CALIFORNIA'S CRITICAL COASTAL AREAS
Non-Point Source Program - WATERSHED ASSESSMENT

Watsonville Slough CCA #37

Intent of this document. This assessment is intended to be a literature review of watershed planning efforts within the Watsonville Slough system. Several sections of this documents are reproduced directly from the original, with permission from the authors. Tables and figures have been extracted from previous reports and are cited appropriately. Credit for work and facts should be accredited to the original authors. While significant information exists and is readily available about Watsonville Slough, the information has not been compiled to enable the State Nonpoint Source Program to prioritize Management Measure implementation. Please examine the literature citations for contributing authorships.

A. NPS WATERSHED ASSESSMENT

Description:

The Watsonville Slough system is located in Santa Cruz County and is comprised of Harkins, Gallighan, Hanson, Struve, and Watsonville Sloughs. The system drains an area of approximately 50 km2 (13,000 acres). The Watsonville Sloughs watershed contains relatively steep headwaters in the northern Larkin Valley area with rural, grazing, and natural lands as the primary land use types (Figure 1). The mid-section of the watershed is characterized by the rapidly growing City of Watsonville to the east and hill slopes dominated by rural residential, landfills, agriculture, and natural lands to the west. The sloughs continue down to a broad alluvial flood plain, with irrigated agriculture as the primary land use in the Beach Road area and industrial land uses in the Lee Road area. Watsonville Slough finally drains to the Pajaro River Lagoon near a small residential dunes complex. The upper reaches are more stream-like, whereas the lower areas are low gradient and sluggish. The lowest reach of the Watsonville Slough, near the confluence with the Pajaro Lagoon, is tidally influenced. (1)

Watsonville Slough is a remnant of a more expansive system of estuarine and fresh water marshes, linked to the natural breaching events of the Pajaro lagoon. The slough contains small but significant coastal habitats including, salt marsh, brackish and fresh water marsh, and seasonal wetlands. The diversity of habitats within this coastal area makes the Watsonville Slough a valuable resource for both coastal plant communities as well as fish and pacific flyway bird communities (2) The system was historically modified to meet the needs of adjacent land uses, such as agriculture and urban development. Many areas of the slough system were channelized and filled to drain surface water beginning in the 1880s. (1) An 1853 USGS T-Sheet map of the west section of the Watsonville Slough shows early signs of the conversion of some of the rich lowland soils to agriculture purposes (Figure 2). A comparison between the historic T-Sheet wetland extent and that currently delineated by the Coastal Commission, demonstrates the extensive loss of tidal marsh habitat as these areas were converted to agriculture and channelized for flood control purposes (Figure 3). In addition to tidal marsh loss,

much of the “grasslands” identified within the T-Sheet may also have been seasonal freshwater wetlands.

In addition to the significant channelization, two pump stations were installed for flood control and to enable farming of the often-inundated lowlands. The two pump stations are located at Shell Road and at the confluence of Harkins Slough and Watsonville Slough. The Shell Road pump station and tide gates, currently maintained by the County of Santa Cruz, were installed in the 1940’s and formed an abrupt boundary between saltwater (downstream) and freshwater (upstream). The Harkins Slough pump station, currently operated by the Pajaro Valley Water Management Agency, was also originally installed for flood control but today serves as a diversion project to deal with seawater intrusion (1 & 3).

Many other hydrologic control structures have also been installed throughout the watershed, including pumps, gates, culverts, bridges, and road crossings (Figure 4). Many of these structures modify the rate at which water flows through various portions of the system, dewatering habitat in some areas while causing flooding in others. Most of these structures were not installed with the purpose of preserving habitat or managing flow to protect water quality.

(1) **Evaluation of the status of water quality conditions in the CCA**

Watsonville Slough is listed on the California 303d list under the Federal Clean Water Act as being impaired due to “sedimentation/ siltation”. Accordingly, the Central Coast Regional Water Quality Control Board is required to develop and implement a Total Maximum Daily Load (TMDL) specification for sediment. (1) The slough complex has also been listed as impaired for bacteria and nutrients. Numerous water quality studies have documented contaminants within the water and soils of the watershed (3). Hunt et al. (1999) documented high nutrient loading and toxicity within the lower portions of the watershed adjacent to agriculture areas. Other pollutants in the slough system include trace metals, pesticides (Chlordane & DDTs), increased sedimentation and bacteria (1,2,3,5, 6).

The Central Coast Regional Water Quality Control Board has defined certain beneficial uses for Watsonville Slough that are thus protected under the Clean Water Act, such as Warm Fresh Water Habitat, Estuarine Habitat, Spawning, Reproduction, and/or Early Development. Flood control is not on the list. Rather, it is assumed that protected beneficial uses of the Watsonville Slough primarily refer to habitat for birds, fish, and other aquatic fauna. The area is well known for its bird habitat, and native fish have been recorded recently (1).

The Watsonville Sloughs system forms the largest wetland complex between Pescadero Marsh, approximately 80 km (50 miles) to the north, and Elkhorn Slough, immediately to the south. The sloughs are home to diverse plant communities, with wetland and riparian vegetation that provide nesting sites and habitat for a variety of migratory and wetland birds, many of which are threatened, endangered, or California species of concern (Busch, 2000; Swanson Hydrology and Geomorphology, 2003). Many wetland birds depend on abundant fish and macro-invertebrates for survival, and thus require a healthy functioning aquatic ecosystem free from excessive pollutants. Watsonville Sloughs serve as habitat for a variety of fish, amphibian, reptile, and small mammal species. The sloughs are also popular places for recreational activities such as fishing, nature walks, and bird watching. Struve Slough and Harkins Slough, which has an

extensive deepwater section, are especially popular areas for these types of recreational activities. (1)

The Watsonville Sloughs watershed is comprised of 5 sub-watersheds: Watsonville Slough, Harkins Slough, Gallighan Slough, Hanson Slough, and Struve Slough. Table 5 shows land cover data for the area as well as subwatershed boundaries. Primary land uses include urban, commercial/ industrial, agriculture and rural residential. Approximately 10% of the watershed is undeveloped, much of which is located in the upper watershed.

(2) **Delineation of CCA and watershed planning area boundaries**

Figure 5 identifies the boundary of the Watsonville Slough CCA, the watershed planning area boundaries and the adjoining land uses. While the CCA boundaries include approximately 50% of the total watershed and include much of the Urban and Agricultural land uses currently impacting water quality and wetland resources, there is evidence of NPS pollution impact and threats from changing land use intensity which necessitates extending the inland boundary of the watershed planning area to the full extend of the watershed.

(3) **Identification of existing and planned water quality programs, projects, and plans affecting the CCA**

Central Coast Agricultural Organizations

The Coalition of Central Coast County Farm Bureaus has developed an agricultural watershed management program for six counties throughout the Central Coast region of California. The Coalition was organized to increase agricultural participation in addressing water quality issues and to assist the Monterey Bay National Marine Sanctuary in the implementation of the Water Quality Protection Program Action Plan for Agriculture and Rural Lands (MBNMS 1999). A major component of each county's program includes the formation of voluntary networks of landowners, growers, and ranchers, known as 'watershed working groups'. Participants in the program work with technical assistance organizations to monitor water quality, improve management practices, and develop watershed plans to address nonpoint source pollution. During the winter of 2003/2004, water quality monitoring was conducted by CCoWS for 3 of the watershed working groups that have formed in the region, including the Watsonville Slough watershed working group. (1) This program has expanded since the Central Coast Irrigated Agriculture Conditional Waiver program was instituted. The conditional waiver applies to all irrigated lands used for producing commercial crops.

Farmers are expected to complete 15 hours of farm water quality education within three years of adoption of the waiver, develop farm water quality management plans that address, at a minimum, irrigation management, nutrient management, pesticide management and erosion control, and begin implementing management practices identified in their plans. The program also requires monitoring to ensure the effectiveness of the waiver program and the adequacy of waiver conditions. A Cooperative Monitoring Program has been developed to improve regional monitoring. The Cooperative Monitoring Program is an option allowed under the waiver to satisfy the monitoring requirement. Under the conditional waiver, a group of twenty three Central Coast agricultural organizations have agreed to implement the Cooperative Monitoring

Program. The program will be supported initially with a combination of settlement and grant funds, and for the first two to three years of the program it is likely that costs to participate will be minimal or none. The agricultural industry is forming an Agricultural Committee to oversee the program (4).

The Central Coast Ambient Monitoring Program has developed an on line tool for reporting of Irrigated Agriculture Conditional Waiver implementation and for evaluating the regional implementation of various agriculture management measures as defined within the numerous Farm Water Quality Management Plans. Currently, much of the Watsonville Slough Watershed is identified as irrigated agriculture (green) under the Program (Figure 6). While various agricultural Management Measures are presently planned (orange) within this area, none have been reported as completely implemented (blue). Results of the current tracking suggests that a significant portion of agriculture within the Watsonville Slough will be implementing Nutrient and Pesticide Management Measures while less of the farms will be implementing irrigation and erosion control measures. Future reporting of implementation and water quality monitoring should be able to identify a result of these measures.

Water Resource and Habitat Management Plans for Watsonville Slough (1995 & 2001)

The 1995 Water Resources Management Plan for Watsonville Slough Systems (1995 Plan) outlined many of the necessary actions to improve both wetland habitat and water quality (2). Many of the habitat restoration actions have been adopted and expanded upon within the 2001 Watsonville Sloughs Resource Conservation and Enhancement Plan (2001 Enhancement Plan) and are now being implemented as part of the Integrated Watershed Restoration Program. The IWRP has taken on many county watershed planning and restoration projects several of which involve actions within the Watsonville Slough watershed. These include, the Rural Roads program which is working with rural residential land owners to provide training and technical guidance on how to better design and maintain rural paved and dirt roads. The program also included the initial assessment of Watsonville Slough within the first year of the County Lagoon Study. The Lagoon Study identified many land uses contributing to the degradation of coastal lagoons including the Watsonville slough and competed an initial assessment of water quality and habitat value associated with these lagoons. Watsonville Slough was identified as one of the most degraded systems in Santa Cruz County but had high restoration potential based on the lack of urban encroachment within much of the lower portion of the slough (Figure 7). The IWRP program has also begun to implement restoration projects within the Watsonville Slough including the acquisition of lands within the Gallighan Slough and is in the final planning stages of a restoration project within the upper portion of the Watsonville Slough (Manabe-Burgstrom Wetland Enhancement Project). The County has received additional funding to implement additional projects including construction of agriculture BMPs in the lower watershed.

There are several suggested planning and implementation actions within the 1995 plan, however, that were not addressed in the 2001 Enhancement Plan. The completion of several suggested actions would help guide the implementation of the 2001 Enhancement Plan and integrate urban water quality actions with the wetland restoration actions. These actions are identified and discussed in section 5. The 1995 Plan also included targeted lists of Management Measures to be implemented through out the watershed and are provide here in Table 2.

Central Coast Ambient Monitoring Program

The Central Coast Ambient Monitoring Program has been orchestrated by the Regional Board for 6 years and includes 14 sampling stations within the Watsonville Sloughs system. This program includes monthly sampling at select locations, intensive investigations for TMDL development and a 5 year rotational watershed investigation. Watsonville Slough has been include in all aspects of CCAMP monitoring and has identified numerous nutrient and pesticide contamination problems. These data are available at the www.ccamp.org website.

In addition to ambient monitoring, numerous water quality studies have been completed over the past 20 years and were listed in previous studies (1) (Table 3). Current volunteer monitoring efforts are also underway within the Watsonville Slough including seven years of monitoring during the annual Snapshot Day event. One value of the Snapshot Day event is the ability to identify Areas of Concern and track those areas over time. Areas of Concern are defined as those stations which exceed three or more of the water quality parameters (6). Six sites within the Watsonville Slough complex have been identified as Areas of Concern including four sites which have been identified during three of the events (Figure 8).

City of Watsonville Stormwater Program

Approximately 75% of the City of Watsonville's Stormdrain system drains into the Watsonville Slough system (Figure 9). Much of the historic urban areas and urban stormdrain infrastructure dose not include necessary BMPs to protect water quality. The City does however have a stormwater ordinance language which gives the city the authority to regulate polluted runoff which may impact adjacent wetland resources (6-3.525 Discharge of pollutants into City storm water sewer system). The City also has development standards to protect water quality (City of Watsonville Storm Water Land Development Standards). The development standards include significant water quality protection requirements for all development over an acre in size, thus meeting the Phase II Stormwater Discharge Conditions of the State and Regional Boards. While historic and small development are not addressed within these regulatory programs, the City also institutes a significant Public Education program and other municipal water quality protection efforts including an extensive street sweeping effort.

(4) **Analysis and evaluation of existing or planned programs, projects, and plans**

Significant success in protecting water quality has been achieved within the Watsonville Slough Critical Coastal Area. There is an active restoration program underway, guided by the 2001 Enhancement Plan. There is an active urban stormwater program which includes public education and outreach, pollution reduction efforts (street sweeping and oil recycling), and updated development guidelines for new development over 1 acre in size. Two TMDLs are in development and will soon be ready for implementation. In addition, the Pajaro Valley agriculture community is beginning to implement agriculture BMPs as identified in developed Farm Water Quality Management Plans.

All of these programs should be supported and expanded so that they reach their full potential. While some of these programs are in their initial stages of development and implementation, there is great potential to improve the habitat and water quality of the Watsonville Slough CCA. Currently, however, water quality and wetland habitat are still highly degraded, urban and

agricultural encroachment on current and historic wetland habitat continues, historic urban stormdrain systems have not been updated, and few of the programs have been evaluated for success.

Below (Section 5) is a set of recommended Management Measures and actions which may provide additional water quality and habitat enhancement opportunities, which in combination with the extensive efforts already underway in this watershed, should lead to the protection and restoration of coastal wetland resources.

(5) **Identification of gaps in NPS pollution prevention plans in watershed**

Many actions were identified in the 1995 Plan, many of which were integrated into the 2001 Enhancement Plan. Some of the current planning and restoration activities would benefit from revisiting several of the identified 1995 Plan Management Measures. Specific Management measures which are not currently a priority and could be considered Gaps include several identified in section 7.3 of the 1995 plan, including:

Wet Detention/ Sedimentation Basins; including basins upstream of wetland systems could provide pretreatment of urban and agriculture area for current and restored wetland areas.

Drainage Modifications: Drainage modifications as defined here would increase the residence time of water within low lying areas of the slough system, providing greater water quality improvement and increasing fresh and brackish water marsh habitat. This modification would require system wide hydrologic and habitat planning and the purchase of priority lands currently in agriculture.

Channel Filling: filling some channel sections would move water from confined degraded channels to a flat low marsh area which would increase wetland habitat and effectively filter pollutants from water.

Constructed Wetlands: Constructed wetlands in combination with drainage modifications, and tailwater recirculation could provide additional filtering of water prior to that water being added back to the slough system.

Slough/ Tailwater recirculation: directing water from pumps and drainage channels through various wetland components rather that pumped directly into the main slough system would increase residences time and filtering of water.

Restore Brackish Marsh: Little planning has occurred to integrate linkages between the Watsonville Slough, the Watsonville Lagoon and the Pajaro River Estuary during flood periods. Such linkage would improve rare brackish water habitat and could increase water mixing and improve water quality.

Other actions which would help to direct future efforts include:

- **Create a historic condition assessment for the Watsonville Slough**
- **Integrate historic condition with current 2001 Enhancement Plan actions to expand guidelines for future conservation and restoration actions.**
- **Develop priority list of stormwater retrofit projects**
- **Complete a hydraulic model for the wetland system which improved mixing and habitat management.**
- **Removal of hydraulic structures**

Management Measures listed in the 2000 Nonpoint Source Plan which could be better integrated into the Watsonville Slough Critical Coastal Areas Action Plan.

Hydromodification Management Measures.

Channel modification activities were undertaken within the Watsonville Slough area which lead to straightened, enlarged, deepened and relocated channels. These activities are known to affect water temperature, change the natural supply of fresh water to a water body, and alter rates and paths of sediment erosion, transport, and deposition. Hardening the banks of waterways with shoreline protection or armor also accelerates the movement of surface water and pollutants from the upper reaches of watersheds into coastal waters. Channelization can also reduce the suitability of instream and streamside habitat for fish and wildlife by depriving wetlands and estuarine shorelines of enriching sediments, affecting the ability of natural systems to filter pollutants, and interrupting the life stages of aquatic organisms (USEPA, 1993).

Several Hydromodification Management Measures which should be addressed within the CCA Action Plan include

Hydromodification Management Measure 5.1A — Physical and Chemical Characteristics of Surface Waters
1. Evaluate the current effects of historic channelization and channel modification on the physical and chemical characteristics of surface waters; 2. Develop an operation and maintenance program for existing modified channels that includes identification and implementation of opportunities to improve physical and chemical characteristics of surface waters in those channels.

Hydromodification Management Measure 5.1B — Instream and Riparian Habitat Restoration
1. Evaluate the potential effects of proposed channel modification on instream and riparian habitat; 2. Plan and design channel modification to reduce undesirable impacts; 3. Develop an operation and maintenance program with specific timetables for existing modified channels that includes identification of opportunities to restore wetland habitat.

Urban Management Measures:

The control of urban NPS pollution require the use of two primary strategies: the prevention of pollutant loadings and the treatment of unavoidable loadings. Urban runoff management requires that several objectives be pursued simultaneously. These objectives include the following (American Public Works Association, 1981):

- Protection and restoration of surface waters by the minimization of pollutant loadings and negative impacts resulting from urbanization;
- Protection of environmental quality and social well-being;
- Minimization of soil erosion and sedimentation problems;
- Protection of ground-water resources;
- Maintenance of the predevelopment hydrologic conditions;
- Control and management of runoff to reduce or prevent flooding; and
- Protection of natural resources, e.g., wetlands and other important aquatic and terrestrial ecosystems;
- Management of aquatic and riparian resources for active and passive pollution control.

The City of Watsonville has aggressively addressed stormwater pollution reduction efforts. The City has addressed all of the above objectives while emphasizing the first four listed. Additional attention and planning, integrated with wetland restoration efforts and agriculture programs could enhance the success of the latter four objectives. The below urban management measures could be expanded within City programs for the benefit of the Watsonville CCA.

Several Urban Management Measures which should be addressed within the CCA Action Plan include

Urban Management Measure 3.1A — Watershed Protection [1]
Develop a watershed protection program to: 1. Avoid conversion, to the extent practicable, of areas that are particularly susceptible to erosion and sediment loss; 2. Preserve areas that provide important water quality benefits and/or are necessary to maintain riparian and aquatic biota; 3. Protect to the extent practicable the natural integrity of water bodies and natural drainage systems associated with site development—including roads, highways, and bridges;

[1] Sound watershed management requires that both structural and nonstructural measures be employed to mitigate the adverse impacts of storm water. Nonstructural Management Measures 3.1A (Watershed Protection) and 3.1B (Site Development) can be effectively used in conjunction with Management Measure 3.1C (New Development) to reduce both the short-and long-term costs of meeting the treatment goals of this management measure.

Urban Management Measure 3.3A — Existing Development
Develop and implement watershed management programs to reduce runoff pollutant concentrations and volumes from existing development: 1. Identify priority local and/or regional watershed pollutant reduction opportunities (e.g., improve existing urban runoff control structures); 2. Specify a schedule for implementing appropriate controls; 3. Limit destruction of natural conveyance systems; and 4. Where appropriate, preserve, enhance, or establish buffers along surface water bodies and their tributaries.

Monitoring

Many monitoring efforts have been implemented within this watershed. There are, however, few effectiveness monitoring efforts currently being implemented. The City of Watsonville will be completing a monitoring program as part of their Phase II NPDES Program, the Agriculture community has begun a Ag Waiver monitoring effort, and the IWRP will include a monitoring component. Those monitoring efforts should strive to coordinate the collection of data to determine their ability to track implementation and document the effectiveness of the cumulative actions on water quality and wetland habitat. Initial dialog has begun to integrate the California Rapid Assessment Method for wetland into restoration efforts to quantify the improvement in habitat condition associated with these project.

(6) **Summary**

In Summary, continued support of ongoing activities is of primary importance. Several gaps and opportunities, however, have been identified in this assessment which warrant further discussion.

Initial next steps should include developing an expanded historic model for the slough and identifying a set of restoration objectives (acres restored, hydrologic connectivity, consistent setbacks, priority lands for restoration) that can provide on the ground decision makers the necessary information to evaluate the positive and negative results of various opportunities.

Finally, program effectiveness monitoring should be expanded to demonstrate the water quality and habitat response of various program activities.

Literature Citations

1 Watsonville Sloughs Sediment Problems and Sources. 2005. The Watershed Institute. http://watershed.csumb.edu

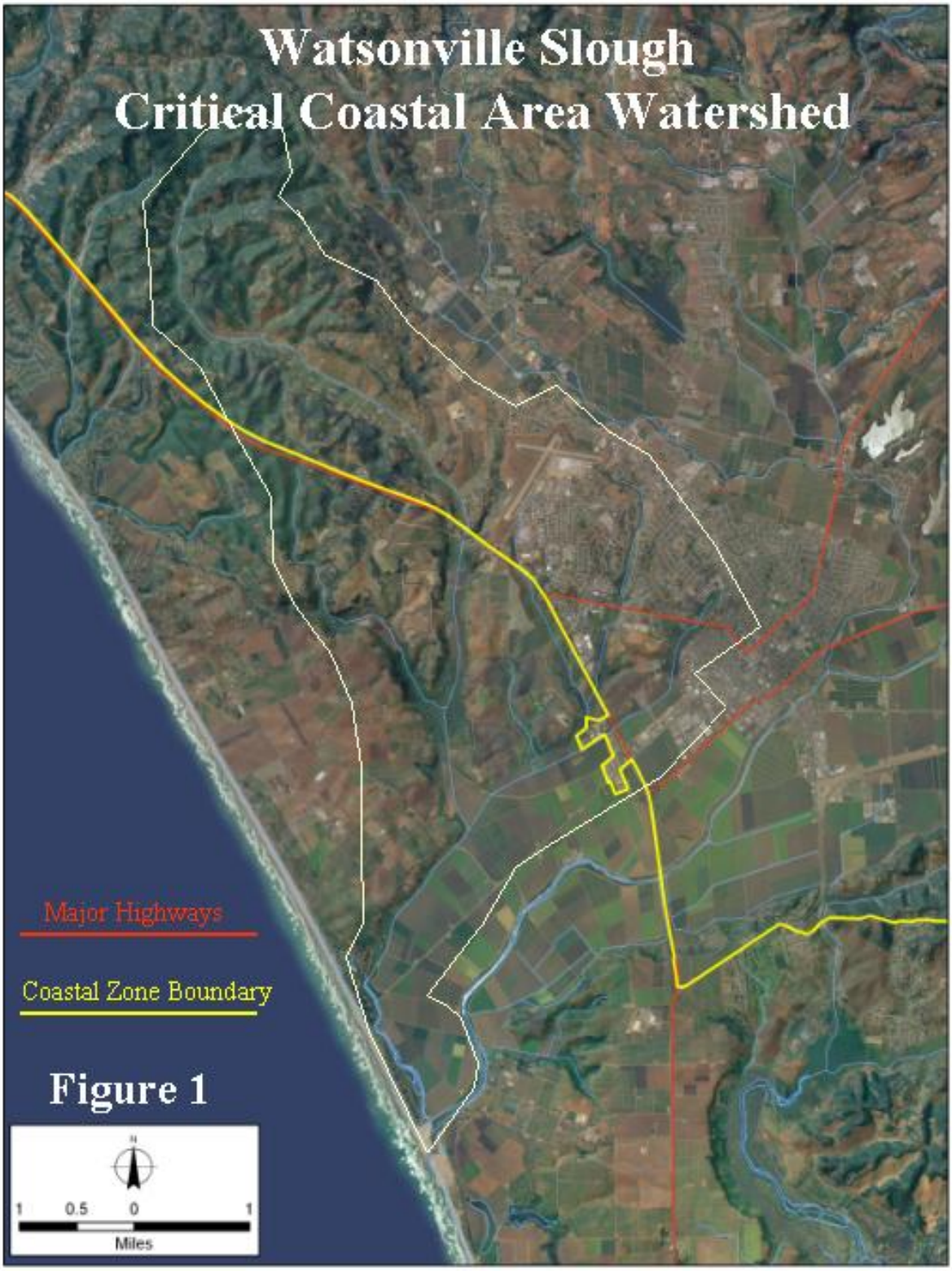
2 Water Resources Management Plan for Watsonville Slough System. 1995. AMBAG & Questa Engineering

3 Watsonville Sloughs Watershed Resource Conservation and Enhancement Plan. 2001 Santa Cruz County & Swanson Hydrology and Geomorphology

4 Frequently Asked Questions about the new Conditional Waiver for Irrigated Agriculture, Central Coast Regional Board

5 Comprehensive Watershed Management Solutions to Nonpoint Source Pollution in the Salinas Valley & Pajaro River Basin. 1997. The Watershed Institute.

6 Snapshot Day Report. 2005. Monterey Bay Sanctuary Citizen Monitoring Network.


Watsonville Slough
Critical Coastal Area Watershed
Major Highways
Coastal Zone Boundary
Figure 1
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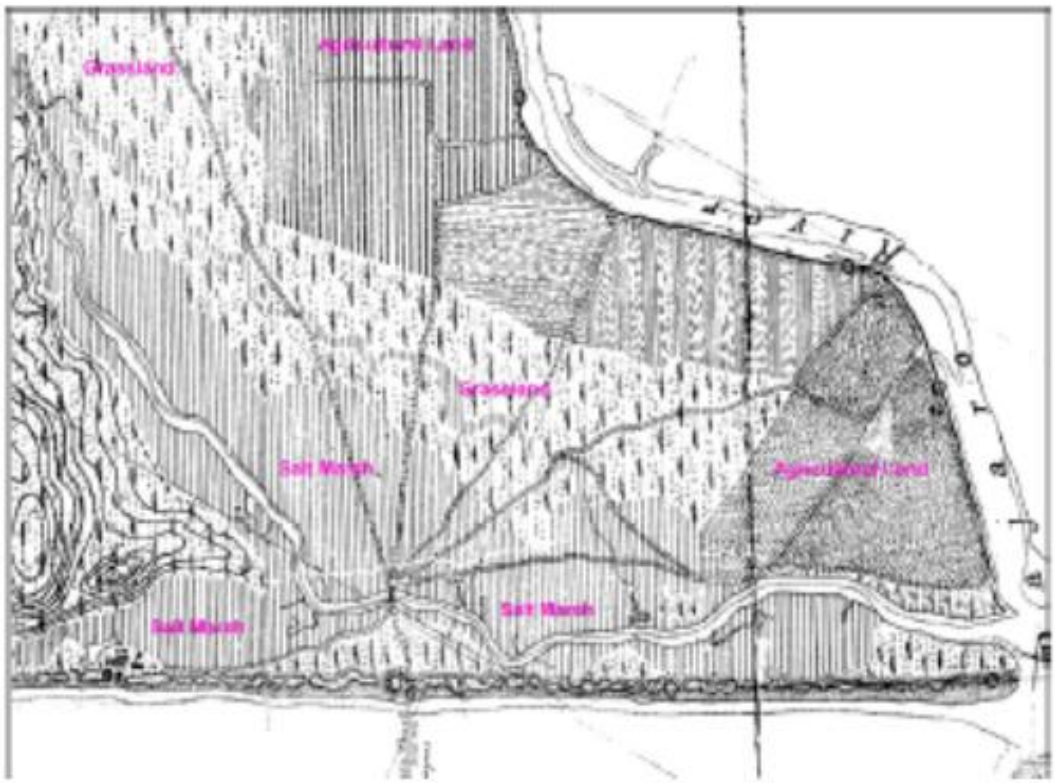

Figure 2. 1853 USGS Survey of Pajaro and Watsonville Slough habitat.
Reproduced from Watsonville Sloughs Sediment Problems and Sources. 2005

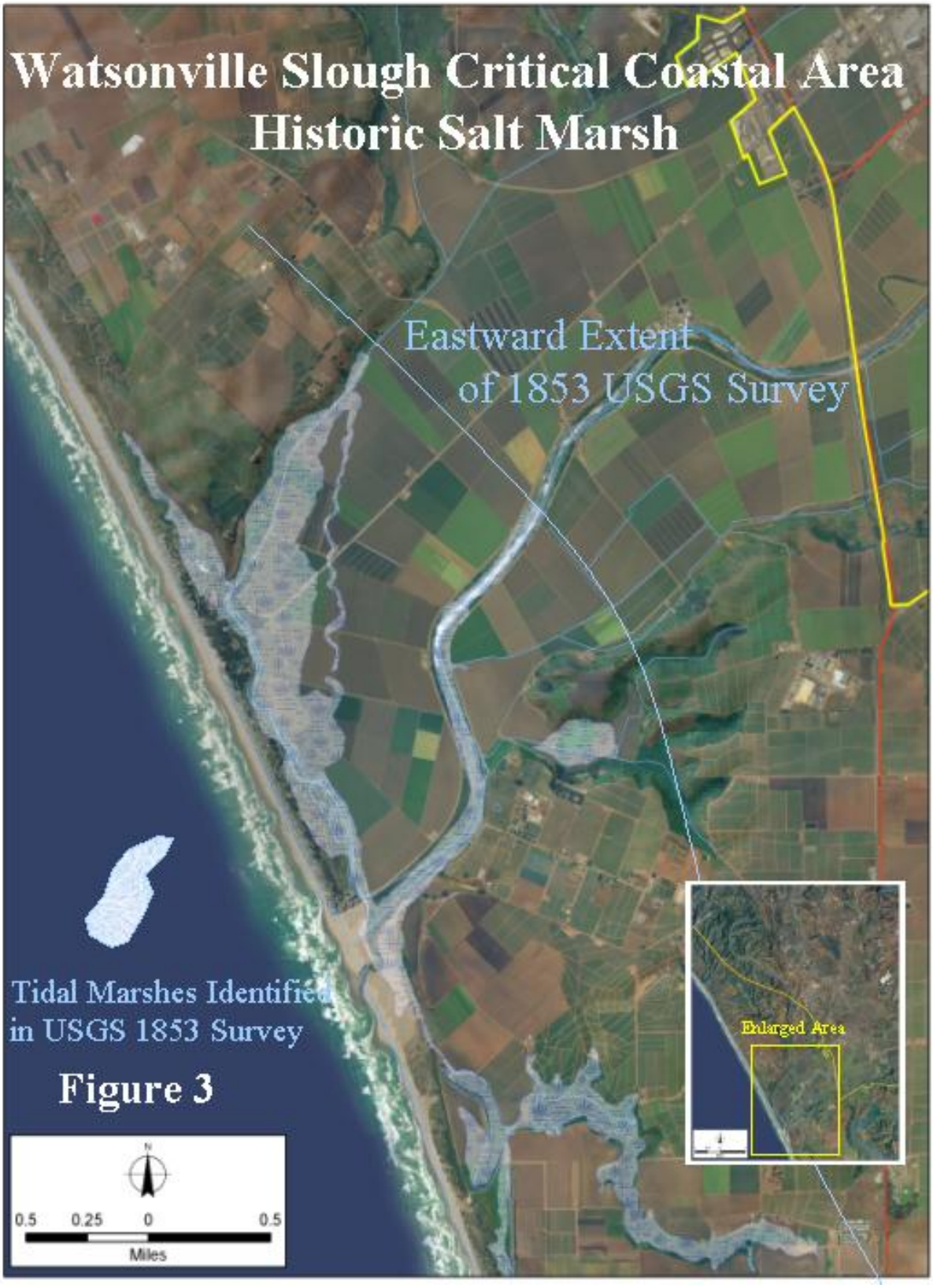
Watsonville Slough Critical Coastal Area
Historic Salt Marsh
Eastward Extent
of 1853 USGS Survey
Tidal Marshes Identified
in USGS 1853 Survey
Enlarged Area
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Figure 3

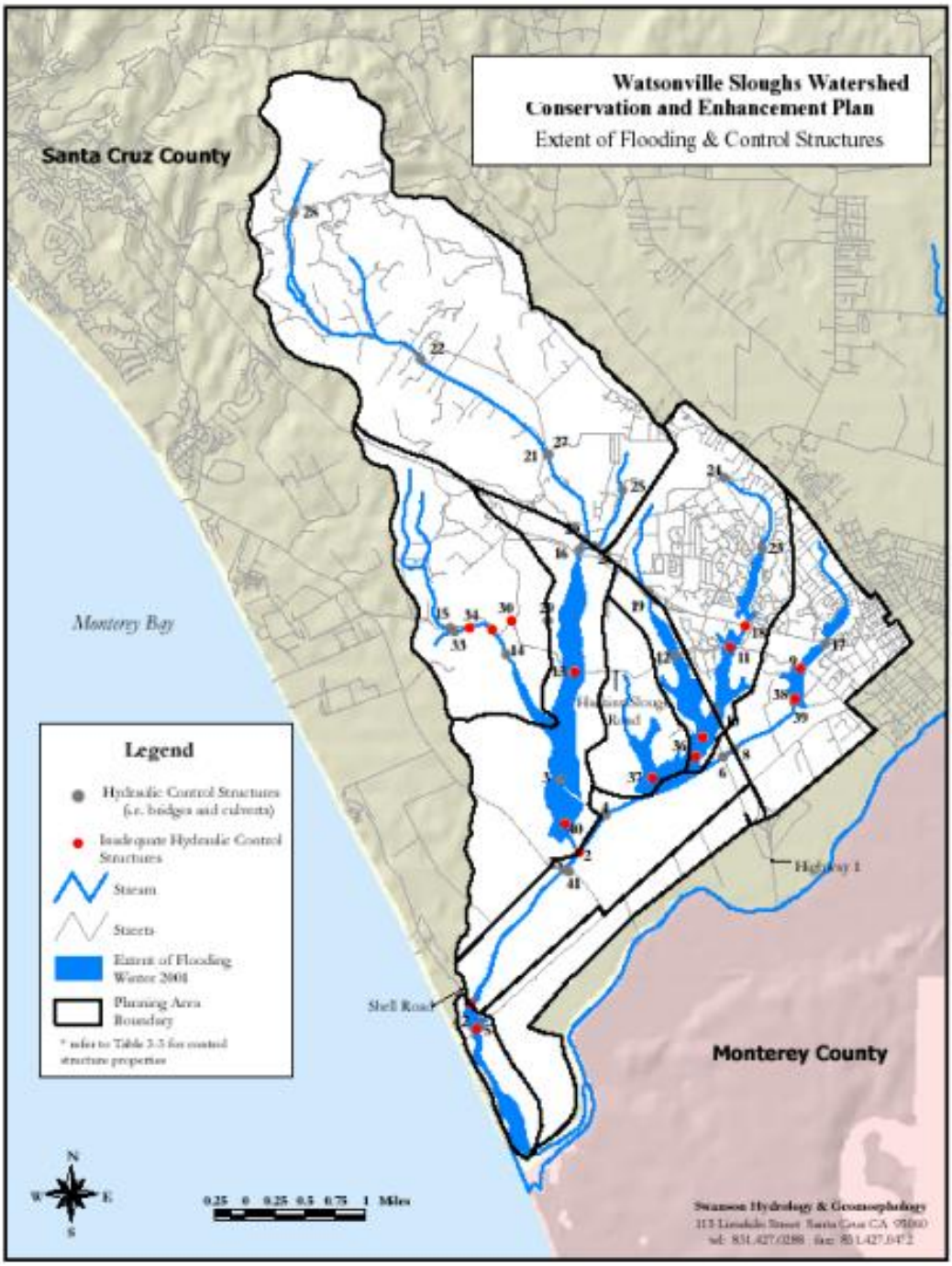
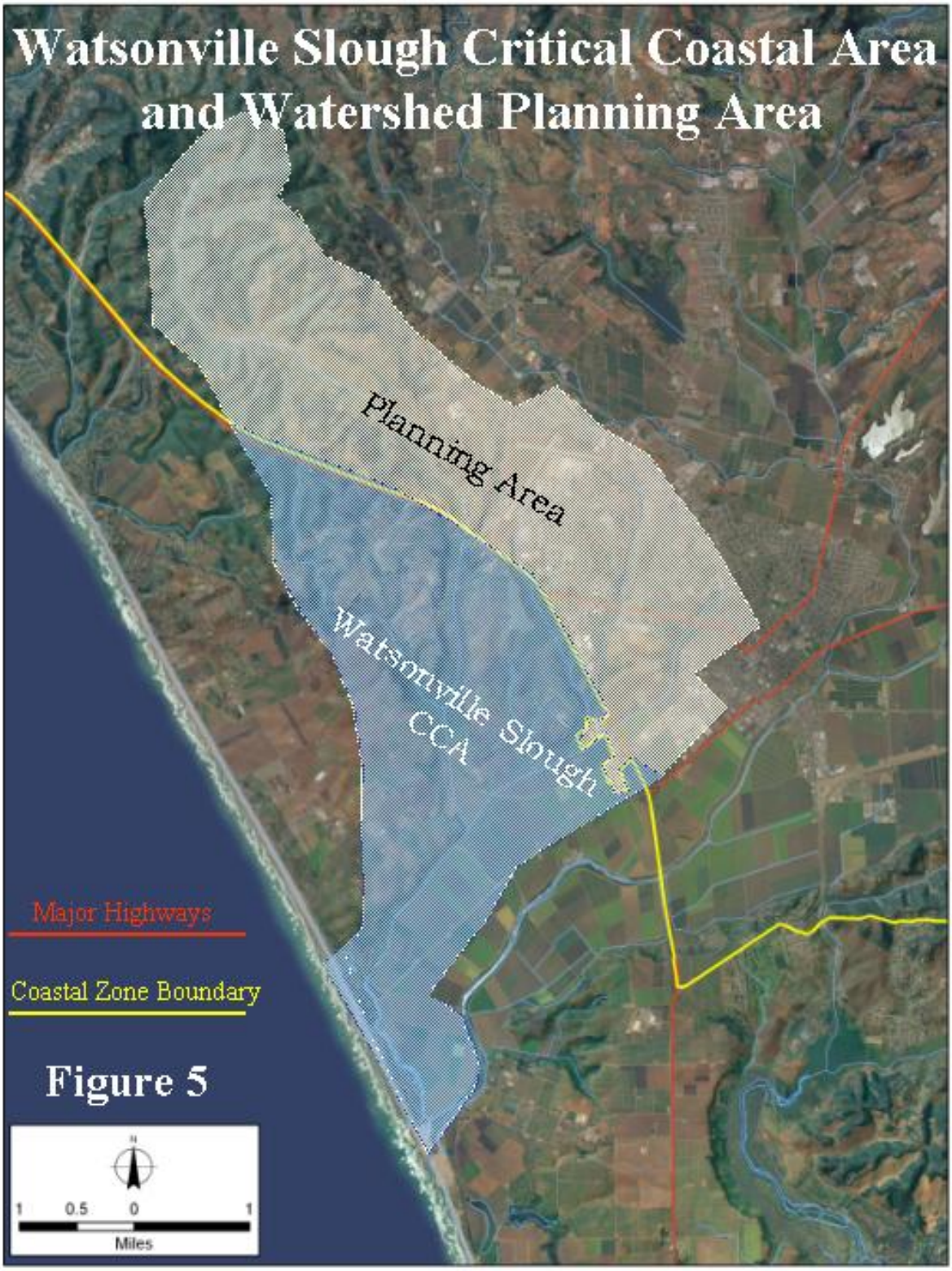


Figure 4. Water Control Structures in the Watsonville Slough Critical Coastal Areas
Reproduced from Watsonville Sloughs Watershed Resource Conservation and Enhancement Plan. 2001 Santa Cruz County & Swanson Hydrology and Geomorphology


Watsonville Slough Critical Coastal Area and Watershed Planning Area
Planning Area
Watsonville Slough CCA
Major Highways
Coastal Zone Boundary
Figure 5
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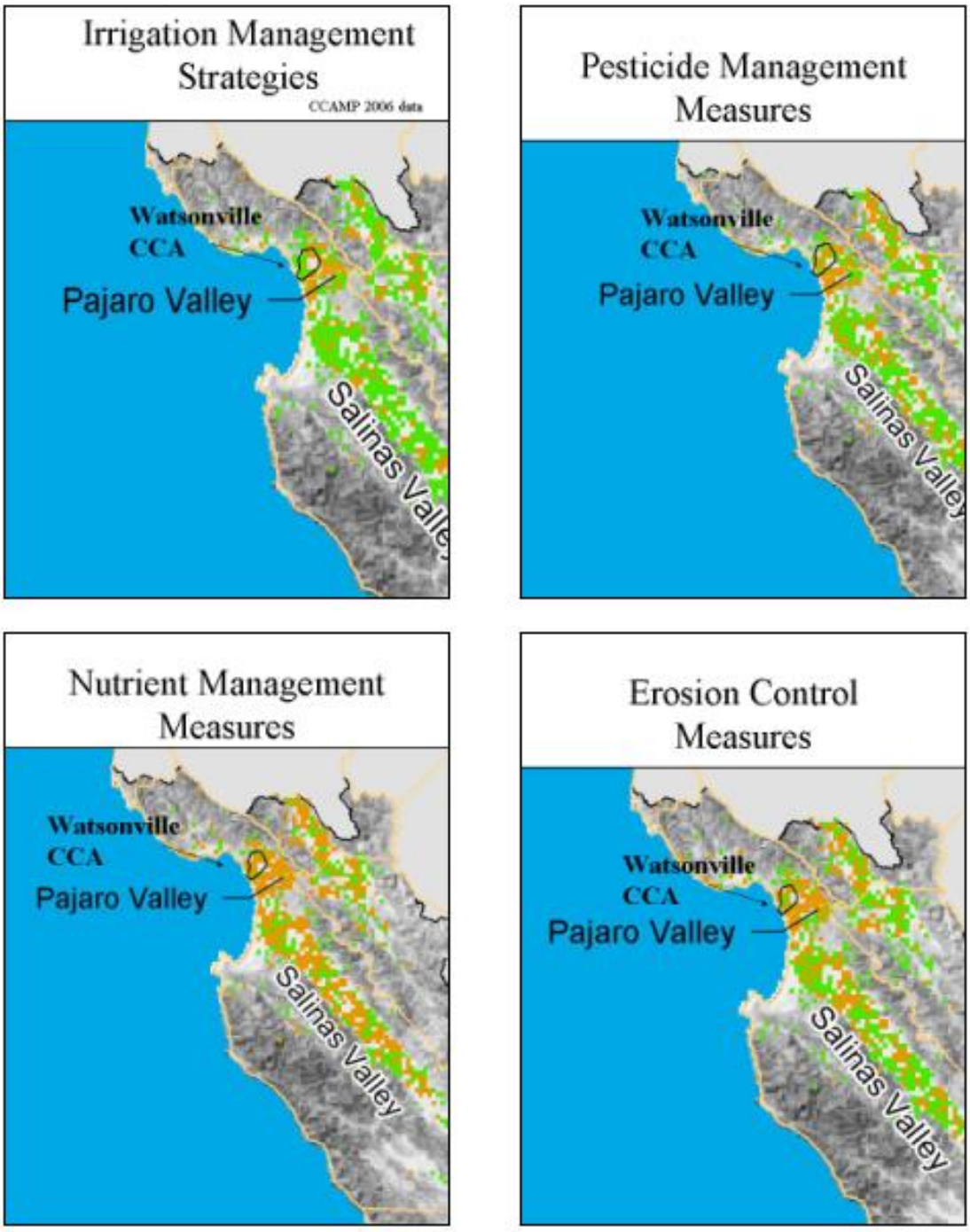

Figure 6. Current distribution of irrigated agriculture (green) and irrigated agriculture with Farm Water Quality Management Plans which include efforts to implement various Management Measures (orange). CCAMP 2006 (www.ccamp.org)

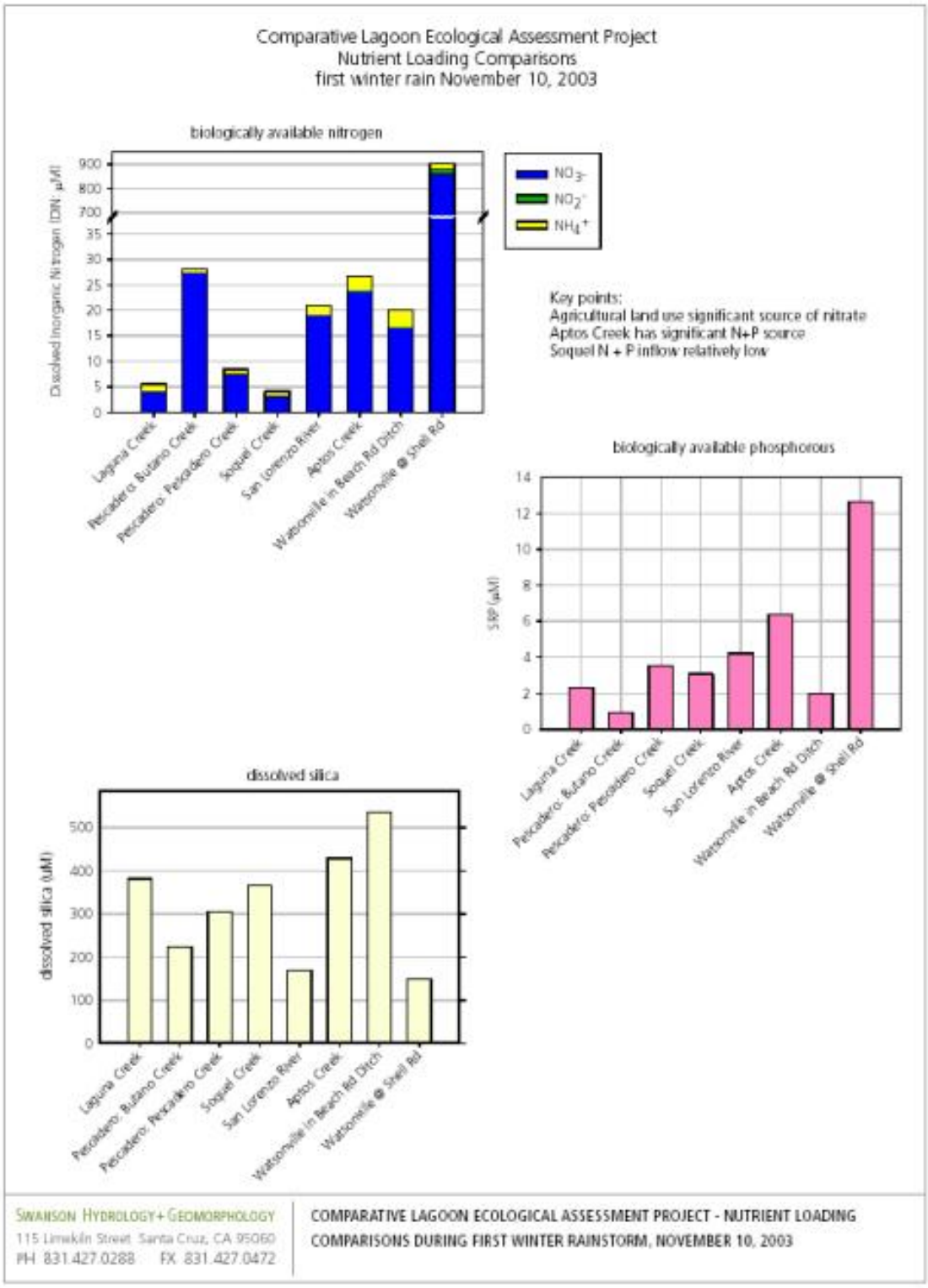

Figure 7. Water Quality Comparison among Santa Cruz County Lagoons

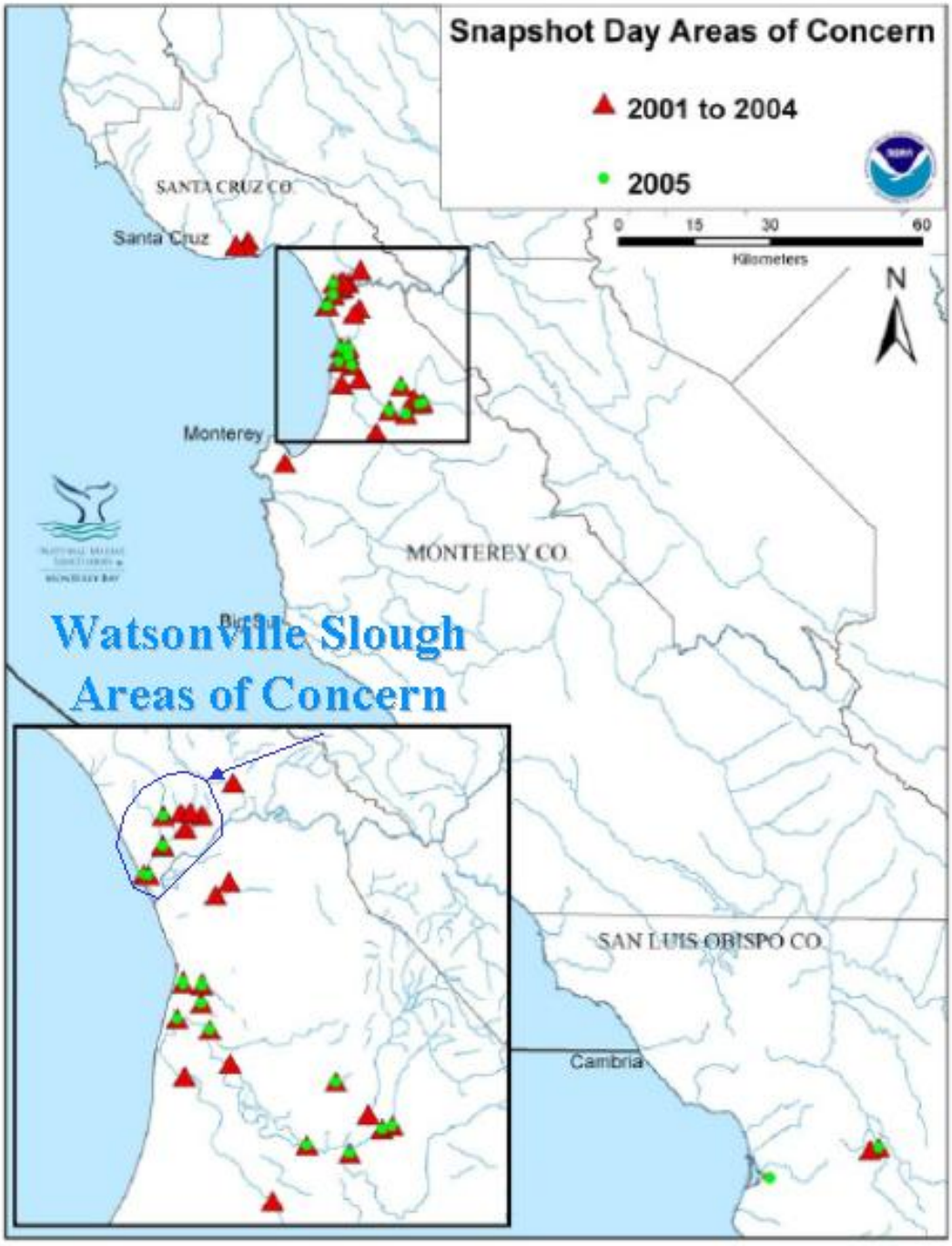

Figure 8. Snapshot Day Areas of Concern within the Watsonville Slough and Central Coast. 2005 Snapshot Day Report. www. montereybay.noaa.gov/monitoringnetwork

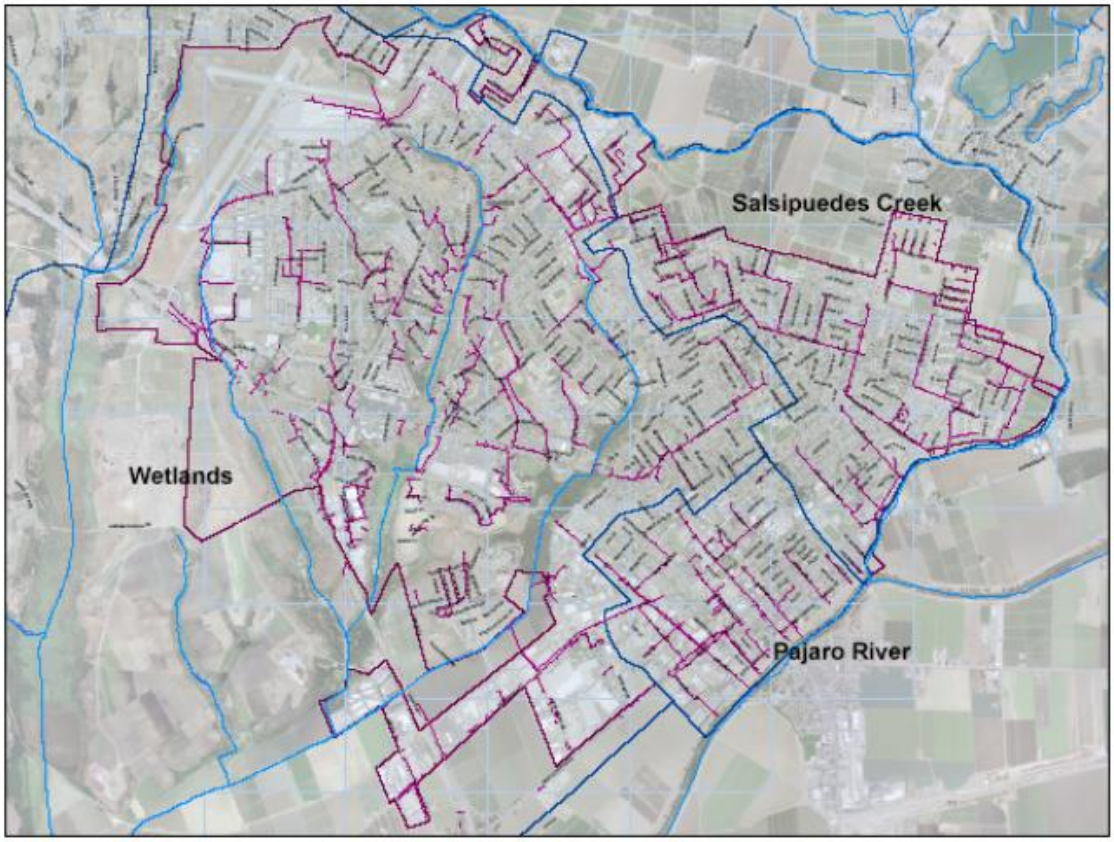

Figure 9. Stormdrain System for City of Watsonville. Provided by City of Watsonville.

Table 1 Land use coverage types by Planning Area

Planning Area	Planning Area Size (acres)	Approximate Land Use Coverage Distribution (acres)						
		Urban Residential	Agricultural	Undeveloped	Rural Residential	Industrial	Commercial	Grazing
Upper Watsonville	1128	564	282	0	0	0	282	0
Middle Watsonville	1430	0	1216	0	0	214	0	0
Lower Watsonville	780	624	0	156	0	0	0	0
Upper Struve	1424	855	0	0	0	142	427	0
West Branch and Lower Struve	627	0	188	376	0	32	31	0
Gallighan Slough	2047	0	716	409	614	103	0	205
Hanson Slough	1002	0	200	401	100	0	0	301
Upper Harkins	4812	0	48	481	2887	241	0	1155
Lower Harkins	2571	0	771	1029	257	0	0	514
Beach Road Ditch	1675	0	1675	0	0	0	0	0
Totals	**17496**	**2043**	**5096**	**2852**	**3858**	**732**	**740**	**2175**

Source: Santa Cruz County GIS Database

Reproduced from Watsonville Sloughs Watershed Resource Conservation and Enhancement Plan. 2001
Santa Cruz County & Swanson Hydrology and Geomorphology

Table 2 Summary of previous water quality studies for Watsonville Sloughs

Project Agency		# sites in Watsonville Sloughs	Fecal Coliform	*E. Coli*	TSS	Turbidity	pH, temp, cond/salinity	DO	Nutrients	Pesticides	Metals	Oil & Grease	Water Depth	Chloride
Swanson Hydrology and Geomorphology (report 2003)*	YSI data loggers	4					X	X					X	
	Water depth	5											X	
	Vertical profiles	3 (above/below each site)					X (no pH)	X	X				X	
Hunt et al. (report 1999)*		4								X				
Questa Engineering Corporation (report 1995)*		10				X	X			X	X	X		
State Mussel Watch (sampling 1982 to 1993)		5								X	X			
Toxic Substance Monitoring Program (sampling 1980 to 1992)		7								X	X			
Santa Cruz County Env. Health		22	X (16 sites)	X (1 site)	X (4 sites)	X (8 sites)	X	X	X	X	X			X
Santa Cruz County Public Works Buena Vista Landfill NPDES monitoring (sampling 1992 to 2002)		4			X		X					X		X
City of Watsonville (sampling 1996 to 1998)		6			X	X	X	X	X					X
Watershed Institute–John Oliver (sampling 1995 to 1997)		3				X	X	X	X					
CCRWQCB - Metals, Oil & Grease, Pesticide (study 2002)		11								X	X	X		
PVWMA (sampling 1994 to present)	Diversion Project NPDES monitoring	5	X (4 sites)		X	X	X	X	X	X (2 sites)	X (2 sites)	X (1 site)	X (3 sites)	
	Other	5			X	X	X		X					X
Central Monterey Bay Wetlands Project – Coastal Watershed Council and Santa Cruz & Monterey Resource Conservation Districts (sampling July 2000 to June 2001)		10				X	X	X	X					
UCSC - Marc Los Huertos et al. (sampling October 2000 to September 2001)		2					X	X	X					

red text highlights data that pertain to suspended sediment and turbidity

Reproduced with permission from *Watsonville Sloughs Sediment Problems and Sources*. 2005. The Watershed Institute

Table 3

SUMMARY OF
MANAGEMENT MEASURE IMPACTS

DOWNSTREAM TREATMENT MEASURE	Agriculture	Urban	Flood Control	Mosquito Abatement	Wetlands Biotic	Pajaro River Estuary
• WET DETENTION/SEDIMENTATION BASINS	PS	B/PS	B	PS	B	B
• DRAINAGE MODIFICATIONS	PS	N	PS	B/PS	B	N
• CHANNEL DREDGING	B	N	B	B	S	PS
• CHANNEL FILLING	PS	N	PS	PS	B	B
• CONSTRUCTED WETLANDS	PS	B/PS	B	PS	B	B
• FLOW DIVERSION	B/PS	B/PS	B/PS	B/PS	B/PS	B/PS
• SLOUGH/TAILWATER RECIRCULATION	N/PS	N	N	B/PS	B	B
• VEGETATED RIPARIAN BUFFERS/FILTER STRIPS	PS	B/PS	N	N/PS	B	B
• FLOW AUGMENTATION	N	N/B	N	B	B	PS
• WATER LEVEL CONTROLS	PS	N	PS	B/PS	B/PS	PS

IMPACT CODE:

S = Significant
PS = Potentially Significant
N = Negligible or None
B = Beneficial

Reproduced from Water Resources Management Plan for Watsonville Slough System. 1995. AMBAG & Questa Engineering

NPS Management Measure Evaluation Status
Watsonville Slough CCA Summary 2006

NPS Category	Management Measures	MM Implementation			
		Full Ongoing	**Partial**	**Planned**	**Needs more planning**
AGRICULTURE	1A Erosion and Sediment Control			**X**	
	1B Facility Wastewater and Runoff from Confined Animal Facilities				**NA**
	1C Nutrient Management			**X**	
	1D Pesticide Management			**X**	
	1E Grazing Management			**X**	
	1F Irrigation Water Management			**X**	
	1G Education and Outreach	**X**			
FORESTRY	**Not Applicable**				NA

NPS Category	Management Measures	MM Implementation			
		Full Ongoing	Partial	Planned	Needs more planning
Hydromodification	5.1 Channelization and Channel Modification 5.1A Physical and Chemical Characteristics of Surface Waters 5.1B Instream and Riparian Habitat Restoration				X
	5.2 Dams 5.2A Erosion and Sediment Control 5.2B Chemical and Pollutant Control 5.2C Protection of Surface Water Quality and Instream and Riparian Habitat				**NA**
	5.3 Streambank and Shoreline Erosion 5.3A Eroding Streambanks and Shorelines				X
	5.4 Education/Outreach 5.4A Educational Programs		X		X
Marinas and Recreational Boating	**Not Applicable**				NA

NPS Category	Management Measures	MM Implementation			
		Full Ongoing	**Partial**	**Planned**	**Needs more planning**
URBAN AREAS	3.1 Runoff From Developing Areas 3.1A Watershed Protection 3.1B Site Development 3.1C New Development	X	X		
	3.2 Runoff from Construction Sites 3.2A Construction Site Erosion and Sediment Control 3.2B Construction Site Chemical Control	X			
	3.3 Runoff from Existing Development 3.3A Existing Development				X
	3.4 Runoff from Onsite Wastewater Treatment Systems (OWTSs) 3.4A New OWTSs 3.4B Operating OWTSs		X		
	3.5 Transportation Development (Roads, Highways, and Bridges) 3.5A Planning, Siting, and Developing Roads and Highways 3.5B Bridges 3.5C Construction Projects 3.5D Chemical Control 3.5E Operation and Maintenance 3.5F Road, Highway, and Bridge Runoff Systems		X		
	3.6 Education/Outreach 3.6A Pollution Prevention/Education: General Sources	X			
Wetlands, Riparian Areas, and Vegetated Treatment Systems	6A Protection of Wetlands and Riparian Areas		X		X
	6B Restoration of Wetlands and Riparian Areas		X		X
	6C Vegetated Treatment Systems				X
	6D Education/Outreach		X		X