UPPER GRANDE RONDE RIVER SUB-BASIN

TOTAL MAXIMUM DAILY LOAD (TMDL)
& WATER QUALITY MANAGEMENT PLAN (WQMP)

Response to Public Comment

Prepared by:
Oregon Department of Environmental Quality
April, 2000

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Introduction

This Response to Public Comment is to address comments received on the Draft Upper Grande Ronde River Sub-Basin TMDL and WQMP. Many of the comments received from different individuals or organizations overlap. This responsiveness summary document attempts to combine similar comments and provide a single response where appropriate. Grammatical, editorial, and formatting errors are not addressed here but corrections are made in the documents. In addition to comments, many specific questions were raised. These are addressed separately at the end of the summary document to the extent possible. DEQ appreciates the time and effort that all the commentors put into reviewing the documents. All comments have been considered by DEQ and, where appropriate, have been addressed in the final documents that will be submitted to the Environmental Protection Agency along with a copy of this responsiveness summary. EPA will then either approve or disapprove the TMDL.

Background

The public comment period on the proposed submittal of the Upper Grande Ronde River Sub-Basin Total Maximum Daily Load (TMDL) & Water Quality Management Plan (WQMP) opened on December 10, 1999. Prior to the opening of the comment period DEQ received a request from the Oregon Cattlemen's Association (OCA) to extent the comment period beyond the normal 30-day period. In response, DEQ initially set the close of comments for February 16, 2000 (for a 63-day comment period). On January 3, 2000 DEQ received a request from the OCA for an additional extension of the comment period. In response, DEQ extended the comment period to March 3, 2000 (for a total of a 79-day comment period). A public information open house was held at the Agriculture Service Center in Island City on January 13, 2000. A formal public hearing was held at the Agriculture Service Center in Island City on February 2, 2000. The comment period was closed one month later on March 3, 2000. The majority of comments received by DEQ were submitted in written or electronic mailed form.

The TMDL document, appendices, and WQMP document were available for downloading from DEQ's web site throughout the comment period. Hard copies of the

documents were also available for viewing at all public libraries in Union County, at the Union soil and Water Conservation District office, at the Grande Ronde Model Watershed Program office, and at DEQ's Offices in La Grande, Pendleton, and Portland. Copies of the documents were also provided to those individuals who requested individual copies.

List of Commentors

Comment #	Code	Comments Received From	Date Received	Media
01	DC	Dale Counsell	2-2-00 hearing	Oral
02	BH	Bill Howell	2-2-00 hearing	Oral
03	NMFS	National Marine Fisheries Service	2-9-00 HQ	Mail
04	RC	Rodney Case	2-9-00 ERP	Mail
05	ODA	Oregon Department of Agriculture	2-16-00 LaGrande	Fax
06	PRC	Pacific Rivers Council	2-18-00 ERP	Mail
07	A&P	Anderson Perry & Associates, inc.	2-23-00 ERP	Mail
08	PH	John P. (Phil) Hassinger	2-24-00 ERP	Mail
09	Imbler	City of Imbler	2-28-00 ERP	Mail
10	LF	Loren Fleet	2-28-00 ERP	Mail
11	LaGrande	City of La Grande	2-28-00 ERP	Mail
12	LI	Lee Insko	2-29-00 ERP	Mail
13	PL	Patricia Larson/Union County Cattlemen	3-1-00 ERP	Mail & oral
14	LL	Larry Larson	3-1-00 ERP	Mail
15	Weyer	Weyerhaeuser Company	3-2-00 ERP	E Mail
16	SL	Dr. Shane L. Larson	3-2-00 ERP	Mail
17	BJ	J.T. (Bud) Jones	3-2-00 ERP	Mail
18	USFW	US Fish & Wildlife Service	3-2-00 ERP	Mail
19	SB	Sharon & Bob Beck	3-2-00 ERP	Mail & oral
20	OCA	Oregon Cattlemen's Association	3-2-00 ERP	Mail
21	OFB	Oregon Farm Bureau	3-3-00 ERP	Fax
22	OFIC	Oregon Forest Industries Council	3-3-00 ERP	Email & oral
23	SH	S. Hawkins, Inc.	3-3-00 ERP	Mail
24	HCPC	Hells Canyon Preservation Council	3-3-00 ERP	Mail
25	Union	City of Union	3-3-00 ERP	Mail
26	NC	Norman J. Cimon	3-3-00 ERP	Mail
27	BCC	Boise Cascade Corporation	3-3-00 LaGrande	Hand
28	NFA	Northwest Forest Association	3-3-00 ERP	Email & oral
29	BB	Barton G. Barlow	3-3-00 LaGrande	Hand & oral
30	EPA	USEPA	3-3-00 ERP	Fax
31	CTUIR	CTUIR	3-3-00 ERP	Fax
32	NPP	Northwest Pulp & Paper	3-3-00 ERP	Fax
33	USFS	US Forest Service	3-3-00 ERP	E Mail
34	ODFW	ODFW	3-3-00 ERP	E Mail
35	NEDC	Northwest Environmental Defense Center	3-6-00 WQ/HQ	Hand
36	OSU	Oregon State University	3-6-00 ERP	Mail
37	AEF	Arlie E. Fisk	3-14-00 ERP	Mail

General

The Draft Upper Grande Ronde River TMDL and WQMP reviewed during the public comment period represented several years of data collection, data analysis, public participation, and document development. This included over 25 meetings of DEQ's Grande Ronde Water Quality Committee. All of this work led to the release of a draft TMDL and WQMP for the Upper Grande Ronde River Sub-Basin for public review and comment. The years of work and investment of time by numerous individuals is very much appreciated by DEQ and led to the best document DEQ could put forward for public review and comment. The numerous comments received are thoughtful and led to changes that improved the TMDL and WQMP and will undoubtedly lead to clear implementation of the TMDL and ultimate attainment of water quality standards.

A sub-basin scale TMDL and WQMP like the Upper Grande Ronde presents numerous challenges. Different land management and ownership, a mixture of point sources and non-point sources, several different parameters of concern, numerous beneficial uses of water, endangered species, changing landscape and land use, and layers of local, state and federal authorities all create confusion and concern when attempting to resolve serious water quality issues.

The range of comments DEQ received from local, state and federal agencies, environmental interests, industrial organizations, stakeholder organizations, researchers, and individuals reflect the interest in this TMDL and WQMP. Often the comments are competing and represent different views of the Clean Water Act, State authority, the strength of the scientific knowledge, and the ability of designated management agencies to implement the TMDL. All in all the comments resulted in improvement of the TMDL and WQMP.

Prior to responding to specific comments, DEQ needs to make a few general statements:

- Water quality in the Upper Grande Ronde Sub-Basin is seriously impaired. There is no question that water quality standards are being violated and beneficial uses are being compromised. The TMDL and WQMP are the avenues and tools to start on a path of improving water quality – a requirement of the Clean Water Act and Oregon Law and, more importantly, a necessity if we are to protect this valuable resource and save imperiled salmon species.

  The science used to develop the TMDL is well established and supported in the scientific literature. As with any analysis, there is some uncertainty. As time goes on, we will continue to understand this uncertainty and be able to address it. Everyone participating in the development of the TMDL and WQMP and providing comments helped in providing more certainty on the outcome of implementing actions to address the allocations in the TMDL. While more data collection and analysis prior to finalizing the TMDL and WQMP might shed additional light on some of the issues, in DEQ's opinion it would not significantly alter the conclusions and would only delay implementation of needed improvement in the sub-basin.

- On the ground management activities need to change if we are to meet the goals of the Clean Water Act and water quality standards in the Upper Grande Ronde Sub-Basin. This affects forest, agriculture, urban and rural residential land uses. This causes tremendous concern for those that live on and use the land in the Upper Grande Ronde Sub-Basin especially those on or near surface water bodies. DEQ recognizes that change is difficult and expects the TMDL and WQMP will function as a tool that provides a foundation for reasonable and logical approaches to this change.

- Local, state and federal agencies responsible for implementing allocations in the TMDL need to be able to adjust their programs and implementing mechanisms over time. That is why DEQ is using an adaptive management approach for this TMDL. We recognize there needs to be a mechanism for changing the TMDL and WQMP as we learn more while at the same time moving forward with implementing measures that will lead us down the path of improving water quality. We have expanded the adaptive management language in the TMDL and WQMP to make it clear that there is a mechanism for change and periodic review of the TMDL and WQMP.

- Much concern has been raised regarding how site potential vegetation will be applied on the ground and whether it means there cannot be any human activity within riparian areas. DEQ's analytical approach demonstrates the importance of shade in controlling warming water temperatures. DEQ recognizes that active management within riparian areas will continue. DEQ is not advocating unmanaged vegetation growth in riparian areas and understands that non-management may result in the establishment of certain climax conditions that promote invasive species, create opportunities for disease, and may encourage unwanted fire. Riparian management, however, must also target the production of healthy, long-term riparian vegetation consistent (as much as practicable) with the site potential effective shade.

TMDL

Comment - Several comments suggested the TMDL and WQMP is difficult to read and understand and therefore needs to be resubmitted in summary form.

Response – DEQ recognizes the complexity of some of the water quality issues being addressed in the TMDL and WQMP. This becomes even more complex when addressing TMDLs on a sub-basin scale such as this TMDL and WQMP and including years of data in the analysis. The TMDL document itself is a summary of all the data and data analysis used for the development of the load allocations and surrogates for the Upper Grande Ronde sub-basin. Additional detail on the data analysis is provided in Appendices A and B. Many graphs, maps and tables have been used in the TMDL. These are an effective and common way of summarizing and presenting information and data. They are a necessary tool to assist the public with interpreting and understanding complex data sets and are commonly used by both the technical and popular media. We disagree that

rewriting the TMDL will be productive. In fact, most of the commenters, including many of those concerned about its readability, provided detailed comments suggesting their understanding of the document.

Comment - Several comments stated the 64 degree water quality standard is not attainable, therefore a Use Attainability Analysis should be done.

Response - It is important to understand the State of Oregon's temperature standard and that there is more to it than just a 64 degree standard. Specifically for the Upper Grande Ronde Sub-Basin OAR states at 340-041-0725:

> *(A) To accomplish the goals identified in OAR 340-041-0120(11), unless specifically allowed under a Department-approved surface water temperature management plan as required under OAR 340-041-0026(3)(a)(D)* ***, no measurable surface water temperature increase resulting from anthropogenic activities is allowed:***
> *(i) In a basin for which salmonid fish rearing is a designated beneficial use, and in which surface water temperatures exceed 64.0°F (17.8°C);*
> *(ii) In waters and periods of the year determined by the Department to support native salmonid spawning, egg incubation, and fry emergence from the egg and from the gravels in a basin which exceeds 55.0°F (12.8°C);*
> *(iii) In waters determined by the Department to support or to be necessary to maintain the viability of native Oregon bull trout, when surface water temperatures exceed 50.0°F (10.0°C);*
> *(iv) In waters determined by the Department to be ecologically significant cold-water refugia;*
> *(v) In stream segments containing federally listed Threatened and Endangered species if the increase would impair the biological integrity of the Threatened and Endangered population;*
> *(vi) In Oregon waters when the dissolved oxygen (DO) levels are within 0.5 mg/l or 10 percent saturation of the water column or intergravel DO criterion for a given stream reach or subbasin;*
> *(vii) In natural lakes.*

Therefore, even though the TMDL shows that under site potential conditions 64 degrees may not be attainable, the fact that water exceeds 64 degrees means the no measurable increase due to anthropogenic activities applies. DEQ has determined that attainment of site potential conditions for shade meets the **no measurable surface water temperature increase resulting from anthropogenic activities requirement**.

It is clear that salmonid fish rearing is a beneficial use in the Upper Grande Ronde Sub-Basin. DEQ therefore does not believe that changing that use through a Use Attainability Analysis is appropriate. We do, however, recognize that if the 64 degree standard is not achievable, a site specific standard may be appropriate at some point in the future. However, many of the waters in the Upper Grande Ronde Sub-basin greatly exceed 64 degrees and a much reduced level can be attained by providing increased shade, improving stream structure, and increasing flows as is clearly laid out in the TMDL. We will consider a site specific standard in the future as all feasible steps to improve water quality are implemented and the results are realized.

Comment - Several comments stated a TMDL should not be required on streams where waters do not exceed 64 degrees.

Response - As stated above, the temperature standard for the Upper Grande Ronde River are broader than just 64 degrees (i.e. 55 degrees for spawning, 50 degrees for bull trout, cold water refugia, and presence of threatened and endangered species).

In addition, as we look at water quality limited water bodies, the TMDL must address the source of that impairment. To the extent that upstream sources are contributing to the impairment, then the TMDL must capture these sources. Our analysis clearly shows that upstream sources of stream warming have a downstream effect for some distance.

Comment - Several comments stated the 55 degree temperature criterion (spawning salmonids) was not addressed in the TMDL.

Response - The TMDL was developed to ensure that water is as cool as possible by removing management caused sources of stream heating. The TMDL sets load allocations for solar radiation which establishes effective shade targets needed to meet those load allocations. The load allocations are based on the maximum shade (removal of solar loading) that can potentially be achieved for given stream segments. The effective shade targets, when met, would ensure no increase in water temperature due to anthropogenic sources of stream heating. Meeting the salmonid spawning criteria is therefore an objective of the TMDL.

In regards to point sources, all sources have been given a zero allocation in the TMDL for the critical period. When DEQ revises the permits for the point sources, it will determine if and when salmonid spawning might be occurring down stream from the points of discharge and ensure that the permit limitations are consistent with the zero allocation for the critical period.

Comment – With reference to site potential, several commenters felt that suggested site potentials are not realistic or achievable. Others support the use of site-potential based on composite assessments of potential riparian vegetation by physiographic unit because this approach represents sound science. One felt that landsat mapping data is not appropriate for describing riparian areas. One suggested that DEQ assumes that late seral stage provides maximum shade.

Response - Clausnitzer and Crowe (1997), considered the best riparian and wetland guide in the Upper Grande Ronde Sub-Basin, was used to develop site potential vegetation. Riparian vegetation composition was developed for composite communities for each of the Physiographic Units as outlined in Table A-19 in Appendix A. The Landsat satellite vegetation data coverages used were developed by the USEPA in 1993 and ODF in 1997, and specifies height class, canopy density, and species composition. The pixel size of the Landsat data is 25 meters. This data was checked against recent aerial photographs (Digital Orthophoto Quads) and field measurements for accuracy. Site Potential near stream vegetation used for each physiographic unit does not represent

the late seral stage. Instead, they represent a composite of several species in a mature stage. For example, all of the composite heights used in the Upper Grande Ronde Sub-Basin varied from 57 to 114 feet. One would not expect to find these height ranges in late serial stage communities (they would be taller).

Comment – Several comments stated the TMDL fails to provide load allocations for habitat modification and flow.

Response - Although we believe that the CWA and related EPA regulations do not require load allocations for habitat modification and flow (they are not pollutants) we do feel that they are important factors in the watershed and have therefore addressed them in the TMDL and WQMP. The TMDL provides an assessment of habitat and flow related issues and includes recovery goals and passive and active restoration to meet the goals. The TMDL and WQMP further describes management measures and restoration targets that are related to habitat and flow including targets for stream width, stream sinuosity, and width to depth ratios.

Comment – Several commenters wondered when and who will apply the Surrogate Measures #3, #4, and #5 identified on page 22 of the TMDL?

Response - As stated on page 22, Surrogate Measures #3, #4, and #5 should apply when active stream restoration is occurring. A lot of channel restoration is currently occurring in the Upper Grande Ronde Sub-Basin and it is expected this will continue in to the future. Whatever management agency is involved in funding, reviewing or approving active channel restoration, these targets should be used in designing that restoration. It is not expected that WQMPs promote aggressive implementation of these surrogates but rather support voluntary restoration activities. It is expected that over years as vegetation become established that channel form and function will return to those targets identified in the TMDL.

Comment – A few comments stated DEQ is beginning its triennial review of water quality standards and wondered how will any changes to the water quality standards through this triennial review of water quality standards be incorporated in to the TMDL?

Response - DEQ has appointed a Policy Advisory Committee to help in its review of water quality standards through the triennial review process. DEQ and the Committee will be reviewing temperature as well as other water quality standards. If changes are proposed, the Environmental Quality Commission must adopt them before they are sent to EPA for final approval. It is our intent to incorporate any standards change into the 5 year review of the TMDL. That point has been clarified in the TMDL, pages 2-3.

Comment - Several comments stated the TMDL document should provide a clear definition of "reasonable assurance" of implementation.

Response - The TMDL on page 42 describes the practical application of reasonable assurance and how and under what authority different designated management agencies will implement the TMDL load allocations. The document has been modified to include the definition of reasonable assurance as provided in EPA guidance.

Comment - A couple of comments stated that the Oregon Forest Practices Act is established to protect water quality and meet water quality standards and there is a process other than the TMDL to address sufficiency of the Act.

Response - The comments are correct that the Oregon Forest Practices Act is identified in statute as meeting water quality standards. It is also true that there is a process for determining the sufficiency of the Act in meeting water quality standards. This process is established in a Memorandum of Agreement between ODF and DEQ. The two agencies are in the process of completing this sufficiency analysis.

The MOA also describes how individual TMDLs can identify basin specific issues related to non-achievement of water quality standards from activities on state and private forests. If this occurs, the MOA describes how the two agencies, Environmental Quality Commission, and Board of Forestry will deal with any necessary basin specific changes to Forest Practices Act. ODF and DEQ intend to follow the requirements of the MOA.

Comment - Sediment – Several comments pointed out that using Umatilla Sub-Basin turbidity and sediment analysis might not be transferable to the Upper Grande Ronde. Some comments suggested that specific load allocations for sediment from nonpoint source pollution in the Upper Grande Ronde should be established. The USEPA endorsed the TMDL's integrated approach that acknowledges the relationships between efforts to reduce temperature and control sediment but indicated that sediment targets should be expressed in terms of allocations.

Response - References to the Umatilla turbidity and sediment work has been deleted from the TMDL document. The site potential effective shade surrogate measure for temperature will result in improvements to woody vegetation in riparian areas. As noted in the sedimentation discussion in the draft TMDL document, high fine sediment distributions in the Upper Grande Ronde River Sub-Basin correlate with non-woody riparian vegetation conditions. In Figure A-30 in Appendix A of the TMDL, woody riparian vegetation types correlate to lower fine sediment distributions (median values less than 20% fine sediment). Sediment will be greatly reduced as a result of the riparian vegetation improvements necessary to meet the site potential surrogate for temperature in the TMDL. Therefore, a loading capacity of <20% surface fines will be established. Load allocations (expressed as surrogates) will reflect that loading capacity. Temperature surrogates will also be relied on as surrogate measures for sedimentation. Long-term

monitoring, the adaptive management nature of the plan, and potentially, additional management measures, will be used to insure that sediment standards are met.

Comment - Bacteria – a few comments pointed out that only limited data is available for bacteria – as acknowledged in the draft TMDL. One comment suggested that specific load allocations for bacteria should be set. The Oregon Department of Agriculture suggested that their Grande Ronde specific rule related to waste management should be included in this section.

Response- As indicated in the Draft TMDL, the Grande Ronde River was added to the 303(d) list for bacteria based on the fecal coliform standard. The standard was revised to an E. coli standard during the last triennial review as recommended by USEPA. Since that time only limited data on E. coli has become available for the Upper Grande River Subbasin. The data is inadequate to determine compliance with the standard or to determine load allocations. As with sediment, the load allocations and surrogates established for other parameters are likely to also significantly reduce bacterial loads. DEQ will continue monitoring and use the adaptive management nature of the plan to insure that compliance with bacteria standards is demonstrated or that additional steps are taken to ensure compliance. Reference to ODA's water management rule will be added.

Comment - One comment suggests that release of the draft TMDL violates DEQ's own rule on special policies and guidelines for the Upper Grande Ronde Sub-Basin (specifically OAR 340-041-0745(2)(e)). The comment quotes from the rule that silvicultural activities "shall be addressed pursuant to ORS 468b.110 and ORS 527.765 through 527.770 and consistent with a Memorandum of Understanding developed between the Oregon Department of Forestry and the Department of Environmental Quality."

Response - DEQ disagrees. ORS 468B.110(2) states that implementation of limitations or controls applying to nonpoint source discharges from forest operations are subject to ORS 527.765 and 527.770 which, in turn, state that the Board of Forestry (BOF) establishes BMPs to insure that forest operations do not impair achievement and maintenance of water quality standards set by EQC. Also, BOF shall consult with EQC in adoption and review of BMPs. And finally, forest operators acting in good faith to comply with required BMPs will not be considered in violation of water quality standards. Nothing in the draft TMDL precludes any of these statutory requirements.

As described under non-federal forestlands in the draft WQMP, the MOU between DEQ and ODF was designed to improve coordination between the two agencies in evaluating and proposing possible changes to the forest practice rules as part of the TMDL process. The discussion in the WQMP acknowledges that the two agencies have not yet made a determination of the sufficiency of current rules to meet the TMDL and achieve water quality standards. A schedule and process is outlined for completing this activity. This section of the WQMP was written jointly by ODF and DEQ. The agencies are continuing to operate within the framework of the MOU.

Comment - Several comments stated that the TMDL failed to adequately identify and address all sources of pollution.

Response - DEQ disagrees. It is true that DEQ could have invested substantially more time and resources into refining its identification of the sources of pollution. Such additional investment would not have significantly altered the conclusions of the TMDL, however. DEQ expects that additional refinement in identifying and addressing sources of nonponit source pollution will be accomplished as the WQMP is implemented.

Comment - Several comments stated that insufficient data has been collected to support the TMDL.

Response - DEQ disagrees. DEQ believes that it has collected sufficient data to verify violation of water quality standards, to reasonably identify the causes of pollution which are contributing to water quality standards violations, and to construct water quality models to support the assignment of waste load and load allocations. Additional data collection would have consumed both time and resources and would not have significantly changed the conclusions. In addition, it would have delayed completion of the TMDL and implementation of the WQMPs which is needed to begin improving water quality.

Comment - Several comments stated concerns about the TMDL not providing room within the load allocations for new sources.

Response - DEQ agrees that new or increased discharges cannot be allowed because there is no available nutrient or heat load to allocate for new sources. During low flow conditions, background levels consume all available assimilative capacity of the sub-basin. New or expanding sources of wastewater will need to provide control facilities that will not result in increased discharge of heat and/or nutrients within the subbasin.

Comment - Several comments pointed out that seasonal variation is a requirement of a TMDL.

Response – DEQ agrees. It was originally discussed in Appendix A. Seasonal variability has now been included in the TMDL main document as well.

Comment – Some comments suggest that the TMDL fails to identify the degree by which the pollutant load deviates from the targets.

Response - Existing nutrient concentrations are presented in the form of box plots (Appendix B, Figures B-13 and B-14) and a table (Appendix B, Table B-4). Percent reductions in nutrients estimated to be needed to meet standards for pH and dissolved oxygen are identified in the main body of the TMDL (Tables 18-21).

Comment – Some comments indicate that specific sources of pollutants are not identified.

Response - The TMDL identifies target nutrient reductions needed to meet standards. However, only general non-point sources of pollutants have been identified in the TMDL. These are based on broad land use categories. Specific sources of pollutants will be identified during the implementation phase of the TMDL process so that loads from these sources can be reduced and the recommended targets met.

Comment – Several comments were made about the dissolved oxygen and pH components of the TMDL. These included suggestions that DEQ used the wrong dissolved oxygen criterion, Catherine Creek should be modeled separately from the Grande Ronde River, it has not been shown that pH problems are human caused, and the 7-day and 30-day average dissolved oxygen criteria are not addressed.

Response - The controlling standard (i.e., the standard for which compliance required the largest nutrient reduction) was pH rather than dissolved oxygen. Modeling indicated that nutrient reduction needed to meet the pH standard would result in minimum dissolved oxygen concentrations much greater than 6.5 mg/L and generally greater than 8.0 mg/L (Appendix B, Tables B-26, B-27, B-29, and B-30). Note that the standards specify that where conditions of barometric pressure, altitude, and temperature preclude attainment of the 8.0 mg/L, dissolved oxygen shall not be less than 90% of saturation. At the relatively high elevations of the Upper Grande Ronde Sub-Basin, 90% of saturation is frequently less than 8.0 mg/L. The modeling indicates that the load allocations provided will result in minimum dissolved oxygen concentrations of not less than 90% of saturation.

Catherine Creek was not modeled due to the absence of sufficient flow in the stream. During critical time periods, up to 100% of the flow in Catherine Creek is diverted. For this reason conventional stream models of the type used for the Grande Ronde River could not be calibrated for Catherine Creek. Due to the lack of a calibrated model, what was learned from modeling the Grande Ronde River was applied to Catherine Creek. Therefore, the same load allocations applied to the Grande Ronde River in the valley were applied to Catherine Creek in the valley. It is DEQ's intent to continue evaluate Catherine Creek to ensure that under conditions of 100% flow diversion, the load allocation developed based on Grande Ronde River modeling are adequate to insure that pH and dissolved oxygen standards are met in Catherine Creek. Any necessary modifications to the current load allocation will be made through the adaptive management process and periodic review.

Considerable data was presented on the extent of pH problems and there causes (Figures B-6, B-7 and B-9). As described in the TMDL, anthropogenically influenced summer pH violations frequently occur.

Modeling performed indicates that the load allocations provided will allow all dissolved oxygen standards to be met, including the 7-day and 30-day averages.

Comment - Several comments stated that there is no consideration of seasonal variability in the TMDL thereby resulting in no waste load allocations for the non-critical discharge period.

Response - DEQ has intentionally not set allocations for those times of the year when river flows and lower temperatures allow the river to accept additional wastes. The fact that allocations have not been set does not bar DEQ from issuing permits to discharge during these periods. Anyone wishing to discharge, however, would have to apply for a permit and demonstrate that their discharge would not violate water quality standards and, pursuant to DEQ's antidegradation requirements, also show that any lowering of water quality due to the discharge is justifiable for social and/or economic reasons.

Comment - At least one commenter requested that DEQ revised item #5 in the "Reasonable Assurance of Implementation" section (page 42 of the draft TMDL) to indicate that SB 1010 rules for the Upper Grande Ronde Sub-Basin are now in effect. In addition, the SB 1010 rules should be included in the WQMP in an appendix.

Response - DEQ concurs and will make the suggested change on page 42. DEQ will also add the adopted SB 1010 rules to an appendix of the WQMP as approved by the Grande Ronde Water Quality Committee.

Comment – Some comments were concerned about assumptions used in the analysis. Some felt that assumptions were over simplified.

Response - Every effort associated with the Upper Grande Ronde TMDL was made to minimize simple assumptions and to maximize data collection and analysis. The descriptions of near stream vegetation, channel morphology, hydrology, atmospheric parameters and stream temperature are the best that planned data collection efforts could accommodate. Site potential vegetation descriptions were based on Clausnitzer and Crowe (1997), considered the best riparian and wetland guide in the Upper Grande Ronde Sub-Basin.

Comment – at least one commenter felt that increasing ground water through wet meadow restoration will provide thermal regulation to surface water and that this is not sufficiently addressed in the TMDL.

Response - FLIR data collection was necessary to address ground water interactions with surface water. At the conclusion of FLIR monitoring of 274.5 river miles in the Upper Grande Ronde Sub-Basin and after the inspection of the data, it was determined that ground water effects on stream temperature in the Upper Grande Ronde Sub-Basin is minimal. DEQ agrees that ground water augmentation of surface waters can play a significant role in the production and maintenance of cold water refugia. Without a basis for quantifying restored sources and quantities of ground water connectivity, DEQ choose not to include ground water as a surrogate measure. However, ground water connectivity is discussed in pages A-55 through A-56 in Appendix A of the TMDL.

Comment – Some comments related to nutrients suggest that 1) The TMDL does not specify which of the two sets of nutrient load allocations is the TMDL. 2) The TMDL does not explicitly specify that the nutrient load allocations will resolve concerns regarding excessive aquatic weeds and algae. 3) The TMDL does not explicitly mention the State Ditch. 4) The TMDL does not show that a 60% reduction in Reach 9 will not lead to attainment of the pH criteria.

Response -

1. Language was added to the TMDL to indicate that the nutrient load allocations associated with the site potential shade load allocation is the TMDL.

2. Revisions were made to the TMDL to explicitly state that the TMDL will resolve concerns regarding excessive aquatic weeds and algae.

3. Revisions were made to the TMDL to explicitly refer to the State Ditch.

4. Reach 9 includes nutrients from the La Grande WWTP. As described in the TMDL, the 60% reduction in nutrients in Reach 9 is in addition to the elimination of nutrients from the WWTP. Modeling indicates that for the current shade condition scenario a 60% reduction in non-point source nutrients coupled with removal of WWTP nutrients will result in pH and DO standards being met. For the site potential shade scenario, modeling indicates that a 50% reduction in non-point nutrients coupled with removal of WWTP nutrients will result in pH and DO standards being met.

Comment – Some comments suggested that the data set was not large enough to run the periphyton model

Response - An extensive amount of water quality monitoring data has been collected in the Upper Grande Ronde Sub-Basin over the last twenty years. The data collected was sufficient for model calibration, as described in the TMDL report.

Comment – There were many comments related to the temperature model used in the TMDL. These ranged from suggestions that it was not validated to suggestions that it is one of the most comprehensive methods ever developed to assess stream temperature. Specific issues raised include 1) at 100% shade (night time) the model would show all streams to have the same temperature of 54 degrees. 2) The model looks only at one day and is not reproducible. 3) The model does not consider all factors that affect stream and can only be applied to 2000 foot sections. 4) The model does was not verified and does not account for elevation or local climate. 5) Reliability of the data used is not identified.

Response – 1) 100% effective shade is not night time. 100% effective shade occurs when 100% of direct solar radiation is attenuated. Diffuse solar radiation provides light. The comment that all streams should have the same temperature of 54 degrees is unsubstantiated. The TMDL does not imply such, and Heat Source does not predict this. Night time minimum stream temperatures are in fact variable depending upon factors

such as daily maximum temperature, stream surface area, flow volume, flow velocity, and atmospheric conditions. Local sunrise and sunset are known for any day of any year at any latitude and longitude. Local sunrise and sunset are included in the model, and zero solar radiation is occurring between sunset and sunrise.

2) The model can simulate temperatures for any day in question and documentation is provided that it is reproducible.
3) All parameters that affect stream temperature are accounted for in the methodology, which is documented in Appendix A. The model incorporates spatial inputs at 100 foot intervals.
4) The model was calibrated both to the longitudinal FLIR temperature profile and to several continuous temperature monitoring instruments (Vemcos) placed within the stream. See page A-86 for validation statistics. Elevation is accounted for in multiple ways. It is used to describe the stream gradient at each modeled reach. It is also used when calculating the amount of solar radiation that can reach the stream surface at that elevation.
5) ODEQ laboratory conducts specific quality assurance and quality control (QA/QC) procedures for all collected field data. Additional data sets used in the effort were obtained from Oregon Department of Forestry (ODF), United States Environmental Protection Agency (USEPA), and Untied States Geological Survey (USGS). These agencies preformed data quality checks before its release to the public.

Comment – Several comments point out that sunshine is not a pollutant and even if it were, it's natural. They suggest that DEQ does not have the authority to call sunshine a pollutant.

Response - Solar heat energy is a source of stream temperature increase that results from anthropogenic activities. DEQ agrees that solar heat energy is natural; however, anthropogenic activities have unnaturally increased the amount of solar heat energy reaching the streams in the Upper Grande Ronde Sub-Basin.

WQMP

Comment - Several comments raised issues related to cost benefit and identifying costs associated with implementation of load allocations in the TMDL.

Response - Costs to point sources have been clearly identified in the WQMP. There are currently no incremental costs to private forestry as a result of this TMDL because the current Forest Practices Act is the implementing plan and it is not certain how the FPA will change statewide in the future. That is being reviewed in a different process. Future costs will depend on whether statewide changes will accommodate the TMDL load allocations. The developers of the agricultural component of the plan did not provide costs associated with implementing Agricultural Water Quality Management Area Plan and so costs cannot be included here.

Comment – Many comments expressed concern that the individual water quality management plans are not adequate to meet the load allocations in the TMDL and that they needed to be changed. Many also expressed concern that the individual WQMPs need to change prior to finalizing the TMDL

Response – Certainly one of the biggest challenges in meeting load allocations will be working with designated management agencies on their process to translate load allocations to on-the-ground implementation. DEQ has Memoranda of Agreement with the Oregon Department of Agriculture and Oregon Department of Forestry that recognize and describe this process. Both the TMDL and WQMP reference these agreements.

DEQ also recognizes the importance of adaptive management to ensure that there is a mechanism for change and adjustment as load allocations are being addressed through implementation. We have expanded the TMDL and incorporated more specific language on adaptive management.

Comment - Upstream Storage/Improved Flow - Several comments raised the issue of the need to improve flow in the Grande Ronde River and Catherine Creek, particularly in the Valley. Several pointed out that the most severe water quality problems occur at low flow and that increasing those flows might be the easiest solution to those problems. Upstream storage and wet meadow restoration were identified as potential mechanisms to improve stream flow. It was suggested that DEQ had not adequately considered flow augmentation in the development of the TMDL and WQMP.

Response - DEQ does not have the authority to mandate flow augmentation. The importance of flow has, however, been acknowledged throughout the process of TMDL and WQMP development. The desirability of improved river flow was discussed several times during the development of the TMDL and WQMP. The effect of potential flow (the flow that would currently exist instream if no water were diverted from the Grande Ronde River in the Valley) on stream temperature is estimated and displayed in Figure 3 of the TMDL. Maintaining or increasing instream flow during critical periods is included in the temperature TMDL as surrogate measure #6. Improved instream flow, including augmentation is identified as a high priority management category in the WQMP (page 39).

DEQ's position has consistently been that improved flow can be an acceptable management component of a WQMP so long as the responsible management agency provides information on the amount of additional flow that would be made available during the critical period, the mechanism by which it would be provided, and how the availability of the flow during the critical period would be assured. None of the "designated management agencies" have identified mechanisms for increasing flow as components for implementing their portions of the WQMP. As an example, the agricultural component of the Upper Grande Ronde River Sub-Basin WQMP is the "SB 1010" plan and it's implementing rules. These were developed by the Oregon

Department of Agriculture (ODA) and a local advisory committee under the authority of Senate Bill 1010 adopted by the Oregon State Legislature in 1993. The current Agricultural Water Quality Management Area (AWQMA) plan does not identify flow augmentation or improved instream flow as a component of it's strategy to improve water quality and achieve water quality standards. If, in the future, there is an identification of an amount of additional flow that will be provided, a mechanism by which it will be provided, and assurance that the instream flow will be available during the critical period, then DEQ can consider this information in future revisions of the TMDL and WQMP under the adaptive management provisions.

Comment - At least one commenter requested that DEQ adopt a water quality-based, in-stream water right for the Upper Grande River Sub-Basin.

Response - DEQ is not opposed to this request and will consider it at a future date. DEQ's resources for doing this type of work is totally invested in doing TMDLs at this time. In order to divert resource to the development of an in-stream water right, DEQ would have to delay work on TMDLs, which is not a viable option at this time.

Comment - Three comments criticize the inclusion of certain citations in the draft TMDL because the commenters believe that referencing other people's opinions is not verification of validity or because the commenters believe that Ph.D. dissertations and Master's thesis are not peer reviewed.

Response - DEQ disagrees. References are cited in the draft TMDL and WQMP in order to provide documentation of where information used came from. These references are cited in accordance with standard practices for documenting sources in technical reports and publications. The draft TMDL does not rely solely on Ph.D. Dissertations or Master thesis. However, many times information is first published in that form because graduate students, under the supervision of University faculty members, do much academic research. Ph.D. and Master's research are peer reviewed by interdisciplinary committees prior to acceptance of the research and graduation of the students. In fact they generally receive as much or more scrutiny than many technical journal publications. Therefore they are commonly referenced in the research literature by other academics as well as government and private sector technical reports.

Comment - One comment suggests that the WQMP should identify priority areas that will receive immediate attention. These areas should include Vey Meadows and the Grande Ronde Valley and priorities should prescribe clear restoration actions. Another comment supports the priorities but suggests that they should be reassessed on a yearly basis and updated, as new information becomes available.

Response - The WQMP does identify priority areas based on problem locations and potential benefit to endangered fish (as described under "priorities" at the end of Element 1). High priorities include sections of the Grande Ronde River and Sheep Creek contained in Vey Meadows and the Grande Ronde River, Catherine Creek and Willow Creek in the Grande Ronde Valley. The WQMP also identifies high priority restoration

activities including restoration of riparian vegetation, improvements in channel morphology, and improve instream flows.

As discussed in Element 9: Maintenance of Effort over Time, the Union County Commissioners "will impanel an ongoing committee which will meet regularly (at least 1 time per year) to oversee plan implementation, review plan priorities and practices, and encourage public education and involvement."

Comment - Several comments objected to a photograph on page 10 of the WQMP that shows old car bodies being used as rip-rap on a bank of the Grande Ronde River. The objection is based on this not being representative of conditions in the Grande Ronde Valley.

Response - All the photographs have been removed from the WQMP.

Comment - Several management agencies provided information for revising their components of the WQMP.

Response – Recommended revisions have been included in the final WQMP. This was endorsed by the Grande Ronde Water Quality Committee on April 13, 2000 .

Upper Grande Ronde River Sub-Basin
Total Maximum Daily Load (TMDL)
& Water Quality Management Plan (WQMP)

Answers to Specific Questions (in the order received)

Several of the letters received during the public comment period contained numerous detailed questions that range from specific requests for clarification of methods to broad non-specific questions. DEQ has on several occasions met with individuals posing similar questions and have discussed and provided answers. We will continue to do so even after the TMDL and WQMP are finalized. We are providing answers to the questions raised by the commenters here but that should not be construed to mean we will not continue to answer questions that are raised on the TMDL and WQMP.

In some cases the answers to the questions are contained in the documents being reviewed. In other cases the requested information can be found in the references to the documents or in the scientific and/or historical record. The volume of questions makes it impractical to provide detailed answers in all cases. DEQ has, however, made an attempt to respond to all questions either with a complete answer or with a reference to further information. In some cases the same question was asked by more than one individual. In those cases the question is answered only once on the first occurrence of the question.

1. **Question: It is unclear throughout the document as to which reaches will have a TMDL, all or some?**

Answer: The TMDL and WQMP apply to the entire sub-basin. As stated in the cover letter accompanying the TMDL and WQMP, the Upper Grande Ronde River Sub-Basin, includes all lands draining to the Grande Ronde River upstream of its confluence with the Wallowa River. The TMDL, under scope on page 3, states, "the area covered by the Upper Grande Ronde River Sub-Basin TMDL corresponds to hydrologic unit code (HUC) 17060104, which includes all lands that drain to the Grande Ronde River upstream of the confluence of the confluence with the Wallowa River at Rondowa. The WQMP states, under Geographic Region of Interest on page 11, "…includes the river, all of its tributaries, and all lands that drain to the river or its tributaries upstream of the confluence of the Wallowa River at Rondowa."

2. **Question: Where has this [the Grande Ronde River water quality analysis done by Chen et.al.] been demonstrated with experimentation that validate the modeling scenarios presented?**

Answer: The citation on page 22 of the WQMP contained a typographical error. It has been changed to read "Chen et.al., 1998", not 1988. The complete citation is provided in the references section for element 1 on page 44: Chen, Y.D., et.al., 1998, Stream Temperature Simulation of Forested Riparian Areas: I. Watershed-Scale Model Development, J. Enviro. Engineering, 124(4):304-315. The validation is provided in that peer-reviewed publication.

3. Question: Is the document a draft or a final product?
Answer: The document released for review on December 10, 1999 was a public review draft.

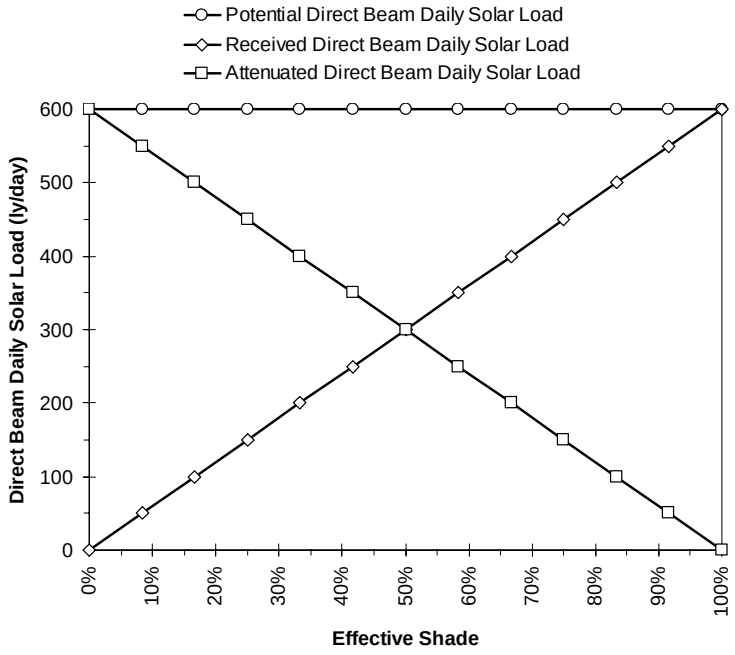
4. Question: What does "serve as a linear translator" mean [in reference to the use of shade as a surrogate for solar loading, page 19]?
Answer: Effective shade is the percent of the daily direct beam potential solar load that is attenuated before reaching the stream.

$$E_s = \frac{\Phi_A}{\Phi_P} = \frac{(\Phi_P - \Phi_R)}{\Phi_P}$$

Where,

E_s:	Effective Shade (%)
Φ_P:	Potential Direct Beam Solar Flux (ly/day)
Φ_R:	Received Direct Beam Solar Flux at Stream Surface (ly/day)
Φ_A:	Attenuated Direct Beam Solar Flux Between Stream Surface and Edge of Atmosphere (ly/day)

As an example, assume that the potential direct beam solar flux (Φ_P) is 600 ly/day. We can see that both the received (Φ_R) and the attenuated (Φ_A) direct beam solar flux are linear functions of the effective shade. Hence the statement that "effective shade is a linear translator" of solar loading is appropriate.



5. Question: How much is a "large amount" of continuous monitoring data?
Answer: DEQ, USFS and ODFW have collected continuous data at 234 sites in the Upper Grande Ronde Sub-Basin between 1991 and 1999.

6. **Question: How much light is present with 70% shade? Might this be too dark for other kinds of life? Is it possible that achievement of shade levels throughout the basin between 50-70% might harm another plant or aquatic species?**

Answer: Using 600 ly/day as an estimate of potential daily direct beam solar radiation, 70% effective shade would correspond to roughly 180 ly/day of solar radiation received at the stream surface. DEQ biomonitoring data (collected in the Upper Grande Ronde Sub-Basin) and TMDL data demonstrate that high levels of shade (i.e. 70% range) correlate to healthy riparian function, stable macroinvertebrate and salmonid populations and lower stream temperatures. The only biologic communities that experience detriment from high shade levels are non-native warm water species and perhaps excessive primary productivity (periphyton), both of which are undesirable.

7. **Question: What elements in the Ag 1010 plan will effectively implement and cause the agriculture lands to produce 50-70% shade and will effectively cool the river?**

Answer: It is not clear how the current Agricultural Water Quality Management Area Plan will achieve the temperature load allocations, including the percent effective shade surrogate. This is why the WQMP, under section 3.2.4, calls for an evaluation of the AWQMA plan and its implementing rules to determine if the rules provide reasonable assurance that the load allocations will be achieved. This evaluation is to occur in the year 2000.

8. **Question: What other management options has DEQ considered that could cool the river water?**

Answer: DEQ looked at all of the heat energy processes that effect stream temperature: direct and diffuse solar radiation, longwave radiation, convection, evaporation, and bed conduction. The various management agencies then look at what management measures under their control effect those processes and develop management measures that are included in the WQMP.

9. **Question: What is the difference between night and 100% shade? Is 90% shade the same as dawn or dusk?**

Answer: Effective shade as defined in the TMDL document (page A-29), is the potential daily radiation load minus the actual delivered radiation load, divided by the potential daily radiation load. Night is not the same as 100% effective shade. 100% effective shade occurs when 100% of direct solar radiation is attenuated. Diffuse solar radiation provides light so light can still be present with 100% shade. The answer to the second part of the question is no.

10. **Question: How many miles from the banks of the stream is DEQ suggesting the riparian areas will need to be stretched? How do these ideas work across the valley? Is DEQ intending to place this burden only on those who live next to the stream?**

Answer: Who will be affected by the implementation of management measures will depend on the parameter and load allocation for that parameter. If riparian vegetation is needed to meet shade allocations then lands next to streams will be affected. The

elimination or reduction in pollutant waste loads from wastewater treatment plants will affect those that use those treatment systems. Necessary reduction of nutrient load will affect those that contribute nutrients to stream loading, etc.

11. Question: What documentation does DEQ have that associates total suspended solids with the presence of phosphorus in water as indicated by the model output on page 36 of the TMDL?

Answer: The graph on page 36 is not a computer model out-put. It is an Ordinary Least Squares regression showing a correlation between the measured total phosphorus and measured total suspended solids in the Grande Ronde River. It is well established in the scientific literature that sediment and phosphorus are often associated. The graph simply confirms that a relationship exists in the Grande Ronde as it does most other places.

12. Question: The narrative (page 34) describes DEQ as studying a way to translate the standards for bottom sludge and turbidity in the Umatilla basin into derived targets which were then applied to the Upper Grande Ronde Sub-Basin. How was that translation made?

Answer: Targets for Turbidity (NTU) and Total Suspended Solids (TSS) developed in the adjacent Umatilla Sub-Basin were conservatively assumed to also be protective of the identical *beneficial uses* in the Upper Grande Ronde Sub-Basin. Turbidity (NTU) and Total Suspended Solids (TSS) targets for the Umatilla Sub-Basin were developed such that they provided protection of the *beneficial uses* and were intended be used as a translation of the narrative solids and turbidity standards. This approach has been modified so that the Umatilla Sub-Basin turbidity and TSS work is no longer used, or referred to, in the Upper Grande Ronde Sub-Basin TMDL.

13. Question: How does DEQ measure phosphorus in the solids from the suspended solids filtration?

Answer: DEQ does not routinely measure the phosphorus in the suspended solids filtration. Suspended and dissolved forms of phosphorus are separated by filtration. Phosphorus in the water column is measured. Methods can be found in Standard Methods for the Examination of Water and Wastewater, published jointly by American Public Health Association, American Water Works Association, and Water Pollution Control Federation.

14. Question: [with regard to figure A-1] How much variability is in the data between years? Without verifying that the variability is within acceptable limits … how do we determine if the years are different…?

Answer: The variability is displayed in the figure. As noted in the caption to the figure, the number of years of data at each site is displayed. The bars indicate the minimum and maximum values. So where there is more than one year of data the median value is displayed and the bar indicates the entire range of values (variability). The purpose of the graph, as indicated by its title, is to compare the 7-day temperature statistic (the maximum 7-day average of the daily maximum temperature for each year) to various locations and to the numeric criteria in the state standards. The purpose is not to establish

the historic variability in stream temperature and it would be unreasonable to expect the figure to do so.

15. Question: [With regard to Vey Meadow] Why does Vey Meadow have Rapid temperature increases..? Is it the Meadow sinuosity that is causing the heating? Is it the velocity of the water moving across the meadow? Is it the gradient of the stream as it crosses the meadow? What other factors might cause this situation?

Answer: Stream temperature change is an expression of heat energy exchange per unit volume, which in turn is an indication of the rate of heat exchange between a stream and its environment. The heat transfer processes that control stream temperature include solar radiation, longwave radiation, convection, evaporation and bed conduction (Wunderlich, 1972; Jobson and Keefer, 1979; Beschta and Weatherred, 1984; Sinokrot and Stefan, 1993; Boyd, 1996). With the exception of solar radiation, which only delivers heat energy, these processes are capable of both introducing and removing heat from a stream.

Almost no riparian vegetation is present along the stream banks of the Grande Ronde River within Vey Meadow. Accordingly, the amount of solar radiation loading reaching the stream surface within Vey Meadow is extremely high which results in rapid temperature increases. Removal of riparian vegetation, and the shade it provides, contributes to elevation stream temperatures (Rishel et al., 1982; Brown, 1983; Beschta et al., 1987). Rapidly rising temperatures in the Grande Ronde River within Vey Meadow have been consistently measured during monitoring efforts over the years. Although many factors affect stream temperature, because of the lack of riparian vegetation, solar radiation loading is the most predominant contributor to heat energy processes in the Grande Ronde River within Vey Meadow.

16. Question: [With regard to FLIR] Are the visual observations using FLIR more indicative of actual thermal conditions than on-the-ground data collected with thermometers? How cost effective is the use of FLIR in the TMDL process? How was the imaging calibrated..? What kind of processing was done on the photos? How were the photos interpreted? How then is FLIR imagery useful for determining water temperature several inches to several feet below the surface..? experimental measurements were made to calibrate the FLIR interpretation for water surveys?

Answer: FLIR gives a continuous spatial temperature profile of a stream for the time that it was flown, revealing longitudinal stream temperature patterns. Continuous monitoring instruments (i.e., Vemcos) deployed within the stream record temporal temperature patterns for a single location (i.e., hourly temperatures for several months). FLIR and continuous temperature monitoring are examined together to characterize both spatial and temporal stream temperature patterns.

How cost effective is the use of FLIR in the TMDL process?

FLIR costs an average of $235 per mile flown. Collecting FLIR data reduces the number of continuous temperature monitoring instruments (Vemcos) that must be deployed and maintained in a sub-basin.

How was the imaging calibrated? What kind of processing was done on the photos? How were the photos interpreted?

FLIR images were collected digitally and recorded directly from the sensor to an on-board computer. Images were collected at a rate of 1 image frame/second. The FLIR detects emitted radiation at wavelengths from 8-12 microns and records the level of emitted radiation in the form of an image. Each image pixel contains a measured value that can be directly converted to a temperature. The FLIR images represent the full dynamic range of the instrument and were tagged with time and position data provided by a Global Positioning System (GPS).

Day TV images were recorded to an on-board digital videocassette recorder at a rate of 30 frames/second. GPS time and position were encoded on the recorded video. The Day TV sensor was aligned to present the same ground area as the thermal infrared sensor. The GPS time coding provides a means to correlate Day TV images with the FLIR images during post-processing.

Watershed Sciences distributed in-stream temperature data loggers (Onset Stowaways) in the basin prior to the survey in order to ground truth (i.e. verify the accuracy of) the radiant temperatures measured by the FLIR. The advertised accuracy of the Onset Stowaway's is $\pm 0.2^{o}$C. These locations were supplemented by data provided by ODEQ from seasonal in-stream temperature loggers (Vemcos).

A computer program was used to scan the FLIR imagery and create a text file containing the image name, time, and location it was acquired. The text file was then converted to an ArcView GIS point coverage. This coverage shows the spatial extent of the survey and allows for the integration of the FLIR with other spatially explicit data layers in the GIS. In addition, we identified the FLIR images associated with the ground truth locations from this coverage. The data collection software was used to extract radiant temperature values from the associated images at the location of the in-stream recorder. The radiant temperatures were then compared to the kinetic temperatures from the in-stream data loggers to assess the accuracy of the FLIR data.

The image points were associated with a river kilometer using the dynamic segmentation features of Arc/Info GIS software. The river kilometers were derived from 1:100K "routed" stream covers from the Environmental Protection Agency (EPA). The route measures provide a spatial context for developing longitudinal temperature profiles of stream temperature.

In the laboratory, a computer algorithm was used to convert the raw thermal images (radiance values) to ARC/INFO GRIDS where each GRID cell contained a temperature value. During the conversion, the program recorded the minimum and maximum

temperature value found in each image. An ArcView Extension was used to display the GRID associated with an image location selected in the point coverage. The GRID was color-coded to visually enhance temperature differences, enabling the user to extract temperature data. The GRIDS were classified in one-degree increments over the temperature range of 10 to 50^{o}C.

Once in the GRID format, the images were analyzed to derive the minimum, maximum, and median stream temperatures. To derive these measures, an ArcView program was used to sample the GRID cell (temperature) values in the stream channel. Ten sample points were taken longitudinally in the center of the stream channel. Samples were taken on every 4th image to provide complete coverage without sampling the same water twice (there is approximately 40-60% overlap between images). Where there were multiple channels, only the main channel (as determined by width and continuity) was sampled. In cases where the channel was obscured by vegetation the next image where the stream channel was clearly visible was sampled. For each sampled image, the sample minimum, maximum, median, and standard deviation was recorded directly to the point coverage attribute file. We have found the median value to be the most useful measure of stream temperatures because it minimizes the effect of extreme values.

The temperature of tributaries and other detectable surface inflows were also sampled from images. These inflows were sampled at their mouth using the same techniques described for sampling the mainstem channel. If possible, the surface inflows were identified on the USGS 24K base maps. The inflow name and median temperature were then entered into the point coverage attribute file.

Day TV images corresponding to the FLIR images were extracted from the database using a computer-based frame grabber. The images were captured to correspond to the thermal infrared images and provide a complete coverage of the stream. The video images were "linked" to the corresponding thermal image frame in the ArcView GIS environment.

How then is FLIR useful for determining water temperatures several inches to several feet below the surface?

FLIR systems measure thermal infrared energy emitted at the water surface. Since water is essentially opaque to thermal infrared wavelengths (8 - 12μm), the sensor is only measuring the water surface temperature. This is typically not an issue on streams where the water column is thoroughly mixed. The majority of stream miles surveyed in the upper Grande Ronde River Sub-Basin are not stratified. This is evidenced by the comparison of the image temperature measurements to the in-stream temperature measurements at locations throughout the sub-basin. However, field measurements showed some level of stratification in the Lower Catherine Creek. This was supported by initial review of the FLIR imagery.

17. Questions: With regard to vegetation:

17 a. How will shade be made in areas where the sites won't support shade?

Answer: If shade cannot be supported at a specific location it is not expected to be provided at that location.

17 b. What will be the cost per stream mile? Per degree decrease?

Answer: See the response to the comment on cost benefit under WQMP in the Response to Public Comment.

17 c. And will this shade cool the water 10-15 degree F? How much shade will it take to cool 78 degree F water to 63.9 degree water? How much cooler will various amounts of shade make the water?

Answer: The answers vary depending on location and site characteristics. Figure 3 on page 16 of the TMDL shows the estimated changes in temperature expected on the mainstem Grande Ronde River if site potential is achieved. The figure also demonstrates that 63.9 degrees F will not be reached in all locations. This is not inconsistent with the state water quality standard for temperature which states that when the temperature exceeds the criteria a management plan must be in place and no human caused increase is allowed. The standard does not state that the criteria must be achieved at all times.

17d. What role does leaf size play in creating shade? Do pine trees in the uplands block as much sunshine as cottonwoods do in the valley?

Answer: Leaf size would effect canopy density, which in turn affects shade. The amount of solar radiation blocked by pine trees compared to the amount blocked by cottonwood trees would depend on the density of the trees.

17e. What role will soil type have in the implementation of the plan? Where has it been demonstrated that the % shade suggested can be achieved in each of the soil classifications shown in Table A-20?

Answer: Soil type affects the growth of plants and will affect the site potential of a specific location. As stated in the text preceding Table A-20, assumptions are based on Silvics of North American Trees and a soils map of the Grande Ronde Valley. If evidence is presented indicating that these preliminary estimates need to be revised based on new or better information, the estimates can be revised under the adaptive management provisions of the TMDL.

17f. What will the ground cover species composition be under a canopy of cottonwoods of this type? With the reduction of light, will there be a reduction in ground cover? What influence will the light reduction and ground cover density have on erosion control?

Answer: The plant associations are also identified in Silvics of North American Trees and in Mid-Montane Wetland Plant Associations of the Malheur, Umatilla and Wallowa-Whitman National Forests as well as in other references.

18. Question: What effect does forest canopy have on overnight stream temperatures when there is a streamside shade producing canopy at 50-70%.
Answer: Vegetative canopy will insulate the stream overnight reducing the diurnal fluctuation in stream temperature. So, riparian vegetation results in a reduction in the maximum temperature during the day and an increase in the minimum temperature over night.

19. Questions: There are three of premises set up related to black cottonwood and hybrid poplars followed by a number questions. Premises include 1) hybrid poplars are sensitive to soil alkalinity resulting in stunted growth, 2) cottonwoods are not tolerant to flooding, 3) "DEQ states that overuse of cottonwood by livestock is a common problem. This is an opinion and implies an agency bias that should be unacceptable in state agency documents."
Answer: DEQ used the following references to support its riparian vegetation assumptions:

Crowe & Clausnitzer, 1997, Mid-Montaine Wetland Plant Associations of the Malheur, Umatilla and Wallowa-Whitman National Forests, USDA Forest Service R^-NR-ECOL-TP-22-97.

Dean S. DeBell, Populus trichocarpa Torr. & Grey, Black Cottonwood, in R.M. and B. H. Honkala (1990), Silvics of North American Trees, Vol.2, Hardwoods, U. S. Department of Agriculture, Washington D.C.

Maurice E. Demeritt, Jr., PopulusL., Polar Hybrids, in R.M. and B. H. Honkala (1990), Silvics of North American Trees, Vol.2, Hardwoods, U. S. Department of Agriculture, Washington D.C.

Cynthia A Hines, 1998, Evaluating the Restoration Potential of Black Cottonwood (Populus trichocarpa) from multiple scales of Observation, Grande Ronde River Basin, Oregon, USA. Master's Thesis in Forest Science, Oregon State University.

These references do not support the premises put forth by the questions.
For example:
1) "Optimum pH ranges from 6.0 to 7.0, though some hybrids tolerate high or low pH conditions. Hybrids grow well on Upland and bottom-land soils… Hybrids show extreme variation in tolerance of adverse site conditions." Demeritt, 1990.
2) "Black cottonwood is tolerant of flooding throughout its lifespan, including seedling stage. This flood tolerance along with the rapid growth of seedlings gives black cottonwood a competitive advantage…" Crowe & Clausnitzer, 1997.
3) "Overuse of cottonwood populations by livestock is a common problem in the Blue Mountain Province. Sever browsing and trampling by livestock and wild ungulates can prevent new stands from establishing on fresh scour or depositional surfaces, which leads to an unbalanced age structure in the population and eventual loss of cottonwood from the site." Crowe & Clausnitzer, 1997.

These are well respected, documented, and established references. DEQ is not aware of any references that contradict these findings. If such references exist and are provided to DEQ, we will consider revising the TMDL or WQMP under the adaptive management approach.

20. Question: Page A-49 Isn't there any other citation DEQ can use besides Boyd. 1996?
Answer: Boyd (1996) is only one of 78 citations the TMDL draws from.

21. Question: Page 50 & 51 Who has determined that pea size gravel is detrimental to fish eggs?
Answer: DEQ can find no reference to pea size gravel on the pages referred to. It is well established that fine sediment compromises fry emergence. References are provided in the text.

22. Question: [With reference to the temperature model used in the TMDL] Where is the detailed analysis….which shows that this model makes legitimate and reproducible predictions?
Answer: Appendix A, Analytical Framework, Results, Validation, Page A-86.

23. Questions related to car bodies being used as rip rap:

23a How many miles of the Grande Ronde river are line with car bodies?
Answer: DEQ does not know the answer to this question.

23b Was the purpose of placing the picture in the document to illustrate a common practice by landowners along the river?
Answer: No.

23c What was the general message that DEQ wanted to send to the public about the state of the land management along the Grande Ronde River?
Answer: None. The pictures in the WQMP were include merely to add interest and break up the text. That picture, along with the other pictures in the WQMP (Rip-rap on the Grande Ronde River (page 10), no title (page 17), Catherine Creek in the Grande Ronde Valley (page 20), Unconfined Channel, Upper Grand Ronde (page 40), Vegetation, Upper Grande Ronde River (page 49)), will be removed from the final WQMP to avoid any misunderstandings.

23d Is that the only picture of riparian management that DEQ has?
Answer: No. As pointed out in 23c above, there were several other pictures in the WQMP (and many more in the TMDL).

24. Questions related to Table 17, margin of safety, and desirability of being conservative:

24a Why is it conservative…to assume that one set of factors … should be set at or near 0, while at the same time maximizing the influence of other factors to the point that they become unrealistic?

Answer: DEQ can find nothing in Table 17 indicating that one set of factors is set at or near zero while another is unrealistic.

24b What authority did DEQ use to make these arbitrary decisions?

Answer: The authority of the Environmental Quality Commission and DEQ are set out in Oregon Revised Statutes (ORS) 468B. In particular, ORS468B.075 states "The commission may perform or cause to be performed any and all acts necessary to be performed by the state to implement within the jurisdiction of the state the provisions of the Federal Clean Water Act, enacted by Congress, October 18, 1972, and Acts amendatory thereof or supplementary thereto, and federal regulations and guidelines issued pursuant thereto."

As to the assertion of the questioner that any actions contained in the TMDL or WQMP are arbitrary, this is clearly not the case. Arbitrary means determined by chance or by individual preference. The voluminous documentation contained in the TMDL and WQMP, demonstrates that the decisions and actions taken, whether the questioner agrees with them or not, are not based on chance or individual preference.

25. Questions: "On page A-30 DEQ correctly states that 'there is little quantitative data regarding historic vegetation'. However, in the very next line DEQ claims that 'undoubtedly, riparian trees and shrubs historically were more abundant than today'".

25a ….where is the documentation that establishes that fact?

Answer: The historical documentation is provided in the paragraphs that follow the questioner's citation from the TMDL documents.

25b How much more abundant were the trees? What were the species of trees? What were their heights? Where were they located?

Answer: DEQ's position is that there are no quantitative answers to these questions and that is pointed out in the TMDL. This does not preclude general knowledge of the types, heights, and distribution of vegetation in the basin as described in the document and it's references.

26. Questions related to site potential.

26a How did DEQ determine that a difference in mean annual temperature of 6 F and an annual precipitation difference of 44 inches would not influence tree height?

Answer: DEQ makes no such determination in the document.

26b What data...did DEQ use to validate that a black cottonwood population of that size would all be the same height at the same time?

Answer: DEQ has not made that determination in the TMDL.

26c What valid data (quantified) source from the valley did DEQ use to establish tree heights for each of the soils?

Answer: DEQ used the best information available for the region. References are given. Not all data in the references was collected in the Grande Ronde Valley. It is assumed that the biology of cottonwoods and other vegetation is similar in the Grande Ronde Valley as it is elsewhere in the west were the information contained in the referenced scientific literature was collected. If there is site-specific information that DEQ is not aware of, we will consider it and change the TMDL and WQMP in the adaptive management context.

26d Is it DEQ's policy that denuding a river channel bank for at least 2 years is a desired treatment?

Answer: There is nothing in the TMDL documents that would indicate DEQ has such a position.

27. Questions related to potential vegetation heights listed in Table A-19.

27a What valid local data (quantified) did DEQ use to field verify the accuracy of these numbers?

Answer: As indicated in the footnote to the referenced table, the information comes from a local study, Clausnitzer, R.R. and E.A. Crowe, 1997. Mid-Montain Wetland Plant Associations of the Malheur, Umatilla and Wallowa-Whitman National Forests. United States Department of Agriculture Forest Service. Pacific Northwest Region. Technical Paper R6-NR-ECOL-TP-22-97.

27b How did DEQ verify that sunlight blockage was equivalent across species and age groups within species?

Answer: DEQ makes no such claim in the TMDL documents.

27c Clausnitzer and Crowe do not give a height estimate for the tree [black cottonwood]…Where did DEQ obtain these numbers?
Answer: ODA provided species composition and height values for the Grande Ronde Valley, where cottonwoods were prescribed as a site potential community.

28. Questions related to a photo of car bodies used as rip rap along the Grande Ronde.
Answers: See 23 above.

29. Questions related to adaptive management implementation.

29a Where is the experimentation that validated all of the hypotheses proposed in this document?
Answer: The TMDL is not an experiment and it does not propose or test hypotheses. Rather, a TMDL attempts to use existing data and apply existing research results to determine a loading capacity, load allocations, and waste load allocations. A TMDL is applied science not an experimental exercise.

29b Where is the experimentation that validates the internal assumptions and equations that form the model?
Answer: As stated above, the TMDL is not an experimental exercise. Documentation of model development and validation is clearly described in Appendix A, Temperature Analysis.

29c Where is the valid experimentation that verified that these outcomes can be achieved given local parameters.
Answer: See the answer to 29b above. The model is calibrated to local conditions. The parameters affecting temperature are the same locally as they are everywhere.

29d Where is the legislative authorization…?
Answer: See the answer to24b above.

30. Question: **What are the experimental statistics that were used to validate the hypotheses proposed by DEQ?**
Answer: The TMDL is not an experiment and hypotheses are not proposed by DEQ. See the answer to 29a above.

31. Questions related to model discussions near or on page B-42.

31a Is it DEQ's policy that meaningless data is all that is needed to regulate the citizens of the state?
Answer: No. DEQ uses the best available, locally generated, site specific data.

31b …how did DEQ validate the results and assumptions made in this modeling exercise?
Answer: The calibration of the periphyton model, including the correlation of periphyton mass with algal growth rate and the methodology used, is clearly described in Appendix B, Periphyton Analysis.

32. Question: How did DEQ validate the [manning] coefficients that they selected?
Answer: Manning's roughness coefficients were used to calibrate the hydrology (flow velocity and depth to measured values.

33. Questions related to figure 13 on page 36 of the TMDL.

33a What were the analyses performed and specific results that demonstrated that the data set used in this figure did not violate the basic regression assumption that for each x value there is a normal distribution of y values and that the distribution of the y values for each x has the same variance?
Answer: Statistics generated for Figure 13 included a coefficient of determination (R^2) and standard error (SE). Coefficient of determination can be interpreted as the percent variability in the dependent variable (total suspended solids) that is explained by the independent variable (total phosphorus). Standard error addresses the standard deviation of the sampling distribution. Analysis assumed a normal distribution.

33b Why did DEQ conclude that significant reductions in phosphorus could be attained from sediment reduction when your own data tells you that you can flip a coin and have an equal chance of being correct?
Answer: The question appears to misunderstand the meaning of the r^2 (coefficient of determination) statistic. An r^2 of 0.53 does indicate that a little more than 50% of the variance in Y (phosphorus) is accounted for by the regression. This does not, however, equate with randomness (flip a coin and have an equal chance of success). The R^2 must always be between zero and one, with one corresponding to a perfect relationship and zero corresponding to no relationship (random scatter). Clearly an R^2 of 0.53 falls somewhere between the two.

33c How can DEQ conclude that they are meeting the margin of safety requirement of conservative assumptions when your analysis contains invalid statistical conclusions?
Answer: It is unclear if the questioner's point is that DEQ should increase the margin of safety (i.e. make the load allocations more stringent). See answer to33b.

34. Question: **What is the policy of DEQ regarding data and report quality?**
Answer: DEQ uses the best available data and produces the best possible quality reports in an open process that allows citizens the opportunity to review and bring additional data or constructive suggestions for improvement to the process.

35. Question: **What is DEQ's legal responsibility to answer questions posed during a comment period?**
Answer: In the case of TMDLs, the state is required by federal regulation to involve the public in development, solicit public input, and provide response to issues raised by the public. The recently concluded public comment period on the Upper Grande Ronde Sub-Basin TMDL and WQMP, and this responsiveness summary, are part of that process.

36. Question: What portions of the proposed document exceed current federal requirements for addressing non-point pollution?
Answer: In DEQ's opinion, none.

37. Question: What was the intent of DEQ when they prepared this document? … The original authors obviously do not understand the task they were given because the document is based upon 'green religion' not valid science.
Answer: The intent in preparing the document was to develop a TMDL, as required by federal law, that analyzes the factors affecting water quality and identifies the amount of pollution that can be present without causing state water quality standards to be violated. In addition, the intent was to prepare a WQMP that describes the actions that will be taken to reduce the pollutant loads identified in the TMDL. The WQMP is authored by a group of local stakeholders representing all of the affected interest groups and using the best available information and science.

38. Questions related to the following quote from page 6 of the TMDL, "Monitoring shows that water quality in the Upper Grande Ronde Sub-Basin frequently violates numeric criteria contained in the State water quality standards (WQS)."
How 'frequently' are the water quality standards violated? When do violations occur? How long is a violation sustained? Is the water quality always in violation of the standards? How much data has been taken to document the violations? In what peer-reviewed scientific journal have the data … been documented and published?
Answer: Frequency, daily and seasonal variation, duration, and data quantity vary by parameter and location. This information is published in the decision matrix of the 303(d) list and it's supporting documentation. While not a journal (routine monitoring data is seldom published in research journals) the 303(d) list goes through a rigorous public and technical review each time it is published.

39. Questions related to the following quote from page 7 of the TMDL, "… no measurable surface water temperature increase resulting from anthropogenic activities is allowed in State of Oregon Waters…" The questioner asserts that the language quoted is imprecise because the word surface is not defined. To demonstrate the perceived importance of this definition the questioner provides a "simple logic tree". Two questions are then asked: How far below the plane of the stream surface constitutes 'the surface' of the water? Given the logic tree … what path of reasoning does ODEQ use to relate surface temperature to its effect on fish?
Answer: The quote is from Oregon's administrative rules related to the water quality standard for temperature. It appears that when the questioner considered the quote, outside of its context in the rules, a misunderstanding developed as to the reference of the word surface. The logic chart provided indicates that the questioner believes the word surface refers to the surface of the water, leading to the questions relative to how far into the water column the water surface extends. In the context of the rule language, the word surface refers to the surface of the earth and is used simply to distinguish the water in rivers, streams and lakes – which reside on the surface of the earth (surface water) from the water that resides in underground aquifers (groundwater). When read in the full and proper context, the language is not imprecise but, in fact, says exactly what it means.

40. Questions relating to the definition of temperature. The questioner eludes to statements made in the TMDL documents relevant to temperature: On page A-74, water temperature is a function of the total heat energy contained in a discrete volume and may be described in terms of energy per unit volume. And on page 15, water temperature is an expression of heat energy per unit volume. The questioner then argues that this is an inappropriate definition of the word temperature and follows with two questions: How does ODEQ explain (and/or justify) their definition of temperature? To what extent does ODEQ recommend that the rest of the TMDL be trusted if it is based on this definition of temperature?

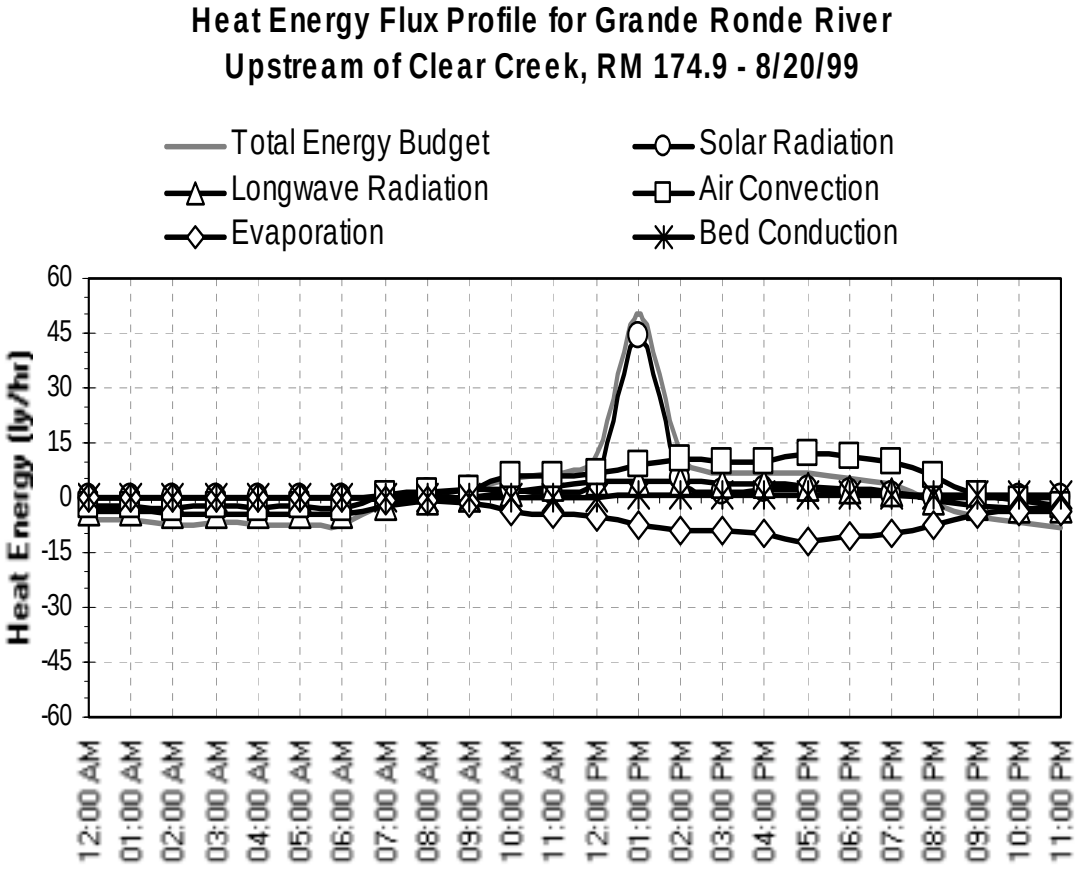
Answer: The questions and premises set up here imply that DEQ has used the wrong definition of temperature and then attempt to discredit the entire TMDL because of that definition. One does not follow from the other. First of all, DEQ does not define temperature. DEQ states that water temperature is a function of the amount of heat energy contained in a discrete volume. This is a true statement that is not disproved by the discussion of the definition of temperature. Second, regardless of the definition of temperature, one cannot legitimately call into question the entire TMDL, the loading capacity and the allocations developed in the TMDL, on the basis of the definition of temperature. The TMDL is not dependent on the questioner's definition of temperature.

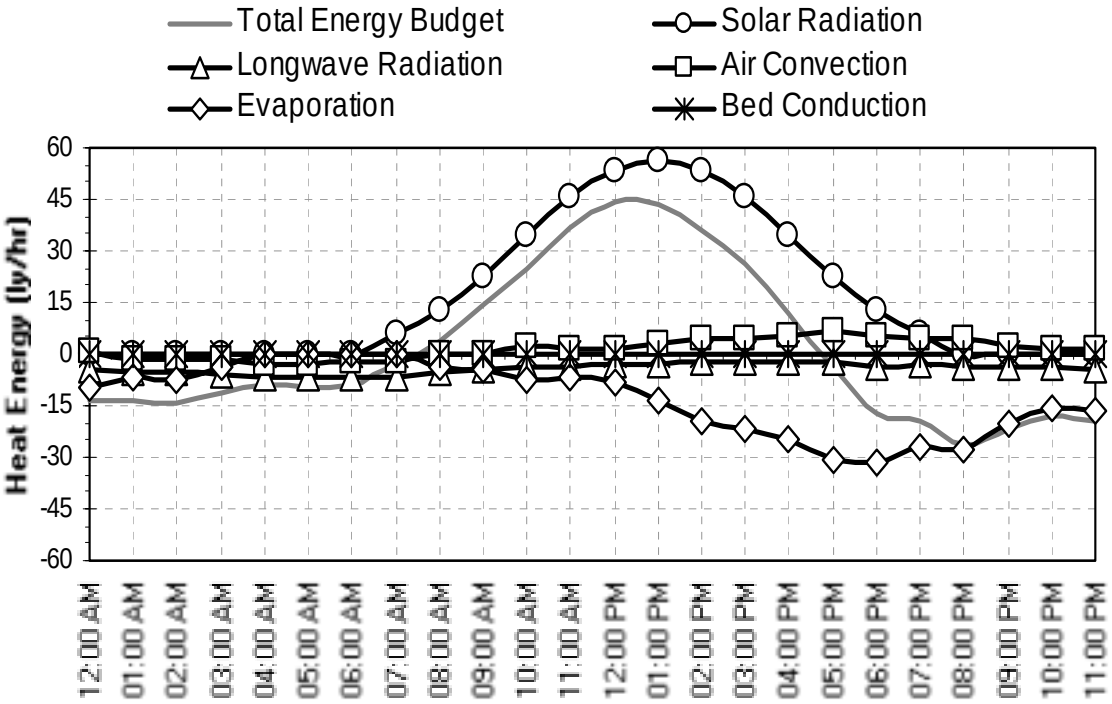
41. Questions related to heat energy continuity. After several pages of discussion of equations from the TMDL related to heat energy continuity one commenter posed a number of related questions.

1. **Since it is obvious that the flux is being used as a bulk scalar quantity, are the fluxes listed in Eq. A-3 treated as a constant in time?**
2. **If the fluxes are not treated as a constant in time, are they averaged over? How is the average conducted? What about spatial geometric averaging to account for the varying angle θ for various sources (e.g. the changing angle due to solar motion over the course of a day)?**
3. **Even if the geometric relationship is changing, there is still the question of the flux magnitude, Φ_o. Are the flux magnitudes taken to be constant? How do each of the flux magnitudes vary with time over the course of the day?**
4. **What implications do your answers to these questions have for the treatment of flux in Eq. A-8, where flux is listed as a scalar quantity without directional or time dependence?**
5. **When used later, in the PDE [Partial Differential Equation] of Eq. A-8, are the fluxes treated generally and updated as part of the integration with respect to the time variable? How about with respect to the spatial variable?**
6. **Since flux depends on the temperature of both the stream and the environment that the stream is interacting with, how are the fluxes updated in the evolution of Eq. A-8 to accommodate changes in the relative temperature between the stream and the environment (e.g. if the stream becomes warmer than the air, does the 'convection flux' $\Phi_{convection}$ transport heat to the atmosphere)?**

Answers:

1. No. Thermodynamic components are variable in time and space.
2. All thermodynamic components are calculated every 60 seconds over the simulation period at 100 feet (30.5 meters) spatial intervals. For example, the solar angle is calculated every 60 seconds in the simulation period and every for all 100 feet length interval.
3. As mentioned in Answer #2, all thermodynamic components are calculated every 60 seconds over the simulation period at 100 feet (30.5 meters) spatial intervals. Energy components differ greatly in both temporally and spatially as demonstrated in these graphs.





4. Answers #1 - #3 clearly explain that thermodynamic components are a function of time and space. Further, The units of the energy flux components are ly/time (i.e. heat energy per surface area per time). Since the units correspond to space and time, it should be clear that both are considered in the methodology.
5. The thermodynamic components are updated with respect to time (every 60 seconds) and space (every 100 feet) in the finite difference methodology.
6. The finite difference solution is utilized to update thermodynamic components that are functions of stream and air temperatures (i.e. convection, evaporation and longwave radiation and bed conduction). Specifically, stream temperature profile from the previous time step (i.e. 60 seconds prior) is used to supply stream temperature information for every distance step (i.e. every 100 feet).

   All thermodynamic components that are a function of temperature (air and stream) use updated values during the simulation period. If this methodology failed to do so, temperature extremes would occur (such as the river reaching a boiling point in 30 miles). Fortunately, the methodology accounts for increasing heat dissipation as stream temperature increase. For example, the Grande Ronde River below La Grande has near zero shade levels for approximately 30 miles. This is an extreme condition which allows worst case condition for solar loading (see chart above – Heat Energy Flux for Grande Ronde River, Grande Ronde Valley, Pierce Lane) and thus, heat

energy input to the river. However, measured and simulated temperatures increase throughout this 30-mile area from approximately 75°F to over 80°F. Only a 5°F increase over this relatively long and unshaded river reach is occurring. So what is happening?

Mid day stream temperatures are warming. The temperature gradient between the stream and air temperatures is decreasing, and convective heating from the air to the stream is decreasing (result – reduced stream heating). Evaporation rates are increasing (result – reduced stream heating). Back radiation from the stream surface is increasing (result – reduced stream heating). The temperature gradient between the stream and streambed temperature is decreasing, and streambed conduction heating from the streambed to the stream is decreasing (result – reduced stream heating). The overall result of increasing stream temperatures is increased heat dissipation. If extreme thermal conditions persist, heat input will eventually equal heat dissipation, at which point, temperature no longer increases (this is referred to as an equilibrium temperature). Currently, in the case of the Grande Ronde River Valley during July and August, this equilibrium temperature is in the 75°F to 85°F range.

42. Question: How does ODEQ explain the maximal stream temperature occurring in the late afternoon, many hours after the maximal input of heat energy flux from solar radiation (at local noon)?
Answer: Lower in the sub-basin maximum daily temperatures consistently occur later than upper sub-basin maximum daily temperatures. This is caused by advection (movement of water downstream). Daily maximum temperatures are transferred downstream and a shift in the timing of daily maximum temperatures occurs. An example of this would be that maximum daily temperatures at Vey Meadow occur at 2:00 PM, while maximum daily temperatures at Rondowa occurs at 6:00 PM.

43. Question: Is it ODEQ's position that the temperature profile of the river in February will be obtained year round with only 35% effective shading on the river?
Answer: DEQ does not make this assumption. During February the solar cycle, hydrology and meteorology will be very different than the summertime period analyzed in the TMDL.

44. Question: If air has such a 'small' effect on the water temperature, then how does ODEQ explain the drastic difference in temperature profiles between February and August?
Answer: DEQ has demonstrated that air temperature effects are small when compared to potential summertime solar heat inputs. This should not be interpreted to mean that DEQ does not account for air temperature effects in the methodology presented in the Upper Grande Ronde TMDL. DEQ does account for air temperature effects and has found it to be a dominant factor when shade levels are very high and the solar energy component is minimized. The methodology used in the Upper Grande Ronde TMDL is robust (i.e. all thermodynamic and hydrodynamic factors that affect stream temperature are accounted for using the best available data).

Regardless, when comparing Grande Ronde River temperatures in February one should consider the solar cycle, hydrology and meteorological differences that occur. It becomes obvious that stream temperature in February is much cooler than in August for many reasons, some of which are presented in the table below.

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Parameters that Affect Temperature	Average	
	August	**February**
Flow (Hilgard)	31 cfs	220 cfs
Air Temperature (La Grande)	68.9^{o}F	35.1^{o}F
Precipitation (La Grande)	0.85"	1.41"
Snow Depth (La Grande)	0.0"	1.1"
Relative Humidity (Pendleton)	39%	73%
Potential Solar Load (La Grande)	541.7 ly/day	180.6 ly/day
Likely Source of Water	Groundwater	Snow Melt

45. Question: Has ODEQ considered the loss of mechanical energy in the river? Where do they think the energy went? What studies have been done to determine if the loss of mechanical energy is an important effect in the rise of stream temperatures?
Answer: No. Mechanical heat is not accounted for nor is it believed to be significant.

46. Question: With regard to setting the dispersion coefficient to zero, why would ODEQ set one of these terms equal to zero in Eq. A-8, but not the other, when the coefficients are similar in size?
Answer: Sinokrot and Stefan (1992) demonstrated that dispersion can be assumed to be zero in flowing (unstratified) conditions. Advection dominates mass transfer when compared to mass transfer occurring via dispersion.

47. Questions: One commenter posed a long list of questions relating to the model and it's algorithms.

1. **What does 'assumed to equal zero the boundary condition at time t_o' mean? Does this mean that at the time of the finite differencing, the temperature on the initial Coucy surface is assumed to be constant and equal to the temperature at the upstream inputs? What physical situation does this type of initial data represent?**
2. **Was implicit or explicit finite differencing used?**
3. **Was a known algorithm used to solve the finite differencing evolution? What is the name of the algorithm, and what source was it taken?**
4. **Did ODEQ write the finite differencing code from scratch, or was it someone else's routine used (e.g. routines from Numerical Recipes)?**
5. **How was the code written? What language was it implemented?**
6. **For what precision was the code written (i.e. what is the byte length for real values)?**

7. **What testing procedure was carried out to verify the stability and veracity of the code before it was given actual stream data? How was the accuracy of its performance evaluated?**
8. **What stability criteria are used to check the finite differencing?**
9. **How big is the gridding in ΔX and ΔT**
10. **What is the estimated discretion error from the finite differencing?**
11. **What is the estimated round-off error?**
12. **How many miles did the original Cauchy surface correspond to?**
13. **If short spans of the river are evaluated by the code, how are they linked together to make a prediction for the entire river length? Are only the temperatures matched, or are the first and second derivatives (with respect to t and x) matched as well.**
14. **What is the maximum span covered by the code?**
15. **How sensitive is the code to small perturbations in the initial condition?**
16. **If the stream is very HOT, does the code correctly handle the cooling of the stream into its surrounding environment? Was this tested and verified?**
17. **What does the model do if the water temperature were to reach boiling or freezing points?**
18. **Has the code been tested against stream data taken at different seasons? Does it correctly predict the temperature behavior?**
19. **How well does the code perform to matching data on days other than Aug. 20, 1999? Where is the detailed analysis showing that this code can be trusted in general and thus a good model to use for making decisions about how to manage the stream environment every day of the year?**

Answers:

1. Yes, at the time of the finite differencing, the temperature on the initial Coucy surface is assumed to be constant and equal to the temperature at the upstream inputs. Since the model is run until convergence on a solution, the only effect that initial conditions have on the solution is the number of iterations required to reach convergence.
2. Explicit finite differencing
3. DEQ staff derived the explicit form. It can be found at the following website: http://waterquality.deq.state.or.us/wq/HeatSource/HeatSource.htm.
4. DEQ staff wrote the code. The solution methods were taken from Applied Numerical Methods (Wiley, 1969).
5. Visual Basic
6. Double-precision floating-point variables with 8 bytes that span the real value range of -1.79769313486232E308 to -4.94065645841247E-324 for negative values; 4.94065645841247E-324 to 1.79769313486232E308 for positive values
7. Stability requirement is: $dX \geq UdT$ (where U is local velocity). In terms of veracity, accuracy and model performance, see page A-86.
8. See Answer #7.
9. $\Delta X = 100$ m and $\Delta T = 60$ seconds
10. Not calculated
11. Not calculated
12. Approximately 96 miles
13. The finite differencing grid is continuous over the simulation length (96 miles).

14. The maximum time length simulated is user defined. The model takes five days to reach convergence. So, five days are required at a minimum.
15. The model is very insensitive to initial conditions when allowed to run to convergence.
16. Yes the model handles stream temperature cooling and yes, it has been verified.
17. The model has never predicted a temperature that would fall below freezing or above boiling temperatures.
18. The model has been run between June and October. It has accurately predicted temperature during these times.
19. In terms of predicting temperatures on other days of the year, see Answer #18. Detailed analysis is presented in the TMDL in Appendix A that demonstrates that the methodology is sound, scientifically accepted and provides results that will be used for making decisions about how to manage the stream environment every day of the year. Further, this analytical work completed in the TMDL confirms the conclusions of other research efforts that have been completed in the Upper Grande Ronde Sub-Basin (Chen, 1996).

48. Question: What is the cause of longitudinal heating?
Answer: The heat transfer processes that control stream temperature include solar radiation, longwave radiation, convection, evaporation, and bed conduction. This is discussed under "Heat Energy Processes" beginning on page A-74.

49. Question: Does DEQ recognize the influence of "adiabatic" process as elevations change?
Answer: Yes. This is accounted for in the analysis.

50. One commenter asserts that the temperature model used by DEQ shows that "…at the predicted rate of 'longitudinal heating', the water in a river would reach a boiling point after 200 miles. The results are ridiculous. Verification of the model suggests that we should notice the Columbia River boiling as it spills over the dam at Bonneville or even before."
Answer: If the analysis did show longitudinal heating of the water resulting simply from its distance from the headwaters, and resulting in boiling water after 200 miles, that would indeed be ridiculous. DEQ can not determine how the questioner arrives at this conclusion. The actual output of the model is provided in the TMDL documents under review. Figure 3 on page 16 displays the current modeled temperatures and the modeled site potential temperatures. Under no scenario does the model predict a temperature greater than 85 degrees F. It is also important to note that the modeled longitudinal heating is not a smooth continuos increase in temperature as one moves from headwaters down stream. The validation of the model is shown in Appendix A. Figure A-58 on page A-86 compares the predicted spatial temperature to the actual observed data. It can be seen that the two correlate extremely well with an average deviation of less that a degree and a half.

51. Question: The questioner asserts that temperature model used by DEQ contains an equation to predict the percent shade required to cool streams. It is suggested that the writer used the equation to "demonstrate that with 100% shade (night) all streams would have an overnight water temperature of 54 F."
Answer: An equation to predict shade required to cool streams is eluded to but not provided. The fact is that there is no such equation in DEQ's analysis. The validated model employed by DEQ does predict the water temperature that would result under varying conditions. One in-put condition that can be varied is percent effective shade. This is an important distinction. Percent effective shade is an in put to the model. The model then predicts the resulting temperature (out put). The model does not predict the amount of shade needed to cool water as asserted by questioner. As mentioned in the answer to 51 above, the validation of the model is given in Appendix A. That appendix also contains the governing equations of the model. No equation or algorithm to "predict the percent shade required to cool streams" is included nor is DEQ aware of any such equation.

52. Question: What is the protocol for measuring density as it is used in the term "assumed density?"
Answer: Density is the percent ground area covered by shade-producing vegetation when looking downward upon the area of interest (i.e., canopy cover). Current condition vegetation densities were obtained from Landsat satellite vegetation data and aerial photograph interpretation. Based upon this analysis, 80% site potential density is attainable and has been attained in mature undisturbed stands.

53. Question: What is the protocol for measuring % effective shade?
Answer: Percent effective shade can be measured at the stream surface using a Solar Pathfinder®.

54. Question: What are the standards for beneficial use in addition to temperature?
Answer: All of the state water quality standards are developed to protect beneficial use. See **Appendix D - Applicable Water Quality Standards and Criteria** in **the Upper Grande Ronde River Sub-Basin TMDL**. Or refer to the Oregon Administrative Rules compilation on the internet at the following URL:
http://arcweb.sos.state.or.us/rules/OAR_default.html

55. Question: What is DEQ's intent relative to whether or not areas will have to receive anthropogenic activities to compensate for non-anthropogenic activities (planting trees in the riparian area after a fire)?
Answer: There are some areas of the Grande Ronde River Sub-Basin that may require active restoration (i.e., tree plantings) to initiate the progression to site potential conditions. Conversely, there are some areas of the sub-basin where riparian trees currently exist and removal of anthropogenic activities will enhance progression to site potential conditions.

56. Question: What is DEQ's intent relative to whether or not areas will have to receive anthropogenic activities to compensate for previous anthropogenic activities (planting tress in the riparian area that does not meet the shade specification)?
Answer: See answer to number 55.

57. Questions related to the WQMP Element 3.2.1 Transportation Sources: Are their riparian areas near roads in high priority places where shade-producing vegetation should be planted or protected? Are there opportunities to reconnect surface and ground water and/or restore flood plain function? Are the opportunities in the valley to design or replace stream crossings so that sinuosity is increased? What about removal of problem roads? What about timing of scraping county ditches?
Answer: There undoubtedly are opportunities to address many of the issues raised in the questions. It is the intent that the evaluation of transportation practices described on page 56 under transportation sources will identify and prioritize these opportunities. Within six months of implementation of the plan a committee is expected to "identify and inventory localized transportation related "hot spots" such as stream bank stability problems associated with road, problem native surface roads that are major sediment sources, improperly sized or maintained culverts, roads that are seriously constraining a stream, etc."

58. Question: With regard to WQMP Element 3.2.2 Municipal Sources, Is Oregon Goal 5 applicable here and would implementing it help achieve some of the Element 1 priorities?
Answer: Yes. It is anticipated the evaluation of city and county ordinances will include consideration of Oregon's landuse planning goals and related ordinances.

59. Question: With regard to WQMP Element 9, Maintenance of Effort, would an interagency committee that meets as infrequently as once per year have a detailed enough working knowledge of the overall plan to recommend needed changes and the authority to do so?
Answer: The referenced committee overlaps the membership of the committee and agency advisors that developed the WQMP. It is also made p of representatives of the entities identified as responsible participants in Element 5. It is anticipated that the staff involved will be day to day participants in the implementation of the plan. They have the authority to carry out the responsibilities identified in Element 5.

60. Questions with reference to a decrease in site potential temperature below the State Ditch: Is that strictly a function of a shade potential assumption? If so, does that imply that shade can cool water as it moves downstream? If so, what is the basis for that assumption? If the modeled decrease is a function of a tributary input, what were the volume and temperature inputs of the tributary? Are these measured or, again, are they simply assumed?
Answer: Directly below the State Ditch, Catherine Creek is assumed to be entering the Grande Ronde River with a maximum diel temperature of 64^{o}F. Flow volume of Catherine Creek was maintained the same as the day that the model was calibrated to

(approximately 10 cfs measured at the mouth). Catherine Creek decreases the Grande Ronde temperature approximately 5^{o}F. Downstream of the Catherine Creek confluence is a large pool. This slow-moving, deep pool was accounted for in the model, and explains the second temperature decrease 57^{o}F.

61. Question: Ground water inflows are assumed to be zero. Why? Is that realistic in a heavily irrigated valley?
Answer: FLIR imagery is extremely useful for locating stream segments where ground water is having an impact on stream temperatures. Every frame of the Grande Ronde River FLIR imagery was examined, and there were no locations where ground water or saturated riparian soils were measurably cooling Grande Ronde River temperatures. Thus, ground water was assumed to be zero in the modeling effort. There may have been diffuse groundwater contributions to the Grande Ronde River, during the time FLIR was flown; however no effects on stream temperatures were observed.

62. Question: How does the statement page A-5 "Maximum daily temperatures occur during afternoon and early evening periods when heat energy delivery peaks" justify the assumption in the model that direct solar radiation is the primary influence on water temperature and the only one worthy of modeling?
Answer: There is no assumption that direct solar radiation is the only influence on water temperature that is worthy of modeling. In fact, the discussion of the conceptual model and governing equations included in Appendix A describes all of the heat energy processes that are included in the model.

63. Question related to the statement on page A-27 that percent effective shade is the most straightforward stream parameter to monitor/calculate. The assertion is then made that this is not a justification for using "effective shade" as the sole parameter to use as a management objective.
Answer: This TMDL does not use effective shade as the sole parameter to use as a management objective.

64. Questions: With reference to composite vegetation dimensions on page A-47, What is 80% potential vegetation density? On what basis is 80% assumed?
Answer: See answer to question #53.

65. Question related to channel width on page A-49. The questioner suggests that "rather than having a basis in research results, the number 10 in PACFISH was product of fisheries biologists…" The suggestion is then made that because this is not a research document it should not be used to justify regulating specific channel characteristics.
Answer: While the PACFISH target of 10 is discussed in the channel width section of Appendix A, it is not used to regulate specific channel widths in the TMDL.

66. Questions related to the discussion of the correlation between sediment and riparian vegetation types, does the last paragraph on page A-52 imply that gravel

substrate is the result of having woody riparian vegetation? Could it be that the reverse is actually the appropriate relationship?
Answer: No and yes. The discussion referenced merely acknowledges the demonstrated correlation between vegetation type and substrate type. There is no speculation as to cause and effect in the discussion nor would that be appropriate or relevant to the context of the discussion. The point is simply that "established deciduous/mixed/conifer riparian vegetation types correlate with higher median gravel substrate."

67. Question related to large woody debris discussion on page A-53. The questioner asserts that "this appears to be a uniform recommendation, not based on site characteristics. If done in the wrong places or improperly in appropriate places, this recommendation will have the same long-term results that the former recommendation by fisheries biologists (i.e. cleaning woody debris out of streams) has had."
Answer: DEQ agrees that woody debris should be placed properly. There is no implication in the referenced discussion that would imply large woody debris should be placed indiscriminately in "the wrong places or improperly in appropriate places."

68. Questions: Page A-54 It is stated that the lowest mainstem flows occur during late September and early October. Are temperatures at their highest at that time? Are water temperatures above the "standard" at that time? Are relationships between flow volume, vegetation, channel characteristics, etc. perhaps more complex than this draft TMDL suggests?
Answer: Stream temperatures can be high in late September and early October. Whether or not they are at their highest would depend on the year in question. Temperatures in excess of the criteria in the state water quality standard can occur at that time. DEQ believes the analysis used in the TMDL has accounted for the complexities in the relationships between flow, vegetation, and channel characteristics to a very high degree as demonstrated by the validation of the model.

69. Questions related to the statement on page A-76 that net transfer of heat via long-wave radiation usually balances so that the amount of heat entering is similar to the amount of heat leaving. Is the statement made to discount the influence of long-wave radiation on stream temperature? …has long-wave radiation been adequately factored into the influence of "effective shade" versus other potential influences on stream temperature?
Answer: The statement is not made to discount but rather is made to document that the referenced citations have found this to be the case. DEQ believes long-wave radiation has been adequately factored into the analysis.

70. Questions related to potential vegetation estimates on page A-82. Did DEQ simply accept ODA (who in ODA?) suggested potential heights for black cottonwoods, or did DEQ verify that the assumptions are valid for the Upper Grande Ronde Sub-Basin? What makes a soil characteristic best, better, or good? Is it possible there are reaches with riparian and/or terrace soils that are not conducive to black cottonwood growth, or that would require significant cultural

inputs such as transplanting, irrigating, and controlling competing vegetation? If so, have potential costs and problems with those activities been evaluated?
Answers: DEQ verified the information included in the reference provided as well as other references. This includes not only information on potential heights but also on former abundance in the Grande Ronde Valley, preferred climate, soils, topography, and associated species. Key findings and additional citations will be added to the TMDL documents. As additional information comes in it, too, can be included and changes can be incorporated as necessary through the adaptive management provisions of the TMDL and WQMP.

Best, better and good descriptors were used to identify soil groupings. These designations will be changed to category 1-3 to avoid the impression of value judgement. The categories are listed below with examples of soil types included:

Category 1

La Grande silt loam – deep-rooted plants suitable where drainage is adequate.
Alicel fine sandy loam – rooting depth 60+ inches, well suited for planting trees
Alicel loam – well suited for growing trees

Category 2

Catherine silt loam – Deep but somewhat poorly drained
Veazie-Voats – moderate depth, well drained, rooting depth 20-40 inches.

Category 3

Conely silty clay loam – rooting depth 18-30 inches, dense clay below.
Hot Lake – old lake basin, compact, high pH.
Hooly – restricted root depth, elevated pH.

It is probable (nearly certain) that specific sites exist that are not conducive to black cottonwood growth without "cultural inputs." The Agricultural Water Quality Management Area plan, which is the agriculture component of the WQMP to implement this TMDL, has not yet addressed specific actions, costs, or problems associated with riparian vegetation restoration.

71. Question: On page A-82, on what basis are tributary temperatures assumed to be below 64 degrees F?
Answer: The State temperature standard has a basic absolute criterion of 64^{o}F.

72. Question: On page A-83, where does sinuosity .1.7 come from? What is the basis?
Answer: The old Grande Ronde River channel (approximately 32 river miles) that was circumvented by the State Ditch can be seen in aerial photographs. The old channel, part of which is currently the lower section of Catherine Creek, had a sinuosity of 1.7.