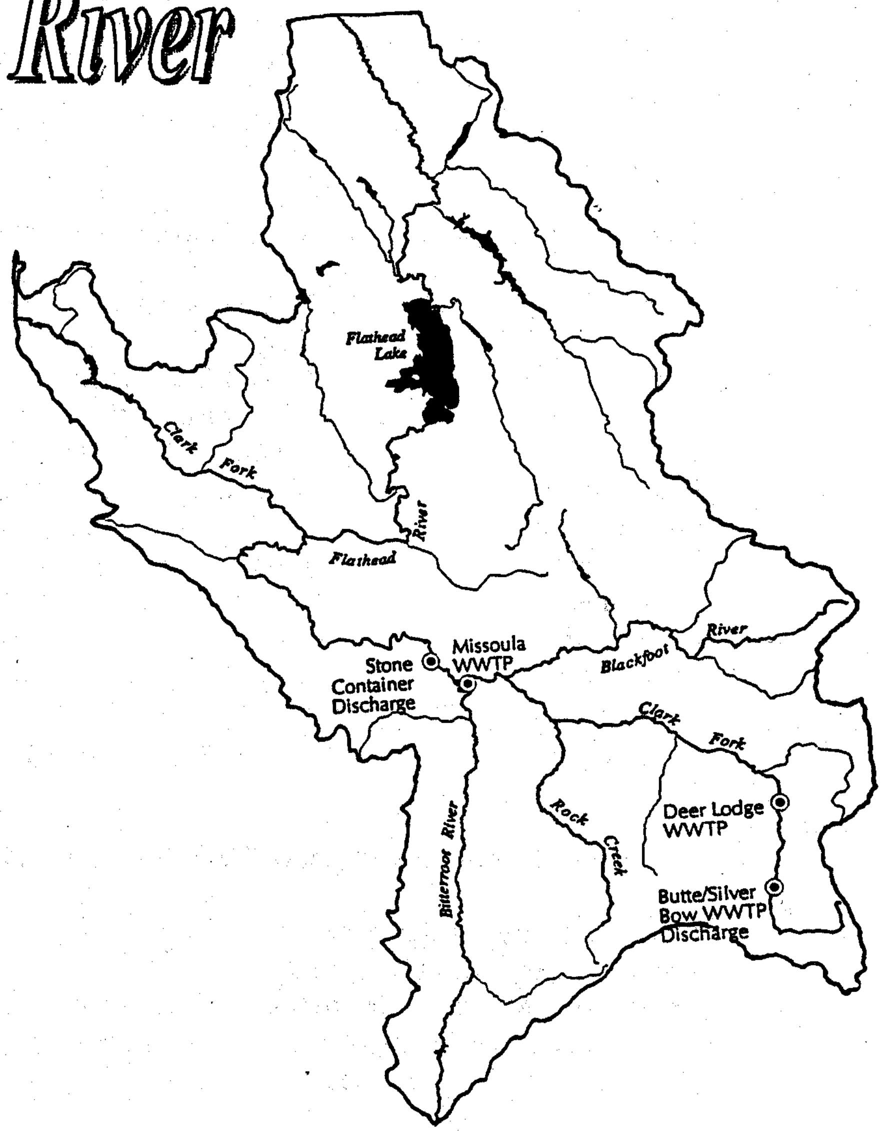
Clark Fork River

Voluntary Nutrient Reduction Program



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1.0 Summary of the Clark Fork River Voluntary Nutrient Reduction Program

In February 1994 a Nutrient Target Subcommittee was established by the Tri-State Implementation Council (Council) to achieve consensus on in-stream nutrient targets for the Clark Fork River and to develop a basin wide nutrient source reduction program to meet those targets. Subcommittee representation included the cities of Butte, Deer Lodge and Missoula; Stone Container Corporation; the University of Montana; the Clark Fork-Pend Oreille Coalition; the Missoula City-County Health Department; and the Montana Department of Environmental Quality. The U. S. Environmental Protection Agency Region 8 also contributed to the development of this document.

Driven by 303(d) requirements of the federal Clean Water Act and the immediate need to develop a specific plan of action for reducing nutrient loading, the subcommittee wrestled with the controversial questions and complex issues associated with the reduction of nutrient loading. Over the months members built a foundation for open dialogue and trust as they worked to resolve the issues and concerns. Guided by the Council's April 1995 decision to take a voluntary approach rather than mandatory, permitted approach to the reduction strategy, the subcommittee completed its task of developing a specific plan of action, the Clark Fork River Voluntary Nutrient Reduction Program (VNRP.)

The ten-year VNRP calls for site-specific measures to be taken by each of the four key point source dischargers and significant reductions in key nonpoint sources to meet specific in-stream algal density and nutrient targets. Based on river study results, literature review, third party reviews, and citizen concerns about nuisance algae, the subcommittee believes in its best professional judgment that these targets and the accompanying reduction measures to achieve them are reasonable. At three-year intervals during implementation of this plan, the VNRP targets, discharger measures and river water quality will be evaluated and revisions made as needed and agreed upon by subcommittee members.

Having formed a partnership, members of the subcommittee have agreed to the following:

1.) The goal of the VNRP is to restore beneficial uses and eliminate nuisance algae growth in the Clark Fork River from Warm Springs Creek to the Flathead River confluence.

2.) To reach this goal, the VNRP sets the following targets for the Clark Fork River mainstem:

- a.) 100 mg/square meter (summer mean) and 150 mg/square meter (peak) chlorophyll a, at any site, for the entire Clark Fork River area of the VNRP;
- b.) 20 ug/l total phosphorus upstream of the Reserve Street bridge at Missoula, where Cladophora is a problem and the 15:1 N:P ratio should be maintained;
- c.) 39 ug/l total phosphorus downstream of the Reserve Street bridge at Missoula; and
- d.) 300 ug/l total nitrogen.

3.) A margin of safety is provided by the use of nutrient targets that are more conservative than those recommended by third party review, and the use of a 30Q10 low flow as the basis for monitoring the attainment of in-stream targets.

4.) While the focus will be on algal densities, it will be critical to monitor for any changes to both total and soluble nutrient concentrations in the river.

5.) The river can be unpredictable, so the group is using its best judgment to address uncertainties through a phased approach.

6.) The VNRP is a voluntary program that provides four key dischargers with an opportunity to develop and implement their own plan to reduce nutrient discharges and improve in-stream water quality, as opposed to a DEQ-administered mandatory program of permit-based effluent reductions.

7.) Each of the four signatory point sources is committed to: attaining the in-stream targets for summertime (defined as June 21 - September 21) discharges by implementing specific measures at each site as described in Section 3.4; participating in the on-going monitoring evaluation process; and developing new alternatives as necessary, reasonable and agreed to by the parties to the VNRP, should VNRP measures not meet in-stream targets at the 30Q10.

8.) The City of Missoula, Missoula City-County Health Department Board of Health, and Missoula County Commissioners are committed to carrying out a strategy to control septic system and other nutrient source impacts in the Missoula area.

9.) To minimize the potential for losing any ground that may be gained through improvements at the four key point source sites, an approach will be employed that simultaneously addresses other point sources, key nonpoint sources and growth-related issues that impact water quality.

10.) Commitment and involvement in the VNRP by other point and nonpoint sources will be attained through the efforts of a VNRP Coordinator employed by the Council.

11.) The VNRP is a dynamic and flexible approach; changes and adjustments can be made as needed and agreed upon by the members, which can include the consideration of other innovative solutions.

12.) The VNRP sets ten years from the date of signature by the parties to this VNRP to achieve in-stream nutrient and algal targets with an interim evaluation at least every three years.

13.) All members are committed to carrying out their respective site-specific actions in the VNRP; the VNRP can only be successful if all parties fulfill their commitments.

14.) In keeping with a watershed approach, Idaho should be equally committed to nutrient control measures in the Pend Oreille basin, to ensure downstream water quality benefits from the Montana VNRP.

15.) The members are committed to continued coordination and administration of the VNRP through the Council.

The following list summarizes the actions that each party is committed to taking to meet the targets in this VNRP:

Montana Department of Environmental Quality:

- implementation of procedures to address new and other existing discharge permits;
- implementation of appropriate subdivision review procedures to reduce water quality impacts;
- working with the City of Missoula, Missoula County and the City-County Health Department to address septic effluent and groundwater-to-surface water issues in Missoula and surrounding areas;
- working with the Council on a prioritization and implementation strategy to reduce impacts from nonpoint sources in the upper Clark Fork;
- serving as the repository for the Clark Fork model and working with the subcommittee to continue to refine the model; and
- continued coordination with the Council's nutrient target subcommittee.

Butte-Silver Bow:

- meeting in-stream nutrient and algae targets just below Warm Springs ponds through:
  -installation of an effluent pump at the Metro sewer plant;
  -flow augmentation of Warm Springs Creek from Silver Lake water;
  -a combination of other possible options outlined in the Bureau of Reclamation study;
  -continued implementation of voluntary phosphate detergent ban; and
- continued participation on nutrient target subcommittee to monitor and evaluate program effectiveness.

City of Deer Lodge:

- meeting in-stream nutrient and algae targets by reducing loading by 100% through construction of a land application system; and
- continued implementation of phosphate detergent ban.

City of Missoula:

- reducing loading to meet in-stream nutrient and algae targets in the Clark Fork River through:
  -continued biological nutrient removal experimentation at present wastewater treatment facility;
  -biological nutrient removal upgrade to wastewater treatment plant;
  -capacity upgrade at wastewater treatment plant;
- working with Missoula County, the City-County Health Department and DEQ to address septic effluent/groundwater-to-surface water issues in the Missoula valley both inside and outside of sewer service areas; through actions that include:

-reviewing state and local regulations with the goal of removing disincentives and /or offering incentives for connecting new and existing septic systems to public sewage collection and treatment facilities that will remove nutrients;
-maintaining existing local regulations and modifying state subdivision regulations as appropriate to encourage clustering and smaller lots in new subdivisions and provide for the economically feasible, orderly and timely connection of new subdivisions in the area onto public sewer;
-encouraging development of alternatives to municipal wastewater disposal to reduce nutrients from new development (such as land application, wetlands, and nutrient removal septic systems;)
-connecting 50 percent of the existing 6,780 septic systems in the Missoula urban area, resulting in an estimated reduction of approximately 130 kg/day nitrogen discharged to the Bitterroot and Clark Fork Rivers;
-continuing to connect existing septic systems in the Missoula area to public sewage treatment and collection facilities at a rate approximately equivalent to the number of new septic system permits issued with the Missoula Valley Water Quality District; and
-limiting nutrient loading from septic systems outside the Missoula WWTP service area.

- working with Missoula County, the City-County Health Department and DEQ to control other nutrient source impacts in the Missoula area;
- continued implementation of phosphate detergent ban; and
- continued participation on nutrient target subcommittee to monitor and evaluate program effectiveness.

Stone Container Corporation:

- reducing loading to meet in-stream nutrient and algae targets in the Clark Fork River through:
  -early start-up of the color removal plant at flow at or below 4000 cfs;
  -no direct discharge to the river during July and August at flow below 4000 cfs;
  -summer use of storage ponds farthest from river to reduce seepage;
  -researching additional nutrient reduction techniques; and
- continued participation on nutrient target subcommittee to monitor and evaluate program effectiveness.

Clark Fork-Pend Oreille Coalition:

- continued participation on nutrient target subcommittee to monitor and evaluate program effectiveness

Missoula City/County Health Department:

- working with the City of Missoula, Missoula County, and DEQ to address septic effluent/groundwater-to-surface water issues in the Missoula valley both inside and outside of sewer service areas through actions that include:
  -reviewing state and local regulations with the goal of removing disincentives and /or offering incentives for connecting new and existing septic systems to public sewage collection and treatment facilities that will remove nutrients;

-maintaining existing local regulations and modifying state subdivision regulations as appropriate to encourage clustering and smaller lots in new subdivisions and provide for the economically feasible, orderly and timely connection of new subdivisions in the area onto public sewer;
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-limiting nutrient loading from septic systems outside the Missoula WWTP service area.

- working with the City of Missoula, Missoula County, and DEQ to control other nutrient source impacts in the Missoula area;

Missoula County:

- working with the City of Missoula, the City-County Health Department and DEQ to address septic effluent/groundwater-to-surface water issues in the Missoula valley both inside and outside of sewer service areas; through actions that include:
-reviewing state and local regulations with the goal of removing disincentives and /or offering incentives for connecting new and existing septic systems to public sewage collection and treatment facilities that will remove nutrients;
-maintaining existing local regulations and modifying state subdivision regulations as appropriate to encourage clustering and smaller lots in new subdivisions and provide for the economically feasible, orderly and timely connection of new subdivisions in the area onto public sewer;
-encouraging development of alternatives to municipal wastewater disposal to reduce nutrients from new development (such as land application, wetlands, and nutrient removal septic systems;)
-connecting 50 percent of the existing 6,780 septic systems in the Missoula urban area, resulting in an estimated reduction of approximately 130 kg/day nitrogen discharged to the Bitterroot and Clark Fork Rivers;
-continuing to connect existing septic systems in the Missoula area to public sewage treatment and collection facilities at a rate approximately equivalent to the number of new septic system permits issued with the Missoula Valley Water Quality District;
-limiting nutrient loading from septic systems outside the Missoula WWTP service area.
- working with the City of Missoula, the City-County Health Department and DEQ to control other nutrient source impacts in the Missoula area;

Tri-State Implementation Council:

- providing coordination and administration of the VNRP to ensure program effectiveness;

- overseeing the nutrient target subcommittee's responsibilities to implement, monitor, evaluate and address progress of the VNRP measures;
- reviewing interim program evaluations and developing any changes to the VNRP as necessary to meet the targets;
- coordinating the monitoring subcommittee's in-stream data with the nutrient target subcommittee's efforts;
- working with other parties in the watershed, in addition to those signatory to this VNRP, to expand nonpoint and other point source awareness and participation in nutrient reduction measures;
- hiring a VNRP coordinator to assist the nutrient target subcommittee in carrying out the VNRP; and
- reporting to EPA and the public on VNRP progress.

2.0 Background

2.1 Clark Fork-Pend Oreille Project History

In April 1984, Montana Governor Ted Schwinden initiated a long-range comprehensive study of the Clark Fork River basin to draw together fragmented information about the river and to develop a management plan for the future. The culmination of that effort was the release in 1988 of the Clark Fork Basin Project Status Report and Action Plan (Johnson and Schmidt, 1988). The document included a review of the resources and special issues affecting the basin, a summary of efforts underway to solve problems, and recommendations for future action.

Along with controlling heavy metals pollution in the upper Clark Fork Basin, the problem of nutrients and algae growth was considered the highest priority issue. It was also ranked as the major water quality issue jointly affecting Montana and Idaho and the one for which the least amount of predictive information was available. The Action Plan gave specific recommendations for addressing the nutrient problem, and introduced a coordinated program to investigate the sources and fates of nutrients in the Clark Fork-Pend Oreille basin of Montana, Idaho and Washington. That program was authorized by Congress in Section 525 of the 1987 federal Clean Water Act amendments.

The Section 525 Project was a response to increasing public attention on water quality degradation in the basin and recognition of the need for a basin wide approach to water quality management. The Clean Water Act language directed EPA to conduct an assessment of the extent and sources of cultural pollution in the three-state drainage area and to develop recommendations for pollution control.

State agencies were assigned responsibility by EPA to conduct investigations within their state boundaries and the project was coordinated by an interstate/interagency steering committee. The project was initiated in 1988, with the Montana Department of Health and Environmental Sciences (now Montana Department of Environmental Quality (DEQ)) designated as the lead state agency for Montana. Project studies were conducted from 1988-1992 and following a series of basin wide public hearings, a three-state water quality management plan was finalized in 1993. The plan focuses on control of nutrients and eutrophication in the three-state basin.

The watershed management plan is being implemented by the Council, a broad based 28-member group established by EPA Regions 8 and 10 and the states of Montana, Idaho and Washington in October 1993. In addition to setting policy and direction for water quality management actions, the Council oversees the efforts of eleven subcommittees working in local communities throughout the watershed to carry out specific priorities from the plan. One of the highest priorities is the development of a nutrient target and nutrient reduction strategy for the Clark Fork River. A subcommittee consisting of dischargers, agencies, citizen groups and other interested parties formed in 1994 to hammer out an agreeable and workable plan for in-stream nutrient reductions to address concerns about algae growth in the river.

Recognizing the value of partnerships that were developing on the subcommittee, the State of Montana gave the Council the chance—and the time—to develop a nutrient reduction plan of action to meet 303(d) requirements. In April 1995, the Council voted in favor of pursuing a voluntary approach to the nutrient target priority whereby the main point source dischargers would be given an opportunity to develop actions for reducing nutrient loading to the river. Following this decision, the Council asked the subcommittee to work with the State of Montana to develop an appropriate voluntary nutrient reduction program.

2.2 Description of the Water Quality Problem

Nutrients are natural components of every aquatic ecosystem. The inherent fertility of a stream, measured as the concentration of nitrogen, phosphorus and other nutrients, is an important factor in fish production and often controls the amounts of algae a river or lake produces. When a waterbody becomes overloaded with nutrients, from natural or cultural sources, nuisance growths of algae may result. In extreme cases, large concentrations of attached algae can deplete the dissolved oxygen needed by fish and other aquatic organisms, favor the propagation of rough fish over game fish, and otherwise impact various uses of the waterbody. In the past, there have been occasions when nighttime oxygen uptake in the Clark Fork River during low flow periods caused violations of the in-stream dissolved oxygen standard in effect at that time.[1]

The upper and middle reaches of the Clark Fork River are some of the most productive stream waters in Montana west of the Continental Divide from the standpoint of nutrient concentrations and the potential to grow algae (Bahls et al, 1979a, 1979b.) Concentrations of nitrogen and phosphorus in the Clark Fork have resulted in dense mats of filamentous algae in the river above Missoula and heavy growths of diatom algae below Missoula.

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[1] State of Montana Water Quality Bureau standards for dissolved oxygen were modified in July, 1994.

Seasonally, as attached algae in the Clark Fork die and decay, oxygen, water clarity and visual appeal of the river are reduced. Decaying algae has also been implicated in the production of river foam.

The highest densities of attached algae (measured as chlorophyll a, in mg/square meter) in the upper Clark Fork River are found in the upper reaches below Deer Lodge to the Blackfoot River confluence, and in the middle reaches between Missoula and Huson (Watson,1989,1996.) There is concern that the existing nutrient levels (nitrogen and phosphorus) and algal densities impair beneficial uses in segments of the Clark Fork River.

In the lower Clark Fork, where attached algae are not a significant issue, concerns have focused on nutrient discharges into Idaho's Pend Oreille Lake. The Clark Fork is the source of more than 90 percent of the lake's water and about 75 percent of its total nutrient loading. Although local sources are the primary cause of the lake's increasing nearshore aquatic weed and algae problems, nutrient loading from the Montana portion of the watershed promises to remain an issue of great interest to Idahoans.

2.3 Clark Fork Basin Nutrient Sources

From 1988 to 1991, an intensive monitoring program was conducted to identify and rank the major point and nonpoint sources of phosphorus and nitrogen in the 340 miles of the Clark Fork River from its headwaters to the Idaho border. This study determined that, on a year round basis, approximately half of the soluble phosphorus came from wastewater discharges, while the remainder came from tributary inflows. About three-fourths of the soluble nitrogen loading during the study came from tributaries, with the remaining one quarter coming from wastewater.

Of the wastewater discharges (or point sources,) the majority of nutrients came from just four sources: the Missoula, Butte and Deer Lodge municipal wastewater treatment plants, and the Stone Container Corporation kraft paper mill near Missoula. These sources also provided the largest share of nutrients to the reaches where, and during the times of year when, algae and related problems are most prevalent. Up to half of the soluble nitrogen in the lower Bitterroot River during summer came from contaminated groundwater seepage from the Missoula area. Recent findings from research generated during the City of Missoula's facility planning has quantified this significant link between groundwater and surface water in the Missoula area; pollution from the widespread use of septic systems is a major nutrient source contributing to surface water degradation. Silver Bow Creek and about a third of the other tributaries to the Clark Fork were found to have high nutrient concentrations but smaller nutrient discharges, or loads. Some of those tributaries may have been locally important by nourishing algae colonies in the Clark Fork below their confluences.

A series of basin wide nonpoint source stream reach assessments conducted during the Section 525 study helped identify the sources and causes of elevated nutrients in impaired Clark Fork basin tributaries. They also provided overall assessments of stream condition and use support, as affected by a wide variety of pollution problems. In general, summertime nutrient loading from nonpoint sources, although significant, was relatively less than contributions from point sources. As improvements are made to point sources, however, nonpoint sources will become relatively more significant. Geographically, the largest share of nonpoint source problems was found in the upper Clark Fork and Blackfoot River basins, where more than 300 miles of river and tributaries to the Clark Fork are listed as impaired for nutrients. Studies currently being conducted in the Bitterroot River basin will identify and assess sources from this key tributary as they relate to downstream impacts on the Clark Fork.

Based on results of the Section 525 study and stream reach assessments, management efforts on the Clark Fork to reduce nutrient-related use impairment will focus on key point and nonpoint sources, which include: the Missoula, Deer Lodge and Butte municipal wastewater discharges, direct discharges and groundwater seepage from the Stone Container mill, other point sources, septic systems, agriculture, forestry, mining, urban/suburban land use and sediment sources.

2.4 Clark Fork River Nutrient Criteria: Development of In-stream Goals

Of the many nutrients required by algae and other aquatic plants, nitrogen and phosphorus are the two elements usually in shortest supply in natural water relative to the needs of the plants. As a result, the growth of algae is sometimes controlled by the availability of nitrogen or phosphorus, or both, in the water column. The soluble inorganic forms of these two nutrients--nitrate, nitrite and ammonia nitrogen and orthophosphate--are most available for plant uptake.

A number of factors besides nutrient levels influence algal densities in waterbodies. These include, but are not limited to, the type of algae, stream flow patterns and scouring, water temperature and velocity, light intensity, and grazing by aquatic insects. From a management perspective, factors other than nutrients are difficult to control. During the Section 525 studies, a significant effort was put into the development of site-specific nutrient criteria for the Clark Fork River. The studies focused on determining what nutrient concentrations limited algal development in the Clark Fork, when and where nutrients were limiting algal development, and which nutrient (nitrogen or phosphorus) was most often limiting algal development. An ultimate goal was the establishment of in-stream nutrient threshold levels where all intended beneficial uses of the Clark Fork would be supported. These nutrient "target levels" would serve as just that—targets—for reducing in-stream nutrient concentrations so that nutrient-impaired water uses could be restored.

2.5 Section 525 Study Results and Recommendations

Experimental results indicated that attached diatom algae in the middle Clark Fork continued to increase in response to nutrient additions up to 30 ug/l for soluble phosphorus and 250 ug/l for soluble nitrogen. These values were established as "saturation" concentrations below which diatom algae standing crops could be reduced. Much of the Clark Fork was often found to be below these levels, hence any reduction in nutrients would be expected to reduce algal densities.

Further, it was determined that management of both phosphorus and nitrogen is important to reducing algae, because both were found to limit diatom algae for significant periods of the year in almost all areas.

Algae that dominates the upper Clark Fork is a filamentous green species called Cladophora. It may respond to nutrients somewhat differently than the diatom-dominated communities. Heavy growths of Cladophora are seen in the upper Clark Fork even where nutrient levels are consistently well below 30 ug/l soluble phosphorus and 250 ug/l soluble nitrogen. Even if Cladophora densities are reduced by controlling nutrients, because of their ability to persist in relatively low-nitrogen environments, occasional algae blooms may still occur.

The reduction in nutrients necessary to achieve control of the algae problem is less easy to quantify. A Rationale and Alternatives For Controlling Nutrients and Eutrophication Problems in the Clark Fork River Basin (Ingman, 1992) concluded that decreases in algal biomass, especially for diatom algae, can be expected with reductions in soluble phosphorus and nitrogen concentrations below 30 ug/l and 250 ug/l, respectively. To achieve target concentrations where all water uses would be protected, the report suggested an approach which would set summer nutrient targets at the nutrient concentrations found in reaches of the Clark Fork where algae are not as frequent a problem. Based on this approach, the report proposed summer targets at 6 ug/l or less for soluble phosphorus and 30 ug/l or less for soluble nitrogen. These concentrations are typical of the Clark Fork from Turah to Missoula and from Alberton to the Idaho border during July through September. These sections of the river do not normally exhibit appreciable attached algae growth.

2.6 Subcommittee Conclusions on Target Numbers

The nutrient target subcommittee was unable to reach a consensus on the use of 6 ug/l soluble phosphorus and 30 ug/l soluble nitrogen as the basis for the nutrient reduction strategy. Some members were concerned that these figures may prove to be too restrictive, and in general the group questioned whether nutrient management and monitoring should focus on total or soluble forms of nutrients. The group began by reviewing available literature.

Research by Watson (1988,1990) on the response of algae to nutrients in natural and artificial streams concluded that both nitrogen and phosphorus were limiting algae densities at some time in some parts of the river, hence both should be controlled. Concerning which forms of nutrients to manage, soluble forms stimulate algal growth most directly and most controlled studies of nutrient limitation have focused on these forms. Artificial stream studies show that attached diatom algal densities are saturated at around 30 ug/l for phosphorus (Bothwell 1989) and 250 ug/l for nitrogen (Watson 1988,1990) but that there would be little observable improvement in in-stream algae until nutrient levels were well below 30/250. In the field, soluble nutrients may not be well correlated with algal densities because nutrients may be rapidly depleted to very low levels by algal uptake where algal biomass is high.

The subcommittee decided to have an independent third party review to evaluate possible approaches to predicting algal densities from nutrient levels and to recommend appropriate nutrient targets. Drs. Walter Dodds (Kansas State University) and Val Smith (University of Kansas) were retained to accomplish this task. The subcommittee also received additional input from Dr. John Priscu (Montana State University) and Dr. Eugene Welch (University of Washington.)

Using a data base consisting of 200 rivers to relate algal densities to nutrient concentrations, Dodds and Smith concluded that total nutrients were a better predictor than soluble nutrients and that total nitrogen was a better predictor than phosphorus (Dodds and Smith, 1995.) The subcommittee considered this approach but recognized that control of nitrogen without control of phosphorus might reduce nitrogen:phosphorus (N:P) ratios and favor nuisance densities of Cladophora (which reaches its highest level in the river where N:P ratios are low.) Hence the subcommittee concluded that both nitrogen and phosphorus should be controlled.

Using three approaches (regression, probabilistic and reference reaches) to predict in-stream concentrations for improved water quality, Dodds and Smith evaluated a range of targets for total nitrogen and phosphorus. Their final recommendation was a total nitrogen target of 350 ug/l and a total phosphorus target of 45.5 ug/l. Based on the range of targets considered for total nitrogen (200-350 ug/l) the subcommittee decided to use a conservative target of 300 ug/l. The subcommittee then agreed on a total phosphorus target of 39 ug/l which approximates the Redfield ratio of 7.23:1 N:P by weight (Redfield 1958) for optimum ambient nutrient balance. To further inhibit Cladophora in river segments where it is the dominant problem (above Missoula,) a high N:P ratio of 15:1 was agreed upon, which set the in-stream total phosphorus concentration target in these areas at 20 ug/l. The Reserve Street bridge in Missoula was selected as the point of change of the phosphorus target from 20 ug/l (upstream) to 39 ug/l (downstream), as this area exhibits both a change in algae types and a change in river substrate.

To select a target for chlorophyll a, the subcommittee considered data from Dodds and Smith, and previous work by Welch and Nordin as referenced by Dr.Vicki Watson (Watson 1996.) Based on previous studies of chlorophyll a levels from 50 to 150 mg/sq.meter, known levels in the Clark Fork, and the VNRP targets for total nitrogen and total phosphorus, the subcommittee decided on a chlorophyll a target of 100 mg/sq.meter as a summer mean (June 21-September 21,) and 150 mg/square meter as a peak value, at any site.

The subcommittee agreed that in the absence of more definitive in-stream nutrient criteria for the Clark Fork, the proposed target values are reasonable. The subcommittee agreed that managing and monitoring only total loads might allow soluble loads (which most stimulate algal growth) to rise. Based on recommendations in Ingman's A Rationale and Alternatives For Controlling Nutrients and Eutrophication Problems in the Clark Fork River Basin, Watson's Clark Fork artificial stream studies and literature reviews, the subcommittee agreed to monitor for total and soluble nitrogen and phosphorus. The group agreed that although the in-stream targets will focus on total nutrients, it will be important to monitor soluble nutrients and algal densities in order to evaluate potential changes in the ratio of total-to-soluble nutrients and algal response.

Table 1. Summertime Algal and Nutrient Targets

	Chlorophyll a	Total Phosphorus	Total Nitrogen
Upper Clark Fork: Above Reserve St. bridge	100 mg/sq.meter summer mean 150 mg/sq.meter peak	20 ug/l	300 ug/l
Middle Clark Fork: Below Reserve St. bridge	100 mg/sq.meter summer mean 150 mg/sq.meter peak	39 ug/l	300 ug/l

2.7 Target Summary

The nutrient target subcommittee made use of study results, literature review, third party review and citizen complaints to develop in-stream targets to control algae and associated nutrient-related problems on the river. These targets, as summarized in Table 1 above, are:

- 100 mg/sq. meter (summer mean) and 150 mg/sq.meter (peak) chlorophyll a, was agreed upon as the management focus;
- 20 ug/l total phosphorus upstream of Missoula, where Cladophora is a problem and the 15:1 N:P ratio should be maintained;
- 39 ug/l total phosphorus downstream of Missoula; and
- 300 ug/l total nitrogen

In addition to pursuing the summertime algal and nutrient targets, the group agreed to the following:

- Both nitrogen and phosphorus should be managed since both appear limiting at various times and places on the river.
- Algal densities will be the management focus, but both total and soluble forms of nutrients will also be monitored to ensure that there are no upward trends in dissolved nutrient levels and to give the best picture of bioavailability and of loads from point and nonpoint sources.
- The goal is to reduce algal densities by reducing point and nonpoint source nutrient loading.
- Each discharger will be responsible for implementing site-specific actions to achieve in-stream algal and nutrient targets.
- Algal densities in the river will be evaluated annually during VNRP implementation to determine if levels are unchanged, increasing or decreasing.

3.0 Nutrient Control Strategy Implementation

3.1 Rationale

The subcommittee based its implementation plan on the following:

1.) Algae problems in the Clark Fork River are generally limited to the late June through September period.

2.) Nutrient loading from point sources and groundwater seepage is most critical during these low flow periods.

3.) Four point source dischargers—the Butte, Deer Lodge, and Missoula municipal wastewater treatment facilities and the Stone Container Missoula paper mill—are presently the dominant summer sources of nutrient loading.

4.) The voluntary nutrient reduction measures agreed upon have been developed on a site-specific basis, but downstream dischargers will benefit from, and are relying on, upstream source reductions resulting from this plan.

5.) The voluntary nutrient reduction measures are intended to accomplish a reduction in algae biomass (measured as chlorophyll a) through achievement of the in-stream nutrient concentration targets of 300 ug/l total nitrogen, 20 ug/l total phosphorus upstream of Missoula and 39 ug/l downstream of Missoula.

6.) The in-stream concentration targets for Butte apply in the Clark Fork River just below the Warm Springs ponds.

7.) Projected reductions are based on achieving in-stream targets during 30Q10 summertime stream flows. In-stream targets apply to all flow regimes during the June 21 - September 21 period.

8.) It is anticipated that in-stream concentrations will be lower than the target values during high flows and higher than the targets when flows are less than 30Q10.

9.) The nutrient target subcommittee recognizes that control of other point sources and widespread nonpoint sources throughout the basin will be important to the long term protection of Clark Fork water quality.

10.) As nutrient load reductions are achieved by the major point source dischargers, and as population in the basin continues to rise, nonpoint sources of nutrient pollution, new industry and other growth-related issues will assume a very high priority. Without a long-term water quality protection plan, improvements or gains made in water quality through implementation of the VNRP measures could be gradually lost.

3.2 Projected Reductions

Montana DEQ contracted in early 1994 with Science Applications International Corporation (SAIC) to develop a nutrient allocation model for the Clark Fork River (Samuels and Hallock, 1994). The purpose of the SAIC project was to estimate acceptable rates of summer nutrient loading from critical targeted sources. The SAIC calculations were based on suggested targets of the 525 study project (6 ug/l soluble phosphorus and 30 ug/l soluble nitrogen) and focused on the major contributors of soluble phosphorus and nitrogen during summer months as identified in the 525 study: the Butte, Deer Lodge and Missoula municipal wastewater treatment facilities, the Stone Container Corporation industrial facility, and the Bitterroot River. In April 1994 the SAIC report was issued and became the starting point for subcommittee deliberations.

Subsequent to the SAIC report, the subcommittee agreed on targets for total phosphorus and total nitrogen. Based on the work done by the SAIC consultants, Montana DEQ and EPA Region 8 developed a Clark Fork River nutrient response model (Appendix B, "Agencies' Clark Fork Model") to illustrate the present nutrient concentrations in the river and to estimate the reductions in effluent nutrient loading needed to meet the agreed-upon in-stream target concentrations below each of the critical sources during the summer period.

The parties to this voluntary reduction agreement differ on the degree to which the agencies' model accurately predicts the individual target conditions that each of the principal dischargers would need to achieve to meet the targeted nutrient concentrations in the Clark Fork River. Given concerns about the model, the subcommittee used best professional judgement to develop specific point and nonpoint source load reductions (Table 2) to meet the in-stream nutrient and algal targets in Table 1. The actions to achieve these reductions are described in Section 3.4. The model predicts that these reductions will meet the targets for total nitrogen and total phosphorus in most instances (see Model Run C, Appendix B;) however, the model also predicts some nitrogen excursions. These excursions will be addressed through the feedback loop process described below.

Because of the uncertainties involved in dealing with an ever-changing biological system, the subcommittee is reluctant to rely solely on the model as the basis for its reduction program. To address concerns about the model's predictive capabilities, the subcommittee has elected to emphasize a feedback loop approach to the reduction program that consists of:

- implementing specific point and nonpoint reduction actions;
- monitoring algae growth and total and soluble nutrient levels in the river through the Council's water quality monitoring program;
- assessing if actions are meeting the goal of eliminating nuisance algae; and
- modifying the reduction program as necessary, reasonable and agreed to by the parties to the VNRP.

Montana DEQ is committed to revising the Clark Fork model as more in-stream data becomes available for calibration, flow, nutrient cycling and the gain/loss factor. Subcommittee members are committed to assisting the State with this endeavor.

Table 2. Point and Nonpoint Source Ten Year Projected Nutrient Reductions

Source	Stakeholder	Calibration Conditions					Predicted Summertime Conditions (9) (10)				
		Discharge	T P		T N		Discharge	T P		T N	
		cfs	kg/d	ug/l	kg/d	ug/l	cfs	kg/d	ug/l	kg/d	ug/l
Butte WWTP (1) (2)	City of Butte	8.8	51.6	2400	204.2	9487	1.8	4.4	1000	44	10000
Deer Lodge (1)	Deer Lodge	2.8	8.5	1249	35.4	5177	0	0	1249	0	5177
Philipsburg WWTP (3) Drummond WWTP (3)	City of Philipsburg City of Drummond										
Clark Fork Nonpoint (4)	MT DEQ			11		180			9		144
Other Nonpoint (5)	MT DEQ										
Missoula Area Groundwater/Septic System Load (6) (7)	MT DEQ Msla Health Dept City Msla Msla County East Msla	40.5	6	60	49	500	40.5	5.4	54	30	300
Missoula WWTP (1)	City Msla	12.8	78.6	2513	382.4	12216	16.5	40	1000	404	10000
Bitterroot Groundwater/Septic System Load in Missoula area (6)	MT DEQ Msla Health Dept Msla County City Msla	92.6	13.6	60	270	1200	92.6	12.2	54	162	720
Bitterroot Nonpoint Sources (5)	Ravalli County										
Bitterroot Point Sources (3) Hamilton WWTP Stevensville WWTP Lolo WWTP	 City Hamilton City Stevensville Msla County										
Stone Container (1) (8)	Stone Cont.Corp. Direct (8) Seepage	 0 12.3	 0 23.1	 905 768	 0 30	 1101 997	 0 12.3	 0 23.1	 905 768	 0 30	 1101 997

(1) Calibrated loadings for Butte, Deer Lodge, Missoula and Stone Container point sources are based on monitored data from summer months, 1991.
(2) Butte's predicted condition is based on measurements at the Clark Fork below Warm Springs Creek.
(3) Point source loadings not included in VNRP wasteload allocation, but addressed on pages 23-24.
(4) Clark Fork nonpoint reduction based on concentrations--not load--at Clark Fork above Missoula site, Model Run C.
(5) Nonpoint loads are incorporated into background, but are not quantified; addressed on pages 25-28.
(6) Calibration loadings for groundwater/septic systems in the Missoula area are based on Land & Water Consulting estimates, 1996.
(7) Loading encompasses area east of the Clark Fork/Bitterroot confluence; area to west of confluence still requires inventory.
(8) Direct discharge from Stone typically does not occur during July and August.
(9) In-stream targets = 39 ug/l TP upstream of Missoula, 20 ug/l TP downstream of Missoula, and 300 ug/l TN.
(10) Achievement of target loading conditions assumed to be accomplished over 10 year implementation period, for summertime conditions (June 21 - September 21.)

3.3 Margin of Safety

To provide a margin of safety, the subcommittee chose to use more protective targets than those recommended by Dodds' and Smith's third party review. Dodds and Smith recommended a total nitrogen target of 350 ug/l and a total phosphorus target of 45.5 ug/l. The subcommittee elected to set a more conservative 300 ug/l total nitrogen target which represents a 15 % margin of safety. This was consistent with later recommendations by Dodds, Smith and Zander (1996.) The selected total phosphorus targets of 20 ug/l above Missoula and 39 ug/l below Missoula represent a 56% and 15% margin of safety respectively.

In addition, the monitoring of the attainment of the in-stream targets will be based on a 30Q10 low flow. The 30Q10 low flow used is the lowest 30-day average typically observed in one summer out of ten over the period of record for each site. Hence, if site-specific actions meet the targets at 30Q10, in-stream nutrient concentrations will be less than the target nutrient levels at all times except for about one month out of ten years.

As described in Section 3.2, the monitoring of the attainment of in-stream targets plays a key role in the feedback loop approach, which establishes an on-going process to ensure program effectiveness. Utilizing this approach, point and nonpoint reduction actions will be implemented and algae and nutrient levels will be measured and assessed—based on 30Q10—to ascertain if these actions are meeting the goal of eliminating nuisance algae. The reduction program will be further modified to meet the targets if necessary and as considered reasonable and agreed to by the parties to the VNRP.

3.4 Reduction Actions

The four predominant summertime point sources of nutrients on the river will be an important early focus of the VNRP. Because they are more easily measured and in many cases historically quantified, it is relatively easy to document successes in point source reductions. These reductions will require substantial capital investments which, in the case of publicly owned facilities, will be financed by the affected citizens. Simultaneous to key point source reductions, other sources of nutrients, including smaller point sources, septic systems, nonpoint sources and new and growth-related sources, will also be addressed in the VNRP.

The following section describes actions that are: 1) completed and/or ongoing efforts to reduce nutrient loading; and 2) proposed additional nutrient control measures to meet in-stream targets of the VNRP.

3.4.1 Butte Wastewater Treatment Plant

1.) Butte's voluntary phosphate detergent ban will continue to be in force. The city has contacted all major water users (hospital, nursing homes, restaurants, etc.) and received their agreement to eliminate the use of phosphorus-containing detergents. Butte will continue to meet with any new potential users to continue this program. A shelf survey of grocery stores showed little or no detergents containing phosphorus.

2.) Butte is well into a plan with ARCO to coordinate nutrient reduction efforts with Superfund clean-up and a proposed land use "Greenway" project. This involves an extensive stormwater plan utilizing sediment basin catchment ponds and a stormwater /groundwater treatment plant. Design of the ponds began in August 1995 and construction is scheduled to be completed in the second quarter of 1998. A final decision on the scope and function of a potential treatment plant will be made by the year 2000. Butte believes the sediment/stormwater project will have a significant effect on nutrient loading to Silver Bow Creek and is currently working with ARCO to develop estimates of water quality benefits.

3.) Butte-Silver Bow continues to investigate the feasibility of using wetlands as a means of summer time nutrient removal. Work is being coordinated with ARCO and the possibility of developing an integrated system for simultaneous nutrient removal from Butte municipal wastewater effluent and metal and sulfate removal from Colorado tailings water is being discussed. No definite time frame has been developed.

4.) Butte entered into an agreement for technical assistance with the Bureau of Reclamation under Title XVI of Public Law 102-575 to develop an appraisal investigation of alternatives to Butte's direct discharge of treated wastewater to the headwaters of the Clark Fork River. Realizing that wetlands may not be the total answer to the problem at Butte, the city and BOR investigated:

- a.) the feasibility of seasonal land application;
- b.) possible cooperative efforts between Butte-Silver Bow and Montana Resources, Inc., a local mining company;
- c.) the impact of water rights issues;
- d.) the potential to interface with existing Superfund programs; and
- e.) the potential for any innovative solutions to assist the city in its efforts to meet the nutrient reduction program.

The BOR work plan and scope of services were submitted in September 1995. Work began in January 1996 and was completed in January 1997. The plan is being used as resource and background material for the overall Butte operation.

5.) In an effort to allow for greater flexibility and enhance the potential for beneficial uses, Butte-Silver Bow will install an effluent pump station at the Metro Sewer plant. This station will be capable of moving up to 5 million gallons per day (MGD) of sewage effluent allowing the treatment plant to pump to Montana Resources or to a variety of future industrial users or potential land application sites. Bid letting is scheduled for Spring 1998.

6.) Butte-Silver Bow has recently acquired ownership of the Silver Lake water system. Present plans call for the annual distribution of approximately 56 MGD in the following manner:

4 MGD: Butte-Silver Bow (to be used by ASIMI, an industrial user)
2 MGD: Montana Resources Inc.
12 MGD: New industry
8 MGD: ARCO
30 MGD: Irrigators

Of ARCO's total annual allocation (8 MGD x 365 days), 24 MGD will be placed into Warm Springs Creek during the months of June, July, August and September. This corresponds with the timeframe identified as the most critical for affecting algae growth. Initial calculations indicate a significant reduction in both phosphorus and nitrogen concentrations due to flow augmentation.

3.4.2 Deer Lodge Municipal Wastewater Treatment Plant

1.) The city will continue to enforce its phosphate detergent ban ordinance, passed in 1993.

2.) During the summer1995, the City lined the irrigation ditch adjacent to its sewage lagoon to stop leakage into cell 4 of the lagoon. The results thus far indicate that the amount of water processed through the system has been reduced by 413,860 gallons per day. This reduction is important because it paves the way for pumping the city's entire effluent discharge onto the Grant Kohrs Ranch hay fields and adjacent private lands. Prior to lining the ditch, elevated effluent volumes caused land area requirements that jeopardized the feasibility of land application of the city's wastewater.

3.) The City is constructing a land application system that will eliminate discharge into the Clark Fork River during critical summer months. A feasibility plan was prepared by Professional Consultants, Inc. for development of a system to land apply the city's treated wastewater on hayfields at the National Park Service's Grant Kohrs Ranch and on adjacent private lands. A public hearing was held on the feasibility study in March 1995 and the final report was issued December 1995. In October 1995 the city petitioned for a declaratory ruling from the state's Department of Natural Resources and Conservation (DNRC) regarding water rights issues associated with land application of the city's wastewater. In June 1996 a favorable ruling was received from the state. (This ruling may have impact on other potential land application projects in the basin as well.)

After receipt of the declaratory ruling, an Environmental Assessment was prepared cooperatively by the National Park Service and DEQ to determine any significant impacts as a result of the proposed project. Clean Water Act regulations, public health concerns, hazardous materials issues and impacts to the resources of the ranch were considered in the assessment. A Finding on No Significant Impact was issued on the EA in January 1997.

The National Park Service has granted a waiver from policy for the land application project. The city has acquired the necessary funding and easements and is currently working on contracting agreements in order to begin construction in 1998.

3.4.3 Missoula Municipal Wastewater Treatment Plant

1.) Missoula and the surrounding area became the first metropolitan area along the Clark Fork mainstem to ban the sale of phosphorus detergents in November 1988. This resulted in a 40% reduction in phosphorus discharges from the Missoula wastewater treatment plant and started a trend which has virtually eliminated phosphorus detergents from store shelves throughout the basin. Due to the ban, the city's discharge was reduced from an annual average of 342 pounds per day in 1988 to an average of 228 pounds per day in 1989.

2.) In anticipation of future restrictions on nutrient discharges, the city hired Thomas, Dean and Hoskins, a Great Falls, Montana consulting firm to complete a Land Application of Wastewater Assessment (March 1991.) The study included in-depth evaluations of irrigation reuse, rapid infiltration, and a cursory look at wetlands treatment for nutrient management.

3.) In anticipation of future restrictions on nutrient discharges, the city hired Montgomery Watson, a national consulting firm, to conduct a Missoula WWTP Phosphorus Removal Evaluation (July, 1993.) This study looked at chemical precipitation technologies and biological removal technologies that could be used at the plant. Some of the recommendations of this report have been implemented on an experimental basis, as discussed below in #5, resulting in substantial reductions in phosphorus discharges.

4.) In mid-1995 the city hired Brown and Caldwell, a national wastewater consulting firm, to perform a comprehensive update of its 1984 Facility Plan (also known as a 201 Plan.) The updated plan, which the city plans to complete in the summer of 1998, will make recommendations about the collection and treatment of wastewater in the Missoula area. Nutrient management actions will be an important part of the planning process; the plan will also have a substantial public participation component. In-stream nutrient targets, which have been agreed upon, are the basis for future treatment facility designs. Land application, effluent reuse, wetland treatment, and in-plant nutrient removal options are all being evaluated as part of this comprehensive planning effort.

Although the Facility Plan has not been adopted at the time of this writing, the following elements will be included in the final document:

a.) Chosen Alternative. The chosen Wastewater Management Plan Alternative is central treatment, which is identified as alternative B in the Facility Plan. In this alternative, the major wastewater management facility continues to be the existing Missoula wastewater treatment plant. The facility would be upgraded to provide for the biological removal of the nutrients, nitrogen and phosphorus. The central treatment facility will also be expanded to accommodate increased loadings due to the predicted growth of the Missoula area.

b.) Biological Nutrient Removal (BNR). Both nitrogen and phosphorus will be removed utilizing BNR. Typically, an "aeration" basin for this process includes zones with no oxygen (anaerobic) and low oxygen (anoxic), as well as conventional aerated zones. These modified aeration basins are called bio-reactors. In the bio-reactors, nitrogen is removed by oxidizing the ammonia compounds, forming nitrates in the aerobic zones, then reducing the nitrates to nitrogen gas in the anoxic zones. Nitrogen gas, a natural component of the air we breathe, is released into the atmosphere.

The anaerobic zones in the bio-reactors encourage the growth of specific bacteria that consume large quantities of phosphorus in a process called "luxury uptake." In the BNR facility, phosphorus is removed from the liquid stream in the form of phosphorus-rich sludge, which is made into compost at a nearby facility.

Nominal effluent quality parameters for BNR at the Missoula facility are:

Biochemical Oxygen Demand (BOD)	10 mg/l
Total Suspended Solids (TSS)	10 mg/l
Total Nitrogen	10 mg/l
Ammonia Nitrogen	1 to 2 mg/l
Total Phosphorus	1 mg/l

While the facility is expected to meet effluent levels of 1mg/l total phosphorus and 10 mg/l total nitrogen under the optimum-treatment BNR regime, in actual operation the plant may attain lower levels than these. If the plant can be operated at lower than expected levels, the extra reduction in nutrients would likely provide an even greater potential for algal reductions in the river downstream of the facility.

5.) Based on recommendations from the Montgomery Watson Phosphorus Removal Evaluation study, attendance by facility staff at several BNR seminars, and observations of BNR technology at Kalispell, Montana and Heidelberg, Germany, the Missoula plant operations staff have been experimenting with BNR since September 1994. This is being done, at no cost, using the existing aeration basin capacity. The air has been shut completely off in two of the eight aeration cells, creating the anaerobic and anoxic zones which are necessary for BNR. This experimental operational mode has not only resulted in substantial phosphorus removal, but has significantly improved the overall stability and performance of the treatment facility. In spite of the substantial growth of the Missoula area, the City has continued to improve the quality of its wastewater discharge to the Clark Fork River through these improvements in plant efficiency. Currently the City is providing a much higher level of treatment than is required in its discharge permit, despite thousands of new hook-ups to the system.

6.) During the interim period between now and the time the recommendations of the new Facility Plan are implemented, City wastewater staff will continue to operate the treatment facility in the experimental nutrient removal mode. Staff may have to temporarily suspend this operational mode during periods of high influent flows, usually in the spring. Higher flows require additional aeration capacity, which is lost in the experimental nutrient removal mode. Without the additional capacity, treatment of the conventional pollutants, BOD and TSS, might be compromised.

7.) In the Missoula urban area, various groundwater pollution sources contribute an estimated 319 kg/day of nitrogen and 19.6 kg/day of phosphorus into the lower Bitterroot River and the Clark Fork near its confluence with the Bitterroot. (Land & Water Report, 1996.) The source of nutrients in groundwater is likely a combination of development and land use activities including septic systems, agriculture, and urban/suburban sources such as stormwater, land fertilizers, and road de-icers. Nitrate loading from 6,780 septic systems in the Missoula urban area to the Clark Fork and Bitterroot rivers is estimated to be 257 kg/day (MCCHD 1996.) Septic systems in the outlying portions of the Missoula area contribute additional loads. Phosphorus loading to surface water from urban area septic systems has not been reliably estimated. This compares to a discharge of 712 kg/day nitrogen and 40.5 kg/day phosphorus from the Missoula WWTP in 1995. It is apparent that to ignore the impact of septic systems on surface water while implementing nutrient removal measures at the WWTP will: a.) not solve nutrient problems in the river for the long term; b.) place the economic burden of temporarily solving the problem on those people connected to the WWTP; c.) provide a disincentive to connect to public sewer thus perpetuating groundwater impacts of septic systems; and d.) further encourage large parcel suburban and rural sprawl resulting in septic discharges that cannot be feasibly sewered and adequately treated.

To resolve these issues, the City of Missoula, the City-County Health Department Board of Health, the Missoula County Commissioners, and Montana DEQ commit to developing strategies in Missoula and surrounding areas that will:

a) recognize the connection between septic effluent/ground water/surface water in the Upper Clark Fork watershed and in the Missoula Valley;
b.) review state and local regulations with the goal of removing disincentives and /or offering incentives for connecting new and existing septic systems to public sewage collection and treatment facilities that will remove nutrients;
c.) provide for the extension of sewer mains into high density unsewered areas as quickly as is feasible;
d.) maintain existing local regulations and modify state subdivision regulations as appropriate to encourage clustering and smaller lots in new subdivisions and provide for the economically feasible, orderly and timely connection of new subdivisions in the area onto public sewer;
e.) give credit to the Missoula WWTP for meeting part of its nutrient reduction as additional connections of existing septic systems are made;
f.) encourage development of alternatives to municipal wastewater disposal to reduce nutrients from new development (such as land application, wetlands, and nutrient removal septic systems.)
g.) connect 50 percent of the existing 6,780 septic systems in the Missoula urban area, resulting in an estimated reduction of approximately 130 kg/day nitrogen discharged to the Bitterroot and Clark Fork Rivers;

h.) continue connecting existing septic systems in the Missoula area to public sewage treatment and collection facilities at a rate approximately equivalent to the number of new septic system permits issued with the Missoula Valley Water Quality District;
i.) reduce groundwater phosphorus loads to the Bitterroot and Clark Fork Rivers by 10%, or approximately 2 kg/day, and reduce surface water loads by 10% through such measures as best management practices for urban/suburban development and agriculture; control of stormwater pollution sources; enforcement of existing local regulations such as the Aquifer Protection Ordinance, Riparian Regulations and Lakeshore Regulations; and through connection of septic systems located in shallow groundwater areas near streams to public sewer; and
j.) limit nutrient loading from septic systems outside the Missoula WWTP service area.

In addition to this local commitment, efforts will be made to work with and involve Ravalli County to assess groundwater/surface water contamination from increasing septics in the Bitterroot River valley and develop a strategy to reduce these impacts.

3.4.4 Stone Container Corporation Missoula Mill

Since 1986, a number of improvements and/or operational changes have reduced the levels of nitrogen and phosphorus contained in the treated effluents that are discharged to the Clark Fork River from the Missoula mill. These changes, as well as current and future proposed efforts are outlined as follows:

1.) The mill's discharge permit issued in 1986 stipulated that the mill pursue a course of action designed to return the nutrient concentrations of nitrogen and phosphorus to pre-1983 levels. It was not possible to determine accurately those pre-1983 levels. Nevertheless, the mill embarked on a reduction program to gradually reduce the level of supplemental nutrients added to the wastewater secondary treatment system with the goal of ultimately achieving levels in the treated effluent at or below 1983 levels. At the same time, the mill had to ensure that the biological health of the secondary system be maintained. Over the course of the next ten years, the mill gradually reduced the amount of supplemental nutrients added to the treatment system.

2.) In 1990 the mill added an additional 650 horsepower of aeration capability and introduced a third aeration basin to the secondary treatment system to improve the biological oxygen demand (BOD) reduction efficiency and reduce BOD and total suspended solids (TSS) in the treated effluent. A secondary benefit of the project was the ability to reduce further the supplemental nutrients required to maintain the biological health of the secondary treatment system. It is uncertain at this time if the operational stability of the secondary treatment system can be maintained indefinitely under this operating scenario. The mill adds small quantities of supplemental phosphorus-containing compounds (25 pounds per day as phosphorus,) and adds small quantities of nitrogen on a regular basis (25 pounds per day as nitrogen.)

3.) In 1995 the Missoula mill voluntarily adopted the following operational changes which will be continued in order to reduce the levels of nitrogen and phosphorus entering the Clark Fork River:

a.) The mill will start up the Color Removal Plant on or before June 15th of each year in an effort to reduce the levels of total nitrogen and phosphorus in treated effluent, provided that river flow is at or below 4000 cfs. The CRP will run through the critical low flow period (through September 21.) Future in-plant process changes may make operation of the CRP unnecessary to achieve nutrient reductions. In addition to a demonstrated nutrient reduction potential, the early operation of the plant allows the mill to utilize long-term storage ponds that are a greater distance from the river, which in turn reduces the seepage component to the river during the summer months. In the event that equipment malfunctions or regular scheduled maintenance prevents CRP operation, the plant will start up as soon as repairs are completed.

b.) The mill will utilize other long-term storage ponds (for non-color treated effluent) that are farthest away from the river to reduce seepage contribution to the river.

c.) The mill will not direct discharge to the river during the months of July and August of any future year if the river flow is less than 4000 cfs. The mill is currently allowed by permit to discharge up to and including July 15th of any year providing that the river flow is greater than 1900 cfs.

4). Additional future reduction efforts: While the mill continues to follow the operational practices that were initiated in 1995, research into additional nutrient reduction processes and techniques will be evaluated. This will consist of working with biological experts and consultants to evaluate the existing treatment system and determine what additional steps may be required to further reduce the levels of nitrogen and phosphorus in the mill's treated effluents. A list of alternatives will be developed and ranked according to specific criteria (i.e. efficiency, cost, simplicity of operation, etc.)

3.4.5 Other Point Sources

In addition to the implementation of strategies for the key point source discharges targeted above, the nutrient target subcommittee:

1.) Will assist with the development and implementation of equitable treatment technologies for smaller point sources such as Drummond, Philipsburg, Hamilton and Lolo.

2.) Will be active in review of the state's permitting process to ensure that in-stream targets are being met from other existing and new MPDES permits.

3.) Requests that DEQ develop a policy to address new and other existing discharge permits to achieve in-stream targets identified in this VNRP and to address current 303(d) listed segments. The subcommittee believes that in order to successfully meet the in-stream targets, new and existing discharges should be required to either a.) implement sufficient levels of treatment that will ensure targets will be met in-stream or b.) implement pollutant trading.

3.4.6 Septic Systems

To meet in-stream targets, the following actions will be implemented to reduce impacts from septic systems:

1. Missoula City-County Health Department

a.) A strategy for treatment of septic systems as point sources will be explored. In order to control the contribution of nutrients from septic systems entering surface water via ground water, changes will be needed in the way septic systems are permitted and, perhaps, constructed. This issue is especially relevant in the Missoula area where the large community investment in reducing nutrient discharge from the wastewater treatment plant will likely be offset in the long term by the continued proliferation of septic disposal systems. Addressing septics as a nutrient point source will require the cooperation of the City, County, Board of Health and Montana DEQ to determine the appropriate allocation of allowable discharge and necessary mitigation strategies. Since owners of land on which septic systems may be placed in the future are not signatories to the VNRP, it will be necessary to develop some requirements to mitigate these sources through state and local point source regulation. Septic systems meet the definition of "Point Source" in 75-5-104 which "means a discernible, confined and discrete conveyance including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, or vessel or other floating craft, from which pollutants are or may be discharged."

The subcommittee does not intend that the treatment of septic systems as point sources will mean that state-authorized MPDES or groundwater permits would be required. The goal is to establish a sound basis for mandatory county and/or health department septic regulations (through Title 50 and Title 76 authorities) to deal with septic contributions to surface water.

b.) The strategy will also consider ways to control septic densities outside of areas serviced by wastewater treatment facilities. This will require working closely with DEQ's Subdivision Section to implement lot size requirements and appropriate subdivision review policies that address the impacts of groundwater on surface water quality and are protective of the nutrient targets. In Missoula County, outside the designated service area for the Missoula WWTP, the City, County, Board of Health and DEQ commit to development and implementation of a strategy that will:

1.) estimate the discharge of septic nutrient effluent and track the number of new septic permits and new public sewer connections each year in the Missoula Valley;
2.) develop a maximum permissible allocation of septic nutrient discharge to surface waters in the Missoula Valley;
3.) institute adequate requirements and policies to implement the allocation;

4.) explore options for addressing discrepancies in surface water and groundwater standards in areas where the two are strongly interconnected; and
5.) develop a program to address potential groundwater contribution to surface water from existing small community land application and rapid infiltration systems.

2. Additional Septic Source Controls

Although the impetus for the development of the above strategy to treat septic systems as point sources and develop protective subdivision regulations is directly related to concerns over septic contributions to surface water in the Missoula area, the subcommittee recognizes that other developed and developing areas covered by the VNRP may also have similar problems. The subcommittee firmly believes that to ignore the impact of septic systems on surface water while implementing nutrient removal measures at publicly owned treatment works (POTW's) will not solve nutrient problems in the river for the long term. Where necessary and feasible, the subcommittee will implement strategies in VNRP communities that:

a.) recognize the connection between septic effluent, ground water, and surface water;
b.) review state and local regulations with the goal of seeking opportunities to remove disincentives and /or offer incentives for hook-up to POTW's;
c.) provide for the extension of sewer mains into high density unsewered areas as quickly as is feasible;
d.) provide for the orderly and timely connection of new subdivisions onto public sewer;
e.) give credit to wastewater treatment facilities for meeting nutrient reductions as additional hook-ups are made; and
f.) encourage planning for alternatives to municipal wastewater disposal to reduce nutrients from new development (such as land application, wetlands, and nutrient removal septic systems.)

3.4.7 Nonpoint Sources

1. Existing Nonpoint Sources

The findings of the Section 525 studies and the nonpoint source stream reach assessments provide a good foundation for the development of a nonpoint source nutrient control strategy for the Clark Fork basin.

Of 99 suspected impaired streams surveyed in the nutrient source assessment, 65 percent were given an overall rating of "impaired" (partial or non-support of the streams' designated uses.) Fifty-seven percent of the 272 individual reaches examined within those 99 streams were rated as impaired. The largest share of nonpoint source problems was found in the upper Clark Fork and Blackfoot River basins, where more than two-thirds of the assessed streams were rated as impaired. Conditions were marginally better in the Clark Fork drainage below Missoula and in the Bitterroot valley, where 45 and 33 percent of the assessed streams, respectively, were rated as impaired.

Based on the information from these assessments, DEQ's Watershed Management Section staff will be developing and implementing nonpoint source plans and TMDL processes to target nutrients as part of the state's combined nonpoint and TMDL strategy. Working with state staff on areas specific to the Clark Fork basin, the nutrient target subcommittee will develop a nonpoint strategy that includes the following:

a.) Setting of priority drainages. This includes the state's priorities from the Section 525 and Section 305b reports, the state's nonpoint source stream reach assessments, and priorities identified at the community level by local groups and conservation districts based on available information. The Natural Resources Conservation Service (NRCS) suggests that the nonpoint priorities for the Clark Fork basin should focus on areas where groups are already working on these issues, such as in the upper Clark Fork mainstem (Upper Clark Fork River Basin Steering Committee), the Blackfoot River (Blackfoot Challenge), and the Bitterroot River (Bitterroot Water Forum.) Because the Section 525 study identified the Bitterroot River as a critical source of nitrogen to the Clark Fork during summer months, it will be a high priority to focus on groundwater nitrogen loading to the Bitterroot River.

b.) Identification of sources of pollution in priority drainages through water quality investigations and monitoring.

c.) Completion of an assessment of water quality data to prioritize for corrective measures. Issues to be considered will likely include, but will not be limited to, impacts from agriculture, forestry, mining, and urban/suburban land uses (stormwater and erosion/sedimentation control.) Nonpoint source nitrogen and phosphorus loading from the five principle drainage basins contributing to the Clark Fork have been estimated by Brown and Caldwell (1997) based upon land use, area (acres) and loading factors (kg/acre.) The EPA BASINS program was used to identify land use and area in the following categories: Forest, Urban, Rangeland, Agriculture, and Barren. Loading factors for nitrogen and phosphorus were selected from literature values. For example, continuous flow nonpoint source loads in the upper Clark Fork River basin were identified and estimated for irrigation return flows (500 kg/d total nitrogen and 190 kg/d total phosphorus) and livestock (100 kg/d total nitrogen and 30 kg/d total phosphorus.) The preliminary analysis identified the magnitude of nonpoint source loading by drainage basin and by land use. These estimates will be used to prioritize nonpoint efforts throughout the basin.

d.) Engaging local groups in problem-solving in collaboration with the state and the local conservation districts.

e.) Implementation of voluntary best management practices to address identified impacts.

f.) Tracking overall progress towards meeting nutrient targets; this includes keeping track of how local groups' efforts relate to the big picture and monitoring for water quality improvements in the Clark Fork River.

2. Local Program Implementation

To meet VNRP targets, the subcommittee has set a goal for a 20 percent reduction in nitrogen and phosphorus loading from existing nonpoint sources. To meet this goal, the subcommittee will work in an advisory capacity with basin groups to encourage nonpoint source planning and TMDL implementation. Initial efforts will focus on the upper Clark Fork and Bitterroot drainages where established groups and projects are underway. Recognizing the need for reductions in other areas, the subcommittee will direct its VNRP coordinator to work with DEQ on a prioritization and implementation strategy as described above. Looking at the "big picture," the Council views its role as a potential advisor or assistant to local groups, recognizing that nonpoint plans and TMDL's in tributaries to the Clark Fork will in turn help meet the algal and nutrient targets of this VNRP.

DEQ will be working with local conservation districts and watershed planning groups to reduce nonpoint source nutrient loads in the Upper Clark Fork basin (upriver of Missoula) over the next ten years. Strategies for dealing with nonpoint reductions in the upper basin will be determined by local watershed planning groups such as the Upper Clark Fork River Basin Steering Committee, the Blackfoot Challenge and local conservation districts. The following projects are currently underway and have anticipated water quality benefits:

a.) Upper Clark Fork River Basin Steering Committee: In cooperation with other partners, the committee is beginning a water quality planning approach to smaller watersheds in the upper Clark Fork. The group will be conducting a systematic evaluation of causes of impairment to Section 303(d) listed waters, and developing pilot watershed projects to reduce pollutant levels.

b.) Blackfoot Challenge: The Challenge is a local citizen-based group that is conducting nonpoint source pollution reduction projects in the Blackfoot River basin. Over thirty projects have already been implemented to improve fish habitat, restore natural stream channels and improve riparian vegetation.

c.) Bitterroot Watershed: The Bitterroot Water Forum is a citizen-based group working to increase awareness of water quality issues in the Bitterroot River valley. In 1998 the group is holding several "Know Your Watershed" workshops to foster involvement in water quality planning and restoration efforts. The workshops are expected to generate interest in forming local watershed planning groups to begin developing TMDL's for 303(d) listed waterbodies in the valley, with an emphasis on land use and development issues. DEQ, USGS and Ravalli County have been coordinating on GIS development and ground and surface water monitoring.

d.) Nevada Creek: The North Powell Conservation District is sponsoring a watershed restoration project that proposes to meet water quality standards by improving riparian conditions, stabilizing streambanks, implementing grazing management BMP's, and reducing agricultural wastes from two major confinements and three winter feeding grounds. The project will potentially meet the requirements of a nonpoint source TMDL and proposes to reduce sediment delivery to the Blackfoot River by 50 percent over a ten-year period.

e.) Rock Creek: The Forest Service and Bureau of Land Management are conducting the Rock Creek Sub-basin Analysis to assess the historic and current conditions of fish and wildlife, vegetation, social and economic resources in the Rock Creek watershed. The process is expected to assist federal lands managers with developing a "desired future condition" for Rock Creek which may be used as a TMDL in this watershed. Local landowners, county officials, tribes and state agencies have been invited to participate in the process.

3. New Activities and Growth-related Issues

To address new nonpoint sources and increases to current sources from expanded population growth, the VNRP calls for actions which the nutrient target subcommittee will oversee including:

a.) Developing a priority listing of areas where growth and nutrient increases are likely to take place.
b.) Investigating possible local control options.
c.) Assisting local entities with implementation of appropriate water quality controls in priority areas to buffer impacts from growth.
d.) Working closely with the Growth Management Task Force established for the Missoula valley.
e.) Attaining involvement of Ravalli County to address growth and Bitterroot River-related issues.
f.) Seeking opportunities for nutrient pollution trading and evaluate the need for changes to state laws.

3.5 Timelines

The following milestone tables illustrate timelines and associated projected or actual costs for the point and nonpoint source reduction measures.

Table 3: VNRP Implementation Timeline

		Prior to VNRP								VNRP Ten-Year Program											Costs
		90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	
BUTTE																					
Voluntary phosphate detergent ban						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	$4,000
Stormwater containment pond							x	x	x	x	x	x	x	x	x	x	x	x	x	x	$4,000,000
Groundwater/stormwater treatment plant + wetland											x	x	x	x	x	x	x	x	x	x	$10,000,000
BOR investigation of direct discharge alternatives								x	x												$40,000
Installation of effluent pump station										x											$650,000
Warm Springs Creek flow augmentation										x	x	x	x	x	x	x	x	x	x	x	$11,500,000
																		Subtotal			$26,194,000
DEER LODGE																					
Phosphate detergent ban					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	0
Lining of irrigation ditch							x														$30,000
Rebuild irrigation ditch								x													$5,000
Land application feasibility study							x	x													$8,500
Declaratory ruling from DNRC								x													$2,500
Construct land application system at Grant Kohrs Ranch										x											$207,000
Land application system operational											x	x	x	x	x	x	x	x	x	x	
																		Subtotal			$253,000
MISSOULA																					
Phosphate detergent ban	1988	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	$10,000
Land application assessment			x																		$20,000
WWTP phosphorus removal evaluation					x																$10,000
Facility plan update							x	x	x	x											$500,000
WWTP biological nutrient removal (BNR) experimentation						x	x	x	x	x	x	x									0
WWTP BNR upgrade												x	x	x	x						$15,000,000
WWTP capacity upgrade (12 MGD)																			x	x	$20,000,000
																		Subtotal			$35,540,000
STONE CONTAINER																					
Upgrade of secondary treatment system		x																			$750,000
Reduction of supplemental phosphorus					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	n/a
Reduction of supplemental nitrogen		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	n/a
Summer storage pond selection to reduce seepage							x	x	x	x	x	x	x	x	x	x	x	x	x	x	n/a
Early start-up of color removal plant (at flow below 4000 cfs)							x	x	x	x	x	x	x	x	x	x	x	x	x	x	$50,000
No direct discharge July/August (at flow below 4000 cfs								x	x	x	x	x	x	x	x	x	x	x	x	x	n/a
Contractor evaluation of other nutrient reduction alternatives										x	x	x	x	x							$100,000
																		Subtotal			$900,000
OTHER POINT SOURCES																					
Committee / DEQ coordinate on other MPDES permits										x	x	x	x	x	x	x	x	x	x	x	n/a
DEQ permit policy implemented for others to meet targets										x	x	x	x	x	x	x	x	x	x	x	n/a

Table 3: VNRP Implementation Timeline

	Prior to VNRP								VNRP Ten-Year Program											Costs
	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	
SEPTIC SYSTEMS: Missoula area septic system connection schedule (1)																				
E. Reserve, South: 1,029 units										x	x	x	x	x	x	x	x	x	x	$4,000,000 (2)
E. Reserve, North: 948 units												x	x	x	x	x	x	x	x	$5,000,000 (2)
W. Reserve Interceptor: 516 units														x	x	x	x	x	x	$5,000,000 (2)
East Missoula: 766 Units											x	x	x	x	x	x	x	x	x	$ 820,000 (2)
South Avenue: 1,227 units																			x	$ 660,000 (2)
Target Range Collectors: 660 units																			x	$3,400,000 (2)
Miscellaneous Projects: 113 units																			x	unknown
																		Subtotal		$18,880,000
NONPOINT																				
DEQ TMDL Strategy																			(3)	$2,000,000
Phase I: Existing Clark Fork Basin Nonpoint Projects								x	x	x										
Phase II: Clark Fork Basin TMDL Implementation										x	x	x	x	x	x	x	x	x		
Phase III: Target remaining Clark Fork TMDL needs														x	x	x	x	x		
VNRP Coordinator works w/ DEQ; EPA start-up grant									x	x	x									$50,000
Upper Clark Fork Water Quality Planning projects								x	x	x	x	x	x	x	x	x	x	x		$450,000 (4)
Rock Creek									x	x	x	x	x	x	x	x	x	x		
Blackfoot River 319 projects		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Nevada Creek 319 project						x	x	x	x	x	x									
Little Blackfoot MT Fish, Wildlife & Parks projects								x	x	x	x									
Mainstem Clark Fork Superfund Clean Up																				$20,000,000
Bitterroot River																				$300,000 (5)
Three Mile Creek 319 project		x	x	x	x	x	x													
Bitteroot Water Forum projects, current			x	x	x	x	x	x	x	x	x									
Bitteroot Water Forum projects, projected										x	x	x	x	x	x	x	x	x		
Water Quality Characterization, EPA								x	x	x	x									
Committee/VNRP coordinator develop growth-related issues strategy										x	x									
																		Subtotal		$22,800,000
TOTAL PROJECTED COSTS																				$104,567,000

(1) Numbers indicate potential units for sewer connection
(2) These amounts do not include individual connection fees @ $3,000 per unit
(3) DEQ nonpoint and TMDL schedule currently planned through May, 2007
(4) $450,000 has been spent over the last 8 years; DEQ estimates it will spend about the same amount through 2007.
(5) $300,000 has been spent since 1991; DEQ estimates it will spend about the same amount through 2007.

3.6 Monitoring Plan

A monitoring plan has been developed that incorporates in-stream water quality monitoring and management option evaluation.

1. In-stream Water Quality Monitoring Goals

In 1995, the Council's Monitoring Subcommittee contracted with Land & Water Consulting, Missoula, Montana to design a coordinated, consistent and meaningful monitoring program for the three-state watershed. The work performed by the contractor included: data inventory and compilation; data analysis; definition of monitoring information expectations; assessment of statistical "power of trend"; optimization of the existing monitoring network; and development of operating plans/procedures and reporting procedures. The contractor developed monitoring plan alternatives—based on variables, frequencies, confidence levels and costs—for subcommittee consideration prior to the development of a final monitoring plan. (See Appendix C, related excerpts from the Clark Fork-Pend Oreille watershed monitoring program Sampling and Analysis Plan.) The final plan was completed in 1997 and is being implemented in the 1998 field season.

The monitoring subcommittee has set the following goals for the Montana (Clark Fork River) portion of the watershed:

- Improve water quality, which includes monitoring of seasonally based total phosphorus and total nitrogen concentrations, to detect significant water quality trends;
- Control nuisance algae, which includes measurement of attached algae levels to be compared year to year to detect significant trends in algae growth; and monitoring for changes in algal species to detect trends in species composition as a result of nutrient targets; and
- Achieve in-stream nutrient targets, which includes monitoring of total and soluble phosphorus and nitrogen to evaluate success at achieving targets.

The nutrient target subcommittee believes that a monitoring program based on these goals will fulfill its need for an effective in-stream assessment process. The nutrient target subcommittee worked in conjunction with the monitoring subcommittee to ensure that these goals were included in the final monitoring plan. If the nutrient target subcommittee determines a need for other specific monitoring to assess whether in-stream targets are being met, plans will be developed with the monitoring subcommittee.

2. Evaluation of Management Actions

At least every three years, using the feedback loop approach, the nutrient target subcommittee will complete an evaluation of the VNRP to address the following:

- Based on the time lines, have nutrient reduction measures been implemented?
- Based on in-stream monitoring results and a reasonable expected reduction from each action, are measures as effective in reducing nutrients as anticipated?
- Based on in-stream monitoring results, are algal densities unchanged, increasing or decreasing?
- Based on discharge monitoring reports, in-stream data and model calibration, would in-stream targets be met at 30Q10 flow?

If measures are not meeting expectations, new alternatives will be developed as necessary, reasonable and agreed to by the parties to the VNRP.

3. Responsibilities

To carry out the monitoring/evaluation plan, the following responsibilities have been agreed to:

a.) Point and nonpoint source measures aimed at meeting the in-stream targets will be implemented by the parties to this agreement. The nutrient target subcommittee will oversee this implementation.
b.) The monitoring subcommittee will be responsible for implementing a process to assess in-stream progress, including photo documentation at algal sampling sites.
c.) The nutrient target subcommittee will be responsible for coordinating with the monitoring subcommittee and providing discharger and other monitoring information that it deems appropriate to the monitoring subcommittee's work. (To ensure information coordination and consistency, a nutrient monitoring chart has been prepared by each discharger and forwarded to the monitoring subcommittee and contractor.)
d.) The nutrient target subcommittee will be responsible for evaluating the progress of the VNRP, reporting progress to the Council, and recommending to the Council any revisions to the reduction program that may be deemed necessary if actions are not meeting in-stream targets.

3.7 Public Participation/Education Plan

To gain public support and approval of the VNRP, the Council worked with DEQ and the nutrient target subcommittee to facilitate public meetings. In July 1996, meetings were held in Missoula and Butte. The subcommittee prepared a response document to public comments (Appendix E) and incorporated some of these comments into the final VNRP.

Because keen interest in the Clark Fork VNRP exists in downstream Idaho communities, the Council has sent a copies of the VNRP to its Pend Oreille Lake nutrient target subcommittee for dissemination to the Idaho public.

Once implementation of the VNRP is underway, the nutrient target subcommittee will develop and implement a plan for continued public education in coordination with the Council's Montana public education subcommittee. Through the education subcommittee, a program will be developed to build public support and participation on key issues in priority tributary watersheds, with emphasis on implementation of nonpoint and growth-related issues.

3.8 Administration

Implementation of the VNRP will be coordinated through the Tri-State Implementation Council. Under direction of the Council, the nutrient target subcommittee will be responsible for:

- tracking site-specific management actions for the point sources;
- expanding the present subcommittee to include representation from key nonpoint sources (which may include local governments, water quality districts, conservation districts, subdivision and nonpoint experts from Montana DEQ, NRCS, and other appropriate agencies, and local interest groups;)
- designing and implementing strategies for nonpoint sources and new nutrient sources;
- conducting interim program evaluations with water quality monitoring results;
- developing any changes and adjustments to the VNRP;
- reporting to EPA and the pubic regarding the overall success of the VNRP; and
- providing guidance and oversight to the VNRP Coordinator.

A VNRP Coordinator will be hired by the Council in Fall 1998 to assist the subcommittee with implementation of the VNRP. The key objectives for the Coordinator's position will be to:

- assist the subcommittee with management and oversight of the VNRP;
- gain support for and involvement in the VNRP from a variety of stakeholders representing point and nonpoint sources of nutrient loading;
- assist the subcommittee and stakeholders with implementation of specific nutrient reduction measures;
- establish a basinwide communication network on VNRP progress; and
- establish a foundation for long term project maintenance.

3.9 Funding

In coordination with the Council's funding subcommittee, the nutrient target subcommittee will explore funding possibilities to support implementation measures, especially public education/participation, program administration, and monitoring.

A $50,000 grant has been received from EPA Region 8's Ecosystem Protection Program Regional Geographic Initiative (RGI) FY97 funds to support the VNRP Coordinator's position for a two-year period. An extension request for these grant funds will be submitted by the Council to cover the position for the 1998 to 2000 timeframe.

4.0 Appendices

Appendix A: Clark Fork River Basin Map

Appendix B: Agencies' Clark Fork Model

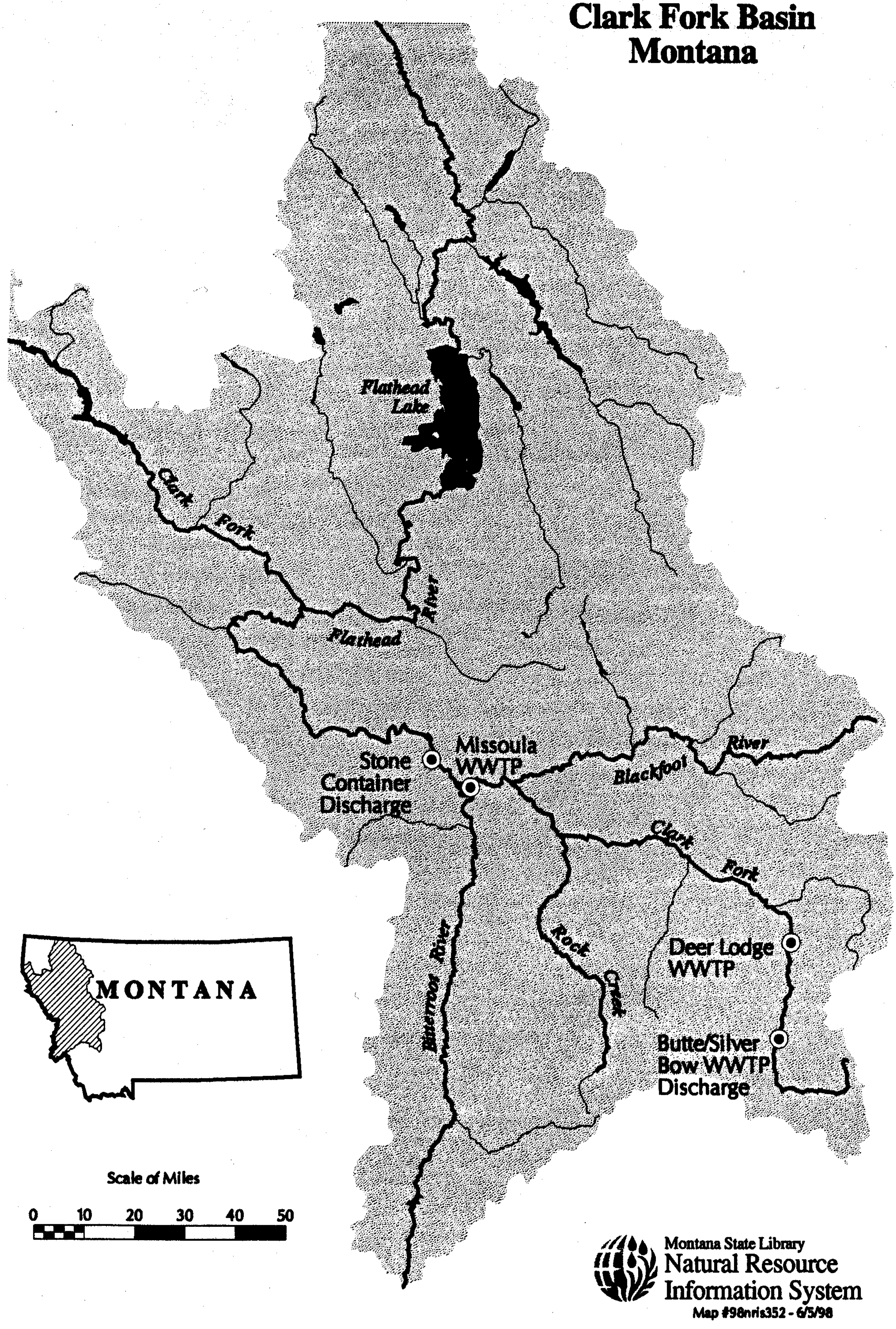
Appendix C: Excerpts, Clark Fork-Pend Oreille Watershed Water Quality Monitoring Program Sampling and Analysis Plan

Appendix D: Reference List

Appendix E: Response to Public Comments

Appendix A

Clark Fork Basin Montana



Appendix B: Agencies' Clark Fork Model

The Clark Fork River nutrient model predicts total phosphorus and total nitrogen concentrations in the Clark Fork River from nutrient concentrations and stream flow adjusted with a gain/loss factor. Several assumptions have been made to simplify the calculations and needed inputs. The assumptions are:

1) Constant concentration. The concentration of nutrients in the tributaries and from point sources remains the same as flow changes. The calibration nutrient concentrations were based on the average of July, August and September monitored values. Long term summer mean concentrations could improve the calibration and acceptability of the inputs.

2) Critical flow conditions: 30Q10. The critical period of algae growth is during the summer low flow periods. At these times, the minimal dilution of the point sources and warm water can result in maximum algae growth and large daily changes in dissolved oxygen concentrations. Using the 30Q10 acknowledges that the in-stream nutrient conditions may not be met once in a 10 year period because of the extreme low flow.

3) Gain/loss factor. The gain/loss factor represents the combined effects of algal uptake of nutrients and groundwater and tributary increases or decreases that have not been explicitly input to the model. The factor is assumed to remain constant for the purpose of the model predictions. The factor in fact probably changes with flow, time of year, and between years, and is influenced by the amount of periphyton growth.

4) Steady state. The model is steady state; that is, diel and day-to-day variations are not addressed.

5) Flow increment factor. Adjustment of flow between stations was made by using a flow increment factor. Flow increases or decreases did not contain nutrients. Therefore, increases in flow diluted the in-stream concentrations and decreases concentrated the in-stream concentrations. The impact of these nutrient-free flow modifications is greatest at low flow conditions.

6) Clark Fork mainstem predictions. The mixed conditions, end-of-segment, predicted concentrations are the expected values in the Clark Fork mainstem, regardless of the spreadsheet row name.

The attached model runs illustrate expected values for the following scenarios:

- **Model Run A**: Calibration, Clark Fork River, Summer (corresponds to Calibration Conditions in Table 2, page 16.)
- **Model Run B**: 30Q10, No controls in place
- **Model Run C**: 30Q10, VNRP reductions in place (corresponds to Predicted Summertime Conditions in Table 2, page 16.)

MODEL RUN A: CLARK FORK RIVER SUMMER CONDITIONS

Average summer (July, August, September 1991) flow scenario.   Flows along mainstem are adjusted to approximate average summer flow conditions for 1991.
Based on data from Montana DEQ 525 report, 1992. Last spreadsheet modification May 1998.

	----EFFLUENT/TRIBUTARY CONDITIONS----						----UPSTREAM CONDITIONS----					----MIXED CONDITIONS---- (beginning of segment)		
STREAM SEGMENT	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	IncrFlowFactor	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	FLOW cfs	TP ug/l	TN ug/l-N
1 Butte WWTP	**8.80**	**51.66**	**2400.00**	**204.21**	**9487.00**	0.22	8.00	1.5459	79	43.11	2203	16.80	1295	6018
2 Silver Bow Cr. blw CT	1.00	0.00	0.00	0.00	0.00	2.00	16.80	53.20	1295	247.31	6018	17.80	1222	5681
3 Silver Bow @ Miles Cr	10.00	0.00	0.00	0.00	0.00	1.00	17.80	51.10	1174	238.79	5485	27.80	752	3512
4 Silver Bow @ ab WSPs	5.50	0.00	0.00	0.00	0.00	0.50	27.80	22.81	336	118.26	1739	33.30	280	1452
5 WSP disch/Mill-Willow Bypass	2.00	**0.00**	**0.00**	**0.00**	0.00	0.50	33.30	9.40	115	54.60	670	35.30	109	632
6	0.00	0.00	0.00	0.00	0.00	0.50	35.30	6.80	79	41.22	477	35.30	79	477
7 Warm Sprs Cr @ mouth	1.12	0.00	0.00	0.00	0.00	0.75	35.30	6.80	79	41.22	477	36.42	76	463
8 Clar Fork blw WS Creek	0.25	0.00	0.00	0.00	0.00	0.50	36.42	6.03	68	37.10	416	36.67	67	414
ark Fork nr Dempsey	6.00	0.00	0.00	0.00	0.00	0.75	36.67	5.94	66	37.36	417	42.67	57	358
10 Clark Fork @ Sager Ln Brdg	6.25	0.00	0.00	0.00	0.00	1.25	42.67	4.65	45	41.91	402	48.92	39	350
10a Clark Fork av Deer Lodge	16.00	0.00	0.00	0.00	0.00	2.00	48.92	3.99	33	45.03	376	64.92	25	284
11 Deer Lodge Discharge	**2.80**	**8.55**	**1249.00**	**35.46**	**5177.00**	0.00	64.92	3.13	20	50.51	318	67.72	71	519
12 Clark F. ab L. Blackfoot	21.00	0.00	0.00	0.00	0.00	1.40	67.72	11.68	71	85.97	519	88.72	54	396
Little Blackfoot River	77.00	6.59	35.00	40.87	217.00	0.00	88.72	13.28	61	69.00	318	165.72	49	271
Gold Creek	16.00	4.42	113.00	9.67	247.00	0.00	165.72	19.87	49	109.87	271	181.72	55	269
13 Clark Fork below Gold Cr	13.13	0.00	0.00	0.00	0.00	1.25	181.72	24.29	55	119.54	269	194.85	51	251
Flint Creek	30.00	5.58	76.00	28.11	383.00	0.00	194.85	18.80	39	103.80	218	224.85	44	240
14 Clark F. @ Bonita	152.50	0.00	0.00	0.00	0.00	3.05	224.85	24.37	44	131.91	240	377.35	26	143
Rock Creek	338.00	10.75	13.00	173.62	210.00	0.00	377.35	27.54	30	319.91	347	715.35	22	282
15 Clark F. @ Turah	0.00	0.00	0.00	0.00	0.00	0.00	715.35	38.29	22	493.54	282	715.35	22	282
16 Blackfoot R nr mouth	1016.00	22.37	9.00	521.90	210.00	0.00	715.35	32.76	19	673.99	385	1731.35	13	282
17 Clark F blw Milltown Dam	-25.00	0.00	0.00	0.00	0.00	-10.00	1731.35	55.13	13	1195.89	282	1706.35	13	287
18 Clark F ab Missoula	0.00	0.00	0.00	0.00	0.00	0.00	1706.35	59.51	14	1107.95	265	1706.35	14	265
Ground Water abv Missoula	16.20	2.38	60.00	19.81	500.00	0.00	1706.35	74.83	18	881.07	211	1722.55	18	214
20 Missoula WWTP discharge	**12.80**	**78.68**	**2513.00**	**382.48**	**12216.00**	0.00	1722.55	77.21	18	900.89	214	1735.35	37	302
Ground Water below Missoula	**24.30**	**3.57**	**60.00**	**29.72**	**500.00**	0.00	1735.35	155.89	37	1283.37	302	1759.65	37	305
21 Clark F @ Shuffield's	0.00	0.00	0.00	0.00	0.00	0.00	1735.35	157.26	37	1294.96	305	1735.35	37	305
Clark Fork ab Bitterroot	0.00	0.00	0.00	0.00	0.00	0.00	1735.35	137.49	32	1673.59	394	1735.35	32	394
Bitterroot R nr mouth	**1105.60**	**58.19**	**21.62**	**990.40**	**366.22**	0.00	1735.35	137.49	32	1673.59	394	2840.95	28	383
23 Clark F at Harper Brdg	-37.50	0.00	0.00	0.00	0.00	-5.00	2840.95	195.68	28	2663.99	383	2803.45	29	388
23a Clark F ab Stone Container	0.00	0.00	0.00	0.00	0.00	0.00	2803.45	129.55	19	1580.10	230	2803.45	19	230
24 Stone Container Direct Dischar	**0.00**	**0.00**	**905.00**	**0.00**	**1101.00**	0.00	2803.45	129.55	19	1580.10	230	2803.45	19	230
25 Stone Container Pond Seepage	12.30	23.11	768.00	30.00	**997.00**	0.00	2803.45	129.55	19	1580.10	230	2815.75	22	234
26 Clark F @ Huson	0.00	0.00	0.00	0.00	0.00	0.00	2815.75	152.66	22	1610.10	234	2815.75	22	234
27 Clark F nr Alberton	0.00	0.00	0.00	0.00	0.00	0.00	2815.75	137.60	20	2131.26	309	2815.75	20	309
28 Clark F @ Superior	0.00	0.00	0.00	0.00	0.00	0.00	2815.75	137.60	20	2131.26	309	2815.75	20	309
									20					

Conversion (ug/l)*(cfs) to kg/day = 0.0024461

STREAM SEGMENT	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N		FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	FLOW cfs	TP ug/l	TN ug/l-N
Bitterroot River above mouth	1013.00	44.60	18.00	718.59	290.00	0.00	0.00	0.00	0	0.00	0	1013.00	18	290
Ground Water to Bitterroot River	92.60	13.59	60.00	271.81	1200.00	0.00	1013.00	44.60	18	718.59	290	1105.60	22	366
22 Bitterroot R nr mouth	1105.60	0.00	**0.00**	**0.00**	**0.00**	0.00	1105.60	58.19	22	990.40	366	1105.60	22	366

MODEL RUN A

STREAM SEGMENT	CLARK FORK MILE MARK	DISTANCE (cumul.) miles	TIME (cumul.) hours	FLOW cfs	TP Target ug/l	TP ug/l	summer '91 calibration value	TP kg/day	TN Target ug/l	TN ug/l-N	summer '91 calibration value	TN kg/day
Upstream Values...	-28.00	-0.50	-0.05	8.00	20.0	79	79	1.5459	300.00	2203	2203	43.11
1 Butte WWTP	-27.50	0.00	0.00	16.80	20.0	1295		53.2033	300.00	6018		247.31
2 Silver Bow Cr. blw CT	-27.00	0.50	0.73	17.80	20.0	1174		51.10	300.00	5485		238.79
3 Silver Bow @ Miles Cr	-17.00	10.50	15.40	27.80	20.0	336		22.81	300.00	1739		118.26
4 Silver Bow @ ab WSPs	-6.00	21.50	31.53	33.30	20.0	115		9.40	300.00	670		54.60
5 WSP disch/Mill-Willow Bypass	-2.00	25.50	37.39	35.30	20.0	79		6.80	300.00	477		41.22
6	-2.00	25.50	37.39	35.30	20.0	79		6.80	300.00	477		41.22
7 Warm Sprs Cr @ mouth	-0.50	27.00	39.59	36.42	20.0	68		6.03	300.00	416		37.10
8 Clar Fork blw WS Creek	0.00	27.50	40.33	36.67	20.0	66	65	5.94	300.00	417	417	37.36
9 Clark Fork nr Dempsey	8.00	35.50	52.06	42.67	20.0	45		4.65	300.00	402		41.91
10 Clark Fork @ Sager Ln Brdg	13.00	40.50	59.39	48.92	20.0	33		3.99	300.00	376		45.03
10a Clark Fork av Deer Lodge	21.00	48.50	71.12	64.92	20.0	20	20	3.13	300.00	318	320	50.51
11 Deer Lodge Discharge	21.00	48.50	71.12	67.72	20.0	71		11.68	300.00	519		85.97
12 Clark F. ab L. Blackfoot	36.00	63.50	93.12	88.72	20.0	61	61	13.28	300.00	318	317	69.00
Little Blackfoot River	36.00	63.50	93.12	165.72	20.0	49		19.87	300.00	271		109.87
Gold Creek	36.00	63.50	93.12	181.72	20.0	55		24.29	300.00	269		119.54
13 Clark Fork below Gold Cr	46.50	74.00	108.52	194.85	20.0	39	39	18.80	300.00	218	217	103.80
Flint Creek	46.50	74.00	108.52	224.85	20.0	44		24.37	300.00	240		131.91
14 Clark F. @ Bonita	96.50	124.00	181.84	377.35	20.0	30	30	27.54	300.00	347	343	319.91
Rock Creek	96.50	124.00	181.84	715.35	20.0	22		38.29	300.00	282		493.54
15 Clark F. @ Turah	113.50	141.00	206.77	715.35	20.0	19	19	32.76	300.00	385	383	673.99
16 Blackfoot R nr mouth	119.50	147.00	215.57	1731.35	20.0	13		55.13	300.00	282		1195.89
17 Clark F blw Milltown Dam	122.00	149.50	219.23	1706.35	20.0	14		59.51	300.00	265		1107.95
18 Clark F ab Missoula	129.50	157.00	230.23	1706.35	20.0	18	18	74.83	300.00	211	210	881.07
Ground Water abv Missoula	129.51	157.01	230.23	1722.55	20.0	18		77.21	300.00	214		900.89
20 Missoula WWTP discharge	129.51	157.01	230.23	1735.35	39.0	37		155.89	300.00	302		1283.37
Ground Water below Missoula	129.51	157.01	230.24	1759.65	39.0	37		159.46	300.00	305		1313.09
21 Clark F @ Shuffield's	131.51	159.01	233.17	1735.35	39.0	32	32	137.49	300.00	394	393	1673.59
21a Clark Fork ab Bitterroot	134.51	162.01	237.57	1735.35	39.0	32		137.49	300.00	394		1673.59
22 Bitterroot R nr mouth	134.51	162.01	237.57	2840.95	39.0	28		195.68	300.00	383		2663.99
23 Clark F at Harper Brdg	142.01	169.51	248.56	2803.45	39.0	19	19	129.55	300.00	230	230	1580.10
23a Clark F ab Stone Container	144.51	172.01	252.23	2803.45	39.0	19		129.55	300.00	230		1580.10
24 Stone Container Direct Dischai	144.51	172.01	252.23	2803.45	39.0	19		129.55	300.00	230		1580.10
25 Stone Container Pond Seepag	145.51	173.01	253.70	2815.75	39.0	22		152.66	300.00	234		1610.10
26 Clark F @ Huson	154.01	181.51	266.16	2815.75	39.0	20	20	137.60	300.00	309	310	2131.26
27 Clark F nr Alberton	164.51	192.01	281.56	2815.75	39.0	20		137.60	300.00	309		2131.26
28 Clark F @ Superior	202.51	230.01	337.28	2815.75	39.0	20		137.60	300.00	309		2131.26

		miles	hours	cfs	ug/l	ug/l		kg/day	ug/l	ug/l-N		kg/day
Bitterroot River above mouth	0.00	0.00	0.00	0.00	20.0	18.00		0.00	300.00	290		0.00
Ground Water to Bitterroot River	2.00	2.00	2.93	1013.00	20.0	21.52		53.32	300.00	366		907.45
22 Bitterroot R nr mouth	4.00	4.00	5.87	1105.60	20.0	21.52		58.19	300.00	366		990.40

MODEL RUN B: 30Q10, NO CONTROLS IN PLACE

Low flow conditions with no controls in place for any source. Constant concentrations for tributaries and other sources. Flows along mainstem are adjusted to approximate flow conditions for 30Q10. Last spreadsheet modification April 1988.

STREAM SEGMENT	EFFLUENT/TRIBUTARY CONDITIONS FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	IncrFlowFactor	UPSTREAM CONDITIONS FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	MIXED CONDITIONS (beginning of segment) FLOW cfs	TP ug/l	TN ug/l-N
Butte WWTP	**8.80**	**51.66**	**2400.00**	**204.21**	**9487.00**	0.00	14.00	2.7054	79	75.44	2203	22.80	975	5014
Silver Bow Cr. blw CT	0.00	0.00	0.00	0.00	0.00	0.00	22.80	54.36	975	279.63	5014	22.80	975	5014
Silver Bow @ Miles Cr	0.00	0.00	0.00	0.00	0.00	0.00	22.80	52.25	937	268.03	4806	22.80	937	4806
Silver Bow @ ab WSPs	0.00	0.00	0.00	0.00	0.00	0.00	22.80	23.61	423	114.64	2056	22.80	423	2056
WSP disch/Mill-Willow Bypass	0.00	**0.00**	**0.00**	**0.00**	0.00	0.00	22.80	9.86	177	45.04	808	22.80	177	808
	0.00	0.00	0.00	0.00	0.00	0.10	22.80	7.17	129	32.07	575	22.80	129	575
Warm Sprs Cr @ mouth	0.15	0.00	0.00	0.00	0.00	0.10	22.80	7.17	129	32.07	575	22.95	128	571
Clar Fork blw WS Creek	0.05	0.00	0.00	0.00	0.00	0.10	22.95	6.37	113	28.23	503	23.00	113	502
Clark Fork nr Dempsey	0.80	0.00	0.00	0.00	0.00	0.10	23.00	6.27	111	28.44	505	23.80	108	488
) Clark Fork @ Sager Ln Brdg	0.50	0.00	0.00	0.00	0.00	0.10	23.80	4.91	84	31.90	548	24.30	83	537
)a Clark Fork av Deer Lodge	0.80	0.00	0.00	0.00	0.00	0.10	24.30	4.22	71	34.27	577	25.10	69	558
1 Deer Lodge Discharge	**2.80**	**8.55**	**1249.00**	**35.46**	**5177.00**	0.00	25.10	3.30	54	38.44	626	27.90	174	1083
2 Clark F. ab L. Blackfoot	33.00	0.00	0.00	0.00	0.00	2.20	27.90	11.86	174	73.90	1083	60.90	80	496
ttle Blackfoot River	16.00	1.37	35.00	8.49	217.00	0.00	60.90	13.48	90	46.74	314	76.90	79	294
old Creek	7.00	1.93	113.00	4.23	247.00	0.00	76.90	16.88	90	55.23	294	83.90	92	290
) Clark Fork below Gold Cr	0.00	0.00	0.00	0.00	0.00	0.00	83.90	18.82	92	59.46	290	83.90	92	290
int Creek	10.00	1.86	76.00	9.37	383.00	0.00	83.90	12.80	62	50.65	247	93.90	64	261
Clark F. @ Bonita	100.00	0.00	0.00	0.00	0.00	2.00	93.90	14.66	64	60.02	261	193.90	31	127
ock Creek	110.00	3.50	13.00	56.50	210.00	0.00	193.90	17.08	36	145.56	307	303.90	28	272
Clark F. @ Turah	0.00	0.00	0.00	0.00	0.00	0.00	303.90	20.58	28	202.06	272	303.90	28	272
Blackfoot R nr mouth	359.00	7.90	9.00	184.41	210.00	0.00	303.90	17.61	24	275.94	371	662.90	16	284
Clark F blw Milltown Dam	57.50	0.00	0.00	0.00	0.00	23.00	662.90	25.52	16	460.35	284	720.40	14	261
Clark F ab Missoula	34.50	0.00	0.00	0.00	0.00	23.00	720.40	31.12	18	380.33	216	754.90	17	206
ound Water abv Missoula	16.20	2.38	60.00	19.81	500.00	0.00	754.90	35.06	19	339.16	184	771.10	20	190
) Missoula WWTP discharge	**12.80**	**78.68**	**2513.00**	**382.48**	**12216.00**	0.00	771.10	37.44	20	358.98	190	783.90	61	387
round Water below Missoula	**24.30**	**3.57**	**60.00**	**29.72**	**500.00**	0.00	783.90	116.12	61	741.46	387	808.20	61	390
Clark F @ Shuffield's	0.00	0.00	0.00	0.00	0.00	0.00	783.90	116.09	61	747.99	390	783.90	61	390
a Clark Fork ab Bitteroot	0.00	0.00	0.00	0.00	0.00	0.00	783.90	102.74	54	943.37	492	783.90	54	492
2 Bitterroot R nr mouth	**445.60**	**29.15**	**26.74**	**522.50**	**479.37**	0.00	783.90	102.74	54	943.37	492	1229.50	44	487
Clark F at Harper Brdg	-30.00	0.00	0.00	0.00	0.00	-4.00	1229.50	131.89	44	1465.87	487	1199.50	45	500
a Clark F ab Stone Container	0.00	0.00	0.00	0.00	0.00	0.00	1199.50	91.42	31	927.06	316	1199.50	31	316
I Stone Container Direct Dischar	**0.00**	**0.00**	**905.00**	**0.00**	**1101.00**	0.00	1199.50	91.42	31	927.06	316	1199.50	31	316
5 Stone Container Pond Seepage	12.30	23.11	768.00	30.00	**997.00**	0.00	1199.50	91.42	31	927.06	316	1211.80	39	323
Clark F @ Huson	0.00	0.00	0.00	0.00	0.00	0.00	1211.80	114.52	39	957.06	323	1211.80	39	323
Clark F nr Alberton	0.00	0.00	0.00	0.00	0.00	0.00	1211.80	103.22	35	1266.84	427	1211.80	35	427
Clark F @ Superior	0.00	0.00	0.00	0.00	0.00	0.00	1211.80	103.22	35	1266.84	427	1211.80	35	427
									35					

Conversion (ug/l)*(cfs) to kg/day = 0.0024461

STREAM SEGMENT	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N		FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	FLOW cfs	TP ug/l	TN ug/l-N
itterroot River above mouth	353.40	15.56	18.00	250.69	290.00	0.00	0.00	0.00	0	0.00	0	353.00	18	290
ound Water to Bitterroot River	92.60	13.59	60.00	271.81	1200.00	0.00	353.00	15.56	18	250.69	290	445.60	27	479
2 Bitterroot R nr mouth	445.60	**0.00**	**0.00**	**0.00**	**0.00**	0.00	445.60	29.15	27	522.50	479	445.60	27	479

MODEL RUN B

STREAM SEGMENT	CLARK FORK MILE MARK	DISTANCE (cumul.) miles	TIME (cumul.) hours	FLOW cfs	TP Target ug/l	TP ug/l	TP kg/day	TN Target ug/l	TN ug/l-N	TN kg/day
Upstream Values...	-28.00	-0.50	-0.05	14.00	20.0	79	2.7054	300.00	2203	75.44
1 Butte WWTP	-27.50	0.00	0.00	22.80	20.0	976	54.3627	300.00	5014	279.63
2 Silver Bow Cr. blw CT	-27.00	0.50	0.73	22.80	20.0	937	52.25	300.00	4806	268.03
3 Silver Bow @ Miles Cr	-17.00	10.50	15.40	22.80	20.0	423	23.61	300.00	2056	114.64
4 Silver Bow @ ab WSPs	-6.00	21.50	31.53	22.80	20.0	177	9.86	300.00	808	45.04
5 WSP disch/Mill-Willow Bypass	-2.00	25.50	37.39	22.80	20.0	129	7.17	300.00	576	32.07
6	-2.00	25.50	37.39	22.80	20.0	129	7.17	300.00	576	32.07
7 Warm Sprs Cr @ mouth	-0.50	27.00	39.59	22.95	20.0	113	6.37	300.00	503	28.23
8 Clar Fork blw WS Creek	0.00	27.50	40.33	23.00	20.0	111	6.27	300.00	505	28.44
9 Clark Fork nr Dempsey	8.00	35.50	52.06	23.80	20.0	84	4.91	300.00	548	31.90
10 Clark Fork @ Sager Ln Brdg	13.00	40.50	59.39	24.30	20.0	71	4.22	300.00	577	34.27
10a Clark Fork av Deer Lodge	21.00	48.50	71.12	25.10	20.0	54	3.30	300.00	626	38.44
11 Deer Lodge Discharge	21.00	48.50	71.12	27.90	20.0	174	11.86	300.00	1083	73.90
12 Clark F. ab L. Blackfoot	36.00	63.50	93.12	60.90	20.0	90	13.48	300.00	314	46.74
Little Blackfoot River	51.00	78.50	115.11	76.90	20.0	90	16.88	300.00	294	55.23
Gold Creek	51.00	78.50	115.11	83.90	20.0	92	18.82	300.00	290	59.46
13 Clark Fork below Gold Cr	61.50	89.00	130.51	83.90	20.0	62	12.80	300.00	247	50.65
Flint Creek	61.50	89.00	130.51	93.90	20.0	64	14.66	300.00	261	60.02
14 Clark F. @ Bonita	111.50	139.00	203.83	193.90	20.0	36	17.08	300.00	307	145.56
Rock Creek	111.50	139.00	203.83	303.90	20.0	28	20.58	300.00	272	202.06
15 Clark F. @ Turah	128.50	156.00	228.76	303.90	20.0	24	17.61	300.00	371	275.94
16 Blackfoot R nr mouth	134.50	162.00	237.56	662.90	20.0	16	25.52	300.00	284	460.35
17 Clark F blw Milltown Dam	137.00	164.50	241.22	720.40	20.0	18	31.12	300.00	216	380.33
18 Clark F ab Missoula	138.50	166.00	243.42	754.90	20.0	19	35.06	300.00	184	339.16
Ground Water abv Missoula	138.50	166.00	243.42	771.10	20.0	20	37.44	300.00	190	358.98
20 Missoula WWTP discharge	138.50	166.00	243.42	783.90	39.0	61	116.12	300.00	387	741.46
Ground Water below Missoula	138.50	166.00	243.42	808.20	39.0	61	119.68	300.00	390	771.18
21 Clark F @ Shuffield's	140.50	168.00	246.35	783.90	39.0	54	102.74	300.00	492	943.37
21a Clark Fork ab Bitterroot	143.50	171.00	250.75	783.90	39.0	54	102.74	300.00	492	943.37
22 Bitterroot R nr mouth	143.50	171.00	250.75	1229.50	39.0	44	131.89	300.00	487	1465.87
23 Clark F at Harper Brdg	151.00	178.50	261.75	1199.50	39.0	31	91.42	300.00	316	927.06
23a Clark F ab Stone Container	153.50	181.00	265.42	1199.50	39.0	31	91.42	300.00	316	927.06
24 Stone Container Direct Disch:	153.50	181.00	265.42	1199.50	39.0	31	91.42	300.00	316	927.06
25 Stone Container Pond Seepa	154.50	182.00	266.88	1211.80	39.0	39	114.52	300.00	323	957.06
26 Clark F @ Huson	163.00	190.50	279.35	1211.80	39.0	35	103.22	300.00	427	1266.84
27 Clark F nr Alberton	173.50	201.00	294.74	1211.80	39.0	35	103.22	300.00	427	1266.84
28 Clark F @ Superior	211.50	239.00	350.47	1211.80	39.0	35	103.22	300.00	427	1266.84
		miles	hours	cfs	ug/l	ug/l	kg/day	ug/l	ug/l-N	kg/day
Bitterroot River above mouth	0.00	0.00	0.00	0.00	20.0	18.02	0.00	300.00	290	0.00
Ground Water to Bitterroot River	2.00	2.00	2.93	353.00	20.0	26.74	23.09	300.00	479	413.92
22 Bitterroot R nr mouth	4.00	4.00	5.87	445.60	20.0	26.74	29.15	300.00	479	522.50

MODEL RUN C: 30Q10, VNRP REDUCTIONS IN PLACE

Summer (July, August, September 1991) low flow 30Q10 scenario. Effluent concentrations modified to meet technology-based effluent quality of 10,000 ug/l TN and 1,000 ug/l TP for Butte and Missoula WWTP's. Includes flow reduction of 4.5 mgd (7 cfs) from Butte WWTP for other industrial use and Silver Lake water diversion to Warm Springs Creek, 24 mgd (37.2 cfs.) Missoula flow at 10-year projection. New line added above Missoula WWTP to indicate 20% nonpoint source control for mainstem (not tributaries) above Missoula; used gain/loss factor to make reduction of nutrient concentration. Missoula area groundwater concentrations reduced 10% for TP, 40% for TN.
Last spreadsheet modification, June 1998.

STREAM SEGMENT	----EFFLUENT/TRIBUTARY CONDITIONS---- FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	IncrFlowFactor	----UPSTREAM CONDITIONS---- FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	----MIXED CONDITIONS---- (beginning of segment) FLOW cfs	TP ug/l	TN ug/l-N
1 Butte WWTP	1.80	4.40	1000.00	44.03	10000.00	0.00	14.00	2.7054	79	75.44	2203	15.80	184	3091
2 Silver Bow Cr. blw CT	0.00	0.00	0.00	0.00	0.00	0.00	15.80	7.11	184	119.46	3091	15.80	184	3091
3 Silver Bow @ Miles Cr	0.00	0.00	0.00	0.00	0.00	0.00	15.80	6.83	177	115.35	2985	15.80	177	2985
4 Silver Bow @ ab WSPs	0.00	0.00	0.00	0.00	0.00	0.00	15.80	3.05	79	57.13	1478	15.80	79	1478
5 WSP disch/Mill-Willow Bypass	0.00	0.00	0.00	0.00	0.00	0.00	15.80	1.26	32	26.37	682	15.80	32	682
SILVER LAKE transfer to Warm Springs	37.20	0.91	10.00	22.75	250.00	0.10	15.80	0.91	24	19.91	515	53.00	14	329
7 Warm Sprs Cr @ mouth	0.15	0.00	0.00	0.00	0.00	0.10	53.00	1.82	14	42.66	329	53.15	14	328
8 Clar Fork blw WS Creek	0.05	0.00	0.00	0.00	0.00	0.10	53.15	1.61	12	38.39	295	53.20	12	295
9 Clark Fork nr Dempsey	0.80	0.00	0.00	0.00	0.00	0.10	53.20	1.59	12	38.67	297	54.00	12	293
10 Clark Fork @ Sager Ln Brdg	0.50	0.00	0.00	0.00	0.00	0.10	54.00	1.24	9	43.38	328	54.50	9	325
10a Clark Fork av Deer Lodge	0.80	0.00	0.00	0.00	0.00	0.10	54.50	1.07	8	46.61	350	55.30	8	345
11 Deer Lodge Discharge	0.00	0.00	1249.00	0.00	5177.00	0.00	55.30	0.84	6	52.28	386	55.30	6	386
12 Clark F. ab L. Blackfoot	33.00	0.00	0.00	0.00	0.00	2.20	55.30	0.84	6	52.28	386	88.30	4	242
Little Blackfoot River	16.00	1.37	35.00	8.49	217.00	0.00	88.30	0.95	4	41.96	194	104.30	9	198
Gold Creek	7.00	1.93	113.00	4.23	247.00	0.00	104.30	2.32	9	50.45	198	111.30	16	201
13 Clark Fork below Gold Cr	0.00	0.00	0.00	0.00	0.00	0.00	111.30	4.25	16	54.68	201	111.30	16	201
Flint Creek	10.00	1.86	76.00	9.37	383.00	0.00	111.30	3.29	12	47.48	174	121.30	17	192
14 Clark F. @ Bonita	100.00	0.00	0.00	0.00	0.00	2.00	121.30	5.15	17	56.85	192	221.30	10	105
Rock Creek	110.00	3.50	13.00	56.50	210.00	0.00	221.30	5.82	11	137.88	255	331.30	11	240
15 Clark F. @ Turah	0.00	0.00	0.00	0.00	0.00	0.00	331.30	9.32	11	194.38	240	331.30	11	240
16 Blackfoot R nr mouth	359.00	7.90	9.00	184.41	210.00	0.00	331.30	7.97	10	265.45	328	690.30	9	266
17 Clark F blw Milltown Dam	22.50	0.00	0.00	0.00	0.00	9.00	690.30	15.88	9	449.87	266	712.80	9	258
18 Clark F ab Missoula	61.75	0.00	0.00	0.00	0.00	9.50	712.80	17.14	10	416.79	239	774.55	9	220
Nonpoint reduction to CFR mainstem	0.00	0.00	0.00	0.00	0.00	0.00	774.55	20.90	11	341.72	180	774.55	11	180
Ground Water abv Missoula	16.20	2.14	54.00	11.89	300.00	0.00	774.55	17.40	9	273.41	144	790.75	10	147
20 Missoula WWTP discharge	16.50	40.36	1000.00	403.61	10000.00	0.00	790.75	19.54	10	285.30	147	807.25	30	349
Ground Water below Missoula	24.30	3.21	54.00	17.83	300.00	0.00	807.25	59.90	30	688.91	349	831.55	31	347
21 Clark F @ Shuffield's	0.00	0.00	0.00	0.00	0.00	0.00	807.25	61.27	31	686.09	347	807.25	31	347
21a Clark Fork ab Bitteroot	0.00	0.00	0.00	0.00	0.00	0.00	807.25	53.56	27	886.69	449	807.25	27	449
22 Bitterroot R nr mouth	445.60	27.79	25.50	413.78	379.62	0.00	807.25	53.56	27	886.69	449	1252.85	27	424
23 Clark F at Harper Brdg	-30.00	0.00	0.00	0.00	0.00	-4.00	1252.85	81.36	27	1300.47	424	1222.85	27	435
23a Clark F ab Stone Container	0.00	0.00	0.00	0.00	0.00	0.00	1222.85	53.86	18	771.35	258	1222.85	18	258
24 Stone Container Direct Discharg	0.00	0.00	905.00	0.00	1101.00	0.00	1222.85	53.86	18	771.35	258	1222.85	18	258
25 Stone Container Pond Seepage	12.30	23.11	768.00	30.00	997.00	0.00	1222.85	53.86	18	771.35	258	1235.15	25	265
26 Clark F @ Huson	0.00	0.00	0.00	0.00	0.00	0.00	1235.15	76.97	25	801.35	265	1235.15	25	265
27 Clark F nr Alberton	0.00	0.00	0.00	0.00	0.00	0.00	1235.15	69.38	23	1060.73	351	1235.15	23	351
28 Clark F @ Superior	0.00	0.00	0.00	0.00	0.00	0.00	1235.15	69.38	23	1060.73	351	1235.15	23	351

Conversion (ug/l)*(cfs) to kg/day = 0.0024461

STREAM SEGMENT	FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N		FLOW cfs	TP kg/day	TP ug/l-P	TN kg/day	TN ug/l-N	FLOW cfs	TP ug/l	TN ug/l-N
Bitterroot River above mouth	353.40	15.56	18.00	250.69	290.00	0.00	0.00	0.00	0	0.00	0	353.00	18	290
Ground Water to Bitterroot River	92.60	12.23	54.00	163.09	720.00	0.00	353.00	15.56	18	250.69	290	445.60	25	380
22 Bitterroot R nr mouth	445.60	0.00	0.00	0.00	0.00	0.00	445.60	27.79	25	413.78	380	445.60	25	380

MODEL RUN C

STREAM SEGMENT	CF MILE	DISTANCE (cumul.) miles	TIME (cumul hours	FLOW cfs	TP Target ug/l	TP ug/l	TP kg/day	TN Target ug/l	TN ug/l-N	TN kg/day
Upstream Values...	-28	-0.50	0	14	20.0	79	2.71	300	2203	75.44
1 Butte WWTP	-27	0.00	0	16	20.0	184	7.11	300	3091	119.46
2 Silver Bow Cr. blw CT	-27	0.50	1	16	20.0	177	6.83	300	2986	115.35
3 Silver Bow @ Miles Cr	-17	10.50	15	16	20.0	79	3.05	300	1478	57.13
4 Silver Bow @ ab WSPs	-6	21.50	32	16	20.0	32	1.26	300	682	26.37
5 WSP disch/Mill-Willow Bypass	-2	25.50	37	16	20.0	24	0.91	300	515	19.91
SILVER LAKE transfer to Warm Sprin	-2	25.50	37	53	20.0	14	1.82	300	329	42.66
7 Warm Sprs Cr @ mouth	-1	27.00	40	53	20.0	12	1.61	300	296	38.39
8 Clar Fork blw WS Creek	0	27.50	40	53	20.0	12	1.59	300	297	38.67
9 Clark Fork nr Dempsey	8	35.50	52	54	20.0	9	1.24	300	328	43.38
10 Clark Fork @ Sager Ln Brdg	13	40.50	59	54	20.0	8	1.07	300	360	46.61
10a Clark Fork av Deer Lodge	21	48.50	71	55	20.0	6	0.84	300	386	52.28
11 Deer Lodge Discharge	21	48.50	71	55	20.0	6	0.84	300	386	52.28
12 Clark F. ab L. Blackfoot	36	63.50	93	88	20.0	4	0.95	300	194	41.96
Little Blackfoot River	36	63.50	93	104	20.0	9	2.32	300	198	50.45
Gold Creek	36	63.50	93	111	20.0	16	4.25	300	201	54.68
13 Clark Fork below Gold Cr	47	74.00	109	111	20.0	12	3.29	300	174	47.48
Flint Creek	47	74.00	109	121	20.0	17	5.15	300	192	56.85
14 Clark F. @ Bonita	97	124.00	182	221	20.0	11	5.82	300	255	137.88
Rock Creek	97	124.00	182	331	20.0	11	9.32	300	240	194.38
15 Clark F. @ Turah	114	141.00	207	331	20.0	10	7.97	300	328	265.45
16 Blackfoot R nr mouth	120	147.00	216	690	20.0	9	15.88	300	266	449.87
17 Clark F blw Milltown Dam	122	149.50	219	713	20.0	10	17.14	300	239	416.79
18 Clark F ab Missoula	129	156.00	229	775	20.0	11	20.90	300	180	341.72
Nonpoint reduction to CFR mainstem	130	157.00	230	775	20.0	9	17.40	300	144	273.41
Ground Water abv Missoula	130	157.01	230	791	20.0	10	19.54	300	147	285.30
20 Missoula WWTP discharge	130	157.01	230	807	39.0	30	59.90	300	349	688.91
Ground Water below Missoula	130	157.01	230	832	39.0	31	63.11	300	347	706.74
21 Clark F @ Shuffield's	132	159.01	233	807	39.0	27	53.56	300	449	886.69
21a Clark Fork ab Bitteroot	135	162.01	238	807	39.0	27	53.56	300	449	886.69
22 Bitterroot R nr mouth	135	162.01	238	1253	39.0	27	81.36	300	424	1300.47
23 Clark F at Harper Brdg	142	169.51	249	1223	39.0	18	53.86	300	258	771.35
23a Clark F ab Stone Container	145	172.01	252	1223	39.0	18	53.86	300	258	771.35
24 Stone Container Direct Discl	145	172.01	252	1223	39.0	18	53.86	300	258	771.35
25 Stone Container Pond Seep	146	173.01	254	1235	39.0	25	76.97	300	265	801.35
26 Clark F @ Huson	154	181.51	266	1235	39.0	23	69.38	300	351	1060.73
27 Clark F nr Alberton	165	192.01	282	1235	39.0	23	69.38	300	351	1060.73
28 Clark F @ Superior	203	230.01	337	1235	39.0	23	69.38	300	351	1060.73

		miles	hours	cfs	ug/l	ug/l	kg/day	ug/l	ug/l-N	kg/day
Bitterroot River above mouth	0	4.00	0	0	20.0	18.02	0.00	300	290	0.00
Ground Water to Bitterroot River	2	4.00	3	353	20.0	25.50	22.02	300	380	327.79
22 Bitterroot R nr mouth	4	4.00	6	446	20.0	25.50	27.79	300	380	413.78

Appendix C: Excerpts, Clark Fork-Pend Oreille Watershed Water Quality Monitoring Program Sampling and Analysis Plan

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APPENDICES

1.0 Introduction

The mission of the Tri-State Implementation Council has been to develop a management strategy to restore and protect designated water uses within the Clark Fork-Pend Oreille Basin. The monitoring subcommittee oversees water quality monitoring efforts and makes recommendations to improve the basin-wide monitoring program.

The monitoring program described in this report includes sampling design to detect long-term trends in water quality and meet monitoring objectives identified by the Tri-State Implementation Council. The program is a statistically based design derived from analysis of approximately 10 years of historical data (Land and Water, 1995). This document recommends procedures for sample collection, analysis, and reporting to ensure technically sound water quality monitoring throughout the watershed.

1.1 Tri-State Monitoring Goals and Objectives

Eight priority water quality monitoring objectives are defined for the Clark Fork-Pend Oreille Watershed. These include:

1) trend detection of nutrient concentrations in tributaries and mainstem of the Clark Fork River,
2) assessment of trends in periphyton in the Clark Fork mainstem,
3) assessment of compliance with mid-summer nutrient targets for the Clark Fork,
4) estimation of nutrient loads to Lake Pend Oreille,
5) assessment of trends in periphyton in the Lake Pend Oreille nearshore,
6) trend analysis of Secchi disk transparency in Lake Pend Oreille
7) trend assessment of nutrient concentrations in the Pend Oreille River and nutrient concentrations and fecal coliform in tributaries, and
8) assessment of macrophyte composition and density in the Pend Oreille River.

The objective of monitoring is to generate reliable information on water quality trends and status for watershed managers. Analysis of approximately 10 years of historical nutrient and periphyton data for the watershed provided statistical design criteria for the monitoring program (Land and Water, 1995). Sampling frequencies and locations are optimized to maximize information for watershed management decision making while minimizing monitoring costs. Individual management/monitoring goals are outlined with appropriate statistical criteria in the following sections:

1.1.1 Clark Fork River, Nutrient Trend Detection

MANAGEMENT GOAL:	Improve water quality
MONITORING GOAL:	Detect significant trends in nutrient concentrations
DEFINITION OF WATER QUALITY:	Total phosphorus, total nitrogen, ortho phosphate, dissolved inorganic nitrogen.
DEFINITION OF TREND:	50% change in 10 year period at 95% confidence level, 90% power or 40% change at 90% C.L., 80% power
STATISTICAL METHODOLOGY:	Seasonal Kendall with Sen slope estimate
STATISTICAL HYPOTHESIS:	Ho: No trend exists Ha: Trend exists
DATA ANALYSIS RESULT:	Conclusions regarding presence of trends Provide estimate of trend magnitude
INFORMATION PRODUCT:	Management goal met when no trend exists, or indicates improvement

1.1.2 Clark Fork River, Nuisance Algae

MANAGEMENT GOAL:	Control Nuisance Algae
MONITORING GOAL:	Detect significant trends in attached algae
DEFINITION OF WATER QUALITY:	Chlorophyll *a* (mg/m2)/ Ash Free Dry Weight (g/m2)
DEFINITION OF TREND:	35% change in 10 years at 90% C.L., 80% Power, for annual, 50% change at 90% C.L., 80% power
STATISTICAL METHODOLOGY:	Kendall with Sen slope estimate
STATISTICAL HYPOTHESIS:	Ho: No trend exists Ha: Trend exists
DATA ANALYSIS RESULT:	Conclusions regarding presence of trends Provide estimate of trend magnitude
INFORMATION PRODUCT:	Management goal met when slope indicates improvement

1.1.3 Clark Fork River, Instream Nutrient Targets

MANAGEMENT GOAL:	Achieve Instream Nutrient Targets
MONITORING GOAL:	Evaluate excursions of summer nutrient concentrations
DEFINITION OF NUTRIENT TARGETS:	20 µg/L total phosphorus upstream of Missoula; 39 µg/L total phosphorus downstream on Missoula; 300 µg/L total nitrogen; ortho phosphate 6 µg/L, dissolved inorganic N 30 µg/L
STATISTICAL METHODOLOGY:	Excursion Analysis, 95% below target/year, 95% C.L.
STATISTICAL HYPOTHESIS:	Ho: Proportion <= .05 Ha: Proportion > .05
DATA ANALYSIS RESULT:	Conclusions regarding achievement of targets
INFORMATION PRODUCT:	Management goal met when target achieved or exceeded

Table 4. Sampling Frequency by Station - Clark Fork River

Station	Name	Frequency
00	Silver Bow above WWTP	N12
02.5	Silver Bow at Opportunity, replaces 03	N12, S6
04	Discharge AMC pond 2 (Silver Bow)	N12
05	Mill-Willow bypass at mouth	N12
06	Warm Springs Creek near mouth	N12
07	Clark Fork below Warm Springs Creek	N12, S6
09	Clark Fork at Deer Lodge	N12, P10
10	Clark Fork above Little Blackfoot River	N12, S6, P10
10.2	Little Blackfoot River near mouth	N4
11	Clark Fork at Gold Creek Bridge	N12
11.5	Flint Creek near mouth	N4
12	Clark Fork at Bonita	N12, P10
12.5	Rock Creek near mouth	N12
13	Clark Fork at Turah	N12
14	Blackfoot River near mouth	N12
15.5	Clark Fork above Missoula	N12, P10
18	Clark Fork at Shuffields	N12, S6, P10
19	Bitterroot near mouth	N12
20	Clark Fork at Harper Bridge	N12
22	Clark Fork at Huson	N12, S6, P10
22.5	Ninemile Creek near mouth	N4
25	Clark Fork above Flathead	N12, P10
26	Flathead River near mouth	N12
26.6	Little Bitterroot near mouth	N4
26.7	Crow Creek near mouth	N4
26.9	Mission Creek near mouth	N4
27	Clark Fk above Thomp. Fls Reservoir	N12
27.5	Thompson River near mouth	N4
28	Clark Fk above Noxon Rapids Reservoir	N12
29	Clark Fork at Noxon Bridge	N12
29.5	Bull River near mouth	N4
30	Clark Fork below Cabinet Gorge Dam	N18

Codes: N12=nutrient parameters, 12 samples/year
S6 = Summer nutrient levels, 6 samples in addition to regular monitoring
P10= Periphyton, 10 replicates per site

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Appendix E:
Clark Fork River Voluntary Nutrient Reduction Program
Response to Public Comments

Introduction

This document contains public comments received on the July 1996 draft of the Clark Fork River Voluntary Nutrient Reduction Program (VNRP.) Notices that the draft plan was available for public review were published in the *Montana Standard* and the *Missoulian*. The public comment period ended August 15, 1996. Public meetings were held in Missoula (July 23, 1996) and Butte (July 30, 1996) to hear comments and concerns. Those meetings were taped recorded and the comments received are summarized (paraphrased) below. Responses to written comments follow the responses to comments at the public meetings. Responses to all comments are provided by the Tri-State Implementation Council's nutrient target subcommittee and appear in italic.

PUBLIC MEETINGS

- Are all dischargers signing on to the VNRP?

  Yes, although a few items remain to be worked out, we are expecting everyone who has been involved to sign.

- You plan to achieve reductions over the next ten years. Will the measures all begin at once for a smooth reduction or go in fits and starts?

  It will be highly variable from source to source. For example, in Missoula it will be a few years yet or not until they implement biological nutrient removal; in Butte it will occur in stages; in Deer Lodge they should be ready for construction next spring.

- Regarding the timeline, is there any plan at the half-way mark or somewhere during the program to look at whether actual reductions are being made? Are you hoping for measurable reductions along the way?

  We will review the program every 3 years; but at this point we have no rigid milestones for any of the facilities; our approach is cooperative. We are looking for the most cost-effective solutions to reach the desired water quality goals for the river by the end of the ten years.

- After 3 years are you looking to find at least some reduction?

Yes. However, in-stream monitoring results are affected by variable stream flows and other conditions from year to year, so it will take long term monitoring to really judge our progress.

- Since monitoring in-stream can be iffy, the easiest and most effective place to monitor discharges would be end of pipe. Also it's best to do this if we don't have the money to do sufficient in-stream monitoring. End-of-pipe results will show that point sources have done their part, then in-stream monitoring can complement that by telling us if nonpoint sources are wiping out what the point sources have accomplished.

  Agree. The point sources identified in the VNRP already do end-of-pipe monitoring and in-stream monitoring.

- I understand changes have been made to deal with growth-related issues. Did you change any allocation numbers?

  No.

- So Missoula is being asked to cut back nutrients and at the same time being asked to take on more load as people hook up?

  Response 1: This is part of the concern from the City of Missoula that if we provide a higher level of treatment at the plant, people will go somewhere else cheaper to develop. This is counter to the city's growth objective to develop in sewered areas. The higher costs would make a disincentive for people to hook up to sewer. We will be working to address this issue in the VNRP.

  Response 2: During summertime low flows, 80% of the nutrient load comes from the four key point sources. Our strategy is two-fold: to restore water quality by focusing on the key point sources over the short term, and to maintain these improvements by getting a handle on nonpoint sources, other point sources and growth-related impacts.

- But you don't want to create a disincentive for people to hook up to the sewer because of potential groundwater problems from septics. At least with the sewer you get the wastewater at one point and then you can treat it.

  Agree. We don't want to trade a point source problem for a nonpoint problem. Nutrient loading from septic seepage will decrease as areas are hooked up to the sewer; also we can work out a system that does not penalize the city for the additional hook-ups.

- Is the urban area of Missoula considered as one overall source that needs to be reduced, or are we just looking at point source? It seems logical that we look at the whole urban area as a source of nutrients whether it's from a discharge pipe or into the ground as nitrates seeping into the river.

Response 1: We have design criteria for the Missoula plant and we already anticipate problems meeting those criteria into the future because of growth and added hook-ups. We're not sure how we'll deal with this yet, other than to evaluate improvements through nonpoint reductions and if we're meeting targets downstream then that would be acceptable and we'd give the Missoula WWTP credit for that.

Response 2: The groundwater contributions from the Bitterroot are being considered in this. We're looking at seepage from both the Clark Fork and the Bitterroot.

Response 3: Agree it makes sense to look at the whole Missoula area, and both point and nonpoint sources.

- Regarding the mention of nutrient trading in the nonpoint section, I recommend that whenever we do nutrient trading we build <u>reduction</u> into it. Without reductions, trading only maintains the status quo, at best. If new development pays for some other water quality clean-up but that clean-up is not successful, meanwhile you've let the new development come in so the overall result is a negative. Recommend a 2-for-1 requirement for nutrient trading so new development would have to pay for double the amount of what their project would add.

  We will consider this when we work out the nutrient trading details.

- What about smaller discharges such as Alberton, Superior, etc.? They aren't set up to do much on nutrient reduction. Maybe nutrient trading is the way to deal with them?

  Yes. For example, in the Bitterroot, we're looking at no increase over the ten year period. We are depending on DEQ to think of this as they renew discharge permits to the smaller discharges; we expect the agency to consider how smaller ones will impact the targets.

- It would strengthen our hand on nonpoint source if we tie it to other nonpoint issues such as floodplains, riparian habitat protection, sewering old developments near the river, preventing new development to maintain riparian areas, etc. I would like to see the subcommittee spend its efforts to reduce/minimize streamside developments.

  Yes. This will fall under the specifics of the nonpoint strategy.

- Does the VNRP suffice as a TMDL for the Clark Fork River?

  Yes. DEQ is looking at this as a functional equivalent to a TMDL. That's why we're (DEQ) involved in this effort.

- What is the legal incentive to carry on from here with the nonpoint strategy? On the Flathead basin TMDL we're really wrestling with nonpoint and having trouble quantifying it.

The VNRP must be equitable. There will be pressure from the 4 point source dischargers for us to address nonpoint since they're being asked to spend money to reduce their loading. We have identified some significant hotspots in the basin where we can make some real improvements (for example, the area upstream of Deer Lodge, and sewering in the lower Bitterroot in the area between Hwy 93 and McClay bridge.) So if we focus on some localized areas where we already know there's a problem, we may not have to change land use practices over a huge area to see some results, at least in the short term. Also, we are sending the VNRP to EPA for approval and they will make sure we focus on nonpoint.

- Thanks to the subcommittee for putting time and effort into this. I have some concerns about what happens if folks don't meet the voluntary goals and I think there needs to be a hammer for nonpoint too, but overall I think this VNRP is a good outcome. Here are a few things to consider when you get to the details on nonpoint:

  - The phosphate detergent bans exempted some phosphate cleaners such as dishwashing detergents and products used by hospitals and painters. The subcommittee should research what other phosphate-free products are now available for these uses, and their costs, to see if eliminating the exemptions is a feasibility. These smaller increments would still be cheaper than some of the other things we're talking about.
  - Riparian zone protection is really the key to protecting the river in the long term. We need more widespread riparian zone standards in the basin's communities.
  - Feedlots/animal confinements next to streams may be a bigger impact than we think. A dollar spend on fencing may be money better spent than a dollar spent on nutrient removal at the plant, if you get down to it. Riparian restoration in areas that have already been hammered is just as important as riparian protection in other areas.
    Yes. Agree there are lots of opportunities here; probably a big issue in Flint Creek drainage, Deer Lodge valley and other areas too.
  - Connection of septics to WWTP's is a goal we should not hinder. It gets the sewage to one place where you can deal with it and gives you a larger rate base to pay for dealing with it.
  - I encourage DEQ to be more active in its enforcement of illegal discharges, even on small-scale activities such as the spill at the Missoula library project that sent sediment into the river.
  - I encourage the subcommittee to look at land application as an option, especially in areas outside those served by sewer where they want to develop at higher densities and don't want to be in the city. Land application needs to be carefully controlled and I think we need to develop some good state standards for it. (Missoula is currently coming up with new regulations for land application and lagoons.)
  - Also look at new septic systems that claim they can remove nutrients; level two treatment can increase densities and pollution. A developer can get credit for nitrogen removal when in fact the system isn't performing very well; there are

also design and maintenance questions; I recommend that the state look into how systems are performing.

Thank you for these recommendations; we concur that they are important. The subcommittee will make note of these as we are considering the details of the nonpoint strategy.

- This is my recommendation for the first project that we tackle under the nonpoint work: develop model floodplain and riparian protection ordinances (even tougher than Missoula's) and take these to the city and county governments in the basin for implementation. The ordinance should deal with development already in the floodplain too. Missoula has an ordinance that a use near a stream or river can be phased or if it's been abandoned for a certain amount of time. This is especially true of a mobile home near the river with a seepage pit or cesspool. If it's vacant for six months, their services cannot be reconnected. Also, any riparian regulations upstream from Missoula should be coordinated with the Superfund effort, which should make it easier for people there to deal with.

  The subcommittee will make note of this recommendation as we are considering the details of the nonpoint strategy.

- What is the Council planning to do next?

  Once EPA approves the VNRP, we will look at: expanding the subcommittee to draw in the best people to work on nonpoint planning; prioritizing issues and timelines; and probably dividing the subcommittee into subgroups to tackle specific areas since nonpoint is so broad. Also, the Council has recently acquired a grant to bring on a VNRP coordinator. This person will assist the subcommittee with involving point and nonpoint stakeholders in VNRP implementation.

- Will you be monitoring the river on a segment-by-segment basis to detect improvements?

  Yes. The Council will be conducting watershed-wide monitoring.

- How closely is Butte/Silver Bow government working with the Superfund project to coordinate clean-up efforts?

  Very closely. We want to coordinate with ARCO and the Superfund clean-up so we can perhaps save some money for the ratepayers. Work is being coordinated with ARCO for the possibility of developing an integrated wetlands system for nutrient removal from the Butte wastewater treatment plant and metal and sulfate removal from Colorado tailings water. We are looking into a wide range of alternatives that includes wastewater re-use, replacing some effluents with fresh water, a Silver Lake pipeline option to irrigate land, and flow augmentation in Warm Springs Creek with Silver Lake water. We will be working with the alternatives in the BOR document;

solutions at Butte will probably be a combination of 3 or 4 options. We want to leave adequate water in Silver Bow Creek, and we want to seek the most cost-effective means to meet the targets.

WRITTEN COMMENTS

- The proposed in-stream nutrient levels do not appear to be attainable in the future, even with the highest (and most expensive) level of treatment [the City of Missoula] could provide. The design criteria are based on treated wastewater discharge flow rates which are already being exceeded. Missoula could not meet the design criteria at our projected wastewater flow rates for the future, even with the best facility we could construct...The VNRP is not based on an understanding of how growth in future flows and loadings will be accommodated.

  To address this concern, the subcommittee has revised the target for phosphorus; it is now 39 ug/l total P downstream of the Reserve Street bridge at Missoula, but remains 20 ug/l upstream of the bridge where Cladophora is a problem and the 15:1 N:P ratio will be maintained. The subcommittee has also changed its approach to the issues at Missoula by incorporating an equal priority to resolving impacts from septics, offering incentives for hooking up to the WWTP, and giving credit to Missoula for meeting part of its nutrient reduction as additional hook-ups are made.

- Not only will the design criteria limit the City of Missoula's ability to grow, but the margin of safety is based on 7Q10, a flow condition which only occurs for one week in a ten-year period. This is further justification for construction of a very good biological nutrient removal facility, but not necessarily one that guarantees this high level of protection.

  The flow statistic used to compute the margin of safety has since been revised to a 30Q10 stream flow, calculated with actual Clark Fork River data that averages the lowest flow day of the last eleven years during summertime low flows of July, August and September.

- It is imperative to control other nutrient sources as described in Part II, page 17-18. At present there is no comprehensive information in the VNRP on all sources which in total share the assimilative capacity of the Clark Fork...Although the VNRP discusses a strategy for nonpoint sources, new activities, growth-related issues and other point sources, there is little concrete action proposed. These sources have not even been incorporated into the "Agencies Clark Fork model." Without quantification of these other pollutant sources, it will be difficult to implement nutrient trading and other options in the future.

The subcommittee has made substantial revisions to the July draft to reflect priority for nonpoint issues. Reference to Part I and Part II have been eliminated and language has been added to make point and nonpoint actions simultaneous. Working in conjunction with the Missoula City-County Health Department and the County Commissioners, language has been added to develop incentives for sewering areas both within and outside the sewer service area thereby reducing ground-to-surface water contamination; developing a strategy for increased regulation on septics by considering them as point sources; and controlling rural densities through zoning. With the assistance of the City's consultant, Brown & Caldwell, the subcommittee is working on a revised model that includes loading from nonpoint sources; this model will form the basis for nonpoint reductions.

- Without a common commitment from all sources, Missoula could be burdened with a higher standard of treatment at a greater expense to its ratepayers. Equivalent commitments for reductions from other point source contributors and nonpoint sources are not being made and the City of Missoula believes that these commitments should be part of the VNRP.

  The proliferation of septic systems in the Missoula area is a large problem, and the subcommittee believes that the large investment being made to reduce nutrient discharge from the wastewater treatment plant will likely be offset in the long term by septics if the problem is not addressed. The Missoula City-County Health Department has become an active and committed member of the subcommittee and is helping to bring the County Commissioners on line to ensure changes in the way septics will be managed. The subcommittee is also seeking strong commitment from DEQ to help with regulatory back-up of local mitigation measures. In addition, as soon as the VNRP is approved and the VNRP Coordinator is hired, this person's responsibility will be to involve and acquire commitment from a wide array of point and nonpoint sources.

- In conjunction with the City of Missoula's facility planning effort, research has demonstrated that groundwater and surface water are connected in the Missoula valley. Nutrient pollution of groundwater is adversely impacting the quality of surface water in the Clark Fork immediately downstream of Missoula as nutrient-laden groundwater seeps enter the Bitterroot and Clark Fork Rivers. We believe that Missoula County may have the authority to limit the number of septic tanks that can discharge into the Missoula aquifer. In the near future, this may become the most cost-effective way to control contributions to the Clark Fork, especially after the large point sources have been controlled.

  Agree. As discussed above, the subcommittee is working with the health department and the county to line out goals in the VNRP for septic hook-up to the WWTP within the sewer service area and reduced septic densities outside the sewer service area. We are working with DEQ on clarification of authority and assistance from them to give the county some leverage for new density and septic regulations.

- We encourage the City of Butte to meet the in-stream concentration targets at the discharge point, rather than designating all of Silver Bow Creek as a mixing zone. Since 1995 when a Record of Decision was released for Silver Bow Creek/Streamside Tailings Operable Unit through the Superfund process, design work has been ongoing to remove mine waste and remediate the creek to a level at which the creek could maintain a self-reproducing trout fishery. Nutrient levels should be low enough to allow the creek to recover to a level that will support such a fishery and other beneficial uses as well. We encourage the Council to work with Montana DEQ Superfund Division to address appropriate nutrient levels for Silver Bow during remediation, operation and maintenance of the streamside Tailings Operable Unit.

  The presence of nutrients in the stream from the Butte wastewater treatment facility to the Warm Springs ponds actually enhances the removal of metals, which are the primary pollutants of concern in this stretch of water. Until these metals are completely removed, it makes little sense to measure nutrient removal above the Warm Springs ponds. Secondly, the ponds themselves do a good job of removing nutrients and need to be part of the overall solution in solving our problem in the upper Clark Fork basin.

- We encourage coordination of Superfund remedies and nutrient reduction remedies where technically and economically feasible.

  Comment noted.

- Several years of studies must be completed to determine if wetlands are a feasible treatment option for nutrients and metals in the Butte community. Concerns include ability to remove phosphorus over a long period of time, size of land area required, and problems in cold climates. Although wetlands may have the potential to effectively treat the Butte wastewater nutrient problem, we encourage the use of appropriate technologies until the effectiveness of wetlands has been validated by the Montana Tech Wetlands Demonstration Project.

  Agree. The subcommittee is closely following the results of the wetlands project and is also looking into a combination of alternatives at Butte in case the wetlands method proves ineffective over time.

- Because the Clark Fork River is the source of most of Pend Oreille Lake's water and nutrient loading, Idaho DEQ appreciates the commitment of the VNRP subcommittee to provide for a cleaner Clark Fork.

  Comment noted.

- Idaho DEQ is concerned about the specifics of the interim evaluation using the feedback loop approach. The feedback look implies that if what we believe is the best way to control a pollutant is not working based on water quality, then we change how we control the pollutant. The VNRP addresses this approach, but we are concerned that the parties signatory to the agreement may have different ideas of how this approach will be implemented. It is unclear whether nutrient targets, discharger control measures, or both, will be revised to meet the intent of the VNRP.

Comment noted. As stated in the VNRP, we have developed a re-evaluation mechanism for our program. At least every three years we will look at the in-stream data and assess where we are with meeting the targets. The parties agree that they may have to adjust their control measures if targets aren't being met. As the downstream state, Idaho will benefit from improvements to water quality in the VNRP. It should be noted that after the river enters Idaho, it is not on the Idaho 303(d) list for nutrients.

- As the downstream state, we would like some assurance that mandatory nutrient measures will be instituted if voluntary efforts are unsuccessful at the end of the term of the VNRP.

Comment noted. The State of Montana does intend to pursue mandatory measures if the voluntary program proves ineffective in meeting the nutrient targets at the end of ten years.

- The VNRP states the margin of safety will be assured by using the 7Q10 stream flow and revised nutrient targets. The revised targets provide for an additional margin of safety of 14% for total nitrogen and 56% for total phosphorus. The Council's monitoring subcommittee's draft alternatives document indicates coefficient of variation for the Clark Fork River nutrient trend detection is 57% for total nitrogen and 65% for total phosphorus. When this data is flow-adjusted, coefficient of variation decreases to 45% for total nitrogen and 48% for total phosphorus. Given the biological variability demonstrated in the river system, can we be assured of providing for an adequate margin of safety?

Since the July draft, the margin of safety has been revised. It is now based on a 30Q10 stream flow, calculated with actual 11-year Clark Fork River. The subcommittee has confidence in the flow data to account for levels of variability. The nutrient targets are based on a conservative flow estimate that averages the lowest flow day of the last eleven years during summertime low flows of July, August and September. The subcommittee believes that the use of the conservative 30Q10 assumption translates into a significant margin of safety in 9 out of 10 years.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
999 18TH STREET - SUITE 500
DENVER, CO 80202-2466

Ref: 8EPR-EP

OCT 21 1998

Mr. Tim Fox, Division Administrator
Planning, Prevention and Assistance Division
Department of Environmental Quality
1520 East Sixth Avenue
P.O. Box 200901
Helena, Montana 59620-0901

Re: TMDL Approval
Clark Fork River

Dear Mr. Fox:

Thank you for your recent submittal dated September 21, 1998 requesting approval of the phosphorus and nitrogen total maximum daily loads (TMDLs) for the Clark Fork River. We have completed our review of this project and wish to approve it as TMDLs. In particular, we approve the TMDLs as indicated on the attached table in accordance with Section 303(d) of the Clean Water Act (33 U.S.C. 1251 et. seq.). The TMDL is documented in the report entitled "Clark Fork River, Voluntary Nutrient Reduction Program" (Tri-State Implementation Council; August 1998). We wish to acknowledge that these TMDLs within the Voluntary Nutrient Reduction Program (VNRP) are based primarily on a voluntary approach to solving water quality problems. We acknowledge that the implementation phase of this TMDL includes the continuation of field monitoring to gauge effectiveness of control measures and to assure water quality goals are met.

We would like to make special note regarding the efforts of all the individuals that contributed to the Voluntary Nutrient Reduction Plan. It is evident in the final product that much was accomplished in developing a solution to the Clark Fork nutrient issue...a solution we feel will result in improvements to the waterbody. A special note of appreciation goes to the Tri-State Implementation Council staff and the DEQ staff for the contributions made to the effort. Further, we acknowledge the significance of the VNRP Memorandum of Understanding signed by key actors and the commitment to water quality as given in this MOU.

Thank you for this submittal. If you have any questions concerning this approval, feel free to contact Bruce Zander of my staff at 303/312-6846.

Sincerely,

Max H. Dodson
Max H. Dodson
Assistant Regional Administrator
Office of Ecosystems Protection and Remediation

cc: Ruth Watkins, Tri-State Implementation Council

Enclosure

APPROVED TMDLS

Waterbody Name*	TMDL Pollutant	Water Quality Targets	TMDL (all values given as a 30 day averaging period and are based on the critical 30Q10 summer low flow condition)			
			Location	WLA (kg/day)	LA** (kg/day)	TMDL (kg/day)
Clark Fork River USGS HUC 17010204 segments: MT76G001-1, MT76G001-2, MT76G001-3, MT76G001-4 USGS HUC 17010201 segments: MT76M001-1, MT76M001-2, MT76M001-3)	nitrogen (total) phosphorus (total)	**algae**: 100 mg/m² (summer mean) chlorophyll *a*; 150 mg/m² (peak) chlorophyll *a* (at all locations in TMDL segments)	Silver Bow Creek ab. Butte		75 (TN), 2.7 (TP)	
			Butte WWTP	44 (TN), 4.4 (TP)		
		phosphorus: 20 ug/l total phosphorus upstream of the Reserve Street bridge at Missoula	Clark Fork above Deer Lodge		52 (TN), 0.84 (TP)	
		39 ug/l total phosphorus downstream of the Reserve Street bridge at Missoula	Deer Lodge WWTP	0 (TN), 0 (TP)		
			Clark Fork below Deer Lodge			52 (TN), 0.84 (TP)
		nitrogen: 300 ug/l total nitrogen at all locations in TMDL segments	Blackfoot River		184 (TN), 7.9 (TP)	
			Clark Fork above Missoula		285 (TN), 19 (TP)	
		nutrient ratio: 15:1 N:P ratio above Reserve Street bridge at Missoula	Missoula	404 (TN), 40 (TP)		
			Clark Fork below Missoula			689 (TN), 59 (TP)
			Bitterroot River		414 (TN), 28 (TP)	
			Clark Fork above Stone Container		771 (TN), 54 (TP)	
			Stone Container (seepage) (direct)	30 (TN), 23 (TP) 0 (TN, 0 (TP)		
			Clark Fork Below Stone Container			801 (TN), 77 (TP)

* These waterbodies are currently on or have been on the State's Section 303(d) waterbody list. The TMDLs associated with these waters are considered Section 303(d)(1) TMDLs.
** Some of the Load Allocations include all upstream sources of the pollutant.
These TMDL, LA, and WLA values on this page are based on a 30 day average during summer months.

■ TMDL Checklist ■

EPA Region VIII

State/Tribe: Montana
Waterbody Name: Clark Fork River
Point Source-control TMDL: X Nonpoint Source-control TMDL: X (check one or both)
Date Received: September 24, 1998 Date Review completed: October 16, 1998

Review Criteria (All criteria must be met for approval.)	Approved (check if yes)	Comments
■ TMDLs result in maintaining and attaining water quality standards	X	The purpose for the Voluntary Nutrient Reduction Program (VNRP)/TMDL is to restore the recreational designated uses to the Clark Fork River by eliminating nuisance algae growth in the river.
■ TMDLs have a quantified target or endpoint	X	There are no State numeric standards for phosphorus and nitrogen as they relate to recreational impairment. The VNRP/TMDL process used the recreational use classification and narrative provisions of the State water quality standards as a basis to develop site-specific targets for total phosphorus, total nitrogen, and algal biomass. These targets were established by relying on various methods including reference reach approach, global regression of TN and chlorophyll *a*, cellular N/P analysis of Cladophora, nutrient uptake tests with Cladophora, and artificial stream tests. This overall methodology for determining appropriate TMDL targets is appropriate.
■ TMDLs include a quantified pollutant reduction target, but this target can be expressed in any appropriate manner	X	Phosphorus and nitrogen are not conservative pollutants within the watershed. Concentrations of these pollutants change in the river as they are utilized for algal growth. To best describe the reduction targets in terms of TMDLs, LAs, and WLAs while taking the unconservative nature of the pollutants into consideration, Figures 1 and 2 describe these values in key locations throughout the basin. The Load Allocations upstream each of the point source discharger reflect the acceptable loading upstream from the facility which includes the nutrient loads from the upstream segment. The TMDLs, LAs, and WLAs are given as 30 day averages and a based on a 30 day, 10 year low flow critical condition.
■ TMDLs must consider all significant sources of the stressor of concern	X	All the significant sources of nutrients were considered in this VNRP/TMDL effort. Estimates and measures of loads from tributaries, groundwater, nonpoint sources, and point sources were considered. Individual allocations were given to the sources that needed to be controlled to assure attainment of the ambient targets.
■ TMDLs are supported by an appropriate level of technical analysis	X	A basin model was used to predict ambient concentrations of nutrients in the Clark Fork River mainstem. The model was based on simple mass balance principles and utilized first-order nutrient utilization rates derived from monitored data in the Clark Fork. The model considered all significant sources. The level of analysis was appropriate to support the TMDL.
■ TMDLs must contain a margin of safety and consider seasonality	X	An appropriate margin of safety was included by 1) basing the TMDL on a critical 30Q10 low flow regime and 2) incorporating a safety factor in the ambient nitrogen and phosphorus targets. Seasonality was considered by analyzing seasonal flow patterns, seasonal algal growth patterns, and by developing a TMDL that applies to the critical season (late June - September).
■ TMDLs allocate loads to sources	X	Load allocations were made to the various sources within the watershed, with individual wasteload allocations given to the sources that need to be controlled to achieve the in-stream targets. Load allocation values were calculated for significant sources, including point sources, nonpoint sources (including groundwater sources), and tributaries.
■ TMDLs involve some level of public review	X	The public was adequately solicited by the public through a number of notices, public meetings, and coverage in the various press media.

Figure 1. Components of Phosphorus TMDL for the Clark Fork River

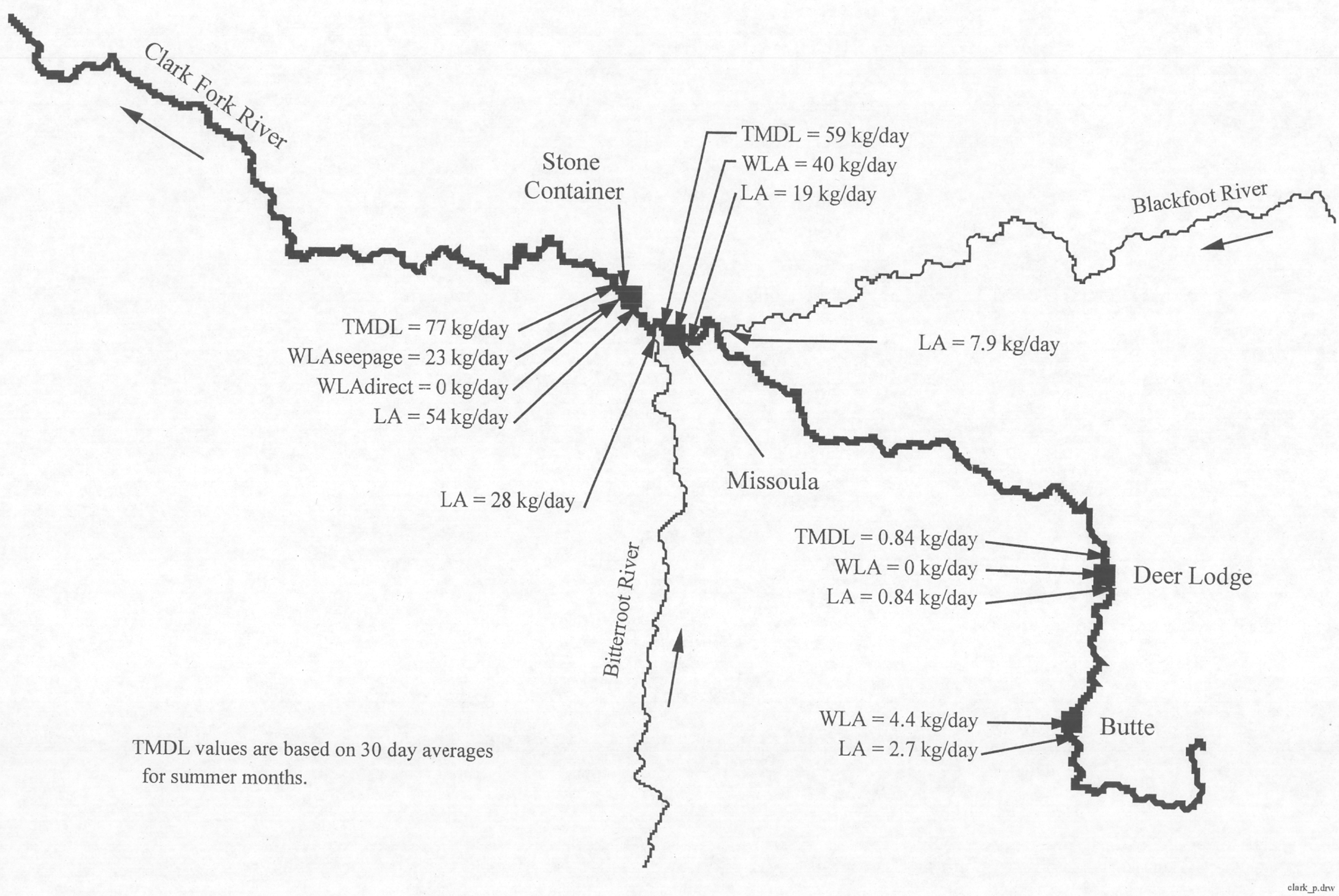

Figure 2. Components of Nitrogen TMDL for the Clark Fork River