Appendix F

Staff Recommendations for Agricultural Order

TECHNICAL MEMORANDUM:

Cost Considerations Concerning Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands

CENTRAL COAST REGIONAL WATER QUALITY CONTROL BOARD

March 2011

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TABLE OF CONTENTS

1 INTRODUCTION 5

2 COSTS OF IMPLEMENTATION 6
2.1 Introduction 6
2.2 Cost Of Compliance to Growers and Farmland Owners 6
2.2.1 Management Practice Implementation, Monitoring and Reporting 6
2.2.2 Costs of Implementing Management Practices 10
2.2.2.1 Estimated Costs of New Compliance Actions 10
2.2.2.2 Potential Water Quality Management Practices 10
2.2.2.3 Potential Cost Factors Considered 11
2.2.2.4 Unit Costs for Management Practices 15
2.2.2.5 Conclusions on Cost of Management Practice Implementation 24
2.2.3 Cost of Aquatic Habitat Protection Using Buffers 28
2.2.3.1 Spatial Analysis to Support Cost Analysis 28
2.2.3.2 Factors to Consider Relative to Buffer Cost Estimates 30
2.2.4 Monitoring Program Costs 33
2.2.4.1 Receiving Water Monitoring 33
2.2.4.2 Groundwater Monitoring 34
2.2.4.3 Individual Monitoring 34
2.2.4.4 Quality Assurance Project Plan (QAPP) 35
2.2.4.5 Photo-Monitoring 35
2.3 Cost to Water Board for Program Administration 38

3 EFFECTS OF INCREASED COSTS ON FARM AND REGIONAL ECONOMY 40
3.1 Introduction 40
3.2 Strawberries: An Example of Multiple Factors Affecting Farm Economy 40
3.2.1 Price Elasticity 42
3.2.2 Effects of Increased Costs on Regional Economy 44

4 SOURCES OF FUNDING FOR IMPLEMENTATION 46
4.1 Summary of Funding Sources 46
4.1.1 Federal Farm Bill 46
4.1.2 State Water Resources Control Board 47
4.1.3 Safe, Clean, and Reliable Drinking Water Supply Act of 2010 47
4.1.4 Other Funding Programs 47
4.2 Effect of External Funding on Economic Impacts 48

5 COMPREHENSIVE COST CONSIDERATIONS 48
5.1 Costs of Implementation and Costs of Current Conditions 48
5.2 Full Costs of Agriculture as Currently Practiced 48
5.2.1 Financial Costs of Production 48
5.2.1.1 Public Sector Funding for Agriculture 48
5.2.1.2 Public Health and Environmental Financial Impacts of Discharges of Waste Associated with Agriculture (Externalities) 49
5.2.2 Social Costs of Current Conditions 49
5.2.2.1 Public Health 49
5.2.2.2 Environmental Health 50
5.2.2.3 Environmental Justice 57

5.2.3 Environmental Cost of Current Conditions 58
5.2.3.1 Watershed Health 58
5.3 The Triple Bottom Line 59

TABLE OF TABLES

Table 1: Requirements in Draft Ag Order with Potential to Increase Costs to Dischargers 8
Table 2: Water Quality Management Practices with Potential to Change Costs to Dischargers 12
Table 3: Example Types of Management Practice Implementation Costs 15
Table 4: Cost Estimates and Potential Benefits for Nine Conservation Practices 17
Table 5: Sample Per-Unit Costs of Management Practices Benefiting Water Quality 19
Table 6: Management Practice Costs for Central Valley Water Board Region 23
Table 7: Estimation of Cost to Implement Management Practices 27
Table 8: Acreage Potentially Affected by Buffers on Waterbodies Impaired by Sediment [a] 29
Table 9: Estimated Average Gross Value per Acre of Select Crops, by County (2009) 32
Table 10: Calculated Loss in Gross Production Value and Crop Acreage for Habitat Buffers 32
Table 11: County Farmland Designations Not Included in Buffer Analysis 36
Table 12: Estimated Farmland Within 50 feet of a Waterbody 36
Table 13: Cost Calculation for Photo Monitoring Requirement 38
Table 14: Water Board Staff Annual Cost to Administer Program 39
Table 15: Own Price Elasticity of Several Crops in the Central Coast Region 44
Table 16: Central Coast Counties Total Agricultural Production from Crop Reports 45
Table 17: Baseline Economic Agricultural Production, Monterey County 2001 45
Table 18: Economic Impact of General Plan Farmland Conversion, Monterey County 2001 46
Table 19: Example Public Sector Funding to Agriculture 49
Table 20: Well Replacement Costs 53
Table 21: Estimated Costs for Salinas Valley Water Project for Assessed Area33 57

1 INTRODUCTION

On July 9, 2004, the Central Coast Regional Water Quality Control Board (Central Coast Water Board) adopted a *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands* (2004 Conditional Waiver). Since the adoption of the 2004 Conditional Waiver, the Central Coast Water Board has documented that discharges of waste from irrigated lands, including nutrients, toxic compounds, and other constituents found in fertilizers, pesticides, and sediment, continue to degrade water quality and impair beneficial uses. Activities that have resulted in the discharges of waste that degrade water quality and impair beneficial uses include farm management practices and removal and degradation of riparian and wetland habitat. The 2004 Conditional Waiver expired on July 9, 2009 and has been renewed without revisions until March 2011. The Central Coast Water Board will consider renewing the 2004 Conditional Waiver prior to the expiration of the 2004 Conditional Waiver.

Central Coast Water Board staff prepared this Technical Memorandum to present cost considerations concerning the proposed renewal of the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Draft Agricultural Order No. R3-2011-0006 (Draft Ag Order)). The goal of this cost analysis is to present the full range of costs associated with the Draft Ag Order and to address concerns raised at Public Workshops held during the spring and summer of 2010.

The Central Coast Water Board is not generally required to consider costs when it adopts a waiver of waste discharge requirements pursuant to Water Code section 13269. Water Code section 13269 requires the Water Board to impose conditions on any waiver and the waiver must be consistent with the applicable water quality control plan (Basin Plan). Water Code section 13141 requires regional water boards to estimate the total costs of any agricultural water quality control program and an identification of potential sources of financing when a Regional Water Board amends a Basin Plan. The Draft Ag Order is not proposed to be included in the Basin Plan; however, this cost analysis provides the information that would be required by Water Code section 13141. The Central Coast Water Board is not required to consider economic or social impacts under the California Environmental Quality Act (CEQA) except where such impacts result in actual physical adverse impacts on the environment caused by the project. This cost analysis provides information that is used in the CEQA document to be considered by the Central Coast Water Board. The Central Coast Water Board is not required to perform a formal cost/benefit analysis when issuing waste discharge requirements or a waiver of waste discharge requirements or when complying with CEQA.

2 COSTS OF IMPLEMENTATION

2.1 Introduction

Growers, farmland owners, and the Central Coast Water Board, as the administering entity, would potentially incur the direct costs of implementing the Draft Ag Order. Staff compiled information available from various sources to characterize the type and approximate scale of these costs.

2.2 Cost Of Compliance to Growers and Farmland Owners

2.2.1 Management Practice Implementation, Monitoring and Reporting

The Draft Ag Order includes specific conditions requiring irrigated agricultural dischargers to implement management practices and conduct monitoring and reporting. The Draft Ag Order does not generally specify the manner of compliance – many different management practices could be implemented to comply with the conditions of the Draft Ag Order to attain water quality standards in the receiving waters. This portion of this Memorandum includes an estimate of costs of implementation of possible management practices that growers could use to comply. These requirements, summarized in Table 1, have the potential to increase costs to growers and agricultural land owners, depending on current level of compliance and other factors.

The Draft Ag Order requires dischargers to comply with conditions for the "tier" that applies to their operation. The tiers are based on criteria that indicate operations that have a low, moderate or high level of waste discharge, or a low, moderate or high threat or contribution to water quality degradation. Tier 1, lowest threat, dischargers have the fewest requirements (including implementation, monitoring and reporting) and Tier 3, highest threat, dischargers have the most requirements. Therefore, Tier 3 dischargers will most likely incur higher costs than Tier 1 or Tier 2 dischargers and a greater increase in costs compared to the cost of complying with the 2004 Conditional Waiver. For all dischargers, most of the costs to comply with the Draft Ag Order will be for implementation of management practices. Remaining additional costs will be for monitoring and reporting.

For example, the proposed draft 2011 Agricultural Order proposes the following implementation and reporting requirements:

- Implement pesticide management practices to reduce toxicity in discharges so receiving waterbodies meet water quality standards;
- Implement nutrient management practices to eliminate or minimize nutrient and salt in discharges to surface water so receiving waterbodies meet water quality standards;
- Implement nutrient management practices to minimize fertilizer and nitrate loading to groundwater to meet nitrate loading targets ;

- Install and properly maintain back flow prevention devices for wells or pumps that apply fertilizers, pesticides, fumigants or other chemicals through an irrigation system;
- Implement erosion control and sediment management practices to reduce sediment in discharges so receiving water bodies meet water quality standards;
- Protect and manage existing aquatic habitat to prevent discharge of waste to waters of the State and protect the beneficial uses of these waters;
- Implement stormwater runoff and quality management practices.
- Develop, implement, and annually-update Farm Water Quality Management Plans.
- Submit an Annual Compliance Document (for higher threat dischargers) that includes individual discharge monitoring results, nitrate loading potential evaluation and, if nitrate loading potential is high, irrigation and nutrient management plan, verification of irrigation and nutrient management plan effectiveness.
- Submit a water quality buffer plan (for higher threat dischargers), if operations contain or are adjacent to a waterbody identified on the Clean Water Act Section 303(d) List of Impaired Waterbodies as impaired for temperature or turbidity.

Staff developed this Draft Order to address the documented severe and widespread water quality problems in the Central Coast Region, predominately unsafe levels of nitrate in ground water used for drinking water and toxicity impairing communities of aquatic organisms.

This proposed draft 2011 Agricultural Order requires dischargers to implement practices or operational changes to reduce pollutant loading to waters of the State in the Central Coast Region. The proposed draft 2011 Agricultural Order requires more specific and measurable tracking and evaluation of effectiveness of practices and more comprehensive water quality monitoring (e.g., individual discharges and groundwater) than the 2004 Conditional Waiver.

Table 1: Requirements in Draft Ag Order with Potential to Increase Costs to Dischargers

CONDITIONS	Due in:[1]
Pesticide Runoff/Toxicity Elimination	
All dischargers must implement management practices to eliminate or minimize toxicity and pesticide discharges so receiving water bodies meet water quality standards	immediately
Nutrient and Salt Management	
All dischargers must implement nutrient management practices to minimize nutrient and salt discharges so receiving water bodies meet water quality standards	immediately
All dischargers must minimize nutrient discharges from fertilizer and nitrate loading to groundwater so receiving water bodies meet water quality standards and safe drinking water is protected	immediately
Tier 3 dischargers must evaluate the nitrate loading potential factor (as high, medium or low) of their operations, annually	1 Yr
Tier 3 dischargers *with a high nitrate loading potential* must develop and initiate implementation of a certified Irrigation and Nutrient Management Plan (INMP) to meet specified nitrogen balance ratio targets	2 Yrs
Sediment Management / Erosion Control / Stormwater Management	
All dischargers must implement erosion control and sediment management practices to eliminate or minimize the discharge of sediments and turbidity so receiving water bodies meet water quality standards	3 Yrs
All dischargers must protect existing aquatic habitat (including perennial, intermittent, or ephemeral streams, lakes, and riparian and wetland area habitat or other waterbodies) to prevent discharges of waste so receiving water bodies meet water quality standards.	immediately
All dischargers must implement stormwater management practices to minimize stormwater runoff	immediately
Tier 2 and Tier 3 Dischargers must evaluate conditions of riparian and wetland habitat areas *if their operations contain or are adjacent to a waterbody identified on the Clean Water Act Section 303(Dd) List of Impaired Waterbodies as impaired for temperature or turbidity.*	1 Yr
Tier 3 dischargers must develop and initiate implementation of a Water Quality Buffer Plan to prevent waste discharge or water quality degradation, *if their operations contain or are adjacent to a waterbody identified on the Clean Water Act Section 303(d) List of Impaired Waterbodies as impaired for sediment, temperature or turbidity and the discharger's runoff drains to that waterbody.* The plan must include the following or the functional equivalent: minimum of 30 foot buffer; wider buffer if necessary to prevent discharge of waste; three zones with distinct types of vegetation (moving from area closest to waterbody to areas away from waterbody) to jointly provide shade, pollutant treatment through infiltration and reduced velocity of flow to promote sediment deposition; schedule for implementation; and maintenance provisions.	4 Yrs
General Groundwater Protection Requirements	
All dischargers that apply fertilizers, pesticides, fumigants or other chemicals through an irrigation system must have functional and properly maintained back flow prevention devices installed at the well or pump to prevent contamination of groundwater or surface water.	3 Yrs
All dischargers must properly destroy all abandoned groundwater wells, exploration holes or test holes, in such a manner that they will not produce water or act as a conduit for mixing or otherwise transfer groundwater or waste constituents between permeable	NA

[1] Where specified time periods/deadlines are included in the proposed Order. NA = no time period specified in order.

zones or aquifers.	
All dischargers who choose to utilize containment structures (such as retention ponds or reservoirs) to achieve treatment or control of the discharge of wastes, must construct and maintain such containment structures to avoid percolation of waste to groundwater that causes or contributes to exceedancess of water quality standards and to avoid surface water overflows that have the potential to impair water quality	NA
MONITORING	
All dischargers must sample private domestic and agricultural supply groundwater wells located at their operation, twice in one year	2Yrs
All dischargers must conduct watershed-scale (receiving water) monitoring as part of cooperative group or individually, monthly for five years	6 Months
Tier 2 and Tier 3 dischargers must photo-document existing conditions of riparian and wetland habitat areas, one time in five years, *if their operation(s) contain or are adjacent to a waterbody identified on the Clean Water Act Section 303(d) List of Impaired Waterbodies as impaired for sediment, temperature or turbidity.*	1 Yr
Tier 3 dischargers must conduct individual discharge monitoring, two to four times per year for five years	6 months
REPORTING	
All dischargers must submit Notice of Intent to Enroll	60 days
All dischargers must submit results of groundwater sampling and related well information	6 Months
Tier 2 and 3 dischargers must submit an Annual Compliance Document that includes status information on implementation of required conditions (e.g. implementation of management practices) and results of any required sampling or monitoring, appropriate for the tier applicable to the discharger's operation.	2 Yrs
Tier 2 and Tier 3 dischargers must submit photo-documentation of conditions of riparian and wetland habitat areas with the Annual Compliance Document, *if their operation(s) contain or are adjacent to a waterbody identified on the Clean Water Act Section 303(d) List of Impaired Waterbodies as impaired for sediment, temperature or turbidity.*	1 yr
Tier 3 dischargers must submit results of individual discharge monitoring	2 Yrs
Tier 3 dischargers must submit results of evaluating nitrate loading potential factor (high, medium, or low)	1 Yr
Tier 3 dischargers *with a high nitrate loading potential* must submit verification of Irrigation and Nutrient Management Plan (INMP) and other related nitrate loading and balance information	2 Yrs
Tier 3 dischargers must submit Water Quality Buffer Plan to prevent waste discharge or water quality degradation, *if their operations contain or are adjacent to a waterbody identified on the Clean Water Act Section 303(d) List of Impaired Waterbodies as impaired for sediment, temperature or turbidity.*	4 Yrs

2.2.2 Costs of Implementing Management Practices

2.2.2.1 Estimated Costs of New Compliance Actions

The scope of this cost analysis is intended to encompass the incremental costs to growers and landowners of new compliance actions beyond those taken to comply with the 2004 Conditional Waiver. Compliance actions for the Draft Ag Order are attached to a schedule (Table 1, above) and staff recognizes these actions may include the implementation of management practices in addition to those already implemented in response to the 2004 Conditional Waiver. However, staff possesses limited information to determine the extent of management practice implementation to date. Consequently, staff can not quantify the incremental costs associated with additional management measures. Staff assumes that many growers will not have to incur entirely new cost of implementing management practices as they will have already implemented some practices for compliance with the 2004 Conditional Waiver. Growers and landowners are likely to implement only some of the actions described below. The higher the assumed rate of management practice implementation over the past nearly seven years, the lower is the incremental increase in cost of the 2011 Draft Ag Order. This analysis provides an estimate of total costs, but the Water Board does not expect that each grower will be subject to all the costs identified since it is up to the grower to choose and implement management practices specific to its situation.

2.2.2.2 Potential Water Quality Management Practices

A broad choice of water quality management practices is available to growers to achieve compliance with the Draft Ag Order. Practices include those designed to manage sediment, nutrients, pesticides, and aquatic habitat. Growers implement many of these management practices for purposes other than water quality protection and staff makes no estimation of the proportion of practices that growers have implemented, or will implement, exclusively for water quality protection.

Most management practices contribute to meeting multiple management objectives (Table 2). For example, management practices implemented to capture and treat irrigation water runoff (tailwater) before it leaves the farming operation can result in improved irrigation efficiency and reduced transport of multiple constituents off-site, including nutrients, sediment and pesticides. Similarly, management practices that emphasize source control, such as nutrient management planning, reduce the need for more expensive management practices to remove a pollutant from tailwater before it enters receiving waters.

Source control practices also provide cost savings to growers who reduce their use of irrigation water and agricultural chemicals. These cost savings potentially combine with other benefits to reduce the cost of management practice implementation. Reduced water use, energy use, labor costs for irrigation and fertilization, and chemical use are all examples of benefits with potential to decrease costs to dischargers (Table 2).

2.2.2.3 Potential Cost Factors Considered

Staff evaluated detailed implementation requirements for management practices to identify specific costs of management practice implementation (Table 2). For example, the practice of installing backflow prevention and safety devices has a direct cost associated with purchasing and installing the devices and various related costs to the farming operation, including potential system upgrades to accommodate backflow prevention devices and regular maintenance of backflow prevention devices.

The specific combination of management practice actions undertaken by growers will be unique to the water quality conditions of each operation and will vary widely. To further illustrate the types of costs associated with management practice implementation, Table 3 describes typical activities that incur costs in managing sediment and stormwater, nutrients, pesticides, irrigation, and riparian habitat on farms in the Central Coast Region. Management practices include costs associated with assessment, on-the-ground actions, and technical assistance.

Table 2: Water Quality Management Practices with Potential to Change Costs to Dischargers

WATER QUALITY MANAGEMENT PRACTICES WITH POTENTIAL TO INCREASE COSTS TO DISCHARGERS	DETAILS OF IMPLEMENTATION REQUIREMENTS FOR WATER QUALITY MANAGEMENT PRACTICES	BENEFITS WITH POTENTIAL TO DECREASE COSTS TO DISCHARGERS	*Implementation Achieves Management Objectives for:*			
			Irrigation	*Nutrients*	*Erosion*	*Pesticide*
Eliminate or reduce irrigation runoff through installation and management of a highly efficient irrigation system	Weather station equipment and/or data Expertise/ technical assistance in crop growth, soil science, atmospheric demand, irrigation requirements and economics to prepare an irrigation strategy Labor for installation, operation, and maintenance Direct cost of equipment/system investment	Reduced water use Reduced energy use Reduced agro-chemical use Reduced labor for fertilizer applications Reduced labor through fewer irrigations	✓	✓	✓	✓
Capture and treat irrigation water runoff before it leaves the farming operation	Land out of production to collect tailwater Design and implementation of a tailwater recovery system that collects all discharge Direct cost for recovery/recycle system components Labor for installation, operation, and maintenance Design and implementation of a tailwater treatment system Management time to create and implement a monitoring plan that verifies treatment: collect water samples; evaluate results of samples and recalibrate treatment system	Reduced water use Reduced energy use Reduced need for additional conservation practices Reduced time dealing with clean-ups associated with chemical contamination of other farm water supplies/systems Reduced agro-chemical use	✓	✓	✓	✓
Install backflow prevention and safety devices	Purchase of backflow prevention device Labor for installation and regular maintenance of backflow prevention device Potential system upgrades to accommodate backflow prevention device Expertise/technical assistance	Reduced time and cost dealing with clean-ups associated with chemical contamination of other farm water supplies/systems Reduced agro-chemical use		✓		✓
Conduct analysis of salts to limit unnecessary leaching	Reduced yield from growing current crops with higher salinity in irrigation water Less profit from growing alternative, salt-tolerant crops/varieties Proper training for the collection of samples Labor for the collection of soil samples and water samples Laboratory costs for salinity tests that identify salt problems in soil	Reduced water use and cost by altering irrigation schedule for less frequent heavy watering Reduced energy use to not pump extra water for leaching salts Reduced fertilizer costs by keeping nutrients at the root zone instead	✓	✓		

WATER QUALITY MANAGEMENT PRACTICES WITH POTENTIAL TO INCREASE COSTS TO DISCHARGERS	DETAILS OF IMPLEMENTATION REQUIREMENTS FOR WATER QUALITY MANAGEMENT PRACTICES	BENEFITS WITH POTENTIAL TO DECREASE COSTS TO DISCHARGERS	*Implementation Achieves Management Objectives for:*			
			Irrigation	*Nutrients*	*Erosion*	*Pesticide*
	Expertise/technical assistance to interpret results	of leaching				
Stormwater Management Plan to control, stop, and/or eliminate the release of pollutants from farms to surface waters	Management time to: prepare a stormwater management plan coordinate with other growers and agencies submit plan to Central Coast Water Board oversee implementation of management plan continually review and update management plan Labor associated with implementation Implementation and structural improvements Labor for continued maintenance Expertise/technical assistance to help develop measures, strategies, practices, etc.	Reduced need for additional conservation practices	✓	✓	✓	✓
Dredge, remove, and dispose of sediments from treatment systems every year, before the first rain event	Management time to oversee dredging operation Labor to operate heavy equipment Rental/use of heavy equipment Disposal of contaminated soil Re-vegetating treatment system				✓	✓
Drainage Water Management Program for Dischargers who operate tile drains or other sub-surface drainage systems	Expertise/technical assistance to assist with system design and program Modification of drainage system design and operation Equipment cost for water control structures and/or retrofits Installation of structures Management time to operate structures at appropriate times	Reduced water use Reduced energy use	✓	✓		✓
Develop, implement, and periodically update a Nutrient Management Plan that is approved by a Certified Crop Advisor, a PE, GR, or similarly certified professional	Acquire technical assistance to help measure, calculate, budget, and/or estimate nutrient requirements, uptake, application, including consultant costs to review and approve management plan (CCA, PE, CR, etc.) Train on how to measure, calculate, budget, estimate, and apply nutrients Management time to oversee implementation of management	Reduced energy use Reduced agro-chemical use Reduced labor for fertilizer applications Reduced labor through fewer applications Increased crop yields		✓		

WATER QUALITY MANAGEMENT PRACTICES WITH POTENTIAL TO INCREASE COSTS TO DISCHARGERS	DETAILS OF IMPLEMENTATION REQUIREMENTS FOR WATER QUALITY MANAGEMENT PRACTICES	BENEFITS WITH POTENTIAL TO DECREASE COSTS TO DISCHARGERS	*Implementation Achieves Management Objectives for:*			
			Irrigation	*Nutrients*	*Erosion*	*Pesticide*
	plan; continually review and update management plan Labor for implementation Direct costs associated with implementation Labor associated with continued maintenance					
Estimate loading of nutrients directly below the root zone	Direst cost for measurement equipment Management time and labor for installation and maintenance Management time for regular checks and pumping for sampling Laboratory analysis of samples Management time evaluate sample and make appropriate system changes Hire consultant to collect samples or proper training for employees to collect samples	Reduced water use Reduced energy use Reduced labor for fertilizer applications Reduced agro-chemical use Reduced labor through fewer irrigations	✓	✓		✓
Trap residual fertilizers (and nutrients) in the root zone, between crop rotations	Soil testing and measurements Management time to analyze results and make appropriate fertilizer application changes Installation of leaching reduction (nutrient trapping) control practices	Reduced fertilizer use Reduced energy use Reduced water use and costs for leaching fertilizer to root zone	✓	✓	✓	✓

Table 3: Example Types of Management Practice Implementation Costs

PLANNING AND ASSESSMENT COSTS	ON-THE-GROUND COSTS	COST OF TECH ASSISTANCE
SEDIMENT / EROSION CONTROL / STORMWATER MANAGEMENT		
Prepare Stormwater Management Plan Measure runoff from field Implement smart irrigation scheduling Install and monitor weather station	Construct stormwater storage facility Construct sediment basin Residue and tillage management Re-grade to alter drainage Plant cover crop, filter strips, field borders, grassed waterways, etc. Apply polyacrylamides (PAM)	Consulting fees for technical assistance to implement Stormwater Mgmt. Plan
IRRIGATION MANAGEMENT		
Install and monitor weather station Conduct irrigation system evaluation on a drip, sprinkler, and/or furrow irrigation system Measure soil moisture content Implement smart irrigation scheduling Install flow meter on a pipeline Measure runoff from a field	Convert to drip irrigation from either sprinkler or furrow irrigation, Install dual drip and sprinkler system for frost control Repair and/or replace sprinkler system Install filter station for drip irrigation system Install time clock for irrigation pump Install automatic equipment such as a shut-off switch, backflow prevention device (when chemigation is used) Construct furrow irrigation tailwater recovery/recycling system, including storage facilities Construct water holding structure Construct underground detention / retention unit for tailwater recovery/recycling system	Retain irrigation scheduling service that provides growers with written reports of soil and crop status information throughout the growing season, as well as a seasons end agronomic report
NUTRIENT AND SALT MANAGEMENT		
Prepare Nutrient Management Plan Measure soil moisture content Measure runoff from a field Install and monitor weather station Install shallow groundwater monitoring well Do laboratory well water analysis Do laboratory soil analysis	Install automatic equipment such as a shut-off switch, backflow prevention device Time for a manager and an irrigator to improve the irrigation efficiency and water management (including research, education, and information gathering) Install time clock for irrigation pump to improve irrigation scheduling The cost of additional PVC pipe runs Install or improve sprinkler irrigation system Nutrient trapping Effective cover crops	Consulting fees for technical assistance to implement a nutrient management plan
PESTICIDE RUNOFF / TOXICITY ELIMINATION		
Conduct smart irrigation scheduling Install and monitor weather station Install flow meter on pipeline Do laboratory well water analysis Do laboratory soil analysis	Purchase and install wellhead protection block Install automatic equipment such as a shut-off switch, backflow prevention device Install dual drip and sprinkler system Establish windbreaks/shelterbelts to reduce pesticide drift Apply polyacrylamides (PAM) Construct furrow irrigation tailwater recovery/recycling system Construct underground detention/retention unit for a tailwater recovery/recycling system	The cost of technical assistance to implement an Integrated Pest Management Plan (IPM)
AQUATIC HABITAT PROTECTION		
Prepare Water Quality Buffer Plan	Erosion Control Modify drainage infrastructure Plant riparian vegetation Install irrigation Monitoring and maintenance (for several years to ensure success) Stream bank and channel re-contouring Weed (invasive vegetation) management	Consulting fees for technical assistance to implement a nutrient management plan

2.2.2.4 Unit Costs for Management Practices

This Technical Memo presents unit cost information for the common management practices available to dischargers to achieve compliance with the Draft Ag Order. Staff reviewed information from the United States Department of Agriculture Natural

Resources Conservation Service, the University of California Cooperative Extension (UCCE), and obtained cost quotes from numerous agricultural technical consultants and growers.

2.2.2.4.1 UCCE Conservation Practices

UCCE prepared estimates of costs and potential benefits for a selection of common conservation practices employed in the Central Coast Region. UCCE estimated low, representative, and high costs for the installation and maintenance of the conservation practices. UCCE emphasizes that farmers, ranchers and landowners should evaluate each conservation practice for potential benefits and drawbacks with respect to their own operation.[2] Furthermore, UCCE states their assumptions in preparing the estimates. For example, UCCE did not include in the analysis land ownership and rental rates, which are specific to each operation. Also, the estimates reflect current prices as of 2003, when the studies were prepared.

Table 4 presents a summary of UCCE's cost estimates for nine conservation practices. The complete UCCE studies detail specific actions required to implement each practice and break out costs by machine and non-machine labor, material costs, and annual operation and maintenance costs for up to five years of implementation.

Costs and reduced returns refer to direct costs for practice installation, operation and maintenance, and any negative impact on returns. Two practices, non-engineered water/sediment control basins, and underground outlets, include reduced returns of up to $1,125 from the removal of 0.1 acre of strawberry from production. The representative net change in income for these two practices however, is the greatest of all the practices studied: non-engineered water/sediment control basins *decrease* income by -$1,367/unit/year while underground outlets *increase* income by $1,332/unit/year, over the longer term (four to five years), according to UCCE. These positive and negative effects of implementing conservation practices illustrate how a reduction in returns does not necessarily translate into a reduction in income.

As expected, most conservation practices UCCE evaluated result in a negative effect on income that may be reduced after the initial year of implementation. For example, critical area planting may cost $903/acre in the first year of implementation, but in years 2 – 4, that cost could go down to $121/acre/year.

[2] University of California Cooperative Extension, 2003. Estimated Costs and Potential Benefits for [Nine Conservation Practices] http://www.awqa.org/pubs/coststudies.html

Table 4: Cost Estimates and Potential Benefits for Nine Conservation Practices

CONSERVATION PRACTICE	COSTS PER UNIT		
	Low	**Representative**	High
Annually Planted Cover Crop			
Costs & Reduced Returns	$48	$147	$163
Additional Returns & Reduced Cost	$0	$28	$110
Net Change in Income Per Acre	*-$48*	***-$119***	*-$53*
Annually Planted Grassed Filter Strip (0.5 ac)			
Costs & Reduced Returns	$26	$234	$580
Additional Returns & Reduced Cost	$0	$165	$220
Net Change in Income Per Unit Per Year	*-$26*	***-$69***	*-$360*
Grassed Farm Roads (5,800 Linear Feet/20 ac of Cropland)			
Costs & Reduced Returns	$137	$310	$503
Additional Returns & Reduced Cost	$0	$650	$1,950
Net Change in Income Per Unit (5,800 Linear Ft.) Per Year	*-$137*	***$340***	*$1,447*
Non-Engineered Grassed Waterways (1,000 Linear Ft.)			
Costs & Reduced Returns Per Unit Year 1	$28	$980	$2,250
Costs & Reduced Returns Per Unit Per Year - Years 2-5	$27	$329	$767
Additional Returns & Reduced Cost Per Unit Year 1	$0	$275	$660
Additional Returns & Reduced Cost Per Unit Per Year -Years 2-5	$0	$275	$660
Net Change in Income Per Unit Year 1	*-$28*	***-$705***	*-$1,590*
Net Change in Income Per Unit Per Year - Years 2-4	*-$27*	***-$54***	*-$107*
Non-Engineered Water/Sediment Control Basin (237 Cubic Yards)			
Costs & Reduced Returns Per Unit Year 1	$1,698	$4,061	$7,002
Costs & Reduced Returns Per Unit Per Year - Years 2-5	$354	$2,017	$3,751
Additional Returns & Reduced Cost Per Unit Per Year	$0	$650	$1,950
Net Change in Income Per Unit Year 1	*-$1,698*	***-$3,411***	*-$5,052*
Net Change in Income Per Unit Per Year - Years 2-4	*-$354*	***-$1,367***	*-$1,801*
On-Farm Row Arrangement (25 Acre Parcel)			
Costs & Reduced Returns Per Unit Per Year**	$474	$920	$1,849
Additional Returns & Reduced Cost Per Unit Per Year	$0	$3,500	$7,000
Net Change in Income Per Unit Per Year	*-$474*	***$2,580***	*$5,151*
Net Change in Income Per Acre Per Year	*-$19*	***$103***	*$206*
** First year costs are $125 higher than subsequent years to account for costs to purchase measuring devices			
Perennial Critical Area Planting (Acre)			
Costs & Reduced Returns Per Unit - Year 1	$394	$903	$1,780
Costs & Reduced Returns Per Unit Per Year - Years 2 - 5	$50	$121	$241
Additional Returns & Reduced Costs Per Unit Per Year - Years 1-5	$0	$0	$0
Net Change in Income Per Acre Year 1	*-$394*	***-$903***	*-$1,780*
Net Change in Income Per Acre Per Year - Years 2-5	*-$50*	***-$121***	*-$241*
Perennial Hedgerow Planting (1,000 Linear Ft. X 8 Ft.)			
Costs & Reduced Returns Per Unit Year 1	$1,276	$2,918	$3,938
Costs & Reduced Returns Per Unit Per Year - Years 2-5	$280	$515	$739
Additional Returns & Reduced Cost Per Unit Per Year	$0	$0	$0
Net Change in Income Per Unit (1,000 LF) Year 1	*-$1,276*	***-$2,918***	*-$3,938*
Net Change in Income Per Unit Per Year - Years 2-5	*-$280*	***-$515***	*-$739*
Underground Outlet (400 Linear Ft.)			
Costs & Reduced Returns Per Unit Year 1	$4,630	$5,918	$6,834
Costs & Reduced Returns Per Unit Per Year - Years 2-5	$91	$726	$1,362
Additional Returns & Reduced Cost Per Unit Per Year	$0	$2,058	$4,062
Net Change in Income Per Unit Year 1	*-$4,630*	***-$3,860***	*-$2,772*
Net Change in Income Per Unit Per Year - Years 2-5	*-$91*	***$1,332***	*$2,700*

2.2.2.4.2 Sample Per-Unit Costs from NRCS and Other Sources

The detailed analysis of potential costs and benefits of practice implementation developed by UCCE covers soil conservation practices principally supporting sediment/erosion control and stormwater management objectives. A variety of management practices are available to address other management objectives identified in the Draft Ag Order, including: irrigation management, nutrient and salt management, pesticide runoff/toxicity elimination, and aquatic habitat protection. A broad sample of the per-unit costs associated with these practices is presented in Table 5.

The UCCE cost studies illustrate the variable effect of practice implementation on the bottom line of farming operations. As the UCCE cost studies show, and as Table 2 describes, most practices do yield benefits that improve overall conditions for farming operations, potentially reducing, and in some cases completely covering, the direct cost of implementation. The cost information presented in Table 5, by contrast, simply identifies per unit costs and includes no estimate of potential effects on returns, be they positive or negative.

The practices described in Table 5 range from planning and assessment actions to on-the-ground changes to field operations, including, for example, purchasing or replacing new equipment, constructing new facilities, and managing edge-of-field vegetation for habitat protection. The highest per-unit costs are associated with facility construction. For example, stormwater basins, tailwater recovery facilities, and monitoring wells can exceed several thousand dollars per facility. Habitat restoration and revegetation costs are substantial as well on a per-acre basis, including stream habitat improvement and management costs of approximately $10,000/acre, according to NRCS.

Irrigation management includes several costly practices (in excess of $3,000 per unit). The costs to improve irrigation efficiency may include assessment activities, equipment upgrades, and storage facility construction that represent significant investments for growers. Investments in irrigation efficiency however, may have the greatest potential of all the management practices to generate a stream of benefits that over time are likely to decrease costs for water and energy use. Most critically, irrigation efficiency improvements that result in the elimination of tailwater runoff from the operation allow the grower to avoid the costs of monitoring and treating tailwater discharges.

Table 5: Sample Per-Unit Costs of Management Practices Benefiting Water Quality

MANAGEMENT PRACTICE	DESCRIPTION	UNIT	UNIT COST*	COST RANGE		SOURCE
				Low	High	
SEDIMENT/EROSION CONTROL/STORMWATER MANAGEMENT						
Conservation Cover	Orchard/Vineyard Floor Cover	Acre		$429.91	$690.18	1
	Erosion Control, Water Quality, Wildlife	Acre		$569.71	$1,255.34	1
	Permanent Native Cover; Prep, Seed/Seeding, Weed Control	Acre		$1,252.76	$1,445.26	1
	Perm Native Cover Arid Lands; Prep, Seed/Seeding, Weed Control	Acre		$1,271.81	$1,736.81	1
Conservation Crop Rotation	Rotation for IPM/Organic/SCI/Erosion	Acre	$394.36			1
Cover Crop	Cover Crop	Acre		$159.14	$249.14	1
Cover Crop for Roads	Seasonal Road Cover, Non-Irrigated	Acre	$96.06			1
Residue and Tillage Management	Residue Management	Acre		$50.88	$61.14	1
Sediment Basin	Embankment Sediment Basin <1,200 CYD	No.	$8,190.00			1
	Embankment Sediment Basin	CYD	$3.15			2
Well Decommissioning	1,000-foot deep, 6-inch diameter	Foot	$3.75			1
	30-foot deep, 48-inch diameter	Foot	$140.65			1
Field Border	Seedbed Preparation, Seed	Acre		$392.46	$969.18	1
Filter Strip	Seedbed Prep, Seeding	Acre		$461.68	$1,015.30	1
Grassed Waterway	Grassed Waterway	Acre		$811.88	$1,246.58	1
Underground Outlet	4" diameter	Foot		$5.95	$19.82	1
	12" diameter	Foot		$19.82	$49.52	1
Polyacrylamides Erosion Control	Furrow erosion control	Acre	$50.00			1
Mulching	Soil Fertility, Moisture, Weed & Erosion Control	Acre		$314.05	$807.50	1
	Soil Cover - Moisture, Weed, Erosion Control	Acre				1
Stormwater Management Plan	Stormwater Management Plan for typical scale operation	-		$3,000.00	$1M	3
Greenhouse Covering	Permanent covering construction costs	Sq. Ft.		$6.00	$12.00	24
IRRIGATION MANAGEMENT						
Irrigation System, Microirrigation	Row-Field Cropland	Acre		$990.00	$1,500.00	1
	Nursery or Greenhouse	Acre	$3,000.00			1
	Orchard/vineyard <10 ac and >10ac	Acre		$1,400.00	$2,000.00	1
	Micro Irrigation on Hillside	Acre	$1,500.00			1
	Upgrade media filter tank	Each	$4,500.00			1
	Upgrade media filter station	Each	$15,000.00			1
	Upgrade screen or disk filter unit	Each	$1,800.00			1
	Upgrade screen or disk filter station	Each	$7,000.00			1
Drip irrigation	Materials and installation (w/filter station) new system in vineyard	Acre	$2,353.00			4
	New wellhead protection block	Each	$8,000.00			5

MANAGEMENT PRACTICE	DESCRIPTION	UNIT	UNIT COST*	COST RANGE		SOURCE
Row Arrangement	Row Arrangement Moderate to Steep Slope	Acre		$100.00	$150.00	1
Water and Sediment Control Basin	Embankment, <1,200 CYD	Each	$8,190.00			1
	Earthen Reservoir	Acre-Ft	$1,020.00			1
Irrigation Regulating Reservoir	Tank, <15K gal	Gal	$1.00			1
Pond Sealing or Lining, Soil Cement	Pond Sealing, Soil Cement	SqFt	$0.72			1
Roof Runoff Structure	Rain Gutters & Downspouts	Foot	$11.64			1
Water Harvesting Catchment	Storage Tank	Each		$2,500.00	$3,500.00	1
	Catchment	Each	$1,500.00			1
Runoff Management System	Runoff Management System	Each	$10,000.00			1
Tailwater Recovery System	Installed in: Crop/Pasture	Acre		$153.00	$306.00	1
	Installed in: Nursery	Acre		$1,632.00	$2,550.00	1
	Excavated pond/basin/catchment	CYD	$1.58			2
	Embankment pond/basin/catchment	CYD	$3.15			2
	Underground detention/retention unit	CuFt	$6.00			6
Irrigation Efficiency Measurement	Equipment to measure applied irrigation water	Each		$800.00	$1,200.00	7
	Equipment Installation	Each	$500.00			7
	Mobile Irrigation Lab: measure Distribution Uniformity (furrow length)	1/4 Mile		$950.00	$1,100.00	8
		1/2 Mile		$1,250.00	$1,450.00	8
	Equipment to measure runoff from a field: flume with a stilling well and pressure transducer	Each		$2,200.00	$2,600.00	7
Consulting Costs for Irrigation Management Plan Implementation	Irrigation Scheduling Service: monitor soil moisture 1/wk; recommend irrigation timing; reports, yield analysis; 2 visits/week	Acre		$20.00	$45.00	8
	Single irrigation scheduling visit	Acre	$3.50			8
NUTRIENT AND SALT MANAGEMENT						
Nutrient Management	Implemented for Seasonally Planted Crops	Acre	$55.00			1
	Implemented for Tree and Vine Crops	Acre	$56.00			1
Irrigation/Chemigation System Improvements	Backflow Prevention Check Valves	Each		$95.00	$435.00	9
	Chemigation Check Valves	Each		$597.00	$1,097.00	9
	Ancillary Equipment: smaller check valves, switches, controllers	Each		$21.00	$134.00	9
	Chemical injection pump	Each	$1,022.00			9
Vegetated Treatment Area	Vegetated Treatment Area	Acre	$404.00			1
Fertilizer Additives to Increase Nitrogen Utilization by Crop	Additive (urease inhibitor) to nitrogen-based fertilizers	Per pound of Fertilizer		4.5 cents	6 cents	10
Equipment to Measure Soil Moisture, Crop Water Demand, Evapotranspiration	Tensiometer	Each		$70.00	$120.00	11
	Atmometer equipped with a data logger. ETgage Model E	Each	$608.00			13
	ETGage Model A	Each	$192.00			13
Quantifying Nutrients in	Groundwater Monitoring Well (shallow, 40-ft)	Each	$6,000.00			14

MANAGEMENT PRACTICE	DESCRIPTION	UNIT	UNIT COST*	COST RANGE		SOURCE
Groundwater	Laboratory analyses of water sample	Each	$55.00			15
	Laboratory analyses of soil sample	Each		$40.00	$60.00	15
Equipment Rental to Measure Soil Moisture and Service to determine actual Crop Water Demand	4 tensiometers and central communication unit	Acre/Yr	$152.00			12
Consulting Costs Associated with Nutrient Management Plan Implementation	Crop logging service (tissue sampling prior to each side dress and irrigation, record keeping of pertinent agronomic information such as varieties, irrigations, fertilizer applications, and yield; season end agronomic report with cost, and yield analysis)	Acre/Yr		$11.10	$19.47	8
	Field sampling and consulting fee: Sampling, GPS, Report	Day	$766.00			8
		Acre	$20.00			8
	Certified Crop Advisor	Hour		$120.00	$240.00	18
PESTICIDE RUNOFF/TOXICITY ELIMINATION						
Pest Management	Year-Round IPM Level 1	Acre		$88.00	$160.00	1
	Reduced Risk Level 1	Acre		$45.00	$117.00	1
	Basic IPM consulting; Wine Grapes	Ac/Yr	$22.00			17
	Basic IPM consulting: Pears	Ac/Yr	$40.00			17
	High Cost Organic Pest Management Practices	Acre	$72.00			1
	Pest Suppression during Transition to Organic	Acre	$95.00			1
Precision Pest Control Application	Precision Spray Technology	Acre	$60.00			1
	Fumigant, Sprinklers for crop irrigation and VOC control	Acre	$40.00			1
Consulting Services	IPM and related consultations by: Certified Professional Agronomist, Accredited Farm Manager, Accredited Rural Appraiser, Certified Professional Soil Scientist	Hour		$110.00	$250.00	18
		Acre		$5.00	$20.00	19
Windbreak/Shelterbelt Establishment	Direct costs to implement practices to reduce drift	Foot	$1.76			20
Tailwater Recovery/Recycling System	Waste Utilization	Acre		$9.00	$10.00	20
	Storage Facility	Each		$13,000.00	$18,000.00	20
	Water Structure	Each		$1,000.00	$1,200.00	20
Products to Treat Water to Reduce Pesticide Content	PAM total cost per acre; includes product, labor, other	Acre	$25.70			22
	PAM: Liquid; 2 to 3 applications/year to wine grapes	Ac/Yr		$54.00	$81.00	23
AQUATIC HABITAT PROTECTION						
Critical Area Planting	From seed to establishment	Acre		$1,043.56	$4,673.70	1
Channel Bank Vegetation	Native Tree & Shrub Establishment	Acre	$3,324.28			1
Stream Habitat Improvement and Management	Stream Improvement	Acre	$10,027.20			1
Channel Stabilization	Bioengineered Stabilization	Foot	$50.00			1
Riparian Herbaceous Cover	Native Seed, Drilled	Acre	$1,085.86			1

MANAGEMENT PRACTICE	DESCRIPTION	UNIT	UNIT COST*	COST RANGE		SOURCE
	Native Species, Plugs	Acre	$4,392.40			1
Riparian Forest Buffer	Establishment	Acre		$640.05	$2,282.25	1
Hedgerow Planting	Hedgerow Planting	Foot		$2.25	$4.07	1
Restoration and Management of Rare and Declining Habitats	Arundo Eradication	Acre		$1,000.00	$4,310.00	1
	Blackberry Eradication	Acre		$1,142.50	$3,770.00	1
	Perennial Pepperwood Eradication	Acre		$79.00	$180.00	1
	Thistle or Other Invasive Eradication	Acre		$84.50	$129.00	1
	Wildlife Structures	Acre		$20.00	$40.00	1
Establishing Upland Wildlife Habitat	Irrigation System, Microirrigation	Acre	$800.00			1
Native Perennial Herbaceous Veg.	Irrigation System, Microirrigation	Acre	$1,678.16			1
Wetland Wildlife Habitat Mgmt.	Various Intensity	Acre	$20.00	$100.00		1
Constructed Wetland	Constructed Wetland	Acre	$4,351.76			1
Wetland Restoration	Wetland Restoration - Shaping & Grading	Acre	$330.76			1
	Wetland Restoration - Planting Only	Acre	$1,282.64			1
	Wetland Restoration - Southern California	Acre	$595.82			1
	Wetland Restoration - Coast	Acre	$2,470.58			1
Wetland Enhancement	Various Intensity	Acre		$55.00	$205.00	1
Tree/Shrub Site Preparation	Hand Site Preparation, Light	Acre	$1,045.00			1
Early Successional Habitat Development/Management	Early Successional Habitat Management	Acre	$25.00			1

* A low to high range is provided where available. The reported unit cost from Natural Resources Conservation Service (NRCS), Environmental Quality Incentives Program (EQIP) source is two times the unit cost provided by NRCS. Costs provided by NRCS are based on EQIP Program's cost basis for financial assistance, which is one-half the cost to implement the practice (personal communication, Roney Gutierrez, NRCS)

SOURCES for Table 5:

1 Natural Resources Conservation Service (NRCS), Environmental Quality Incentives Program 2010 Cost Tables, provided by Roney Gutierrez, NRCS.
2 Beau Schoch - Engineer USDA - NRCS Salinas Service Center
3 Dale Gropp, former Civil Engineer Technician at Cachuma RCD
4 Quote from Pacific Ag Water, Santa Maria
5 Coastal nursery manager re: installation of a new block Sept-Nov 2008
6 Hanes Geo Components, Area Sales Manager
7 USDA Engineer, NRCS Coastal RCD
8 Irrigation consultant and CCA who wishes to remain anonymous
9 Quote from Pacific Ag Water, Santa Maria
10 Regional Manager, Agrotain International
11 Irrometer, Google devices and Ben Meadows; ETgage Company
12 Hortau Simplified Irrigation
13 ETgage.com; ETgage Company rep., Loveland, CO
14 RWQCB, NPS Section 319 proposal for Pinto Lake grant
15 A&L Western laboratories
16 Numerous Certified Crop Advisors quotes for services
17 Devin W. Gordon, AG Unlimited, Ukiah, CA
18 Numerous Pesticide Crop Advisors quotes for services
19 Pesticide Crop Advisor, Yuba City, CA; Devin W. Gordon, AG Unlimited
20 NRCS online EQIP data for Pacific Region: http://www.ers.usda.gov/Data/eqip/
22 Michael Cahn, Irrigation Specialist UC Cooperative Extension, Davis
23 Stillwaters Aviation
24 California Association of Nurseries and Garden Centers, March 30, 2010 letter to staff. http://www.waterboards.ca.gov/centralcoast/water_issues/programs/ag_waivers/docs/ag_order/group_2.pdf

Management practices vary in terms of scope, making it difficult to identify actual costs of practices. For example, a runoff management system ($10,000 each) may include several of the individual tailwater recovery practices listed separately at lower per-unit cost, such as excavated pond/basin/catchments at $1.58/cubic yard excavated. Table 5 is therefore intended to provide as broad a sample as possible from available information, and to illustrate the range of options available for selecting the appropriate suite of practices to achieve specific management objectives. While entries are listed under management practice categories, there is considerable overlap among the categories. For example, tailwater recovery is a management practice supporting both irrigation and pesticide runoff management objectives. For the purposes of complying with the Draft Ag Order, a grower's selection of a particular management practice would be based on the effectiveness and extent of existing practices and water quality issues specific to the operation.

2.2.2.4.3 Management Cost Estimates from the Central Valley Region

Table 6 provides cost figures from the Central Valley Water Board to compare with Table 5 and UCCE expenditures (Table 4) above. The starkly different costs reported for the low and high cost ranges, as well as among the various sources available, point to the level of uncertainty associated with any estimates of actual individual or cumulative cost of management practice implementation.

Table 6: Management Practice Costs for Central Valley Water Board Region

Management Practice	Cost Range	Source of Information*
Nutrient Management	$5–$9/acre-year excludes idle land	Blackman 2010; Fry 2010; Kasapligil 2010; and Rathburn 2010
Irrigation Water Management	$50–$88/acre-year excludes idle land	Fry 2010; IID 2007
Tailwater Recovery System	$89/acre-year	NRCS 2010; IID 2007
Pressurized Irrigation System	$160/acre-year	NRCS 2010; IID 2007
Cover Crop	$48/acre-year	Tourte and Buchanan 2003a, b, c
Buffer Strip-Sediment Trap	$1/acre-year	Tourte and Buchanan 2003a, b, c
Abandoned Well Protection	$250/well/year	Lewis 2010
IID = Imperial Irrigation District, NRCS = Natural Resources Conservation Service, UCCE = University of California Cooperative Extension.		

* Secondary sources cited in CVRWQCB, 2010, p. 2-17.

2.2.2.4.4 Discharger Estimates of Cost

Groups representing dischargers provided cost information to the Water Board in response to the February 1, 2010 release of Preliminary Draft Staff Recommendations for an updated Agricultural Order. The information, presented in letters[3] and public comments at two Public Workshops (May 12 and July 8, 2010), reported on information

[3] Grower-Shipper Association of Central California, March 31, 2010 and May 5, 2010 letters to Central Coast Water Board Chair Jeffrey Young; Central Coast Agricultural Water Quality Coalition April 1, 2010 letter to Jeffrey Young.

collected through various methods including surveys and interviews with grower members, and economic modeling to estimate the economic effects of staff's draft recommendations. The results were gross estimates and indicated a wide range of approximate values for per acre costs of compliance in select crops, and county and regional losses to: business revenues, indirect tax revenue, labor income, and jobs.

The discharger representatives' estimates were based on the February 1, 2010 Preliminary Draft Staff Recommendations, and on assumptions about monitoring requirements, which were not included in those Staff Recommendations. The stated requirements in the February Preliminary Draft Staff Recommendations and any assumptions about their implementation are no longer valid, since staff has modified the Draft Ag Order.

2.2.2.5 Conclusions on Cost of Management Practice Implementation

Most water quality management practices achieve multiple objectives, though they often vary in terms of scope, making it difficult to identify actual costs. Management practices typically result in costs that lessen after the initial year of implementation. Detailed studies of implementation costs illustrate both positive and negative effects and reveal that a reduction in returns does not necessarily translate into similar effects on income. Most practices do yield benefits that improve overall conditions for farming operations, partially reducing the direct cost of implementation.

The highest per-unit costs are associated with management practices that require facility construction. Habitat restoration and revegetation costs can be substantial on a per-acre basis. Investments in irrigation management practices may have the greatest potential to generate a stream of benefits that over time support cost-effective farming operations. Notably, irrigation efficiency improvements that result in the elimination of tailwater runoff from the operation allow the grower to avoid the costs of treating discharges.

For the purposes of complying with the Draft Ag Order, a grower's selection of a particular management practice would be based on the effectiveness and extent of existing practices, and on water quality conditions specific to the operation. However, starkly different costs reported for the low and high cost ranges, as well as among the various sources available, point to the level of uncertainty associated with any estimates of actual individual or cumulative cost of management practice implementation. Furthermore, staff possesses limited information to determine the extent of management practice implementation to date.

Staff therefore applied best professional judgment and conservative assumptions in constructing an estimate of total cost for management practice implementation. Staff estimated costs in five management practice categories using median costs/acre for practices in each category (Table 7). The categories were then summed and total costs for the first year and for all five years of the program were calculated.

In the absence of information about the current extent of management practice implementation, staff made assumptions concerning the number of acres to which dischargers might apply management practices to achieve compliance with the Draft Ag Order. For practices to manage sediment, erosion and stormwater, staff conservatively assumed the basis, or the area potentially requiring management improvements, to be all irrigated farmland. However, staff then used a correction factor of five percent to estimate the number of acres that might be subject to actual management to reduce erosion, sedimentation and stormwater impacts to water quality.

The management practice cost per acre was derived from the broad selection of costs staff compiled and reported in Table 5. Staff calculated the median of all reported values presented in cost per acre, using the high value of the cost range where available to maintain a conservative bias. This cost per acre value was then applied to the acres that might be subject to management practice implementation.

Staff followed this approach for each management practice category, using a different area basis and correction factors based on professional judgment. For example, the basis for irrigation management was assumed to be operations that generate tailwater and staff assumed 50 percent of these acres might be subject to implementation of an irrigation management practice. For nutrient and salt management practices, staff used the total acreage planted in vegetables as a basis, since vegetables have a higher potential to load groundwater with nitrogen. For both pesticide runoff/toxicity elimination and aquatic habitat protection, staff used the number of operations along listed waterbodies as a basis for calculating acres subject to practice implementation. Staff used the median operation size of 20 acres as the multiplier for estimating the acres potentially requiring treatment for pesticide/toxicity elimination.

Costs for the first year of implementation was the basis for calculating costs in subsequent years, which staff assumed would be from 10 to 50 percent of the first year's cost. Staff did not account for the Draft Ag Order's sequencing of compliance milestones (e.g., aquatic habitat management is not required for Years 1-5, but rather by Year 3), and as a result the estimate of costs for the entire five-year program is higher than it would be if staff assumed a phased implementation of practices.

Several other assumptions further contribute to a bias toward higher estimates of total cost. Staff assumed independence among the investments made in each management practice category, discounting the likely effect that an investment in one category, would reduce the need to invest in another. Staff expects this effect would be stronger in some categories than others. For example, investments in irrigation management have a strong potential to provide benefits to nutrient management by reducing nitrogen loading in tailwater and groundwater. Similarly, aquatic habitat protection could reduce the need for expenditures on practices to control sediment and stormwater, and to eliminate pesticide runoff. Without a way to quantify this overlapping of benefits among implementation practices (also described in Table 2), the total estimate likely exaggerates actual expenditures.

Table 7: Estimation of Cost to Implement Management Practices

Management Practice Category	Area Basis (Acres)	Acres/ Operation	Acres	Correction Factor	Acres Practice Applied to:	Cost/Acre [d]	Cost Year 1	% Year 1 Cost in Yrs 2-4	Cost Years 2-4	Cost 5 Years
Sediment / Erosion Control & Stormwater Management	Total irrigated farm acreage[a]	NA	539,284	5%	26,964	$992	$26,748,486	25%	$26,748,486	$53,496,973
Irrigation Management	Operations with tailwater[b]	NA	74,121	50%	37,061	$903	$33,465,632	10%	$13,386,253	$46,851,884
Nutrient & Salt Management	Total Vegetable Crop acreage[c]	NA	444,443	20%	88,889	$56	$4,977,762	25%	$4,977,762	$9,955,523
Pesticide Runoff / Toxicity Elimination	102 Operations on toxicity impaired streams	20	2,040	50%	1,020	$72	$73,440	50%	$146,880	$220,320
Aquatic Habitat Protection	10 Large Operations on temp. & turbidity impaired streams	1,000	10,000	50%	5,000	$1,184	$5,920,000	10%	$2,368,000	$8,288,000
						One Year	**$71,185,320**		**Five Years**	**$118,812,700**
						Per Operation	**$23,728**		**Per Operation**	**$39,604**

[a] State Farmland Mapping Program (FMMP) data consists of farmland classifications that include Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance.

[c] Total Vegetable Crop acreage from County Crop Reports, Table 12. Staff assumed these crops have high potential to discharge nitrogen to groundwater.

[b] Amount of irrigated acreage that has tailwater and is enrolled and active. Source: Central Coast Regional Water Quality Control Board Agricultural Regulatory Program Database, December 2009. While the number of operations is dynamic, staff has not made a broad effort to verify the accuracy of reported irrigated acreage and tailwater acreage. Growers can continually update their irrigated acreage and tailwater acreage to reflect seasonal growing changes. The Water Board officially requested acreage updates in 2007 and 2008.

[d] Median of high end of cost range/acre, or, unit cost/acre, whichever is higher from Table 5.

2.2.3 Cost of Aquatic Habitat Protection Using Buffers

The following discussion of costs associated with Draft Ag Order requirements for aquatic habitat protection is provided to examine whether there is potential for these costs to affect regional and/or county economies. This discussion is presented separate from the previous discussion of aquatic habitat management practices available to individual growers and farm operations (2.2.2 Costs of Implementing Management Practices).

While implementation of a waterbody buffer is an option available to individual growers to achieve habitat management objectives, staff does not know how many growers will select this option. As such, staff estimated potential costs of buffers only for grower operations that are specifically required to implement them in the Draft Ag Order: those operations larger than 1,000 acres, and adjacent to a waterbody listed as impaired for temperature, sediment or turbidity on the Clean Water Act Section 303(d) List of Impaired Waters.

staff recognizes that buffers provide benefits that can be met through other means, but anticipates that buffers could be selected by growers as the most effective means for maintaining the riparian functions such as, stream bank stabilization and erosion control; stream shading and temperature control; chemical and sediment filtration; flood water storage; aquatic life support; and wildlife support. The greatest potential benefit to the grower of implementing a buffer could be the avoided cost of implementing other potentially more expensive water quality management practices to maintain these functions.

To serve as a basis for considering local and regional economic effects from implementing habitat buffers, staff prepared a spatial analysis of potentially affected farmland and made assumptions regarding the productivity and value of those lands. Staff purposely made conservative assumptions in calculating the approximate scale of anticipated effects, and considers the resulting cost estimate to be considerably higher than is reasonably likely to occur.

2.2.3.1 Spatial Analysis to Support Cost Analysis

Staff estimated the amount of irrigated agricultural land that would be removed from production in order to establish 30- and 50-foot wide habitat buffers. Only lands in operations greater than 1,000 acres and adjacent to waterbodies impaired by temperature, sediment or turbidity were included. Staff selected operations over 1,000 acres using the GIS crop maps distributed by the Agriculture Commissioner's Office in each Central Coast county (excluding San Benito and Ventura Counties). These maps are updated every two years within each county. For the identification of impaired waterbodies, staff used a 2008 version of the 2006 Clean Water Act Section 303(d) List of Impaired Waters spatial data file maintained by the Central Coast Ambient Monitoring Program.

Of all operations with 1,000 acres or more, the analysis identified only ten adjacent to waterbodies impaired for temperature, sediment or turbidity (Table 8). For these operations, staff determined the acreage that would be included in 30-ft and 50-ft buffers.

Table 8: Acreage Potentially Affected by Buffers on Waterbodies Impaired by Sediment [a]

County	Grower Operation	Total Acres	Acres in 30-ft buffer	Acres in 50-ft buffer
Monterey	1	4,017	12.54	43.00
	2	2,164	21.60	37.00
	3	1,329	7.70	27.00
	4	3,879	0.20	0.20
	5	1,020	0.06	0.13
	6	10,619	8.95	30.00
	7	1,132	4.80	17.00
	Subtotal	*24,160*	*56*	*154*
San Luis Obispo	1	1,274	8.12	14.00
	Subtotal	*1,274*	*8*	*14*
Santa Barbara	1	7,331	18.52	65.00
	2	1,490	0.10	0.30
	Subtotal	*8,821*	*19*	*65*
	TOTALS	**34,255**	**83**	**234**

[a] Includes only operations > 1,000 acres in size and adjacent to or including waterbodies listed for temperature, sediment or turbidity on the 2006 Clean Water Act Section 303(d) List of Impaired Waterbodies.

2.2.3.1.1 Crop Report Gross Value Analysis

To assess the potential economic effects of establishing buffers, staff calculated an approximate value of current agricultural productivity from farmlands. Staff compiled county crop report information on crop value and acreage to estimate average gross values per acre of crops requiring irrigation (Table 9). The resulting average crop value per acre ranges from $5,739/ac in San Benito County, to $22,047/ac in Santa Cruz County. This broad range reflects the variation in both crop types and crop values grown throughout the Central Coast. The regional average crop value per acre is $9,387/ac.

2.2.3.1.1.1 Potential Loss in Gross Production and Acreage

Based on the estimated acres of farmland included in buffers (Table 8), and average crop value (Table 9), staff estimated potential loss in production that would result from implementing 30- and 50-ft habitat protection buffers (Table 10). A range of approximately $774K to $2.2M of gross value would be lost to riparian buffers region-wide, based on this analysis. This represents approximately 0.24% to 0.68% of total crop value in the operations affected. Lost income to an individual grower, while not known, is a fraction of gross value lost, since the grower avoids costs of farming areas no longer in production.

2.2.3.2 Factors to Consider Relative to Buffer Cost Estimates

There are several factors to consider when reviewing these estimates of economic effects of implementing buffers on irrigated farm operations. However, for larger operations loss of crop productivity in the range of 0.21% – 1.1% could be less than losses to smaller operations implementing buffers, with a larger proportion of the entire operation dedicated to the buffer. The use of buffers could also result in avoided costs for other potentially high cost methods to achieve farm water quality management objectives, including, for example, tailwater treatment and sedimentation control facilities.

As stated above, staff considers these estimates to be higher than the economic effects that may actually occur. This is because of several conservative assumptions made in constructing the analysis, including:

- *Size of Buffer:* The buffer dimension of 50 feet used in the analysis is potentially larger than what is necessary to protect and maintain beneficial uses affected by discharges from irrigated agriculture. Buffers of smaller dimensions would reduce the effect on losses in acreage and productivity.
- *Uniform Implementation:* staff does not anticipate that buffers would be established in all 1,000-acre plus operations adjacent to impaired waterbodies. Staff expects that some growers will pursue alternatives to buffers on portions of riparian-adjacent farmland that provide comparable protection, restoration and maintenance of beneficial uses.
- *Current Productivity of Farmland Adjacent to Waterbodies:* The analysis assumed that all waterbody-adjacent farmland is currently productive at the average rate for the county in which they are located. This is not the case and there can be many reasons for this, including: land in poor agronomic condition; land impacted by geomorphologic factors (e.g., bank failure, channel migration, overbank sediment deposits, floodplain saturation); flood-related crop loss. These conditions are among those taken into consideration when growers establish the limits of cultivation. Consequently, some lands are currently in riparian or semi-riparian conditions by default, while others are uncultivated and/or entirely de-vegetated, serving as food safety setbacks. Either way, the land is not in production, as was assumed in the analysis. Dedicating low or non-productive lands to riparian buffers would have no near-term effect on individual farm or regional agricultural productivity.
- *No Change to Price-Output Equilibrium:* Lower productivity, (i.e., output, supply), even reductions as low as one to two percent, interacts with market demand to influence the price-output equilibrium for agricultural products. As such, the value per unit of output would be expected to increase as the market compensates for reduced supply. While staff made no attempt to model the change in value – and anticipates a relatively minor overall impact – the effect would be to reduce the

estimated loss in productivity, as expressed in the value per acre figures used in the analysis.

Other areas of uncertainty in the analysis may either overstate or understate the estimated effect. These include specific attributes of the data staff relied upon, including the accuracy of county crop reporting, and Staff's aggregation of those data.

A final factor to consider is that implementation of waterbody buffers would not happen immediately and/or simultaneously throughout the region. The more probable phasing of buffer implementation over a period of years would be expected to significantly lessen economic effects as market forces and changes in farming operations play out. On the other hand, the effect would be recurring, or at least continue beyond a single year, in that some riparian lands with agricultural production potential would be permanently removed from production.

Table 9: Estimated Average Gross Value per Acre of Select Crops, by County (2009)[4]

County	Vegetable Crops			Fruit & Nuts			Seed Crops			Total Irrigated Crops		
	Value (Millions)	Acres	Average $/Ac	Value (Millions)	Acres	Average $/Ac	Value (Millions)	Acres	Average $/Ac	Value	Acres	Average $/Ac
Santa Cruz	$47	7,431	$6,322	$317	9,074	$34,925				$364M	16,505	$22,047
San Luis Obispo	$187	31,926	$5,867	$271	46,034	$5,897				$459M	77,960	$5,885
Monterey	$2,632	314,311	$8,373	$1,043	55,095	$18,925	$9	4,995	$1,863	$3.7 B	374,401	$9,839
Santa Barbara	$469	65,775	$7,135	$547	39,963	$13,698	$10	2,199	$4,701	$1.0 B	107,937	$9,515
San Benito	$157	25,000	$6,262	$31	7,641	$4,029				$187M	32,641	$5,739
TOTAL	$3,492	444,443	$7,857	$2,209	157,807	$14,000	$20	7,194	$2,730	$5.7 Billion	609,444	$9,387

Table 10: Calculated Loss in Gross Production Value and Crop Acreage for Habitat Buffers [a]

County	**Avg. Crop Value per Acre***	**Total Operation Acres**	**Total Operation Crop Value**	**Acres and Value Loss to 30' Buffer**			**Acres and Value Loss to 50' Buffer**		
				Acres	Gross Value	% of Total Operation Crop Value*	Acres	Gross Value	% of Total Operation Crop Value*
Monterey	$9,839	24,160	$237,710,240	56	$549,508	0.23%	154	$1,518,453	0.64%
San Luis Obispo	$5,885	1,274	$7,497,490	8	$47,786	0.64%	14	$82,390	1.10%
Santa Barbara	$9,515	8,821	$83,931,815	19	$177,169	0.21%	65	$621,330	0.74%
Total Operation Loss to Buffers		**34,255**	**$329,139,545**	**83**	**$774,464**	**0.24%**	**234**	**$2,222,172**	**0.68%**

[a] For operations 1,000 acres or larger and adjacent to or including waterbodies impaired for temperature, sediment or turbidity (See Table 8).
* Vegetable, Fruit & Nut, and Seed Crops only (see Table 9).

[4] All figures for 2009 with the exception of San Benito County for which staff used 2008 crop reports, since 2009 crop report was unavailable when calculated.

2.2.4 Monitoring Program Costs

Staff price estimates for MRP analytical costs come from several commercial laboratory bids to the Central Coast Ambient Monitoring Program (CCAMP) and Surface Water Ambient Monitoring Program contractor costs. Anywhere from two to four prices per analyte were used to develop average costs. Water quality lab bids included BC Analytical, Creek Environmental Lab (no longer in business), Sequoia Labs, Surface Water Ambient Monitoring Program (SWAMP) and Groundwater Ambient Monitoring and Assessment Program (GAMA). Pyrethroid pesticide analysis costs came from SWAMP and CalTest, a private water quality lab. Bioassessment pricing came from Pacific Ecorisk and SWAMP. Actual prices charged to a cooperative monitoring program or individual may vary from these estimates. Attachment 1 includes monitoring cost information tables supporting the following discussion of receiving water, groundwater, and individual monitoring.

2.2.4.1 Receiving Water Monitoring

The receiving water monitoring program has estimated analytical costs ranging from about \$600,000 to \$785,000, depending on site count. The current cooperative monitoring program requires 50 sites (plus five percent field duplicates). The proposed program requires at least one site on each of 37 impaired waterbodies. The price range reflects this site count spread. The proposed MRP includes the basic trend component of the current program. In addition, it adds several analytes to the basic monitoring suite, water and sediment chemistry in the second year of the program, and two stormwater samples taken at each trend site each winter. It adds quarterly and stormwater monitoring for pathogen indicators. It eliminates follow-up monitoring entirely (which in the original program was 20 percent of total program costs) and reduces benthic invertebrate monitoring down from annually to once per permit term.

In addition to analytical costs, the cooperative receiving water monitoring program must pay sampling costs, administrative costs, and reporting costs. Depending on how the program is structured these can range widely. For example, if sampling costs are charged on a per site basis, at \$500 per site per visit, these costs could range up to \$250,000 per year. However, if program staff conducts the sampling these costs could be significantly lower. The existing Cooperative Monitoring Program (CMP) maintains two full-time staff, which probably cost the program at least an additional \$150,000 per year. Some of the reporting costs are absorbed by staff. Consulting laboratories may charge additional data management and analysis costs. Using the above estimates for consultant site visits costs and staffing costs, the total program costs would range between \$1,000,000 and \$1,185,000 per year (with higher costs for the second year averaged out through all years of the program), or \$5 to \$5.5 million for the five-year program.

Dropping site count from the 50 required by the current program down to one site per listed waterbody reduces receiving water monitoring costs by about 25 percent. As a result, some larger waterbodies like the Salinas River would have poor site coverage for understanding spatial extent of agricultural impacts. Though CCAMP monitoring can help address this, CCAMP watershed rotation monitoring only occurs once every five years.

The new elements of the program (pollutants in water and sediment, additional monthly parameters, Toxicity Identification Evaluations (TIEs)) add approximately $130,000 to $148,000 per year in analytical costs (amortizing once in five year costs over each of the five years of the program). This is assuming 10 TIEs are conducted per year. If no TIEs are conducted, additional monitoring costs are approximately $76,000 to $97,000 per year. These costs are offset by elimination of follow-up monitoring, reduction of benthic invertebrate monitoring to once per permit term, and any site count reductions.

2.2.4.2 Groundwater Monitoring

Tier 1 and Tier 2 analytical cost estimates for groundwater monitoring described in the MRP are approximately $190 per well for the five-year program (with both sampling events in the first year), using cost estimates from the GAMA program. Tier 3 analytical costs are approximately $760 per well for the five-year program (four times in the first year; annually thereafter for a total of eight sampling events). This does not include costs paid to consultants to collect the samples, assess depth to groundwater and deliver the results. Staff estimates these additional costs at approximately $300 per visit. Staff assumes that there are 1,600 dischargers that fall into Tiers 1 and 2 and another 100 that fall into Tier 3. Based on these numbers and a consultant visit fee of $500 (with a discounted rate of $150 for sampling a second well), and assuming one well sampled for Tiers 1 and 2, and two wells sampled for Tier 3, this program element would cost approximately $1,740,000, or $790 for Tier 1 & 2 growers and $4,740 for Tier 3 growers, for the five-year term of the Draft Ag Order.

2.2.4.3 Individual Monitoring

Tier 1 and 2 does not require any surface water quality monitoring. Tier 3 individual monitoring is further subdivided into operations between 1,000 and 5,000 acres, and operations over 5,000 acres. Staff estimates that analytical costs will be approximately $3,150 per site sampled for smaller operations (1,000 to 5,000 acres) and $6,300 for larger operations (>5,000 acres). Most of this cost is from toxicity sampling. In addition, for each site sampled, flow and field parameters are collected, which may cost between $500 and $750 each visit. This brings the annual cost to between $4,100 and $4,600 for smaller Tier 3 operations and between $8,200 and $9,300 for larger operations.

Tier 3 tailwater pond monitoring can be done using United States Environmental Protection Agency approved field methodologies or a commercial laboratory. Commercial laboratory analysis costs are estimated at $180/year (4 irrigation season, 2 wet season samples). If a consultant is required to visit the pond for each of the six sampling events, at $500 - $750/event, that could add $3,000 to $4,500 to annual costs.

Staff estimate that there are approximately 85 dischargers that fall into the 1,000 – 5,000 acre Tier 3 category, and 15 falling into the >5000 category. Total cost of implementing this monitoring element is approximately $500,000 per year, or $2.5 million for the five-year program. This does not include additional costs for tailwater pond monitoring. Staff does not currently have an estimate of how many tailwater ponds would fall into the Tier 3 category.

2.2.4.4 Quality Assurance Project Plan (QAPP)

QAPP development for a large complex project can cost up to $10,000. If templates with all language for basic individual sampling except for some minor details are prepared and made available, costs could be vastly reduced. Staff estimates these documents could be prepared for $750 or less for individual and/or groundwater monitoring, assuming a ready-to-use QAPP template is available for use. This should be a one-time cost for the term of the program.

2.2.4.5 Photo-Monitoring

To serve as a basis for estimating costs of habitat buffer photo-monitoring, staff prepared a spatial analysis to estimate the amount of irrigated agricultural land that exists adjacent to streams. Staff selected all streams included in National Hydrographic Data-Plus data and “clipped” the adjacent 50 feet of land identified in California Department of Conservation, Farmland Mapping and Monitoring Program (FMMP) land use data. The result provides an estimate of the amount of irrigated farmland that occurs within 50 feet of a stream throughout the Central Coast Region.

The FMMP data consists of farmland classifications that include Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance. Prime Farmland and Farmland of Statewide Importance are irrigated lands with good combination of physical and chemical characteristics for the production of agricultural crops. Unique Farmland has lesser quality soils and is usually irrigated, but may include non-irrigated orchards or vineyards as found in some climatic zones in California. Generally for land to be included in these categories it must have been cropped at some time during the four years prior to the mapping date.

Staff excluded Farmland of Local Importance from the analysis, since these are designated by counties and are generally non-irrigated lands. Specific criteria used by the counties to classify these farmlands support their exclusion from the analysis (Table 11).

Table 11: County Farmland Designations Not Included in Buffer Analysis

County	Designation Criteria for Farmland of Local Importance
Monterey	The Board of Supervisors determined that there will be no Farmland of Local Importance for Monterey County.
San Benito	Land cultivated as dry cropland. Usual crops are wheat, barley, oats, safflower, and grain hay. Also, orchards affected by boron.
San Luis Obispo	Farmland of Local Importance: areas of soils that meet all the characteristics of Prime or Statewide, with the exception of irrigation. Local Potential: lands having the potential for farmland, which have Prime or Statewide characteristics and are not cultivated.
Santa Barbara	All dryland farming areas and permanent pasture (if the soils were not eligible for either Prime or Statewide).
Santa Clara	Small orchards and vineyards primarily in the foothill areas. Also land cultivated as dry cropland for grains and hay.
Santa Cruz	Soils used for Christmas tree farms and nurseries, and that do not meet the definition for Prime, Statewide, or Unique.

Source: "Farmland of Local Importance" http://www.conservation.ca.gov/dlrp/fmmp/Documents/Local_definitions_00.pdf

Table 12 presents the results of the spatial analysis to quantify farmland within 50 feet of a stream. Based on this analysis, Monterey County has approximately 877 acres and the entire Region has approximately 2,373 acres of irrigated farmland within 50 feet of a stream. The majority of this land is classified by the FMMP as prime farmland.

Table 12: Estimated Farmland Within 50 feet of a Waterbody

COUNTY	FARMLAND TYPE	Acres within 50-ft of Stream
		Total
Santa Cruz	Prime Farmland	140
	Farmland of Statewide Importance	2
	Unique Farmland	25
		166
San Luis Obispo	Prime Farmland	292
	Farmland of Statewide Importance	57
	Unique Farmland	158
		507
Monterey	Prime Farmland	550
	Farmland of Statewide Importance	92
	Unique Farmland	235
		877
Santa Barbara	Prime Farmland	181
	Farmland of Statewide Importance	40
	Unique Farmland	111
		332
San Benito	Prime Farmland	73
	Farmland of Statewide Importance	37
	Unique Farmland	155
		265

Santa Clara	Prime Farmland	113
	Farmland of Statewide Importance	26
	Unique Farmland	85
		224
San Mateo	Unique Farmland	1
	TOTAL	**2,373**

Within one year of the adoption of the Draft Ag Order or enrollment, Tier 2 and Tier 3 dischargers that have operations that contain or are adjacent to a waterbody impaired for temperature or turbidity must conduct photo monitoring to document the condition of perennial, intermittent or ephemeral streams (wet or dry), riparian or wetland area habitat, and associated management practices implemented to prevent waste discharge and protect water quality. Photo monitoring must be repeated every three years.

Staff estimated that large (greater than 1,000 acres) operations on temperature or turbidity impaired waterbodies had approximately 234 acres within 50 feet of the waterbodies (see analysis of habitat buffer costs). This is close to ten percent of the total acreage of riparian farmland. Absent information on which Tier an operation will be in, staff took the median of the two acreage figures as a conservatively high estimate of the total number of acres subject to the Draft Ag Order requirement that Tier 2 and Tier 3 dischargers in operations on waterbodies impaired for temperature or turbidity must conduct photo monitoring.

Total farm acres within 50 feet of a waterbody	*2,373*
Total farm acres within 50 feet of a waterbody in large operations on temperature and turbidity impaired waterbodies	*234*
MEDIAN	*1,304*

Using the median of 1,304 acres, staff then calculated the linear distance of riparian farmland to be 1,135,460 feet. Assuming one photo point every 600 feet of linear stream buffer length, a total of 1,893 photo points would be established on farm areas subject to this Draft Ag Order requirement.

Based on a median operation size of 20 acres, approximately 65 operations would be affected by this requirement. Each operation could incur approximately $155 in one-time costs for a camera ($140), compass ($10), farm map ($3), and notebook ($2). Assuming a cost of $27 per photo point ($2.00 to copy photos and $25/hour/photopoint), and two photo monitoring events for the 5-year term of the Order, staff estimates the total cost of complying with this monitoring requirement to be approximately $112,280 (Table 13).

Table 13: Cost Calculation for Photo Monitoring Requirement

Acres	Square Feet = (ac) x (43,560 sq ft/ac)	Stream Length = Sq ft/50 ft width	1 Photo Point/600 ft	Per Point Cost ($54)	One-time Cost ($155)	Total
1,304	56,780,460	1,135,609	1,893	$102,205	$10,075	$112,280

2.3 Cost to Water Board for Program Administration

The cost for the Central Coast Water Board to implement the Agricultural Regulatory Program is incurred primarily to pay for employees' time conducting program activities. Staff in the program generally evaluates compliance and progress by reviewing water quality data, evaluating chemical use, inspecting farms and ranches, conducting outreach and taking enforcement actions.

With the current staffing and budget, staff cannot review information from, nor inspect, most of the operations in the region. Staff prioritizes efforts in watersheds and areas with most severe water quality problems, and focuses on individual farms or ranches that are or may be discharging in violation of water quality laws to determine the amount of outreach and enforcement.

With the Draft Ag Order, staff plans to implement at the same level of resources but expects to gain efficiencies in encouraging and tracking progress and responding with enforcement as needed. Staff will be able to prioritize more effectively by relying on both watershed-scale water quality data and refined and increased reporting. The Draft Ag Order requires basic information from all operations that better indicates water quality threats (such as pesticide use and proximity of applications to waterbodies). Additional reporting information will vary for different tiers of operations based on an operation's threat to water quality and proximity to impaired waterbodies. The highest threat tiers must submit the most information and the lowest threat tiers must submit more limited information. Additionally, staff plans to rely on new and enhanced databases to collect and manage data and information so that the increased volume of information and data can be reviewed, organized and analyzed more efficiently. Staff estimates the cost of program implementation based on the annual cost of each staff position and the numbers of staff positions needed to be approximately $882,375 (Table 14).

Table 14: Water Board Staff Annual Cost to Administer Program[5]

Classification	Cost/position	Positions	Total Cost
Environmental Scientist	$123,360	2.5	**$308,400**
Senior Environmental Scientist	$142,080	0.2	**$28,416**
Environmental Program Manager	$163,620	0.4	**$65,449**
Engineering Geologist	$181,920	0.5	**$90,960**
Senior Engineering Geologist	$193,644	0.5	**$96,822**
Supervisory Engineering Geologist	$212,592	0.2	**$42,518**
Water Resource Control Engineer	$180,984	1.0	**$180,984**
Supervisory Water Resource Control Engineer	$212,592	0.2	**$42,518**
Office Technician, Typing	$70,500	0.2	**$14,100**
Office Assistant, Typing	$61,044	0.2	**$12,208**
All Positions:			**$882,375**

[5] Costs include total cost to State for all expenditures (salary, benefits, etc.).

3 EFFECTS OF INCREASED COSTS ON FARM AND REGIONAL ECONOMY

3.1 Introduction

California's agricultural industry is characterized by a variety of economic conditions that have permitted its expansive growth over the last century – most notably continued population growth contributing consumers of produce and the ability to market produce to consumers worldwide. Numerous studies describe the favorable economic conditions for the agricultural sector, while others caution that in the future growers will have to be increasingly flexible, adaptive and innovative to survive as they confront water scarcity, pressures of a globalizing agricultural economy, and less favorable government crop price support policies.[6] Water quality regulations are also among the factors challenging the industry to adapt.

In this Technical Memorandum the costs for dischargers to achieve compliance with the Draft Ag Order are considered in terms of expenses for management practice implementation, monitoring, and reporting. These expenses combine with other factors, such as increased energy costs and the challenges described above, to incrementally increase the discharger's cost of production. Examining the impact of any increase in cost of production on viability of a farming enterprise is challenging. The fact is that changes in costs of production are one of many factors affecting viability and the interaction of these factors is highly dynamic through time.

3.2 Strawberries: An Example of Multiple Factors Affecting Farm Economy

The anticipated effects of increased costs of production resulting from a ban on methyl bromide[7] in strawberry cultivation, illustrate how many of these factors can affect outcomes for growers. Strawberries are a particularly high value crop and are not necessarily representative of agriculture throughout the Central Coast. Nevertheless, the research on strawberries is particularly germane to the Central Coast Region where strawberries contribute a substantial amount (more than $1.4 billion farm gate value in 2009) to the region's overall agricultural productivity. The region also accounts for more than 50 percent of total United State's strawberry production.[8] (California contributes approximately 90 percent of the nation's strawberries.[9]) Research on the potential costs of the ban[10] is presented here because it specifically addresses how several of

[6] Vaux, Henry J. Jr., 1996. "Future trends challenge irrigated agriculture." California Agriculture, Volume 51, Number 1. p. 2.

[7] Methyl bromide is a toxic chemical pesticide that depletes the earth's protective ozone layer but which also serves as a soil-sterilizing agent for farmers. Strawberry farmers are among users fearing significant losses and even farm failures without the continued availability of methyl bromide as a fumigant.

[8] Mark Murai, President, California Strawberry Commission. April 1, 2010-Letter to Water Board Chair Jeffry Young for May 12, 2010 Workshop on Preliminary Draft Ag Order.

[9] Starrs, Paul F., and Peter Goin, 2010. Field Guide to California Agriculture. U.C. Press.

[10] The Montreal Protocol on Substances that Deplete the Ozone Layer has been the most successful international environmental agreement ever reached (Norman, et al, 2005). While methyl bromide is

the factors that influence the viability of producing any agricultural commodity in the Central Coast interact, including: cost of environmental compliance; costs of production; characteristics of price response in the market; and the effects of globalization (as manifested in competition from Mexican growers).

Researchers[11] found that estimates of economic loss attributable to the new regulation banning methyl bromide “incorporate losses from lower yields, lower quality fruit, and higher production costs. The high end of the estimate translates to between 20 and 57% of net returns above operating costs for a typical grower... These estimates are alarming to farmers but they do not account for important market effects that will reduce the burden borne by farmers even without any transitional assistance.”

In regards to the market response to increased costs of production, the researchers observe that, “A cost increase to producers is reflected in an upward (leftward) shift of the long-term supply curve by an amount equal to the cost increase, as farmers require higher prices to produce any given quantity of strawberries. This interacts with market demand to determine a new price-output equilibrium.” The researchers then state that, “demand at every price is increasing, because of income and population growth effects… at a rate estimated at 2.3% annually. [This] effect dominates, suggesting that farmers will not face losses at all but simply a slowing of the rate of increase in the gains that they would have expected in the absence of a cost increase.” The current conditions of stagnating income growth are different from 2005 when this research was completed. Nevertheless, the ban on methyl bromide is not implicated in declines in strawberry production.

Finally, with respect to the pressures of globalization and the potential for a competitive advantage by Mexican strawberry growers, these economists state:

> “In the long term, all else held constant, on the margin some increase in imported berries from Mexico can be expected if U.S. prices rise in response to a possible cost increase as methyl bromide is phased out in the U.S. while use is still allowed in Mexico. However, capacity to produce for export in Mexico would have to grow dramatically at a rate without historical precedent for imports to make a serious dent in the U.S. market even then.”
>
> ”In the last 10 years, Mexican strawberry exports to the U.S. have quadrupled. If they quadruple again in the next 10 years and if the U.S. market does not grow at all…Mexican imports would then be 24% of U.S. consumption. The majority of the market would still be supplied by domestic producers, and given relatively

only one of many substances being phased out under the Protocol, it has so far been the most controversial.

[11] Norman, Catherine S. 2005. *Potential impacts of imposing methyl bromide phaseout on US strawberry growers: a case study of a nomination for a critical use exemption under the Montreal Protocol*. Journal of Environmental Management 75 (2005) 167-176.

> inelastic demand, cost increases to U.S. growers would be passed through to consumers to a significant degree."

More recent information on strawberry market conditions from USDA further illustrates the diversity of influences affecting market conditions and, by extension, the ultimate viability of agricultural enterprises. The USDA Economic Research Service May 2010[12] outlook reports:

> "Strawberry retail prices experienced the biggest decline in April, falling 10 percent to $1.667 per 12-ounce (oz) pint from the April 2009 price. Retailers were faced with an abundance of strawberries as Florida supplies, while slow to recover from the late-January freeze, soared at the tail end of their shipping season and were competing with early-season supplies from California. Last year the same time, Florida supplies were already winding down. In California, wet and cold weather has interrupted production sporadically this spring but seasonal supply increases are occurring. Production is forecast to be down in California this year, likely putting upward pressure on strawberry prices this summer relative to last."

> "A decline in strawberry supplies in the U.S. market this year may be attributed mostly to smaller crops in two of the biggest producing States—California and Florida. The initial forecast from USDA's National Agricultural Statistics Service (NASS) calls for a 7-percent decline in strawberry production in California in 2010 from a year ago, reaching 2.3 billion pounds. A distant second to California, the winter strawberry crop in Florida was forecast down to 144.0 million pounds, declining by 39 percent. Both strawberry harvested acres and the average yield per acre in California are forecast to be reduced compared to last year, driving down production this year. Intermittent rainy weather caused by an El Nino weather pattern disrupted shipments early in the season as field workers had to alternate between picking and stripping the fields. Current projections are for harvested acreage in 2010 to decline 6 percent from 2009, reaching 37,500 acres (fig. 3). NASS also forecast average yields to be down 2 percent this year to 61,500 pounds per acre."

The strawberry example illustrates the relative influence of multiple factors in determining the ultimate economic viability of farming enterprises, and places in context the incremental increased costs of production attributable to environmental compliance. As the USDA outlook report shows, factors such as weather and the timing of production in Florida appear to dominate the near term economic conditions for the fresh market in strawberries.

3.2.1 Price Elasticity

[12] USDA, Economic Research Service, 2010. "Fruit and Tree Nuts Outlook: California's Strawberry and Peach Crops Smaller but Almond Production Up." May 28.

The market for strawberries, like that of most agricultural commodities, is characterized by relatively inelastic demand. One measure of this, *own price elasticity* – a measure that indicates the extent to which consumption is sensitive to price – is calculated as the percentage change in quantity demanded of a good or service divided by the percentage change in its price, other factors remaining unchanged. The higher the price elasticity, the more sensitive consumers are to price changes. Very high price elasticity suggests that when the price of a good goes up, consumers will buy much less of it and when the price goes down, they will buy much more. Very low price elasticity (or, inelasticity) implies just the opposite, that changes in price have little influence on demand. If elasticity is greater than one, demand is said to be elastic; between zero and one demand is inelastic. Realistically, elasticity is best considered in relative terms, since the greater than/less than one boundary is not a bright line, i.e., calculations of elasticity are generally more reliable the farther they are from the number one.

For strawberries, the mean own-price elasticity reported by the United States Department of Agriculture's Economic Research Service is -0.92826.[13] This means that a one percent increase in price would give a 0.92 percent decrease in quantity demanded. Conversely, a one percent decrease in quantity would give a 1.08 percent increase in price. Own price elasticities for lettuce, broccoli, grapes and celery are presented in Table 15. According to these data, among these major regional crops, only grapes and broccoli have relatively elastic demand.

Several factors affect elasticity of demand for a good, including, for example, availability of substitute goods, necessity, and brand loyalty. The primary determinant of agricultural commodity elasticity is likely necessity: the more necessary a good, the lower the elasticity, since consumers will attempt to buy it no matter the price.

[13] USDA Economic Research Service, 2010. Data Sets. "Commodity and Food Elasticities: Demand Elasticities from Literature Results."
http://www.ers.usda.gov/Data/Elasticities/ShowTable.aspx?geo=United%20States&com=Strawberry

Table 15: Own Price Elasticity of Several Crops in the Central Coast Region

Crop	Own Price Elasticity[a]						
							Average
Strawberries	0.449	0.438	2.398	1.957	0.2753		0.92826
Lettuce	0.131	0.0139					0.07245
Bagged Lettuce	[b]						0.56023
Broccoli	1.048	1.043					1.0455
Onion	0.11	0.289	0.1964	0.1832			0.19465
Grapes	1.468	2.092	1.378	1.5	1.168	0.9075	1.41892
Celery	0.2516	0.0501					0.15085
Fruit and Vegetable	0.45	0.06986					0.25993
Vegetables	[b]						0.68613

Source: USDA Economic Research Service
a) Expressed in terms of absolute value.
b) Individual elasticities too numerous to list in table (see source).

3.2.1.1 The Significance of Price Elasticity on Total Revenue

When increases in costs of production are passed on to consumers as higher prices, elasticity is important in determining the affect this will have on total revenues for the commodity producer. Due to the fact that most agricultural commodities are characterized by relatively inelastic demand (<1), the following relationship between price elasticity and total revenue holds: the percentage change in quantity demanded is smaller than the percentage change in price. So, when prices go up, total revenue rises, and vice versa. Where the price elasticity of demand is relatively elastic, the percentage change in quantity demanded is greater than the percentage change in price, so total revenue falls.

The relatively inelastic nature of demand for most agricultural products means that consumers share the costs of production by paying higher prices, and that the effect on total revenue of increased costs of production is substantially attenuated.

3.2.2 Effects of Increased Costs on Regional Economy

To further characterize the potential effects of implementing the 2011 Draft Ag Order on the regional economy, staff evaluated data on Monterey County's agricultural output, employment and income. At $3.7 billion, Monterey County's agricultural production is three times that of Santa Barbara, the county nearest in production; and it is more than all the other Central Coast counties combined (Table 16). Given the County's dominant role in the region with respect to the agricultural sector, and the limitations in obtaining comparable information from the region's other counties, staff presents the Monterey County data to convey the magnitude of potential effects of the Draft Ag Order region-wide.

Table 16: Central Coast Counties Total Agricultural Production from Crop Reports[14]

County	Production
Monterey	$3,683,754,000
Santa Barbara	$1,027,047,467
San Luis Obispo	$458,783,000
Santa Cruz	$363,888,000
Santa Clara	$247,950,400
San Benito	$187,334,000

A 2004 report completed for the County evaluated output, employment, and income in the agricultural sector based on a popular economic model for which the principal input was total agricultural production.[15] The report put agriculture production in the County at about $2.9 billion, and the model estimated total economic impact to be approximately $5.2 billion (Table 17). The total economic impact included the sum of all direct, indirect, and induced economic activity associated with agricultural production. The indirect industry output is the economic value of the supplier relationships needed to support the production sector. The $5.2 billion figure also includes $788 million of induced output from household spending. The report also cites economic studies that indicate the added economic activity associated with food processing doubles the total economic benefit of the agriculture industry cluster in Monterey County to more than $10 billion.

Table 17: Baseline Economic Agricultural Production, Monterey County 2001

Baseline Monterey County Agriculture	Direct	Indirect	Induced	Total
Industry Output	$2,891,741,245	$1,509,444,557	$788,242,109	$5,189,427,933
Labor Income	$657,575,605	$606,230,491	$301,479,428	$1,565,285,535
Employment (jobs)	26,371	30,434	9,579	66,384

Source: Applied Development Economics, 2004. Table 2-7, p. 30.

The 2004 report examined the economic impact of the then proposed County General Plan. Included among the potential impacts of the General Plan was approximately 12,768 acres of agricultural land conversion to non-agricultural uses. The report assessed the degree to which these land conversions would reduce agricultural production in the County, and examined "the extent to which these direct impacts potentially affect other businesses that have existing buyer-supplier relationships with agricultural businesses or rely on household spending from agricultural workers," (p. 43).

The nearly 12,800 acres of farmland projected for conversion in the General Plan comprised about $131 million of crop production, according to the report (p. 46). The resulting economic impact would total approximately $232 million, or less than five

[14] All figures for 2009 with the exception of San Benito and Santa Clara County for which staff used 2008 crop reports, since 2009 crop report was unavailable.

[15] Applied Development Economics, 2004. "Monterey County General Plan Update: Economic Impact Analysis." February.

percent of total economic activity generated through agriculture (Table 18). Labor income impacts would be around $68 million, and approximately 3,100 jobs would be lost. These impacts would be expected to play out over the 20-year planning horizon of the General Plan.

Table 18: Economic Impact of General Plan Farmland Conversion, Monterey County 2001

Monterey County Agriculture	Baseline	General Plan Agricultural Acreage Reduction Impacts
Industry Output	$5,189,427,933	$231,637,351
Labor Income	$1,565,285,535	$67,655,440
Employment (jobs)	66,384	-3,126

Source: Applied Development Economics, 2004. Table 2-25, p. 46.

Staff finds the County's 2004 report to be valuable in illustrating the indirect effects of economic impacts to agriculture. The report's reliance on economic modeling that integrates multipliers to estimate these impacts is an appropriate and common practice. Given the significance of Monterey's agricultural economy in the Central Coast region overall (Table 16), the report's findings are generally helpful in characterizing impacts to agricultural productivity that could potentially result from implementation of the Draft Ag Order. As the report states:

> "The significance of the impacts of agricultural conversion can vary from one location within Monterey County to another, because different agricultural commodities have different economic value. Although even worst-case estimates of agricultural acreage conversion totals do not generate impacts that would potentially wipe out any of the crop categories…it is still important to examine the impacts that agricultural land conversions will potentially have…because these land conversions do not only affect farm production. A multitude of support services and local-serving businesses depend on spending from not only the agricultural businesses but their employees and their families as well." (pp. 40-41).

4 SOURCES OF FUNDING FOR IMPLEMENTATION

4.1 Summary of Funding Sources

A number of existing or potential funding sources may be available to offset portions of the cost of implementing the Draft Ag Order. These program descriptions were taken from an economic analysis conducted for the Central Valley Regional Water Quality Control Board.[29] Central Coast irrigated agricultural discharges would be subject to the same eligibility criteria and access to these sources of funding. The programs described are illustrative and are not intended to constitute a comprehensive list of funding sources.

4.1.1 Federal Farm Bill

Title II of the 2008 Farm Bill (the Food, Conservation, and Energy Act of 2008, in effect through 2012) authorizes funding for conservation programs such as the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program. Both of these programs provide financial and technical assistance for activities that improve water quality on agricultural lands. For example, the NRCS provides financial and technical assistance to growers to improve water quality.

The assistance is through the Agricultural Water Enhancement Program, an element of the NRCS EQIP. The program is a voluntary conservation initiative in which NRCS develops partnership agreements with eligible growers. Farm bills typically are in place for four to five years. Subsequent farm bills may expand, reduce, eliminate, or replace EQIP. Farm bills or other future legislation may authorize spending for direct grants, loans, or cost-sharing for irrigation practices that improve water quality.

4.1.2 State Water Resources Control Board

The Division of Financial Assistance administers water quality improvement programs for the State Water Board. The programs provide grant and loan funding to reduce non-point-source pollution discharge to surface waters. The Division of Financial Assistance currently administers two programs that improve water quality—the Agricultural Drainage Management Loan Program and the Agricultural Drainage Loan Program. Both of these programs were implemented to address the management of agricultural drainage into surface water. The Agricultural Water Quality Grant Program provides funding to reduce or eliminate the discharge of non-point-source pollution from agricultural lands into surface and groundwater. It is currently funded through bonds authorized by Proposition 84. The State Water Pollution Control State Revolving Fund Program also has funding authorized through Proposition 84. It provides loan funds to a wide variety of point-source and non-point source water quality control activities. The State Water Board also administers Clean Water Act funds that can be used for agricultural water quality improvements.

4.1.3 Safe, Clean, and Reliable Drinking Water Supply Act of 2010

This act was passed by the Legislature as SBX 7-2, and if approved by voters in November of 2010, would provide grant and loan funding for a wide range of water-related activities, including agricultural water quality improvement, watershed protection, and groundwater quality protection. The actual amount and timing of funding availability will depend on its passage, on the issuance of bonds and the release of funds and on the kinds of programs and projects proposed and approved for funding.

4.1.4 Other Funding Programs

Other state and federal funding programs have been available in recent years to address agricultural water quality improvements. Integrated Regional Water Management grants were authorized and funded by Proposition 50 and now by

Proposition 84. These are being administered jointly by the State Water Board and DWR. Proposals can include agricultural water quality improvement projects. The Bureau of Reclamation also can provide assistance and cost-sharing for water conservation projects that help discharges.

4.2 Effect of External Funding on Economic Impacts

The following conclusion from the Central Valley economic study holds for this analysis as well:

> "Funding received from grants, cost-sharing, or low-interest loans would offset some of the local growers' expenditures for compliance and management practice implementation, and likely would reduce the losses in irrigated acreage and value of production described above. Funding that is targeted toward lands, crops, or growers having the greatest potential for losses and economic hardship would be most effective at reducing the impact. Regional economic impacts also would be reduced."

5 COMPREHENSIVE COST CONSIDERATIONS

5.1 Costs of Implementation and Costs of Current Conditions

A comprehensive consideration of costs associated with the Draft Ag Order includes costs of current conditions, without implementation of the Draft Ag Order, and the costs of implementation of the Draft Ag Order. The costs associated with current conditions include, for example, environmental (beneficial use impacts) and public health impacts from contaminated drinking water sources. While these costs may be in part borne by dischargers, they fall principally on the public at-large, with greatest effects felt by the public living in agricultural areas. Though not a formal cost-benefit analysis[16], this Technical Memorandum provides information about costs associated with the Draft Ag Order and identifies sources of financing.

5.2 Full Costs of Agriculture as Currently Practiced

5.2.1 Financial Costs of Production

Environmental regulatory compliance is among the many financial costs borne by growers as primary inputs to production. Other financial costs include: labor, energy, water, equipment, land, agricultural chemicals and seed or nursery stock.

5.2.1.1 Public Sector Funding for Agriculture

[16] A formal cost benefit analysis is not required when issuing waste discharge requirements or a waiver of waste discharge requirements or when complying with CEQA. Benefits to society of agricultural production are nearly immeasurable. However, different forms of agricultural production provide food sources while having different costs and causing different watershed changes.

Federal and State programs supporting conservation practices (e.g., Natural Resources Conservation Service, Environmental Quality Incentives Program (EQIP)), water quality monitoring (Central Coast Water Board funding for cooperative monitoring program), and funding for non-point source pollution control (USEPA CWA Section 319(h)) are examples of agricultural production costs shared by the public sector.

Table 19 presents examples of public funding that supports Central Coast agriculture. These funds contribute to the continued profitability of agriculture by supporting the industry's investments in practices to increase production, while at the same time providing incentive to growers to address environmental impacts, including degraded water quality. In this sense, taxpayers share certain costs of production, including, at times, the costs of environmental protection.

Table 19: Example Public Sector Funding to Agriculture

Funding Type	Amount	Source
Water Board Administered Funding to Agriculture-related Projects, Region-wide	$14.4 Million Total 2005 – 2010	CCRWQCB
Federal EQIP Obligation Amount in Marine Sanctuary Counties	$1.6 - $2.6 Million Per year 2005 – 2009*	USDA[17]

* $18 million in Farm Bill funding was obligated to EQIP contracts in Marine Sanctuary Counties over ten years. Farmers have invested $15 million of their own money in match over the same period.

5.2.1.2 Public Health and Environmental Financial Impacts of Discharges of Waste Associated with Agriculture (Externalities)

Discharges of waste associated with agricultural activities result in impacts on public health and the environment, including impacts related to environmental justice issues. Those impacts result in costs to the public and the environment rather than the discharger of the waste that are not typically considered in evaluating costs.

This Technical Memorandum includes information about some social and environmental costs associated with irrigated agriculture in the Central Coast that staff would expect to be reduced over time with implementation of the Draft Ag Order.

5.2.2 Social Costs of Current Conditions

Costs to the public associated with discharges of waste from irrigated agriculture in the Central Coast Region can be discussed in three broad categories: Public Health, Environmental Health, and Environmental Justice.

5.2.2.1 Public Health

Thousands of people in the agricultural areas of the Central Coast Region rely on public supply wells and shallow private domestic wells with unsafe levels of nitrate and other

[17] Mountjoy, Daniel, USDA, NRCS. Salinas, CA. October 2009 Presentation on 10-Year Anniversary of Agriculture and Rural Lands Program.

waste constituents. Excessive nitrate concentration in drinking water is a significant public health issue resulting in increased health risk to infants and adults. While acute health effects from excessive nitrate levels in drinking water are primarily limited to infants (methemoglobinemia or "blue baby syndrome"), evidence suggests there may also be adverse health effects among adults as a result of long-term ingestion exposure, and in older individuals who have genetically impaired enzyme systems. These effects include: increased risk of non-Hodgkin's lymphoma, diabetes, Parkinson's disease, Alzheimer's disease, endocrine disruption, and cancer of the organs. One recent study identified a role of drinking water and dietary nitrate in risks of thyroid cancer.[18] Generally, families drawing their water supply from farm areas experience the greatest exposure to elevated nitrate concentrations in drinking water.[19]

Nitrate as nitrogen concentrations of 4 mg/L or more in rural drinking-water supplies have been associated with increased risk of non-Hodgkin's lymphoma. [20] Additionally, researchers from the University of Iowa found that up to 20 percent of ingested nitrate is transformed in the body to nitrite, which can then undergo transformation in the stomach, colon, and bladder to form N-nitroso compounds.[21] These compounds are known to cause cancer in a variety of organs in more than 40 animal species, including higher primates.

In addition to nitrate, exposure to other agricultural chemicals is associated with public health risks. For example a recent study in the Salinas Valley identified effects on neurological development in children exposed to organophosphate pesticides.[22]

Staff has not measured the individual or cumulative costs of these public health consequences. The costs range from the direct costs incurred by individuals and their families in lost wages, medical expenses, and pain and suffering, to the collective costs to communities in declining productivity and wealth. Where public sector agencies expend resources to reduce or prevent these costs (e.g., well-head treatment for drinking water supply wells), the costs are alternately described as "Public Health" and "Environmental Health" expenditures. Environmental Health costs are discussed below.

5.2.2.2 Environmental Health

Environmental Health costs are defined here as costs incurred principally by public agencies and service providers for actions to address environmental quality problems. These costs may, but do not necessarily also benefit public health. For example the public health cost of contaminated water is borne by those individuals suffering from health effects and by the public at large. At the same time, the environmental health cost to clean up or prevent the pollution of a water supply falls largely on public

[18] Kilfoy BA, Zhang Y, Park Y, Holford TR, Schatzkin A, Hollenbeck A, Ward MH. 2010. *Dietary nitrate and nitrite and the risk of thyroid cancer in the NIH-AARP diet and health study*. Sept. 7.

[19] R. B. Brinsfield and K. W. Staver, *Addressing groundwater quality in the 1990 farm bill: Nitrate contamination in the Atlantic Coastal Plain*, Journal of Soil and Water Conservation, March 1990, vol 45., no. 2, 285-286.

[20] M.H. Ward, Mark S.D., Cantor K.P., et al., *Drinking Water Nitrate and the Risk of Non-Hodgkin's Lymphoma*, Journal of Epidemiology and Community Health, 1996, Vol. 7, pgs 465-471.

[21] Peter Weyer, *Nitrate in Drinking Water and Human Health*, 2001, http://www.agsafetyandhealthnet.org/Nitrate.PDF

[22] Marks AR, Harley K, Bradman A, Kogut K, Barr DB, Johnson C, et al. 2010. *Organophosphate Pesticide Exposure and Attention in Young Mexican-American Children.* Environmental Health Perspectives.

agencies and private water vendors who must spread these costs broadly among the populations they serve.

This discussion of environmental health costs is limited to those costs associated with addressing groundwater overdraft/seawater intrusion, and treating nitrate contaminated water supplies from groundwater.

The Draft Ag Order does not require any dischargers of irrigated agricultural runoff to implement treatment or to replace drinking water for public or domestic water supplies affected by agricultural pollutants, nor does it establish any conditions or criteria that would trigger these requirements. Therefore, the following costs are not costs to dischargers if the proposed order is adopted. Rather these costs provide examples and estimates of the current and potential future costs to restore groundwater to public health standards, if pollution continues unabated.

The Draft Ag Order does refer to the *existing* authority pursuant to Water Code §13304 for the Central Coast Water Board to require dischargers to provide alternative water supplies or replacement water service, including wellhead treatment, to affected public water suppliers or private domestic well owners. The Draft Ag Order does not add or invoke this authority, nor establish new requirements. Staff does not speculate here on if or how this authority might become a requirement for an individual agricultural discharger complying with the proposed order and therefore, cannot meaningful estimate cost to an individual discharger.

5.2.2.2.1 Cost of Treating Nitrate in Groundwater

Data from public supply wells in the Central Coast region suggest that the municipal beneficial use of groundwater is impaired or threatened by nitrates in several areas of the Central Coast region's groundwater basins. A Department of Water Resources survey of groundwater quality data collected between 1994 and 2000 from 711 public supply wells in the Central Coast found that 17 percent of the wells (121 municipal supply wells) detected a constituent exceeding one or more primary MCL.[23] Nitrate exceeded the MCL (45 mg/L nitrate as nitrate) the most, with approximately nine percent of the wells (64 wells) exceeding the MCL for nitrate. Research shows that nitrate concentrations found in groundwater above 14 mg/L (as nitrate) are likely from anthropogenic activity such as agriculture, so concentrations above 45 mg/L indicate a significant anthropogenic impact.[24] According to the State Water Board's GAMA Geotracker website, recent impacts to public supply wells are greatest in portions of the Salinas Valley (up to 20 percent of wells impacted) and the Santa Maria (approximately 17 percent) groundwater basins. In the Gilroy-Hollister groundwater basin, 11 percent are impacted but the California Department of Health identified more than half of the drinking water supply wells as vulnerable to agricultural related activities.

A study of sources of loading of nitrates and salts to the soil and potentially to groundwater in Santa Cruz and Monterey Counties indicated that irrigated agriculture

[23] Department of Water Resources, 2003. *California's Groundwater Update, Central Coast Hydrologic Region.*
[24] W.M. Alley, 1993. Regional Ground-Water Quality. Van Nostrand Reinhold, New York NY

contributes approximately 78 percent of the loading.[25] Less than 50 percent of applied fertilizer-nitrogen is taken up by the crops and of the approximately 50 percent not taken up, approximately 25 percent is lost to the atmosphere due to ammonia volatilization.[26] Based on these proportions, approximately 38 percent or more of applied fertilizer-nitrogen is leached to groundwater.

Due to elevated concentrations of nitrate in groundwater, many public water supply systems have abandoned wells and established new wells or sources of drinking water, or are required to remove nitrate before delivery to the drinking water consumer, often, at significant cost.

Removing nitrates from groundwater is very expensive. There is significant variability in costs to remove nitrate from groundwater depending on whether the goal is to perform groundwater treatment at the wellhead or to achieve groundwater cleanup on a basin-wide scale. The cost estimates that follow were developed by cost modeling using data from existing pump-and-treat cleanup projects within the region, and present-day nitrate treatment and blending costs for groundwater projects throughout the State.

Current strategies for addressing nitrate in groundwater typically include avoidance (abandoning impacted wells or drilling adjacent deeper wells), groundwater treatment to remove nitrate (i.e., dilution using blending, ion exchange, reverse osmosis, biological de-nitrification, and distillation), or developing additional water supplies (i.e., percolation ponds, surface water pipelines, reservoirs) to dilute nitrate-impacted groundwater resources. The costs associated with these strategies vary depending on various factors including, but not limited to: affected population, area impacted by elevated nitrate concentrations, number of replacement wells needed, capacity and depth of replacement wells, concentration of nitrate to be treated, presence of other constituents in groundwater, distance to alternative low nitrate concentration water source, installation of new infrastructure (e.g., treatment system, conveyance pipeline, etc.), equipment costs, and long-term maintenance and operational expenses.

Private parties and municipalities with elevated nitrate concentrations in the wells they own and operate can incur significant costs to treat or lower nitrate concentrations.[27] Some options include:

- Rely on bottled water: Average costs to buy bottled water for a family of four: $190 per year[25]
- Remove nitrate at sink: Average cost to buy a nitrate removal system (under the sink-type reverse osmosis system): $800 plus $100 per year for maintenance[25]
- Wellhead treatment:

[25] Monterey County Flood Control and Water Conservation District, November 1990. “Report of the Ad Hoc Salinas Valley Nitrate Advisory Committee.” Zidar, Snow, and Mills.

[26] Harter, Thomas, 2009. *Agricultural Impacts on Groundwater Nitrate,* in Southwest Hydrology, July/August.

[27] A.M. Lewandowski, B.R. Montgomery, C.J. Rosen, and J.F. Moncrief, *Groundwater nitrate contamination costs: A survey of private well owners*, Journal of Soil and Water Conservation, May 2008, vol. 63, no. 3, 153-161.

- Average cost to operate an ion exchange system for wellhead treatment on a private well (for a 15 gallons per minute well): $25,000 capital costs plus $37,000/year on operation and maintenance costs.[28]
- Average cost to operate an ion exchange system for wellhead treatment on a municipal supply well (for a 1,000 gpm well): $200,000 plus operating and maintenance costs.

- Replace well:
  - Average cost to install a new replacement shallow private domestic supply well: $7,200.[25]
  - Average cost to install a municipal water supply well (see Table 20).

According to data prepared for the Central Valley Water Board, well replacement costs depend on the geology of the water supply area, well design and depth, well construction, pumping rate and wellhead protection. Table 20 presents a range of well replacement costs. Based on these costs the estimated total costs for well replacement and one year of operation and maintenance range from $76,500 to $1.085 million.[29]

Table 20: Well Replacement Costs

Well Size	**General Cost Assumptions**
10 to 30 gal/min (gpm)	$25,000 to $50,000 ($37,500 average)
30 to 100 gpm	$100,000
1,000 gpm to 2,000 gpm	Can he as high as $1 Million
Items	**Cost Ranges**
Labor per person	$30,000 to $60,000 per year
Power for <100 gpm size	$3,000 to $5,000 (average $4,000)
Administration/fees	$2,000 per year
Analytical Costs – Groundwater	$2,000 per year with no treatment or compliance issues
Maintenance – Groundwater	$1,000 per year if done by operator

Note: Actual costs should be verified by local drilling company
Source: CVRWQCB, 2010, p. 5-4, 5-5.

An example of well replacement costs in the Central Coast Region is provided by the Monterey County community of San Jerardo. At the October 23, 2009 Central Coast

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[28] Stephany Burge and Rolf Halden, *Nitrate and perchlorate Removal from Groundwater by Ion Exchange Pilot Testing and Cost Analysis*, Lawrence Livermore National Laboratory, University of California, Livermore, California, September 8, 1999.

[29] Central Valley Regional Water Quality Control Board (CVRWQCB). July 2010. *Draft Technical Memorandum Concerning the Economic Analysis of the Irrigated Lands Regulatory Program.* Prepared by: Megan Smith, ICF International; with assistance from: Mark Roberson, Ph.D., Stephen Hatchett, Ph.D., CH2MHill, and Thomas Wegge, TCW Economics.

Water Board hearing,[30] the Board approved a resolution requesting $543,826 of Cleanup and Abatement Account funding to assist San Jerardo in financing alternative water supply and interim nitrate treatment. This small rural community (approximately 60 households) located in an agricultural area southeast of Salinas has high levels of nitrate and 1,2,3-Trichloropropane (1,2,3-TCP) in groundwater. The community, whose water system has been under a bottled water order for drinking water since 2001, requested the funds in October 2009 to continue interim treatment of drinking water.[33] Up to that time, Monterey County incurred $615,582 in interim filtration system costs for the San Jerardo water supply, and anticipated an additional $232,400 in expenses through the expected completion date of an approximately $1 million project to permanently replace the water.[31]

When well replacement is not an option, either wellhead treatment (the interim strategy for San Jerardo) or basin wide cleanup (pump and treat) are the typical strategies for reducing nitrate in drinking water supplies. Cleanup strategies rely on source control/removal as the cornerstone component for nearly all groundwater cleanup sites in the Central Coast Region, and the cleanup strategy for nitrate is no different. So, these options are only reasonable if nitrate loading has been addressed through management practices, such as those required in the Draft Ag Order.

To understand the costs associated with nitrate cleanup, staff selected an example involving the cleanup of a perchlorate (a chemical similar to nitrate) plume within the Llagas Subbasin in Santa Clara County.[32] The extent of the perchlorate plume is approximately 10 miles in length and more than two miles in width. The plume also extends through three underlying aquifer zones, to depths greater than 500 feet. To clean up the perchlorate plume to background concentrations, consultants estimate that capital costs to install a hydraulic containment and treatment system (e.g., wells, piping, pumps, treatment system) with reinjection of treated water is approximately $32 million plus operation and maintenance costs estimated to be $11 million per year for at least 20 years. Over a 20-year timeframe, groundwater cleanup for the perchlorate plume described above will cost more than $250 million dollars.

A nitrate plume of similar magnitude would cost significantly more due to the increased cost of nitrate resin compared to perchlorate resin and due to waste disposal costs (nitrate ion exchange resin waste). The perchlorate plume described above is a small fraction of the size of the nitrate plumes found in most of the major groundwater basins throughout the region. Additionally, the nitrate plumes in the Llagas Subbasin and other basins are significantly more concentrated than the perchlorate plume described above. Increased concentration would significantly increase treatment cost regardless of treatment method. The Llagas Subbasin is one of many groundwater basins within the

[30] Central Coast Water Board October 23, 2009 Meeting Agenda: http://www.waterboards.ca.gov/centralcoast/board_info/agendas/2009/oct/item_12/index.shtml

[31] Monterey County Board of Supervisors October 27, 2009 Meeting Agenda http://publicagendas.co.monterey.ca.us/MG75707/AS75733/AS75740/AI84201/DO84202/1.DOC

[32] MACTEC Engineering and Consulting, Inc, *Llagas Subbasin Cleanup Feasibility Study – Revised* Olin/Standard Fusee Site, 425 Tennant Avenue, Morgan Hill, California, December 6, 2006

region that are severely impaired by discharges of nitrate associated with irrigated agriculture.

Given the extent of nitrate pollution in Central Coast groundwater basins, it would cost many times the costs identified for the Llagas perchlorate plume to cleanup nitrate pollution in the region's groundwater.

5.2.2.2.2 Cost of Groundwater Overdraft and Seawater Intrusion

Groundwater overdraft in a basin is a decrease in groundwater storage that results in a significant prolonged period of groundwater level declines. Along the Central Coast, prolonged periods of groundwater level decline are causing seawater intrusion into aquifers that are hydraulically connected to the Pacific Ocean. Overdraft can also cause upward or downward migration of poor-quality groundwater, loss of surface water flows, and land subsidence with corresponding permanent loss of aquifer storage capacity, as well as infrastructure and property damage (settlement damages sewers, other utilities, buildings, etc.).

Agriculture accounts for approximately 80 to 90 percent of groundwater pumping from the Salinas, Pajaro, and Santa Maria groundwater basins. The Gilroy-Hollister, Salinas, and Santa Maria groundwater basins are actively managed to enhance groundwater recharge from streams in order to meet pumping demand, but excessive pumping (primarily related to agriculture) continues to cause seawater intrusion into the Salinas and Pajaro groundwater basins, with increasing portions of the basins unusable for agriculture and municipal supply as a result.

The Salinas Valley Water Project illustrates the scale of costs associated with addressing seawater intrusion. The three major components of the project include, operation and maintenance of Nacimiento and San Antonio Reservoirs; construction of the modification to the spillway at Nacimiento Reservoir; and construction of the Salinas River Diversion Facility (Table 21). The project will reduce seawater intrusion from Monterey Bay into aquifers underlying the Salinas Valley agricultural region by providing a source of water to replace the use of groundwater. The project includes benefits beyond addressing seawater intrusion, groundwater quality and increased recharge, including: flood control, drought protection, and recreation.

The costs for the project are shared by all land owners with land under active use, including: residential, commercial, industrial, institutional, and irrigated agricultural uses. The project's annual assessment to landowners with land under these active uses is expected to range from $3.99 to $23.93 per acre. [33]

[33] Monterey County Water Resources Agency. *Salinas Valley Water Project Cost Advisory Committee Draft Recommended Strategy*, November 2002, p. 9. http://www.mcwra.co.monterey.ca.us/SVWP/draft_final_CAC_summary.pdf

Table 21: Estimated Costs for Salinas Valley Water Project for Assessed Area[33]

Description	Capital Cost	Annual Cost
Operation and Maintenance of Nacimiento and San Antonio Reservoirs	-	$2,390,000
Construction of Modification to Nacimiento Spillway	$7,300,000	$470,000
Construction of Salinas River Diversion Facility	$11,500,000	$750,000
Maintaining Assessment Rolls		$273,000
TOTAL	**$18,800,000**	**$3,883,000**

In addition to the Salinas Valley Water Project, the Castroville Seawater Intrusion Project began construction in 1995 and started delivering recycled water to fields near Castroville in 1998, leading to reduced pumping of groundwater and slowing of the rate of seawater intrusion. More recently, the Watsonville Recycling Project came online. This project provides the Pajaro Valley Water Management (PVWMA) Agency with 4,000 acre-feet of water to distribute to farmers through the PVWMA's Coastal Distribution System. The combined cost of the Pajaro Water Recycling Project and the Coastal Distribution System is $65 million.[34] Grant funding from state and federal sources in the amount of $28 million[35] were requested to off-set the cost to affected landowners.

The PVWMA also constructed the Harkins Slough Project in 2001, to divert and filter wet-weather flows from Harkins Slough, to a recharge basin. The recharged groundwater is then extracted and delivered during the irrigation season for growers through the Coastal Distribution System. Operation of the Harkins Slough project with other supplemental water projects in the basin, help reduce overdraft and slow the rate of seawater intrusion. [36] The project also offers flood control benefits to Watsonville. Excessive sedimentation now prevents the project from functioning as designed and additional public funds are being requested to improve the project's function and improve management of the Watsonville Sloughs wetlands ecosystem.[37]

While these are only examples of projects whose principal purpose is to address the problems caused by groundwater overdraft, they clearly illustrate that overdraft and associated seawater intrusion are significant problems that require expensive public works and capital projects to address. These examples further illustrate that the costs of these large-scale projects are borne not exclusively by the agricultural industry, which has the primary role in causing overdraft in most of our over drafted basins, but also by the public in the form of individual assessments on property, higher prices for delivered water, and state and federal subsidies.

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[34] Eric Anderson, "Water Recycling Project about 95 Percent Complete," Register Pajaronian, October 9, 2008.

[35] Pajaro Valley Water Management Agency, 2010. Web page on Watsonville Area Water Recycling Project: http://www.pvwma.dst.ca.us/project_planning/projects_recycling.shtml

[36] Pajaro Valley Water Management Agency, 2010. Proposition 218 Service Charge Report. March. p. 8.

[37] Regional Water Management Foundation, 2010. *Santa Cruz IRWM Prop 84 Planning Grant Application*, Attachment 3, p. 23.

5.2.2.2.3 Municipal Stormwater Agency Costs

Throughout the Central Coast region, cities and towns have grown alongside a growing agricultural industry resulting in stormwater conveyances that drain both municipal and agricultural lands. Both wet and dry season flows from urban and farm lands commingle in many of these conveyances before discharging to receiving waters. Municipal stormwater discharges are subject to NPDES permits, which require municipalities to address the quality of the discharges from their stormwater drainage facilities to the maximum extent practicable. Where municipal stormwater facilities include non-stormwater tailwater and/or farm stormwater runoff in their discharges, the municipalities are currently under regulatory requirements to implement best management practices to reduce pollutants to the technology-based standard of maximum extent practicable.

Municipal stormwater permits in the Central Coast Region require municipalities to address commingled urban-farm runoff during the current five-year permit cycle. Staff anticipates municipalities will incur costs associated with coordination with growers in and outside of incorporated communities, targeted assessment and monitoring, and capital projects to treat, separate and/or divert flows.

The City of Watsonville incurred such costs when the City constructed a detention system and large trash rack alongside a residential subdivision. The City estimates that approximately 80 percent ($2 million) of the project costs were expended because of agricultural drainage related sedimentation problems caused by a conversion from orchard to strawberry cultivation, upstream, in erosive soils. [38] The City also reports expenditures of approximately $1.4 million to construct cast-in-place culverts and a new pump station at Corralitos Creek to handle additional flow volumes from agricultural areas upstream. [38]

5.2.2.3 Environmental Justice

California statute defines Environmental Justice as "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of all environmental laws, regulations, and policies" (Government Code Section 65040.12).[39] Across the nation, poor and minority communities more often suffer from the impacts of exposure to pollution, poor air and water quality and associated health hazards. The impacts of nitrate contamination on disadvantaged communities may in some communities be considered Environmental Justice impacts.

The costs of drilling a new well or paying for water treatment can be infeasible for small, disadvantaged communities, such as San Jerardo, discussed above, and Chualar, a 900-resident economically disadvantaged community just south of Salinas where nitrate

[38] City of Watsonville Public Works, Robert Ketley.

[39] Consistent with legislative mandates, the State Water Resources Control Boards' Environmental Justice Program includes the goal of integrating Environmental Justice considerations into the development, adoption, implementation and enforcement of Board decisions, regulations and policies.

contamination of the water supply was identified in 1996.[40] The impact is also felt among poor and minority communities in cities such as Salinas, Watsonville, King City and Soledad, where ratepayers pay higher prices for water treatment compared to communities relying on uncontaminated groundwater.

Impacts on Environmental Justice are a social cost of irrigated agriculture as it is practiced under current water quality regulations in the Central Coast Region. While the monetary costs of addressing contaminated drinking water are quantifiable, as described in the Environmental Health examples above, Environmental Justice represents a social value whose loss comes at incalculable costs. Should implementation of the Draft Ag Order result in reduced incidence of drinking water contamination in disadvantaged and minority communities, these social costs would be reduced.

5.2.3 Environmental Cost of Current Conditions

5.2.3.1 Watershed Health

The Draft Ag Order addresses the effects of irrigated agriculture on water quality. Irrigated agriculture has the potential to alter the various processes governing surface water, groundwater, sediment, and aquatic habitat, which play out at the watershed scale. The Draft Ag Order is intended to ensure protection of water quality, beneficial uses, and the biological and physical integrity of watersheds and aquatic habitat.

The costs of failing to provide this protection are manifest in many ways that have been described in detail elsewhere. Where these costs are translated into monetary quantities, such as when dollars are expended to address seawater intrusion caused by over-pumping, or, to reduce flooding impacts exacerbated by loss of flood storage, they can be construed as costs to the public. Where the dollar value of these costs is not known or has not been estimated, they represent agriculture’s unquantified cost to watershed health.

5.2.3.1.1 Land Productivity

The effect of irrigated agriculture on land productivity is difficult to quantify, but information is provided in this Technical Memorandum to be considered when reviewing costs potentially affected by the Draft Ag Order. Declining productivity of agricultural land can eventually lead to an exhausted resource. The long-term productivity and profitability of irrigated agriculture is determined largely by factors such as prices for crops, labor supply, markets, accessibility, and land tenure. But it also depends on practices that maintain and conserve the native land’s characteristics contributing to long-term productivity.

Soil loss, soil salinization, seawater intrusion, land subsidence, and contamination by agricultural chemicals are examples of consequences of unsustainable agricultural practices that can result in potentially lasting negative effects on land productivity.

[40] Monterey County Water Resources Agency, May 2006. *Salinas Valley Integrated Regional Water Management Functionally Equivalent Plan Summary Document Update*. P. 14-3.

Central Coast irrigated agriculture has witnessed some of these effects, most notably seawater intrusion, and the prospect of further declines in productivity exists. Critically, declining productivity from greater intensity of cultivation can result in increased dependence on synthetic nutrients, increasing the risk that applied chemicals will reach surface waters and groundwater in concentrations above protective levels.

5.3 The Triple Bottom Line

The above discussion of financial, social, and environmental costs associated with irrigated agriculture addresses the broad spectrum of effects that could potentially result from implementation of the Draft Ag Order. This framing of the consideration of costs is consistent with what has been termed the "triple bottom line," which attempts to describe the social and environmental impact of an organization's actions to provide a more in-depth evaluation to its economic effects (Presidio Graduate School, 2010).

In considering the costs for the agricultural industry to comply with water quality regulations, the triple bottom line is a useful concept, since these costs are not accurately viewed in isolation from the other social and environmental costs such as those discussed here. The industry's characteristic externalities, which transfer costs to the public-at-large (e.g., groundwater cleanup costs), and the public's share of the cost of production in the form of public subsidies (e.g., federal funding from Environmental Quality Incentives Program) are examples of what is revealed by a more comprehensive analysis of cost.

ATTACHMENT 1:

TABLES SUPPORTING MONITORING COST DISCUSSION

TABLE: RECEIVING WATER MONITORING COST BASIS															
	Laboratory Costs ($)								Receiving Water Monitoring						
	Lab 1	Lab 2	Lab 3	Lab 4	Lab 5	Lab 6	Routine site visit	Test Avg.	No. of Trend	No. of Storm water	No. of Dry Season	QA Sites	No. of Sites	Annual ($)	5-Year Cost ($)
Field Visit (including flow and field measures)							400		12	2			45	252,000	1,260,000
Total Nitrogen		60	60	20				47							
Nitrate+Nitrite		25	30	20				25	12	2		2	45	16,538	82,688
Total Ammonia	35	35	30	20				30	12	2		2	45	19,845	99,225
Orthophos	see NO	25	60	20				35	12	2		2	45	23,153	115,763
Kjehldahl Nitrogen		26	30	30				29	12	2		2	45	18,963	94,815
Total Phosphorus		16	18	20				18	12	2		2	45	11,907	59,535
Total Organic Carbon		12	30	40				27	12	2		2	45	18,081	90,405
Hardness		13	10	20				14	12	2		2	45	9,482	47,408
TDS	35	15	25	12				17	12	2		2	45	11,466	57,330
Color		15	10	15				13							
Chlor a	71	60	75	50				64	12	2		2	45	42,336	211,680
pH		5	5	10				7	12	2		2	45	4,410	22,050
Conductivity		5	5	10				7	12	2		2	45	4,410	22,050
Turbidity		8	5	12				8	12	2		0	45	5,250	26,250
Total and fecal		30	10	30				23	4	2		0	45	6,300	31,500
E. coli		25	10	30				22	4	2		0	45	5,850	29,250
Toxicity															
Ceriodaphnia	750	733	650	375	735			649		2	2	0	45	116,760	583,800
Selenastrum	750	733	650	650	735			704		2	2	0	45	126,660	633,300
Pimephales	775	733	250	375	735			574		2	2	0	45	103,260	516,300
Hyallela in sed		1000			1040			1020			1	0	45	45,900	229,500
Pyrethroid suite		350				395		373			1	0	45		16,763
Organochlorine in sed		130	225	125				160			1	0	45		7,200
Particle size		15	50	75				47			1	0	45		2,100
OP suite	561	175	225	100		190		250		2	2	0	45		45,036
Nitrogen Pesticides (includes atrazine, cyanazine, simazine)		210		190				200		2	2	0	45		36,000
Carbamates (includes diuron, glyphosate, linuron)		160		265				213		2	2	0	45		38,250
Metals															
Boron		5	7	10				7		2	2	0	45		1,320
Cadmium		6	10	30				15		2	2	0	45		2,760
Copper		6	10	30				15		2	2	0	45		2,760
Lead		6	10	30				15		2	2	0	45		2,760
Nickel		6	10	30				15		2	2	0	45		2,760
Molybdenum		6	10	10				9		2	2	0	45		1,560
Selenium		6	10	30				15		2	2	0	45		2,760
Zinc		6	10	30				15		2	2	0	45		2,760
Phenol		40						40		2	2	0	45		7,200
Paraquat dichloride				75				75		2	2	0	45		13,500
Bioassessment	750							750			1		45	33,750	33,750
TIE Water	4250				6000			5125			5			25,625	128,125
TIE Sediment	4250				6000			5125			5			25,625	128,125
Subtotals														**927,570**	**4,688,336**
5-Year Cost															**4,688,336**
Average Annual Cost															**937,667**

TABLE: GROUNDWATER MONITORING COST ESTIMATE										
				Tier 1 and 2			**Tier 3**			
	Cost/visit ($)	**Add'l Well Cost ($)**	**Analysis Cost ($)**	**No. of wells**	**No. of Samples**	**5- yr cost ($)**	**No. of wells**	**Frequency First Year**	**Frequency other 4 years**	**5-year cost ($)**
Field Visit (including depth and field measures)	300	150		1	2	$600	2	4	1	$3,600
Mineral Suite (GAMA)			**95**	1	2	$190	2	4	1	$760
Cost/grower/5 Yr						$790				$4,360
No.of Growers						1,600				100
						$1,264,000				$436,000
TOTAL 5-YR PROGRAM COST ALL TIERS										**$1,700,000**