ATLANTIC RICHFIELD COMPANY'S

Comments on the

Phase II
Milltown Fisheries Protection,
Mitigation, and Enhancement Plan

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EXECUTIVE SUMMARY

This document provides comments on the Montana Power Company's August 9, 1993 Phase II Milltown Fisheries Protection, Mitigation, and Enhancement Plan ("MPC Plan") as well as the Appendices thereto.

These comments are offered with the intent that they be considered as a basis for improving the content and organization of the MPC Phase II Plan by focusing on some of the inconsistencies and deficiencies in the draft. The absence of comments on any section of the MPC Plan or the Appendices does not necessarily mean that the reviewers agree with the content of these sections.

The documents have a common deficiency in that they recognize the importance of the quantity and quality of trout habitat necessary for successful spawning and rearing of trout in tributaries to the Clark Fork River (CFR) and Blackfoot River (BFR), but fail to either recognize or acknowledge the trout habitat requirements of juvenile and adult trout in the mainstem of these rivers. The MPC Plan itself no longer contains any quantification of the Milltown Dam's impacts on trout populations, and therefore has no benchmark to use as a basis for the effectiveness evaluations. There is no indication that any efforts are directed at establishing the baseline trout habitat or population status in the tributaries selected for habitat enhancement in order to evaluate the effectiveness of any mitigation measures.

As used throughout these comments, the term "trout habitat" means all the physical structures and features of the aquatic environment in which trout reside throughout their life cycle. These habitat features include prominent physical characteristics such as water depth, water velocity, bottom features such as cobble, gravel, vegetation, undercut banks (instream cover), stream side over story and riparian cover, pool:riffle proportions, and sediment particle size distributions in spawning gravel. Other habitat characteristics that are less obvious but may also impact and limit trout populations include temperature, dissolved oxygen, pH, nutrient levels, and other water quality parameters. This definition is consistent with that offered by Orth (1983), who also distinguished general habitat from microhabitat, which is the localized area within a larger water body where a species is routinely found. The relationship between the physical habitat and trout abundance has been intensively studied, and measurements of habitat have been successfully used to forecast trout abundance (see Fausch et al., 1988, for comprehensive review). Yet none of these methods are used in the MPC Plan or appendices to estimate reductions in trout abundance due to dam operation or increases in trout abundance the PM&E projects might achieve. The MPC Plan ignores these refined methodologies altogether. Properly employed instream flow incremental methodologies (IFIM), trout cover rating (TCR) indices, and habitat quality indices (HQI) would provide estimates of trout population capacity that this draft of the Plan now lacks, and much more reliable estimates than those found in Appendix I of the Plan. It is no longer clear how or if the MPC Plan relies on the trout population estimates presented in Knudson (1992a).

Appendix I (Knudson (1992a)) contains a substantial number of technical problems in the computations and estimations of the trout populations expected to be present in the middle CFR in the absence of the effects of the continuing operation of the Milltown Dam. The document contains inherent and often unstated assumptions that indicate a propensity to simplify methods for predicting trout populations that are inconsistent with and contrary to the modeling methodologies of contemporary fish population science.

The Knudson 1992a report contains several estimations of potential CFR trout populations that are simplistic and unsupportable with the methodology used. The assumption that tributary recruitment (contribution of young trout to a river section) is the single factor governing the trout/mile numbers in Montana rivers is contrary to the generally accepted concepts that populations can also be limited at older life stages. This assumption leads to the conclusion that enhancement of tributary recruit production will increase the CFR trout populations, which in turn drives the MPC's plans for restoration activities. While this is a possibility, there is evidence that the tributaries that are candidates for enhancement are already productive. The author entirely ignores the strong probability that mainstem habitat limitations, such as high Summer temperatures, accompanied by low flows, have a stronger influence on trout per mile in the CFR. These factors are ignored entirely by the author until the end of his analysis where he offers that an assessment of available habitat would be a means of improving his projections.

SPECIFIC COMMENTS

A. **Phase II Milltown Fisheries Protection, Mitigation, and Enhancement Plan. MPC, August 9, 1993.**

STUDY AREA DESCRIPTION

Page 3, Para. 2, Line 7-8

1. Rainbow trout may be the most common trout species below Milltown Dam and for the first 20 miles above the reservoir (up to Rock Creek). Above the confluence of Rock Creek and the CFR the dominant trout species switches to brown trout up to and above the Warm Springs Creek confluence.

2 Page 3, Para. 3, Lines 1-3

The assertion that toxic materials alone prevented a trout fishery from inhabiting the (CFR) for "nearly a century" fails to consider many other significant factors, including:

- The simultaneous and continuous discharge of untreated municipal and industrial waste into several tributaries and the mainstem of the CFR during the same period.

- Non-point source discharges and releases of nutrients, sediments, and pollutants into the CFR from agricultural and other land use practices throughout the CFR drainage area.

- The effects of highway and railroad construction and operation in and adjacent to the CFR riparian zone, including channelization, sedimentation, and the placement of rip-rap along stream banks.

- The physical impact of fine sediment import and deposition into the gravel of the CFR, substantially reducing the spawning habitat quantity and quality for trout throughout the basin.

- The general reduction in the instream fisheries habitat quality associated with the removal of riparian overstory cover, and destabilization of stream banks attributable to unrestricted livestock grazing adjacent to tributaries and the mainstem of the CFR and BFR.

- Timber harvesting in the CFR and BFR basins contributing to destruction of the riparian zone, enhanced erosion and sediment deposition in both rivers and their tributaries.

- Placer mining sediment distribution and deposition throughout the CFR basin that preceded any releases of toxic materials from hardrock materials.

- The dewatering of tributaries and the upper CFR mainstem from irrigation withdrawals.

Because all of these factors affected the quantity and quality of habitat for trout in the CFR and BFR, selecting a single factor as the cause for trout absence in the CFR is both inaccurate and inappropriate.

3 Page 3, Para. 3, Line 5-end.

The assertion that the CFR brown trout populations ". . . throughout the upper river were relatively stable from 1970-88" was attributed to Johnson and Schmidt (1988). These authors, at page 2-28 (ibid), indicate that these populations ". . . . seem to have been relatively stable over the 1970-88 period with the exception of the Warm Springs area." [Emphasis added]. Available MDFWP population estimates for 1967-1988 varied 2 to 3 fold in range from year-to-year above Drummond, and 1.2 to 3.2 fold from Bearmouth to Turah. The term "relatively stable" apparently means numbers varying within a 200 to 300% range. Such variation means that estimates are accompanied with substantial uncertainty. Platts and Nelson (1988) have evaluated fluctuations in trout populations in 29 Rocky Mountain streams and found substantial uncertainties about means based on 3 to 11 years of data, and warn that errant management decisions can occur if data are insufficient. In view of these uncertainties, the MPC Plan has not established a "bench mark" from which the effectiveness of the proposed mitigation measures can be judged.

4. Page 3, Para. 4, Line 3 - end.

The statement that ". . . the fishery is considered to be far below the carrying capacity of the river." suggests that someone somewhere has defined what that carrying capacity is, and to what degree the existing circumstances demonstrate a sub-capacity in the river sections of interest. Neither of the citations (Knudson, 1992 or Johnson and Schmidt, 1988) contain any definitive or authoritative estimates of CFR carrying capacity in terms of trout/mile for the river sections of interest.

MPC cites Johnson and Schmidt (1988) as concluding that the major limiting factor of fish populations above Milltown was ". . . very limited use of available spawning habitat by adult fishes."(Emphasis added). In fact, Johnson and Schmidt (page 2-29, op. cit.) report that "[m]ost of the upper river seems unsuitable for trout reproduction due to siltation and other substrate deficiencies." This does not suggest that there is available spawning habitat going unused, and expanding a statement specifically applicable to trout to "adult fishes" is inappropriate.

5. Page 3, Para. 5, line All

The population estimates attributed cited to Knudson (1984) are not consistent with those found in the original MDFWP reports that were the basis for Knudson's estimates.

The estimates for some sections of the BFR of 2500 trout/mile are attributed to Peters (1981, 1985) in Knudson (1984). Substantially lower trout densities can be found in the Peters (1985) report for the Johnsrud section of the BFR. For other years Peters (1990) found trout density in the same section to be 1245/mile in 1989 and 1457/mile in 1985. Peters attributed the high populations in the Johnsrud section to the high production of young of year (y-o-y) in Gold Creek (BFR) and large year to year variation in the y-o-y estimates to possible flow limited spawning/rearing conditions in Gold Creek. This suggests that the production capacity of the creek is already saturated. Therefore, any migrants potentially reaching the creek from below the dam would not contribute additional recruits to the CFR mainstem trout populations unless spawning habitat were expanded.

In the CFR basin, Knudson (1984) is cited for population estimates of trout in Warm Springs Creek at levels approximating 1500/mile. Knudson (1984) cites Vashro (1983) as the source of these estimates. The actual numbers in the latter citation are 690 trout in 1977 and 1607 trout in 1982. These average 1149 trout/mile. In another section of Warm Springs Creek, for the same time period, trout averaged 594/mile. These numbers are substantially less than 1500/mile.

Therefore, the trout per mile presented in Knudson (1984) do not represent either the actual numbers presented by the original authors or the substantial year to year variability within any given stream section.

6. Page 4, Para. 2, lines 1-3.

Assuming that the reference to the "upper Clark Fork" means the CFR above Milltown Dam, see comment 2 above.

ASSESSMENT OF IMPACTS TO FISHERIES RESOURCES

7. Page 4, Para. 3, Lines 7-end.

While the impacts of the continued operation of the Milltown Dam are enumerated in terms of habitat losses and impaired or denied passage of trout to spawning and rearing areas upstream of the dam, it is also more likely that habitat, competition, predation, or other limitations exist in the CFR mainstem above, and perhaps below, the dam.

Habitat limitations in the mainstem CFR below Rock Creek are evident in several respects. Fine sediments dominate and have intruded into river gravel to the extent that, according to Young's results (Young, 1979), survival to emergence would be less than 25 percent for either brown or rainbow trout. Successful spawning in this section of the mainstem is also limited by the paucity of good quality gravel. The importance of trout cover in forecasting populations should not be ignored. Both instream and riparian cover is extremely low below Rock Creek when compared to other sections of the upper CFR where more is present. The significance of this lack of cover is illustrated by the fact that Wesche's trout cover rating (TCR) index accounted for 95 percent of the variation in biomass in four large Wyoming streams (Wesche 1980).

Temperature records at Clinton, MT, (below Rock Creek) indicate that Summer MWAT thresholds for rainbow, bull, and cutthroat are exceeded. In Appendix VI (page 35) it is concluded that temperature is the limiting habitat factor that would preclude utilization of the mainstem CFR by these species, while brown trout would find this temperature regime hospitable. This Appendix also points out that minimum winter temperatures are so cold they could cause over wintering mortalities and reduce survival to emergence for all trout species.

Competition among salmonids for limited microhabitat spaces is a well known factor governing species composition in cold water streams and rivers (Chapman 1966, Hearn 1987, Li et al. 1987, Larkin 1956). Brown trout are known to be aggressive (Nilsson (1963) and to displace rainbow trout if microhabitat or food supply attractive to both species is limiting (Lewis 1969). Therefore, the success of any rainbow trout enhancement may still be limited by the space occupied by the more aggressive brown trout competitor, much like the balance demonstrated by Allee (1981) for steelhead trout and coho salmon.

The importance of predation as a mechanism affecting salmonid population levels has also been demonstrated in tributaries and reservoir impoundments along the Columbia River (Jeppson and Platts 1959, Rieman et al., 1991). Fish comprises more than 90 percent of the food for squawfish greater than 12 inches in length (Jeppson and Platts (1969)) and following a squawfish eradication program these authors stated that the trout population index doubled. Knudson (1992b) described the abundance of large squawfish below the Milltown Dam, and EA found 136 squawfish/mile in the CFR above Rock Creek in 1991. Therefore, the presence of a voracious predator of small fish, including young trout, should be considered when evaluating the potential for trout populations to increase in the CFR above Milltown Dam.

All the above listed conditions are significant habitat factors or characteristics of the mainstem CFR above the dam that should be incorporated into the MPC Plan as reasons why mitigation and enhancement projects should focus on tributary spawning and rearing habitat improvements.

8. Page 4, Para. 4, lines 3-6.

The MPC plan does not provide any quantitative estimates of the Milltown Dam's impacts on the fisheries resource.

Methods that are effective in estimating the potential trout population levels in a stream depend on the quantification of available habitat through precise measurements of the habitat parameters of depth, velocity, instream substrate (cover), riparian zone cover, and density independent variables including: temperature, dissolved oxygen, nutrients, and potential toxicants. Once these data are obtained, applicable and well defined models can be employed to establish the quantity of suitable habitat available for trout. These models may include physical habitat simulation and habitat suitability indices (HSI) as part of the instream flow incremental methodology, and indices such as the trout cover rating index (TCR) or habitat quality index (HQI) to forecast trout biomass or factors affecting numbers for a stream section. All of these approaches and an assessment of their effectiveness are found in Fausch, et al (1988), and should be considered as a means to generate an estimate of impacts on the trout populations associated with the continuing operation of Milltown Dam.

9. Page 4, Para. 5, All.

The Plan is deficient in describing its selection process for enhancement projects for tributaries to the CFR above Milltown Dam.

Implicit in the two projects chosen on the CFR is a recognition that recruitment for the mainstem of the CFR is tributary dependent, and that projects even 52 miles upstream of the dam will increase mainstem trout abundance. Figure 1 of the Plan shows that there are four tributaries entering the identified impact section of the CFR, yet no rational explanation is given for excluding enhancement projects on those creeks. Additionally, there is no indication that the Plan or the Milltown TAC considered a larger number of projects or that they selected the two CFR projects (Appendix II and III) on the basis of any criteria whatsoever. If these two projects were selected from a larger set of projects, then the full array of potential projects should be reported so that commenters will have the opportunity to review others to compare the potential benefits of each. Apparently, no consideration of candidate enhancement projects was made for the CFR impact area below the dam, even though it includes many more tributaries in its much greater (39.3 mile) length.

10. Page 5, Para. 1, All

The Plan is deficient in describing the selection process for enhancement projects for tributaries to the BFR.

The only reason given for the selection of the three PM&E projects on tributaries to the BFR is that they are within the impact area of Milltown Dam. The same criterion was not used for the selection of the CFR projects, and no estimates of the benefits to trout populations in the impact area are found anywhere in the Plan.

11. Page 5 Para. 2, Lines 7-11.

The listing of the protection, mitigation and enhancement features of the proposed projects does not include the benefits to the fishery of reducing or eliminating organic wastes and nutrients from entering the tributaries. There is no clear statement of what these proposed projects are intended to accomplish. For instance, stream bank stabilization and fencing the riparian zone are presumably intended to diminish negative effects of cover reduction, sediment erosion and intrusion into potential spawning and rearing areas. Stating and better quantifying these benefits to tributary trout populations would enhance the Plan.

No mention is made of the intent to establish a baseline for trout population levels and species composition in the tributary pre-project sections that would be modified by the projects. This would seem essential as a first step if a basis for demonstrating the effectiveness of the projects is to be established by the monitoring efforts.

12. Page 5, Para. 2, Line 15-19.

MPC's commitment to fund a fixed number of projects for a fixed annual budget may or may not adequately protect or enhance trout populations in the upper CFR and BFR sufficiently to mitigate the effects of the ongoing operations of Milltown Dam. Even with adequate evaluation techniques to demonstrate the effectiveness of the proposed projects, the sufficiency of any achieved population increase can not be compared to a goal that is not quantified. In the absence of a quantitative evaluation of the reduction in CFR and BFR trout populations attributable to the continuing operation of Milltown Dam, there is no foundation established that the projects are sufficient mitigation for current impacts.

PROPOSED PM&E MEASURES FOR FISHERIES RESOURCES

13. Pages 5-8.

This section of the MPC Plan describes various methods and projects intended to increase the mainstem trout populations in the CFR above and below Milltown Dam that primarily focus on improvements to spawning and rearing areas in various tributaries. This is at least clear recognition that the CFR is tributary dependent. However there are conditions in the mainstem which the author recognizes could also control trout populations, including high summer temperatures, cover, predation, and quality of the substitute.

OPERATIONAL

14. Page 6, Para. 2, Lines 6-11.

Management of the drawdown procedures are discussed as a PM&E measure to apparently control associated increases in downstream turbidity. The terms "significant" and "acceptable level" are used in the context of defining turbidity changes occurring during drawdown, but these terms are not defined. It is not known if a 5% or 50% or higher change is considered "significant," and what a change in turbidity means with respect to dam operation impacts in downstream areas of the CFR.

NONOPERATIONAL

15. Page 6, Para. 4, Lines 1-3.

The TAC's stated goal is to increase CFR and BFR trout populations in the impact area, presumably, through their guidance of project selection and implementation within the scope of the MPC PM&E Plan. In view of this goal, it is inconsistent for TAC to recommend projects outside the area of impact in the CFR above the dam. This inconsistency should be addressed in the Plan. Moreover, there is no definition of how much of an increase is sought or how much of an increase is adequate meet the level of mitigation intended in the FERC order. This seems to be a continuing deficiency of the Plan that should be addressed.

16. Page 6, Para. 5, All.

The application of funds to facilitate the recovery of bull and cutthroat trout may not be effective in the CFR above the dam because of the Summer mainstem water temperature increases associated with irrigation dewatering of the system. Plan Appendix VI points out (page 35) that bull trout thermal tolerance levels are exceeded above and below the dam to the extent that migrations and rearing activities would be "severely limited".

B. Appendix I - (Knudson, 1992)

SUMMARY OF COMMENTS

In general, a critical review of this report concludes that Knudson's projections of trout densities in the middle CFR were Milltown Dam not present are of limited value. This report contains a variety of factual, logical, and statistical errors that are detailed below. In addition, little supporting evidence is presented or cited which allows evaluation of the author's methods for projecting trout densities in the middle CFR. Review of other literature (e.g. Fausch et. al 1988) suggest that the methods used by the author are relatively simplistic and lack validation from other studies. While the presence of Milltown Dam obstructs fish passage and thus may reduce trout densities, the author fails to recognize any other factors that might explain his observations (e.g. habitat availability for specific life stages, sampling bias), nor does he recognize the limitations imposed by small data sets that do not take into account the inherent spatial and temporal variability present in nature. Also, the author does not consider the multiplicity of physical, biological, and behavioral factors which interact to produce the abundance and distribution of trouts and their population structure because the his methodology ignores many of them.

Specific Comments

1. Page 1, Insert Table:

The average number of trout reported for the Milltown section disagrees with the numbers in Appendix Figure 2. The average number from the data in the figure is 368 trout per mile rather than 441 trout per mile as stated in the table.

2. Page 1, Para. 2, Line 4 to End of Paragraph:

By reporting only the average number of trout per mile for a variety of Montana river sections, the author ignores year to year variation in trout density that may be substantial. The trout densities reported do not reflect any temporal and spatial variability which may exist within the Montana rivers and CFR tributaries cited. No citations are presented which show the origin of the densities reported, consequently they are difficult to verify. However, published reports indicate substantial variability does occur at some locations. For example, Vincent (1987) presented trout densities in the Varney section of the Madison river which are significantly lower than the 4466/mi density presented in the Knudson report. The data in the Vincent paper indicates the density of brown and rainbow trout (all ages) during the years 1974 to 1976 ranged from 2910 to 3831 fish per mile with an average of 3275 fish per mile. The density of fish in the BFR which the author reports (1066 trout per mile) is inconsistent with the density he reported in Knudson (1984) of 2364 and 2670 trout per mile and is it consistent with the number presented in Table 2 of this report (960 trout per mile). Peters (1990) reported that the Scotty Brown section of the BFR contained 324 trout per mile during 1989. The degree to which CFR trout population densities may be above or below "typical" Montana trout densities is highly dependent upon the location, time of year, and number of years surveys are conducted.

3. P. 2, Para. 4, Line 5 continuing to P. 6, Par. 1, Line 3:

The statement made that "fish habitat... conditions in the middle Clark Fork appear adequate enough to support more trout than are present." is subjective. No data are presented that quantify habitat in the middle CFR or demonstrate that it exceeds the needs of trout at current densities.

Extensive studies in the upper CFR provide evidence that mainstem habitat limits the abundance of adult (2 yr+) brown trout. The pertinent results include the following:

1. A significant correlation exists between the quantity and quality of instream cover and independently measured reach trout populations.

2. Areas of the river substantially affected by irrigation withdrawals, elevated summer temperatures, and low dissolved oxygen daily minima also correspond to areas of decline in trout populations.

3. The absence of sympatric brown and rainbow trout populations reflect a lack of good rainbow trout habitat above the confluence of Rock Creek with the CFR. Additionally, rainbow trout would avoid the high summer temperatures which Chapman observed in the mainstem near Rock Creek. Finally, because recruitment in the mainstem CFR is tributary dependant, one must look at dominant trout species in each of the tributaries, which, above Rock Creek, contain predominantly brown trout.

4. Supplies of invertebrate food in the drift is in excess of the metabolic demand and growth requirements of the existing trout populations, indicating physical habitat saturation by brown trout juveniles and adults. (These river sections also support ample biomass of other fish species.)

4. P. 6, Para 1, Line 1 to Line 6:

It is stated that recruitment for other Montana rivers is tributary dependent. The unstated assumption is that the CFR is equally dependent on tributaries. No substantiating evidence is given for this assumption although it is clear that tributaries are likely responsible for some unknown proportion of mainstem recruitment. Limited evidence from the upper CFR supports the contention that at least some brown trout emigrate from tributaries and rear within the mainstem CFR, but it is unclear what proportion of the mainstem population is derived from the tributaries. The recapture history of tagged brown trout captured near the time of spawning during November 1990 within major tributaries of the upper CFR which drain into mainstem sections has been examined. The data indicated that 44 of 109 adult brown trout (40 percent) with multiple recaptures had spent some time rearing in the mainstem; that is, at least one other recapture was from the mainstem. If the mainstem CFR is, in fact, nearly 100 percent dependent upon recruitment from its tributaries, the implication is that it can not reach its carrying capacity until tributary production of recruits is maximized. Such a corollary ignores mainstem habitat features that may limit numbers of fish living in mainstem sections such as temperature, flow, dissolved oxygen, channelization and other anthropogenic influences.

5. P. 6, Para. 1, Line 6; Table 1 and Table 2:

The methods used by the author to represent the length frequency (i.e. age structure) of the various trout populations contain a variety of inherent biases that should be considered and recognized in the analysis.

The possible sources of these biases include, but may not be limited to:

- selective location of electroshocking stations away from shallower river sections preferred by smaller trout,

- size selective efficiency of electroshocking equipment preferentially attracting larger fish,

- the efficiency and objectives of the collectors on larger specimens in one study and juveniles in another,

- interference by non-target species, obscuring smaller trout from the collector vision, and

- differences in the turbidity of waters in different river sections.

The length frequencies presented may, or may not, accurately reflect the actual age structure within the streams. Apparently, the length frequencies presented in this report were constructed from estimated fish numbers within a size class rather than from a random sample taken from the fish population. These two methods could provide very different length frequencies representing the age structure of the same population.

An additional problem is the negative bias (underestimate) present when low numbers (less than 4) of marked fish are recaptured in a mark-recapture abundance estimate survey. According to the one table in the appendix for which complete data are available (Appendix A, Milltown section, 1991), two age classes contained fewer than 4 recaptures and one contained none. Consequently, these age classes may be under-represented in the assessment of the age structure. Such underestimates of fish in smaller size classes may be a product of the inefficiencies above. Despite the negative sampling bias for small fish, the author's general conclusion that the middle CFR has low recruitment levels is likely correct, at least qualitatively. However, to confer any quantitative accuracy to projections based upon biased data (lacking any statistical corrections) is inappropriate.

An additional concern is the use of different sampling years in the comparisons. Population age structures are not static and often change from year to year. Regional climatic conditions such as a severe winter may affect recruitment into a specific age class during one year and not another. In general, the best practice is to compare different populations during the same year, or years, and compare changes in structure for a single location across years. Comparing different locations across different years confounds the analysis.

6. P. 8, Line 1 to end:

It is unclear whether or not the author is referring to "The **significantly** smaller relative abundance of trout..." in a statistical sense. The word "significant" has a precise statistical meaning in scientific writing and should be used with caution when presenting information in a scientific forum. If it is being used in the statistical sense, the statistical test used, result, and confidence level should be reported, otherwise the statement should be identified as a subjective observation.

7. P. 8, Para. 2, Line 2:

Same comment as Comment 6. In addition, no criteria are given to identify the characteristics of a "significant spawning run." The author states that logging and channelization of the St. Regis River had eliminated trout recruitment to the CFR section but does not recognize any other factors limiting mainstem population levels. Likewise, the author should recognize the profound impact these same activities have had on mainstem populations in the upper CFR where channelization has resulted in the loss of many miles of river length, and logging has destroyed riparian habitat and increased sedimentation.

8. P. 9, Paragraph 1, Line 4 to Line 5:

The author seems willing to admit that a single trout estimate may not represent the densities present over an entire river or stream length. It is stated that the BFR supports "a decent trout fishery -- at least in its lower reaches." Given the apparent recognition that spatial variability is present in trout abundance, it is curious that a single number is often used to represent an entire river during the subsequent analysis.

9. Page 9, Para. 3 to end of Page 11, Para. 1:

In the comparison of age structures presented for the BFR and Milltown section of the middle CFR, no consideration is given for factors other than the Milltown Dam and Reservoir that may be acting on the two populations. These differences are one possible factor in the relative amount of juvenile and adult rearing habitat. The author indicates that the annual flow from the BFR is about one-half the flow of the mainstem below the Milltown Dam. While this fact, in and of itself, does not prove the relative availability of rearing habitat for adult and juvenile life stages is different in the two reaches, it does suggest (as the author indicates) that the reaches are of different size and that the possibility of different habitat structure requires investigation.

10. Page 10, Table 2:

The age structure methodology used by Knudson may lead to false conclusions when comparisons are across years, seasons, and between rivers. In some cases the data used are mislabeled. For example, Table 2 states that the BFR data is based upon fall surveys, whereas the appendix tables indicate the BFR surveys occurred during the spring. In addition, comparison of the proportion of fish greater or less than 13 inches (essentially adults vs. juveniles) between the Milltown section of the middle CFR (Table 2) and the Cascade section of the Missouri River (Table 1) suggests no difference — 22% of the population is greater than 13 inches while 78% is less than 13 inches. This similarity may suggest that the observed differences in age structure reflect temporal variability in recruitment strength among the sites rather than a chronic recruitment problem in the middle CFR.

The author also ignores rainbow trout biomass in his analysis of length frequency, which suggests that the BFR and middle CFR have similar rainbow trout productivity. Based upon the appendix tables (Appendix A), the Johnsrud section of the BFR had a mean rainbow trout biomass of 258.7 lbs per mile during the spring of the years 1989 to 1991. Similarly, the Milltown section of the middle CFR had a mean biomass of 248.0 lbs/mi during fall 1988 and 1991 if the average fish weight is assumed to be similar for both years (no biomass estimates are available for the 1991 data set). The similarity in rainbow trout biomass between the two sections is an indication that trout productivity is also similar, and possibly near carrying capacity; increases in the number of recruits within the middle CFR may lead to a restructuring of the population without an increase in trout biomass. That is, more smaller fish may be realized at the expense of larger fish.

11. P. 11, Para. 1, Line 6 to end:

The author is making an unsubstantiated assumption about fish movements and resulting mortality rates. The author concludes from length frequency comparisons between the BFR and the Milltown section that small rainbow trout emigrating from the BFR incur high mortality rates while passing through the Milltown Reservoir and Dam complex.

The author falsely believes that juvenile rainbow trout have an inherent downstream emigration behavior which would lead them to disperse into the middle CFR regardless of conditions in their natal tributary. His statement "....that small rainbow trout trying to emigrate from the lower Blackfoot River and Rock Creek to the Milltown section...." implies that emigration from tributaries is an innate behavior pattern. Studies of intra- and inter-specific competition (Allee 1981, Chapman 1962, and others) suggest that emigration by juvenile salmonids is often the result of competition for a limited resource such as food or space, both of which related to the quantity and quality of habitat. Allee (1981) examined interactions between coho salmon (Oncorhynchus kisutch) and steelhead trout (the anadromous form of rainbow trout) within an experimental stream, and utilized emigration as one measure of these interactions. He reasoned that "the final population within the habitat types of the stream system was a manifestation of habitat preference of each species and a balance between space available and abundance of available food." Similarly, Chapman (1962) suggests that intraspecific competition between coho salmon lead to downstream movements of subdominant fish. These studies suggest that emigration of juvenile salmonids occurs when the carrying capacity of a stream section is exceeded, not because it is an innate behavior pattern.

12. P. 11, Para. 2, Line 7 3 to end:

The author has provided relatively little empirical data that validate the three assumptions upon which the subsequent analysis is based. The author provides three assumptions upon which his analysis is based, but provides some qualitative, and no quantitative, support for only two of these assumptions. The first assumption states "that the water quality and watershed conditions of Rock Creek and the BFR are at least as good as those in the tributary basins that presently support the middle CFR trout fishery." Descriptions of historical land use on middle CFR tributaries, Rock Creek, and the BFR are provided on Pages 8 (paragraph 1) to 9 (paragraph 1). However, no empirical data on water or habitat quality is given or cited to allow the reader to evaluate the assumption.

The author fails to recognize that streams of equal discharge may not have equivalent habitat characteristics. Assumption two states "that the average annual discharge of streams can be used to compare their relative sizes, and therefore, their potential capacity to support spawning and recruitment for a mainstem trout fishery." Annual discharge is not always an adequate indication of stream size because three factors primarily determine discharge: gradient, channel roughness, and cross-sectional area; a pipe and a stream may both have the same discharge, but it is unlikely they will support the same trout population, likewise two streams of dissimilar gradient and discharge may have similar cross-sectional areas. Appropriate habitat quality is just as important as quantity in determining the potential trout production of a stream. Two streams with large amounts of poor quality spawning gravel may not have a higher potential to produce recruits than one stream with a much smaller amount of high quality spawning gravel. In addition, an unstated corollary assumption is that spawning and rearing habitat within the tributaries is currently under utilized by the current trout populations. No evidence is presented which indicates whether or not these tributaries are at, or below, their carrying capacities for these life stages.

Assumption three states "that river trout would migrate to Rock Creek and the Blackfoot River if these streams were available for spawning." The author provides some data that at least one tagged fish migrated over 80 miles to spawn in a tributary; however it is unclear to what extent this spawning migration distance is typical, and what proportion of the fish move this or a lesser distance. Some evidence is available from tag recapture data (Peters 1990) that trout movements are often relatively short. Data from the BFR (Peters 1990) indicated that for all species of trout 67 of 73 (91 percent) recapture demonstrated movements of less than two miles, 3 (4 percent) had movements of two to five miles, and only 3 (4 percent) had movements of more than 10 miles, and one bull trout moving 52 miles. Brown trout movement in the CFR during spring and fall 1989 was also examined from tag recaptures and indicated short movements were typical. Of 184 recaptured fish 130 (71 percent) showed no movement from the section in which they were initially captured, and of the 54 fish (29 percent) that showed movement, the mean distance moved was 3.9 miles with a maximum of 29.5 miles. Given the fact that immature fish must move the distance covered during a spawning migration (assuming a fish is homing), the evidence suggests that while some fish may migrate large distances, the vast majority of tagged trout move relatively short distances. However, it is unclear to what extent small, untagged fish may migrate.

Salmon and trout are known for their "homing" abilities; that is, they return to their natal stream to spawn in preference to other spawning locations. Straying rates for anadromous salmonids are typically very low, under 10% (Satterthwaite 1988; Quinn and Fresh 1984). Consequently, any increased use of Rock Creek or the BFR for spawning would have to await increased emigration or increased survival of emigrants from these tributaries to adulthood.

13. Page 13, Paragraph 2:

Contemporary fish population modeling includes many variables in addition to flows for estimating trout populations. None rely exclusively on annual discharge alone. The model utilized by the author to project mainstem productivity is simplistic, and lacks supporting empirical data from the author or other cited literature. Flows during a portion of the year have been cited by a variety of authors as an important factor correlated to trout standing stock. Of 85 models reviewed by Fausch et al. (1988), 14 had some measure of seasonal flow as a significant independent variable, and eight were univariate models. All flow related models reviewed were built for salmonid stocks, but were often for only one age group. None used annual flow as a variable, but they typically limit the flow variable to mean flow during summer months, winter months, the period surrounding peak flows, or the period surrounding the abundance estimate. Use of a direct proportional relationship between flow and fish density without a thorough statistical analysis can lead to erroneous conclusions. Indeed, a simple cursory inspection of a graph depicting fish density and annual flow presented by Knudson (1992b, Figure 1, page 4) for rivers in Montana suggests that no apparent relationship exists. Data from small tributary streams within the middle and upper CFR basin (Thomas and Workman 1986) also suggest a poor relationship between trout density and flow (Figure 2). Given the relatively poor empirical support for the linear proportionality model used by the author, it seems unrealistic to expect that the conclusions have any accuracy except by chance.

14. Page 14:

As an alternative method to estimate potential CFR populations, the author "transfers" the age structure observed on the Missouri River at Cascade to the CFR populations. The report states: "If recruitment of small trout was not a problem in the middle CFR, the size distribution of the trout population at Huson/Superior should be similar to that on the Missouri at Cascade." In contrast, there are at least two possible alternative hypotheses which could explain the size distribution: 1) that the availability of habitat for small trout limits their abundance; and 2) that the observed size distribution in the CFR reflects sampling bias. No evidence is available to distinguish among these possible hypotheses.

15. Page 15, Para. 1, Line 1 to Line 6:

The author candidly admits that additional habitat characteristics data are needed to make refined estimates of population levels. Therefore the author acknowledges that the available data is limited for constructing a quantitative and accurate predictive model. The report states: "More refined quantification of the increase in spawning and recruitment provided by Rock Creek and the BFR and the resulting population increases in the CFR could be obtained by calculating the actual miles and/or surface area of stream bottom suitable for spawning and rearing on all present versus potential tributaries." This statement tacitly recognizes that the predictive models presented are simplistic and of limited value.

C. **Appendices II and III - (Dutton, 1992a and Dutton, 1992b)**

These appendices contain descriptions of projects that may be undertaken on tributaries to the upper CFR. They each describe modifications to streamside ranch lands, irrigation canals, and structures that are intended to enhance the spawning and rearing capacity of the respective tributary sections. Neither these appendices nor the MPC Plan contain any explicit descriptions of:

1. how long or large is the section benefiting from the project,

2. what proportion or percentage increase in high quality habitat in the respective tributaries is expected to result from the projects,

3. why only stream-side renovations, in one case, are expected to result in instream habitat improvement.

4. when and where the benefits of these habitat improvement would be manifest in greater trout numbers.

5. how large such an increase would be, and

6. what species would benefit from these projects.

Moreover, neither in these appendices nor in the MPC Plan is any rationale given for the choice of these streams over similar projects on the four creeks entering the CFR between Rock Creek and the dam. Both the Weaver Ranch and Thomas Ranch Projects call for substantial expenditures for equipment and structures that do not directly benefit habitat enhancement. Were projects with more direct habitat improvement such as streamside fencing, etc., considered in a cost-benefit analysis?

D. Appendix IV - (Mabbott, 1992)

The MPC Plan would benefit from an explicit portrayal of the timeline for the various projects and project stages found in the spread sheets in this appendix. Many of the terms used in the project column are self-explanatory, but the description of what is entailed in the "Fishery Assessment" phase of several of the projects would help the reader evaluate the adequacy of the planned work. Does the term mean that there will be a pre-project monitoring effort to establish a basis of comparison with post-project changes in trout populations? If so, where and how will sampling be done to assure that trout populations increase in the Milltown Dam impact area?

E. Appendix V - (Pierce, 1992)

This appendix represents a structures appraisal of habitat degradation and categorized habitat improvement measures that could be taken to reduce the effect or sources of various impacts on tributary streams to the BFR. The MPC Plan would benefit from a similar appraisal of impacts to the tributaries to the upper CFR. Such a parallel effort would enhance the ability of MPC to determine the relative efficacy of expenditures for projects on several of the more than thirty perennial streams entering the upper CFR.

F. **Appendix VI - (Chapman, 1993).**

It is evident that there are several inconsistencies between the conclusions in the Chapman report and the content of the MPC Plan. The direction the Plan has taken seem to be contrary to the Feasibility Study in at least the following respects:

1. The Plan intends to construct an experimental fish capture facility to promote fish passage at the dam, whereas the Chapman report concludes that there is no basis to substantiate the belief that upstream tributaries are presently underseeded, and that there are credible arguments suggesting thermal blockage to migration of bull trout, and competition and predation constraints on the potential success of both upstream and downstream migrants.

2. The Plan intends to proceed with the enhancement of habitat in CFR and BFR tributaries whereas the Chapman report suggests that over harvest of adults and temperature limitations may preclude any realization of increased mainstem trout abundance from these efforts. In addition, there are a host of other habitat constraints, which if unremedied, could limit mainstem population increases, such as dewatering, high summer temperatures, low dissolved oxygen and other habitat constraints.

3. The Chapman report makes 7 recommendations for studies related to delineation of limiting factors and trout movements below the dam whereas the MPC Plan focuses all its attention on habitat enhancement in tributaries above the dam.

4. The Chapman report makes a strong case that low winter and high summer temperatures in the upper CFR are limiting factors for bull, cutthroat and rainbow trout in the mainstem. Additional studies have shown these temperature increases to be a direct response to irrigation withdrawals of water from the upper CFR and its tributaries. The MPC Plan does not emphasize the reduction of irrigation withdrawals as a means to achieve the TAC stated goal TAC to increase the trout populations in the impact areas of the CFR and BFR mainstem section identified in the Plan.

It is suggested that the Phase II PM&E Plan be modified to reconcile these inconsistencies.

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