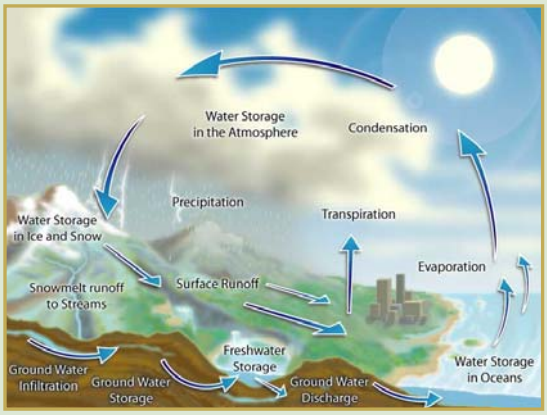
Water Quality & Water-Use Efficiency in Landscapes

A training manual developed for landscape maintenance personnel



Stormwater Management & Urban Water Runoff Pollution

Introduction to Integrated Pest Management

Landscape Irrigation & Water Management

Landscape Water-Use Allocations

Training Manual Provided By:

IRVINE RANCH WATER DISTRICT

CITY OF IRVINE 1971

UC CE University of California Cooperative Extension

Introduction

This manual was developed with landscape maintenance personnel in mind. I met with landscape maintenance crews at two Homeowner Associations (HOAs) sites in the City of Irvine. During my visits to the sites I provided training to the crews on water quality and water-use efficiency in the landscape. At the same time I was able to get ideas on how to best structure this manual in order for it to be more effective with landscape crews working in similar sites.

This manual is split into three main parts, including:

1. Stormwater Management & Urban Runoff Pollution Prevention
2. Integrated Pest Management
3. Landscape Irrigation & Water Management

Each of the three chapters includes an overview of the topic and a description of it's importance as it relates to water quality and water-use efficiency. This is a great tool for landscape maintenance personnel and it's also a great tool for property managers and others who make decisions about landscape management.

I hope you enjoy this manual!

Juan Garcia

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Stormwater Management

&

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Stormwater Management and Urban Runoff Pollution Prevention

Water - one of the most important resources on the planet. Every organism on Earth needs water to survive. Water is valuable biologically and financially. One of the largest consumers of water in Southern California is landscaping. On average, 50%-70% of the water used in commercial and residential settings is dedicated to sustaining plant material.

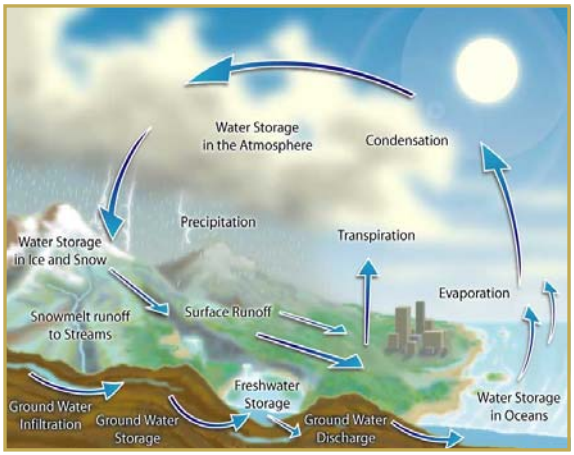
Because water is a finite resource, it is important to safeguard our supply. By instituting better water management practices in our landscapes, we can greatly reduce the amount of water we use and stay within the required Irvine Ranch Water District (IRWD) water allocation.

Water-use efficiency in landscape irrigation will help our water supply and reduce urban runoff pollution.

Stormwater and Urban Runoff

Stormwater and urban runoff is an important topic for maintenance personnel to understand because it can carry many of the chemicals applied to landscapes into local creeks, rivers, and the ocean. Stormwater runoff is caused by natural precipitation while urban runoff is water from human use such as irrigation systems. Water which is not absorbed into the natural environment enters the stormwater system. As the water travels, it picks up pollutants that contaminate not only our environment but our watershed, as well. These pollutants can come from sources such as automotive fluids, emissions, commercial waste, trash, pesticides, and fertilizers. Reduction of runoff can greatly reduce water pollution and protect our watershed.

The Hydrologic Cycle and Watershed



The continuous circulation of the earth's water from sky to land to sea to sky is called the Hydrologic Cycle. Water evaporates from our oceans and condenses into storm clouds. As the water falls from the clouds over our mountains and hills, it either becomes packed away in ice and snow on our mountains or runs off through the environment becoming part of our watershed. Ultimately this water reaches our groundwater, rivers and streams. As rainwater moves slowly toward the groundwater, most of the impurities are removed by biologic processes in the soil.

In the natural environment when it rains the earth absorbs the majority of the water. Rainwater that is not absorbed flows into the nearest body of water. The area of land that drains into a shared body of water is called a watershed and typically is named after the receiving body of water. Cities and towns are part of the watershed because they drain into the same rivers as the land. In the urban or built environment, since most of the ground has been covered with roads and concrete, the ground can no longer absorb water. When it rains the water im-

mediately runs off toward the nearest catch basin which will channel the water directly to the nearest river or ocean. Catch basins are part of the stormdrain system and exist for the sole purpose of flood prevention. They do not clean the water that enters them in any way.

It's important to safeguard our watershed, whether it's a natural watershed or one created by humans.

Watersheds can develop in all shapes and sizes. Watersheds can reach thousands of square miles in size, while some can be as small as a few acres. The impervious surfaces associated with urbanization prevent water from draining and infiltrating into the soil. Our residential and urban areas, including the common areas of most HOAs, are part of the larger watershed. It is important to manage the amount pesticides and fertilizers used on site, and prevent irrigation runoff to conserve our water and protect our watershed.

Prevention of Runoff

As a landscape professional you have a greater impact on the environment, for better or for worse. Because you have the ability to control pesticide and fertilizer use, and can make adjustments to irrigation systems on a large scale, you can do more than the average person. The role you play in improving your local watershed should not be underestimated. The work you do and the decisions you make today will impact the future health of the environment and the people who live in it. Keep this in mind as you take a fresh look at your work sites with an eye toward reducing pesticide and fertilizer use, and irrigation runoff at each landscape site.

Current Site Conditions

Every landscape is slightly different from the next in the types of plants, soil types, slope, sun and shade patterns, irrigation systems, and scope of work required by the client. Information on existing site drainage or runoff may be obtained by inspecting the site during a walk through. However, there are some basic questions you can ask as you observe the landscape's current condition. The following questions and suggestions are designed to help you get an idea of where improvement efforts will be the most effective.

1. What is the current situation with HOA landscape and hardscape areas?
2. Are there existing site drainage or runoff problems?
3. Are there any soil issues such as compaction or heavy clay soils which do not allow water to be absorbed at an efficient rate?

Site personnel must also be aware of current irrigation system problems.

1. How old is the irrigation system?
2. Has the system equipment become outdated?
3. Is the site exceeding its water allocation?

Site maintenance personnel and property managers must understand the site conditions and use

The landscape and irrigation systems require scheduled inspections in order to fix problems promptly.

these as the basis for selecting appropriate runoff controls and water management.

Landscape management involves not only water application, but applications of chemical materials for pest control, plant care, and enhancement. Many of these materials are toxic and enter the water cycle with rain or irrigation runoff. Answering the following questions will help you assess current chemical uses.

1. What are the current pesticide and fertilization practices?
2. What materials are currently used?
3. At what rates are these materials introduced?

Pollutants, such as nitrates, can travel to depths that may ultimately threaten water supply wells. As landscape maintenance workers apply fertilizer or other chemicals to the landscape, this becomes a source of pollutants that can easily be introduced into our water system. If these chemicals are introduced during times of rainfall, they can easily be washed away along with

Irrigation runoff—water intended for landscape is now going down the storm drain.

debris such as leaves, grass clippings, and trash and can be transported by runoff into our storm drains and then the ocean.

Erosion can also play a big role in the contamination of our water. Bare ground or exposed soil areas in the landscape allow soils and sediments to be washed away into our storm drains and other areas. Sediments are harmful to aquatic life and also transport pollutants such as trace metals, nutrients, and hydrocarbons that attach to the soil particles. Illegal dumping of chemical products such as herbicides, pesticides, and other chemicals, presents further risk to our water supply.

Inefficient irrigation practices also transport these materials to our water sources. The excess water (water that does not get absorbed) runs off into our streets and gutters, carrying the chemical fertilizers and other materials picked up along the way. The water then enters the storm drains, contaminating the watershed. The following landscaping and irrigation techniques will decrease runoff, conserve water, and are easy to implement.

Irrigation

Maintaining the irrigation system in good working condition and providing sound water management are the first steps in runoff prevention. It is important to evaluate the systems and fix any problems that may be encountered. Irrigation efficiency is the ability of the irrigation system to distribute water evenly. Irrigation management includes system maintenance and controller scheduling.

IRWD has established an allocation/tiered rate billing system for its landscape customers. The allocations are site specific based on weather data, season, and site acreage. The weather data is collected from weather stations in Newport Coast, Irvine and Foothill Ranch. The weather stations record solar radiation, wind speed and direction, air temperature, and humidity.

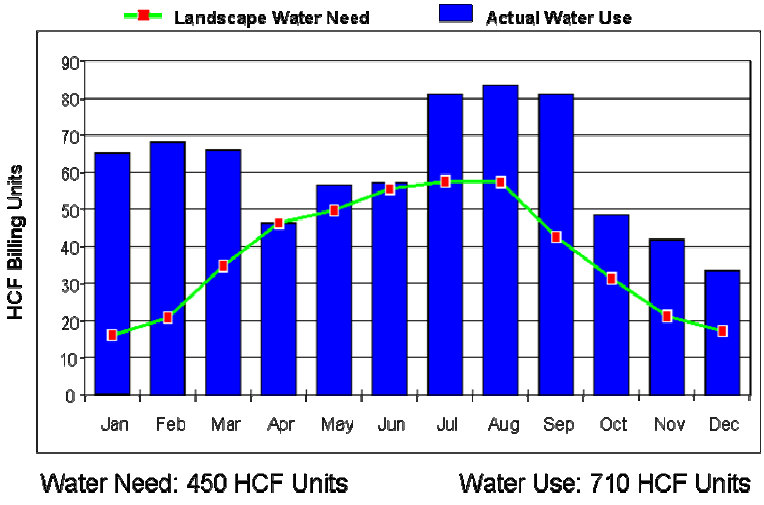
This data is collected daily and transmitted to IRWD where it is used to calculate the allocation. This ET information is used for site water allocations. The allocation is typically at its highest in July and August and at its lowest in December and January. However, changes in weekly allocation can increase or decrease by as much as 40-50%. Even though the weather may still be warm, the water allocation will be lower. It is important to track weekly water usage and compare it to the weekly allocation to properly manage the site.

IRWD's water allocation assumes that the entire landscape area is cool season turf. Cool season turf has the highest water need of all plants in a landscape. By basing the water allocation on 100% cool season turf, IRWD ensures that every landscape will have more than enough water. Water rates progressively increase as you exceed the water allocation.

It's important to manage the site's irrigation system and landscape in order to meet the site's water allocation requirements. Here are some steps to follow:

- Fix broken or malfunctioning sprinklers
- Fix any leaky or broken irrigation lines
- Adjust the sprinkler arc and radius to stay within boundary
- Manage your irrigation scheduling (site water allocations)
- Water at the appropriate time of day (early morning hours before sunrise)
- Be aware of any onsite microclimates
- Use water-efficient sprinklers
- Install Smart Controllers (self-adjusting)

The graph below shows a sample landscape site and compares landscape water need vs. actual water use. The water waste is almost twice the actual water need. Most of the water waste created by poor irrigation practices becomes urban runoff. The runoff eventually makes its way to the stormdrain system with pollutants.



Water Need: 450 HCF Units Water Use: 710 HCF Units

Soils

Soil makeup is one of the most crucial parts of the landscape. Not only is it the media which supports plant material, but it affects the type of irrigation needed and the scheduling of the irrigation. Let's review the three classifications of soils and look at some tips on how to amend or build up soil to be more absorbent and allow for water to move through it with ease.

As we prepare our existing soils, we must classify them into 3 particular groups: sand, clay, or loam. There can be variations in these soil make-ups, but the important thing is to look at them and consider the following options to improve efficiency:

1. The way water moves through the soil;
2. The way the soil supplies water to plants;
3. Soil composition & ability to prevent runoff.

The ideal soil is loam. Loam is a make up of all three particle components (sand, silt, clay), and the percentage of each is relatively similar. A loam soil can provide benefits to plants by also providing a good percentage of air (oxygen), water, and organic matter. Loam soil allows the water to be absorbed at an efficient rate, delivering water to the root zone.

Irvine soils are found to be for the most part made of clay. Clay soils do not allow water to infiltrate easily through the soil surface. They will only absorb water for a minute or two during irrigation, any additional runtime results in runoff. These types of tight soils are a major cause of runoff problems. The particle size is so small that they bind together like bricks.

Sandy soils can also be an issue, but not with runoff. Water runs through the soil so quickly past the root zone that it is not available to the plant material. The best solution for this type of soil is to build them up to be more absorbent.

It is important to achieve a well balanced mix of these soil types or to build them up. We need to amend our soil to be more absorbent while maintaining good drainage. Soils that hold more water prevent runoff and reduce irrigation frequency.

Soil Amendments

Soil amendments improve the physical properties of soils. Amendments are mixed into the soil unlike mulches that are placed on the soil surface. Soil amendments increase water and nutrient holding capacity and improve aeration and water infiltration.

The best method for improving the structure of clay soils and reducing compaction is to add composts and organic mulches on a regular basis. For example, gypsum helps break down the soil particles but should only be added if clay soils are shown to contain high sodium levels or a calcium deficiency. Also, add organic materials such as compost or wood chips to help open the soil and allow water to move through it. Never add sand or other fine particle components to clay soils as they can tighten the soil even more creating compaction.

Organic mulch used to cover bare soil in order to reduce runoff and keep moisture in the soil.

Water runs quickly through sandy soils and as a result, nutrients and water are taken past the root zone. The best solution for sandy soils is to build them up to be more absorbent by adding organic materials such as peat moss and compost. This will improve water retention while maintaining good filtration.

When adding organic material as a soil amendment, be aware that the organic material being added to the soil can draw nutrients such as Nitrogen out of the soil. As a result, adding additional Nitrogen fertilizer may be required to prevent plant material from failing.

We can add synthetic fertilizers or organic materials high in Nitrogen such as blood meal, activated sludge, fish emulsion and manures. The rates of application for soil amendments vary depending on the square footage and depth of the area. These measurements should be known and only the amount of fertilizer that is needed should be applied.

Plantings

When we look at our landscaping, it is important to consider the site's water allocation requirements. Does the plant material onsite require large amounts of water? We must look at the ratio between lawns and planters. Turf areas require most of the water that we use in the landscape. Can we decrease the size of turf areas and use the space for drought tolerant plants?

Lawn area converted to drought tolerant plantings and sprinkler system converted to drip irrigation.

Also, turf areas require a well built and efficient irrigation system since they consume large amounts of water. Most of the runoff problems we see around turf areas are due to the irrigation system. Maintenance personnel need to be vigi-

lant and maintain these systems and keep them efficient to reduce runoff.

Mulching practices are important in the landscape. These materials can keep soils, chemical fertilizers, and other pollutants from washing away into our storm drains. Mulching also helps to reduce evaporation from the soil areas around the plant material reducing irrigation frequency and in turn producing less runoff.

New Techniques and Materials to Prevent Runoff

Use drainage as a landscape design element to reduce runoff. In the landscape we can shape the land to create above-ground drainage swales, to keep the water within the landscape. Runoff can be directed from impervious areas to adjacent pervious areas or the landscape. Turf areas that are near sidewalks or impervious areas can be transformed into planters to prevent water from running off into the storm drains or other areas. Other water efficient landscape solutions include designing or restructuring the landscape as a depressed landscape or rain garden. These areas trap water within the region when water runs off from asphalt or concrete areas.

Combination of porous pavers, rock, and mulch used in this driveway and walkway.

Select permeable pavements and surface treatments. Inspect the site's paved areas and identify locations where permeable pavements can be substituted for impervious concrete or asphalt paving such as parking areas or walkways.

There are a wide range of materials that can be used for pervious hardscape areas such as grass/gravel pavers and interlocking concrete paver blocks. Pervious asphalt looks like normal asphalt, but is porous. Ideal uses include parking lots in parks and community centers.

Walkways can be constructed using decomposed granite. A binder can be mixed into the decomposed granite to reduce erosion, but still allow infiltration.

Porous concrete has become more widely available and cheaper in recent years. The concrete is stronger and able to handle more weight. The material is perfect for any areas where new construction or redevelopment is being considered.

This is an example of porous concrete. Water percolates through the concrete and into the soil instead of running off into the stormdrain system. *Courtesy of The Southeast Cement Association*

This is a demonstration of porous concrete. Most of the water is able to percolate through. *Courtesy of The Southeast Cement Association*

The porous concrete allows water to move through it with ease and filter through the soil into our ground water.

The main goal with all of these materials is to keep stormwater and urban runoff from carrying pollutants into streams, creeks, and the ocean. By managing our landscapes, drainage problems, chemical use, and irrigation systems, we can reduce the amount of toxic runoff and better manage our water use. By using new technologies such as pervious materials we can prevent toxins from entering our water bodies in the first place, ensuring a safe and clean water supply for us all.

Chapter Two

Integrated Pest Management

Integrated Pest Management

Integrated Pest Management (IPM) uses an efficient, effective and environmentally conscious approach to pest management. This approach draws on knowledge from several different sciences including entomology (study of insects), mycology (study of fungi), chemistry and horticulture. This interdisciplinary approach enables the practitioner to develop sustainable and less costly solutions to many common landscape problems.

In an IPM program, we use information on:

- Pest identification
- The life cycles of pests
- Pest's interaction with the environment
- Available pest control methods
- Control pest damage by economical means (economic threshold)
- Cultural practices such as plant maintenance, care and irrigation
- Control methods that cause the least damage to the environment

The IPM approach can be applied to landscapes, the workplace, and the home. IPM takes advantage of all appropriate pest management options including, but not limited to, the use of pesticides. We use methods such as pest management evaluations, decisions and controls.

Landscape professional inspecting the leaves of a plant in order to accurately diagnose the problem.

An IPM program assists the landscape professional in the proper identification of the pest, determining if the pest damage is significant enough to warrant treatment, and in the proper selection of a control method with the least impact on the environment. The proper implementation of an IPM program will reduce the improper use of pesticides that may potentially reach surface or groundwater.

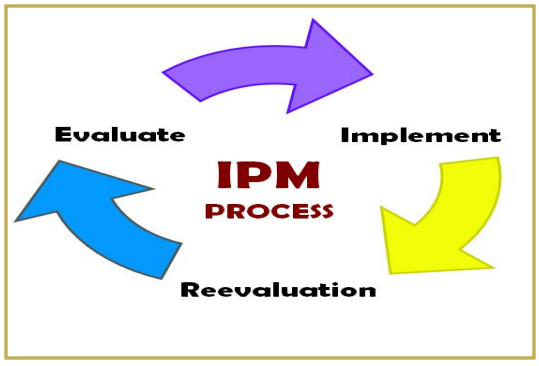
Goals

A good IPM program will consider the economic threshold of the landscape or simply stated how much damage the landscape can sustain until the aesthetic value of the landscape is diminished. Early preventative actions are the key to a successful IPM program. Once you have determined the economic threshold of a site, the evaluation process may begin.

Things to consider:

- Exclusion: preventative measures
- Suppression: keeping the level of damage below the aesthetic threshold
- Eradication: when you cannot tolerate any aesthetic damage
- Plant resistance to disease and pests

The IPM Process



Evaluate

The first step in the IPM process is to evaluate the site and determine the threshold for damage. Use

the steps below and answer the questions to help create an action plan.

1. Identify and monitor the pest population. Is the population at a tolerable level?

2. Predict the damage and loss of plant material if no action is taken. How severe will the damage be?

3. Evaluate the risk of treating or not treating. If left untouched will the problem correct itself over time? For example, will biological predators arrive to feed on the pests? If so, how much time will it take? Can the landscape tolerate this much time?

4. Identify the host plants. Which plants are hosting the pests? Which plants are the pests feeding on? Can any of these plants be removed from the landscape?

5. Research available controls. Implement the management technique that is most effective with the least risk to the environment.

After working through the evaluation process you should know what the pest is and know how to deal with it. The second step of the evaluation process is to determine how long the control you have selected will take to work. This will inform the re-evaluation phase of the process. Once the pest has been identified, the control method has been selected and you know how long you are willing to wait for the results, you are ready to implement your plan.

Implement

Once the evaluation is complete you should have a plan of action that includes the type of pest, the control method, and the timeline for eradication. With this action plan in hand you are now ready to enter phase 2, implementing the action plan. The first course of action should always be the least harmful. The use of pesticides as a first choice is discouraged. They should only be used as a last resort.

Implement the pest control you selected. Observe the effects of the action plan during application and throughout the remaining time of the action plan. After the pre-determined length of time has passed it is time to move into phase 3 and reevaluate the site.

Reevaluate

After action has been taken it is important to go back and reevaluate the original pest problem. The first step during the re-evaluation phase is the same as in the evaluation phase, monitor the pest population. The key question is: Has the pest population been eradicated, decreased, increased, or stayed the same? The answer will determine your next steps.

If the pest population has been eradicated then the control you implemented was successful. If the pest population has decreased but is still present consider implementing the same action plan again if appropriate. If the pest population has increased or stayed the same, then the control method was not successful. Consider possible reasons why the control you selected did not work. Work through the steps in phase 1 again from the beginning paying special attention to pest identification.

Pest Identification and Management

Central to the practice of integrated pest management is the proper identification of the pest. If you do not know what is causing the damage you will not succeed at correcting the problem. The first

This rose is infested with Aphids. The problem here is considered biotic.

question to ask when conducting a site inspection is: Is the damage a result of abiotic or biotic conditions?

Biotic vs. Abiotic

Biotic diseases are those that are caused by insects, fungi, bacteria and viruses. Abiotic disorders are non infectious diseases. Abiotic disorders are caused by elements, such as air pollution, pesticides, fertilizers, improper watering

This is an example of an abiotic disorder. This trimmer is damaging the trunk of the tree and may eventually damage the tree's vascular system.

practices, excessive or inadequate fertility, improper maintenance techniques, improper plant selection and cultural requirements (shade vs. full sun), and mechanical damage.

Identification of the pests/pest that is causing the problem is the most important component of an IPM program. Knowledge of predisposing factors can identify pre-emptive measures, effectively managing pest problems before they become damaging. Determine what the cause is. Is it a beneficial, harmless, or harmful pest or disease? Below are some examples.

Insects

***Chewing Insects*—** Caterpillars, beetles, snails, and others. Damage occurs on the younger growth of leaves and branches. They can also attack flowers and fruit. How can we manage these types of pests without using chemical means? Insects of these types can be picked off the plant by hand. We can use soap solutions to try to smother them. For snails, a barrier can be placed around the plant material to keep them from reaching the top of the plants.

***Sucking and Piercing Insects*—** Aphids, white fly, scale, and others. Damage occurs by discoloration, distortion or the dropping of foliage.

This is an example of piercing insects. These are aphids piercing and removing nutrients from the plant. *Courtesy of Jack Kelly Clark, "UC Statewide IPM Program"*

They prefer to attack young succulent tender growth. You can control them by simply spraying the plant with a high pressure water stream to knock off the pest. You can also use a soap and water-based solution.

Many of the control methods for these insect infestations rely on cultural practices such as maintaining the health of the plants and eliminating vector plant materials, such as weeds.

Annual weed: Spurge.

Weeds

Weeds are unwanted plants growing amongst desired plants. They can be a vector for pests on our plant material. They are woody or herbaceous. They can be classified according to their life cycles: annual, biennial and perennials.
Weeds can be controlled according to their biology of being monocots grasses or single leaved plants, or dicots two leaved or broad leaved plants. The easiest way to control weeds is by mechanical control or simply hand weeding the area. Below you will find descriptions of the classifications of weeds.

Annuals – these types of weeds grow, flower and die in one year. Here are some common examples: spurge, crabgrass, ragweed, foxtails, purslane, and mustard.

Bi-annual weed: Prickly Lettuce

Bi-Annuals/Biennial – these types of weeds take two years to complete their life cycle. The first year is for growth and the second the weed flowers, sets seed and dies. Here are some common examples: bull thistle, burdock, mullein, prickly lettuce.

Perennial Weeds— these types of weeds live for more than two years in order to complete their life cycles. They can also be classified as herbaceous weeds. They die back down to the ground after their life cycle. There are 3 classes of these types of weeds: simple, creeping, and woody.

Simple—herbaceous, reproduce by seed only, roots usually fleshy and may be large. Dandelions are a great example.

Perennial weed: Dandelions

Creeping—herbaceous, reproduce by seed and vegetative parts such as stolons, rhizomes or tubers. Some examples are Bermuda grass, nutsedge, oxalis, and kikuyu grass.

Woody—herbaceous, weeds having secondary growth. Some examples are poison ivy and Algerian ivy.

Fungi

Fungi are pests that can easily grow or spread in warm and wet conditions. One example of a common fungus problem is Shothole Fungus or Coryneum Blight (*Wilsonomyces carpophilus*). This fungus appears as spots on the leaves that start to rot out from the middle giving the ap-

Shothole fungus on the surface of a leaf
Courtesy of Jack Kelly Clark, "UC Statewide IPM Program"

pearance of shot gun holes hence the name shot hole fungus.

You can recognize shot hole in spring, when it causes spots or lesions on buds, leaves, twigs and fruit. The disease can be quite severe following warm, wet winters, and when wet weather is prolonged in spring.

Shothole fungus survives the winter months inside infected buds and in twig lesions. A way to prevent this infection is to not water in the warm part of the day and to not have water on the surface of the plant material

Bacteria

Bacteria need moisture and/or an open wound to infect plant material. Good water management and cultural practices can control some bacteria

Fire Blight bacteria distorting the new growth of the Evergreen Pear. The infected area looks burned.

Picture of bacteria transmitted from one plant to another via infected tools.

Landscape crew disinfecting pruning tools after pruning infected parts of the tree.

if they are caught early. A common bacterial disease that can be seen in the landscape is fire blight (*Erwinia amylovora*). It attacks plants such as Evergreen Pear (*Pyrus kawakami*).

This disease can easily be transmitted tree to tree by contaminated tools. By simply cleaning your tools by dipping them in a 10% bleach solution, you can dramatically cut down on transmitting the disease throughout the landscape.

Viruses

A virus is a microorganism that invades and then reproduces itself inside a living cell. Plant viruses can be transmitted by a vector, most often insects such as leafhoppers, thrips, and nematodes and can be transmitted from contaminated tools. Some viruses are transmitted during the time of initial plant propagation by cuttings, gratings, and rootings from infected plants.

Virus: Rose Mosaic. This virus causes discoloration and distortion.

Viruses can cause curling or distortion of leaf tissue. Stunting, abnormally shortened or deformed leaves, stems and fruit can also occur. An example of a viral disease problem that is commonly seen in the landscape is the Rose Mosaic Virus. This disease causes yellow and brown striping of the leaves. Growth is stunted and flower production can be poor. It is best to use roses that are not infected at initial planting.

IPM Implementation

The last resort should be chemical control and least toxic chemical should be considered first. Always consider pre-emptive control measures such as sanitation and avoidance. Avoidance requires taking action before there is a problem. Also try not to use plant species that are highly susceptible to infection.

Cultural Control: landscaper spraying hedgers with water and bleach solution to disinfect tool.

Preventative Cultural Practices

Preventative cultural practice is the first step in having a healthy landscape. It is crucial to provide optimum cultural conditions for the landscape. Many of the common problems with plant material in the landscape are due to poor horticultural practices that can easily be managed. You may only have to alter current conditions such as watering schedules to help with the problem.

The key to a successful, aesthetically pleasing landscape is to practice preventative measures to ensure a healthy landscape. Irrigate at the right intervals and time of day. Changing watering practices such as not watering in afternoons when conditions are warm and perfect for diseases to thrive. Practice culturally sanitary methods such as cleaning your tools and equipment when pruning or maintaining a landscape. Use mulches to suppress weeds or simply remove weeds by hand. Use pest resistant varieties. Prevention is the key.

Utilize Resistant Plant Varieties

There are many plant species that have been hybridized to help minimize pest problems. Choose plant varieties that are pest resistant and have a higher tolerance to these problems in the landscape.

As mentioned earlier, Evergreen Pear (*Pyrus kawakami)* is highly used in the landscape and has a high susceptibility to fire blight (*Erwinia amylovora*) disease. Fire blight gets its name from the burnt appearance of affected blossoms and twigs. Flowers turn brown and wilt; twigs shrivel and blacken, the ends often curling. In more advanced cases of bacterial infestation, cankers, discolored oozing patches, form on branches. Bradford Pear (*Pyrus calleryana*) is a great substitute and is resistant to the disease.

This is an example of a beneficial insect. This is a Lady Bug Larvae eating aphids.
Courtesy of Jack Kelly Clark, "UC Statewide IPM Program"

Natural Enemies

Are there biological control methods such as beneficial insects or organisms that can help re-

duce the pest problem? Many creatures such as dragonflies, ladybugs, lacewings, and syrphid flies are beneficial to your garden and are natural predators of harmful insects and their young (eggs, larvae). For Example, the ladybug beetle adult and larvae (*Coccinellidae species*) is a predatory insect which feeds on aphids and scale.

One of the most important steps in a good IPM program is to select plants that attract beneficial insects such as Chrysanthemum, Rosemary, California Lilac, Sunflower, and Tidy-tips. Beneficial insects may also be purchased at your local nursery store. Try using natural enemies to control pest problems. Broad-spectrum insecticides should be avoided as beneficial insects will also be eliminated.

Mechanical Control

You can use mechanical control (manual labor) methods such as pruning practices, weeding, and using mulch. For example, you can place a sticky material around the bottom of the trunk to prevent ants from protecting aphids from natural enemies, or place copper bands strategically

Landscaper is placing a sticky material as a mechanical control to keep insects away from the canopy.

throughout the landscape. Snails will not cross over copper because of the unpleasant reaction the copper has with their soft bodies. Copper bands have proven to be an effective and sustainable mechanism in preventing snails from damaging a landscape. You can also simply prune out diseased plant material and/or remove decaying diseased flowers or leaves from the ground.

Pheromones

Pheromones are chemicals given off by an insect that generates a normal behavioral reaction in another species member. There are many types of pheromones that trigger or affect unique behavioral and physiological characteristics. Pheromone compounds can be used in many ways to reduce the amount of pesticides applied to the landscape. They can be used to determine how many pests are present at the peak of the mating season to determine the best time for control. They can also be used to lure the pests into traps, or to confuse the pests so they do not reproduce. Consider using pheromones as a solution before introducing pesticides into the landscape.

Application of pesticides using proper safety equipment and practices.
Courtesy of Jack Kelly Clark, "UC Statewide IPM Program"

Pesticides

The key with using any pesticide is to diagnose the pest problem first and determine if another less toxic method can be utilized first to control the damage caused by the pest. Then use the

proper chemical material at the proper time, at the proper rate, and in an appropriate manner using the right equipment for application.

Always be conscious of chemical applications in the landscape. By reducing chemical use we can reduce the amount of toxic materials from reaching our water supply. Remember to follow all rules and regulations when applying these materials.

Role of a Pest Control Advisor

The role of Pest Control Advisor (PCA) is to recommend the most effective pesticides and/or control methods. A PCA must be educated on California laws and regulations regarding the use, sales, services and types of pesticide used. They are also required by law to have a bachelor's degree (B.A. or B.S.) in Agricultural Sciences, Biological Sciences, and/or Pest Management and are considered experts on the use of these materials.

Landscape personnel training helps to ensure a safe working environment. Safety trainings should be part of the normal procedures for landscape companies.

A Certified Pest Applicator (CPA) is also a licensed pest applicator. A CPA works with the recommendations of the pest control advisor. The CPA is able to apply the pesticides to a site, but not able to sell his services for application or give recommendations on what chemical materials to apply.

A landscape maintenance worker can apply pesticides under the supervision of a CPA once the maintenance worker has gone through an application and safety training by the CPA. This training has to be completed on a yearly basis.

Pesticide Application

Pesticide application should be the last resort when combating a pest problem in the landscape. In a properly maintained or healthy landscape, the need for harsh chemicals is greatly reduced which can also reduce the frequency of aquatic toxicity detections in streams, creeks, and rivers. Once you have reached the decision that the only means to control the situation is to apply a pesticide, there are some factors to consider. Remember, to always follow the laws and regulations when applying pesticides: You must be a licensed certified pest applicator, or trained and supervised by one.

Factors to consider when using pesticides

- What is the pest you are going to control? Remember that identification is the key when controlling a pest problem. Diagnoses of the wrong pest can lead to application of the wrong chemical and cause problems in the landscape.

- Is the pest population worth controlling economically? Do you have the means/budget for control? What are your labor/time costs to control the problem? If you can save time and money by applying a pesticide to combat a pest problem instead of using mechanical means, then it might be a better solution.

- What is the location of the pest? Is it on top of the plant, under the leaves, in the plant itself, in the roots, etc? This is important when selecting a control tactic or pesticide application method. Will you have to use a systemic pesticide that has to be applied either to the soil root zone or as an injectable? Will you have to use a foliar spray for application? You have to make a decision that will be less detrimental to the environment.

- What is the toxicity of the pesticide to the

plant material and to the environment? Use the least toxic pesticide and one with the least residual material. Many pesticides can leave a residue and potentially leave the site of application in surface runoff.

What are the related hazards?

- To the applicator: safety should always be first. Make sure the applicator is not exposed to the material for a prolonged period of time. By law, you must keep records of the materials being applied in case of medical emergencies. This allows doctors to diagnose the problem, combat the symptoms to the applicator, and set up further care.
- To the workers maintaining the area: Worker should always be aware of the pesticide application and keep clear until it is determined that it is safe to reenter the area of application.
- To surrounding plants: Are these chemicals going to harm plants near the area of treatment?
- To beneficial insects: Remember that when dealing with pesticides for control in a certain area, they can harm or affect surrounding beneficial insects.
- To wildlife: What affect are the pesticides going to have on wildlife in the area of treatment? Always be aware of the environment.
- To pets: Pets are often affected by pesticides, since they wander around areas of the landscape during walks or they happen to live near the area treated.
- To the water supply: Chemicals can end up in our water supply through runoff or percolation through the soil. Use only what is needed.

Identify the cost for application

- What is the labor and time costs for application of pesticides? Is a non-chemical control method feasible?
- What are the costs for the material/pesticide that are going to be used?
- What type of equipment will be used for application? Will it be purchased or rented?
- Does a professional (PCA or CPA) need to be hired?

Protective gear needed for the application of pesticides.

Hand-held portable pesticide or herbicide sprayer.

In IPM it is important to use an environmentally conscious approach to pest management. Employ landscape management practices that use non-chemical control methods first, then resort to chemical applications if necessary. It is important to reduce the amount of toxic pesticides that can reach our water supply through runoff or soil leaching. Take preventative actions early to ensure a healthy landscape.

Fertilizer Application and Greenwaste

Just like pesticide use, it is very important to implement good management practices when applying fertilizers to a landscape. Landscape personnel must apply fertilizers at the right time of year and in a correct manner and rate. This can help reduce the amount of chemical runoff from reaching our water supply. By applying fertilizers at an adequate rate, one can reduce the amount of excess growth and cut down on green waste. Also, over-fertilizing can draw pests to the newly developed tender growth.

By establishing a well managed fertilization schedule for the landscape, one can keep the plant material healthy which can make them less susceptible to pest problems. It is important to always take precaution and care when applying these materials to the landscape and always follow application rate recommendations. The fertilizer label will have information on nutrient content as well as application rate for certain plants and safety information.

There are many combinations or types of fertilizers for use. They come in different forms such as chemical fertilizers: granular, slow and quick release, liquid, weed controlling, and organic fertilizers: compost, manures, cottonseed meal, blood meal, fish emulsion, and biosolids (sewage sludge) from water treatment plants.

Chemical vs. Organic Fertilizers

Chemical fertilizers are man-made materials while organic fertilizers derive from natural materials. By using natural organic fertilizers such as composts, we can reduce the amount of chemicals in the landscape. For example use compost in place of chemical fertilizers in planter areas.

The benefits of these organic materials are that they improve the physical structure of the soil allowing air into the root zone, making them more fertile and absorbent. They increase bacterial and fungal activity which makes other nutrients more available.

Organic fertilizers leach slower than chemical fertilizers making them less likely to contribute to water pollution. Compost and biosolid fertilizers may be available through greenwaste and composting companies. In the future, look for city programs where these types of organic materials may be available.

Fertilizers

Fertilizers are like a vitamin pill for plant material. They can help in development of the plant material as well as keep them healthy. It is important to always be careful when applying these chemicals. When they are applied, they should be applied in a conscious manner to avoid excessive nutrients in the landscape, and to prevent them from reaching storm drains.

Let us look at the compounds of these fertilizers. How they are used by the plants? Let us also look at what site conditions are required for fertilizers to be available for the landscape.

Fertilizers have the percentages of Nitrogen (N), Phosphorus (P), and Potassium (K) clearly printed on the bag, box, or container. These percentages are labeled as numbers such as 15-15-15 or 27-10-10, which stand for N-P-K. These numbers represent the percentage of each nutrient. The first number represents Nitrogen, the second number is for Phosphorus and the third number is for Potassium. A fertilizer with an NPK of 15-15-15 has a make up of 45% of actual fertilizer. The other 55% will be fillers or carriers.

- ***Nitrogen*** is for the green and growth of a plant. It is needed in small quantities. This compound is used to form chlorophyll which gives a plant its color, to build enzymes required for plant cells, and basic proteins needed by plants. A plant cannot grow without Nitrogen. Be careful not to add too much or too little Nitrogen. Plant material can suffer from Nitrogen deficiency by turning yellow. Over-application can burn the plant material and cause excess

green growth and reduce flowering. Nitrates can easily dissolve in water and leach into the soil reaching ground water supplies.

Phosphorus is used to produce fruits, flowers, seeds, but most importantly roots. It also helps make your plants more resistant to disease. Unlike Nitrogen, Phosphorus will not dissolve in water and will not leach easily.

Potassium is needed for overall plant health. Potassium is used to produce carbohydrates such as sugars and starches, as well as proteins and enzymes needed for a plant to be healthy and vigorous. Potassium also helps regulate a plant's water use, and helps a plant to better withstand cold and heat (hardiness).

Fertilizers will also contain trace elements, secondary nutrients (minerals such as calcium, iron, and magnesium), as well as fillers such as sulfur compounds. These compounds are necessary in very small amounts for good plant growth. Fertilizer labels will also list the percentages of these micro-nutrients. Your plants need certain trace elements and secondary nutrients to make the best use of soil, water, and air.

Magnesium (Mg) and Iron (Fe) are important to the plant's production of chlorophyll. Dolomitic lime and Epsom salts are good sources of Magnesium. Iron elements are found in fertilizer materials but are usually not available to plants due to high or alkaline pH levels.

Calcium (Ca) and Boron (B) are essential for proper water uptake, and both are important for proper cell formation. Calcium is present in gypsum, lime, and shells. Boron is available in borax and a chelated boron spray.

Sulfur (S), Zinc (Zn), & Manganese (Mn) are the "catalysts" that help other nutrients such as Nitrogen become usable by your plants. Gypsum and flowers of sulfur are good sources of sulfur.

Nutrient Deficiencies

Lack of adequate nutrients and trace elements may result in a deficiency. Signs of a deficiency will show up in the plant material. The following symptoms indicate that the plant is deficient in a particular nutrient. Soil amendments containing these nutrients or an application of fertilizer can be added to improve plant health.

Nitrogen deficiency produces yellowing of leaves (all parts) and this is classified as pallor. Pallor is when the older leaves turn a pale green or yellow. The veins are usually a reddish color. The new growth of the plant will be stunted.

In Phosphorus deficiencies the veins of the leaves will turn red to purple and the plant as a whole will look purplish.

Potassium deficiencies cause the edges of older the leaves to be a purple color and the leaf tips will be a brownish color like in salt burn.

Magnesium deficiency turn older leaves spotty yellow or a tan color.

Zinc deficiency is very rare. The symptoms will look almost like magnesium but here the leaf will be twisted.

Iron deficiency is common in the landscape especially in alkaline soils. The young growth will be stunted and the leaves will be pale in color while the veins on the leaf remain green.

Calcium deficiency cause dead areas to appear in young growth and soon cause the plant tips to die.

Fertilizers and Soil pH

Soil analysis (testing), combined with observations of plant growth, is the key for landscape personnel to develop the most effective nutrition program. Our soils are very important when it comes to fertilizing. Not so much the soil makeup, but the pH levels of the soils.

The soil pH level is very important. It can let

you know what nutrients will be available for the plant to use, and can also help prevent the spread of soil borne diseases. The pH scale ranges from 0-14. 0 being acidic and as we move up the scale 7 is neutral and the further we move up the scale it becomes more alkaline until we reach the 14 on the pH bar scale.

Most plant material requires a pH range from 5.5 – 7 on the pH scale. The pH range will let us know which plant nutrients will be most available. The wider the pH range for a plant, the more available the nutrient.

Nutrients such as, calcium, magnesium and Potassium are most available at high/alkaline pH levels and unavailable at low/acidic pH levels. Nitrogen and sulfur require similar pH ranges. Iron, manganese, zinc, and copper are less available in alkaline soils values. Phosphorus and boron are unavailable at both low pH and high pH.

To correct or level soil pH levels, one can use lime compounds to raise the pH level and sulfur compounds to lower your pH. Remember that when you add these materials to either raise or lower your pH, it might take months to see results. These nutrients need to breakdown in the soil and be used by the plants which can take time.

Fertilizer Application Scheduling

When considering fertilizer use, we must first look at the plant material in the area where it is going to be applied. By over applying fertilizers, not only can you cause excess growth and accumulate more greenwaste, but it can also shorten the life of the plant material and increase the likelihood of some plant diseases.

Over application or incorrect application of fertilizer can contribute to pollution in our rivers, streams, lakes, and oceans. Implementing a well managed fertilizing schedule will cause the landscape to adapt and become less dependent on chemicals. Plants will be healthy and their new growth rate will reduce the amount of pruning and maintenance required. This will cut down on the amount of green waste produced and reduce the overall maintenance costs of the landscape.

When is the best time to fertilize? Fertilizer application usually takes place during the growing season of these plant materials. Never apply fertilizers during time of rain to avoid these chemicals from running off. Not only is this harmful to the environment and water supply but can also be costly.

Understanding the growing cycle of plants is important when fertilizing. First, the plant goes through its growth stage. As it grows it transitions through to the flowering stage where it produces a flower, fruit or seed. After the flowering stage, it either dies (as in the case of annuals) or it goes into the dormant stage. Each stage has its own requirements and they need certain nutrients to aid each particular phase.

Growth Stage – As a plant grows, they require more Nitrogen and Phosphorus. Nitrogen encourages leafy growth, stems and branches. Phosphorous is needed for root development, flowers and seed.

Flowering Stage – During the flowering stage, plants need a generous quantity of Phosphorus and Potassium. Phosphorus helps plants produce fruit and flowers and Potassium aids in the resistance to disease and pests.

Dormant Stage – The plants go into hibernation. They don't require mulch or any fertilizing.

Large areas such as turf require the most care. Turf is usually the largest portion of the landscape and is highly scrutinized. Before applying fertilizers, one must be aware of past fertilization practices.

Has the area been treated so much with fertilizer and water that the landscape has become used to this over application? Do we have to tailor off our watering and fertilizing practices to have the area become less dependent on these materials? By changing our fertilizing practices, will this in turn help us produce less greenwaste? All these

questions must be addressed by the maintenance staff.

Rates of Fertilizer Application

In general, for fertilizing our landscape, we can follow the rates listed below. But, remember to try to minimize the amount we use and see how the landscape reacts:

Turf areas require 3 to 6 pounds of actual Nitrogen per application for every 1,000 square feet. Try to minimize these rates of application and see how your landscape responds.

Trees and shrubs require fertilizer applications 3 times per year.

If we use organic fertilizers such as compost, we can place a 1/2" – 1" layer of this natural material on top of the ground in the planter areas 3-6 times per year. Remember to mulch over the compost.

Always follow instructions on fertilizer labels as to the amount of fertilizer per the noted square footage.

Methods of Application

Fertilizer can be applied in the landscape via:

Surface application can be done by hand, or by spreaders such as wheel spreaders, belly grinder spreaders, or blower spreaders. Make sure that you adjust the rates on the spreaders to the area's square footage.

Application of soluble liquid fertilizer through soil injection. Liquid injection into the soil is rapidly absorbed by the roots. This method can quickly correct nutrient deficiencies.

Application with fertilizer stakes or spikes. Fertilizer stakes or spikes are driven into the soil around the plant material.

Application through foliar sprays. Spraying liquid or water soluble fertilizer on the foliage should be a consideration to correcting minor element deficiencies, especially of iron or manganese.

Application through the tree trunk by injection or implantation. The infusion of liquid or implant fertilizers is common in correcting iron or manganese problems.

Each serves a specific role depending on the site and plant health. Regardless of the method selected, the soil should be moist at the time of fertilizing to prevent fertilizer injury.

Fertilizer application conducted by hand over planter areas. Trees and shrubs require fertilizer application 2 to 3 times per year.

Fertilizer spreader. Make sure to set the spreader to the proper application rate to avoid excess fertilization.

Greenwaste

Earlier in this section we discussed the importance of minimizing greenwaste in the landscape. By allowing our plants to grow naturally and allowing our lawns to grow and not mow them short, not only will our plant material be healthier, but we can decrease greenwaste.

Greenwaste is biodegradable. It is comprised of landscape waste, such as lawn and plant material trimmings. It is important to not dump our green waste into normal disposal bins or containers. Once the greenwaste makes it to the landfill, it becomes an environmental problem. Greenwaste is important as a biodegradable waste. If the green waste is not composted and is disposed in a landfill, it becomes an environmental liability. When greenwaste decomposes in a landfill site, it produces methane, which is a dangerous greenhouse gas. It also produces chemicals, called leachates, which can pollute the local land and water.

Also, landfill space is an issue when disposing of greenwaste. Some cities and landfills have outlawed the dumping of these materials on their sites. Greenwaste can be recycled by waste management companies and made into nutrient rich compost. This material is available for landscape use and is great for fertilizing and building up our soils.

Review

The IPM process of evaluating the pest problem, implementing a form of control that is safe to the environment and reevaluating the effectiveness can greatly help in managing the amount of chemical application and keep our water safe from chemical pollution. When dealing with chemical use in the landscape, whether for pest control or plant maintenance, it is important to use them in a conscious manner to prevent these chemicals from entering our water supply through runoff.

When fertilizing, it is important to use these chemicals in moderation. We can greatly reduce the landscape's need for these chemicals. The plant material will adjust to lower levels of fertilizers, grow at a slower manageable rate, and use less water. In turn, the landscape will require less maintenance, produce less greenwaste, and help conserve overall water use.

By incorporating a well designed landscape, hydro-zoning practices, proper plant selection, correct planting depths, good soil management/ amendment practices, proper irrigation, proper pruning practices, and mulching practices, it becomes easier to have a healthy and almost pest free landscape. There will always be insects in the landscape. The important thing is to try to minimize the damage to plant material by early detection of pests, and eradiation using the least toxic control methods.

Chapter Three

Landscape Irrigation and Water Management

Irrigation and Water Management

The irrigation system is the most crucial component of a landscape when considering water management practices. A well-designed, properly installed and maintained irrigation system helps reduce water consumption. With appropriate scheduling, your landscape can be attractive, water efficient, and less prone to runoff issues.

Choosing California Friendly plant material for the landscape decreases water demand significantly. Not only are these plant materials water thrifty, but they are also durable and require less maintenance.

Managing the irrigation system and the landscape reduces the amount of water used at a site, lower water costs, and stay within water allocations. You also improve plant health which makes a plant less susceptible to plant diseases. Understanding the basic layout, functions, and maintenance of the irrigation system and landscape helps reduce the overall water use.

The Irrigation System

An irrigation system has a variety of components. The benefits of properly maintaining these components include a well-managed and better looking landscape, as well as improved water management. Later in the manual we'll look at some irrigation inefficiency problems, but first, let's look at the irrigation system components.

The Irrigation System Layout

Water used for the landscape is supplied through a water supply line. The water can be fresh potable water, which is the same kind as used for indoor use or it can be reclaimed/recycled water. This water supply line or pipe is called the *main line*. The water moves through the meter and past the backflow and onto the site in some cases. The irrigation valves are connected to the main line. Main lines are always pressurized and have available water within the PVC pipe for the landscape.

The water pipes downstream of the irrigation valves are called lateral lines and these are the pipes which connect to the sprinkler heads or drip systems. Lateral lines have water and pressure only when the valves turn on. In a drip system we see the same layout except for a couple of extra parts, including the filter and pressure regulator. These drip components will be discussed in detail further in the manual.

For reclaimed or recycled water lines we need to use appropriate colored PVC line, valve boxes, irrigation heads, and drip components. These components must be purple in color to let people know that the water is not potable.

Please note that if you're making changes to reclaimed water mainlines used for irrigation, you must follow local laws and regulations to prevent cross contamination. Also, follow all laws and regulations when it comes to maintaining an irrigation system that uses reclaimed water.

Water Meter

The water meter is the first part of a system. This device measures the volume of water that moves through it and displays the total usage in cubic feet on a mechanical or electronic register. The register is read in a similar way as an odometer in a car. On some water meters, you can also find a leak detector (a small triangle) on the dial face that will indicate a system leak by moving or spinning.

The water meter can help manage the amount of water used by the landscape and can help keep track of the site's water allocation. IRWD measures water volume in CCF (hundred cubic feet). One cubic foot of water is approximately 7.48 gallons of water, so 1 unit or 1 CCF is

equal to 748 gallons of water. This is the measurement that IRWD uses for its water allocation requirements. By simply monitoring these numbers on the meter, you can keep track of the water use from week to week. These readings can be compared to the changes in the weekly allocation to make sure you stay on budget.

Backflow Preventer

Since landscape sites have many chemicals present, such as fertilizers, pesticides, herbicides, and other chemicals, it's important to comply with local city codes and provide proper prevention of water backflow that may contaminate the potable water supply.

The backflow preventer is very important to a potable irrigation system. This device prevents water that is inside your irrigation lines, from returning or flowing back to the water agency's main lines due to suction or back pressure that can occur. The backflow device is found after the water meter and before the irrigation valves.

For landscapes that use reclaimed water, it's not necessary to have a backflow preventer installed. We must be aware of the type of water we use in the landscape and have backflow systems inspected yearly by a certified backflow inspector to make sure that the backflow preventers are working properly.

In a residential landscape, you will find anti-siphon type irrigation valves that prevent water backflow into the main line keeping our water safe.

Irrigation Controller

An irrigation controller is the brains of the irrigation system. It will irrigate the landscape based on what the landscaper programs into it. Most controllers share the same basic functions and terminology.

Controllers allow landscape personnel to schedule irrigation using the following programming:

- Frequency or days of the week to water.
- Cycles of irrigation or start times per day.
- Duration or runtime for each valve/station.

Additional features:

- Programs: programs can be used to divide the landscape irrigation zones into specific categories such as turf, planters, and slopes.
- Percentage adjustment: This setting is used to increase or decrease your water duration seasonally without having to reprogram the runtimes station by station.
- Rain shut-off selection, and rain sensor.
- Manual start and test settings.
- Depending on controller brand or type, they can have other functions such as flow sensors or weather sensors.

Improper programming wastes millions of gallons of water a year. A typical landscape has at least two or three different categories, such as:

- Lawn - full sun
- Lawn - partial/full shade
- Planters - full sun
- Planters - partial/full shade

Assigning all stations to the same program means you're overwatering. Runtimes of more than three or four minutes could mean runoff, especially in clay soil or on a slope. Using shorter run times with multiple start times will allow the water to infiltrate the soil more effectively and use less water.

Conventional controllers must be programmed to meet changing weather conditions. (By the way, if the instruction manual is missing for a particular controller most of the major manufacturers have them available on their websites.) This must be done by the landscaper at the controller. This can be very time and labor intensive. There are new self-adjusting controllers (SmarTimers) available. SmarTimer controllers adjust the irrigation schedule automatically by programming ET data (either real time or historical) so that as plant water requirements increase or decrease the irrigation schedule in-

creases or decreases. However, no controller, SmarTimer or manual activation, can improve an irrigation system's distribution uniformity. The distribution uniformity is a measurement of how well the system is performing. A SmarTimer on a poor system may not translate to water savings. The goal is to have a good system and to compliment it by having a SmarTimer.

If you're considering a SmarTimer purchase, be sure to check with your local water agency for any possible rebates.

Weather-Based-Irrigation-Controller or smart controller for landscape irrigation.

IRWD has taken account of overall landscape site conditions such as weather, size of landscape, and plant material (lawn vs. planters), when accounting for these specific water allocations. These water allocations reserve more than enough water for the specific size of landscape material. Check your water meter readings once a week to make sure you stay within the required water allocation for the site.

Water Management

Water management involves using the right amount of water, in the right place, at the right time. Using a water budget program, whether it's on the computer or a simple hand written tracking sheet is an excellent way to make sure the amount of water you're using is within the budget for a particular site. MWDOC offers a free online program which allows you to register any landscape meter and track its usage every month in comparison to a water budget that is calculated for its climate zone. For information see the MWDOC website at www.mwdoc.org.

Irrigation Valves

There are two types of valves used for irrigation. The first type is called an inline valve. Inline valves are commonly used in commercial landscapes because they are installed underground in an irrigation valve box to prevent vandalism. Valves work by allowing water to move through the device when activated. Inline valves require the installation of a backflow preventer on the main line upstream of all inline valves.

In-line irrigation valve installed underground inside a protective box.

The other type of valve is called an anti-siphon valve. Anti-siphon valves work in a similar manor to the inline valve, but they don't require a backflow device on the mainline before the valve. Anti-siphon valves are designed with a backflow preventer mechanism on the valve itself. Anti-siphon type valves are the most common for residential irrigation systems. Each valve turns on/off the water to an area in the garden, while providing backflow prevention at the same time.

Anti-Siphon Valve

The anti-siphon valve must be installed at least 12 inches above the highest sprinkler head on that irrigation line. If you have to run the irrigation up a slope, the valve may be installed on the top of the slope with the lateral running down from it. An alternative is to install an atmospheric vacuum breaker on the top of the hill, after the valve, but before any sprinklers. It is also a good idea to leave an extra outlet for future installations.

Remote control valves serve as the heart of the irrigation system. The controller sends an electric signal to the valve which controls the flow of water to a particular zone. When the runtime expires the signal is discontinued and the valve shuts off.

Valve malfunctions include stuck valves (valves that don't shut off) due to debris in the assembly or a hole in the diaphragm a weeping valves. Both can waste many gallons of water until they're repaired. With older irrigation systems it may be worthwhile to begin a program of preventive maintenance (rebuilding the valves with a new diaphragm and solenoid) on an ongoing basis before the valves fail.

Types of Irrigation Systems

There are two main classifications of irrigation systems. The first is called an overhead irrigation system. This type of irrigation system places water on top of the plant material, usually turf areas and planters. The second type of irrigation system is what is referred to as a drip system. This type of system delivers water directly to the root zone whether by dripping onto the soil directly over the root zone or through subsurface irrigation using special drip lines covered by mulch. Let's look at the components of these types of irrigation systems and see what is required of each to make sure they operate in an efficient manner.

Sprayheads & Rotating nozzles

Sprayheads are for small areas that require irrigation overhead, such as turfs, groundcover, and planter areas. Sprayheads are classified by the area of coverage (arc) and distance of throw (radius). They apply water at a high rate which is referred to as the precipitation rate. Since the precipitation rate is high, the runtimes or minutes of irrigation associated with these types of sprinklers are short in duration.

It's important when scheduling runtimes for sprayheads to divide the runtimes up into more cycles or start times to prevent runoff. Irvine clay soil absorption rates are generally 2-3 minutes before runoff occurs. If the landscape requires a longer runtime than this, then divide the total minutes and use more cycles or start times. *Example: if lawn requires 12 minutes of irrigation, program 4 cycles or start times and set the runtime for 3 minutes in duration.*

Sprayhead sprinkler watering lawn. High precipitation rate.

Sprayheads have a radius of throw or spacing distance ranging from 5-17 feet. They require a pressure of 15-30 pounds per square inch (psi) for optimum working conditions. Pressures higher than that result in misting which makes the spray more likely to be blown away by wind.

Sprayheads can be either fixed heads covering areas in quarter circles, half circles, full circles or three quarter circles (also known as degree of coverage 90, 180, 360) or adjustable arc which can cover areas that the fixed arc nozzle miss. Sprayheads also have special nozzles called side strips which can cover narrow areas such as parkways.

Shrub sprayheads are spray nozzles connected to an adapter which is then screwed onto the tip of an elevated riser. This method is useful in areas where there are plants that have grown tall and where common pop-ups cannot throw over. Shrub sprays work just like a spray head and have the same coverage and precipitation rates.

Rotating nozzles throw multiple thin streams of water (unlike the spray nozzle which throws a fan shaped pattern) and rotates while activated. Rotating nozzles have a much lower precipitation rate and are less likely to produce runoff. Some studies have shown that rotating nozzles distribute water more evenly than spray nozzles, meaning that less total water is used. Because of the lower precipitation rates run times must be increased. Rotating nozzles adapt to many brands of existing spray heads and are installed by simply unscrewing the spray nozzle and installing the rotating nozzle. No digging up of heads or pipe cutting is required. If rotary nozzle retrofits are being considered, be sure to check with your local water agency or MWDOC for any available rebates.

Rotors- Gear driven and Stream Rotor

Gear-driven rotors are for large areas such as turf, groundcover areas, slopes, and planter areas. They apply water in a single stream and at a low precipitation rate. Since the precipitation rate is low, water is able to permeate the soil better and cut down on runoff.

Rotor sprinklers watering lawn. Low precipitation rate.

The runtimes or minutes of irrigation associated with these types of irrigation equipment are longer in duration than sprayheads. The runtimes for rotors can be 2 times or longer than the runtimes for sprayheads. You can still divide the runtimes into more than one cycle to help prevent runoff if needed.

Rotors have interchangeable nozzles that control the amount of water coming out (gpm) and the distance that they throw. Rotors have a radius or can throw water at a distance ranging from 20-60 feet. They require a high pressure (psi) of 40-60 psi for optimum working conditions.

Impact rotors are similar to gear driven rotors in the way they distribute water but have no gears. They get their name from the impact of the spoon on the sprinkler that makes it rotate. Impacts are very durable and are available in brass or plastic material. Impacts are available in pop-up (maxi paws) and non pop-up configurations.

Stream rotor sprinklers have a radius of 20 – 35 feet and sometimes longer. Stream rotors apply water similar to gear rotors but offer multiple streams of water application covering multiple areas at one time.

Direct Root Zone Irrigation

When watering trees, shrubs, and planter beds, it's recommended to irrigate directly at the root zone. This type of irrigation is more efficient because the water goes directly to where it's needed: the root zone. However, the placement of the heads or emitters is even more important than with overhead systems. Over time bubbler and emitters may need to be moved to accommodate the expansion of root growth.

Drip irrigation system applying water directly at the base of a plant.

Direct root zone irrigation includes the use of bubblers, which have a high flow of water, or the use of low flow drip systems, which apply the water at a very slow rate. The following section describes both types of systems.

Bubblers

Bubblers have a high flow and apply water very quickly. We measure the flow of bubblers in gallons per minute (gpm). The bubbler can be adjusted manually to decrease or increase the amount of water that flows out of the fixture. The runtimes for bubblers are short in duration since they apply water very fast. Bubblers are attached to a riser and are placed near the root zone for trees, palms, and shrubs. Bubblers help water deeply to promote deep roots for these types of plant materials.

Drip

Drip irrigation systems also apply the water to the root zone. They are great for shrub beds, planters, trees, and palms. Drip irrigation applies water at a very slow rate and is measured in gallons per hour (gph). The run times for drip are long in duration because the application rate is very slow.

The layout of a drip system is different than a sprinkler system. After the valve, drip systems require a filter and a pressure regulator. The filter prevents debris from clogging the small orifice of the emitters and the pressure regulator maintains the pressure at no more than 30 psi. These items are required in every drip system.

Drip valve with a filter and pressure regulator. This picture shows an anti-siphon valve followed by a filter and a pressure regulator.

Drip systems can be installed using a polyethylene (PE) tube or using PVC pipe. PE tubing is the most common way of installing drip irrigation. PE tubing with ½" diameter is standard, while ¼" tubing (spaghetti) is also available. Spaghetti tubing is used to go from the larger poly tube over to the root zone of the plant material. It is recommended not to run the spaghetti tubing more that 7-8 feet in distance to allow good performance. There is also a drip line called an inline emitter line with drip emitters built into the tube. Inline emitter tubing is used frequently in mass planting areas.

In-line emitter tubing. Emitters are built into the drip line. Various spacing options for the emitters (12 inches is the most common emitter spacing used).

Drip emitters put out water anywhere from ½ - 2 gallons per hour. Emitters can be installed as a single unit per plant or in multiples to get more water over the area. There are also micro-sprays available within drip systems. Micro-sprays allow a fine spray to be delivered to the plant material. Mini bubblers are also available for drip systems.

Irrigation System Maintenance

Irrigation systems require regular inspection and maintenance to operate at maximum efficiency. Broken heads, broken laterals and misdirected nozzles not only waste water but stress plant

material. Teaching all landscape staff to recognize possible irrigation problems should be a part of their training. Mower ruts from overwatering or leaks, water tracks on parking lot surfaces and dirt washing over the sidewalk from a broken head should all be reported to the irrigation tech.

System inspections start with a look at the controller schedule. Make sure that similar zones are programmed to the appropriate programs. Are multiple start times used? Are the water days appropriate for the season? Is the water budget set correctly?

The next step is activating each station for visual inspection. This is done at the controller either by programming a two minute test program (if available) or manually activating each station. (Valves can be bled manually but this can be a problem if the system has a master valve.) A simpler, more efficient way is to have the controller wired for a remote control device such as the Rainmaster Pro Max. This allows activation of a selected valve as you're at the location.

Once the valve is activated look for broken heads, signs of rapid runoff and ensuring that all heads are covering the areas intended (not spraying onto the sidewalk or asphalt). For larger, rotating heads make sure that the rotation of the head is as intended. Any problems should either be repaired at the time (another advantage of the remotes) or flagged for easy identification.

Landscaping

When maintaining or designing new areas of a landscape to be more water efficient, it is important to consider factors such as overall climate and microclimates of the area, plant material choices, soils, hydrozoning, and the irrigation system.

What is a water-efficient landscape? Let's look at some key elements needed for a water-efficient landscape. This section will talk about design of a new landscape and will also talk about working with an existing landscape and irrigation system.

Planning and Design

Design should always be done with water efficiency in mind. It is important to hydrozone or group plants with similar water requirements together. It is also important to ensure that each hydrozone is irrigated independently from other areas or plants that have different water needs.

This is an example of poor design. This irrigation station is watering three different plant types that have varying water needs, including lawn, shrubs, and annual flowers.

Turf Areas and Planters

Lawns may use up to four times as much water as other plants in the landscape. Lawns produce a much greater amount of greenwaste that must be disposed (unless mulching mowers are used) and the emissions produced by mowers and edgers contribute significantly to air pollution.

California Friendly is name used to refer to a selection of plants that includes low water use, drought tolerant, Mediterranean and California natives. There are hundreds of plants for any landscape situation. These plants will require 25% - 75% less water once they are established. You can find a California Friendly plant list in the appendix.

Renovating Existing Landscapes

When redesigning an area of the landscape to be more water friendly, it may be more practical to plan the work in stages. Working in stages will spread out the costs of the project.

The first step in renovating is an analysis of the existing landscape. Look at the features of the landscape to see what can be modified to be water efficient. Existing high water use plant material can be replaced with any of the hundreds of plant selections in the California Friendly plant palette.

This dying plant creates an opportunity to renovate the landscape and install low-water-use plant materials.

Is the irrigation system outdated and inefficient? Retrofit the system to be more efficient and use new water efficient technologies that are available such as SmarTimers and rotating nozzles. Always check with the local water agency or MWDOC for any available rebates.

Water-Efficient Maintenance Practices

Mulches and Mulching

Apply 2-4 inches of mulch to planter or shrub areas for weed suppression. Also, mulch slows the rate of water evaporation from the soil, keeping it from drying out. Reducing soil temperature on hot days can keep the plant material from stressing out. Since mulch helps to moderate soil moisture and temperature, it improves overall plant root growth and health.

Mulch prevents the soil from eroding away when the area is being irrigated or when it rains by diffusing water as it falls. Instead of running off on bare soil, mulch helps the water diffuse through it and into the soil. As mulch breaks down, it helps build up the composition of the soil allowing water to move through it with ease. Before installing any mulch be sure to water the area thoroughly first.

This bare ground area should be covered with mulch to avoid runoff and keep the moisture in the soil.

Pruning

A well planted, healthy and water-conserving landscape will need less pruning in general. By simply letting plant material grow naturally to achieve its natural form, a beautiful landscape can be achieved. When pruning is needed, prune the plant material in a natural form instead of shearing or hedging. Not only is it healthier for the plant but it allows better distribution of water to the shrub's root zone by not blocking the irrigation pattern.

Poor pruning technique has left an open wound, which allows pests and diseases to easily attack this tree.

Clean out branches that are old and unproductive. Prune to clean out dead areas, dead flowers, crossing branches, or irregular growth. When you hedge or shear plant material, you encourage the plant material to throw out sucker growth and to grow rapidly. The plant material may go through stress requiring more water and nutrients to recover from the hard pruning. This can encourage pest and problems for the plants.

Lawn Mowing

Selecting the right mowing height is an important step in managing turf for water conservation. In general, mow higher in the spring and summer (2 1/2" - 3") and shorter in the fall and winter (1 1/2" - 2"). The higher cut provides additional shade to the grass blades and reduces their water loss.

Proper mowing heights will allow the lawn to develop a better root system and will look better.

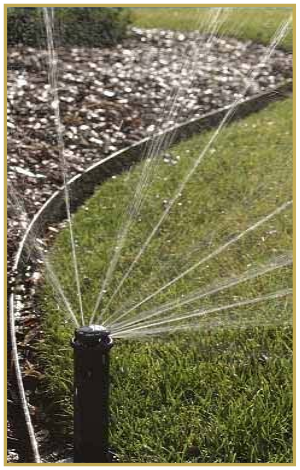
We can conserve water as well by using a mulch mower. Mulch mowers are designed to cut up grass and leaves into small pieces or bits that can be left on top of your lawn to decompose. The mulched lawn blades add nitrogen back into your lawn that reduces the amount of fertilizer that is used on the lawn areas. Mulching mowers mix clippings, in an even layer, blending them in your existing lawn. Mulching lawn mowers reduce the amount of greenwaste that is produced, saving you time and money in labor and waste disposal.

Water-Efficient Technologies

Rotary Spray Nozzles

There are new products on the market such as dual spray heads and rotary spray nozzles which can save up to 20% of the water being used in the landscape. The dual spray nozzle applies water close to the sprinkler thereby eliminating common dry brown spots around the sprinkler.

The rotary spray nozzle is a new nozzle type that fits into existing sprayhead bodies. It is used to retrofit typical spray head body or shrub adapter. It transforms your landscape irrigation system into a high uniformity, low application rate system with matched precipitation rate. Rotary nozzles help to significantly control runoff on slopes and tight or clay soils.



Rotating nozzles used to retrofit conventional spray nozzles on sprayheads. Rotating nozzles can also be used in new construction.

Rotary nozzles have a multi-stream, multi-trajectory distribution, they are wind-resistant, and the rotating streams provide improved uniformity. Rotary nozzles have a range of throw from 5-30 feet which makes them adaptable to many existing irrigation systems. When considering rotary nozzles be sure to check with the local water agency or MWDOC for available rebates.

SmarTimers

SmarTimers, also called ET, or weather based controllers can significantly reduce water waste. SmarTimers, using various technologies (paging signal, radio signal, historical) irrigate each zone of the landscape according to a specific site's weather data, type of sprinkler, soil make up, slope factors, plant evapotranspiration rate, microclimates, wind, and other factors that determine the irrigation schedule. These SmarTimers are designed to apply the right amount of water based on changing water needs, and to apply it at a rate that minimizes runoff.

Based on the data they receive or with an auxiliary rain sensor, SmarTimers are designed to shut off the controller when significant rainfall occurs. This, alone, can save many hours because your staff does not have to drive to each controller to shut it off and return to turn the controller back on after the rain stops.

Real-time SmarTimer controller models use daily weather factors such as heat intensity, solar intensity, moisture, and some even wind speed to adjust to the landscape's irrigation need. There are many types of real-time SmarTimer controllers with unique ways of monitoring and calculating irrigation schedules. SmarTimers that use historical data use regional weather information that has been programmed directly into the controller. Many studies indicate that significant water savings can be achieved by using SmarTimers. However, one key element in ensuring savings is having the irrigation system itself working effectively. No controller, SmarTimer or standard, can improve the efficiency of an existing irrigation system.

Central Control Irrigation System

A central control irrigation system can greatly benefit agencies or entities with multiple landscape sites. This type of irrigation system connects individual controllers or satellites to a central computer to easily monitor and control the entire irrigation system from a central location.

Most central control systems have a weather monitor to schedule the irrigation days and runtimes according to weather changes. Flow sensors can be installed that can detect high flows (broken heads, lateral lines or main lines) and shut off the particular zone or the entire system.

Available Incentives & Rebates

Irvine Ranch Water District offers rebates on many water efficient technologies for the landscape. Contact IRWD for available rebate information at (949) 453-5300 or check online at www.irwd.com/conservation/rebates.

Appendix

California Friendly Plants

Irrigation System Service Form

Irrigation System Inspection Glossary

Landscape Conditions Form

Landscape Elements Inspection Glossary

Landscape & Irrigation Conditions Form

Controller System Service Form

IRWD Landscape Irrigation Water Rates

Policy & Procedure for the Adjustment of Over Allocation Charges to Landscape Irrigation Accounts

Using the Meter & Allocation Log

Meter & Allocation Log

Landscape Irrigation Adjustment Form

Landscape, Landscape Irrigation, and Water Conservation Websites

California Friendly Plants

TREES

1. Arbutus unedo, Strawberry Tree
2. Chitalpa tashkentensis, Chitalpa*
3. Lagerstroemia indica, Crape myrtle
4. Laurus nobilis, Bay Leaf
5. Leptospermum scoparium, New Zealand Tea Tree
6. Pinus eldarica, Afghan Pine
7. Pistache chinensis, Chinese Pistache
8. Prunus caroliniana, Carolina Laurel Cherry
9. Prunus ilicifolia, Catalina Cherry*
10. Quercus agrifolia, Coast Live Oak*
11. Cercis occidentalis, Western Redbud*

SHRUBS/PERENNIALS/ORNAMENTAL GRASSES

12. Abelia grandiflora , Glossy Abelia
13. Arctostaphylos spp., Manzanita*
14. Artemisia californica, California Sage Brush*
15. Baccharis pilularis, Coyote Bush*
16. Ceanothus spp., California Lilac*
17. Cistus spp, Rockrose*
18. Cotoneaster spp., Cotoneaster
19. Encelia californica, California Brittlebush*
20. Eschscholzia californica, California Poppy*
21. Grevillea rosmarinifolia., Grevillea ‘Noellii’
22. Heteromeles arbutifolia, Toyon*
23. Heuchera spp., Coral Bells*
24. Lantana camara, Lantana Camara
25. Lavandula spp., Lavender
26. Ligustrum lucidum, Glossy Privet
27. Malosma laurina, Laurel Sumac*
28. Myoporum parvifolium, Myoporum
29. Nandina domectica, Heavenly Bamboo ‘Nana Purpurea’
30. Pennisetum spp., Fountain Grass
31. Rhaphiolepis indica ‘Clara’, Indian Hawthorn‘Clara’
32. Rhus ovata, Sugar Bush*
33. Rosmarinus officinalis, Rosemary
34. Salvia spp., Sage
35. Sisyrinchium bellum, Blue Eyed Grass
36. Sisyrinchium californicum, Yellow Eyed Grass
37. Stachs byzantina, Lamb's Ear
38. Static spp., Sea Lavender
39. Verbena spp., Trainling Verbena

VINES

40. Bougainvillea spp., Bougainvillea
41. Laurentia fluviatilis, Blue Star Creeper
42. Rosa californica, California Wild Rose*
43. Vitis californica, California Wild Grape*

GROUNDCOVER

44. Artemisia californica 'Canyon Grey', Trailing-Sagebrush*
45. Baccharis spp., Coyote Bush*
46. Dymondia margaretae, Silver Carpet
47. Festuca ovina glauca, Blue Fescue
48. Fragaria californica, California Strawberry*

TURF

49. Stenotaphrum secundatum, St Augustine Grass
50. Zoysia spp., Zoysaigrass

* California Native Species

Note: Many of these plants have other varieties available.

Form 1

Controller #_____
Location:_____
Area of Operation:_____

Irrigation System Service

Irrigation Station Checklist

Date:_____
Name:_____
Start Time:_____
Finish Time:_____

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
OK																																								
Head Broken																																								
Clogged Nozzle																																								
Adjust Pattern																																								
Raised heads																																								
Sunken Heads																																								
Broken Lateral																																								
Bad Solenoid																																								
Bad Valve																																								
Tilted Heads																																								
Interference																																								
Mixed zones																																								
Mixed Equip.																																								
Poor Pressure																																								

Overall Irrigation Rating

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Excellent																																								
Good																																								
Fair																																								
Poor																																								

Irrigation System Inspection Glossary

Distribution uniformity (DU) is important in an irrigation system. DU refers to how well water is placed throughout the landscape. There are many things that can affect DU in the landscape. It is crucial to observe and maintain the irrigation system since it is what keeps the plant material alive. A walk thru inspection can help one identify components of the system that need maintenance, repair, replacement, or other attention so that the system will operate at the highest efficiency and performance. Let's look at a list of things to consider when conducting an irrigation system inspection.

1. Broken Sprinklers
Sprinkler head's performance is below expectation. Problems can be severe damage to the body, and spray nozzle, missing nozzle, leaky seals, and broken or missing cap. Water will rush out these bodies causing runoff and wet areas. Replace the damaged body as soon as possible.

2. Tilted Heads
Tilted heads cause uniformity problems by distorting the spray pattern. Part of the spray go up into the air while the other hits the soil near the head causing wet areas and poor DU. Make sure you adjust the sprinkler head to be level with the ground.

3. Clogged Nozzles
The orifice of the nozzle is blocked by debris or by damage. If the nozzle is clogged by debris, clean the obstruction or the screen within the body. If it is damaged, replace the nozzle.

4. Low or Sunken Heads
When sprinkler heads are to low. Turf, debris, or soil can block the spray. This contributes to wet conditions around the head which encourages tipped heads, clogged nozzles, and breakage. Raise the heads to optimum height at soil level or use a higher pop-up.

5. Broken Lateral Lines
Lateral leaks can damage plantings, soils and hardscape. It can also cause runoff problems. Fix this problem as soon as possible to prevent water waste.

6. Heads too High
Heads that are high in the landscape can be damaged by mowers if they are in a lawn area. If they are in planter areas near walkways, they can be damaged by foot traffic. Lower the heads to soils level.

7. Interference
This is caused by plant material or objects that are in the way of the spray stream. This may create brown spots in lawn and may deteriorate plant health. Spray interference can cause runoff and erosion problems to the landscape near the spray body.

8. Mixed zones on Same Station
Planters and lawn material require different amounts of water. When we have an irrigation system watering lawn and planters at the same time we have inefficiencies. You always have to water to the highest water use plant, in this case it would be the lawn. The planter material will receive excess water and maybe go into decline or suffer. You need to divide these areas into different water zones by installing a separate valve or station for these areas.

Irrigation System Inspection Glossary

9. High Pressure
High pressure causes misting and drifting of the water. Water that mists can easily travel to other parts of the landscape especially when there is slight wind. High pressure can also cause damage to the body, seals, and nozzles of the equipment. One can lower the pressure either with a pressure regulator on the lateral line, a pressure reducing screen for pop up spray heads, or by installing a body that has a pressure regulator within.

10. Low Pressure
Low pressure can cause performance problems. Instead of water being thrown to optimum performance, big droplets are formed and poor DU is caused. It is difficult to fix low pressure problems. Low pressure may be caused by low mainline pressure, larger than needed nozzles, undersized piping, laterals, electric control valves, mainlines, backflow preventor and/or meter, or an improperly adjusted flow control valve.

11. Mixed Equipment
Rotors, spray heads, drip, and bubblers use water at different rates. When a station or valve turns on, it should have one type of these irrigation devices watering at one time. A station that comes on with sprayheads and rotors on the same line is inefficient. They use or distribute water at different rates making some of the areas more watered than others. Make sure that each valve has one type of irrigation device.

12. Incorrect Spray Pattern
Irrigation water that lands outside of the areas of irrigation. This overspray can cause damage to plant material, hardscapes, and pavements due to runoff deterioration. All sprinkler types can be adjusted to fit the area being watered.

13. Bad Solenoid
The solenoid is the part of the valve which triggers the valve to turn on and shut off. If it is not working properly a valve may not operate properly either. Recommend to change out the bad solenoid immediately.

14. Non Operating Valve
The valve is the part of the irrigation system which allows water to pass through irrigation lines to the sprinklers. If the inside mechanisms are damaged, it may not open or may stay stuck in the on position allowing the water to keep running. Depending on the extent of the damage, either fix the valve or change it out completely.

Form 2

Landscape Conditions

Landscape Checklist

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Lawn Brown/Dead																																								
Plant Decline																																								
Nutrient Deficiencies																																								
Pest & Disease																																								
Mixed Hydrozones																																								
Planting Modification																																								
Wet/Saturated Areas																																								
Maintenance Needs																																								
Bare Soils Areas																																								
Poor Pruning																																								
Landscape Lighting																																								
Damaged Hardscape																																								
OK																																								

Overall Landscape Evaluation

by Stations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
EXCELLENT																																								
GOOD																																								
FAIR																																								
POOR																																								

Landscape Elements Inspection Glossary

Managing a landscape to be water efficient and aesthetically pleasing requires landscape personnel to conduct a routine walk through and visually inspect various landscape elements. A walk through can be helpful in finding things such as plant material decline, inefficiencies of irrigation, needed maintenance, and areas for improvement. It is important for managers to schedule a walk through at least once or twice a month. Here are some things to look for.

1. Brown Spots or Dead Areas of Lawn
Brown spots or dead areas require immediate attention in the landscape. They may require turf replacements with sod or reseeding.

2. Plant Material Decline
Plant material is in decline or has died off. Plant material needs to be replaced with live plant material or you can transform the area into a California Friendly landscape.

3. Plant Nutrient Deficiencies
Look for nutrient deficiencies in plant material. Lack of Nitrogen, Phosphorus, Potassium, and other essential nutrients such as Iron and Magnesium, can be corrected if detected early.

4. Pest Problems
Look for pests and disease problems in the landscape and determine control methods using the Integrated Pest Management process of evaluation, implementation, and reevaluation.

5. Mixed Plantings
If landscape areas have high, medium, and low water use plant material in the same areas, consider rearranging the plants according to their water needs and placing them on separate irrigation systems based on these hydrozones.

6. Areas to be Modified to be California Friendly.
Are there existing areas that need or can be redesigned to be California Friendly either with plant material, irrigation modifications, or hardscape elements.

7. Wet or Saturated Landscape Areas
These landscape areas are over watered or saturated due to microclimates or excessive irrigation. If an area is consistently saturated it is being over irrigated.

8. Plant Maintenance Needs
Inspect area for overall plant maintenance needs including the plant health, soil moisture, nutrient needs, water needs, and pruning or mowing needs.

9. Bare Ground/Soil Areas
Areas of the landscape that have bare soil can cause erosion and runoff problems. If the area cannot be covered with vegetation, apply mulch to these areas to keep the soil in place.

10. Past Pruning Practices
Improper pruning practices (topping off, shearing) can weaken plant structure and leave the plant susceptible to pest and diseases. Refer to a reputable guide such as The Sunset Western Garden Book or The California Master Gardener Handbook for proper techniques.

Landscape Elements Inspection Glossary

11. Landscape Lighting
Check any lighting features for damaged or non working components. Check for wiring issues.

12. Damaged Hardscape Features
Check for hardscape features that are damaged by water, plant material (roots, overgrown material) or vandalism.

Form 3

Landscape & Irrigation Conditions

Repairs Made: _____

_____

_____

_____

_____

_____

Comments: _____

_____

_____

_____

_____

_____

Form 4

Controller System Service

Controller Schedule — controller # _____ Date_____

Location _____

Make & Model _____

Water Budget _____

	Run Time	Water Days	Start Times
ST. # 1	_____min.	_____Days/week	_____per day
#2	_____min.	_____Days/week	_____per day
#3	_____min.	_____Days/week	_____per day
#4	_____min.	_____Days/week	_____per day
#5	_____min.	_____Days/week	_____per day
#6	_____min.	_____Days/week	_____per day
#7	_____min.	_____Days/week	_____per day
#8	_____min.	_____Days/week	_____per day
#9	_____min.	_____Days/week	_____per day
#10	_____min.	_____Days/week	_____per day
#11	_____min.	_____Days/week	_____per day
#12	_____min.	_____Days/week	_____per day
#13	_____min.	_____Days/week	_____per day
#14	_____min.	_____Days/week	_____per day
#15	_____min.	_____Days/week	_____per day
#16	_____min.	_____Days/week	_____per day
#17	_____min.	_____Days/week	_____per day
#18	_____min.	_____Days/week	_____per day
#19	_____min.	_____Days/week	_____per day
#20	_____min.	_____Days/week	_____per day
#21	_____min.	_____Days/week	_____per day
#22	_____min.	_____Days/week	_____per day
#23	_____min.	_____Days/week	_____per day
#24	_____min.	_____Days/week	_____per day

Irvine Ranch Water District (IRWD)
Landscape Irrigation Water Rates

IRWD's ascending block rate structure offers very low rates for use at, or below, allocation and higher rates for use above allocation. The allocation for a particular landscape is determined by four factors:

1. **ET** (Evapotranspiration) from IRWD weather stations located in coastal, central or foothill zones.
2. **Kc** (crop coefficient), which is the relative amount of water cool-season turf needs at various times of the year.
3. **1.25** for 80% irrigation system efficiency, which is extra water to make up for inefficiencies in the irrigation system.
4. **LA** (landscape acreage). This assumes that 100% of the landscape is cool-season turf grass.

Allocation formula:
ET x Kc x 1.25 x LA = landscape allocation in acre-inches. To convert to CCF, multiply by 36.3.
CCF stands for "hundred cubic feet." One CCF equals approximately 748 gallons.

Landscape Irrigation Water Rates effective July 1, 2008

Tier	Rate (per acre)	Use (percent of allocation)
Low Volume	$0.91 potable $0.82 reclaimed	0 - 40%
Base Rate	$1.07 potable $0.96 reclaimed	41% - 100%
Inefficient	$2.14 potable $1.92 reclaimed	101% - 110%
Excessive	$4.28 potable $3.84 reclaimed	111% - 120%
Wasteful	$8.56 potable $7.68 reclaimed	121% +

Note: Some areas include a pumping surcharge per CCF of water used.
Potable water account numbers start with 60; reclaimed water account numbers start with 62.

Since the allocation changes weekly, the most effective way to avoid overuse charges is to monitor the usage weekly (using the meter/allocation log sheet or IRWD water management software) and compare it to the weekly allocation.

Allocation information is available at the ET Hotline, updated Monday mornings:
English **(949) 453-5451**
Spanish **(949) 453-5452**
To access this information from the IRWD website, www.irwd.com, click on the ET Hotline icon located on the home page.

If you have any questions, or need to discuss your landscape irrigation account, please contact IRWD's Landscape Water Conservation Specialist, Nick Mrvos, at (**949) 453-5324** or email **mrvos@irwd.com**.

POLICY AND PROCEDURES FOR THE ADJUSTMENT OF OVER ALLOCATION CHARGES TO LANDSCAPE IRRIGATION ACCOUNTS

Landscape irrigation accounts are defined as those accounts with account numbers beginning with 60, 61, 62, 63, 64, and 65. In the event that over-allocation charges are incurred, those over-allocation charges may be adjusted under the following conditions:

- A malfunction of a component(s) of the irrigation system, i.e., a stuck valve, broken mainline, controller malfunction.
- The installation of new plant material.
- The acreage listed for the account is incorrect.

Note that only over-allocation charges are adjusted, therefore if no over-allocation charges are incurred, then no adjustment request is to be made.

1. System Malfunction and/or installation of New Plant Material

The following procedure is to be implemented to request an adjustment to the account.

- Completely fill out a copy of the Landscape Irrigation Adjustment Form (LIAF). Incomplete forms will be returned unprocessed. (Account information is available by contacting the IRWD Landscape Water Conservation Specialist The LIAF is available at the IRWD website - www.irwd.com.)
- A separate LIAF must be filled out for each account each billing period for which an adjustment is being requested. The LIAF must be received no later than three months after the billing period in which the over-allocation usage occurred. (For example, if the billing period is 6/23/08—7/25/08, then the LIAF must be received by IRWD no later than 10/25/08.)
- The LIAF must be accompanied by one of the following:
    i. An invoice showing the repair work or plant installation.
    Ii. A work or job order showing the repair work or plant installation.

Repeat Adjustments

If an account has had an adjustment request approved, any subsequent adjustment requests submitted within a twelve-month period must also be accompanied by one of the following:

- A printout of the IRWD IWMLOG water management program or a copy of the Meter/allocation log sheet for the billing period. (Both are available at www.irwd.com.)
- Participation in the MWDOC Landscape Performance Certification Program. (Information is available at www.mwdoc.com or call 949.963.3058)

Recycled Water

For recycled water loss exceeding 50,000 gallons (approx, 67 CCF) the customer may be required to show proof that the California Regional Water Quality Control Board, Santa Ana Region has been properly notified.

Adjustment Limits

- The maximum adjustment for over-seeding will be 30% above that account's billing period allocation.
- The maximum adjustment for a stuck valve or mainline break will be 24 hours at the flow rate for that particular valve.
- Frequent adjustment requests on the same account may be partially approved or denied if the account is identified as having chronic over-allocation use. Chronic over-allocation use is defined as three consecutive months or six out of twelve months of over-allocation use.

Adjustment Processing

LIAFs will be processed in the order in which they are received. If an LIAF is returned due to incomplete information, the receipt date will be the date on which it is resubmitted. IRWD is not responsible for lost or misdirected LIAFs. It is strongly recommended that the customer keep copies of all submitted LIAFs.

2. Acreage Change

If the acreage for the account is incorrect, a customer can request a change to the acreage listed for the account and adjustment of charges using the following procedure:

- Submit a completed Landscape Irrigation Account Acre Change Request (LIAACR) along with a site map indicating the meter number and area served by that particular meter.

If the acre change is approved, the account's previous bills will be recalculated, using the corrected acreage for a period of six months or from the beginning of the IRWD fiscal year (July 1), whichever is greater.

Using the Meter and Allocation Log

Reading the Meter

Meters measure water used in Cubic Feet (CF) but allocations are based on Hundred Cubic Feet (CCF). To use IRWD's Meter and Allocation Log, you need to read only the CCFs, which are the black on white numbers on the odometer portion of the dial. In this example, the meter shows 5366950 CCFs. You need only record the 5366 CCFs. However, for smaller sites (less than 1/4 acre) you may also want to read the first white on black number as a decimal.

How to Use the Log Sheet

1. Always read the meter on the same day of the week, from week to week.

2. Read the white numbers on the meter, which are in CCFs (hundred cubic feet). Note the date in the "Today's Date" column and the meter reading in the "Today's Meter Reading" column.

3. Wait a week and read the meter again. As before, note today's date and the meter read in the same columns. Write down the previous meter reading in the "Previous Meter Reading" column. Subtract to calculate the "Water Usage" and record the difference in the "Water Usage" column.

4. Call the ET Hotline* at **949-453-5451** to get the allocation per acre for your climate zone. If you are not certain which climate zone this meter is in, call IRWD customer service at **949-453-53OO**.

5. Write in the acreage for this meter in the "Site Acreage" column. This number is on the water bill.

6. Multiply the "Alloc. Per Acre" number by your "Site Acreage" to calculate the allocation for this meter for last week. Write this number in the "Site Alloc." column.

7. From "Site Alloc." subtract "Water Usage' Write this number in the "Over/Under" column. If the number is negative, you are over allocation and should make adjustments to the irrigation schedule.

*Note. Irvine Ranch Water District (IRWD) updates the ET Hotline each Monday. Weekly ET updates are also posted on IRWD's website, www.irwd.com. If you have any questions or concerns regarding water usage on your site, please call IRWD at **949-453-5324**.

Scheduling

Changes in scheduling will need to be done frequently during certain periods of the year, particularly fall and spring. In September, October and November, the rate of plants' Evapotranspiration (ET) typically drops steadily as days get shorter and the energy reaching the earth from the sun is less intense.

Conversely, ET increases by approximately 40 percent in April, but gradually less rapidly during May, June and July. IRWD recommends taking extra care to adequately irrigate during the spring and early summer to ensure that plants develop healthy root structures in this growing season.

Calculating ET

ET changes almost every day because the ET rate is calculated from weather data collected at three weather stations measuring these climate zones: Coastal (covering Newport Coast and Santa Ana Heights); Central (covering the City of Irvine, UCI, Tustin Ranch, and Lake Forest, except Foothill Ranch); and Foothill (covering Portola Hills and Foothill Ranch).

Each weather station monitors solar radiation, air temperature, wind speed, humidity, and other Evapotranspiration factors, 24 hours per day, seven days per week. As every site is assigned to one of these weather stations, the allocation for each site will increase and decrease in response to all weather factors in its specific climate zone, If you're not sure which climate zone your site is located in, please call IRWD at (949) 453-5300.

How Allocations Work

Landscape water-use allocations are determined by the square footage of irrigated landscape and the ET for exactly those day that occurred during the billing cycle. Because ET changes daily, the allocation will change with every bill.

Allocations have several buffers built in, so your usage should **always** be **below** your allocation. For example, IRWD assumes that all landscape is 100 percent turf located in 100 percent sun. There is also an inefficiency factor built into the formula because you are not expected to change your controllers daily nor have a perfect irrigation system. If you believe you have more acreage than is indicated on your bill, contact Nick Mrvos at 949-453-5324.

Site Name:_____

Meter Number:_____

Weather Station Zone:_____

Meter and Allocation Log

Irvine Ranch Water District
www.irwd.com
ET Hotline: 949-453-5451 (English)
949-453-5452 (Spanish)

Today's Date	Today's Meter Reading	Minus	Previous Meter Reading	Equals	Water Usage	Alloc. Per Acre	Times	Site Acreage	Equals	Site Alloc.	Over/ Under
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	
		-		=	CCF	CCF	x		=	CCF	

LANDSCAPE IRRIGATION ADJUSTMENT FORM

Account Name _____

Account Number _____

Meter Number _____

Contact Person _____

Phone Number _____

Billing Period From_____ To_____

Amount to be adjusted _____CCF

Reason for adjustment

_____

_____

_____

STUCK VALVES:

Size of Valve _____ GPM _____ How long was it stuck open? _____

Please submit this form and any invoices related to the problem to:

Conservation Department
P.O. Box 57000
Irvine, CA 92619-7000
Fax: (949) 453-0228

If you have any questions, please call (949) 453-5324

Comments by conservation Department:

_____Approved _____Not Approved CSR#_____

Landscape, Landscape Irrigation, and Water Conservation Websites

Master Gardeners of Orange County

www.uccemg.com

Landscape Sites

www.occnps.org – Orange County Native Plant Society
www.rsabg.org – Rancho Santa Ana Botanical Garden
www.sunset.com/sunset
www.ortho.com
www.gardenweb.com
www.floridata.com – Plant Encyclopedia

Landscape Irrigation Sites

www.rainbird.com
www.toro.com
www.hunterindustries.com
www.mprotator.com

Water Conservation Sites

www.irwd.com
www.mwdoc.com
www.bewaterwise.com

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Publication/Newspaper, Southwest Trees and Turf, Las Vegas NV

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“The training provided was of great use to my crews out on the job. They were able to meet out on the jobsite with very little disruption to the work schedule. With the knowledge gained, the client will be more than paid back for the few hours of class time. I highly recommend this to anyone in the industry. Great work guys!!!”

Chris Holland
Account Manager
ValleyCrest Landscape Maintenance

This training manual was created by:

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