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**STATE OF CALIFORNIA**

**STATE WATER RESOURCES CONTROL BOARD**

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| In the Matter of:<br><br>CACHUMA PROJECT HEARING, PHASE 2 UNITED STATES BUREAU OF RECLAMATION APPLICATIONS 11331 AND 11332 | TESTIMONY OF MARCIN WHITMAN, ASSOCIATE HYDRAULIC ENGINEER |

## TESTIMONY OF MARCIN WHITMAN

I, Marcin Whitman, provide the following written testimony under penalty of perjury in relation to the State Water Resources Control Board's Cachuma Project Hearing, Phase 2, United States Bureau of Reclamation Applications 11331 and 11332.

**Q1: Please state your name, your position, and outline your educational and professional qualifications and background.**

1. My name is Marcin Whitman. I am an Associate Hydraulic Engineer with the California Department of Fish and Game ("DFG"). For the past five years, I have worked on coastal fish passage and river restoration projects on behalf of DFG, based out of our agency's Sacramento headquarters. I have provided engineering expertise on projects such as fish passage facilities at dams and debris basins, passage facility refurbishing and modification, dam removals, and redesigning road crossings that act as fish passage barriers.

2. I hold a Master of Science degree in Agricultural Engineering from the University of California at Davis, with a specialization in aquaculture engineering.. In addition, I hold a Bachelor of Arts degree in Biology from the University of California at Santa Cruz, with a specialization in marine biology. Finally, I hold a Bachelor of Science degree in Naval Architecture and Marine Engineering from the Webb Institute of Naval Architecture.

3. I am a licensed civil engineer in the State of California, License # C52922.

4. During my professional career, I have developed significant knowledge of fish passage requirements. Specifically, I have a working knowledge of fishery management principles including river hydraulics, swimming and migration behaviors of fish, and the latest engineering and fish passage principles. This knowledge was developed during the performance of dozens of projects on behalf of both DFG and the National Marine Fisheries Service ("NMFS"), where I was the lead engineer for the Southwest Region for nearly nine years. My work for both of these agencies have involved me in the lead role on conceptual design and/or reviewing design work of others for compliance with fish passage requirements, guidelines, and criteria. I have provided engineering design or design review on the following projects: a) Potter Valley Project, Federal Energy Regulatory Commission ("FERC") Project 77; b) DeSabala-Centerville, FERC Project 108; c) Red Bluff Diversion Dam, fish passage facilities and experimental pumping station; d) Glenn-Colusa Irrigation District fish screen; e) Reclamation District 108 fish screen; f) Anderson-Cottonwood Irrigation District Dam ladders and screens, including Bonnyview fish screens; g) Maxwell fish screens; h) Harvey Dam ladder and screen; i) Freeman Dam ladder and screen; i) Robles Dam ladder and screens and k) Keswick Stilling Basin.

5. I have offered my engineering expertise during public testimony on numerous occasions, including but not limited to: a) testimony at a United States Senate briefing on fish passage and dams during a presentation on dams and rivers by the Aspen Institute in July, 2003;

b) participation in a United States Congressional Office of Technological Assessment discussion and report on experimental technology in fish passage; and c) testimony on behalf of NMFS during litigation regarding the installation of new fish screens at the Glenn-Colusa Irrigation District's point of diversion on the Sacramento River.

6. I have participated in the design and execution of feasibility studies for fish passage at dams. In particular, I have participated in such work on San Clemente Dam, Los Padres Dam, Keswick Dam, Anderson-Cottonwood Irrigation District's diversion dam, several dams associated with the Battle Creek FERC project, and others.

7. My curriculum vitae is attached as **DFG Exhibit 8**.

**Q2: Have you read the October 2, 2000 report prepared by the Santa Ynez River Technical Advisory Committee ("SYRTAC"), Upper Basin Work Group, entitled, "Upper Basin Actions for the Protection and Enhancement of Southern Steelhead in the Santa Ynez River," included as Appendix E of the Lower Santa Ynez River Fish Management Plan?**

8. Yes, I have.

**Q3: Are you familiar with Section 4 of that report relating to fish passage around Bradbury Dam?**

9. Yes, I am.

**Q4: In your opinion, is that evaluation adequate in regards to making a final determination as to the feasibility of providing fish passage around Bradbury Dam? Explain.**

10. No. It is clear that Appendix E is not, nor was it intended to be, a comprehensive and conclusive study. Instead, it serves as a quick and cursory exploration of the fish passage issue. In its brief inquiry, it does identify several potential challenges. However, by not going the next step and attempting to identify solutions to these challenges, it fails to adequately address the issue of upper basin passage.

11. Section 4.2 of Appendix E is an example of the overall slant and brevity of the report. It mentions that an Alaskan Steeppass should be the proposed ladder type, but there is no mention of how this option was selected from among the variety of ladders types. We are left with the presumption that it was selected for slope and cost. However, this is not specifically stated. Given implied concerns of difficulty, for example, a pool-to-pool ladder, which would afford the fish an opportunity to rest at any point along the way, might be more appropriate.

12. One of the obstacles identified in Section 4.2 is that the possible addition of a fish ladder "must not jeopardize the stability of the dam itself." While this is certainly true, the likely mass of a fish ladder compared to the dam itself makes this a tertiary concern. Section 4.2 concludes that construction would present "serious technical challenges." This is most likely true. However, Appendix E then makes the conclusion that the action is therefore technically infeasible. In my opinion, this is a leap. There are not even rough estimates of the costs of possible options and solutions to back this conclusion. The United States Bureau of Reclamation ("Bureau"), U.S. Army Corps of Engineers ("Corps"), and the Department of Water Resources ("DWR") would have built very few projects if they were turned back based solely on significant technical challenges.

13. Section 4.3 of Appendix E casts further light on the cursory nature of its exploration of fish passage. It states that an 86 foot high ladder "may be difficult for adults to successfully negotiate." This assessment is not supported by any further data or other information. Indeed, it goes against the grain of current successful passage projects. For example, there is an equally tall fish ladder at San Clemente Dam on the Carmel River in Monterey County. It was built based on older and inferior technology and has several problems with its exit and entrance conditions as well as hydraulics, pool-to-pool, and operational concerns. Yet, for all of its known faults, it has demonstrated annually that it regularly and successfully provides steelhead passage.

14. Section 4.3 also raises the issue of a ladder requiring major engineering modifications to Bradbury Dam. However, this section does not contain even a rough sketch of what those modifications would be. There may be several ways, some not mentioned in the report or as yet used, to accommodate reservoir level fluctuations.

15. Section 4.5 of Appendix E raises many concerns with trap-and-truck operations without giving an equal emphasis to the benefits of providing an expanded range for steelhead. It also fails to mention the ability to overcome those concerns. The main technical obstacle, according to this section, is vehicular access due to poor road conditions. Poor road conditions can certainly be overcome. In addition, combined truck and boat options could be explored. When there was a similar concern for critically low stock numbers of winter-run on the Sacramento River, steelhead on the Carmel, and other fish stocks in the northwest, supplementation and captive breeding programs were explored as options. Such solutions are not investigated here.

16. The section on institutional concerns is short on being solution-oriented. It also quotes DFG trap-and-truck policy out of context. Similar institutional concerns have been worked out elsewhere when it would clearly result in the best course of action for protection of the resource.

17. Based on the above examples, it is my opinion that the exploration in Appendix E of the FMP is too cursory to stand as an adequate fish passage feasibility study. In fact, the SYRTAC implies that Appendix E is not a comprehensive or conclusive inquiry into passage around Bradbury Dam. It states that the "Adaptive Management Committee will continue to investigate opportunities to provide passage for steelhead around Bradbury Dam." If Appendix E was indeed sufficient, there would be no need to go any further.

**Q5: Please describe what you believe are the elements of a proper feasibility study for fish passage around Bradbury Dam.**

18. The first element of a proper study would be proper study design. It is critical to clearly articulate a defined goal and course of study at the beginning of the investigation and periodically revise this roadmap in the course of the study. Integral to this outlined course is scheduling, cost estimates for the study, and identification of funding sources and in-kind services. Equally critical is selection of staff and establishment of a management process. As with any other large engineering design process, the design of a large fish passage facility is an iterative approach where a design spiral is used to focus in on a final solution. Often, especially with an innovative design or unusual site, the solution is not approached directly but involves backtracking to re-examine past assumptions or avoid dead ends.

19. The second element of a proper fish passage study is acquisition of primary data, including such elements as historic and anticipated run timing, historic and anticipated hydrology, and various site information. There are several standard sources to help identify data needs.[1] In addition, Cindy Watanabe (also an Associate Hydraulic Engineer with DFG) has made a checklist for smaller projects and much of it is applicable to larger fish passage projects as well. **DFG Exhibit 9**.

20. A concurrent element of a proper study is the familiarization of staff with the project site and the identification of the main problem or need. In formation of a problem/need statement, it is important to anticipate interaction of fish passage alternatives with other anthropogenic and natural channel activities and events. Staff should have a good working

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[1] Bates, Ken, Fish Passageway and Diversion Structures, Fish and Wildlife Academy Coursebook (1997); Bell, Milo, Fisheries Handbook of Engineering Requirements and Biological Criteria, U.S. Army Corps of Engineers, North Pacific Division (1990); Clay, C.H., Design of Fishways and Other Facilities (1995); Collins, N.H. and Gillis, G.F., Upstream Fish Passage, Canadian Electrical Association (1985); Katopodis, C., Fishway Reference, Freshwater Institute, Dept. of Fisheries and Oceans, Winnipeg, Canada (1990); Bonneville Power Association and American Fisheries Society, Bio-Engineering Section literature.

knowledge of the project site and an overall understanding of the basin. It is important that the passage problem be understood on a watershed level so that such issues as fish, sediment, and debris routing can be taken into account.

21. Usually, the next element will be a brainstorming of possible alternatives by an informed technical staff. The goal of this exercise is to get the fullest possible scope of alternatives on the table. It is often helpful to include a moderator and/or additional experts who are not on the team but can help stimulate a creative discussion. Such brainstorming is usually followed by a culling process which identifies the top several candidate alternatives to move forward with. During the selection of alternatives, it is helpful to identify assumptions made in this selection so they can be checked later. From this point, there should be an identification of data gaps and research needs. Following such identification, there should be an attempt to satisfactorily answer any questions raised in order to make a management decision. The alternatives should then be developed, discussed, and ranked. During development, care is taken to check the alternatives against the current problem/needs statement as well as checking and articulating assumptions. Several of the alternatives should then be developed to a point where a cost estimate for preliminary and final design, permits, bids and construction can be made. Finally, a selection of the top two or three alternatives are made. These alternatives then proceed to preliminary design.

22. Proper staffing is also an important element. On a project of the scale and with the unique requirements of Bradbury Dam, it is important to have technical staff supplied by the owners and operators of the dam as well as recognized experts in fish passage with a history of completing projects of this potential size. Often, a member with a solid background in fluvial geomorphology proves useful. Additional input and/or team staffing from consultants and

academics is common as well. It is important that the project get peer reviewed after critical decision steps – especially if it is a small team. Usually, there is a management team representing the various interests as well as a technical team which it directs.

23. In terms of process, the management team must establish regular meetings and open lines of communication amongst study staff. Early in the process, the study plan is presented to the management and technical teams. This study plan is periodically updated and reviewed with both teams. Because staffing for fish passage projects is often limited, it is usually helpful to have regularly scheduled meetings for technical staff so that it is locked into their schedule. Obviously, the management team needs to provide good oversight and respond to new information provided by the technical team. It is imperative that good lines of communication be established between the technical and the management team, protocol for communication established, and a lead person for each team identified.

24. Such a study process, as I have outlined above, is usually followed by the successful execution of a successful fish passage project. Such studies and construction efforts have been successfully performed at several Bureau facilities in California in the past twenty years, such as at Keswick Dam, Red Bluff Diversion Dam, and others.

**Q6: Please outline any potential pitfalls that, in your opinion, must be avoided in order to complete a proper fish passage feasibility study.**

25. Probably the most important pitfall to avoid is proceeding into a study with a lack of an earnest desire to achieve the study's goal. The engineering staff of the Bureau have a long history of pushing the state of the art in dam-building and more recently have continued that tradition in the building of fish facilities, especially amongst their research staff in Denver, who have done significant hydraulic modeling and concept development for many projects in the

western states – including successful Bureau projects in California such as Keswick Dam, Red Bluff Diversion Dam and others. All of these state of the art projects were characterized by a genuine desire to achieve the ultimate goal. Staff members were not intimidated by the difficulty of these projects. Instead, they invested sufficient time and resources into putting the projects in place.

26. A second pitfall to avoid is exploring a scope of alternatives that is too narrow. Unconventional problems demand unconventional solutions. In the case of fish passage at Bradbury Dam, such options as fish ladders, lifts, elevators, bypasses, trap-and-truck and associated collection facilities, a combination of these, and the exploration of yet-to-be-conceived alternatives should all be explored.

27. The premature dismissal of possibly valid concepts should also be avoided. Oftentimes, one or two alternatives will appear to be the easiest solution. What first sorts itself to the top of the pile may remain there based more on momentum than merit. However, as options are developed, the difficulties are often found as the concepts become more refined. Overcoming discovered difficulties needs to be weighed against retracing steps and re-examining alternatives with problems that were more immediately apparent but perhaps more easily remedied.

28. The dismissal of a concept due to lack of existing precedent should also be avoided -- especially in a potentially pioneering project such as fish passage around Bradbury Dam. Specifically, concepts should not be dismissed based solely on the fact that they have not been done before. Although proven concepts rightfully have allure to engineers, pushing the state of the art means carrying forward or furthering a concept or persisting in the pursuit of a new alternative. As in all fields of engineering, the field of fish passage goes through constant development and improvement. There are several examples of fish passage projects in California

that, at the time of construction, were unprecedented or pushing the state of the art. Such examples include:

- *Potter Valley Project (FERC #77)*. NOAA Fisheries' policy for the passage of juvenile salmonids does not normally allow for the pumping of fish due to concerns for injury. However, at Potter Valley, agency staff were convinced that the site required the use of a pump. A modified Archimedes pump was tested and eventually used on an experimental basis. Since then, there have been a few more pumped passage facilities built in California. There were other cutting-edge aspects of this project as well. Other innovative aspects of this project were design and testing of a pneumatic cleaning system for vertical inclined fish screen with attention to unique debris loading characteristics of this site, physical modeling of unique hydraulic features of the diversion intake and the fish bypass, and the inclusion of a sediment trap to accommodate the transitionally high sediment loads of this site.
- *Glenn Colusa Irrigation District Fish Screens*, Sacramento River. This required the reshaping of the screening bay and the bypass channel downstream of the screens as well as the longest set of flat plate screens ever built. Another unique feature was a gradient control structure spanning the entire channel of the river. Development of the grade control necessitated extended research and modeling both for physical stability, constructability and acceptable hydraulics for fish and boat traffic in the Sacramento River.
- *Red Bluff Diversion Dam*, Sacramento River. This project had the largest diameter fish screens ever placed at that time. With four bays of eight screens it also represented one of the largest diversion facilities and a complex bypass system including a terminus that

crossed three-quarters of the mainstem river to take advantage of carefully studied and modeled river hydraulic conditions. Later, an experimental pumping plant was built at this dam, which, combined with seasonal removal of the dam and reservoir, provided a creative solution to improving passage for endangered winter-run Chinook salmon.

- *Parrot-Phelan Dam*, Butte Creek. This included the first pool-chute ladder placed in California. This type of ladder was a recent innovation in the northwest but was extended in length in application at this site. A series of physical model tests were carried out to address momentum concerns about this extended length. This low-maintenance type of ladder has now also been used by Anderson-Cottonwood Irrigation District and is being considered for other California sites.

As illustrated by these examples, innovative new concepts or designs that are pushing the state of the art with existing technology often need new exploration, development and testing.

29. Concepts should not be dismissed solely because some testing is needed to close data gaps. Conversely, premature launching of experimental technology often does that technology a disservice in the long run. A deliberate measured approach, such as is outlined the policies of NOAA Fisheries or AFS Bio-Engineering Experimental Technology, is recommended. Much of the concern with ladder length is based on experimentation that was done by the Corps in the late 1960's. It may well be time to revisit and expand on those studies.

30. A final pitfall to avoid is the premature dismissal of an alternative due to the fact that public agency policies appear to conflict with the alternative. These policies can be adjusted when necessary. The chief goal of the policies of the fisheries agencies is to provide an easy roadmap for a routine project. As we have seen above,' the fisheries agencies, as well as other public agencies, have been open to exceptions to a standing policy when there has been a

compelling need to accommodate an unusual circumstance and a reasonable alternative is proposed. For example, DFG generally disapproves of trap-and-truck passage as mitigation for new facilities. This is because a) it does not provide a continuous passage system allowing the fish to move on their own volition without being handled; and b) because there has been a poor history on operation in maintenance on trap-and-truck facilities in past. However, there are some such facilities in operation around the state because it is currently the best solution for those particular sites. Bradbury may very well prove to be one of those exception sites as well, but only a thorough, deliberate feasibility study/alternatives analysis will answer that question.

**Q7: In your opinion, should the possibility of significant expense and effort be determining factors in deciding whether to pursue the study of the feasibility of fish passage around Bradbury Dam?**

31. No. Generally, a determination as to whether to pursue the study of the feasibility and construction of fish passage facilities should turn on the importance of the project in question and the level of need for fish passage. Expense and effort, in and of themselves, should not, in my opinion, be ultimate determining factors.

32. I have personally worked on many water projects in the state where the significance of the projects and the importance of fish preservation have justified the study of and construction of fish passage and/or preservation facilities despite significant expense. Some of these examples are as follows:

- *Red Bluff Diversion Dam.* This dam is one of the main diversion points on the Sacramento River for the Bureau. Prior to installation of the project, there was a considerable level of mortality to many runs of juvenile salmon and steelhead and strong delays in adult passage under moderate river flows. Installation of drum screens cost around $14 million; installation of an experimental pumping plant cost around $10 million;

- *Shasta Dam.* This dam provides substantial water storage and acts as the keystone of the Central Valley Project. Prior to the installation of a temperature control device, high temperature releases were causing sizeable mortality to winter-run salmon eggs and fry. Installation of the device cost around $50 million;
- *Glenn-Colusa Irrigation District Diversion.* Around one fourth of the Sacramento River is diverted at this point, a major source of water for irrigation in the region. The old fish screens at the diversion were causing substantial predation, impingement, and entrainment – resulting in huge losses to fish. Reconstruction of fish screens and associated grade control at this diversion cost around $76 million;
- *Anderson-Cottonwood Irrigation Dam.* This dam supplies significant domestic and irrigation water for the Redding, Anderson, and Cottonwood areas. Prior to reconstruction of the screen and ladders, there was very poor passage of winter-run salmon. Only a small percentage of the run was able to pass beyond the dam. Reconstruction of the fish ladders and screen cost around $18 million.
- *Reclamation District 108 Fish Screen.* This diversion point supplies substantial amounts of irrigation water to areas downstream of the Colusa area. Prior to installation of the fish screen, significant losses of juvenile salmon and steelhead were occurring. This screen cost around $12 million.

Clearly, fish passage or protective facilities can represent a significant expense and effort. However, all these projects were implemented despite such apparent obstacles due to the relative importance of the project to the area and the significance of the fishery issues involved.

33. In regards to the Cachuma Project, it is an operation of significant importance that has provided substantial benefits to the people of the south coast and the rest of the state throughout its 47 year history. Water is provided for irrigation, domestic, municipal and industrial needs and average deliveries since 1991 have been 27,000 acre-feet a year. (COMB/Bureau, 2003) In addition, the impoundment itself has provided recreational uses and supported businesses catering to those uses. In my opinion, it is reasonable to assume that the benefits over the life of the project to date might be measured in the billions of dollars. The Bureau, DWR and the Cachuma Operations and Management Board ("COMB") have repeatedly affirmed the value of this project by allocating considerable resources to assure the project continues in good working order. A recent example of this was the $30 million seismic retrofit of the dam, the completion of the Coastal Branch of the California Aqueduct that was completed in 1997 at a cost of $500 million, as well as the current flashboard surcharge project and associated relocations.

34. It is crucial to the success of the Santa Ynez River steelhead run that effective passage around Bradbury Dam is accomplished. This is dictated by common sense and biological evidence gathered to date. The disruptive effect of a dam on the biological and natural processes of a river system is well documented in numerous publications.[2] DFG's *Steelhead Restoration and Management Plan for California* highlights the importance of this issue, stating that lack of passage at Bradbury is "probably the most significant limiting factor for steelhead" in the basin. The greatest quality and quantity of spawning and rearing habitat is above the dam. Moreover, the reestablishment of steelhead in this range would best provide for the natural interplay

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[2] Kanehl, P.D., Lyons, J., and Nelson, J.E., Changes in the Habitat and Fish Community of the Milwaukee River, Wisconsin, Following the Removal of Woolen Mills Dam, North American Journal of Fisheries Management 17:387-400 (1997); Mount, J., California Rivers and Streams, University of California Press (1995); Academy of Natural Sciences, Mamatawny Creek: Ecological Studies of Dam Removal (2002); Gephard, Stephen, Biological Issues at Dams, University of Wisconsin Course on Engineering Innovative Fish Passage: Dam Removal and Nature-Like Fishways (2002).

between resident and anadromous populations that is a vital part of the southern steelhead's survival strategy. The fact that Southern California ESU steelhead are listed as "endangered" under the Endangered Species Act ("ESA") serves to heighten the importance of passage.

35. In short, it is my opinion that the significance of the Cachuma Project and the pressing need for fish passage justify proper feasibility studies and potential construction of fish passage facilities or the potential implementation of fish passage operations despite the possibility of a significant expenditure of money, resources, and effort.

I, Marcin Whitman, declare under penalty of perjury under the laws of the State of California that I have read the foregoing "Testimony of Marcin Whitman, Associate Hydraulic Engineer" and know its contents. The matters stated in it are true of my own knowledge except as to those matters which are stated based on information and belief, and as to those matters as I believe them to be true.

Executed on October 15, 2003 at Sacramento, California.

By: MARCIN WHITMAN
Associate Hydraulic Engineer