SACOG

Item #09-10-8

SACOG Board of Directors — Workshop

October 7, 2009

Rural-Urban Connections Strategy: Water Resources Workshop

Issue: Water resources are an important component of the economic and environmental objectives being studied in the Rural-Urban Connections Strategy project.

Recommendation: None. This is for information only.

Committee Action/Discussion: SACOG hired a consultant to write a background paper on water resources in the region as part of the RUCS project. The paper looks at water issues from a rural economic perspective, as well as provides a general overview of water resources issues affecting all uses in the region. This workshop will focus on the agricultural and legislative aspects of the paper. A full presentation will be given at a future Board meeting. Key findings from the background paper (Attachment A) include:

- Water is used for three purposes: urban, agriculture and environment. How water reaches these users is complex due to many decades of layered water rights, contracts and uses.

- Changes in land use and water demand affect users at the margin, where regionally, land converted from agriculture to urban uses in a given area has little affect on overall water allocations. Locally, those changes can have a large impact on users.

- Water is expensive to transport relative to its value and therefore has large economies of scale. Water supply is scarce relative to demand in many places, but can be consumed sequentially by users. Water is usually priced according to physical delivery costs rather than scarcity.

- Resource limitations are driving arrangements where water transfers from agriculture are used to meet urban demands and some environmental needs. As demand and prices increase, more agriculture land may be fallowed or less water intensive crops may be planted possibly affecting the amount or value of production.

- Environmental concerns, particularly the Delta ecosystem, and the state's response are creating unease about not only water sources for in-stream and Delta needs, but also for agricultural lands that may be targeted for conversion to habitat.

- Water management and efficiency efforts can be enacted through local ordinance, stakeholder agreements such as the Water Forum, integrated regional water management plans, or state legislation to achieve a 20 percent per capita reduction in consumption by 2020. These efforts can reduce urban demand and may reduce pressure on agriculture to transfer water.

Approved by:

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Background Report on Sacramento Area Water Resources

Prepared for
the Sacramento Area Council of Governments
Rural-Urban Connections Strategy

By:

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October 2009

Background Report on Sacramento Area Water Resources

Prepared for the SACOG Rural-Urban Connections Strategy[1]

As identified during the Blueprint process, paying close attention to the synthesis between land use and water demands can produce significant reductions in the incremental increase in water necessary to meet future growth[2]. Without such attentiveness, the pressures felt by agricultural and environmental water users as urban needs expand become magnified — resulting in greater conflict among rural and urban water users and uses[3]. Recognizing the concerns of each of these interests during land use planning allows for smarter growth that can successfully accommodate the needs of all. To provide invaluable context and to highlight critical drivers impacting this synthesis during development of the Rural-Urban Connections Strategy (RUCS), SACOG asked Tully & Young to prepare this *Background Report on Sacramento Area Water Resources*.

This paper serves three primary functions: 1) to provide a brief historical context of water resources available within the broader multi-county area influenced by SACOG; 2) to illustrate the technical, legal, regulatory, political and economic drivers that have recently and will continue to influence management of regional surface and groundwater resources, and thus influence rural issues addressed in RUCS; and 3) to provide a grounding for the understanding of agriculture's concerns about the inherent costs and reliability of sustainable water supplies associated with continued increase demand from urban growth pressures and environmental requirements.

If the reader is to take one single idea from this document, it should be the following: *Water resources can be extremely complex and highly context-dependent.*

From historical dependencies in the legal framework of water rights, to the difficulty in predicting outcomes of water-related lawsuits, to the unique economic and emotive properties of water, to the multiple attributes that determine the value of the resource, to the inherent physical

[1] The Sacramento Area Council of Governments' Rural-Urban Connections Strategy is intended to be an economic and environmental sustainability strategy for rural areas, similar to how the Blueprint is an economic development strategy for urban areas.

[2] When compared to a future baseline of land use and housing products that tend to mimic today's higher per-dwelling unit water demands, Blueprint indicated water demands could be reduced by at least 30 percent.

[3] Rural areas predominately use water to sustain agricultural businesses. This is contrary to most of the urban use of water, which is to sustain a livability and to facilitate business functions. On average, 60 to 70 percent of urban water demand in the greater Sacramento region fulfills residential needs – needs for landscaping and indoor use. Of the fraction remaining, only a small percentage is actually part of commercial or industrial services. Most is used for non-residential landscape and "domestic" uses at businesses, such as bathrooms.

variability of the resource, to geographical and physical limitations imposed by the physical nature of water, understanding and addressing management of water resources for multiple interests is a unique challenge.

People have long realized in concept the interconnectedness of the physical and institutional drivers of complex water problems, but are only now grappling with integrating them in planning. While there are no one-size-fits-all solutions to the issues that SACOG and its members will inevitably face during the development of RUCS, careful consideration and a holistic approach to planning can help craft durable solutions to the problems that will arise as the Sacramento region grows and changes.

1 – Historical Perspective

In 1848, James Marshall made a discovery along the south fork of the American River that would change the use and management of water resources derived from the Cosumnes, American, Bear and Yuba rivers forever. People flocked westward to search for gold, eventually developing techniques for mining that used huge quantities of pressurized water. In addition to the dams, canals, flumes and other infrastructure, a system of surface water rights grew out of the desire to protect those who made the first investments to remove water from streams for use in the new mining techniques. The influx of people increased the need for water to search for gold, to grow crops on the fertile soils and to serve the ever-growing communities. As people stretched beyond the feasible reach of rivers, they built more complex diversion and distribution systems and learned to tap the primed aquifers that often lay within several feet of the surface.

Over generations, public agencies formed to manage many of the surface water storage, diversion and distribution systems, first for agricultural and mining uses, but over time, more and more for urban needs. This was especially true for the American River system. When the federal government sought to help Sacramento with managing floods, they built new dams that also became a critical part of the Central Valley Project — serving people and farms throughout the Central Valley, including a significant number of the current water purveyors serving the urban needs within SACOGs boundaries.

Over the past few decades, competition for the surface and groundwater resources in and around the Sacramento Metropolitan region has increased significantly — especially as demands have grown throughout the state and interests often look upstream for easy answers. Because of the seniority in water rights held by many of the agricultural and urban water purveyors in the area, water supplies locally have not been a significant concern — until the last decade. This conflict is noticeably pronounced as the state faces critical drought conditions while at the same time debate rages over the construction of a canal to transport water supplies around the imperiled Delta.

1.1 Significance of water history

The history of water development in this region helps explain the complexity, and sometimes seeming irrationality, of water resources management in California. The development of today's water infrastructure, laws and institutions was largely a haphazard affair that built on the conditions existing at each era, rather than a series of clear planning processes that weighed the issues. (Efforts such as RUCS are a very recent development, and remain the exception rather than the norm). This historical progression has to a large extent constrained and directed water resources management and development and will have a unique impact on the RUCS project.

It is relevant to note that water law is a very slowly progressing branch of the law, for a circular reason — cases take many years to run to completion, and there is very little case law on which to draw precedent. Therefore, water lawsuits are high risk, and parties often settle out of court, further contributing to the dearth of case law. This is reflected in a very conservative and risk adverse culture among water managers — especially those who have long managed water supplies predominantly serving agricultural interests. Finally, it is also relevant to note that the history of California water is a history of urban-rural tensions, with more recent environmental considerations further completing the story. An overly-brief synopsis of water law is included as *Attachment 1* to this paper.

1.2 Local Water Budget Conditions:

In the abstract, the significance of this historical context is difficult to grasp. To help, Figure 1 provides an annual snapshot of urban, agricultural and environmental water uses (A) and the water sources (B) that were used to serve the demands. These water budgets — adapted from California Department of Water Resources data – represent the six individual SACOG counties in 2003, a representative water year with slightly above-average supplies.

It is important to note that while these data provide important big-picture information, they must be treated with caution. First, as described elsewhere in this report, the technical, scientific, and institutional details are often critical to understanding even the big picture. For example, portions of "environmental flows" represent water left in rivers and streams for ecological reasons, which may have originated in other counties and be going to uses further downstream. Other portions represent water that is used consumptively, such as in evaporation and transpiration from wetlands. Thus, within each category multiple types of "demands" on water supplies are represented.

Second, although these figures are rough proxies for supplies and demands, they do not represent those concepts in the economic senses of the terms. Rather, they are a snapshot of annual water supplied, and the uses to which that water was put (e.g., more demand and/or supply may have been present, or groundwater may have been "mined" to serve a demand seen in that year). Nonetheless, while drawing strong conclusions about potential future water supplies and

demands from this snapshot would require more detailed analysis, some important coarse-level inferences can be seen:

- There is great variation among the counties within the SACOG region in supply sources and uses of water. Each county will face a unique set of challenges as land use changes in coming years. These variations stem from the historic development of the water rights and uses over decades.
- Water use is dominated by agriculture in four counties (Placer, Yuba, Sutter, and Yolo), and is more evenly distributed among the categories in Sacramento and El Dorado.
- Groundwater is a significant part of the water supply throughout the SACOG region. Yolo County is the most reliant on groundwater, at 40 percent of deliveries.
- Generally speaking, local water supplies are those surface water resources that originate in watersheds or run through the particular county and are rights held by the local water purveyor. Contract water represents water rights held by the state and/or federal government and delivered to local purveyors under a contract agreement. For instance, for several counties, the Sacramento River represents both a source of contract water and local water, depending on the water right associated with the diversion and use. The situation on each of the local rivers and streams — including the major sources such as the Sacramento, American, Feather, Yuba, Bear, Cosumnes, Putah, and Cache — is unique for each water course.
- Sacramento and Sutter counties rely on substantially larger amounts of contract water than the others. This is significant because deliveries from the State Water Project (SWP) and the Central Valley Project (CVP) have been historically unreliable, as evidenced by operations during the current drought. [*Note that CVP supplies are primarily derived from the Sacramento River watersheds, although some of this also is from the American River watershed, while SWP supplies are fully derived from the Feather River watershed.*]
- El Dorado County has the highest proportion of contract water supplies at about 50 percent, and has the smallest proportion of local supply at 8 percent. However, most of the contract water is a reflection of an agreement between county water rights holders and the federal government recognizing the county's historic local rights on the American River.
- Sacramento County has the greatest diversity in both supplies and uses. This may indicate a more robust water portfolio.
- When considering the potential impacts of land use change, current water uses can be revealing. With the exception of Sacramento County, increases in urban water use would have to be very large to significantly affect any particular county's proportion

of agricultural to urban water use. Conversely, modest percentages of agricultural water use efficiencies could provide a buffer for large urban demand growth. Though this may seem in contrast to what this paper details regarding the competition for limited water supplies, any one particular section of land that may be facing urban growth pressures most likely sees the issue differently than when looking from a countywide perspective.

Note that while this observation is an easy one to make, water use may not be a zero-sum game in practice. As discussed throughout this report, attempts to manage change can be complex given the institutional constraints on water rights and transfers.

- The quantity of environmental water use, though seemingly large, is mostly water passing through each county as in-stream flows and becomes part of the supply to the next downstream county.

Overall, the trend in many of the counties that comprise SACOG, urban demand is growing, but agriculture is not necessarily diminishing in a like manner and in some instances, new irrigated farmland is being brought into production (e.g., vineyards) where non-irrigated grazing land previously existed. Environmental use, as represented in Figure 1, has not varied significantly. Instead, what have varied are the regulations and edicts that require water to remain in-stream, dedicated to riverine habitat benefits.[4] Absent a more complete data set going back decades, any particular trend in water use throughout the collective SACOG region cannot be determined.

With the historic context and recent water budgets as a starting point, the remainder of this paper will discuss the array of factors that affect on-going water management decisions, with noted focus on affects to rural areas and agricultural interests.

Types of water use

To understand many of the factors discussed in this paper requires an understanding of water use in general. For the purposes of this document, water use can be divided simply into consumptive use and return flows.

Consumptive use refers to water that is not available for re-use because it evaporates, transpires, becomes embodied in another product, or has its quality impacted. Return flows refer to the portion of water withdrawn from a stream or aquifer that is used for some purpose and subsequently flows back into an available supply via treatment and return to a stream, through surface runoff, or infiltration to groundwater. It is worth noting that water quality of return flow is generally degraded compared to the water that was originally withdrawn for its use. Partly

[4] For instance, the Sacramento Water Forum requires water to remain in the American River under certain circumstances, but the environment's demand has not changed and the historic conditions are not significantly different than what this agreement is mandating for the future.

because of this, water quality generally decreases when moving downstream through communities.

A typical categorization of water uses at a coarse scale would be between urban, agricultural, and environmental purposes. This framework is useful and relevant when evaluating a region's future growth. Each of the three areas may have agencies and stakeholders with unique and conflicting interests. As land use change proceeds, water use can change in terms of its total amount, but equally important, the proportions of water use in each category can shift, with implications for management and planning.

In the Sacramento region, approximately 60 percent of the water delivered for urban uses is consumed — primarily as evapotranspiration of landscaping and evaporation. About 40 percent returns to surface streams (as treated wastewater discharge and gutter flooding return flows) or to groundwater aquifers via deep percolation of over-applied irrigation water.

Agricultural use tends to have even higher consumptive use than urban — on the order of 70 to 80 percent — but variations between crop types, irrigation methods, and management styles results in wide-varying values on a farm-to-farm basis. For agriculture, unlike urban landscaping, most crops have physically defined water use needs that have to be met to produce the economic output (i.e., to generally produce a ton of tomatoes, a set amount of water must be consumed by the plant). Landscaping is a choice with no physical economic output, thus different choices can be met with different quantities of water.

Unlike the other uses, environmental use generally does not consume water — with the exception of wildlife refuges.[5] Instead, the use represents water dedicated to remain in the streams and rivers.

Though approximately represented in the water budgets shown in Figure 1, the data to really comprehend the water supply and demand attributes in any given boundary is not readily available or readily compiled. The unique nature of water rights, groundwater use and basin conditions, as well as historic and planned uses confounds many efforts to provide a regional picture. Nonetheless, further analysis can be applied to the SACOG region to understand in more detail how various, defined sub-areas use and supply water.

The Association of California Water Agencies (ACWA) recently proposed a conceptual model for partitioning water demand between end use categories. "Business use" would encompass a broadly defined category of economically profit-driven enterprises, including use of water for industry, agricultural, and related services. "Quality of life use" would include landscaping and indoor use by private homeowners, as well as use for parks and recreation and other services aimed at non-business users. Note this conceptual model is novel, but could provide a useful

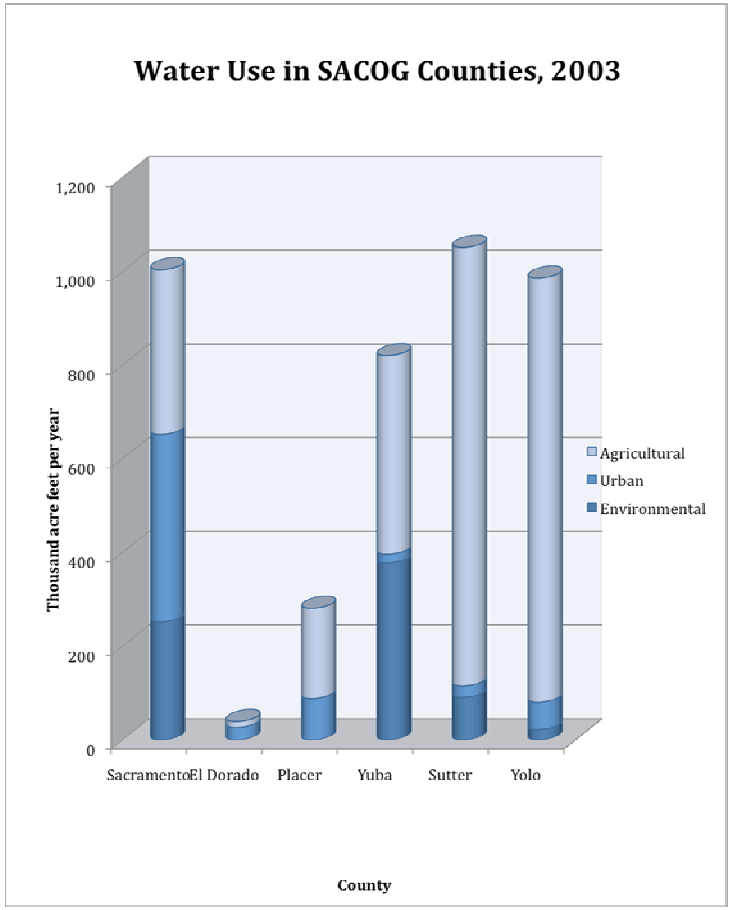
[5] Sutter County is the only county within the SACOG region with significant refuge water demands.

framework for targeting water use efficiency measures by more accurately categorizing the potential impacts of water conservation measures. For example, ordnances to require low-water landscaping or low-flow fixtures in new or existing developments may have a perceived impact on residents that can be weighted against programs that require efficiency measures and have direct or indirect costs to businesses.

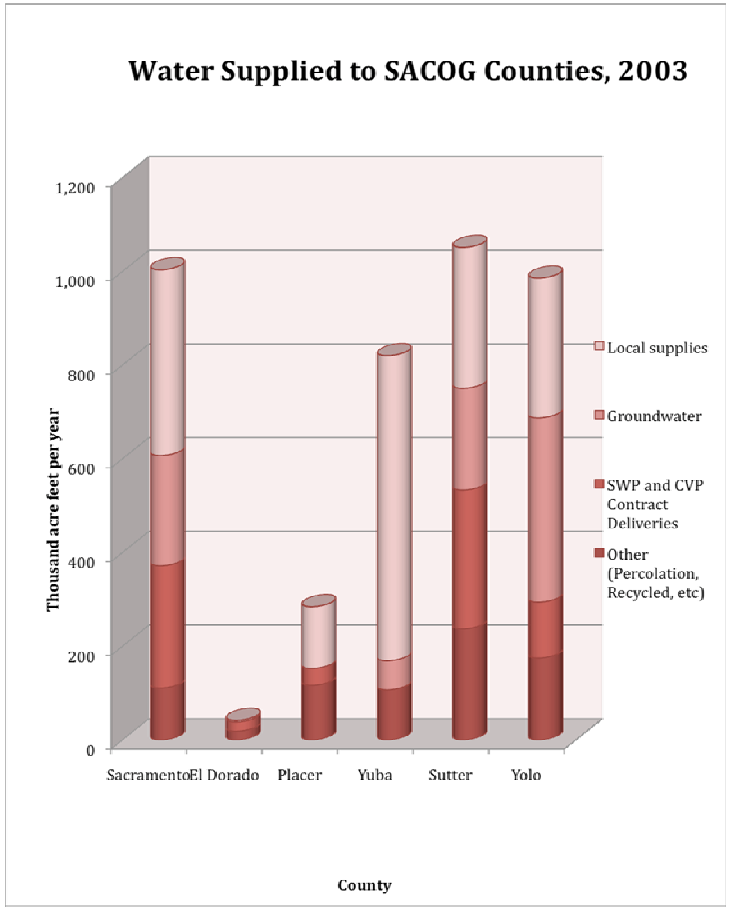
One useful result of the ACWA framing is that it leads logically to thinking of water not in terms of physical quantities, but in terms of the goods and services that humans value it for.[6] For example, a residential water user may not actually care if they are served 25 gallons of water or 13 gallons of water when they turn on their washing machine. They are interested in the resulting product: clean clothes. Similarly, a semi-conductor fabrication plant may not be as concerned about how many gallons of water they use, especially compared to other, more expensive inputs when their main goal is to economically maximize chip production. These issues and the demand for water manifests, though, when questions are raised as to the value of water-demanding landscaping in an ever-increasing environment of limited supplies.

[6] This is a concept often articulated by Dr. Peter Gleick of the Pacific Institute.

Figure 1 – Representative water budgets for each of the six SACOG counties for 2003
(data and categories from the California Department of Water Resources)



A) Water uses: urban and agricultural use is from sources shown in the figure to the right and used to meet consumptive use, while environmental water is generally for in-stream flows originating within or flowing through the county.



B) Water supplied: local supply is surface water originating generally within the watershed of use under water rights owned by local entities or individuals. On the Sacramento, Feather and American rivers, this watershed also contains contract supplies under rights held by the state or federal government.

2 –Drivers of Change

The sections that follow provide a brief overview of various key aspects of water in California. Though far from comprehensive, the discussion represents the critical factors that play into the complexity of water resources planning and decision-making — an important function for RUCS — and why a truly integrated approach to water resources is both essential for sound planning, and very difficult to do well.

2.1 The Changing Land Use Landscape

Primary to the need for integrated planning is the often-voiced concern from agricultural interests that urban growth is creating a slow, but steady erosion of both land and water away from agriculture — a business enterprise — to housing. Agricultural interests know population growth is inevitable and some can picture a future where agricultural productivity immediately around major metropolitan areas is greatly diminished as water is instead used to serve urban needs. While there are examples of this, it is likely an oversimplified representation, but illustrates existing concerns and, thus, a desire to aggressively defend both historic land and water uses.

Over the past several decades, the Sacramento region has expanded outward into otherwise rural areas. Some of this development occurs where little agricultural productivity was occurring (e.g., Folsom), while other developments converted productive agricultural land into urban uses. This change in land use has an associated change in the pattern of water use. For instance, a typical farming operation will use water in accordance with the needs of the crop — more in the hot summer, less in the spring and nothing after harvest and through the winter. That means that the demand for surface or groundwater for three to five months of the year did not exist. In contrast, people need water year round. Though over half of the water supplied for urban uses is to meet the "crop" demand of landscaping, serving the "people" portion of urban use has spread the demand for water into all months of every year. These baseline pressures impact the operation of many of the facilities design to serve agriculture — from reservoirs in the Sierras to canals that route water around the region — by changing reservoir release patterns, affecting the timing of routine maintenance, and increasing the "response" by water purveyors to issues[7]. The magnitude of this change has yet to be significant enough, however, for most agricultural interests to be affected, as serving agricultural continues to be the largest need.

The increased pressure from land use changes has also increased the competition for groundwater, especially during dry years when surface supplies may be short. Since agriculture always had the option of not planting (or limiting planting) during dry conditions, shortages could be managed, although with economic consequences. With the change to baseline urban

[7] As a purveyor begins to serve urban demands as well as agricultural, the number of customers increases exponentially (e.g., with hundreds of customers where there was once only a few) with an accompanying increase in the demands and responsibilities on staff and resources.

demands and the inability to cease delivery under shortages, many urban water purveyors are protecting themselves with new groundwater wells — or programs that ask others to pump groundwater in exchange for limited surface supplies. Tapping groundwater during dry conditions simply increases the pressure on the groundwater basin that underlies the entire region — to the potential detriment of historic groundwater users, such as agriculture and rural homeowners. The groundwater basin under many of the counties in the SACOG region has generally been able to respond to these varied pressures, but could begin to see lowering groundwater levels (increasing the pumping costs) and ground subsidence — issues that have been experienced in the past and, in some remote areas of the six counties, are occurring today.

Many urban purveyors recognize this issue and have developed groundwater management plans. While these plans are focused on urban supply needs, they may also help manage supply for rural uses as well. Initially, many of these plans were simply "check-the-box" efforts to satisfy state legal requirements. Today, however, several coalitions have formed to study and manage the basins. Most have the following objective: protect groundwater quality and levels to ensure a safe and reliable groundwater supply. Efforts to engage affected agricultural interests have been included, although generally more in an informational rather than partnership role. Going forward, direct partnerships with agriculture will be crucial for successful groundwater management. These partnerships can help educate all stakeholders on the impacts of their own pumping as well as help manage or mitigate the potential impact on one another. The Sacramento Groundwater Authority is one example of a successful comprehensive partnership[8].

One significant shortcoming of the changes occurring to land uses around the greater Sacramento metropolitan area is the general lack of communication — or even interest — between the long-range planning activities of water purveyors and those of land use planners. As has been the case throughout the state over the past several decades, land use planning often dictates the type and location of urban growth indifferent to the water resource implications. In turn, water purveyors often react to the plans, rather than influence them.

As water begins to get more attention, this necessary synergy between land and water planning is gaining a foothold. SACOG's Blueprint was an example of how communication can begin. Additionally, newer state laws such as SB 610 and SB 221 (enacted in 2001) require urban areas to assess the sufficiency of water supplies available for new growth. When groundwater is part of the intended urban source, these planning analyses must also assess the ability to meet all demands on the basin — including the existing and future agricultural demands. These planning documents are increasingly becoming a critical step in land use approvals and an opportunity for agricultural and rural interests to raise critical concerns and seek collaborative solutions (e.g., the Sacramento Central Groundwater Authority).

[8] The Sacramento Groundwater Authority is a joint powers authority joining 14 water purveyors together who use groundwater resources north of the American River to the Sacramento County line. Their mission is to help manage and protect the groundwater resources in the basin, consistent with the Water Forum Agreement.

Compounding the communication gap between urban land and water planners is the gap between urban interests and agriculture. Through mechanisms such as SB 610 water supply assessments, agricultural interests are learning that they can play an effective — although unfamiliar — role influencing land use decisions. One growing point of contention by agriculture is that development should "pay its own way" with water rather than stripping it from local agriculture. Promoting water recycling, urban water conservation, new storage facilities, conjunctive management and other tools to introduce new supplies or better use existing supplies is likely to be a growing mantra from engaged agricultural interests as growth pressures continue into the future. As providing adequate water supplies becomes more challenging, regional analysis and coordination will become increasingly important to maintaining adequate supply for all users — including the often under represented environmental uses.

2.2 The Economics of Water

A discussion of the economics of water resources first needs to address the question "Why is water different?" Water is different from other commodities because it has distinctive emotive, physical, symbolic, and economic features.[9] The Dublin Principles consider water an economic good, and in the claims of some scholars, water is no more a necessity than food or housing, and should be treated as such economically. Others view water as a public trust and fundamental human right. Both views have merit, and the reality lies between them. Water is different partly because it is perceived as different, and because it has certain distinct economic features.

- The physical, legal and economic properties of water lead to incentives to collectivize water provision.
- Water is mobile, and while some use is consumptive, it can also be used sequentially for multiple different uses. Sequential use is very prevalent within the agricultural sector surrounding Sacramento. This occurs when the runoff from one farmer's irrigation becomes part of the source water for the next downstream user.
- Water is expensive to transport relative to its value, leading to sparse infrastructure networks compared to higher value liquids such as oil. It is cheap to store once infrastructure exists. In this, different provision strategies apply than for electricity, for example, such as stockpiling instead of generating new amounts of the resource.
    - Naturally occurring groundwater is one of the most economical storage and retrieval infrastructures available, but increasing pressure on groundwater sources is lowering water tables, forcing more cost to lift the water back to the surface. This is particularly burdensome to agriculture which tends to operate on thin margins and fluctuating commodity markets.

[9] This section draws directly from: Hanemann, W. M. (2006). The economic conception of water. *In* Water Crisis: Myth or Reality? P. P. Rogers, M. R. Llamas and L. M.-C. (eds.), Taylor & Francis: 61-91., and from Sax, J. L., B. H. Thompson Jr., J. D. Leshy and R. H. Abrams (2006). Legal Control of Water Resources: Cases and Materials, Fourth Edition. St. Paul, MN, Thomson West..

- Tracking flows can be difficult, leading to difficulty in establishing property rights or enforcing excludability.
- Water has large economies of scale and capital intensity, which again leads to large surface storage projects or treatment plants. This also leads to natural monopolies, and thus to the necessity of state control or strict regulation of its provision.
- Like land, water benefits ecosystems when left undisturbed by humans. Unlike land, water's mobility and renewability means that humans can use it after or before its ecological benefits have been realized.
- Legally, in the Western United States as elsewhere, water is distinct from other commodities. This reflects some of the properties of water described above. There is no ownership of water, per se, rather usufructuary rights — water is in effect owned by the state and given away for free to those who have rights to use it. Thus, water rights are not property rights in the sense of other commodities.
- Water is scarce in many places relative to demands on the resource, whether in an absolute sense because of limited hydrology or in the sense of its actual availability because of the lack of sufficient infrastructure or different distribution spatially or temporally from points of demand, or as a result of regulatory constraints.
- Economically, water is usually priced based on its physical supply cost, rather than scarcity value. In addition, there is a tendency to under-price water partly because of public resistance to rate increases because of the perception of water as unique, but also because agencies tend to price water based on historic rather than replacement cost of infrastructure.
- Water is an essential good, with no substitute as an input to production, but it is the additional uses of water (such as swimming pools) that determine its marginal value.

Many of these aspects of water's uniqueness lead to sensitivity to political and institutional arrangements. If rules are simple, devised locally, transparent, with monitoring and enforcement cheap, and sanctions for non-compliance and fair adjudication, collective action is more likely to be successful in water allocation. Unfortunately, this is not always the case. Furthermore, because of the generally better funded urban users, agriculture often sees itself at an unfair disadvantage.

2.2.1 Water transfers in promise and practice

Prevailing wisdom is that the value of water will only increase as competition increases from urban, agricultural, and environmental customers. Indeed, evidence suggests that urban areas have been willing to invest large amounts to secure water through major investments in infrastructure, conjunctive use arrangements between surface water and groundwater, and other mechanisms. Water sales have been a part of this mix, but perhaps not as much as might be expected on purely economic grounds. In contrast, many of the agricultural interests within the

SACOG area made similar investments decades ago and now are the focal point for urban (and agriculture south of the Delta) as potential sources of new opportunities.

Often the willingness of urban investments are pricing agricultural interests out of the market for new or reliable supplies, which can have a detrimental effect on the economic viability for agriculture, especially within the zones of urban growth pressures.

Studies of water markets in California[10] suggest that there is agreement among a broad range of stakeholders that water markets offer a potential mechanism to increase the economic efficiency of water allocation over the current method (i.e., allow those holding senior water rights to move water to more junior water users). The relatively few large water transfers that have been successfully completed, however, do not support this intuitive assertion.

One of the fundamental economic concepts motivating water transfers is that the value of water resides in reliability (or perceived reliability) of supply, rather than simple quantity. This is reflected in the importance of dry year options in water trades, where a party can buy the right to exercise a water trade in drought years — often by asking agricultural users to fallow land or to pump groundwater instead of using senior surface water rights.

Until recently, the consensus on water marketing seemed to be that fundamental changes will have to take place before water marketing meets the hopes and expectations of many in the academic and water management communities. One of the key factors is the ambiguity in water rights quantification in California — if one cannot demonstrate clearly the right to water, including its past use, then one cannot sell that water. For instance, if a water right is held for 100 units of water, but the historic use (e.g., crop consumption) is only 60 units, then only 60 units can "legally" be sold. The remaining units are assumed to still be in the surface water system and available to downstream users as was the case prior to the proposed transfer. For many agriculturists, this would require fallowing of land or shifting to lower water using crops to make water available, rather than looking to water conservation and efficiency improvements, as these are not viewed as creating saleable water that can transfer to another user in another place in the Sacramento Valley[11].

Since clear quantification of water rights is the first prerequisite to transfers in a fully allocated system, this presents a hurdle to wider use of transfers due to the limited availability of

[10]For instance, the Public Policy Institute of California – California's Water Market, By the Numbers, Ellen Hanak, 2002

[11] It is possible for efficiency improvements that save water to create more available supply within the same designated place of use defined in the underlying water right. The California Water Code allows current right holders to improve their beneficial use of water within their service area, even if it impacts downstream (and/or junior right holders). In contrast, any attempt to move the same water generated through efficiency improvement to a new service area would be disallowed because of the same injury to other legal users of water (e.g., the "move" to a new use is viewed as now the most junior use of a right and therefore, the injury to another user is viewed as legitimate).

documented uses. Other hindrances to water markets include high economic and political transaction costs, third-party effects (e.g., effects on ecosystems, other rights holders, downstream users), situational dependence of each transaction, and the regional nature of water systems that limit the size of regional markets. Further obstacles include veiled speculation and constraints on transfers of water from large publicly funded water projects.

However, one cannot tell the future, and a tipping point can be imagined in the sense of a change in water law, perhaps precipitated by a perceived crisis in water supply brought on by a combination of urbanization, increased dedication of water to environmental needs and drought. This is a primary fear of the agricultural industry — wherein individual right holders' ultimate sell water to urban areas and diminish the supply for production of food and fiber.

A study of historical records of external water transfers from 1990-2003[12] concludes that leases accounted for more of the water changing hands than sales. Sales are by far most commonly made from agricultural to urban buyers. Urban interests have purchased most leases and sales, but a significant number of single year leases are to irrigators or environmental organizations. Municipal water is bought for higher prices than agricultural or environmental water. Prices for both sales and leases have been increasing, as one would expect for a finite resource under pressure from more restrictive uses and increased demands. This has increased the incentive to fallow agricultural land and sell into the water market. Efficiencies in urban use as demonstrated in the Sacramento region's Blueprint and in best management practice efforts can help temper urban water purchases going forward potentially reducing the pressure on agriculture to supply water.

As an illustration of the latest trend in single year leases, this year's Drought Water Bank, being run by the California Department of Water Resources on behalf of the CVP and SWP contractors south of the Delta, has set a price of $275 per acre-foot for transferred water. However, even at this price, there is not significant participation due to a few primary factors: (1) the commodity price for rice is high, so only limited acres of rice land is being fallowed, (2) the rules and restrictions on groundwater pumping are tedious for many smaller water right holders, (3) CVP settlement contractor allocations initially were lower than expected, meaning many were not sure if they would have "extra" water to sell, and (4) the Drought Water Bank is only able to buy water in July through September, a small window that adversely affects how agriculture may operate to either fallow land or substitute with groundwater.

Originally expecting to help with several hundred thousand acre-feet of water, the Drought Water Bank is now expecting to purchase less than 100,000 acre-feet and may end up with only around 60,000 acre-feet.

[12] Brown, T. C. (2006). "Trends in water market activity and price in the western United States." Water Resources Research **42**(W09402): doi:10.1029/2005WR004180.

2.3 Recent and Prospective Local, Regional, and Statewide Regulations and Legislation

Many pressures are being brought onto local water purveyors — often as a result of urban development pressures and land use changes — but also to address the growing sentiment that we divert too much water from our environment and need to embrace more sustainable approaches. Through state and local laws, mandates and regulations, water purveyors are increasingly discovering the need for comprehensive planning. Examples range from Folsom's Measure W intended to protect existing water supplies from being used for additional urban growth, to water conservation reporting requirements that can effectively keep purveyors from accessing state bond resources (e.g., the California Urban Conservation Council's BMP reporting is required for access to state water conservation grants).

From agriculture's perspective — the predominant holder of senior water rights — many of these efforts to impose new regulations are attacks on their water rights and thus on their right to be in business.

Some of these issues are briefly addressed in the following subsections.

2.3.1 – Local ordinances and mandates

A myriad of local ordinances exist around the region that can affect how water resources are managed locally, regionally and statewide. One example is Sacramento County's ordinance requiring its approval prior to the transfer of surface water supplies to any point outside the County (SCWA's Code 3.40.090).

Another example is an ordinance by the City of Visalia (Chapter 16.54) which levies a fee on new developments and a volumetric charge on existing urban customers to help manage and mitigate the impacts of the City's use of groundwater resources. In this instance, the funds collected are used to pay for actions such as new groundwater recharge basins, acquisition of surface water and other functional management tools.

When addressing growth into existing rural areas, ordinances can successfully be used to dictate types of development products, require adherence to conservation objectives, direct landscaping characteristics, and even mandate sources of water, such as non-potable, for use on residential landscaping.

This paper did not intend to list all the ordinances, but rather to note that each local jurisdiction, whether municipal, special district or other, can enact ordinances, pass mandates and generally affect the relationship between land and water use. Though often these ordinances are used by urban purveyors, they are also a tool available to agricultural water districts to help dictate encroachments into their service areas. For instance, an agricultural purveyor could require that a new urban development within its service area that might use groundwater should offset that use

with recharge programs to maintain a beneficial use of the surface supplies otherwise used on the lands. Though these tools are available to agriculture, they generally are not used aggressively.

2.3.2 – The Water Forum Agreement and Local Environmental Needs

As people become more aware of the effect of our water use on the local environment—especially urban use—pressure is put on water purveyors and thus residents to change their behavior.

As noted on the Sacramento Area Water Forum's website:

> *The Water Forum has successfully joined together water purveyors, environmentalists, agriculturalists, business leaders, along with city and county governments in Sacramento, El Dorado and Placer counties in a monumental agreement to secure the future of the Sacramento region water supply to the year 2030.*

This effort, though, took several decades to negotiate and millions of dollars to design. It will cost millions more to fully implement.

What is instructive from the success of the Water Forum is that parties agreed that collective changed behavior will be necessary as this region continues to grow in order to protect the environment. SACOG's Blueprint is another excellent example of a multi-jurisdictional effort to understand how regional growth can be accommodated while protecting many of the environmental attributes of the region.

2.3.3 – Delta and Statewide pressures

If you live elsewhere, you might view the Sacramento-San Joaquin Delta as the hub of California's water system, an interconnected complex of channels through which water is routed on its way to the demand centers of Southern California and the Central Valley in which several endangered and threatened species live. Some members of SACOG would also refer to the Delta as home.

The Delta has been a contentious nexus for statewide conflicts over California water for over 150 years. Immense energy has been spent attempting to construct durable solutions to the Delta's dilemma as an intersection between agricultural, urban and environmental interests.

Although many water users in and upstream of the Delta enjoy senior water rights or water rights seemingly protected by "area of origin" statutes, efforts such as the Delta Vision are beginning to ask whether those rights are prudent. Agricultural interests are by far the largest holder of these water rights and are growing ever concerned with these questions of their rights.

The state of California is under extreme pressure to supply water to its contractors, as is particularly evident during the current drought, and environmental interests are seeking water

supplies to improve the vitality of the Delta ecosystem and upstream watersheds. Implications of curtailment of SWP and CVP contract water sent to the San Joaquin Valley, the Bay Area and Southern California, as has been the case in during the last few years, may cascade upstream to the Delta, and through the water rights system in general.

The public trust doctrine discussed in the Delta Vision Strategic Plan infers that the government can maintain certain resources for the use of the public. This doctrine has been used successfully to assert public interest in environmental factors, such as the Mono Lake restoration efforts. However, the public trust doctrine contains provisions for not only environment but also commerce and navigational uses, which complicates determination of "public good."

The risk from the perspective of water rights holders in the Sacramento region is that these legal theories have not been thoroughly tested in court or in the political sector. While wholesale challenges to prior appropriation and area of origin protections would be considered revolutionary by many, broader statewide pressures may continue to push this question forward until something gives.

Since there is inevitably a political component to legal and regulatory risk, these risks may be exaggerated in places with a reality or perception of wasteful water use (e.g., the *Sacramento Bee's* illustration of many water purveyors in the Sacramento region being wasteful). While such direct risks to water rights are admittedly outside the realm of previous experience, there is reason to expect that such changes may be on the horizon, and prudent planning dictates examining and understanding these risks and developing strategies to react and, if necessary, re-manage.

Currently, efforts by several state agencies under the Delta Habitat Conservation and Conveyance Program are looking to solve the multi-faceted Delta issues through the proposed construction of an isolated canal to route water around the Delta, significant improvements to fishery and riparian habitats in critical sectors of the Delta (e.g., Yolo County) and address the responsibilities of all water right holders to maintaining the health of the Delta ecosystem. Several of the activities being contemplated will have direct impacts to local water supplies and agricultural land uses, especially in the Yolo Causeway.

2.3.4 – Water Use Efficiency

The concept of water use efficiency as a water management tool has been gaining momentum. With this year's drought emergency and last year's Executive Order calling for 20 percent reduction in per-capita use by 2020, the tool has been given center stage.

However, hurdles exist in its implementation, even in areas where water use efficiency could be feasible using accepted cost/benefit calculations. As shown in Figure 2, the participants in the Sacramento Area Water Forum have been able to reduce their per-capita use — albeit only

slightly — over the last few years. But during the same time, overall growth in water demand increased markedly.

Figure 3, developed by the *Sacramento Bee* for an article in June of 2008, shows additional specific information on regional trends in per-capita use. For comparison, the same Sacramento Bee article indicated the state's average is about 165 gallons per capita per day (GPCD), with Los Angeles around 135 GPCD, whereas purveyors around the Sacramento region were shown to consume well over 200 GPCD and even as much as 400 GPCD. Although this figure was derived with data from the purveyors (as listed), any particular purveyors' calculated GPCD value is a function of many discrete data points and can easily be misrepresented[13].

Regardless of the actual GPCD value for any particular purveyors in this region, the implication is that statewide (and legislative) pressures may call on our region to see dramatic reductions. Can these savings be generated? Can the savings be used to accommodate the anticipated growth while preserving other supplies for agriculture? These and other questions will be front-and-center for many local jurisdictions and regional planning efforts as they contemplate the region's future.

Barriers to water use efficiency

The concept of valuing the goods and services rather than water itself, as discussed at the end of Section 1, may seem self-evident, but it represents a paradigm shift. This shift is relevant both in terms of consumer behavior and from the perspective of water purveyors.

To some degree the system of appropriate water rights, as discussed previously and outlined in Attachment 1, creates disincentives to conservation at the scale of water rights holders. Because of the doctrine of adverse prescription, water rights can be lost if water, unused by the original rights holder and left in the stream is then used by another for a period of time. This creates a strong incentive for water rights holders to use their full allotment of water, even if technology is available for more efficient generation of an end product. Efforts have been made to circumvent this particular consequence of water law, but they tend towards individual negotiated solutions in the course of water transfers rather than comprehensive changes.

Again, in contrast to urban uses, water efficiency in agriculture is an economic consideration to most cost-effectively provide the crop its water. With low-cost water generally prevalent in the Sacramento region, efficiency measures for urban uses have different drivers.

[13] For instance, the value shown for the City of Folsom is derived by including the total water supply reported by Folsom, at least 10% of which is supplied as a raw water source to Aerojet. Using the total water supply divided by the population without removing the non-potable delivery to Aerojet presents a higher per-capita water use. Also, the City of Folsom, subsequent to the Sacramento Bee article, discovered that its primary meter has been inaccurately reporting flow values – estimated to be 8% to 12% higher, on average, than what is actually flowing. The manufacturer and the City are working on solutions.

Figure 2 – Water use trends as reported by the Sacramento Area Water Forum in the Years 5 and 6 Water Conservation Report (accessed from: www.waterforum.org)

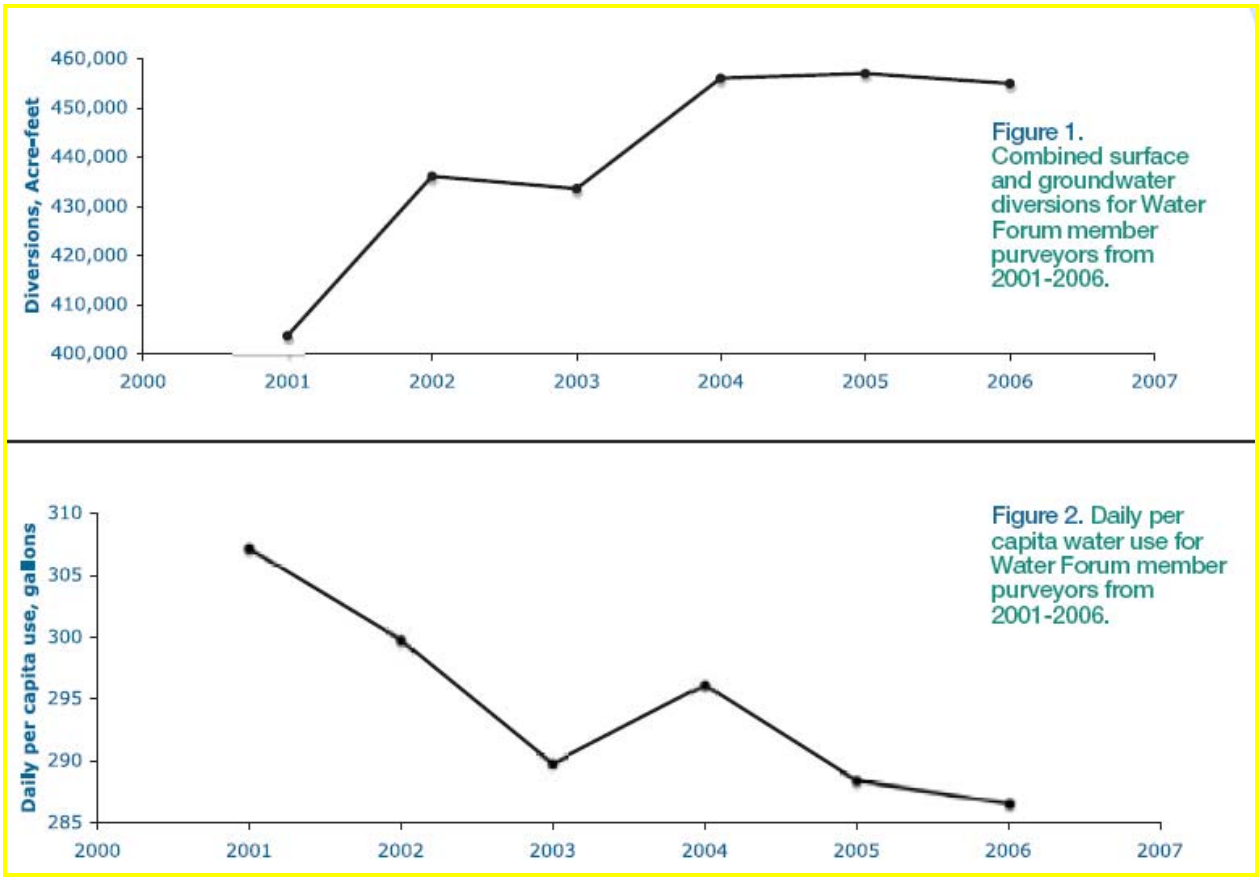
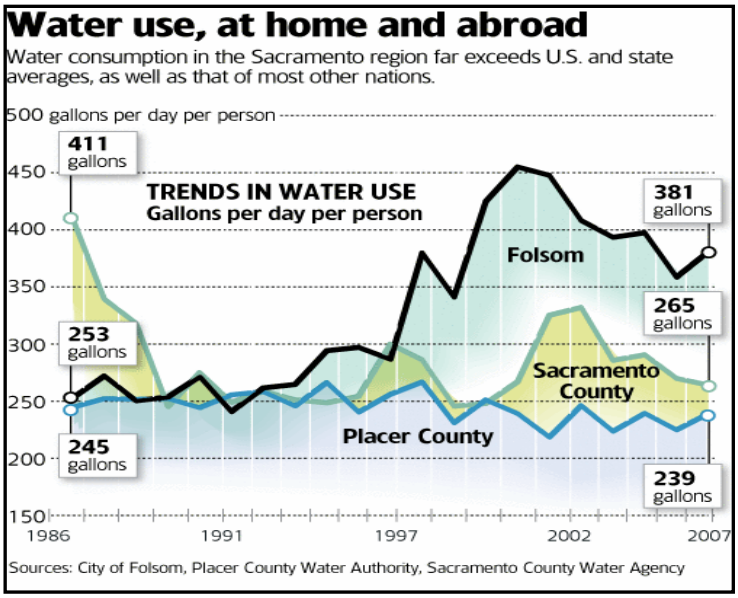


Figure 3 – Water use as reported by the *Sacramento Bee* (June 19, 2008)



If savings can occur from applying water more efficiently to meet the needs of the crop, then there is opportunity to effectively reduce the overall amount of water applied while still maintaining economic viability for agricultural objectives.

Many opportunities for increasing water use efficiency exist in urban, municipal, and agricultural sectors. The obstacles to implementing such measures are often the result of misaligned incentives and institutional constraints.

Moves toward water use efficiency: 20x2020

On February 28, 2008, Governor Schwarzenegger directed state agencies to prepare and implement a program to achieve a 20 percent reduction in statewide average per capita water use by year 2020 (20x2020 Program). While the final outcome is unknown, the 20x2020 Program is scheduled to be finalized in 2009, and will likely be incorporated into legislation.

According to information provided by the state agencies working on the 20x2020 Program, the calculated average statewide baseline water use is 192 gallons per capita per day (GPCD), and Sacramento region (Hydrologic Region 5) water use is 253 GPCD. Region 5 is among the higher water intensity regions by this measure, as shown in Figure 4.

The 20x2020 Program's proposed overall target reductions for the state will be an interim 10 percent reduction by 2015, and a 20 percent reduction by 2020. However, reductions are not evenly distributed throughout the state — higher water-using regions such as the Sacramento region will be expected to reduce their water use by a greater percentage of the average regional water use baseline.[14] The Sacramento region's target reduction suggested by the Program is 42 percent — twice the statewide goal outlined in the original Governor's directive.

The exact nature of the targets is not yet completely clear — nor is it clear whether the targets will apply only to urban users or also include agriculture.

The distribution of individual water suppliers' reductions within each region is not specified, nor is the method for fine-tuning these individual targets. However, the regional approach states that absolute targets relative to baseline regional use, rather than targets relative to current water supplier use, are the goal. Whether this proposed methodology will be successfully incorporated into statute is unknown. At a minimum, urban areas within the Sacramento region will have a significant challenge before them regardless of the specifics.

Depending on how these issues are resolved, new development could lead the way in achieving the regional urban targets with residential and non-residential developments that are well below the target. This could allow for regional trading of "credits" or other mechanisms that would help with the adoption of conservation measures in existing areas.

[14] Note that this set of targets differs from the language in AB 2175, which called for 20 percent reductions at each urban water supplier.

Figure 4 – Per Capita Urban Water Use – Existing and Proposed Targets
(source: 20x2020 Water Conservation Plan, Draft April 30, 2009)

Hydrologic Region Number and Name	Weighted 1995-2005 GPCD	Range
1 North Coast	165	141-170
2 San Francisco Bay	157	149-173
3 Central Coast	154	141-177
4 South Coast	180	171-198
5 Sacramento River	253	237-272
6 San Joaquin	248	236-250
7 Tulare Lake	285	242-341
8 North Lahontan	248	242-385
9 South Lahontan	237	221-286
10 Colorado River	346	272-387

	Proposed Regional GPCD for Regions 1 through 10									
Hydrologic Region	1	2	3	4	5	6	7	8	9	10
Baseline GPCD	165	157	154	180	253	248	285	243	237	346
Target GPCD	135	143	133	144	175	173	181	173	171	194
Reduction (%)	18%	9%	14%	20%	42%	38%	47%	39%	36%	57%

2.3.5 – Integrated Water Planning

Water management has long been a local affair. In spite of much effort put towards statewide planning, the even the state effectively serves local interests. For example, rather than being a truly statewide project, California's State Water Project in effect delivers to one specific, existing set of local contractors with rights to shares of annual project deliveries and individual sets of interests.

This local focus follows directly from the structure of water rights. Where water use is treated as a property right, incentive exists for water users to manage their own affairs. However, because of the perceived importance of water, and the many ways in which water touches interests beyond those of water rights holders, there are many motivations for more coordinated planning.

Integrated water planning attempts to address the broader association water has within a region. True integrated planning addresses the intertwined cause-and-effect relationship between diverse elements such as flood management, land use planning, economic viability, water supply reliability, water quality and environmental sustainability.

Locally, efforts at integrated planning have focused most on the interrelations between and among urban and sometimes agricultural water purveyors and, in the case of the Sacramento Area Water Forum, the environmental and recreational needs of the lower American River.

To help move regions to more integrated planning, the state has offered grant funding over the last several years. Now, many of the specific project-related implementation grants require regions to demonstrate adequate integrated planning and cooperation. Without meeting minimum thresholds, entities interested in state funds are outright restricted from competing. As an example of the state's strong push toward integrated planning, it recently required interested regions to be "accepted" via a mandated process. As noted on Department of Water Resources (DWR)'s website:

> *The region acceptance process is a component of the Integrated Regional Water Management (IRWM) Program Guidelines and will be used to evaluate and accept an IRWM region into the IRWM grant program. It is not a grant funding application, however, acceptance and approval of the composition of an IRWM region into the IRWM grant program will be required before any region can submit an application for IRWM grant funds. DWR has not previously reviewed and accepted any region, therefore, this process applies to all IRWM regions, both existing and developing.*

2.3.6 – Water Quality

Often secondary in the thinking of many water planners, water quality regulations actually are a primary factor in how water is managed today and into the future. For urban water purveyors, threats to the quality of the source water is of paramount importance — with regulatory requirements driving frequent monitoring and testing. Locally, the groundwater contamination from past practices of corporations such as Aerojet, local military bases and even corner gas stations has forced water managers to change sources of water, shut off wells and make significant investments in new infrastructure and treatment. As groundwater is still pumped, these managers must carefully understand whether their actions exacerbate contamination or help contain it.

Once water is used for many of our indoor needs, wastewater treatment plant operators have the dubious task of cleaning the water of human and non-human wastes to meet standards for discharge. Increased regulatory pressure on these discharges can quickly domino upstream to the customer and to the water purveyor in attempts to craft the most optimum solutions — the question remains, though: optimum from whose perspective? This question alone has and will continue to affect discussions about regional water recycling, per-capita water use and even the source of water.

In a similar fashion, regulatory constraints placed on agriculturalists for discharges associated with irrigation activities are adding pressure — especially economic — to how farming operations function. Ever-changing in-stream water quality objectives, established and enforced by the state and regional water quality boards, are increasing the degree of finger-pointing among dischargers. Within this finger-pointing are opportunities for agricultural and urban interests to benefit each other. Efficiency improvements in agriculture can improve the quality of upstream water so that urban areas are discharging into "cleaner" rivers and streams — reducing the added burden on their own requirements for clean discharge. Similarly, treated urban wastewater can be a viable and reliable source for agriculture, reducing the need for urban areas to meet increasingly stringent discharge requirements. Finding economically feasible ways to pursue these options will require collaboration, willingness and a shared interest in seeing each other prevail.

3 –Emerging Strategies in Water Management

Described in this section are some broad categories of water supply and land use planning issues and solutions, whereupon some illustrative examples are provided, and a preliminary bibliography with sources for future research is provided. Some of these may be applicable to the development of RUCS or for use by water agencies or districts as they prepare plans for future service.

This is not intended as an exhaustive or detailed overview. Rather, the goal is to give a sense of precedents and existing ideas from other regions addressing land use and water conflicts relevant to the rural-urban interface.

A repeated theme is that there are no one-size-fits-all solutions to conflicts related to water and land use. In the localized arena of water resources, successful actions related to the water-land use nexus will be highly context-specific, tailored to the specifics of each place and localized emerging conflicts. Integration does not equal centralization. The natural landscape and the institutional landscape are each very complex, and no single legislative, institutional, moral, or behavioral change will adequately protect all the values involved in land use and water changes. Also, all of these considerations are highly context-dependent, and thus a given problem must be attacked understanding the various dimensions. There is not one-size-fits-all solution, since there is no single problem to address.

- The California Water Plan updates have been important sources of information for water planners since 1957. But unlike prior Water Plan updates, which were primarily products of the Department of Water Resources, Update 2009 truly can be viewed as the State Water Plan. It has benefited from the first interagency California Water Plan steering committee representing 21 state government agencies with jurisdictions over different aspects of water resources and integrates companion planning documents of other state agencies.

- Update 2009 provides detailed information and analysis associated with 27 different resource strategies that can be looked at by local regions in a variety of combinations to help them assess effectively managing water resources to meet future needs.

- Concerns about limited water supply can influence restrictions on growth. In the past, developments have been authorized based on "paper water" (contracts for water rights that may not materialize as physical water), or with the assumption that existing agencies would be forced to service new developments once they were in place. This is slowly changing.
  - In California, SB 610 and SB 221 require demonstration of adequate future water supply for new developments exceeding 500 homes. Arizona takes this many steps further and requires developments to prove 100 year water supplies.
  - Concern for aquifer function can also motivate land use restrictions. Aquifer recharge areas are sensitive to development, particularly that with impervious surfaces or with polluting industries. Actions such as the Model Aquifer Protection Bylaw in Cape Cod can motivate reducing new development as well as restricting certain specific types of land uses. Note that aquifer-related concerns can be motivated both by thoughts of protecting sustainable water supply and by environmental protection.

- Potential impacts on environment and water quality can provide justification for regulatory intervention in land use decisions. In particular, local land use regulation can be a powerful and underappreciated tool.
  - In one of the broadest examples of regulation extending upstream to a watershed, in New York, power was granted to New York City to regulate land use in the seven counties of its upstate watershed from where it gets its drinking water.
  - Regulatory authority is often challenged, sometimes with "takings" claims. According to the Fifth Amendment of the Constitution, private property shall not be taken for public use without just compensation. From this stipulation a body of law has emerged that is hotly debated in the context of changing control of water resources, including restrictions on growth. In one example, the Tahoe Regional Planning Authority put a moratorium on development for water quality reasons, which was held not to be a regulatory taking, while in other cases takings claims have been upheld in water disputes.
  - Strategies for restrictions on land use that are specific to locations or types of locations have arguably been more successful than blanket regulations. For example, limiting growth in environmentally sensitive areas like riparian zones, wetlands, and shorelines has been introduced in Pennsylvania, Massachusetts, Texas and Wisconsin.

- Professor Barton Thompson suggests that "water management will not and should not serve as a means of blocking urban growth, but instead should be coordinated more closely with land use planning so as to protect the environment as urban areas grow."[15] He proposes several classes of tools available to mute unfettered development:
  - pricing water to reflect its true marginal cost;
  - requiring adequate water supplies from developers; and
  - requiring planners to evaluate impacts from growth.

- Watershed integrity has been discussed as an ideal of water planning since John Wesley Powell in 1878 famously recommended land management on a watershed basis, a recommendation that was not adopted by the federal government. As inter-basin movement of water has become the norm in the west, and issues resulting from this have become clear, some argue that returning to a watershed view of development may have merits.[16] In a similar vein, Professor Freyfogle[17] argues for the importance of recognizing the interconnectedness of the natural environment in all its aspects (i.e., land, water, biological, human, and nature).

- Water use efficiency can be a powerful tool for conservation of existing water supply.
  - The Pacific Institute[18], among others, has reviewed the potential for significant urban and agricultural water savings. Barriers to realizing these savings may be more institutional and cultural than economic in many cases.
  - Metropolitan Water District of Southern California restricted its growth of water use from 1983-1992 despite population growth of 30 percent, through use of aggressive conservation and water use efficiency programs.
  - Demand management can use tools such as economic incentives to encourage low water use intensity by households and businesses.

[15] Chapter 3, Water Management and Land Use Planning: Is It Time for Closer Coordination? by Barton H. Thompson Jr; Wet growth: should water law control land use? Environmental Law Institute, 2005.

[16] Neuman J. 2005. Dusting Off the Blueprint for a Dryland Democracy: Incorporating Watershed Integrity and Water Availability Into Land Use Decisions. In Wet Growth: Should Water Law Control Land Use, ed. CA Arnold, pp. 119-70. Washington DC: Environmental Law Institute

[17] Freyfogle ET. 2005. Private Rights in a Connected Land. In Wet Growth: Should Water Law Control Land Use, ed. CA Arnold, pp. 315-34. Washington DC: Environmental Law Institute

[18] Cooley H, Christian-Smith J, Gleick PH. 2008. More with Less: Agricultural Water Conservation and Efficiency in California: A Special Focus on the Delta, Pacific Institute, Oakland, CA; Gleick PH, Haasz D, Henges-Jeck C, Srinivasan V, Wolff G, et al. 2003. Waste Not, Want Not: The Potential for Urban Water Conservation in California, Pacific Institute, Oakland, CA

- In a thorough legal review, Waterman[19] describes linkages between land use and water planning, suggesting that the two should be incorporated more tightly at a statewide level. He notes that:
  - CEQA as a vehicle for land use and water planning may grow in importance as legal cases are expanded to test the adequacy of water planning to support growth.
  - Waterman describes cases from Imperial, Inyo, and Riverside counties, which have used similar techniques to link water and land use planning. "These techniques emphasize public participation in preparing the general plan, a comprehensive analysis of water management issues, a land use element that is fully integrated with the water element, regular review and update of the general plan, and provisions for collaboration and cooperation with other agencies."

In sum, there is much experience to draw from in considering the myriad impacts resulting from connections between land use and water. However, connecting the two in scientific, legal and planning arenas remains a new area of exploration that will require creative thinking and bold ideas to come up with workable solutions to regionally specific problems.

[19] Waterman R. 2004. Addressing California's Uncertain Water Future by Coordinating Long-Term Land Use and Water Planning: Is a Water Element in the General Plan the Next Step? Ecology Law Quarterly 31: 117.

Attachment 1

A Very Brief Taste of California Water Law

Water law in California is complex, incorporating aspects of century-old mining customs, Roman law, English common law, judicial and administrative decisions, statutes, and local ordinances. Adding to the complexity, California recognizes several categories of water rights, each relating to various characteristics of land and water. While this attachment is a skeletal overview of a complex and intricate subject, it is critical to consider the fundamentals of water law as the foundational principles behind many water rights decisions — and thus actions and positions of many who hold these rights. Water rights in surface waters are generally classified as riparian, appropriative, or contract rights, while water rights for underground waters are generally classified as overlying or appropriative. All water rights in California are usufructuary rights, granting an individual or entity a right to the use of water but not an absolute right of ownership. The difference, although subtle, is important in that California law prevents an individual from exercising total dominion over the resource, reserving some authority to the state. All water rights are further limited by Article X, Section 2 of the California Constitution, which requires that water be reasonably used for beneficial purposes. In addition, other related regulatory laws such as the Endangered Species Act, water quality rules, and local water supply and export rules, including local government ordinances can indirectly but powerfully influence the course of water rights decisions.

Surface Water Rights

Riparian rights confer upon the owner of land contiguous to the watercourse the right to a reasonable and beneficial use of water on his land. *Appropriative rights* are based on the doctrine of prior appropriation is a system of allocation that confers rights based on historical usage according to the principle "first in time, first in right." The use of water for a beneficial purpose on specific parcels of land earns the right to permanently use that water, so long as the use is reasonable. A senior appropriator may require a junior appropriator to forgo his full allocation in times of shortage so that the senior appropriator may continue use.

Federal and State Project Water

The Central Valley Project (CVP) and State Water Project (SWP) are the major large-scale water storage and conveyance projects in California. The CVP and SWP hold appropriative water rights and sign contracts with individuals for use of the permitted supplies.

Groundwater Rights

Overlying Rights: In California, property owners with land overlying groundwater can drill wells and extract water for use on the overlying land. *Appropriative Rights*: If there are groundwater supplies in a basin that are surplus to the needs of overlying owners, then this water is available for appropriation by non-overlying users for use on non-overlying lands. *Overdraft*: Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years, although this is a complex and contentious calculation. Though overdraft conditions are not prevalent in the Sacramento Valley, increased reliance on groundwater for urban development without proper management and planning could lead to overdraft. *Artificial Recharge*: Theoretically, artificial groundwater recharge allows the "recharger" to extract the water they have "stored" in a basin at a later time, minus calculated losses, so long as there is no injury to other users.