Rainbow Creek
Nutrient Reduction Management Plan

University of California
Cooperative Extension

County of San Diego

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Introduction to the Rainbow Creek TMDL and NRMP

This Nutrient Reduction Management Plan (NRMP) is a requirement of the Rainbow Creek Total Maximum Daily Load (TMDL) program for nitrogen (N) and phosphorus (P). The TMDL was adopted by the California Regional Water Quality Control Board, San Diego Region in 2005 and mandates the reduction of total N and total P to levels that restore the creek's beneficial uses. The impacted beneficial uses identified in the TMDL include municipal water supply (MUN), contact and non-contact water recreation (REC-1 and REC-2), warm and cold freshwater habitat (WARM and COLD), and wildlife habitat (WILD). The full TMDL report is available at **www.waterboards.ca.gov/sandiego/tmdls/rainbow%20creek.html**.

This NRMP was developed by the University of California Cooperative Extension and the Rainbow Creek Nutrient Reduction Management Plan Stakeholder Advisory Committee with the objective of providing the businesses and residents of Rainbow Creek Watershed with a user-friendly document that summarizes readily available nutrient reduction measures. If implemented, these strategies will advance the goal of reducing nutrient levels in Rainbow Creek and help restore the creek's beneficial uses as required by the TMDL. The NRMP provides a range of specific management options targeting commercial nurseries, field agriculture and orchard operations, residents, animal owners, as well as general practices applicable to all land uses in the watershed.

Detailed information on N and P loading reductions for various land use categories, as required by the TMDL is provided in Appendix 1 (pg. 37). Based on current estimates of N and P concentrations in Rainbow Creek, the TMDL mandates overall N and P reductions of 74% and 85%, respectively.

Water Quality Targets

The water quality objective for the protection of the municipal water supply beneficial use is 10 mg/ Liter nitrogen and is based on established public health standards for nitrate in drinking water. Nitrate-nitrogen levels in excess of 10 mg/ L have been shown to impair bloodstream oxygen-carrying capacity in infants, leading to methemoglobinemia or 'blue baby syndrome'. There is no comparable drinking water standard for phosphorus. The management options outlined in this NRMP, if implemented will reduce nitrogen concentrations in Rainbow Creek and will allow the restoration of the MUN beneficial use over time.

The San Diego Region Basin Plan does not define precise water quality objectives for N and P for the protection of recreational and habitat-related beneficial uses. Instead, the Basin Plan references desired *goals* when site specific data are lacking as is the case with Rainbow Creek. These desired goals are 0.1 mg/L P in flowing waters and an N to P ratio of 10:1, which is translated to 1.0 mg/L N in the Rainbow Creek TMDL report.

The total allowable daily loads for nitrogen and phosphorus are calculated based on these Basin Plan goals with the intent of restoring the contact and non-contact recreation, warm and cold freshwater, and wildlife habitat beneficial uses. Elevated nitrogen and phosphorus levels impair the REC-1 and REC-2 beneficial uses of Rainbow Creek by stimulating the growth of unsightly and potentially noxious algal blooms and mats. This condition normally occurs during warm periods when abundant nutrients (N and P) and sunlight stimulate photosynthesis and the over-production of algal biomass. Impairment of the WARM, COLD, and WILD beneficial uses result from the wide fluctuations in dissolved oxygen (O_2) associated with such algal blooms.

Executive Summary

The NRMP chapters below are arranged in relation to nutrient source categories/ land uses (nurseries, field agriculture/orchards, residential/animal, and common). However, the Stakeholder Advisory Committee concluded that users of this document may find it helpful to also consider the management options according to the manner in which nutrient reduction is achieved. The following groups of management options were identified:

1. *Water Conservation Measures*

   Residential and commercial water use in Rainbow Watershed has over time, resulted in a year round flowing creek and a highly elevated groundwater table. The use of water for irrigation, cleaning and maintenance activities, and on site sewage disposal mobilize soluble and particulate forms of nitrogen and phosphorus and transport them from their point of origin/ application to Rainbow Creek via surface and subsurface flow. Water conservation by the residents and businesses in the watershed will reduce the ongoing transport of nutrients to Rainbow Creek; reduce pressures on regional water supply systems, and save money.

2. *Measures that Prevent Unnecessary Runoff*

   Many management options outlined in this document address the goal of preventing surface runoff from leaving a particular property and moving offsite into the drainage system. If not retained on site, the nutrients contained in water, soil, fertilizers, and green waste are likely to ultimately reach the creek. Runoff prevention measures are extremely effective methods of reducing nutrient loading especially when used in conjunction with water conservation.

3. *Measures that Minimize Fertilizer Use*

   The overuse of nitrogen and phosphorus-containing fertilizers provides an obvious pathway for the contamination of Rainbow Creek. Effective formulation and application of plant fertilizer is a critical element of the overall nutrient reduction strategy.

4. *Maintenance/ Good Housekeeping Measures*

   These management options are designed to prevent the unnecessary exposure of fertilizers, animal wastes, septic system wastes, and green waste to the environment where they may be transported to Rainbow Creek by runoff, wind, or accidental or illicit disposal.

The following chapters are designed to briefly introduce each land use to be addressed, provide a list of priority management practices based on effectiveness and ease of implementation, and outline all potential management options in greater detail. Additional useful information directed to septic systems, online resources, and photographs of the various management options is provided in the appendices.

Chapter 1
Management Options for Nurseries

Introduction

The Rainbow Creek watershed is home to over 150 nurseries, covering approximately 5% of the watershed. These nurseries grow a wide variety of plant species, including palms and other tropicals, ornamental shrubs, flowers, cacti, herbs, mushrooms, and many more. While the warm climate is suited to many native species, as well as non-natives such as South African protea, Rainbow and Fallbrook nurseries are most always obligated to use irrigation and/or fertilization to produce sufficient yields. Unfortunately, these practices contribute significantly to the problem of nutrient pollution in Rainbow Creek.

The Rainbow Creek TMDL estimates the nutrient load from commercial nurseries by multiplying established loads from nurseries in comparable regions by the area of land used for nurseries in Rainbow Creek. According to the TMDL commercial nurseries contribute 15% of the annual nitrogen load in Rainbow Creek and 7% of the annual phosphorus load. In order to comply with the TMDL, commercial nurseries in Rainbow Creek are required to make a 77% reduction in their nitrogen contribution, from 507 to 116 kg N/yr, and a 90% reduction in their phosphorus contribution, from 27.4 to 3 kg P/yr.

What follows is a list of the diverse management options nursery operators can choose from to help reduce their nitrogen and phosphorus contributions. We will begin by listing those practices we recommend as priorities based on effectiveness, ease of implementation and cost. Full descriptions of these priority practices can be found below, along with all other management options.

Top priority irrigation management options:	
- pressure regulators (MG 1.5)	- keep emitters in plants (3.2)
- pressure minimizing emitters (1.6)	- turn off irrig. in unused areas and backfill (3.3)
- group flow rates (1.9)	- use on/off valves (3.5)
- group plants by need (1.10)	- check overhead emitters for direction (3.6)
- uniform sprinkler heads (1.13)	- base irrigation schedule on plant water needs (4.1)
- inspect/repair leaks (2.1)	- adjust to weather (4.2)
- maintain filters (2.3)	- group plants by needs (4.3)
- maintain appropriate pressure (2.4)	- avoid irrigating when windy (4.4)
- replace parts (2.5)	- check automatic clocks (4.6)
Top priority nutrient management options:	
- keep records of water quality (1.3)	- use compliant storage of fertilizers (3.1)
- use crop recommendations (1.8)	- use secondary containment (3.4)
- test fertigation water (1.9)	- mix and load on impermeable surface (3.5)
- distribute solid fert. evenly (2.1)	- inspect equipment (3.6)
- use injected fertilizer carefully (2.4)	- cover and avoid overfilling liquid fertilizers (3.7)
- calibrate fertilizer injectors (2.5)	- avoid spilling in transfer (3.8)
- time fertilizer use with growth (2.7)	- clean spills immediately (3.9)
- use EC for leaching (2.9)	- check valves (3.10)

Top priority nutrient management options, continued:	
- only leach sometimes (2.10)	- avoid backflow during fertigation (3.11) - dispose of fertilizer bags in covered bins (3.12)
Top priority erosion/runoff management options:	
- inventory chemicals used (1.1)	- use berms (4.4)
- sample runoff water (1.2)	- use proper hill irrigation (4.5)
- analyze runoff water (1.3)	- use proper pest/nutrient management on hills (4.6)
- compare with standards (1.4)	- design new roads to avoid irrigation (5.1)
- mulch/cover crop (2.3)	- use waterbreaks (5.2)
- note runoff amt. and locations (3.1)	- inspect/clean culverts (5.4)
We also recommend prioritizing all personnel training and record keeping (Sec. D and E).	

A. Irrigation Management Goals and Management Practices

The first section addresses irrigation management as a way of reducing nutrient runoff from nurseries. The overall goal of irrigation management is to use irrigation water in a way that minimizes the amount of wasted water and the amount of water leaving the property and potentially reaching the creek. Since nutrients are most often carried to the creek through surface or ground water, then minimizing the amount of water runoff will minimize nutrient runoff as well.

MG 1 Design or retrofit your irrigation system for improved irrigation uniformity and efficiency to reduce runoff and leaching.

1.1 Conduct an in-house irrigation audit or utilize professional services to determine the efficiency of the system and make appropriate adjustments. An irrigation system audit or evaluation typically includes measuring the distribution uniformity of sprinklers using the "catch can" method and of emitters by a representative discharge sampling, as well as pressure distribution methods.

1.2 Have a schedule for regular audits; over time an efficient system can become inefficient if modifications are made or as clogging and wear reduce uniformity.

1.3 Make system upgrades, improvements and/or repairs as audits require.

1.4 If irrigation uniformity remains low after all practical improvements have been made, consider converting to an irrigation system with potential of high uniformity.

1.5 Use pressure regulators where appropriate. (Photo #1, p.42)

1.6 Use emitters that minimize pressure differences or pressure compensating emitters. (Photo #2, p.42)

1.7 When growing on slopes, compensate for pressure differences at the top and bottom of the slope by running the main line vertical to the slope with pressure controllers at each horizontal line junction and running each subline horizontal to the slope; include a pressure control valve.

1.8 When using overhead or impact systems, use flow control nozzles when pressure is too

high or variable. (Photo #3, p.42)

1.9 Each watering zone should have spray stake/emitters with similar flow rates to maintain good uniformity; do not combine emitters with different flow rates in the same watering zone.

1.10 Place plant types and pot sizes with similar water needs in the same watering zone.

1.11 Correlate emitter flow rates for spray stakes and drippers with plant types, media infiltration rates, and pot sizes in each watering zone; emitters with flow rates that are too high will apply water faster than plants can absorb and runoff will result.

1.12 Use appropriate and uniform nozzle sizes.

1.13 Use sprinkler heads with a high uniformity rating.

MG 2 Regularly maintain your irrigation system so that it continues to operate efficiently.

2.1 Regularly inspect for leaks in mains and laterals, in irrigation connections, or at the ends of drip tape and feeder lines. Repair any found leaks. (Photo, #4, p.42)

2.2 Regularly flush and unclog lines and emitters, keeping them free of mineral deposits and biological contaminants such as algae and bacterial slimes.

2.3 Ensure that appropriate filtration is used and regularly clean filters.

2.4 Maintain appropriate pressure throughout the system.

2.5 Regularly replace worn, outdated or inefficient irrigation system components and equipment.

MG 3 Regularly manage crops, crop areas, and irrigation systems to avoid applying water to non-cropped areas or applying irrigation when not needed.

3.1 When using overhead or impact systems, regularly space pots or plants as closely together as is possible without compromising plant quality due to reduced light. This will minimize runoff from spaces between pots and plants. (Photo #5, p.42)

3.2 Manage spray stake and dripper systems to ensure every emitter is located in a plant or pot; manage harvest operations and retail areas to avoid creating watering zones with emitters located outside of pots. (Photo #6, p.42)

3.3 Consolidate plants and shut off irrigation in unused portions, including spray stakes and other emitters that can be "turned off" when not in use. Backfill plants into areas where plants have been sold.

3.4 Consider using overhead emitters with check-valves to prevent line drainage and drip damage. (Photo #7, p.43)

3.5 Use an on/off valve in hand watering systems to prevent runoff. (Photo #8, p.43)

3.6 Check regularly to ensure that spray patterns of overhead irrigation systems are managed to uniformly deliver water only to plants, without creating overspray in walkways and edges.

MG 4 Use appropriate irrigation rates and scheduling.

4.1 Base irrigation scheduling and amount on environmental conditions and plant moisture requirements. Water requirements can be determined from a reference evapotranspiration (ET) value modified with a coefficient for the specific crop. ET and coefficient values, which reflect actual weather conditions, are available from the California Irrigation Management Information System—CIMIS, although coefficient values for many ornamental crops have yet to be determined. Irrigation scheduling can also be based on measured water content in the soil or plant growing media (determined with pot weight, tensiometer, electrical resistance blocks, or dielectric soil moisture sensor). (Photo #9, p.43)

4.2 Regularly adjust irrigation schedules to reflect changes in weather, plant needs, or measured soil moisture values.

4.3 Group pot sizes and/or plant types in watering zones according to moisture requirements.

4.4 Avoid irrigating outdoors in windy conditions.

4.5 Consider pulse irrigation to split irrigation into smaller increments that can more effectively be used by plants.

4.6 When automatic time clocks are used, check regularly for accuracy and adjust to correlate scheduling with changing environmental conditions and plant growth stage. (Photo #10, p.43)

B. Nutrient Management Goals and Management Practices

The second section addresses Nutrient Management. The goal here is to apply only the amount of nutrients actually needed and usable by the target plants, and at the appropriate time based on plant growth stage and environmental factors. The intended result is that fewer nutrients end up unused and exposed to runoff. In addition, nutrient management involves handling fertilizers carefully at all stages of their use in order to prevent runoff to the creek.

MG 1 Evaluate irrigation water, soils, growing media, and plant tissue to optimize plant growth and avoid over-fertilization.

1.1 Regularly monitor the quality of your irrigation source water. Sample seasonally (if well water or if surface water such as ponds or creeks) or annually (if municipal water). Analyze for levels of constituents such as bicarbonates (HCO_3^-), sodium (Na), chloride (Cl^-), nitrate (NO_3^-), boron (B), soluble salts, and pH. Undesirable levels of these constituents may affect crop growth and health. Utilize a commercial lab for analysis. Soluble salts, pH, nitrate, and phosphate (PO_4^{3-}) can be analyzed on-site with instruments and kits designed for use by individual growers. (Photo #11, p.43)

1.2 If well water is used on-site for human consumption, have the well water tested regularly for contamination from fertilizers.

1.3 Maintain records of irrigation source water quality, especially if of variable quality.

1.4 Consider nutrients already present in your irrigation water, recovered runoff, composts, manures, and previous fertilizer applications in fertilizer management decision-making. Over-fertilization can result if nutrients already present in the growing environment are not taken into account.

1.5 Regularly test soil/growing media for nutrients, soluble salts, and pH. Along with plant tissue analysis, soil tests are your best guide to effective use of fertilizers. (Photo #12, p.43)

1.6 Test plant tissue to determine concentrations of macro- and micro-nutrients.

1.7 Use information and recommendations from soil, growing media, and plant tissue analyses in fertilization management.

1.8 When available, use nutrient recommendations for your specific crop. Use the most up-to-date recommendations from farm advisors and publications.

1.9 Periodically test fertigation water to monitor fertilizer levels and ensure injectors are properly operating.

MG 2 Conduct efficient fertilizer and leaching practices.

2.1 Incorporate solid fertilizers in a manner that optimizes nutrient availability to growing roots. When mixing fertilizer into media, be sure that fertilizer is evenly distributed throughout the root zone/container and at the correct rate; this will provide good nutrition and avoid leaching losses of fertilizer nutrients.

2.2 Use composts or manures that are thoroughly composted before application. Composts and manures that are not thoroughly composted may contribute bacteria and other contaminants to runoff. (Photo #13, p.44)

2.3 Carefully apply top-dressed fertilizers to keep granules in the pot or around the plants at the correct rate. (Photo #14, p.44)

2.4 Ensure that injected fertilizers are carefully mixed and applied at correct rates. Excessive amounts of highly soluble liquid fertilizers are easily lost with leachate water.

2.5 Calibrate fertilizer injectors to accurately deliver liquid fertilizer through the irrigation system.

2.6 Utilize slow-release or controlled-release fertilizers to minimize leaching losses of nutrients.

2.7 Time fertilizers with environmental parameters and growth stage of the plants. Fertilizer management that provides nutrients at appropriate growth stages will result in better plant nutrition and minimize nutrient losses to the environment.

2.8 Flush excess salts from the root systems by using carefully managed leaching practices. Excessive leaching represents wasted water, fertilizer, and greater runoff volumes to manage. Excess nutrients carried by leached water can be a source of groundwater and surface water contamination.

2.9 Use the electrical conductivity (EC) of root media or leachate water to determine leaching practices. The soluble salt level of leachate water and/or root media can be monitored with a portable EC meter. Different plants have different tolerances to EC. High fertilizer concentrations are not recommended as they require frequent leaching to avoid salt build-up in containers.

2.10 Set irrigation schedules to perform leaching at specific irrigation events, rather than every time irrigation is performed. Perform leaching only with fertilizer injectors turned off (clear water).

2.11 Measure the amount of leaching that occurs, and ensure that only 10-15% of the water applied runs through the container. Without actual measuring, the tendency is to underestimate leachate volumes and therefore leach excessively.

MG 3 Avoid fertilizer material spills during all phases of transport, storage, and application.

3.1 Store fertilizers in a storage structure that complies with local, state, and federal guidelines. (Photo #15, p.44)

3.2 Locate fertilizer storage and mixing areas as far away from water conveyances (streams, creeks, and storm drains) as possible.

3.3 Prevent fertilizer residues from washing into surface waters. One strategy is to include a concrete pad and curb to contain spills and leaks in the fertilizer storage facility. This pad area should be protected from rainfall and irrigation to prevent fertilizer residues from washing into surface water bodies.

3.4 Equip fertilizer tanks with secondary containment to contain spills and leaks. (Photo #16, p.44)

3.5 Conduct fertilizer mixing and loading operations on an impermeable surface such as a concrete floor in areas where potential for runoff is low; perform fertilizer operations at least 100 feet down-slope of a well or other water supply. These are legal requirements. (Photo # 17, p.44)

3.6 Verify regularly that fertigation equipment is properly calibrated and fertilizer solution tanks are free of leaks.

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

3.8 When transferring fertilizer into on-farm storage or into a fertilizer applicator, take care that you do not allow materials to spill.

3.9 Immediately clean up fertilizer spills, and do so according to a predetermined protocol.

3.10 Use check valves on application equipment. When applying fertilizer from a tractor or

rig in a field, shut off the fertilizer applicators during turns.

3.11 Whenever you are injecting fertilizer into irrigation water, make sure that you do not allow backflow into wells or other water sources; install backflow prevention devices and check them at least once a year, recording the date and result of this check.

3.12 Dispose fertilizer bags in trash bins with lids to prevent trash with fertilizer residues from blowing into nearby waterways.

C. Erosion and Runoff Management Goals and Management Practices

The third section deals with erosion and runoff management designed to prevent sediments and water, which can both carry nutrients, from leaving the nursery property. Erosion and runoff management involves modifying soil and container substrates to enhance their ability to hold water, creating barriers to the movement of sediments and water and capturing unused irrigation water for reuse or storage. While the TMDL does not regulate sediments in the creek specifically, erosion and runoff management can help decrease the amount of nutrients reaching the creek.

MG 1 Evaluate water quality of storm runoff to comply with water regulations and determine options for reuse or treatment.

1.1 Inventory chemicals used in your operation, especially those likely to be present in runoff such as pesticides, fertilizers, and shading compounds.

1.2 To measure the effect of management practices, regularly sample storm runoff water. Irrigation runoff should not exit property. Follow commercial lab instructions for taking and handling storm runoff samples, as this will greatly affect the results.

1.3 Conduct analyses on runoff water samples to determine what is in it and at what levels. Parameters to test for include pH, electrical conductivity (EC), nitrate (NO_3^-) and phosphate (PO_4^{3-}), which can be analyzed on site with instruments and kits designed for use by growers. Alternatively, water samples can be sent to commercial labs. In addition, it is recommended to use a good commercial lab to test for other contaminants such as specific pesticides that you suspect may be present in runoff. The lab should use EPA standards and be certified for Good Laboratory Practices (GLP).

1.4 Compare water analyses against local and state water quality standards and regulations.

MG 2 Use practices that improve soil/media infiltration and water-holding capacity to reduce soil erosion, runoff, and excessive leaching.

2.1 Incorporate organic amendments on sandy soil to improve water holding capacity and prevent excessive leaching.

2.2 Incorporate amendments on clayey soil to improve infiltration and reduce runoff.

2.3 Use mulches or cover crops on bare soil to reduce runoff. (Photo #18, p.44)

2.4 Test media used in containers and select media for high water holding capacity as well

as good drainage.

2.5 Consider the use of wetting agents in container media to increase water absorption, allow quicker wetting, and reduce channeling down the sides of pots. Wetting agents should not be overused, as they can be toxic to plants and a contaminant in runoff.

MG 3 Use practices that will retard movement of runoff water and sediment and keep it on the property.

3.1 Determine where and how much erosion and runoff is generated and if runoff exits the property. All dry weather runoff and sediment is prohibited from entering street gutters, rivers, creeks, or other conveyances that drain to public waters. Discharging dry weather runoff and sediment onto neighboring properties is also illegal, unless done with consent.

3.2 Establish engineered barriers or buffers between production areas and ditches, creeks, ponds, lakes, or wetlands. Examples of plant buffers include vegetated buffer strips, grass-lined channels, grass swales, and constructed wetlands. Buffer vegetation can help absorb both dry and wet weather contaminated runoff if properly located. Engineered barriers such as berms and containment structures can regulate runoff flow and contain it. For example, detention basins can temporarily hold excess storm water; the basin will slowly drain as the collected water infiltrates into permeable soil or evaporates. (Photo #19 and #20, p.45)

3.3 Convert paved or bare soil areas to vegetation that will retard runoff and take up nutrients, pesticides, and other pollutants wherever possible. (Photo #21, p.45)

3.4 Consider using polyacrylamide (PAM) to remove sediment from runoff water.

3.5 Use windbreaks or shelterbelts in areas prone to wind erosion. (Photo #22, p.45)

3.6 If your property is affected by discharge sediment or runoff from upslope or upstream properties, use practices to contain this sediment or runoff (such as diversions, filter strips, sediment basins, underground outlets, etc.).

3.7 Perform maintenance on any runoff buffers annually or as needed to ensure they continue to function as intended.

MG 4 Manage hilly, sloped areas to prevent soil erosion and increased runoff volume and velocity. This includes hilly production areas as well as sloped non-production areas.

4.1 Use terraces where appropriate to control soil erosion and runoff. Ensure that any required permits are obtained for larger-scale terracing. (Photo #23, p.45)

4.2 Use mulches where appropriate to control soil erosion and runoff.

4.3 Use vegetation (cover crops, buffer strips, grassed swales, etc) to control soil erosion and runoff.

4.4 Use berms to control soil erosion and runoff. (Photo #24, p.45)

4.5 Use proper irrigation management in hilly production areas and in hilly landscaped non-production areas avoid runoff and soil erosion.

4.6 Use proper pest and nutrition management practices in hilly production areas and in hilly landscaped non-production areas to avoid pesticide and fertilizer runoff.

4.7 Perform maintenance on any hill erosion buffers annually or as needed to ensure they continue to function as intended.

MG 5 Design and manage nursery roads to prevent erosion and contaminated runoff.

5.1 Ensure that all new roads are properly designed and permitted to avoid erosion. This may require the submission of an engineering plan, specifications, and an environmental assessment. Soils should be evaluated for erodibility, and excessive slopes should be avoided.

5.2 Use waterbreaks (waterbars) on nursery roads with gradients exceeding 8%. These should be properly sized and placed only where water flow has an outlet and diverted water does not flow into septic fields or waterways.

5.3 Use filter strips between roads and waterways to absorb runoff from roads and trap toxic sediment. (Photo #25, p.46)

5.4 Inspect culverts and clean them out during winter rains so that water drains freely. (Photo #26, p.46)

5.5 Prevent contaminant-laden dust from traffic and wind erosion by sealing or watering unpaved roads. This will also help in mite control. Ensure that dust control with applied water does not create runoff.

5.6 Perform road maintenance annually or as needed.

MG 6 Collect excess irrigation and storm water runoff and sediment.

6.1 Use retention basins to store excess irrigation runoff and storm water. Basin capacity should be designed on the basis of probable storm events and to prevent seepage and groundwater contamination. Use qualified engineers for design and implementation. (Photo #27, p.46)

6.2 Use captured water to irrigate non-crop areas, thereby preventing overflow. (Photo #28, p.46)

6.3 Use captured water and then recycle it onto crops, treating or blending with fresh water as necessary, avoiding basin overflow during both dry and wet weather. (Photo #28, p.46)

MG 7 Manage greenhouse roof runoff to reduce pollution and erosion, to prevent flooding, and improve drainage.

7.1 Direct roof runoff away from the municipal storm water system or sewer system. Roof runoff may contain pollutants e.g. toxic sediments and shading compounds. (Photo #29, p.46)

7.2 Direct roof runoff into pervious areas (gravel, vegetative, paving material, self-contained tail water system or retention ponds). (Photo #29, p.46)

7.3 Reuse collected roof runoff to irrigate non-crop or crop areas. (Photo #29, p.46)

D. Personnel Training

This section outlines the various practices in which all relevant operation personnel should be trained. Training ensures that personnel understand why and how nutrient reduction management practices should be done and increases the likelihood that practices will be implemented. (Photo #30 p.46)

MG 1 Provide appropriate training for personnel involved in irrigating in a language that personnel clearly understand, and maintain records documenting training.

1.1 Provide training to ensure that irrigation duties are performed only by personnel who understand and practice appropriate irrigation scheduling, irrigation application practices, and crop management practices related to runoff management.

1.2 Ensure that appropriate personnel are trained in proper irrigation system maintenance procedures and record keeping related to maintenance.

1.3 If in-house irrigation audits are performed, ensure that personnel are trained to evaluate irrigation systems correctly and regularly.

MG 2 Provide organized training sessions for personnel handling fertilizers in a language that personnel clearly understand, and maintain records documenting training.

2.1 Provide training to ensure that appropriate personnel understand how and when to use fertilizers.

2.2 Provide training to ensure that appropriate personnel understand how and when to leach.

2.3 Provide training to ensure that appropriate personnel understands safe fertilizer transport, storage, and disposal practices.

2.4 Provide training for all personnel on what to do in case of a fertilizer spill.

MG 3 Provide organized training sessions for personnel in runoff management in a language that personnel clearly understand, and maintain records documenting training.

3.1 Ensure that all appropriate employees receive training in runoff management and all applicable regulations. All growing operation employees must understand and implement the required practices for runoff management to be effective.

3.2 Train staff so that they become aware of all drainage conduits and ditches on the property and know where they drain.

3.3 Ensure that all municipal stormwater or sewer system conduits and ditches are stenciled or designated with signs, and that there are no illicit connections to the municipal stormwater or sewer system.

E. Record Keeping

This section describes the pieces of information of which growers should keep record. Records allow growers to prove which practices they have implemented in order to reduce their nutrient contribution, in addition to complying with other regulations that require records.

MG 1 Maintain records of all nursery practices and data.

1.1 Maintain records of fertilizer use. These may be required by regulatory agencies and are useful in obtaining permits or conditional waivers for agricultural discharge. Records can help you make informed decisions regarding fertilizer management.

1.2 Maintain records of runoff water quality for at least 5 years.

1.3 Implement and maintain a record-keeping system for documenting management practices addressing runoff management. Record-keeping may be required by some regulating authorities.

1.4 Maintain records of all personnel training for at least 5 years. Records should include when training occurred, who led the training, who participated, and what information was covered.

Chapter 2
Management Options for Orchards and Field Agriculture Operations

Introduction

Orchards and field agriculture operations cover approximately 11% and 6% of the Rainbow Creek watershed, respectively. Field agriculture operations in the watershed grow mostly warm-weather row crops such as pumpkins and aloe. Rainbow Creek orchards focus largely on citrus and avocados, as well as some in-ground palms for nursery sales. Because of their strong presence in the watershed and common use of irrigation and fertilization for increased yields, field agriculture and orchards contribute significantly to the nitrogen and phosphorus loads in Rainbow Creek.

The Rainbow Creek TMDL estimates the nutrient load from fields and orchards by multiplying established loads from comparable regions by the area of land used for each type of operation. These estimations show that field agriculture contributes 20% of the annual nitrogen load from land uses in Rainbow Creekand 9% of the annual phosphorus load. Orchards are estimated to contribute 22% and 16% of nitrogen and phosphorus, respectively. In order to comply with the TMDL, agricultural fields in Rainbow Creek are required to make a 77% reduction in their nitrogen contribution, from 655 to 151 kg N/yr, and a 90% reduction in their phosphorus contribution, from 35.4 to 4 kg P/yr. Orchards are required to make a 77% reduction in nitrogen contribution, from 790 to 182 kg N/yr and a 90% reduction in phosphorus contribution from 63 to 6 kg P/yr.

What follows is a list of the diverse management options field and orchard operators can choose from to help reduce their nitrogen and phosphorus contributions. We will begin by listing those practices we recommend as priorities based on effectiveness, ease of implementation and cost. Full descriptions of these priority practices can be found below, along with all other management options.

Top priority irrigation management options:

- irrigation audits (MG 1.1)
- pressure regulators (1.4)
- pressure minimizing emitters (1.5)
- slope pressure control (1.6)
- flow control nozzles (1.7)
- group flow rates (1.8)
- use approp. flow rate for plant type (1.9)
- use uniform nozzle sizes (1.10)
- use highly uniform sprinkler heads (1.11)
- inspect/repair leaks (2.1)
- flush/unclog lines (2.2)
- maintain filters (2.3)
- maintain appropriate pressure (2.4)
- replace parts (2.5)
- keep emitters in plants (3.1)
- turn off irrig. in unused areas (3.2)
- use check valves (3.3)
- use on/off valves (3.4)
- check overhead emitters for direction (3.5)
- base irrig. schedule on water needs (4.1)
- adjust to weather (4.2)
- use pulse irrigation (4.4)
- check automatic clocks (4.5)

Top priority nutrient management options:

- test soil and plant tissue for nutrients and use data in fertilizer management (1.5-1.7)
- test well water (1.2)
- use crop recommendations (1.8)
- time fertilizer use with growth
- use compliant storage of fertilizers

Top priority nutrient management options, continued:	
- periodically test fertigation water (1.9)	- store fertilizers far from waters (3.2)
- disk/plow in solid fertilizer (2.1)	- mix and load on impermeable surface (3.5)
- apply top fert. and injected fert. carefully (2.3, 2.4)	
- grow border vegetation (2.3)	- inspect equipment (3.6)
- calibrate fertilizer injectors (2.5)	- clean spills promptly (3.9)
- use controlled-release fertilizer (2.6)	- check valves (3.10)
	- avoid backflow during fertigation (3.11)
Top priority erosion/runoff management options:	
- inventory chemicals used (1.1)	- shape/seed field edges (3.4)
- sample runoff water (1.2)	- use sticking mulches (4.2)
- analyze runoff water (1.3)	- use vegetation to block water flow (4.3)
- compare against regulatory standards (1.4)	- use berms (4.4)
- maintain crop residues on unused land (2.4)	- use proper hill irrigation (4.5)
- determine runoff amount and locations (3.1)	- use proper hill pest/nutrient manag. (4.6)
- use barriers/buffers to water flow (3.2)	- direct roof runoff to avoid contaminants (7)
We also recommend prioritizing all personnel training and record keeping (Sec. D and E).	

A. Irrigation Management Goals and Management Practices

The first section addresses irrigation management as a way of reducing nutrient runoff from fields and orchards. The overall goal of irrigation management is to use irrigation water in a way that minimizes the amount of wasted water and the amount of water leaving the property and potentially reaching the creek. Since nutrients are most often carried to the creek through surface or ground water, then minimizing the amount of water runoff will minimize nutrient runoff as well.

MG 1 Design or retrofit your irrigation system for improved irrigation uniformity and efficiency to reduce runoff and leaching.

1.1 Conduct an irrigation audit or utilize professional services to determine the efficiency of the system and make appropriate adjustments. An irrigation system audit or evaluation typically includes measuring the distribution uniformity of sprinklers using the "catch can" method and of emitters by a representative discharge sampling, as well as pressure distribution methods.

1.2 Have a schedule for regular audits; over time an efficient system can become inefficient if modifications are made or as clogging and wear reduce uniformity.

1.3 If irrigation uniformity remains low after all practical improvements have been made, consider converting to an irrigation system with potential of high uniformity.

1.4 Use pressure regulators where appropriate.

1.5 Use emitters that minimize pressure differences or pressure compensating emitters.

1.6 When growing on slopes, compensate for pressure differences at the top and bottom of the slope by running the main line vertical to the slope with pressure controllers at each

horizontal line junction and running each subline horizontal to the slope; include a pressure control valve.

1.7 When using overhead or impact systems, use flow control nozzles when pressure is too high or variable.

1.8 Each watering zone should have spray stake/emitters with similar flow rates to maintain good uniformity; do not combine emitters with different flow rates in the same watering zone.

1.9 Correlate emitter flow rates for spray stakes and drippers with plant types; emitters with flow rates that are too high will apply water faster than plants can absorb and runoff will result.

1.10 Use appropriate and uniform nozzle sizes.

1.11 Use sprinkler heads with a high uniformity rating.

MG 2 Regularly maintain your irrigation system so that it continues to operate efficiently.

2.1 Inspect monthly for leaks and clogs in mains and laterals, in irrigation connections, or at the ends of drip tape and feeder lines. Repair any found leaks.

2.2 Flush and unclog lines and emitters yearly, keeping them free of mineral deposits and biological contaminants such as algae and bacterial slimes.

2.3 Ensure that appropriate filtration is used and regularly clean filters.

2.4 Maintain appropriate pressure throughout the system.

2.5 Regularly replace worn, outdated or inefficient irrigation system components and equipment.

MG 3 Regularly manage crops, crop areas, and irrigation systems to avoid applying water to non-cropped areas or applying irrigation when not needed.

3.1 Manage spray stake and dripper systems to ensure every emitter is located near a plant or plants; manage harvest operations to avoid creating watering zones with emitters located away from plants.

3.2 Shut off irrigation in unused areas, including spray stakes and other emitters that can be "turned off" when not in use.

3.3 Consider using emitters with check-valves to prevent line drainage and drip damage.

3.4 Use an on/off valve in hand watering systems to prevent runoff. (Photo #31, p.47)

3.5 Check regularly to ensure that spray patterns of irrigation systems are managed to uniformly deliver water directly to plants.

MG 4 Use appropriate irrigation rates and scheduling.

4.1 Base irrigation scheduling and amount on environmental conditions and plant moisture

requirements. Water requirements can be determined from a reference evapotranspiration (ET) value modified with a coefficient for the specific crop. ET and coefficient values, which reflect actual weather conditions, are available from the California Irrigation Management Information System—CIMIS, although coefficient values for many ornamental crops have yet to be determined. Irrigation scheduling can also be based on measured water content in the soil (determined with pot weight, tensiometer, electrical resistance blocks, or dielectric soil moisture sensor). (Photo #9, p.43)

4.2 Regularly adjust irrigation schedules to reflect changes in weather, plant needs, or measured soil moisture values.

4.3 Avoid irrigating outdoors in windy conditions.

4.4 Consider pulse irrigation to split irrigation into smaller increments that can more effectively be used by plants.

4.5 When automatic time clocks are used, check regularly for accuracy and adjust to correlate scheduling with changing environmental conditions and plant growth stage. (Photo #10, p.43)

B. Nutrient Management Goals and Management Practices

The second section addresses nutrient management. The goal here is to apply only the amount of nutrients actually needed and usable by the target plants, and at the appropriate time based on plant growth stage and environmental factors. The intended result is that fewer nutrients end up unused and exposed to runoff. In addition, nutrient management involves handling fertilizers carefully at all stages of their use in order to prevent runoff to the creek.

MG 1 Evaluate irrigation water, soils, growing media, and plant tissue to optimize plant growth and avoid over-fertilization.

1.1 Regularly monitor the quality of your irrigation source water. Sample seasonally (if well water or if surface water such as ponds or creeks) or annually (if municipal water). Analyze for levels of constituents such as bicarbonates (HCO_3^-), sodium (Na), chloride (Cl^-), nitrate (NO_3^-), boron (B), soluble salts, and pH. Undesirable levels of these constituents may affect crop growth and health. Utilize a commercial lab for analysis. Soluble salts, pH, nitrate, and phosphate (PO_4^{3-}) can be analyzed on-site with instruments and kits designed for use by individual growers. (Photo #11, p.43)

1.2 If well water is used on-site for human consumption, have the well water tested regularly for contamination from fertilizers.

1.3 Maintain records of irrigation source water quality, especially if of variable quality.

1.4 Consider nutrients already present in your irrigation water, recovered runoff, composts,

manures, and previous fertilizer applications in fertilizer management decision-making. Over-fertilization can result if nutrients already present in the growing environment are not taken into account.

1.5 Regularly test soil for nutrients, soluble salts, and pH. Along with plant tissue analysis, soil tests are your best guide to effective use of fertilizers. (Photo #12, p.43)

1.6 Test plant tissue to determine concentrations of macro- and micro-nutrients.

1.7 Use information and recommendations from soil and plant tissue analyses in fertilization management.

1.8 When available, use nutrient recommendations for your specific crop. Use the most up-to-date recommendations from farm advisors and publications.

1.9 Regularly test fertigation water to monitor fertilizer levels and ensure injectors are properly operating.

MG 2 Conduct efficient fertilizer and leaching practices.

2.1 Incorporate solid fertilizers in a manner that optimizes nutrient availability to growing roots. Incorporate solid fertilizers into the soil through disking, plowing, rotary tilling or subsurface banding; this will provide good nutrition and avoid leaching losses of fertilizer nutrients.

2.2 Use composts or manures that are thoroughly composted before application. Composts and manures that are not thoroughly composted may contribute bacteria and other contaminants to runoff.

2.3 Carefully apply top-dressed fertilizers to keep granules around the plants at the correct rate. If using a spreader with an uneven broadcast ensure fields are bordered by vegetation to trap misapplied nutrients.

2.4 Ensure that injected fertilizers are carefully mixed and applied at correct rates. If applying fertilizers using sprinkler irrigation ensure that fields are bordered by vegetation. Avoid sprinkler fertigation during windy weather.

2.5 Calibrate fertilizer injectors to accurately deliver liquid fertilizer through the irrigation system.

2.6 Utilize slow-release or controlled-release fertilizers to maximize the amount of fertilizer used by plants.

2.7 Time fertilizers with environmental parameters and growth stage of the plants. Fertilizer management that provides nutrients at appropriate growth stages will result in better plant nutrition and minimize nutrient losses to the environment.

MG 3 Avoid fertilizer material spills during all phases of transport, storage, and application.

3.1 Store fertilizers in a storage structure that complies with local, state, and federal guidelines. (Photo #15, p.44)

3.2 Locate fertilizer storage and mixing areas as far away from water conveyances (streams, creeks, and storm drains) as possible.

3.3 Include a concrete pad and curb to contain spills and leaks in the fertilizer storage facility. This pad area should be protected from rainfall and irrigation to prevent fertilizer residues from washing into surface water bodies.

3.4 Equip fertilizer tanks with secondary containment to contain spills and leaks. (Photo #16, p.44)

3.5 Conduct fertilizer mixing and loading operations on an impermeable surface such as a concrete floor in areas where potential for runoff is low; perform fertilizer operations at least 100 feet down-slope of a well or other water supply. These are legal requirements. (Photo #17, p.44)

3.6 Verify regularly that fertigation equipment is properly calibrated and fertilizer solution tanks are free of leaks.

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

3.8 When transferring fertilizer into on-farm storage or into a fertilizer applicator, take care that you do not allow materials to spill.

3.9 Immediately clean up fertilizer spills, and do so according to a predetermined protocol.

3.10 Use check valves on application equipment. When applying fertilizer from a tractor or rig in a field, shut off the fertilizer applicators during turns.

3.11 Whenever you are injecting fertilizer into irrigation water, make sure that you do not allow backflow into wells or other water sources; install backflow prevention devices and check them at least once a year, recording the date and result of this check.

3.12 Dispose fertilizer bags in trash bins with lids to prevent trash with fertilizer residues from blowing into nearby waterways.

C. Erosion and Runoff Management Goals and Management Practices

The third section deals with erosion and runoff management designed to prevent sediments and water, which can both carry nutrients, from leaving the property. Erosion and runoff management involves modifying soil to enhance its ability to hold water, creating barriers to the movement of sediments and water and capturing unused irrigation water for reuse or storage. While the TMDL does not regulate sediments in the creek specifically, erosion and runoff management can help decrease the amount of nutrients reaching the creek.

MG 1 Evaluate water quality of storm runoff to comply with water regulations and determine options for reuse or treatment.

1.1 Inventory chemicals used in your operation, especially those likely to be present in runoff such as pesticides, fertilizers, and shading compounds.

1.2 Regularly sample storm runoff water, as there will likely be seasonal variations in the analyses. Irrigation runoff should not exit property. Follow commercial lab instructions

for taking and handling storm runoff samples, as this will greatly affect the results.

1.3 Conduct analyses on runoff water samples to determine what is in it and at what levels. Parameters to test for include pH, electrical conductivity (EC), nitrate (NO_3^-) and phosphate (PO_4^{3-}), which can be analyzed on site with instruments and kits designed for use by growers. Alternatively, water samples can be sent to commercial labs. In addition, it is recommended to use a good commercial lab to test for other contaminants according to the products utilized such as specific pesticides that you suspect may be present in runoff. The lab should use EPA standards and be certified for Good Laboratory Practices (GLP).

1.4 Compare water analyses against local and state water quality standards and regulations.

MG 2 Use practices that improve soil/media infiltration and water-holding capacity to reduce soil erosion, runoff, and excessive leaching.

2.1 Incorporate organic amendments on sandy soil to improve water holding capacity and prevent excessive leaching.

2.2 Incorporate amendments on clayey soil to improve infiltration and reduce runoff.

2.3 Use mulches or cover crops on bare soil to reduce runoff. (Photo #32, p.47)

2.4 Maintain crop residues when not using cover crops. (Photo #33, p.47)

MG 3 Use practices that will retard movement of runoff water and sediment and keep it on the property.

3.1 Determine where and how much erosion and runoff is generated and if runoff exits the property. All dry weather runoff and sediment is prohibited from entering street gutters, rivers, creeks, or other conveyances that drain to public waters. Discharging dry weather runoff and sediment onto neighboring properties is also illegal, unless done with consent.

3.2 Establish engineered barriers or buffers between production areas and ditches, creeks, ponds, lakes, or wetlands. Examples of plant buffers include vegetated buffer strips, grass-lined channels, grass swales, and constructed wetlands. Buffer vegetation can help absorb both dry and wet weather contaminated runoff if properly located. Engineered barriers such as berms and containment structures can regulate runoff flow and contain it. For example, detention basins can temporarily hold excess storm water; the basin will slowly drain as the collected water infiltrates into permeable soil or evaporates. (Photo #19 and #20, p.45)

3.3 Discharge pumped or runoff water into filter areas.

3.4 Shape and seed field edges to filter runoff as much as possible.

3.5 Use conservation tillage practices such as no-till, ridge till, strip till and minimum till. (Photo #34, p.47)

3.6 Convert paved or bare soil areas to vegetation that will retard runoff and take up nutrients, pesticides, and other pollutants wherever possible. (Photo #21, p.45)

3.7 Consider using polyacrylamide (PAM) to remove sediment from runoff water.

3.8 Use windbreaks or shelterbelts in areas prone to wind erosion. (Photo #22, p.45)

3.9 If your property is affected by discharge sediment or runoff from upslope or upstream properties, use practices to contain this sediment or runoff (such as diversions, filter strips, sediment basins, underground outlets, etc.).

3.10 Perform maintenance on runoff barriers annually or as needed to ensure they continue to function as intended.

MG 4 Manage hilly, sloped areas to prevent soil erosion and increased runoff volume and velocity. This includes hilly production areas as well as sloped non-production areas.

4.1 Use terraces where appropriate to control soil erosion and runoff. (Photo #35, p.47)

4.2 Use appropriate mulches where appropriate to control soil erosion and runoff. Ensure that mulch will stick to the soil where applied, and does not include large clumps that will run off instead of absorbing/blocking water flow.

4.3 Use vegetation (cover crops, buffer strips, grassed swales, etc) to control soil erosion and runoff.

4.4 Use berms to control soil erosion and runoff. (Photo #24, p.45)

4.5 Use proper irrigation management in hilly production areas and in hilly landscaped non-production areas avoid runoff and soil erosion.

4.6 Use proper pest and nutrition management practices in hilly production areas and in hilly landscaped non-production areas to avoid pesticide and fertilizer runoff.

4.7 Perform maintenance on erosion control annually or as needed to ensure they continue to function as intended.

MG 5 Design and manage property roads to prevent erosion and contaminated runoff.

5.1 Ensure that all new roads are properly designed and permitted to avoid erosion. This may require the submission of an engineering plan, specifications, and an environmental assessment. Soils should be evaluated for erodibility, and excessive slopes should be avoided. To prevent contaminant-laden dust from traffic and wind erosion, seal or water unpaved roads. Roads can be sealed with non-toxic sealants, or seeded with perennial grass when possible.

5.2 Use waterbreaks (waterbars) on property roads with gradients exceeding 8%. These should be properly sized and placed only where water flow has an outlet and diverted water does not flow into septic fields or waterways.

5.3 Use filter strips between roads and waterways to absorb runoff from roads and trap toxic sediment. (Photo #25, p.46)

5.4 Inspect culverts and clean them out during winter rains so that water drains freely. When not maintained, build-up of eroded soil or other matter can clog culverts, potentially directing water over areas where it can become contaminated. To avoid creating contaminated runoff, culverts must be kept clear. (Photo #26, p.46)

5.5 Perform road maintenance annually or as needed.

MG 6 Collect excess irrigation and storm water runoff and sediment.

6.1 Use retention basins to store excess irrigation runoff and storm water. Basin capacity should be designed on the basis of probable storm events and to prevent seepage and groundwater contamination. Use qualified engineers for design and implementation. (Photo #27, p.46)

6.2 Use captured water to irrigate crops and/or non-crop areas, thereby preventing basin overflow. (Photo #28, p.46)

6.3 Consider planting water-loving crops (e.g. curly willow, papyrus) in collection basins to absorb water. (Photo #20, p.45)

MG 7 Manage roof runoff to reduce pollution and erosion, to prevent flooding, and improve drainage.

7.1 Direct roof runoff to avoid flow across areas where contaminants will be washed into the municipal storm water, sewer system, or agricultural drainage system. Roof runoff may contain pollutants e.g. toxic sediments and shading compounds. (Photo #29, p.46)

7.2 Direct roof runoff into pervious areas (gravel, vegetative, paving material, self-contained tail water system or retention ponds). (Photo #29, p.46)

7.3 Reuse collected roof runoff to irrigate non-crop or crop areas. (Photo #29, p.46)

D. Personnel Training

This section outlines the various practices in which all relevant operation personnel should be trained. Training ensures that personnel understand why and how nutrient reduction management practices should be done and increases the likelihood that practices will be implemented. (Photo #30, p.46)

MG 1 Provide appropriate training for personnel involved in irrigating in a language that personnel clearly understand.

1.1 Provide training to ensure that irrigation duties are performed only by personnel who understand and practice appropriate irrigation scheduling, irrigation application practices, and crop management practices related to runoff management.

1.2 Ensure that appropriate personnel are trained in proper irrigation system maintenance procedures and record keeping related to maintenance.

1.3 If irrigation audits are performed, ensure that personnel are trained to evaluate irrigation systems correctly and regularly.

MG 2 Provide organized training sessions for personnel handling fertilizers in a language that personnel clearly understand.

2.1 Provide training to ensure that appropriate personnel understand how and when to use

fertilizers.

2.2 Provide training to ensure that appropriate personnel understands safe fertilizer transport, storage, and disposal practices.

2.3 Provide training for all personnel on what to do in case of a fertilizer spill.

MG 3 Provide organized training sessions for personnel in runoff management in a language that personnel clearly understand.

3.1 Ensure that all appropriate employees receive training in runoff management and all applicable regulations. All growing operation employees must understand and implement the required practices for runoff management to be effective.

3.2 Train staff so that they become aware of all drainage conduits and ditches on the property and know where they drain.

3.3 Ensure that all municipal stormwater or sewer system conduits and ditches are stenciled or designated with signs, and that there are no illicit connections to the municipal stormwater or sewer system.

E. Record Keeping

This section describes the pieces of information of which growers should keep record. Records allow growers to prove which practices they have implemented in order to reduce their nutrient contribution, in addition to complying with other regulations that require records.

MG 1 Maintain records of all nursery practices and data.

1.1 Maintain records of fertilizer use. These may be required by regulatory agencies and are useful in obtaining permits or conditional waivers for agricultural discharge. Records can help you make informed decisions regarding fertilizer management.

1.2 Maintain records of runoff water quality for at least 5 years.

1.3 Implement and maintain a record-keeping system for documenting management practices addressing runoff management. Record-keeping may be required by some regulating authorities.

1.4 Maintain records of all personnel training for at least 5 years. Records should include when training occurred, who led the training, who participated, and what information was covered.

Chapter 3
Management Options for Residents and Animal Owners

Introduction

The Rainbow Creek watershed is for the most part sparsely populated, but certain areas in the watershed have a high density of residences and businesses. Homes and offices can contribute nitrogen and phosphorus to the creek through the use of septic tank disposal systems and through landscape irrigation and fertilization. In addition, animal ownership in the area, which mostly consists of hobby horses and some goats and fowl, can contribute nutrients from runoff of manure and used bedding, either directlyor through contaminated water.

The Rainbow Creek TMDL estimates the nutrient load from residential sources by multiplying established loads from comparable regions by the area of land used for residences. These estimations show that residential sources contribute 17% of the annual nitrogen load from land uses in Rainbow Creek and 32% of the annual phosphorus load. In order to comply with the TMDL, residential areas in Rainbow Creek are required to make a 77% reduction in their nitrogen contribution, from 650 to 149 kg N/yr, and a 90% reduction in their phosphorus contribution, from 125 to 12 kg P/yr. Septic tanks systems as a whole are also required to make a 77% reduction in nitrogen contribution, from 200 to 46 kg N/yr.

The following management options were developed to help home, business, and animal owners work toward compliance with the TMDL by choosing those options that make the most sense for them. First, we will list the management options we consider to be priorities based on effectiveness, cost and ease of implementation.

Top priority septic system management options:	
- avoid construction over leachfield (MG1.3)	- fix leaking faucets and toilets (2.5)
- shallow-rooted plants over leachfield (1.5)	- avoid garbage disposal (3.1)
- pump septic system regularly (1.6)	- collect grease in a jar (3.2)
- use high-efficiency toilets (2.1)	- do not flush non-degradable items (3.4)
- use faucet aerators (2.2)	- do not pour haz mats in drain (3.5)
- turn off faucets (2.3)	
- run dish/clothes washers only when full (2.4)	
Top priority garden management options:	
- use compost (1.2)	- perform irrigation system review (3.1)
- use mulch (1.4)	- perform irrigation needs review (3.2)
- use slow-release fertilizer (1.5)	- use drip irrigation (3.3)
- fertilize carefully (1.6)	- water in early morning (3.4)
- assess garden needs (2.1)	- use an outdoor water timer (3.5)
Top priority lawn management options:	
- use compost (1.2)	- water in early morning (1.9)
- use slow-release fertilizer (1.7)	- avoid watering sidewalks (1.10)

Top priority animal management options:	
- inspect/clean culverts (1.8)	- store dry wastes in sheds (4.3)
- divert wash water into barriers (1.1)	- collect pet waste and dispose in trash (6.1)
- div. water away from manure/bedding (1.2)	- do not compost do and cat waste (6.2)
- clean pens 2 times/wk or as needed (4.2)	- put kitty litter in trash (6.3)

A. Septic System Management Goals and Management Practices

The first section addresses septic system design and management as a way of reducing the nutrient contribution from residences and offices. It describes the proper design and maintenance required to help minimize the risk of damage to the septic system, which can result in added nutrient contribution.

MG 1 Design/retrofit your septic system to fit your household's or staff's needs and maintain the system with inspection and pumping

1.1 Ensure you are using the appropriate size and type of septic system, whether through new design or upgrade, for your household and your volume of water and solids.

1.2 Do not construct structures, walkways, patios, swimming pools, equipment storage, driveways or parking lots over a leachfield to prevent pressure damage and maintain maximum evapotranspiration.

1.3 Divert surface flow away from the leachfield to avoid erosion, minimize excess filtration in the leachfield and maximize the function of the leach lines.

1.4 Plant only shallow-rooted plants over the leachfield. Deep roots of trees and shrubs can cause damage to the system. (Photo #36, p.47)

1.5 Have your system inspected and pumped as recommended, generally every 3 to 5 years. See Appendix 2 for recommended inspection and pumping frequencies (p.38). Keep a record of when and by whom the system was inspected and pumped.

1.6 Keep records of your system size and location of the tank and leachfield. Records of systems for houses built after 1975 can be obtained from the Department of Environmental Health.

1.7 Familiarize yourself with the layout of the septic system: tank inlet, tank cover, tank outlet, and leach lines. Any unusual wetness or plant growth might indicate leakage. See Appendix 2 for a diagram and description of septics (p.38).

MG 2 Use water efficiently to reduce the risk of liquid overload to the system

2.1 When renovating, install high-efficiency toilets and showerheads to save water. To save water with a standard toilet, place a plastic milk jug filled with small rocks and tightly capped into the toilet tank, away from any moving parts. The jug will displace the water in the tank and allow the toilet to use less water with each flush.

2.2 Install faucet aerators in the kitchen and bathroom to reduce the volume of water used.

2.3 Turn off faucets when not in use while shaving, brushing teeth, washing dishes, etc.

2.4 Run the dishwasher and clothes washer only when they are full. Avoid running the clothes washer multiple times in one day to give the system time to process the water.

2.5 Fix all leaking faucets and toilets promptly.

MG 3 Avoid discharging any clogging or hazardous materials into the system

3.1 Minimize or avoid use of the garbage disposal to reduce the amount of solid matter entering the system.

3.2 Collect grease in a container near the sink rather than pouring it down the drain.

3.3 After scraping plates, use paper towels to finish wiping off food residue such as sauces and oil.

3.4 Do not flush non-degradable items such as diapers, sanitary napkins, kitty litter, paper towels, dental floss, cotton swabs, cigarette butts, coffee grounds, etc that can clog pipes.

3.5 Do not pour hazardous materials such as household chemicals, gasoline, oil, pesticides, antifreeze or paint down drains. These materials can destroy the biological treatment taking place in the system and can contaminate surface and ground water.

3.6 Do not use commercially-sold septic tank additives, which can disrupt the biologically processes occurring in the tank.

B. Garden Management Goals and Management Practices

The second section addresses garden management practices. These practices encourage the establishment of healthy soil that can retain water and nutrients, the choice of appropriate plants for the climate of Rainbow Creek, and the efficient use of water and nutrients to minimize loss of these landscaping elements from the property.

MG 1 Build and maintain healthy soil

1.1 Use soil tests to determine how much nitrogen, phosphorus, potassium, lime, etc your soil already has. If enough of one or more nutrients already exists in your soil, you can avoid adding them artificially. Contact the Mission Resource Conservation District or Cooperative Extension office for soil tests. (Photo #37, p.48)

1.2 Use compost to increase the nutrient absorption capacity and porosity of your soil. Dig or rototill one to three inches of compost into 6 to 12 inches of top soil when you're making new beds. Compost helps sandy soils hold nutrients and water, loosens clay soils and feeds the beneficial soil life so it can feed and protect your plants. Compost can be obtained from garden stores or the county landfill, or you can make your own. See Appendix 3 for helpful online composting resources (p.40). To make your own compost you can use leaves, chopped stalks, flowers and grass, as well as vegetable scraps and coffee grounds from the kitchen. Meats, dairy and oils can attract pests, so should be avoided. Turn your compost every few weeks with a pitchfork to distribute air and moisture. Sprinkle water on your pile in dry weather. Compost is ready when the waste becomes a dark, crumbly material that is uniform in texture. Use the hand-squeeze test: The compost should hold its shape when squeezed but then crumble gently

as you open your hand. You can then spread your compost in garden beds, under shrubs, on your lawn, or use it as potting soil. (Photo #38, p.48)

1.3 Avoid placing compost piles near drains or surface waters.

1.4 Spread mulch, a layer of organic material like leaves, aged wood chips, compost or grass clippings around your plants in spring or fall. Never exceed more than three inches of mulch in your landscaping beds, and keep mulch about an inch away from stems and tree trunks. Mulch stabilizes soil temperature, prevents weeds, feeds the soil for healthier plants and helps to conserve water. (Photo #39, p.48)

1.5 When fertilizer is required use slow-release fertilizer. Nutrients are distributed to plants more evenly and slowly, allowing plants to use more of the nutrients provided. Fewer nutrients are therefore unused and able to leave the property as runoff.

1.6 When fertilizing, following fertilizer instructions carefully. Take care to ensure no fertilizer is applied to sidewalks or walkways. Do not fertilize during or directly before rain.

MG 2 Choose appropriate plants for your site

2.1 Assess the characteristics of your garden site (soil pH, soil type and sunlight) as well as your desires for the garden (privacy, play area, color) to determine appropriate plants.

2.2 Select plants that grow well in a warm and dry climate and fit the amount of sun, type of soil and water available in your yard. When possible, use low-water plants to save the time and expense of watering and minimize runoff. See Appendix 3 for websites with helpful plant lists (p.40). Think about how big a tree or shrub will be when mature, especially next to your house or driveway and near power lines.

2.3 Choose pest-resistant plants. Many garden centers and nurseries offer information about pest- and disease-resistant plant varieties. After they're established, they'll save you time and money on pest control.

MG 3 Water efficiently to conserve water and minimize the amount of water running off the property

3.1 Perform an irrigation system review to ensure your system is in working order.

3.2 Perform an irrigation review, consulting published irrigation recommendations, to determine the amount of water required by your plants. Both over- and under-watering can be damaging to plants.

3.3 Use soaker hoses or drip irrigation rather than sprinklers on beds to save water. (Photo #40, p.48)

3.4 Water in the early morning if possible. Water evaporates more readily at midday, and in the evening water is more likely to encourage the growth of mold or plant diseases.

3.5 Use an outdoor water timer to automatically adjust watering to weather conditions.

C. Lawn Management Goals and Management Practices

The third section deals with lawn management practices designed to prevent water and nutrients from leaving the property. Often in Southern California and other areas of dry, warm weather residents choose to landscape with native and low-water plants instead of traditional lawn grass. However, if you choose to grow a lawn, these practices can be used to maximize the efficiency of water and fertilizers and to prevent runoff.

MG 1 Water and fertilize lawns carefully and efficiently to avoid runoff

1.1 Plant lawns only on relatively level ground with sufficient sun. When planting lawns consult with your local nursery or the UCCE Master Gardeners to determine the best variety for your location. On slopes or shady areas consider planting other ground covers that require less water and maintenance. (Photo #41, p.48)

1.2 Incorporate 6 to 12 inches of compost into the soil for a new lawn. Top dress existing lawns with a quarter- to half-inch of compost every spring or fall to maintain soil nutrients and porosity.

1.3 Sharpen the mower blade frequently to cut the grass blades cleanly and evenly. Dull mower blades leave jagged tips on the grass that will dry out and turn brown, that causes many homeowners to over-water or over-fertilize needlessly.

1.4 Maintain an optimal blade height to keep the lawn healthy.

1.5 Aerate and de-thatch lawns routinely to provide a healthy root system. This practice can lead to more efficient irrigation and fertilizer use by allowing the soil easier access to applied water and nutrients.

1.6 Avoid placing lawn clippings in storm drains or in areas where they are likely to be washed into drains. Clippings can be composted or thrown away.

1.7 Use slow-release fertilizers when necessary to maximize the benefit to plants.

1.8 Water only as much as required by your variety of grass. Avoid over watering your lawn to prevent runoff. (Photo #42, p.49)

1.9 Water in the early morning, if possible, minimize evaporation and growth of mold and plant diseases.

1.10 Ensure that sprinklers do not water sidewalks or other impervious areas. (Photo #42, p.49)

D. Livestock and Pet Management Goals and Management Practices

The fourth section provides management options to prevent the contribution of nutrients by pets and livestock. Animals can contribute nutrients to the creek and groundwater primarily through their waste. These management options help to keep waste and water contaminated with waste from reaching surface and/or ground waters. Practices that address erosion are intended to prevent soil and water contaminated with nutrients from leaving the property and entering waterways.

MG 1 Design and manage property facilities to prevent erosion and contaminated runoff.

1.1 Locate livestock facilities and conduct activities away from waterways, flood-prone areas and steep hillsides. Address water quality concerns in the design of new facilities and work to upgrade existing facilities.

1.2 Ensure that all new roads are properly designed and permitted to avoid erosion. This may require the submission of an engineering plan, specifications, and an environmental assessment. Soils should be evaluated for erodibility, and excessive slopes should be avoided.

1.3 Ensure that all new horse trails are designed to avoid erosion. Incorporate switchbacks on sloping trails.

1.4 Prior to October 1st, re-blade and repair erosion-prone roads and trails. Make sure they are graded properly to minimize erosion.

1.5 Install erosion control devices such as sandbags, silt fences and straw wattles along erosion-prone roads and trails as temporary measures. If left alone in place, these devices can break down and present a safety hazard. (Photo #43 and #44, p.49)

1.6 Use waterbreaks (waterbars) on property roads with gradients exceeding 8%. These should be properly sized and placed only where water flow has an outlet and diverted water does not flow into septic fields or waterways.

1.7 Use filter strips between roads and waterways to absorb runoff from roads and trap sediment. (Photo #25, p.46)

1.8 Inspect culverts and clean them out prior to October 1st so that water drains freely during winter rains. (Photo #26, p.46)

1.9 Prevent contaminant-laden dust from traffic and wind erosion by sealing or watering unpaved roads. Ensure that dust control with applied water does not create runoff.

1.10 Use dry cleaning methods, such as sweeping regularly in parking areas and roads to remove dirt and other contaminants that could enter waterways.

MG 2 Limit runoff of livestock waste by containing animals and their waste.

2.1 Use fencing to restrict livestock access to surface waters and drainage areas. Fencing limits the amount of animal waste reaching these areas, in addition to protecting surface water edges from erosion caused by livestock grazing. (Photo #45, p.49)

2.2 Use barriers such as vegetated filterstrips to protect surface waters, hold soil in place and filter runoff water. Buffers can be built around animal holding areas or facilities, and/or along the edge of surface waters. They can also be used to separate animal grazing areas from cropland treated with manure. (Photo #25, p.46)

2.3 Divert rainwater away from animal confinement areas to keep water from picking up wastes.

MG 3 Keep livestock wash water away from surface and ground water.

3.1 Divert animal wash or cooling water away from surface waters and/or into vegetated

filterstrips and/or gravel filtration areas to allow for absorption of nutrients and salts. 3.2 Divert animal wash or cooling water away from manure and used bedding stockpiles to prevent water from collecting nutrients and salts.
MG 4 Collect and store livestock waste carefully to prevent runoff of wastes. 4.1 Utilize animal bedding such as straw or wood shavings in confinement areas to absorb moisture and manure. (Photo #46, p.49) 4.2 Clean animal pens at least twice per week or as needed to prevent build up of wastes. 4.3 Use sheds or dumpsters, located away from surface waters, for storage of waste. Waste can then be incorporated into soil to meet the needs of treated plants or transported out of the watershed for disposal in a landfill.
MG 5 Treat animal wastes to create safe, usable material for fertilization or soil treatment. 5.1 Compost manure in sheds or open-air stacks to make a humus-like material that can be applied to land as a fertilizer or soil conditioner. Regularly mix or turn the stack to provide air for decomposition of waste solids. Household organic waste can be added to this compost. If spreading a thin layer of horse manure over the top of cropland use approximately 7 tons/acre. If incorporating into the soil use between 5 and 6 tons/acre to distribute 80 lb N/acre. (Photo #13, p.44)
MG 6 Collect and dispose of household pet waste properly to avoid contribution to surface or groundwater nutrient levels. 6.1 Collect pet wastes from yard and pet walking areas daily and dispose of in trash. (Photo #47, p.49) 6.2 Do not compost pet wastes to prevent transmission of parasites. 6.3 Dispose of used kitty litter in the trash as opposed to flushing down the toilet.

Chapter 4
Common Pollution Prevention Management Options

Introduction

The section illustrates further ways all those working and/or living in the Rainbow Creek watershed can reduce their nutrient contribution from areas such as roads, walkways, vehicles and restrooms. These management options apply to all types of development, commercial and residential, in the watershed.

MG 1 Ensure that all non-production areas do not contribute to dry or wet weather runoff. These include walkways, driveways, packing areas, loading areas and parking areas.

1.1 Clean indoor walkways, loading areas, and packing areas using only "dry" methods (such as sweeping, dry absorbents) or if wet cleaned, ensure that wash- and rinse-water remain on the property. These areas may contain fertilizers, pesticides and vehicle fluids that could contaminate surface or groundwater.

1.2 Periodically clean outdoor driveways, walkways, parking areas, loading areas, and packing areas to remove debris, vehicle residues, and other contaminants and prevent them from washing off during wet weather. Use only "dry" methods (such as sweeping, dry absorbents) or if wet cleaned, ensure that wash- and rinse-water remain on the property.

MG 2 Maintain vehicles, trucks and tractors and their storage areas so that they do not leak fluids into ground or surface waters.

2.1 Regularly maintain vehicles, trucks, and tractors used in the operation to detect and prevent fluid leaks that are very toxic to the environment.

2.2 Take vehicles to a car wash, or ensure that wash runoff from vehicles, trucks, and tractors remains on the property and does not drain into the municipal stormwater or sewer system, or leach into groundwater.

2.3 Properly dispose of collected fluids. (Photo #48, p.49)

2.4 Whenever possible, remove vehicles, equipment, and storage tanks that are no longer used on the property.

2.5 Drain and properly dispose of fluids from vehicles and equipment in long-term storage.

2.6 Locate maintenance and storage areas for vehicles, trucks, and tractors where wet weather will not wash fluids into surface water or cause them to percolate into groundwater.

2.7 Clean maintenance and storage areas to avoid oil and grease buildup.

2.8 Immediately and properly clean up spills from vehicles, trucks and tractors.

MG 3. Locate and maintain fuel tanks so that they do not leak, spill, overflow, or leach into ground or surface water.

3.1 Locate fuel tanks where wet weather will not wash fluids into surface water or cause them to percolate into groundwater.

3.2 Check and maintain fuel tanks to prevent leaks.

3.3 Perform fueling activities carefully to avoid overflow and spills.

3.4 Immediately and properly clean up fuel spills.

MG 4 Keep the property free of green waste, construction debris and trash so that it does not clog storm drains and create an unsightly mess in waterways and on beaches.

4.1 Regularly maintain the entire property to keep it clean and free of debris. Solid waste and debris can cause fatalities for marine life through strangling or ingestion.

4.2 Ensure that an adequate number of waste containers are available where needed and that they are regularly collected to avoid overflow.

4.3 Ensure that waste containers are kept in good condition and kept closed.

4.4 Ensure that waste containers, collection areas, storage areas, and stockpile areas are located indoors or covered when outdoors to prevent wet weather or wind from washing or blowing trash into storm drains and waterways.

4.5 Dispose of green waste in designated greenwaste receptacles or compost in a contained compost pile or bin.

MG 5 Maintain restrooms to avoid spills and leakage of fecal coliform from human waste into the municipal stormwater or sewer system. Fecal coliform at high levels causes beach closures and poses serious human and animal health hazards.

5.1 Ensure that adequate restrooms and portable toilets are available where needed. Providing restrooms prevents human waste from contributing nutrients to the soil or water of the property. In addition, restrooms are required in work places by the Department of Labor's Occupational Safety and Health Standards.

5.2 Ensure that toilets, floor, and sink drains in restrooms are properly hooked up to the sanitary sewer system.

5.3 Ensure that portable toilets are located where wet weather will not wash waste into the municipal stormwater system and where vehicles will not knock them over.

5.4 Ensure that restrooms and portable toilets are regularly maintained to prevent sewage and human waste from entering the municipal stormwater systems.

MG 6 Provide organized training sessions in waste, sanitation, and spill management for all personnel in a language that they clearly understand, and maintain records documenting training.

6.1 Ensure that all employees receive training in proper waste disposal and use of restrooms/portable toilets.

6.2 All employees should be trained on what to do in the event of a spill.

6.3 Educate and require your employees to recycle all the waste that you can from your nursery operation, such as metal, oil, paper, and plastic.

6.4 Educate employees in the proper disposal of batteries, paints, and other potentially hazardous materials used.

6.5 Document and maintain records of employee training for at least five years. Record-keeping helps to document waste, sanitation, and spill management practices and is required by some regulating authorities.

Appendix 1
Nitrogen and Phosphorus Reductions Required by the TMDL

The TMDL report outlines required nutrient reductions over a 16-year period beginning 2005. These initial estimates were developed by the California Regional Water Quality Control Board, San Diego Region. These are based on available land use models and are calculated by multiplying the acreage of land in a particular use in 2000 by an appropriate nutrient export coefficient obtained from literature studies. These reductions will serve as targets with which to begin the process of reducing nutrient levels in Rainbow Creek. The TMDL includes provisions for re-evaluating the nutrient reduction targets at regular intervals as the program is implemented and new data becomes available. The following tables summarize the required percent reductions and the current and final target amounts of each nutrient in kilograms per year.

Required Reduction in Nitrogen

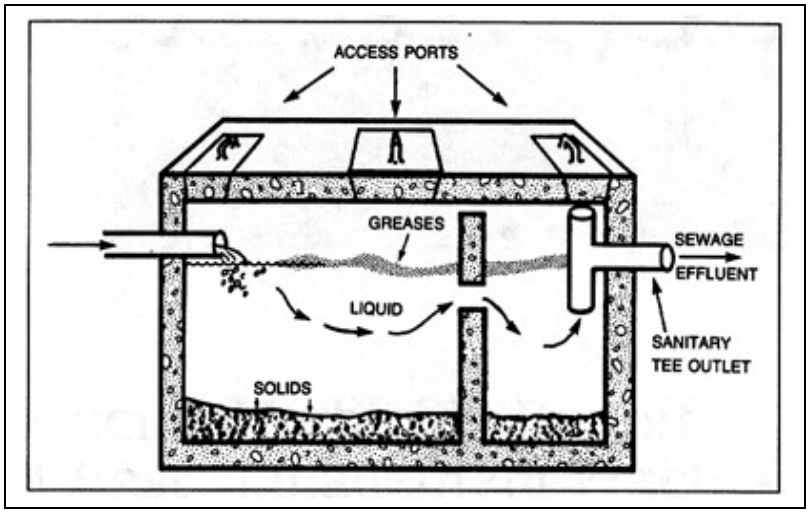
Source	% Required Reduction	Current kg N/yr	Target kg N/yr
Commercial nurseries	77	507	116
Agricultural Fields	77	655	151
Orchards	77	790	182
Residential Areas	77	650	149

Required Reduction in Phosphorus

Source	% Required Reduction	Current kg P/yr	Target kg P/yr
Commercial nurseries	89	27.4	3
Agricultural Fields	89	35.4	4
Orchards	90	63	6
Residential Areas	90	125	12

Appendix 2
Septic System Diagrams and Tables

Cross Sectional Diagram of Typical Septic Tank



There are two main parts to the basic septic system: the septic tank and the drain field. Household wastewater first flows into the septic tank where it should stay for at least a day. In the tank, heavy solids in the wastewater settle to the bottom forming a layer of sludge, and grease and light solids float to the top forming a layer of scum. The sludge and scum remain in the tank where naturally occurring bacteria work to break them down. The bacteria cannot completely break down all of the sludge and scum, however, and this is why septic tanks need to be pumped periodically. The separated wastewater in the middle layer of the tank is pushed out into the drain field as more wastewater enters the septic tank from the house. If too much water is flushed into the septic tank in a short period of time, the wastewater flows out of the tank before it has had time to separate. This can happen on days when water use is unusually high, or more often if the septic tank is too small for the needs of the household.

Homeowners should stagger their laundry throughout the week and try to do no more than two wash loads per day. When wastewater leaves a septic tank too soon, solids can be carried with it to the drain field. Drain fields provide additional treatment for the wastewater by allowing it to trickle from a series of perforated pipes, through a layer of gravel, and down through the soil. The soil acts as a natural filter and contains organisms that help treat the waste. Solids damage the drain field by clogging the small holes in the drain field pipes, and excess water strains the system unnecessarily. Conventional septic systems are a very simple way to treat household wastewater. They contain no moving parts and are easy to operate and maintain. Although homeowners must take a more active role in maintaining septic systems, once they learn how their systems work, it is easy for them to appreciate the importance of a few sound operation and maintenance practices.

Recommended Septic Tank Pumping Frequencies (in years)

Household Size (Number of Occupants)										
	1	2	3	4	5	6	7	8	9	10
Tank Size (gal)*										
1000	12.4	5.9	3.7	2.6	2.0	1.5	1.2	1.0	0.8	0.7
1250	15.6	7.5	4.8	3.4	2.6	2.0	1.7	1.4	1.2	1.0
1500	18.9	9.1	5.9	4.2	3.3	2.6	2.1	1.8	1.5	1.3
2000	25.4	12.4	8.0	5.9	4.5	3.7	3.1	2.6	2.2	2.0

* Septic Tank minimum size requirements
1000 gallons for 1-3 bedrooms
1250 gallons for 4 bedrooms
1500 gallons for 5-6 bedrooms
2000 gallons for 7 or more bedrooms

Appendix 3
Helpful Online Resources

General:

University of California Cooperative Extension

http://www.cesandiego.ucdavis.edu/

The UC Cooperative Extension, a branch of the UC Division of Agriculture and Natural Resources, employs farm, 4-H, and nutrition, family and consumer sciences advisers throughout the state to research and provide public education on these topics.

Master Gardener Association

http://www.mastergardenerssandiego.org/

The Master Gardeners are a branch of the University of California Cooperative Extension. They are over 100 trained volunteers who provide free home gardening and pest control advice in the county.

United States Department of Agriculture

http://www.usda.gov

The USDA is the federal department devoted to issues of food, agriculture, and natural resources. It oversees federal farm policies such as the Farm Bill, and also has departments in each state.

Natural Resources Conservation Service

http://www.nrcs.usda.gov

The NRCS is the division of the US Department of Agriculture dedicated to helping private land owners and operators in the conservation of natural resources.

Mission Resource Conservation District

http://www.missionrcd.org

The MRCD is a unit of state government that disseminates information on natural resource conservation issues, agricultural advice, and environmental quality/wildlife concerns. This website provides advice for growers and residents of the area. In addition, MRCD can be contacted for irrigation water and soil tests.

County of San Diego

http://www.co.san-diego.ca.us/

Use this website to access all County of San Diego projects, departments and resources.

County of San Diego Agriculture, Weights and Measures

http://www.sdcounty.ca.gov/awm/

This site links to all agriculturally related programs in the County of San Diego.

San Diego Regional Water Quality Control Board

http://www.waterboards.ca.gov/sandiego/

The RWQCB works to "preserve, enhance and restore" the quality of regional water bodies. This site links to all RWQCB programs and regulations.

Project Clean Water

www.projectcleanwater.org

Project Clean Water is an organization that provides a forum for interested parties to identify, become educated, discuss, and find consensus on relevant water issues in the San Diego Region.

Rainbow Creek

www.rainbowcreek.org

This site was created to track the progress of the this document. It includes information on the TMDL, links to various resources, meeting details, and more.

Composting:

How to Compost

http://www.howtocompost.org

This site provides a large amount of information on composting from small to large scale.

Cornell Composting

http://www.css.cornell.edu/compost/Composting_Homepage.html

This site is operated by the Cornell University Waste Management Institute and provides information on the science and practice of composting.

Solana Center for Environmental Innovation

http://www.solanacenter.org/1solana_compost.html

This site is the composting page of the site of the Solana Center, a private nonprofit organization located in San Diego County. The composting page includes a downloadable "Guide to Backyard Composting," among other useful information.

Low Water-Use Plants:

San Diego County Water Authority Xeriscape Principles

http://www.sdcwa.org/manage/conservation-xeriscape.phtml

This site provides principles for growing a xeriscape, or low water-use, landscape, including a downloadable xeriscape brochure.

Eastern Municipal Water District Low Water-Use Plants List

http://www.emwd.org/conservation/pdf/PlantsforSC.pdf

This PDF file is both a list of low water-use plants and a guide for gardening with them.

San Marcos Growers Low Water-Use Plants List

http://www.smgrowers.com/products/plants/region_list.asp?region_id=19&page=1

This site from the San Marcos Growers in Santa Barbara provides an extensive list of plants.

Appendix 4
Photographs

1. Pressure regulators (1.A.1.5, p.8)

2. Pressure compensating emitters (1.A.1.6, p.8)

3. Flow control nozzle (1.A.1.8, p.8)

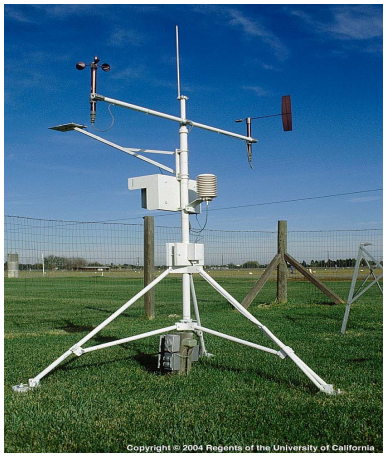
4. Leaking irrigation lines (1.A.2.1, p.9)

5. Closely spaced plants (1.A.3.1, p.9)

6. Misplaced emitters (1.A.3.2, p.9)

7. Emitters with check-valves (1.A.3.4, p.9)

8. On/off valve on hand watering (1.A.3.5), p.9



9. CIMIS weather monitoring (1.A.4.1, 2.A.4.1, p.10, 21)

10. Automatic watering clocks (1.A.4.6, 2.A.4.5, p.10, 21)

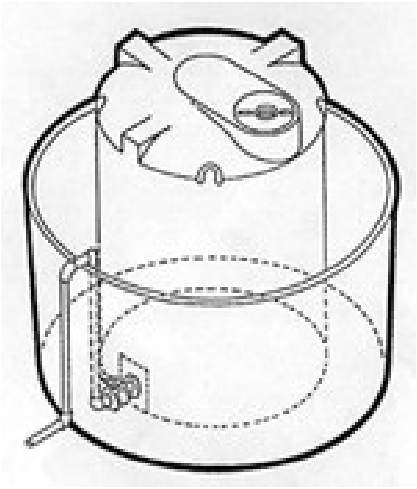
11. Source water quality monitoring (1.B.1.1, 2.B.1.1, p.10, 21)

12. Soil/growing media testing (1.B.1.5, 2.B.1.5, p.11, 22)

13. Thoroughly-composted compost (1.B.2.2, 3.D.5.1, p.11, 34)

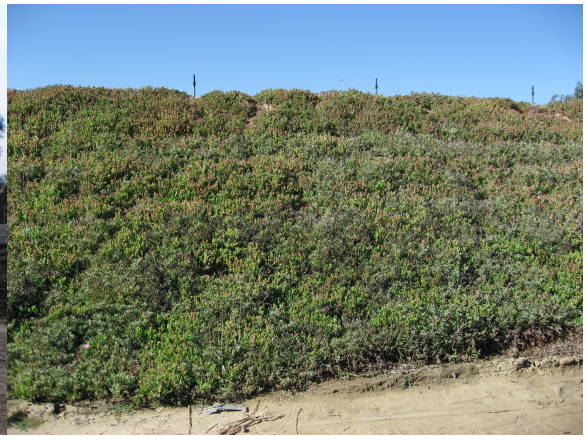
14. Top-dress fertilizer in pot (1.B.2.3, p.11)

15. Fertilizer storage container (1.B.3.1, 2.B.3.1, p.12, 22)



16. Secondary fertilizer containment (1.B.3.4, 2.B.3.4, p.12, 23)

17. Fertilizer mixed on impermeable surface (1.B.3.5, 2.B.3.5, p.12, 23)



18. Cover crops on bare hills (1.C.2.3, 1.C.4.3, p.13)

19. Grass-lined channel (1.C.3.2, 2.C.3.2, p.14, 24)

20. Drainage channel with water-loving plants (1.C.3.2, 2.C.3.2, 2.C.6.3, p.14, 24, 26)

21. Use vegetation in bare soil areas (1.C.3.3, 2.C.3.6, p.14, 24)

22. Windbreaks to control erosion (1.C.3.5, 2.C.3.8, p.14, 25)

23. Terraced hills (1.C.4.1, p. 14)

24. Berm (1.C.4.4, 2.C.4.4, p.14, 25)

25. Filterstrip next to waterway (1.C.5.3, 2.C.5.3, 3.D.1.6, 3.D.2.3, p.15, 25, 33)

26. Culvert (1.C.5.4, 2.C.5.4, 3.D.1.7, p.15, 25, 33)

27. Retention basin (1.C.6.1, 2.C.6.1, p.15, 26)

28. Treatment of captured water (1.C.6.2, 1.C.6.3, 2.C.6.2, p.15, 26)

29. Capturing of runoff (1.C.7.1-3, 2.C.7.1-3, p.15-16, 26)

30. Personnel training (1.D, 2.D, p.16, 26)

31. Hand watering nozzle with on/off valve (2.A.3.4, p.20)

32. Cover crops on bare soil (2.C.2.3, p.24)

33. Crop residue (2.B.2.4, p.24)

34. Conservation tillage (2.C.3.5, p.24)

35. Use terracing on hills (2.C.4.1, p.25)

36. Myrtle, a shallow-rooted plant (3.A.1.4, p.29)

37. Garden soil test for nutrients (3.B.1.1, p.30)

38. Garden compost pile (3.B.1.2, p.30)

39. Mulch between garden plants (3.B.1.4, p.30)

40. Drip irrigation (3.B.3.3, p.31)

41. A low-water groundcover (3.C.1.1, p.31)

42. Sidewalks with lawn runoff (3.C.1.4, 3.C.1.6, p.32)

43. Silt fences next to a road (3.D.1.5, p.33)

44. Straw wattle near road (3.D.1.5, p.33)

45. Fencing to restrict livestock from surface waters and riparian areas (3.D.2.2, p.33)

46. Animal bedding (3.D.4.1, p.34)

47. Pet waste bags in walking area (3.D.6.1, p.34)

48. Vehicle oil disposal (4.2.3, p.35)