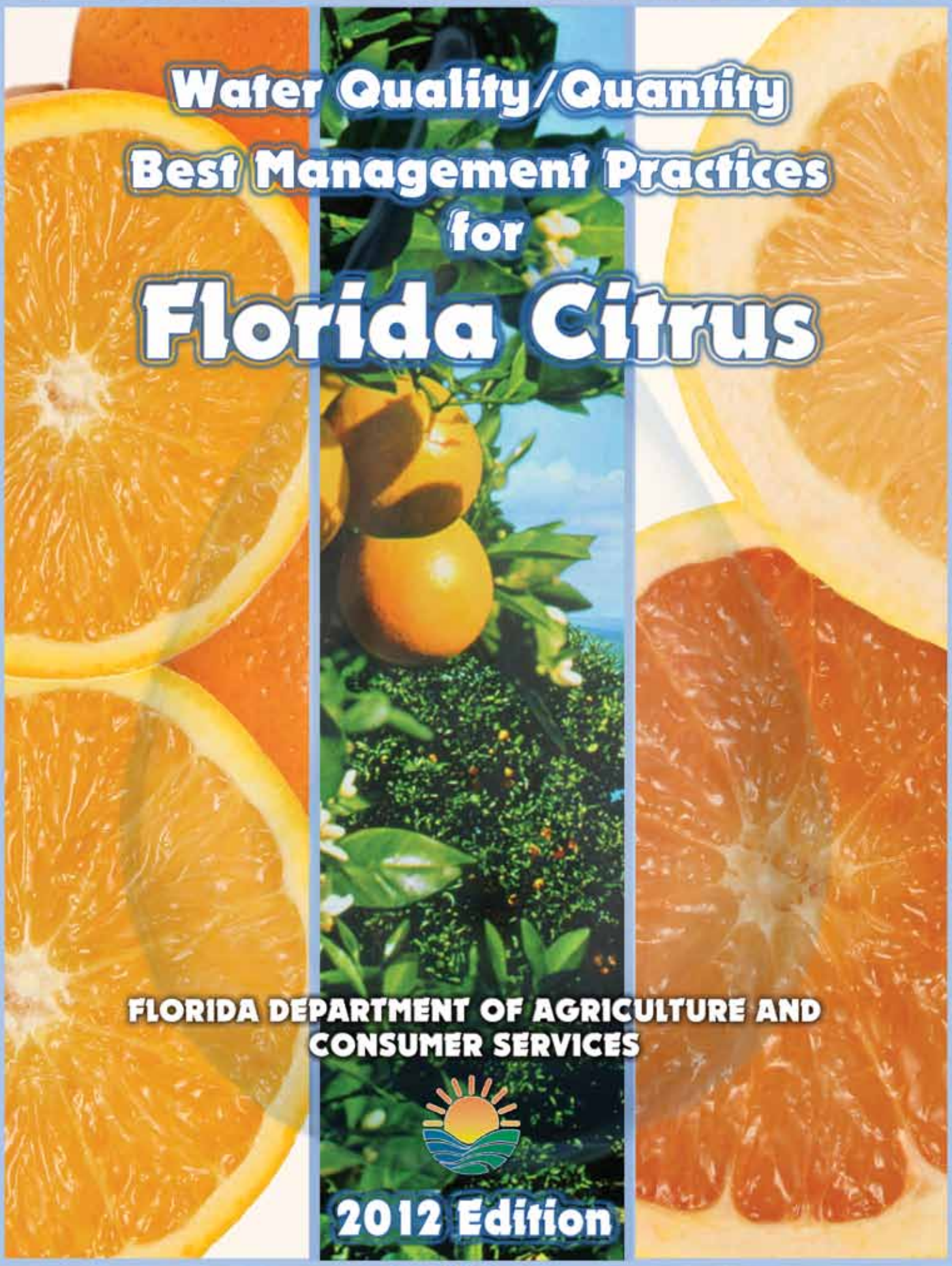


Water Quality/Quantity Best Management Practices for Florida Citrus

FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES

2012 Edition

DACS-P-01756

Office of the Commissioner
(850) 488-3022

The Capitol
400 South Monroe Street
Tallahassee, Florida 32399-0800

Florida Department of Agriculture and Consumer Services
Commissioner Adam H. Putnam

COMMENTS BY COMMISSIONER ADAM H. PUTNAM

Dear Agricultural Producers:

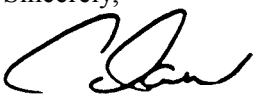
This manual, *Water Quality/Quantity Best Management Practices for Florida Citrus,* reflects the hard work of representatives of the industry; federal, state, and local government; and other stakeholders. In general, agricultural lands maintain valuable water recharge areas and preserve open spaces. The BMPs in this manual address water quality and quantity impacts from production activities and help maintain the environmental advantages of keeping the land in agriculture.

While best management practices have been in place for many years in our state, their role in environmental protection was formally established in 1999 with the passage of the Florida Watershed Restoration Act. This legislation provides the framework for implementing Florida's Total Maximum Daily Load program, which sets water quality targets for impaired waters. It also identifies best management practices implementation as the means for agriculture to help meet those targets.

As Florida's population continues to increase, there are more impacts to and competition for Florida's limited water resources. All Floridians must take part in conserving and protecting these resources. This manual represents the industry's commitment to do just that.

As a native Floridian whose family has long been involved in agriculture, I want to thank all who participated with the Department in the development of this important manual. With the active support and participation of so many dedicated people, I am optimistic about the future of Florida's agricultural industry. I trust that you will join me in supporting this valuable water resource protection effort.

Sincerely,



Adam H. Putnam
Commissioner of Agriculture

ACKNOWLEDGEMENTS

This statewide BMP manual for the citrus industry consolidates existing regional programs and extends rule-adopted BMPs for areas of the state not already covered. The following is a list of individuals who participated in the development of this manual. Each of these individuals and their organizations made important contributions to the process, and their work is sincerely appreciated.

Steering Committee

Bill Bartnick – Florida Department of Agriculture and Consumer Services

Dr. Brian Boman – University of Florida/IFAS

Doug Bournique – Indian River Citrus League

Staci Braswell – Florida Farm Bureau

Barbara Carlton – Peace River Citrus Growers Association

Ron Hamel – Gulf Citrus Growers Association

Laurie Hurner – Florida Citrus Mutual

Kerry Kates – Florida Fruit and Vegetable Association

Dr. Tom Obreza – University of Florida/IFAS

Ray Royce – Highlands County Citrus Growers Association

Dr. Mike Thomas – Florida Department of Environmental Protection

Reviewers

Glenn Horvath – Suwannee River Water Management District

Lance Laird – Northwest Florida Water Management District

Mark Luchte – Southwest Florida Water Management District

Vince Singleton – St. Johns River Water Management District

Benita Whalen – South Florida Water Management District

Additional Contributors

James Dodson – Florida Department of Environmental Protection

Mark Mealo – Florida Department of Agriculture and Consumer Services

Holly Stone – Florida Department of Agriculture and Consumer Services

Dr. Kelly Morgan – University of Florida/IFAS

Dr. Steve Futch – University of Florida/IFAS

Editor

Terry Pride – Florida Department of Agriculture and Consumer Services

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INTRODUCTION

Operations Intended to Use this Manual

This manual is designed for use by commercial agricultural operations that produce citrus crops (oranges, grapefruit, tangerines, tangelos, limes, lemons, or similar citrus cultivars). Citrus nurseries should enroll in the Nursery BMP manual.

Things to Keep in Mind as You Use this Manual

Italicized words that appear in ***bolded red italics*** are defined in the glossary.

Specific record-keeping requirements are noted using a pencil icon:

You can access this manual electronically at www.floridaagwaterpolicy.com.

Overview of the Industry

The State of Florida remains the number one citrus producer in the country. Most of the industry grows oranges for juice processing; however, the bulk of the grapefruit, tangelos and tangerines are grown for the fresh market.

Florida citrus producers have faced many challenges in the past two decades, including trying to deal with two severe exotic diseases, citrus canker and greening. Despite these difficulties, the citrus industry has been a leader in embracing ***Best Management Practices*** (BMPs) for water quality and water conservation purposes. Much of the industry utilizes low-volume under-tree irrigation systems to conserve water, and incorporates precision application equipment into their nutrient management regimes.

The citrus industry has had a long-standing role in BMP development. In 1998, the Production Committee of the Indian River Citrus League, in conjunction with the Florida Department of Agriculture and Consumer Services (FDACS) and the University of Florida Institute of Food and Agricultural Sciences (UF-IFAS), took the initiative to develop BMPs for Indian River Area citrus groves. The objective was to identify practices that have the potential to improve water quality and reduce the quantity of runoff water draining into the St. Lucie Estuary and Indian River Lagoon. A steering committee was formed to guide the BMP development process. The steering committee consisted of representatives from FDACS, the Florida Department of Environmental Protection (FDEP), the South Florida Water Management District (SFWMD), UF-IFAS, the Natural Resources Conservation Service (NRCS), the Florida Farm Bureau, and the Indian River Citrus League. The BMPs were adopted in June, 2002. Because growers were engaged in the development of the BMP manual, many were early implementers of the BMPs once they were adopted by FDACS.

Other citrus-producing areas in the state faced their own unique environmental issues, and grower organizations spearheaded the effort to develop BMP manuals for the Central Florida Ridge, the Peace River and Manasota basins, and the Gulf Citrus area. A stakeholder involvement process similar to that used in developing the Indian River Citrus BMPs was followed in the other three citrus areas. The Ridge Citrus rule was adopted in February 2003, followed by the Peace River manual in February 2005, and the Gulf Citrus manual in May 2007. All regional geographic BMP areas covered prior to the development of this manual are highlighted in **Figure 1**. This provided the impetus to consolidate the existing manuals into a single document that addresses both statewide and region-specific practices for water quality and water conservation.

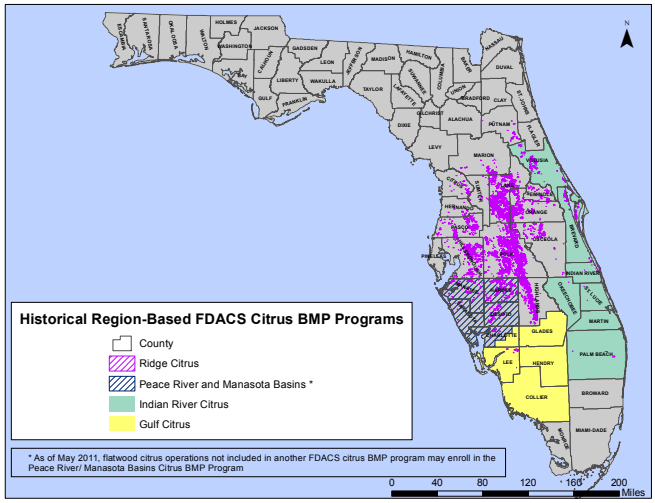


Figure 1

The citrus industry remains committed to protecting water resources through the implementation of BMPs. This manual, which has been endorsed by industry associations, has been developed to promote BMPs for citrus groves throughout Florida. Although these practices are designed primarily to protect water quality, some of the BMPs also will have water conservation benefits.

Best Management Practices Defined

BMPs are individual practices or combinations of practices that, based on research, field-testing, and expert review, have been determined to be the most effective and practicable means for maintaining and/or improving water quality. BMPs typically are implemented in combination to prevent, reduce, or treat pollutant discharges. BMPs must be based on sound science, be technically feasible, and be economically viable.

BMPs and Water Quality

Studies conducted in 2002 by the Environmental Protection Agency (EPA) indicate that nonpoint sources (both urban and agricultural) are the nation's greatest contributors to water pollution. Much of the contribution is due to rainwater carrying pollutants into lakes, rivers, wetlands, estuaries, and groundwater. It is good stewardship and makes sense for growers to prevent or minimize these impacts by using BMPs. In fact, the Florida Legislature has established BMP implementation as the non-regulatory means for agricultural nonpoint sources to comply with state water quality standards. When you implement BMPs you are also confirming the Legislature's support for this approach.

Total Maximum Daily Loads

Under the Federal Clean Water Act and Florida law, FDEP must identify impaired surface waters and establish Total Maximum Daily Loads (TMDLs) for pollutants entering these waters. A TMDL establishes the maximum amount of a pollutant that can be discharged to a waterbody and still meet state water quality standards. Some pollutants for which TMDLs have been set include: total phosphorus, total nitrogen, total suspended solids, and coliform bacteria.

FDEP may develop and adopt Basin Management Action Plans (BMAPs), which contain the activities that affected interests will undertake to reduce point and nonpoint source pollutant loadings. In ***watersheds*** with adopted BMAPs, and in some other areas, agricultural producers either must implement FDACS-adopted BMPs or conduct water quality monitoring prescribed by FDEP or the water management district (WMD).

Florida already has adopted a significant number of TMDLs, and many more waterbodies are listed for TMDL development. This list encompasses lakes, rivers, streams, springs, and estuarine systems. More information on listed waterbodies and adopted TMDLs is available at http://www.dep.state.fl.us/water/tmdl/index.htm. To see a map of BMAP areas and learn more about their development, go to http://www.dep.state.fl.us/water/watersheds/bmap.htm. If you need help figuring out whether you are in a BMAP area, call (850) 617-1727, or e-mail AgBMPHelp@freshfromflorida.com.

Good Agricultural Practices (GAPs) for Food Safety

GAPs have not been incorporated into this BMP manual. However, this manual recognizes that GAP programs may play a role in the marketing of fresh citrus fruit to some commercial domestic and foreign markets. Therefore, citrus growers should be aware that future GAP standards may exceed the water quality BMP requirements in this manual, and three sidebars (text boxes) are provided later in the manual that refer to these points.

Benefits of Implementing BMPs

Before FDACS adopts BMPs, the FDEP reviews them and determines whether they will be effective in addressing water quality impacts from agricultural operations. Benefits to enrolling in and implementing FDACS BMPs include:

- BMP participation demonstrates agriculture's commitment to water resource protection, and maintains support for this approach to meeting water quality and conservation goals.
- Some BMPs increase production efficiency and reduce costs.
- Technical assistance with BMP implementation
- Eligibility for cost-share for certain BMPs (as available).
- A presumption of compliance with state water quality standards for the pollutants addressed by the BMPs. Even if EPA numeric nutrient criteria become part of state standards, producers who enroll in and implement the BMPs still have the presumption of compliance.
- Release from the provisions of s. 376.307(5), Florida Statutes (F.S.), (fines for damages) for pollutants addressed by the BMPs.
- The Florida Right to Farm Act generally prohibits local governments from regulating an agricultural activity that is addressed through rule-adopted BMPs that growers implement.

- Producers who implement FDACS-adopted BMPs might qualify for exemptions from WMD surface water permitting, and/or satisfy other permitting requirements.

Implementation of BMPs does not excuse agricultural operations from complying with applicable permitting or other regulatory requirements.

Permit Exemptions

Some agricultural activities, especially those that alter on-site hydrology, may require an Environmental Resource Permit (ERP) or other surface water permit, for example, the construction of a stormwater management system (e.g., retention or detention pond). Check with your WMD before beginning construction of any stormwater management system to see whether a permit is needed, or whether the following exemptions apply:

- Under subsection 373.406(2), F.S., any person engaged in the occupation of agriculture may alter the topography of any tract of land for purposes consistent with the practice of agriculture. However, these activities may not be for the sole or predominant purpose of diverting or impeding surface waters, or adversely impacting wetlands. Agricultural activities that meet these criteria may be exempt from an ERP. FDACS has the authority to make this determination whenever a dispute arises, based on specific statutory and rule requirements.
- Under subsection 373.406(9), F.S., environmental restoration activities on agricultural lands that have minimal or insignificant impacts to water resources may also be exempt from an ERP, upon written request by the producer and written notification from FDEP or the WMD that the proposed activity qualifies for the exemption.

Even if an exemption applies, agricultural producers within a watershed with an adopted BMAP that addresses agricultural loadings either must implement BMPs or conduct water-quality monitoring at their own cost.

POTENTIAL WATER QUALITY IMPACTS ASSOCIATED WITH CITRUS

Many of the groves in Florida have been constructed in the flatwoods, which is a landform characterized by sandy soils and high water tables with little relief or slope, thereby requiring drainage infrastructure. The groves in "interior" Florida are mostly constructed on the Central Florida Ridge, which is a landform characterized by very sandy soils and low water tables, thereby requiring no drainage facilities. These differences create regional production and water quality challenges.

Nutrients

Excess nitrogen and phosphorus are the most common causes of water quality impairments in Florida. These nutrients can enter surface waters through stormwater or irrigation runoff, or leach through soils into groundwater.

The nitrogen form most abundant in natural waters is nitrate. Due to its high mobility, nitrate can also leach into groundwater. Phosphorus is one of the key elements necessary for growth of plants and animals. In terms of freshwater ecology, it tends to be the (growth) limiting nutrient in non-flowing waters. Phosphorus is more effectively retained in the soil than nitrogen. However, phosphorus enters waterbodies attached to particulate matter via sediment transport, or can be dissolved in water. In some soils, phosphorus is prone to leaching into groundwater.

Excess Algal Growth

Algae are essential to aquatic systems. As a vital part of the food chain, algae provide the nutrition necessary to support aquatic animal life. Certain types of algae also provide habitat for aquatic organisms. However, high levels of nutrients in surface waters result in abnormal plant growth, including algae. Excess algal production can cause many problems in a waterbody. The presence of algal blooms, noxious weeds, and too many floating aquatic plants can block sunlight necessary for photosynthesis by submerged aquatic plants. If there is a mass die off, the decomposition of these materials lowers the available dissolved oxygen, which can lead to fish kills.

Blue-green algae (***Cyanobacteria***) can become so abundant that they can cause a scum layer to form on the surface, shading the sunlight-dependent life below and disturbing the food chain. Potential risks from recreational contact include skin, respiratory, and mucous membrane irritation.

Sedimentation

Sedimentation occurs when eroded soils are washed into surface waters, creating a buildup of solids on the bottom and suspended solids (turbidity) in the water column. Sedimentation impacts most commonly associated with agricultural operations come from the erosion of unprotected soils.

Sediment can fill in water bodies, clog waterways, carry pollutants, and affect water clarity. These effects combine to reduce fish, shellfish, and plant populations, and decrease the overall productivity of lakes, streams, estuaries, and coastal waters. Decreased penetration by sunlight can affect the feeding and breeding behaviors of fish, and the sediments can clog gills and cause irritation to the mucous membranes covering the eyes and scales. As the sediment settles, fish eggs can be buried. Recreational use may also decline because of reduced fish populations, less visibility, and reduced desirability of downstream swimming areas.

Deposited sediment also reduces the flow capacity of ditches, streams, rivers, and navigation channels, which can require more frequent maintenance dredging or result in flooding. Nutrients and other contaminants can attach to sediments, which can contribute to downstream water quality impairments. Chemicals, such as some pesticides, phosphorus, and ammonium, may be transported in sediment. Over time, these chemicals may be released from the sediment and become suspended in the water column.

Organic Matter

The decomposition of excessive organic matter in water from aquatic plants, algae, or other materials in runoff can lead to increased biological oxygen demand and lower dissolved oxygen levels. Where uncomposted manure or inadequately treated ***biosolids*** are land applied to citrus groves, elevated nutrient and fecal coliform levels may occur. The likelihood of contamination is increased if these materials are applied in excess of agronomic rates, or applied under rainy conditions.

KEYS TO POLLUTION PREVENTION

It is the agricultural industry's responsibility to protect water quality by implementing good land and water management practices. BMPs include many prevention measures that minimize potential water quality and quantity impacts. Implementing BMPs helps demonstrate the industry's commitment to protecting water resources, and garners support for this non-regulatory approach. Below are key guidelines for implementing the specific BMPs in this manual.

Understand Water Quality Issues on Your Operation

Water quality includes chemical, biological, and physical characteristics. Elevated levels of phosphorus, nitrogen, sediment, bacteria, and organic material contribute to the degradation of water quality. The potential for discharges from agricultural operations to cause water quality problems varies, depending on soil type, slope, drainage features, nutrient management, and activities in or near ***wetlands***, surface waters, or sinkholes. Grove management practices determine an operation's impact on water quality. For more information on surface water quality, go to the following link: http://lakewatch.ifas.ufl.edu/LWcirc.html. For information on groundwater quality, go to: http://edis.ifas.ufl.edu/fe601

Manage Nutrient Sources Properly

Minimize the pollutants that leave your property by controlling the types and uses of materials used on your operation. Nutrient-related pollutant discharges can come from excessive use or inefficient placement or timing of commercial fertilizer, manure, and/or biosolids applications. Managing nutrients carefully is critical to protecting water quality.

Manage Irrigation Carefully

Water is the carrier for nearly all pollutants. Precisely managing irrigation inputs to keep moisture primarily in the plant's root zone will significantly reduce nutrient-related impacts from fertilizers. Over-irrigating may exceed the soil's water-holding capacity and lead to runoff or leaching.

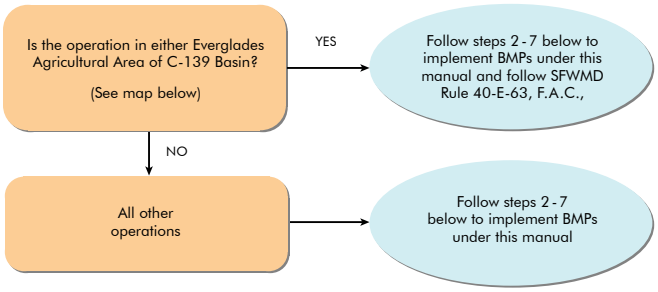
Minimize the Potential for Erosion Impacts

Land clearing, culvert installation, road building, ditch and canal maintenance, and grove rehabilitation can expose soil and lead to erosion that can increase pollutant loading. It is important to take appropriate erosion control measures during these activities.

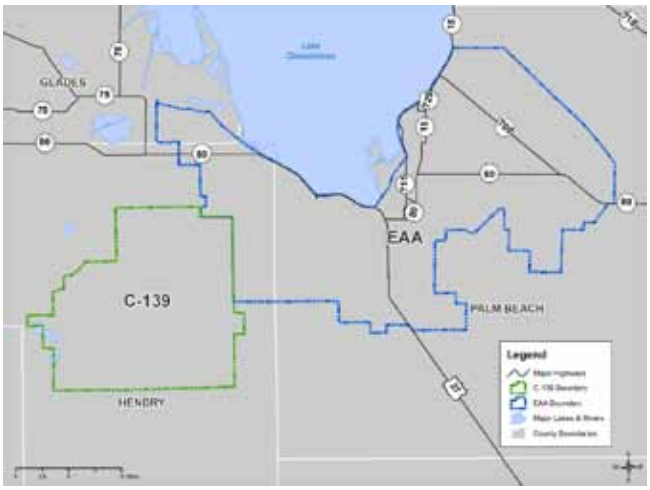
USER'S GUIDE
TO BMP ENROLLMENT AND IMPLEMENTATION

The steps below will help you select which BMPs to implement to reduce or avoid negative impacts to water quality coming from your operation.

1. **Choose the pathway applicable to you:** In the flowchart below, identify the circumstances that apply to you.



Note: *In areas where FDEP has adopted a Basin Management Action Plan, agricultural operations must implement applicable FDACS-adopted BMPs or monitor water quality. See http://www.dep.state.fl.us/water/watersheds/bmap.htm for more information.*



2. **Request assistance, as needed, in assessing your grove(s) and selecting applicable BMPs:** FDACS field staff, UF-IFAS BMP Implementation Teams and Extension Agents, and some Soil and Water Conservation Districts (SWCDs) are available to assist you with evaluating which BMPs are applicable to your operation. To get free assistance, call (850) 617-1729 or email AgBmpHelp@FreshFromFlorida.com.

3. **Conduct an inventory:** The selection of BMPs begins with a basic inventory of the land's natural features, structures, and improvements which will help you determine how the operation and management of your grove(s) may affect environmentally sensitive areas. When developing the inventory, sketch your grove(s), noting buildings, well locations and other water sources, ditches, retention/detention areas, flow control structures, etc. Identify areas of particular concern that need to be addressed. These may include streams, wetlands, springs, ***sinkholes***, and ponded or other poorly drained areas, among others. You can use the inventory as a starting point to select the BMPs applicable to your operation. To help you conduct your inventory effectively, the following tools are available:

- ✓ Aerial photographs (http://earth.google.com/index.html, or other providers)
- ✓ NRCS soil survey maps (http://websoilsurvey.nrcs.usda.gov/app/)
- ✓ USGS topographic maps (http://topomaps.usgs.gov)
- ✓ National Wetlands Inventory (http://www.fws.gov/wetlands/data/index.html)

4. **Select the Applicable BMPs:** Carefully read BMP sections 1.0 through 7.0 and select all of the BMPs in the manual that are applicable to your operation and are technologically and economically feasible for you to implement. Record the BMPs on the checklist in **Appendix 10** of this manual. The checklist includes a column for you to schedule BMP implementation if a practice is not already in place.

The BMPS in this manual focus primarily on management actions, rather than structural practices. In general, the BMPs should not require cost share to implement, though there may be a few exceptions. Depending on the location and specific conditions of the operation, not all of the BMPs may be applicable to a particular site.

It is advisable to consolidate your inventory of features, and all your BMP decision-making, including the BMP Checklist, into a simple

implementation plan. This can serve as a record of scheduled and completed BMPs, including operation and maintenance activities. A well thought-out, written plan enables managers and owners to schedule their activities and accomplish their objectives. Remember to keep the plan available and update it regularly. It will help you communicate with your employees, your county extension agent, NRCS staff, or others.

5. **File a Notice of Intent to Implement (NOI) BMPs:** Complete and submit to FDACS a NOI, contained in **Appendix 10** of this manual, along with the completed BMP checklist. Once received by FDACS, the Notice of Intent formally enrolls your operation under the BMP program. Implementation of the BMPs provides a presumption of compliance with state water quality standards for the pollutants the BMPs address. Implementation includes ongoing record keeping and maintenance of the BMPs.

6. **Implement the BMPs:** Implement all applicable BMPs as soon as practicable, but no later than 18 months after submittal of the Notice of Intent to Implement.

7. **Keep Records on BMP Implementation:** FDACS rule requires record-keeping to document BMP implementation. Record-keeping requirements are highlighted in the manual using this figure:  Fertilizer applications and rainfall amounts are two types of record-keeping. All BMP records should be accurate, clear, and well-organized. You may develop your own record-keeping forms or use the ones provided in **Appendix 7**. You must retain the records for at least 5 years; however, it is desirable to retain records for as long as possible for your own protection. All documentation is subject to review.

BMP Implementation Follow-Up

FDACS has developed a BMP "Implementation Assurance" program to help evaluate how BMPs are being implemented, and to gather feedback on whether there are obstacles to using any of the practices. On a cyclical basis by BMP program, FDACS mails surveys to enrollees, which contain questions about BMP-related activities on enrolled operations. Also, FDACS staff may visit selected operations to get more direct input from producers. The Implementation Assurance effort helps in:

- Documenting the level of participation in implementing agricultural BMPs.
- Identifying needs for education and implementation assistance.
- Reinforcing the importance of BMP implementation.
- Evaluating the effectiveness of FDACS BMP programs.
- Updating FDACS NOI records.

Your participation in these follow-up activities is vital to the continuing success of agricultural BMP programs in Florida.

BEST MANAGEMENT PRACTICES

1.0 GROVE DEVELOPMENT AND RENOVATION

Grove Development and Renovation *practices are practical measures to incorporate upfront design features when developing new groves or renovating existing groves affected by catastrophic disease.*

Site preparation will vary between regions of the state, depending on soil type(s), seasonal-high groundwater conditions, topography, and climate. Eliminating potential problems through simple adjustments made during grove development and renovation can reduce inputs, water quality impacts, and production costs. Follow the guidance below, as appropriate for your citrus grove site.

General Guidance for Site Preparation and Planting

If planting a new grove, it is a good idea to have a wetland delineation performed prior to site preparation, to establish the boundaries of all onsite wetlands that may be in the planned production area. This delineation will allow for the establishment of appropriate setbacks and/or buffers pursuant to the BMPs in this manual. Consider installing or maintaining existing buffers around grove perimeters when creating new groves adjacent to highly urbanized areas. If using soil amendments and/or pH-adjusting materials, manage these inputs to optimize nutrient management and protect water quality.

For more information, go to the UF-IFAS publication, *Water and Environmental Considerations for the Design and Development of Citrus Groves* at: http://edis.ifas.ufl.edu/CH163.

Land Leveling for New Plantings

Develop a plan for land leveling, and consult a public or private engineer to discuss your site-specific needs. Periodic re-grading may be needed to eliminate mounds or depressions that form. Deposit unused ***spoil*** material in an appropriate upland location. If suitable, consider reusing this material somewhere on-site for road base, dike construction, etc.

For more information on land leveling, see the NRCS, Precision Land Farming, Code 462; and Irrigation Land Leveling, Code 464, in Section IV of the Field Office Technical Guide at: http://www.nrcs.usda.gov/technical/efotg

Highly Permeable, Well-Drained Sandy Soils Common to the Florida Ridge

These soils include soil series such as Astatula, Archbold, Tavares, Candler, and other well-drained soils. In these soils, planting on unaltered ground is generally sufficient. In areas of native vegetation, the main requirements for land preparation are to clear and properly dispose of the existing vegetation. Soil amendments are usually required to raise pH, and the rate of applied amendments should be guided by the results of soil testing.

Poorly Drained Sandy Soils of the Florida Flatwoods

These soils include soil series such as Basinger, Immokalee, Myakka, Pineda, Riviera, Smyrna,

Wabasso, Winder, and others. In these soils, control of the naturally high water table and rapid removal of excess surface water from rainfall are essential. Native flatwoods soils are generally acidic and will likely require adjustment of pH with the application of calcitic or dolomitic lime. Applied rates of all soil amendments should be based on the results of soil tests.

1.1 Grove Development BMPs

✓ **1.** If wetlands exist on the site, have a qualified person perform a wetland boundary determination before clearing native land. This determination will be required for groves that must obtain an ERP from the regional water management district.

✓ **2.** Perform land leveling and construction of drainage works in accordance with recognized standards. Guidance on this is contained in the References below.

General Guidance for Grove Renovation

With disease, increased pest pressures, reduced production and/or lack of proper management, groves may experience significant decline. Renovation can involve replanting just a few trees or an entire grove. Important things to consider during renovation activities include:

- Evaluating the ability/need to construct or retrofit the irrigation and drainage systems so they perform more efficiently.
- Instituting proper sediment control measures before and during replanting, especially on highly erodible lands.

1.2 Grove Renovation BMPs

✓ **1.** Use sedimentation and erosion control measures, as needed. These measures should be used upstream of offsite discharge points.

✓ **2.** Upon completion of soil bedding, stabilize all bare soil areas (except tree rows) with grass or other desirable vegetation to minimize loss of soil by erosion.

✓ **3.** For major renovations, install and/or maintain a 50-foot non-fertilized vegetated buffer upland of the normal water level of lakes adjacent to the citrus grove production area.

References:

1. The Florida Stormwater, Erosion, and Sedimentation Control Inspector's Manual, FDEP. http://www.dep.state.fl.us/water/nonpoint/docs/erosion/erosion-inspectors-manual.pdf

2. UF-IFAS, Flatwoods Citrus Best Management Practice: Soil Stabilization, SL-195. http://edis.ifas.ufl.edu/ss408

3. NRCS, Irrigation Systems, Surface and Subsurface, Code 443, Irrigation Canal or Lateral, Code 320, Irrigation Field Ditch, Code 388, Irrigation Reservoir, Code 436, Irrigation Management Tailwater Recovery, Code 447, Irrigation Land Leveling, Code 464, Precision Land Forming, Code 462, Access Road, Code 560, Structure for Water Control, Code 587, Surface Drainage Field Ditch, Code 607, Bedding, Code 310, FOTG Section IV. http://www.nrcs.usda.gov/technical/efotg/

4. UF-IFAS, Detention/Retention for Citrus Stormwater Management. Circ. 1405 http://edis.ifas.ufl.edu/ae216

2.0 NUTRIENT MANAGEMENT

Nutrient management *is the control of the source, rate, placement, and timing of nutrient applications and soil amendments to ensure sufficient soil fertility for citrus tree production and minimize impacts to water quality.*

Fertilizer Sources

Citrus growers typically use fertilizer materials that contain nitrogen (N), potassium (K), and magnesium (Mg). Fertilizer mixtures also will contain phosphorus (P) if the grower determines that the soil P supply is not sufficient. These three elements are referred to as macronutrients because they are required in relatively large amounts by plants. In terms of fertilizer composition and analysis, N is usually expressed as total N; P as available phosphate, or P_2O_5; and K as potash, or K_2O. To calculate the pounds of elemental P or K, a conversion factor must be used, as noted below. No conversion is needed for N, since it is already expressed in elemental form. The conversions for P and K are:

Equation (1): $P = P_2O_5 / 2.29$
Equation (2): $P_2O_5 = 2.29 \times P$
Equation (3): $K = K_2O / 1.21$
Equation (4): $K_2O = 1.21 \times K$

Availability to plants of both macronutrients and micronutrients is necessary to ensure proper plant growth and maintain plant health.

Applying N and P in excess of the plant nutrient requirement can result in nutrient runoff to surface waters and/or leaching to groundwater, especially in Florida's sandy soils. Using fertilizers with a low salt index will help in managing the detrimental effects of salinity on citrus trees. Refer to UF-IFAS Circular 1411, *Managing Salinity in Citrus* at: http://edis.ifas.ufl.edu/ae171 to assist you in selection of fertilizer materials with a low salt index.

Iron (Fe) is a very important micronutrient, and deficiency problems can occur. Chelated-iron fertilizer sources are generally superior to inorganic sources, and can be used at lower rates. See pages 54 and 55 in SL-253 for more information.

Macronutrient fertilizer sources commonly used to produce Florida citrus include:

- Ammonium nitrate or sulfate
- Calcium nitrate
- Di-ammonium phosphate
- Ordinary or concentrated superphosphate
- Potassium chloride, sulfate, or nitrate
- Potassium-magnesium sulfate

These ingredients, which are all inorganic materials, are not the only constituents used in citrus fertilizers. Organic sources of fertilizers, such as biosolids, composts, and animal manures, can also be used, and they contain both macronutrients and micronutrients.

Soils

It is important to understand the physical, chemical, and biological properties of your soil in order to choose effective nutrient management practices. For example, the natural N supply in Florida's sandy soils is low because organic matter degrades rapidly and does not accumulate. Therefore, growers must apply N fertilizer to meet the demand of a commercial citrus crop. Proper management of N fertilizer is important because nitrate is not strongly bound to the soil and is subject to leaching.

As long as the soil pH is within the recommended range of 6.0 to 6.5, citrus grove soils typically provide sufficient phosphorus if they have a history of P fertilizer applications. If soil P supply is low, it is usually associated with an extremely sandy, acidic, highly-leached soil. Soil and leaf tests help determine the need to apply P fertilizer. Inorganic P fertilizers are water- or acid-soluble, which allows P to be readily absorbed by plants.

Phosphorus must be managed carefully, especially if the citrus grove contains soils predominantly composed of coarse ***uncoated sands***. These types of sands are prone to leaching of P and are common throughout Florida. Uncoated soil series where P leaching may be a concern include the following:

Table 1. Common Uncoated Soil Series

Adamsville	Estero	Neilhurst	Ridgewood
Archbold	Hallandale	Nettles	Satellite
Basinger	Hobe	Oldsmar	St. Lucie
Broward	Immokalee	Orsino	Smyrna
Canaveral	Jonathan	Ortega	Tavares
Candler	Kershaw	Ousley	Valkaria
Dade	Lawnwood	Penney	Wabasso
Deland	Leon	Pomello	Wauchula
Duette	Myakka	Pomona	Waveland
EauGallie	Narcoosee	Pompano	Zolfo

Soil Testing

Soil testing is important not only for measuring organic matter and pH, but also to help determine appropriate fertilization amounts of P, magnesium (Mg), and calcium (Ca). Soil test-based nutrient recommendations rely on a correlation between nutrients extracted from the soil and a measure of plant response, such as yield. However, in Florida, information to make this correlation for readily leached elements such as N and K is limited for citrus. Research has demonstrated that soils testing either high or very high for extractable P may be able to support new tree plantings for up to seven years, without the need for additional P fertilization.

Soil samples are not difficult to obtain. **Figure 2** shows a common soil probe used to obtain representative soil samples. Soil testing for citrus should be conducted on a yearly basis. Collecting and maintaining records of soil tests throughout many years will help document the effectiveness of a nutrient management program.

Figure 2

Leaf Tissue Testing

One of the best tools to aid in fertilization decision-making is leaf tissue analysis. For perennial plants such as citrus, leaf tissue composition can be used to fine-tune a fertilization program with improved plant growth and minimal environmental impact. Leaf tissue analysis, along with observation and soil testing, can help determine the effectiveness of a fertilization program, and is especially useful for detecting micronutrient deficiencies even before visual symptoms appear. As with soil testing, collecting and maintaining records of leaf tissue tests throughout many years will help document the effectiveness of a nutrient management program. **Figure 3** shows the optimum range of leaf N concentration in orange trees.

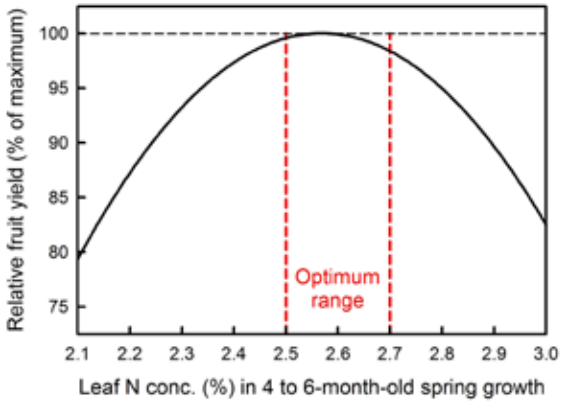


Figure 3

Proper methods to collect soil and leaf samples, and guidelines for interpreting test results, are detailed in the UF-IFAS publication, Nutrition of Florida Citrus Trees (Second Edition) at: http://edis.ifas.ufl.edu/ss478.

Fertilizer Applications

Proper application of fertilizer depends on the skill and knowledge of the applicator. Persons applying fertilizer should receive training in proper techniques from their employer. An excellent source of information for this can be found in UF-IFAS publication, *Fertilizer Application Best Management Practices for Citrus Grove Workers* at: http://edis.ifas.ufl.edu/pdffiles/AE/AE24800.pdf. This short publication also contains quiz questions and answers for the employer to use.

GAP Note: If animal-based soil amendments or biosolids are used, some GAP programs may have more stringent standards than this BMP manual. Citrus growers are encouraged to refer to their particular GAP requirements, if applicable.

Application Timing

To minimize the potential for adverse impacts to water quality from excessive fertilization and reduce costs, growers should base fertilization on specific crop nutrient requirements and related timing factors.

For Florida citrus, the period of highest nutrient application begins in late winter and extends through early summer. Based on nutritional demands, a typical fertilizer application schedule divides the total annual requirement into three equal increments, avoiding the summer rainy season as much as possible:

- The first increment is applied between mid-January and the initiation of flowering.
- The second increment is applied between flowering and late May.
- The third increment is applied between the end of the rainy season (late September) and mid-November.

Splitting fertilizer applications may decrease the potential for salt damage and leaching.

Fertilizer may not be taken up readily if soils are cold. If water is used for frost or freeze protection shortly after a fertilizer application, some of the fertilizer may be lost through leaching or runoff once thaw occurs.

Targeting Applications

When applying granular fertilizer to the soil surface, application equipment should be adjusted to target the area above the root zone. It is especially effective to apply nutrients from the tree canopy drip-line to the tree trunk, as this encompasses the majority of the root zone. Avoid application of nutrients in areas prone to off-site runoff, such as water furrows.

Most Florida citrus groves are irrigated; therefore, fertilization and irrigation practices should be designed to minimize fertilizer loss through leaching. To achieve this goal, increasing the relative amount of fertilizer applied via low-volume irrigation systems (fertigation) and/or using slow-release or controlled-release fertilizers as a portion of the nutrient program is encouraged. It should be noted that slow/controlled-release fertilizers may be particularly useful for grove resets.

Precision Agriculture Technologies for Fertilizer Application

Precision agriculture tools increasingly are used in citrus production. The most common of these are variable-rate application equipment, soil sampling, and yield mapping. The primary benefits of using these tools include reducing inputs (fertilizer, lime, and crop protection products), optimizing nutrient uptake, enhancing fruit quality and yield, and automating grove operations to increase overall efficiency.

The use of variable-rate fertilizer application equipment as shown in **Figure 4** has reduced fertilizer use in groves by as much as 30%. Fertilizer is precisely quantified and placed in optimum position for plant uptake based on tree age using sensor recognition of tree canopies. Use of these techniques avoids application of fertilizer where there are no trees, adjusts the fertilizer application rate based on tree size, and/or considers soil properties that influence tree growth and fertilizer availability.

Figure 4

In citrus yield mapping, harvesters use GPS-enabled data loggers to record the grove position(s) where fruit was harvested. These data can be used to identify both high- and low-production sites within a grove. Inputs can be adjusted accordingly to increase efficiency, reduce costs, and aid in the protection of water resources.

Nutrient Management BMPs

2.1 *Fertilizer Sources*

✓ **1.** Reduce the potential for nutrient loss and improve nutrient use efficiency by choosing appropriate sources and formulations of fertilizer based on nutritional needs, season (rainy vs. dry), and anticipated weather conditions.

✓ **2.** If using irrigation water (tailwater, reclaimed, or well) that has N concentrations of 10 ppm or greater, adjust fertilization rates to account for the additional nutrients. You can estimate the N and P contribution from the reclaimed water by multiplying the average nutrient analysis in the water by the volume of water applied.

✓ **3** If using manure or biosolids, adjust fertilization rates to account for the additional nutrients. You can estimate the N and P contribution by multiplying the nutrient analysis by the amount of material applied and its mineralization rate.

References:

1. UF-IFAS, The Basics of Biosolids Application to Land in Florida, SL-205, http://edis.ifas.ufl.edu/SS424
2. FDEP, Biosolids Rule, Chapter 62-640, F.A.C. http://www.dep.state.fl.us/legal/Rules/mainrulelist.htm

2.2 *Determining Fertilizer Rates*

✓ **1.** Base P fertilization rate on soil and/or leaf tissue tests results from a private or public lab that uses a standard testing method recommended by UF-IFAS Extension Soils Testing Laboratory. Keep a copy of all laboratory test results to track changes over time.

✓ **2.** Comply with the UF-IFAS recommended rates for N as established in Chapter 8 in UF-IFAS document SL 253 in Reference No. 1 below. This information has been excerpted and is contained in Appendix 4.

✓ **3.** Use leaf tissue test results to determine the need for and appropriate rates of supplemental fertilizer applications, and to diagnose the effectiveness of N, K, and micronutrient fertilization programs. Keep a copy of all laboratory test results.

✓ **4.** Keep records of all nutrient applications that contain N or P. Include, at a minimum: date and location of application, total amount applied, acreage covered, fertilizer analysis or grade, rate per acre, and application method.

References:

1. UF-IFAS, Nutrition of Florida Citrus Trees, 2nd Edition, February 2011, SL253, http://edis.ifas.ufl.edu/SS478
2. UF-IFAS, Producer Citrus Test Information Sheet, http://soilslab.ifas.ufl.edu/ESTL_files/Producer-Citrus.pdf
3. NRCS, Web Soil Survey, http://websoilsurvey.nrcs.usda.gov/app/

Note: See Appendix 3 for important details about soil and tissue sampling.

2.3 *Fertilizer Application*

Fertilizer recommendations are based on normal, healthy tree development for their age. Where disease, salinity, or other factors inhibit normal tree development, fertilizer application(s) should be adjusted accordingly.

✓ **1.** Calibrate and adjust fertilizer application equipment to ensure the intended fertilizer rate is applied and that desired distribution and placement at the root zone is achieved.

✓ **2.** When applying soluble fertilizers, use smaller, more frequent (split) applications to minimize the potential for leaching. Guidance for split application frequencies can be found in Chapter 8 of UF-IFAS document SL 253.

✓ **3.** Do not apply fertilizer under high-risk situations, such as before a forecasted rainfall or frost/freeze event.

✓ **4.** To the extent practicable, avoid applying fertilizer during the rainy season.

On ***highly permeable, well-drained soils***, such as those that are typical in the central ridge, follow the fertilizer rate requirements in BMP 2.2.2, and implement the following BMPs:

✓ **5.** Limit any dry season broadcast water-soluble nitrogen fertilizer applications to 65 lbs N/acre/application. Limit dry season fertigation nitrogen applications to 15 lbs N/acre/week.

✓ **6.** Water-soluble nitrogen fertilizer applications made during the summer rainy season (June 15 to September 15) must not exceed 40 lbs

N/acre. This rate can be achieved using a single dry broadcast application of no more than 40 lbs N/acre, or as multiple fertigation applications not to exceed 10 lbs N/acre/week.

References:

1. UF-IFAS, Fertigation Nutrient Sources and Application Considerations for Citrus, Circular 1410, http://edis.ifas.ufl.edu/CH185
2. UF-IFAS, Nutrition of Florida Citrus Trees, 2nd Edition, SL253, http://edis.ifas.ufl.edu/SS478
3. UF-IFAS, Fertilizer Application Best Management Practices for Citrus Grove Workers, AE 248, http://edis.ifas.ufl.edu/pdffiles/AE/AE24800.pdf

2.4 Fertilizer Storage and handling

- ✓ **1.** Protect stored fertilizer from wind and rainfall.
- ✓ **2.** Ensure that fertilizer spilled on the ground during loading is immediately collected and handled properly.
- ✓ **3.** Inform workers on proper fertilizer storage and handling procedures.

References:

1. NRCS, Nutrient Management, Code 590, FOTG Section IV. http://www.nrcs.usda.gov/technical/efotg/
2. UF-IFAS, Nutrition of Florida Citrus Trees, 2nd Edition, SL253, http://edis.ifas.ufl.edu/SS478

Note: See Appendix 7 for list of record-keeping requirements and example record-keeping forms.

3.0 IRRIGATION MANAGEMENT

Irrigation management *involves selecting and maintaining the appropriate irrigation system for your crop; and adjusting irrigation methods, scheduling, and amounts to maximize irrigation efficiency, based on monitoring soil, plant, and weather conditions.*

The goal of proper irrigation management is to keep both the irrigation water and the fertilizer in the crop root zone. This requires knowledge of the characteristics of the crop (particularly rooting depth), so that water and fertilizer inputs can be precisely targeted and properly managed. It also requires knowledge of the characteristics of the primary soil type to determine how these influence the availability of water to the plant.

The Central Florida Ridge features well-drained soils that permit rapid infiltration of rain and irrigation water; consequently, they are vulnerable to nutrient leaching. The irrigation depth to wet the majority of the root zone in these sandy soils is the upper 2 feet of the soil profile. Nitrate losses in poorly drained flatwoods soils, such as those in the Gulf, Peace River, and Indian River citrus production areas, may be through denitrification or surface water runoff. The citrus root zone in flatwoods soils is typically less than 12 inches, although some roots may be found deeper in better drained soils, depending on the water table elevation.

Irrigation System Design and Installation

Irrigation system design generally depends on factors such as topography, soil type, crop type, peak water requirements, and water source. It is important to know the volume and quality of the irrigation water source before designing and installing an irrigation system, because this may affect the selection, design, and operation of the system.

Irrigation system design requires in-depth technical knowledge, and should be handled by trained professionals. These professionals use existing standards and criteria, as well as manufacturers' recommendations, to design the most appropriate irrigation system for a particular location and water source. For information about irrigation system design, contact your local NRCS office or visit the Florida Section of the American Society of Agricultural and Biological Engineers at: http://www.fl-asabe.org/.

Pressurized Irrigation Systems

Pressurized systems deliver water under pressure via closed pipelines and/or laterals. The irrigation system most used for citrus production in Florida is pressurized low-volume micro-sprinkler or drip, as shown in **Figure 5**. When properly designed, operated and maintained, these systems efficiently deliver precise amounts of water, nutrients and other materials to the citrus root zone.

Figure 5

A typical irrigation system consists of four main components:

1. **Water Supply Mechanisms** (e.g., a water source, pumps, filters, valves, water gates and/or level controls.)
2. **Water Conveyance Mechanisms** (e.g., canals and main ditches, a main pipe, manifold pipes, lateral hoses or pipes, and/or isolation valves.)
3. **Water Application Mechanisms** (e.g., sprinkler, micro-sprinkler, or drip.)
4. **Control Mechanisms** (e.g., manual or automatic float switches, computerized control systems, weather stations, and/or soil moisture sensors.)

Irrigation Water Sources

Agricultural irrigation water sources can come from ground or surface water. Depending on the aquifer characteristics, groundwater can contain high levels of minerals that can form scale, which may plug emitters. Additionally, elevated chloride and total dissolved solids (TDS) concentrations greater than 1,200 micro-Siemens per centimeter (an electrical conductivity measurement, approximately 840 ppm total dissolved solids) can significantly stress crops, leading to low fruit yield, leaf drop, twig dieback and reduction in growth. Young citrus trees are especially vulnerable. High TDS irrigation water that is allowed to run off may cause impacts to both on-site and off-site water resources. Obtaining routine water quality analyses will help you determine whether the water is appropriate to use on your crop based on its chemistry.

GAP Note: If animal-based soil amendments or biosolids are used, some GAP programs may have more stringent standards than this BMP manual. Citrus growers are encouraged to refer to their particular GAP requirements, if applicable.

Well water may also be vulnerable to iron and/or sulfur-reducing bacteria that can cause emitter plugging. Chlorination (done before filtration) is the most common method for treating bacterial slimes, and should be considered for most micro-irrigation systems.

Surface water sources can present problems with algal and bacteria growth. Algal cells and organic residues of algae can pass through irrigation system filters and form aggregates that may plug emitters. Surface water can also contain organic debris, which must be filtered to prevent irrigation system plugging. If using surface water sources, evaluate treatment alternatives to reduce the incidence of emitter clogging.

For more information on irrigation water source issues, go to: UF-IFAS publication, Causes and Prevention of Emitter Plugging at: http://edis.ifas.ufl.edu/AE032.

Well Construction Permits

Florida's five WMDs have the primary regulatory authority for issuing well-construction and water-use permits for agriculture. Well-construction permits are required prior to the drilling, construction and may be required to repair a well. These permits ensure that wells are constructed by qualified, licensed contractors to meet safety, durability, and resource protection standards. The WMDs sometimes delegate the issuance of well-construction permits to county governments. For more information about WMD permitting requirements, go to: http://www.dep.state.fl.us/water/waterpolicy/districts.htm.

Alternative Irrigation Water Sources

As Florida continues to grow in population and water supply demands increase, growers are being asked to use alternative sources of irrigation water, such as reclaimed water, tailwater recovery, and rainfall harvesting. Use of alternative sources can also benefit water quality. For instance, tailwater recovery allows nutrients to be re-used on-site and not discharged to downstream waters.

Note: The use of alternative water sources has both advantages and drawbacks, and growers should evaluate their potential use thoroughly. In some cases, food safety or other legal restrictions apply.

Reclaimed Water

In recent years, the use of reclaimed water has been on the rise in Florida, as shown in **Figure 6**. This is mostly due to the high influx of people to the state over the last twenty years and the resulting increase in treated domestic wastewater available for use. Regulations governing reclaimed water use are contained in Chapter 62-610, Florida Administrative Code (F.A.C.). According to the rule, any type of irrigation system may be used to grow crops, such as citrus, that will be peeled, skinned, cooked, or thermally processed before human consumption.

Using reclaimed water involves a contractual arrangement with a wastewater treatment plant. Many wastewater treatment plants have a need to

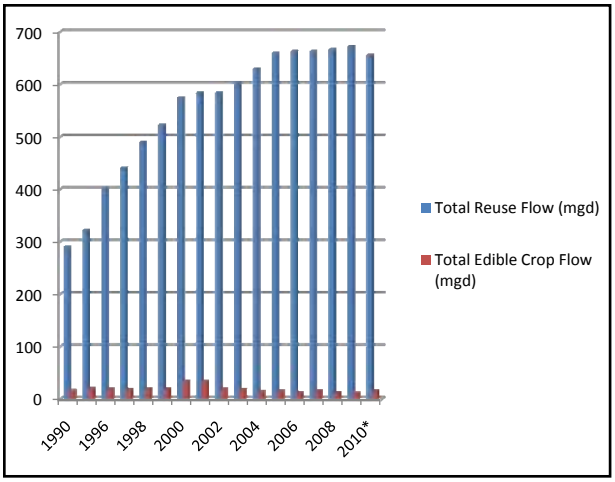


Figure 6: *Please note that the 2010 reuse and edible crop flow are based on the draft 2010 reuse inventory report and may be subject to change.

dispose of their water, often during rainy times when crops do not need water. It is important to review your contract so that you are not obligated to over-irrigate during wet-weather periods. Over-irrigating wastes water, can damage crops, and can cause excessive leaching of nitrogen or phosphorus from the soil.

Citrus growers should work with the WMD to arrange for a backup water source in case the reclaimed water source is insufficient or becomes unavailable or economically unfeasible.

Tailwater Recovery

Detention/retention areas allow all or a portion of the drainage water to be stored on-site temporarily. In some cases, the excess water can be stored for tailwater recovery or released later at low flow rates. Tailwater recovery systems are designed to collect and re-apply irrigation water and/or rainfall that discharges or seeps from production areas. An example layout is depicted in **Figure 7**. These systems can be constructed to intercept subsurface lateral flow, which makes them very suitable in high-water-table environments. The size, type, and location of proposed tailwater recovery ponds are variables considered when determining the need for an ERP.

Figure 7

Tailwater recovery systems can also help protect and preserve water resources, since they retain and/or reuse excess nutrients, rather than allowing them to reach downstream natural systems. Use NRCS Irrigation Management Tailwater Recovery Code 447 (http://www.nrcs.usda.gov/technical/efotg/) and consider the following when determining whether and/or how to implement tailwater recovery:

- A tailwater recovery system typically consists of collection and storage components (ditches, ponds), and also delivery components (pump stations, pipes).
- Tailwater recovery ponds should be located at the lowest elevation(s), and sized according to runoff volume and rates. In some cases, tailwater cannot be collected by gravity and must be pumped.
- Offsite seepage from the tailwater recovery system should be controlled and managed properly, especially if the system is expected to receive chemical-laden waters. Control may be in the form of dike compaction, natural-soil liners, soil additives, commercial liners, drain tile, or other approved methods.
- In order to minimize disease risk when growing high-value crops, use chlorine or other approved disinfectants, as applicable, in the collected tailwater.
- Implement routine maintenance of all mechanical components, and maintain dikes and berms to keep the tailwater recovery pond structurally sound.

Note: The installation of tailwater recovery ponds may have food safety implications or may require an Environmental Resource Permit or other type of authorization, so growers should check with the FDACS Division of Food Safety http://www.freshfromflorida.com/fs/index.html or the WMD before installing them.

Horizontal Wells

Horizontal wells allow access to shallow surficial aquifers as a water source for irrigation, if the soil type and aquifer yield characteristics are suitable. Trenching and the placement of a horizontal well screen in the surficial aquifer create a flow path

through impermeable layers, and provide an efficient means of recovering shallow groundwater. These wells may need additional water treatment due to the presence of iron and other elements.

Protecting the Water Source

Backflow Prevention

It is important to ensure that the irrigation water source does not become contaminated through the backflow of chemicals that are injected into the irrigation system. Florida law requires backflow prevention (antisiphon) devices on all irrigation systems used for the application of pesticides or fertilizers (i.e., fertigation) (see **Appendix 6**). An example of such a device is shown in **Figure 8**.

Figure 8

Backflow prevention should include a check valve between the irrigation pump and the injection device to prevent backward flow; a low-pressure drain to prevent seepage past the check valve; a vacuum relief valve to ensure that a siphon cannot develop; and a check valve on the injection line. For more information on backflow prevention, go to UF-IFAS publication, Causes and Prevention of Emitter Plugging: http://edis.ifas.ufl.edu/AE032.

Saline Water

All natural waters contain soluble salts; however, the amount and type of salts they contain vary greatly. Irrigation water can degrade when wells are pumped at high rates or for prolonged periods. Sometimes "up-coning" can occur from pumping, whereby saline water, rather than fresh water, is drawn into the well. Similarly, saltwater intrusion from groundwater pumping near coastal areas can create a problem with some irrigation wells. During the dry season, salinity levels in ditches, canals, and reservoirs can increase through evaporation and irrigation water re-use (tailwater recovery).

Saline water typically is unsuitable for irrigation because of its high content of TDS. Saline irrigation water remediation consists of a few options:

- **Back-Plugging** - If fractures of flow zones in the well casing can be identified through well logging instrumentation, then the well may be a candidate for back-plugging. In this case, a cement-type material is injected into the well casing and sealed to a particular depth.
- **Surface Water Augmentation** - If a surface water reservoir exists, then saline groundwater can be mixed (blended) with the reservoir water to lower the total salt concentration. If using augmentation, water quality monitoring is important to ensure that salt concentrations are in the acceptable range.
- **Fertilizer Selection and Split Application** - A fertilization program that uses soluble fertilizers with a relatively low concentration of salts in frequent applications (more than 2-3 times per year), and/or that incorporates controlled release fertilizer (CRF), normally results in less potential for salt injury.
- **Irrigation Frequency** - To manage saline water effects, irrigate frequently. Periodically, apply excess irrigation to move salt accumulations downward beyond the root zone. Be mindful that this activity can also move N beyond the root zone of the plant.

Irrigation System Maintenance

Maintenance is necessary on any irrigation system to keep it operating at peak efficiency according to manufacturer's recommendations. The benefits of maintaining irrigation systems in good working condition include water conservation, uniform plant growth and production, and reduced operation and maintenance costs.

A primary goal of an irrigation maintenance program is to ensure that the system is always capable of uniformly delivering the proper amount of water. This includes: (1) application efficiency measurements; (2) meter calibration; (3) preventative maintenance; (4) corrective maintenance/repairs; and (5) appropriate recordkeeping. Regular visual inspections aid in identifying necessary repairs and corrective actions.

For traditional open-ditch seepage irrigation systems, water control structures (such as risers and culverts) should be kept clean and operational. Ditch banks should be maintained at their designed side slope, and vegetative cover should be adequate to maintain the structural integrity of the ditch and prevent erosion.

Maintenance of pressurized pipe systems includes operational checks of pump stations, valves, and irrigation emitters, and maintenance of irrigation

lines through chlorination/acidification and flushing. ***Chelating*** and ***sequestering agents*** are available to prevent plugging caused by scale deposition. Malfunctioning or worn-out nozzles need to be replaced with similar ones that have the same flow and pressure characteristics. Conserving water and improving efficiency through proper maintenance also may enhance yields.

In some parts of the state, Mobile Irrigation Laboratories (MILs) are available, free of charge, to perform irrigation system evaluations and propose system improvements and basic maintenance recommendations. System improvements to increase uniformity and efficient scheduling can help growers conserve significant amounts of irrigation water while still providing the water required to meet citrus crop needs. For more information on MILs, go to: http://www.floridaagwaterpolicy.com/MobileIrrigationLabs.html.

Tracking Irrigation System Performance

It is also important to measure the amount of water that is actually delivered through the irrigation system, via a water meter or a calibrated flow measurement device. Knowing the flow or volume will help you determine how well your irrigation system and irrigation schedule are working.

Keeping irrigation records (amount applied, duration of irrigation events, etc.) will help you track and minimize the amount of water used and reduce the costs associated with running the irrigation system.

Managing Irrigation

Efficient irrigation management provides greater water resource protection and reduced operational costs through more efficient water use. It conserves water, reduces the chances of over- or under-irrigating, and reduces leaching of agrichemicals in areas that are prone to such losses. Efficient irrigation targets the application of water to the plant's root zone, using only the amount needed for proper plant growth. Over-irrigation wastes water and promotes nutrient leaching.

Ensuring efficient irrigation requires development of a site-specific irrigation management plan that incorporates the use of information on soil properties, topography, crop types, ***evapotranspiration*** (ET), and seasonal climatic conditions in order to generate customized irrigation methods and schedules. This can be part of an overall BMP implementation plan.

Precision Irrigation

Precision irrigation for citrus can range from simple to more elaborate techniques. Simple techniques that rely on soil moisture measurement devices will require a high level of "hands-on" management decisions. More complex techniques usually involve high-technology methods employing computers, geographic information systems, remote-sensing equipment, etc. At its most sophisticated level, precision irrigation allows irrigation events to be adjusted in real time for location, frequency, and duration, based on soil properties and weather conditions. You may want to explore the feasibility of installing equipment and computer software that will provide you with real-time, site-specific irrigation and/or weather information for your operation. You may contact FDACS, UF-IFAS Extension, or an independent contractor for help.

Irrigation Scheduling

Irrigation scheduling consists of determining when to start irrigating, at what intervals to irrigate, and how long to irrigate. In order to develop an irrigation schedule, you should:

- Estimate irrigation water requirements.
- Make adjustments based on available soil moisture content, soil water tension, or historic or real-time ET and appropriate crop factors.
- Make further adjustments based on replenishment of soil moisture through rainfall.

Irrigation Water Amounts

Irrigation water amounts are determined primarily by the crop's water requirements, the water-retention characteristics of the soil, the chemical characteristics of the irrigation water, and type and efficiency of the irrigation system. Simple tools, like a water table observation well shown in **Figure 9**, help growers decide if irrigation is needed. Crop

Figure 9

water requirements refer to the actual water needs for plant growth, taking into account ET and other climatic factors.

Citrus irrigation requirements vary with soil type, climate, ground cover, cultivation practices, weed control, tree size, age, and tree health. Large, vigorous, healthy trees require more water than young or non-productive trees. Enough water should be applied only to wet to the bottom of the root zone area. Citrus trees should not be water-stressed in the spring. In general, ***soil water depletion*** should be no greater than 25% in the spring, but can range from 50 to 66% in the fall and winter season. The amount of irrigation area covered will depend on tree spacing and canopy size. For mature trees irrigated with micro-sprinklers two to three times per week in the spring, 50% or more of the area should be covered. If frequent pulses can be applied daily with drip irrigation, less area can be covered.

Most citrus producers have WMD consumptive use permits that allocate an approximate irrigation water amount on an annual average basis. The WMDs use irrigation allocation models to determine how much water will be granted via the permit. Permits take into consideration factors such as grove spacing, root depth, soil types, average rainfall, etc., to account for regional differences. For more specific information about water use permitting requirements, go to UF-IFAS publication, *Handbook of Florida Water Regulation: Consumptive Use* at: http://edis.ifas.ufl.edu/fe604.

Irrigation Scheduling Considerations

Irrigation scheduling should be based on information such as: reference ET (ETo) rates, as noted in **Table 2**; rainfall total, which can be determined by rain gauges; and soil moisture, which can be determined by sensors.

Table 2. Reference Evapotranspiration Rates (ETo) - From K. Morgan, UF-IFAS (2012)

Month	North Region ETo (inches/day)	South Region ETo (inches/day)
Jan	0.07	0.07
Feb	0.09	0.09
Mar	0.11	0.11
Apr	0.15	0.14
May	0.16	0.16
June	0.16	0.16
July	0.16	0.16
Aug	0.15	0.16
Sept	0.14	0.14
Oct	0.12	0.12
Nov	0.08	0.09
Dec	0.07	0.07

More refined ET rates can be obtained from the University of Florida's Florida Automated Weather Network (FAWN) and the National Weather Service. Coupled with this technology, the observation of visual symptoms, such as wilting, will enhance the efficiency of irrigation scheduling. Prior to implementing an irrigation schedule, the irrigation system must be evaluated to determine the system's rate of application per acre. MILs can help with this.

Measuring Soil Moisture

There is no universally recognized standard method to measure soil moisture, and no uniform way to compute and present the results. The most commonly used device is the tensiometer, however capacitance sensors are rapidly gaining in popularity.

Tensiometers indicate the water status of a soil by measuring the soil water potential, or tension, which is related to the force a plant must exert to extract water from the soil. Using capacitance methods, soil water content is determined by measuring the capacitance between two electrodes implanted in the soil. ***Capacitance*** sensors provide a near-instantaneous measure of soil water content.

Weather-Related Information

Weather is one of the most important factors that affect citrus growth and production. Irrigation water-loss rates are affected by sunlight, wind speed, relative humidity, and air temperatures. When scheduling irrigation, it is important to have good rainfall and temperature data. Water loss can be reduced by irrigating when conditions do not favor excessive evaporation, especially when overhead irrigation systems are used. Irrigation should occur in the early morning or at night before air temperatures rise and relative humidity drops.

The FAWN system, which maintains weather stations throughout most of the state, provides growers accurate, real-time weather data that can be accessed via the internet or by phone. A FAWN station is depicted in **Figure 10**. Each station measures air temperature, soil temperature, ETo, wind speed and direction, rainfall, relative humidity, and solar radiation. These parameters are critical to calculate supplemental irrigation requirements for your crop. FAWN also provides information on other irrigation tools. You can access this information at: http://fawn.ifas.ufl.edu.

Figure 10

Special-Case Irrigation Measures

Frost/Freeze Protection

Options for protecting citrus crops from frosts and freezes include micro-sprinkler and flood irrigation, tree-wraps, heaters, and soil banking. Each method has application for specific regions and crops.

Most citrus growers use irrigation water to protect crops. When used for cold protection, the proper application and timing of water application is critical. FAWN has developed tools to help determine under what climatic conditions to use your irrigation system for frost and freeze protection (see http://fawn.ifas.ufl.edu/tools/). Adhere to any frost/freeze protection provisions in your consumptive use/water use permit.

Drought

The National Drought Mitigation Center maintains a number of tools to assist growers in monitoring the intensity level of a drought. You can access these tools at http://drought.unl.edu/dm/monitor.html. Irrigation frequency and duration should be based on rooting depth, to provide adequate moisture to the crop root zone. Contact the WMD to inquire about water shortage requirements.

Irrigation Management BMPs

Note: You can refer to SL-253 (Nutrition of Florida Citrus Trees) for general guidance on citrus irrigation management to help you implement the applicable BMPs below.

3.1 Irrigation Decision-Making and Management Practices

Using the practices below, maintain soil moisture within the recommended range for the crop and soil type. Base your irrigation amounts and timing on crop water demands, soil moisture availability, and weather conditions. Contact your local UF-IFAS Extension or NRCS office to obtain specific information (i.e., water-holding capacity, depth to water table) about the soils, and to determine what the water demand is for your particular crop(s). This is usually expressed as inches-per-acre or gallons-per-plant.

✓ **1.** Use available tools and data to assist in making irrigation decisions. Tools may include water table observation wells, on-site soil moisture sensors, crop water use information, weather data, and the feel and appearance method. Real-time weather data is available by visiting FAWN, United States Geological Survey (USGS), and WMD websites; or by installing your own on-site weather station.

✓ **2.** Minimize application losses due to evaporation and wind drift by appropriate irrigation scheduling (e.g., irrigating early in the morning, late in the afternoon, at night, and/or when cloud cover is abundant and wind speed is minimal).

✓ **3.** Do not irrigate beyond ***field capacity***, except as necessary to manage salinity.

References:

1. UF-IFAS, Tensiometers for Soil Moisture Measurement and Irrigation Scheduling, CIR-487, http://edis.ifas.ufl.edu/AE146
2. Food and Agricultural Organization, Crop Evapotranspiration – Guidelines for Computing Crop Water Requirements, FAO Paper 56, http://www.fao.org/docrep/X0490E/X0490E00.htm
3. UF-IFAS, Field Evaluation of Micro-irrigation Water Application Uniformity, BUL-265, http://edis.ifas.ufl.edu/AE094
4. UF-IFAS, Field Devices for Monitoring Soil Water Content, BUL-343, http://edis.ifas.ufl.edu/AE266
5. USDA- NRCS, Irrigation System-Sprinkler, Code 442; Irrigation System-Microirrigation, Code 441; and Irrigation Water Management, Code 449, FOTG Section IV, http://www.nrcs.usda.gov/technical/efotg/

3.2 General Irrigation System Maintenance

✓ **1.** Test irrigation source water quality at least annually to detect issues with water chemistry that may result in irrigation system plugging. The analysis could include pH, total dissolved solids, alkalinity, dissolved iron, hydrogen sulfide, and calcium carbonate. Run the pump long enough to purge the water in the well to ensure a representative sample. Adjust your maintenance actions as needed.

✓ **2.** Use water meters (flow or volume) or other measuring devices/calculations to determine how much water is applied to the irrigated

area. Use this information to help you determine how well your irrigation system and irrigation schedule are working. Make any needed schedule adjustments or system repairs.

✓ **3.** Monitor water meters or other measuring devices for unusually high or low readings to detect possible leaks or other problems in the system. Make any needed repairs.

✓ **4.** If one is available, get a Mobile Irrigation Lab to check the distribution or emission uniformity and the conveyance efficiency of the irrigation system(s). This should be done every three to five years.

✓ **5.** Maintain pump stations and wells, and related components, in good working order. Check them on an annual basis. Replace parts as needed.

✓ **6.**  Maintain a record-keeping system for inspection and maintenance of key irrigation system components. Records should be compared over time for any changes that would indicate problems with the system.

References:

1. UF-IFAS, Potential Impacts of Improper Irrigation System Design, Agricultural Engineering Fact Sheet 73, http://edis.ifas.ufl.edu/AE027
2. UF-IFAS, Maintenance Guide for Florida Microirrigation Systems, Circular 1449, http://edis.ifas.ufl.edu/ss436

3.3 *Pressurized Irrigation Systems*

✓ **1.** Examine irrigation emitters for wear and malfunction, and replace them as necessary.

✓ **2.** Clean and maintain filtration equipment.

✓ **3.** Flush irrigation lines regularly to minimize emitter clogging. To reduce sediment build up, make flushing part of a regular maintenance schedule. If fertigating, prevent microbial growth by flushing all fertilizer from the lateral lines before shutting down the irrigation system.

References:

1. UF-IFAS, Evaporation Loss During Sprinkler Irrigation, BUL290, http://edis.ifas.ufl.edu/pdffiles/AE/AE04800.pdf
2. UF-IFAS, Causes and Prevention of Emitter Plugging in Micro-Irrigation Systems, BUL 258, http://edis.ifas.ufl.edu/ae032
3. NRCS Irrigation Pipeline, Code 430, http://www.nrcs.usda.gov/technical/efotg/

3.4 *Non-pressurized Irrigation Systems*

✓ **1.** Clean debris and control weeds in irrigation ditches and canals, to maintain water flow and direction.

✓ **2.** Keep water-level-control structures (such as culverts and risers) in irrigation ditches in good working order.

References:

1. NRCS, Irrigation Systems, Surface and Subsurface, Code 443, Irrigation Canal or Lateral, Code 320, Irrigation Field Ditch, Code 388, Irrigation Reservoir, Code 436, Irrigation Management Tailwater Recovery, Code 447 http://www.nrcs.usda.gov/technical/efotg/

3.5 *Reclaimed Water*

If you are using reclaimed water:

✓ **1.** As needed, design or retrofit irrigation systems to handle reclaimed water, taking into account source water quality and delivery pressures.

✓ **2.** Separate reclaimed water supplies from existing ground or surface water sources to prevent cross-contamination.

References:

1. FDEP, Water Reuse for Florida: Strategies for Effective Use of Reclaimed Water. http://www.dep.state.fl.us/water/reuse/docs/valued_resource_Final-Report.pdf
2. FDEP, Reuse of Reclaimed Water and Land Application Rule, Chapter 62-610, F.A.C. http://www.dep.state.fl.us/legal/Rules/rulelistnum.htm

3.6 *Special-Case Irrigation Measures*

✓ **1.** When using irrigation for frost/freeze protection, monitor wet-bulb temperatures, and shut off the irrigation system as soon as the risk of evaporative cooling has ended. You can find this information at http://fawn.ifas.ufl.edu/tools/irrigation_cutoff/. If the FAWN weather station is not in close proximity to the grove, you can use other alternative measures such as a psychrometer to get more accurate wet and dry bulb temperatures. (Use the comments section at the end of the BMP checklist).

✓ **2.** During a drought, closely monitor soil moisture levels. Whenever practicable, irrigate at

times when the least amount of evaporative loss will occur.

During drought or freeze events, contact your WMD to inquire about water shortage requirements. It is critical that you adhere to any frost/freeze protection provisions in your consumptive use/water use permit.

Note: See Appendix 7 for list of record-keeping requirements and example record-keeping forms.

4.0 DRAINAGE MANAGEMENT

Drainage management is the ability to manipulate and control the water table, runoff, and/or rate of discharge to ensure adequate citrus tree health and production while minimizing impacts to water quantity and quality.

On poorly drained soils, effective drainage management is essential for profitable citrus production. It also allows air to move into the soil, and prevents oxygen-deprived conditions. Drainage management has environmental benefits as well. Holding water on-site for as long as possible and releasing it slowly will provide water quality treatment, and help prevent an excess volume of water being discharged downstream.

Drainage management systems in flatwoods groves may contain some or all of the following components: canals, retention/detention areas, open ditches, subsurface drains, beds, water furrows, swales, and pumps required to move surface water. These systems require continuous maintenance to minimize the chances of root damage from prolonged exposure to waterlogged soils caused by poor drainage, high-intensity rains, and high water tables.

Flooding Damage

Water table levels vary greatly in flatwoods areas during the rainy season, due to the effects of different soil types, non-uniform rainfall, and high-intensity rainstorms. Drainage of soil-water is especially important in the wet season, since citrus root damage may occur under prolonged high water-table conditions. Research has shown that there is potential for water damage to citrus roots **(Figure 11)** if water saturates beds for more than two days. During the cooler months of December-February, citrus trees can tolerate flooded conditions for much longer periods than in the summer.

Figure 11

Water table observation wells are good tools for observing soil-water dynamics. They are a reliable method for evaluating water-saturated zones in sites subject to chronic flooding injury. These wells also can be used to measure the rate of water-table drawdown. Wells with measuring rods allow observation of water tables while driving by the well site.

Drainage Rate and Volume

Following intense rainfall events, drainage rates and release volumes should provide for an adequately drained root zone while minimizing off-site impacts. Structures and/or pumps that regulate off-site water discharge should be designed, constructed, and maintained so that target water-table levels within the grove can be achieved.

When the water table approaches the target level, off-site discharges should be moderated. Depending on the grove design, irrigation method (e.g., micro-sprinkler or drip), and soil characteristics, this may require adjusting the pumping rate, the discharge structure, or use pulse drainage. Pulse drainage involves discharging for short periods of time and then allowing for recharge in the ditches. If adequate drainage in one portion of a grove results in water tables that are below target levels in another area, ditch cleaning, drainage system redesign, or auxiliary pumps may be needed to achieve more uniform drainage.

For additional information on drainage rates, contact your local NRCS representative.

Permitting Considerations

Construction or alteration of a drainage management system may alter on-site hydrology, and therefore may require an ERP or other WMD surface water management permit. Check with your WMD before beginning construction of any drainage management system.

Flatwoods Drainage Management BMPs

4.1 Water Table Management

✓ **1.** Install and use water table observation wells and inspect them periodically for any needed repairs. Calibrate wells after installation and/or after any maintenance.

References:

1. UF-IFAS, Water Table Measurement and Monitoring for Flatwoods Citrus. Circular 1409. http://edis.ifas.ufl.edu/AE085, http://edis.ifas.ufl.edu/ch151
2. NRCS Drainage Water Management, Code 554 FOTG-Section IV. http://www.nrcs.usda.gov/technical/efotg

4.2 Structures and Conveyances

✓ **1.** For board risers, remove only the boards necessary to achieve desired drainage.

✓ **2.** Keep water velocities near drainage structures slow enough to reduce potential for soil particles to enter the drainage system.

References:

1. UF-IFAS, Simple Water Level Indicator for Seepage Irrigation, Circ. 1188. http://edis.ifas.ufl.edu/AE085
2. Obreza and Boman, 1992. Simulated Citrus Water Use from Shallow Groundwater.
3. Obreza and Admire, 1985. Shallow Water Table Fluctuations in Response to Rainfall, Irrigations, and Evapotranspiration in Flatwoods Citrus. http://www.fshs.org/Proceedings/Password%20Protected/1985%20Vol.%2098/32-37%20(OBREZA).pdf
4. UF-IFAS, Manual Monitoring of Farm Water Tables, Circ. 731. http://edis.ifas.ufl.edu/AE130
5. UF-IFAS, Water Budgeting for High Water Table Soils. Circ. 769. http://edis.ifas.ufl.edu/ae374
6. NRCS Structure for Water Control, Code 587, Surface Drainage Field Ditch, Code 607, FOTG-Section IV. http://www.nrcs.usda.gov/technical/efotg

4.3 Stormwater Management

✓ **1.** Operate and maintain all stormwater management conveyances (swales, ditches, and canals) to ensure they perform their intended function.

✓ **2.** If you have an existing flatwoods grove that does not have an ERP or other WMD surface water permit and has a history of downstream flooding issues, develop and implement a written stormwater management plan that provides specific responses to various types and levels of rainfall, as feasible. The goal of the plan should be a reduction in volume of off-site discharge while maintaining a healthy rooting environment for citrus trees.

✓ **3.** Evaluate the plan's effectiveness, and make adjustments as needed.

In developing the plan:

- Contact your local NRCS District Conservationist to help you identify soil types that are historically prone to flooding or standing water. Evaluate the storage capacity, size, and elevations of existing ditches, ponds, creeks, rivers, and wetlands, and the size, layout, and elevations of the fields. You should also contact your county or WMD to obtain maps (FEMA, FIRM) or other information related to flooding issues at the proposed or existing location. You can access this information via the web at http://www.fema.gov/hazard/map/firm.shtm.
- You may wish to consult with a public or private agricultural engineer to discuss your stormwater management needs and considerations. If so,

find an engineer qualified to provide an appropriate analysis for your site.

- Include target water table levels and pump/drainage structure operating procedures that will be used for extreme rainfall events.

References:

1. NRCS, Runoff Management System, Code 570, FOTG-Section IV. http://www.nrcs.usda.gov/technical/efotg
2. Water Management Districts, ERP Stormwater Quality Applicant's Handbook.
3. ANSI/ASABE, Design and Construction of Surface Drainage Systems on Agricultural Lands in Humid Areas, EP302.4. http://www.asabe.org/standards/
4. UF-IFAS, Detention/Retention for Citrus Stormwater Management. Circ. 1405. http://edis.ifas.ufl.edu/ae216

5.0 SEDIMENT AND EROSION CONTROL MEASURES

Sediment and Erosion Control Measures *are temporary or permanent practices to prevent sediment loss, slow water flow, and/or trap or collect debris and sediments in runoff.*

Sediments or suspended solids are recognized forms of water pollution and often result in the loss of ditch or canal capacity. Unlike many chemical pollutants, sediment is a natural component of water bodies and the resources they support. Excessive amounts of suspended solids or sediments are often a product of erosion from un-stabilized or disturbed land areas. These solids originate from four primary sources:

- Soil particles eroded into or from ditches
- Plant material washed into ditches
- Plant and biological material growing within the ditches and canals

Excessive sediments deposited on stream bottoms and suspended in the water column can affect fish spawning and impair fish food sources, reduce habitat complexity, potentially harm public water supply sources, and reduce water clarity. Reduction in water clarity can affect aquatic resources, such as sea grasses and oysters, in the receiving estuary.

In addition to potential downstream water quality impacts, the build-up of silts and sediments in ditches and canals can negatively affect the operation. This reduction in cross-sectional area results in higher water velocities, as compared to clean ditch or canal. This higher water velocity (compared to clean ditches/canals) may induce greater amounts of erosion of fine and coarse particles from ditch and canal banks. The presence of shoals and sandbars are good indicators of soil losses. Field erosion also results in site degradation, with increased costs for ditch cleaning and reshaping of beds and furrows.

Minimizing downstream transport of sediments from groves and canal/ditch banks requires an integrated approach of managing erosion at the grove-level and in the primary and secondary canal systems. Efforts should focus on keeping soils in the groves and stabilizing canal and ditch banks similar to that shown in **Figure 12**. While the BMPs that follow generally help reduce sediment losses at the grove level, many of these practices may be applicable for the primary and secondary canal systems. Significant soil losses from groves are expected during construction of new groves or renovation of older ones. Losses from mature, well-managed groves will be much lower.

Figure 12

Sediment and Erosion Control BMPs

5.1 Vegetative Cover

✓ **1.** Stabilize water furrows and ditch and canal banks by encouraging a good coverage of noninvasive vegetation.

✓ **2.** Maintain desirable vegetation on bed "middles" to minimize erosion and trap sediments.

✓ **3.** For mature trees in bedded groves, restrict the area of tree-row-applied herbicides to within the citrus tree canopy drip line.

5.2 Erosion Control

✓ **1.** Create and maintain sumps upstream of pump intakes (e.g. lift pumps) within collector ditches.

✓ **2.** Use drain pipe or flexible pipe to connect all water furrows to lateral ditches. Extend the pipe on the downstream side far enough away from the ditch bank to prevent bank scouring.

✓ **3.** Slope ditch bank berms to divert surface water away from drainage ditches and canals. This is especially important when there is an access road adjacent to the water feature.

✓ **4.** In areas subject to high water velocities, protect ditch and canal banks from erosion using rip-rap, concrete, headwalls, or other materials that buffer against turbulence.

✓ **5.** Maintain ditch and canal drainage function by removing unconsolidated sediments in order to retain the original design cross-sectional area. Use slotted or cross-drilled buckets, avoid disrupting ditch side slopes, and deposit vegetation in an appropriate upland location.

References:

1. NRCS, Access Road, Code 560; Runoff Management System, Code 570; Irrigation Canal or Lateral, Code 320; Irrigation Field Ditch, Code 388; Surface Drainage Field Ditch, Code 607; Sediment Basin, Code 350; Heavy Use Protection, Code 561; Structure for Water Control, Code 587. FOTG-Section IV. http://www.nrcs.usda.gov/technical/efotg

2. The Florida Stormwater, Erosion, and Sedimentation Control Inspector's Manual, FDEP. http://www.dep.state.fl.us/water/nonpoint/docs/erosion/erosion-inspectors-manual.pdf

3. National Management Measures for the Control of Nonpoint Pollution from Agriculture, Chapter 4C, EPA Document No. 841B03004. http://www.epa.gov/nps/agmm/

6.0 WATER RESOURCES PROTECTION

Water Resources *are distinct hydrologic features, including wetlands, springs, streams, and aquifers.*

Wetlands, Springs, and Streams Protection

Under Florida Law, wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Florida wetlands generally include swamps, marshes, bayheads, bogs, cypress domes and strands, sloughs, wet prairies, riverine swamps, hydric seepage slopes, tidal marshes, mangrove swamps and other similar areas. Florida wetlands generally do not include longleaf or slash pine flatwoods with an understory dominated by saw palmetto.

Chapter 62-340, Florida Administrative Code, entitled *Delineation of the Landward Extent of Wetlands and Surface Waters*, contains the methodology that must be used by all state and local governments in Florida to determine the boundary between wetlands and uplands and other surface waters. The National Food Security Act manual is used by NRCS to determine wetlands boundaries on agricultural lands. In most cases, both methodologies produce the same or nearly the same determinations.

Springs are defined by the Florida Geological Survey as a point where undergroundwater emerges to the earth's surface. They flow naturally from underlying aquifers and are classified based on their magnitude, or amount of flow coming from the spring vent. Springs and spring runs attract wildlife, provide over-wintering habitat for endangered manatees, contain unique biological communities, and are important archeological sites.

The area within groundwater and surface water basins that contributes to the flow of the spring is a spring's recharge basin, also called "springshed." This area may extend for miles from the spring, and the size of the area may fluctuate as a result of undergroundwater levels. First magnitude springs discharge 64.6 million gallons per day (MGD) or more; second magnitude springs discharge between 6.46 to 64.6 MGD. FDEP has initiated an effort to delineate springsheds in the state, on a prioritized basis.

Wetlands and springs are important components of Florida's water resources. Wetlands often serve as spawning areas and nurseries for many species of fish and wildlife, perform important flood-storage roles, cycle nutrients in runoff water, contribute moisture to the hydrologic cycle, and add plant and animal diversity. They can also provide limited

grazing opportunities. Both wetlands and springs offer valuable recreational opportunities for the public and can provide an economic benefit to the surrounding communities.

Rivers and streams are naturally flowing watercourses. There are approximately 51,000 miles of rivers and streams in Florida. They are generally classified as sand-bottom, calcareous, swamp and bog, alluvial, or spring-fed systems. There are three measurable components that contribute to stream flow: base flow, interflow, and surface runoff. Surface runoff is most affected by rainfall (stormwater runoff), and contributes most to peak flow. Rivers and streams can readily transport pollutants received in stormwater runoff to wetlands, lakes, estuaries, and other water bodies. Consequently, it is important to minimize pollutant discharges to rivers and streams.

Conservation Buffers

Conservation buffers are permanently vegetated, non-cultivated areas that function to retain water and soil onsite to help reduce pollutants in surface water runoff. They include grove borders, filter strips, grassed waterways, and ***riparian*** buffers, and are particularly effective in providing water quality treatment near sensitive discharge areas. A good example of a conservation buffer used to protect a lake within a grove is depicted in **Figure 13**.

Figure13

- Grove Borders are strips of permanent vegetation, either natural or planted, at the edge or perimeter of groves. They function primarily to help reduce erosion from wind and water, protect soil and water quality, and provide wildlife habitat. Consider installing borders in existing groves, based on adjacent land uses and their environmental sensitivity.
- Filter strips and grassed waterways are areas of permanent vegetation between grove areas that drain to natural waterbodies. Their main purpose is to decrease the velocity of runoff water and remove sediment particles before they reach surface waters.
- Riparian buffers can be forested or herbaceous areas located adjacent to streams, which help reduce amounts of sediment, organic material, nutrients, and pesticides in surface water sheetflow. Riparian buffers are most effective on highly sloped lands when next to perennial or intermittent streams with high groundwater recharge potential.

Consider using native vegetation to establish conservation buffers. Conservation buffers should be inspected periodically, and restored as needed in order to maintain their intended purpose. Any use of fertilizers, pesticides, or other chemicals should be done so as to not compromise the intended purpose of the buffer. As necessary, use prescribed burns in accordance with Florida Forest Service guidelines, to maintain the native vegetation and discourage the establishment of nuisance vegetation.

Aquifer Protection

With the majority of Florida's water supply originating from underground sources (***aquifers***), it is extremely important that agricultural operations help protect wellheads from contamination. Successful wellhead protection includes complying with regulatory requirements and using common-sense measures with regard to well placement and agricultural practices near wells. For existing wells, the focus should be on management activities near the wellhead, aimed at reducing the potential for contamination. For new-well construction, the initial focus should be on well location and following sound well-construction practices, followed by proper maintenance.

Water Resources Protection BMPs

6.1 Wetlands Protection

Do not dredge or fill in wetlands. Consult with the WMD and the NRCS prior to conducting activities in or near wetlands to ensure that you are complying with any permitting or NRCS program eligibility requirements.

Minimize adverse water quality impacts to receiving wetlands by progressively applying measures until the problem is adequately addressed. Practices such as filter strips, conservation buffers, swales, or holding water on-site may preclude the need for more aggressive treatment measures.

Note: Use an NRCS county soil survey map to help identify the location of wetlands, hydric soils, or frequently flooded areas. If you do not have an

environmental resource permit (which provides a wetlands delineation), seek technical assistance from the WMD or NRCS to determine the landward boundary of wetlands on your operation.

✓ **1.** Install and/or maintain a minimum 25-foot, non-fertilized ***vegetated buffer*** upland of the landward boundary of all wetlands and lakes, unless you have an existing WMD permit (e.g., ERP, or management and storage of surface waters permit) that specifies a different buffer. For lakes that have an adopted TMDL for nutrients, expand the buffer to 50-feet.

✓ **2.** For existing operations without an ERP that are unable to meet the vegetated buffers specified above, submit to FDACS a written description of the alternative measures you will take to protect the wetlands from water quality impacts (Use the comments section at the end of the BMP checklist).

When broadcast-applying fertilizer near a wetlands buffer, ensure that the fertilizer does not land inside the buffer.

References:

1. NRCS, Wetland Enhancement, Code 659, Nutrient Management, Code 590, FOTG-Section IV. http://www.nrcs.usda.gov/technical/efotg
2. EPA, National Management Measures for the Control of Nonpoint Pollution from Agriculture. http://www.epa.gov/nps/agmm/chap4c.pdf

6.2 *Streams Protection*

✓ **1.** Install and/or maintain a riparian buffer along perennial streams on production areas that exceed 1-percent slope and discharge directly to the streams. Contact FDACS, NRCS, or a NRCS approved Technical Service Provider for assistance in properly designing the riparian buffer in accordance with NRCS Codes 390 and/or 391 in Reference 1 below.

✓ **2.** Locate and size any stream crossings to minimize impacts to riparian buffer vegetation and function. Refer to NRCS Stream Crossing, Code 578 for design criteria.

References:

1. NRCS Field Border, Code 386, Riparian Herbaceous Cover, Code 390, Riparian Forest Buffer, Code 391, Filter Strip, Code 393 and Grassed Waterway, Code 412, FOTG-Section IV. http://www.nrcs.usda.gov/technical/efotg

6.3 *Protection for First- and Second-Magnitude Spring Recharge Basins*

✓ **1.** Install and/or maintain a 100-foot non-fertilized vegetated buffer upland of the landward boundary of springs and spring runs.

✓ **2.** Install and/or maintain a 50-foot non-fertilized vegetated buffer around sinkholes.

✓ **3.** If you have a sinkhole on your property, never use it to dispose of used pesticide containers or other materials.

References:

1. Department of Community Affairs, 2002 Protecting Florida's Springs, Land Use Planning Strategies and Best Management Practices. http://www.dep.state.fl.us/springs/reports/files/springsmanual_2002.pdf.

6.4 *Well Operation and Protection*

When installing a new well, contact your regional WMD to see whether the well requires a consumptive use/water use permit. Potable water wells as defined by Chapter 62-521, F.A.C, must follow the requirements of that rule.

Locate new wells up-gradient as far as possible from likely pollutant sources, such as petroleum storage tanks, septic tanks, chemical mixing areas, or fertilizer storage facilities. Use a licensed Florida water well contractor, and drill new wells according to local government code and WMD well construction permit requirements.

✓ **1.** Use backflow-prevention devices at the wellhead to prevent contamination of the water source.

✓ **2.** Inspect wellheads and pads at least annually for leaks or cracks, and make any necessary repairs.

✓ **3.**  Maintain records of new well construction and modifications to existing wells.

References:

1. NRCS Water Well, Code 642; Well Decommissioning, Code 351; Well Plugging, Code 755. FOTG-Section IV. http://www.nrcs.usda.gov/technical/efotg
2. FDEP, Water Well Permitting and Construction Requirements Rule, Chapter 62-532, F.A.C. http://www.dep.state.fl.us/legal/Rules/rulelistnum.htm
3. Florida Water Permits. http://flwaterpermits.com/

Note: See Appendix 7 for list of record-keeping requirements and example record-keeping forms.

7.0 INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) *combines the monitoring of pest and environmental conditions with the judicious use of cultural, biological, physical, and chemical controls to manage pest problems.*

Under Florida law (section 482.021, F.S.), IPM is defined as: …"the selection, integration, and implementation of multiple pest control techniques based on predictable economic, ecological, and sociological consequences, making maximum use of naturally occurring pest controls, such as weather, disease agents, and parasitoids, using various biological, physical, chemical, and habitat modification methods of control, and using artificial controls only as required to keep particular pests from surpassing intolerable population levels predetermined from an accurate assessment of the pest damage potential and the ecological, sociological, and economic cost of other control measures."

Most cultural control methods are designed to help plants avoid contact with pests, create unfavorable conditions for pests, and eradicate or reduce the incidence of pests in a grove. Biological controls (and some cultural controls) improve plant resistance to pests, or utilize organisms that prey upon pests. Physical methods are generally used to deter, trap, destroy, or provide barriers to pests. Chemical methods involve the use of chemical pesticides or other repellants.

The basic steps of an IPM program are as follows:

- Identify key pests.
- Determine the pest's life cycle and which stage of the life cycle to target (for an insect pest, whether it is an egg, larva/nymph, pupa, or adult).
- Use cultural, biological, and physical methods to prevent problems from occurring (for example, prepare the site and select resistant plant cultivars); and/or reduce pest habitat (for example, practice good sanitation). Consider all of the cultural, biological, and physical control measures available and appropriate before moving to a chemical control method for preventing and controlling pest infestations.
- Decide which pest management practices are appropriate, and implement associated corrective actions.
- Direct the control where the pest lives or feeds. Use properly timed preventive chemical applications only when your experience indicates that they are likely to control the target pest effectively, while minimizing the economic and environmental costs.

Scouting

Scouting is the most important element of a successful IPM program. It involves monitoring pest presence and development throughout the growing season. By observing plant conditions regularly and noting which pests are present, an informed decision can be made regarding severity of damage and what pest control method is necessary.

Pests may be present for some time before they are observed or actual crop damage occurs. Therefore, it is essential to record the results of scouting in order to develop historical information, document patterns of pest activity, and document the treatment's success or failure. It is also important to determine whether the "corrective actions" actually reduced or prevented pest populations, were economical, and minimized risks. It is recommended that growers record this information, and use it when making similar decisions in the future.

Cultural Controls

Site selection, plant selection and establishment, and production techniques are cultural control practices. Growers should practice strict sanitation and use only registered planting stock that is disease-free. Planting schemes should promote good air circulation, which reduces the incidence of some disease.

Groves near wooded areas, power lines, and ponds are generally more vulnerable to pests. Managing the habitat around crop production areas to encourage predator species of nuisance animals or reducing the habitat of the nuisance animals is another control method option. Using native vegetation in borders and buffers can attract beneficial insects and help reduce the imbalance in which crop pests thrive.

Biological Controls

Biological controls involve the use of natural enemies to control, suppress, or the active manipulation of antagonistic organisms to reduce pest population densities to acceptable levels. Natural enemies help to reduce the amount of pesticides needed to control pests, thus protecting water quality and reducing production costs. Biological control techniques should be tailored to the pest's life cycle, availability of effective predators and parasites, environmental conditions, and historical data.

Predators and parasites (insects, mites, and microbes) are the most commonly used biological control agents, and are known as "beneficials." These alone will generally not prevent damage from pests, but can reduce the severity. A management plan for the use of beneficials must be closely adhered to in order for it to be effective and economical over the long-term. **Figure 14** shows a parasitic wasp and is a good example of biological control on citrus.

Figure 14

Physical Controls

The EPA regulates various mechanical devices and allows their use in order to minimize or prevent negative impacts from nuisance pests. EPA refers to these as "pest control devices." A product is a pest control device if it uses only physical or mechanical means to trap, destroy, repel, or mitigate any pest and does not include any pesticidal substance or mixture of substances.

Pest control devices alone are not required to be registered with EPA. However, if a device and a pesticide product are packaged together, the combined product is a pesticide product subject to registration requirements. For more information, refer to: http://www.epa.gov/pesticides/factsheets/devices.htm.

Chemical Controls

The EPA and FDACS regulate the use of pesticides in Florida. The term pesticide is defined by EPA as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Chemical control involves the use of pesticides, as necessary. Factors that influence the selection of chemical controls in Florida include:

1. The product's registration status within Florida
2. The effectiveness of the product against the target pest
3. The potential risk of a particular pesticide for beneficial organisms (e.g., honey bees)
4. The product's cost effectiveness

5. The potential hazards to applicators, bystanders (e.g., residents, nearby businesses), the environment (i.e., non-target organisms, water quality), food safety, and the viability of a citrus crop

   - Certain pesticides may be of concern because of the potential toxicity to non-target plant, invertebrate, fish, and wildlife species.
   - Pesticide use may result in ***phytotoxicity*** to trees, foliage, and/or the crop. Some combinations of pesticides or overlapping applications of incompatible materials can cause phytotoxicity.
   - Limitation of or restrictions on application areas - Product selection may be influenced by a farm's location relative to residential areas, human traffic in the vicinity, and weather conditions favoring drift of materials to non-target sites.
   - Impact on development of pest resistance - Resistance develops because one or more individuals in any given pest population may tolerate or resist effects of exposure to a specific pesticide active ingredient. When used consecutively for several applications, the offspring of resistant individuals multiply, and eventually establish a resistant population. Consequently, management decisions need to consider the known impacts of a pesticide on pest resistance development. In general, repeated use of any pesticide over short intervals should be avoided.

Adjuvants are substances that are applied with pesticides to enhance their performance, and include surfactants, compatibility agents, anti-foaming agents and spray colorants (dyes), and drift control agents. For more information on adjuvants, go to UF-IFAS publication, Adjuvants at: http://edis.ifas.ufl.edu/wg050.

GAP Note: If animal-based soil amendments or biosolids are used, some GAP programs may have more stringent standards than this BMP manual. Citrus growers are encouraged to refer to their particular GAP requirements, if applicable.

Choosing the proper pesticide requires familiarity with product labels and performance. Always follow the label directions. The label is the single most important document in determining the correct use of a pesticide. State and federal pesticide laws require strict adherence to label directions.

Proper records of all pesticide applications should be kept according to state and federal requirements. These records help to establish proof of proper use, facilitate the comparison of results of different applications, or find the cause of an error. Sample record keeping forms can be found at the FDACS Bureau of Compliance Monitoring at: http://www.flaes.org/complimonitoring/databasesearch/pesticidecertlicensingformsanddocuments.html.

Certain pesticides are classified as Restricted Use Pesticides (RUPs). Florida Pesticide Law (Chapter 487, F.S.) requires licensed applicators to keep records of all RUP use. Pursuant to Rule 5E-9.032, F.A.C., information on RUPs must be recorded within two working days of the application and maintained for two years from the application date. There are many other important issues involving pesticide use that affect storage, calibration, mixing and loading, and spill management decisions. For additional information, contact your County Extension Agent or the Division of Agricultural Environmental Services of the Florida Department of Agriculture and Consumer Services at http://www.flaes.org.

Before applying pesticides, citrus growers are encouraged to review recommendations in the applicable Florida Citrus Pest Management Guide at: http://edis.ifas.ufl.edu/topic_book_florida_citrus_pest_management_guide.

Aquatic Plant Control

An over-abundance of aquatic weeds in ditches/canals can clog or restrict drainage, and can cause nutrient-rich organic sediments to be transported downstream into receiving water bodies during heavy rain events.

As aquatic weeds decompose, nutrients are released back into the water column by wind or wave action and remain suspended for long periods of time. **Figure 15** is an example of a common aquatic plant that occurs in canals and ditches. These "organic particles" contribute to increased water turbidity, block light from penetrating into the water, and, as a result, cause a reduction in sea grasses and other aquatic species in affected areas.

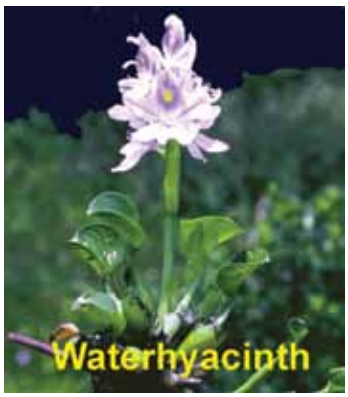


Figure 15

Citrus growers who are considering an aquatic plant chemical control program should carefully select herbicides based on their efficacy on target species, mode of action, non-target toxicity, and residual behavior. Remember to apply only herbicides that are registered and labeled for aquatic applications, and give consideration to chemical drift, target species habitat (submersed, emergent, or floating), and movement of herbicidal materials into non-target areas. The Florida Fish and Wildlife Conservation Commission issues aquatic plant control permits under Rule Chapter 68F-20, F.A.C. However, agricultural waters are usually exempt from permitting if the waterbody is used exclusively for agriculture or is wholly on the property. The FFWCC will perform free site inspections and aquatic plant guidance upon request. For more information about this regulation, go to: https://www.flrules.org/gateway/ChapterHome.asp?Chapter=68F-20. For more information about aquatic weed management, go to UF-IFAS publication, Aquatic Weed Management in Citrus Canals and Ditches at: http://edis.ifas.ufl.edu/ch181.

There are many other important issues involving pesticide use that affect storage, calibration, mixing and loading, and spill management decisions. For additional information, refer to Best Management Practices for Agrichemicals and Farm Equipment Maintenance at: http://www.floridaagwaterpolicy.com/BestManagementPractices.html.

Pest Management BMPs

Practice IPM and use all pesticides in accordance with the label. Rinse, recycle, or dispose of empty pesticide containers following federal, state, and local regulations. When applying a pesticide close to a stream, canal, pond, or other waterbody, choose a pesticide with an active ingredient that has a lower toxicity to aquatic organisms.

7.1 Pesticide Storage and Mixing

✓ **1.** Store pesticides in an enclosed, roofed structure with an impervious floor and lockable door, at least 100 feet from wetlands or other waterbodies.

✓ **2.** When practicable, construct a permanent mix/load facility with an impermeable surface, and locate it at least 100 feet from wells and/or waterbodies.

✓ **3.** Where permanent facilities are not practicable, use portable mix/load stations or conduct any field mix/load activities at random locations in the field, with the aid of nurse tanks if applicable.

✓ **4.** Use a check valve or air gap separation to prevent backflow into the tank or water source when filling a sprayer.

7.2 Aquatic Plant Management

✓ **1.** Use barriers, traps, screen devices and debris baffles to control floating aquatic weeds.

✓ **2.** Use biological control agents that have a narrow range and are specific to the targeted aquatic weed species.

✓ **3.** Use herbicides registered and labeled for aquatic applications, when chemical control is warranted.

References:

1. FDACS/FDEP, Best Management Practices for Agrichemical Handling and Farm Equipment Maintenance Manual. http://www.floridaagwaterpolicy.com/BestManagementPractices.html

2. UF-IFAS, Integrated Pest Management Program. http://ipm.ifas.ufl.edu/

3. Southern Region Integrated Pest Management Center. http://www.sripmc.org/

4. UF-IFAS, Protecting Water Resources from Agricultural Pesticides, CIR PI-1. http://edis.ifas.ufl.edu/PI001

5. NRCS Agrichemical Handling Facility, Code 309; Pest Management Code 595. FOTG-Section IV. http://www.nrcs.usda.gov/technical/efotg

6. UF-IFAS, Pesticide Application Best Management Practices for the Citrus Grove Worker, Publication AE247. http://edis.ifas.ufl.edu/pdffiles/AE/AE24700.pdf.

APPENDICES

APPENDIX I: ACRONYM LIST AND GLOSSARY

Aquifer: Soil or rock formation that contains groundwater and serves as a source of water that can be pumped to the surface.

Best Management Practices (BMPs): A practice or combination of practices based on research, field-testing, and expert review, to be the most effective and practicable on-location means, including economic and technological considerations, for improving water quality in agricultural and urban discharges. Best management practices for agricultural discharges shall reflect a balance between water quality improvements and agricultural productivity.

Biosolids: Solid, semisolid, or liquid residue generated during the treatment of domestic wastewater in a domestic wastewater treatment facility.

BMAP: Basin Management Action Plan.

Ca: Calcium.

Capacitance: The ratio of the electric charge transferred from a pair of conductors to the resulting potential difference between them.

Chelating: Process by which a molecule can form several bonds to a single metal ion.

Confining Layer: A layer of earth material, usually clay, which does not readily transmit water and thus restricts the vertical movement of water into and out of an aquifer.

CREP: Conservation Reserve Enhancement Program.

CRP: Conservation Reserve Program.

CSP: Conservation Security Program.

CRF: Controlled Release Fertilizer.

Cu: Copper.

Cyanobacteria: Also known as blue-green bacteria, which produce their energy through photosynthesis. Certain Cyanobacteria produce cyanotoxins that can be toxic to animals and humans.

ECP: Emergency Conservation Program.

EDIS: Electronic Document Information System.

EPA: Environmental Protection Agency.

EQIP: Environmental Quality Incentives Program.

ERP: Environmental Resource Permit.

Evapotranspiration (ET): The combined loss of water through evaporation and emission of water vapor (transpiration) through plant leaf openings (stomata).

F.A.C.: Florida Administrative Code.

FAWN: Florida Automated Weather Network.

FDACS: Florida Department of Agriculture and Consumer Services.

FDEP: Florida Department of Environmental Protection.

FFWCC: Florida Fish and Wildlife Conservation Commission.

Field Capacity: The amount of soil water remaining in soil after the free water has drained through the profile.

FOTG: Field Office Technical Guide.

F.S.: Florida Statutes.

FSA: Farm Services Agency.

GCGA: Gulf Citrus Growers Association.

GPS: Global Positioning System.

Highly Permeable, Well-Drained Soils: Are soil series that are vulnerable to nutrient leaching and include Adamsville, Archbold, Astatula, Bahiahonda, Broward, Canaveral, Candler, Cocoa, Dade, Florahome, Fort Meade, Gainesville, Lake, Lakewood, Neilhurst, Orlando, Palm Beach, Paola, Satellite, St. Augustine, St. Lucie, Tavares, and Orsino.

IPM: Integrated Pest Management.

IRCL: Indian River Citrus League.

Mg: Magnesium.

MGD: Million Gallons Per Day.

MIL: Mobile Irrigation Lab.

N-P-K: Nitrogen, Phosphorus and Potassium.

NOI: Notice of Intent.

NRCS: Natural Resources Conservation System.

Perennial Streams: Streams or rivers that flow in a well-defined channel throughout most of the year under typical climatic conditions.

Phytotoxicity: The toxic effect of a compound on plant growth. Such damage may be caused by a wide variety of compounds, including trace metals, pesticides, or salinity.

PPM: Parts Per Million.

PVC: Poly Vinyl Chloride.

Restricted Use Pesticides (RUPs): Pesticides registered by EPA that may only be applied by or under the direct supervision of trained and certified applicators.

Riparian: Vegetated areas along a watercourse through which materials and water pass. Riparian areas characteristically have a high water table and are subject to periodic flooding and influence from the adjacent watercourse.

Sequestering Agents: A chemical compound used to tie up undesirable ions, keep them in solution, and eliminate or reduce their effects.

SFWMD: South Florida Water Management District.

Sinkhole: For the purposes of this manual, a sinkhole is an opening in the ground resulting from the collapse of overlying soil, sediment, or rock into underground voids created by the dissolution of limestone or dolostone.

Soil Water Depletion: The amount of available water capacity in the root zone, usually expressed as a percentage.

Spoil: The soil material obtained from excavating an area to construct such works as canals/ditches and/or ponds. This material is typically used to build berms and/or dikes along or in the vicinity of the excavation site.

SWCD: Soil and Water Conservation District.

TDS: Total Dissolved Solids.

TMDL: Total Maximum Daily Load.

UF-IFAS: University of Florida, Institute of Food and Agricultural Sciences.

Uncoated sands: Sand particles that lack clay and organic matter coating, and have poor water and nutrient holding capacities.

USGS: United States Geological Survey.

Vegetated Buffer: An area covered with vegetation suitable for nutrient uptake and soil stabilization, located between a production area and a receiving water or wetland.

Watershed: Drainage basin or region of land where water dra ins downhill into a specified body of water.

Wetlands: As defined in section 373.019(25), F.S., wetlands means those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soils. Soils present in wetlands generally are classified as hydric or alluvial, or possess characteristics that are associated with reducing soil conditions. The prevalent vegetation in wetlands generally consists of facultative or obligate hydrophytic macrophytes that are typically adapted to areas having soil conditions described above.

WHIP: Wildlife Habitat Incentives Program.

WMDs: Water Management Districts.

WRP: Wetland Reserve Program.

APPENDIX 2: ADDITIONAL BMP REFERENCES

1. **Nutrition of Florida Citrus Trees, Second Edition – SL 253**

   This document, developed by the University of Florida, Institute of Food and Agricultural Sciences, provides background information and recommendations to develop a sound citrus nutrition program; and incorporates the findings of numerous citrus nutrition research projects conducted since the mid-1990s. The document can be found at: http://edis.ifas.ufl.edu/SS478.

2. **Florida Citrus Pest Management Guide – SL 43**

   This document, developed by the University of Florida, Institute of Food and Agricultural Sciences, assists citrus growers in the identification of pest management options and the selection of appropriate control measures. It does not replace pesticide product labels which contain important information, so that pesticide products are used in conformance with state and federal laws. Products listed in the associated tables have been shown to be efficacious, non-phytotoxic to citrus, and relatively safe on non-target arthropods and microorganisms when used as directed. The document can be found at: http://edis.ifas.ufl.edu/topic_book_florida_citrus_pest_management_guide.

3. **New Best Management Practices for Coastal Citrus**

   This document, developed by the Florida Research Center for Agricultural Sustainability, Inc., was produced in conjunction with the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration. It provides guidance on the use of foliar fertilization and organic matter. The document can be found at: http://www.flaresearch.com/Documents/BMP_Rept_Revised_3-2010.pdf.

4. **Field Operation and Harvesting Harmonized Food Safety Standard (Version 7/22/2011)**

   United Fresh Produce Association, 1901 Pennsylvania Ave. NW, Suite 1100, Washington, DC 20006 http://www.unitedfresh.org/newsviews/gap_harmonization.

APPENDIX 3:
SOIL AND TISSUE TESTING INFORMATION

Soil Testing

The soil testing process comprises four major steps, and understanding each one clearly will increase the reliability of the process tremendously. The steps in the soil testing process are:

- soil sampling
- sample analysis
- interpretation of test results
- nutrient recommendations

Soil Sampling: Soil samples need to be representative of the field and soil types and the soil analysis results will be only as good as the submitted sample. Samples collected from areas that differ from typical characteristics of the grove should be submitted separately and should not be consolidated with the primary samples. Using a management zone (area on the grove that is managed similarly) as a guiding factor to collect and consolidate samples is strongly recommended to optimize resources. Consult the IFAS Extension Fact Sheet SL 279 for further information on soil sampling strategies and/or to obtain the appropriate soil test sheet which can be found at: http://soilslab.ifas.ufl.edu/ESTL_files/producercitrus.pdf.

Sample Analysis: The soil samples that are submitted to the testing laboratories undergo a series of physical and chemical processes that are specific to the soil types, crops, and management regimes. Once the soil samples are homogenized through grinding and/or sieving, a precise volume of the sample will be extracted for plant nutrient through an extraction procedure. The following standard methods are followed at the IFAS Extension Soils Testing Laboratory (ESTL) for different soils in Florida:

a. Mehlich-1 extraction - this method is performed on all acid-mineral soils up to a soil pH of 7.3.

b. AB-DTPA extraction – this method is performed on alkaline (calcareous) soils with a pH of 7.4 and above.

c. Water extraction - this method is used for extraction of P in all organic soils.

d. Acetic acid extraction - this method is performed on all organic soils for extraction of K, Mg, Ca, Si, and Na.

It is extremely important that procedures used at private laboratories are well understood before submitting the samples, since BMPs are tied to the standardized procedures used by the ESTL. Similarly, it is also very important to note that the ESTL laboratory does not offer any test for N since there is no reliable test for plant available N under Florida conditions. N recommendations are based on crop nutrient requirements found in the research literature. More information regarding the procedures used at the IFAS ESTL in Gainesville can be found in the extension publication, Circular 1248, at: http://edis.ifas.ufl.edu/ss312.

Interpretation of Test Results: The primary goal of laboratories that offer soil test services is to provide interpretation of the soil test results. These should be based on soil test-crop response trials and field calibration of the test results using optimum economic yields. Economic yield increases resulting from added nutrients cannot be obtained once the test results are interpreted as 'High' resulting in no recommendation for that particular nutrient. The interpretations provided are specific to the soil and plant species.

Nutrient Recommendations: Recommendations can originate from crop nutrient requirement research, soil test results, and/or tissue test results as discussed below. Nutrient recommendations based on soil test results are formulated based on the optimum economic crop response to an added nutrient to the soil.

Tissue Testing

Tissue testing is the analysis and diagnosis of the plant's nutritional status based on its chemical composition. It is commonly performed as analyses on dried leaves, with results compared to recommended nutrient ranges. For citrus, there is a good correlation between tissue test results and economic yield. Nitrogen concentrations of 2.5% to 2.7% on 4- to 6-month old spring flush leaves on non-fruiting twigs are considered optimum for orange trees.

Growers should use leaf tissue results to determine if ground-applied P fertilization is necessary.

For more information on using tissue testing, refer to Chapter 4 of UF-IFAS, Nutrition of Florida Citrus Trees, 2nd Edition, February 2011, SL253, at: http://edis.ifas.ufl.edu/SS478.

References:

1. Obreza, T.A. and K.T. Morgan. 2008. Nutrition of Florida Citrus, 2nd Edition. SL253. Soil and Water Science, Cooperative Extension Service. IFAS. http://edis.ifas.ufl.edu/ss478.
2. Mylavarapu, R.S. and E.D. Kennelley. 2002. UF/IFAS Extension Soil Testing Laboratory Analytical Procedures and Training Manual. Soil and Water Science, Circular 1248, Cooperative Extension Service, IFAS. http://edis.ifas.ufl.edu/SS312.
3. Rao Mylavarapu, Kelley Hines and Thomas Obreza. 2008/2011. Diagnostic Nutrient Testing for Commercial Citrus in Florida. http://edis.ifas.ufl.edu/ss492.

APPENDIX 4: CITRUS FERTILIZATION TABLES

Recommended N rates and minimum number of annual applications for non-bearing citrus trees

Year in grove	lbs N/tree/ year(range)	Lower limit of annual application frequency		
		Controlled-release fertilizer	Dry soluble fertilizer	Fertigation
1	0.15 – 0.30	1	6	10
2	0.30 – 0.60	1	5	10
3	0.45 – 0.90	1	4	10

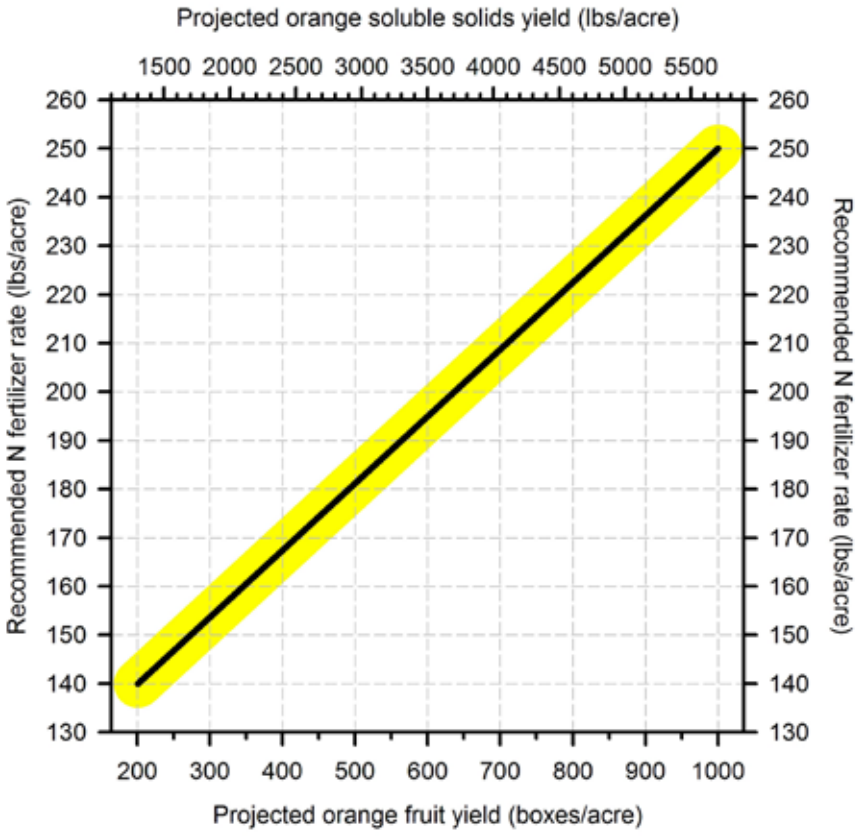
Recommended N rates and minimum number of annual applications for bearing citrus trees

Year in grove	Oranges	Grapefruit	Other varieties	Lower limit of annual application frequency		
	lbs N/acre/year (range)			Controlled-release fertilizer	Dry soluble fertilizer	Fertigation
4 through 7	120 – 200	120 – 160	120 – 200	1	3	10
8 and up	140 – 250 Yield-based[1]	120 – 160[2]	120 – 300[3]	1	3	10

1 See table below for specific production-based N fertilizer rate recommendations.

2 For grapefruit groves producing more than 800 boxes/acre, the maximum recommended N rate is 180 lbs/acre.

3 For Orlando tangelos, the maximum recommended N rate is 250 lbs/acre. For Honey tangerines (Murcotts), the maximum recommended N rate is 300 lbs/acre.



Graph footnote: Production-based N fertilizer rate recommendations for normal, healthy, 8+ year-old Florida orange trees. Where disease, salinity, or other factors inhibit normal tree development or yield, fertilizer applications should be adjusted accordingly.

APPENDIX 5:
INCENTIVE PROGRAMS FOR QUALIFYING OPERATIONS

The implementation of Best Management Practices can reduce non-point sources of pollution, conserve valuable soil and water resources, and improve water quality. The implementation of these management practices can also be expensive and, in some cases, may not be economically feasible for agricultural producers. To reduce the financial burden associated with the implementation of selected practices, several voluntary cost-share programs have been established. These programs are designed to conserve soil and water resources and improve water quality in the receiving watercourse. The narrative below is intended to provide basic information regarding the primary federal, state, and regional cost-share programs. Sources of additional information have also been included, and growers are encouraged to contact the identified agencies or organizations for current information about each program.

I. Programs Administered by USDA - Farm Services Agency (FSA)

Conservation Reserve Program (CRP): This program encourages producers to convert highly erodible cropland or other environmentally sensitive lands to vegetative cover including grasses and/or trees. This land use conversion is designed to improve sediment control and provide additional wildlife habitat. Program participants receive annual rental payments for the term of the contract in addition to cost share payments for the establishment of vegetative cover. CRP generally applies to highly erodible lands and is more applicable to North Florida.

Conservation Reserve Enhancement Program (CREP): CREP uses a combination of federal and state resources to address agricultural resource problems in specific geographic regions. This program (which is not limited to highly erodible lands) is designed to improve water quality, minimize erosion, and improve wildlife habitat in geographic regions that have been adversely impacted by agricultural activities.

Emergency Conservation Program (ECP): The ECP provides financial assistance to producers and operators for the restoration of lands on which normal agricultural operations have been impeded by natural disasters. More specifically, ECP funds are available for restoring permanent fences, terraces, diversions, irrigation systems, and other conservation installations. The program also provides funds for emergency water conservation measures during periods of severe drought.

For further information on CRP and CREP, including eligibility criteria, please contact your local USDA Service Center. Information is also available on the Internet at www.fsa.usda.gov.

II. Programs Administered by NRCS

Conservation Plans: Conservation planning is a natural resource problem-solving and management process, with the goal of sustaining natural resources. Conservation Plans include strategies to maintain or improve yields, while also protecting soil, water, air, plant, animal, and human resources. They are particularly well-suited to livestock operations and farming operations that produce multiple commodities.

Conservation Plans are developed in accordance with the NRCS FOTG. Assistance in developing a plan can be obtained through the local Soil and Water Conservation District (SWCD), the NRCS, the Cooperative Extension Service, and private consultants who function as technical service providers. However, the decisions included in the Conservation Plan are the responsibility of the owner or manager of the farm. Conservation Plans are usually required to receive cost share for any of the programs described below.

Environmental Quality Incentives Program (EQIP): EQIP provides financial assistance for the implementation of selected management practices. Eligibility for the program requires that the farm have a NRCS approved conservation plan. Practices eligible for EQIP cost share are designed to improve and maintain the health of natural resources and include cross-fences, water control structures, brush management, prescribed burning, nutrient management and other erosion control measures.

Conservation Security Program (CSP): CSP is a voluntary conservation program that supports ongoing stewardship on private lands. It rewards farmers and operators who are meeting the highest standards of conservation and environmental management. Its mission is to promote the conservation and improvement of soil, water, air, energy, plant and animal life.

Wetlands Reserve Program (WRP): WRP is a voluntary program designed to restore wetlands. Program participants can establish easements (30-year or perpetual) or enter into restoration cost-share agreements. In exchange for establishing a permanent easement, the landowner usually receives payment up to the agricultural value of the land and 100 percent of the wetland restoration cost. Under the 30-year easement, land and restoration payments are generally reduced to 75 percent of the perpetual easement amounts. In exchange for the payments received, landowners agree to land use limitations and agree to provide wetland restoration and protection.

Wildlife Habit Incentives Program (WHIP): The Wildlife Habitat Incentives Program provides financial incentives for the development of fish and wildlife habitat on private lands. Program eligibility requires that landowners develop and implement a Wildlife Habitat Development Plan. Participants enter multiyear (5 to10 year) agreements with NRCS.

For further information on these programs, including eligibility criteria, please contact your local USDA Service Center. Information is also available on the Internet at the following web site: www.nrcs.usda.gov.

III. Programs Administered by State and Regional Entities

Office of Agricultural Water Policy: In order to assist agricultural producers in the implementation of BMPs, the Florida Department of Agriculture and Consumer Services/Office of Agricultural Water Policy contracts with several of the state's Soil and Water Conservation Districts and Resource Conservation and Development Councils to provide cost share, as funding is available.

Water Management District Cost-Share Programs: Some of the WMDs may have agricultural cost-share programs in place for eligible producers.

IV. Payment for Services Programs

Water Farming: Water farming is the utilization of fallow/out-of-production lands to store water, attenuate nutrients, manage stormwater as an alternative water supply, and improve overall water quality. Pilot projects are under way in the St. Lucie and Caloosahatchee estuaries to determine the overall feasibility of the water farming concept. These projects will provide information to compare environmental benefits gained to the estimated costs of on-site construction, infrastructure improvements, environmental assessments, and facility maintenance. Potentially, landowners could sell stored water to public or private entities, or otherwise receive payment for the environmental benefits of water farming.

These projects are being conducted by cooperative agreement between the SFWMD, Indian River Citrus League (IRCL), and Gulf Citrus Growers Association (GCGA). Under the agreement, the IRCL and GCGA each will use guidelines developed jointly with the SFWMD to select a "typical" citrus grove on which to gather scientific and engineering data and other information to determine the costs/benefits of water farming. This portion of the pilot project will be considered Phase I Information Gathering, which is necessary to support Phase II Project Implementation. The pilot projects will take about 3 to 4 years to complete.

For further information on these programs, including eligibility criteria, please contact your soil and water conservation district, your WMD, or FDACS. Information and links to other sites are also available on the Internet at the following web site: www.floridaagwaterpolicy.com.

APPENDIX 6: CHEMIGATION/FERTIGATION STATUTORY REFERENCES

487.064 Antisiphon requirements for irrigation systems.

1. Any irrigation system used for the application of pesticides must be equipped with an antisiphon device adequate to protect against contamination of the water supply. The requirements of this section shall also apply to water supply lines to pesticide mixing-loading equipment other than those systems which incorporate a physical gap between the water source and the application equipment.
2. It is unlawful for any person to apply chemicals through an irrigation system which is not equipped with an antisiphon device as required by this section, or to mix and load pesticides for application unless there is a physical gap or its equivalent between the line from the water source and the application equipment.
3. The department may establish by rule specific requirements for antisiphon devices and for sites where pesticide mixing-loading occurs.
4. Any governmental agency which requires antisiphon devices on irrigation systems used for the application of chemicals shall use the specific antisiphon device requirements adopted by the department.

576.087 Antisiphon requirements for irrigation systems.

1. Any irrigation system used for the application of fertilizer must be equipped with an antisiphon device adequate to protect against contamination of the water supply.
2. It is unlawful for any person to apply fertilizer through an irrigation system which is not equipped with an antisiphon device as required by this section.
3. The department shall establish specific requirements for antisiphon devices.
4. Any governmental agency which requires antisiphon devices on irrigation systems used for the application of fertilizer shall use the specific antisiphon device requirements adopted by the department.

Note: The FDACS Bureau of Compliance Monitoring is responsible for antisiphon requirements. Go to their website for more information at: http://www.flaes.org/complimonitoring/index.html

APPENDIX 7: EXAMPLE RECORD-KEEPING FORMS

Record keeping aids in operating and maintaining BMPs. The following record keeping is required:

2.2.1 Base P fertilization rate on soil and/or leaf tissue tests results from a lab that uses a standard testing method used by UF/IFAS Extension Soils Testing Laboratory. Keep a copy of all laboratory test results to track changes over time.

2.2.3 Use leaf tissue test results to determine the need for and appropriate rates of supplemental fertilizer applications, and to diagnose the effectiveness of N, K, and micronutrient fertilization programs. Keep a copy of all laboratory test results.

2.2.4 Keep records of all nutrient applications. Include, at a minimum: rate and location of application, total amount applied, acreage covered, fertilizer analysis or grade, rate per acre, and application method.

3.2.6 Maintain a record-keeping system for inspection and maintenance of all irrigation system components. Records should be compared over time for any changes that would indicate problems with the system.

6.4.5 Maintain records of new well construction and modifications to existing wells. The tables below serve as a set of templates to develop your own record-keeping system. You may maintain your records as hard copies or in an electronic format, depending on your preference. You may use these tables, develop your own, or choose commercially available record-keeping software suited to your commodity.

Soil Sample Records (Retain all Lab Results)				
Date	**Field Location**	**# of Samples**	**Name of Lab**	**Records Location**

Tissue Sample Records (Retain all Lab Results)			
Date	**Field Location**	**# of Samples**	**Name of Lab**

Fertilization/Nutrient Records (Retain all Lab Results)					
Date	Location	Acreage Covered	Type[1]	Formulation[2]	Grade[3]

Irrigation Maintenance							
Date	Location	Last Inspected	Motor Values[4]	Withdraw Rate (GPM)	Pump Values[5]	Current System Efficiency[6]	Irrigation Lines Condition

Rainfall (in.)											
Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.

Well Records					
Location	Year Constructed	Constructed By	Last Modified	Modified By	Records Location

1 Organic, Inorganic, Chemical
2 Granular, Water Soluble, etc.
3 e.g. 10-10-10
4 Energy Consumption (KwH); Motor Amperage (Amps); RPM
5 Discharge Rate (GPM) and PSI (lb/in2)
6 Ratio, Source Withdraw vs. Crop Available (V1:V2)

APPENDIX 8: CONTACT INFORMATION

Emergency Information

Emergency Reporting Numbers

State Warning Point Division of Emergency Management - contact in case of oil or hazardous substance spill.	24 hours/ Toll-Free	1-800-320-0519

Emergency Information and Follow-Up Numbers.

	Monday – Friday	
State Warning Point Information Line	8:00 am - 5:00 pm	(850)413-9900
DEP Emergency Response	8:00 am - 5:00 pm	(850)245-2010
State Emergency Response Commission For follow-up reporting only.	Toll-Free	1-800-635-7179

Non-Emergency Information

Florida State Agency Numbers

Toll Free

Department of Agriculture and Consumer Services **www.freshfromflorida.com**

Office of Agricultural Water Policy ..... (850) 617-1700

For assistance with BMP enrollment/implementation ..... **(850) 617-1727**

Division of Agricultural and Environmental Services ..... (850) 617-7900

Bureau of Pesticides ..... (850) 617-7917

Bureau of Compliance Monitoring ..... (850) 617-7850

Department of Environmental Protection **www.dep.state.fl.us**

Non-point Source Management Section ..... (850) 245-7508

Hazardous Waste Management Section ..... (850) 245-8707

Northwest District Office (Pensacola) ..... (850) 595-8300

Northeast District Office (Jacksonville) ..... (904) 256-1700

Central District Office (Orlando) ..... (407) 897-4100

Southeast District Office (West Palm) ..... (561) 681-6600

Southwest District Office (Tampa) ..... (813) 632-7600

South District Office (Ft. Myers) ..... (239) 344-5600

Water Management Districts **www.flwaterpermits.com**

Northwest Florida (Tallahassee)	(850) 539-5999	
Suwannee River (Live Oak)	(386) 362-1001	1-800-226-1066
St. John's River (Palatka)	(904) 329-4500	1-800-451-7106
Southwest Florida (Brooksville)	(352) 796-7211	1-800-423-1476
South Florida (West Palm)	(561) 686-8800	1-800-432-2045

Other Helpful Numbers - Main offices

NRCS - Florida Office (Gainesville) ..... (352) 338-9500

UF/IFAS Extension Administration ..... (352) 392-1761

Association of Florida Conservation Districts
Soil and Water Conservation Districts ..... (407) 321-8212

APPENDIX 9: CHAPTER 5M-16

WATER QUALITY/QUANTITY BEST MANAGEMENT PRACTICES FOR FLORIDA CITRUS

5M-16.001 Approved BMPs.

The manual titled Water Quality/Quantity Best Management Practices for Florida Citrus (2012), DACS-P-01756, is hereby adopted and incorporated by reference. Copies of the manual may be obtained from the University of Florida Cooperative Extension Service county office or from the Florida Department of Agriculture and Consumer Services (FDACS), Office of Agricultural Water Policy, 1203 Governor Square Boulevard, Suite 200, Tallahassee, FL, 32301 or accessed online at http://www.flrules.org/Gateway/reference.

Rulemaking Authority: 403.067(7)(c)2., 570.07(10), 570.07(23), F.S. Law Implemented: 403.067(7)(c)2., F.S. History – New _____.

5M-16.002 Presumption of Compliance.

Pursuant to Section 403.067(7)(c)3., F.S., agricultural operations that implement BMPs, in accordance with FDACS rules, that have been verified by the Florida Department of Environmental Protection as effective in reducing pollutants addressed by the practices are presumed to comply with state water quality standards, and are released from the provisions of Section 376.307(5), F.S., for those pollutants. In order to meet the requirements for a presumption of compliance and release from Section 376.307(5), F.S., the producer must:

(1) Submit a Notice of Intent to Implement, as provided in Rule 5M-16.003, F.A.C., that identifies the applicable BMPs;

(2) Implement all applicable BMPs in accordance with the timeline requirements in Rule 5M-16.003; and

(3) Maintain records to document the implementation and maintenance of the identified BMPs, in accordance with Rule 5M-16.004.

Rulemaking Authority: 403.067(7)(c)2., 570.07(10), 570.07(23), F.S. Law Implemented: 403.067(7)(c)2., F.S. History – New _____.

5M-16.003 Notice of Intent to Implement BMPs.

(1) A Notice of Intent to Implement (NOI) BMPs and the accompanying BMP Checklist, both of which are in the manual referenced in Rule 5M-16.001, F.A.C., shall be submitted to the FDACS Office of Agricultural Water Policy, 1203 Governor Square Boulevard, Suite 200, Tallahassee, Florida 32301. The Notice of Intent to Implement Water Quality/Quantity Best Management Practices for Florida Citrus (DACS-01598, Rev. 05/12), hereby adopted and incorporated by reference, may be obtained from FDACS or accessed online at http://www.flrules.org/Gateway/reference.

(2) The Notice of Intent to Implement BMPs shall include:

(a) The name of the property owner, the location of the property, the property tax ID number(s), and any other pertinent property identification information;

(b) The amount of acreage on which BMPs will be implemented;

(c) The name and contact information of a person to contact;

(d) The signature of the land owner, lease holder, or authorized agent; and

(e) A BMP Checklist with a schedule for implementation, as contained in the manual. The producer shall select the applicable BMPs by following the instructions in the manual. Except as provided in the manual, all applicable BMPs must be implemented as soon as practicable, but no later than 18 months after submittal of the NOI.

(3) Submittal of the Notice of Intent to Implement BMPs enables the producer to receive assistance with BMP implementation.

Rulemaking Authority: 403.067(7)(c)2., 570.07(10), 570.07(23), F.S. Law Implemented: 403.067(7)(c)2., F.S. History – New _____.

5M-16.004 Recordkeeping.

BMP participants must keep records, as directed in the manual, to document the implementation and maintenance of the practices submitted to FDACS pursuant to this rule. These records are subject to inspection upon request, in accordance with a mutually agreed upon time and manner, and must be retained for a period of at least five years.

Rulemaking Authority: 403.067(7)(c)2., 570.07(10), 570.07(23), F.S. Law Implemented: 403.067(7)(c)2., F.S. History – New _____.

5M-16.005 Previously submitted NOIs.

(1) In order to retain a presumption of compliance with state water quality standards:

(a) Citrus growers who, prior to the effective date of this rule, submitted a Notice of Intent to Implement Nitrogen Best Management Practices for Florida Ridge Citrus (July 23, 2002) and adopted by reference in Rule 5E-1.023, F.A.C., must:

1. Within two years of the effective date of this rule, submit a new NOI and BMP checklist in accordance with Rule 5M-16.003, F.A.C., and

2. Implement the applicable BMPs on the checklist, in accordance with Rule 5M-16.003, F.A.C.

(b) Flatwoods citrus growers who, prior to the effective date of this rule, submitted an NOI and checklist under the programs listed in subparagraphs 1., 2., or 3., below must continue to implement the applicable BMPs on the checklist, and must follow the guidelines applicable to the operation contained in Nutrition of Florida Citrus Trees, Second Edition, UF-IFAS Publication SL253 (January 2008), hereby adopted and incorporated by reference. Copies of the document may be obtained from the University of Florida Cooperative Extension Service county office or accessed online at http://www.flrules.org/Gateway/reference.

1. Water Quality/Quantity BMPs for Indian River Area Citrus Groves (January 2005), as revised by the January 2005 updates adopted by reference in Rule 5M-2.002, F.A.C.

2. Best Management Practices for Citrus Groves in the Peace River and Manasota Basins (October 2004), adopted by reference in Rule 5M-5.002, F.A.C.

3. Best Management Practices for Gulf Citrus (March 2006), adopted by reference in Rule 5M-7.002, F.A.C.

(2) Flatwoods citrus growers re-establishing inactive groves or renovating groves, who enrolled prior to the effective date of this rule, must contact FDACS for assistance in submitting a new NOI and BMP checklist pursuant to Rule 5M-16.003, F.A.C.

(3) NOIs or BMP checklists submitted on or after the effective date of this rule chapter for citrus BMP programs adopted prior to the effective date of this rule chapter will be deemed invalid.

Rulemaking Authority: 403.067(7)(c)2., 570.07(10), 570.07(23), F.S. Law Implemented: 403.067(7)(c)2., F.S. History – New _____.

APPENDIX 10

Notice of Intent and BMP Checklist

ADAM H. PUTNAM
COMMISSIONER

Florida Department of Agriculture and Consumer Services
Office of Agricultural Water Policy

FDACS-OAWP
1203 Governor's Sq. Blvd.
Suite 200
Tallahassee, FL, 32301

NOTICE OF INTENT TO IMPLEMENT
Water Quality/Quantity BMPS for Florida Citrus

Rule 5M-16.003, F.A.C.

- **Complete all sections of the Notice of Intent (NOI).** Each NOI may list only properties that are within the same county and are owned or leased by the same person or entity, and on which applicable BMPs will be identified and implemented under this manual.
- Submit the **NOI**, along with the **BMP Checklist**, to the Florida Department of Agriculture and Consumer Services (FDACS), at the address below.
- **Keep a copy of the NOI and the BMP checklist in your files** as part of your BMP record keeping.

You can visit http://www.freshfromflorida.com/onestop/forms/01598.pdf to obtain an electronic version of this Notice of Intent to Implement (NOI) form.

If you would like assistance in completing this NOI form or the BMP Checklist, or with implementing BMPs, contact FDACS staff at (850) 617-1727 or AgBmpHelp@freshfromflorida.com.

Mail this completed form and the BMP Checklist to:

FDACS Office of Agricultural Water Policy
1203 Governor's Square Boulevard, Suite 200
Tallahassee, Florida 32301

Person To Contact

Name: _____

Business Relationship to Landowner/Leaseholder: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Telephone: _____ FAX: _____

Email: _____

☐ **Landowner or** ☐ **Leaseholder Information** *(check all that apply)*

NOTE: If the Landowner/Leaseholder information is the same as the Contact Information listed above, please check: ☐ **Same as above**. If not, complete the contact information below.

Name: _____

Mailing Address: _____

City: _____ State: _____ Zip Code: _____

Telephone: _____ FAX: _____

Email: _____

DACS-01598 05/12

Complete the following information for the property on which BMPs will be implemented under this NOI. You may list multiple parcels if they are located within the same county and are owned or leased by the same person or entity.

Operation Name: _____

County: _____

Tax Parcel Identification Number(s) from County Property Appraiser

Please submit a copy of your county tax bill(s) for all enrolled property, with owner name, address, and the tax parcel ID number(s) clearly visible. **If you cannot provide a copy of the tax bill(s), please write the parcel owner's name and tax parcel ID number(s) below in the format the county uses.** Attach a separate sheet if necessary *(see form provided)*.

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

☐ Additional parcels are listed on separate sheet. *(check if applicable)*

Total # of acres of all parcels listed ***(as shown property tax records)***: _____

Total # of acres on which BMPs will be implemented under this NOI: _____

In accordance with section 403.067(7)(c)2, Florida Statutes, I submit the foregoing information and the BMP Checklist as proof of my intent to implement the BMPs applicable to the parcel(s) enrolled under this Notice of Intent.

Print Name: _____

(check all that apply) ☐ **Landowner** ☐ **Leaseholder** ☐ **Authorized Agent** *(see below)**

**Relationship to Landowner or Leaseholder:* _____

Signature: _____ Date: _____

Name of Staff Assisting with NOI:

NOTES:

1. You must keep records of BMP implementation, as specified in the BMP manual. All BMP records are subject to inspection.
2. You must notify FDACS if there is a full or partial change in ownership with regard to the parcel(s) enrolled under this NOI.
3. Please remember that it is your responsibility to stay current with future updates of this manual. Visit the following website periodically to check for manual updates: www.floridaagwaterpolicy.com

DACS-01598 05/12

Additional Tax Parcel Listings

Operation Name: _____

County: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

Parcel No.: _____ Parcel Owner: _____

FLORIDA CITRUS OPERATIONS
WATER QUALITY/QUANTITY BMP CHECKLIST

Checklist Instructions

Note: Before you fill out this checklist, follow the section on BMP Enrollment and Implementation, which begins on page 6 of this manual. Read the text and the BMPs in Sections 1.0 - 7.0 before filling out the checklist, in order to know what the practices entail. The checklist summaries are for identification purposes only.

1. Check "In Use" for each BMP that you are currently practicing and will continue to practice.

2. For the applicable BMPs you do not implement currently but will implement, enter the month and year you plan to implement them in the "Planned" column. FDACS rule requires that applicable BMPs in the manual be implemented as soon as practicable, but not later than 18 months after submittal of the NOI. However, if you need more time to implement practice 6.2.1, you must provide justification in the section provided at the end of the checklist.

3. If you are using or will be using a practice similar to a BMP in the checklist, you may enter AMU (alternative measures used) under the "In Use" or "Planned" column. Be sure to include an implementation date (month/year) in the "Planned" column. Explain in the comments section what alternative measure(s) you are or will be implementing. If applicable, include the NRCS FOTG number associated with the practice.

4. For BMPs you will not implement, check all of the following that apply under "Will Not Implement."
- **NA** = Not Applicable (you do not have a resource concern that requires use of the BMP).
- **TNF** = Technically Not Feasible.
- **ENF** = Economically Not Feasible.
- **Other** = You must explain your reason in the comments section at the end of the checklist.

5. Make sure you follow the record-keeping requirements. BMPs that include record keeping are marked by the following pencil icon: 

6. Mail this BMP checklist with your NOI form to FDACS, and keep a copy of both documents in your files.

		In Use	Planned	Will not implement *(check reason below)*			
BMP #	**BMP Group**	**Check/ or AMU**	**Month/ Year**	**NA**	**TNF**	**ENF**	**Other**
	1.0 Grove Development and Renovation						
1.1.	**Level I - Grove Development BMPs**						
1.	If wetlands exist on the site, have a qualified person perform a wetland boundary determination before clearing native land. This determination will be required for groves that must obtain an ERP from the regional water management district.						
2.	Perform land leveling and construction of drainage works in accordance with recognized standards. See references on page 10.						
1.2	**Level I - Grove Renovation**						
1.	Use sedimentation and erosion control measures, as needed. These measures should be used upstream of offsite discharge points.						
2.	Upon completion of soil bedding, stabilize all bare soil areas (except tree rows) with grass or other desirable vegetation to minimize loss of soil by erosion.						

BMP #	BMP Group	In Use	Planned	Will not implement *(check reason below)*			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
3.	For major renovations, install and/or maintain a 50-foot non-fertilized vegetated buffer upland of the normal water level of lakes adjacent to the citrus grove production area.						
	2.0 Nutrient Management						
	2.1. Level I - Fertilizer Sources						
1.	Reduce the potential for nutrient loss and improve nutrient use efficiency by choosing appropriate sources and formulations of fertilizer based on nutritional needs, season (rainy vs. dry), and anticipated weather conditions.						
2.	If using irrigation water (tailwater, reclaimed, or well) that has N concentrations of 10 ppm or greater, adjust fertilization rates to account for the additional nutrients. You can estimate the N and P contribution from the reclaimed water by multiplying the average nutrient analysis in the water by the volume of water applied.						
3.	If using manure or biosolids, adjust fertilization rates to account for the additional nutrients. You can estimate the N and P contribution by multiplying the nutrient analysis by the amount of material applied and its mineralization rate.						
	2.2. Level I - Determining Fertilizer Rates						
1.	Base P fertilization rate on soil and/or leaf tissue tests results from a private or public lab that uses a standard testing method recommended by UF-IFAS Extension Soils Testing Laboratory. Keep a copy of all laboratory test results to track changes over time.						
2.	Comply with UF-IFAS recommended rates for N as established in Chapter 8 in UF-IFAS document SL 253. This information has been excerpted and is contained in Appendix 4.						
3.	Use leaf tissue test results to determine the need for and appropriate rates of supplemental fertilizer applications, and to diagnose the effectiveness of N, K, and micronutrient fertilization programs. Keep a copy of all laboratory test results.						
4.	Keep records of all nutrient applications. Include, at a minimum: date and location of application, total amount applied, acreage covered, fertilizer analysis or grade, rate per acre, and application method.						
	2.3. Level I - Fertilizer Application						
1.	Calibrate and adjust fertilizer application equipment to ensure the intended fertilizer rate is applied and that desired distribution and placement at the root zone are achieved.						
2.	When applying soluble fertilizers, use smaller, more frequent (split) applications to minimize the potential for leaching. Guidance for split application frequencies can be found in Chapter 8 of UF-IFAS document SL 253.						

BMP #	BMP Group	In Use	Planned	Will not implement *(check reason below)*			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
3.	Do not apply fertilizer under high-risk situations, such as before a forecasted rainfall or frost/freeze event.						
4.	To the extent practicable, avoid applying fertilizer during the rainy season.						
	BMPs 2.3.5 and 2.3.6 below pertain only to highly permeable, well-drained soils, such as those typical in the central ridge. Follow the fertilizer rate requirements in BMP 2.2.2, and implement the following BMPs, 2.3.5 and 2.3.6.						
5.	Dry Season Applications: Limit any dry season broadcast water-soluble nitrogen fertilizer applications to 65 lbs N/acre/application. Limit dry season fertigation nitrogen applications to 15 lbs N/acre/week.						
6.	Rainy Season Applications: Water-soluble nitrogen fertilizer applications made during the summer rainy season (June 15 - September 15) must not exceed 40 lbs N/acre. This rate can be achieved using a single dry broadcast application of no more than 40 lbs N/acre, or as multiple fertigation applications not to exceed 10 lbs N/acre/week.						
2.4.	**Level I - Fertilizer Storage and Handling**						
1.	Protect stored fertilizer from wind and rainfall.						
2.	Ensure that fertilizer spilled on the ground during loading is immediately collected and handled properly.						
3.	Inform workers on proper fertilizer storage and handling procedures.						
	3.0 Irrigation Management						
3.1.	**Level I – Irrigation Decision-Making and Management Practices**						
1.	Use available tools and data to assist in making irrigation decisions. Tools may include water table observation wells, on-site soil moisture sensors, crop water use information, weather data, and the feel and appearance method. Real-time weather data is available by visiting FAWN, United States Geological Survey (USGS), and WMD websites; or by installing your own on-site weather station.						
2.	Minimize application losses due to evaporation and wind drift by appropriate irrigation scheduling (e.g., irrigating early in the morning, late in the afternoon, at night, and/or when cloud cover is abundant and wind speed is minimal).						
3.	Do not irrigate beyond field capacity, except as necessary to manage salinity.						
3.2.	**Level I – General Irrigation System Maintenance**						
1.	Test irrigation source water quality at least annually to detect issues with water chemistry that may result in irrigation system plugging. The analysis could include pH, total dissolved solids, alkalinity, dissolved iron, hydrogen sulfide, and calcium carbonate. Run the pump long enough to purge the water in the well to ensure a representative sample. Adjust your maintenance actions as needed.						

BMP #	BMP Group	In Use	Planned	Will not implement *(check reason below)*			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
2.	Use water meters (flow or volume) or other measuring devices/ calculations to determine how much water is applied to the irrigated area. Use this information to help you determine how well your irrigation system and irrigation schedule are working. Make any needed schedule adjustments or system repairs.						
3.	Monitor water meters or other measuring devices for unusually high or low readings to detect possible leaks or other problems in the system. Make any needed repairs.						
4.	If one is available, get a Mobile Irrigation Lab to check the distribution or emission uniformity and the conveyance efficiency of the irrigation system(s). This should be done every three to five years.						
5.	Maintain pump stations and wells, and related components, in good working order. Check them on an annual basis. Replace parts as needed.						
6.	Maintain a record-keeping system for inspection and maintenance of key irrigation system components. Records should be compared over time for any changes that would indicate problems with the system.						
3.3.	**Level I - Pressurized Irrigation Systems**						
1.	Examine irrigation emitters for wear and malfunction, and replace them as necessary.						
2.	Clean and maintain filtration equipment.						
3.	Flush irrigation lines regularly to minimize emitter clogging. To reduce sediment build up, make flushing part of a regular maintenance schedule. If fertigating, prevent microbial growth by flushing all fertilizer from the lateral lines before shutting down the irrigation system.						
3.4.	**Level I - Non-Pressurized Irrigation Systems**						
1.	Clean debris and control weeds in irrigation ditches and canals, to maintain water flow and direction.						
2.	Keep water-level-control structures (such as culverts and risers) in irrigation ditches in good working order.						
3.5.	**Level I - Reclaimed Water**						
1.	As needed, design or retrofit irrigation systems to handle reclaimed water, taking into account source water quality and delivery pressures.						
2.	Separate reclaimed water supplies from existing ground or surface water sources to prevent cross-contamination.						

BMP #	BMP Group	In Use	Planned	Will not implement *(check reason below)*			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
3.6. Level I - Special Case Irrigation Measures							
	1. When using irrigation for frost/freeze protection, monitor wet-bulb temperatures, and shut off the irrigation system as soon as the risk of evaporative cooling has ended. You can find this information at http://fawn.ifas.ufl.edu/tools/irrigation_cutoff/. If the FAWN weather station is not in close proximity to the grove, you can use other alternative measures such as a psychrometer to get more accurate wet and dry bulb temperatures. (Use the comments section at the end of the BMP checklist).						
	2. During a drought, closely monitor soil moisture levels. Whenever practicable, irrigate at times when the least amount of evaporative loss will occur.						
4.0 Drainage Management							
4.1. Level I - Water Table Management							
	1. Install and use water table observation wells, and inspect them periodically for any needed repairs. Calibrate wells after installation and/or after any maintenance.						
4.2. Level I - Structures and Conveyances							
	1. For board risers, remove only the boards necessary to achieve desired drainage.						
	2. Keep water velocities near drainage structures slow enough to reduce potential for soil particles to enter the drainage system.						
4.3. Level I - Stormwater Management							
	1. Operate and maintain all stormwater management conveyances (swales, ditches, and canals) to ensure they perform their intended function.						
	2. If you have an existing flatwoods grove that does not have an ERP or other WMD surface water permit and has a history of downstream flooding issues, develop and implement a written stormwater management plan that provides specific responses to various types and levels of rainfall, as feasible. The goal of the plan should be a reduction in volume of off-site discharge while maintaining a healthy rooting environment for citrus trees.						
	3. Evaluate the plan's effectiveness, and make adjustments as needed						
5.0 Sediment and Erosion Control Measures							
5.1. Level I – Vegetative Cover							
	1. Stabilize water furrows and ditch and canal banks by encouraging a good coverage of noninvasive vegetation.						
	2. Maintain desirable vegetation on bed "middles" to minimize erosion and trap sediments.						

BMP #	BMP Group	In Use	Planned	Will not implement *(check reason below)*			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
3.	For mature trees in bedded groves, restrict the area of tree-row-applied herbicides to within the citrus tree canopy drip line.						
5.2.	**Level I - Erosion Control**						
1.	Create and maintain sumps upstream of pump intakes (e.g. lift pumps) within collector ditches.						
2.	Use drain pipe or flexible pipe to connect all water furrows to lateral ditches. Extend the pipe on the downstream side far enough away from the ditch bank to prevent bank scouring.						
3.	Slope ditch bank berms to divert surface water away from drainage ditches and canals. This is especially important when there is an access road adjacent to the water feature.						
4.	In areas subject to high water velocities, protect ditch and canal banks from erosion using rip-rap, concrete, headwalls, or other materials that buffer against turbulence.						
5.	Maintain ditch and canal drainage function by removing unconsolidated sediments in order to retain the original design cross-sectional area. Use slotted or cross-drilled buckets, avoid disrupting ditch side slopes, and deposit vegetation in an appropriate upland location.						
6.0	**Water Resources Protection**						
6.1.	**Level I – Wetlands Protection**						
1.	Install and/or maintain a minimum 25-foot, non-fertilized vegetated buffer upland of the landward boundary of all wetlands and lakes, unless you have an existing WMD permit (e.g., ERP, or management and storage of surface waters permit) that specifies a different buffer. For lakes that have an adopted TMDL for nutrients, expand the buffer to 50-feet.						
2.	For existing operations without an ERP that are unable to meet the vegetated buffers specified above, submit to FDACS a written description of the alternative measures you will take to protect the wetlands from water quality impacts (Use the Comments section at the end of this checklist).						
6.2.	**Level I - Streams Protection**						
1.	Install and/or maintain a riparian buffer along perennial streams on production areas that exceed 1-percent slope and discharge directly to the streams. Contact FDACS, NRCS, or an NRCS-approved Technical Service Provider for assistance in properly designing the riparian buffer in accordance with NRCS Codes 390 and/or 391.						
2.	Locate and size any stream crossings to minimize impacts to riparian buffer vegetation and function. Refer to NRCS Stream Crossing, Code 578 for design criteria.						

BMP #	BMP Group	In Use	Planned	Will not implement *(check reason below)*			
		Check/ or AMU	Month/ Year	NA	TNF	ENF	Other
6.3.	**Level I - Protection for First-and-Second Magnitude Springs Recharge Basins**						
1.	Install and/or maintain a 100-foot non-fertilized vegetated buffer upland of the landward boundary of springs and spring runs.						
2.	Install and/or maintain a 50-foot non-fertilized vegetated buffer around sinkholes.						
3.	If you have a sinkhole on your property, never use it to dispose of used pesticide containers, or other materials.						
6.4.	**Level I - Well Operation and Protection**						
1.	Use backflow prevention devices at the wellhead to prevent contamination of the water source.						
2.	Inspect wellheads and pads at least annually for leaks or cracks, and make any necessary repairs.						
3.	Maintain records of new well construction and modifications to existing wells.						
7.0	**Integrated Pest Management**						
7.1.	**Level I - Pesticide Storage and Mixing**						
1.	Store pesticides in an enclosed, roofed structure with an impervious floor and lockable door, at least 100 feet from wetlands or other waterbodies.						
2.	When practicable, construct a permanent mix/load facility with an impermeable surface, and locate it at least 100 feet from wells and/or waterbodies.						
3.	Where permanent facilities are not practicable, use portable mix/load stations or conduct any field mix/ load activities at random locations in the field, with the aid of nurse tanks if applicable.						
4.	Use a check valve or air gap separation to prevent backflow into the tank or water source when filling a sprayer.						
7.2.	**Level I - Aquatic Plant Management**						
1.	Use barriers, traps, screen devices and debris baffles to control floating aquatic weeds.						
2.	Use biological control agents that have a narrow range and are specific to the targeted aquatic weed species.						
3.	Use herbicides registered and labeled for aquatic applications, when chemical control is warranted.						

Citrus BMP Checklist Comments Section

BMP #	Describe Alternative Measures Used
6.1.2	
BMP #	
BMP #	
BMP #	
BMP #	
BMP #	Justification for additional time to implement specified Level I BMP
6.2.1	
BMP #	Enter "Other" reasons for not implementing BMPs
BMP #	Justification for additional time to implement specified Level I BMP
6.2.1	
Field Notes:	
ERP #	