PUBLICATION 8097 FWQP FACT SHEET 3.4

Management Goals and Management Practices:

Nutrient Management Goals and Management Practices for Cool-Season Vegetables

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This Fact Sheet includes Management Goals and Management Practices for reduction of nutrient pollution in cool-season vegetables. For our purposes, we are defining a *Management Goal* (MG) as the best economically achievable technology or process for limiting the movement of nutrients, particularly nitrogen (N) and phosphorus (P), into ground or surface waters. Management Goals are general (for example, "Base the amount and timing of N fertilizer applied on crop needs").

As used here, a *Management Practice* (MP) is a specific practice to be used in accomplishing a Management Goal (for example, "Use plant tissue analysis to aid in fertilization decisions"). Growers and crop advisors have found these practices suitable for vegetable production in California's coastal region. Management Practices are not requirements and will not necessarily be feasible or necessary for pollution control in every situation. Rather, they are options for managing N and P fertilizers and water efficiently.

The development of a comprehensive farm plan for nutrient management on cool-season vegetable crops involves a series of ten Management Goals:

MG 1. Evaluate current irrigation and fertilization practices and plan improvements in management.

MG 2. Avoid fertilizer material spills during all phases of transport, storage, and application.

MG 3. Base the amount and timing of N fertilizer applications on crop needs and production goals.

MG 4. Place N fertilizer materials where maximum plant uptake will occur.

MG 5. Minimize leaching losses of nitrate during non-crop periods.

MG 6. Operate irrigation systems to minimize deep percolation and N losses.

MG 7. Improve the uniformity of existing furrow irrigation.

MG 8. Improve the uniformity of existing sprinkler irrigation.

MG 9. Improve the uniformity of existing drip irrigation.

MG 10. Evaluate and maintain nutrient management goals and recommended practices.

To implement the Management Practices, you may require specific technical information. Consult your local UCCE Farm Advisor or visit the UC Davis Vegetable Research and Information Center Web site for help with developing these practices.

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Division of Agriculture and Natural Resources
http://anrcatalog.ucdavis.edu

In partnership with
NRCS Natural Resources Conservation Service
http://www.nrcs.usda.gov

Farm Water Quality Planning
A Water Quality and Technical Assistance Program for California Agriculture
http://waterquality.ucanr.org

This FACT SHEET is part of the **Farm Water Quality Planning (FWQP)** series, developed for a short course that provides training for growers of irrigated crops who are interested in implementing water quality protection practices. The short course teaches the basic concepts of watersheds, nonpoint source pollution (NPS), self-assessment techniques, and evaluation techniques. Management goals and practices are presented for a variety of cropping systems.

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MG 1. Evaluate current irrigation and fertilization practices and plan improvements in management

MP 1.1. Determine nitrate and salt contamination of ground water in existing wells; and assess the potential for transport of soluble contaminants such as nitrates and salts downward to the ground water and laterally to surface

MP 1.2. Develop and implement a system for keeping long-term records on each field for water and nutrient/soil amendment inputs, cultural operations, pest problems, land leveling or other improvements, and crop yield and quality. The Farm Water Quality Plan (ANR Pub 9002) gives one method for developing a long-term system.

MP 1.3. Review current cultural practices to develop improved nutrient and water management plans.

MG 2. Avoid fertilizer material spills during all phases of transport, storage, and application

MP 2.1. Have organized training sessions for field personnel.

MP 2.2. When transporting fertilizer, do not overfill trailers or tanks. Cover or cap loads properly and display appropriate placards on vehicles.

MP 2.3. When transferring fertilizer into on-farm storage or into a fertilizer applicator, take care not to allow materials to accumulate on the soil.

MP 2.4. Maintain all fertilizer storage facilities to meet government and industry standards and protect them from the weather.

MP 2.5. Clean up fertilizer spills promptly.

MP 2.6. Shut off fertilizer applicators during turns and use check valves on application equipment.

MP 2.7. Maintain proper calibration of fertilizer application equipment.

MP 2.8. Whenever injecting fertilizer into irrigation water, ensure that there is no backflow into wells or other water sources.

MP 2.9. Distribute rinse water from fertilizer application equipment evenly throughout the field.

MG 3. Base the amount and timing of N and P fertilizer applications on crop needs

MP 3.1. Determine crop nutrient requirements and establish a crop nutrient budget.

MP 3.2. Measure nitrate levels in the irrigation water and adjust N fertilizer rate accordingly.

MP 3.3. Before applying N and P early in the growth cycle, assess the amount of nitrate and phosphorous already present through the use of soil sampling and analysis. For soils with pH > 6.2, the most appropriate soil test is the Olsen (or *bicarbonate*) procedure. The Olsen procedure is acceptable for soils with a lower pH, but some laboratories may recommend a different method.

MP 3.4. Use soil nitrate quick tests or plant tissue sampling to guide your decisions on N fertilization in the middle and late periods of the crop growth cycle.

MP 3.5. Make multiple small applications of N fertilizer.\

MP 3.6. Make efficient P fertilizer applications.

MP 3.6.1. When appropriate, apply injected bands of P fertilizer into the soil. P fertilizer is generally more available to the plants if it is injected in bands than if it is applied as a broadcast application.

MP 3.6.2. Apply P fertilizer as close to the time of planting as possible. The longer P fertilizer is in contact with the soil, the less accessible it is to plants.

MP 3.6. When applying manure before you plant a crop, determine the nutrient content and release rate of the manure and the amount of nitrate already present in the soil. Apply manure at a rate consistent with the crop nutrient requirements.

MP 3.7. When possible, avoid water-running N fertilizer in the furrows. If fertilizer N must be water-run, make sure to maximize the uniformity of the irrigation, inject the fertilizer during the last half of the irrigation set, and manage the tailwater.

MP 3.8. Do not apply fertilizer N or surface broadcast P less than 24 hours in advance of a predicted large storm event.

MG 4. Place N fertilizer materials where maximum plant uptake will occur

MP 4.1. Incorporate N fertilizer into the crop bed by placing fertilizer on the seed row and watering it in, by knifing fertilizer into the bed, or by broadcasting fertilizer and then listing it up into the bed.

MG 5. Minimize leaching losses of nitrate during non-crop periods

MP 5.1. If conditions permit, grow a cover crop rather than leave fields fallow during the rainy season.

MP 5.2. Use only low-N fertilizers (such as $N:P_2O_5:K_2O$ equal to 1:3:3) during bed preparation in the fall. Higher N materials may be appropriate if a crop is to be planted soon.

MG 6. Operate irrigation systems to minimize deep percolation and N and P losses (These practices apply to all system types.)

MP 6.1. Monitor soil moisture between irrigations and use that information to guide your irrigation timing decisions.

MP 6.2. Crop need should determine irrigation amount.

MP 6.3. Know the irrigation system flow rates and the time required to apply the desired inches of water.

MP 6.4. Use the minimum leaching fraction that will prevent stand establishment problems or yield reductions from salinity.

MP 6.5. When fertigating with a drip or sprinkler system, run the fertilizer in the later part of the set so as not to leach nutrients beyond the root zone. Avoid fertigating with furrow systems.

MP 6.6. Follow state regulatory requirements and industry guidelines for backflow prevention when injecting fertilizer into irrigation water (CCR Title 3). Schedule regular maintenance of backflow prevention devices.

MP 6.7. If irrigation uniformity remains low after all practical improvements have been made, consider converting to an irrigation system with a greater potential to improve uniformity in a way that minimizes deep percolation.

MP 6.8. Minimize the amount of tailwater leaving the farm during the irrigation season. Even tailwater from fields with only moderate soil nutrient levels can contain significant quantities of N and P that can lead to algal blooms and associated problems.

MG 7. Improve existing furrow irrigation uniformity

MP 7.1. Convert to surge irrigation.

MP 7.2. Where furrow runs are more than 1000 feet long, consider cutting the furrow run length in half with a corresponding decrease in set time.

MP 7.3. Use high irrigation flow rates initially to get water down the furrow and then cut the flow rates back to finish the irrigation.

MP 7.4. Reduce variations in slope when preparing irrigation furrows.

MP 7.5. Use practices that increase irrigation uniformity between furrows (e.g., by using torpedoes in furrows that don't get wheel traffic or by alternating wheel rows with each tractor pass, you can ensure greater uniformity in water advance time in all furrows).

MP 7.6. Recirculate, rechannel, or reuse surface water runoff.

MP 7.7. Keep records on a field-by-field basis of advance and recession times.

MP 7.8. Utilize the services of a mobile irrigation lab.

MG 8. Improve existing sprinkler irrigation uniformity

MP 8.1. Monitor flows and pressure variations throughout the system to detect non-uniform application.

MP 8.2. Maintain the irrigation system by repairing leaks, replacing malfunctioning sprinklers, monitoring nozzle performance for wear, and maintaining adequate water pressure through the entire set.

MP 8.3. Operate sprinklers during the least windy periods, whenever possible. When sprinkler irrigating under windy conditions, reduce the spacing between laterals when possible to optimize application uniformity.

MP 8.4. Use offset lateral moves on successive irrigations to improve distribution uniformity.

MP 8.5. Use flow-control nozzles when the pressure variation throughout the system is excessive.

MP 8.6. Make set times as short as possible during stand establishment.

MP 8.7. For very large blocks, consider converting to linear-move sprinkler systems.

MP 8.8. Utilize the services of a mobile irrigation lab.

MG 9. Improve existing drip irrigation uniformity

MP 9.1. Monitor flows and pressure variations throughout the system to detect non-uniform application.

MP 9.2. Use lateral hose lengths that ensure uniformity.

MP 9.3. Use drip tape that has a small emitter discharge exponent to reduce flow variations that result from pressure differences.

MP 9.4. Check for the potential for emitter clogging by conducting water analysis and fertilizer/water compatibility tests.

MP 9.5. Use filtration, chemical treatments, and flushing as needed to prevent or correct clogging problems.

MP 9.6. Maintain appropriate water pressure throughout the system.

MP 9.7. Utilize the services of a mobile irrigation lab.

MG 10. Evaluate and maintain nutrient management goals and recommended practices

MP 10.1. Periodically evaluate management goals and recommended practices implemented for nutrient management. Correct deficiencies as needed.

REFERENCE

Pettygrove, G. S., S. R. Grattan, B. R. Hanson, T. K. Hartz, L. E. Jackson, T. R. Lockhart, K. F. Schulbach, and R. Smith. 1998. Production guide: Nitrogen and water management for coastal cool-season vegetables. Oakland: University of California Division of Agriculture and Natural Resources, Publication 21581.

FOR MORE INFORMATION

You'll find detailed information on many aspects of field crop production and resource conservation in these titles and in other publications, slide sets, CD-ROMs, and videos from UC ANR:

Nutrients and Water Quality, slide set 90/104

Protecting Groundwater Quality in Citrus Production, publication 21521

Sediments and Water Quality, slide set 91/102

To order these products, visit our online catalog at http://anrcatalog.ucdavis.edu. You can also place orders by mail, phone, or FAX, or request a printed catalog of publications, slide sets, CD-ROMs, and videos from

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An electronic version of this publication is available on the ANR Communication Services Web site at http://anrcatalog.ucdavis.edu.

Publication 8097

rev-9/05-WJC/CR ISBN 978-1-60107-271-9

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This publication has been anonymously peer reviewed for technical accuracy by University of California scientists and other qualified professionals. This review process was managed by the ANR Associate Editor for Natural Resources.

Site Assessment and Practices Planning–Sediment, cont'd.

	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Vegetation is established along field edges to shield from wind									
Herbaceous Wind Barrier #603									
Windbreak/Shelterbelt #380 & #650									
Irrigations are ended if significant runoff occurs									
Cover crops are used to enhance soil aggregate structure and improve infiltration									
Cover Crop #340									

Site Assessment and Practices Planning–Sediment, cont'd.

I5. Are some areas drip irrigated?
☐ Yes ☐ No

Notes:

Improve Drip Irrigation Uniformity									
	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Drip tape and emitters are used with an application rate that matches system design, soil or substrate type, and crop needs									
The water supply is evaluated for high bicarbonates that can cause clogging									
A filter is selected that filters the mineral and sand particles in the water supply									
Filters are regularly flushed/cleaned									
Lateral lines are flushed regularly									
Lateral lines are periodically chlorinated to prevent bacterial and algal build-up and root intrusion into emitters									
Emitters are regularly checked to ensure they are delivering water to plants									
Leaks on mains and laterals are repaired									
Emitters with shut-off valves to isolate unused containers or benches are used									
Drip tape with a small emitter discharge exponent is used									
Pulse irrigation is used									
A pressure regulator is used for each submain									
Pressures of submains are regularly adjusted									
Pressure compensating emitters are used									
Cover crops are used to enhance soil aggregate structure and improve infiltration									
Cover Crop #340									

Site Assessment and Practices Planning–Sediment, cont'd.

Managing Pesticides

Pesticides that move from their site of application into surface or groundwater can affect the beneficial uses of water through their potential impact on human and animal health, and on non-target organisms. Wind and water erosion of soil, or drift from pesticide applications may contribute to pesticide movement away from the target area. Pesticides may enter surface waters in irrigation return flows and tile drainage either as water-soluble residuals or adsorbed to sediments. Groundwaters in agricultural areas may also be subject to pollution from pesticides when deep percolation from irrigated land carries water-soluble pesticides to the groundwater. Many practices in this section fall under NRCS Conservation Practice Standard Pest Management #595. Consult other sources such as the UC Integrated Pest Management (IPM) Pest Management Guidelines for crop-specific IPM practices and alternatives to pesticide use http://www.ipm.ucdavis.edu.

Pesticide Management Program

P1. Does your pest management program have the potential to impact water quality?
☐ **Yes** ☐ **No**

Notes:

Use IPM to Make Informed Pesticide Management Decisions http://www.imp.ucdavis.edu									
	Used or could be helpful	**Location(s)**	**Year(s) used**						
			2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Prepare Site and Use Plant Materials to Promote Crop Health									
Fields are designed or managed to reduce water related stress									
Bedding #310									
Irrigation Land Leveling #464									
Irrigation Water Management #449									
Container media is selected to reduce water related stress									
Resistant varieties are planted									
Crop rotations are used to break pest population cycles									
Conservation Crop Rotation #328									
Cover crops are used to promote soil health and reduce weeds, insects, and pathogens									
Cover Crops #340									
Non-cropped areas are managed (planted, paved or mulched) to discourage weeds									

Site Assessment and Practices Planning–Sediment, cont'd.

	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Assess Pest Populations									
UC IPM Pest Management Guidelines are consulted for crop-specific assessment techniques http://www.ipm.ucdavis.edu									
Blocks are scouted regularly for early detection of pests and diseases									
"Hot spots" are identified									
Records of pests and beneficial insects are maintained									
Adopt Cultural Practices for Pest Management									
Sanitation - Plant material is certified and inspected for vigor, sanitation is practiced when handling plant material and equipment									
Pest-ridden and diseased plants are removed or rogued out									
Alternate host plants that are non-native and/or not harboring beneficial insects are replaced									
Dust from roads onto fields is reduced by mulching graveling, watering down, or treating with an environmentally safe dust suppressant									
Access Road #560									
Mulching #484									
Mechanical weeding such as mowing, tilling, disking, and hand weeding is used whenever practical									
Physical or environmental controls are used (changing humidity or temperature in greenhouses, switching to drip irrigation in row crops, etc.)									
Pest exclusion is performed in greenhouses									

Site Assessment and Practices Planning–Sediment, cont'd.

	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Adopt Biological Control Practices for Pest Management									
Biological controls are used to control pest populations, where possible									
Populations of beneficial insects are considered when making pesticide selection									
Make Efficient Pest Control Decisions									
UC IPM Pest Management Guidelines are consulted for alternatives to chemical pest control, or for reduced risk pesticide selections. http://www.ipm.ucdavis.edu									
Compatible pesticides such as selective pesticides are used when beneficial insects are present									
Application decisions are based on scouting data, pest thresholds and/or risk assessment models									
Pesticides are selected for lower risk of runoff or leaching based upon site conditions, pesticide label warnings, or transport models www.wcc.nrcs.usda.gov/pestmgt/winpst.html									
"Hot spots" are treated independently									
Pesticides are applied at the lowest effective labeled rate									

Site Assessment and Practices Planning–Sediment, cont'd.

Pesticide Handling

P2. Are pesticides stored on site?
☐ Yes ☐ No

Notes:

P3. Are pesticides mixed and loaded on site?
☐ Yes ☐ No

Notes:

P4. Are pesticides (organic and/or synthetic) applied to crops, including ground applied, foliar applied, and chemigation?
☐ Yes ☐ No

Notes:

Implement Responsible Storage Application and Disposal Practices									
	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Handle Materials Safely									
Pesticide handlers and applicators receive yearly training									
Pesticide label instructions and environmental hazard warnings are followed									
Application equipment and/or injectors are checked and calibrated regularly									
Acreage to be treated and soil types are known									
Pesticides sprayers are turned off when equipment is making turns outside of rows									
Pesticides are not sprayed when winds could move pesticides off-target as 'drift'									
Greenhouse exhaust fans are turned off during applications									
Rain events are considered – pesticides are not applied prior to projected rain events									

Site Assessment and Practices Planning–Sediment, cont'd.

	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Pesticide applications in ditches occur when water quality impacts are minimal and materials are used that are approved for use near aquatic habitat									
Disposal methods are environmentally safe									
Design Facilities Appropriately									
The pesticide storage facility includes a concrete pad and curb to contain spills and leaks									
Production wells are located on elevated, impervious bases and are upslope of pesticide storage and handling facilities									
Wellhead protection consists of an impermeable pad, sump or buffer area of 100' around the wellhead that excludes pesticide handling and pesticide laden drainage									
Containment basins are lined to prevent leaching of pesticides									
Mixing is performed on low runoff hazard sites – over 100 feet downslope of wells on an impermeable surface									
Agrichemical Handling Facility # 702									

Site Assessment and Practices Planning–Sediment, cont'd.

Reducing Pesticide Movement

P5. Do the pesticides applied to your crops have the potential to move offsite adsorbed to sediment, in runoff water and/or by leaching?
☐ Yes ☐ No

Notes:

P6. Are you aware of pesticides in the soil from historic applications?
☐ Yes ☐ No

Notes:

Reduce Pesticide Movement with Water and Eroding Soil									
	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Design Field Layout to Minimize Pesticide Movement									
The field is shaped to planned grades									
Irrigation Land Leveling #464									
Land Smoothing #466									
Rows are placed on slopes, grades, widths, or on the contour to minimize erosion and runoff									
Contour Farming #330									
Contour Orchard and other Fruit Area #331									
Row Arrangement #557									
Manage Field to Reduce Pesticide Movement									
Bare soil in the field has been covered with vegetation to reduce soil erosion, increase infiltration and build soil organic matter									
Conservation Cover #327									
Cover Crop #340									
Vegetative Barrier #601									

Site Assessment and Practices Planning–Sediment, cont'd.

	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Plant residues are retained or other materials are applied to the soil or substrate surface									
Mulching #484									
Residue Management #329									
Deep tillage is performed to fracture restrictive soil layers and increase deep percolation where leaching of pollutants to groundwater is not a significant risk									
Deep Tillage #324									
Irrigations are managed to minimize leaching and runoff									
Irrigation Water Management #449									
Strips of perennial vegetation are placed along rows farmed on the contour									
Contour Buffer Strip #332									
A structure to collect sediment containing pesticides is installed and maintained									
Sediment Basin #350									
Water and Sediment Control Basin #638									
Irrigation System, Tailwater Recovery #447									
Vegetation is established along the downslope field edge to filter sediment containing pesticides									
Conservation Cover #327									
Filter Strip #393									
A vegetated channel is placed downslope of the field									
Grassed Waterway #412									

Site Assessment and Practices Planning–Sediment, cont'd.

Managing Nutrients

Nutrient sources associated with agricultural production practices include fertilizers and other amendments, nutrients in groundwater used in irrigation, biodegradation of crop residues, agricultural and municipal waste applied to land, and waste generated by animals directly. Nutrients from these sources become pollutants when they are transported offsite into nearby streams and lakes or percolate in excessive amounts to groundwater. Nitrates and phosphates in surface water bodies contribute to eutrophication. Eutrophication leads to increases in aquatic plants and algal blooms that deplete dissolved oxygen, impacting aquatic organisms. Nitrate pollution of groundwater is widespread and a serious problem statewide because of impacts to drinking water. Nitrates are water-soluble and have the potential to leach or to run off in surface water. Phosphates attach to soil particles and have the potential to move offsite with eroding soil. In areas with high concentrations of accumulated soil phosphorus, phosphorus can also be carried off as dissolved phosphate in runoff water. Many practices in this section fall under NRCS Conservation Practice Standard Nutrient Management #590.

Nutrient Management Program

N1. Do you apply sources of nitrogen (N) and/or phosphorus (P) (fertilizer, compost, manure)?
☐ Yes ☐ No

Notes:

Make Informed Nutrient Management Decisions									
	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Base Fertilizer Use on Crop Needs									
N and P requirements are determined for each crop									
N and P status of soil amendments or substrate is determined									
Well/irrigation water is monitored for N and P levels									
Pre sidedress nitrogen testing is used where applicable									
Tissue samples are taken for N and P status									
All N and P sources (irrigation water, amendments, crop residue, etc.) are considered in a nutrient budget									
Use a nutrient budget in determining fertilizer applications									

Site Assessment and Practices Planning–Sediment, cont'd.

	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Make Efficient Fertilizer Decisions									
Fertilizer application is timed according to crop requirements									
Fertigation is used									
Split applications are made									
A controlled/slow release fertilizer is used alone or with a liquid feed									
Nitrogen accumulating species are used for cover cropping									
Cover Crop #340									
Irrigations are managed to avoid nutrient loss below the rootzone									
Irrigation Water Management #449									

Site Assessment and Practices Planning–Sediment, cont'd.

Nutrient Handling

N2. Are fertilizers stored and/or mixed on site?
☐ Yes ☐ No

Notes:

N3. Are fertilizers (organic and/or synthetic) applied to crops, including pre-mixing with soil substrates, ground applied, foliar applied, and fertigation?
☐ Yes ☐ No

Notes:

Implement Responsible Storage, Application, and Disposal Practices									
	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Handle Materials Safely									
Application equipment and/or injectors are checked and calibrated regularly									
Precision placement is used to apply fertilizer close to roots									
Fertilizer handlers and applicators receive training									
Rain and irrigation events are considered – Fertilizers are not applied prior to projected rain events or irrigations									
Design Facilities Appropriately									
The fertilizer storage facility includes a concrete pad and curb to contain spills and leaks									
Mixing is performed on low runoff hazard sites – over 100 feet downslope of the well on an impermeable surface									
Agrichemical Handling Facility #702									

Site Assessment and Practices Planning–Sediment, cont'd.

Reducing Nutrient Movement

N4. Does the fertilizer applied to your crops have the potential to move offsite attached to sediment, in runoff water or by leaching?
☐ **Yes** ☐ **No**

Notes:

Reduce Nutrient Movement with Water and Eroding Soil										
	Used or could be helpful	Location(s)	Year(s) used							
			2004	2005	2006	2007	2008	2009	2010
Field Layout										
The field is shaped to planned grades										
Irrigation Land Leveling #464										
Land Smoothing #466										
Rows are placed on slopes, grades, widths or on the contour to minimize erosion and runoff										
Contour Farming #330										
Contour Orchard and other Fruit Area #331										
Row Arrangement #557										
Plants in poorly drained soil are placed on parallel ridges or 'beds'										
Bedding #310										
Manage Field to Reduce Nutrient Movement										
Bare soil in the field has been covered with vegetation to reduce soil erosion, increase infiltration and build soil organic matter										
Conservation Cover #327										
Cover Crop #340										
Vegetative Barrier #601										
Plant residues or other materials are applied to the field soil surface										
Mulching #484										
Residue Management #329										

Site Assessment and Practices Planning–Sediment, cont'd.

	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Deep tillage is performed to fracture restrictive soil layers and increase deep percolation where leaching of pollutants to groundwater is not a significant risk									
Deep Tillage #324									
Irrigations are managed to minimize leaching and runoff									
Irrigation Water Management #449									
Strips of perennial vegetation are placed along rows farmed on the contour									
Contour Buffer Strip #332									
A structure to collect sediment containing nutrients is installed and maintained									
Irrigation System, Tailwater Recovery #447									
Sediment Basin #350									
Water and Sediment Control Basin #638									
Vegetation is established along the downslope field edge to filter sediment containing nutrients									
Conservation Cover #327									
Filter Strip #393									
Vegetation is placed downslope of the field									
Grassed Waterway #412									
Constructed Wetland #656									

Site Assessment and Practices Planning–Sediment, cont'd.

Nutrient Waste

N5. Is there a septic system on the farm or operation?
☐ Yes ☐ No

Notes:

N6. Do livestock have access to a waterbody?
☐ Yes ☐ No

Notes:

N7. Is there a feedlot, loafing area, or concentration of livestock near a waterbody?
☐ Yes ☐ No

Notes:

Reduce Nutrient Pollution from Human and/or Livestock Waste									
	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Septic systems are inspected and maintained									
Portable toilets are regularly maintained to avoid spills									
Livestock are fenced off from waterways									
Fence #382									
Use Exclusion #472									
Livestock are directed away from waterbodies with placement of troughs, salt licks, dusters and/or trails.									
Animal Trails or Walkways #575									
Prescribed Grazing #528									
Watering Facility #614									

Site Assessment and Practices Planning–Sediment, cont'd.

Managing Salinity

Irrigation water is essential for crop production in the arid and semiarid regions of California. Irrigation water naturally contains a certain amount of dissolved minerals (salts) depending on its source. Typical irrigation water contains a substantial amount of salt. For example a water source with an EC of 1.0 mmho/cm, a quality suitable for irrigation of most crops, contains nearly a ton of salt in every ac-foot of water applied. In some coastal areas, increased groundwater pumping has resulted in salt water intrusion from the ocean, threatening the overall groundwater quality. In areas such as the Salinas Basin, surface water quality degradation of ponds and sloughs has resulted from high salt levels in irrigation return flow.

Salinity Management Program

1. Is salt accumulation from irrigation, fertilizer, and/or amendments a potential problem?
☐ **Yes** ☐ **No**

Notes:

Manage Soil Salinity										
	Used or could be helpful	**Location(s)**	**Year(s) used**						
			2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Manage Salinity from Irrigation Water									
The salinity of irrigation water is evaluated									
The distribution uniformity of the irrigation system is improved or maintained									
Appropriate leaching fractions are used									
Fields are graded to improve irrigation uniformity									
Irrigation Land Leveling #464									
Saline wells are decommissioned and alternative water supplies are used									
Well Decommissioning #351									
Manage Salinity from Fertilizers and Amendments									
Fertilizers and amendments that have a low salt index are used									

Site Assessment and Practices Planning–Sediment, cont'd.

	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Manage Saline Soils									
Soil salinity is evaluated									
Gypsum and other calcium containing amendments to reduce the build-up of exchangeable sodium (ESP) are used									
Sulfur amendments are used to reduce soil pH									
Where leaching of pollutants to groundwater is not a significant risk, deep tillage is used to break-up hardpan layers that prevent salts from leaching									
Deep Tillage #324									
A tile drain system is used to improve drainage									
Subsurface Drain #606									
Cover crops are used to improve water infiltration into soil									
Cover Crop #340									
Amendments are used to improve infiltration (PAM, gypsum, organic amendments)									
Anionic Polyacrylamide (PAM) #450									

Site Assessment and Practices Planning–Sediment, cont'd.

Practices to Improve Water Quality in Waterways

Waterways, streams, and riparian areas are sensitive to damage from agricultural, forest and other land use activities and practices. Healthy riparian areas protect farmland from erosion and flooding. They also buffer waterways from the effects of potential nutrient and pesticide runoff.

Land Management Impacts on Waterways

W1. Is there the potential for soil to fall into the waterway or riparian area from cultural operations along the banks (disking, road grading, etc...)?
☐ Yes ☐ No

Notes:

W2. Are there cattle trails along the waterway and/or do cattle graze in the waterway?
☐ Yes ☐ No

Notes:

W3. Do you see mud or sediment filling the waterway?
☐ Yes ☐ No

Notes:

Protect Waterbodies and Riparian Areas										
	Used or could be helpful	Location(s)	Year(s) used							
			2004	2005	2006	2007	2008	2009	2010
Minimize Physical Impacts										
Setbacks are established between cultural operations and waterways.										
Riparian Forest Buffer #391										
Roads have been placed away from waterways.										
Access Road #560										
Livestock access to waterways is controlled with fencing and/or management										
Fence #382										
Prescribed Grazing #528										
Use Exclusion #472										
Watering Facility #614										

Site Assessment and Practices Planning–Sediment, cont'd.

	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Filter Pollutants									
A herbaceous vegetative strip is placed between the operation and waterway to filter out pollutants									
Conservation Cover #327									
Filter Strip #393									
Riparian Herbaceous Cover #390									
Woody vegetation is planted near the natural waterway to filter out pollutants, reduce erosion, and provide wildlife habitat and shade									
Riparian Forest Buffer #391									
Channels carrying water from the farm operations to waterways are planted with vegetation to filter out pollutants									
Grassed Waterway #412									

Site Assessment and Practices Planning–Sediment, cont'd.

Waterway Bank and Channel Management

W4. Is there bare soil along banks and/or are there bank sections that are unstable (i.e. vertical banks) due to inadequate vegetation?
☐ Yes ☐ No

Notes:

W5. Do you notice the waterway depth is eroding or downcutting?
☐ Yes ☐ No

Notes:

W6. Do you notice bank erosion caused by the impacts of bank armoring?
☐ Yes ☐ No

Notes:

W7. Does concentrated runoff entering the waterway result in bank erosion or gullies?
☐ Yes ☐ No

Notes:

Stabilize Banks and Channels									
	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Vegetative cover is established on the banks to reduce erosion and enhance habitat									
Channel Bank Vegetation #322									
Critical Area Planting #342									
Streambank Protection #580									
Obstructions in the waterway are removed to improve water flow and prevent bank erosion									
Clearing and Snagging #326									
The channel bed is stabilized to prevent erosion									
Grade Stabilization Structure #410									
Stream Channel Stabilization #584									

Site Assessment and Practices Planning–Sediment, cont'd.

	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Structures to convey field drainage water into waterways are installed and maintained									
Diversion #362									
Grade Stabilization Structure #410									
Structure for Water Control #587									
Underground Outlet #620									

Site Assessment and Practices Planning–Sediment, cont'd.

Waterway Crossings

W7. Is the waterway crossing prone to washing out?
☐ Yes ☐ No

Notes:

W8. Do you notice channel or bank erosion caused by the impacts of structures such as bridges or crossings?
☐ Yes ☐ No

Notes:

W9. Do your culverts have problems with debris buildup or sediment accumulation?
☐ Yes ☐ No

Notes:

W10. Do you notice water collecting upstream from culvert inlets during storms?
☐ Yes ☐ No

Notes:

W11. Do you see sediment deposited from pooled water above the culvert inlet?
☐ Yes ☐ No

Notes:

W12. Do you see debris deposited upstream of the culvert inlet?
☐ Yes ☐ No

Notes:

W13. Are there high rust lines in any of the metal culvert pipes (this may indicate undersized pipe)?
☐ Yes ☐ No

Notes:

W14. Are any culvert inlet or outlets crushed, torn, jagged or with worn through bases?
☐ Yes ☐ No

Notes:

W15. Is there the potential for water to run down the road when the culvert plugs?
☐ Yes ☐ No

Notes:

Site Assessment and Practices Planning–Sediment, cont'd.

W16. Is the water that comes out of the culvert undercutting the road banik or scouring the channel downstream?
☐ Yes ☐ No

Notes:

Protect Waterway Crossings									
	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Road crossing and culverts have been assessed for proper flows and channel grades									
Access Road #560									
Structure for Water Control #587									
Stream banks are stabilized with vegetation and/or structural measures to reduce erosion									
Channel Vegetation #322									
Critical Area Planting #342									
Streambank Protection #580									
Obstructions are removed to improve water flow and reduce bank erosion									
Clearing and Snagging #326									
Channel crossings and culverts are sized, placed, and maintained to provide a stable channel grade									
Stream Channel Stabilization #584									
Structure for Water Control #587									
Undersized, worn/compacted, or improperly placed culverts are replaced									
Structure for Water Control #587									
Energy dissipaters are installed below culverts to prevent scouring									

Site Assessment and Practices Planning–Sediment, cont'd.

Stream Habitat

W12. Are sections of streamflow exposed to sun for more than half the day?
☐ Yes ☐ No

Notes:

W13. Are there potential impediments to fish passage in the stream?
☐ Yes ☐ No

Notes:

W14. Do you notice the encroachment of non-native invasive plant species and/or the loss of native riparian or wetland habitat?
☐ Yes ☐ No

Notes:

Maintain or Improve Stream Habitat									
	Used or could be helpful	Location(s)	Year(s) used						
			2004	2005	2006	2007	2008	2009	2010
Vegetative cover is established along banks to reduce erosion and enhance habitat									
Channel Bank Vegetation #322									
Riparian Forest Buffer #391									
Riparian Herbaceous Cover #390									
Tree/Shrub Establishment #612									
Wetland Wildlife Habitat Management #644									
Invasive plant species are identified, removed and replaced with native species									
Restoration and Management of Declining Habitats #643									
Stream conditions are improved for aquatic species									
Irrigation Storage Reservoir #436									
Obstruction Removal #500									
Barriers that restrict or prevent fish migration are removed									
Fish Passage #396									

SELF-EVALUATION

An essential element of a water quality site self-assessment is the tracking of land use and management activities on your agricultural operation. Self-evaluation data that you can provide can be important in explaining any water quality changes that may occur due to implementation of management practices. Self-evaluation techniques can help determine whether water quality changes can be attributed to implementing management practices and not to other confounding influences such as regional geology or a source upstream of the operation.

Simple field measurements are often undervalued and suspected of lacking scientific validity. When properly designed and carefully executed, however, they can provide sound data. Their strength lies in the possibility of taking large numbers of measurements inexpensively and with only semi-skilled assistance to obtain results that are more pertinent to your site than sophisticated measurements taking place at some distant monitoring station.

Record Keeping

Keep with Plan for reference

Do you keep a record of:

- ☐ **weather conditions such as air temperature, precipitation, and evapotranspiration**
- ☐ **extreme weather events such as severe storms, floods, and droughts**
- ☐ **natural vegetation and/or wildlife observations**
- ☐ **grazing (animal numbers, in and out pasture dates)**
- ☐ **natural vegetation and/or wildlife observations**

Photo Point Self-Evaluation

Keep photos and historic records with Plan for reference

Do you have any historic records and/or photographs that can help you document short or long term changes on the farm/ranch? ☐ **Yes** ☐ **No**

How many photo points are on your farm/ranch?

How many times per year will photographs be taken?

Other Self-Evaluation Techniques You Perform or Plan to Perform

Keep with Plan for reference

Technique	Location(s)	Dates or Schedule
Sediments		
☐ Erosion Pins		
☐ Erosion Pipes		
☐ Estimating Streambank Loss		
☐ Imhoff Cones		
☐ Paint Collars		
☐ Sediment Basin or Sand Trap - (record amount of sediment removed)		
☐ Staking Gullies or Streambanks		
☐ Walking the Runoff		
☐		

Self-Evaluation, cont'd.

Nutrients		
☐ Drainage Water Analysis		
☐ Irrigation Water Analysis		
☐ Plant Tissue Analysis		
☐ Record Fertilizer Use		
☐ Soil Analysis		
☐ Utilize Crop Budgets		
☐		
Pesticides		
☐ Monitor for Pests and Beneficial Insects		
☐ Review Use Reports		
☐ Assess Risk of Pesticide Loss		
☐		
Riparian Habitat		
☐ Percent Bare Soil Along Banks		
☐ Percent Canopy Cover over Stream		
☐ Staking Gullies or Streambanks		
☐ Streambank Erosion Measurements		
☐ Walking the Runoff		
☐		
Surface Water Quality		
☐ Ammonia		
☐ Conductivity		
☐ Dissolved Oxygen (DO)		
☐ Nitrate		
☐ pH		
☐ Phoshpates		
☐ Rapid Bioassessment Technique		
☐ Stream Flow		
☐ Stream Temperature		
☐ Stream Turbidity		
☐		

Self-Evaluation, cont'd.

Irrigation/Groundwater Quality		
☐ Electroconductivity (EC)		
☐ Nutrient Levels in Irrigation or Well Water (N, P, Na)		
☐ pH		
☐ Sodium Adsorption Ratio (SAR) or adjusted SAR		
☐ Toxicity Levels in Irrigation water (Sodium, Cl, B)		
☐		
Tailwater/Ditch Drainage Water Quality		
☐ Effluent flow		
☐ Electroconductivity (EC)		
☐ Nutrient Levels in Drainage Water (N, P, Na)		
☐ pH		
☐ Turbidity		
☐		

REFERENCES

Much of the information in the Farm Water Quality Plan has been adapted from the Ranch Water Quality Management Plan created by University of California Cooperative Extension and the USDA Natural Resources Conservation Service (unpublished).

Some practices in the Site Assessment and Practices Planning section were adapted from *Production guide: Nitrogen and water management for coastal cool-season vegetables.* 1998. G. S. Pettygrove, et al., Division of Agriculture and Natural Resources, University of California, Oakland CA; *Farm-A-Syst farmstead assessment system,* University of Wisconsin–Extension http://www.uwex.edu/farmasyst; and *The Positive Points System,* Central Coast Vineyard Team http://www.vineyardteam.org/pps/index.htm.

Numbered practices in the Site Assessment and Practices Planning section refer to USDA–NRCS *National handbook of conservation standards.* Individual practices can be found at http://www.ftw.nrcs.usda.gov/nhcp_2.html.

Site Assessment and Practices Planning questions E7 through E11 adapted from Downie, Scott, Dennis Halligan and Ross Taylor. 1998. *Watershed processes and erosion control: A workbook and compendium.* Fish, Farm, and Forest Communities Forum.

ACKNOWLEDGMENTS

The editors and workgroup wish to acknowledge Julie Fallon, Farm Water Quality Project Program Representative, for her commitment, creativity, and tenacity in the development of the Farm Water Quality curriculum and in particular the Template Farm Water Quality Plan. Julie guided every publication in the curriculum from peer review to publication while incorporating input form researchers, technical staff, and growers. Our thanks and appreciation to her for her work.

NPS Pollutant Information Collaborators

The following provided technical information in the Site Assessment and Practices Planning section for these specific areas:

Basin water quality information

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Practices to improve water quality in waterways

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Self-evaluation

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Commodity Information Collaborators

The following provided technical information in the Site Assessment and Practices Planning section for these commodities:

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Special thanks for review of Farm Water Quality Plan sections –

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Albert Cerna, USDA–NRCS
David Robledo, USDA–NRCS
Tina Vander Hoek, USDA–NRCS
Marc Los Huertos, UC Santa Cruz
Mike Hill, California Department of Fish and Game

The Farm Water Quality Working Group would like to thank the growers from

Chualar/Quail Watershed Group Pilot Course January 2001, Monterey County
Los Osos/Chorro Watershed Group Pilot Course February 2001, San Luis Obispo County
Pescadero/Butano Watershed Group Pilot Course June 2001, San Mateo County

for contributions instrumental in the development of the Farm Water Quality Planning curriculum. Their participation and suggestions were invaluable in the process of building this final product.

Additionally we wish to acknowledge the efforts of Carolyn Richardson, whose energy and dedication is greatly missed.

The Farm Water Quality Plan has been made possible with funding through:

USDA Cooperative State Research, Education, and Extension Service Water Quality Program 1999-2000

David and Lucille Packard Foundation Conserving California Landscapes Initiative 2000-2001

DANR Water Quality Workgroup Farm Water Quality Task Force 2000-2003

California State Water Resources Control Board Section 319(h) Grant Program 2001-2004

FOR MORE INFORMATION

You'll find detailed information on many aspects of resource conservation in these titles and in other publications, slide sets, CD-ROMs, and videos from UC ANR:

Farm Water Quality Planning Short Course Objectives, publication 8052

Nonpoint Sources of Pollution in Irrigated Agriculture, publication 8055

Practices for Reducing Nonpoint Source Pollution from Irrigated Agriculture, publication 8075

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An electronic version of this publication is available on the ANR Communication Services website at http://anrcatalog.ucdavis.edu.

Publication 8332

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pr-3/04-WJC/CR rev. 2009

This publication has been anonymously peer reviewed for technical accuracy by University of California scientists and other qualified professionals. This review process was managed by the ANR Associate Editor for Natural Resources.

ISBN-13: 978-1-60107-579-6