THE FIXED-STATION SURFACE-WATER-QUALITY MONITORING NETWORK IN MONTANA

DEQ and USGS

OBJECTIVES AND SCOPE

The purpose of the fixed-station monitoring network is to provide data that can be used to describe water-quality conditions on major rivers across Montana over a wide range of flows. The monitoring network, as initially configured, will consist of 37 fixed stations (table 1). The distribution of sites is designed to provide coverage of the major hydrologic sources in each of the State's four TMDL watershed units -- Upper Missouri, Lower Missouri, Yellowstone, and Westslope (fig. 1).

The fixed stations will be sampled four times per year for nutrients and suspended sediment; and twice annually for major ions and selected trace elements (table 2). Water temperature will be continuously monitored at several stations on a seasonal basis to provide information on thermal stress -- a characteristic critical to fisheries, especially during low-flow years. At some of the stations, temperature will be monitored on a long-term basis to document the effect of climatic cycles on water temperature. At other sites, temperature will be monitored for a 3-4 year period to establish a baseline. Short-term temperature monitoring would be rotated among the sites to eventually provide a baseline of water temperature for the entire network.

All of the fixed stations will be located at active USGS streamflow gaging stations in order to quantify streamflow conditions at the time of sampling and total streamflow for the year. Fourteen of the 37 stations proposed for the network currently are operated as part of existing USGS water-quality sampling programs. Sampling at some of these sites fully meet the needs of the Montana statewide network; whereas sampling at other sites will be modified to include any additional parameters necessary to provide consistency with the statewide program. The remaining 23 stations will be newly established for water-quality operations in FY99.

APPROACH

The statewide monitoring network is planned to be operated for a long-term period in order to describe the year-to-year variability associated with changing hydrologic conditions or changes in land use. The actual length of network operation, however, will be dependent on the availability of funding in future years. Fixed stations will be sampled every year to maintain continuity of data collection through natural climatic and hydrologic cycles. This continuity can provide the basis for assessing the representativeness of data collected at shorter-term synoptic sites where the data represent only a single hydrologic condition rather than the full range of variability

Field Operations

Streamflow is one of the major factors controlling instream concentrations and the quantity (load) of material transported through the basin to downstream reaches. Because streamflow can be highly variable on a daily, seasonal, and annual basis, quantifying the magnitude and duration of flow is critical to understanding chemical and biological responses to flow variations. The current availability of streamflow record at the water-quality fixed stations provides essential hydrologic information.

Samples will be collected four times per year, with an effort made to sample a wide range of flow conditions. Sampling typically would occur between March and November. Winter sampling generally would not be scheduled because of the inherent safety risks during ice conditions and because flow during December to February constitutes only a small proportion of the total annual flow in most years. To the extent possible, samples will be collected during the rising limb, peak, and falling limb of the runoff portion of the annual hydrograph, plus during the late summer or fall to characterize base flow. Because peak high-flow conditions can be short-lived, it may not be possible to sample the peak at all sites in the network during a given year; consequently, priorities would be arranged in subsequent years to try to maximize the coverage of high flow across the entire network over time. Base-flow sampling will be coordinated, to the extent possible, with biological sampling schedules in order to provide a measure of aquatic conditions near in time to the sampling of biota. Because biological characteristics reflect long-term exposure to a wide range of aquatic conditions during a year, it will not be necessary to sample water on exactly the same day as biota, although a measure of chemical conditions during low flow is necessary to define the full range of annual water-quality conditions.

Water samples will be width- and depth-integrated to obtain a discharge-weighted composite sample that is representative of the entire flow passing the site (Edwards and Glysson, 1988). Samples will be collected using standard USGS depth-integrating samplers (e.g., DH-81, D-74, or

D-77) that are either constructed of non-contaminating material or coated with a non-contaminating material. Sampling protocols (Horowitz and others, 1994) will be followed to prevent trace-element contamination. Additional sample-processing protocols are described in Knapton (1985) and Ward and Harr (1990).

Water temperature, specific conductance, and pH will be measured onsite at the time of sample collection. Samples will be composited, split, filtered, and preserved according to procedures described by Horowitz and others (1994). Instantaneous streamflow at the time of sampling will be determined from stage-discharge rating tables established for each site (Rantz and others, 1982).

Laboratory

Water samples will be analyzed for concentrations of chemical constituents by the USGS National Water Quality Laboratory (NWQL) in Denver, Colo., and for suspended sediment concentration and particle size distribution (percent finer than .062 mm) by the USGS Montana District sediment laboratory in Helena, Mont. Samples will be analyzed for nutrients (including low-level phosphorus) and suspended sediment four times per year, while samples will be analyzed for major ions and trace elements twice per year. Methods of chemical analyses used by the NWQL are described by Fishman (1993). Methods of suspended-sediment analyses used by the Montana District sediment laboratory are described by Lambing and Dodge (1993) and Guy (1969). A list of the chemical constituents to be analyzed by the NWQL for the fixed-station sampling program is presented in table 2.

Table 1. -- Statewide Network of Water-Quality Fixed Stations

Station	USGS Station Number	Water Quality (4/year) [1]	Daily Temp. [2]	Current USGS sampling [3]	Additn'l analyses needed [3]
UPPER MISSOURI					
Beaverhead River near Twin Bridges	06018500	X	ST	--	all
Jefferson River near Three Forks	06036650	X	LT	--	all
Gallatin River at Logan	06052500	X	ST	--	all
Missouri River at Toston	06054500	X	ST	--	all
Prickly Pear Creek near Clancy **	06061500	X	--	--	all
Dearborn River near Craig	06073500	X	LT	--	all
Sun River near Vaughn	06089000	X	LT	N, S	MI, M
LOWER MISSOURI					
Teton River at Loma **	06108800	X	ST	N, S	MI, M
Musselshell River at Mosby	06130500	X	ST	--	all
Peoples Creek near Dodson	06154550	X	--	--	all
Milk River at Nashua	06174500	X	ST	--	all
Poplar River near Poplar	06181000	X	LT	--	all
Missouri River near Culbertson	06185500	X	--	NASQAN	none
YELLOWSTONE					
Yellowstone River near Livingston	06192500	X	LT	--	all
Shields River near Livingston	06195600	X	LT	--	all
Boulder River at Big Timber **	06200000	X	LT	--	all
Stillwater River near Absarokee **	06205000	X	--	--	all
Clarks Fork Yellowstone at Edgar	06208500	X	ST	NAWQA	M
Bighorn River near Bighorn	06294500	X	ST	--	all
Rosebud Creek near Rosebud **	06296003	X	--	--	all
Tongue River at Miles City	06308500	X	ST	--	all
Powder River near Locate	06326500	X	--	NAWQA	M
Yellowstone River near Sidney	06329500	X	--	NASQAN	none

Table 1. (continued)

Station	USGS Station Number	Water [1] Quality (4/year)	Daily [2] Temp.	Current [3] USGS sampling	Additn'l [3] analyses needed
WESTSLOPE					
Kootenai River below Libby Dam	12301933	X	LT	N	MI, M, S
Fisher River near Libby	12302055	X	--	--	all
Yaak River near Troy	12304500	X	ST	--	all
Little Blackfoot River near Garrison	12324590	X	LT	M, S	N, MI
Rock Creek near Clinton	12334510	X	--	M, S	N, MI
Clark Fork at Turah Bridge	12334550	X	--	NAWQA	none
Blackfoot River near Bonner	12340000	X	LT	M,S	N, MI
Bitterroot River near Missoula	12352500	X	ST	NAWQA	none
Clark Fork at St. Regis	12354500	X	--	NAWQA	none
N. Fk. Flathead near Columbia Falls	12355500	X	--	--	all
M. Fk Flathead near West Glacier	12358500	X	--	--	all
Whitefish River near Kalispell **	12366000	X	--	--	all
Swan River near Bigfork **	12370000	X	ST	--	all
Flathead River at Perma	12388700	X	LT	NAWQA	none

[1] Nutrients and suspended sediment analyzed 4 times per year; major ions and trace elements analyzed 2 times per year.

[2] Abbreviations for daily temperature monitoring: LT, long term (temperature monitoring to be maintained for the duration of the program); ST, short term (temperature monitoring to be rotated among sites every 4 years to establish baseline data for the entire network)

[3] Abbreviations for constituent groups: N, nutrients; MI, major ions; M, metals; S, suspended sediment. NASQAN and NAWQA listing indicates that the full constituent group is covered by these USGS programs, unless otherwise noted.

** Funding for streamgaging operation is short-term and may be terminated in near future; alternate funding source will be needed to continue daily streamflow data collection into the future.

Table 2. -- Chemical constituents to be analyzed by the USGS National Water Quality Laboratory for the Montana fixed-station water-quality network

Constituent	Analytical Method	Minimum Reporting Level
Nutrients:		
nitrate plus nitrite, dissolved as N	colorimetry	.05 mg/L
nitrite, dissolved as N	colorimetry	.01 mg/L
ammonia + organic, total as N	colorimetry	.01 mg/L
orthophosphate, dissolved as P	colorimetry	.001 mg/L
phosphorus, total as P	colorimetry	.004 mg/L
Major Ions:		
calcium, dissolved	ICP	.02 mg/L
magnesium, dissolved	ICP	.01 mg/L
sodium, dissolved	ICP	.06 mg/L
silica, dissolved	ICP	.05 mg/L
potassium, dissolved	AA	.10 mg/L
alkalinity, dissolved	titration	1.0 mg/L
sulfate, dissolved	IC	.10 mg/L
chloride, dissolved	IC	.10 mg/L
fluoride, dissolved	colorimetry	.10 mg/L
Trace Elements:		
arsenic, total recoverable	GFAA	1.0 ug/L
cadmium, total recoverable	GFAA	1.0 ug/L
chromium, total recoverable	GFAA	1.0 ug/L
copper, total recoverable	GFAA	1.0 ug/L
lead, total recoverable	GFAA	1.0 ug/L
nickel, total recoverable	GFAA	1.0 ug/L
zinc, total recoverable	AA	10.0 ug/L

Abbreviations: AA - atomic absorption spectrophotometry; GFAA - graphite furnace, atomic absorption spectrophotomety; IC - ion chromatography; ICP - inductively coupled plasma

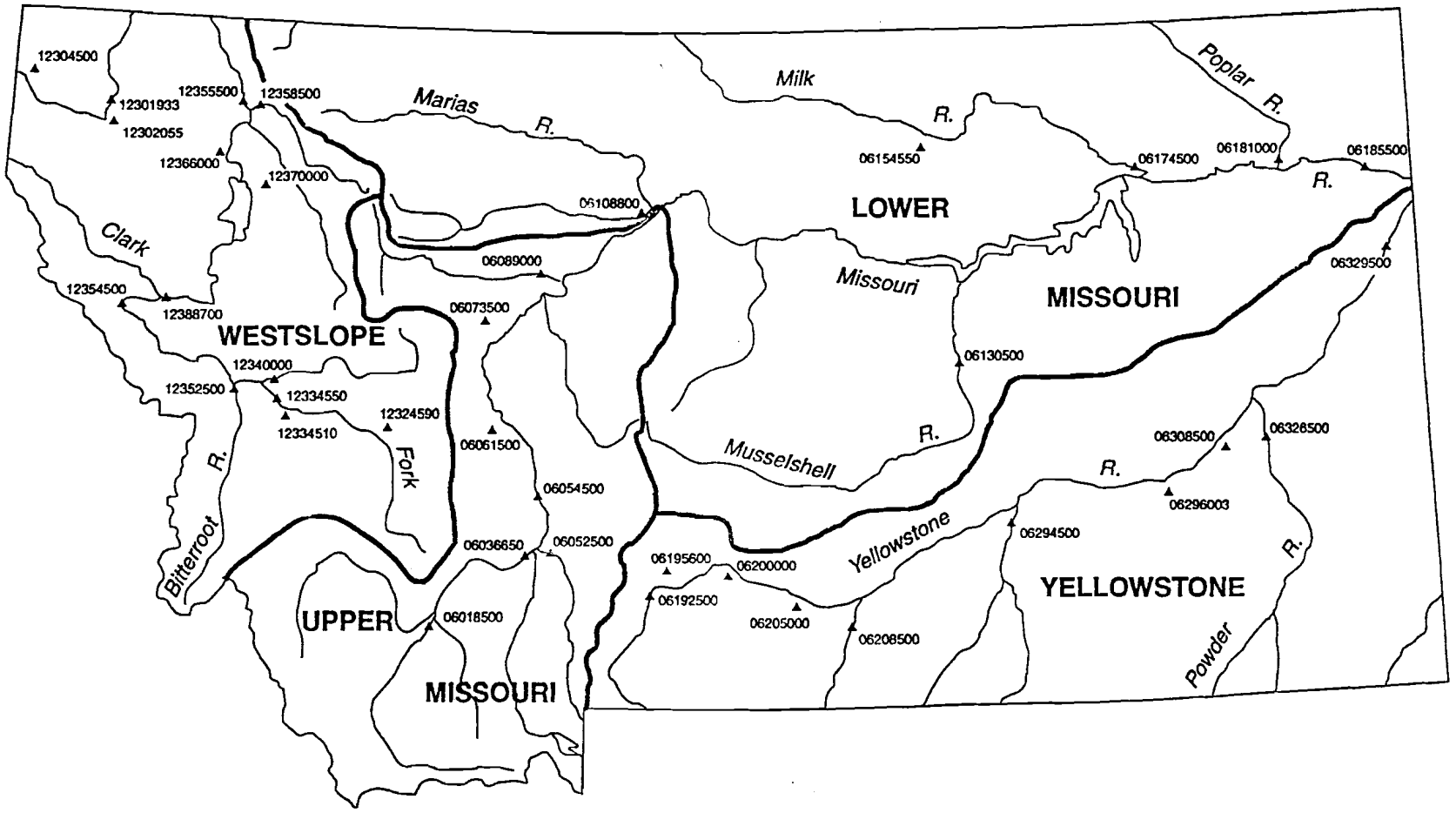

Figure 1. Water-quality fixed stations and watershed units