

SAN JUAN CREEK WATERSHED MANAGEMENT PLAN



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Chapter I: Introduction

1.1 Purpose

The San Juan Creek Watershed Management Plan (WMP) was developed to promote activities in the watershed that will enhance watershed health. A watershed's health is dependent on the strength and sustainability of its resources, many of them dependent on water. A healthy watershed is one that will nourish human beings, wildlife, vegetative communities, physical resources, culture, economic development, and the needs of the community at large, while being sustainable for the enjoyment of all future generations. There are many activities that will promote sustainable health. These may be activities you might get involved in as an individual or as part of a larger group.

Although the entire group of documents, together with the appendices, looks like a stack of phonebooks, only some of it may be of interest or real use *to you*. The goal of this document is to make the watershed study products useful to you. The outline will direct you to information that you or your group, association, or agency can apply in this watershed to enhance positive attributes, or reverse negative trends that impact watershed resources.

If you need to locate a certain type of information, go to the outline and look for a topic. If you are just interested in learning about the watershed, keep reading this document, and then go to sections or appendices that might appeal to you, for more information. The appendices are great sources of detailed information.

The WMP is meant to be a “living” document. As new information is generated, it is anticipated that sections of the document will be updated and new sections added.

1.2 Report Outline

Watershed Management Plan: The WMP is an outline for the management of the watershed. It is a summary of all the work done in the main report and supporting appendices. The WMP contains the objectives of the study, the stakeholders and involved parties, a problem statement, a list of observed (by the public and agencies) package of watershed problems, a discussion on the issues associated with each, recommendations for treatment, recommendations for implementation and monitoring, public and agency coordination, and a list of references. The WMP is also accompanied by three appendices listed below.

Appendix A to the WMP – **Individual's Recommendations:** A guide to activities that YOU, as a home-owner or renter, a resident, visitor or business operator, can do to promote watershed health. This appendix contains the “Refrigerator List.”

Appendix B to the WMP – **Municipality/Neighborhood Association Recommendations:** A guide for municipalities, homeowner associations, neighborhood groups, and other small groups can use to promote watershed health.

Appendix C to the WMP – **Exotic Species Eradication Program (Recommendations):** A guide for environmental action groups, county and city employees, persons tasked with mitigation activities, and others in local government to promote watershed health.

1.3 Other Related Documents

San Juan Creek Watershed Management Study, Orange County, California – Feasibility Phase – F5 Report, (August 2002, (a.k.a. “The Main Report”): The main report is a document containing a description of the numerous decision-making processes that resulted in the “Recommended Plan.” It contains information on problems and opportunities and a summary of existing resources such as water (hydrology), floodplains (hydraulics), geology, soils, transportation, land use, and numerous other subjects. If you are interested in more detail on any of these subjects, take a look at the main report first, and if you are still interested in even more detail on the subject, it may be contained in one of the appendices.

Hydrology Appendix (Part of Volume 1 of the appendices): Contains information on peak flows (discharges) from flood events, low flows that exist in the channels during the remainder of the year, and what might be expected under different floods of varying frequency.

Hydraulics Appendix: (Part of Volume 1 of the appendices): Contains information on the hydraulic characteristics of the channel system and floodplains. This information is used to determine how water behaves in the channel, how it behaves if it breaks out of the channel, and its potential extent and depth once on the floodplain surface.

Engineering Design (Part of Volume 2 of the appendices): Contains the preliminary designs used in the analysis of alternatives for flood damage reduction and ecosystem restoration. The design plates illustrate the features of each alternative and are used to

determine material volumes, design issues, and cost estimates.

Ecosystem Restoration (Part of Volume 2 of the appendices): Contains details on the background, formulation, and features of each examined ecosystem restoration measure and the decision-making process that led to the selection of the National Ecosystem Restoration (NER) plan, which is recommended in the main report.

Real Estate (Part of Volume 2 of the appendices): Contains details on the preliminary studies determining real estate costs of each flood damage reduction and ecosystem restoration alternative.

Economics (Part of Volume 2 of the appendices): Contains a breakdown of the values of structures and property in the floodplains within the watershed. Provides an analysis of potential costs of structural and content inundation, emergency and clean-up costs under various flood event scenarios. Details the analysis that resulted in benefit-cost ratios, net benefits, and other economic indicators for each examined alternative.

Hazardous, Toxic, Radioactive Waste (Part of Volume 2 of the appendices): Examines, at a preliminary level, the potential issues related to hazardous, toxic, and radioactive wastes in the watershed for each site at which an alternative might be sited.

1.4 Objective of the Watershed Management Plan

The objective of the plan is to present a package of recommendations that can be acted upon by individuals, neighborhood groups, special interest groups, municipalities, the County, and the Federal government that will promote actions that result in the improvement of the health of the San Juan Creek watershed. The Watershed Management Plan (WMP) is intended as a decision-making tool to guide future activities in the watershed of San Juan Creek in such a way that watershed resources are protected or improved, economic development and quality of living can be maintained, survivability of resources are guaranteed,

and negative impacts are minimized. The central component around which this document is written, as appropriate for a *watershed* management plan, is that of water and water-related resources.

The Watershed Management Plan is not an ordinance or law, but should be used to determine what actions might be undertaken to positively affect water and related land resources. These activities might be used on a countywide basis to meet Total Maximum Daily Load (TMDL) requirements, which are being mandated as part of Federal requirements to improve water quality issuing from watersheds all over the country. They may also be used by City governments to develop local ordinances used in improving the quality of living within their communities. To this end, the activities discussed here are recommendations, developed by a consortium of Federal, State, and local agencies and others familiar with methods that can be used to improve watershed health.

Because most activities in a watershed may impact the waters contained in the watershed, or resources, which depend on those waters for their survival, most of these recommendations are geared toward positively affecting water quality, the environment, flood issues, and watershed resources.

Not all of these activities should be implemented by government, be it City, State, or Federal. Many things can be done only at the individual property level. Individuals should examine the recommendations to determine those that might be done within a household, residential or commercial property, or neighborhood. Homeowner's groups should also examine the list to determine

what activities they might undertake to contribute to a better quality of life within their immediate neighborhood, and consider their impact to areas downstream. After all, every activity can have a positive or negative impact. It is hoped that these recommendations might be implemented at all levels within the watershed.

1.5 Local Sponsors, Stakeholders, and Involved Parties

The feasibility phase of the watershed study has been formally cost-shared between the Corps of Engineers, Los Angeles District, and the primary local sponsor, the County of Orange, California. Orange County's share of study responsibilities is divided among several municipalities and utility districts. The feasibility study cost sharing sponsors are identified in Table 1.

All study partners contributed funding to meet the local sponsor cost-sharing requirements for the feasibility study. In addition to study funding, the County of Orange also contributed technical services. The Orange County Public Facilities & Resources Department (PFRD) was responsible for technical studies related to water supply and demand, recreation, and cultural resources.

Other technical responsibilities of the local cost-sharing partners included assistance in study tasks related to public involvement, environmental resources, real estate studies, and study management. In addition to their responsibilities as defined in the project study plan, all study partners provided valuable input and assisted with collection for nearly all of the watershed study tasks.

The study process was critically supported by the numerous individuals who donated their time to participating in the study process and provided vital contributions in defining the problems, developing solutions, reviewing documents, and in general, contributing to positive solutions to the many problems facing the watershed.

Table 1: San Juan Creek Study Partners

Study Partners	
<ul style="list-style-type: none"> ◆ County of Orange Flood Control District ◆ Orange County Transportation Authority ◆ City of Dana Point ◆ City of Laguna Hills ◆ City of Laguna Niguel ◆ City of Mission Viejo ◆ City of San Juan Capistrano ◆ Transportation Corridors Agency 	<ul style="list-style-type: none"> ◆ California Department of Parks and Recreation ◆ South Coast Water District ◆ Moulton-Niguel Water District ◆ San Juan Basin Authority ◆ Santa Margarita Water District ◆ South Orange County Water Authority ◆ Municipal Water District of Orange County ◆ Rancho Mission Viejo Company
Additional Study Participants	
<ul style="list-style-type: none"> ◆ Orange County Harbors, Beaches, and Parks ◆ Orange County Planning and Development Services ◆ City of San Clemente ◆ California Regional Water Quality Control Board ◆ California Coastal Commission ◆ Surfrider Foundation ◆ California Department of Fish and Game 	<ul style="list-style-type: none"> ◆ California Water Resources Control Board ◆ U.S. Forest Service ◆ U.S. Fish and Wildlife Services ◆ Resource Conservation Service ◆ Clean Water Now! Coalition ◆ Dana Point Harbor Water Quality Commission

Chapter II: Watershed Resource Issues

2.1 Problem Statement

The San Juan Creek watershed suffers from a number of problems related to water resources. Not all of these problems are human-induced. Some of these problems are only the response of a natural system to excessive rainfall, sediment fluxes, and other occurrences that are part of the evolution of a watershed. Some problems, like the loss of sand from area beaches, may not be caused by human interference, but simply by natural erosion by waves in the nearshore environment. This is not to say, however, that the problem does not need to be addressed. Even in natural systems that have insignificant human effects imposed on them, there may be things going on that are undesirable to an ecosystem, a body of water or stream reach, a species of bird, or a grove of trees. The recommendations made here contain no value judgments, but are directed toward maintaining or promoting a condition in which sufficient clean water is available for a variety of uses, that the water does not cause undesirable effects, and the ecosystems the water supports are maintained with a maximum of biodiversity and vigor. The recommendations are also designed to address potential negative effects of water, such as flood damage, erosion of desirable resources, and many other issues.

The San Juan Creek watershed contains unique and valuable resources. The problems in the watershed are not insurmountable. You can help in many ways.

2.2 Specific Problems

The San Juan Creek watershed is currently suffering from a variety of water resource and related land resource problems. Most of these are related to widespread changes in the watershed, including changes in the hydrologic regime, channel instability, habitat loss, ecosystem degradation, declines in water quality, threats to recreational resources, and others. While change is part of the evolution of any landscape, dramatic change from a balanced historic state often results in undesirable consequences. The San Juan Creek watershed has suffered several recent dramatic changes that are currently negatively impacting watershed resources. For example, channel downcutting, which is occurring as a result of both human and non-human influences, is negatively impacting infrastructure in the floodplain and riparian habitats, as well as other natural resources.

As part of this comprehensive watershed management effort, every opportunity was taken to solicit input from all individuals, parties, and agencies involved in the watershed to ensure a complete list of the problems impacting human beings, wildlife, and physical and intangible resources. Several public meetings, numerous stakeholder meetings, and many field trips resulted in the (unranked) list of observed problems shown in Table 2.

Table 2: List of Observed Problems

1. Flood Inundation Damage to Structures
2. Flood-Related Costs for Emergency Services, Clean-Up, and Flood fighting
3. Land Loss due to Erosion
4. Channel Instability and its Effects on Resources
5. Infrastructure Destruction by Surface Water Flow
6. Water Quality Problems in the Ocean Nearshore Environment
7. Surface Water Quality Problems in San Juan Creek Mainstem and Tributaries
8. Water Quality Problems in Groundwater Aquifer(s)
9. Loss of Floodplain Habitat
10. Loss of Riparian Habitat
11. Loss of Recreation Opportunities
12. Decline in Floodplain Moisture
13. Geotechnical Instability
14. Decline in Water Supply
15. Depletion of Sand Sources for Coastal Sand Replenishment
16. Higher Flood Peak Discharges for a Given Storm Frequency
17. Decrease or Disappearance of Aquatic Species
18. Decrease or Disappearance of Riparian (non-Aquatic) Species
19. Decrease or Disappearance of Floodplain (non-Aquatic) Species
20. Invasive Species
21. Declining Local Aesthetic Quality
22. Piecemeal Treatment of Problems and its Consequences
23. Excess Litigation Due to Watershed-Related Problems
24. Excessive Regulatory Actions
25. Degradation of Cultural Resources
26. Degradation of Habitat for Endangered and Threatened Species
27. Degradation of Surface Water/Groundwater Interface

Following development of this long list of problems, the watershed stakeholders group and other groups of interested participants convened to discuss how these problems

might be addressed, particularly in light of the multiple goals of the many stakeholders. Potential means and methods were also discussed as to how the larger issues in the watershed relate to where these problems originate and how they might be dealt with in an overlapping manner. The list was continually referred back to so that as many problems as possible were dealt with by the fewest means possible. Using this approach, input from stakeholders and the public indicated that the most severe problems in the watershed could be grouped as:

- ◆ Flooding and erosion damages
- ◆ General ecosystem degradation, including channel and floodplain instability
- ◆ Poor water quality, both in surface waters and the ocean nearshore zone
- ◆ Loss of habitat and associated wildlife loss

2.2.1 *Flooding and Erosion*

Flooding in the watershed may occur from either of two mechanisms: that of overtopping of the channel, or by undermining and failure of the levee system. To date, floodwater breakout has occurred only from the former mechanism, and only in the period prior to installation of the current levee system. However, during the floods of 1996, were it not for emergency levee reinforcement conducted by the County with assistance from the Corps of Engineers, levee failure may have well occurred. This flood undermined portions of the levee lining on both San Juan and Trabuco Creeks, causing collapse of the concrete lining, with subsequent erosion of the levee core. Dumped stone, placed during the height of the flood event, saved the levee from further erosion and potential failure. Had the levee failed, subsequent floodplain inundation would have occurred. This flood event, estimated as an approximately 4% exceedance (approximate 25-year) event, became the basis for the *levee failure* frequency used later in this study effort to estimate potential flood damages resulting from this type of failure only. Additional hydrologic and hydraulic studies conducted during this feasibility study, estimated the *overtopping failure* frequency at an approximate 2% exceedance (approximate 50-year) event, which is *rarer* than that estimated for the *levee failure* event. This

lesser failure frequency may be partly due to the increased channel capacity, which has resulted from channel downcutting and subsequent capacity increases that subsequently occurred. In its “as-built” configuration, the channel system would be considerably more resistant to failure by undermining, although it would also possess a lesser degree of protection from flooding due to channel overtopping given the levels of upstream development that have occurred.



Photo 1. Oso Creek - 1993

Erosion continues to plague many areas of the watershed, primarily those outside the existing levee system. In particular, the channels of Trabuco and Oso Creeks in their downstream reaches, have suffered phenomenal degrees of erosion damage in the last two decades. Erosion problems also exist on San Juan Creek and several smaller tributaries.

2.2.2 General Ecosystem Degradation

General ecosystem degradation has resulted from a number of factors. Development has replaced natural habitats with structures, roads, and other infrastructure. Natural channels have been replaced by drains, culverts, and engineered channels. Paved surfaces allow less infiltration and create greater runoff within remaining

natural channels. Large rainfall events produce larger runoff volumes, delivered with higher velocities, resulting in higher rates of erosion. Less benign climatic conditions have also produced larger flood events in recent years than in past decades. In turn, this has produced widespread negative trends in the immediate area of the channel. These trends include channel degradation (incision of the invert or channel bed); damage to nearby infrastructure; a decline in floodplain moisture resulting from drainage of the alluvium (soils in and below the floodplain), and hence, loss of riparian, floodplain, and aquatic habitat and associated wildlife; increased water temperatures from a loss of shading; an expansion of the extent of exotic species; damage to utilities, roads, trails, and other infrastructure; undermining of bridge foundations; and a devalued recreational experience.

2.2.3 Poor Water Quality

Poor water quality in the watershed is not completely understood and may be related to numerous factors, but is most objectionable in the form of bacteria and the exceedance of human health standards. Additional concerns include the presence of herbicides and pesticides, metals, and other contaminants. High water temperatures (due to a loss of shaded riparian habitat and destruction of “riffles” in the channel), low dissolved oxygen content, and high sediment load (turbidity) are also water quality problems. Causes of contamination may include human occupancy, pets, native wildlife populations, leaking pipes, fertilizer application, sewage spills, leaking dumpsters, and many other factors. Lack of riffles or rocky “falls” in the creek reduces oxygenation. Lack of tree shading raises water temperatures. The outcome of these factors has been the listing of San Juan Creek as an “impaired” water body for human contact, and closures of beaches to swimming during periods of each year due to high bacteria counts. The effect of poor water quality on environmental resources includes exceedance of the parameters that would allow survival of native aquatic species, and of course, the wildlife dependent on them.



Photo 2. San Juan Creek downstream of PCH Bridge

2.2.4 Loss of Habitat

Habitat loss is related to the problems discussed above, as well as to the high degree of development in the watershed. The conversion of natural plant communities to first agriculture and then urbanized landscapes has eliminated many native plants and their dependent wildlife. Channel instability and associated floodplain drainage has impacted the hydrologic connection on which the habitat was dependent. Outside of the riparian zone, residential and commercial development has eliminated many upland area habitats that provided a complete range of habitat types within the watershed. Those few areas outside of public lands left in a somewhat “original” state have been dramatically affected by surrounding development. The wildlife dependent on these areas has largely disappeared. Elements of the water quality problem have severely constrained the survival of wildlife in the riparian zone and elsewhere. Unlike many watersheds in nearby areas, however, the San Juan Creek watershed retains a significant amount of acreage within the floodplain and headwaters that is not developed and retains some environmental value.

Chapter III: Problem Discussion and Recommended Measures for the San Juan Creek Watershed

3.1 Introduction

The problems identified in the watershed were grouped, and measures developed to solve each problem. Potential for combining measures as multi-purpose alternatives was identified. The development, iteration, and selection of final plans are discussed in detail in the main report. For those that want to fully understand the decision-making process that led to exactly which measures and alternatives were selected, it is urged that the section on plan formulation be read. Further information is contained in the technical appendices. The following is a short discussion of each problem listed above, and a recommendation for measures that might be implemented to solve the problem, or otherwise reverse the negative trend.

3.2 Flood Erosion Damages, Including Land Loss (Problems 1, 2, and 3 on Table 2)

Discussion

This problem is defined as the inundation of structures and other valuable property by floodwaters in such a way that damage is caused, and the incurring of costs due to emergency activities and clean-ups associated with the event. It is important to understand that ANY structure in the watershed could be inundated by water at any time. Water entering your home or business may not come from one of the obvious channels in the area, but might come from a slope upstream, a backed-up storm drain, or a burst water main. It is

also in the nature of rainfall in southern California that a high-intensity storm cell may “park” itself over your neighborhood and exceed the ability of local drains to carry the runoff away. Repair of damages caused by flood events is *not* normally covered by homeowner’s insurance.



Photo 3. Downstream of San Juan Creek-Trabuco Creek confluence – post-1998 floods

The watershed study included an analysis of the current flood threat in the San Juan Creek watershed. The results indicated that most structures in the watershed have a somewhat low probability of flood inundation. Currently, the Federal Emergency Management Agency (FEMA) publishes maps that contain the likely extent of floodwater inundation during a “100-year” flood. The “100-year” floodplain encompasses an area in which the approximate threat of flooding is greater than an approximate 1% chance of flooding in any given year. This means that this size flood event is rare, and should only occur on average approximately once in a hundred-year period. It does not mean that this size flood *cannot* occur several times in a century, or even twice in one year. Probability is not a guarantee, but an “educated guess” given past experience. FEMA floodplain maps

are used to determine whether a structure should be subject to mandatory floodplain insurance. However, regardless of location in the watershed, insurance for flood damage is always a wise idea. Because the risk from flood inundation in the floodplain should be a consideration for all that lives in the watershed, monitoring of weather forecasts and floodwater levels in the channels during storm events is also a wise precaution. During large flood events, it would be wise for residents to have a plan in place to evacuate to higher ground should water go over the banks.



Photo 4. Trabuco downstream of Del Obispo, left bank, post-February 1998 storm

The analyses contained in the main report discuss the potential impacts of floods under a variety of flood scenarios. The information, particularly on the maps furnished therein, does *not* supplant the information in the FEMA floodplain maps. The information in the main report and hydrologic/hydraulic appendices was generated solely for the purposes of determining Federal interest in potential flood damage reduction measures, and should not be used to determine whether you are, or are not, within a “regulatory” floodplain. Regardless of the generally low risk of flooding to most in the watershed, and given that there are approximately four thousand structures within the floodplains of the San Juan Creek watershed, the fact

remains that many structures could be at risk from *large* flood events.

The analysis of measures formulated and evaluated during this watershed management effort resulted in the generation of a “National Economic Development” (NED) plan for flood damage reduction. The NED plan is not necessarily the plan that would be pursued by Federal or County government, but is identified to determine the plan that maximizes net benefits and would be the basis for cost-sharing if a Federally implemented plan were to be pursued. The fact that a plan was generated that had a positive benefit-to-cost ratio for flood damage reduction in the San Juan Creek watershed means that there is a potential Federal interest, and thus that an implemented plan that generates similar reductions in flood damage has potential for considerable funding contributions by the Federal government. This could result in a large savings of funds that would otherwise have to be generated by local government. Measures that were examined and rejected for not meeting one or more criteria include traditional dams, floodproofing, relocation, ring levees, or buy-out of flood prone structures. The preliminary NED plan is a combination of floodwalls and channel stabilization measures for middle and lower San Juan, and lower Trabuco Creeks. Other measures that bear additional study include channel enlargement, detention basins, and various combination plans.

The preliminary NED plan also potentially solves the erosion problem to levees that could also result in flood damage. Erosion elsewhere in the watershed is not solved by the NED plan, because the damages do not warrant Federal expenditure for the costs of potential measures meant to solve the problem. There are cases of site-specific erosion that can be dealt with by other means and are discussed below.

The actual project that might be pursued at a later date will have to be one that meets public acceptability standards, is demonstrated to be an efficient use of public dollars, is environmentally feasible, technically sound, and provides a fairly complete solution to the problem. While all but the first criteria have been demonstrated, the plan eventually implemented as a

“Locally Preferred Plan” (meaning that plan that is most acceptable and supportable by local government and residents) for flood damage reduction may look considerably different from the NED plan. No LPP has been identified to date, but will likely be the result of continued effort by local and Federal government study toward that end.

Erosion by surface water flow is currently causing land loss to adjacent properties. This is largely due to degradation of the channel (channel instability), which has been progressing in an exponential manner since the late 1960's. Although this has been related to development of the watershed, increased impermeability, and increases in flood flow peaks and volumes, there is no definitive cause-and-effect relationship. It is sufficient to recognize that erosion of channel bed and banks is increasing, and that land loss is accelerating. It is also recognized that treatment of the existing channel instability problem may reduce, or in some cases halt, land loss by erosive forces in certain locations.

More detail on the formulation of measures and generation of the NED plan for flood damage reduction may be found in the Main Report.

Recommendations

Continue the County's productive relationship with Congress to seek out and obtain funding for the “spin-off” phase of the Corps of Engineers feasibility study effort, focusing on optimization and finalization of a combined flood damage reduction, channel stabilization, ecosystem restoration, and recreation alternatives for the San Juan Creek watershed. The remaining study effort is recommended to:

- optimize of the alternative for flood

- damage reduction/channel stabilization; b) determine the best method and spacing of channel grade stabilization; c) further examine means to reduce the costs of the ecosystem restoration package, most notably by reducing real estate costs, and better incorporate fish passage; d) examine in the context of the above alternatives what best means can be provided for recreation along the project reach, and; e) fully develop a Locally Preferred Plan (LPP). Once these issues are resolved, the cost allocation and apportionment can be applied to both NED/NER and Locally Preferred Plans, and a recommendation can be made to Congress.

It is also recommended that a point-of-contact be appointed for this specific effort, with the goal of pursuing funding through construction through that office. Other erosion problems in the watershed that threaten public properties should be pursued under the Corps of Engineers' Section 14 – Emergency Streambank Erosion Control program. The Corps' Los Angeles District representative for this program can be contacted at (213) 452-3826. Private property owners that suffer from erosion problems may have to address these problems without benefit of outside funding sources, but are strongly urged to contact the Corps' Regulatory Branch for advice on methods that will avoid impacts to jurisdictional waters of the U.S., and potential permitting requirements.

3.3 Channel Instability and Its Effects on Resources

(Problem 4 on Table 2)

Discussion

The problem of channel instability is regarded as one of the most fundamental problems in the San Juan Creek watershed. This problem has been related to natural channel change, development inside the watershed, increased flood flow peaks and/or volumes, increased dry weather (low-flow) discharge, impervious cover increases, the random nature of recent large flood events, and other issues. Whatever the reasons, degradation (lowering) of the channel invert, which historically would be interspersed with periods of channel aggradation (or infilling), has turned into an increasingly destructive trend as the cyclical erosion and fill cycle has

been replaced by continued degradation. It can be seen that replacement of bare soils in the watershed by development has cut off the traditional source of sediment in the watershed. This being the case, it may be that the now hungry, or sediment-poor, runoff from the watershed is compensating by picking up more of its characteristic sediment load from the channel bed itself. Ultimately, a lack of sediment as a source will result in continued erosion in other locations, and eventually a lower sediment delivery to the coast. This will have long-term negative effects on beaches downcoast, as eventually the channel source will also dry up, robbing the beaches of needed sediment.

Degradation can also be tied to infrastructure damage (water pipes, sewer pipes, roads, bridges, etc.), decreasing floodplain soil moisture levels, gradual disappearance of historical floodplain and riparian zone vegetation and related wildlife species, conversion of vegetation to xeric species, land loss (see above discussion), destruction of “pool-and-riffle” sequences (i.e., disappearance of the sequences of “falls” and “pools” that once characterized the stream channel), disappearance or reduction of aquatic and riparian-related species, and many other problems.

Due to the central nature of this issue in all the problems mentioned above, treatment of the channel instability problem is recognized as a key feature of flood damage reduction and ecosystem restoration alternatives in the San Juan Creek watershed. It is also identified as a key component of any Federal plan to deal with problems in this watershed. The local sponsor understands the depth of this problem, and its influence on the above-mentioned resources in the watershed.



Photo 5. San Juan Creek downstream of Trabuco Creek confluence after the 1998 storms

Recommendations

The critical impact of channel instability on existing flood control measures, ecological resources, infrastructure, and the disappearance of species and habitats is sufficient reason to identify that treatment of the channel instability problem must be a component of a comprehensive plan to address watershed problems. Minimization of this problem has the potential to reduce infrastructure damages by potentially at least several millions of dollars per year. Also important, it is recognized that success of any environmental restoration plans for the watershed must include treatment of this problem along San Juan Creek. Therefore, this measure was combined into the plans for flood damage reduction, and is recommended for further analysis as an essential component of the “spin-off” feasibility study for flood damage reduction, channel stability, and environmental restoration on San Juan Creek. Recommendations include installation of a series of wildlife-passable “spilling” drop structures at locations within the leveed channel system on both San Juan and Trabuco Creeks. Details on plan formulation of channel stabilization measures are contained in Section 7 of the Main Report.

3.4 Infrastructure Destruction by Surface Water Flow

(Problem 5 on Table 2)

Discussion

Infrastructure destruction by surface water flow is largely related to channel instability, in that if the channel were currently stable, there would be little except potential geotechnical instability that would threaten existing infrastructure. Existing infrastructure destruction is almost wholly occurring in channel reaches that are highly unstable. Those sites, which are not related to channel instability currently, cannot be recommended for a Corps-funded solution, but should be addressed on an individual basis by those affected entities. It is important to coordinate the treatment of problems in close proximity to the channel system with the overall goals of restoration of channel stability as covered by Sections 3.2 and 3.3 above.

Recommendations

See Section 3.3 above. Treatment of problems outside of riparian and/or wetland areas would not be regulated by the Section 404 permitting process of the Corps, or Section 401 permitting process of EPA/State RWQCB, but may be subject to local (County or City) permitting. Permitting of this type may be addressed by contact with Mr. George Britton of the Environmental and Project Planning Services Division at (714) 834-5312.

3.5 Water Quality Problems in Ocean Nearshore Environment, Creek Mainstem and Tributaries

(Problems 6 and 7 on Table 2)

Discussion

It has been identified, both in past and current study, that water quality problems exist in the ocean nearshore environment in the immediate proximity of the creek mouth, and immediately downcoast. The key water quality problem is the exceedance of Federal and State standards for Fecal and Total Coliform (and potentially pathogens, indicated by the presence of *e. coli* and *enterococcus*) both in the nearshore environment on several days per year, and, as indicated during the course of this study, at several locations within the watershed along the creek and/or its tributaries. Treatment of water quality problems as they relate to public health or domestic water supply is not a Corps of Engineers' mandate, but does have a Federal interest in that this may potentially violate Clean Water Act standards. Given the depth of this problem indicated by the water quality testing conducted during the course of the study, this is a long-term problem with long-term solutions. Many of the recommendations made toward reducing this problem may not be eligible for Corps of Engineers cost-sharing participation, but should be implemented nonetheless, as reduction of the problem may be mandated by law with the implementation of "Total Maximum Daily Load" (TMDL) criteria, applied in pursuit of minimum Clean Water Act standards.



Photo 6. Sediment-laden water at the mouth of San Juan Creek

Surface water quality problems in the San Juan Creek mainstem and tributaries may be contributing directly to those of the nearshore environment discussed above. Recent testing also indicates that bacterial contamination is the primary concern in this watershed. Testing has indicated that it is not from a single source, but located in many storm drains throughout the watershed. Contamination is also found in the most remote locations of the watershed, even those upstream of human residence. Contamination by bacteria occurs from both human and animal sources. Continued water quality monitoring has indicated a problem at numerous locations within the watershed.

Water quality problems related to habitat and wildlife have also been identified. These problems primarily relate to elevated temperature and turbidity in the water column, and low levels of dissolved oxygen. High water temperature and sediment (turbidity), and low oxygen content can be implicated in the decline of aquatic species, and those riparian and floodplain species dependent on them for survival. Water temperatures in certain locations along San Juan Creek are among the highest in Orange County, and are in excess of that determined to be necessary for survival of a broad range of aquatic species. This is both a function of lack of shading of the water in the channel, and lack of an effective cooling process, which is tied to low slope and long residence time of water in many channel reaches. All of these problems can be partially tied to the problem of channel instability, and some of the piecemeal treatment measures taken to deal with the problem. A major impediment to resolution of the problem is that of “drop structures” in certain stream reaches, which cause unnaturally low-

sloped inter-reach channel segments, with low water turnover, and also provide an impediment to migration, either upstream or downstream, of aquatic species. These tall drop structures are identified as requiring modification in order to reestablish a desirable aquatic ecosystem, as well as being impediments to establishing a stable bed slope.

Recommendations

Monitoring of water quality should continue, and those locations identified with high bacterial counts (or other high exceedances) should be dealt with as funds become available, and on a prioritized basis. Additional funding should be a priority for those responsible for funding governmental agencies mandated with water quality improvement. The Orange County Department of Public Health has the mandate to trace, and potentially direct treatment by those responsible, of those sources that may directly affect public health. Therefore, additional funds should be made available to the Department so that the sources of contamination might be tracked down and treated. If it is determined that no responsible party can be identified, then application of the recommendations indicated above should be more closely pursued to ensure that everything possible is being done to address the problem by all practicable means. Should the problem still not ameliorate, chemical treatment of contaminated waters within the watershed may be necessary.

In addition to monitoring, implementation of Best Management Practices (BMPs) and other measures that impact water quality at the local and regional level should be further developed and mandated. There remains a great deal of uncertainty regarding the exact sources and locations of bacterial contamination in the watershed and ocean nearshore zone. This is due to the large scale of the problem, the high cost and time involved in conducting study efforts of this complexity, and limits on government funding directed to this issue.

It is strongly recommended that remaining study on water quality issues first focus on identifying both sources and locations of bacterial contamination before any large-scale water treatment projects be considered. It is very important to recognize that funding directed at

treatment wetlands or other structural measures may yield a poor result if it is not first understood exactly where, and from what source the bacteria originates. Key amongst these issues is that of identifying human and non-human sources, as management of animal sources may be difficult, if not impossible. Focus initial follow-on efforts on the implementation of on-site biofiltration or infiltration treatments, landscape controls aimed at reduction of water, pesticide and fertilizer application, and enforcement of ordinances aimed at pet waste control. Seek out and obtain grants to aid in these costly efforts from the Environmental Protection Agency, the State of California, and from other granting bodies. Further, the study team also recommends that the long-term effort must include evaluation of the effectiveness of existing BMPs, and adjustment as needed. Once site-specific information can be developed which indicates particular “warm spots”, treatment wetlands or directive water quality improvement “plants” may be implemented.

Toward solving the water quality problems of high temperatures and low dissolved oxygen, it is recommended that measures be taken to reestablish appropriate bed slope and configuration, modify existing drop structures, and incorporate into the larger channel stability measures, where possible. This is discussed in Sections 3.2 to 3.4 above.

Additional measures that will positively impact water quality, that may be implemented on an individual basis, or at a neighborhood association or municipality level, are contained in Appendices A and B to this WMP. Take a look. The “Refrigerator List”, attached to Appendix A can be removed and attached to your refrigerator door to remind you of things

that you can do around your home on a daily basis. Finally, brochures that address things that you can do to promote watershed health are available from the County of Orange.

3.6 Water Quality in Groundwater Aquifer(s)

(Problem 8 on Table 2)

Discussion

In general, water quality problems in the San Juan Creek watershed are related to high dissolved solids content, rather than bacteriological, toxins, or heavy metal contamination. Because it is generally less expensive to import domestic water into the watershed rather than to pump groundwater and treat it to reduce undesirable constituents, groundwater is not used as a large source of domestic water in this watershed.

Recommendations

Groundwater quality could be improved by dilution, thereby reducing the concentration to acceptable standards. While on-site detention and infiltration of stormwater may be an admirable goal, it is currently not known whether or not stormwater should be encouraged to infiltrate in many areas due to the undesirable contaminants it might pick up from the surface, or in contact with sediments or other contacts zones it may travel through on its way to an aquifer. Artificial recharge may be a valid option, in designated sites in which this would not be an issue. Treatment of groundwater can be costly, and at present may be economically unjustified. Due to the many unknowns related to groundwater volumes, pumping issues, contaminants, and surface/groundwater interfaces, it is recommended that detailed groundwater studies be undertaken to answer these questions.

3.7 Loss of Floodplain Habitat

(Problem 9 on Table 2)

Discussion

Floodplain habitat, as discussed here, refers to vegetation complexes that would be found on the generally low-sloped “overflow” areas adjacent to the channels throughout the watershed.

The gradual conversion of floodplain habitat from trees and bushes of certain more water-dependent types, dominated by the complex known as “California Oak Woodland”, to those of a more xeric (less water-dependent) nature is related by many observers who have spent much time in the watershed. Several long-term residents have noted that the trees once found in the floodplain are now largely gone, replaced by scrub and dry grasses. It is believed that many trees were cut in the “Mission” period, as the oaks, sycamores, and others were a valuable resource in the production of ships, structures, charcoal, and other uses. Still, many trees survived into this century, as evidenced by in-person accounts with older residents. It is not definitively known what caused the recent disappearance of many trees in the floodplain outside of developed areas, but it has been noted that areas dominated by channel degradation have few resident trees, and those not suffering from appreciable degradation have a much greater associated tree population.

Given that the degradation of the channel has been accompanied by a decline in floodplain soil moisture levels, it may be the case that the sources of water for these large trees have disappeared, and taken the trees with them. Taproots for these trees, although lengthy, may have been of insufficient length to reach the far deeper

groundwater table under current conditions. Environmental resource agencies, land managers, and wildlife specialists have indicated that historic floodplain vegetation is rapidly disappearing in southern California.

Recommendations

This issue requires support of efforts currently directed at balancing development and environmental needs throughout the watershed. Support of the Corps’ current “Special Area Management Plan” (SAMP), the Natural Community Conservation Plan (NCCP) program, and numerous other efforts that endeavor to establish a balance between competing interests in the watershed are vital to the interests of floodplain habitat protection and/or restoration. Support for the Corps of Engineers watershed study effort is also vital, as this effort seeks to integrate ecosystem restoration with other goals currently being pursued for the watershed that are not being sought elsewhere, including integrated flood damage reduction, ecosystem restoration and channel stabilization. Support of all of these efforts is the best way to ensure that the maximum number of needs is met in a way that does not allow for continued degradation of environmental resources.

3.8 Loss of Riparian Habitat

(Problem 10 on Table 2)

Discussion

This issue differs from the issue of floodplain habitat loss in that riparian habitat is located within close proximity to the channel systems of the watershed. Riparian communities are considerably different from upland (floodplain) communities, in terms of both vegetation and wildlife, but have suffered from the same impacts. These impacts include modification for infrastructure (most notably levee construction), conversion to other uses, and general clearance.



Photo 7. San Juan Creek (looking at Stonehill Bridge) – lack of riparian habitat evident

Riparian habitats have also suffered extensively from erosion. Although erosion of channel beds and banks is a normal part of the evolution of riverine systems, San Juan Creek and its tributaries are suffering from accelerated erosion. This erosion removes portions of habitat with each flood event, even under “natural” conditions. However, a period of recovery after flood destruction generally occurs. In recent years, this recovery has been less dramatic or long-lived. The reasons may be due to a gradual dwindling of sites, a lack of sediment sources and therefore substrate for plants to re-establish, and other unknown factors. This impact could be lessened if the structure of the stream channel were more stable. Riparian habitat that supports fish, reptiles, insects, and mammals that traditionally occupied the watershed, is more evident in the upper reaches of San Juan Creek that are in public ownership, and on those undeveloped lands remaining in private hands.

Recommendations

Because riparian habitat is dependent on both water availability and structural stability, much of the success of a riparian habitat restoration and/or preservation campaign is dependent on the success of

channel restabilization measures. Support for the Corps of Engineers Watershed Study effort is vital. The recommendations presented under Section 3.7 apply equally to this issue.

3.9 Loss of Recreation Opportunities

(Problem 11 on Table 2)

Discussion

The size and natural diversity of the landscape in the San Juan Creek watershed produces numerous opportunities for public recreation, education, and environmental awareness. Recreational activities available throughout the watershed include bird watching, hiking, jogging, bicycling, surfing, golfing, mountain biking, and many others. Numerous recreational parks and other facilities are linked to local watercourses within the watershed. In fact, some of these parks and facilities depend on San Juan Creek, or one of its tributaries.

In the watershed study area, residential development has increased at a rapid pace, making the existing recreation parks and facilities even more valuable for humans, as well as wildlife habitat.

A recreation demand analysis conducted for this study indicates that demand for certain types of recreation exceeds the availability of facilities. Impacts to existing facilities include overuse, vandalism, lack of funding for maintenance and upgrading, and damage from erosion. Water quality impacts also affect recreational opportunities, as in recent years; poor water quality has resulted in major beach closure issues.

Recommendations

While overuse and vandalism issues may be beyond the scope of this study effort, monetary support for these facilities has in general not kept pace with increased population pressure. Funding support for these facilities is vital. In addition, support for efforts such as the Corps of Engineers Watershed Study, which seek to incorporate recreation opportunities along with other major objectives, will be critical, particularly in regards to creating or maintaining “linked” areas. Support for the concept of recreational biking/hiking of a contiguous nature that extends from headwaters parks to the ocean is

possible only when this issue is pursued both by local government and by the public.

3.10 Decline in Floodplain Moisture

(Problem 12 on Table 2)

Discussion

The decline of floodplain moisture is primarily an issue only in non-developed portions of the floodplain that are adjacent to channels that are downcutting. Floodplain moisture is directly related to the lowering of the channel invert (bed). As downcutting proceeds, the floodplain is gradually “drained”. This may have an impact on vegetation on the banks and on the surface of the floodplain, as those plants with shallow roots cannot reach an adequate source of water. There are numerous areas in southern California in which this phenomenon has been observed. As the original vegetation disappears, the habitat changes, and so goes the wildlife associated with the original type of floodplain habitat.

An additional impact to floodplain moisture that does not appear widespread in the San Juan Creek watershed is that of shallow groundwater overdraft.

Recommendations

This issue should be addressed by pursuit of the recommendations contained in Section 3.3.

3.11 Geotechnical Instability

(Problem 13 on Table 2)

Discussion

Geotechnical instability is evident all over the San Juan Creek watershed. There are numerous areas in which rotational slumping, soil slips, and deep-seated

instability exists. Geotechnical instability can impact development, transportation, and other types of infrastructure, as well as recreational facilities, flood damage prevention measures, pipelines, and even stream channel behavior. This issue has been thoroughly covered in numerous publications of the State of California Division of Mines and Geology, and the U.S. Geological Survey.

Recommendations

Because it is such a site-specific issue, treatment of geotechnical instability problems is really beyond the scope of this study. It is recommended that anyone attempting to site facilities that could be affected by soil or slope movement contact the County of Orange for advice as to the site-specific geologic conditions that might affect this activity. There are maps available that indicate many of the faults, slumps, and soil slides that have occurred, and could potentially re-occur throughout this watershed.

3.12 Decline in Water Supply

(Problem 14 on Table 2)

Discussion

The decline of water supply in the San Juan Creek watershed may be as much a matter of perception as reality. There is currently not a great deal of domestic water supply in the San Juan Creek watershed that is derived from in-watershed sources. This is primarily due to the quality of water available within the watershed when compared to outside sources. It is currently less expensive to import water for domestic purposes than to pump and treat local sources. This may change dramatically if outside sources were reduced, or if outside sources became incapable of meeting the needs of increased population or other demands. The needs of other water users, such as vegetation and wildlife, appear to be met at the present time. This is due to the widespread lack of pumping within the watershed, and application of outside source water to landscapes. There is currently a small amount of water “wasted” to the ocean on a daily basis. This could change with increased water demand or pumping.

Recommendations

Continued monitoring of the water supply situation is ongoing by the South Coast Water District and San Juan Basin Authority, the Metropolitan Water District of Orange County, the County of Orange, and others. These agencies are highly capable and are exploring numerous options to ensure future water supplies for domestic usage. Support for these agencies may be needed in the event of interference with existing sources, or if there were other reasons for alarm, such as an extended regional drought.

It is also recommended that long-term monitoring of water availability for environmental purposes occur. Almost all of the environmental resources in the San Juan Creek watershed are dependent on water availability, most of them throughout the year. This guaranteed source of water would need to be secured to ensure a healthy resource base in the future. Support for water agencies on this issue is also vital, as they attempt to balance multiple needs.

3.13 Depletion of Sand Sources for Coastal Sand Replenishment

(Problem 15 on Table 2)

Discussion

The depletion of sand sources for coastal beach sand replenishment is directly tied to the loss of sand sources. Actual transport of sand through the system is largely unimpeded in all but small parts of the watershed, with the exception of areas in which in-stream sediment mining is occurring. Sand sources are removed from future supply with each increase in the amount of pavement or other soil surface sealing that occurs. Headwaters areas are the most productive sources for sand

(sediment), as they are steeper, contain more erodible material, and thus put more sediment into the system on a per acre basis than lower-sloped hillslopes or floodplains. Fortunately, for the San Juan Watershed as a whole, much of the headwaters area is in public hands and not subject to changes in surface sealing. Unfortunately, several subwatersheds, most notably Oso Creek, do not have extensive headwaters, and thus have suffered dramatically from sediment starvation. A sediment-starved system exhibits certain behaviors that differ from a system in which sediment sources are plentiful. The water that comes off areas that have no sediment to contribute to the flow will attempt to pick up sediment as it passes downstream. Sediment-starved (a.k.a. "hungry") water will tend to erode channel banks and beds to a much greater degree than water containing a lot of sediment. This is most evident on Oso Creek in its downstream reaches. The relatively clear water being discharged from upstream urbanized plots and lined channels are highly sediment starved, and thus has attacked the downstream channel. The result is highly evident channel erosion. The bed of Oso Creek has been lowered by as much as thirty feet as a result of this phenomenon. As the channel bed and banks erode, much of the environmental resource associated with that channel reach disappears.

Recommendations

Preserve sediment sources wherever possible, throughout the watershed. This will take a concerted effort to purchase and preserve open space, in as many small subwatersheds as possible. The most productive are headwaters areas and other steep slopes that historically produce(d) large volumes of sediment. Where available land is insufficient to meet this need, the downstream channel must be protected by other means, including erosion buffer purchase, channel bed stabilization, and/or bank and valuable habitat area protection. This type of treatment is oftentimes much more costly than the cost of land set aside for this and other purposes. If this is not done, downstream channels and their associated resources will suffer the consequences.

3.14 Higher Flood Peak Discharges for a Given Storm Event

(Problem 16 on Table 2)

Discussion

The issue of higher flood peak discharges for a given storm event relates to the issue of reductions in pervious cover. As rain falls on surfaces throughout the watershed, a certain percentage infiltrates into the soil (and eventually groundwater aquifer). Under natural conditions, a high percentage of rainfall percolates into the soil, with that percentage declining over the duration of the storm event as the soil becomes saturated. As soil surfaces are paved or otherwise interfered with in a way that reduces permeability, more of the rainfall falling on the watershed becomes runoff, which enters the stormdrain or channel system. Thus, both the peak and volume of runoff off a given plot will tend to be larger off a developed plot than a natural one. Larger runoff peaks and volumes have a dramatic effect on downstream channel erosion and channel morphology. This is because many stream channel networks are in a state approaching a sort of “balance” between water and sediment inflow and water and sediment outflow. A channel in a certain state (width, depth, vegetative cover) that is subject to higher runoff (and lower sediment) input will tend to erode at a faster rate. The more water (or less sediment), the more erosion.

This issue has almost certainly impacted the channel system in many locations throughout the San Juan Creek watershed. It is no coincidence that the most severe channel erosion has occurred downstream of the most developed areas. Undeveloped headwaters channels in the San Juan Creek watershed tend to exhibit little erosion.

Recommendations

It is difficult to come up with a “perfect” recommendation on this issue due to its close ties with the sediment issue. However, it is very important in a system such as San Juan Creek to attempt to minimize changes in water and sediment input, as the natural system appears to have been somewhat adjusted to a regime in which water appeared in less dramatic peaks and volumes and sediment was more plentiful. Therefore, the goal should be to limit changes in peak and volume of runoff to something not significantly different from the “natural” condition. A goal of “no more than 10% increase or decrease” in peaks and volumes should be considered adequate. This may be achieved by detaining, by installation of low-energy detention basins or other structures, the “excess” runoff until such time as it may be safely released into the downstream channel. It is also necessary, though, to ensure sediment through flow in areas that have upstream development or instream modifications, as otherwise downstream erosion may occur. This may require the careful design of structures to ensure that significant sediment trapping does not occur. Incorporation of outlet structures that create minimal interference with sediment transport, and “guide channels” that permit sediment to flow through the impoundment area without significant deposition of carried sediment load may be vital to ensure downstream delivery of sediment. While it is recognized that the downstream-most reaches of San Juan Creek may be depositional during lesser flood events (and perhaps even during the falling limb of large flood events), it is of great importance that sand delivery to the ocean be unimpeded. The cost of limited sediment removal from the San Juan Creek channel will be considerably less expensive than the ecosystem destruction, erosion of land, and artificial nourishment of area beaches with purchased sand that would result otherwise.

3.15 Decrease or Disappearance of Aquatic Species

(Problem 17 on Table 2)

Discussion

The decrease or disappearance of aquatic species is directly linked to the destruction of in-channel habitats. This has generally occurred as the riparian (in this case, in-stream) habitat needed to sustain aquatic species has declined. Please see Section 3.8 for a discussion of this issue.

Recommendations

Reestablishment of aquatic species requires restoration or preservation of these environments. This will then require the preservation of as much remaining in-stream habitat as possible, and restoration of critical “links” between upstream and downstream areas to ensure connectivity. Please see the “Recommendations” portion of Section 3.8.

3.16 Decrease or Disappearance of Riparian Species

(Problem 18 on Table 2)

Discussion

The decrease or disappearance of riparian species is also directly linked to the destruction of in-channel habitats. This has generally occurred as the riparian habitat needed to sustain riparian species has declined. Please see Section 3.8 for a discussion of this issue.

Recommendations

Reestablishment of riparian-related species requires restoration or preservation of these environments. This will then require the preservation of as much remaining riparian habitat as possible, and restoration of critical “links” between upstream and

downstream areas to ensure connectivity. Please see the “Recommendations” portion of Section 3.8.



Photo 8. Upstream reach of San Juan Creek showing a more vegetated natural system

3.17 Decrease or Disappearance of Floodplain Species

(Problem 19 on Table 2)

Discussion

The decrease or disappearance of floodplain species is directly linked to the destruction of habitat on the floodplain. This type of habitat is the most impacted of any within the watershed, due to development pressure. Floodplain habitat loss has generally occurred as the habitat needed to sustain these species has declined. Please see Section 3.7 for a discussion of this issue.

Recommendations

Reestablishment of floodplain species requires restoration or preservation of these environments. This will then require the preservation of as much remaining floodplain habitat as possible, and restoration of critical “links” between upstream, downstream, and upslope areas to ensure connectivity. Please see the “Recommendations” portion of Section 3.7.

3.18 Invasive (Exotic) Species

(Problem 20 on Table 2)

Discussion

The spread of exotic, and sometimes invasive plants in the San Juan Creek watershed has been impressive, and in some cases quite destructive. Of most concern is *Arundo donax*, or “giant reed”. This exotic plant has supplanted native vegetation, converted native habitats to habitat unusable by many native wildlife species, and provides a large source of water withdrawal to a system that does not need further stresses on water supply. Other major exotic species of concern are castor bean and tobacco tree. All of these exotic species are causing exponential change in the San Juan Creek watershed. While eradication efforts are ongoing, the effects seem to be more prevalent with each passing year. Eradication of exotic species is important to the long-term survivability of native plant and animal species alike.

Recommendations

Pursuit of a comprehensive exotic species eradication campaign will be very expensive and highly labor intensive. Nevertheless, it is highly important to ensure the continuance of native ecosystems in the future. A proposed exotic species eradication plan is provided as Appendix C to this document. Utilizing these exotic species eradication guidelines, it is suggested that a comprehensive program for elimination of exotic species in the watershed be established. Critical in this program is the need to conduct initial eradication efforts in an “upstream-to-downstream” approach. It is recommended that a “pool” of funding be established, involving Corps of Engineers Regulatory Branch, State of California Department of Fish and Game, and other resource

agencies, to address this program in a systematic manner. Random eradication efforts have shown themselves to be ineffective, as upstream stands of exotics may re-infest areas cleared in prior efforts. Obtaining funding through regulatory programs and other mitigation efforts, establishing a schedule of activities that is broadly distributed by both hard and electronic media, and establishing a plan of action for tributaries, then mainstem, including a long-term monitoring plan, is critical.



Photo 9. *Arundo donax* along a creek

3.19 Declining Local Aesthetic Quality

(Problem 21 on Table 2)

Discussion

The decline of local aesthetic quality is a highly subjective one, and perhaps beyond the scope of this study. However, when asked for more detail, local residents referred to the previously “natural”, “rural”, or less developed” nature of what they truly desired the watershed to be. In today’s world, realistically the San Juan watershed will never approach these goals. Development pressure, a desire by many to live and/or work in the watershed, and decreasing land availability in nearby communities conspire to reduce open space and increase the general sense of crowding that many

feel. The realities of access, competing uses, land conversion, decreasing vegetative cover, and other issues have genuinely resulted in what most would refer to as aesthetic quality. Regardless, there are things that might be done to preserve much of what remains.

Recommendations

As with many issues discussed above, preservation and/or restoration of degraded ecosystems will go a long way toward providing aesthetic quality. The natural environment is believed by many to provide a relief from urban pressures. As such, support for parks, National Forests, open space preservation, and ecosystem restoration is vital. Sections 3.7, 3.8, 3.9, 3.13, 3.15, 3.16, and 3.17 contain more information that may be helpful in regards to what might be done.

3.20 Piecemeal Treatment of Problems

(Problem 22 on Table 2)

Discussion

The piecemeal treatment of problems in the watershed is felt to be one reason why problems seem to “get out of hand”, and that solutions are often combating one another, rather than working in concert. It is true that some solutions will work against one another. Installation of structural fixes, with no consideration for upstream and downstream effects, when not coordinated to minimize impacts, may actually cause more problems than the magnitude of the original problem. For example, removal of invasive species in one reach of channel may be pointless if invasive species in the reaches of channel upstream are later carried down and the original area is re-infested. Coordination of efforts directed toward making sure that the multiple efforts

being carried out in the watershed work together is critical.

Recommendations

Support for comprehensive watershed planning efforts, such as the Corps’ San Juan Creek Watershed Management Study, the Corps’ Regulatory Branch “Special Area Management Plan” (SAMP), and the County’s “Natural Communities Conservation Plan” (NCCP) is vital. The efforts are directed at eliminating piecemeal efforts, and replacing them with a comprehensive approach that meets multiple needs. In addition, efforts directed at eliminating overlap among various jurisdictions in the watershed will tend to reduce the impacts of this issue.

3.21 Excessive Litigation (on) Watershed Problems

(Problem 23 on Table 2)

Discussion

The perception of excessive litigation relating to watershed problems is also a difficult issue to get an exact definition of. When asked, those involved referred to the many lawsuits being filed on environmental, developmental, transportation, and land-use issues. Excessive litigation may be perceived to result in lost time and resources that might otherwise be directed toward end products that are more positive.

Recommendations

While probably beyond the scope of this study, some litigation could certainly be reduced by proper knowledge of permitting requirements, types of acceptable treatments and activities, and amenability to compromise and negotiation. A large knowledge base provides the background for intelligent discussion. It is hoped that this document, the main report, and all of the appendices will provide some of the tools needed to avoid some future misunderstanding, and hopefully then the reasons for litigation. Contact with appropriate agencies, when questions of interference with “Waters of the U.S.” (stream channels in the watershed), or wildlife or habitats under various jurisdictions is encouraged, as impacts to these resources cannot be ignored, and

substantial penalties may be applied to the parties involved in the impact. Calls to appropriate staff at the Corps of Engineers' Regulatory Branch and California Department of Fish and Game, in the case of activities that might impact stream channels; to the California Regional Water Quality Control Board, for activities that might impact water quality; and U.S. Fish and Wildlife, for activities that might impact threatened and endangered species (don't assume you know the answer!), are especially important, as many of the resources being protected are present in this watershed. The County of Orange can be very helpful on these issues.

3.22 Excessive Regulatory Actions

(Problem 24 on Table 2)

Discussion

The perception that excessive regulatory actions in the watershed are taking place may be valid.

If a property owner does not understand that dumping debris into a channel may impact resources, or that dumping stone into a channel to minimize an erosion problem may impact habitat, there will almost certainly be a regulatory response. Some of the penalties exacted for repeated violations of the Clean Water Act or Endangered Species Act may be substantial. It is no excuse to claim that one "did not know" about the rules and regulations.

Recommendations

Please read "Recommendations" of Section 3.21 above.

3.23 Degradation of Cultural Resources

(Problem 25 on Table 2)

Discussion

The degradation of cultural resources in the San Juan Creek watershed is primarily the result of folks not knowing the location or significance of the resource they are impacting. This can occur where land is disturbed, by lateral shifts in channel location, and by other means.

Recommendations

As with issues 23 and 24 (discussed above), it is not an excuse to say that one "did not know" that there were cultural resources on a site. Contact with the State of California's "State Historic Preservation Officer" and the Juaneños and Luiseños Tribes is strongly urged prior to undertaking any activity that may impact cultural resources. A map generated during this study effort that illustrates various known sites may be viewed at the Corps of Engineers' Los Angeles District Environmental Branch Offices.

3.24 Degradation of Habitat for Endangered and Threatened Species

(Problem 26 on Table 2)

Discussion

The degradation of habitat for threatened and endangered species is directly linked to issues 9, 10, 17, 18, and 19. There are numerous threatened and endangered species in the San Juan Creek watershed, as it is one of the highest value remaining watersheds in southern California. Unfortunately certain significant areas, and links between areas, no longer exist. Some areas of the watershed have been designated as "Critical Habitat" for certain species. Certain species that historically made their home in the watershed may no longer exist here. Others maintain a tenuous hold. Responsibility for monitoring the presence and state of various species is held with the U.S. Fish and Wildlife Service and the State of California. A detailed discussion on these resources is contained in the Environmental Appendix to the main report. Further information on areas of critical habitat and other issues

can be obtained from Fish and Wildlife Service and the State of California.

Recommendations

Preservation of remaining habitat and implementation of measures to restore degraded habitats for these species is a vital link in the goal of providing a healthy watershed. Support for the Corps' San Juan Creek Watershed Study, its Regulatory Branch's "Special Area Management Plan," and County's "Natural Communities Conservation Plan" may aid in this effort. All of these efforts will provide some measure of protection, preservation, and restoration to habitats required for the survival of such species. Please see the recommendations under Sections 3.7, 3.8, 3.15, 3.16, and 3.17 for additional information.

3.25 Degradation of Surface Water/Groundwater Interface *(Problem 27 on Table 2)*

Discussion

The degradation of the surface water/groundwater interface is an issue that is not on the forefront of most people's minds. It involves the ability, on a watershed-wide basis, of surface water to percolate into the groundwater table. Percolation of surface waters into the groundwater table is of prime importance in the recharge of underground aquifers.

To date, interference with this process has primarily occurred due to paving of soil surfaces throughout the developed portions of the watershed. Paving reduces infiltration. However, the majority of surface water/groundwater percolation in the San Juan Creek watershed occurs in the channel/below-ground materials interface. This is primarily due to the presence of water in the channel system throughout

much of the year. The channel and immediate bank and overbank area consist of highly porous soils. The alluvial fill that comprises the floodplain and its underlying structure contains most of the available "fresh" water in the watershed. Obviously, if the ability of the channel and floodplains to percolate water is interfered with, and pumping of groundwater continues, groundwater levels will fall. Luckily, most of the channel system in the San Juan Creek watershed maintains a porous bed, which allows for a good deal of continuous groundwater recharge.

Recommendations

Maintenance of natural existing channel beds is of primary importance in maintaining a healthy surface water/groundwater interface. As it is unlikely that permitting agencies will allow wholly-lined channels to be installed in the future at many locations in the watershed, this issue is not likely to become critical. Unfortunately, the issue of existing pavement is a tricky one. Although retrofitting of existing paved areas with catch basins or enhancements to recharge (such as porous areas) seems at first look to be productive, paved areas tend to generate undesirable constituents, such as asbestos, heavy metals, and petroleum by-products, that will infiltrate into the groundwater table. Therefore, means to improve infiltration such as drilling holes in the pavement, or installing porous pavement, cannot be recommended in high traffic areas. It is suggested that, for higher traffic areas, pavement be constructed in such a way (or that retrofitting of existing paved areas be done in such a way) that runoff be collected and funneled into small treatment facilities such as sand filters, and other such means by which contaminants can be removed. In areas that do not sustain large amounts of traffic, porous pavement media can be used. These techniques will not only ensure continued rainfall percolation, but will also reduce runoff into local channels.

3.26 Further Recommendations

3.26.1 *Develop a Watershed Education Program*

This is, of course, easier said than done. It is not a program that can be funded through the Corps of Engineers, and probably cannot be easily afforded at the local level. However, it is probably the single most important long-term recommendation toward maintaining a healthy watershed. An education program will teach children the importance of the issues brought up in this document. It will teach them what needs to be done and how. It will teach them that they can do something to affect their environment in a positive way. In addition, that by doing so with the help of their classmates, acting locally they can affect the world around them. An education program will establish objectives, goals, curricula, schools involved, teaching requirements, funding sources, and a teaching plan. The program should be introduced as part of the standard curricula for grades K through 12. The program can incorporate the existing subject matter of science, biology, geography, social studies, and geology, with lessons learned outside their front door. School administrators are encouraged to take these subjects into the “outside classroom”. Schoolchildren would be encouraged to engage in revegetation programs, clean-up days at local parks or refuges, and do projects on the subjects discussed in this document. This issue cannot be stressed too much! The “Adopt-A-Watershed” website contains a fine sample curriculum for grades K through High School. The website is shown below:
<http://www.adopt-a-watershed.org/matrix/matrix.htm>.

3.26.2 *Develop and Distribute a “Non-Point Source Public Awareness Plan” Watershed-Wide*

Although some dissemination of this issue has occurred in some jurisdictions, it is highly important to implement a plan watershed-wide. This plan will educate all residents of the watershed in wise management techniques. The plan will make people aware of the ways in which they can reduce pollution and engage in “watershed-healthy” activities. There are several good examples of this strategy within the County currently. It must be implemented through other media, and to all parts of the watershed. It is also suggested that this information be disseminated to people that work in the watershed, particularly those that affect resources. Good targets for this plan include restaurant workers, janitorial/clean-up staff, landscaping staff, city and local jurisdictional staff, and neighborhood association representatives.

3.26.3 *Establish a “Watershed Keeper” (Steward) Committee*

Funded jointly by the County and cities that will coordinate, integrate, and leverage programs and projects by Federal government, cities, County, schools, universities, utility districts, and public and private entities, establish a “Watershed Keeper Committee.” This will guide implementation of the local action items (BMPs, conduct water quality monitoring, identify grants and corporate sponsors for special projects, organize volunteer efforts, etc.), and provide the means by which planning and implementation will occur once this initial study effort is complete.

3.26.4 *Fully Implement a Watershed-Wide Monitoring Program*

As part of the watershed stewardship program, fully implement a watershed-wide monitoring program. Monitor continuing problem areas; monitor project performance, monitor efficacy of established programs for Water Quality, Exotic Species, 404 permits, channel degradation trends, wildlife surveys conducted each year, completed and proposed projects in the watershed,

and annual flooding and/or erosion damages. An annual or biannual “State of the Watershed” report could be issued, possibly on an Internet website, and by attachment to utility bills or other existing dissemination programs.

3.26.5 Fully Implement a Comprehensive Package of Best Management Practices

The piecemeal application of BMPs is not recommended until appropriate research has been done to determine the most cost-effective techniques to apply to the San Juan Creek watershed. Because of the nature of this watershed, its location in a semi-arid environment, and the host of competing jurisdictions and interests, a full suite of BMPs should be evaluated. The following BMPs are widely acknowledged as productive and can be recommended to the public at large without reservation. Some of these are contained in appendices A and B. A preliminary list of productive BMPs includes:

Reduce Fertilizer Application

Fertilizer, as used for plants, or crops, may have negative effects when over applied. The excess fertilizer may run off into storm drains, then are carried into stream channels and eventually the ocean. Fertilizers, which rely heavily on nitrogen, can cause algal blooms, or large growths of algae, in lakes and streams. Algal blooms have been seen in several stream reaches that possess slow-moving water. These algal blooms deplete oxygen in the water, causing difficulty for fish and other organisms that need it. Studies in other areas have indicated that overapplication by homeowners is common. For an appropriate application schedule, one can contact a local landscape professional or your local garden supply

store. For additional information, refer to the following link.

Helpful website:

<http://cumberland.ces.nc.us/fertpage>

Reduce Pesticide Application

Learning about your plants/crops and the insects that you encounter could greatly reduce the use of pesticides. There are less harmful methods to deal with pests and weeds than commonly used chemicals. Some examples of alternative measures include, hand removal, barriers, traps, biological control, and “least toxic” chemicals. Also, know your pests. Some insects may actually help your crop by eliminating a smaller, more harmful pest. Spiders, for example, may be the best insect control feature in your crops.

Once you identify the problem (i.e., a harmful pest), the appropriate alternative measure may solve the problem before reaching for the chemicals that harm the environment, and more importantly, your watershed.

Helpful website:

<http://www.multnomah.lib.or.us/metro/rem/garden/pestalt.html>

Minimize Spills of Undesirable Liquids and Solids

Taking necessary precautions when handling toxic liquids and solids will reduce the chance of a spill. All undesirable liquids and solids should be properly contained and stored until properly disposed. For aboveground tank spill control, local governments should install (or require the installation of) safeguards against accidental releases, such as secondary container units. Local governments should also enforce or create Uniform Building Codes and Uniform Plumbing Codes that address spill prevention and clean up.

Motor Oil Collection

Motor oil is one of the most common, yet easily controlled pollutants, in local waterways. Motor oil should *never* be disposed of in the storm drain, trash, or yard. Some local service stations may dispose of the oil properly, if dropped off in proper containers. Call to find out. There are some automotive parts businesses that will also recycle motor oil. For the nearest Oil Recycling Center in Orange County, contact the

California Integrated Waste Management Board (CIWMB) Recycling Hotline at (800) 553-2962. Several local businesses participate in this program as oil collection centers, so call for convenient locations nearest you.

Hazardous and Toxic Waste Collection

Paint, solvents, cleansers, pool chemicals, propane tanks, medical wastes, cosmetics, oil, fuel, all auto fluids, etc., should be disposed of properly. Never dump liquids or solids that might be harmful to the environment in your yard or in the trash! Store the materials in child-safe containers until you drop it off. Orange County has a Household Hazardous Waste Collection Center (HHWCC). HHWCC is a **FREE**, easy, drive-through operation that collects many toxic liquids and solids. Call (714) 834-6752 or visit www.oc.ca.gov/iwmd/ for the locations, hours of operation, and related information.

Septic Tank Control

Approximately 25% to 33% of homes in the U.S. rely on private sewerage disposal, called septic tanks, but many of these homeowners lack the basic knowledge required to properly maintain them. A septic tank is a watertight, underground container (usually concrete), located adjacent to the home. The tank accepts all household sewer water from your home including the commode, sinks, shower, and sometimes dishwashers and garbage disposals. As liquid and solid waste enter the tank, bacteria “eats away” at the solids leaving only liquids and sludge. The sludge will eventually need to be cleaned out, while the liquid flows out of the tank into perforated drainpipes. The drainpipes expand out into a section of your yard called a drain field or leach field. The vegetation feeds off the wastewater,

naturally cleansing it, before it enters the subsoil, into the groundwater.

Proper maintenance of your septic tank is important in maintaining a healthy watershed. Problems in the septic system may pollute the groundwater. The most common cause of septic problems is too much water use, overflowing the system and saturating the drain field. If the vegetation in the drain field does not feed off the wastewater, raw sewage enters the groundwater system. Some helpful suggestions for maintaining a properly functioning septic system include the following: (1) follow basic water conservation methods, (2) fix leaking faucets or toilets, (3) divert other sources of water, such as roof drains and sump pumps, away from the drainage field, so as to not saturate the soil, and (3) never dispose of hazardous liquids in your household drain, as the septic system will not clean these liquids, and they will pollute the groundwater.

It is recommended to avoid septic tank additives. Additives containing chemicals are sold, claiming to be helpful in cleaning the septic system. However, there is NO scientific evidence to support such claims. In fact, some cleaners may disrupt the solids, causing clogs in the system. The drain field also requires some degree of maintenance.

- ◆ Keep automobiles and heavy equipment off the drain field.
- ◆ Grass and shallow rooted plants are the most effective vegetation for a drain field. Deep-rooted trees can clog or damage the drainpipes.
- ◆ Contrary to popular belief, it is not necessary or beneficial to fertilize the drain field.
- ◆ Grass on the drain field should be mowed regularly to promote evaporation, preventing the water from unnecessarily infiltrating the soil above the drain field.

If a septic tank is not properly maintained and routinely pumped (cleaned), the tank may overflow into the drain field, damaging the pipes, or worse, backing up into your home.

How do you know when it is time to pump? There are many variables that enter into such a question. If you do not know the size of your tank, or cannot predict the amount of water use in your house, pumping every 3 to 5 years is a good rule of thumb. If you do know the size of your tank, use the helpful table below

Table 3: Estimated Septic Tank Pumping Frequencies in Years (for year-round occupancy)

Tank Size (gal)	Household Size (Number of People)				
	1	2	3	4	5
750	9	4	3	2	1
1000	12	6	4	3	2
1250	16	8	5	3	3
1500	19	9	6	4	3
1750	22	11	7	5	4



Always have the septic tank cleaned by trained professionals. The gases inside the septic tank are lethal!

Helpful websites:

<http://www.septic-tank.com/>
<http://sdahq.org/sdalatest/html/septic/>
http://www.cahe.nmsu.edu/pubs/_m/m-113.html

Minimization of Illegal Stormdrain Connection

Wastewater sewer systems are designed to handle the maximum flows anticipated from a specific area. When other sources of water enter the system, it may overflow through manholes. A common source of undesirable flows into a wastewater sewer system is storm water. Storm drains are designed to handle storm water and runoff from streets and yards. Illegal stormdrain connections increase the flow into the wastewater system, thereby increasing

treatment costs and may result in sewage spills that will eventually end up polluting San Juan Creek or its tributaries.

Inspect the yard drains and rain gutters on and around your home or business. They should drain into your yard or into the gutter on your street. Check the curb in front of your house; if you see drain holes in the curb (usually about 3" in diameter), then it is likely that you have a proper drain system. If you do not see a drain hold or other area where the yard water drains off your property, or if you find your gutters or yard drains leading into your sewer system, you may have an illegal connection.

If you suspect you have such a connection, or if you are not sure, you should call County Directors Thomas B. Mathews at (714) 834-2300 or Vicki L. Wilson at (714) 834-2300. The County may perform a free inspection. If necessary, they may also provide you assistance and even some materials to help you disconnect your yard drains from the sewer system and connect them properly.

Minimization of Illegal Dumping

Illegal dumping, also referred to as "open dumping," "fly dumping," and "midnight dumping", is disposal of waste in an unpermitted area. Illegally dumped wastes are usually non-hazardous materials that are dumped to avoid either disposal fees or the time and effort required for proper disposal. However, some material may include toxins, such as paint cans, medical waste, and automotive waste.

Illegal dumping may impact proper drainage of runoff, making areas more susceptible to flooding when wastes block streams, creeks, culverts, and drainage basins. Worse, runoff from illegal dumpsites containing hazardous material may contaminate your drinking water supply. If you see someone dumping anything onto street surfaces or into the drains, please report it immediately by calling the local police.

Helpful websites:

<http://www.epa.gov/region5/guidebook/index.html>
<http://ci.corona.ca.us/./publws/dumprpt.htm>

Erosion Control

Erosion and channel degradation is a primary source of land loss, sediment removal, and nutrient transport. Erosion results in the loss of floodplain habitats, which act as buffers that help filter out nutrients, bacteria, and sediment contained in urban runoff. There are many options when deciding what erosion control method to use. The design should be based on site-specific conditions and should consider the environmental impacts and benefits during and after construction.

Recycling

Recycling is a proven success. Plus, it is the law! What started out as just bottles and cans has expanded to paper, cardboard, and other material. To find out more about what can be recycled in your community, contact Sue Gordon (IWMD) at (714) 834-4176.

Property Clean Up

Litter on your property will eventually find its way into San Juan Creek and the Pacific Ocean. Rainfall, and the runoff it generates, may carry it to a local stream or storm drain, polluting the rivers, lakes, streams, bays, and ultimately the ocean; and possibly your drinking water supply!

If you have any hazardous materials, such as motor oil or paint cans, store properly until disposal, contact Orange County's Household Hazardous Waste Collection Center (HHWCC) at (714) 834-6752 for proper disposal.

Street Sweeping

Street sweeping is a great method of keeping trash away from the storm drains, and more importantly, out of San Juan Creek! Street sweeping is an effective measure of reducing sediment, nutrient, and heavy metal loads into the drainage system.

Many areas already have street sweeping schedules posted (by way of "NO PARKING" signs, during certain hours). If there are no signs on your street and you feel the street is in need of regular street sweeping, contact County Director of Public Facilities and Resources, at (714) 834-2300.

Litter Control

What may seem like a minor amount of litter in your yard could lead to major problems. Newspapers, plastics, leaves, garden debris, and a variety of other waste objects, when not properly disposed of, will eventually be picked up by runoff and make their way off your property. If these items get into the storm drains, which they will during a rainstorm, they will pollute the system. Make it part of your routine to pick up the litter that has accumulated in your yard. There may be local groups that meet periodically to clean litter in public parks and streets in your area. Ask around and offer your assistance. Every little bit helps maintain a healthy watershed.

Monitoring

Storm water monitoring is a cost-effective method of analyzing the pollutants in storm runoff and is a key component in pollutant source identification in any watershed. Nutrients can be found in their dissolved form during dry weather monitoring, while toxins and sediments can be found in wet weather monitoring. Monitoring is also necessary after BMP implementation to determine the effectiveness of implemented measures. Support the County of Orange's long-term water quality monitoring program!

Runoff Ordinances

Local government should be encouraged to enforce or create runoff ordinances to protect the quality of water reaching storm drains.

Watershed Ordinances

Local government should enforce or create watershed ordinances. A Watershed Protection ordinance will assist in protecting storm water quality, as well as identify potential land uses within a watershed. The ordinance can be used to determine what types of

activities occur in the watershed and what types of control measures are being implemented and enforced.

Landscape Ordinances

Local government should enforce or create landscape ordinances. These ordinances control pesticide application, herbicide application, and the timing and extent of watering. Appropriate landscape ordinances are likely to have significant impacts on the reduction of sediments, nutrients, and heavy metals into the drainage system.

Inspection

City and/or County (depending on jurisdiction) officials should inspect construction sites for compliance to existing ordinances and proper procedures relating to protecting water quality. They should also monitor to ensure that drainage connections are properly constructed and that no illegal connections are made. Pretreatment inspections of industrial facilities, auto businesses, and restaurants should be conducted to ensure the proper handling and disposal of hazardous and toxic materials.

Pet Clean Up

Cleaning up after your pets minimizes the chances that their wastes will end up in San Juan Creek or its tributaries or storm drains. Carry a plastic shopping bag with you to clean up and dispose of properly in the trash. Engage a commercial clean-up firm if this task is not to your liking or if you are unable to do so. Local communities should have laws created or enforced to ensure the removal and proper disposal of pet feces on public property. Leash laws should also be created in areas where pet feces are a known pollutant to an adjacent waterway.

Trash Receptacles

Trash and recycling receptacles should be placed throughout public areas, including roadsides, to reduce the amount of litter in the area. In order to obtain trash receptacles on private property for recycling motor oil, hazardous waste, etc., contact your local Recycle Coordinator (see Appendix A).

Channel Clean Out

Cleaning trash and debris (not sediment) out of local streams in dry weather will reduce the amount of litter carried downstream during storm events. Using neighborhood groups, volunteer groups (such as the Boy/Girl Scouts, little league teams, etc.), or prisoner work release programs are cost-effective methods of directly contributing to the health of the watershed.

Maintenance of Natural Channels

In very few instances, paving of a natural channel might be a consideration. However, in the vast majority of cases, maintenance of natural channels should be a priority. Vegetation provides bank stabilization (roots), resistance to streamflow, protection against rainfall impact, and a filter for sediments and pollutants. Additionally, consideration should be given to removing concrete channels and replacing with natural channels, where possible.

Maintenance and/or Construction of Wetlands

Maintaining existing wetlands, or the construction of new wetlands specifically for the achievement of multiple objectives, is an effective method of reducing sediment and nutrient transport. Wetlands act as a natural filter, trapping sediments and reducing nutrient loadings. Maintaining and reestablishing wetlands should be encouraged in preference to other land uses, as wetlands are in such short supply in the San Juan Creek watershed.

Composting

Composting is beneficial to the environment when done properly. Not only will it reduce trash that would otherwise add to area landfills, it also creates a substance that is excellent for plants and garden soil. In order to maintain a clean watershed, it is important to know what can and cannot be composted. Lawn clippings, hay,

vegetables, tea bags, coffee grounds, eggshells, leaves, manure (horse, cow, sheep & poultry), straw, weeds, and wood chips are all good composting material. Some foods should not be composted if you suspect pet or animal problems.

Some items that may contain toxins or diseases should not be composted. These impurities will seep into the groundwater and may affect the drinking water supply or the local creeks. Chemically treated wood, diseased plants, human waste, meat, bones, fatty foods, pernicious weeds (ivy, morning glory, sheep sorrel, several types of grasses, etc.), or pet waste (cat and dog) should NEVER be composted. All these items are harmful to the water supply!

Helpful website:

<http://www.vegweb.com/composting/>

Spill Prevention

Taking necessary precautions when handling toxic liquids and solids will reduce the chance of a spill. All undesirable liquids and solids should be properly contained and stored until properly disposed. For aboveground tank spill control, local governments should install (or require the installation of) safeguards against accidental releases, such as secondary container units. Local governments should also enforce or create Uniform Building Codes and Uniform Plumbing Codes that address spill prevention and clean up.

Water Conservation

Water conservation is always a good idea, especially in Southern California. Conservation goes beyond the basic recommendations we have grown up learning (shorter showers, not leaving faucets running, etc.). Make sure leaky pipes, faucets, or toilets (including toilets

that constantly run) are repaired. These small leaks add up to gallons per day! Consider learning more about appropriate times and volumes of water application to outside landscaping and inside plants. They and the environment will appreciate your efforts!

Hazardous Materials Response

Local governments should have an emergency response team trained and prepared to respond to a hazardous material spill, 24 hours a day. If the resources were not available, an option would be to contract to a private company that specializes in hazardous material response.

Stenciling

Stenciling storm drain systems (inlets, catch basins, channels, and creeks) with prohibitive language and/or icons is a very visible method of discouraging harmful material into the storm drain system. Volunteers may be used, making this a low cost, but highly effective practice.

Retrofitting of Existing Infrastructure

Consider the retrofitting of existing infrastructure to reduce pollutant loading to area streams. Suitable retrofits include the installation of catchment basins and filters to catch and treat stormwater flow before it gets into area streams. Although expensive, this method has been shown to be effective in many areas.

Strengthen Ordinances

Some cities within Orange County have existing Industrial Waste Ordinances specific to controlling hazardous material/waste dumping into surface waters. These ordinances should be expanded to include a variety of environmental protection features, including watershed, runoff, and landscape ordinances. Other cities in the county should follow suit, and create local ordinances of their own.

Revision of General Plans

A municipality's General Plan is a good place to codify the watershed recommendations and goals for maintaining a healthy watershed.

Further Public Education

A plan should be developed that establishes the framework for community and school-based participation in future watershed rehabilitation efforts. Programs could include:

- ◆ Clean up of degraded environments (parks, lots, etc.)
- ◆ Curriculum guidelines for science projects involving field work
- ◆ Tree planting campaigns
- ◆ Fund raisers for riparian corridor improvements
- ◆ Education for management of pet wastes
- ◆ Education for proper disposal of motor oil and other household chemicals
- ◆ Classroom presentations by groups who have implemented successful projects (ex. Quiet Oak Creek)
- ◆ Plan activities for celebrating Earth Day

Chapter IV: Implementation and Monitoring

4.1 Implementation

Elements of the recommended Watershed Management Plan (WMP) must be implemented in a logical order. There are some alternative plans that rely on the existence of others to function. There are also issues that need to be dealt with, evaluated, and decisions made regarding the pursuit of others prior to implementation.

4.1.1 *The First Year*

First and foremost: The County, as local sponsor for the plan, must continue to seek Congressional support to pursue the “spin-off” studies needed to get Federal funding for construction of the San Juan Creek Flood Damage Reduction and Ecosystem Restoration project. Once this support is obtained, and funding allocated, the additional studies may take place that will allow optimization of the plan and completion of the report to Congress that will allow construction of the largest and most important element of the plan to reduce flood damage and initiate ecosystem restoration.

Second: Application of Best Management Practices, where these are not being uniformly applied, should be pursued. Recommendation at the local level of the BMP portion of the WMP should occur following the completion, and approval, of this report.

Third: Pursuit of water quality testing, monitoring, and most importantly, intelligent interpretation of results, must continue. The County has a long-term plan

for addressing the water quality issue. The problem is that the science of tracking and solving water quality problems is an extremely expensive proposition. One must remember that water quality problems have always been with us, and that solutions will take time, reevaluation, and more money than may be available at any one time.

Fourth: A campaign for exotic species eradication should be undertaken. Measures must begin in the upstream-most areas of the watershed to prevent re-infestation of cleared reaches. This campaign need not address areas that may be involved in construction of structural measures downstream, unless later determined that construction activities will not occur. The campaign must be largely complete for areas upstream of construction reaches prior to initiation of construction. Funding for implementation of exotic species eradication may be obtained through mitigation for on-going projects, mitigation for un-permitted regulatory actions, or other means. For good sources of information on additional funding sources, see Section 7.0 of the Exotic Species Removal Plan (Potential Funding Sources) and the EPA web site on watershed funding sources.

Fifth: A Watershed Education Plan would be a valuable, and long-term asset to the communities in the watershed. Funding for this program may be sought at the State level, but also through contributions from schools of higher learning, philanthropic organizations, and others. Although this is a long-term measure, there is no better time than the present to get the ball rolling. Lastly, the continued participation of the County, cities, water districts, and others in a long-term stewardship program is encouraged. After the study is completed, it is imperative that concerned parties continue to monitor progress, to ensure that efforts are achieving their objectives and that new problems are dealt with in a timely, non-confrontational manner.

4.1.2 *The Next Few Years*

First: Completion of the “spin-off” study needed for Congressional authorization of the San Juan Creek Flood Damage Reduction and Ecosystem Restoration project. This project functions as the keystone for several upstream plans, but is also the most critical element of the damage reduction, stabilization, and restoration effort in this watershed. Completion of this study should be targeted for fiscal year 2004.

Second: Water quality wetlands and treatment projects: It is anticipated that in the next few years, testing will indicate numerous “warm spots” of bacterial exceedance in the watershed. Implementation of the water quality monitoring program will point out areas of greatest need, particularly after the results of recent water quality improvement projects begin to accumulate. It is likely that testing may change priorities, and that existing priority sites may give way to higher priority sites, depending on results. Given that application of demands by water quality oversight agencies will likely require cities and the County to direct more effort at sites not yet determined to be problem areas, this campaign may operate independently of any other efforts, and is not dependent on any alternative plans discussed here. Regardless, plans for water quality improvement should be pursued.

Third: Erosion sites on San Juan, Trabuco, and Oso Creeks (and other tributaries) must be monitored, and if warranted, funds directed toward treatment. Alternately, a request may be issued from the city in which the problem resides to the Corps of Engineers for consideration as an emergency streambank erosion control project (Section 14), for which a letter to

the Corps will be required. The Corps will then study the site and determine if Federal participation is warranted. These sites are not currently critical, although at least one site not discussed here may warrant immediate attention.

4.1.3 *For the Long Term*

First: Long-term monitoring of performance for projects, BMPs, and other measures must occur. The process through which this might occur would be under the auspices of the stewardship program administered by the County. This is discussed below.

Second: Continued pursuit of the funding needed for construction of the San Juan Creek Flood Damage Reduction and Ecosystem Restoration project must occur. This will take the continued efforts of elected officials, particularly at the County and Congressional level, to ensure that this happens.

4.2 Monitoring

4.2.1 *The First Year*

The initial recommendation for monitoring is the establishment of a County-led stewardship program. This program can act as the clearinghouse for data, a discussion forum, and decision-making body for future efforts. It is recommended that each year, a one-day “state of the watershed meeting” be held. At this meeting, the participants go over general data and observations from the past year or two and assess what direction they are going in. It should be considered an annual or biannual physical for the watershed. Types of data they may monitor could include:

- ◆ Water Quality
- ◆ Exotic Species – It would be very simple to have someone document the extent of infestation of *Arundo* and salt cedar and report on the success of removal efforts.
- ◆ 404 permits – Regulatory could easily provide a summary of 404 permits and mitigation projects in the watershed.

- ◆ Channel degradation trends – Establish key spots and do annual cross sections to monitor aggradation/degradation trends.
- ◆ Summary of wildlife surveys conducted each year – This would not entail funding any new species surveys, but would just be a compilation of new data (from whatever source) to make use of the available data.
- ◆ Summary of completed and proposed projects in the watershed and potential funding sources for future work, including restoration, enhancement, parks, infrastructure, etc.
- ◆ Summary of annual flooding and/or erosion damages if any.
- ◆ Opportunities for watershed clean-up days and/or environmental education events.

First: The County, as local sponsor for the plan, will be asked to continue water quality monitoring. A sound basis for this monitoring will be established, and testing conducted. Analysis of the data will indicate areas of greatest need. Future efforts may be prioritized and directed based on what the monitoring indicates.

Second: No less important than this monitoring will be monitoring of existing problem locations for issues other than water quality. This will include the channel system on San Juan, Trabuco, Oso, and other creek systems. Degradation of the system must be evaluated, at least every year.

Third: Evaluation of BMP performance will also be needed. Misdirection of funding will impact problem treatment in other locations. BMPs that fail to achieve the desired objective must be eliminated in

favor of other measures. This must be done on an iterative basis. Monitoring should occur on a yearly, or better, semi-annual basis.

Fourth: Monitoring of exotic species removal and eradication efforts must be conducted. Monitoring by university students as part of their curricula may be possible. Monitoring should occur on a yearly, or better, semi-annual basis.

Fifth: Monitoring of watershed education should occur. Schools that teach material that lends itself to earth science laboratory participation might consider a long-term monitoring aspect to the curriculum. Monitoring should occur on a yearly, or better, semi-annual basis.

4.2.2 Monitoring – For the Long Term

Monitoring of project performance should continue. This may involve site visits and potentially survey of the project sites, any new erosion control or bridge protection projects, and other water resource-related projects.

Monitoring of water quality wetlands, erosion sites, and ecosystem restoration sites must continue over in the long term. It is important to identify areas of need before large problems develop. Monitoring of the situation on San Juan Creek in its downstream reaches is important, as continued scour of the channel, or vegetation die-off, may impact overall goals for the alternative.

Long-term monitoring of performance for BMPs must occur. The process through which this might occur would be under the auspices of the stewardship program administered by the County.

Chapter V: Public and Agency Coordination

This study effort included extensive public and agency coordination. The study effort involved the creation of a study team of technical and planning staff that met regularly (on a monthly or bi-monthly basis), and of a stakeholders' group which met on a monthly or bi-monthly basis, generally within the watershed. The stakeholders' group consisted of anyone that wished to attend, but regularly hosted members of the Surfrider Foundation, the Clean Water Now! Coalition, the San Diego Regional Water Quality Control Board, California Coastal Commission, the Corps of Engineers, U.S. Fish and Wildlife Service, California Department of Fish and Game, the co-sponsors, water districts, and City and County staff, concerned residents, the League of Women Voters, Orange County Department of Public Health, State Parks, Orange County Public Facilities and Resources Department, Orange County Planning, the County Executive Office, the Orange County Grand Jury, Supervisor Tom Wilson of the 5th District, and others.

Agency coordination and public input was very important in the plan formulation of measures, alternative plans, and plan selection. A tremendous volume of opinion, data, insight, and oversight was provided by the above groups and individuals.

Aside from the regular stakeholders meetings, several public information meetings were held, primarily at the beginning of the study effort. These meetings solicited input, allowed venting of

frustrations, explained the study process, and in later phases, disseminated findings of the numerous studies conducted.

The public and agency interaction was a critical element of the process, and greatly contributed to a positive conclusion.

It is anticipated that a public review of this document may be forthcoming. Those results may be incorporated in the final document.

Appendix

A

SAN JUAN CREEK WATERSHED MANAGEMENT PLAN

September 2002

Reference Guide to a Healthy Watershed - Residential

SAN JUAN CREEK WATERSHED MANAGEMENT PLAN

Reference Guide to a Healthy Watershed - Residential

San Juan Creek Watershed Study Management Team
Orange County, California
September 2002

Section
A1

Landscaping, Gardening and Pest Control

Landscaping and garden maintenance activities can be major contributors to ocean pollution. Soils, yard wastes, overwatering, and garden chemicals become part of the urban runoff mix that winds its way through streets, gutters, and storm drains before entering the ocean.

Poorly functioning sprinklers and overwatering, can both waste water and increase the amount of pollutants flowing into storm drains. Fertilizers, pesticides, and herbicides are washed off lawns and landscaped areas. These chemicals not only kill garden invaders, they also harm useful insects, poison fish, and contaminate ground and ocean water.

Leaves, grass clippings, and tree trimmings, that are swept or blown into the street and gutter, are also ocean polluters. These wastes clog catch basins, increasing the risk of flooding on your streets, and carry garden chemicals into the ocean. As they decompose, they also utilize oxygen fish need to survive.



Garden and Lawn Maintenance

- ♦ **Do not overwater.** Conserve water by using irrigation practices such as drip irrigation, soaker hoses, or micro-spray systems. Water your yard during early morning or evening hours when evaporation is less.
- ♦ **Do not blow or rake leaves into the street, gutter, or storm drains.** Compost this material yourself for mulch, or bag for municipal composting.
- ♦ **Use a broom to clean up yard debris on surfaces, not water.**
- ♦ **Use organic or non-toxic fertilizers, such as compost.**
- ♦ **Do not over-fertilize** (follow manufacturers' direction) and do not fertilize within 50 feet of ditches, streams, or other water bodies.
- ♦ **Do not apply pesticide or fertilizers immediately before a rainstorm.**
- ♦ **If your community has curbside yard waste recycling, place clippings and pruning waste in approved containers for pickup.**
- ♦ **Store pesticides, fertilizers, and other chemicals in a covered area to prevent unwanted leakage and runoff.**

ICON KEY	
	Valuable information
	Helpful hints
	Helpful website
	Important numbers



Pesticide Alternatives

The “chemicals-only” approach to pest control is only a temporary fix. A more common-sense approach is needed for a healthy long-lasting landscape. Plan your strategy in this order:

- ♦ **Physical Controls:** Caulking holes, hand picking, barriers, traps
- ♦ **Biological Controls:** Predatory insects (e.g., lady bugs and green lacewings eat aphids), bacterial insecticides
- ♦ **Chemical Controls: (*Your last resort*)** Dehydrating dusts, insecticidal soaps, boric acid powder, horticultural oils, pyrethrin-based insecticides

Safe Substitutes for Pest Control

- ✎ **Garden aphids and mites** – Mix 1 tablespoon of liquid soap and 1 cup of vegetable oil. Add 1 teaspoon of this mixture to a cup of water and spray. (Oil may harm vegetable plants in the cabbage family.)
- ✎ **Caterpillars** – When caterpillars are eating, apply products containing *Bacillus thuringiensis* to leaves.
- ✎ **Ants** – Place boric acid powder or hydramethylnon baits in problem areas, cracks, and insect walkways. It is a mild poison, so be sure it is inaccessible to children and pets.
- ✎ **Roaches** – Apply boric acid powder to cracks and entry points (see ants above). Place bay leaves on pantry shelves.

If You Must Use Pesticides

- ♦ **Use a pesticide that is specifically designed to control your pest.** The insect should be listed on the label. Approximately 90 percent of the insects on your lawn and garden are not harmful.
- ♦ **Use only enough product to treat the affected area.**
- ♦ **Mix and load spray over grass, not on sidewalks or driveways.**
- ♦ **Avoid spraying in or near gutters, stormdrains and channels.**
- ♦ **Read labels!** Use only as directed by the manufacturer.



Pesticide Disposal

- ♦ **Never dump left-over pesticide.** Dumping toxics into the street, gutter, or storm drain is illegal. Pesticides can pollute the ocean and poison groundwater if disposed of in storm drains or gutters.
- ♦ **Disposal Centers** - Orange County has several Household Hazardous Waste Collection Centers - See A3 for details.
- ♦ **Save remaining pesticide for future applications.**

- ♦ **Rinse empty pesticide containers and use rinse water as you would the product.** Dispose of empty rinsed containers in the trash.



Recycling

- ♦ **Composting:** Composting is the natural process of decomposing organic material, like leaves or grass clippings. A major advantage of composting for any gardener is that home-grown compost can be used instead of commercial fertilizers and mulches.
- ♦ **Grasscycling:** Grasscycling is the natural practice of leaving clippings on the lawn when mowing. This can save time, money, and other resources like landfill space. The clippings quickly decompose, returning nutrients to the soil. Proper turf management, in conjunction with the practice of grasscycling, can reduce water and fertilizer requirements, mowing time, and disposal costs.
- ♦ **Xeriscaping:** Xeriscaping means simply landscaping with slow growing, drought-tolerant plants to conserve water and reduce yard trimmings.
- ♦ Contact the name and/or office below for your city to inquire about recycling issues.

City	Address	Phone Number	Fax
Dana Point	Cindy Asher 33282 Golden Lantern Dana Point, CA 92629	(949) 248-3571	(949) 248-7372
Laguna Hills	Don White 25201 Paseo de Alicia, #150 Laguna Hills, CA 92653	(949) 707-2625	(949) 707-2614
Laguna Niguel	Ken Montgomery 27821 La Paz Road Laguna Niguel, CA 92656	(949) 362-4339	(949) 362-4385
Mission Viejo	Denise Matsone 25909 Pala, Suite 200 Mission Viejo, CA 92691	(949) 470-3010	(949) 581-5394
Rancho Santa Margarita	Tom Wheeler 30211 Avenida de las Banderas, Suite 101 Rancho Santa Margarita, CA 92688	(949) 635-1800	(949) 635-1840
San Juan Capistrano	Douglas Dumhart 32400 Paseo Adelanto San Juan Capistrano, CA 92675	(949) 443-6316	(949) 493-1053
Unincorporated Communities/ County of Orange	Sue Gordon 320 N. Flower St., #400 Santa Ana, CA 92703	(714) 834-4118	(714) 834-4110

 For recycling information, contact the city office listed in the table above.

 For more information, visit <http://www.oc.ca.gov/iwmd>

Animals/Household Pets

PICK UP AFTER YOUR PET!

When walking your dog, always carry a pooper scooper or plastic bag with you to pick up your pet's waste. It is a neighborhood nuisance that can wash into gutters and storm drains carrying bacteria and diseases into our rivers and ocean. Remember, if you do not pick up pet waste at the source, you might accidentally pick it up on your body at the beach. Properly dispose of pet waste by flushing it down the toilet or placing it in the trash.

Pet waste is not only unsightly, it is also unhealthy. Our parks should be places for children of all ages to play; instead, they are treated as open toilets. Think of the individual using a wheelchair, and their tires roll across pet waste on the sidewalks. Would you want this on *your* hands?

Although dogs cause the more common pet waste problem, other urban animals, such as domestic or semi-wild ducks, also contribute to non-point source pollution where their populations are high enough. It has been estimated that for a small bay watershed (up to 20 square miles), 2 to 3 days of droppings from a population of 100 dogs can contribute enough bacteria, nitrogen, and phosphorus to temporarily close a bay to swimming.



Composting Pet Wastes

Burying pet wastes is a simple, effective way to compost if a few simple guidelines are followed.

- ♦ Pet wastes should only be buried around ornamental plants.
- ♦ For pest-free burying, dig a hole about one foot deep. Put 3 to 4 inches of pet waste at the bottom of the hole, and use a shovel to mix the wastes into the soil at the bottom. Cover the wastes with at least 8 inches of soil to keep rodents and pets from digging them up. It's that simple!



THE GOOD – FLUSH IT

- ♦ Sewage systems are equipped to deal with pet poop.
- ♦ No added burden to landfills
- ♦ Set a standard for environmentally health conscious dog owners
- ♦ Very hygienic solution
- ♦ Ask your pet store about cat litter alternatives and other methods of collecting and disposing of pet waste that won't contaminate water courses or ground surfaces accessible to children.



When You Can't Flush It, Bag It

- ♦ By bagging and disposing of dog waste, you contribute to a good public image for the dog owning community.

THE BAD & THE UGLY - DON'T LEAVE IT!

- ♦ Waste from healthy dogs typically contain hidden hazards such as microorganisms that cause stomach upset, muscle aches and pains or eye damage leading to blindness in children.
- ♦ Health risks remain even after the waste is disintegrated beyond recognition.
- ♦ In most cases untreated storm water flows directly into local waterways carrying health hazards with it. This can cause beach closures when bacteria levels become too high.

Remember...

- ♦ **Bring a bag,**
- ♦ **Clean it up,**
- ♦ **Dispose of it properly.**

Section A3

Household Hazardous Wastes

KEEPING OUR WATERWAYS FREE OF HOUSEHOLD POLLUTANTS

Household hazardous wastes, such as household cleaners and automobile fluids, are a serious threat to all waterways within a watershed. In fact, one quart of motor oil spilled into a storm drain can contaminate 250,000 gallons of water. When improperly disposed of in storm drains, household wastes can have serious impacts on habitat and water quality downstream, adversely affecting streams, lakes, wetlands, and the ocean.

Stormdrains are meant to carry rainfall runoff from streets to the appropriate drainage channels; however, urban runoff is often composed of flow generated by over-watering, car washing, and illegal dumping. The resulting flows pick up wastes from the ground and carry them along their path. Since stormdrains, and their resulting flows, are often not connected to any conventional treatment system, this untreated water is delivered directly to the waterways within our watershed. Such pollutant loading can be detrimental to water quality, and have the potential to harm marine life, coastal and wetland habitats, and negatively affect the beaches, harbors, and bays we enjoy.

Protection of water quality can start at home. This process involves recognizing household hazardous wastes and learning to store, apply, and disposing of them properly. Also, recognizing proper uses for water and being conscious of how much we use can help to minimize the contamination of this important natural resource.



Identification of Household Hazardous Wastes

The following items can have the potential to pollute our waters if disposed of improperly:

- ♦ Automotive – antifreeze, batteries, gasoline, motor oil and other fluids; metal plating, paint;
 - ♦ Home – cleaning solutions, paint; paint removers;
 - ♦ Yard – fertilizers, herbicides, and pesticides.

Steps to eliminating accidental contamination include maintaining vehicles to avoid fluid leaks; if leaks occur, use an absorbent material like kitty litter to remove fluid from surface. Store yard and household chemicals in leak-proof containers and off the ground.



Proper Disposal

Proper use and disposal of household chemicals can reduce impacts to receiving water bodies and aquatic habitats, and aid in the improvement of water quality. To keep stormdrains free of harmful household pollutants, do not pour or wash off any of these materials into the storm drain system. Household hazardous wastes can be disposed of properly at any one of the Household Hazardous Wastes Collection Centers (HHWCC) located throughout Orange County. This service is **FREE**, and is an easy, drive-through operation that collects most toxic liquids and solids.



For more information on locations, hours of operation, acceptable materials, and related information, call (714) 834-6752, or visit the following website:



<http://www.oc.ca.gov/iwmd/>

For the nearest Oil Recycling Center in Orange County, contact the California Integrated Waste Management Board (CIWMB). Several local businesses participate in this program as oil collection centers, so find one that's convenient for you!



CIWMB Recycling Hotline: (800) 553-2962



Illegal Dumping

Dumping of household pollutants into the street, gutter, or stormdrain is illegal. Illegal dumping can have serious impacts on the downstream water quality of creeks, lakes, wetlands, and the ocean, affecting habitats and recreational opportunities along beaches, bays, and rivers. Therefore, it is imperative to report illegal dumping activity.



To report illegal dumping, call 1-800-69-TOXIC.

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Appendix

B

SAN JUAN CREEK WATERSHED MANAGEMENT PLAN

September 2002

**Reference Guide to a
Healthy Watershed –
Municipal and
Neighborhood Associations**

SAN JUAN CREEK WATERSHED MANAGEMENT PLAN

Reference Guide to a Healthy Watershed – Municipal & Neighborhood Associations

San Juan Creek Watershed Study Management Team
Orange County, California
September 2002

Purpose and Scope

This manual specifies management measures and practices to protect San Juan Creek waters from urban sources of nonpoint pollution. This manual serves as a reference guide and a planning tool for designated users. Designated users include engineers, planners, managers, and field operations personnel. This information may also be useful to neighborhood associations and community action groups who are actively involved in local watershed protection and enhancement.

The primary purpose of this manual is to assist city and county engineers and managers in planning, developing and selecting optimum management practices for various applications and to aid community groups in the implementation of their own neighborhood water management plans. It is important to note that use of this manual DOES NOT supersede requirements of a National Pollutant Discharge Elimination System (NPDES) permit or other regulatory permits.

The following sections address the major sources of urban pollution that affect San Juan Creek waters:

- ♦ Runoff from developing areas;
- ♦ Runoff from construction sites;
- ♦ Runoff from existing development;
- ♦ On-site disposal systems;
- ♦ General sources (households, commercial, and landscaping); and
- ♦ Roads, highways, and bridges.

The control of nonpoint source pollution requires the use of two primary strategies: the prevention of pollutant loadings and the treatment of unavoidable loadings. The strategies in the following sections rely primarily on the watershed approach, which focuses on pollution prevention or source reduction practices.

Section
B2

Urban Runoff

A. New Development Management Measure

The “New Development” management measure is intended to accomplish the following for developing and developed areas:

1. Decrease the erosive potential of increased runoff volumes and velocities associated with development-induced changes in hydrology;
2. Remove suspended solids and associated pollutants entrained in runoff that result from activities during and after development; and
3. Preserve natural systems including in-stream habitat.

Structural practices to control urban runoff rely on three basic mechanisms to treat runoff: ***infiltration***, ***filtration***, and ***detention***. Table 1 lists specific urban runoff control practices that relate to these and includes information on advantages, disadvantages, and costs.

Infiltration devices, such as infiltration trenches, infiltration basins, filtration basins, and porous and concrete block pavement, rely on absorption of runoff to both reduce and treat urban runoff discharges. Water is percolated through soils, where filtration and biological action remove pollutants. (NOTE: Infiltration systems should be installed after construction has been completed and the site has been permanently stabilized. Failures of these systems can often be attributed to clogging due to sediment loadings generated during the construction process and/or premature use of the device before proper stabilization of the site has occurred.

Filtration practices such as filter strips, grassed swales, and sand filters treat sheet flow by using vegetation or sand to filter and settle pollutants. After passing through the filtration media, the treated water can be routed into streams, drainage channels, or other waterbodies; evaporated; or percolated into ground water.

Detention practices temporarily impound runoff to control runoff rates, and settle and retain suspended soils and associated pollutants. Properly designed detention basins protect downstream channels by controlling discharge velocities, thereby reducing the frequency of bankfull flooding and resultant bank-cutting erosion to what would have occurred under natural conditions. If landscaped and planted with appropriate vegetation, these systems can reduce nutrient loads, and provide terrestrial and aquatic wildlife habitat.

Table 1: Advantages and Disadvantages of Management Practices¹

Management Practice	Advantages	Disadvantages	Comparative Cost
Infiltration Basins are impoundments in which incoming urban runoff is temporarily stored until it gradually infiltrates into the soil surrounding the basin.	<ul style="list-style-type: none"> ♦ Can provide groundwater recharge ♦ Can serve large developments ♦ High removal capability for particulate pollutants and moderate removal for soluble pollutants ♦ Micro organisms in soil can breakdown organic pollutants in storm water ♦ When basin works, it can replicate predevelopment hydrology more closely than other BMP options ♦ Can reduce volume of water discharged to streams, alleviating impacts caused by excess flow to receiving channels ♦ Basins provide more habitat value than other infiltration systems 	<ul style="list-style-type: none"> ♦ Possible risk of contaminating groundwater ♦ Only feasible where soil is permeable and there is sufficient depth to rock and water table ♦ Fairly high failure rate ♦ If not adequately designed and maintained, can be an eyesore, breed mosquitoes, and create undesirable odors ♦ Regular maintenance activities cannot prevent rapid clogging of infiltration basins ♦ Improper construction procedures can generate excess sediment and compact soil, thus causing premature clogging and reduction of infiltration rates 	Construction cost moderate but rehabilitation cost high.
Infiltration Trenches are shallow excavated ditches that have been backfilled with stone to form an underground reservoir.	<ul style="list-style-type: none"> ♦ Can provide groundwater recharge ♦ Can serve small drainage areas ♦ Can fit into medians, perimeters, and other unused areas of a development site ♦ Helps replicate predevelopment hydrology, increases dry weather baseflow, and reduces bankfull flooding frequency 	<ul style="list-style-type: none"> ♦ Possible risk of contaminating groundwater ♦ Only feasible where soil is permeable and there is sufficient depth to rock and water table ♦ Should be used in combination with another BMP to control flow ♦ Since not as visible as other BMPs, less likely to be maintained by residents ♦ Can require significant maintenance 	Cost effective on smaller sites. Rehabilitation costs can be considerable.
Vegetated Filter Strips (VFS) are areas of land with vegetative cover that are designed to accept runoff as overland sheet flow from upstream development.	<ul style="list-style-type: none"> ♦ Low maintenance requirements ♦ Can be used as part of the runoff conveyance system to provide pretreatment ♦ Can effectively reduce particulate pollutant levels in areas where runoff velocity is low to moderate ♦ Provides excellent urban wildlife habitat ♦ Economical 	<ul style="list-style-type: none"> ♦ Often concentrates water, which significantly reduces effectiveness ♦ Does not recharge groundwater table ♦ Ability to remove soluble pollutants highly variable ♦ Limited feasibility in highly urbanized areas where runoff velocities are high and flow is concentrated ♦ Requires periodic repair, regrading, and sediment removal to prevent channelization 	Low
Grassed Swales are	<ul style="list-style-type: none"> ♦ Requires minimal land area 	<ul style="list-style-type: none"> ♦ Low pollutant removal rates 	Low compared to curb and

¹ USEPA, 1993, 1999.

Management Practice	Advantages	Disadvantages	Comparative Cost
infiltration/filtration methods that are usually used to provide pretreatment before runoff is discharged to treatment systems.	<ul style="list-style-type: none"> Can be used as part of the runoff conveyance system to provide pretreatment Can provide sufficient runoff control to replace curb and gutter in single-family residential subdivisions and on highway medians 	<ul style="list-style-type: none"> Does not recharge groundwater table Leaching from culverts and fertilized lawns may actually increase the presence of trace metals and nutrients 	gutter
Porous Pavements and Permeable Surfaces , alternative to conventional pavement, reduce much of the need for urban runoff drainage conveyance and treatment off-site.	<ul style="list-style-type: none"> Can provide groundwater recharge Provides water quality control without additional consumption of land Can provide limited peak discharge reduction High removal rates for sediment, nutrients, organic matter, and trace metals When operating properly can replicate predevelopment hydrology for road systems Reduces safety concerns from flooding on streets Eliminates the need for stormwater drainage, conveyance, and treatment systems off-site 	<ul style="list-style-type: none"> Requires regular maintenance to unclog pores Possible risk of contaminating groundwater Only feasible where soil is permeable, there is sufficient depth to rock and water table, and there are gentle slopes Not suitable for areas with high traffic volume Need extensive feasibility tests, inspections, and very high level of construction workmanship High failure rate due to clogging Not suitable to serve large off-site pervious areas 	Cost effective compared to conventional asphalt when working properly
Concrete Grid Pavement consists of concrete blocks with regularly inter-dispersed void areas that are filled with pervious materials, such as gravel, sand, or grass.	<ul style="list-style-type: none"> Can provide limited peak discharge reduction Provides groundwater recharge Provides water quality control without additional consumption of land 	<ul style="list-style-type: none"> Requires regular maintenance Not suitable for area with high traffic volume Possible risk of contaminating groundwater Only feasible where soil is permeable, there is sufficient depth to rock and water table, and there are gentle slopes 	Information not available
Filtration Basins are impoundments lined with filter media, such as sand or gravel.	<ul style="list-style-type: none"> Ability to accommodate medium-size development (3 – 80 acres) Flexibility to provide or not provide groundwater recharge Can provide limited peak discharge reduction 	<ul style="list-style-type: none"> Requires pretreatment of storm water through sedimentation to prevent filter media from prematurely clogging 	Information not available
Water Quality Inlet Catch Basins with Sand Filter are single-chambered urban runoff inlets in which the bottom has been lowered to provide 2 to 4 feet of additional space between the outlet pipe and the structure bottom for collection of sediment. A second chamber contains a sand filter for the	<ul style="list-style-type: none"> Provide high removal efficiencies of particulates Require minimal land area Flexibility to retrofit existing small drainage areas Higher removal of nutrient as compared to catch basins and oil/grid separator 	<ul style="list-style-type: none"> Not feasible for drainage area greater than 5 acres Only feasible for areas that are stabilized and highly impervious Not effective as water quality control for intense storms Does not recharge groundwater 	Information not available

Management Practice	Advantages	Disadvantages	Comparative Cost
removal of finer suspended solids by filtration.			
Water Quality Inlet Oil/Grease Separators consist of three chambers. The first removes coarse material and debris; the second provides separation of oil, grease, and gasoline; and the third provides safety relief should blockage occur.	<ul style="list-style-type: none"> • Captures coarse-grained sediments and some hydrocarbons • Requires minimal land area • Flexibility to retrofit existing small drainage areas and applicable to most urban areas • Shows some capacity to trap trash, debris, and other floatables • Can be adapted to all regions of the country 	<ul style="list-style-type: none"> • Not feasible for drainage area greater than 1 acre • Minimal nutrient and organic matter removal • Not effective as water quality control for intense storms • Concern exists over the pollutant toxicity of trapped residuals • Require high maintenance 	High, compared to trenches and sand filters
Extended Detention Dry Ponds temporarily detain a portion of urban runoff for up to 24 hours after a storm, using a fixed orifice to regulate outflow at a specified rate, allowing solids and associated pollutants the required time to settle out.	<ul style="list-style-type: none"> • Can provide substantial peak discharge reduction • Possible to provide good particulate removal • Can serve large development • Requires less capital cost and land area when compared to wet pond • Does not generally release warm or anoxic water downstream • Provides excellent protection for downstream channel erosion • Can create valuable wetland and meadow habitat when properly landscaped 	<ul style="list-style-type: none"> • Removal rates for soluble pollutants are quite low • Generally not economical for drainage area less than 10 acres • If not adequately maintained, can be an eyesore, breed mosquitoes, and create undesirable odors 	Lowest cost alternative in size range
Wet Ponds are basins designed to maintain a permanent pool of water and temporarily store urban runoff until it is released at a controlled rate.	<ul style="list-style-type: none"> • Can provide limited peak discharge reduction • Can serve large developments; most cost-effective for larger, more intensively developed sites • Enhances aesthetics, provides habitat and recreational benefits • Little groundwater discharge • Permanent pool in wet ponds helps to prevent scour and resuspension of sediments • Provides moderate to high removal of both particulate and soluble urban stormwater pollutants • Biological uptake of nutrients and metals by aquatic plants and algae, biological conversion and volatilization of organic compounds 	<ul style="list-style-type: none"> • Not economical for drainage area less than 10 acres • Potential safety hazards if not properly maintained • If not adequately maintained, can be an eyesore, breed mosquitoes, and create undesirable odors • Requires considerable space, which limits use in densely urbanized areas with expensive property values • Not suitable for permeable soils hydrologic soil groups “A” and “B” (NRCS Classification) • With possible thermal discharge and oxygen depletion, may severely impact downstream aquatic life 	Moderate to high compared to conventional storm water detention
Extended Detention Wet Ponds	<ul style="list-style-type: none"> • Can provide peak discharge reduction 	<ul style="list-style-type: none"> • Not economical for drainage area less than 	Information not available

Management Practice	Advantages	Disadvantages	Comparative Cost
<p>temporarily detain a portion of urban runoff for up to 24 hours after a storm, using a fixed orifice to regulate outflow at a specified rate, allowing solids and associated pollutants the required time to settle out.</p>	<ul style="list-style-type: none"> ♦ Can serve large developments; most cost-effective for larger, more intensively developed sites ♦ Enhances aesthetics and provide recreational benefits ♦ Permanent pool in wet ponds helps to prevent scour and resuspension of sediments ♦ Provides better nutrient removal when compared to wet pond 	<p>10 acres</p> <ul style="list-style-type: none"> ♦ If not adequately maintained, can be a potential safety hazard, an eyesore, breed mosquitoes, and create undesirable odors ♦ Requires considerable space, which limits use in densely urbanized areas with expensive property values ♦ Not suitable for hydrologic soil groups “A” and “B” (NRCS classification) ♦ With possible thermal discharge and oxygen depletion, may severely impact downstream aquatic life 	
<p>Constructed Stormwater Wetlands are engineered systems designed to simulate the water quality improvement functions of natural wetlands to treat and contain surface water runoff pollutants and decrease loadings to surface waters.</p>	<ul style="list-style-type: none"> ♦ Can serve large developments; most cost-effective for larger; more intensively developed sites ♦ Provides peak flow control ♦ Enhances aesthetics and provides recreational benefits ♦ The marsh fringe also protects shoreline from erosion ♦ Permanent pool in wet ponds helps to prevent scour and resuspension of sediments ♦ Has high pollutant removal capability 	<ul style="list-style-type: none"> ♦ Not economical for drainage area less than 10 acres ♦ Potential safety hazards if not properly maintained ♦ If not adequately maintained can be an eyesore, breed mosquitoes, and create undesirable odors ♦ Requires considerable space, which limits use in densely urbanized areas with expensive land and property values ♦ May contribute to nutrient loadings during die-down periods of vegetation (must mow and remove vegetation to avoid) 	<p>Marginally higher than wet ponds</p>

It is important to note that BMP performance, effectiveness, and cost may vary greatly from site to site with differences in design criteria and performance goals and standards. Also, it is often difficult to quantify the effectiveness of a BMP since inflows and outflows to the structure may be diffuse, and therefore not conducive to representative sample collection. Therefore, BMP effectiveness may need to be determined through the monitoring of downstream habitat, water quality, and hydrologic conditions, although this may also prove difficult to quantify due to the highly variable nature of urban watershed conditions and contributing factors. For further information and discussion regarding BMP implementation, performance, and relative cost and benefit data, visit the following websites:

U.S. Environmental Protection Agency, <http://www.epa.gov/OST/stormwater/>
American Society of Civil Engineers, National Storm Water BMP Database, <http://www.bmpdatabase.org/>.

Recommendations

- ♦ **Develop training and education programs and materials for public officials, contractors, and others involved with the design, installation, inspection, and maintenance of urban runoff facilities.**

Training programs and educational materials are crucial to implementing effective urban runoff management programs. Contractor certification, inspector training, and competent design review staff are also extremely important for program implementation and continuing effectiveness.

- ♦ **Ensure that all urban runoff facilities are operated and maintained properly.**

Once installed, it should receive thorough maintenance in order to function properly and not pose a health and safety threat. Maintenance should occur at regular intervals; be performed by one or more individuals trained in proper inspection and maintenance of urban runoff facilities; and performed accordance with the adopted standards of the local government. It is more effective and efficient to perform preventive maintenance on a regular basis than to undertake major remedial or corrective action on an emergency basis.

B. Watershed Protection Management Measure

This management measure is intended to be applied to new development or redevelopment including construction of new and relocated roads and bridges that generate nonpoint source pollutants. This measure was selected for the following reasons:

1. Watershed protection is a management technique which provides long-term water quality benefits and lacks the high operation and maintenance costs associated with structural controls.
2. Setting general water quality objectives oriented toward protection of environmentally sensitive areas and areas that provide water quality benefits allows flexibility in the pursuit of widely differing water quality priorities and reduces potential conflicts that may arise due to existing program goals and requirements.

Recommendations

Listed below are examples of the types of development regulations and other implementation tools that could be utilized to control nonpoint source pollution.

- ♦ **Development and enforcement of ordinances or regulations requiring nonpoint source pollution controls for new development and redevelopment**

These ordinances or regulations should address, at a minimum: (1) Control of off-site urban runoff discharges (to control potential impacts of flooding and erosion); (2) The use of source control BMPs and treatment BMPs; (3) The performance expectations of BMPs; (4) The protection of stream channels, natural drainage ways, and wetlands; (5) Erosion and sediment control requirements for new construction and redevelopment; and (6) Treatment BMP operation and maintenance requirements and designation of responsible parties.

- ♦ **Infrastructure planning**

Infrastructure planning can be an effective practice to help guide development patterns away from areas that provide water quality benefits, are susceptible to erosion, or are sensitive to disturbance or pollutant loadings. New developments should be targeted for areas that have adequate infrastructure to support growth in order to promote infill development, prevent urban sprawl, and discourage the use of septic tanks where they are inappropriate.

- ♦ **Local ordinances**

General site design standards, such as preservation of environmentally sensitive areas, are one example of subdivision regulations. Requirements for new developments that do not allow an increase in stormwater runoff from pre-development conditions are another example.

- ♦ **Setback (buffer zone) standards**

The use of setbacks or buffer zones may prevent direct flow of urban runoff from impervious areas into adjoining surface waters. Setbacks also provide pollutant removal, sediment attenuation, and infiltration.

- ♦ **Slope restrictions**

Slope restrictions can be effective tools to control erosion and sediment transport.

- ♦ **Site plan reviews and approval**

Depending on the size of the local government and the amount of new development occurring, this inspection could be incorporated into the duties of existing staff at minimal additional cost to the local government, or could require the addition of staff to conduct onsite inspections and monitoring. The effectiveness of such a program depends on the ability of the inspectors to evaluate property for its natural resource value and their knowledge of the effectiveness of practices used to protect areas necessary for the preservation of water quality.

- ♦ **Designation of an entity or individual who is responsible for maintaining the infrastructure, including the urban runoff management systems**

If desired, the local government could be designated to maintain urban runoff systems, with financial compensation from the developer(s). Homeowner groups are not the best entity for monitoring

infrastructure because they are not (usually) trained in infrastructure maintenance. The amount of funding needed depends on the size of the local government.

♦ **Official mapping**

Official maps can be used to designate and/or protect environmentally sensitive areas, zoning districts, identified land uses, or other areas that provide water quality benefits. These maps can be used as legal instruments to make land use decisions related to nonpoint source pollution.

Pollution Prevention

Pollution Prevention Management Measure

This management measure is intended to prevent and reduce nonpoint source pollutant loadings generated from a variety of activities not addressed by Section 2. Everyday activities have the potential to contribute to nonpoint source pollutant loadings. Some of the major sources include individual households, garden and lawn care activities, turf grass management, diesel and gasoline vehicles, illegal discharges to urban runoff conveyances, commercial activities, and pets and domesticated animals.

Recommendations

Listed below are types of practices that can be applied successfully to achieve the management measure described above.

- ♦ **Promote public education programs regarding proper use and disposal of household hazardous materials and chemicals**

Public education is an important component of the pollution prevention management measure. The provision of information regarding the environmental impacts of common household activities can produce long-term shifts in behavior and may result in significant reductions in household-generated pollutants. Education programs are especially effective when alternatives to household hazardous chemicals are made available. School curricula on watershed protection, including nonpoint pollution control, should be developed for elementary and secondary education programs. Incorporating such programs into regular school curricula is an effective way to educate youth on the importance of environmentally conscious behavior, which in turn can help reduce the need for and cost of technology-based pollution control.

Public involvement should be encouraged during the planning process through attendance at meetings, workshops, and private or group consultations. Newsletters are an effective means of keeping the public informed of what planning steps are being taken and how the public can become and stay involved.

- ♦ **Establish programs such as “Amnesty Days” to encourage proper disposal of household hazardous chemicals**

Collection programs can have a significant impact on the amount of hazardous chemicals entering the waste stream. The most common type of collection system is a one-day event at a temporary site (“Amnesty Day”). Local governments are encouraged to establish and sponsor these programs.

- ♦ **Develop and promote used oil, antifreeze, and hazardous chemical recycling programs and site collection centers in convenient locations**

- ♦ **Encourage proper lawn management and landscaping**

Because most people are not trained in proper fertilization and maintenance application, homeowner lawn care may result in significant amounts of nonpoint source pollution. To significantly decrease homeowners’ pesticide and fertilizer loadings require a broad-based educational effort. Mass media approaches are generally the most effective way to reach a large part of the population, though some possibilities are listed below.

- (1) Proper pesticide and herbicide use, and reduced applications;
- (2) Reduced fertilizer applications and proper application timing;
- (3) Limited lawn watering;
- (4) Xeriscaping;
- (5) Reduced runoff potential (e.g., landscape terracing reduces runoff and erosion when gardening on slopes; and wood decking or brick pavers allow greater infiltration than solid concrete structure.); and
- (6) Training, certification, and licensing programs for landscaping and lawn care professionals

- ♦ **Encourage proper onsite recycling of yard trimmings**

Home composting promotes onsite recycling of plant nutrients contained in yard trimmings and reduces the potential for nutrients to enter surface waters. Home composting programs may result in municipal cost savings. An average suburban yard generates up to 1,500 pounds of yard trimmings per year, most of which is landfilled. Homeowners should be encouraged to place compost piles or bins away from streams and roadways that may serve as conveyances of leached nutrients. Recycling of grass clippings and mulched leaves should also be encouraged through education and incentive programs. Backyard composting programs can include the following: providing compost bins free or at cost, creating pamphlets explaining benefits and methods, and providing credits on waste removal fees for people who compost yard wastes. Communities can also develop composting facilities and collect yard waste for this purpose. Sterilized, composted yard waste can then be sold at home and garden centers to pay for the cost of the program.

- ♦ **Encourage the use of biodegradable cleaners and other alternatives to hazardous chemicals**

The use of non-toxic, biodegradable alternatives, which quickly break down, should be encouraged through public education and incentive efforts. Non-toxic cleansers can also be offered at low cost through community centers and other venues.

♦ **Manage pet waste to minimize runoff into surface waters**

Laws requiring pet owners to clean up after their pets when they are walked in public areas and to dispose of the droppings properly should be enacted. Proper cleanup and disposal of canine fecal material and discouragement of public feeding of waterfowl are two ways of potentially controlling the adverse impacts of animal droppings. Local municipalities should be encouraged to develop and distribute informational material on all aspects of animal waste problems.

♦ **Use storm drain stenciling in appropriate areas**

Storm drain stenciling programs can be effective tools to reduce illegal dumping of litter, leaves, and toxic substances down urban runoff drainage systems. These programs also serve as educational reminders to the public that such storm drains often discharge untreated runoff directly to the ocean.

♦ **Control commercial sources of nonpoint source pollutants by promoting pollution prevention assessments and developing nonpoint source pollution reduction strategies or plans and training materials for the workplace**

It is important to develop pollution prevention programs tailored specifically to an activity or site. For example, local municipalities should promote and/or provide pollution prevention training and on-site assessments of individual facilities to help reduce the amount of hazardous wastes entering the environment from households and commercial facilities. A typical assessment for a facility will identify the types of waste produced, appropriate disposal methods, disposal sites, and source reduction techniques. An education program to instruct personnel about proper materials handling and waste reduction strategies is also recommended.

♦ **Promote water conservation**

Excessive use of water contributes to numerous nonpoint source pollution problems, including runoff from fertilized areas, car washing, and sewage leaks

♦ **Discourage the use of septic systems additives**

There is little scientific evidence that septic system cleaners are effective in improving the function of septic systems. Many of the septic system cleaners contain chemicals (e.g., chlorinated hydrocarbons, aromatic organic compounds, and acids and bases) that may have an adverse affect on the biological treatment systems and may pollute groundwater.

♦ **Encourage litter control**

- (1) Encourage businesses to keep the streets in front of their buildings free of litter;
- (2) Develop/enforce local ordinances restricting or prohibiting food establishments using disposable food packaging;
- (3) Implement “bottle bills” and mandatory recycling laws;
- (4) Provide technical and financial assistance for establishing and maintaining community waste collection;
- (5) Distribute public education materials on the benefits of recycling; and
- (6) Develop “user-friendly” ways for recycling (e.g., curbside pick-up, voluntary container buy-back systems, and drop-off recycling centers).

- ♦ **Promote programs such as “Adopt-a-Stream” to assist in keeping waterways free of litter and other debris**

These programs can eliminate much of the floatable debris found in coastal waters and their tributaries. These involve volunteers who pick up trash along designated streambeds. In addition to the visible benefits of such clean-up efforts, these programs offer valuable educational opportunities for volunteers and provide a significant amount of data on the amounts and types of debris found in waterways. The sources of various types of debris can be traced as well. For example, debris can be traced to a specific company or organization based on labeling marketing. Where possible, contact these organizations about the finding, inform them of the problems caused by the debris, and ask them to join the battle against the debris problem.

Construction Activities

Construction Site Erosion and Sediment Control Management Measure

The goal of this management measure is to reduce the sediment loadings from construction sites that enter surface waterbodies. It is intended to be part of a comprehensive land use or watershed management program.

An erosion and sediment control (ESC) plan is a document that explains and illustrates the measures to be taken to control erosion and sediment problems on construction sites. ESC plans ensure that provisions for control measures are incorporated into the site planning stage of development and provide for the reduction of erosion and sediment problems and accountability if a problem occurs. An effective ESC plan includes both structural and nonstructural controls. Nonstructural controls address erosion control by decreasing erosion potential. Structural controls are both preventive and mitigative since they control both erosion and sediment movement.

Recommendations

Some erosion and soil loss are unavoidable during land-disturbing activities, however most is preventable. While proper siting and design will help prevent areas prone to erosion from being developed, construction activities will invariably produce conditions where erosion may occur. To reduce the adverse impacts associated with construction, a system of nonstructural and structural erosion and sediment controls are recommended below.

Erosion Control Practices

Erosion controls are used to reduce the amount of sediment that is detached during construction and to prevent sediment from entering runoff.

- ♦ **Schedule projects so clearing and grading are done during the time of minimum erosion potential (dry season)**
- ♦ **Stage construction so that only the minimum amount of land necessary is cleared at one time**
- ♦ **Clear only areas essential for construction**

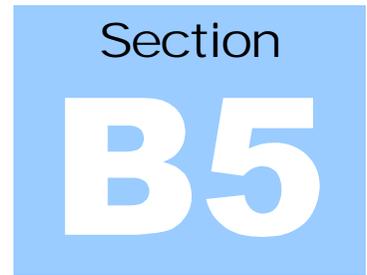
- ♦ **Locate potential nonpoint pollutant sources away from steep slopes, waterbodies, and critical areas**
- ♦ **Use terrace contouring to reduce velocities of stormwater runoff down slopes**
- ♦ **Cover disturbed areas with straw whenever the site will not be worked for more than 72 hours**
- ♦ **Route construction traffic to avoid disturbance of existing or newly planted vegetation and stabilize construction areas**
- ♦ **Protect natural vegetation with fencing, tree armoring, and retaining walls or tree wells**
- ♦ **Stockpile top soil and reapply to revegetated site**
- ♦ **Cover or stabilize topsoil stockpiles**
- ♦ **Use wind erosion controls**
- ♦ **Intercept runoff above disturbed slopes and convey it to a permanent channel**
- ♦ **Use retaining walls**
- ♦ **Provide linings for urban runoff conveyance channels**
- ♦ **Use check dams**
- ♦ **Use seeding and mulch/mats**
- ♦ **Use sodding**
- ♦ **Use wildflower cover**

Sediment Control Practices

Sediment controls capture sediment that is transported in runoff. Filtration and detention are the main processes used to remove sediment from urban runoff.

- ♦ **Sediment basins** are most cost effective, but must be designed to contain a 25-year storm event or greater. Discharge from basins should be monitored to ensure sediment is not being discharged.
- ♦ **Sediment traps** can be effective for small areas, and must be maintained to ensure proper settling of sediment prior to release of water.
- ♦ **Filter fabric fencing** is not very effective except on relatively flat property where runoff volumes are low.
- ♦ **Straw bale barriers** are also not very effective except when the volume of water passing through is very low.
- ♦ **Inlet protection** protects drains from stormwater runoff. Typical barriers include sandbags and straw bales; only effective for low runoff volume.

- ♦ **Construction entrances** should always be stabilized with rock to reduce transport of sediment from the construction site onto roadways. Washing facilities can be built into construction entrances to wash down vehicle tires when leaving the site.
- ♦ **Vegetated filter strips** can provide sediment retention for low volumes of stormwater runoff.



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Appendix

C

SAN JUAN CREEK WATERSHED MANAGEMENT PLAN

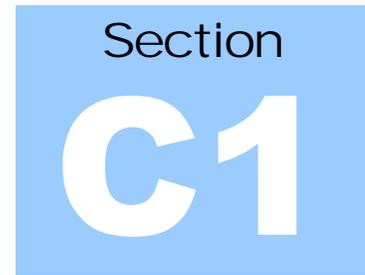
September 2002

Exotic Species Eradication Program

SAN JUAN CREEK WATERSHED MANAGEMENT PLAN

Exotic Species Eradication Program

San Juan Creek Watershed Study Management Team
Orange County, California
September 2002



Background

Although many exotic species have minor (or unknown) impacts on native ecosystems, some are extremely disruptive. This report offers guidelines and recommendations about exotic species management.

Invasion or increase of exotics plant species usually is the result of a disturbance or degradation of a natural system. A healthy, well-managed ecosystem usually will not experience problems with these species. Therefore, long-term control of problem species ultimately depends on restoring the natural processes that originally maintained the health of the system. In many cases, measures that concentrate solely on control of problem species without restoring natural processes will merely treat symptoms of the “disease.”

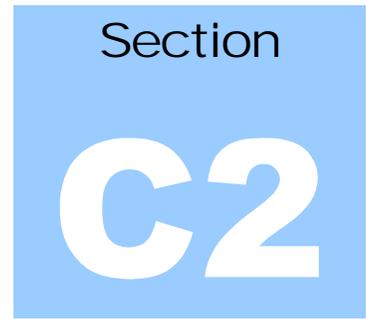
Eradication vs. Control

The goal in protecting natural areas from exotic species is maintaining or restoring ecosystem health and the native biodiversity of the natural area. Eradication of non-native plants is a preferred goal. Although eradication of an undesirable plant may be ideal for the health and aesthetics of an ecosystem, it can be difficult to achieve due to the labor and resources required. Controlling an exotic species by reducing density and population size to low levels sometimes is a more practical goal than is complete eradication.

Certain control measures, such as herbicides, can be harmful to native flora and fauna, and the potential risks must be considered carefully. It rarely is desirable to risk degradation of ecosystem health and diversity by using pesticides on a large scale to eliminate an exotic species completely. Rather, herbicides could be used to control (reduce the population size) an exotic species, and then less risky measure (e.g., fire, cutting, or hand pulling) could be used to eliminate or further reduce the problem species.

Chemical vs. Mechanical or Natural Control

Use of herbicides to control exotics in a natural area should be initiated only after critical consideration of the effects that pesticide use might have. This should be avoided when natural (e.g., fire) or mechanical (e.g., cutting, girdling, mowing) control measures exist. Chemicals should be used only when the consequences of not using the chemical are worse than the risk of chemical use. Herbicide use often is justified when labor available to manage exotic plants is severely limited, or when mechanical methods are ineffective due to the extent of the infestation or to environmental limitations (too wet, too rocky, etc.). Even so, non-chemical methods always should be given first consideration when management of exotic species is undertaken. Chemical could also be used as a second step, following mechanical methods such as cutting or mowing, followed by spot applications of chemicals.



Effective Prevention

The most efficient and cost-effective way to stop the establishment and subsequent damage by invasive plants is to prevent them from becoming a problem in the first place. To do this, foreign invasive plants must be stopped from accidentally or intentionally arriving in this country. Invasive plants that are already here must be prevented from infesting new areas. Hundreds of invasive plants infest millions of acres of range, forest, wild areas, and croplands in the United States; thousands more potentially invasive species are not yet present in the country.

Preventing New Invasions: Stop invasive plant entry and spread

It is vital to improve procedures to intercept invasive plants at the border and prevent their spread within the United States. Plants known to be invasive must be prevented from entering the country. Invasive plants already established in the United States must be kept from spreading to uninfested areas. Procedures need to be established to evaluate and mitigate the risk that any plant species proposed for importation may pose.

Opportunities for partnerships

Tourist boards, government agencies, and conservation and industry organizations can pool resources for education and outreach to the public. Land managers can review activities authorized or conducted for their potential to spread invasive plants. Research agencies can share expertise to develop risk assessment tools and commodity screening technologies to minimize the spread of problem species.

Opportunities for education

Foreign and domestic travelers and tourists need to understand how to help prevent the spread of invasive plants into and throughout the United States. Hikers, boaters, hunters, anglers, equestrians, and other users of natural areas need to be informed about outdoor practices that prevent the spread of invasive plants to uninfested areas. Importers of plants and plant materials can evaluate the risk of new introductions becoming invasive. Since plantings of non-native species as ornamentals is a major source of invasive exotic plants, education of nursery and seed growers, landscapers, and homeowners is also essential.

Opportunities for research

New procedures must be developed to improve inspection of materials at ports of entry or between states that could increase the establishment of invasive plants. Basic ecological studies are needed to determine what conditions make ecosystems vulnerable to plant invasion. Risk assessment procedures are needed to determine

the invasive potential of new plants proposed for import. Additional controlled breeding and selection of nonnative plants may be needed to minimize invasive tendencies.

Detecting and Monitoring: Expand and improve systems for detecting, reporting, and monitoring new infestations of invasive plants.

Early detection and removal of new infestations, both of plants known to be invasive and those not yet known to spread aggressively, will keep eradication and control costs at a minimum. Information is needed regarding initial sightings of new plants with invasive potential and new infestations of recognized problem plants. In addition, a national or regional system for storing and disseminating information about weed occurrences would drastically improve our ability to fight invasive plants.

Opportunities for partnerships

Establishing a central network among landowners, public land management agencies, recreation groups, conservation organizations, botanists, horticulturists, and weed organizations to report new invasive plant infestations would help meet detection and monitoring objectives. An herbarium or other facility could serve as a central repository for this information, making it available on the Internet, creating a national or regional alert system so that new and spreading plants can be monitored on a broad scale.

Opportunities for education

Schools, conservation groups, weed organizations, outdoor recreation groups, garden clubs, nature centers, and extension programs could help raise public awareness about the effects of invasive plants on lands, waters, wildlife, native vegetation, and agriculture.

Opportunities for research

Effective and standardized invasive plant monitoring protocols are needed. Tools must be developed to assess the invasive potential of recently arrived foreign species. Technologies such as Geographic Information Systems (GIS) and remote sensing need to be adapted so that invasive plant distributions and their potential ecological range in the watershed could be located and mapped.

Complying with Laws and Regulations: Provide resources to ensure compliance with laws and regulations.

Coordination of State and Federal laws and regulations would improve control of widespread invasive plants such as the giant reed. Effective regulation of interstate movement of invasive plants will further protect natural resource areas and other ecosystems from invasion by new species of plants.

Opportunities for partnerships

States with existing invasive plant legislation can coordinate activities between other states and federal agencies to provide adequate enforcement.

Opportunities for education

Concerned citizens, consumer groups, conservation organizations, industry, and our nation's leaders can be informed about the costs of invasive plants on our food prices, user fees, habitat quality, and biodiversity. They also can be informed about existing Federal and State laws and regulations and the roles of various agencies in responding to invasive plant problems.

Opportunities for research

The full economic impact of invasive plant infestations needs to be determined in order to demonstrate the cost savings associated with preventing new infestations.

Using Native Species: Expand use of native species conservation purposes.

Native plant species provide forage, cover and habitat required by native fauna and are frequently beautiful low maintenance plants for landscaping and gardening. Use of native species for landscaping, rights-of-way, erosion control, and habitat improvement will help prevent the inadvertent spread of nonnative invasive plants and help maintain local biodiversity.

Opportunities for partnerships

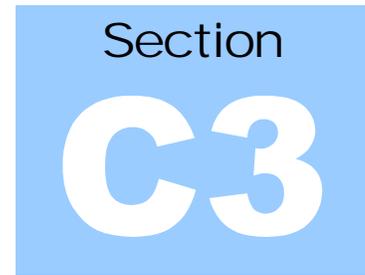
The demand for native plant nursery stock is increasing, and the nursery industry and others can help develop and expand this national market. State and private nurseries can work with State and Federal conservation agencies to provide stock for native plantings.

Opportunities for education

All plant users need to know about the native plant choices available that will meet their goals. These goals include ornamental planting, rights-of-way, buffer strips, and restoration of natural areas. Native plant conservation groups can work at the "grass-roots" level to stimulate local awareness and interest in native plants. Incentives for gardeners, such as periodic native plant fairs, or other forums, can provide information and native plants to homeowners and landscapers.

Opportunities for research

Research is needed to identify the most effective means of seed harvest and propagation for a wide range of native plants. Cleaning methods for removing invasive plant seed from native plant seedlots can be developed so that weed-free certification is feasible. Methods to maintain native plantings, especially during the first few years, must be developed or improved. Additional controlled breeding and selection of native plants may be needed to ensure horticultural value, landscape adaptability, and consumer acceptance.



Effective Control

Once an invasive plant has become established, it must be kept below economically and environmentally damaging levels and prevented from spreading to new areas. Like a wildfire, an invasive plant infestation is most easily suppressed or eliminated when it is still small. After an infestation has greatly expanded, controlling around the edges prevents its further spread, while long-term control efforts should focus on the remainder of the infestation. Since most invasive species colonize disturbed ground, all control efforts must be followed with an aggressive native plant revegetation plan.

Planning and Determining Priorities: Establish priorities through watershed-wide partnership-based approaches.

Private landowners, State and Federal land management agencies, weed organizations, and interest groups should establish priorities and coordinate control efforts based on watershed-wide invasive plant management plans.

Opportunities for partnerships

Watershed-wide invasive plant management problems provide an excellent opportunity for diverse interests to work collaboratively, developing mutually beneficial and cost-effective approaches. An example of a successful areawide program is the Team Arundo, a multi-agency group dedicated to the control of the Giant Reed.

Opportunities for education

Landowners, State and Federal land managers, interest groups, and citizens can learn about each other's specific concerns regarding invasive plants and their control. Each group needs to understand the regional impact of weeds.

Opportunities for research

Site-specific control methods may need to be developed for high-priority invasive plant infestations. Studies of risks and effects of hydrologic manipulations, prescribed burning, biological control technologies, or chemical applications may be required.

Implementing Integrated Pest Management: Practice integrated invasive plant management on a watershed-wide basis.

Integrated invasive plant management relies on a combination of technologies including biological, mechanical, chemical, and cultural applications. Cooperation is essential for control when infested areas include several landowners because invasive plants respect no boundaries. Factors to consider in selecting control technologies include compatibility, effectiveness, and environmental effects. Because of the complexity of environmental, economic, and cultural concerns associated with invasive plant management, programs that are based on a combination of technologies tend to be most successful.

Opportunities for partnerships

Invasive plant management can be practiced on a single land parcel in isolation, but resource-sharing and watershed-wide management will lead to more rapid, effective, and long-lasting control. Means should be created for all land managers, including State and Federal agencies, to share resources for integrated weed management.

Opportunities for education

Public land managers and private landowners need to learn the advantages of integrated invasive plant management methods. The general public and private interest groups need to understand the risks and benefits of control technologies proposed for use in their region. Demonstrating integrated invasive plant management practices to the public will hasten acceptance of integrated invasive plant management technologies.

Opportunities for research

Research is needed to identify, evaluate, and clear new biological and chemical controls that are safe, effective, and target-specific. Site-specific studies are needed to determine the best combination of these controls.

Management Invasive Plants: Eradicate small infestations and contain expansive infestations.

Early eradication of a small infestation will save significant time and money and will be more successful than attempts to eradicate the infestation after it becomes substantial. An expansive infestation should be contained by preventing the edges from advancing, with long-term control efforts, such as biological control, focused on the core.

Opportunities for partnerships

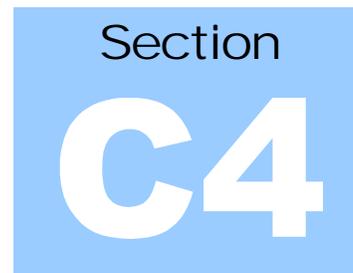
Regionally based rapid response teams, consisting of landowners, weed specialists, botanists, foresters, and land managers should be established to provide professional assessments and recommendations regarding new weed infestations and support local efforts at eradication

Opportunities for education

Schools, conservation groups, outdoor recreation groups, nature centers, and extension programs can inform the general public about invasive plant impacts. Interest groups and others could sponsor weed roundup activities to eradicate small or newly discovered infestations.

Opportunities for research

Eradication and control technologies for new invasive plants will be needed. Studies are needed to determine what conditions make ecosystems vulnerable to invasion so these conditions can be considered in preventing the spread of invasive plants. For many large invasive plant infestations, more work is needed to identify suitable integrated invasive plant management techniques for use in natural resource areas.



Effective Restoration

Invasive plant infestations displace native plant communities, increase erosion, decrease agricultural productivity, and disrupt ecosystem processes. Restoration or rehabilitation is intended to return the lost components or functions to degraded lands. Restoration is a crucial next step after invasive plant control or eradication; without it, areas are subject to re-invasion.

Formulating Methods and Procedures: Develop and implement effective restoration methods and procedures for invasive plant degraded areas.

The practice of restoring degraded lands and maintaining their productivity is relatively new and there is much to learn about how this is best accomplished.

Opportunities for partnerships

Restoration provides excellent opportunities for collaborative demonstration projects. Nurseries, land management agencies, conservation groups, schools, local businesses, recreation groups, weed organizations, and others can work together to eradicate invasive plants and revegetate with appropriate species. Through partnerships, watershed-wide plans to restore missing components or disrupted processes to degraded lands will be feasible.

Opportunities for education

Informing the public about the benefits of restoring native species, increased agricultural productivity, and natural areas with associated social, economic, and biological benefits will lead to adoption of restoration efforts.

Opportunities for research

Methods are needed for restoring ecosystem biodiversity and productivity to appropriate levels after invasive plant control and to determine when an area is sufficiently restored and stable. Assessments of the economic, ecological, and social advantages of restoration and maintenance are needed to demonstrate the cost-benefit ratio of efforts to restore ecosystems.

Promoting Stewardship: Encourage activities that help keep lands and waters free from invasive plants.

This objective brings the strategy full circle and back to watershed goal of, “Prevention.” If we can maintain restored lands, we will certainly be making progress. Certain land uses and activities are more likely to contribute to natural environments, and these should be encouraged.

Opportunities for partnerships

Enterprises in the agriculture and outdoor recreation industries could work with public land management agencies and weed organizations to develop plans for weed-free practices. Private and state nurseries can work with State and Federal Conservation agencies to provide materials for revegetation projects. An invasive plant-prevention code of ethics could be developed and adopted by concerned land users.

Opportunities for education

All land users, including visitors to parks and natural areas, should understand what practices can prevent the spread of invasive plants and be encouraged to apply an invasive plant-prevention code of ethics.

Opportunities for research

Methods are needed for screening and certifying that pack animal feed is free of weed seed, and that “native” wildflower garden mixes contain no non-native seed content. Additional monitoring of natural areas and better information on the effectiveness of various weed-prevention practices are needed.

Arundo Eradication Program

By far, the greatest threat to the dwindling riparian resources of coastal southern California is the exotic grass species known as *Arundo donax*. *Arundo* dramatically alters the ecological processes in riparian systems and ultimately moves most riparian habitats toward pure stands of this exotic species (Bell, 1997). This species is capable of spreading rapidly throughout a watershed once established. Floods provide the mechanical disturbance necessary to break off rhizome sections from the parent plant, and act as the dispersing agent by carrying the pieces downstream.

Arundo is a genus of tall perennial reed-like grasses (Poaceae) with six species native to warmer parts of Europe, Asia, and Africa. *Arundo*, also referred to as giant reed, bamboo reed, giant reed grass, arundo grass, donax cane, giant cane, river cane, bamboo cane, canne de Provence, is the largest member of the genus and is among the largest of the grasses, growing to a height of 3 to 10 meters, a diameter of 1 to 4 centimeters, and commonly branch during the second year of growth.

Background

Effective control of exotic weeds requires a coordinated effort throughout a watershed. In 1992, Federal, state, local, and private organizations formed Team *Arundo* to eradicate *Arundo donax* from the Santa Ana Watershed, the largest river system in southern California covering San Bernardino, Riverside, and Orange counties.

Since 1992, Team *Arundo* has published documents on problems and control strategies for *Arundo* infestation, fostered partnerships by holding regular team meetings and equipment demonstrations, explored sources of revenue, helped established other regional teams, and provided innovative opportunities for wetland mitigation (Stein, 1997).

Why it is “bad”?

Arundo is an undesirable plant due to its ability to take over large areas because of its aggressive growth and ability to survive in a variety of environmental conditions.



Arundo donax along a river
Photo courtesy of D. Graber for the National Park Service

This species readily invades riparian channels, especially disturbed areas, is very competitive, difficult to control, and does not provide significant food or nesting habitat for native animals (Bell, 1997). *Arundo* alters large-scale processes such as erosion, sedimentation, flooding, and fire, which affect the entire life cycle of the riparian system and the creatures within it.

The high density and height of *Arundo* stems create a structure that increases fire intensity. *Arundo* is highly flammable throughout most of the year (even when green) and highly adapted to extreme fire events (Scott, 1994). Because *Arundo* tends to fill in all areas that it grows in, fire is spread to neighboring structures of vegetation types. Furthermore, the height of *Arundo* can spread fire into tree canopies.

During flood events, *Arundo* stems and rhizomes break off and are carried downstream. This biomass of stems and rhizomes collects on bridges, drainage pipes, and other flood control structures, causing costly cleanup, clogging river channels and altering flow regime causing flooding to adjacent lands, and structure failure in some instances.

Arundo provides little value to native and migratory animal species. It does not provide food and habitat resources for native wildlife that are equivalent to the native vegetation. Recent studies by the Santa Ana Watershed Project Authority (Bell, 1997) suggest that *Arundo* also lacks canopy structure necessary to provide significant shading of bank-edge river habitats, resulting in warmer water than would be found with a native gallery forest of cottonwoods and willows. Consequently, this results in lower oxygen concentrations and lower diversity of aquatic animals, including fishes (Dunne and Leopold, 1978).

Control Methods

Controlling *Arundo* can be accomplished by a variety of methods. Methods of controlling *Arundo* are commonly categorized as follows: physical, chemical, and biological. Physical methods include both manual and mechanical methods. Chemical control includes both broadcast and spot application. Biological control is usually interpreted as the introduction of insects or pathogens, which are highly selective for a particular weed species. The most desirable approach is that of an integrated pest management plan. This involves the optimum use of all control strategies to control weeds. In cases where more than one control technique is used, the various techniques should be compatible with one another (Hoshovsky, 1987).

Physical Control

The two types of physical control methods include both manual and mechanical methods. Manual methods use hand labor to remove undesirable vegetation. These methods are highly selective and permit weeds to be removed without damage to surrounding native vegetation. Removal of undesirable vegetation includes hand pulling and hand digging. Hand pulling may be used to destroy seedlings or plants up to 2 meters tall. Plant or seedlings are best pulled after a rain when the soil is loose. This facilitates removal of the rooting system, which may resprout if left in the ground. Hand digging is a slow but sure way of destroying weeds, which resprout from their roots. This technique is only suitable for small infestations or around trees and shrubs where other methods are not practical. Mechanical methods use mechanized equipment to remove above ground vegetation. These methods are often non-selective in that all vegetation on a treated site is affected. It is also of limited use where soils are highly susceptible to compaction or erosion, or where excessive soil moisture is present.

Typically, *Arundo* is removed from larger and fully infested patches using tractor-powered equipment (e.g., hammer-flair, hydro-axe, chipper/shredder, and articulating arm). Chainsaws and hand tools are used for

smaller patches, or when sensitive native species are intermixed with *Arundo*. Rather than completely removing *Arundo* plants from the substrate, Team *Arundo* cuts the stalks then applies herbicide either by foliar spraying or by using the “cut-stem” approach. (SAWPA, 2002)

Chemical Control

Chemical treatment requires application of a broad-spectrum herbicide at specific times during the year to ensure adequate uptake by the plant’s root system. However, the types of herbicides that can be used in wetland areas are limited. The most effective chemical treatment method involves the foliar application of glyphosate herbicide during summer and fall (June to November) (SAWPA, 2002). Full foliar spraying takes place when the can is fully grown and up to 10 or 12 meters tall. When spraying, glyphosate-based herbicide is diluted to a rate range of 1 to 5% for mature stalks, and 1 to 8% for immature stalks.

The “cut-stem” method involves hand cutting of the *Arundo* stalks and application of glyphosate-based herbicide to the cut within 2 to 3 minutes before the plant seals the cut. Typically, a finger-trigger spray bottle or backpack sprayer is used for this method. Although this approach is more time and labor-intensive than foliar spraying, it is highly effective and it significantly reduces the amount of herbicide used and potential for over-spray. Furthermore, all herbicide material is delivered to the target areas of each plant thereby reducing potential environmental problems.

Biological Control

The term biological control refers to the use of insects or pathogens to control weeds. The introduction of exotic natural enemies to control plants is a complex process and must be thoroughly researched before implementation to prevent biological disasters. Currently, no known biological agents have been proven to be effective for *Arundo* control.

Integrated Pest Management

As previously stated, the most desirable approach or method of weed management is that of an integrated pest management plan. This method combines the above methods to control *Arundo*. In the Santa Ana Watershed, Team *Arundo* members chip or cut *Arundo* stalks then return 2 to 4 weeks later (when plants are between 0.5 – 1 m high) to apply a foliar spray solution of a glyphosate-based herbicide. The primary advantage of this alternate method is the reduction of herbicide used on the fresh growth in comparison to the amount used in full spraying for full-grown stalks. However, one disadvantage associated with this method is that cutting the stalks encourages the plant to reenter the growth stage, consequently displacing less of the herbicide to the roots and rhizomes. These control efforts are vital to the long-term viability of all species in the riparian systems. To ensure the success of control and management of *Arundo* within a watershed, it requires a coordinated, watershed-wide approach.

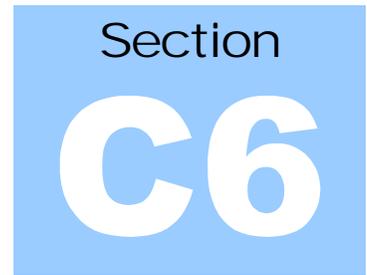
Arundo in San Juan Creek Watershed

Arundo spread downstream from early plantings at San Juan Hot Springs and nearby cabins outside the Cleveland National Forest boundary. In 1995, *Arundo* clearance between La Novia Avenue and I-5 in San Juan Capistrano was not maintained and *Arundo* reinvaded the area. The Hot Springs area in Caspers Regional Park was cleared of *Arundo* during 1997 and 1998 by Orange County staff and prison crews as mitigation for downstream bridge construction (Neill and Giessow). For additional information on *Arundo* removal efforts within the San Juan Creek Watershed, contact the various agencies and representatives presented in Table 1.

Table 1: Contacts for *Arundo* Removal Efforts

Agency/Organization	Role in Arundo Removal	Contact Person	Address	Phone	Email Address
California Department of Fish and Game	Issues Lake or Streambed Alteration Agreements necessary for Arundo Removal (Necessary permit for Arundo removal)	Juan Hernandez	4775 Bird Farm Road Chino Hills, CA	(909) 614-1936	jhernand@dfg2.ca.gov
Regional Water Quality Control Board, Region 8	Issues Clean Water Act Section 401 water quality certification (Necessary permit for Arundo removal)	Kelly Schmoker	3737 Main Street, Ste. 500 Riverside, CA 92501-3348	(909) 782-4130	kschmoke@rb8.swrcb.ca.gov
US Army Corps of Engineers, Los Angeles District	Issues Clean Water Act Section 404 permit (Necessary permit for Arundo removal)	Robert Smith	911 Wilshire Blvd. Los Angeles, CA 90017	(213) 452-3419	rsmith@spl.usace.army.mil
Santa Ana Watershed Project Authority (SAWPA)	Administers Prop 13 funding, coordinates Team Arundo meetings	Jeff Beehler	11615 Sterling Ave. Riverside, CA 92503	(909) 354-4239	jbeehler@sawpa.org
EIP Associates	Authored Arundo Removal Protocol Document and prepared Categorical Exemption for ARP	Wendy Katagi Christy Loper	12301 Wilshire Blvd., Ste. 430 Los Angeles, CA 90025	(310) 268-8132	wkatagi@eipassociates.com cloper@eipassociates.com
Nelroy E. Jackson, Ph.D.	Served in advisory capacity for Arundo Removal Protocol	SAME	400 S. Ramona Ave., Ste. 212 Corona, CA 92879	(909) 279-7787	nelroy.e.jackson@monsanto.com
Riverside-Corona Resource Conservation District	Removes Arundo, coordinates SAWA	Kerwin Russell Shelli Lamb	4500 Glenwood Drive Riverside, CA	(909) 683-7691	russell@rcrcd.com
Riverside County Parks and Open Space District	Removes Arundo, performs planning and monitoring	Dan Bogan Paul Frandsen	4600 Crestmore Road Riverside, CA 92509	(909) 955-4398	PFRANDSE@co.riverside.ca.us
Inland Empire West RCD	Removes Arundo, performs planning and monitoring	Paul Hogan	1609 South Grove Ave. Suite 103	(909) 930-2779	iewrcd.iewrcd@verizon.net
Riverside County Flood Control and Water Conservation District	Removes Arundo, performs planning and monitoring	Mark Biloki	1995 Market Street Riverside CA	(909) 275-1310	mbilok@co.riverside.ca.us
Orange County Water District	Removes Arundo, performs planning and monitoring	Richard Zembal	10500 Ellis Avenue Fountain Valley, CA	(714) 378-3200	rzembal@ocwd.com
Orange County Conservation Corps	Subcontractor for Arundo removal	Rick Stroup	700 North Valley Street Suite B, Anaheim CA	(714) 956-6222	rstroup@occcorps.org
Team Angeles/Riparian Repairs	Performs Arundo Removal in LA County	Bill Neill			bgneill@earthlink.net

Source: SAWPA, 2002



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