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THE PROMOTION AND PREVENTION OF AHWAHNEE
WATER PRINCIPLES FOR RESOURCE EFFICIENT
LAND USE IN THE CITIES OF ONTARIO
AND SAN BERNARDINO

A Project
Presented to the
Faculty of
California State University,
San Bernardino

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
in
Environmental Sciences

by
Melissa Danielle Miller

December 2009

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ABSTRACT

The Ahwahnee Water Principles for Resource Efficient Land Use were created and then accepted by the State of California to aid in water conservation. California's growing population is having a negative effect on water supplies. Communities need to incorporate these principles into their general plan, municipal code, and specific area plans for the greatest ability of water conservation. City ordinances contain barriers to prevent the implementation of Ahwahnee Water Principles. The City of Ontario's municipal code, New Model Colony General Plan, and several specific area plans as well as San Bernardino's general plan, municipal code, and University Hills Specific Plan were analyzed to identify preventions and promotions of these water principles. It was discovered both cities have high percentages in the use of impervious cover which increases runoff and causes water contamination. Ontario commissioned the use of Ahwahnee Water Principles significantly through ordinances for mixed-use livable communities that their specific area plans supported. San Bernardino's main goal in their general plan was for mixed-use livable communities, but their municipal code mainly enacted the preservation of natural resources which is an

important water principle. Both cities have many improvements to make to reach their potential for water conservation.

ACKNOWLEDGEMENTS

I would like to thank my husband for his patience, the Water Resource Institute for the opportunity to work closely with and gain knowledge from experienced staff especially Susan Lien Longville for believing I was the right person for this project, Dr. James Mulvihill for being my adviser, Dr. Brett Stanley for keeping me on track, my Aunt Mary for helping me with the most difficult part., the formatting, and anyone else who helped me get where I am today. Thank you.

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CHAPTER ONE

INTRODUCTION AND PURPOSE OF PROJECT

Introduction

California has grown by 10 million residents between 1980 and 2000, and is expected to increase by another 14 million by 2030 (Hanak, 2005). The California Department of Finance's projections are for 15% population growth by 2010, 31% by 2020, and 69% by 2040. Construction on more than one-half million new residential units started between 2000-2006, in the Southern California region including Los Angeles, Kern, San Bernardino, Riverside, Orange, San Diego, Imperial, Ventura, Santa Barbara, and San Luis Obispo (Governor's Office of Emergency Services, State of California Multi-Hazard Mitigation Plan). These trends in future land usages will affect the quality and quantity of California's water supply and environment.

This project specifically explores the environmental benefits of sustainable land use practices as defined in The Ahwahnee Water Principles for Resource Efficient Land Use. These principles identify resource efficient land use practices that local communities can implement in new development and redevelopment. The practices are designed

to reduce the physical impacts of new development on aquatic, wetland, riparian habitat and habitat connectivity, curb the steady increase in urban runoff from new development, and promote local watershed sustainability to reduce dependency on imported water supplies. My research focused on two local governments in San Bernardino County and specific examples from California that demonstrate the effects of their land use practices upon the quality and quantity of future water supply and the local environment.

Land use authority in California historically rests solely with local governments under existing state and federal regulations. Concerns by the State about whether there will be enough reliable water for current residents as well as for new development have resulted in legislation during the last decade related to water and land use. In 2001 Governor Schwarzenegger signed Senate Bills 221 and 610, requiring water suppliers provide verification of future water supplies in an approved Urban Water Management Plan before a city or county can approve substantial new development. Developers are being sent back to the drawing board to come up with more secure supply options, and many

projects are being designed to incorporate recycling and conservation (Hanak, 2005).

Water conservation is an inexpensive way to create water for new population. It also dramatically helps the environment by reducing runoff and water contamination. The majority of water conservation needs to be done on the exterior of homes and business through the reduction of landscaping and/or installation of drought tolerant landscaping and through the use of permeable surfaces. Reducing water use would expand our reservoirs.

Valuable drinking water that is already in high demand is becoming polluted. Water contamination is an increasing issue with population growth. Environmental development will reduce impure water and help to preserve natural resources.

Many cities and counties are using an environmental design or smart growth to help with water conservation and water quality. Smart growth policies call for compact, diverse, and walkable neighborhoods; alternatives to the car; protection of open land and natural resources; and integration, rather than a separation, of housing types and prices (Fulton, Guide to California Planning).

Purpose

The Awahnee Water Principles could be significant in communities' water conservation. They were accepted by the state of California to help cities conserve their water. An abundance of cities are unable to establish the nine principles because of barriers in their municipal codes, development codes, and specific area plans. I went through the codes for the City of Ontario and the City of San Bernardino and identified the barriers preventing the city of implementing these principles.

The way a community is designed is important for nearby natural resources. The community needs to be built in a way to ensure the least amount of disturbance as possible. The decision on where and how a neighborhood is built can affect existing and future water supplies. Sprawl growth which is spread out growth with oversized lots and separated land use is intentionally more harmful than a mixed use livable community which has a compact design and mixed land uses. Sprawl growth creates a distance from people and the amenities they rely on. This creates a dependence on automobiles to get people to their destinations which creates more land covered by road ways and aids in the abundance of stormwater runoff.

Stormwater runoff is unfiltered water that reaches streams, lakes, and the ocean by flowing across impervious surfaces. Impervious surfaces are mainly manmade constructed surfaces that repel water and prevent precipitation from infiltrating soil. These structures include rooftops, sidewalks, roads and parking lots which are made with asphalt, concrete, brick and stone. Most urban areas have a small portion of open space with permeable surfaces for excess water to infiltrate into. This small area is not great enough to soak up or slow down runoff. Floods are then created and toxins are washed off surfaces.

Stormwater runoff may be highly polluted. Toxins may accumulate on these impervious surfaces. Brake wear releases nickel, chromium, lead and copper. Tires shed zinc, lead, chromium, copper and nickel. Engine wear releases nickel, chromium, copper and manganese (Corbett, 2006). With these toxins accumulating on our roadways they may be harmful to our watershed. When a storm releases water onto the roadways, it flushes the toxins off the roads. These toxins are washed into the storm drains and released into natural habitats affecting our water supply and the environment around. If the runoff reaches coastal

waters it could damage habitat that aquatic life depends on for survival.

Automobile related hardscapes generally account for more than 60% of the total imperviousness in suburban areas (Corbett, 2006). Automobile hardscape contains the highest concentrations of harmful pollutants. In the State of California the majority of the population drives to their destination. Every time a person gets into their car and drives on the roadways more chemicals are being stored on the impervious surfaces. Several studies have investigated trace metal composition of highway runoff. The concentration of different pollutants varies within storm events. Suspended solids, petroleum hydrocarbons, lead, cadmium, copper and iron were found at high concentrations during the first flush (Hoffman, 1984).

First flush is the initial runoff of stormwater. The first flush is comprised of the majority of the pollutants compared to the runoff in the middle and at the end of a storm. The runoff in the beginning of a storm is more harmful and could have a greater effect on water supplies. The first flush picks up all the pollutants left on the roads from automobiles and carries them down storm drains. The first flush has significant economic implications in

relation to the management and treatment of urban stormwater runoff (Goonetilleke, 2004).

Urban expansion transforms local environments. Any type of activity in catchments that changes the existing land use will have a direct impact on the quantity and quality characteristics of the water environment (Goonetilleke, 2004). The addition of impervious surfaces to an environment will increase stormwater runoff. Low-density development on the urban fringe would produce ten times more runoff than a high-density development in the urban core (Corbett, 2006). Urban runoff needs to be reduced as much as possible to help conserve water supplies. By having high-density development you will have a smaller area with a reduced amount of impervious cover.

To reduce stormwater runoff you need to reduce impervious surfaces and increase permeable surfaces. By the reduction of impervious surfaces you will not get that first flush of heavy toxins being dumped into the water supply. In developed lands the rain flows faster off the suburban landscapes collecting pollutants on its way to a water body. There is nothing to slow the water down or help filter it. In natural lands trees, plants and soil help to intercept rain and slow it down so it does not all

enter streams at once, which helps prevent flooding. Impervious surfaces are reducing groundwater recharge by preventing the percolation of the stormwater into the ground.

Mixed use livable communities are a great way to reduce impervious surfaces. By integrating communities to give compact walkable distances to destinations, you decrease the use of the automobile and decrease the amount of toxins being distributed onto the surfaces. Land use patterns that create a network of well-connected streets and paths that support walking, biking, and mass transit have many water resource benefits (Corbett, 2006).

Method

Documents were obtained from the official websites of the City of Ontario and the City of San Bernardino. The municipal code, New Model Colony General Plan, and several specific area plans were reviewed for Ontario and the general plan, municipal code and University Hills Specific Area Plan were reviewed for San Bernardino. Each document was read through carefully to identify ordinances that promoted or prevented the implementation of Ahwahnee Water Principles. Ontario's general plan was not reviewed

because it was being updated. A database was created for each city that contained all promotion and preventions identified. See Appendix A (Ontario) and Appendix B (San Bernardino) for a summary of the databases created.

Figures were created from the database to demonstrate which Ahwahnee Water Principle has a greater percentage of being or not being implemented.

CHAPTER TWO

AHWAHNEE WATER PRINCIPLES FOR WATER EFFICIENT LAND USE

Ahwahnee Water Principles

The Ahwahnee Water Principles for Water Efficient Land Use were created to help with water conservation. In 2005 the Ahwahnee Water Principles were presented to one hundred mayors, city council members, and county supervisors who agreed the principles were an optimally comprehensive way to conserve water. Many cities and counties are using these water principles to improve the vitality and property of their communities (LGC, Ahwahnee Water Principles, A Blueprint for Regional Sustainability).

The Ahwahnee Water Principles consist of nine principles (LGC, Ahwahnee Water Principles, A Blueprint for Regional Sustainability):

1. Mixed-Use Livable Communities. This includes a design that is compact and walkable. The community outline will reduce the use of automobiles by placing commercial and residential development in close proximity of one another. Mixed-use livable communities reduce runoff pollutants and create

more open land that absorbs water. Figures 1 and 2 demonstrate an increase in expanded development increases impervious surfaces which increase runoff. Redevelopment and infill development are encouraged to reduce runoff. It is better to recreate a community than to build on undeveloped land. The problem with this is it is more costly and time consuming than to build on undeveloped land.

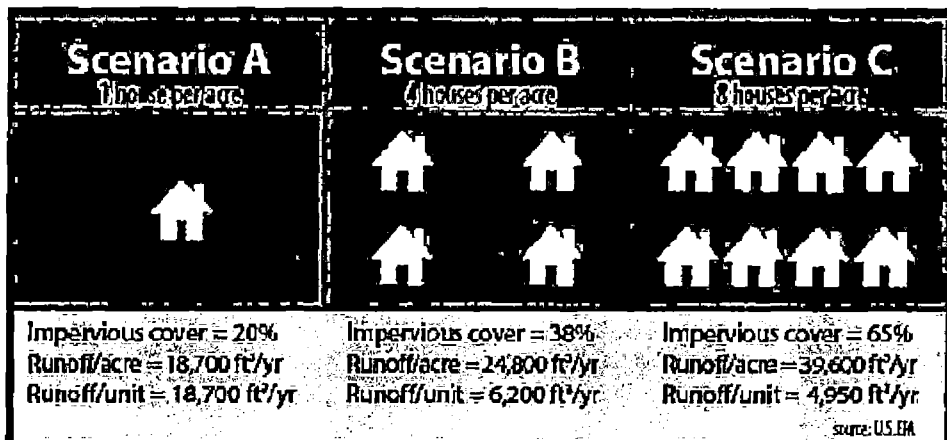


Figure 1. One-acre Scenarios
 The Ahwahnee Water Principles: A
 Blueprint for Regional Sustainability

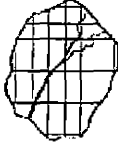


Scenario A	Scenario B	Scenario C
		
<p>10,000 houses built on 10,000 acres produce: 10,000 acres x 1 house x 18,700 ft³/yr of runoff = 187 million ft³/yr of stormwater runoff Site: 20% impervious cover Watershed: 20% impervious cover</p>	<p>10,000 houses built on 2,500 acres produce: 2,500 acres x 4 houses x 6,200 ft³/yr of runoff = 62 million ft³/yr of stormwater runoff Site: 38% impervious cover Watershed: 9.5% impervious cover</p>	<p>10,000 houses built on 1,250 acres produce: 1,250 acres x 8 houses x 4,950 ft³/yr of runoff = 49.9 million ft³/yr of stormwater runoff Site: 65% impervious cover Watershed: 8.1% impervious cover</p>

Figure 2. A 10,000-acre Watershed Accommodating 10,000 Houses
The Ahwahnee Water Principles: A Blueprint for Regional Sustainability

2. Preserving Natural Resources. By protecting natural resources you are protecting the drinkable water for a community. All water in the watershed is interconnected. Quality of both surface and groundwater supplies is dependent upon land cover within a watershed. Natural areas need to be protected and restored; sensitive ecological areas need to be preserved. Natural areas are a community's biggest asset. Communities need to identify undeveloped land with the greatest

potential of being a natural resource so developers will then be able to evolve the land and protect natural resources.

3. Maximize Permeability. Permeable ground cover decreases runoff and increases water absorption. Absorption into the groundwater is known as infiltration which is a very important natural process that helps clean the water and replenish the groundwater supply. Permeable surfaces can be in the form of swales, rain gardens, and depressed turf areas and can be used in parking areas, along road sides, in traffic islands, below roof gutters, and in public areas such as parks, greenbelts, and residential landscaping. Permeable surfaces are cost effective and important in the reduction of runoff.
4. Water-efficient Landscaping. The majority of household water use is exterior. California uses around 977 billion gallons of water for landscape each year. By using drought-tolerant plants and water-wise irrigation systems water could be conserved and stored as well as a decrease in the consumer's water bill. If the majority of the

water is used in landscaping, the majority of cutbacks need to be in the same area. We do not need to eliminate all landscaping; we need to reduce turf and plants which absorb large amounts of water. Plants are very important to the community and we need them, we just need to plant the appropriate plants for the Southern California environment.

5. Minimize Impervious Surface Cover. Impervious cover is what creates large amounts of runoff. It does not allow water to infiltrate into the ground. The majority of impervious cover is linked to transient ways. Streets may be covered with many kinds of pollutants from automobiles that may include lead, nickel, chromium, and copper that accumulate over time. When it rains, the water washes these pollutants into storm drains and drainage channels that connect and mix with natural stream and habitats causing damage. To create less damage, street widths and oversize parking lots need to be reduced and pervious hardscape need to be incorporated into streets, parking lots, and sidewalks.

6. Gray water Reuse. Gray water is reusable water from the home that includes shower, sink, and laundry water. There may be a dual drain installed in the home which will send reusable water to your garden. By the reuse of water many homes can cut down on their water use.

7. Water Recycling. Wastewater is sent to a wastewater treatment plant where it is cleaned, treated and put back into the environment. Recycled water can be used for fire fighting, sprinkler systems, landscape irrigation, agriculture, cooling towers, commercial laundries, car washes, and artificial snow making. The uses for recycled water are increasing everyday and are becoming a more reliable source of water. Many communities are becoming worried about the safety of this water. The water has been cleaned and treated to California standards and is safe to use. Recycled water is considered non-potable and is carried in a purple-colored pipe to help prevent mix-ups.

8. Water Conservation. Water conservation is very important to a growing community. By conserving

water you are extending water use. With many areas increasing in population, water is becoming scarce. The whole community needs to come together to conserve water. Water conservation is the most effective and least expensive way communities are able to maintain water supplies.

9. Cleaning Groundwater Supplies. Many communities rely on groundwater and contamination is increasing due to of urban pollution. Communities need to make important decisions to protect their groundwater and need to take the appropriate actions to clean the water.

CHAPTER THREE

RESEARCH AREA: TWO CITIES IN UPPER

SANTA ANA WATERSHED

Cities of Ontario and San Bernardino

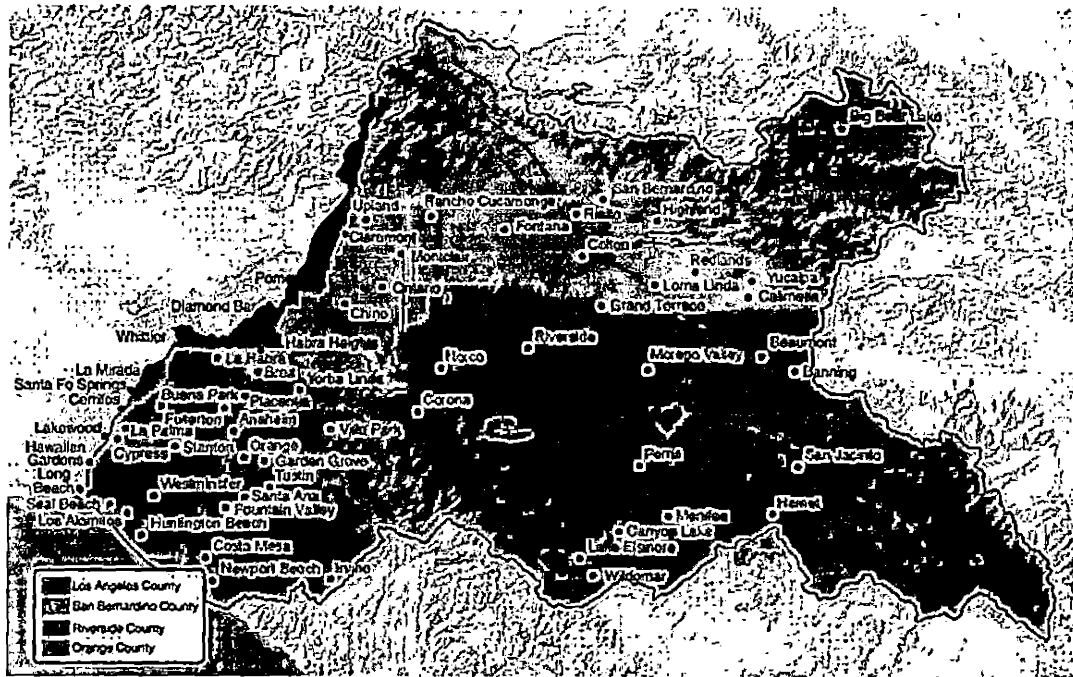


Figure 3. Santa Ana Watershed

http://www.santaanawatershed.com/Portals/0/images/WatershedMap_onlySmall.jpg

The Santa Ana Watershed is located in Southern California, southeast of Los Angeles. It is Southern California's largest watershed stretching 2,800 sq. miles.

San Bernardino, Riverside, Orange, and some of Los Angeles County are all connected to the watershed. Figure 3 outlines the watershed and identifies the counties and cities associated with it. This region of California is one of the fastest growing in population. By 2050 it is estimated the population should reach around ten million. In the year 2000, 1.4 million acre feet of water were needed to meet the demand of the population (State of the Santa Ana Watershed). As the population grows, the demand for water will grow.

The Santa Ana Watershed has been divided into two parts, the upper and lower portions. The lower portion of the watershed has been extensively developed and the upper portion remains closer to its natural form (State of the Santa Ana Watershed). The upper portion provides habitat for plants and animals and performs important watershed functions. These functions are very important to watershed management and need to be preserved. If we do not preserve this land and protect it as a natural resource, we could contaminate our main source of water.

The City of Ontario and the City of San Bernardino are located in the upper portion of the Santa Ana Watershed and were selected for this project because of the unique

dimensions each has to offer. I examined the municipal and development codes to identify the barriers that prevented implementing these principles and practices that promoted them. I selected a growing General Law city that is moving towards form based codes, Ontario, and a built-out Charter City that employs traditional use-base codes, San Bernardino. The way these communities have been designed and will be designed in the future is important for nearby natural resources.

Form-based codes pay more attention to the structure rather than the use. The codes focus on building types, dimensions, parking locations, and different building features. Form-based codes are defined around districts, de-emphasize density, emphasize mixed use and a mix of housing types, give great attention to streetscape and the public realm, and are a design-focused public participation process (LGC, Ahwahnee Water Principles A Blueprint for Regional Sustainability). Conventional codes follow strict regulations and keeps zoning separate. These codes may also be difficult for the public to understand and follow. Form-based codes are designed for easy comprehension and contain all relevant information in a well organized layout with pictures for examples to help with any confusion.

The City of San Bernardino is a charter city which has the ability to overrule state law in "municipal affairs." Municipal affairs are defined in four categories: 1) regulation of the "city police force"; 2) "subgovernment in all or part of a city"; 3) "conduct of city elections"; and 4) "the manner in which... municipal officers are elected" (Ca. Const. art. XI). There is a belief that local necessities are best satisfied by local governments. The City of Ontario is a General Law City that is organized by state law. It follows the State of California's constitution even with respect to municipal affairs.

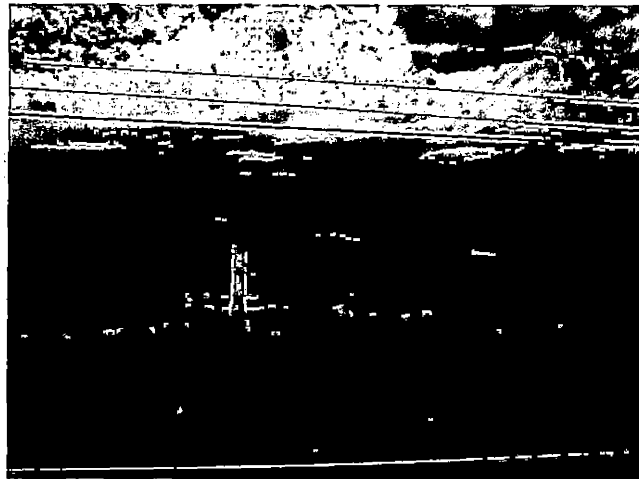


Figure 4. Open Land Ontario Plans to Develop Into their New Model Colony

Ontario is a growing city that has development expanding outward (Figure 4). Since the city uses form-based codes there should be examples of the use of Ahwahnee Water Principles in their new development. The city is a General Law City and that may cause barriers the city is unable to adjust.



Figure 5. An Infill Development Opportunity in San Bernardino Along 5th Street

San Bernardino's development focuses more on infill and redevelopment because there is limited land for new development (Figure 5). The city follows conventional codes that are not as environmentally friendly, but they are a charter city which gives them the ability to change

and follow different municipal affairs that may be a barrier in the implementation of the Ahwahnee Water Principals.

CHAPTER FOUR
RESEARCH RESULTS ON THE APPLICATION OF
AHWAHNEE WATER PRINCIPLES

Ontario

Going through the City of Ontario's municipal and developmental codes barriers were identified that prevented the implementation of the Ahwahnee Water Principles. The City does contain regulations that promote the use of these principles because the City understands the importance of watershed management. Ontario seems to have a goal to establish mixed-use livable communities to help reduce the use of automobiles. The incorporation of water use efficiency landscaping is another important aspect Ontario is trying to implement in a greater volume.

The City of Ontario believes and wants mixed-use livable communities, but has created barriers for themselves which would deter them from their target. Between different zoning districts the municipal codes calls for 6-8 foot masonry walls. Section 9-1.1517 of the municipal code requires solid masonry walls around the perimeter of mobile home parks. This enclosure would prevent a free flowing walkway. Sections 9-1.1630, 9-

1.1815, and 9-1.2005 all require the use of a 6 foot masonry wall to separate commercial, public facilities, and off street parking from residential districts. Figure 6 demonstrates a masonry wall surrounding a residential district. These create an obstruction from a walkable community.



Figure 6. Turner Avenue, Ontario

To have a successful mixed-use community there needs to be a variety of housing types in one area. Section 9-1.1445 prevents this through the discouragement of multi-family development adjacent to single family development. This hurdle is designating development to a certain area instead of overlapping uses. Another example of this is Section 9-1.2315 which prohibits certain stores (Drive-

thrus, car washes, machine shops) in the Euclid Avenue Corridor district.

Open space in a mixed-use livable community is an unbounded area where citizens in the community may enjoy the outdoors. The City of Ontario wants at least 75% of open space to be bounded by buildings or walls (Section 9-1.1445). This may have a negative effect and deter the citizens from its use. Open space means just that, open, not confined by walls.

The City of Ontario does try to encourage mixed-use in the municipal code. Residential districts need to have a livable community design (Section 9-1.1422), should be oriented around a community use (Section 9-1.1445), neighborhood blocks should average between 350 feet and 400 feet in length for a walkable community (Section 9-1.1445), on the edge of neighborhoods transit stops should be provided (Section 9-1.1445), and there should be a connection of walkways and bicycle facilities (Section 9-1.3050). These regulations will help in the reduction of vehicle use and promote a walkable community.

A walkable community does require a compact design, open space and public amenities and are important to the public well being. Section 9-2.1515 dedicates three acres

of open land for recreation for every 1000 people and section 9-1.1445 says a development of 100 to 200 units must provide five recreational amenities. These sections help Ontario better reach their goal for community open space.

Preserving natural resources conserves the watershed that the City of Ontario relies on. The City needs to protect and restore natural areas as open space and use compact design. Going through the municipal code, regulations on the process to conserve natural resources were not found. Ontario is trying to establish a mixed-use livable community and does require open space for recreational purpose; however the City also needs to protect recharge zones and native habitats that should have been more extensively discussed in the codes.

The City of Ontario is trying to prevent water waste through the promotion of water use efficiency landscaping. Section 9-1.3225 would like landscaping to be designed in a way that is consistent with the water conservation goals and should incorporate drought tolerant plants and water efficiency irrigation systems. Section 10-2.012 encourages the planting of drought tolerant trees and shrubs in the parkways.

In the municipal code, Ontario does a lot of encouraging instead of regulating. The City encourages drought tolerant landscaping, but if you have grass it needs to be healthy (Section 5-22.02) which requires a great amount of water. It is a public nuisance for a front yard to contain only dirt. It is required for property owners to have landscaping or groundcover (Section 5-22.02). The section is not clear on the definition of groundcover, predominantly it is rocks which can be costly to put in compared to the planting of grass seed. For drive-thru business the code recommends grass or ivy for suitable groundcover (Section 9-1.1305) which can use an excess amount of water. With more precise writing of the municipal code, areas in water efficiency landscaping can be better implemented.

Every city is able to improve on their impermeable surfaces because they are a main portion of development. Ontario wants nice, neat landscaping that provides a six inch curbing separating plants from turf (Section 9-1.1305 and 9-1.3040). Section 9-1.3225 of the General Development Requirements wants all landscaping areas to be bounded by curves, concrete, or masonry (Figure 7). The curbing

provides an unnecessary impermeable surface that is only incorporated for the vanity of the city.

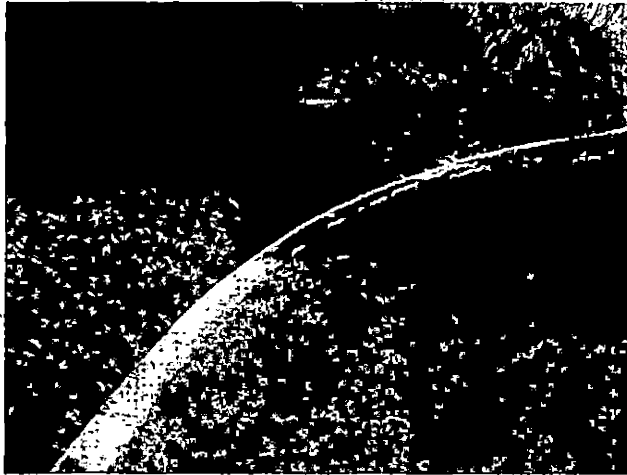


Figure 7. Milliken Avenue,
Ontario

Another way for Ontario to keep a clean looking atmosphere is through the use of masonry walls. The City uses the walls to help screen unsightly areas that include rubbish from a gas station (Section 9-1.1305), parking lots (Section 9-1.1445), loading or storage areas (Section 9-1.1730) and the storage of recreational vehicles (Section 9-1.3010). The walls are also used in the separation of commercial and public facilities from residential districts (Section 9-1.1630 and 9-1.1815). These walls do give the

city a nice, clean look, but they also provide impermeable surfaces that stop infiltration of water into the soil (Figure 6). Chain linked fences can be used and would provide a more permeable area, but Section 9-1.1412 states a chain linked fence may only be used if it is predominately used in the neighborhood. New development uses masonry walls and chain linked fences are being phased out.

Ontario is trying to reduce impermeable surfaces through the use of wood chips, decomposed granite and shale along trails in residential districts (Section 9-1.1435). Those are good materials to allow permeability of water. The City does want to avoid large expansive paved areas between streets and buildings (Section 9-1.1730). In residential districts, Section 9-1.1445 would like the City to reduce street widths, but the regulation does not entail the recommended street width it would like to accomplish or if it will be enforced.

The municipal code had very little information on recycled water and no information on grey water. It seems grey water use is not permitted in the City. Ontario does have recycled water goals it does aim to meet. Recycled water is not allowed for residential use (Section 6-8.702).

The majority of water use in residential districts is used for landscaping that could be extensively reduced with the use of recycled or grey water. Commercial and industrial areas who would like to use recycled water must go through a long application process and may have their water rights revoked at any time (Section 6-8.711). Recycled water is an important tool in water conservation. Regulations and policies are making it difficult for the use of recycled water because it has to be treated through a secondary process before it can be recycled back.

Examining the municipal code there were few regulations concerning water use efficiency appliances and low impact development. The implementation of these two principles into development will be successful in water conservation. Ontario needs to understand the importance of applying as many water conservation techniques as possible to ensure future water supplies.

Ontario's New Model Colony was formally San Bernardino County Agriculture Preserve and was annexed by the City in 1999. The land occupies approximately 8,200 acres. The New Model Colony contains its own general plan. This general plan was chosen to depict Ontario's future in

development and the City's use of Ahwahnee Water Principles.

Analyzing the general plan there were many examples of the implementation of Ahwahnee Water Principles. The New Model Colony focuses on mixed-use livable communities through the promotion of intermixing of land uses, discrimination against leap frog development, having a town center as a community's focal point, and providing five acres of parkland for every 1000 residents. Figure 8 is the recent development of the New Model Colony and shows their compact design.



Figure 8. Edenglen Avenue,
Ontario

To preserve the New Model Colony's natural resources the general plan finds it important to educate the public. Without the support of the public it may be difficult to protect waterfowl and raptor habitats. The general plan also would like to restore the Delhi Sands Flower-loving fly if possible.

The general plan did not have much information on water use efficiency landscaping. This is of major concern since a great amount of water is wasted on landscaping. The plan did say for open space and recreational areas to have minimized water use and it will be enforced. The New Model Colony does encourage the development of golf courses which will only be suitable if recycled water will be used for irrigation. The general plan is considering requiring dual plumbing, but does not give details. Dual plumbing is a useful technique and an effective way to reuse water.

San Bernardino

The first step in the analysis of San Bernardino was their general plan to identify the City's vision and goals. This will help pinpoint the City's barriers in implementing the Ahwahnee Water Principles.

Going through the general plan, mixed-use livable communities seem to be the major objective. The City plans to link neighborhoods through the improvement of bicycle and pedestrian paths, develop a diverse supply of houses, encourage compact design, expand and provide more options for transportation, and provide incentives for redevelopment or infill development. To help with the uses of these types of development the City is going to provide a redevelopment program, with high priority awarded to infill development, and reduced fees and modified development standards for affordable infill housing projects.



**Figure 9. Blue Sky Court,
San Bernardino**

The general plan contains many aspects to help San Bernardino reach their goal of a compacted, mixed-use design, but also contains hurdles that would prevent the City from reaching the full extent of these intentions. The general plan addresses the use of consistent fencing throughout the City. Fences are walls and will create a longer distance for travel that will encourage the use of automobiles. One of the City's objectives is to build on a health care cluster to attract employment. Clusters prevent mixed-use design and put a greater distance between businesses and residents. The City requires, wherever possible, a buffer zone between residential districts and highways, this will increase travel time. Cul-de-sacs are useless and prevent compact design. The general plan would like to minimize noise and vehicle traffic in residential neighborhoods through the use of cul-de-sacs (Figure 9).

In the introduction of the general plan it was stated that conserving natural resources is a necessity. The City intends to promote development that minimizes the disturbance of natural water bodies and natural drainage systems. The City plans to implement an urban runoff reduction program and use natural drainage systems, detention ponds, or filtration pits to collect and filter

runoff. The management and protection of the quality of the City's surface and ground water is a top priority.

Analyzing the general plan, the City had aspects to help prevent impervious cover, but it did not seem a high priority because the quantity was minimal. Impermeable reduction was fostered through the reuse of buildings, suggesting porous pavement systems in parking lots, and increasing permeable areas to allow percolation. The general plan would like to provide continuous sidewalks, provide walls to screen unsightly areas, and establish off-street parking. These measures will help to increase runoff.

The general plan did not have goals for water use efficiency landscaping, recycled water, and grey water except to use reclaimed water on industrial projects, golf courses, and freeways. Increasing the use of recycled water needs to be designed into the municipal code through a goal in the general plan. Water use efficiency landscaping needs to be one of San Bernardino's top objectives since it is an efficient means of water conservation.

San Bernardino's municipal code seems to reiterate the same regulations. It was a lengthy code and more difficult

to sort through than Ontario's code. There was not as much useful information as in Ontario's.

In the general plan, mixed-use livable communities are a main priority, but after examining the municipal code it was not regulated, enforced, or barely written about. Section 19.02.020 only allows mixed-densities in select residential neighborhoods. San Bernardino needs to have mixed-densities throughout the city to create a mixed-use livable community. Another hurdle is the prevention of particular stores in certain areas (Section 19.06.025). San Bernardino does urge infill and redevelopment (Section 19.02.020) as well as require five acres of open space for every 1000 residents (Section 3.27.070). These are essential for a more compact designed community.

San Bernardino has concentrated many regulations on conserving natural resources. The City is going to protect and enhance the water quality of local, state, and federal water courses, water bodies, and ground water (Section 8.80.102) through the use of Storm Water Quality Management Plans (SWAMP) and Best Management Practices (BMPs). Section 8.80.501 requires all qualifying development and redevelopment projects shall submit and have approved a SWAMP. Section 8.80.505 enforces all construction projects

which may have an adverse impact on the City's storm water drainage systems or waters of the state shall implement appropriate construction of BMPs. These will help in the reduction of pollutants from runoff that damage natural preserves. San Bernardino discharges treated effluent to the Santa Ana River Bed (Section 13.32.100) which will assist in the replenishment of water sources and enforces the use of recycled water more than the City of Ontario. The City would like to improve opportunities to recycle water (Section 13.32.105), golf courses will use effluent water for irrigation (Section 19.04.030) and wherever else the City deems appropriate. There were no barriers identified in the municipal code that would hinder the implementation of preserving natural resource regulations.

San Bernardino has many barriers that prevent permeable surfaces. An increase in impervious cover can cause water pollution from runoff. Drive-thru, convenience store, service stations parking lots, and loading areas are required to be constructed with (PCC) concrete (Section 19.06.030). Those types of areas are ideal for permeable paving. Section 19.24.040 requires all driveways and parking areas to be surfaced with a minimum thickness of three inches in asphaltic concrete, concrete, or any City

Engineer approved bituminous surfacing over four inches of an aggregate base material. Similar to Ontario the City does require concrete mow strips to separate groundcover from all other landscaping (Section 19.28.030) and enforces the use of masonry walls. Chain link fencing is not in conformance with code requirement (Section 19.62.020). Convenience store parking and loading areas, commercial/industrial public parking, and any other type of loading area abutting a residentially designed property is to be screened by a six foot masonry wall (Section 19.06.030).

To try and reduce impermeable surfaces, San Bernardino seems to focus on parking. In University Business Park Specific Plan the City plans to reduce parking spaces by 25% (Section 19.24.030). A great incentive to help with redevelopment and the reduction of impervious paving is allowing a developer to reduce the required parking 25% if they put in a new use to the already existing structure (Section 19.62.020).

San Bernardino's municipal code, like their general plan, did not have many regulations that would either promote or prevent the use of water efficient landscaping.

In the northern foothills of San Bernardino lay the project area for University Hills that will demonstrate San Bernardino's current developmental implementation. It overlooks California State University San Bernardino (CSUSB), Cajon Creek Wash, and Glen Helen. The project area has CSUSB and Badger Hill to the south, Devil's Canyon Flood Control Basin to the west, and San Bernardino National Forest to the north and east.

University Hills was formally known as Paradise Hills Specific Area Plan. This project was submitted to the City of San Bernardino in 1991 and approved in 1993. Paradise Hills proposed 504 residential units on approximately 229 acres with 175 acres of open space (City of San Bernardino, EIR).

The project site now is 404 acre piece of land where the developer plans on using 170 acres; the rest will be left for open space. The open space will be dedicated to CSUSB to use for laboratory study of local wildlife and habitat. In the 170 acres University Hills plans to accommodate 980 residences in single-family detached, small-lot detached, cluster court homes, townhomes and stacked flats. In addition the project area will contain

10 acres of parkland (City of San Bernardino, Specific Area Plan).

The vision and objectives according to the Specific Area Plan will help advance the community. The project hopes to attract educators to the community by providing housing closer to CSUSB. University Hills will provide a mixture of housing types for different income ranges and interconnecting trails throughout the community. The developer wants to achieve a strong community identity, create a direct connection to CSUSB, minimize the development footprint, create a workable design, and utilize green building techniques (City of San Bernardino, Specific Area Plan).

University Hills has specific development standards for each land use category that include density, building site specifications, set backs, and height. The project contains general development standards which include regulations that apply to most, if not all, land use designations within the project site area (City of San Bernardino, Specific Area Plan).

The general development standards contain many regulations, in which some of the following will be discussed. Detention and drainage areas will be permitted

in all land use designations. The area needs to be designed to blend in and needs to be landscaped. The detention ponds need to be capable to withstand flooding from either recreation or open space (City of San Bernardino, Specific Area Plan). Detention ponds can be very useful in a compact development. They help minimize water pollution from runoff as well as give a place for the water to go instead of collecting on the streets.

There are two kinds of open space in the development project. Private open space which is exclusive to the homeowner and common open space which is for all residents and includes parks, trails, pools, and University Hills club house. The project would like to focus more on common open space to create community gathering (City of San Bernardino, Specific Area Plan). Common open spaces compared to private may also help to decrease the project footprint and help to create a shared community.

Pedestrian circulation is of major concern for the project. The developers want to have easy access to different amenities. Sidewalk systems shall be developed adjacent to all public streets, and have a connection to all major trails. There needs to be varying widths of the sidewalks and they should be constructed from concrete,

decomposed granite, brick or flagstone (City of San Bernardino, Specific Area Plan). By creating an area with safe and reliable paths, residents will feel comfortable to use them which may reduce vehicle traffic. Using permeable bricks to construct the sidewalks is an easy way to minimize impermeable surfaces.

University Hills has created sustainable guidelines to help create a sustainable, resource efficient community that are divided into site design and community planning, green infrastructure, landscaping, building-level sustainability, resource conservation, construction practices, and commitment to sustainable building practices (City of San Bernardino, Specific Area Plan). These guidelines are intended to meet current and future needs as well as impact the environment as little as possible. Some examples include clustering homes together to reduce the overall footprint, incorporation of infiltration basins and bioswales, install high efficiency appliances, use xeriscape landscaping to reduce the amount of water devoted to landscaping, strive to utilize renewable or recycled building material, and installation of water and energy saving fixtures (City of San Bernardino, Specific Area Plan).

CHAPTER FIVE
RESEARCH RESULTS ON THE APPLICATION OF
AHWAHNEE WATER PRINCIPLES IN
WATERSHED-BASED PLANNING

The Ahwahnee Water Principles or similar water principles are being used in cities and counties to help conserve water for anticipated future growth. Sonoma and Ventura Counties are examples of how water principles may be implemented in a community successfully.

Sonoma County

Sonoma County has produced a land use audit that details and identifies their success in land management. Sonoma plans for the future growth of the county. They believe mixed-use livable communities are a key factor in the preservation of natural resources.



Figure 10. Sonoma County
Open Land
[http://media-cdn.tripadvisor.
com/media/photo-s/01/15/0a/c7/
ramond-burr-winery.jpg](http://media-cdn.tripadvisor.com/media/photo-s/01/15/0a/c7/ramond-burr-winery.jpg)

Natural resources and agricultural land is a priority for Sonoma County. The County would like to conserve agricultural lands since it is their main industry and very important to their economy. Figure 10 shows agricultural land and the beautiful open space. There may be a conflict with other land uses that may want to expand in which the county plans to promote cluster development through the County Zoning Ordinance that gives bonus provisions for compact development. Sonoma has a responsibility to protect natural resource areas since the county contains habitats that are unique and support many different plants

and animals. These habitats include Coast Range Forests, Oak woodland habitats, riparian corridors, wetlands, and uplands.



Figure 11. Example of Sonoma County's Compact Design
<http://www.sonomaasthma.org/display/green-building-green-cleaning%20H.jpg>

Urban growth boundaries were set up to help with the prevention of sprawl. Any local policies that encouraged high density development were supported as well as infill and redevelopment. Figure 11 is an example in Sonoma County of compact development design with houses in close proximity of each other with little landscape. Sonoma

County is trying to increase city-oriented development through the support of the public. The County invested more of its resources into transit, parks, and other amenities to build a reliable urban community that had a small footprint and has a micro impact on the natural environment.

Sonoma County has slowly been moving away from sprawl with the use of land use patterns and permanently protected lands. There is over 25,000 acres of permanently protected land that was established through the purchase of coastal land in the 1960s for state parks, the Sonoma Land Trust of 1976, and through the creation of the Sonoma County Agricultural Preservation and Open Space District in the 1990s. The County's land use patterns contain an intermix of residential, commercial, and industrial uses with a different array of parcel sizes that are intertwined with schools and parks walking distance away from each other. In 1970 there was approximately 51% of the County's population living in unincorporated areas by 2003 it was 33% (Economic and Planning System, Sonoma County Land Audit). The change in growth patterns demonstrates how high density development may be incorporated into local policies to prevent scattered development.

To help sustain the projected growth and to protect the County's agricultural and natural resources, the County has a firm oriented urban growth plan. In 2000, the overall density was 7 persons per acre. For future growth, vacant land will need to be developed to accommodate 16.25 persons per acre (Economic and Planning System, Sonoma County Land Use Audit). The County is projecting 90% of the future population will be urbanized. Development patterns will continue to be mixed-use, farm lands will continue to use effluent water for irrigation, and conservation of natural resources will stay a major priority.

Ventura County

Ventura County demonstrates the successful use of the Ahwahnee Water principles. The County realizes the importance of these principles in accomplishing their goals in natural resource preservation and water conservation. Ventura County created a watershed -based planning strategy to help with the implementation of these water principles. The planning strategy goes through what and how regulations should be enforced in individual cities.

Ventura County puts a lot of focus on compact design with mixed uses. Their goal is to minimize their footprint and to still be able to provide a community with the appropriate amenities. The greater the developmental footprint, the more impervious cover there will be. Each of the cities in Ventura County support compact design which is not for just new development, but also redevelopment and infill development.

Redevelopment helps the watershed through reusing already developed areas to lessen impervious cover, intensifying built areas can reduce the need to expand the overall development footprint onto non-built areas, and redevelopment offers the best opportunities to retrofit paved sites with water quality improvements (Watershed-based Planning Strategies for Ventura County).

Redevelopment reuses developed land and prevents new development on permeable surfaces. Ventura County encourages the use of redevelopment and infill development through tax increment financing. This is a mechanism to establish a taxing district whereby the taxes assessed on the increased value of redevelopment is directed to projects within the district (Watershed-based Planning Strategies for Ventura County).

Ventura County realized how harmful impervious surfaces can be on their natural resources. Roadways count for 50% of impervious cover and parking lots can take up as much as 30% (Watershed-based Planning Strategies for Ventura County) The County has been trying to seek alternative solutions to this increasing problem. Some examples include narrower street widths and complete streets (no dead ends) and mixed-use livable communities which will reduce the public's reliance on cars.

The County has successfully accomplished mixed-uses through overlaying zones and designating mixed-use districts. Overlay zones were created to bring variation or new regulation to underlying single use zones (Watershed-based Planning Strategies for Ventura County). Many of the cities in the county offer density bonuses to promote mixed-use development.

Improvements on Water Quality in Communities

Other counties and cities in the nation are trying to incorporate water principles and green infrastructure into their communities to help conserve water. The use of green infrastructure in development is helping cities to protect and restore their water supplies. Green infrastructure is

the interconnected network of open spaces and natural areas- greenways, wetlands, parks, forests preserves, and native plant vegetation- that naturally manages stormwater, reduces the risk of floods, captures pollution, and improves water quality (American Planning Association, Green Infrastructure).

The Town of Apple Valley in Southern California is involved in a program with the Mojave Water Agency called Cash for Grass. Apple Valley is located in the Mojave Desert where water is scarce. This program offers property owners a rebate cash incentive to remove their water-loving lawns and replace them with water-efficient landscaping. In addition Apple Valley also offers a high-efficiency toilet rebate/voucher program and high-efficiency clothes washer rebates for residential customers.

New York City realized the importance of keeping natural areas intact for the quality of their water. Instead of New York's Department of Environmental Protection investing \$8 billion in a new water treatment system, they purchased land and conservation easements upstream to protect their drinking water for \$1.5 billion (LGC, Livable Communities and Water). This will help keep their water protected for future use.

Seattle, Washington created a project in 2001 called Street Edge Alternatives that narrowed the streets to create a meandering, river-like road that reduced impermeable cover by 11% (American Planning Association, Green Infrastructure). The streets are 14 feet wide with an 18 foot intersection and a sidewalk on only one side. On either side of the street there are bioswales incorporated and the planting of evergreens and shrubs. Seattle's project reduced runoff volume by 98%, at a cost 25% below that of conventional street design (American Planning Association, Green Infrastructure).

Pasadena, California has adopted a new general plan that will designate new development around transit stops. Hercules, California has incorporated "Regulating Codes" to help with mixed-use, walkable, compact design in new development. These codes have specific regulations that are being followed and will help with the city's water conservation efforts. Kansas City, Missouri is installing rain gardens to help protect their water against pollution.

The programs, general plans, and project designs have all helped these cities in their efforts in the reduction of runoff and water conservation. There are many different ways individual cities can apply water conservation

techniques. Each city needs to find an application that works best in their city's surrounding environment and apply it as accurately as possible.

CHAPTER SIX
ENVIRONMENTAL BENEFITS OF THE
APPLICATION OF WATER
PRINCIPLES

Land use regulations and development standards can be correlated with environmental issues. Preserving natural resources takes a successful implementation of standards developed by local, state, and federal governments. Codes and ordinances have an impact on water conservation.

20x2020 Water Conservation Plan

The 20x2020 Water Conservation Plan was assembled by state agencies to reduce urban water use by 20% per capita by the year 2020. Between the years 2009 and 2020 the plan will increase the state's urban water efficiency and conservation efforts. Conservation is the leading strategy to ensure future water.

Water conservation has multiple benefits to help the state. New infrastructure and improvements to treat and deliver water can be costly. Reducing water consumption will decrease or postpone costs associated. Reduced water use will diminish costs in wastewater treatment and

lessening water used on landscape will decrease the amount of fertilizer, pesticides, and herbicides infiltrating our water system (State Water Resource Control Board, 20x2020 Plan)

The goal for reduction of water use will be implemented through Best Management Practices (BMPs), codes, and ordinances, but their will need to be additional regulations to ensure a 20% reduction per capita in all the state's ten regions. Current actions being used include mandating unmetered connections be metered by 2020; new construction with sufficient landscaped areas be subject to ensure that efficient irrigation systems and low water-using plants are being used; and better coordination between land use and water use planning (State Water Resource Control Board, 20x2020 Plan).

Additional measures need to be implemented to ensure the success of the state's goal. These measures include efficient clothes washers, residential weather-based irrigation controllers, grant funding, accelerated coverage goal for BMPs, landscape practices, new technologies, and the use of recycled water (State Water Resource Control Board, 20x2020 Plan). The current practices need to be

intertwined with the additional measures for a promising water conservation plan.

The 20x2020 Plan will be commissioned through three phases. Phase I will be the completion of the plan and the starting-up actions. The plan will be finalized, establish a lead agency, develop detailed task descriptions for recommended actions, provide technical assistance, collect and manage data, implement conservation actions, conduct legislative, regulatory, and administrative actions, and provide oversight (State Water Resource Control Board, 20x2020 Plan). Phase II will implement, monitor, and evaluate adjustments. This phase will establish a long-term data collection, monitor implementation progress, asses and design additional measures, and conduct an Interim Target Assessment and Performance Evaluation by 2015 (State Water Resource Control Board, 20x2020 Plan). Phase III will be the conclusion of the plan and consist of a Final Target Assessment and Performance Evaluation and the publishing of the results and the lessons learned (State Water Resource Control Board, 20x2020 Plan).

Low Impact Development Guidance Manual

The Low Impact Development (LID) Manual was created to aid Southern California in the implementation of LID. This manual may be used as a tool by developers to ensure proper techniques are used. The goal of LID is to mimic the site's pre-development hydrology- including runoff rates and volumes- by using design techniques that infiltrate, filter, store, evaporate, capture and reuse runoff close to the source of rainfall (State Water Resource Control Board). The use of LID will increase the quality and the abundance of water.

To reduce volume runoff, LID measures are based on infiltration, evapotranspiration, and capture then reuse. Infiltration is advantageous to groundwater recharge, wetland sustainability and base streamflow. There are a variety of LID BMPs which rely on the infiltration function, such as permeable pavement with infiltration beds, dry wells, infiltration trenches, surfaces and sub-surface infiltration basins, and other systems (Southern California Stormwater Monitoring Coalition, LID Guidance Manual).

Evapotranspiration is a natural occurrence in vegetation where water vapor is exchanged through the plant

into the atmosphere. Evapor-transpiration is harder to administer. It uses plants and trees to return the rainfall to the atmosphere. Southern California has extreme seasonality of rainfall; the use of non-native plants in BMPs will require irrigation (Southern California Stormwater Monitoring Coalition, LID Guidance Manual). The capture and reuse of water will be beneficial to a community's water supply. New development should incorporate a design to capture rainfall.

The LID Guidance Manual contains ten principles for implementing LIDs into development. These principles help to ensure the quality of development by minimizing the impact of stormwater runoff. The use of the LID principles will aid in the implementation of the Ahwahnee Water Principles.

Principles of LID (Southern California Stormwater Monitoring Coalition, LID Guidance Manual):

1. Plan First. You want to incorporate LID where it will be most beneficial and into the design planning.
2. Prevent, then Mitigate. At the site design you want to maximize every non-structural BMP, and then mitigate structural BMPs wherever possible.

3. Manage as a Resource. Capturing rainfall to reuse can be a significant water source.
4. Minimize Site Disturbance. Developing LIDs while preserving natural resources.
5. Mimic the Natural Water Cycle. The natural water cycle is complicated, but the closer we are to mimicking it, the more we are able to ensure water supplies.
6. Disconnect, Decentralize, Distribute. Where feasible, decentralize and distribute BMPs.
7. Integrate Natural Systems Into Design. Incorporate green infrastructure into the project layouts.
8. Maximize the Multiple Benefits of LID.

Environmental benefits may be the result of proper implementations of BMPs. LID has been documented as reducing total site development costs and enhancing property values in a number of different well-studied cases (Southern California Stormwater Monitoring Coalition, LID Site Design Procedures).
9. LID Everywhere. LID can be designed into new development, infill, and redevelopment.

10. Make Maintenance a Priority. Proper maintenance of LID BMPs after construction is important to ensure the most beneficial outcome.

A general plan states a community's goals and objectives. Incorporating LID into a general plan would help to inform the public of water standards. A community's general plan land use and conservation elements can be amended to include LID. LID may also be included in an optional water element that can be amended at any time, which is important since LID is an evolving practice (Southern California Stormwater Monitoring Coalition, LID Guidance Manual).

Specific plans try to incorporate the general plans goals and objectives into development. Implementing LID through specific plans can be a very useful tool. Once a specific plan is adopted, all zoning regulations, all public work projects, and all subsequent subdivision and development must be consistent with the specific plan (Southern California Stormwater Monitoring Coalition, LID Guidance Manual).

The adoption of LID into municipal codes will help regulate standards and criteria which may be updated as new information becomes available (Southern California

Stormwater Monitoring Coalition, LID Guidance Manual).
Municipal codes may contain hurdles which may make it
difficult to implement LID. These hurdles need to be
identified so successful standards of LID can help with the
reduction of runoff and raise the quality and quantity of
our watershed.

CHAPTER SEVEN
ENVIRONMENTAL BENEFITS OF THE APPLICATION
OF AHWAHNEE WATER PRINCIPLES
IN WATERSHED-BASED
PLANNING

Smart Growth

Smart growth policies call for compact, diverse, and walkable neighborhoods; alternatives to the car, protection of open land and natural resources; and an integration, rather than a separation of housing types and prices (Fulton, Guide to California Planning). Smart growth was created to help minimize impact on geographical areas. It was created by Governor Glending of Maryland in the late 1990s and contains ten principles that are similar to the Ahwahnee Water Principles.

Ten Principles of Smart Growth (Fulton, Guide to California Planning):

1. Create a range of housing opportunities and choices
2. Create walkable neighborhoods
3. Encourage community and stakeholder collaboration

4. Foster distinctive, attractive communities with a strong sense of place
5. Make development decisions predictable, fair, and cost effective
6. Mix land use
7. Preserve open space, farmland, natural beauty, and critical environmental areas
8. Provide a variety of transportation services
9. Strengthen and direct development toward existing communities
10. Take advantage of compact building design

Smart Growth contains environmental benefits that include the reduction of greenhouse gases through reduced transportation, preservation of natural habitats, and reduction of runoff through compact design.

Transportation accounts for nearly a third of our nation's greenhouse gases (Pew Center on Global Climate Change, Reducing Greenhouse Gas Emissions from U.S. Transportation). Sprawl development creates a dependence on automobiles and creation of a compact, mixed-use, livable community will help decrease the use.

Ontario's New Model Colony's General Plan says leapfrog development is forbidden (Chapter 3). The

municipal code promotes livable community design (Section 9-1.1422), transit stops provided at the edge of neighborhoods (Section 9-1.1445), and increased employment opportunities close to homes (Section 9-1.1700). Ontario demonstrates their efforts in the California Commerce Center Specific Plan where cluster development is encouraged (VIII-8) and plans to reduce trip length and ultimate vehicle miles traveled by locating shopping and support facilities within convenient distances from their uses (VIII-7). Ontario Mills Specific Plan encourages carpooling, vanpooling, alternative work hours, walking and bicycling (III-17). Subarea 29 Specific Plan is placing residential development within walking distances of schools, recreational amenities, and commercial retail (Section 4.1). Ontario's municipal code did express regulations to increase transportation that include the use of masonry walls around residential district (Section 9-1.1630). This would have an enclosed effect on residents with limited entry and exit points.

San Bernardino's general plan wants to link neighborhoods with the city (Chapter 1), provide a variety of transportation options (Chapter 2), and work with Omnitrans to explore initiatives that promote redevelopment

near transit stops (Chapter 2). Evaluating San Bernardino's municipal code, it does not coincide with their general plan. San Bernardino's goals for the reduction of automobile use are not expressed in their regulations.

Preserving natural habitats and creating wide open space is essential to ensure the livelihood of plants and animals. Plants and animals have formed their own niche in the environment and if the environment is altered it can destroy the wildlife that depends on it. People also need habitats to learn from and enjoy. The use of smart growth helps to ensure preservation of habitat for animals and open space for humans.

San Bernardino's general plan wants to conserve natural resources (Chapter 1), promote development that minimizes impact (Chapter 2), and pursue voluntary open space projects (Chapter 12). Through the municipal code the city does require five acres of open land for each thousand residents (Section 3.27.070), prohibits throwing or disposing of any garbage or any other pollutants into bodies of water (Section 8.80.206), protects natural drainage courses (Section 19.17.060), and establishes a water conservation plan (Section 19.28.010).

Ontario's municipal code has minimal regulations to preserve natural habitats and provide open space. Section 9-1.1445 would like neighborhoods to be designed to protect natural features and Section 9-2.1515 does require three acres of land for every thousand residents. Ontario's New Model Colony General Plan does have many goals for preservation. The City hopes to promote preservation of natural habitats through public education, encouraging the reduction of pesticides on agriculture, maintain connection with other preserved habitats, and restoring habitats for threatened or endangered species (Chapter 6).

Compact design is one of smart growths ten principles. An expanded developed area creates more impermeable surfaces that increase the amount of runoff produced. Runoff can damage the environment by introducing pollutants into a habitat. There can be negative effects to plants, wildlife, and the natural habitat itself. The use of permeable surfaces in development can significantly decrease the amount of runoff.

Ontario's New Model Colony is a great example of a compact design. It contains different housing types intermixed, reduced street widths (Figure 12), garages located in the rear (Figure 13), community facilities

(Figure 14) and parks (Figure 15) that are centrally located.

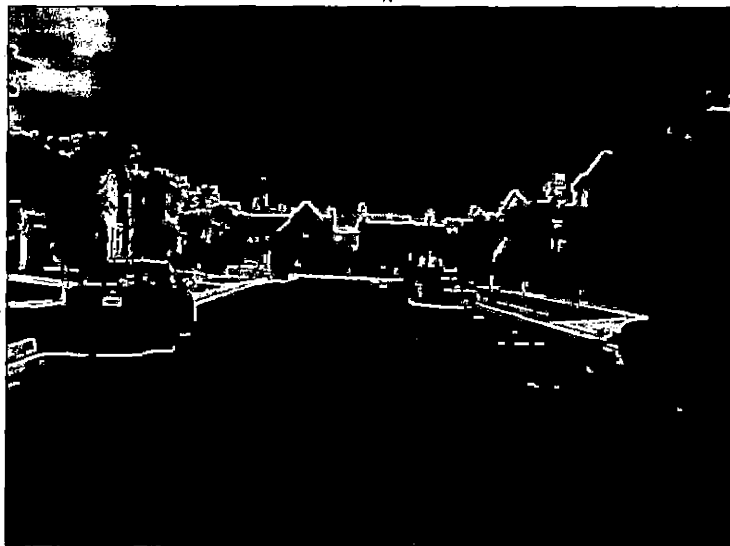


Figure 12. Lindenwood Dr.
in Ontario's New Model Colony
Demonstrates Reduced Street Widths



Figure 13. Parking in the Rear in the
New Model Colony



Figure 14. Community Club House
Centrally Located



Figure 15. Parks Centrally Located

Water Quality Benefits

Water quality is a major issue concerning wildlife as well as humans. Natural bodies of water and water supplies are being affected by sediment, heavy metals, and pesticides. These issues can be correlated with development.

Increased sedimentation can be caused by the clearing of vegetated land. An increase in clearing of the land yields a greater amount of sediment in the water. The change in drainage pattern may increase sediment. Permeable surfaces are less likely to erode than impervious

cover. A high concentration of sediment in a water body will cause the water to turn cloudy and let less light to reach plants for photosynthesis which will cause adverse effects on the ecosystem. Increased sediment in the water can be costly to clean. Communities whose water supply source has become more turbid often invest millions of dollars to upgrade their treatment facilities in order to remove the increased sediment load (Water Encyclopedia, Erosion and Sedimentation).

Agriculture runoff is a major concern. Farmlands contribute to pollution through soil erosion, feeding operations, grazing, plowing, animal waste, irrigation, fertilizer, and application of pesticides. These applications bind to sediment. When stormwater washes the loose sediment away into the nearest water body it brings the harmful agriculture pesticides with it. Fertilizers add nutrients to the water that cause alga to thrive and disturb the natural habitat. Increased pesticides in the water can have a negative effect on plants and animals.

Heavy metals are entering water supplies through runoff. Stormwater runoff may be highly polluted. Vehicles accumulate heavy metals on roadways. Break wear releases nickel, chromium, lead, and copper; tires shed

zinc, lead, chromium, copper, and nickel; engine wear releases nickel, chromium, copper, and manganese (Corbett, 2006). These metals build up on streets until stormwater washes them away to the nearest water body. Increase heavy metal pollution is harmful to human and wildlife. Heavy metal bioaccumulation in the body creates health risks. To reduce the impact polluted runoff has on local water supplies, communities need to participate in the reduction of pollution being distributed on roadways. Having compact design, reduced street width, and an increase in permeable surfaces will decrease runoff.

Ontario is moving to a compact design with their new development. The New Model Colony will create less runoff and have LID incorporated into the design to help filter contaminants. San Bernardino does not have any design plans for compact growth compared to Ontario, but the City does have goals to decrease their new development footprints and to link already existing neighborhoods together through the use of trails.

Permeable paving is a technique to improve water quality that both cities use very little of. The cities need to incorporate permeable paving where possible to increase the quality and quantity of water supplies. None

of these cities have ordinances in their municipal codes stating the use of permeable paving for sidewalks, driveways, or parking lots.

Reduce Flooding Benefits

Flooding carries harmful pollutants to water supplies and causes damage to natural habitats affecting wildlife. To reduce flooding stormwater needs to be able to infiltrate the ground instead of running off an impermeable surface.

Permeable paving is ideal to use in parking lots, residential driveways, alleys, and low-volume, low-speed streets. Automobile-related hardscape generally account for more than 60% of the total imperviousness in suburban areas (Ahwahnee Water Principles: A Blueprint for Regional Sustainability). Reducing that 60% by adding pervious paving into allotted areas will significantly decrease flooding.

Compact design can reduce flooding by reducing impervious cover. A high density community uses less land to accommodate the same amount of citizens as a low-density community (Figure 1 and 2). Decreasing street widths is another successful way to reduce impervious cover.

Using LID is a way to help manage flooding. Bioswales can absorb low flows or carry runoff from heavy rains to storm sewer inlets or directly to surface waters (Natural Resource Conservation Center, Bioswales). Bioswales are an inexpensive way to improve water quality and reduce flooding. Bioswales are best used in parking lots for absorption of automotive pollutants, at downspouts to slow and direct rooftop rainwater, and along any hard impervious surface to slow rainwater (City of Portland Bureau of Planning and Sustainability).

Rain gardens are a LID that can be incorporated into landscape design. They are great at catching excess water from roof tops and driveways. Rain gardens are able to absorb runoff more efficiently, as much as 30%- 40% more than a standard lawn (Rain Garden Network). Rain gardens can hold a large capacity of water and let water slowly leach into the ground, cleaning the water of all its contaminants. These appealing gardens are a great way to minimize flooding.

Ontario has incorporated LID into some of their specific area plans. Centrelake Business Park will control and contain runoff through the construction of swales, berms, and storm drains and have special design

considerations made to parking lots to catch, filter, and reduce discharge. California Commerce Center South Specific Plan will utilize swale design in grass areas to slow down runoff and maximize infiltration and discharge of roof leaders on buildings into pervious areas (Section X-3). Esperanza would like to include landscape strips that are swaled to catch excess water and in parks, design a series of shallow storm water treatment basins (Section 6.5) to help filter the water. Ontario has demonstrated their use of LID in their specific plans, but in their municipal code there are few regulations to use LID.

San Bernardino does not have many goals for LID in their general plan and vague regulations in their municipal code to support LID. The City's general plan does require new development to incorporate improvements to channel stormwater runoff (Chapter 13), but no detail how to improve. The municipal code does contain an ordinance that would like site drainage to be directed to the nearest street or drainage area (Section 15.04.110). This code is causing an increase in runoff. Excess water needs to be directed to an infiltration pond to help clean and conserve water.

Supply Benefits

According to Southern California Census Data, the region has grown 12.81% from 1990-2000. An increasing population needs a sustainable water supply. Incorporating Ahwahnee Water Principles and LID into development design will help provide water for future growth. Water conservation and recharging water supplies need to be a priority in Southern California.

Water conservation can be accomplished through informing the public, use of drought tolerant plants, installation of proper irrigation, and use of reclaimed water where possible, and the installation of water-use efficient appliances. The City of Ontario has incorporated water conservation regulations into their municipal code and has enforced them in their specific area plans. Section 9-1.3225 states landscaping should be designed in a way that is consistent with their water conservation goals and landscaping is to incorporate drought tolerant plants and water efficient irrigation systems. Centrelake Business Park, Archibald Business Center, California Commerce Center, California Commerce Center South, and Ontario Mills are all specific plans of Ontario that contain a regulation to use drought tolerant plants where

possible. The City does contain ordinances that cause barriers to prevent the successful accomplishment of their goals. A property needs to contain healthy landscaping, dirt lots are not allowed (Section 5-22.02 and 7-3.12), and front yards in residential tracts shall be landscaped and fully irrigated prior to Certificate of Occupancy issuance (Section 9-1.1425). Edenglen specific plan requires at a minimum the developer will install turf in the front yards of homes in residential areas (Section 6.17.1) and Esperanza Specific Plan requires at a minimum the developer will install turf, shrubs, and two trees in the front yards of homes in residential areas (Section 6.7.1). The landscaping that is required is using water that needs to be saved for consumption.

Ontario does have recycled water goals for the City, but they limit their recycled water use by forbidding its use in residential areas (Section 6-8.702), having a strict regulations (Section 6-8.711), and having tedious application process (Section 6-8.713). Edenglen and Subarea 29 Specific Plan are installing new recycled water lines. Bringing recycled water to new locations will decrease the amount of water wasted on high irrigated landscaping.

Water-use efficiency appliances are a great way residential and commercial owners can contribute to the conservation of water. Ontario did not mention water-use efficiency appliances in their municipal code, but California Commerce Specific Plan is requiring low-flush toilets, low-flush showers and faucets, and insulation of hot water recirculating systems (Section VIII-7) and restaurants are recommended to use water-conserving models of dishwashers (VIII-8).

The City of San Bernardino's General Plan objective is to conserve water. Their goals for reaching this accomplishment is to monitor demands of water systems (Chapter 9), establishment of incentives, funding programs, or rebate programs for projects that implement water conservation (Chapter 13). The City created an ordinance in the municipal code to establish a water conservation plan (Section 19.28.010) to aid in the achievement of the City's objectives.

Drought tolerant landscaping is a simple solution to conserve water. San Bernardino's municipal code contains minimal information and ordinances on drought tolerant landscaping. Section 19.28.010 does emphasize the use drought tolerant plants wherever possible. More

regulations should be amended into the municipal code for a higher yield of water conservation.

San Bernardino discharges treated effluent into the Santa Ana River Bed (Section 13.32.100). The use of recycled water helps the future growth of the City. They plan to improve opportunities to use recycled and reclaimed water (Section 13.32.105). In Special Purpose Districts the City would like to use treated effluent where possible (Section 19.10.030) and to use treated effluent on golf courses (Section 19.04.030).

Final Analysis

Ontario and San Bernardino plan to grow in population. The Cities have incorporated water conservation into their codes. Ontario's main focus seems to be on compact design. It was found that 40% (Figure 16) of Ontario's ordinances that favored the use of Ahwahnee Water Principles were for the implementation of mixed-use livable communities. Ontario is trying to reduce vehicle use and improve on compact design. The specific area plans that were reviewed demonstrate Ontario's implementation of mixed-use livable communities. 26% of regulations for the specific area plans commission the use of compact design (Figure 18). In

the City of Ontario's municipal code 57% of ordinances that were found prevented the achievement of the Ahwahnee Water Principles were the use of unnecessary impervious cover (Figure 17). Their specific area plans concur with the municipal code by providing the greatest percentage of preventing impervious cover reduction (Figure 19). Ontario needs to improve on using permeable surfaces where possible to help with water supplies for future growth.

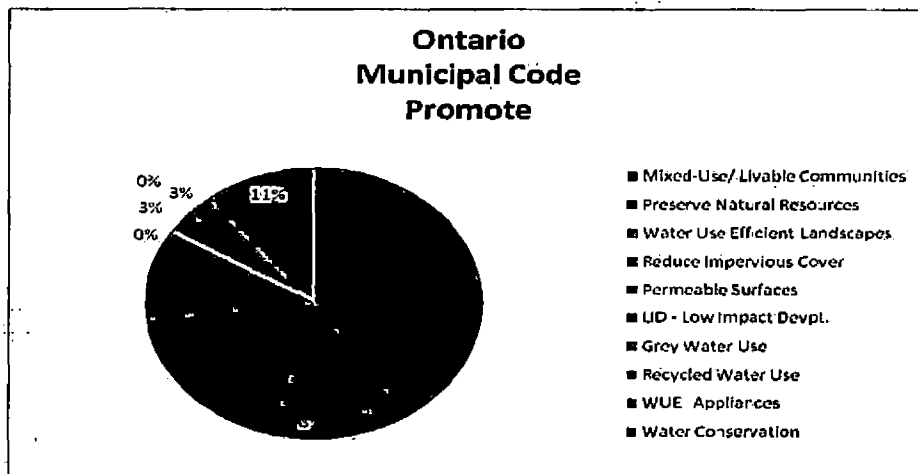


Figure 16. Ontario Municipal Code Promote

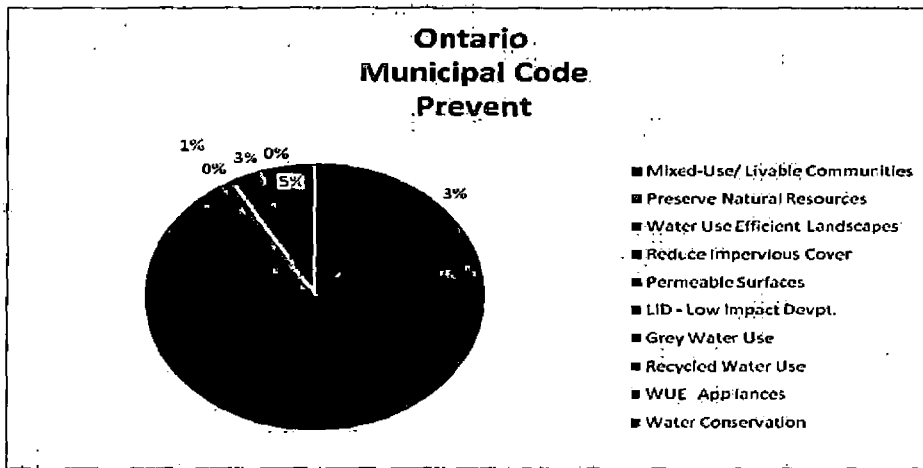


Figure 17. Ontario Municipal Code Prevent

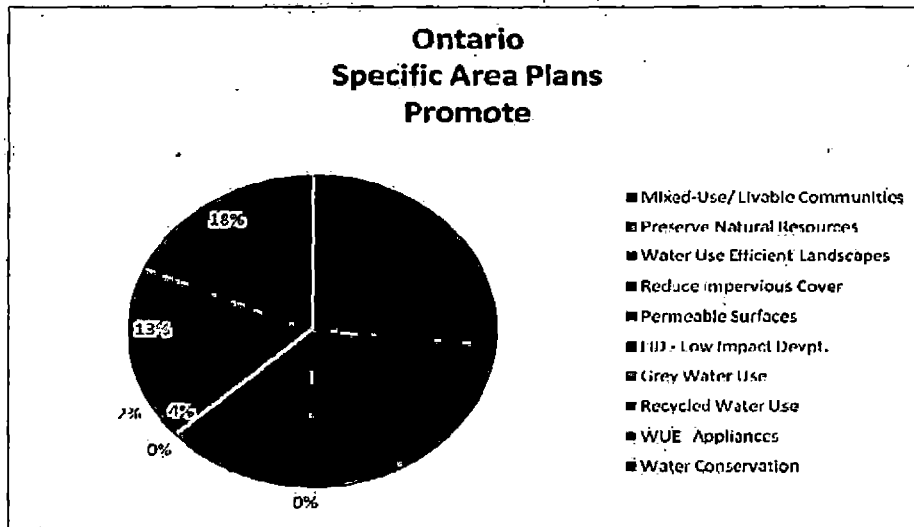


Figure 18. Ontario Specific Area Plans Promote

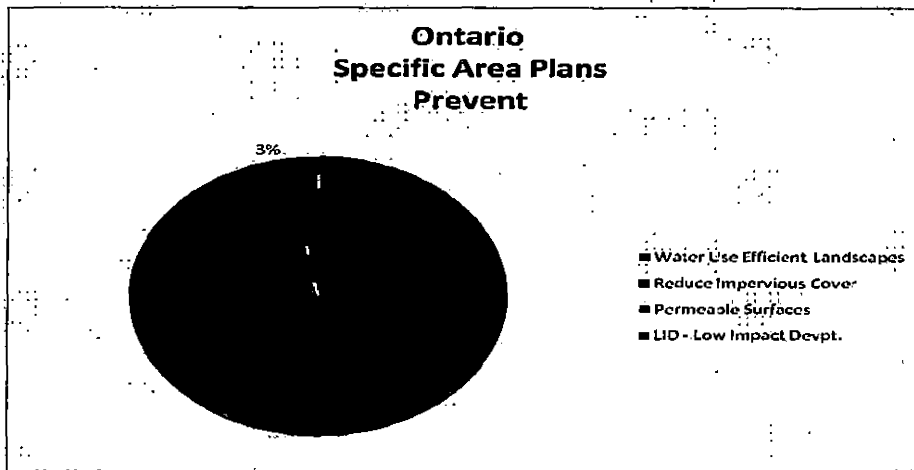


Figure 19. Ontario Specific Area Plans Prevent

San Bernardino has very broad views on water conservation and contains general regulations in their codes. Their general plan mainly promotes mixed-use livable communities (Figure 20) which does not coincide with their municipal code that mainly concentrates on preserving natural habitats (Figure 22). Only 9% of regulations promote mixed-use communities. San Bernardino's goals need to be accomplished through their ordinances which currently are not being fulfilled. Similar to Ontario, San Bernardino has an issue with the use of impervious cover. The City's general plan and municipal code have high percentages in the use of this barrier (Figure's 21 and 23). These cities need to

incorporate the use of permeable paving to reduce potential water pollution as well as to reduce runoff and conserve water. Both cities need to incorporate a variety of water conservation techniques in detail into their codes to increase water conservation abilities.

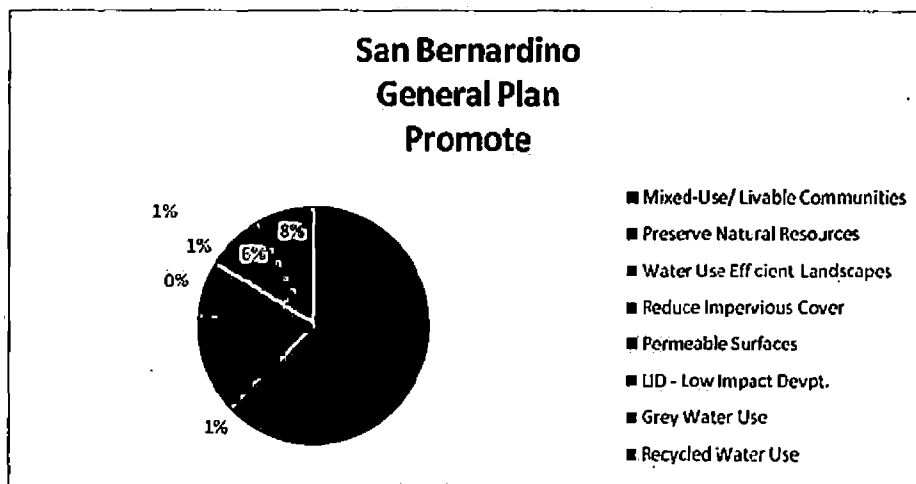


Figure 20. San Bernardino General Plan Promote

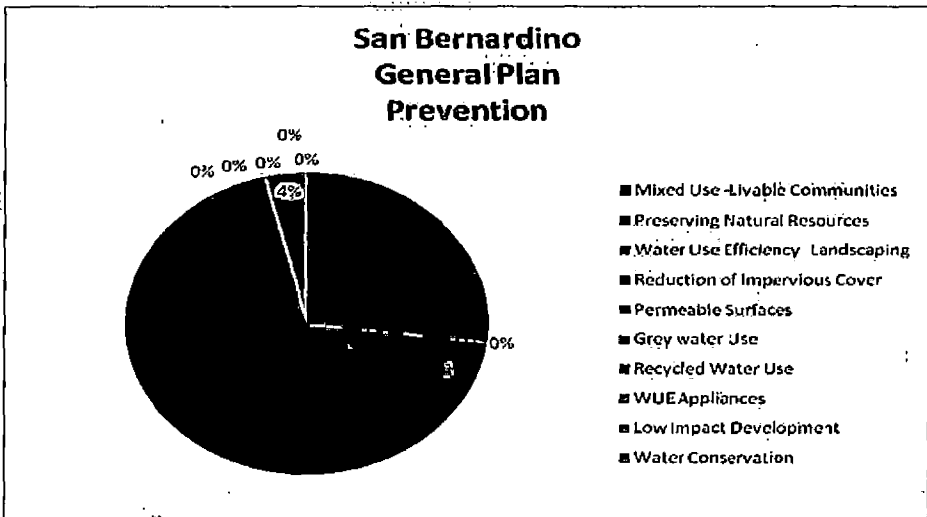


Figure 21. San Bernardino General Plan Prevention

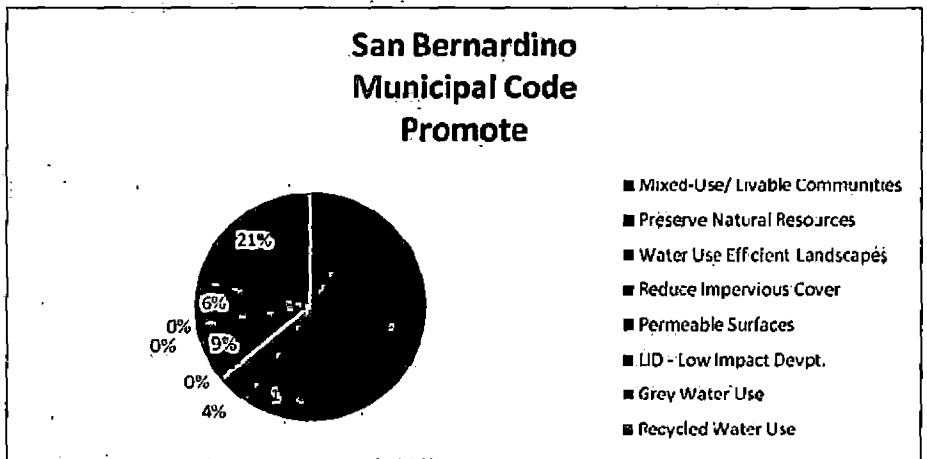


Figure 22. San Bernardino Municipal Code Promote

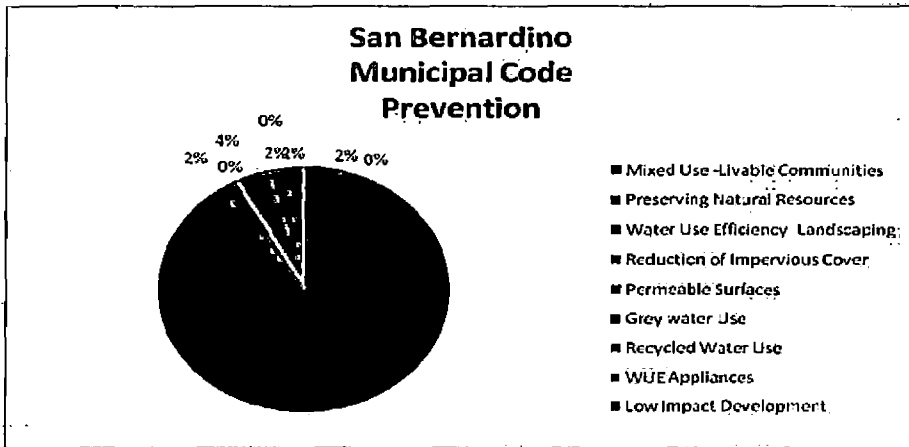


Figure 23. San Bernardino Municipal Code Prevention

APPENDIX A
SUMMARY OF THE CITY OF ONTARIO, CALIFORNIA
PROMOTING AND PREVENTING RESOURCE
EFFICIENT LAND USE AS DEFINED IN
THE AHWAHNEE WATER PRINCIPLES
BY THE LOCAL GOVERNMENT
COMMISSION

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
Municipal Code	Title 5	Chapter 22		5-22.02	Property Appearance Nuisance	Property must have landscaping or groundcover	Prevents			1							1
Municipal Code	Title 5	Chapter 22		5-22.02	Property Appearance Nuisance	Property must have healthy grass, or landscaping, and irrigation system	Prevents			1							1
Municipal Code	Title 6	Chapter 8C		6-8.702	Recycled Water Use	No residential use	Prevent							1			
Municipal Code	Title 6	Chapter 8C		6-8.711	Recycled Water Use	May revoke if all conditions are not satisfied	Prevent							1			
Municipal Code	Title 6	Chapter 8C		6-8.713	Recycled Water Use	Long application process	Prevent							1			
Municipal Code	Title 7	Chapter 3		7-3.12	Public Rights-Of-Ways	Install and maintain sprinkler system in parkway. Must maintain neat parkway. (no dirt)	Prevents		1	1							1
Municipal Code	Title 9	Chapter 1	Article 13	9-1.1305	Land Use and Special Exceptions	Drive-through business- suitable plant material (grass, ivy, etc..) should be used as ground cover	Prevent			1							

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
Municipal Code	Title 9	Chapter 1	Article 13	9-1.1305	Land Use and Special Exceptions	Gas stations- landscape should be separated from vehicular areas by a wall or curbing of at least 6 in higher than adjacent vehicular areas	Prevent				1						
Municipal Code	Title 9	Chapter 1	Article 13	9-1.1305	Land Use and Special Exceptions	Gas stations- all rubbish shall be screened by a solid wall which is a minimum of 6 ft high	Prevent				1						
Municipal Code	Title 9	Chapter 1	Article 14	9-1.1412	Residential Districts	Chain link may only be used if it is predominately used in the neighborhood	Prevent				1						
Municipal Code	Title 9	Chapter 1	Article 14	9-1.1422	Residential Districts	Livable community design	Promote	1									
Municipal Code	Title 9	Chapter 1	Article 14	9-1.1425	Residential Districts	Front yards of residential tracts shall be landscaped and fully irrigated prior to Certificate of Occupancy issuance	Prevent			1							1

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
Municipal Code	Title 9	Chapter 1	Article 14	9-1.1435	Residential Districts	AR District- Trails should be surfaced with hard materials- wood chips, decomposed granite and shale are preferred	Promote					1					
Municipal Code	Title 9	Chapter 1	Article 14	9-1.1445	Residential Districts	Neighborhoods should be oriented around community use	Promote	1									
Municipal Code	Title 9	Chapter 1	Article 14	9-1.1445	Residential Districts	Neighborhoods should be designed to protect natural features	Promote		1								
Municipal Code	Title 9	Chapter 1	Article 14	9-1.1445	Residential Districts	Multiple family development adjacent to single family development is discouraged	Prevent	1									
Municipal Code	Title 9	Chapter 1	Article 14	9-1.1445	Residential Districts	Blocks should average between 350 ft and 400 ft in length	Promote	1									

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
Municipal Code	Title 9	Chapter 1	Article 14	9-1.1445	Residential Districts	At least 75 % of open space should be bounded by buildings or walls	Prevents	1									
Municipal Code	Title 9	Chapter 1	Article 14	9-1.1445	Residential Districts	Development of 100 to 200 units must provide 5 recreational amenities	Promote	1									
Municipal Code	Title 9	Chapter 1	Article 14	9-1.1445	Residential Districts	Should have reduced street width	Promote				1						
Municipal Code	Title 9	Chapter 1	Article 15	9-1.1517	Mobile Home Park District (MH)	Solid masonry walls are required around the MH perimeter	Prevent	1									
Municipal Code	Title 9	Chapter 1	Article 16	9-1.1630	Commercial and Professional Districts	Where a side or rear property line of a commercial site adjoins a residential district, a 6 ft solid wall is required at the adjoining property line	Prevent	1			1						

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
Municipal Code	Title 9	Chapter 1	Article 16	9-1.1630	Commercial and Professional Districts	Where a side or rear property line of a commercial site adjoins a residential district, a 6 ft solid wall is required at the adjoining property line	Prevent	1			1						
Municipal Code	Title 9	Chapter 1	Article 17	9-1.1700	Industrial Districts	Increase employment opportunities close to home	Promote	1									
Municipal Code	Title 9	Chapter 1	Article 17	9-1.1730	Industrial Districts	When loading or storage areas face the street they should be screened by a decorative wall or berm	Prevent				1						
Municipal Code	Title 9	Chapter 1	Article 17	9-1.1730	Industrial Districts	Large expansive paved areas between the street and buildings are to be avoided	Promote				1	1					

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
Municipal Code	Title 9	Chapter 1	Article 18	9-1.1815	Public Facilities District (PF)	Where the side or rear property line of a site adjoins a Residential District, a 6 ft solid masonry steel reinforced wall may be required	Prevents	1			1						
Municipal Code	Title 9	Chapter 1	Article 18	9-1.1815	Public Facilities District (PF)	Where the side or rear property line of a site adjoins a Residential District, a 6 ft solid masonry steel reinforced wall may be required	Prevents	1			1						
Municipal Code	Title 9	Chapter 1	Article 20	9-1.2005	Off street Parking District (P1)	Where the side or rear property line of a site adjoins a Residential District, a 6 ft solid masonry steel reinforced wall may be required	Prevent	1			1						
Municipal Code	Title 9	Chapter 1	Article 23	9-1.2315	Euclid Avenue Corridor District (EA)	Many different kinds of stores prohibited in this district (ex: drive-through, car wash, machine shop, etc...)	Prevents	1									

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
Municipal Code	Title 9	Chapter 1	Article 30	9-1.3010	Parking and Loading Requirements	Recreational vehicle parking shall be screened by a wall	Prevent				1						
Municipal Code	Title 9	Chapter 1	Article 30	9-1.3040	Parking and Loading Requirements	Curbing at least 6 in. in height if concrete, or 8 in. in height if masonry shall contain the landscaping	Prevent				1						
Municipal Code	Title 9	Chapter 1	Article 30	9-1.3050	Parking and Loading Requirements	On-site pedestrian walkways and bicycle facilities are to be provided connecting each building	Promote	1									
Municipal Code	Title 9	Chapter 1	Article 32	9-1.3225	General Development Requirements and Exceptions	Landscaping should be designed in a way that is consistent with the water conservation goal	Promote			1							1
Municipal Code	Title 9	Chapter 1	Article 32	9-1.3225	General Development Requirements and Exceptions	All landscape areas are to be bounded by curves, concrete or masonry	Prevent				1						

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
Municipal Code	Title 9	Chapter 2	Article 15	9-2.1515	Park Dedication In-Lieu Fee Regulations	3 acres of land dedicated for recreational for every 1000 people	Promote	1			1						
Municipal Code	Title 10	Chapter 2		10-2.012	Parkway Trees	City encourages the planting and maintenance of drought tolerant trees and shrubs	Promote			1							
New Model Colony General Plan		Chapter 3			Community Development	Intermixing of land use	Promote	1									
New Model Colony General Plan		Chapter 3			Community Development	Mitigate impact on natural resources	Promote		1								
New Model Colony General Plan		Chapter 3			Community Development	Establish greenways & trail	Promote				1						
New Model Colony General Plan		Chapter 3			Community Development	No leapfrog development	Promote	1	1								

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
New Model Colony General Plan		Chapter 3			Community Development	Extensively landscape parkways	Prevent			1							
New Model Colony General Plan		Chapter 3			Community Development	Sidewalk separated from curve	Promote				1						
New Model Colony General Plan		Chapter 3			Community Development	Use of expanded landscape to separate people from busy roads instead of walls	Promotes				1						
New Model Colony General Plan		Chapter 3			Community Development	Promote neighborhood centers	Promote	1									
New Model Colony General Plan		Chapter 3			Community Development	Town center as focal point	Promote	1									
New Model Colony General Plan		Chapter 3			Community Development	15 foot + sidewalks for public use	Prevent				1						

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
New Model Colony General Plan		Chapter 4			Infrastructure and Public Service	Consider requiring dual pipelines	Promote							1			
New Model Colony General Plan		Chapter 4			Infrastructure and Public Service	Joint use of detention basins (storm water) with recreational purposes	Promote				1					1	
New Model Colony General Plan		Chapter 5			Aesthetic, Cultural, Open Space, & Rec. Resources												
New Model Colony General Plan		Chapter 5			Aesthetic, Cultural, Open Space, & Rec. Resources	5 acre parkland per 1000 residents	Promote	1			1						
New Model Colony General Plan		Chapter 5			Aesthetic, Cultural, Open Space, & Rec. Resources	Link parks through pedestrian greenways	Promote				1						

APPENDIX B
SUMMARY OF THE CITY OF SAN BERNARDINO, CALIFORNIA
PROMOTING AND PREVENTING RESOURCE EFFICIENT
LAND USE AS DEFINED IN THE AHWAHNEE
WATER PRINCIPLES BY THE LOCAL
GOVERNMENT COMMISSION

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
General Plan		Chapter 2			Land Use	Redevelopment programs	Promote	1			1						
General Plan		Chapter 2			Land Use	Enjoy attractive neighborhoods	Promote	1									
General Plan		Chapter 2			Land Use	Encourage future development to require open space	Promote	1			1						
General Plan		Chapter 2			Land Use	Promote development that minimizes impact	Promote		1		1						
General Plan		Chapter 2			Land Use	Sensitively integrate regionally beneficial land uses (transportation corridor, flood control, utility corridor)	Promote	1									

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
General Plan		Chapter 2			Land Use	Development adjacent to natural areas shall be designed to preserve natural features	Promote		1								
General Plan		Chapter 2			Land Use	Control the location of a number of community sensitive business (adult business, game arcades, alcohol sales)	Prevent	1									
General Plan		Chapter 2			Land Use	Connecting, blending, and marketing the communities	Promote	1									
General Plan		Chapter 2			Land Use	Commercial centers, open space, educational facilities, and recreational facilities should be linked to residential neighborhoods	Promote	1									

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
General Plan		Chapter 2			Land Use	Promote compact development	Promote	1									
General Plan		Chapter 2			Land Use	Variety of transportation options	Promote	1									
General Plan		Chapter 2			Land Use	Infill development shall be accorded a high priority	Promote	1			1					1	
General Plan		Chapter 2			Land Use	Provide special incentives and improvement programs to revitalize the community	Promote	1									
General Plan		Chapter 2			Land Use	Work with Omnitrans to explore initiatives that promote redevelopment near transit stops	Promote	1									

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Gray Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
General Plan		Chapter 2			Land Use	Explore the use of incentives that can be awarded to projects that provide pedestrian amenities	Promote	1									
General Plan		Chapter 2			Land Use	Require all new development achieve a high level of architectural design and provide special attention to detail	Prevent				1					1	
General Plan		Chapter 2			Land Use	Use of consistent fencing	Prevent	1			1						
General Plan		Chapter 2			Land Use	Linkages to pedestrian, bicycle, and equestrian paths	Promote	1									
General Plan		Chapter 2			Land Use	Extensive site landscaping	Prevent			1							

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
General Plan		Chapter 3			Housing	Facilitate the development of a variety of types of housing to meet the needs of all income levels	Promote	1									
General Plan		Chapter 3			Housing	Avoid concentrations of housing for a single income group	Promote	1									
General Plan		Chapter 3			Housing	Continue to rehabilitate and reuse abandoned houses	Promote	1									
General Plan		Chapter 3			Housing	Reduce fees and modify development standards for affordable infill housing projects	Promote	1									
General Plan		Chapter 4			Economic Development	Establish employment sectors to support business growth	Promote	1									

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
General Plan		Chapter 4			Economic Development	Build on Health Care clusters to attract and retain related employment sectors	Prevent	1									
General Plan		Chapter 4			Economic Development	Build on Transportation clusters to attract and retain related employment sectors	Prevent	1									
General Plan		Chapter 5			Community Design	Create conspicuous gateways at key points in the community	Promote	1									
General Plan		Chapter 5			Community Design	Well-integrated network of bike and pedestrian paths should connect residential areas to schools, parks and shopping centers	Promote	1									

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
General Plan		Chapter 5			Community Design	Orienting new homes to the street and garages located in the rear	Promote	1									
General Plan		Chapter 5			Community Design	Multi-family housing- provide common open space	Promote				1						
General Plan		Chapter 5			Community Design	Provide continuous sidewalks	Prevent				1						
General Plan		Chapter 5			Community Design	Loading bays should be screened by walls and landscaping	Prevent				1						
General Plan		Chapter 6			Circulation	An adequate, safe, and interconnected system of pedestrian and bicycle paths	Promote	1									
General Plan		Chapter 6			Circulation	Study parking standards to determine if shared parking is adequate	Promote				1						

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General Plan		Chapter 6			Circulation	Expand the supply of public parking in off-street parking facilities	Prevent				1						
General Plan		Chapter 8			Park, Recreation, and Trails	5 acres of parkland for every 1,000 residents	Promote				1						
General Plan		Chapter 8			Park, Recreation, and Trails	Disperse park facilities and equipment throughout the City	Promote	1									
General Plan		Chapter 9			Utilities	Impose limits on new water hook-ups	Promote								1		1
General Plan		Chapter 9			Utilities	Minimize the disturbance of natural water bodies and natural drainage systems	Promote		1								

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General Plan		Chapter 9			Utilities	Minimize the amount of impervious surfaces in conjunction with new development	Promote				1					1	
General Plan		Chapter 9			Utilities	Implement an urban runoff reduction program	Promote									1	1
General Plan		Chapter 9			Utilities	Increase permeable areas	Promote					1					
General Plan		Chapter 9			Utilities	Replanting and hydro seed of native vegetation	Promote			1							
General Plan		Chapter 9			Utilities	Use of porous pavement systems with an underlying stone reservoir in parking areas	Promote					1					
General Plan		Chapter 9			Utilities	Use natural drainage, detention ponds, or filtration pits to collect and filter runoff	Promote		1			1					

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General Plan		Chapter 10			Safety	Protect surface water and groundwater from contamination	Promote										1
General Plan		Chapter 10			Safety	Reduce urban run-off from new and existing development	Promote					1				1	1
General Plan		Chapter 10			Safety	Implement an urban runoff reduction program	Promote		1								
General Plan		Chapter 10			Safety	Increase permeable areas to allow more percolation	Promote					1					
General Plan		Chapter 10			Safety	Use natural drainage, detention ponds, or filtration pits to collect and filter runoff	Promote					1					

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
General Plan		Chapter 10			Safety	Use porous material, whenever possible, for construction of driveways, walkways, and parking lots	Promote					1					
General Plan		Chapter 11			Historical and Archaeological Resources	Require that an environmental review be conducted on all new applications	Promote		1								
General Plan		Chapter 12			Natural Resources and Conservation	Preserve and enhance the natural characteristics of the Santa Ana River, City Creek, and Cajon Creek	Promote		1								

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General Plan		Chapter 12			Natural Resources and Conservation	Promote a pattern of land use which locates residential uses in close proximity to employment and commercial services	Promote	1									
General Plan		Chapter 12			Natural Resources and Conservation	Disperse urban service centers (library, post offices, etc) throughout the city	Promote	1									
General Plan		Chapter 12			Natural Resources and Conservation	Facilitate the development of centralized parking lots	Promote	1			1						
General Plan		Chapter 12			Natural Resources and Conservation	Expand as necessary the mass transit system	Promote	1									

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General Plan		Chapter 13			Energy and Water Conservation	Manage and protect the quality of the City's surface waters and ground waters basins	Promote		1								
General Plan		Chapter 13			Energy and Water Conservation	Require that development not degrade surface or groundwater	Promote										1
General Plan		Chapter 13			Energy and Water Conservation	Consider the establishment of incentives, funding programs, or rebate programs for projects that implement water conservation	Promote										1

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
General Plan		Chapter 13			Energy and Water Conservation	Require the use of reclaimed water for landscape irrigation and other non-contact uses for industrial projects, golf courses, and freeways	Promote							1			
General Plan		Chapter 13			Energy and Water Conservation	Require new development incorporate improvements to channel storm runoff	Promote									1	
General Plan		Chapter 13			Energy and Water Conservation	Continue to inform the public of water conservation	Promote										1
General Plan		Chapter 14			Noise	Provide for the development of alternative transportation modes such as bicycle paths and pedestrian walkways	Promote	1									

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General Plan		Chapter 14			Noise	Require that all parking for commercial uses abutting residential areas be enclosed within a structure, buffered by a wall, and/or limited hours of operation	Prevent				1						
Municipal Code	Title 3	Chapter 3.27		3.27.070	Development Impact Fee	5 acres of land for each 1000 residents within the City be devoted to park and recreation	Promote	1									
Municipal Code	Title 8	Chapter 8.80	Article 1	8.80.102	Authority, Purpose, and Policy	Protect and enhance the water quality of local state and federal water courses, water bodies, groundwater	Promote		1								1

Source	Title	Chapter	Article	Section	Description	Citation	Promotes or Prevents	Mixed Use/ Livable Community.	Preserve Natural Resources	Water Use Efficient Landscapes	Reduce Impervious Cover	Permeable Surfaces	Grey Water Use	Recycled Water Use	WUE Appliances.	LID Low Impact Development.	Water Conservation
Municipal Code	Title 8	Chapter 8.80	Article 5	8.80.501	Construction Requirements	All qualifying land development/ redevelopment projects, shall submit and have approved a Storm Water Quality Management Plan (SWAMP)	Promote		1							1	
Municipal Code	Title 8	Chapter 8.80	Article 5	8.80.505	Construction Requirements	All construction projects which may had an adverse impact on the City's storm water drainage system or waters of the state shall install and/or implement appropriate construction of BMP's	Promote		1							1	
Municipal Code	Title 13	Chapter 13.32	Article 1	13.32.100	Administrative Provisions	City discharges treated effluent to the Santa Ana River Bed	Promote		1					1			1

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Municipal Code	Title 13	Chapter 13.32	Article 1	13.32.100	Administrative Provisions	Effluent can effect the quality of the stream flow	Prevent							1			
Municipal Code	Title 13	Chapter 13.32	Article 1	13.32.100	Administrative Provisions	RWQCB has selected limits on the concentration of biological and chemical constituents of the effluent discharge	Prevent							1			
Municipal Code	Title 13	Chapter 13.32	Article 1	13.32.105	Administrative Provisions	Improve opportunities to recycle and reclaim wastewater	Promote							1			
Municipal Code	Title 19		Article 1	19.02.020	General Provisions	Allow for infill and recycling of areas	Promote	1									
Municipal Code	Title 19		Article 1	19.02.020	General Provisions	Allow for mix-densities in select residential neighborhoods	Promote	1									
Municipal Code	Title 19		Article 1	19.02.020	General Provisions	Maintain and enhance environmental resources	Promote		1								

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Municipal Code	Title 19	Chapter 19.04	Article 2	19.04.030	Residential Districts	Golf Courses-treated effluent shall be used for irrigation where available	Promote							1			
Municipal Code	Title 19	Chapter 19.06	Article 2	19.06.025	Commercial Districts	Prohibit the use of certain stores	Prevent	1									
Municipal Code	Title 19	Chapter 19.06	Article 2	19.06.030	Commercial Districts	Service stations-all parking and loading needs to be constructed with (PCC) concrete	Prevent				1						
Municipal Code	Title 19	Chapter 19.06	Article 2	19.06.030	Commercial Districts	Service stations adjacent to a residential district needs to have a 6ft masonry wall	Prevent				1						
Municipal Code	Title 19	Chapter 19.24	Article 3	19.24.030	Off-Street Parking Standards	Parking spaces may be reduced 25% in University Business Park Specific plan as long as requirements are met	Promote				1						

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Municipal Code	Title 19	Chapter 19.24	Article 3	19.24.040	Off-Street Parking Standards	All driveways and parking areas shall be surfaced with a minimum thickness 3in of asphaltic concrete, concrete, or any City Engineer approved bituminous surfacing over 4in of an aggregate base material	Prevent				1						
Municipal Code	Title 19	Chapter 19.28	Article 3	19.28.030	Landscaping Standards	Concrete mow strips are required to separate groundcover from all other landscaping	Prevent				1						

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Municipal Code	Title 19	Chapter 19.62	Article 4	19.62.020	Nonconforming Structures and Uses	New uses in existing structures may be entitled to a reduction of up to 25% in the number of required parking spaces	Promote				1						
Municipal Code	Title 19	Chapter 19.62	Article 4	19.62.020	Nonconforming Structures and Uses	Chain link fencing not in conformance with Code requirements	Prevent				1	1					

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