

Section C: Flood Management

Flood management is an important part of Integrated Regional Water Management (IRWM) planning. The Proposition 84 IRWM Grant Program encourages implementation projects that improve flood management, particularly projects that support integrated flood management. Integrated flood management is one of the Statewide Priorities for the IRWM Grant Program. Preference is given to proposals that contain projects that promote and practice integrated flood management to provide multiple benefits including:

- Better emergency preparedness and response
- Improved flood protection
- More sustainable flood and water management systems
- Enhanced floodplain ecosystems
- Low Impact Development (LID) techniques that store and infiltrate runoff while protecting groundwater

A separate allocation of IRWM Grant Program funds also exists under Proposition 1E, the Disaster Preparedness and Flood Prevention Bond Act of 2006. To be eligible for grant funds under Proposition 1E, a project must be included in an adopted IRWM Plan, must be designed to manage stormwater runoff to reduce flooding, and must yield multiple benefits, including groundwater recharge, water quality improvement, ecosystem restoration and benefits, and/or reduction of instream erosion and sedimentation.

Flood management is considered to be an integral part of the collective water management system in the Greater Monterey County IRWM region. It is discussed briefly in the Region Description section (Section B.3.3.e Floodwater and Flood Management) and is discussed separately in this section to allow for a more in-depth review. This chapter describes the current framework for flood management in the Greater Monterey County IRWM region and identifies the potential for integrated flood management. *Note that most of the information in this chapter has been either excerpted or summarized from the Monterey County Floodplain Management Plan Update 2008 (MCWRA 2008).*

C.1 HISTORIC FLOODING

As population and urbanization increase in a region, so does flood risk. Increased impervious surfaces and channelization of streams results in increased runoff and intensified flood flows; and increased development in floodplains, including houses, buildings, and agricultural fields, puts more property and lives at risk for flooding. The damages caused by flooding in the Salinas Valley today—even with the construction of major flood control infrastructure—are far more substantial than they were a century ago. Along the Big Sur coast, streams and rivers draining the steep coastal mountains are subject to short, intense floods, capable of producing significant damage to property. Wildfires also exacerbate flood risk in Big Sur, denuding areas of vegetation, which can lead to increased sheet flow and greater velocities during subsequent rainstorms, and causing water quality problems in coastal waters.

Historic records from 1911-2007 show flooding and flood damage to have occurred on a fairly regular basis (every few years) within Monterey County. The County experienced severe damages in:

- 1969: Two distinct floods, each of which resulted in Monterey County being declared a disaster area;
- 1978: A series of storms emanating from a southerly direction, causing extensive beachfront and coastal damage;
- 1983: “El Niño” storms that brought an extremely unusual series of high tides, storm surges, and storm waves along the coast, and heavy rains causing extensive flooding and erosion in the

Salinas Valley;

- 1995: A second significant winter storm that brought devastating flooding and extensive damage throughout the County, and in particular the Pajaro community where life was lost and extensive damage occurred in both Santa Cruz and Monterey counties; and
- 1998: A series of “El Niño” winter storms that hit various parts of California. In Monterey County there were impacts to agricultural lands and to the City of Salinas. Several communities were evacuated and Monterey County was declared a disaster area by the Federal Emergency Management Agency (FEMA).

In the 1998 storm event, the Las Lomas area experienced severe damage of eight residential parcels. Monterey County acquired the parcels through the Federal Hazard Mitigation Grant Program and all structures were removed. Each parcel was subsequently rezoned to “open space” in perpetuity. Countywide losses from that storm were estimated at over \$38 million, with agriculture-related losses totaling over \$7 million and involving approximately 29,000 damaged acres.



Flooding on the Salinas River, March 1995, looking south toward Castroville. Used by permission from MCWRA.

C.2 FLOOD MANAGEMENT

The agency with primary responsibility for floodplain management in Monterey County is the Monterey County Water Resources Agency (MCWRA). The MCWRA also has responsibility for flood control in benefit assessment areas. Flood control also falls under the authority of municipalities throughout the region, which are responsible for storm drain maintenance and surface water disposal. In addition, several

other organizations—most notably the Resource Conservation District (RCD) of Monterey County and the Natural Resources Conservation Service (NRCS)—contribute significantly to flood control and floodplain management efforts in the region through sediment and erosion control programs and grant incentives, though they have no jurisdictional flood control authority per se.

The MCWRA employs both structural and non-structural approaches to flood control and floodplain management in the county.

C.2.1 Structural Approaches to Flood Management

The flood control infrastructure in the Greater Monterey County region is considered a critical component of the region’s overall water management system, providing not only flood control protection but water supply and recreational benefits as well. Existing flood control infrastructure within the Greater Monterey County IRWM region includes the Nacimiento and San Antonio Dams, constructed in 1957 and 1967 respectively. Note that there are no federally constructed (i.e., U.S. Army Corps of Engineers) flood control structures in the Greater Monterey County IRWM planning region (though the Pajaro levee system, in northern Monterey County and located within the Pajaro River Watershed IRWM planning region, is a federally constructed system).

Nacimiento Dam is a large earthfill dam originally constructed for flood control, water conservation, water supply (including percolation into the Salinas Valley aquifer), and recreation. It also provides water supply and recreation activities to San Luis Obispo County. The dam is located in San Luis Obispo County but is owned and operated by MCWRA, and provides an important source of water supply for the Greater Monterey County IRWM region. The drainage basin for Nacimiento Reservoir covers 324 square miles with half the basin in Monterey County and half in San Luis Obispo County.

The Nacimiento Reservoir has a minimum pool volume of 22,300 AF and a conservation pool of 237,700 AF. Flood protection is provided by reserving storage capacity in the reservoir (known as the “flood pool”) to temporarily store flood water during the winter. The flood pool storage is 117,900 AF, and is located between elevation 777 feet and the top of the spillway, elevation 800 feet. Lake Nacimiento has spilled three times since its construction in 1957; spilling occurred in 1958, 1969, and 1983. The Nacimiento Spillway was modified as part of the Salinas Valley Water Project in 2009. Modifications to the spillway include lowering of the existing spillway, installation of an inflatable dam on the new spillway, and enlargement of the spillway chute. The modifications were necessary to enable the dam’s spillway to release enough water in the event of a large storm event to ensure flood protection and safety of the dam. The adjustable spillway crest also allows for greater storage flexibility, which has resulted in an ability to store more water in the reservoir. Since modification of the spillway, Nacimiento has spilled one additional time in 2011—after which the reservoir was at full capacity on April 1.



Nacimiento Dam (used by permission from MCWRA)

San Antonio Dam is an earthfill dam that is also owned and operated by MCWRA. Like the Nacimiento Reservoir, the San Antonio Reservoir is a multi-use facility operated for flood control, water supply (including groundwater percolation), and recreation uses. The dam is located approximately 7 miles southwest of Bradley on the San Antonio River in Monterey County, and has a 330 square mile watershed. The reservoir has minimum pool storage of 23,000 AF. During the 1980s, the storage required by the Flood Rule Curve of the reservoir was increased to allow safe passage of the Probable Maximum Flood (PMF), resulting in less water conservation storage. More recent analysis of the PMF was performed using extensive data obtained during the March 1995 event, and showed that the San Antonio Dam spillway could safely pass the PMF. In July 2000, the MCWRA Board of Directors adopted a new Flood Rule Curve increasing the water conservation pool to 282,000 AF and reducing the flood pool storage to 30,000 AF. When the lake is full (spillway elevation 780 feet), it has a maximum storage capacity of 335,000 AF. The maximum elevation during flood stage is 802 feet, with a maximum temporary capacity of about 477,000 AF and a temporary surface area of about 7,500 acres. Almost 2,050 cubic feet/second (cfs) were discharged through the outlet works on March 4, 1971, and three small spills have since occurred (in 1982, 1983, and 2006).



San Antonio Dam (used by permission from MCWRA))

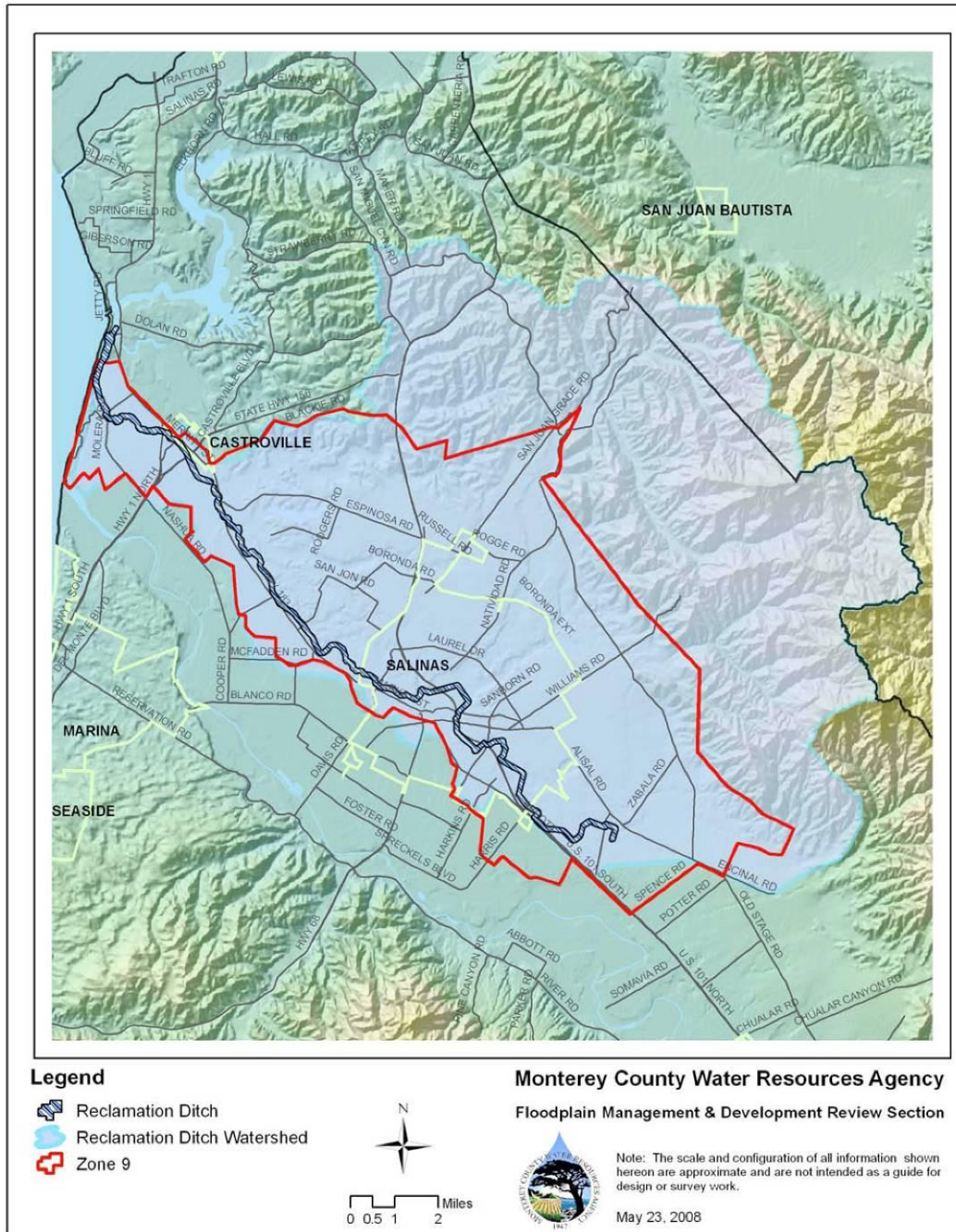
The Salinas Reclamation Ditch, originally named Reclamation Ditch District No. 1665, was constructed in 1917 to drain the marshlands in the northern Salinas Valley for agricultural use and urban development. The ditch connected a series of seven shallow lakes roughly between the City of Salinas and Castroville. The Reclamation Ditch watershed area covers approximately 157 square miles of rural, agricultural, and urban lands located in northern Monterey County and a small mountainous region in San Benito County, including the watersheds of Tembladero Slough, Merritt Lake, Santa Rita Creek, Espinosa Lake, Gabilan Creek, Natividad Creek, Alisal Slough, and Alisal Creek. The Ditch eventually joins Tembladero Slough near Castroville, then the Old Salinas River Channel, and eventually discharges into Moss Landing Harbor through tide gates at Potrero Road.

While the original purpose of the Reclamation Ditch was to reclaim lands, the Ditch came to be used and depended upon by local residents as a flood control channel. Rapid agricultural and urban development throughout the 1900s, however, significantly changed the hydrology of the watershed, causing a dramatic increase in the rate and amount of runoff from storms. Even just 24 years after completion of the Ditch, the County Surveyor began investigating the feasibility of enlarging the Ditch's drainage capacity to accommodate increased runoff. By the end of the 1950s it had become clear that the system lacked capacity to manage flooding from storms (which was not its original intent).

In 1967, the Monterey County Flood Control and Water Conservation District (now MCWRA) took over maintenance over portions of the Reclamation Ditch from the Northern Salinas Valley Mosquito Abatement District. After two major floods in the 1990s (March 1995 and February 1998) that resulted in substantial damage to agricultural lands west of Salinas, the MCWRA initiated an evaluation of the Reclamation Ditch and a committee was convened to assist MCWRA in planning for an improved drainage system. That committee, the Reclamation Ditch Improvement Plan Advisory Committee (RDIPAC), has made several recommendations for improvements and provided guidance during the development of several studies such as the Potrero Tide Gates study (September 2000) as a result of changes in the watershed. The implementation of those recommendations is included as a proposed project in this IRWM Plan.

Figure C-1 below provides a map of the Salinas Reclamation Ditch and its watershed.

Figure C-1: Present Location of Reclamation Ditch and its Watershed



Source: MCWRA Monterey County Floodplain Management Plan, used by permission.

C.2.2 Non-Structural Approaches to Flood Management

Non-structural approaches to flood management include land use management tools such as regulation and flood insurance, and emergency response systems.

The MCWRA first developed the *Monterey County Floodplain Management Plan* in 2002 with the goal of creating an action plan to minimize the loss of life and property in areas where repetitive losses have occurred, and to ensure that the natural and beneficial functions of the County's floodplains are protected. The Plan, updated in 2008, lists, describes, and assesses Repetitive Loss Properties (RLPs) in the County. A RLP is a property for which two or more claims of \$1,000 or more have been paid by the National Flood Insurance Program (NFIP) within any given 10-year period since 1978. Monterey County has 107 RLPs. The vast majority of these RLPs are located along the Carmel River, however, which is outside of the Greater Monterey County IRWM region. There are a total of 13 RLPs occurring within the Greater Monterey County IRWM region along 10 different waterways (including the Big Sur River, Carneros Creek, El Toro Creek, and Santa Rita Creek). There are no RLPs along the Salinas River.

The *Monterey County Floodplain Management Plan* also describes the County's flood control system (infrastructure), identifies flood zones defined by FEMA, including maps depicting RLPs and 100-year floodplains, provides a general hazard assessment (including atmospheric, geologic, hydrologic, seismic, fire, system failure, and general flood hazards), assesses the flood hazards of specific waterways in the county in terms of repetitive losses, and provides an implementation plan for flood mitigation and for mitigation of RLPs. The Plan also describes the County's emergency response system for flood events. In the late 1970s, Monterey County developed the first ALERT (Automated-Local-Evaluation-in-Real-Time) flood warning system. Recent enhancements to the ALERT system include the addition of a network of "satellite data concentrators and transmitters" which pass data, via satellite, to a system of secure servers. Now, in addition to accessing ALERT data from a base-station which receives radio or microwave signals directly from the monitoring stations, the system is designed so multiple operators can monitor rainfall and stream conditions throughout the county as storm events occur from anywhere internet access is available.

The *Monterey County Floodplain Management Plan* supports existing Monterey County Code floodplain management policies and objectives. Monterey County Code Chapter 16.16, Regulations for Floodplains in Monterey County, contains the minimum FEMA requirements necessary for participation in the regular phase of the NFIP, as well as the higher regulatory standards that are credited through the Community Rating System (CRS). The NFIP is a federal program, administered by FEMA that makes federally backed flood insurance available in communities that adopt and enforce floodplain management ordinances to help reduce future flood losses. Monterey County joined the NFIP in 1984. Compliance and ongoing participation in the NFIP ensures that all County residents can purchase flood insurance. The CRS is also a federal program that was implemented in 1990 to encourage communities to implement floodplain management activities beyond the minimum NFIP standards. Of the approximately 21,600 communities that participate in the NFIP, only about 1,100 participate in the CRS program. Monterey County has been a voluntary participant in the CRS since 1991. CRS allows for reductions in flood insurance premium rates according to the extent to which a community implements additional floodplain management activities. The County was upgraded in the CRS to "Class 5" in May 2007; of the 1,100 communities participating in the CRS program, only six have a higher rating than Monterey County (based on August 2009 CRS statistics).

Figure C-2 below illustrates FEMA-defined Special Flood Hazard Areas in Monterey County.

Figure C-2: Monterey County FEMA-Defined Special Flood Hazard Areas



Source: MCWRA Monterey County Floodplain Management Plan, used by permission.

C.3 INTEGRATED FLOOD MANAGEMENT

Both the *California Water Plan Update 2009* and the Proposition 84/1E IRWM Program Guidelines strongly support the concept of integrated flood management. Integrated flood management “does not rely on a single approach to flood management, but instead uses various techniques, including traditional (meaning structural) flood protection projects, nonstructural measures (such as land use practices), and reliance on natural watershed functions, to create an integrated flood management system” (DWR 2009b, vol. 1, p. 2-21). The importance of integrated flood management is explained in the *California Water Plan* as follows:

Floodplains are formed by periodic inundation and the deposition of sediment. Over time, the repeated process creates a landform that is favorable for human settlement, due to the relatively flat land, good soils, and easy access to water. Sparse settlements have grown into urban areas, greatly complicating the task of flood management, as many people now live in locations that are within historic floodplains.

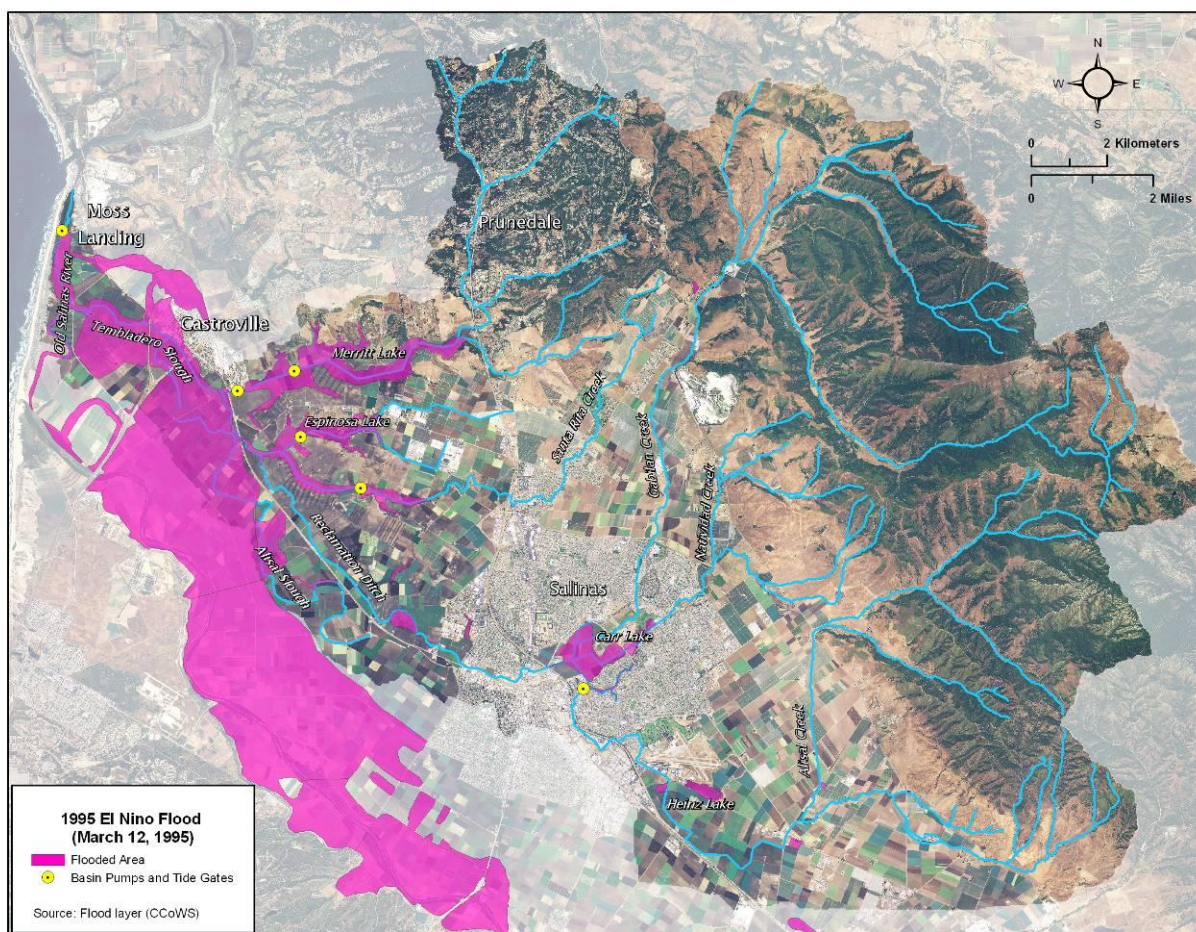
Traditionally, flood management practices largely focused on reducing flooding and susceptibility to flood damage through physical measures intended to store floodwaters, increase the conveyance capacity of channels, and separate rivers from adjacent populations. Although this approach may reduce the intensity and frequency of flooding, it limits the natural role of floodplains to reduce flooding in developed areas.

In recent years, flood managers have recognized the potential for natural watershed features to reduce the intensity or duration of flooding. Undeveloped floodplains can store and slowly release floodwaters. Wetlands can act as sponges, soaking up floodwaters, filtering runoff, and providing opportunities for infiltration to groundwater. Healthy forests, meadows, and other open spaces can slow runoff during smaller flood events, reducing peak flows, mudslides, and sediment loads in streams.

A challenge for flood managers is to integrate these natural functions with more traditional flood protection methods, thus reducing floodflow peaks and their subsequent impacts during small and frequent flood events, while simultaneously providing other water resource benefits. To address this integration, the FloodSAFE California initiative and this update of the Water Plan promote the concept of integrated flood management, a comprehensive approach to flood management that considers land and water resources at a watershed scale within the context of integrated water management; employs both structural and nonstructural measures to maximize the benefits of floodplains and minimize loss of life and damage to property from flooding; and recognizes the benefits to ecosystems from periodic flooding. (DWR 2009b, vol. 1, pp. 2-21 – 2-22)

The *Monterey County Floodplain Management Plan* recognizes the importance of protecting “the natural and beneficial functions of [the county’s] floodplains.” While substantial progress is being made to return natural floodplain function to some waterways in Monterey County (most notably the Carmel River system, which lies outside of the Greater Monterey County IRWM region), most of the waterways in the Greater Monterey County region, with the exception of the rivers and streams along the Big Sur coast, have been significantly altered. Perhaps the greatest challenges for integrated flood management in the region are the waterways in the Salinas Reclamation Ditch (Gabilan) watershed and the Salinas River. All sections of the lower watershed below, and most sections within, the City of Salinas are ditched and are at risk for flooding, as evidenced in the 1995 and 1998 floods. The map below shows flooding during the 1995 El Niño flood.

Figure C-3: 1995 El Niño Flood



Used by permission from CCoWS at the Watershed Institute, CSUMB.

Significant potential exists to improve riparian coverage and floodplain function along the Salinas River system and Arroyo Seco River, and along waterways in northern Monterey County, including Elkhorn Slough and its tributaries, and Moro Cojo Slough. The Salinas River system, in particular, is a challenge to approach from an integrated approach because of the adjacent agricultural lands and food safety concerns with flooding and agricultural production.

The Greater Monterey County RWMG supports integrated flood management as a desirable goal. The IRWM Plan's Flood Protection and Floodplain Management goal is to "develop, fund, and implement integrated watershed approaches to flood management through collaborative and community supported processes." IRWM Plan objectives that aim to achieve integrated flood management together include:

- Promote projects and practices to protect infrastructure and property from flood damage.
- Improve flood management infrastructure and operational techniques/strategies.
- Implement flood management projects that provide multiple benefits such as public safety, habitat protection, recreation, agriculture, and economic development.
- Develop and implement projects to protect, restore, and enhance the natural ecological and hydrological functions of rivers, creeks, streams, and their floodplains.

- Promote public education about local flood management issues and needs.

The RWMG is still in the early stages of considering how to promote integrated flood management in the region. One effort underway (and funded through the Proposition 84 IRWM Planning Grant) is the “Water Resource Project Coordination” process. The Water Resource Project Coordination process is a stakeholder outreach program that aims to bring together IRWM Plan project proponents and other stakeholders in the lower Gabilan/Reclamation Ditch watershed, to discuss and reconcile any significant conflicts between projects or project objectives, to coordinate and integrate the projects where possible, and to find new potential areas of collaboration. Through this process the RWMG also hopes to find additional opportunities for integrated flood management. Please see Section I Integration for a detailed description of the Water Resource Project Coordination process.

C.4 FLOOD MANAGEMENT AND CLIMATE CHANGE

Climate change is expected to have many serious impacts on water resources, and will pose significant challenges for water managers in the Greater Monterey County IRWM planning region. One of the anticipated impacts of climate change is increased flooding. Increased flooding is expected to occur in coastal areas due to sea level rise and storm events, as well as in upper watershed areas due to changes in precipitation patterns resulting in higher peak flood events.

A study conducted by the Pacific Institute (Heberger et al. 2009) evaluated and mapped areas of the California coast that are vulnerable to flooding with a 55-inch (1.4 meter) increase in sea level rise. Low-lying coastal areas of the Monterey Bay region will be exposed to a greater risk of major flooding events, and storm surge, high tides, and waves will travel farther inland (ibid.). Elevated sea levels combined with increases in winter storm intensity and wave heights will make coastal inundation a more serious risk (Storlazzi and Wingfield 2005; Wingfield and Storlazzi 2005). Monterey and Santa Cruz counties were identified in the Pacific Institute study as the two counties most vulnerable to flood-related risks of sea level rise in terms of population, due to the vast low lying areas of the Pajaro and Salinas valleys. The low-lying coastal location of many agricultural properties in this region increases the likelihood of significant loss of agricultural land due to storm-induced flooding and salinization with increasing sea level and long-term inundation. Loss of agricultural production in the region will have lasting consequences for the largest sector of the regional economy.

The Pacific Institute study also noted that a 1.4 meter sea level rise will put a wide range of critical infrastructure, such as roads, hospitals, schools, emergency facilities, wastewater treatment plants, and power plants, at risk. To help protect against the impacts of sea level rise, the study identified the need to construct, raise, or repair 53 miles of levees and seawalls in Monterey County.

Coastal inundation also poses a risk to local wetlands. The impact of sea level rise on wetlands is significant for the Greater Monterey County area, since the region contains several important wetland systems. If the rate of sea level rise exceeds the rate of wetland accretion, or if wetlands cannot transgress (migrate up and inland) large tracts of critically important habitat, such as Elkhorn Slough, will become permanently submerged (Heberger et al. 2009; Largier et al. 2010).

In the upper watersheds, natural creeks and managed conveyance will see higher flow rates leading to increased erosion and flooding. Regional river levees will provide less protection during higher storm flow events, and coastal levees and control structures will be undersized to manage the combined influences of higher river flows and sea level rise. According to *the California Water Plan Update 2009* (Volume 3), failure to take into account the impacts of climate change may lead to the underestimation of areas inundated by 100-year floods. Authors of the *California Water Plan* therefore advise that protection provided by flood control infrastructure should be raised to at least the 200-year level in order to

accommodate any inaccuracies in floodplain delineation on FEMA Flood Insurance Rate Maps and the challenges put forth by climate change.

Water managers, flood control managers, and other decision-makers in the Greater Monterey County IRWM region are in the early stages of analyzing and planning for the impacts of climate change on water resources in the region. The Greater Monterey County RWMG is working closely with scientists, government agencies, environmental and community organizations, and other leaders throughout the broader Monterey Bay and Central Coast region to obtain the most up-to-date scientific data and to refine the current analytical tools in order to develop climate change adaptation strategies. This IRWM Plan will incorporate the latest climate change information and regional planning efforts with each new Plan update.

Please see Section R Climate Change for a full discussion of climate change and its anticipated impacts in the Greater Monterey County IRWM region.