as a component of the surface water monitoring program. During surface water sampling at high-flow events, water samples will be collected and filtered to separate the water-suspended sediment. Water-suspended sediment (collected as filter residue) will be prepared and analyzed following the same procedures as other sediment samples collected for the BEMP.

Samples will be analyzed for the seven metals determined in the EcoRA to be COECs for sediment (arsenic, cadmium, copper, lead, mercury, silver, and zinc) with the evaluation focused on cadmium, lead, and zinc, the three primary COECs. In order to maximize comparability and evaluation of results, soil/sediment samples will be sieved to clay (<4 μm), silt (4-63 μm), and sand (63-250 μm) size fractions and prepared using a 4-acid digestion. Details for sample collection, preparation, and analysis are presented in Section 5.

The soil and sediment-monitoring program is summarized in Table 4-2 and sampling locations are shown on Figure 4-2.

4.2.3 Biological Resources

The biological resources monitoring program is designed to evaluate two of the BEMP monitoring hypotheses discussed in Section 3.3.

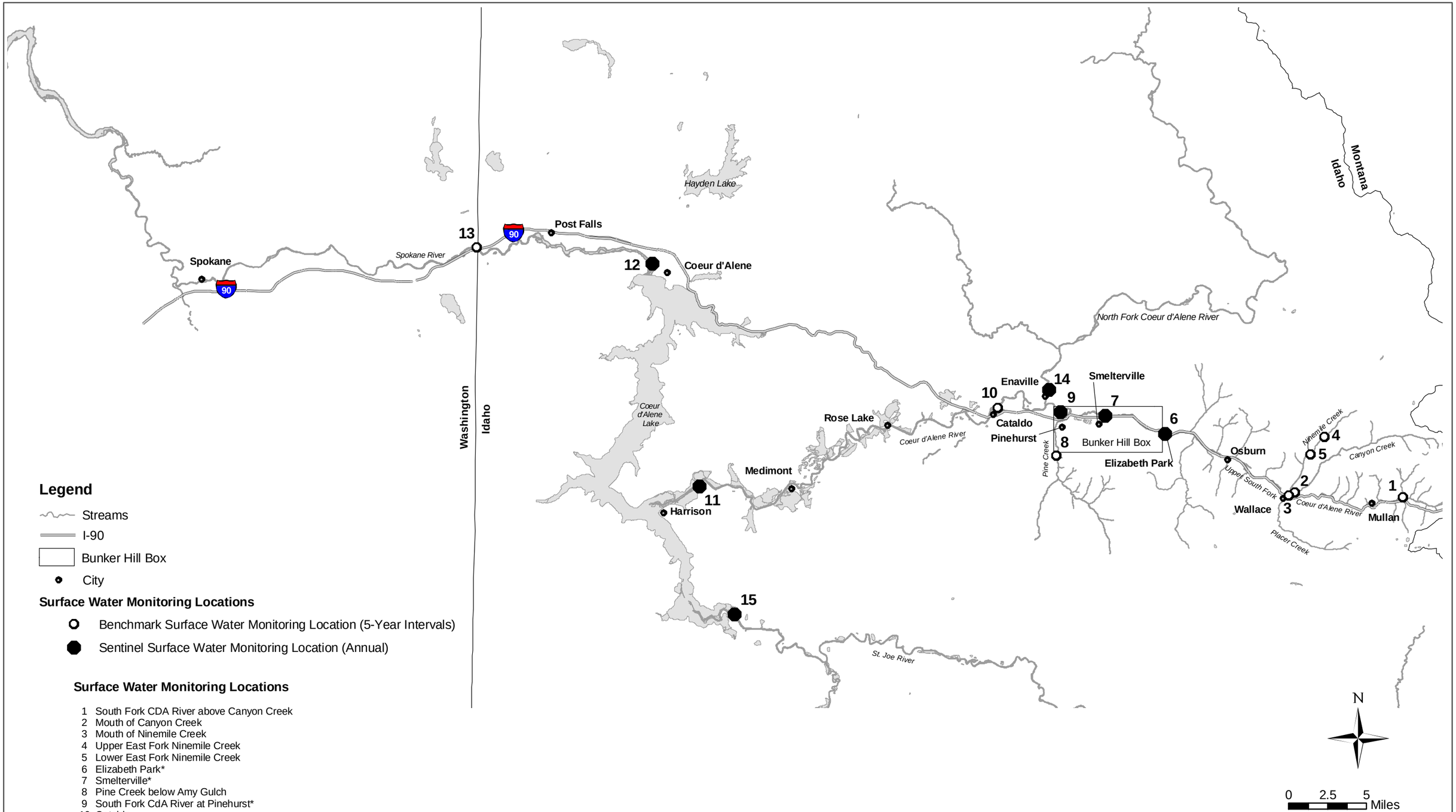
- **Monitoring Hypothesis 5.** There is an improvement in biotic benchmarks from the recent historic trend or pre-remediation condition.
- **Monitoring Hypothesis 8**. There has been progress toward achieving benchmarks of selected remedy.

Biotic benchmarks were established in the ROD (EPA 2002) and focus on indicators such as fish, songbirds, and waterfowl. Biological benchmark monitoring under the BEMP will evaluate improvements in biological resources on a habitat basis through the monitoring of habitat-specific indicators. The specific habitat indicators include:

- **Riverine habitat –** aquatic macroinvertebrates, fish, aquatic habitat assessment
- **Lacustrine / palustrine habitat –** waterfowl
- **Riparian habitat –** songbirds, terrestrial macroinvertebrates, riparian vegetation

Monitoring will be conducted at varying frequencies appropriate for the anticipated rate of change and variability of the specific biological indicators. Parameters anticipated to show considerable variation from year to year or sensitivity to changing ecological conditions (e.g. macroinvertebrate diversity/abundance, waterfowl population) are scheduled for monitoring at increased frequencies (e.g., twice or three times per five years). Most parameters are planned for monitoring at less frequent intervals (5-years). The frequencies are shown in the summary of the biological resources monitoring program presented in Table 4-3. The frequencies of monitoring for the different parameters allow for the biological monitoring to be distributed over time by staggering the schedules for the different parameters. The schedule for biological resources monitoring is presented in Table 4-5.

Monitoring of biological resource parameters will be conducted in accordance with Upper Columbia Fish and Wildlife Office (UCFWO) protocols designed for data continuity and comparability with existing studies. Data and sample collection methods are presented in Section 5. Results from the BEMP biological resources monitoring activities may be supplemented with results from remedial action-specific effectiveness and Box biological resources monitoring.



Legend

- Streams
- I-90
- Bunker Hill Box
- City

Surface Water Monitoring Locations

- Benchmark Surface Water Monitoring Location (5-Year Intervals)
- Sentinel Surface Water Monitoring Location (Annual)

Surface Water Monitoring Locations

1 South Fork CDA River above Canyon Creek
2 Mouth of Canyon Creek
3 Mouth of Ninemile Creek
4 Upper East Fork Ninemile Creek
5 Lower East Fork Ninemile Creek
6 Elizabeth Park*
7 Smelterville*
8 Pine Creek below Amy Gulch
9 South Fork CdA River at Pinehurst*
10 Cataldo
11 Harrison*
12 Lake Outlet*
13 Spokane River at Stateline (WA)
14 North Fork at Enaville*
15 Mouth of St. Joe River*

Note:
* Sentinel Surface Water Monitoring Locations

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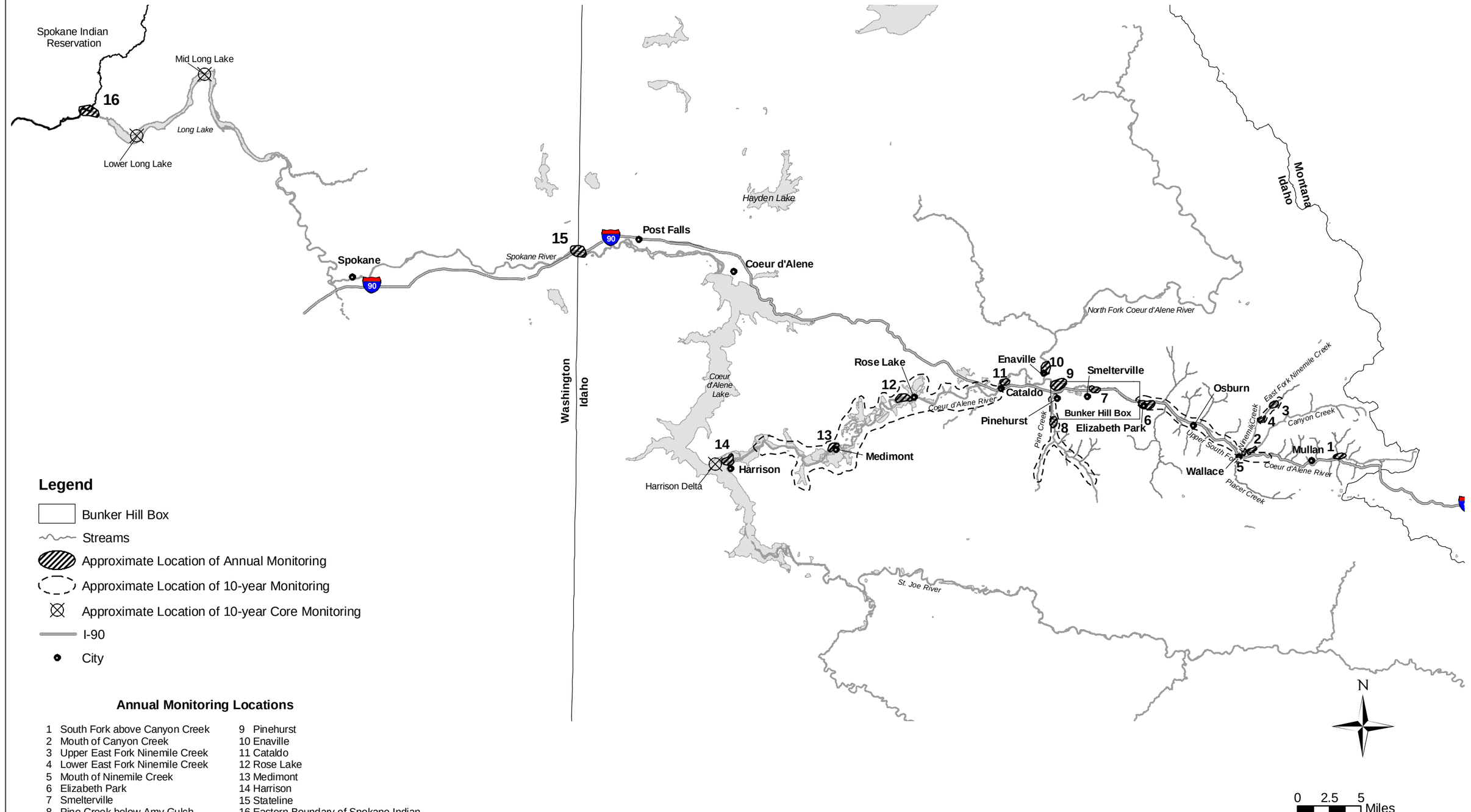
Coeur d'Alene Basin
Environmental
Monitoring Plan

DCN 4162500.07190.05.a

March 26, 2004

Figure 4-1

Surface Water Monitoring Locations
Coeur d'Alene Basin Environmental Monitoring Plan



Legend

- Bunker Hill Box
- Streams
- Approximate Location of Annual Monitoring
- Approximate Location of 10-year Monitoring
- Approximate Location of 10-year Core Monitoring
- I-90
- City

Annual Monitoring Locations

1 South Fork above Canyon Creek
2 Mouth of Canyon Creek
3 Upper East Fork Ninemile Creek
4 Lower East Fork Ninemile Creek
5 Mouth of Ninemile Creek
6 Elizabeth Park
7 Smelterville
8 Pine Creek below Amy Gulch
9 Pinehurst
10 Enaville
11 Cataldo
12 Rose Lake
13 Medimont
14 Harrison
15 Stateline
16 Eastern Boundary of Spokane Indian Reservation at Spokane River

10-Year Monitoring Locations

South Fork Coeur d'Alene River
Ninemile Creek
Pine Creek
Lower Basin Floodplain
Harrison Delta (Core Sampling)
Mid Long Lake (Core Sampling)
Lower Long Lake (Core Sampling)

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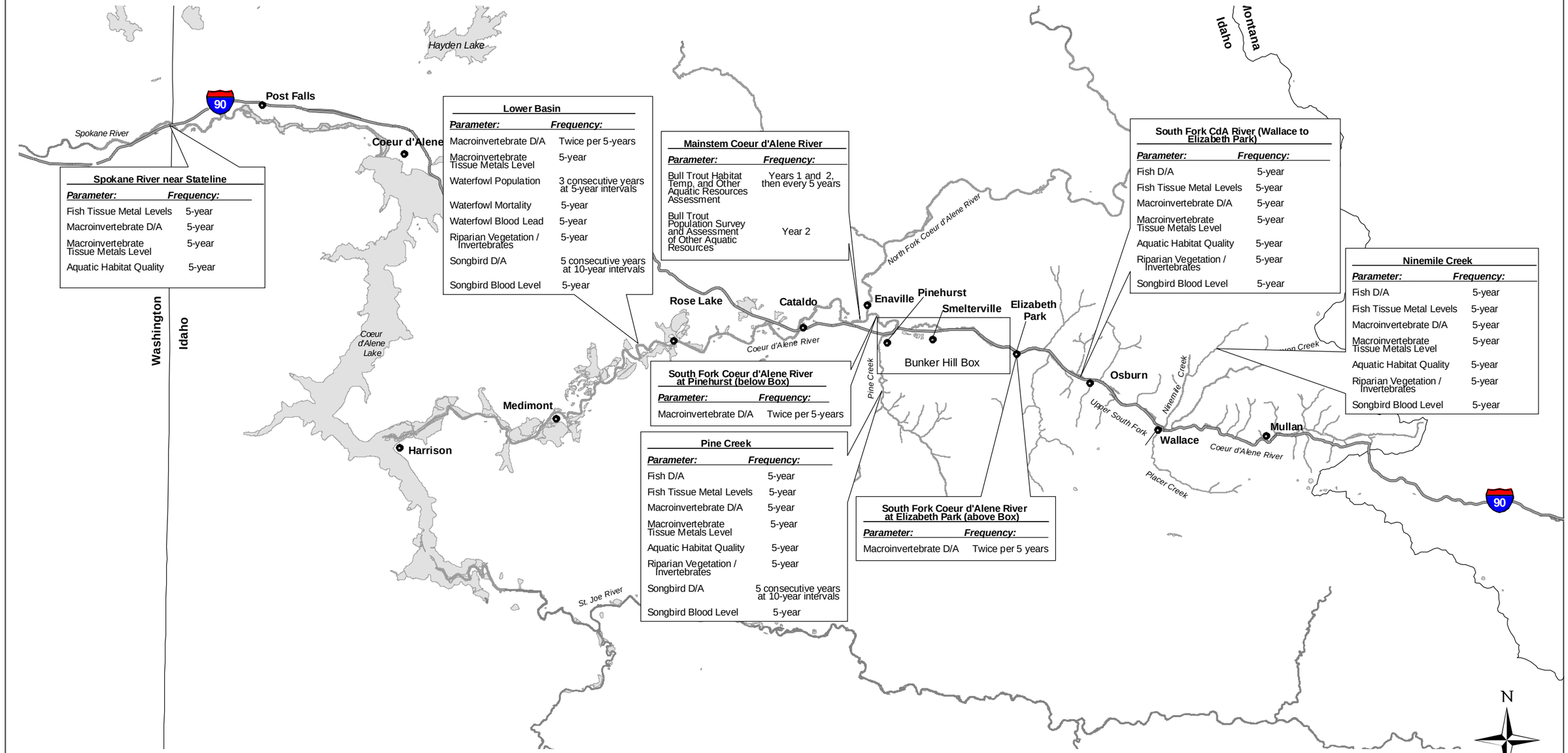
Figure 4-2
Soil / Sediment Monitoring Locations
Coeur d'Alene Basin Environmental Monitoring Plan



Spokane River near Stateline

Parameter:	*Frequency:*
Fish Tissue Metal Levels	5-year
Macroinvertebrate D/A	5-year
Macroinvertebrate Tissue Metals Level	5-year
Aquatic Habitat Quality	5-year

Lower Basin

Parameter:	*Frequency:*
Macroinvertebrate D/A	Twice per 5-years
Macroinvertebrate Tissue Metals Level	5-year
Waterfowl Population	3 consecutive years at 5-year intervals
Waterfowl Mortality	5-year
Waterfowl Blood Lead	5-year
Riparian Vegetation / Invertebrates	5-year
Songbird D/A	5 consecutive years at 10-year intervals
Songbird Blood Level	5-year

Mainstem Coeur d'Alene River

Parameter:	*Frequency:*
Bull Trout Habitat Temp. and Other Aquatic Resources Assessment	Years 1 and 2, then every 5 years
Bull Trout Population Survey and Assessment of Other Aquatic Resources	Year 2

South Fork Coeur d'Alene River at Pinehurst (below Box)

Parameter:	*Frequency:*
Macroinvertebrate D/A	Twice per 5-years

Pine Creek

Parameter:	*Frequency:*
Fish D/A	5-year
Fish Tissue Metal Levels	5-year
Macroinvertebrate D/A	5-year
Macroinvertebrate Tissue Metals Level	5-year
Aquatic Habitat Quality	5-year
Riparian Vegetation / Invertebrates	5-year
Songbird D/A	5 consecutive years at 10-year intervals
Songbird Blood Level	5-year

South Fork Coeur d'Alene River at Elizabeth Park (above Box)

Parameter:	*Frequency:*
Macroinvertebrate D/A	Twice per 5 years

South Fork CdA River (Wallace to Elizabeth Park)

Parameter:	*Frequency:*
Fish D/A	5-year
Fish Tissue Metal Levels	5-year
Macroinvertebrate D/A	5-year
Macroinvertebrate Tissue Metals Level	5-year
Aquatic Habitat Quality	5-year
Riparian Vegetation / Invertebrates	5-year
Songbird Blood Level	5-year

Ninemile Creek

Parameter:	*Frequency:*
Fish D/A	5-year
Fish Tissue Metal Levels	5-year
Macroinvertebrate D/A	5-year
Macroinvertebrate Tissue Metals Level	5-year
Aquatic Habitat Quality	5-year
Riparian Vegetation / Invertebrates	5-year
Songbird Blood Level	5-year

Legend

- Streams
- I-90
- Bunker Hill Box
- City

D/A Diversity and Abundance

Biological Resources Monitoring Locations

1 Ninemile Creek
2 South Fork Coeur d'Alene River (Wallace to Elizabeth Park)
3 South Fork Coeur d'Alene River at Elizabeth Park (above Box)
4 South Fork Coeur d'Alene River at Pinehurst (below Box)
5 Pine Creek
6 Mainstem Coeur d'Alene River
7 Lower Basin
8 Spokane River at Stateline

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Figure 4-3

Biological Resources Monitoring Locations Coeur d'Alene Basin Environmental Monitoring Plan

Table 4-1
Surface Water Monitoring Program

Location	Station ID	USGS Station ID	IDEQ Station ID	Gaging Station Type	Sentinel Monitoring [a] (Annual)	ROD Benchmark Monitoring [a] (Every 5 years)	Fall Baseflow Monitoring [b] (Every Oct.)	Rationale
SFCDA above Canyon Creek (near Mullan at Deadman Gulch)	SF-208	12413040	None	Misc.	--	X	X	Supports ROD Benchmark Evaluation
Mouth of Canyon Creek	CC-287/ CC-288	12413125	CC-1	Standard	--	X	X	Supports ROD Benchmark Evaluation
Mouth of Ninemile Creek	NM-305	12413130	NM-1	Standard	--	X	X	Supports ROD Benchmark Evaluation
Upper E Fork Ninemile Creek (above Success Mine)	NM-295	124131265	ENM-3	Misc.	--	X	X	Supports ROD Benchmark Evaluation
Lower E Fork Ninemile Creek	NM-298	12413127	ENM-1	Misc.	--	X	X	Supports ROD Benchmark Evaluation
Elizabeth Park [c]	SF-268	12413210	SF-3	Standard	X	--	X	Sentinel Station, Load from SFCDR above Bunker Hill Box, Supports ROD Benchmark Evaluation
Smelterville [c]	SF-270	12413300	SF-2	Misc.	X	--	X	Sentinel Station, Load from SFCDR below CIA & Govt. Gulch
Pine Creek Below Amy Gulch	PC-339	12413445	None	Standard	--	X	X	Supports ROD Benchmark Evaluation
South Fork at Pinehurst [c]	SF-271	12413470	SF-1	Real-time	X	--	X	Sentinel Station, Load from SFCDR below Bunker Hill Box, supports ROD Benchmark Evaluation
Cataldo	LC-50	12413500	Cataldo	Real-time [e]	--	X	X	Upper Basin/Lower Basin River Character Transition
Harrison	L-C60	12413860	Harrison	Real-time (w/ suspended sediment)	X	--	X	Sentinel Station, Inflow to Lake
Spokane River at Outlet (See Note [d])	See Note [d]	See Note [d]	None	Misc. [e]	X	--	X	Sentinel Station, Outflow from Lake
Spokane River near Stateline	SR-55	12419500	None	Misc.	--	X	X	Required for WA State
NF CDR at Enaville	NF-50	12413000	None	Real-time	X	--	X	Sentinel Station, Load from North Fork CDR
St. Joe River at Mouth (Chatcolet)	SJ-60	12415130	None	Real-time (w/ suspended sediment)	X	--	X	Sentinel Station, Load from St. Joe River

Schedule for Sentinel (Annual) and Benchmark (Every 5 Years) Monitoring

Coeur d'Alene River, its Tributaries and St. Joe River

1. Fall Baseflow (early October)
2. Initial Flush after Baseflow (Fall)
3. Rain-on-snow (Winter or Early Spring)
4. Winter Baseflow (January - March)
5. Peak Snowmelt Runoff (late May. - Suspended sediment chemistry)
6. Hydrograph Recession 1 (mid-June)
7. Hydrograph Recession 2 (mid July)
8. Hydrograph Recession 3 (mid-August)

Spokane River

1. Mid-Fall Drawdown (mid-October)
2. Post-Fall Drawdown (late December)
3. Low Pool (mid-Winter)
4. Rain-on-snow (late Winter or early Spring)
5. Lake Filling (late April or early May)
6. Snowmelt Runoff Peak (late May)
7. Full Pool (mid July)
8. Full Pool, Maximum Productivity (late August)

Notes:

[a] Sentinel and benchmark station samples collected 8 times per year will be analyzed for total metals, dissolved metals, hardness, and nutrients. Metals analysis will include COECs (Cd, Pb, Zn; ROD Sect. 5.2.2). Nutrient analysis will include total and dissolved nitrogen and total and dissolved phosphorus. Samples collected during high flows (i.e. during peak snowmelt runoff in late May) will also be analyzed for suspended sediment grain size distribution metals.

[b] Benchmark stations sampled once a year will be analyzed for dissolved metals and hardness only. Metals analyses will include COECs (Cd, Pb, Zn; ROD Sect. 5.2.2).

[c] BEMP monitoirng within the Box will be coordinated with ongoing surface water / groundwater monitoring performed for the Box. Coordination of these programs (to the extent practical) will aid in the interpretation of monitoring results from the BEMP and the Box monitroinf programs.

[d] Discharge measurements to be taken at Post Falls gaging station (USGS Station No. 12419000); surface water sample to be collected at Lake Outlet. EPA Station ID for Lake Outlet is SR-5 and for Post Falls is SR-50.

[e] Funded by Idaho Water Resources

Table 4-2
Sediment Monitoring Program

Area	Sampling Description [a]
Sentinel Locations: Annual sampling to evaluate time-history trends (Fall)	
Upper Basin and Lower Basin : Surficial in-channel sediment from selected locations [b]	Composite surface samples
Spokane River : Near Stateline and near eastern boundary of Spokane Reservation	
Upper Basin, Lower Basin, and Spokane River: Water-suspended sediment sampling during high-flow conditions [c]	Filter residue from filtration of surface water samples collected during high flow events.
Basin-Wide Assessment ("Snapshot") Locations: Sampling every 10 years to evaluate aggregated, area-wide temporal averages (i.e. ratio analysis) (Fall)	
Upper Basin : Ninemile Creek, South Fork, Pine Creek	Composite surface sampling of in-channel and riparian sediment and soil.
Lower Basin : Floodplain and Harrison Delta [d]	Grid-based, composite surface sampling of riparian, lacustrine, and palustrine sediment deposits.
Spokane River: Mid and lower Long Lake [d]	Sediment core sampling

[a] Samples will be analyzed for grain size distributions of COEC metals (arsenic, cadmium, copper, lead, mercury, silver, and zinc). Sampling methods and analytical protocols for grain size distributions, sample digestion, and analysis are presented on BEMP Tables 5-1 and 5-2. (i.e. grain size distributions, sample digestion, and analytical methods). Suspended sediment monitoring locations and frequencies are presented on BEMP Table 4-1 (Surface Water Monitoring Program).

[b] In-channel (low water) locations include: 1) South Fork above Canyon Creek, 2) Mouth of Canyon Creek, 3) Upper East Fork Ninemile Creek, 4) Lower East Fork Ninemile Creek, 5) Mouth of Ninemile Creek, 6) Elizabeth Park, 7) Smelterville, 8) Pine Creek below Amy Gulch, 9) Pinehurst, 10) Enaville, 11) Cataldo, 12) Rose Lake, 13) Medimont, and 14) Harrison.

[c] Water-suspended sediment sampling locations and frequencies are presented on BEMP Table 4-1 (Surface Water Monitoring Program).

[d] Sampling at the Harrison delta and at Long Lake will be accomplished with a core sampler.

Table 4-3
Biological Resources Monitoring Program

Parameter	Representative Scale	Frequency	Location(s)
Riverine Habitat			
Fish diversity/ abundance	Representative habitats at segment level (or weir counts of migratory fish)	5-year	Ninemile Creek
			Pine Creek
			South Fork (Wallace to Elizabeth Park)
Fish Tissue Metal Levels (Upper Basin and Spokane River)	TBD	5-year	Ninemile Creek
			Pine Creek
			South Fork (Wallace to Elizabeth Park)
			Spokane River near Stneareline
Bull Trout Habitat/ Temp. and Other Aquatic Resources Assessment	TBD	Years 1 and 2, then every 5 years	Mainstem CdA River
Bull Trout Population Survey and Assessment of Other Aquatic Resources	TBD	Year 2 only	Areas of cold refuge (bull trout) and representative habitats in Mainstem CdA River (other aquatic resources)
Macroinvertebrate diversity/abundance	Quadrants in representative habitats	Twice per 5-years	Elizabeth Park (above Box)
			SFCdA at Pinehurst (below Box)
			Lower Basin
		5- year	Ninemile Creek
			Pine Creek
			South Fork (Wallace to Elizabeth Park)
			Spokane River near Stneareline
Macroinvertebrate tissue metal levels	Quadrants in representative habitats	5-year	Ninemile Creek
			Pine Creek
			South Fork (Wallace to Elizabeth Park)
			Spokane River near Stneareline
Aquatic habitat quality	Parameter dependent scale, representative habitats	5-year	Ninemile Creek
			Pine Creek
			South Fork (Wallace to Elizabeth Park)
			Spokane River near Stneareline
Lacustrine / Palustrine Habitat			
Waterfowl population	Wetland/lake units	3 Consecutive years @ 5 year intervals	Lower Basin
Waterfowl mortality	Mortality rate per unit effort (High use habitats)	5-year	Lower Basin
Waterfowl blood lead	Representative stations, Harrison Slough (sentinel area)	5-year	4 Stations (including Harrison Slough)
Riparian Habitat			
Riparian vegetation / invertebrates	Transects in representative locations	5-year	Ninemile Creek
			Pine Creek
			South Fork (Wallace to Elizabeth Park)
			Lower Basin
Songbird diversity/abundance	Point survey technique	5 Consecutive years @ 10-year intervals	Monitoring Avian Productivity & Survivability survey routes (MAPS) in Pine Creek and Lower Basin
Songbird blood lead	Representative stations	5-year	Ninemile Creek
			South Fork (Wallace to Elizabeth Park)
			Pine Creek
			Lower Basin (2 stations)

Table 4-4
Monitoring Program Summary

Location	Station Type	USGS Gaging Station Type	Surface Water			Sediment				Biological Resources														
										Riverine								Lacustrine/Palustrine			Riparian		
										Fish				Macroinvertebrates			Habitat	Waterfowl			Habitat	Songbirds	
			Sentinel Monitoring	Benchmark Monitoring	Low Flow	Surfical in-channel Sampling	In-channel, lacustrine, palustrine& riparain	Water-suspended Sediment at high flows (part of SW sampling)		Diversity/ Abundance	Tissue Metals Levels	Bull Trout Habitat Assessment[c] and Other Aquatic Resources	Bull Trout Pop. Survey[c]	Diversity/ Abundance	Diversity/ Abundance	Tissue Metals Levels	Aquatic Habitat Quality Assessment	Population Survey	Mortality Survey	Blood Lead	Riparian Veg. + Inverts	Diversity/ Abundance	Blood Lead
	Monitoring Frequency		Annual	5 Years	Annual	Annual	10 Years	Annual	5 Years	5 Years	5 Years	Years 1 & 2, then every 5 years	Year 2 only	2 per 5 years	5 Years	5 Years	5 Years	3 consec. yrs. every 5 yrs.	5 Years	5 Years	5 Years	5 consec. yrs. every 10 yrs.	5 Years
SFCDA above Canyon Creek	Benchmark	Misc.		X	X	X			X														
Mouth of Canyon Creek	Benchmark	Std.		X	X	X			X														
Ninemile Drainage							X			X	X				X	X	X				X		X
Mouth of Ninemile Creek	Benchmark	Std.		X	X	X			X														
Upper E. Fork Ninemile Creek	Benchmark	Misc.		X	X	X			X														
Lower E. Fork Ninemile Creek	Benchmark	Misc.		X	X	X			X														
SFCDA Drainage (Wallace-Elizabeth Park)							X			X	X				X	X	X				X		X
Elizabeth Park (above Box)	Sentinel/ Benchmark	Std.	X		X	X		X						X									
Smelterville	Sentinel	Misc.	X		X	X		X															
Pine Creek Drainage							X			X	X				X	X	X				X	X	X
Pine Creek below Amy Gulch	Benchmark	Real-time		X	X	X			X														
SFCDA at Pinehurst (below Box)	Sentinel/ Benchmark	Real-time	X		X	X		X						X									
NFCDA at Enaville	Sentinel	Real-time	X		X	X		X															
Lower Basin							X					X	X	X				X	X	X	X	X	X
Cataldo		Real-time[a]		X	X	X			X														
Rose Lake		NA				X																	
Medimont		NA				X																	
Harrison	Sentinel/ Benchmark	Real-time/SS	X		X	X	X[b]	X															
Spokane River at Outlet	Sentinel	Misc.	X		X			X															
Spokane River at Post Falls		Std.[a]																					
Spokane River near Stateline		Misc.		X	X	X			X		X				X	X	X						
Mid and lower Long Lake		NA					X[b]																
Near Eastern Boundary of Spokane Reservation		NA				X																	
St. Joe River at Mouth near Chatcolet	Sentinel	Real-time/SS	X		X			X															

[a] Funded by Idaho Water Resources

[b] Surface sediment sampling of Harrison delta and mid and lower Long Lake using a core sampler

[c] Bull trout habitat assessemnet to be performed years 1 and 2, then every 5 years. Surveying (electroshocking) locations will be identified based on habitat assessment (i.e. areas of cold refuge)

Notes:
Surface water samples to be analyzed for total and dissolved metals (Cd, Pb, Zn), suspended sediment, and nutrients.
Gaging station types:
Standard - recording equipment that needs the data to be physically downloaded
Real-time - satellite transmission of recording data
Real-time/SS - satellite transmission of recording data plus suspended sediment data
Miscellaneous - no actual gaging station but can measure instantaneous flow and estimate hourly flow

Table 4-5
Monitoring Schedule

Media/Organism	Activity	Location	Year	2004	2005*	2006	2007	2008	2009	2010*	2011	2012	2013	2014	2015*	2016	2017	2018
				Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15
SURFACE WATER																		
Sentinel stations + annual low flow sampling		7 stations / 15 stations		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Benchmark stations		8 stations						X					X					X
SEDIMENT																		
Surfical sediment sampling + suspended sediment		16 areas		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Broader sediment sampling + coring		7 areas							X									
BIOLOGICAL RESOURCES																		
Waterfowl	Population survey	Lower Basin			X	X	X			X	X	X			X	X	X	
Waterfowl	Mortality Survey	Lower Basin					X					X					X	
Waterfowl	Blood Lead	4 stations						X					X					X
Songbird	Blood Lead	5 stations								X				X				X
Songbird	Population survey	2 MAPs		X	X	X	X	X						X	X	X	X	X
Riparian spp.	Riparian habitat	5 stations				X					X					X		
Aquatic Invertebrate	Diversity/adundance	3 locations		X	X				X	X				X	X			
Aquatic Invertebrate	Diversity/adundance	4 additional locations			X					X					X			
Aquatic Invertebrate	Tissue residues	4 locations			X					X					X			
Fish and invertebrate	Habitat assessment	3 locations			X			X					X					X
Fish	Diversity/abundance	3 locations				X					X					X		
Fish	Tissue residues	4 locations				X					X					X		
Bull trout	Habitat/temperature assessment	S.F.CdA and Mainstem		X	X					X					X			
Bull trout	Population survey	Areas of cold refuge			X													
REPORTING																		
Annual data report/assessment				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tech memo to support Five-Year Review report preparation										X					X			

Notes:
* Indicates the year that five-year reviews will need to be completed.

Table 4-5 (Continued)
Monitoring Schedule

Media/Organism	Activity	Location	Year	2019	2020*	2021	2022	2023	2024	2025*	2026	2027	2028	2029	2030*	2031	2032	2033
				Y16	Y17	Y18	Y19	Y20	Y21	Y22	Y23	Y24	Y25	Y26	Y27	Y28	Y29	Y30
SURFACE WATER																		
Sentinel stations + annual low flow sampling		7 stations / 15 stations		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Benchmark stations		8 stations						X					X					X
SEDIMENT																		
Surfical sediment sampling + suspended sediment		16 areas		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Broader sediment sampling + coring		7 areas		X										X				
BIOLOGICAL RESOURCES																		
Waterfowl	Population survey	Lower Basin			X	X	X			X	X	X			X	X	X	
Waterfowl	Mortality Survey	Lower Basin					X					X					X	
Waterfowl	Blood Lead	4 stations						X					X					X
Songbird	Blood Lead	5 stations							X					X				
Songbird	Population survey	2 MAPs							X	X	X	X	X					
Riparian spp.	Riparian habitat	5 stations				X					X					X		
Aquatic Invertebrate	Diversity/adundance	3 locations		X	X				X	X				X	X			
Aquatic Invertebrate	Diversity/adundance	4 additional locations			X					X					X			
Aquatic Invertebrate	Tissue residues	4 locations			X					X					X			
Fish and invertebrate	Habitat assessment	3 locations						X					X					X
Fish	Diversity/abundance	4 locations				X					X					X		
Fish	Tissue residues	4 locations				X					X					X		
Bull trout	Habitat/temperature assessment	S.F.CdA and Mainstem			X					X					X			
Bull trout	Population survey	Areas of cold refuge																
REPORTING																		
Annual data report/assessment				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tech memo to support Five-Year Review report preparation					X					X					X			

Notes:
* Indicates the year that five-year reviews will need to be completed.