Appendix A – Summary of AWWQRP Research Projects

Discharger Survey—Following completion of the Research Agenda and Research Plan, it was apparent that more effort was needed to characterize western dischargers and the water quality issues they faced. The RWG recommended that as many dischargers as possible be surveyed to obtain such information.

Using EPA's database the project identified 4,515 NPDES permits within the 17 western states. Of this permit pool, 1,001 permits were issued to major municipal dischargers and of these dischargers, 251 permits were issued in the arid and semi-arid portions of the 17 western states. Through the use of questionnaires and telephone interviews it was determined that 71 of the 251 permit holders discharge to ephemeral, intermittent or effluent dependent streams. Information was not available for an additional 37 permit holders that probably discharge to one of these stream types. This set of 71 dischargers represented the core of the survey and was used for additional analysis. Information was gathered to characterize water quality issues of concern to each discharger and the nature of each discharge, e.g., discharge rates, designated uses of receiving waters and the physical, chemical and biological characteristics of receiving waters. Although the issues of concern identified by dischargers ranged widely from specific chemical criteria to endangered species, three key areas were identified as common concerns: nutrient criteria, especially ammonia, chlorine and pesticides. Future potential issues were anticipated to include nitrogen (mostly ammonia), metals, dissolved solids and toxicity.

Habitat Characterization Study—Effluent-dependent waters represent unique aquatic ecosystems, aquatic environments that have been created as a result of the discharge of treated effluent to an otherwise dry or intermittent streambed. The Habitat Characterization Study represents the completion of a two-year effort to characterize the habitats of selected effluent-dependent waters across the arid West. It is believed that this effort represents the first attempt to focus data gathering efforts on this type of aquatic ecosystem.

The Habitat Characterization Study was commissioned to identify the physical chemical and biological characteristics that collectively structure the habitat of selected effluent-dependent waters. For the purposes of this study, effluent-dependent waters were defined as surface waters where treated effluent from wastewater treatment plants was being discharged into a normally dry streambeds or a stream that otherwise, in the absence of effluent would have had minimal flow during only part of the year. Also, for this study the term "habitat" was broadly interpreted to include all physical attributes, e.g., flow, gradient and substrate, and chemical attributes, e.g., effluent and ambient water quality, of the effluent-dependent water ecosystem that influence the biological response in both the aquatic and terrestrial components of the ecosystem.

Ten effluent-dependent waters, representing a broad range of ecoregions, watershed sizes and degrees of urbanization, were evaluated using historical and site reconnaissance level data to document ecosystem attributes. These sites serve as case studies of effluent-dependent waters in the arid West. As originally designed, a projected outcome of the Habitat Characterization Study was the establishment of a habitat characterization scheme based on the physical, chemical and

aquatic and terrestrial biological attributes of effluent-dependent waters. It was believed that this outcome could provide the basis for making decisions on how different types of effluent-dependent waters should be protected and regulated. However, as the project progressed it became apparent that effluent-dependent waters, as a whole, are a distinct class of waterbody, i.e., as a group, effluent-dependent waters share more in common with each other than with any other types or classes of waterbodies.

The finding that effluent-dependent waters represent a distinct waterbody class has significant implications with regards to the implementation of water quality programs in these created ecosystems. These implications range from potential limitations on what is biologically attainable in the aquatic community to the economics of wastewater treatment. Accordingly, as part of this final report, the project team presented results, not only from a technical perspective, but also from a regulatory and economic perspective. Specifically, the results of the review of historical and site reconnaissance data were presented to first ground the reader in the physical, chemical and biological characteristics of effluent-dependent waters. Subsequent to that presentation, the technical results were discussed in an economic and regulatory context that includes a recommendation that a specific designated use be established to recognize the uniqueness of effluent-dependent water ecosystems. The report closes with recommendations for future research to build upon the findings of the study.

The final report is essentially an electronic document. Although paper copies can and have been made, the primary document consists of an electronic CD containing the summary final report and a collection of appendices. The final report may be downloaded from the AWWQRP web site at http://www.co.pima.az.us/wwm/wqrp/index.html.

Extant Criteria Evaluation—National Ambient Water Quality Criteria (AWQC, or criteria) set maximum threshold concentrations of inorganic and organic contaminants for both freshwater and marine environments. These criteria are derived from empirical toxicity data and are designed to protect all but the most sensitive 5% of species in an aquatic community. AWQC can also be lowered to protect species in this lower 5th percentile if they are deemed ecologically, economically, or recreationally important. These AWQC are used for several regulatory purposes, including protection of beneficial uses and derivation of NPDES discharge permit levels.

One major difficulty in applying AWQC and their resulting local standards to surface waters across the U.S. is that they are derived chiefly from standardized toxicity tests (i.e., uniform types of water and laboratory exposure conditions) using aquatic species that may not be representative of the biota in arid streams of the western U.S. Because the physical and chemical characteristics of surface waters and aquatic community composition varies markedly in different regions of the U.S., AWQC cannot reasonably be expected to provide a consistent level of protection for all species and all surface waters. As reported in the Habitat Characterization Study, effluent-dependent and ephemeral waters in the arid West share a set of unique biotic, hydrologic, and geochemical characteristics that are distinct from waters in more mesic regions of the United States. These distinct characteristics are such that national AWQC may be either

over- or under-protective of these kinds of surface waters in the arid West, and thus may need to be re-evaluated for surface waters in this region.

The primary focus of the Extant Criteria Evaluation is to evaluate existing methods for generating water quality criteria, methods for site-specific modifications to criteria and, if appropriate, develop an approach for regional AWQC modification that takes into account the unique characteristics of ephemeral and effluent-dependent watercourses in the arid West. Four "model" AWQC, which represent different types of pollutants, were used as the basis for this evaluation: copper, selenium, diazinon and ammonia.

The approach to evaluating each "model" criterion consists of two parts. First, some of the most unique characteristics of ephemeral and effluent-dependent watercourses that warrant modifications to AWQC or their implementation are identified. Second, each of the main components of an AWQC (i.e., magnitude, duration, and frequency) are evaluated separately against these unique characteristics. The primary focus is to what extent the highly variable flow dynamics and harsh physicochemical conditions of ephemeral and effluent-dependent watercourses might impact AWQC components. In particular, the study evaluates whether modifications to the duration and/or frequency values are warranted owing to the complex hydrology and geochemistry of these systems as compared to conditions found in more "typical" waters in mesic regions of the U.S.

In addition to the evaluation of four model criteria, a pilot hardness toxicity study was done to evaluate the relationship between hardness and metals toxicity at hardness > 400 mg/L (as $CaCO_3$). For several metals, e.g., cadmium, copper, lead, silver and zinc, the mitigating effect of increasing hardness on toxicity has been incorporated into regulatory standards and criteria over a range of > 25 to < 400 mg/L (as $CaCO_3$). However, the applicability of this hardness-toxicity relationship in very hard waters, characteristic of many arid West watercourses, is unknown. To provide an initial evaluation of this data gap, a series of studies were conducted to determine the relationship between metal toxicity and water hardness at concentrations > 400 mg/L (as $CaCO_3$). For the purposes of these preliminary experiments, only a single metal (copper), and a single test species *(Ceriodaphnia dubia)* were chosen.

The final report for the Extant Criteria Evaluation will include a series of recommendations regarding the relevance of national AWQC for protection of aquatic life in ephemeral and effluent-dependent watercourses of the arid West. Recommendations will be developed for the following areas: (1) Alternative magnitude, duration, and frequency values for ephemeral and effluent-dependent watercourses; (2) general recommendations for AWQCs similar to the four "model" criteria being evaluated; and (3) alternative approaches for criteria/standard modification, derivation, or implementation.