# Chapter 3: Environmental Consequences

## 3.0 Land Use: Irrigated Lands and Irrigation Practices

### Flood to Sprinkler Conversion – Acreage Changes

Cumulatively, the proposed projects would increase the number of acres irrigated in the Smith River basin by about 1,207 acres. The change proposals would increase the amount of land irrigated in the Smith River basin by about 1,082 acres, and the ground-water proposals would add another 125 acres. Most of the ground-water permit applications are for use of ground water to irrigate lands that have been historically irrigated with surface water. One ground-water permit application would bring 125 new acres into production. Four of the change projects involve the conversion of flood irrigation to sprinkler irrigation. The projects call for some acres to be no longer flood irrigated to offset the new sprinkler irrigated acres. In each of these projects, a portion of the acres to be irrigated by sprinkler already are flood irrigated while the remainder of the acres have not been previously irrigated.

In filing the Applications to Change a Water Right, the applicants have based their proposed projects on the acres included in the Statements of Claim filed in the early 1980s. These statements of claim have not yet been examined by DNRC in accordance with the Supreme Court Examination Rules nor have the claims been included in Water Court decree where they would be subject to objection. They simply represent what the owner of the water right asserted at the time the Statement of Claim was filed. Also, since the early 1980s irrigation practices may have changed and acres that have historically been irrigated are no longer irrigated. For these reasons the acres included in the Statements of Claim throughout Montana including the Smith River basin do not necessarily represent those acres currently actively irrigated.

Because this supplemental EA must evaluate the actual existing physical circumstances and the actual physical impacts of the project, each of the projects involving a change from flood to sprinkler irrigation was evaluated to determine the number of acres presently irrigated. Only the acres being changed from flood to sprinkler irrigation are evaluated. Aerial photos from 1996-98 were used to evaluate the actual present flood irrigation. Table 3.0-1 compares the acres that were included in the Statements of Claim that are proposed to be converted from flood to sprinkler irrigation with the actual acres verified as being irrigated by analyzing aerial photos. The table also includes the number of proposed sprinkler irrigated acres.

Table 3.0-1 Comparison of claimed to verified acres for the change applications.

| Application No. | **A.** Claimed Flood Acres Proposed for Conversion | **B.** Flood Acres Proposed for Conversion Verified as Irrigated | **C.** Proposed Sprinkler Acres | Estimated Increase in Irrigated Acres (**C-B**) |
|---|---|---|---|---|
| 14609300-41J | 405 | 31.9 | 405 | 373.1 |
| 14610300-41J | 80 | 59.2 | 288 | 228.8 |
| 30002272-41J | 1,177.7 | 1,053.7 | 1,177.7 | 124 |
| 30003392-41J | 283 | 148.4 | 504 | 355.6 |
| **Cumulative Totals** | **1,945.7** | **1,293.2** | **2,374.7** | **1,081.5** |

For the purposes of evaluating the environmental impacts of the proposed changes, the verified acres are used to represent the existing condition. This is not a judgment on the part of the DNRC as to the validity of the Statements of Claim; it is only an analysis of the present condition.

The new irrigated acres represent a moderate gross increase in irrigated acres in the basin. Even though the increase in acreages to the applicants would be positive, this must be weighed against the probability that acres irrigated by irrigators other than the applicants would at times be diminished. During dry years, the proposals may impact the ability of other existing irrigators to effectively irrigate all of their irrigated acres. For this reason, the impacts to irrigated lands is not simply an accounting of the impact to the number of total irrigated acres.

To the degree that this irrigation is a valid water right, it is protected as a private property right. The impact to these private property rights must be given consideration too. These considerations will be taken into account by DNRC during the notice and hearing processes.

Based on a consideration of the criteria found in DNRC Admin. Rule 36.2.524, "Determining the Significance of Impacts," the impact to irrigated lands is not a significant adverse impact. It is best classified as moderate, because there would be a moderate increase in the acres of land irrigated in the basin, at least during wetter years.

# 3.1 Ground-Water Resources

## Impacts of Ground-Water Development

The potential for adverse effects to ground-water resources depends on aquifer properties, distances, and pumping rates in the short term, and on capture of ground water that discharges to surface water or induced leakage from surface water in the long term. Initially, wells pump water from aquifer storage that causes groundwater-level declines in all directions, thus forming a cone of depression. The cone of depression for wells, such as the proposed new wells in the Smith River basin that pump for only part of the year, will mostly dissipate as storage is redistributed between pumping cycles. The amount of drawdown associated with a pumping well can be estimated using standard analytical ground-water-flow equations and estimates of aquifer properties.

Figure 3.1-1 is an example of a distance-drawdown graph that illustrates how drawdown diminishes radially away from a pumping well, assuming that the aquifer is unconfined. Figure 3.1-1 illustrates drawdown for the largest requested volume of the newly-proposed Smith River ground-water appropriations in which the average pumping rate of 730 gpm was determined to pump the volume of water requested for a 153-day irrigation season (i.e. from May through September). The graph shows estimates of drawdown for various distances from the well after 153 days of pumping and for different values of aquifer transmissivity (i.e. measure of an aquifer's ability to transmit water). Drawdown estimates range from 0 to about 95 feet, depending on distance from the pumping well. This proposed appropriation may adversely impact the ground-water levels in neighboring wells depending on the distance to those wells from the pumping well and the transmissivity. Smaller volumes of water requested by other proposed appropriations should require smaller average discharge rates. Because drawdown is proportional to pumping rate, providing the unconfined aquifer is not significantly dewatered, expected drawdowns from other proposed wells should be less than drawdowns shown in Figure 3.1-1.

Cones of depression from closely-spaced wells add together to increase drawdown. Interference between closely-spaced wells can adversely affect the availability of ground water to existing and new water users. Considering the distances that the newly-proposed wells are from one another, mutual drawdown interference impacts will probably be negligible to small during an irrigation season. However, impacts from the new wells to other nearby wells will occur, some of which may be adverse.

Ground-water levels do not entirely recover between pumping cycles, causing water levels to gradually decrease over time. It is unknown whether pumping water levels in the new wells will recover during the time interval between the end of one irrigation season and the beginning of the next season. Full recovery may occur if a cone of depression intersects a recharge boundary but, in the event that no boundaries are encountered, pumping will begin the following irrigation season with residual drawdown. The implication of pumping a well in which the water level has not fully recovered to the pre-pumping level is to begin each new pumping cycle at an increasingly lower water level, that will cause the pumping water level to decline further than it did the previous irrigation season, eventually resulting in a decreased well yield.

Figure 3.1-2 shows estimates of drawdown assuming the aquifer is confined. However, interpretations from drilling logs suggest that a valley-wide, confining clay barrier does not exist in the alluvial aquifer. Clay layers appear to be laterally discontinuous and therefore different water-bearing zones function as a hydraulically interconnected aquifer system. Discontinuous clay layers simply impede, rather than prevent, ground-water flow between interconnected water-bearing zones. A confined drawdown response may, however, be observed for short periods of pumping where the well is completed beneath a clay lens.

The capture by pumping wells of water that would otherwise discharge to surface water or be consumed by riparian vegetation will mitigate the impact of declining ground-water levels by stabilizing ground-water levels. The long-term impact of ground-water appropriation is diminishment of surface-water availability. A better understanding of aquifer geometry and properties is necessary to evaluate the effectiveness of capture and the sustainability of increased ground-water development.

Figure 3.1-1. Drawdown at various distances from a well pumping continuously at 730 gpm for 153 days in an unconfined aquifer for different values of transmissivity; $S_y$ = 0.20.

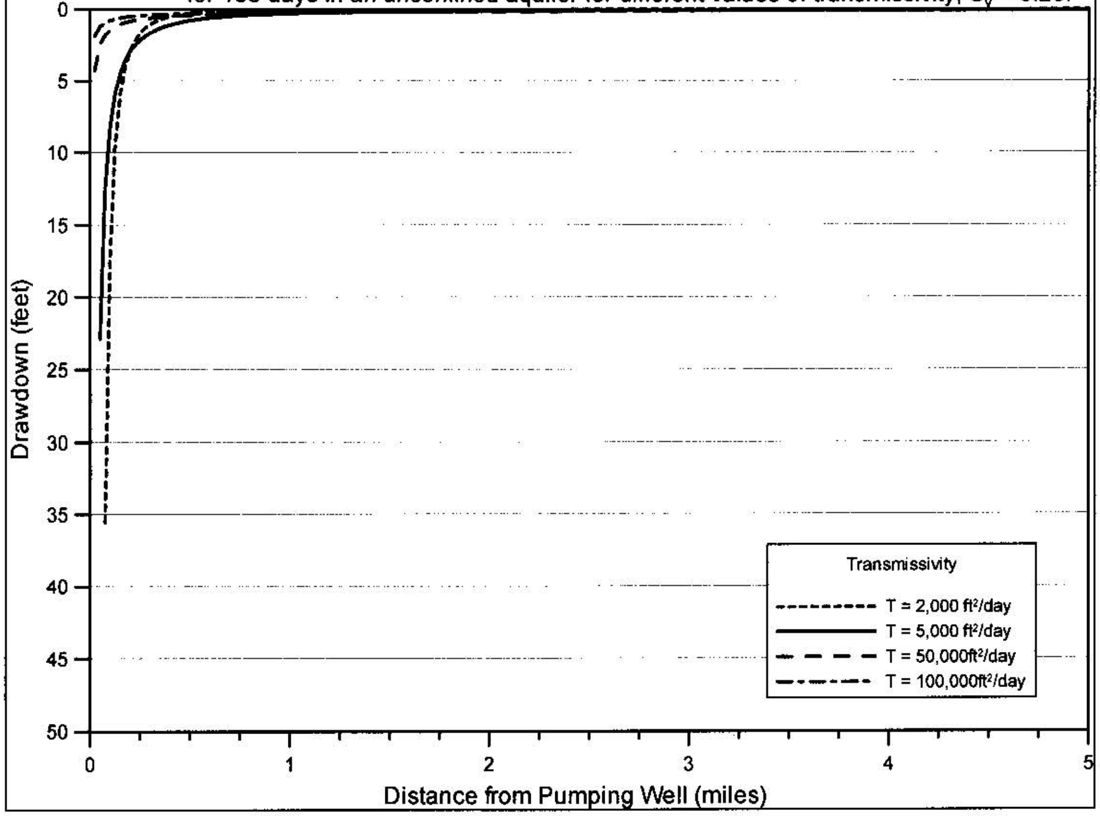
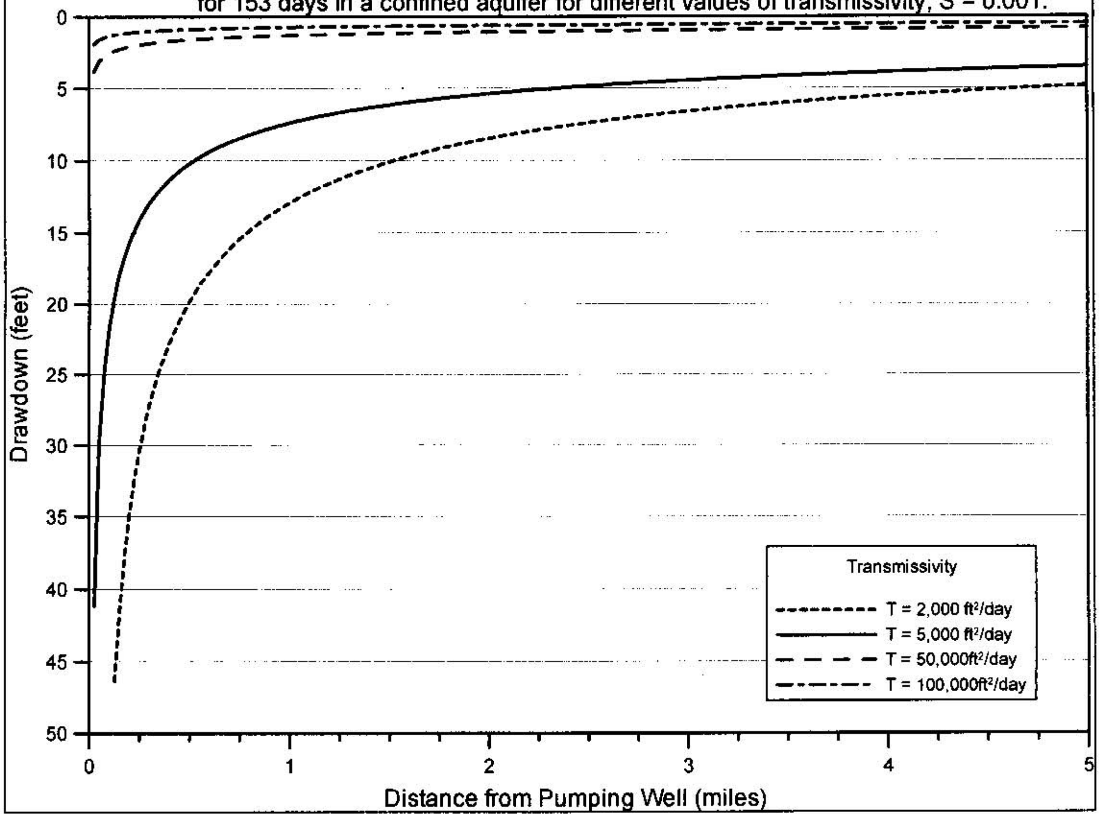



Figure 3.1-2. Drawdown at various distances from a well pumping continuously at 730 gpm for 153 days in a confined aquifer for different values of transmissivity; S = 0.001.



Based on a consideration of the criteria found in DNRC Administrative Rule 36.2.524, "Determining the Significance of Impacts", the cumulative effects of pumping from the proposed new wells on other wells are interpreted to be "minor adverse" because of the distances between the proposed new wells. Individual new wells could have significant impacts on other wells located within about one-half mile. The significance of the impacts of individual wells on nearby wells will be addressed in the checklist EAs for each project.

## Effects of Ground-Water Pumping on Stream Flows

Ground-water pumping initially takes water from storage in an aquifer by reducing ground-water levels in an expanding circular area around a well. The area in which ground-water levels are reduced continues to expand until the rate of ground-water flow out of an aquifer is reduced or the rate of recharge to the aquifer is increased. In an intermountain valley, such as the upper Smith River basin, this typically occurs when the expanding area of influence of a well reaches a stream that is hydraulically connected to an aquifer. Initially, when the area of influence of a well intercepts a stream that normally gains flow from ground-water seepage, the gradient, or difference between ground-water levels and stream levels, is reduced. This results in a lower rate of ground-water seepage to the stream and thereby reduced streamflow. Ground-water levels eventually can drop below the water level in a gaining stream causing water to flow from the stream to ground water. Ground-water pumping can reduce flows in losing steams by increasing the gradient between the stream and ground water. Ground-water pumping will not affect stream flows in cases where an aquifer is unsaturated beneath a stream or where ground water is otherwise not hydraulically connected to a stream. The Smith River and its principal tributaries in the upper Smith River basin are interpreted to be gaining streams that are hydraulically connected to ground water. Also, depletion caused by the proposed new wells is interpreted to occur by interception of ground water discharge rather than by direct infiltration of streamflow.

Where depletion occurs, its rate is determined by the amount of drawdown, the thickness and hydraulic conductivity of streambed sediments, and flow in the stream. In turn, the amount of drawdown depends on the pumping rate, and the flow and storage properties of the aquifer. Effects of pumping from new wells in the Smith River basin on stream flows are expected to vary by location and timing depending on well locations, pumping rates, aquifer properties, and degree of stream-aquifer connection.

The computer model MODFLOW (McDonald and Harbaugh, 1988) is used to simulate the potential cumulative spatial and temporal effects on stream flows caused by pumping from proposed new wells in the Smith River basin (Appendix A). Figure 3.1-3 shows the percent of the total volume of water pumped by the proposed new wells expected to appear as stream depletion over 100 years of pumping. This graphs show that the volume of stream depletion in the first year of pumping is estimated to be 37 percent of the volume pumped.

**Figure 3.1-3 Percent of pumping appearing as stream depletion by year for new wells proposed for Smith River Basin.**

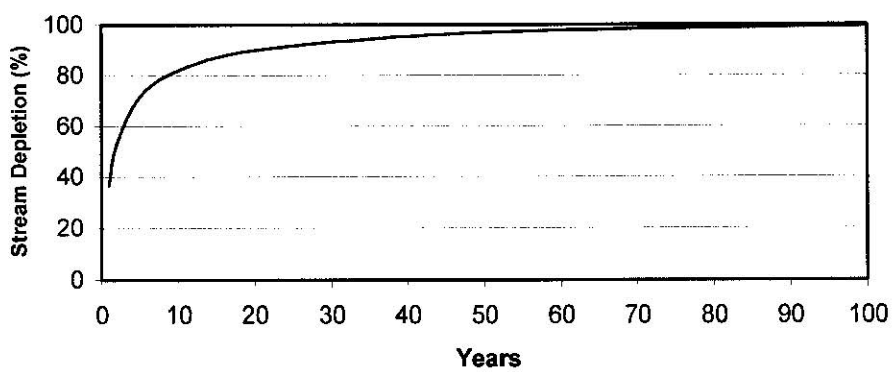
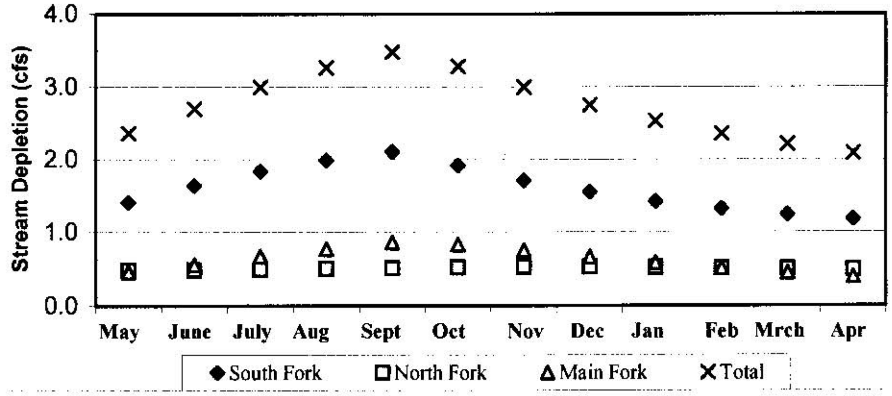


Figure 3.1-4 shows the potential monthly rates of depletion from new wells after rates have stabilized. The peak rate of stream depletion is expected to be approximately 52 percent of the average pumping rate for a five-month long irrigation season (6.7 cfs), and residual stream depletion at the beginning of subsequent irrigation seasons is expected to be approximately 31 percent of the seasonal average pumping rate.

**Figure 3.1-4. Potential rate of depletion by reach by proposed new wells in the Smith River Basin in the 100th year of pumping.**




Response ratios listed in Table 3.1-1 represent the expected relative effect of each proposed new well on three stream reaches: South Fork Smith River, North Fork Smith River, and the main Smith River from the confluence of the South Fork and North Fork to the mouth of Big Birch Creek. For example, 65 percent of potential stream-flow depletion resulting from pumping proposed under application #11366700-41J is expected to come from the South Fork Smith River with the remainder coming from the North Fork Smith River. Similarly, pumping proposed under application #30000211-41J is expected to deplete flow in the South Fork Smith exclusively. Overall, 59 percent of potential depletion from new wells in the Smith River basin is expected to come from the South Fork Smith River with the remainder roughly split between the other two stream reaches. The potential impacts of these stream-flow reductions will be further discussed in the surface water section that follows.

Table 3.1-1. Steady state response ratios for new wells in the Smith River basin.

| Application # | River Reach | | | |
|---|---|---|---|---|
| | **South Fork Smith** | **North Fork Smith** | **Smith** | **Other** |
| 11366700-41J | **0.65** | **0.35** | **0.00** | **0.00** |
| 11508000-41J | **0.99** | **0.00** | **0.01** | **0.00** |
| 11510000-41J | **0.17** | **0.83** | **0.00** | **0.00** |
| 11778600-41J | **0.01** | **0.13** | **0.85** | **0.01** |
| 11779100-41J | **0.95** | **0.04** | **0.00** | **0.01** |
| 30000211-41J | **1.00** | **0.00** | **0.00** | **0.00** |
| 30001310-41J | **0.01** | **0.69** | **0.25** | **0.05** |
| Total | **0.59** | **0.17** | **0.23** | **0.01** |

## 3.2 Surface-Water Resources

DNRC has put together a surface-water flow model for the upper Smith River basin using a computer spreadsheet program. The model is used to estimate impacts to Smith River streamflows due to cumulative effects of the proposed projects, and to model cumulative impacts of converting from flood to sprinkler irrigation in the basin. Only results from the model will be discussed in this section. More details on the model and data inputs are presented in Appendix D. Impacts of flood to sprinkler conversions will be discussed first, because this discussion will help to explain some of the cumulative impacts that can be expected from the proposed projects, if granted.

### Conversions from Flood to Sprinkler Irrigation

Prior to the 1970s almost all irrigation in the Smith River basin was by flood irrigation. Since then, about one-third of the irrigated lands in the basin have been converted to sprinkler systems, and the number of sprinkler systems continues to grow. All of the pending change applications would seek to convert flood systems to sprinklers or to expand from smaller flood systems to larger sprinkler systems.

The model was used to compare Smith River flows above and below the mouth of Sheep Creek under the following three scenarios: (1) pre-1970 conditions, or 100 percent flood irrigation, (2) existing conditions where about 34 percent is sprinkler irrigation and 66 percent flood irrigation, and (3) a future scenario with 66 percent sprinkler irrigation and 34 percent flood irrigation. It is assumed in the scenarios that the number of irrigated acres would stay constant, at about 36,000 acres. The results of these model runs are summarized in Figure 3.2-1. through 3.2-4 to show potential impacts to streamflow volumes and streamflow timing.

*Streamflow volume*

Modeled basin water budgets for the pre-1970 conditions and the future scenario with 66 percent sprinkler irrigation are presented in Figures 3.2-1 and 3.2-2. The basin water budget under existing conditions was presented earlier in Chapter 2 (Figure 2.2-2). These water budgets are for average annual flows for the upper Smith River basin to below the mouth of Sheep Creek. The figures show sprinkler irrigation conversions to have a moderate impact on the volume of water that leaves the upper basin. The biggest modeled changes are to the volume of water diverted and return flow volumes which, in turn, will affect streamflow timing.

*Streamflow Timing*

Figures 3.2-3 and 3.2-4 contain modeled seasonal average streamflow rates for the Smith River, both above and below the mouth of Sheep Creek for different irrigation scenarios. In general, sprinkler conversions are predicted to increase early season flows, and to decrease late-season flows. Early-season flows are predicted to increase because early-season irrigation demands for flood systems are higher than those for the more efficient, sprinkler systems. Late-season flows would decline because return flows from early-season flood irrigation would be less, and because some acres that only could be irrigated as partial service under flood irrigation could be irrigated more effectively and later in the season with the more efficient sprinkler systems.

Changes in Smith River flows will be more pronounced above the mouth of Sheep Creek, because this is where most of the irrigation in the basin occurs. Downstream, the changes will be a smaller percent of the total flow because Sheep Creek flows, which are substantial and much less influenced by irrigation, will be added.

Research has documented similar types of impacts to streamflows due to changes from flood to sprinkler irrigation. The Wyoming Water Research Center (Sando and others, 1988) studied the hydrologic impacts due to changes from flood to 50 percent sprinkler irrigation in the Salt River drainage of Wyoming. Conclusions from the study were that the conversion to sprinklers resulted in increased May and June flows and decreased flows from August through November, when climatic variations were accounted for, and that less total water was diverted from the stream.

Figure 3.2-1. Estimated Smith River basin water budget with 100% flood irrigation.

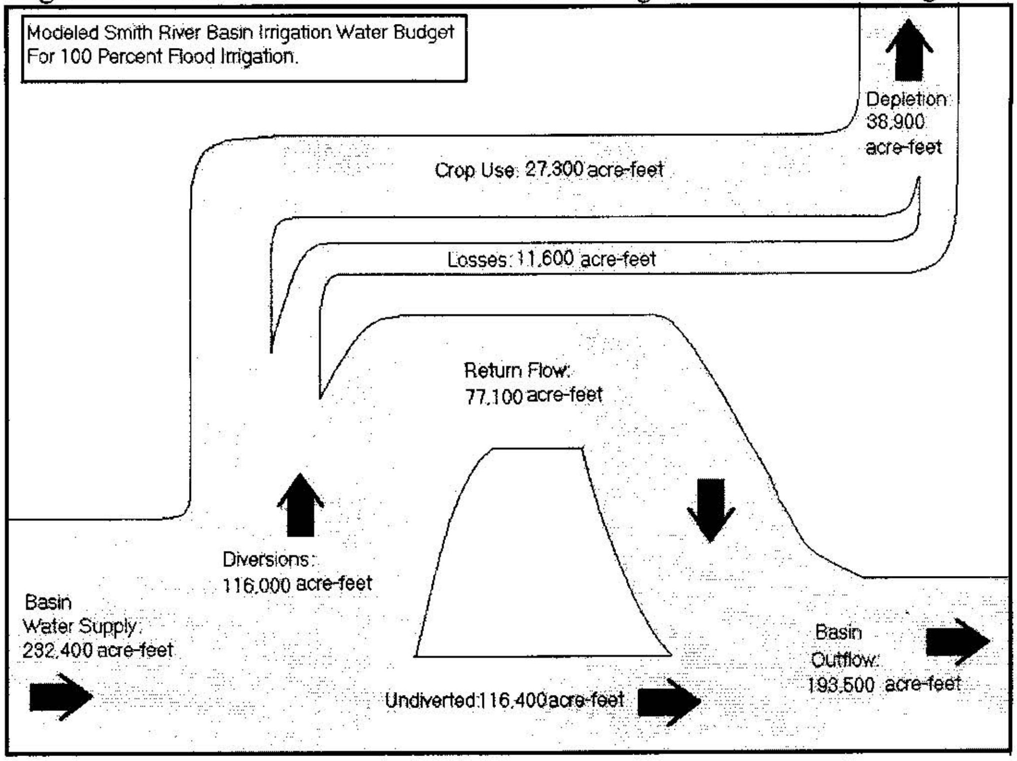



Figure 3.2-2. Estimated Smith River basin water budget with 66% sprinkler irrigation.

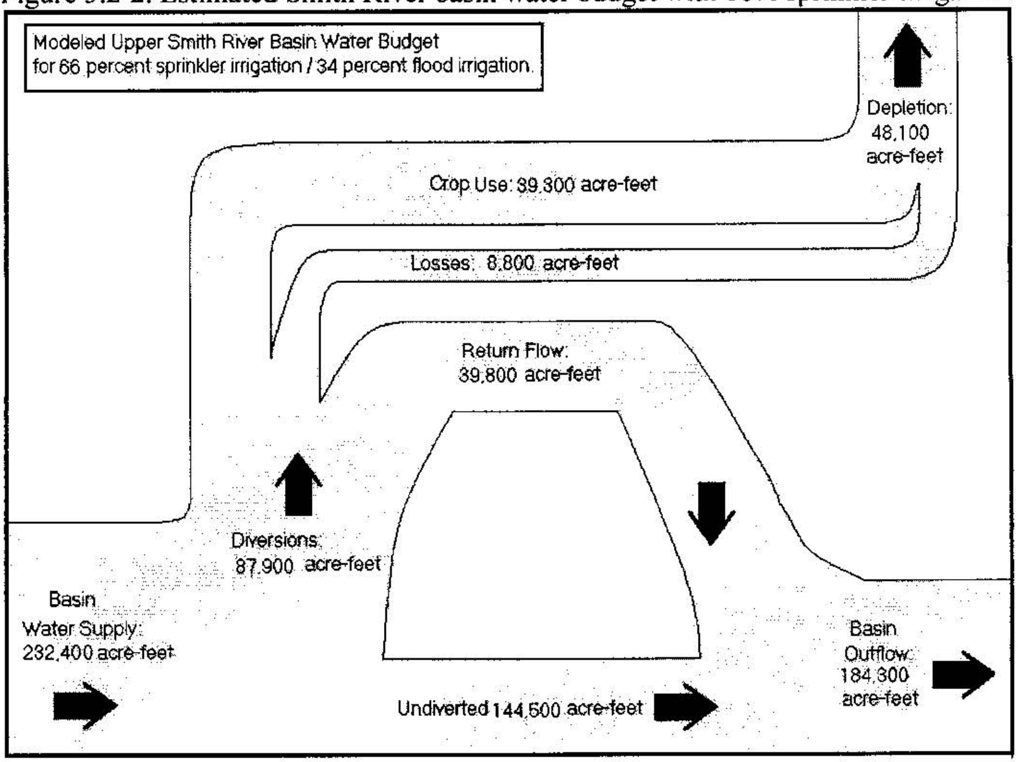


Figure 3.2-3. Estimated average Smith River flows above Sheep Creek under different irrigation scenarios.

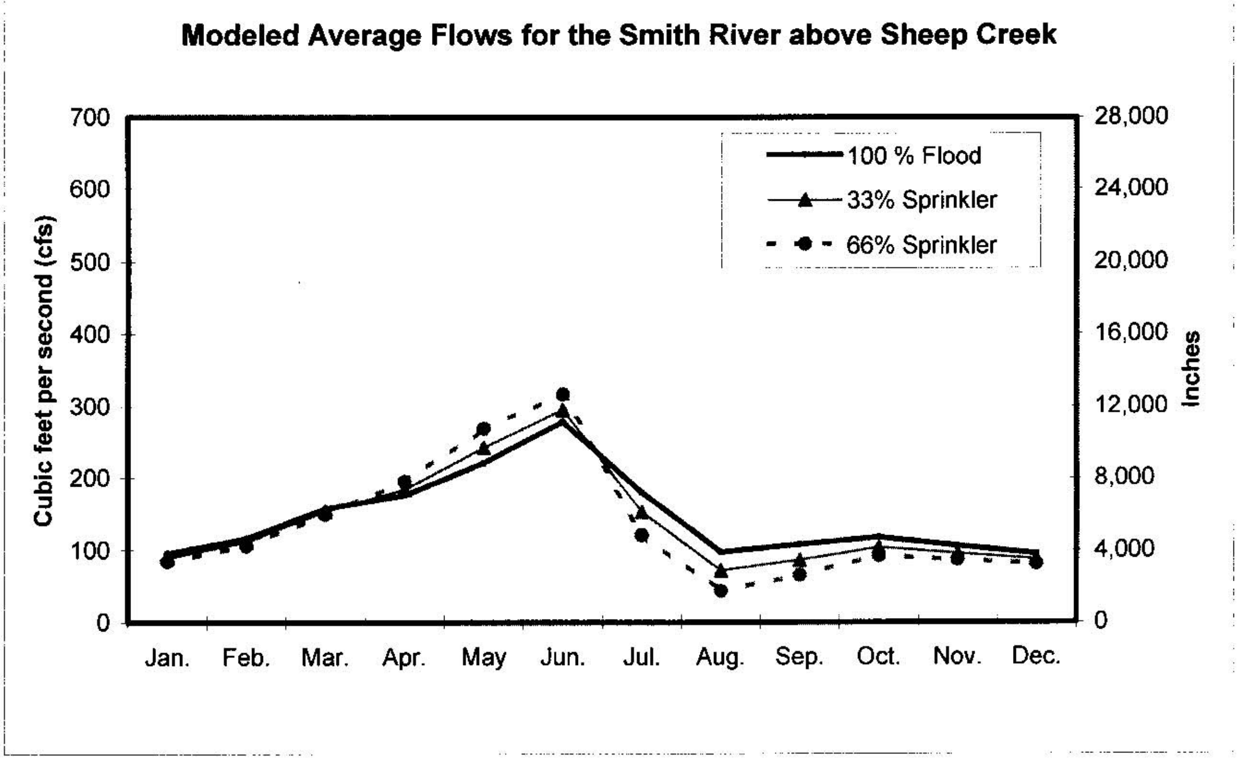
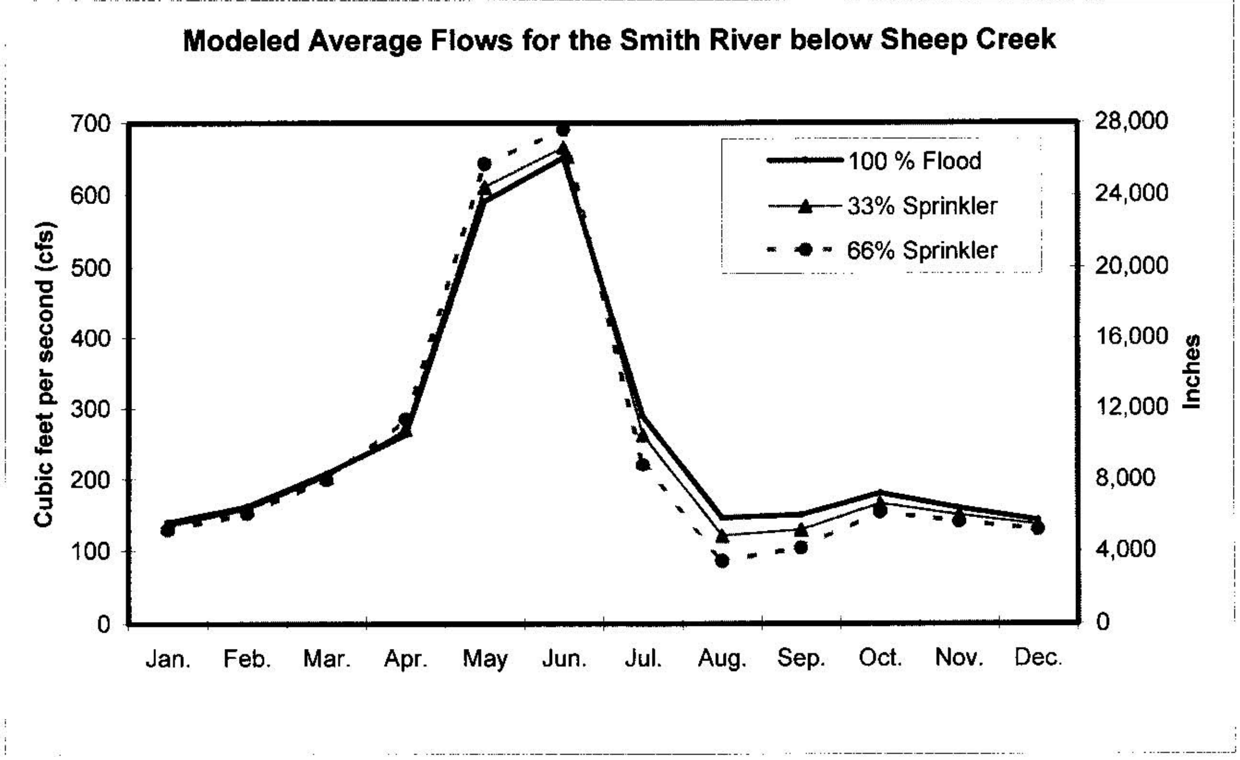



Figure 3.2-4. Estimated average Smith River flows below Sheep Creek under different irrigation scenarios.



## Cumulative Impacts of the Proposed Projects

Average cumulative flow reductions in cfs from the proposed projects for the Smith River above and below the mouth of Sheep Creek are presented in Table 3.2-1. These flow reductions include those predicted to result from the ground-water projects as described in the ground-water section (Section 3.1) and those resulting from the irrigation change applications. Potential impacts for the change applications were estimated using the model described above. The amount of sprinkler irrigation proposed was added to the model input files, and acres of flood irrigation that would be removed were subtracted.

Table 3.2-1. Potential changes to Smith River flows resulting from the cumulative effects of the proposed projects in cfs.

| | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Above Sheep Creek | -3 | -3 | -2 | 0 | -1 | -4 | -13 | -12 | -8 | -4 | -4 | -3 |
| Below Sheep Creek | -3 | -3 | -2 | 0 | -2 | -6 | -17 | -14 | -9 | -4 | -4 | -3 |

Flows are predicted to be reduced during all months except April. These changes in flows include depletions attributed to all of the applications, including the new ground-water projects. Flow reductions from the ground-water projects and the estimated additional 1,082 acres that would be brought into production by the change applications probably will account for the majority of the impacts. The reason that there are no spring flow increases shown, as would be predicted with conversion to sprinkler irrigation, is because of the additional acres of irrigation that would be added and the time-lagged flow reductions due to the ground-water projects. Maximum predicted flow changes for Smith River tributaries are presented in Table 3.2-2.

Table 3.2-2. Predicted changes in Smith River tributary flows due to the cumulative effects of the proposed projects.

| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South Fork | -1.3 | -1.1 | -1.0 | -0.7 | -3.3 | -4.9 | -6.9 | -6.1 | -4.1 | -1.8 | -1.7 | -1.4 |
| North Fork | -0.6 | -0.6 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.5 | -0.6 | -0.6 | -0.6 | -0.6 |
| Birch Creek | -0.5 | -0.5 | -0.4 | 1.6 | 3.0 | 2.0 | -5.2 | -4.2 | -2.7 | -1.1 | -0.8 | -0.6 |
| Sheep Creek | 0.0 | 0.0 | 0.0 | 0.3 | -0.9 | -1.8 | -3.5 | -2.6 | -1.2 | 0.2 | 0.1 | 0.1 |

The changes in flows in Tables 3.2-1 and 3.2-2 are those that are predicted to occur if water were available for all the proposed projects at all times. During July, August, and September of dry years, absolute late-summer flow reductions in the Smith River are predicted to be substantially less. This is because Birch Creek, Catlin Springs, and the South Fork of the Smith River probably would not have enough water to irrigate all of the acres proposed in the change applications during the late summer, especially during dry years. Further, a flow reduction upstream in the basin during the summer of a dry year may simply result in a lost opportunity for downstream irrigators--or an upstream junior user--who would have diverted the water if it were available.

It is difficult to predict what impact the flow reductions upstream would have on the lower Smith River, especially below the canyon. During wetter years, flow reductions similar to those stated in Table 3.2-1 may occur at downstream locations. During the later summer of drier years, the absolute flow reductions downstream could be substantially less than those stated in Table 3.2-1. This is because some of the water would be lost to channel evaporation, transpiration by phreatophytes, channel seepage, or diverted for irrigation. The lower river has already been documented to cease to flow during severe drought. These cumulative flow reductions would increase the frequency of times of zero flow and could increase the length of stream that is dewatered.

DNRC considers the potential impacts to surface-water flows as moderate. The greatest impacts to Smith River flows would be during the late summer and early fall because average cumulative flow reductions from about 10-to-25 percent may occur. During the remainder of the year, the flow reductions would be a smaller percentage of the flow of the Smith River and the impacts only minor. Predicting the impacts to flows on the tributaries is more difficult because there is not much data on existing flows. Also, because there probably is not enough water in the South Fork of the Smith River and Birch Creek to supply existing demands during the late summer of dry years, the impact may not be a reduction to streamflow, but rather a reduction in the amount of water available to other users.

## Indirect Impacts to Water Users Due to Streamflow Changes

Decreases in streamflow directly impact irrigators in that water may simply no longer be available to adequately irrigate. However, there also may be indirect impacts to other irrigators. The prior appropriation system of administering water rights in Montana creates this possibility.

When a senior water user with an older priority date is short of water, they ask the junior water user to stop using water until sufficient water is made available for the senior water user. This is referred to as placing a "call" on water. The senior water user may place a call on any junior water user, not just the water user with the most recent priority date. Because the call can be placed on any junior water user, a senior water user is inclined to place a call that would result in the most immediate and substantial increase in streamflow. This may mean calling the largest or nearest diversion that may not necessarily be the most junior water right. This scenario creates a chain reaction where the junior water user who is called then must place a call on water users who are junior to his or her water right. This chain may extend into tributaries where calls on water previously did not occur. Calls would be most likely to occur where the impacts from the proposal are greatest and most direct, such as on the Smith River proper, South Fork, North Fork, Big Birch Creek, and Sheep Creek.

Changes in existing water rights that decrease streamflow can potentially cause impacts to all water users junior to the water right being changed as they are now all potentially subject to a greater likelihood of being called by other senior water rights. Decreased streamflow due to new ground-water diversions creates a situation where placing a call may not be a sufficient remedy. The impacts to streamflow may take days, months or years to diminish after the pumping is stopped. Therefore, a call on water may be deemed to be futile in this situation and the ground-water diversion could continue because cessation of pumping would not produce increased streamflow within a reasonable time. In these situations, senior water users could now call junior surface-water users who would otherwise not be called, and who were not called in the past.

Because of the nature of the prior appropriation system, water users who experience no decrease in streamflow, may be more limited in their ability to exercise their water rights. Downstream depletions caused by new ground-water diversions or changes in existing water rights may cause such water users to be called by senior water users, even when they see no decrease in streamflows in their location.

## 3.3 Water Quality

Phosphorous and nitrogen fertilizers are used on irrigated hay fields in the Smith River basin. In some areas of the upper basin, a lot of phosphorous fertilizer is used on fields with limy soils, and nitrogen fertilizer applications can be relatively heavy (Ohlson, 2002). Nutrients, such as nitrogen and phosphorous, can be leached into the water table and eventually to streams via ground-water return flows. Nutrients also could be carried directly into the stream with surface return flows. The potential for this type of pollution is greater with flood irrigation than sprinkler irrigation, because water application rates, and resulting surface and ground-water return flows are higher under flood irrigation.

Nitrogen in the form of water-soluble nitrates would be the nutrient most likely to leach through the soil, to the water table, and eventually with return flows to a stream. Phosphorus fertilizers are less likely to be leached through to the water table because phosphorus is relatively insoluble and tends to quickly bind to soil particles. Phosphorus could enter a stream via sediment in surface-water return flows because it will readily attach to soil particles. However, soil erosion by surface return flows is probably low in the Smith River basin because the soils on most irrigated fields are well protected by an alfalfa or grass crop cover.

Conversion from flood to sprinkler irrigation could reduce the potential for nutrients, especially nitrates, to leach to the water table and eventually enter Smith River basin streams because ground-water return flows that could transport the nutrients would be reduced. Further, there could be minor reductions in the amounts of phosphorous that may enter streams via surface-water return flows because surface-water return flows should be minimal under well managed sprinkler irrigation. Beneficial impacts to water quality because of reduced nutrients are expected to be moderate.

Stream dissolved oxygen concentrations could decline with a reduction in nutrients. However, the cumulative impacts of reducing flows due to the proposed projects could warm water temperatures which could reduce dissolved oxygen concentrations.

Because ground water is in contact with soil, alluvium and rock for a longer time than surface water, it generally dissolves more solids and, consequently, usually has higher TDS concentrations than surface water. Because of this, ground-water return flows, which are highest under flood irrigation, could be increasing salt concentrations in Smith River basin streams. By reducing ground-water return flows, conversion to sprinkler irrigation could reduce TDS concentrations in Smith River basin streams.

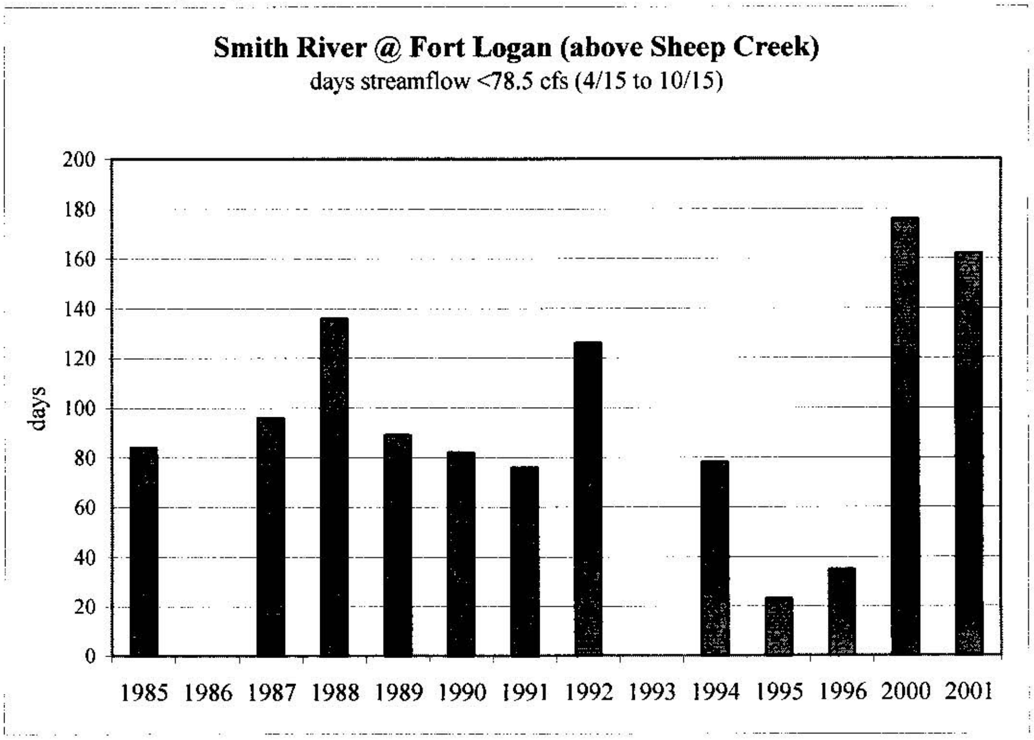
Overall, DNRC determines the potential cumulative impacts to water quality to be minor beneficial. The potential reductions in return flows would result in less opportunity for water contamination due to nutrients and TDS. The beneficial impacts are considered minor, because they would be offset to some degree by potential increases in dissolved oxygen and water temperature due to lower streamflows.

## 3.4 Fisheries

Changes in surface flows of the Smith River and potentially affected tributaries, Eagle Creek, Sheep Creek, Big Birch Creek, North Fork Smith River, and South Fork Smith River, will result from the cumulative effects of the proposed irrigation projects (Tables 3.2-1 and 3.2-2).

Surface water modeling results discussed in Section 3.2 indicate flow reductions would occur in the Smith River in most months throughout the year, if the proposed irrigation projects are implemented. Wetted perimeter analysis conducted by DFWP during the Missouri basin water reservation process identified the minimum flows required to maintain a minimal fish population and prevent the loss of the most critical habitat for all the potentially affected streams. Since 1985, 12 out of 14 years of record at the USGS Smith River at Fort Logan streamflow gage site have had days when the identified minimum flows were not met during the irrigation season (Figure 3.4-1). The modeled reductions in flow will likely increase the number of days these critical flows are not met. Lack of flow data since 1985 precludes similar comparisons in other reaches of the Smith River or tributaries.

Figure 3.4-1. Number of days fisheries instream flow needs are not met (based on 78.5 cfs flow identified in DFWP water reservation request).




Critical thermal maximums or the upper incipient lethal temperature for rainbow and brown trout would be expected to be between 78° F and 86° F (Hokanson and other, 1977; Armour, 1994; Lee and Rime, 1980; Elliot, 1981). DFWP has measured temperatures within this range for several reaches of the Smith River. High temperatures have typically coincided with low flow conditions.

Flow reductions such as those modeled for the Smith River, above and below Sheep Creek, the North Fork Smith River, South Fork Smith River, Birch Creek, and Sheep Creek (Section 3.2) will affect fisheries in several ways. Reduced flows between July and September can result in loss of fish habitat, elevated temperatures, and increased oxygen demand, all of which increase stress on sport fish and likely reduce the carrying capacity of the river. Lower flows between October and March may reduce available winter habitat for fish and increase winter mortality. Because reductions in trout habitat and populations are a function of decreased flows, further reductions in flow that result from the implementation of the proposed projects would raise concern for the maintenance of the existing fishery.

In addition to the proposed irrigation projects, modeling results have indicated that increasing sprinkler irrigation in the upper basin from its present use of about 34% of total irrigation to 66% will result in increased flows from April through June, and lower flows during the rest of the year (Figures 3.2-3 and 3.2-4). Flow reductions associated with this increase would likely affect fisheries similarly to the impairments discussed in the previous paragraph.

Based on data presented in Sections 3.2 and 3.4, there is a high probability that surface flow reductions and therefore reductions in trout habitat will occur resulting from the implementation of the proposed projects. The extent of flow reductions will include the entire Smith River and the lower reaches of the North Fork Smith River, South Fork Smith River, Birch Creek, and Sheep Creek. Although the severity of potential fishery impacts cannot be quantified, it is likely that some impacts will occur during average to less than average water years. Therefore, based on a consideration of the criteria found in DNRC Administrative Rule 36.2.524, "Determining the Significance of Impacts", the cumulative effects of streamflow reductions on fishery resources resulting from the implementation of the proposed projects is determined to be moderate adverse.

## 3.5 Economics

### Agriculture

The proposed conversion from flood to sprinkler irrigation of 1,293 acres is likely to increase hay yields by one to two tons per acre depending on the characteristics of the project lands. At $62.08 per ton (Montana Department of Revenue, 2002b), this increase in productivity represents $80,269 to $160,539 in additional annual cash receipts or an increase of 0.33 to 0.66 percent in Meagher County agricultural marketings per year. Because sprinkler irrigation is less labor and more capital intensive compared to flood irrigation, labor requirements would decline while costs related to the investment in and operation of the irrigation system would increase.

The 1,207 increase in irrigated acres resulting from the proposed projects would increase the county's acreage in irrigated hay by 3.4 percent. Presumably, the conversion of this land to irrigated hay replaces its current use for grazing or the production of dry land hay or some other crop. Introducing sprinkler irrigation to land growing non-irrigated hay may increase yields by 3 tons per acre. The increase in productivity could result in an additional $246,518 in agricultural sales annually.

The increases in production associated with the proposed projects are approximately 1.5 percent of annual agricultural sales. These gains in production may be offset by diminished productivity experienced by downstream irrigators affected by the proposed projects. As suggested in other sections, determining the extent of those impacts may be quite difficult.

### Recreation

#### Fishing

The appeal of the Smith River as a desirable fishing site depends largely on the presence of a productive fishery. Impacts to the fishery directly affect prospects for recreation to the extent that the proposed projects diminish the viability of the fishery--particularly through crossing critical thresholds described in Section 3.4. Consequently, the projects may threaten the continuation of recreational opportunities for many Montanans and non-residents as well as the considerable economic activity generated by their visitation.

Lower flows in the Smith River potentially diminish the quantity and quality of recreational opportunities through poorer floating conditions and fewer fish. They may create marginal conditions or lead to crowded conditions at substitute sites. Persistently poor conditions may reduce economic activity related to recreation or affect property values in areas with access to recreational opportunities.

#### Floating

*Cumulative impacts of the proposed projects*

Cumulatively, the impacts of the proposed projects on the floating season would be minor. During the most popular floating months of May and June, flow reductions attributed to the proposed projects would be below 6 cfs, which is a minor reduction when compared to the flow of the river during those runoff months (see Table 2.3-2) and the flows required for floating (Table 2.6-1.). During the fall season, when the flow reductions would be higher and the river flows lower, the cumulative reductions could be considered moderate at about 3-to-6 percent of the flow required for canoeing.

*Flood to Sprinkler Conversions*

As discussed under the hydrology section (3.2), flood to sprinkler conversions are predicted to increase early-season flows and decrease late season flows. Higher spring flows usually would benefit early season floaters, especially those using rafts and drift boats. The greatest benefits probably would occur during dry years, when a short floating season may be extended by several days. These benefits to early-season floater would be moderate.

Fall floating opportunities are marginal, do not occur every year, and are often limited to canoeists. Because of this, predicting the impacts to fall floating is more difficult. Because moderate declines in fall flows are predicted, the result would likely be a moderate decline in the duration and quality of fall floating opportunities.

## Hydropower

In general, the reduced flows expected through the development of the proposed projects would result in declines in hydropower production at the Missouri River dams. Applying the estimated flow reductions resulting from the proposed projects to the turbine factors of the power plants at a price of $35 per mega-watt hour (MWh) yields a loss of hydropower revenues of $71,025 annually.

Realistically, however, some of the water that is depleted by the proposed projects would not have arrived at the Missouri River absent the projects' development--particularly during the late summer of dry years. Quite likely, some of the water would have been lost to evaporation, consumption by vegetation and intervening users and, during extreme drought, flows would be inadequate to transport the water.

## Taxation

Converting from flood to sprinkler irrigation would change the grade and water class used in determining the assessed value of the project acreage. The change in the tax per acre would vary for each project, probably remaining the same or decreasing. Based on the per acre tax estimates in the taxation section of section 2.5, converting 1,293 acres from non-irrigated hay to irrigated alfalfa would result in a reduction in tax receipts of approximately $595.

## Socioeconomics

To the extent that the proposed projects increase the viability of agricultural operations in the area they may indirectly bolster the local economy and assist in retaining population in the area. Because the increase in production provided by the projects may be offset by declines in production by downstream operations, the net impact to the local economy of the proposed projects appears to be somewhat ambiguous. Impacts to population, employment, and income in the area are likely to be minimal.

Based on a consideration of the criteria found in DNRC Admin. Rule 36.2.524, "Determining the Significance of Impacts," there is not a significantly adverse impact. The discussion of the economic implications of the proposed projects described in this section suggests that impacts of the projects would be minor.