THE BENEFITS AND COSTS OF PRESSURIZED DUAL WATER SYSTEMS IN COLORADO

AND THE

POTENTIAL ROLE OF CANAL COMPANIES AND IRRIGATION DISTRICTS IN PROVIDING THE PRESSURIZED IRRIGATION WATER SUPPLY PORTION OF DUAL SYSTEMS

REPORT PREPARED BY THE

SOCIOLOGY WATER LAB
AND THE
COLORADO INSTITUTE FOR IRRIGATION MANAGEMENT

COLORADO STATE UNIVERSITY

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EXECUTIVE SUMMARY

This study was funded by the Colorado Water Conservation Board and several water districts in the Colorado Front Range. The study was designed to assess the benefits and costs of pressurized dual water systems, with an emphasis on the most effective way for the state to promote these systems. Dual water systems provide separate, noncontiguous, pressurized treated and untreated water lines into residential lots. The pressurized untreated water line is referred to as the secondary water system, and is used for landscape purposes. The study focused on the potential role of traditional agricultural water suppliers (i.e. canal companies and irrigation districts) in developing, operating and maintaining secondary systems around the state. The study drew heavily upon important innovations in secondary systems occurring in other areas of the Rocky Mountain region.

A major conclusion was that there is an important connection between the involvement of traditional agricultural water suppliers in providing secondary water service and the strengthening of the economic position of irrigated agriculture in the state. This strengthening occurs principally by way of (1) the continued beneficial use of irrigation water freed up as a result of residential and commercial land development in the service areas of canal companies and irrigation districts, and (2) the utilization of revenue earned from providing secondary water service to modernize irrigation canals. While water remains attached to the service areas of these enterprises, the revenue earned can finance significant canal system upgrades, thereby allowing farmers to move toward more efficient on-farm irrigation methods. Significant improvements in water conservation and water quality occur in the process. It is shown that water rights are not affected in the process, nor is the value of water owned by farmers wishing to leave agriculture materially affected.

A second important conclusion is that the involvement of canal companies and irrigation districts in the provision of pressurized untreated water is an important drought mitigation strategy for the state. The development of secondary water systems is very compatible with such ideas as water banking and interruptible supplies. However, the development of more integrated and centralized secondary water systems, as described in this report, is expected to stretch present potable water supplies and treatment capacity farther into the future. Since potable water is commonly used to irrigate landscapes around the state, every unit of pressurized untreated water developed for residential landscape use frees up a comparable unit of potable water and treatment capacity. This reduces the need for municipalities to include landscape water use in their “drought yield” projections. The development of secondary water systems operated and managed by canal companies and irrigation districts represents a new partnership between urban and agricultural water users. It is a partnership that benefits municipalities, agriculture, developers, and homeowners, while addressing environmental concerns.

Water conservation is an essential part of addressing future water shortages. Water conserved in agricultural production is expected to be an important source of future urban water supplies. However, water conservation in agriculture comes at a cost. It involves canal delivery improvements, as well as improvements in the use of water on the farm. To ask farmers to pay for conserving water, in order that water can be made more available for urban uses, seems highly inequitable. By allowing, and promoting, the involvement of canal companies and irrigation districts in secondary water management, new water conservation technologies can be paid for by revenue earned from residential water users, rather than being paid for by already scarce farm income. This is a valuable income transfer to irrigated agriculture, but one that actually involves a reduced cost to residential water users as well. These reduced savings in residential water costs are transferred from financing additional treatment facilities to financing canal infrastructure improvements. Treatment facilities do not conserve water. Canal improvements and on-farm irrigation improvements do conserve water, but they must be financed by those who will use the

conserved water, not farmers. The involvement of canal companies and irrigation districts in the provision of secondary water is an excellent way of accomplishing this water conservation goal in a more equitable way.

The provision of secondary water by canal companies and irrigation districts is expected to result in a more orderly transfer of agricultural land and water to urban uses. First, agricultural water rights are difficult to transfer into urban treatment facilities, both legally and from an engineering standpoint. It is much easier to convert agricultural water rights to residential landscape use within an agricultural water supplier service area.

Second, an economic analysis of secondary water shows that it is most profitable to agricultural water suppliers when delivered to higher density residential development. This promotes more compact subdivision development in urban fringe areas, and promotes more residential development on less productive agricultural lands.

Third, the provision of secondary water by canal companies and irrigation districts provides opportunities for these entities to secure better control of their facility rights-of-way, and provides opportunities to reduce such urban encroachment externalities as trash, vandalism and canal drownings. This is accomplished by using the revenue stream from secondary water service to modernize canal facilities and to hire more employees to supervise the system when needed. Again, this is paid for by urban water users who have penetrated deep into these canal service areas, rather than by farmers having to pay increased canal assessments or land taxes to cover these urban encroachment costs.

It is recommended that this study be shared with municipalities and developers in Colorado, in order to promote greater involvement of traditional agricultural water suppliers in secondary supply.

It is recommended that funds be made available for staff members and directors of these entities to visit their counterparts in Utah and Idaho, in order to learn more about how they can become involved in pressurized secondary supply.

It is recommended that the sample ordinances found in the study (Chapter 6) governing the promotion and use of secondary systems be communicated to municipal and county governments.

Finally, it is recommended that the state, in cooperation with the Department of Agriculture and such organizations as the Farm Bureau, communicate to the agricultural community the findings of this report, and that the state help make available attractive financing of these endeavors when agricultural water suppliers express interest in them.

We are pleased to share this report with you.

Sincerely,

John Wilkins-Wells
Principal Investigator
Assistant Professor, Senior Research Scientist
Sociology Water Lab
Department of Sociology
Colorado State University (970-491-5635)

Terence H. Podmore
Co-Investigator
Professor and Co-Director
Colorado Institute for Irrigation Management
Department of Civil Engineering
Colorado State University (970-491-1624)

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RESEARCH TEAM

The following people conducted the research, contributed chapters to the report, and/or supported the research staff:

John Wilkins-Wells, Principal Investigator, Assistant Professor, Senior Research Scientist, Department of Sociology, Sociology Water Lab., Colorado State University.

Terence H. Podmore, Co-Investigator, Professor, Co-Director, Colorado Institute for Irrigation Management, Department of Civil Engineering, Colorado State University.

Raymond L. Anderson, Director of Graduate Student Research, Sociology Water Lab, Professor (retired), Department of Agricultural and Resource Economics, Colorado State University. (Chapter 5).

Stephen W. Smith, P.E., Landscape Engineer, Chairman, Aqua Engineering, Inc., Fort Collins, Colorado. (Chapter 10)

Karen L. Rademacher, P.E., Specialist on Mutual Ditch and Irrigation Companies, CWR Consulting, LLC, Longmont, Colorado. (Chapter 9)

Daniel K. Brown, Attorney, Fischer, Brown and Gunn, P.C., Fort Collins, Colorado. (Chapter 7)

Jennifer Lee, Secondary System Researcher, Graduate Student, Department of Civil Engineering, Colorado State University. (Chapter 8)

Walter Epley, Geographic Information Systems and Graphic Specialist, Graduate Student, Department of Agronomy and the Sociology Water Lab, Colorado State University.

Andrew Griguhn, Data Analyst and Manager, Graduate Student, Department of Sociology and Sociology Water Lab, Colorado State University.

Ms. Marilee H. Rowe, Coordinator, Department of Civil Engineering, Colorado State University

Ms. Cathy L.Z. Smith, Program Assistant, College of Engineering, Colorado State University

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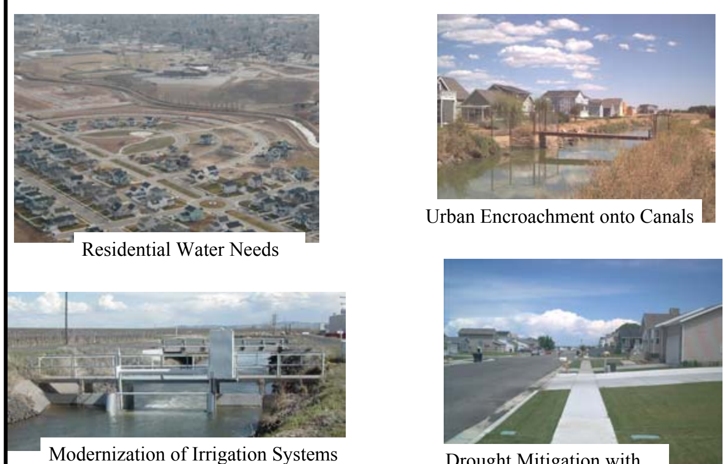
CHAPTER 1

INTRODUCTION

This study is concerned with important innovations in pressurized secondary (non-potable) water management. Secondary water management is one side of "dual" water systems, the other side being conventional potable water supply. There are four key policy issues underlying the study (Figure 1). The first involves finding ways to better address water supply needs to residential users in both incorporated and unincorporated parts of rapidly urbanizing areas in Colorado. The second key issue, by way of modernizing traditional mutual ditch and irrigation companies and irrigation districts, concerns improving water right use in irrigated agriculture. The third issue concerns the impact of growth on mutual ditch and irrigation companies and irrigation districts, and possible adaptive adjustments these traditional agricultural water suppliers might make in localities where urbanization is spreading quickly onto irrigated cropland. The fourth key issue has to do with drought mitigation, and how new innovative uses of native water rights can improve water use efficiencies. The central innovation in water management that brings all of these key issues together is the concept of dual systems.

Figure 1 – Four Key Issues Addressed by the Study


Residential Water Needs

Urban Encroachment onto Canals

Modernization of Irrigation Systems

Drought Mitigation with Secondary Systems

Regarding the first issue, in Colorado there is reason to believe that we are treating more water to a potable level than we need to treat. The use of potable water for outdoor landscape use may well have major economic inefficiencies associated with it for the region, for the water supplier, and to the end user. Many small communities are looking to ensure future water treatment through reverse osmosis, an often expensive and high maintenance option for rural communities. For many of these communities, there appear to be ample ways to substitute untreated, non-potable water for treated potable water currently being applied to residential, public and commercial landscapes. This may be accomplished in such a way as to help reduce the cost of water to both urban and rural residential water users, while at the same time benefiting agricultural water delivery systems and reducing drought risk for both agriculture and cities in the process. This latter is accomplished by way of traditional agricultural water suppliers becoming more involved in providing pressurized non-potable water to residential areas.

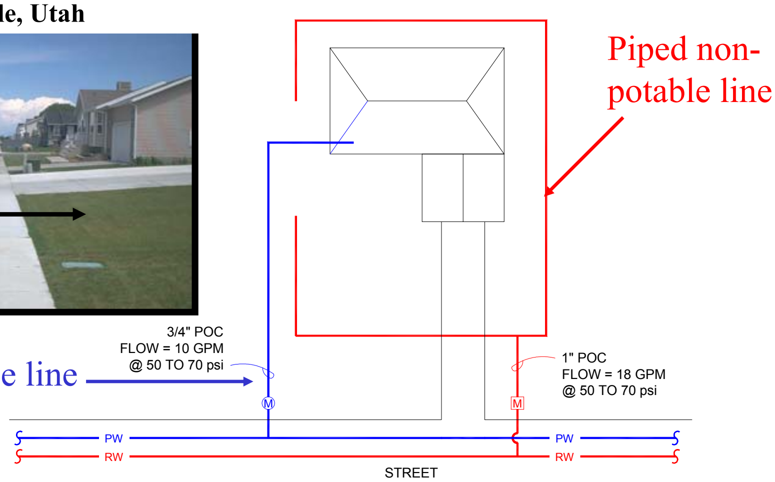
Regarding the second issue, that of improving agricultural water deliveries throughout the state, the expansion of pressurized raw water supplies for landscape use appears to play into the improved capabilities of canal companies and irrigation districts in a very positive way. Potential revenue accruing to these traditional agricultural water suppliers by way of providing pressurized irrigation water to residential properties in their service areas could be used to partially finance or encourage pressurization and other improvements to agricultural water deliveries at the same time. A potential reduction in annual water assessments for agricultural water users appears feasible through this process as well. How this might occur and be supported by state and local policies and initiatives is a central theme of this report.

Regarding the third issue, the provision of pressurized secondary water expands the role of mutual irrigation companies and irrigation districts in addressing changes in land use in their service areas (i.e., the conversion of land from agricultural to residential use). Entering into pressurized secondary service could ensure that their assets, including both their water rights and existing irrigation infrastructure, will remain whole, be protected, while the associated water rights remain anchored to the local community.

Regarding the fourth issue, it is likely that efforts to reduce or mitigate the future risk of drought will require creating new opportunities to more efficiently use water already developed for the community. In this report, it will be shown how expanding the role of traditional agricultural water suppliers in the provision of pressurized raw water for landscape use will improve overall efficiencies in water use.

Figure 2 - Pressurized Non-Potable Piped (Secondary) Supply for Subdivisions Provided by a Canal Company in Utah.

Davis and Weber Counties Canal Company, Kaysville, Utah



Courtesy of Stephen Smith, Aqua Engineering, Inc., Fort Collins, CO

Finally, what is proposed as a potential strategy to meet both residential and agricultural water needs appears to be greatly benefited by two additional resources. The first is the Colorado Water Conservation Board's own construction fund loan program, the terms of which appear to be supportive of, and conducive to, projects designed to improve agricultural water deliveries and create new efficiencies in water delivery systems. The second important resource is the 2002 Farm Bill's Environmental Quality Incentives Program (EQIP). This program, administered by the Natural Resources Conservation Service (USDA), is estimated to have substantial funds over the next five years to modernize agricultural water deliveries throughout the western United States, and particularly for the purposes of improving water quality and water conservation. How these two important resources play into the four key policy issues previously mentioned will be presented in Chapter 3.

Pressurized Dual Water Systems

This report covers a one-year investigation of the present and potential benefits and costs of pressurized dual water systems in Colorado. Pressurized dual water systems are characterized by two separate underground piped water systems serving a residential parcel of land or lot. One water system conveys treated water for household use, while the other piped system conveys untreated water for landscape irrigation (Figure 2). Potentially dangerous cross connections are avoided through proper installation procedures, pipe and point-of-connection identifiers, and sometimes a lower supply pressure gradient for the untreated system. For this report, we are defining the pressurized piped system for the untreated water as the residential parcel/lot's "secondary water supply." This term is used frequently in other areas of the West where well-developed pressurized dual water systems of this nature are already in operation. The terms "dual water system," "secondary water supply," and "non-potable water supply" are used interchangeably herein to describe these discrete water systems.

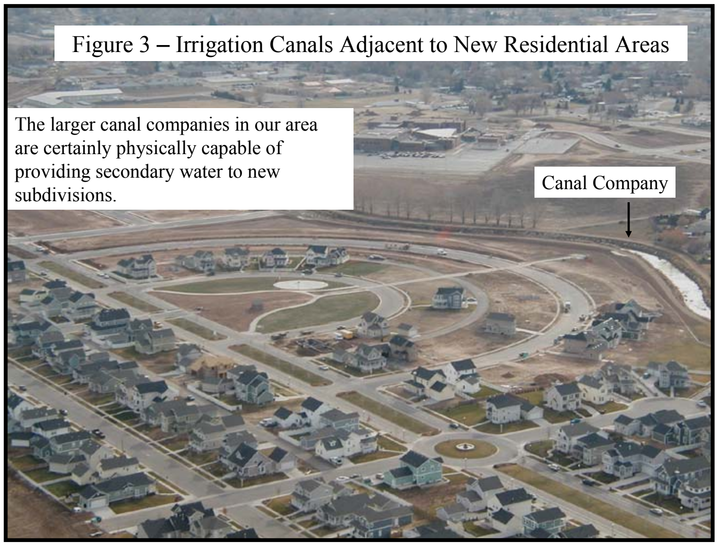


Figure 3 – Irrigation Canals Adjacent to New Residential Areas

Much has recently been written on dual systems.[1] The unique focus of this study, compared to other recent studies on dual systems, was to evaluate the potential role of traditional agricultural water suppliers (mutual irrigation companies and irrigation districts) in providing this secondary water supply service to residential, commercial and institutional outdoor water users, particularly in unincorporated areas or annexed rural areas, but also in some inner-city areas. Inner city situations would necessarily involve retrofitting existing homes and businesses with an additional pressurized system for the secondary water supply. This is being done in several communities in other areas of the Rocky Mountain region, such as Nampa, Idaho, and Kaysville, Roy, Coalville, Midway and Hurricane, Utah. Some retrofit examples will be discussed in a later chapter. However, the study has focused more on the use of secondary water supply in future residential subdivision development in unincorporated areas. These are localities where traditional agricultural water suppliers could provide pressurized untreated water reasonably, economically, and safely (Figure 3).

Figure 4 shows the typical configuration of irrigation company service areas along the Colorado Front Range. Urban development affecting these enterprises includes both typical residential lots in incorporated areas, as well as a growing popularity in larger hobby farm acreage throughout the unincorporated areas. The potential of the irrigation company in Figure 4 to provide pressurized irrigation water to residential lots is considerable, given its location in the urban corridor of northeast Colorado. It is argued that, by providing secondary water service, the local irrigation company or irrigation district could benefit financially. This financial benefit would be in the form of modest revenue from the provision of secondary service, this revenue then being used to upgrade existing agricultural water delivery facilities. This would be accomplished in such a way as not to endanger the non-profit status of these enterprises, since revenue earned through secondary service is an assessment on the water right. Residential water users, as well as the state, could benefit enormously as well, through more efficient use of native water supplies.

It is true that some traditional agricultural water suppliers will not be suited to providing secondary water service. However, many of these traditional entities are indicating interest in evolving in this direction. In brief, secondary water systems as they are envisioned in this study appear to represent a "pareto optimum" opportunity for all stakeholders.[2]

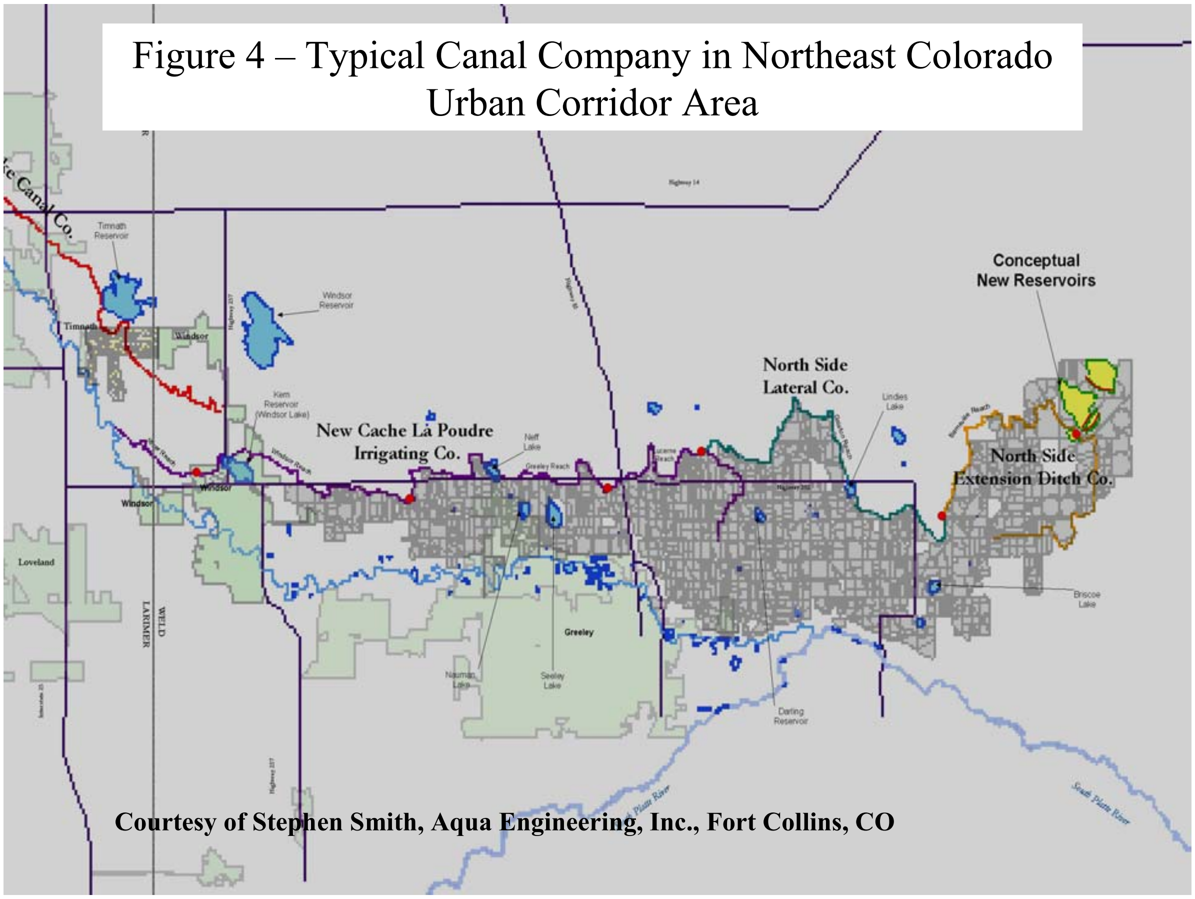


Figure 4 – Typical Canal Company in Northeast Colorado Urban Corridor Area

The study has taken many sources of information into account, including state, municipal, agricultural water supplier and public/consumer interviews and publications, and out-of-state contacts. Developers have been interviewed and consulted. Four mutual irrigation companies participated in the study.[3] All four are considering providing pressurized secondary water service in their traditional established service areas. Two rural domestic water districts, a filter plant, and two conservancy districts helped fund the study.[4] In addition, several other rural domestic water suppliers were interviewed regarding their viewpoints on having traditional agricultural water suppliers provide secondary water service.[5] Everyone was queried to assess how future pressurized secondary water supply in the region might affect their own future water supply and transmission needs as well as potentially benefiting their existing customers. The net result of the queries, the discussion, and the resultant "discovery process" has been this report.

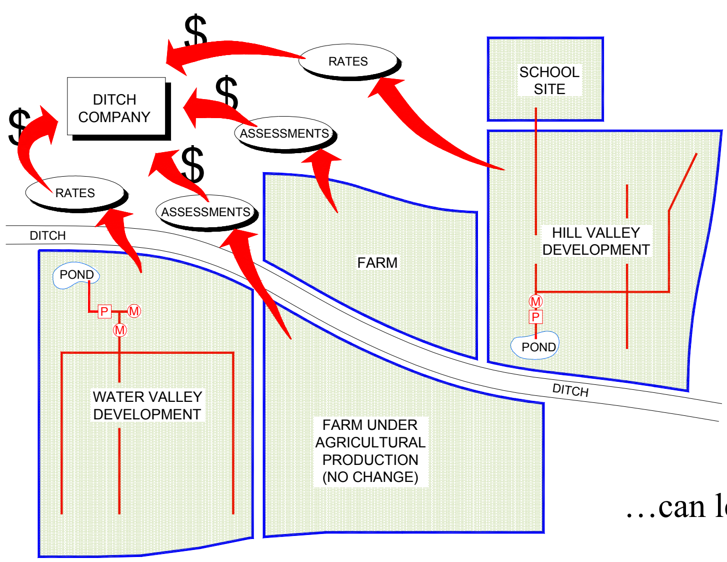
The Value of Dual Systems

There is a growing recognition that although the expansion of dual water systems is only one of many possible solutions to the state's growing water demands in urban growth areas, it may be a crucial one. One of its strengths is that, as a water management strategy, dual systems may indirectly serve both residential and agricultural needs at the same time. For instance, if long-established irrigation companies or irrigation districts can provide pressurized secondary water supply, this may lessen the need of municipalities to acquire large, and potentially expensive and excessive, amounts of raw native water rights from landowners, developers or subdivision builders as part of their "raw water turnover requirement" for developing these residential subdivisions. Continuing to have municipalities gradually assume the control and fiduciary responsibility of canal companies and irrigation districts in the process of accumulating this raw water turnover requirement in unincorporated areas may create major problems for both municipalities and irrigated agriculture. Municipalities often end up holding ownership in canal facilities that they are reluctant to fully maintain, while agriculturalists lose decision-making control of their irrigation facilities over time.

The Role of Canal Companies and Irrigation Districts

If traditional irrigation companies or irrigation districts were to provide pressurized secondary water supply service, this could strengthen the economic position of these enterprises by providing new sources of revenue to improve and maintain their irrigation canal system. This could improve the overall water delivery capabilities of irrigated agriculture in the process, by leading to the pressurization of agricultural water deliveries. Meanwhile, local municipalities would not be obliged to assume ownership in these agricultural water suppliers. In turn, a financially strengthened irrigation company or irrigation district might be expected to ensure more timely and reliable water deliveries to irrigators, leading to improved irrigation application efficiencies on the farm as well. This nexus of water management factors and relationships, ultimately linking residential water needs to improved efficiencies in irrigated agriculture, emphasizes the expanded scope of potential benefits of dual water systems in the state (Figures 5 and 6).

Figure 5 – Combining canal company/irrigation district revenue streams from agricultural water delivery and residential secondary water delivery…



…can lead to

Courtesy of Stephen Smith, Aqua Engineering, Inc. Fort Collins, CO

Much is already known about dual systems.[6] The concept is not new. A recent regional survey in northeast Colorado reported that pressurized secondary supply systems are being installed more frequently in the urban fringe areas, often by subdivision developers.[7] Several developers have been very innovative in this regard and are moving ahead with their unique design plans. However, their irrigation systems are frequently left to homeowners' associations (HOAs) to manage. Design approaches tend to vary greatly, and there is often little agreement on local standards for secondary systems, other than those suggested by the American Water Works Association. Some municipalities have developed pressurized secondary supply systems to irrigate parks and other recreational facilities, many of these involving pumping out of open ditch systems or adjacent storage facilities. In only a few instances has this kind of water service been extended by municipalities to residential lots, and only in limited areas of town.[8]

Figure 6 - …a modestly improved revenue stream for these entities…..

- …that could help modernize irrigation canal systems and help growers move to higher end irrigation technologies and additional cropping systems, meanwhile…

…higher end irrigation technologies mean water conserved, benefiting all of us.

Meanwhile, rural domestic water suppliers providing treated water to many of the unincorporated areas of northeastern Colorado appear to welcome the introduction of pressurized secondary supply systems, as long as their own water delivery system is not adversely affected. Generally, rural domestic water districts have not indicated interest in providing secondary water service themselves. The viewpoints of developers, municipalities and rural domestic water suppliers may change in the future. For the present, there does not appear to be much alignment in perspectives. All parties are generally proceeding with their own plans and philosophies.

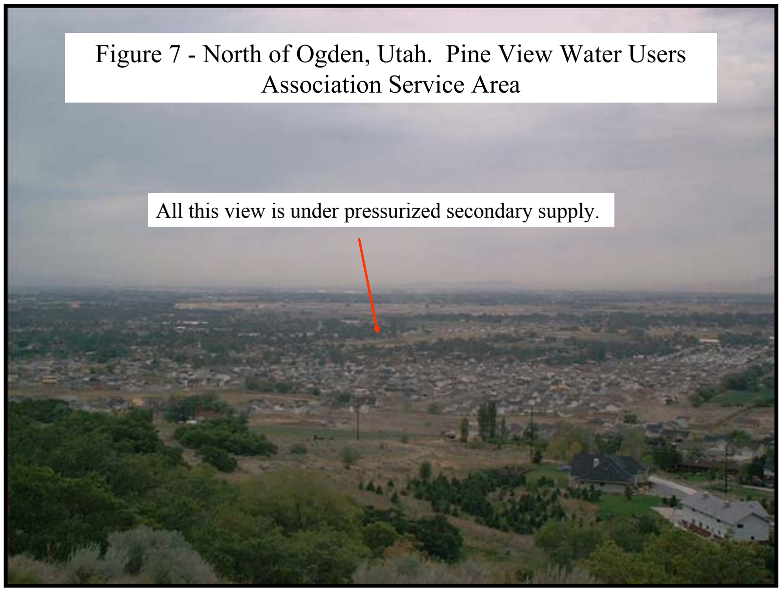
What is new, at least in Colorado, is the idea of traditional agricultural water suppliers providing pressurized secondary water service to residential or commercial users and lots. As we will see, having irrigation districts or canal companies supply secondary water is a far more common practice in other states, particularly Utah and Idaho (Figure 7). If these entities are to become involved in secondary water supply in Colorado, they need information about what risks they are facing, what benefits can be expected from entering into such service, and how long it might take for these benefits to be realized. Case studies will be presented in Chapter 8 and 9, assessing the risks and benefits for two canal companies participating in the study.

Advantages for Municipalities

Pressurized secondary water supply may help to reduce the cost of providing treated water within urban growth boundary areas or unincorporated areas by reducing the need to develop water treatment facilities to provide for both indoor and outdoor water needs. Today, water applications for outdoor use on residential parcels or lots may comprise more than 50 percent of annual treated water demand in many instances.[9] Substituting pressurized untreated water to meet this outdoor demand would greatly reduce the demand on existing municipal and rural domestic water treatment systems.

Most outdoor water demand occurs in a span of three to four peak months of use in arid areas.[10] Secondary water systems would allow municipalities to downscale the capacity and capitalization of water treatment facilities built to meet this peak summer usage (Figure 8). It appears that for municipal treated water systems, the greater the percentage increase in peak summer usage over usage in other periods of the year, the greater the potential benefits of secondary supply systems for municipalities. A three to one difference, or more, between summer and other seasonal uses is clearly an open invitation to the advantages to municipalities of secondary water supply systems.[11]

Figure 7 - North of Ogden, Utah. Pine View Water Users Association Service Area



Meanwhile, many municipalities appear to have fewer problems with the cost of treating water than with meeting the transmission and infrastructure capacity needs to deliver this water. Studies show that water treatment usually makes up only a small fraction of municipal water costs.[12] It is the storage and transmission facilities and infrastructure that are costly for municipalities. Eliminating the need to deliver treated water for outdoor use would free up infrastructure capacity for future municipal growth. In short, although dual systems do not create more water for use, dual systems may be shown to achieve better economies and efficiencies in the allocation of water within a given area.[13] These are some of the key themes addressed in this report.

<u>Concerns About Secondary Systems</u>

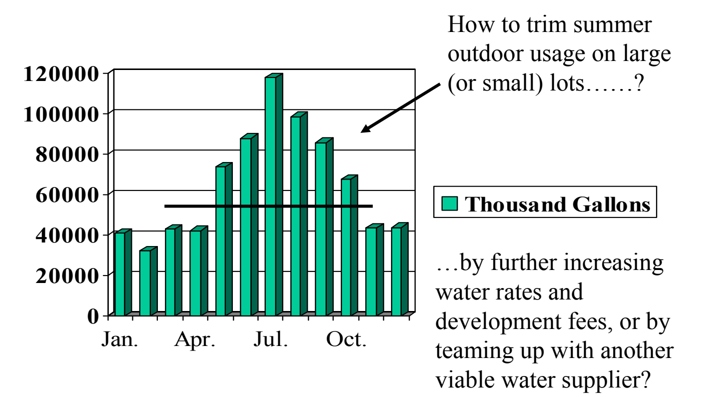
Although dual systems are believed to be beneficial in several ways, numerous issues are being raised in the region about the design and operation of secondary supply systems. These include the effect of poorly designed, installed and supervised secondary systems on water suppliers, homeowners, and local jurisdictions. Municipalities and Title 32 districts (rural domestic water districts) want assurance, if not guarantees, that a secondary system is not likely to fail if canal companies and irrigation districts, or even homeowners' associations, provide the secondary service. Potential liability concerns about water quality and accidental, or purposeful, cross connections with potable water systems are high on the list as well.

A key goal of the study was to assess these various concerns and the overall economic benefits and costs of pressurized secondary systems to a variety of stakeholders. These economic concerns include long range projections of how pressurized secondary supply might affect local water rates for treated water, how these systems might be expected to affect land values and land use, how they could affect the future capital needs of treated water suppliers, how they could affect growth patterns in unincorporated areas, and ultimately how they might affect the regional water market. For instance, examples from Utah suggest that the provision of pressurized secondary supply increases residential property values substantially.[14] Information from interviews with several secondary water suppliers in Utah and Idaho, both municipal and agricultural, are discussed later in the report and will be used to answer some of these questions.

Concerns Voiced by Canal Companies and Irrigation Districts

Since we are suggesting a significant new role for traditional irrigation companies and irrigation districts, the provision of pressurized secondary water supply for residential parcels and lots, the study was designed to identify the set of circumstances under which these agricultural water suppliers could and would voluntarily expand their traditional operation that now serves predominately agricultural irrigation. Although the involvement of traditional agricultural water suppliers in secondary systems is a common practice in other areas of the Rocky Mountain region, particularly along the Wasatch Front Range in Utah and in Idaho's Boise Valley, it is fully recognized that many irrigation company and irrigation district boards may not want to enter into this type of water service. They may be fearful that efforts are simply being made by those promoting such involvement to commandeer their water rights without paying for them. In addition, traditional agricultural water suppliers may not want to assume the new responsibilities that might be associated with providing secondary supply.

Figure 8 – Typical Potable Water Demands on Municipal Water Systems Without Pressurized Secondary Systems.



The future involvement of agricultural water suppliers in secondary water supply to residential property, small farms, and large rural subdivision lots will undoubtedly depend on the willingness of irrigators to allocate a portion of the irrigation company's decreed water rights to this purpose. There may also be legal "change of water use" issues, although this appears unlikely at this juncture for Colorado. According to the Colorado State Engineer's Office, the use of irrigation water for residential and commercial lawns, gardens and city recreational facilities is not considered a change of use. Third party injuries could play a role in certain instances. These issues will be taken up in Chapter 7.

In addition, irrigators have concerns about (1) continued adequate water supplies to maintain irrigated agriculture needs into the future, (2) the range of realized economic benefits to the canal company or irrigation district from providing secondary water supply, (3) the present physical condition of the irrigation system and the cost of retrofitting this system to meet urban fringe and rural residential subdivision needs, and (4) the potential availability of low interest loans or cost sharing with federal or state agencies to finance these systems. Yet other concerns include the future financial health of the canal company or irrigation district, the use of metered versus unmetered secondary water service and associated costs, and the demand by residential property owners for year-round versus seasonal (traditional irrigation season) secondary water service. These concerns are included in a checklist appraisal of key considerations for the boards and staffs of canal companies and irrigation districts to examine before getting involved in secondary water service. This checklist is discussed later in the report.

The study attempted to identify a step-by-step, low risk "method of entry" by traditional agricultural water suppliers into secondary water service, when their stockholders or district landowners are favorable to this business innovation for their enterprise. The checklist appraisal was implemented on two canal companies seemingly well positioned to provide pressurized secondary supply in the future. It is assumed that until such time that a revenue stream is well-established through secondary service, canal companies and irrigation districts might face a period of financial risk early on in the development of secondary service. Undoubtedly, this will depend upon the growth in water user subscriptions (and therefore the overall growth in a given secondary supply service area), the terms and size of the repayment contract (assuming that these systems will be financed through bonds or state agency financing), and the revenue (plant investment or "tap" fees) generated by the secondary water supply system.

Historical Precedents

It is important to remember that the rural domestic water districts began much in the same way in the 1960s. In order to initiate and capitalize these Title 32 districts, rural domestic organizers often went from door-to-door in rural areas compiling a list of subscribers for their new potable water service. Once the district boundaries and the number of potential customers was identified, it was often a simple matter of determining what the capital costs for the water system would be, and what water rates would be required to meet these capital costs and future annual operation and maintenance costs. It is likely that the development of secondary supply systems, particularly if they are to be operated and maintained by canal companies and irrigation districts, will follow a similar developmental process. This developmental process is also discussed in the report.

Four traditional and well-established canal companies in Colorado, the New Cache La Poudre Irrigating Company, the Highland Ditch Company, the Lake Canal Company and the Grand Valley Irrigation Company participated as case studies to identify a "process of discovery" and assessment or appraisal of their potential in providing secondary water supply service to residential-commercial-industrial parcels in their traditional irrigation service areas. The Grand Valley Irrigation Company already provides secondary water service indirectly, by delivering water through "historical" headgates to its many affiliated lateral companies. The study provided assistance to the four canal companies in developing a Geographical Information Systems (GIS) database and digital map of their respective irrigation systems, including updated information on residential parcels, zoning, rural domestic water district pipeline systems, municipal pipeline systems and urban growth boundaries overlapping their service areas.

The study focused on the potential for secondary water systems in Water Districts 1,2,3,4,5, and 6 in northeastern Colorado, in addition to the Grand Junction area. However, what was learned should be directly applicable to all areas of Colorado. There appear to be many opportunities for pressurized secondary water systems in this region as well as in other areas of the state.

Conclusion

In summary, the aim of the study was to identify the conditions under which dual systems can be developed and made to work effectively, what the benefits are, how the participation of canal companies and irrigation districts in pressurized secondary water supply may contribute to maintaining irrigated agriculture as a viable industry in the region and the risks involved during development, how local jurisdictions can help promote these systems through the passing of specific ordinances, where dual systems are appropriate for the region, and specific recommendations for a state-wide "secondary system policy" that would be clear and simple for the needs of the state, local jurisdictions, developers and agricultural irrigation water suppliers.

The study has tried to ascertain ways in which dual systems contribute to both general public interest goals and private property rights and benefits at the same time. Rather than advocating a strictly market approach to water resource development in the state or, conversely, a strictly public interest approach, the research has attempted to ascertain how these two perspectives can be optimized in the development and use of the state's water resources through secondary water systems. Particularly in regard to the role of traditional agricultural water suppliers in dual systems, it is anticipated that landowners, farmers, rural residents, city dwellers, environmental groups, local jurisdictions, and the state can all benefit from improving the overall economic position of irrigated agriculture. We believe that it can be demonstrated that not only are canal companies and irrigation districts excellent and very appropriate entities to enter into pressurized secondary water service, but that in doing so, they will be strengthened. In turn, the involvement of mutual ditch and irrigation companies, and irrigation districts, will strengthen the economic position of irrigated agriculture in the state.

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[1] These are noted in a short bibliography in an important publication by the American Water Works Association: *Dual Water Systems, American Water Works Association Manual of Water Supply Practices*, AWWA M24 (1994).

[2] We define "pareto optimality" as an economic activity in which one interest group is made better off and no other interest group is worse off. In the instance being discussed here, agricultural water users are no worse off, while the new water users (residential users) are better off, when canal companies or irrigation districts enter into secondary water service.

[3] These four companies are the New Cache La Poudre Irrigating Company (Lucerne, Colorado), the Lake Canal Company (Windsor, Colorado), the Highland Ditch Company (Longmont, Colorado), and the Grand Valley Irrigation Company (Grand Junction, Colorado).

[4] Many Title 32 water districts, better known as rural domestic water suppliers, generously provided us data on their water supply systems, as well as some small towns in the study area. The rural domestic water supplier providing funding included the North Weld County Water District (Lucerne, Colorado) and the St. Vrain Left Hand Water Conservancy District (Longmont, Colorado). The study was also funded by the Soldier Canyon Filter Plant (Fort Collins, Colorado). The two conservancy districts providing funding were the St. Vrain and Left Hand Water Conservancy District and the Northern Colorado Water Conservancy District.

[5] These included the East Larimer County Water District (Fort Collins, Colorado), the Fort Collins-Loveland Water District (Fort Collins, Colorado), the Little Thompson Water District (Berthoud, Colorado), and the Longs Peak Water District (Longmont, Colorado).

[6] Dual Water Systems (2nd Edition), American Water Works Association (1994); *To Drink or to Irrigate: Dual Water Systems Benefit Agricultural and Urban Areas*, WaterNews (2002).

[7] *Nonpotable Water: Greeley, Loveland, Fort Collins, Windsor, Eaton, Evans, and Water Valley. A Survey.* Applegate Group, Inc. (January, 2002)

[8] Following a presentation on our study in Evans, Colorado, Ault, Colorado and Swink, Colorado, it was learned that these communities have a variety of secondary systems. The City of Evans has six pressurized secondary systems. These are operated out of ponds fed by local irrigation ditches, or in the case of the older part of town, by open ditches. This type of secondary system configuration is very common in smaller communities throughout the Rocky Mountain region. In addition, many small communities, such as Ault, Colorado, and Swink, Colorado, currently operate (or plan to operate) their secondary system with wells.

[9] The subject of residential and outdoor landscape water use will be discussed in Chapter 5.

[10] Records of regional city water deliveries collected for this study document this summer peak in water use.

[11] Personal communication with J-U-B Engineers, Inc. This Utah-based engineering firm has built a number of pressurized secondary water systems along the Wasatch Front Range. The firm is reporting that a three to one ratio between summer and winter usage (combining both indoor and outdoor water use) more than justifies a municipality's need for pressurized secondary systems.

[12] The City of Fort Collins is a useful example of this, and is observed in its annual water system operating reports. *Annual Operating Reports, City of Fort Collins (1998-2001)*.

[13] As will be discussed later in the report, if the entry of irrigation companies and irrigation districts into secondary water supply improved the economic position of these traditional agricultural water suppliers, and if some of the revenue from the provision of pressurized secondary water service were to go into improving water deliveries to farms (i.e., piped and pressurized irrigation systems to farms, etc), more water could be made available within the ditch company's service area or to the region through these indirect "water conservation mechanisms."

[14] Personal communication with J-U-B Engineers, Inc., Kaysville, Utah. The engineering firm cites these figures for the City of Clinton and the City of Kaysville, Utah. The engineering firm has constructed pressurized secondary systems in both of these communities.

CHAPTER 2

CURRENT ISSUES AND TRENDS

Issues surrounding pressurized secondary water supply development in Colorado appear to involve seven principal interest groups. These include: 1) the state and the Colorado Water Conservation Board, 2) municipalities, 3) rural domestic water suppliers, 4) water users (consumers), 5) residential housing and subdivision developers, 6) landscape irrigation engineering firms, and, 7) most important to this study, agricultural water suppliers. These agricultural water suppliers include mutual ditch and irrigation companies and irrigation districts. There are obviously other interest groups important to water development and use, such as recreational, environmental and commercial-industrial groups. However, for the purposes of this study and report, these groups are somewhat peripheral to the issues being raised here.

What we would like to accomplish in this chapter is to identify and link the needs of these various involved interest groups to each other in such a way as to suggest points of consensus and conflict over the future of pressurized secondary supply. To begin, we will briefly outline the general trend in this type of water service for the Rocky Mountain region, and then relate these trends to what we are observing in various areas of Colorado. The next chapter covers more directly the relationship between secondary supply, the programs of the Colorado Water Conservation Board, and the future of agricultural water suppliers in the state.

The discussion begins with the issues and trends in secondary water supply by looking at the development of this type of water service in Utah and Idaho. These two states have been involved in the development of secondary water systems on a large scale for more than fifteen years.

<u>The Davis and Weber Case Study</u>

Two agricultural entities with very well developed pressurized secondary systems serving residential areas are the Davis and Weber Counties Canal Company in Sunset, Utah, and the Nampa-Meridian Irrigation District in Nampa, Idaho. These two irrigation systems were originally totally agricultural in nature. They gradually entering into secondary water service as urbanization occurred around them.

The full story of the Davis and Weber Counties Canal Company's (D&W) entry into secondary service is presented in Chapter 6. Briefly, in order to ensure that their traditional irrigation facilities were not unduly disrupted by residential subdivision development, the stockholders in this mutual ditch and irrigation company had the foresight to recognize that providing secondary water supply to homes in newly developed subdivisions was, oddly enough, a way to protect their irrigation system assets. This was accomplished by ensuring that the D&W water decree could be protected through continued beneficial use of its decree, utilizing a portion of the revenues from its secondary supply system for canal improvements, while obtaining improved cooperation from local municipalities to protect the agricultural irrigation system serving the remaining farms (Figures 9-16).

Today, the D&W irrigation system is comprised of two operations that are carefully integrated with each other. One is the traditional system of open ditches serving agricultural area production, while the second system is pressurized to serve upwards of 8,000 residential houses in the area. Local

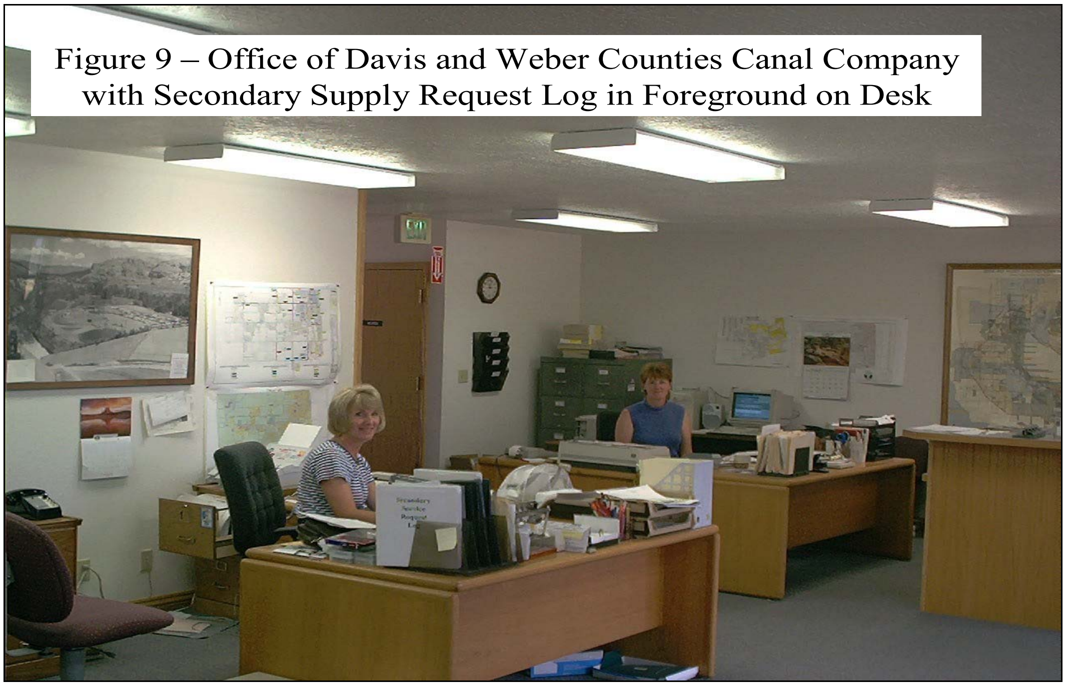


Figure 9 – Office of Davis and Weber Counties Canal Company with Secondary Supply Request Log in Foreground on Desk

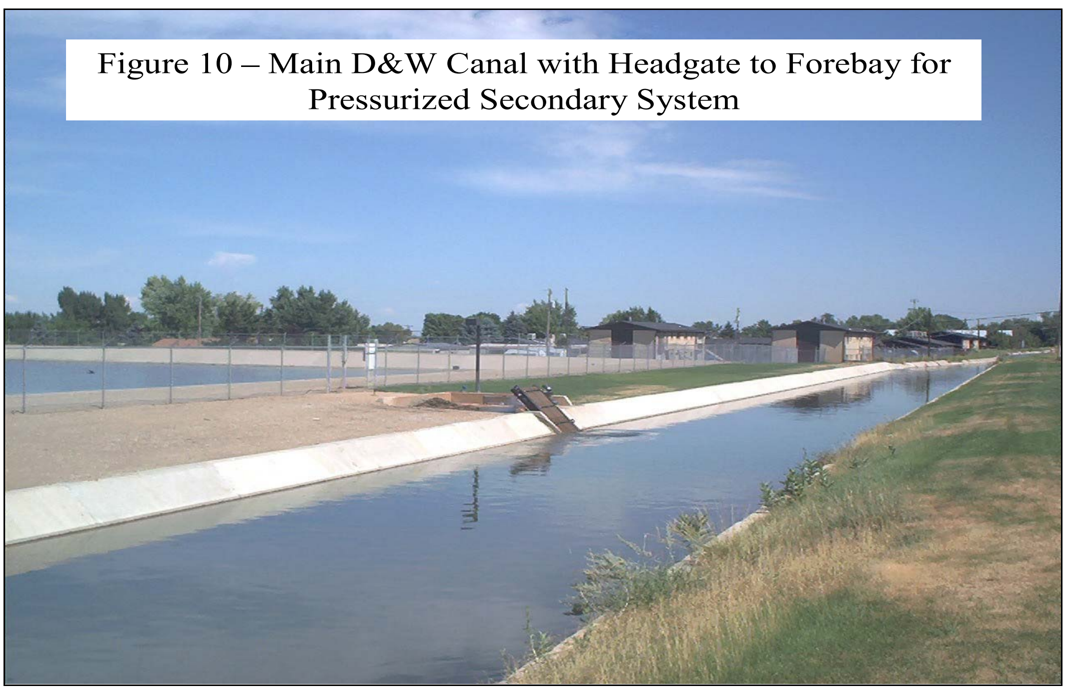


Figure 10 – Main D&W Canal with Headgate to Forebay for Pressurized Secondary System

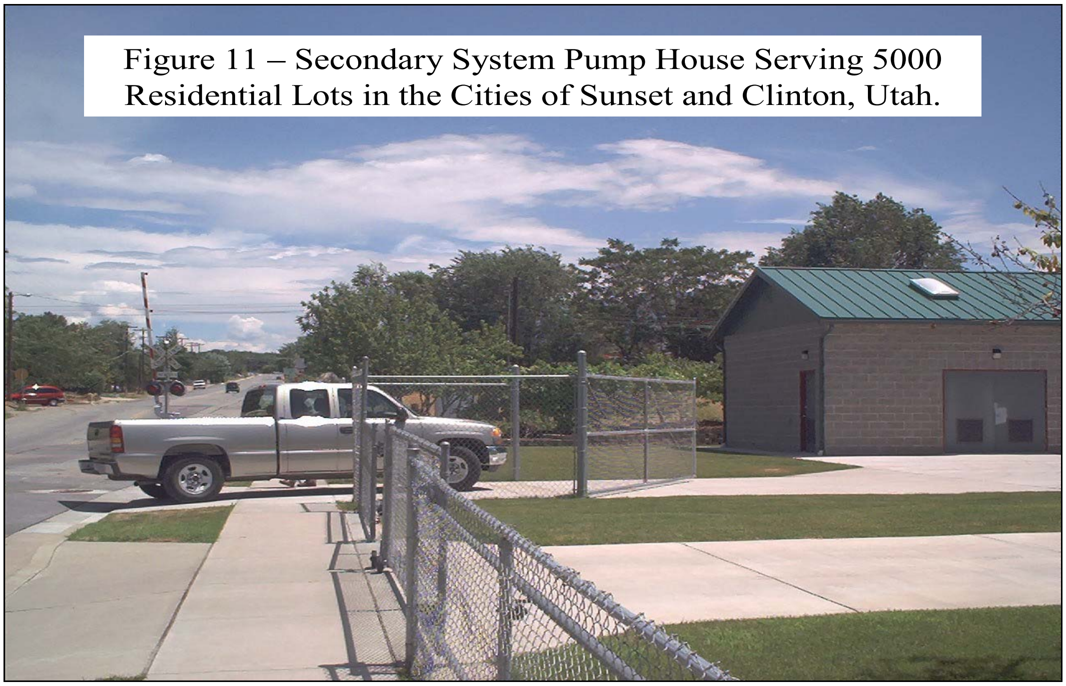


Figure 11 – Secondary System Pump House Serving 5000 Residential Lots in the Cities of Sunset and Clinton, Utah.

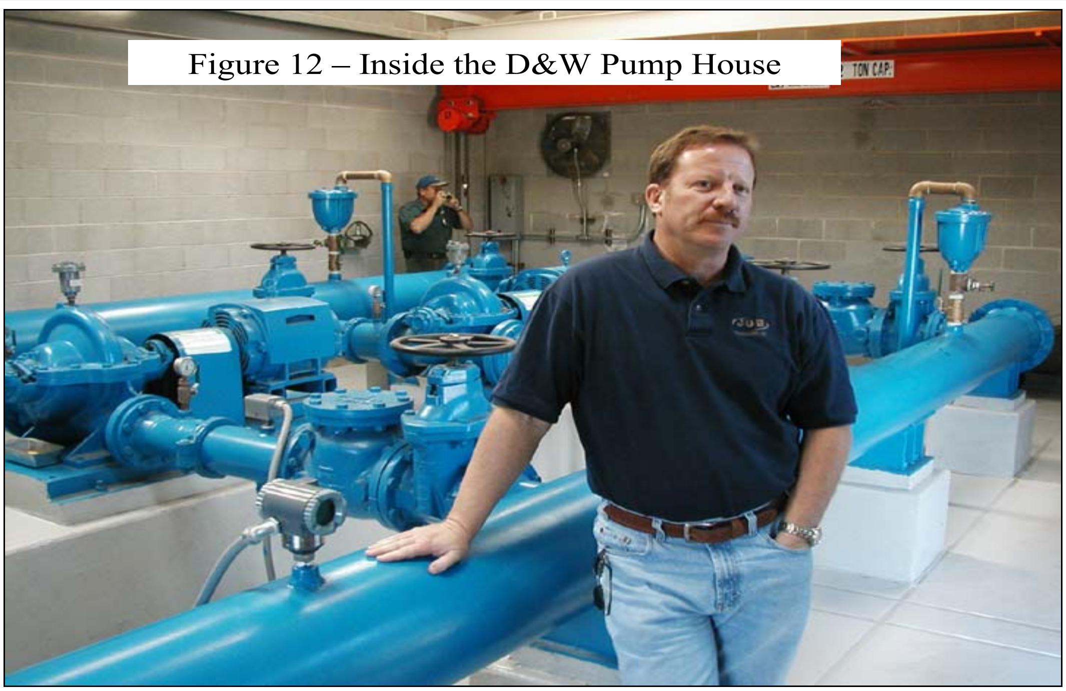


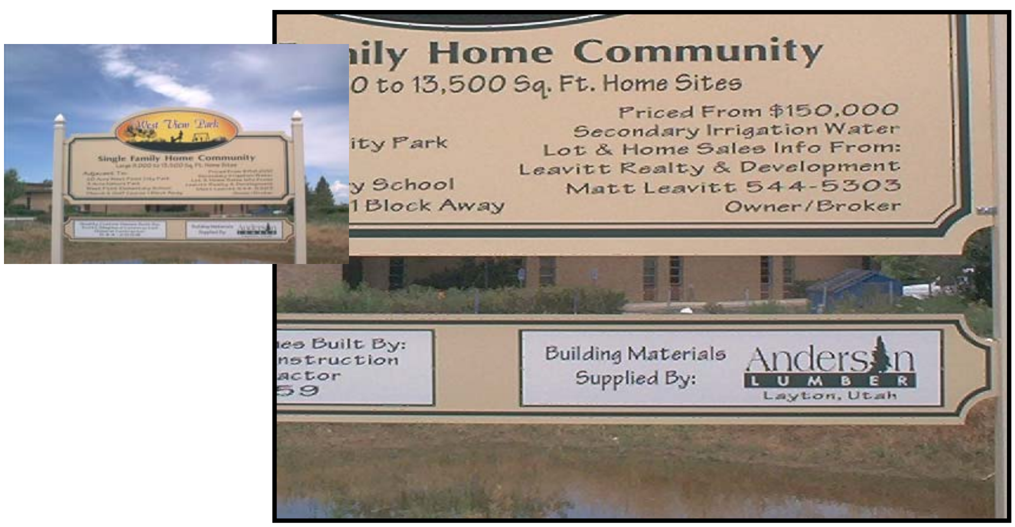
Figure 12 – Inside the D&W Pump House

Figure 13 – Older Residential Neighborhood in Sunset, Utah Served by the D&W Secondary System

Figure 14 – Secondary System (Irrigation) Valving Access in a Residential Street

Figure 15 – New Residential Subdivision in Sunset, Utah Served by the D&W Secondary System

Figure 16 – Advertisement for Secondary Water in a New Subdivision Under the D&W System, Sunset, Utah



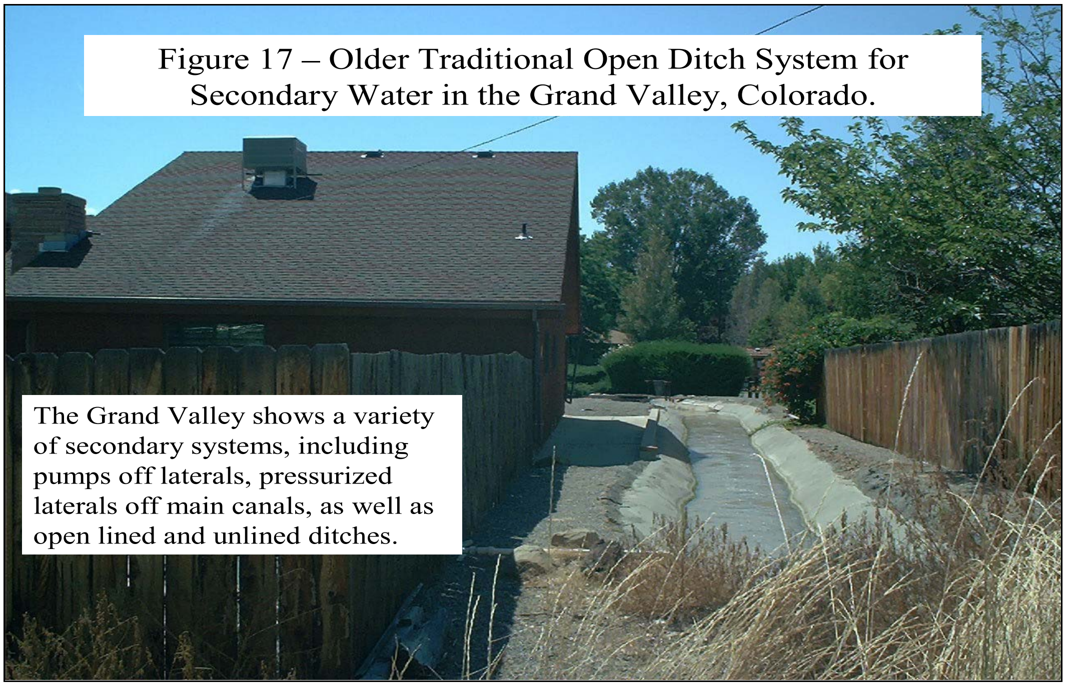


Figure 17 – Older Traditional Open Ditch System for Secondary Water in the Grand Valley, Colorado.

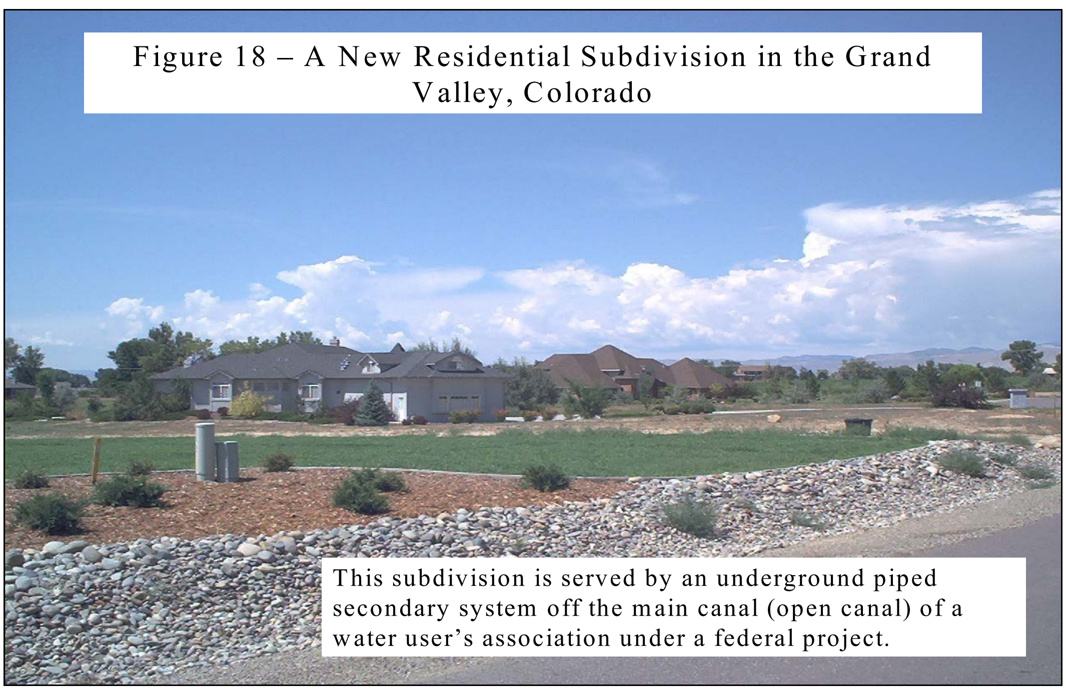


Figure 18 – A New Residential Subdivision in the Grand Valley, Colorado

ordinances, a special water rate structure for the secondary system, and a policy that ensures that D&W is in full control of secondary system development, makes it possible for the D&W stockholders to realize the many benefits of providing secondary water service. The canal company continues to operate on a nonprofit basis. Although until recently there has been little discussion of the possibility of pressuring agricultural water deliveries under the D&W system, this appears to be changing, and may be partly influenced by funds available through the 2002 Farm Bill for on-farm and group (lateral) projects.

Meanwhile, the municipalities located in or near the D&W irrigation system have benefited enormously from the development of the pressurized secondary supply. Although many municipalities in Utah have subsequently developed their own secondary systems, the benefits of having a canal company in the immediate vicinity providing secondary service is a great savings to them.[1] Potable water treatment facility expansion costs are reduced. A reliable water entity is in charge of the secondary system, thereby assuring municipalities that they will not have to assume management of the secondary system in the future. Finally, since the canal company is operated on a nonprofit basis, municipalities are assured that water charges to homeowners for the secondary service are commensurate with what would normally be expected from a utility.

Municipalities in Utah have realized enormous benefits from pressurized secondary supply, mainly through reduced costs associated with domestic water treatment, but also by way of ensuring that the higher quality water available in the region can be earmarked for potable use in the future. This is not to suggest that agriculturalists are thus left with the poorer quality water, only that the community in general can achieve a more rational use of water over time. Pressurized secondary water systems do not create more water for a region. Rather, these systems rationalize the use of water in both the economic and conservation sense, while ensuring that water rates in the locality remain reasonable. We would simply point out that revenue from secondary supply can help agricultural water suppliers too, through perhaps somewhat reduced water costs or annual assessments for irrigated agriculture by way of general improvements in canal company and irrigation district delivery systems. Customer satisfaction of secondary systems is very high in Utah, for both those operated by canal companies and municipalities.[2]

The Nampa-Meridian Case Study

The Nampa-Meridian Irrigation District (NMID), Nampa, Idaho, although originally developed to provide irrigation water to cropland, is now almost 90 percent urbanized. This has brought about a gradual transfer of open ditch deliveries to pressurized raw water deliveries for residential lots. NMID now has about 40,000 individual water accounts, the vast majority of which are represented by residential water users. Meanwhile, NMID has developed a wide range of ordinances, covenants, contracts and agreements protecting their irrigation facilities from construction activities associated with residential subdivision development. NMID operates very much like a conventional utility company, with its own dedicated rights-of-way, water billing, growth management planning capabilities and professional staff. This is not to suggest that NMID is not subject to the headaches of growth in its service area. However, the district status in the community is greatly enhanced by providing secondary service. Further, cooperation from local municipalities is more readily assured, now that they have a more direct stake in the irrigation district's future. The irrigation district is a "player" in the community.

Colorado Examples

Although other instances can be identified in the Rocky Mountain region to highlight the success of these pressurized secondary systems, the evolution of this practice in Colorado has been slow, at least until recently. This appears to be because the practice was either not perceived as being needed, for various reasons unpopular in the minds of people, or because the state was not attentive to emerging trends in other parts of the region. Another factor is that many of our mutual irrigation company boards are focused on the immediate, and mostly agricultural demands, of water delivery. It does take a paradigm shift and a "discovery process" to identify the opportunity and then to react to it. Colorado is clearly taking leadership in dual water systems today. However, many of the innovations being tried in the state appear to have questionable futures. In order to understand this fact, we must briefly describe what the trends have been in Colorado.

Although pressurized secondary water supply has many origins in the state, some contribution can be traced to the Colorado River Basin Salinity Control Program. Beginning with salinity control program activities under USDA's Agricultural Conservation Program funds in the early 1980s, efforts commenced to improve agricultural water deliveries in western Colorado, primarily in Mesa, Delta and Montrose counties, as well as elsewhere on the Western Slope. This was a period when municipalities throughout the state were only beginning to experiment with secondary supply, and generally on a very limited basis.

In the late 1970s, the Grand Valley in Mesa County began experiencing renewed growth from oil shale exploration, a temporary boom that would send housing costs upward, only to reverse precipitously in the 1980s. Nevertheless, planning agencies in the Grand Valley, primarily the City of Grand Junction and Mesa County government, were alerted to the need to secure adequate potable water supplies for the future. The acquisition of mountain storage facilities by the Ute Water Conservancy District, the principal potable water supplier for the Grand Valley, was predicated on the idea that residential outdoor water use in the Grand Valley would have to be served by the traditional ditch systems, many of which were in great need of repair. Enter the salinity control program with funds to address the problem of leaky laterals throughout the valley.

Under the salinity program, many attempts were made to organize lateral groups to improve water deliveries to farms and larger residential acreages. The Grand Valley Irrigation Company (GVIC), a principal agricultural irrigation water supplier in the Grand Valley, was also positioned to help residential water users, many of whom were now living in newly developed subdivisions along irrigation company canals. Improvements were made to lateral headgates, piping open ditches, and where feasible, allowing residential water users to pump directly from open canal systems. However, even with these important innovations, many of which lessened the pressure on the valley's precious potable water supplies developed by the Ute Water Conservancy District, people continued to experience difficulties irrigating lawns and ornamentals. Each residence became a "farm" with new, unique demands on the canal company's delivery system. The number of stockholders in GVIC soared due to land splits.[3] Rather than having a fully pressurized secondary irrigation system serving the entire GVIC service area, there developed a wide variety of open and partly pressurized irrigation systems for residential area watering, many of them operated by small homeowners' associations.

Figures 17 and 18 show some of the many kinds of secondary systems in the Grand Valley. Aside from a few planned unit developments with their own dedicated secondary system (much to the credit of innovative subdivision developers), the development of secondary water delivery in the Grand Valley has seemingly not achieved the levels of simplicity, efficiency and durability shown by the newer variety of secondary systems emerging in other areas of the Rocky Mountain region. Irrigation company and irrigation district efforts to modernize irrigation systems in the Grand Valley, and elsewhere in Colorado, have been beset by inadequate cooperation from local jurisdictions, the lack of ordinances to protect canal property, and a rather indifferent attitude by local jurisdictions toward accommodating housing subdivision development needs to pre-existing agricultural production needs.

In the mid-1990s, interest in pressurized secondary systems began to grow along the Colorado Front Range, particularly north of Denver where surface water supplies were ample. The decade of the 1990s combined wet years with rapid urban growth. The interest in secondary supply systems emerged somewhat slowly initially, despite the idea's rapid takeoff in other localities in the Rocky Mountain region. It was only toward the end of the decade that interest really intensified, frequently lead by subdivision developers seeking ways to counter the rising cost of raw water turnover requirements to municipalities and rural domestic water districts for potable water supplies. In addition, although perhaps not crucial to this growing interest, a workshop was organized by the principal investigator of this study on secondary water systems, including the invitation of several enterprises, such as the Kennewick Irrigation District (Kennewick, Washington), the Davis and Weber Counties Canal Company (Sunset, Utah) and several of the Colorado West Slope irrigation companies that were in the process of seeing more urban growth and looking for ways to accommodate this growth through secondary water supply development.[4]

What has emerged in Colorado today, principally through the inspiration and energy of land developers and civil and irrigation engineers, is a plethora of secondary system designs. Even local municipalities have entered the picture, in the Denver Metro Area, Boulder, and in Larimer and Weld counties. The City of Greeley now has a well-developed secondary supply system, albeit mainly for parks and open space landscapes (i.e., not residences), by way of converting a traditional irrigation company canal to serve these needs. This particular instance, although highly successful, does not necessarily represent the strategy being discussed in this report, and involving the participation of irrigation companies or districts that are still predominately agricultural in nature. However, the City of Greeley program is quite viable because the city itself is managing the secondary system. What has transpired since the entry of the City of Greeley, and the City of Windsor, Colorado, into secondary water supply suggests some equity and sustainability concerns for future water users in the area.

Current Trends

Before discussing these equity and sustainability issues, we should point out that most municipalities and rural domestic potable water suppliers have been reluctant to enter into the provision of secondary service. Why? There are perhaps new administrative cost and legal issues that municipalities and rural domestics do not want to shoulder. Although, in the event of a lawsuit over accidental drinking of pressurized secondary water by a homeowner or pet, municipalities would seemingly have governmental immunity, this might not be the case for rural domestic water suppliers. Furthermore, rural domestics are often governed by bylaws, and entering into secondary supply might require major changes in these bylaws. However, the main reason appears to be that both municipalities and rural domestic water suppliers are already hard-pressed to secure water supplies for their potable systems. The provision of secondary water simply places an additional burden on these entities, and since the provision of water service of any kind is often a volatile public issue, it is therefore not an attractive prospect. This fact begins to narrow down the candidates for operating and maintaining secondary systems. This list of candidates includes homeowners' associations, special districts, private water companies and traditional agricultural water suppliers.

Taking northeast Colorado as a useful case study area, it appears that homeowners' associations initially became popular among housing subdivision developers as the decade of the 1990s came to an end. This area experienced a 25 percent growth rate during the decade, and much of the growth occurred in unincorporated areas. For instance, Larimer and Weld counties, and to some extent, Boulder County, saw a rapid increase in large acreage housing subdivisions outside city boundaries. These often included the development of a localized secondary system for these large lots, fed by an excavated pond or pumped directly from an open farm ditch. Land developers were aware that the property values of these lots could be enhanced by the presence of secondary water service, particularly if water was needed to maintain recreational livestock. It was a relatively simple engineering task to develop a sound system. The long-term issue of maintaining the secondary system was largely left in the hands of a subdivision homeowners' association, with property covenants to the effect that the homeowners' association was responsible for picking up the costs of operation and maintenance as well.

Homeowners' associations, as providers of public goods of this nature, have certain drawbacks, potentially notable drawbacks. Given the size of these smaller secondary systems, the revenue generated from them, although not insubstantial, may frequently be insufficient to hire a full-time maintenance person with adequate knowledge, tools and equipment to operate, maintain and protect the system. It is true that a full-time maintenance person may not be needed, in which case the operation and maintenance of the secondary system will likely fall back on voluntary help on the part of homeowners. In addition, there is need of setting water rates, responding to the operational complaints of homeowners, dealing with temporary water shortages, repairing pumps and waterlines, reading meters if meters exist, and organizing meetings. Where such systems exist, they do not appear to be fairing well in the region as a whole. If this trend were to continue, municipalities and rural domestic water suppliers might well be drawn into maintaining them, in order to prevent homeowners from reverting to the potable water system to irrigate their lots. Municipalities and rural domestics are concerned about the use of homeowners' associations as long-term operators in the provision of secondary water service.

Subdivision developers pride themselves on the development of property that is both attractive and innovative in design. Furthermore, increased profits from land development can be realized through anticipating or directly responding to market demand for new lifestyles. Recent demand for "country living," particularly for those who can afford larger properties and the commuting often associated with them, has resulted in an explosion of new rural subdivisions, often with a golf course, man-made water bodies, and large green spaces. In order to ensure that these subdivisions have ample water for the future to irrigate this acreage, it has been necessary to build pressurized secondary supply into the overall design of the subdivision.[5]

Although developers will go to considerable effort and expense to build such systems, it is unlikely that they wish to be held responsible for operation and management of these systems in the future, unless it represents a profit-making venture to them. In some instances, this may be a viable option. However, in most instances, it will be necessary to set up a legal entity to operate and maintain the secondary system. In response to these concerns, developers have turned to the concept of "special districts." This is a very viable option, and one that ensures that the properties in question are served by a legally recognized (and potentially bonded) entity.

However, water development needs are never-ending. Subdivisions continue to be added to existing water service, forcing special districts to secure more water for the future. Staff must be hired, equipment must be purchased, and billing gradually becomes a major operational cost item. In these respects, secondary systems are no different from potable water systems. Finally, some planning is normally required by a special district to ensure the protection of water users from water shortages, particularly when expanses of "commons" green space, expensive ornamentals and recreational livestock are involved. There are many instances throughout the region where special districts have been forced to merge with larger water supply entities to ensure continued service. This leaves open the distinct possibility that many of these special district arrangements for rural subdivision secondary water supply will someday require agglomeration with municipalities. As with homeowners' associations, special districts for secondary water service will have to be shown to be viable over time. They have not been popular in other areas of the Rocky Mountain region unless, as with the City of Highland, Utah system, they are providing water service to a large municipal area of several thousand homes.

Colorado has seen many successful special districts formed for potable water service, such as the Title 32 districts throughout the state. However, these special districts are in a constant race with other water supply entities to secure additional water rights for the future. As water supplies become scarce with population growth throughout the state, special water districts will be forced to more aggressively secure water for future needs. When a special district is established for secondary water service in an area, local government should view it with the same concern as if this district were providing potable service. If this philosophy is not adhered to, there is the potential for growing dissatisfaction on the part of the public in how public goods such as water are provided and administered in the region. The establishment of a special district should be overseen by the state in such a way as to ensure that ample water rights are secured for the future and that the special district will have adequate revenue to operate and maintain the water system. This was the very minimal requirement made on Title 32 districts when they were being established in Colorado in the 1960s under USDA's Farmers Home Administration.

The provision of secondary water through private water companies is clearly another option for an overall secondary water supply policy for the state. In fact, this is already being tried in northeast Colorado. Recently, the research team visited a system that is currently providing secondary water to a newly constructed affordable housing subdivision near the City of Fort Collins. The residential lots are quite small, although the subdivision has been designed with considerable open space for recreational use. The secondary system is served by wells and a pumping system that distributes water through a well-designed pipeline network serving the entire subdivision. The secondary water service is on demand, although homeowners are encouraged to water lawns and gardens between the hours of 6:00 p.m. and 6:00 a.m., particularly in prolonged dry spells. Despite these well-designed features, the water rates for secondary supply appear unusually high, particularly for low-income housing. This raises the issue of how local government addresses equity in the provision of water.

Some Equity and Sustainability Concerns

Municipal systems in Colorado, and throughout the Rocky Mountain region, are routinely operated as not-for-profit enterprises rather than as tax districts. That is to say, the cost of water to the consumer is a reflection of the actual cost of providing the service, whether for potable or non-potable (secondary) use, and no more. Conservation is often achieved through metering rather than through imposing water rates that penalize excessive use, except perhaps in the case of drought. Under rural domestic water systems that provide potable water to residential and commercial users in unincorporated areas, water is also provided at cost, while conservation is more frequently met through variable water rates for different size lots rather than through metering.[6] These observations suggest that the privatization of water service, such as in the low income housing subdivision mentioned earlier, raises considerations of public policy. Although interest has been growing in the region, as well as in other parts of the world, for the privatization of water service, it is likely that some form of public utility oversight will ultimately be needed to ensure that public policy goals are met. These may include quality of service, the cost of water relative to differential income in the community, safety issues, and sustainability of these systems. The presence of the private sector in the provision of water service will be a function of profit rather than public policy. Although service may be measurably improved through privatization, public policy objectives may be compromised.

Are there yet other options available to the community? We will continue to point out in this study that the entry of traditional agricultural water suppliers into pressurized secondary water service is not only a viable option, it is a proven one, and furthermore, an option that is likely to have a positive impact on agricultural water use and water conservation. In other words, although pressurized secondary water supply does not in itself create more water for the community, it may very well indirectly help conserve water by way of being a mechanism that leads agricultural water users to improve irrigation water management. Meanwhile it ensures that water remains in the agricultural system to meet future needs, as well as mitigating drought conditions when they arise. This is a policy issue for the state that is central to the study and this report, and will be addressed in the next chapter.

Briefly, the City of Lamar has recently entered into an agreement with Aqua Engineering, Inc. of Fort Collins, Colorado and the Sociology Water Laboratory at Colorado State University to conduct a feasibility study for secondary water service in that community. The effort involves a cooperative agreement with one of the canal companies that skirts the City of Lamar, and in which the city owns some shares. Rather than trying to buy out the canal company, the city is taking an approach that would guarantee the identity of the canal company into the future, strengthening the canal company in its provision of agricultural water deliveries to local farms. However, in the background is the idea that such a partnership will ultimately prevent outside interests from buying out the canal company and diverting its river decree out of the Arkansas Valley. The idea of secondary water service being provided by an irrigation company affords these kinds of opportunities between municipalities and agricultural water suppliers, in both large and small communities that still have important agricultural production in their midst. Recent, the City of Hooper, Utah has taken up the same strategy with the local Hooper Irrigation Company.[7]

Conclusion

In conclusion we can state that although issues remain as to what kind of entity ultimately provides secondary water service to the community, the concept itself should be a central feature of the state's water policy. As discussed in the next chapter, it is apparent that secondary water supply issues have some bearing on the future of irrigated agriculture in the state. For the most part, it has been observed that canal companies and irrigation districts are providing secondary water supply in other states of the Rocky Mountain region. The use of homeowners' associations, private water companies and specially formed water districts has been less evident. However, many municipalities are now entering into secondary water service, a trend that appears very viable for the future. Nevertheless, it is believed that agricultural water suppliers are an excellent player in secondary water supply development, if certain conditions and objectives are realized. These are addressed in the next chapter.

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[1] Layton City, Utah and the City of Highland, Utah have well-developed secondary systems, in both instances operated and maintained by a separate water utility. The research team visited these systems and found them to be successful and popular.

[2] Unfortunately, due to a Davis and Weber Counties Canal Company canal breach that flooded a subdivision in Riverdale, Utah in 1999, the company was sued for $8 million. With only $3 million in insurance at the time, the canal company is considering selling its assets to a local conservancy district. This affects the example only materially; the concept of providing secondary water to local subdivisions having measurably proved itself over the past ten years. Canal companies and irrigation districts in the Rocky Mountain region are in harms way with urban growth. Clearly, the provision of pressurized secondary water provides these entities with a means of leveling the playing field, through new sources of revenue to upgrade their canal facilities, and thus avoid what happened to Davis and Weber. The canal company was in the process of upgrading its canal system at the time of the breach, and in doing so, exhibiting good faith in maintaining its irrigation system. This diligence did not satisfy the plaintiffs in the lawsuit, the case being settled out of court rather than facing a trial jury over a $15 million lawsuit.

[3] It is estimated by the management of GVIC that approximately 40% of the stock in the company is represented by urban water users. This includes some speculative stock acquisitions, as well as a few large institutional water users.

[4] This workshop was held on October, 22, 1996 at the Fort Collins Holiday Inn.

[5] The best example of this in northern Colorado may be the Water Valley project in the City of Windsor, which was developed by Martin Lind. Lind's development company continues to be a notable regional player in secondary water supply concept development and provision.

[6] The metering of secondary water supply has been only rarely observed in the Rocky Mountain region. Most secondary supply providers interviewed as part of the study have stated that variable rates for lot size, or more frequently, water tap size, is far superior and of much less cost to the water user than metered systems.

[7] Personal communication with the board of directors of the Hooper Irrigation Company, Hooper, Utah. The pressurized secondary system for the Hooper Irrigation Company is being built by J-U-B Engineers of Kaysville, Utah, an innovator in working with small communities and irrigation companies in developing secondary systems.

CHAPTER 3

THE FUTURE ROLE OF AGRICULTURAL WATER SUPPLIERS IN SECONDARY WATER MANAGEMENT

Mutual ditch and irrigation companies and irrigation districts have a deeply-rooted history in Colorado. Most ditches have been in operation for over 100 years. In the past, and continuing to the present, the operational approach to these enterprises has been appropriate to the rural farming community. They hire staff locally, stockholders or landowners attend meetings regularly, and community attitudes ensure that cooperation is strong. The organizations have performed well, and, for the most part, satisfaction with water deliveries has been adequate, except perhaps in drought years.

However, irrigated agriculture in the western United States is at a crossroad, due not only to reduced levels of farm income frequently experienced by growers, but equally to rapid changes in land use and increased competition over water supplies. Although this report is not designed to address these issues, it is argued that secondary water supply development in the region has an important bearing on the future of irrigated agriculture. We will attempt to show how the Colorado Water Conservation Board's water resource project lending program, and the 2002 Farm Bill, may provide opportunities for canal companies and irrigation districts to enter into secondary water service, while preserving the irrigation system and improving agricultural production and conserving water at the same time.

New Challenges

There is an urgent need to look at innovations occurring among agricultural water suppliers in the Rocky Mountain region. In recent years, canal companies and irrigation districts have had to address issues with which they have had little previous experience. Urban encroachment along canal facilities is a prime example. Urban encroachment has been accompanied by the dividing up of farmland, changing shareholder makeup, water stock sales and increased ownership of canals and company stock by municipal interests. Liability issues have increased, associated with new residential subdivisions located near ditches running through the area, along with a wide array of water delivery changes and financial and water delivery record keeping burdens. Agricultural water organizations or systems live in a different world today with the onset of urbanization, the environmental movement, and changing agricultural production practices and needs (Figures 19-22).[1]

Nevertheless, Colorado ditch companies continue their principal historical function of providing irrigation water to farms. They must ensure that their irrigation facilities are protected. Often the best way to accomplish this is to require that new water users coming into the canal company or irrigation district service area follow the same governing principles and usages as the traditional agricultural water users. Many of these new water users are small shareholders (or small landowners in the case of irrigation districts) operating recreational farms or living on large estate lots. Their water needs are often quite different. Nevertheless, the agricultural water supplier must address these new needs. Here is where pressurized secondary water supply enters the picture.

Many of these changed water needs can best be met by pressurized piped water deliveries in small quantities. Traditional surface irrigation as practiced in agriculture is not appropriate in timing and quantity and probably would waste considerable water in the process of irrigating small parcels of urban

Figure 19 – Old Agricultural Trade Centers Expanding Onto Irrigation Canal Systems

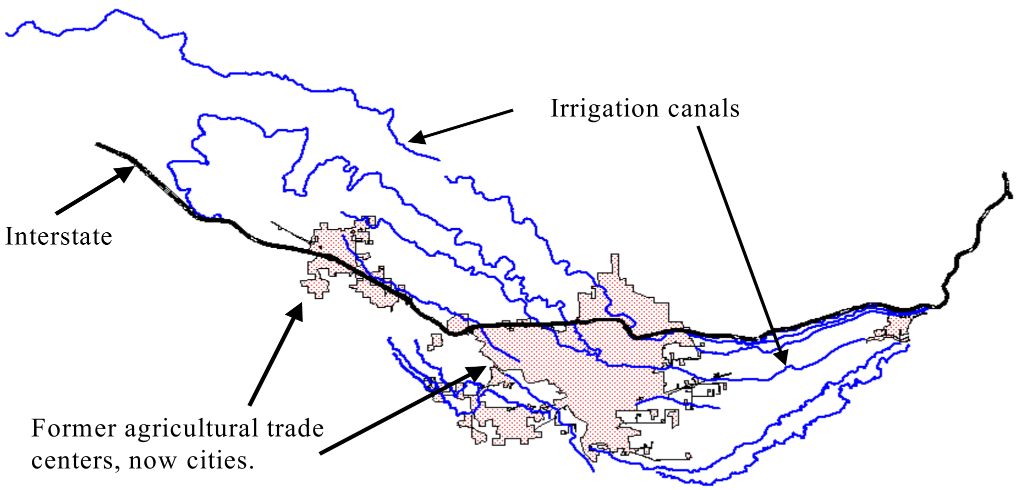
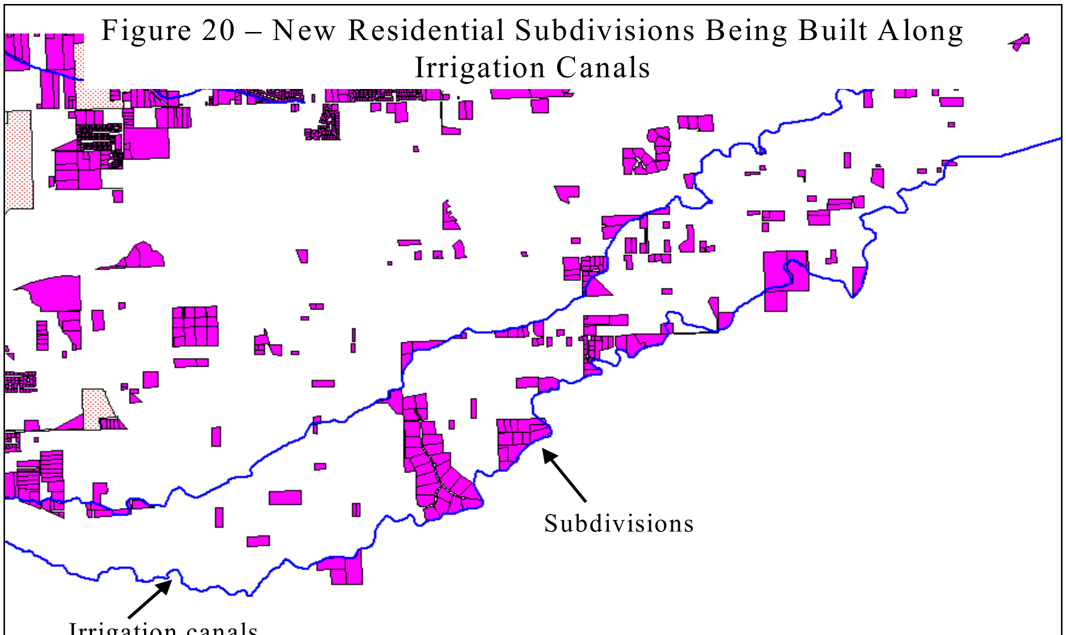


Figure 20 – New Residential Subdivisions Being Built Along Irrigation Canals



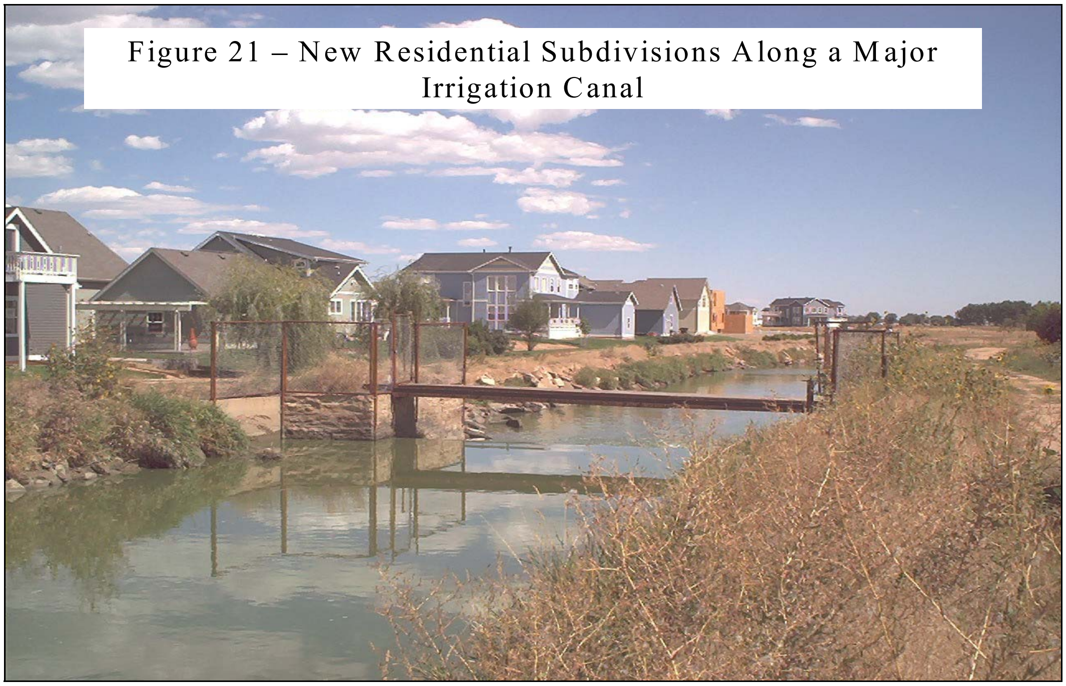


Figure 21 – New Residential Subdivisions Along a Major Irrigation Canal

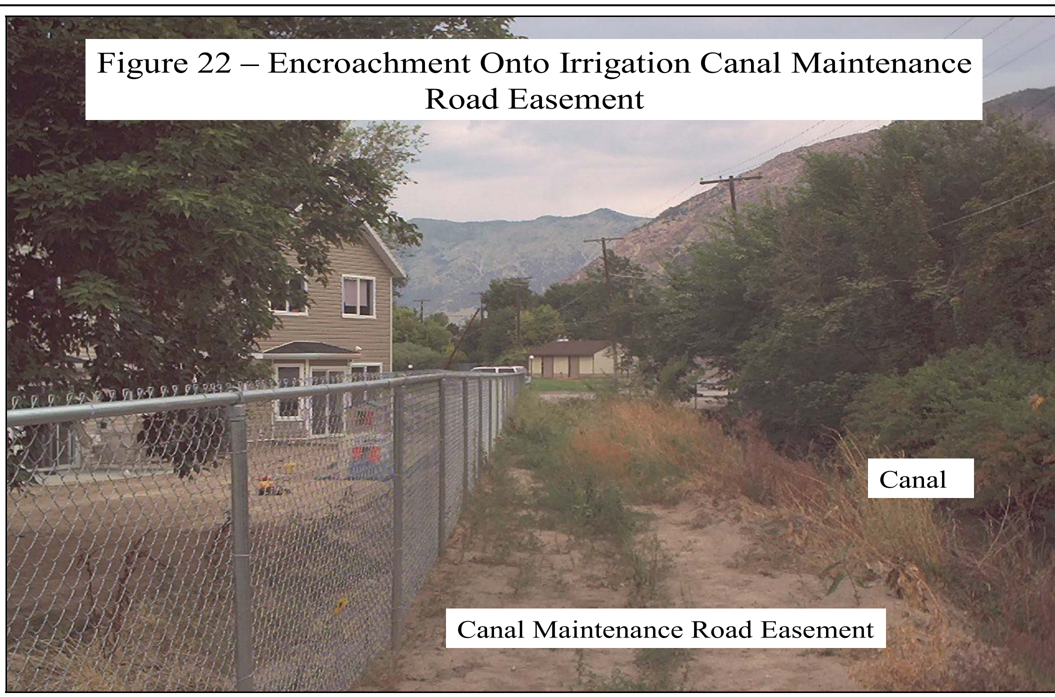
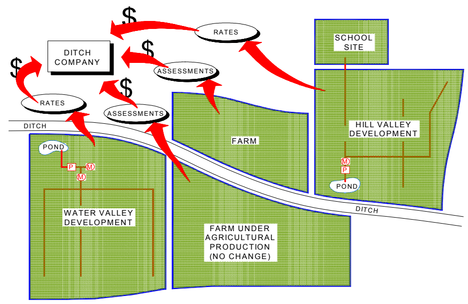


Figure 22 – Encroachment Onto Irrigation Canal Maintenance Road Easement

Figure 23

OUTDOOR WATER USE:

Regional standard is 100 gal. per capita/day, but varies with lot size, income, etc.



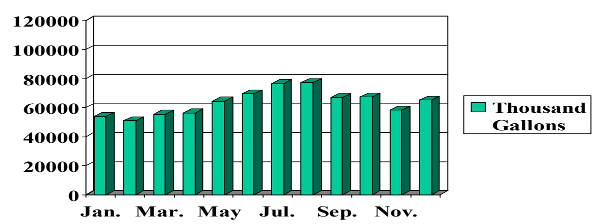
In brief …

- **Including pressurized, non-potable (secondary) water supply systems into a canal company's existing operation is simply 're-packaging' the product and service that the company has historically provided.**

Figure 24

INDOOR WATER USE:

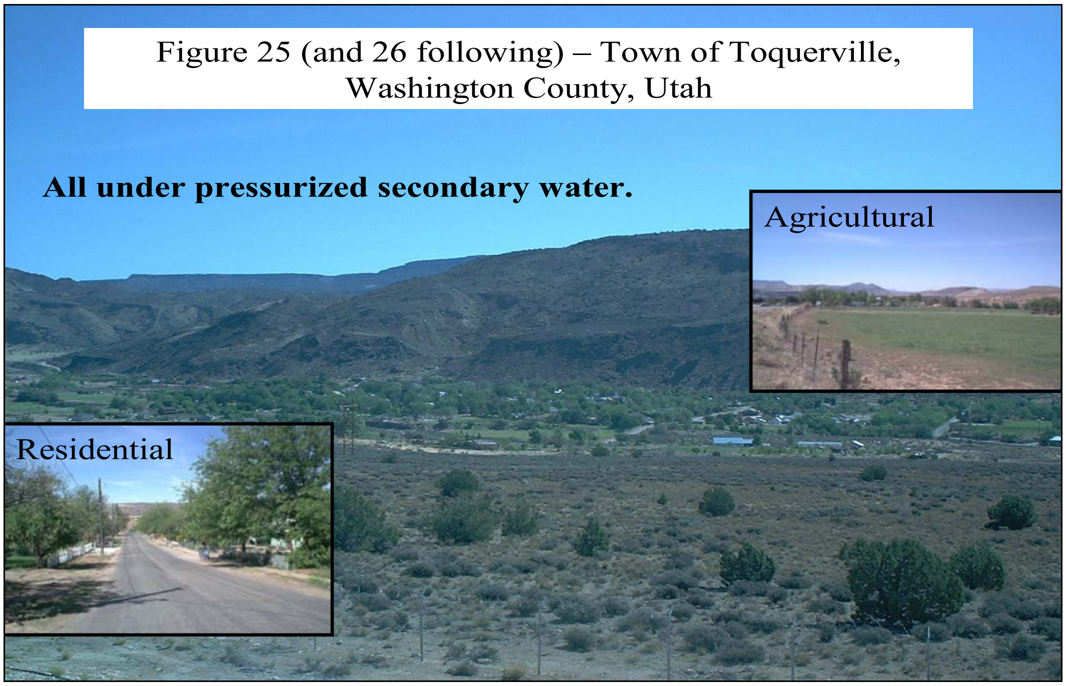
Regional standard is 70 gal. per capita/day

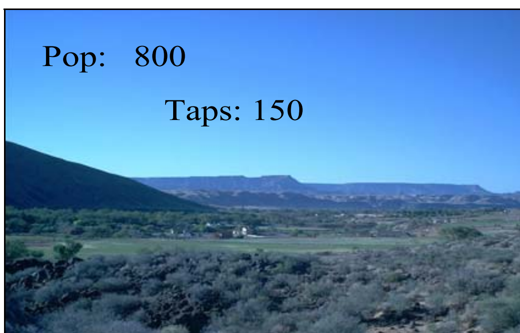


In brief…

- **Teaming up with a <u>viable</u> secondary water supplier will allow potable water providers to plan more effectively for potable water needs, without worrying about the variable needs of outdoor watering in the summer.**

Figure 25 (and 26 following) – Town of Toquerville, Washington County, Utah





Toquerville Water Rates (unmetered)

- 1, $1\frac{1}{2}$, 2 and 4 inch taps
- All taps = $1500 connection fee
- $\frac{1}{2}$ acre or less = $120 per year
- Up to 1 acre = $180 per year
- Ag. Acreage = $50 per acre/year

Davis and Weber Canal Co.Water Rates (unmetered)

- 1, 2 and 3 inch taps
- All taps = development fee, plus a connection fee (both vary with lot size)
- $\frac{1}{2}$ acre or less = $200 per year
- More that $\frac{1}{2}$ = $244 to $2,740, depending upon lot size and tap size.

Figure 27 – Typical Urban Irrigation Headgate

- Check structure and headgate.
- Storage pond.
- Pump / filter system.
- Piped delivery infrastructure.
- Points of connection (POC) to individual lots or open space areas.

New meets old …

Figure 28– The Urban Irrigation Delivery Infrastructure

Figure 29– The POC for a Lot or Open Space Area

Raw water point-of-connection valve, valve box, and winterization point

Figure 30– The POC for a Lot or Open Space Area

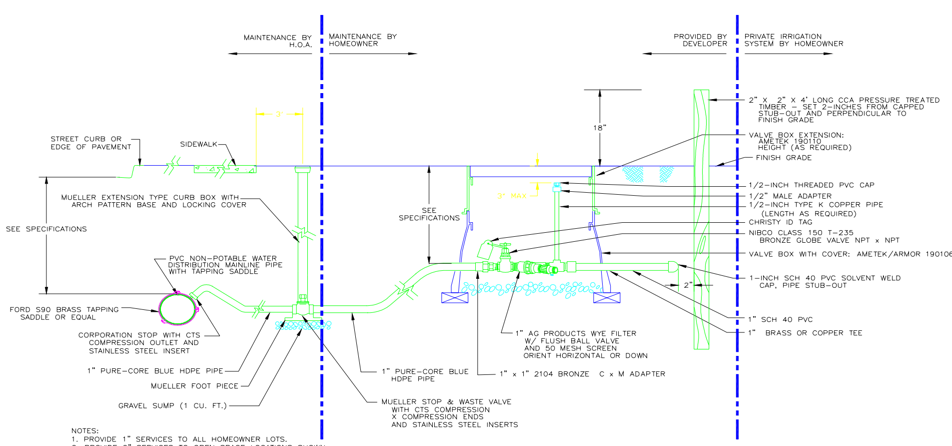
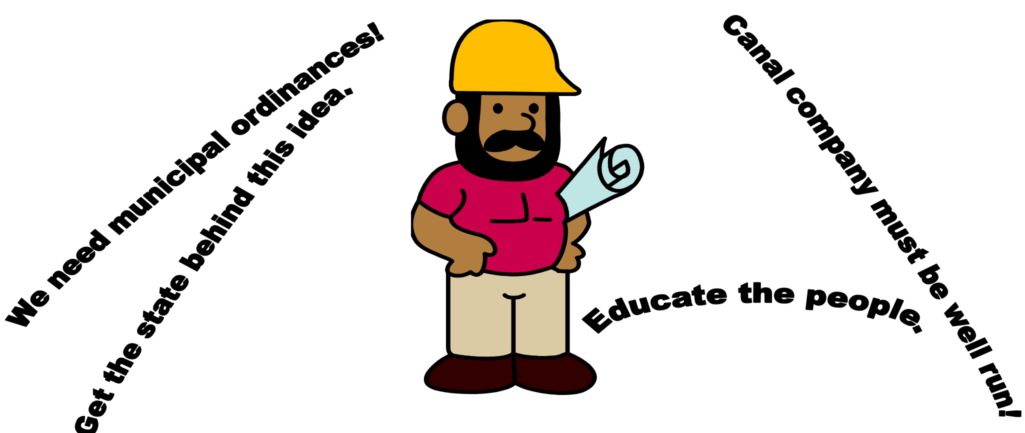


Figure 31– The POC for a Lot or Open Space Area

Figure 32– Viewpoints of Developers



"Secondary systems managed by canal companies brings me a reduction in development costs associated with water. I can realize savings, increase my property values, and help Ag. at the same time."

Figure 33 -Raw Water Turnover Requirement for Residential Lots

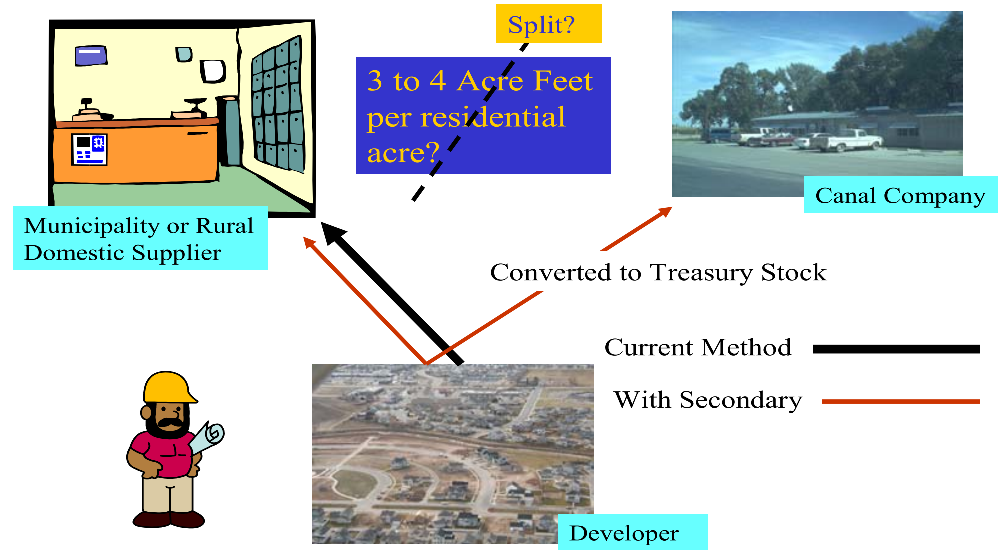


Figure 34 - Raw Water Turnover Requirement for Residential Lots under the Colorado-Big Thompson Project

Figure 35 – Financing Pressurized Secondary Systems in Colorado

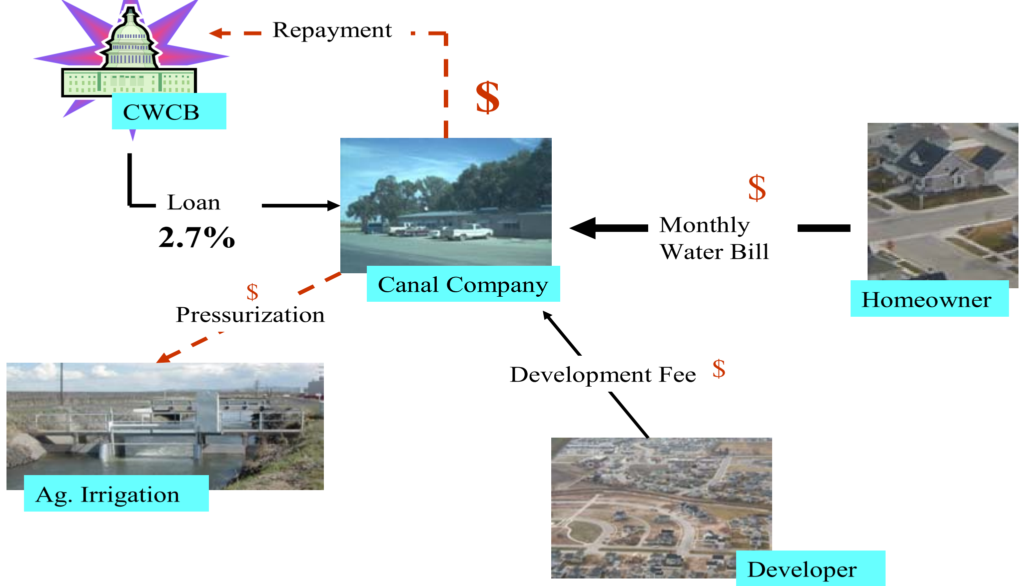
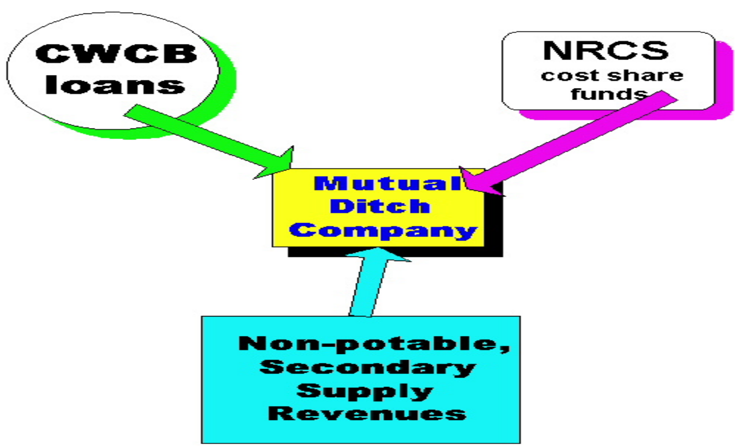


Figure 36 – Financing Pressurized Secondary Systems by Combining Federal Cost Sharing under the Farm Bill with Funding from the Colorado Water Conservation Board and Secondary System Revenues



land. The secondary water service as emphasized in this report provides a new opportunity for agricultural water suppliers to appropriately address these new water needs, while at the same time strengthening their financial position, protecting their water rights, improving management of their overall water supply and providing new opportunities for agricultural irrigators to change from traditional surface irrigation methods to more modern practices. Once more, pressurized secondary water supply can fit the traditional role of irrigation companies and districts in supplying water to arid lands. These entities often have well-trained and adaptable staff, equipment, and other resources to ensure that any new water service taken on by the agricultural water suppliers can be sustained into the future.

Modernizing Agricultural Systems

One of the principal ways of modernizing agricultural production is through the pressurization of agricultural water deliveries. The entry of agricultural water suppliers into secondary water service would not only enable them to modernize their canal system, but contribute to the overall water supply picture for the larger community. Revenues generated from providing pressurized secondary water service to newly built residential subdivisions in unincorporated areas can help to finance the pressurization of the entire canal system, thereby bringing agricultural water use and production to a higher level of performance.

Even though water conservation may not be fully realized from the residential subdivision lots or parcels served by the secondary supply system, the potential for pressurizing water deliveries to farms for crop irrigation as a part of a planned development of secondary systems for residential lots could realize major water conservation and improved irrigation practices on these farms. Growers currently served by canal companies and irrigation districts in the Rocky Mountain region that provide secondary water service are now beginning to see these pressurized systems extended to crop irrigation, thus providing opportunities for both farms and households to experience the benefits of pressurized agricultural water deliveries. Opportunities are subsequently opened up for new methods of irrigation, improved means of irrigating more effectively later in the growing season, and changing production to meet new market demands. Labor costs associated with irrigating are often reduced through pressurization of agricultural water deliveries, and crop yields can be improved.

The strategy of utilizing federal monies of the Natural Resources Conservation Service's Environmental Quality Incentives program to help finance the pressurization of agricultural water use, as the pressurized secondary system is installed for local residential use, is exemplified by the small ditch companies around Coalville, Utah. Six small ditch companies receiving water out of Chalk Creek above the City of Coalville, consolidated their water shares into one parent ditch company, the Chalk Creek Narrows Canal Company. In the process of apportioning a percentage of the ditch company water supply for the secondary system in Coalville, NRCS came in and designed the pressurization of agricultural water deliveries in the valley, and then cost-shared on the on-farm improvements. The Utah Division of Water Resources financed the Coalville secondary system at 0% interest, due mainly to the nature of the project, which involved the local community and agricultural water users coming together in a partnership to improve the water resources in the valley. In August, 2003, in the middle of a drought, the farmers in the valley above Coalville were irrigating and making their third cutting of hay, something they would never have been able to do in the past. Using 40% less water due to the pressurization of irrigated agriculture, the community of Coalville and surrounding agricultural production have extended their water supply well into the future, without having to develop new water supplies, a strategy that a small community of 1400 could ill-afford. Although small in scale, the Coalville example shows the effectiveness of this strategy of having canal companies participate in secondary water development. The Davis and Weber Counties Canal Company (see previous chapter) is an example of a large irrigation company doing the same thing that six small ditch companies did in the Coalville area. The Coalville example is discussed again in the concluding chapter of this report.

Financing Resources for Secondary Systems

Fortuitously, in the bigger picture, there are new financial resources for canal companies and irrigation districts to improve their water delivery systems in this way. Through the Colorado Water Conservation Board, the state has made available low interest loans at very favorable terms to modernize canal systems. Small planning grants are also available to help with development of loan applications, along with technical assistance. Meanwhile, funds may be available from the Farm Security and Rural Investment Act of 2002 (FSRIA), reported to be one of the largest Farm Bills in history. Billions of dollars will be provided over the next five years through the Environmental Quality Incentives Program (EQIP) of the Natural Resources Conservation Service to modernize small lateral canals (through group projects) and on-farm irrigation systems. Under this revitalized program, group lateral improvement projects are being emphasized along with on-farm irrigation system improvements. A new national emphasis is being placed on development of pressurizing agricultural water deliveries, and this naturally lends itself to pressurized irrigation methods that can dramatically improve water application efficiency, reduce labor, and increase yields.[2]

The CWCB and the FSRIA financial resources, combined with potential revenue derived from secondary water supply, can together dramatically improve agricultural and residential water use. At the conclusion of this chapter, a modernization strategy for agricultural water suppliers will be presented, and involving the development of secondary water supply, and at minimal or no cost to farmers. Bringing in new water customers to help support the ditch company, mainly non-potable residential and commercial landscape users, is a central component of this modernization strategy. It is a strategy that virtually assures that farmers will incur a minimal cost for irrigation system improvement. The change to more efficient on-farm irrigation will incur additional equipment costs for farmers that can be offset through the EQIP cost sharing program.

The Secondary System Revenue Stream

As urban encroachment extends out into the service areas of these traditional canal systems, farmland becomes intermixed with subdivision developments, schools and commercial property. In order to ensure a continued water supply to agriculture, and in order to ensure that local growers are not discouraged from remaining in production, a pressurized secondary system serving both residential landscape and agricultural uses can be developed. Revenue from this pressurized secondary system flows to the ditch company, much in the way that conventional water assessments have in the past. Traditional water assessments for crop irrigation are collected as usual, while water rates are set for residential uses that are reflective of the costs of providing pressurized water service for this type of usage. A plan and strategy can be implemented whereby pressurized secondary system water revenues cover both the installation of the pressurized system as well as some of the overall modernization of the ditch system for agriculture (Figures 23-24).

In addition to allowing for canal infrastructure improvements by way of pressurized secondary supply revenues, the development of this type of water service helps to keep the ditch company water rights in the traditional service area. Water stays on the land and in the local area. The expansion of such service preserves the assets of the agricultural water supplier, continues to preserve the historic role of the entity, and most of all allows the agricultural water supplier to realize benefits from area growth and urban development rather than just coping with the problems and aggravations of urban encroachment.

As mentioned in the previous chapter, other parts of the Rocky Mountain region have set the stage for this innovation. Colorado is now experiencing the development of many of these pressurized secondary systems, but generally only for new residential subdivisions or, in a few cases, in some municipal areas.[3] So far, these Colorado developments are not benefiting agricultural water suppliers directly in any meaningful way. By comparison, in Utah, the state has aggressively financed pressurization of irrigation systems for agricultural production and landscape use as a "development package." Loans are provided by the state to ensure that not only are new water needs met, but that the development is clearly designed to conserve more water in agricultural applications as well. Mutual irrigation companies are converting, on an as-needed basis, part of their traditional irrigation systems to serve residential development, in addition to crop irrigation. In the process, conserved water from the pressurization of agricultural water deliveries has improved water availability under drought conditions.

An example is Washington County, Utah, where the local conservancy district is providing assistance to rural farming communities to pressurize their water deliveries to municipal and agricultural users at the same time. Thus, municipalities are working together with farmers to ensure that the needs of both are being met in the transition from older open ditch systems to pressurized piped underground water systems. Substantial water is conserved in the process, protecting both the municipal and agricultural water users from drought. Although preference is given to municipal uses during drought, the pressurization of agricultural water deliveries greatly increases the likelihood that water will continue to be available for crops in such years. In addition, farmers have a better chance to have water to irrigate later in the season than if they were still using the traditional open ditch systems (Figures 25-26).[4]

Elsewhere, in Idaho, mutual ditch companies and irrigation districts are realizing added revenue from secondary water supply to operate and improve their entire irrigation systems. In the process, there has been improved cooperation between irrigation companies and municipalities in managing drought, and also in cooperating with each other on a day-to-day basis. Special ordinances and policies have been developed to ensure that agricultural water suppliers are indemnified from possible liabilities associated with operating facilities in urban corridors. Improved agricultural water deliveries have been secured in the process.[5]

Colorado's "Missing Link" in Water Policy?

Meanwhile, in Colorado, although state resources have generally been available to agricultural water suppliers to install pressurized piped systems, these resources have often not been tapped to their full extent. Ditch companies are not realizing the potential benefits of pressurization, infrastructure improvements, and overall system modernization. They are the "missing link" in the development of secondary water supply systems in the state. It is believed that this condition exists primarily because there has not been adequate publicizing of the potential role of agricultural water suppliers in this type of service, and perhaps a lack of awareness or lack of oversight on the potential limitations of other strategies currently in vogue. Most of all, there appears to be a lack of awareness of how these systems can strengthen the position of irrigated agriculture in the state and prolong the ability of agricultural water suppliers to provide water service to farms. Development of secondary supply is occurring in Colorado at the present time but mostly through local conditions, happenstance and some residential real estate market factors.

The current players in the development of pressurized secondary systems in Colorado are municipalities and "stand-alone" housing subdivision development systems, although municipalities and rural domestic water suppliers are somewhat reluctant to provide this kind of water service.[6] Meanwhile, many of the systems currently being installed in Colorado, particularly in the rapidly growing areas such as the Colorado Front Range, are thought to have questionable durability in the long run without a proven water purveyor to manage them. The current study has found that mutual ditch companies and irrigation districts have much to gain by being the "management umbrella" for pressurized non-potable supply in the state. Most certainly, local water users, both agricultural and residential-commercial, have much to gain by the entry of canal companies and irrigation districts into pressurized secondary water service, while the state has much to gain from the conservation of water through the pressurization of agricultural water deliveries and the likely improvements in agricultural production that occurs in the process.

Recent Trends in Secondary Supply

Some of the new pressurized secondary systems being installed in Colorado are laudable in their design. Residential subdivision developers who are seeking to respond to market demand for a special lifestyle are leading the way in these innovations. This lifestyle is represented by rural residential lots, often with large acreages, and often surrounded by small water bodies and green space. Elsewhere, golf courses are often the anchor for residential subdivisions with smaller lots, often catering to a growing population of retirees moving into Colorado. The design of these residential subdivisions is believed to have its origins in such localities as Sun City, Arizona and other places where rural living of this nature has been popularized. Many farmers in the region are being approached by developers who are offering to convert their farm into residential subdivisions irrigated by pressurized systems supplied by duck ponds, ponds on golf courses and other small storage facilities. There is much money to be made in land development of this nature. However, the question may be posed as to how adaptable this type of land development is in an arid area, given the opposition to new water development projects that will ultimately be required to serve these residential communities in the future.[7]

The typical raw water irrigation system installed in urbanizing corridors in Colorado is often characterized by traditional canal headgates delivering water into residential subdivisions through small open ditches, piped laterals, or conveyed into a small storage pond to be subsequently pumped to irrigate lawns, open space, and gardens in that particular development. Small filtration systems may accompany these pressurized raw water systems, along with valving and air relief for better control. Points of connection to individual lots or open space areas are provided, so that each household has its own individual water tap for landscape use. In the event that the secondary system breaks down, or if there is a water shortage in the area, these subdivisions are also provisioned with an outdoor potable water tap. It is common for even the most well designed secondary systems to allow for potable water to be applied to ornamentals and trees during a desiccating winter or during the so-called shoulder periods of the irrigation season. However, it is important to ensure that cross-connections between the potable and non-potable supplies do not occur (Figures 27-31).

Maintenance and winterization of these systems are accomplished by placing raw water point-of-connection (POC) valves at the edge of residential lots, often in or around the planter strip easement adjacent to the street or driveway. A dedicated right-of-way, or a portion of the utility easement, is usually required for the non-potable distribution system to ensure that maintenance does not interfere with other utility infrastructure. Traditional irrigation canal corridors can often be used as rights-of-way for these pressurized irrigation systems. These irrigation systems are often provided with metering systems and imposed scheduling to regulate instantaneous flows, although the metering of individual POCs has not achieved the popularity it may well deserve in the future.

Consumer satisfaction with these irrigation systems is high, at least initially. The question is how sustainable they will be in the future, and how they will be maintained. This is an issue that has been raised in the previous chapter, and one of some concern to the irrigation industry. When one visits these irrigation systems in unincorporated areas where residential development is occurring, one often finds an assortment of irrigation system designs, often with varying standards of installation and operation. Frequently, homeowner's associations are left with the responsibility of operating them in the future. We have already indicated that this may not be the most sustainable strategy for the state. Under these management circumstances it may be difficult to guarantee future replacement needs or the requirements of maintaining a water right, particularly when the water supply is from an open ditch system in the area.

It is expected that such irrigation systems will pose problems for municipalities and rural domestic water suppliers in the future, not so much because of the engineered design of these systems but rather because of unclear maintenance responsibilities. It has already been observed that when these systems experience maintenance problems or water shortages during the irrigation season, water users are prone to turning to the potable system to continue with their irrigation. Municipalities and rural domestics are fearful of ending up with homeowner's associations that want to re-enter the potable system for lawn and garden irrigation purposes. It is known from experience that this often arises with open ditch pumping and partly pressurized irrigation systems in some communities in Colorado. These issues are of concern to municipalities and rural domestic water suppliers who would like to see these irrigation systems succeed, in order that they can concentrate on developing and providing water service for potable use only. In most cases, rural domestics are not able to supply water for both indoor and outdoor use. This is the ultimate advantage of pressurized secondary water supply systems to the community.

These issues bring us back to the traditional ditch company or irrigation district as the pressurized secondary water supplier. The alternative being suggested in this report is to provide a means by which the traditional ditch company can provide secondary service and, in the process, pressurize agricultural water deliveries. There is great potential to pressurize and pipe all or a substantial part of these open ditch systems in unincorporated areas. In doing so, the water right of the canal company or district can be protected for future use in the area. Efforts by communities to ensure that water remains in a locality for future use, rather than being exported out of the area, can be facilitated through this water development strategy. Keeping water on the land, and keeping irrigated agriculture viable in an area, at least for as long as people wish to farm, is an effective means of banking water for future water needs.[8]

This innovation in water development and management can provide increased revenues for ditch improvements in the area. Pressurized secondary water systems have the potential to reduce the water assessments paid by agricultural irrigators. This is accomplished by a separate water rate for residential use that can spread the costs of water delivery in a way that lowers agricultural water assessments, thereby improving farm income in the area and lowering the feelings of impermanence that many farmers have about the future of agricultural production in the area. The conversion of open canal systems to a piped system that pressurizes water service is a proven means of helping agriculture and land development at the same time.[9] It can be argued that all players in certain secondary water strategies can win. Namely, the developer can save money in the development, the ditch company survives and sees a future with an assured revenue stream, the farmer sees reduced or stabilized assessments, the potable water purveyor controls their water treatment facility and pipeline expansion costs, and the homeowner has lower cost non-potable water available for their landscape irrigation into the future (Figure 33).

Supporting Policies Leading to Success

The most successful approach to the development of pressurized secondary water supply is anchored in the development of local ordinances requiring land developers and home builders to make use of these systems. A local ordinance is passed for the incorporated and unincorporated areas that promotes ditch company pressurized secondary systems. The residential subdivision developer is required to turn over water rights to ditch companies for the provision of the secondary supply, and to connect to the ditch company's pressurized system. This raw water turnover requirement normally requested of developers today from potable water suppliers is a policy that is simply extended to the non-potable secondary system. In those instances where this policy is being practiced, municipalities and rural domestic water suppliers are usually prepared to lower their potable raw water turnover requirement in order to promote the expansion of these pressurized secondary systems (Figure 33).[10]

Furthermore, local ordinances ensure that the pressurized system is designed, built and financed by the developer according to the ditch company's specifications and installation requirements.

Developers do not end up being constrained in their development goals where these ordinances have been developed. Rather, the water system for the land is greatly assured for the future. The ditch company has been in the area for 100 years, and will remain a viable enterprise with the development of this extended service that now supplies pressurized water to both residential and agricultural users. Municipalities and rural domestic water suppliers are also assured that their interests are met, relative to the future expansion and use of the potable water system. By having the pressurized secondary system supply replace the demand for potable water for outdoor use, existing potable water treatment capacity and delivery infrastructure is better able to meet indoor use and automatically increases its capacity for the future with minimal expense. It is essentially a win-win solution for the community at large, as the developer and irrigated agriculture in the area are gradually brought into the pressurized secondary system.

Other features of these local ordinances have to do with health and safety issues of secondary supply (i.e., cross connections and backflow prevention), the by-covenant requirement of the homeowners to abide by special irrigating schedules, and guidelines for the proper design and installation of these systems. These issues will be covered more thoroughly in Chapter 6 when we discuss the Davis and Weber Counties Canal case study. Additional ordinance language may be needed to cover rules and regulations for irrigating, application procedures for secondary service, billing, inspection checklists, drought response, etc. Rather than utilizing a homeowner's association, these administrative requirements are overseen by a well-established canal company or irrigation district, one that has delivered water to the land for many years. Throughout the Rocky Mountain region where these systems are currently being installed, the local canal company or irrigation district is the system manager.

In summary, the strategy being advocated here, after thoughtful review of secondary systems in Colorado and the region, might be described as follows. In unincorporated areas, a farmer sells land to a developer or develops the land into residential subdivisions himself. Through a local ordinance, the developer is allowed to realize a reduced raw water turnover requirement normally required by the potable water supplier to the land. Under this policy, the ditch company water right on the land is now effectively available for the ditch company to provide the pressurized non-potable, secondary system (Figure 33).

Perhaps northeast Colorado is a good case example of how such a policy could take almost immediate effect. It is known that units of water from the Colorado-Big Thompson (C-BT) project are generally the preferred or required raw water rights for potable use for Front Range municipalities. This is because ditch water rights often have limitations and uncertainties to them, at least from the points of view of the municipalities and rural domestic water suppliers. Consequently, the potable water purveyor requires, by formula, a turnover of C-BT units (or cash equivalent) for potable water needs in perpetuity.

It has been determined through the study that some potable water purveyors will actually reduce the C-BT water turnover requirement in consideration of the provision, by the land developer, of a credible, pressurized, non-potable supply provided through ditch water rights. The reduction in this raw water turnover requirement can often be substantial (+/- 50 percent). Meanwhile, studies show that 50 percent of the total annual water requirement under potable systems is for outdoor water use, and could be effectively met by a non-potable source (Figure 34).

This creates a situation in which native ditch water rights can play a more significant role in the region in meeting the remaining 50 percent of this raw water turnover requirement. Native ditch water rights historically used for agriculture can now be kept with the developer's project to meet non-potable needs. The reduced investment in the raw water turnover requirement can help the developer to pay for the non-potable infrastructure.

The issue then falls back on what particular entity is most capable of operating and maintaining a fully pressurized secondary system, ideally one that is fully capable of serving many thousands of homes. The position is clearly taken in this report that only a well-established entity can accomplish this successfully, if we are to ensure that secondary water supply systems are to become an integral part of the state's water development policy. This entity is the traditional canal company or irrigation district, where these entities have determined that it is in their best interests, and where the development of the system will not impose new costs on agricultural producers in excess of their existing water costs.

A State Policy in the Making?

First, it must be recognized that the process of providing water for the pressurized secondary system can occur in several ways. As just pointed out, one way is through the process of pooling water for the secondary system through the raw water turnover requirement process mentioned earlier, thus effectively creating "treasury stock" for the secondary supply system, or in the case of an irrigation district, a fraction of the district water right attached to the land.

Another way that the secondary water system can be initiated is through a process whereby the stockholders of the canal company (or landowners of the irrigation district) dedicate a portion of their water right to developing the secondary system. Canal companies in other states have successfully accomplished the task in this way.[11]

A third observed way is for a local conservancy district to assist a number of smaller ditch systems in consolidating their operation, pooling their water rights, and financing the secondary supply system through an ad valorem tax. Conservancy districts are useful for this purpose, since the ad valorem tax on real property values secures support from all potential benefactors of the secondary system. This third strategy is the one being employed in Washington County, Utah.[12]

These efforts are greatly facilitated by the potential water conserved in the irrigation system through pressuring agricultural water deliveries. This is a key to the water development program being put forward, a virtual "pareto optimum" policy for the community and the state. All parties are benefited to some degree, with very little if any loss on the part of any water user category or interest group. However, a few additional things need to happen.

In discussions with farmers throughout the region, it is clear that agricultural producers will be both unwilling and unable to shoulder any costs associated with developing these secondary systems. Due to the levels of farm income experienced in the region, but also regardless of this fact, a way must be found to ensure that this does not happen. Otherwise, the state is clearly left with an idea that is conceivable but impractical.

These canal systems can be modernized and pressurized by making use of present resources available to agricultural water suppliers and agricultural water users. This is currently made possible through state resources as well as through the 2002 Farm Bill. For several years, the Colorado Water Conservation Board has funded improvements in irrigation systems throughout the state. There have even been instances where funds were provided to an entity to develop a pressurized secondary supply system. However, no known instance exists under the CWCB program where state funds have been loaned to a mutual ditch and irrigation company or irrigation district to develop pressurized secondary water supply. One of the reasons is the total cost involved in building such a system, even if the state program has very favorable interest rates for long-term loans (Figure 35).

However, State funding can now be complemented with the resources available through the 2002 Farm Bill. Under the current Farm Bill, cost share funds are being provided through USDA's

Environmental Quality Incentives Program, administered through the Natural Resources Conservation Service. These funds are available for the next five years, and are designed to target the installation of high-end water conservation technologies on farms throughout the West. Funds are currently available for small and large group projects to improve farm ditches and laterals, as well as for improving on-farm irrigation systems. Emphasis is being placed on pressurizing agricultural delivery systems. Some of this cost sharing will be at 75 percent federal sharing or higher (Figure 36).

Meanwhile the Colorado Water Conservation Board has indicated willingness to loan funds to cover the producer cost-share requirements under the Farm Bill. This loan can be paid off over the 20-year term with revenue generated from pressurized secondary water service to residential subdivisions. Thus, a mechanism is now available for agricultural water users to largely avoid the cost of upgrading most of their irrigation system. As land is converted from crops to houses, the irrigation system is easily converted to new uses. In the process, water has been conserved, and the water that has traditionally been available to the land is kept on the land for the future. The process represents an informal water banking system for the area, characterized by an orderly transformation of land and water use over time. Meanwhile, farmers are able to continue farming in the area with improved water deliveries and conserved water through the pressurized system, doing so for as long as it is affordable for them to do so. Open space is more readily assured into the future with continued farming in the area, which may now include organic farming, more extensive produce production, seed production, and the production of ornamentals for urban landscapes. Land maintenance (avoidance of dried up acres and unattended land) is also assured through the process of keeping water on the land, rather than being taken off the land and exported to other watershed areas or to competing uses.

Stockholders of ditch companies have expressed concern about potential costs to them in developing these systems. As with all projects, the potential revenue generated from such systems should be shown to be sufficient to meet the design and installation costs of the system. When this occurs, the design and installation cost becomes simply a "pass-through" cost for the canal company or irrigation district. As with all water projects, but particularly projects potentially affecting farm income, it is important that the revenue stream generated from pressurized secondary water be well defined. Chapter 8 will focus on this development cost and repayment issue.

In summary, including pressurized, non-potable (secondary) water supply into a ditch company's existing operation is a "re-packaging" of the product and service that the company has historically provided. The strategy represents a bonus for agricultural production. It ensures improved cooperation between potable and non-potable water purveyors. It is a means of conserving water. It is an environmentally friendly water development strategy. Finally, it assures the continuation of some of the lifestyles that people in the region desire to have available to them as options, one of which is mixed land use.

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[1] Wilkins-Wells, J. and Epley, W., *Urbanization of Irrigation Systems*. Proceedings of the 2nd International Conference on Irrigation and Drainage. U.S. Committee on Irrigation and Drainage. Phoenix, May 12-15 (2003).

[2] Under the U.S.D.A., Natural Resources Conservation Service's Environmental Quality Incentives Program (EQIP), group projects have been traditional authorized, the only stipulation being that each and every agricultural producer (or urban lateral user for that matter) benefiting in a cost sharing program for a lateral group project be a signatory to the cost share contract, rather than just a board of director member. Although a little more involved, in terms of the local NRCS District Conservationist writing up the project, many examples of successful group projects are found, particularly under the Colorado River Basin Salinity Control Program.

[3] Efforts currently underway in the Dolores County Water Conservancy District to provide pressurized secondary water service to the Town of Dove Creek is an exception; an effort that is more reflective of what is being advanced in this report.

[4] Information obtained from interviews with water managers in the City of Toquerville and the City of Hurricane, Utah.

[5] The Nampa Meridian Irrigation District has been an innovator, not only with regard to pressurized secondary systems, but in the development of local ordinances to protect irrigation facilities from some of the negative effects of urban encroachment (trash, vandalism, right-of-way issues, etc.).

[6] The City of Greeley appears to be an exception. The city is aggressively pursuing the acquisition of local ditch companies, for the purpose of converting them into pressurized systems that can be used to irrigate parks and recreational facilities.

[7] The installation of small ponds in subdivisions for amenity value, and also to provide water for local pressurization of secondary systems, has its costs. It has been estimated that evaporation rates off the water surface of these small ponds can equal or exceed three acre-feet per acre of evaporative surface.

[8] Questions have been raised about what happens to irrigation water potentially conserved through the transformation of open, unlined, ditch systems to pressurized piped systems. These and other questions are addressed in Chapter 7.

[9] Farmers located in relatively high growth areas often realize an additional benefit to pressurizing agricultural water deliveries. As this land is converted to residential lots, a pressurized system is already available for an easy and orderly conversion to secondary water delivery for lawns and gardens.

[10] It is interesting to note that there is variability in the acceptance of a reduced water turnover requirement for the potable water needs. East Larimer County Water District (ELCO) has agreed to reduced water turnover on a case-by-case basis while their sister rural domestic, Fort Collins-Loveland Water District, has not to this date accepted such an argument.

[11] The Davis and Weber Counties Canal Company in Sunset, Utah, began its pressurized secondary supply system in this way. Although still irrigating approximately 18,000 acres of agricultural land, the company provides pressurized secondary water to some 8,000 homes in its original service area. The water for the secondary system was developed by agreement of the stockholders in the company to dedicate a fraction of their water stock to the development of the secondary system.

[12] The Washington County Water Conservancy District, St. George, Utah, has used this strategy to pressurize several agricultural water delivery systems in the county, including the Town of Toquerville, Utah and its surrounding agricultural acreage (Figures 25 and 26).

CHAPTER 4

STATE WATER DEVELOPMENT AND SECONDARY WATER SUPPLY SYSTEMS

There is growing concern about how Colorado's water needs will be met in the coming years. As with many other states, history, economic development, population growth, and geography come together in an interesting interplay of needs. For Colorado at least, the physical distribution of water and population, along with the ever-present potential of drought, define the terms by which the state must approach the planning of water resources. Water conservation is important, but it is not a silver bullet. Most of the state's water is on the West Slope, while most of the state's population is on the East slope (Table 1). Continued economic development and population growth, particularly along the Colorado Front Range, will require a rational and practical use of the state's water resources.

TABLE 1
Colorado Population Growth and Average Water Yield

Area	Population		Average Water Yield
	1950	2000	Acre Feet Per Year
Rio Grande*	38,383	46,190	896,900
South Platte	744,767	2,833,000	880,900
Arkansas River*	273,321	406,288	683,500
Total EAST SLOPE + FRONT RANGE	**1,056,471**	**3,285,478**	**1,654,300**
Colorado/Gunnison			4,491,000
White			595,100
Yampa	{ 134,980	459,423	1,623,000
Gunnison			1,873,000
Other S.W. Rivers			1,987,740
Total WEST SLOPE	**134,980**	**459,423**	**10,596,840**

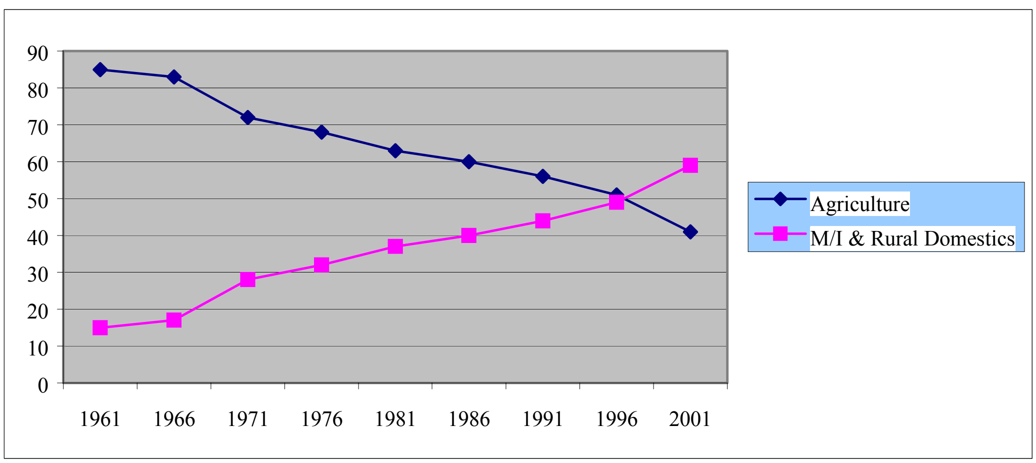
*rd = River Drainage

In addition, there is concern, or perhaps should be concern, about how growth will affect irrigated agriculture in the state. Without further water storage development, most assuredly water in irrigated agriculture will be sought out for urban use in the future. Data from the Colorado-Big Thompson Project serving the northeast Colorado Front Range is indicative of the amount of water that has migrated over the years from agricultural to municipal use in an otherwise highly productive agricultural area (Tables 2 and 3). This may have some unintended consequences. Although domestic market prices for U.S. crop production have been low in recent years, disposable income is growing globally with economic development.[1] This global economic development will potentially introduce new demands for U.S. food production in the future.[2] Add to this a potential national food security concern resulting from global political events, the needs of irrigated agriculture in the state, and for that matter the nation, cannot be easily dismissed.

These rather complex issues have arisen mainly because of the general moratorium and/or difficulty confronting treated water providers in developing new water supplies to capture and store annual high flow waters in the state. Increased barriers in developing new water supplies, and primarily for treated water use, stem primarily from the environmental movement's resistance to new water storage and transfer projects. This has resulted in the need for treated water providers to use existing supplies more efficiently and to search for ways to reallocate water out of irrigated agriculture and into municipal and industrial use.

TABLE 2
Change in Ownership of C-BT Allotments from Agriculture to Municipal/Industrial and Rural Domestic Districts (total of 310,000 allotment units)

YEAR	**AGRICULTURE**		**M/I & RURAL DOMESTICS**	
	UNITS	**%**	**UNITS**	**%**
1961	264,344	85	45,656	15
1966	257,584	83	52,416	17
1971	223,420	72	86,580	28
1976	210,722	68	99,278	32
1981	194,922	63	115,078	37
1986	185,265	60	124,735	40
1991	173,872	56	136,128	44
1996	156,776	51	153,224	49
2001	128,254	41	181,746	59



One of the issues confronting the transfer of water out of current agricultural production systems is the impact it has on rural communities that depend on this crop production. Furthermore, there is the issue of the many ways in which water transfers out of agriculture affect local hydrology. One-hundred years ago, water supplies were relegated to the immediate river course. With settlement, water was

TABLE 3
Ownership of Colorado-Big Thompson Water by Selected Cities, Towns
Northern Colorado Water Conservancy District 2002

AREA	CBT Allotment Units Held			
	1972	**1982**	**2002**	**Current Water Yield @ 70% quota**
Boulder	13,647	20,785	21,174	14,822 af
Fort Collins	6,906	10,899	18,801	13,160 af
Greeley	12,362	18,672	22,270	15,589 af
Longmont	5,180	10,494	12,293	8,605 af
Loveland	4,498	8,988	10,538	7,376 af
25 Other Towns	-	-	43,181	30,226 af
Rural Domestics*	16,584	18,881	38,759	27,131 af

*and other non-agricultural users

diverted from the rivers onto bench lands for irrigation. This created a fairly complex new hydrological system of irrigation canals, irrigation wells augmented by canal seepage, and return flow regimes that created many new opportunities for water reuse. When water is transferred out of agriculture today, it affects this hydrologic system. In short, the transfer of water out of agriculture will have repercussions on local communities and production systems organized around these historical diversions and water usages.

Most native water supplies in the state are fully appropriated, new water projects are limited by political factors, and the competition over remaining water supplies is intensifying with ever-increasing population growth.[3] This growth is highly concentrated along the Front Range from Ft. Collins to Pueblo, in a strip not more than twenty miles wide in most places. Current water withdrawals in the state are estimated to be about 12,300,000 million acre-feet. Of this, it is estimated that 90 percent is for irrigation and 10 percent for municipal and industrial use.[4] Thus, agriculture is still the predominant water user, and owner of water, in the state.

Water planners have concluded that there is sufficient water in agriculture to meet municipal and industrial water needs well into the future, and that reallocation of water out of agriculture and into more valuable income generating uses makes strong economic sense for the state.[5] Agriculturalists do not necessarily share this viewpoint, nor does this study. It is felt that the expansion of secondary water service in the state, particularly along the Colorado Front Range, can help the state's water planning considerably, while helping to maintain the viability of irrigated agriculture in the process. However, this study will continue to argue that simply counting on the diversion of water out of agriculture to serve municipal and commercial-industrial uses is short-sighted, misguided and generally inequitable. The state must consider developing more water supplies for a future population estimated at 7.2 million by 2030, the vast majority of which will be located along the Colorado Front Range where the employment is.[6]

The strategy of simply counting on water from irrigated agriculture to serve the needs of future growth, although perhaps reassuring to those outside of agriculture, is having considerable repercussions on irrigators and the communities and wholesale and retail services that irrigated agriculture supports in many rural areas.[7] Farmers sense a strong feeling of impermanence, particularly the older generation of farmers. Irrigators worry about how these trends will affect their water supplies, particularly how reallocation of water out of agriculture may be expected to change the operation and management of 100 year-old canal systems.[8] Of even greater concern to irrigators is the fear that municipalities will continue to threaten condemnation of irrigation systems or aggressively buy up irrigation water via purchases of irrigated land, as has occurred in the past.[9] Often, it is a wonder why anyone would want to continue in agriculture under these strains.

Perhaps these more aggressive moves by municipalities can be shown to be unnecessary and avoided in many instances, if agricultural water suppliers are helping out via expansion into pressurized secondary water supply management.[10] If our study can demonstrate this, it may have made an important contribution toward reducing the current strain between municipalities and irrigated agriculture throughout the state. Because the entry of irrigation companies and irrigation districts into secondary water supply management must occur within the context of current water management issues and traditions in the state, it is valuable to briefly review where the state has been in its water development.

Prior to World War II, water development and use in Colorado was primarily for agriculture. Even as late as the 1970 irrigation census, municipal and industrial uses of water in Colorado were estimated to be only 5 percent, and in the Northern Colorado Water Conservancy District area, only 4.4 percent of water use.[11] As urbanization came, new methods were sought to develop water in the state for municipal uses. These included: 1) large scale transbasin diversions; 2) developing additional storage to collect remaining flood flows; 3) moving water from irrigated lands to municipal use; 4) condemning water rights, and; 5) recycling water. The current popular emphasis is on water conservation, or what many simply prefer to call water reallocation.[12] The following is a brief overview of these strategies. Hopefully, secondary water management will simply become another member, but important member, of the "basket" of water management strategies for the state.

Transbasin Diversions

Colorado has been a major innovator in transbasin water projects, beginning with the Cache La Poudre basin before the turn-of-the century.[13] In years past, issues surrounding water needs and water development in Colorado were relatively simple, at least from today's perspective. From the State's beginning, the majority of the people and industry were located on the East Slope, while most of the water supplies were located on the West Slope (Table 1).[14] Therefore, the principal concern of early water planners was simply one of working collaboratively within the state to transfer water where it could be most beneficially used to meet future water needs. In the early years, this beneficial use was primarily on the East Slope. This remains so today, at least from a demographic and employment point of view, although perhaps less so from environmental, recreational and tourism points of view.

Except perhaps for a few very early projects, the concept of transbasin diversions did not preclude fairness toward future West Slope needs or, in later years, toward environmental needs. In the early years, commencing with the Denver Water Board projects on the Blue and Fraiser rivers and other tributaries of the Colorado River, followed by the Colorado-Big Thompson Project and the Arkansas-Fryingpan and Windy Gap projects, there was an emphasis on compensatory storage programs and state funding for West Slope water development projects, in return for transbasin projects to serve the needs of East Slope growth.[15] Most people viewed these projects as successful, although admittedly 100 percent satisfaction could rarely be achieved. However, some of these very important early lessons in the need for state-wide cooperation would soon begin to unravel with the onset of the environmental movement and new types of water users. A "dog-in-the-manger" attitude toward water development began to set in with the onset of this environmental movement.

Developing Additional Storage

Meanwhile, flood storage projects were in the planning stages, including the Narrows Reservoir and the Two Forks project on the South Platte River and the Grey Mountain Reservoir project on the Poudre River. All of these projects met strong opposition from highly vocal environmental groups, many of which, in retrospect, may not have fully appreciated the highly variable stream flows (ephemeral streams) in the state and the opportunity this often presented for capturing additional flood flows in the Spring. Flood stage flows and the constant fear of drought drove the concerted efforts of early settlers in the state to develop water for future generations.

The pressures of environmental demands and needs were beginning to be felt through recreational uses of water after the 1960s. These new demands on water use slowly merged as part of the environmental movement's approach toward future water development in Colorado, which ultimately translated into general opposition to large water projects for the East Slope, such as the Two Forks Project, despite the growing population on the East Slope and despite a growing interest in utilizing the state's water resources for recreational purposes. The bottom line was that broader public interests regarding water were beginning to emerge, and ones that questioned the notion of beneficial use based solely on agriculture, population, employment, commercial-industrial development or shear economic efficiencies through market mechanisms.

Unlike the economic efficiency argument that has recently been advanced in support of the transfer of water out of agriculture,[16] the arguments advanced for foregoing further water development in the state on environmental grounds was often based more on changing values rather than solely on economic efficiencies. Only recently has there seemingly been a "marriage" between more neoliberal approaches to water management (i.e., extensive use of market principles, privatization of resources, etc.) and the environmental movement.[17] It appears that the environmental movement now generally welcomes the use of market principles in allocating (or reallocating) water, particularly if it can serve the interests of the environment. Meanwhile, neoliberal economists must struggle with the role of changing values in their econometric models of market efficiencies.

With the onset of the Clean Water Act, the Endangered Species Act and new emerging Upper and Lower Colorado Basin management plans, such as the Colorado River Basin Salinity Control Program, the issues surrounding increased water demands and water development in Colorado became more complex. The shear number of people and the potential economic multiplier effects of water use as key criterion for sound water planning gave way to a host of new water demands having to do with diminishing water quality, diminishing instream flows, reduced wetlands, concern for species extinction, and other externalities sometimes (but not always) created by large water development projects for agricultural, municipal or industrial uses. Due primarily to changing demographics in the state, approaches to water planning based on strong values supporting the continued viability of irrigated agriculture and water development for the future were gradually supplanted by strong values supporting predominately environmental objectives and conservation of existing water supplies (agricultural water supplies) for urban growth. Meanwhile, many interest groups failed to give full recognition to or did not fully comprehend the already well-documented extensive reuse of water in most areas of the state, for both urban and agricultural use. Opportunities for water reuse are an essential component of water conservation in any hydrologic regime.

In addition, conflicts began to emerge between municipalities along the East Slope regarding the sharing of existing developed water supplies. Disagreements between the Denver Water Board and the new suburbs in the Denver Metro Area resulted in many of these suburban municipalities turning toward nearby agricultural water suppliers to serve their future needs. The Environmental Protection Agency's disallowance of the Two Forks Project further shifted municipal focus aggressively toward obtaining agricultural water by almost any means. A report in the mid-1970s highlighted how irrigated agriculture would most likely be affected by such trends; the effects being mostly negative and potentially at considerable cost to rural areas, if not the state as a whole.[18] Nevertheless, with the new moratorium on large water development projects, either in the form of East Slope projects or cooperative transbasin projects, the acquisition of agricultural water supplies by municipalities intensified and has continued unabated. Today, this trend is driven by the 2.5% percent annual growth rate experienced in many urbanizing counties in Colorado during the 1990s, and particularly along the northern Colorado Front Range. The Arkansas Basin, the South Platte Basin and the Cache La Poudre River Basin are only three of the many state watersheds experiencing aggressive efforts by municipalities to secure their own water supplies for the future, and seemingly much to the detriment of irrigators in these watersheds.

<u>Water Exchanges</u>

Many forms of temporary water exchanges have traditionally been practiced in Colorado.[19] The practice of water exchanges in Colorado, mostly developed through cooperation between irrigators and municipalities with a strong agricultural value base over the years, has been a major source of innovative thinking about how to manage water in a complex society. Water exchanges developed primarily by irrigators over the years include sale of water rights on a stream for alternate points of diversion, sale of irrigation company stock within an irrigation company, the rental of water on a seasonal basis within and between irrigation companies, and seasonal one-for-one exchanges of water between irrigation organizations, municipalities and other water users. These have traditionally been the most active forms of water exchanges in the state. The importance of proposed new innovations in water management, such as water banks and interruptible supplies, tend to pale in comparison to the aforementioned 100 year old practices.

It is insightful to listen to the comments of a past observer concerning the role of temporary seasonal water exchanges in meeting local water needs and contributing to community cooperation, trust and creativity. It is a message that communicates the spirit and logic of local "social capital" applied to water management, whether through water exchanges, water markets, interruptible supplies, water banks, or pressurized secondary supply systems. It is an attitude that often has seemingly been lost in today's environment. E.S. Nettleton, a major source of information on early agriculture in the Cache La Poudre Basin states:

> The plan of exchange or "trading around" of water was conceived, agreed to, and carried on by the people themselves without legislative enactments, court decrees, or legal council or advice. It was simply the outcome of the necessity to dispose of water profitably that could not be utilized on lands in one locality by transferring it to another, thus benefiting one and often both of the parties to the exchange. It was first brought about by practical men, getting together in a friendly, neighborly, and businesslike manner, and consolidating the rights that each might have under existing laws into one common interest in the storage of water. The result has been that there has been no quarreling or litigation over the division and exchange of water from reservoirs."[20]

In other words, the allocation of water was a community issue, rather than simply one of interest groups always looking out for themselves. There is an element of cooperation in these older strategies that seemingly has been lost in today's approach to water development in the state. The role of agricultural water suppliers in secondary water management, a viewpoint strongly advocated in this report, might be considered as an attempt to get back to these practical strategies.

<u>Municipal Acquisition of Canal Company Stock</u>

An important way of permanently transferring water out of agriculture and into municipal-industrial uses was through municipalities acquiring canal company stock. Municipalities, and to a great degree, irrigators, felt that this was a sound policy. Although it was often difficult for municipalities to run such water stock through water treatment facilities, both legally and physically, municipalities could rent this water acquisition back to irrigators until such time that there was no further demand for this water in the agricultural community. By and by, legal and physical means would be found to run this water through municipal treatment systems.

This strategy made sense as long as irrigation companies and irrigation districts, through cooperation with municipalities, continued to have some degree of access to municipal water rentals and return flows, and as long as irrigators maintained control over their canal company assets. However, if the fiduciary responsibility of these irrigation enterprises were in a sense aggressively "bought out" by municipalities through the purchase of their water stock, or passively acquired through the acquisition of raw water from developers or subdivision builders, then such a policy might not necessarily benefit agriculture in the long run. This would depend on many local conditions. Direct benefits to agriculture of rental water and municipal return flows would appear to be contingent upon a continued degree of cooperation between municipal and agricultural water suppliers.

Municipalities could, and often subsequently did, gain control of water use and reuse to the point where irrigated agriculture became more or less subservient to urban interests. This was not inevitable, as evidenced by some creative agreements between municipalities and agricultural water suppliers.[21] However, the outright purchase of irrigation company water stock by municipalities, or the gradual transfer of such stock to municipal ownership by way of demanding from developers sufficient water in return for local subdivision plat approval, has lead to many canal companies and irrigation districts gradually coming under the fiduciary responsibility of municipalities; in effect, municipal control, if not ownership, of the canal system serving local irrigators.

The benefits of this trend for irrigated agriculture are indeed mixed. There may be another way for urban thirst to be dealt with by irrigators, and one that is gaining increased support in the Rocky Mountain region. This involves the fiduciary responsibility of the irrigation company or irrigation district remaining in the control of irrigators, but still achieving urban water needs, and at greatly reduced costs to municipalities and rural domestic water suppliers. This involves the participation of these traditional agricultural water suppliers in the pressurized secondary water supply portion of dual systems.

Many farmers must realistically cash in their water and land, given current farm income, although many simply relocate their farm today, or use the asset sale to further capitalize their current farm operation. The individual farmer is often benefited through land and water right sales, but those farmers remaining behind can be negatively affected in various ways, not the least of which is the potential loss of the benefits of a more even distribution of water throughout the irrigation enterprise service area and to meet canal management needs. If ways were available for irrigation company stock or irrigation district water to remain within the service areas of these enterprises, while at the same time meeting the needs of emerging non-agricultural uses, this would appear to be a win-win solution for agriculture and municipalities. We believe this report demonstrates a way in which this win-win solution can be achieved through pressurized secondary water supply systems managed by traditional agricultural water suppliers.

Condemnation

Another method of water transfer was through condemnation. For instance, in the 1970s, the cities of Westminster and Thornton brought condemnation proceedings against three mutual irrigation companies after an offer they had made to buy out the companies had been refused by the irrigators.[22] Fortunately, the condemnation suits led to negotiations between the cities and irrigators, resulting in water storage development, water exchanges and water recycling programs to minimize the effects of irrigation company buyouts on irrigators and to improve water supplies for irrigated agriculture. However, condemnation as a strategy still looms in the future, although it is believed by most municipal planners to be the least desirable approach to water transfers.

Recycling

As stated earlier in the discussion of return flows, the transfer of water through recycling from municipal to agriculture use, and as a way of minimizing the effects of water transfers on irrigated agriculture, has been a popular strategy with some municipal and irrigated agriculture cooperators. California now has more than a dozen recycling programs that treat water to a sufficient level to meet agricultural production needs, and other states are moving in this direction.[23] However, new water quality requirements at the federal and state level may make recycling of municipal water for irrigated agriculture more difficult in the future. In addition, other water users, such as environmental and recreational interests, may well out-bid irrigated agriculture for this recycled water in the future. In spite of these facts, it is entirely possible that irrigated agriculture will have to rely more on recycled water for production proposes, provided municipalities are willing to treat it to a level that can be used by agriculture.

Water Banking

Very recently, efforts have been undertaken in Colorado to form water banks, such as for the Arkansas Valley, as well as efforts in northeast Colorado involving some municipalities and rural domestic water suppliers. These efforts have been facilitated by new legislation for water banking. Water banking initiatives are often driven by the concern of citizens that water not leave their local watershed. This concern has been prompted due to aggressive efforts by Denver Metro Area municipalities to purchase irrigated land and water stock for the purpose of transferring water out of a nearby basin. Within-basin water banks are designed to protect local communities from economic damages resulting from these out-of-basin transfers. However, such efforts at protecting basin water supplies often meet resistance from those in a basin owning water, since water banking efforts can restrict the market value of a water right to its demand within the basin only (a “socialized market” of sorts). Experimental efforts are currently underway in the Arkansas River Basin to optimize these competing interests through water banking, while new state legislation is moving the initiative to all areas of the state and to the concept of out-of-basin transfers.

Water Conservation

Water conservation is an obvious strategy for ensuring future water supplies for urban growth. Ever since the “water conservation movement” began many years ago, there was recognition by at least a few people that what one was doing with water conservation was essentially reallocating water. This in no way diminishes the importance of water conservation. It simply places this strategy in its proper context.

Most discussion of water conservation has been directed at ways to improve water management in irrigated agriculture. There have been associated efforts to improve water use in municipalities as well. This has included the use of water meters and tiered water pricing. However, given that 80% to 90% of current water supplies are used by agriculture, it is agriculture that has been the logical target of water conservation. However, water conservation in irrigated agriculture does cost money. Irrigators intending to improve water management must allocate a portion of their farm budget to this effort. Water conservation is simply another farm production cost for them. Given that irrigators are essentially “price-takers” in the marketing of their commodities, water conservation, in the long run, means a potentially further reduction in net farm income (net profit after paying for production inputs). Some of this reduction in net farm income can be made up through improved production from new irrigation technologies. The issue for irrigators is the margin of profit ultimately to be realized from water conservation measures, not the inherent value of water conservation per se.

Summary

Pressurized secondary water supply, particularly as it is described in this report, tends to reduce the need for water banking. First of all, any effort that is effective in keeping water locally on the land, and in such a way as to meet the needs of old as well as new land uses (residential-commercial) is a form of water banking for the community. We have discussed in previous chapters how this occurs through the developer's raw water turnover requirement going to the canal company or irrigation district. In addition to maintaining high quality irrigation water supplies for the future (in terms of quality, quantity and timing), pressurized secondary water supply provided by canal companies and irrigation districts can address new water needs (municipal, industrial and recreational) effectively without necessarily requiring new water projects and the legal and political issues associated with such development. Secondary water supply can reduce intra-area competition over water since municipalities are not so intensely driven to secure water, and potable water at that, for both indoor and outdoor use.

TABLE 4
Charges for Treated Water* 2000

Large Cities	**Avg. Water Bill****	**Value per AF**
Broomfield	$540	$777
Fort Collins	$400	$576
Greeley	$380	$547
Longmont	$575	$828
Loveland	$360	$518
Small Cities	**Avg. WB**	**Value per AF**
Berthoud	$400	$576
Eaton	$575	$828
Johnstown	$425	$612
Mead	$560	$806
Windsor	$575	$828
Rural Domestics	**Avg. WB**	**Value per AF**
Left Hand WD	$700	$1008
North Weld WD	$500	$720
Central Weld WD	$480	$691
East Larimer WD	$350	$504
Little Thompson WD	$300	$432

*Data gathered by the Little Thompson Water District for 183,000 gallons/year.
** Approximate bill based on billing statements for the year 2000 and an average water use of 183,000gal/. 56af.

The opinions of irrigators are divided over the benefits of water transfers, water banking, and the overall increased competition over the water remaining in agriculture. Irrigators located within the "urban fringe" can benefit economically from the increased value of their water rights and land due to development. On the other hand, irrigators located outside the urban fringe area often express concern about the ability to continue farming, due to urban encroachment and competition over their remaining water supplies. Municipalities may often express the desire to protect existing agricultural production to maintain open space and a diversified local economy. However, even when municipal leaders continue to show strong support for agriculture and follow water policies that are favorable to irrigated agriculture, their first calling will generally always be to those who elect and appoint them, and those are citizens advocating inexpensive utilities, affordable housing, security against drought, and the availability of good paying jobs by way of attracting new industry into the area.

There appear to be at least three important aspects to municipal water planning today. One is the need to accurately project water needs into the future, a forecasting exercise that often includes a significant hedge against drought (dry year yields). This forecasting hedge often results in municipal water ownership substantially beyond what can presently be put to real and unimpeachable beneficial use by the municipality. This water hedge is driven by political pressure on municipalities to ensure that they are banking enough water to meet dry year yields. In the process, the market value of water in the region may be driven up somewhat artificially, almost in a speculative manner, not by way of speculation for profit, but rather speculation over dry year yields and anticipated municipal needs based on frequently debatable population forecasts.

A second important aspect of municipal water planning is the linking of water to land use planning, in an attempt to rationalize growth in a given municipality or region. This form of planning involves making sure that land development does not outstrip the municipality's ability to finance water delivery needs. There is often a constant tension between "public interest" and private property rights. Through zoning, condemnation procedures, conservation easements, land and water trusts, smart growth initiatives and other forms of public interest tools, free and open markets in water and land are tempered by public interest and municipal financial limitations. Ultimately, the need is to ensure that water supplies are adequate to meet changing land uses and life styles. There must be a constant search for new ways of meeting these objectives.

TABLE 5
Market Value of Water in the Colorado Front Range

	Northern Colorado	Denver Metro	West Slope
Native Water Estimated Market Value	**$3,400 – $12,200**	**$1,166 – $15,000**	**$1,300/AF**
Trans-basin Water Estimated Market Value	**C-BT: $10,500 – $12,450**	**Windy Gap: $10,000 - $17,000**	**None**

These figures are reported offers & sales for the 1st half of 2002. Sources consulted:
Northern Colorado Water Conservancy District
Denver Post
Colorado Water Marketing Website http://www.waterbank.com/water_listings.htm

Finally, a third aspect of municipal water planning today is the overall financing of water treatment in municipal or unincorporated areas. Table 4 shows some examples of charges for treated water in recently urbanizing areas of the East and West Slope of Colorado, while Table 5 shows the current market value of this water in the study area. In the next chapter, this report presents information on ways in which this growing cost of treated water might be minimized for municipalities. Generally, it is through the allocation of untreated water for outdoor and landscape use, rather than using treated water for such purposes. Some of the providers of this untreated water for landscape use in urbanizing areas could be the traditional agricultural water suppliers (irrigation companies and irrigation districts), when and where this is feasible.

Quite simply, the role of secondary water in the state water policy is largely being overlooked, perhaps because its contribution to the pool of water is often difficult for planners to quantify. Perhaps it is more valuable to examine what results are being achieved in nearby Rocky Mountain states, and to adapt those results to Colorado as needed. However, what appears to be true is that the kind of cooperation represented by secondary water, the cooperation between municipalities and agriculture, is reminiscent of the cooperation that existed in the past with water exchanges and local rental markets, but which is now slowly eroding with the headlong plunge into securing municipal water at any cost, regardless of the consequences to our food production systems.

[1] Many developmental economic sources report on global economic growth. See Todaro, M, *Economic Development*. 7th Edition.
[2] McCalla, A.F., *Agriculture and Food Needs to 2025*, in Eicher, C.K. and Staatz, J.M., International Agricultural Development (3rd Edition). John Hopkins University Press (1998).
[3] *Water in the West: Challenges for the Next Century. Report of the Western Water Policy Review Advisory Commission* (June, 1998).
[4] Litke, D. and Appel*, USBR, 1989 – Estimated Use of Water in Colorado – Water Supply Paper 2350*; Colorado Division of Water Resources Data (1997).
[5] Anderson, Terry, *Water Markets*. The CATO Institute (1997). Hartman, L.M. and Seastone, D.A. *Water Transfers and Economic Efficiency*. Johns Hopkins Univ. Press (1970).
[6] A recent report by the State Demographer's Office estimates that both Larimer and Weld counties, predominately rural until the early 1990s, will have a combined population of nearly 1 million by 2030. Fort Collins, Coloradoan, June 21, 2003.
[7] Colorado Water Conservation Board. Agricultural Water Policy Development. January, 2002.
[8] *Arkansas Valley Water Flows to Citizens Takes Past With It*. Denver Post, October 4, 1998. *Arkansas Valley Water Sales*. Denver Post, August 15, 2000. *Reserve Water for Flycatcher on Rio Grande*. Denver Post, May 6, 2001. *Agriculture's Future Tough in Lower Arkansas Valley*. Pueble Chieftan, October 1, 2001. *Aurora Buys Rocky Ford Shares, Tries to Avoid Legal Battle*. Aurora Sentinel, March 29, 2001. *Selling Off a Way of Life*, Denver Post, December 16, 1999.
[9] *The Physical and Economic Effects on the Local Economy of Water Transfer to Cities*. Colorado Water Resources Research Institute, CR75. Colorado State University, October 1976.
[10] For now, we can briefly identify repercussions on irrigated agriculture to be: 1) rising opportunity costs of remaining in agriculture because of increased water and land prices on the open market and due primarily to urbanization; 2) urban encroachment onto irrigation canal systems resulting in increased canal operating costs for irrigators, and; 3) water shortages in some canal delivery systems and the drying up of traditional irrigated areas due to the transfer of water out of agriculture. In addition, poor farm income contributes significantly to rising opportunity costs of remaining in irrigated agriculture, further stimulating the voluntary transfer of water and land out of irrigated agriculture.
[11] Anderson, R.L., *Transfer Mechanisms Used to Acquire Water for Growing Municipalities in Colorado: Economic Issues in the Transfer of Water Rights*. Western Agricultural Economics Meeting, Bozeman, Montana, 1978.
[12] Brosz, D., *Increasing Irrigation Water Efficiencies and Resulting Return Flows*. Wyoming Water Research Center (undated). This author argues persuasively that water conservation strategies do not conserve water. They merely reallocate water to other uses. Because of the flowing nature of water, one can no more conserve it than one can conserve a minute of the day. Irrigators in the West have long understood this, hence the suspicion they have traditionally had about so-called "water conservation programs."
[13] Hemphill, R*., Irrigation in Northern Colorado*. USDA Bulletin 1026. May 1922. Wilkins-Wells, J., Freeman, David M.Freeman, Griguhn, A., *Water Exchanges and Agricultural Production in Northeast Colorado: Opportunities and Constraints for the Future*. Colorado State University, Agricultural Experiment Station Technical Report TRO3-3 March (2003).
[14] Hydrologic Branch, USGS. *Water Data Report, CO-93*.
[15] Tyler, D, *The Last Water Hole in the West. History of the Colorado-Big Thompson Project*. University Press of Colorado (1992).
[16] Young, R., *Economic Impacts of Transferring Water from Agriculture to Alternative Uses*. CR.122, Colorado Water Resources Research Institute. Colorado State University, 1983. Young, R.A., *Measuring Economic Benefits for Water Investments and Policies*. World Bank Technical Paper, No. 338. World Bank (1996).
[17] Thompson, B.H. Jr., *Institutional Perspectives on Water Policy and Markets*, in California Law Review (81:3:1993). See also, Isė, S. and Sunding, D.L., *Reallocating Water from Agriculture to the Environment under a Voluntary Purchase Program*, in Review of Agricultural Economics (20:1:1998); Taylor, R.G. and Young, R.A., *Rural-to-Urban Water Transfers: Measuring Direct Foregone Benefits of Irrigation Water under Uncertain Water Supplies*. Journal of Agricultural and Resource Economics (20:2:1995).
[18] op. cit., *The Physical and Economic Effects of Water Transfers*.
[19] J. Wilkins-Wells, David M. Freeman and Andrew Griguhn, *Water Exchanges and Agricultural Production in Northeast Colorado: Opportunities and Constraints for the Future*. Agricultural Experiment Station Technical Report TRO3-3 (March, 2003).

[20] Op. cit*., Irrigation in Northern Colorado*.

[21] The historical cooperation between the City of Fort Collins and the North Poudre Irrigation Company (Wellington, Colorado), and between the City of Northglenn and the Farmers Reservoir and Irrigation Company (FRICO) in the Northglenn area are examples of innovative ways to minimize the impact of urban development on irrigated agriculture. In the process of transferring ownership of canal company stock from irrigators to the municipalities, these enterprises have worked with the municipalities to either reduce canal assessments for irrigators, or developed water rental programs for agricultural users to meet local agricultural demand in a timely and efficient manner.

[22] Op. cit., *The Physical and Economic Effects of Water Transfers*.

[23] Roche, M.W., *Use of Municipal Wastewater for Irrigation in California: Past, Present and Future*. Proceedings of the 2nd International Conference on Irrigation and Drainage. U.S. Committee on Irrigation and Drainage (May, 2003). See also, Seasholes, K., *Agriculture's Role in the Storage and Recovery of Urban Water Supplies: Central Arizona Trends and Issues.*

CHAPTER 5

THE COST AND USE OF TREATED WATER AND IMPLICATIONS FOR THE EXPANSION OF SECONDARY SYSTEMS

A canal company considering entering into pressurized secondary water service would ideally have an engineering feasibility study conducted to determine feasibility and costs. This chapter is designed to derive a conservative estimate of the cost and amount of water used for outdoor landscape purposes in the study region. In order to do this, we will often have to look at indoor water usage as well, since so much of the region uses potable water for both indoor and outdoor use, and much of this use is unmetered. Good estimates of outdoor water use under various conditions will be useful in helping canal companies and irrigation districts in Colorado determine initially whether or not their water rights (i.e., current water supply) are adequate to consider providing secondary water service to subdivisions within their service area, presently or in the future.

We will discuss trends in municipal and rural domestic water costs in the region as well. The current cost of treated water is important in determining a competitive water rate structure for secondary systems in the future, as well as assessing the potential economic benefits to traditional agricultural water suppliers if they provide secondary water service.

Finally, a brief discussion will be presented on water costs and water usage rates under fully established secondary systems in Utah. The chapter will conclude with an assessment of the likely success of these secondary systems, given what is known about current potable water use and water costs in the region. Note that Chapter 8 and 9 will provide case study methods of determining the benefits to canal companies from entering into secondary water delivery.

Overview

When the term "water rights" is used in the context of canal companies, we acknowledge that, although the water decree serving a canal company is held in common by the stockholders, water rights are real property owned by individual stockholders. As with the case of the Davis and Weber Counties Canal Company, a case study of secondary water development presented in the next chapter, stockholders of a canal company will have to make a joint decision as to how they want to provision the secondary system with their individual shares, or otherwise commit an appropriate amount of water. The lending agency providing funds to help develop the secondary system, such as the Colorado Water Conservation Board, may require a minimum commitment of water rights before lending development funds. A canal company may have to develop or acquire additional water for a secondary system if it currently does not have sufficient supplies above what is needed for agricultural purposes. However, we will present data suggesting that this additional acquisition of water will probably not be required in most cases.

Irrigation districts are a little different, and this has a bearing on the "raw water turnover requirement" concept being invoked by municipalities throughout the Colorado Front Range. Again, the raw water turnover requirement is the amount of water that the developer of residential property is normally required to provide the local municipality (or other potable purveyor) in order to ensure potable water service to the residential lot in the future. Throughout the northern Colorado Front Range, this raw water turnover requirement is highly variable between water purveyors, but has normally been in the range of 1.5 to 3.0 acre-feet per acre of developed land (Chapter 3, Figure 33, page 31).

When it comes to irrigation districts, municipalities cannot easily institute the raw water turnover requirement, at least in the same way as for land served by canal companies. That is because under most Rocky Mountain state statutes, water rights under an irrigation district are tied to the land. This represents somewhat more of a restriction than the situation for canal companies, where municipalities can request a substantial water turnover requirement from the developer of the land, and then divert the consumptive use portion of that raw water requirement into its water treatment facilities.[1]

Some irrigation districts are fairly well endowed with a water supply to provide secondary water service. A case in point is the previously cited Nampa-Meridian Irrigation District in Nampa, Idaho. Irrigation districts under Bureau of Reclamation projects receiving full supply from the project were typically designed with sufficient water supplies to meet agricultural water needs (often four to five acre feet/acre or more). Privately organized irrigation districts often had much less water. One such privately organized irrigation district in northern Colorado has a historically average water supply of around 0.5 acre-feet per acre of irrigated land.[2] Such an enterprise might have a difficult time contemplating the provision of secondary water service in the future. Nevertheless, in the case of both canal companies and irrigation districts, joint decisions representing the interests of all of the water users will be required, and sound knowledge about the potential demands on a proposed secondary system will help in this decision-making.

Since municipalities and rural domestic water suppliers (Title 32 districts) along the northeast Colorado Front Range are operated essentially as non-profit enterprises, information in this chapter utilizes total revenues from water delivered, divided by total population, in calculating the costs borne by water customers for indoor/outdoor water service. There will always be differences in the cost and use of treated water from one locality to the next. Differences in the cost of water can occur as a result of differences in infrastructure costs and employee costs. Differences in use can occur as a result of climate and lifestyle (i.e., income, lot size, size of family, desire for certain types of landscaping, etc), water metering and/or water pricing.

Capital costs and operation and maintenance (O&M) costs for delivering treated water comprise a large portion of the cost of water to consumers today. Due to rising capital and O&M costs, including employee salaries and overhead administrative costs, the cost per capita for potable water may be five times or more the actual cost of just treating the water. One municipality reports the cost of treating water at 25¢ per 1000 gallons, or approximately $80 per acre-foot.[3] On the other hand, the cost of delivering this water to the end consumer may range from $500 to $700 or more per acre-foot (Table 6). Among both municipalities and rural domestic water suppliers, the cost of delivering treated water is increasing exponentially, particularly with the onset of additional water quality standards, rising employee salaries, expanded employee benefits, and the cost of equipment and materials.

Per capita water use has increased over the years as well (i.e., overall increased demand per capita). Since the figures shown in Tables 6-9 do not separate out the various types of use (residential, commercial, industrial and city greenspace and recreation), it is unclear where the increase in per capita water use is coming from. Most likely it is from commercial-industrial use, and most particularly, expansion in the amount of municipal greenspace and recreational facilities. This is an important area of future research, since residential uses are often the first to be targeted for increased water charges, but may not necessarily be at the root of increased per capita water use in a municipality.

TABLE 6 – Average Cost (Gross Revenue) Per Acre Foot from Delivered Treated Water and Average Water Used Per Capita for Large Cities in the Northern Front Range

City	Avg. Cost Per AF delivered			Avg. Water Use Per Capita/Day		
	1982	2000	% Change	1982	2000	% Change
Boulder	$297	$	N/A	164 gal.	226 gal.	37.8
Broomfield	$629	$904	43.7	119 gal.	184 gal.	54.6
Longmont	$365	$991	171.5	211 gal.	195 gal.	-8.2
Ft. Collins	$306	$633	107.0	182 gal.	185 gal.	1.6
Loveland	$564	$627	11.2	167 gal.	146 gal.	-14.4
Greeley	$253	$698	176.0	271 gal.	264 gal.	-2.6

Population -- 1982 =292,760
Six cities 2000 = 540,228 Population Increase = 84. 53%

Water Delivered -- 1980 = 73,360 AF
6 cities 2000 = 103,885 AF Water Use Increase = 41. 6%

TABLE 7 – Average Cost (Gross Revenue) Per Acre Foot from Delivered Treated Water and Average Water Used Per Capita for Rural Domestics Water Users in the Northern Front Range

Rural Domestic	Year	Total Water delivery (AF)	Avg. Water Revenue (AF)	Avg. Water Use (per Capita/Day)
East Larimer Co. W.D.	1972	972	$295	Unknown
	1982	2160	$347	Unknown
	2000	3277	$640	214
North Weld Co. W.D.	1972	1594	$292	284
	1982	2098	$397	260
	2000	3543	$489	193
Little Thompson W.D.	1972	1170	$235	234
	1982	2190	$313	200
	2000	5054	$440	200
Fort Collins-Loveland W.D.	1972	847	$252	216
	1982	2940	$228	282
	2000	4920	$448	200

Municipal Water Systems

The greater revenue necessary to supply potable water today is one of the reasons why municipalities are interested in how pressurized secondary water supply could positively affect their future potable supply needs. If experience in Utah and Idaho are a guide, the entry of traditional agricultural water suppliers into secondary water service is likely to have very positive effects on the future affordability of potable water systems. In order to better assess this issue, we need to look at recent

TABLE 8 – Average Treated Water Used Per Capita for Small Municipalities in the Northern Front Range*

Town	Acres in Town by Year			Population				Water Use Per Capita/Day		
	1972	1983	2001	1972	1983	1990	2000	1972	1983	2000
Ault	98	472		800	1066	1107	1432	142	149	158
Firestone	800	1672		690	1309	1358	5428	59	113	44
Johnstown	320	347	3942	1345	1543	1579	3827	228	390	239
Windsor	550	1200	10,446	1564	4657	5062	9896	151	144	123
Louisville	480	4530		3288	7200	12,363	18,937	119	98	214
Berthoud	425	527	4992	2072	2741	2990	4839	271	192	172

* Water Delivery estimates for 2000 from South Platte Water Conservation Project Study, NCWCD 2000.

trends in treated water cost and its use among both municipal suppliers and rural domestic water districts. We can then relate these cost and use trends to secondary systems managed in the future by traditional canal companies and irrigation districts.

From an economic viewpoint, municipal water systems are somewhat unusual in that they operate at high fixed-cost and low variable-cost. Once the systems have been built, operating them at near capacity generally lowers both fixed costs and variable costs per unit of water delivered. This is why it might be questionable whether municipalities would promote the idea of canal companies in the area providing pressurized secondary water, at least in the established municipal areas. Revenue earned by canal companies or irrigation districts in providing secondary water service can represent revenue lost to municipalities to pay for their existing potable water infrastructure.

On the other hand, as discussed in a previous chapter, it might be in the interests of municipalities to entertain how the provision of pressurized secondary water supply to newly developing areas by irrigation companies -- and again those who show capability in providing such service dependably -- could save the municipalities money in future development of water treatment facilities.

To begin our analysis, Tables 6, 7 and 8 show the increase in water rates (water charges per acre-foot) and per capita water use for a selection of typical municipal and rural domestic water suppliers in the study area. Table 6 shows that the larger communities have experienced increases in either their water rates or the amount of water used, but with no discernable correlation between the two. Rural domestic water suppliers (Table 7), on the other hand, show predominately uniform increases in both water rates and water usage. The increase in water rates for rural domestics is believed due to these systems serving many more homes than in the past, and often in much less densely populated areas. Infrastructure development costs are divided among fewer people, while rural residential lots tend to be larger, and therefore with higher water needs. The same situation tends to hold for small towns.

Water Costs

There are many different classes of water users in municipal settings, including businesses, industries, institutions, open space and parks, street washing, and firefighting. We include all of these water uses together when estimating gross municipal water cost and water use. Thus, in the following discussion we consider the total amount of water delivered through municipal water supply systems, then relate it to the reported gross revenue obtained per acre-foot, and the gallons per capita delivered to the general population. Although there is some good municipal information on residential water use under meters (as there is with fixed rate water charges), differences in residential indoor and outdoor uses remain difficult to separate out even in those instances.

Referring again to Tables 6 and 7, the cost of water to the consumer has ranged from a high of $990 per acre-foot in Longmont to a low of $627 per acre-foot in Loveland. Rural domestic water suppliers show comparable trends in water costs, although lower costs overall compared to municipalities. Over time, the cost of municipal water to the consumer has increased dramatically. This trend is likely to continue, particularly if municipalities continue to seek more capacity by way of increased conservation through higher water rates, rather than by way of developing more water.

The variation in municipal water costs may have more to do with the approach taken by the municipal water utility in assessing its employment and manpower needs. For instance, Fort Collins water has increased from $66 per acre-foot in 1972 to $633 per acre-foot in 2000. Loveland water has increased from $135 per acre-foot in 1972 to $627 per acre-foot in 2000. The per capita use in Fort Collins has been stable, while costs have doubled since 1982. Loveland, on the other hand, has decreased its water use modestly through metering while costs have remained relatively stable since 1982.

The smaller towns (Ault, Windsor, Louisville) generally show higher costs and lower usage per capita, due primarily to the fact that fewer customers are supporting a higher per capita investment in the water system (Table 8).[4] In addition, in these small towns, irrigation water is often still being provided through open ditches or wells to residential lots, leading to somewhat reduced usage of treated water for outdoor use, and therefore less overall per capita use (Table 8).

Relevance to Canal Companies and Irrigation Districts

Tables 6 and 7 give some insight into the potential role of canal companies and irrigation districts in secondary water supply. The figures suggest what urban users are willing to pay for water, and equally indicate some of the potential revenue available to traditional agricultural water suppliers if they enter into secondary water service. These revenue figures are helpful in assessing what affordable and competitively priced secondary water service might be in the Colorado Front Range.

Present fully developed secondary systems in Utah and Idaho operated by canal companies tend to charge the residential user $100.00 to $250.00/residential tap/year.[5] If it is assumed that sixty percent of the treated water currently provided by Colorado Front Range municipalities and rural domestics is used outdoors (see later discussion), and assuming the cost of the treated water applied to outdoor use is therefore approximately sixty percent of the current total cost to the residential water user (Tables 6 and 7), secondary systems would appear to show excellent affordability for the residential user, as well as being an important revenue generator for the traditional agricultural water supplier. Of course, all of this assumes that any decrease in municipal or rural domestic water use due to secondary system use would result in a proportional decrease in potable water charges to the consumer made by these entities.

Currently, one-half of the reported potable water costs along the Front Range (Tables 6, 7 and 8) exceed the cost of secondary water service reported in Utah and Idaho by a margin 50 percent or more.

Several municipalities and small towns in northern Colorado and elsewhere have indicated that the advantages of secondary water may not be so valuable when existing and leveraged capital costs of potable systems are considered. For instance, a municipal system may not be able to meet its capital costs if a cutback in potable water usage occurs as a result of secondary water. This is an important consideration and will be taken up in the final chapter of the report. In order to assess the benefits of secondary water to municipalities, we need to look more carefully at water use in urban areas.

Total Water Use

We will look at the amount of water applied per acre of land in urban areas, compared to irrigated agriculture. Information on per acre use may be more relevant to an irrigation company or irrigation district board or stockholders in determining what percentage of its present water decree might be needed to provide a given amount of land converted to residential use with secondary water service.

In 1983, municipal potable water deliveries (combining indoor and outdoor use) ranged from 3308 A.F. (or 0.55 A.F./Acre) in Broomfield to 11,654 A.F. (or 1.34A.F./Acre) in Longmont. Likewise, in Fort Collins, the water delivered per acre of land in the city boundaries was 1.28 A.F. in 1980. Twenty years later, Fort Collins delivered 27,620 A.F. to 30,067 acres of land, or 0.92 A.F./Acre.[6]

An earlier study showed that municipal water supply per acre in small towns was frequently greater than it is in large cities.[7] This was attributed to the larger lot sizes in smaller towns. Initially, this is not borne out with present figures. The City of Johnstown shows a rate of 0.26 A.F./Acre, while the City of Berthoud and the City of Windsor show 0.18 A.F./Acre and 0.13 A.F./Acre respectively.[8] However, the current usage rates in these smaller communities are believed deflated due to the large annexations of undeveloped land these cities have made in recent years. These small towns do not deliver water to the large annexed areas of essentially irrigated farmland or partially developed housing projects. The figures from smaller towns are more biased by "annexation fever," driven by the obvious need of these small towns to establish a tax revenue base for services to lands being proposed for development by developers (Table 8). Consequently, the gross water use figures from large cities in the region would appear to be more reliable estimates of municipal per acre usage.

Comparing these municipal uses with water use on agricultural lands (i.e. water use on lands before they are converted into subdivisions) can be difficult. Agricultural water rights vary greatly from one locality to the next. However, something can be gained by looking at regional figures. An earlier study of water actually delivered to irrigated farmland in one basin in the region showed an average of 2.5 to 2.9 A.F./Acre.[9] A later study on irrigation in the Rocky Mountain region reported similar figures.[10] Bureau of Reclamation projects substantiate this level of water use for irrigated agriculture in the Rocky Mountain region.[11] One can compare these figures with our municipal figures of .50 to 1.50 A.F./Acre discussed above.

What these figures tend to suggest is that, on average, earlier estimates of water use per acre in municipal areas (based on our Front Range municipal estimates) may be no more than fifty percent of that used by irrigated agriculture in the same area. Furthermore, considering that anywhere from fifty to sixty percent of the water allocated in municipalities might be for outdoor use (we will shortly present data to support this), the figures for irrigated agricultural use suggest that, on the average, the potential demands of the secondary systems on canal company and irrigation district water rights and service area lands in the region appear to be modest, at the very most.[12]

In terms of agricultural water cost, canal company and irrigation district charges in the Rocky Mountain region can range anywhere from $1.50 to $20.00 or more per acre-foot, depending upon canal operating costs.[13] The difference between what canal companies and irrigation districts currently charge for irrigation water to agricultural water users in order to operate their irrigation systems at cost, and what municipalities currently charge for the delivery of the same amount of treated water (Table 6), represents the potential range of competitive water charges available to irrigation enterprises, in order to deliver pressurized secondary water supply. The difference may be one-thousand percent or more, clearly making it possible and often desirable for traditional agricultural water suppliers to consider providing secondary service.

Separating Indoor from Outdoor Use

Better estimates of indoor and outdoor water use are needed to understand what the potential demand will be on pressurized secondary water systems for outdoor use. We will examine both flat rate and metered figures, although we assume that future pressurized secondary systems will not be metered for reasons that will be discussed later.

Some municipalities in the study area have made their own estimates of gross per capita residential use, for both indoor and outdoor use. We will discuss these values in addition to presenting some of our own findings. Finally, we will conclude with some observations from an informative study recently conducted by the State of Utah.[14]

1. Lot Size as a Factor. In a recent study conducted by the East Larimer County Water District, a rural domestic water supplier for northern Larimer County, Colorado, it was found that lot size was highly correlated ($r^2 = 0.99$) with water use, up to a point.[15] Although that study was not able to separate out indoor and outdoor usage, the results are informative in clarifying the important role of lot size in water use. A total of 256 residential lots were studied, and the results showed that for a lot size of less than 0.5 acres, increased water use was positively correlated with increased lot size. Thereafter, lot sizes of 0.5 to 5 acres tended to show fairly constant levels of water usage. This indirectly suggests a possible optimal size for turf and landscape areas on larger lots served by potable water systems. Time and effort expended in maintaining landscaping is probably subject to increased opportunity costs for the homeowner.

TABLE 9 – Estimated In-House Water Use in Municipalities; Six-Year Average Use (1994-1999)

	Gallons	Acre Feet	Gal. Per. Cap/Day
Single Family Metered	126,210	.39	144
Single Family Flat Rate (2.4 persons)	178,685	.55	204
Duplex Metered	71,777	.22	109
Duplex Flat Rate (1.8 persons)	100,301	.31	153

2. Municipal Use. The City of Fort Collins reports a ten-year per capita average use of 211 gallons capita/day, combining both indoor and outdoor use.[16] This figure is based on the sum of all classes of municipal use, divided by the population. Because of the lumping of all classes of water use (i.e., residential, commercial, parks and recreation, etc.), this figure probably over-estimates per capita use. Another figure reported for the City of Fort Collins is based on single-family flat rate usage (Table 9). Based on a family size of 2.4 for single-family units, the water use would be about 204 gal. per capita/day, again combining both indoor and outdoor use. The metered water usage of 144 gal. per capita/day is considerably less (Table 9), and clearly shows the affect of metering on water use.

3. Duplex Usage. Table 9 also shows duplex water use. Duplex water use is of interest because it is a residential type thought to represent a minimum of outdoor use, at least compared to typical residential lots. Duplex figures may help isolate residential indoor use somewhat. Duplexes are believed to represent the lower end in family size (1.8 persons) and minimum daily occupancy (primarily in evenings) as well. Using a six-year average, it was found that duplex units with flat rates use 200,602 gallons annually, or approximately 100,301 gallons (0.31AF) per unit.[17] This would amount to about 153 gallons per capita/day. Note that the duplex flat rate use (153 gal. per capita/day) and the metered single-family use (144 gal. per capita/day) are comparable.

4. Extrapolating from Summer/Winter Usage. The Utah Division of Water Resources recently completed a study of water usage in thirteen communities over a three-year period (1994-96).[18] That study appears to support previous studies conducted in Utah, as well as a national study conducted by the American Water Works Association.[19] The Utah study reports a metered winter use of 99 gallons per capita/day. This is subtracted from the total summer metered use of 169 gallons per capita/day to give an outdoor summer use of 70 gallons per capita/day.[20] Given that family sizes are somewhat larger in Utah (3.2 persons/household) than Colorado, and given that there has been some previous positive correlation established between family size and water use in other studies, the Utah figures would appear to be very comparable to what is shown in Table 9 for single-family metered water use in one Colorado Front Range community (i.e., 144 gallons per capita/day). It should be noted that using metered winter usage to extrapolate summer outdoor use may overlook increased summer indoor use for bathing purposes.

5. Indoor Use under Secondary Systems. Estimates of both indoor and outdoor water use under conditions where the indoor use is metered but where some of the outdoor use is conveyed through an unmetered secondary system are also reported in the Utah study. Indoor use in these instances is estimated by the State of Utah at 114 gallons per capita/day, while outdoor use is estimated at 114 gallons per capita/day, giving a total of 228 gallons per capita/day. However, the strongest evidence supporting the Utah indoor water use figures of 70 gal. per capita/day is found elsewhere. In three communities in Utah that have fully developed pressurized secondary water service for outdoor use, the metered indoor usage rate was 73 gallons per capita/day.

We can summarize the data to this point. Under densities and lot sizes characteristic of urban areas, the demand on secondary systems might be in the range of 0.54 to 1.10 A.F./Acre for outdoor use. These ranges represent approximately 25-50 percent of the typical average water supply for irrigated agriculture in the region. Given that one acre can accommodate on the average four homes (and perhaps more depending upon municipal zoning), and given that a canal company could provide secondary water service to individual residential hookups in the range of $200 to $250 per year, based on our Utah examples, this would represent a potential revenue stream to the canal company or irrigation district of anywhere from $800 to $1000 per acre foot of water (based on 1.00 AF/acre). This may be compared to the current revenue from agricultural uses (stock assessments or land taxes) of $1.50 to $20 (or slightly more) per acre-foot.

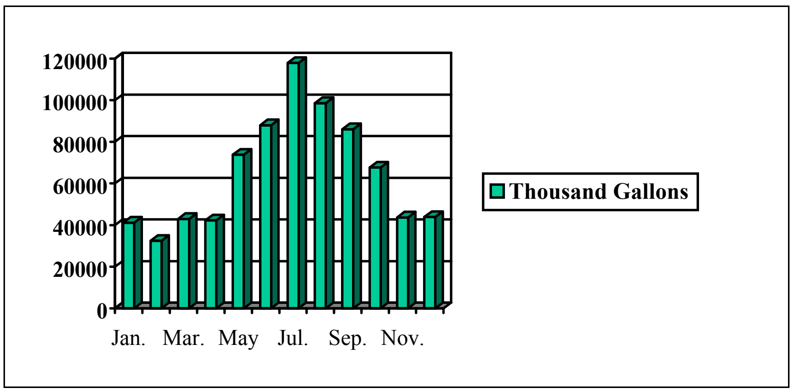
In unincorporated areas with lot sizes in the range of 0.5 to 2 acres or more, the revenue stream for pressurized secondary systems managed by traditional agricultural water suppliers would be less. Obviously, the denser the subdivisions served by secondary supply, the more revenue would be available to traditional agricultural water suppliers for this kind of service. Higher residential unit densities will not only reduce the water consumption under secondary systems, they will likely generate more revenue for the secondary system as well. Secondary system suppliers would therefore likely support zoning for higher densities in both incorporated and unincorporated areas, an issue that is important for urban planners. This is a counterargument to those who perceive secondary systems as leading to more urban sprawl.

Based on other regional examples, it appears likely that future secondary systems may develop first in unincorporated areas where the lot sizes are also likely to be larger. If they are shown to be successful, then retrofitting may well occur in older developed residential areas in incorporated areas.

Seasonal Differences in Municipal Water Use

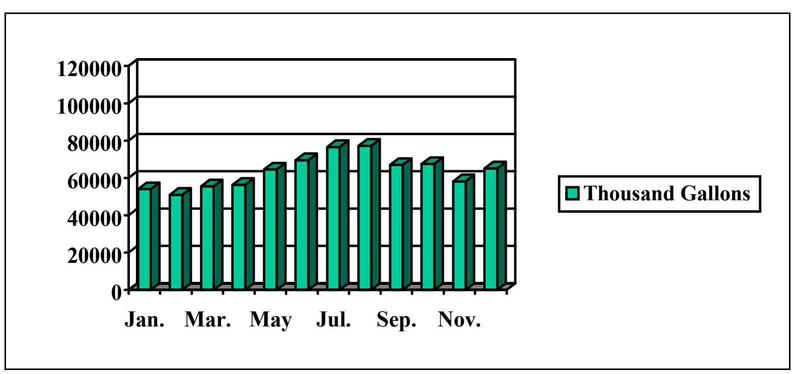
The seasonal difference in municipal potable water use today in the region is quite dramatic, most of the water use coming from water application on lawns, gardens and for municipal recreational uses in the summer. Figure 37 shows the typical seasonal water use in a suburban municipality in Utah. Comparable patterns would be found in almost any municipality in northern Colorado. Nearly 60 percent of all annual water use occurs during the summer season (from the beginning of June through the end of August), and the consumption of water during these months is often double or triple that of winter months. Indoor usage can be increased through more bathing, while outdoor use is obviously increased through landscape watering.

FIGURE 37 – CITY OF KAYSVILLE, UTAH
1987-1990 AVERAGE TREATED WATER USE
BEFORE THE INTRODUCTION OF SECONDARY WATER SUPPLY



This highlights the fact that municipal water supplies (and systems) are constrained in three important ways. First, unlike water for agriculture, water supplies for municipal use must be available year around. Second, treated municipal water supplies (and system infrastructure) must be able to meet the surge in demand during the summer months. Third, these systems must accommodate fire suppression needs. These characteristics represent important challenges for piped pressurized secondary water supply systems.

FIGURE 38 – CITY OF KAYSVILLE, UTAH
1993-1998 AVERAGE TREATED WATER USE
AFTER THE INTRODUCTION OF SECONDARY WATER SUPPLY



Pressurized secondary water service provided by traditional agricultural water suppliers can be used to meet peak potable water demands during the summer months. Figures 37 and 38 show treated water use in the City of Kaysville, Utah before and after the introduction of pressurized untreated water in the early 1990s. The Davis and Weber Counties Canal Company provides the secondary water supply service to this municipality. Prior to 1990, the City of Kaysville showed a dramatic peak in treated water use between May and October. After the introduction of pressurized secondary water supply to homes in the area, this peak usage leveled off. Although the City of Kaysville has developed treated water capacity over the years to meet its peak summer demand, no longer will this demand be the same with the presence of secondary water. Furthermore, treated water transferred away from outdoor use in the municipal area can be used to meet future urban development needs, while existing treatment capacity can serve a proportional amount of new growth without further expansion of treatment capacity.

In the case of the City of Kaysville, the secondary water supply provided by the Davis and Weber Counties Canal Company is confined to the local growing season (April to October). The community has made this decision, and to this date, there do not appear to have been problems with complaints from homeowners wishing to have service during dry winter months. On the whole, over the years it has been found that lawns may suffer mildly from lack of watering during dry winter months, but generally recover. The issue of dry winters has not been considered important enough to warrant year-around irrigation through these secondary systems. Valuable woody ornamentals can be watered by hand with the potable system, without increasing consumption significantly. This has precluded the need for secondary water systems to be in service year-around, and makes it much more likely that traditional agricultural water suppliers can provide secondary service. Their water rights are generally available only during the irrigation season.

It is true that some irrigation companies and irrigation districts have reservoirs that could be used to meet winter residential outdoor irrigation needs. Furthermore, in some localities in southern Colorado or elsewhere in the Southwest, the ground does not get cold enough to threaten the operation of these systems during the winter. This is the case in southern Utah, where these systems are operated through the winter. However, in most areas of the Rocky Mountain region where secondary water systems are operated successfully by traditional agricultural water suppliers, secondary water service is normally only provided during the traditional (agricultural) irrigation season.

In one reported instance on the Colorado Front Range, with the closing of the traditional open irrigation ditch, homeowners in a new rural subdivision turned to the potable supply to irrigate lawns during a winter dry spell.[21] These "bucket brigades" tend to undermine regional attempts to rationalize water delivery through dual systems. Clearly, this suggests several options. One is enforcing restrictions on outdoor residential water use in secondary supply system service areas in the winter. This is generally what is practiced under secondary supply systems elsewhere in the Rocky Mountain region. Another option is the promotion of xeriscape concepts through subdivision covenants and other means. A third option is increased winter water rates in areas where such outdoor potable water use is likely to occur. Fundamentally, the problem is not unlike what farmers face with winter drought conditions affecting winter wheat and other crops. Re-planting is often the only option. People who have lived in cities for many years and are used to the convenience of year-round potable supplies may have the most difficulty adjusting to seasonal secondary supply systems. But it is being done elsewhere, and without apparent undue hardship to homeowners.

<u>Secondary Systems and Return Flows</u>

Most municipal water that is treated and consumptively used is removed from the annual hydrologic system when applied to landscaping, minus some modest street runoff into storm drains from over-irrigating. On the other hand, the vast percentage of indoor water use is recycled through municipal treatment facilities and returned more or less immediately to the river basin. In the past, this non-consumptive water has been available for other "downstream" users, most particularly, agricultural water users. However, in recent years, municipalities have begun to file for special water decrees allowing treated water to be used to extinction. Although, in the future, most municipal treated water will likely continue to be available to downstream users, it will be at a cost. Municipalities will want to exchange this effluent with agricultural water suppliers having irrigation water that can be used by municipalities in their treatment plants. Return flows (effluent) from the treated water system have become a valuable commodity in the local water market, particularly in drought years.

Although flows from non-consumptive indoor uses are often available to agriculture after they have been treated in wastewater reclamation plants, there are concerns about nitrates in these treated effluents. For instance, early in the growing season, nitrates in treated effluent may represent a positive net benefit to crops. In mid-season, nitrate levels in irrigation water may simply constitute a modest augmentation to side-dressing (fertilizer) applications. However, with some specialty crops, such as sugar beets and barley, nitrate loads in effluent destined for irrigated crops can be detrimental to production quality.

It is likely that under pressurized secondary water supply systems operated by canal companies or irrigation districts, there would be minimal return flows associated with applying pressurized water to residential lots. In other words, water application efficiencies and consumptive use under these situations would be close to 90% or more, much more than irrigation efficiencies under current furrow irrigated systems. Chapter 7 discusses some of the implications this might have for canal companies and Colorado water law, although it is not believed that these implications are negative except in a few circumstances.

In a water management scenario where municipalities are providing treated water for indoor use and the local irrigation enterprises are providing pressurized raw water for outdoor use, the planning target for the former would be average non-consumptive use while the planning target for the latter would be average consumptive use. Return flows from municipal use could go to irrigated agriculture, directly or through exchanges. Meanwhile, although significant return flows would not be generated from secondary systems, irrigated agriculture would be strengthened by the better financial position of irrigation companies and irrigation districts, by way of revenue generated from pressurized secondary service.

Effects of Metering

Table 10 shows a typical municipal water delivery system with both base charges and unit charges. In the late 1970s, only a few of the larger cities in the region were delivering water through meters. In recent years, metering has increased dramatically. Although residential in-house water demand has been generally found to be relatively inelastic (i.e., not very susceptible to changes in use due to metering), outdoor use does change with metered pricing. Water use for single-family dwellings with meters is often lower than water use for single-family dwellings that are charged a flat rate, and much of this reduction is probably in outdoor water use. In short, such factors as income and lot size held constant, outdoor water use can be effectively curtailed through metering.

The issue of metering is important to the future of pressurized secondary water supply provided by irrigation companies and irrigation districts. For the most part, successful secondary water supply systems in other key localities in the Rocky Mountain region, such as along the Wasatch Front Range and in the Boise Valley of Idaho, are not metered. The use of lot size and pipe sizing constraints for pressurized secondary water charges has been found to be adequate for this type of system. Metering of such systems tends to make them less economically competitive with municipal and rural domestic suppliers because of the cost of installing and maintaining meters and, more importantly, the annual cost of reading meters and billing accordingly. Under metered secondary systems, customers would likely not realize a reduction in their water bill, therefore traditional irrigation enterprises might have difficulty selling the concept to the community, and as a result, irrigated agriculture would not materially benefit from a new revenue stream that would allow them to upgrade their canal system. Furthermore,

TABLE 10 – Typical Municipal Water Charges

Metered Single Family Water Charge
Yearly water use .42 AF per household
Base Charge:
$14.69 per month x 12 = $176.28 per year
Unit Charge:
$ 1.31 per 1000 gallons x 136.3 per 1000 gallons = $178.55
Total Charge:
$354.83 per year; $29.57 per month average
Value per acre foot delivered to metered single family use:
$354.83 / 0.42 AF = $845 AF

Flat Rate Single Family Water Charge
Average lot size 8600 sq. ft. in lot size
Rate is 0.166 per 100 sq. ft./ month
Base Charge:
$26.33 per month
Lot Charge:
0.166 x 86 = $14.27 per month + $26.33 x 12 = $487 per year
$487 / 0.54 AF = $901 per AF

***Non-metered water users pay an average of $57 per AF more than metered water users. A six year average shows single family flat rate users utilizing about 39 percent more water than single family metered users (178,006 gallons annually versus 126,219 gallons annually (City of Ft. Collins annual reports).**

TABLE 11 - Size of Water Taps and Water Use by Selected Rural Domestic Districts

	North Weld W.D.		East Larimer Co		Little Thompson W.D.	
Tap Size	# of Taps	Water Use	# of Taps	Water Use	# of Taps	Water Use
5/8”	2858	2451 AF	3591*/324**	2313 AF	5769	4239 AF
¾”	77	361 AF	39 / 18	93 AF	8	11 AF
1”	37	157 AF	11 / 42	119 AF	35	239 AF
1.5”	22	445 AF	22 / 20	90 AF	17	377 AF
2”	3	129 AF	- / 5	124 AF	9	188 AF
3”			- / 6	168 AF		
Total Taps	2997		3663 / 415		5838	
Water Delivery		3543 AF		2907 AF	5980	5054 AF
Whole Sale	7	2023 AF		370 AF	8	918 AF
Total Water Delivered		5566 AF		3277 AF		5972 AF

* Residential Taps
** Commercial Taps

developers indicate that the cost of metered secondary water often negates the increase in parcel property values that comes with the provision of pressurized secondary water supply to their lots.[22]

Some communities have been forced in the past to turn to metering out of necessity to reduce water use, because of the lack of water supplies or the failure of the municipality to keep up with population growth. This was the case in Boulder in the 1970s. Boulder was one of the first communities to turn to metering. Other communities have had strong advocates of metering, some of these advocates representing private sector firms who install these meters. Yet other communities turned to metering as a result of political fallout associated with drought conditions. Although there is a general reluctance to challenge the benefits of metering today, it is clear that advocating the use of water meters for pressurized secondary supply systems may have negative consequences for the promotion and development of these systems.

Although the levels of water use under meter regimes might suggest that additional water development in the region is not as pressing, the economic effects of metering in a basin-wide sense can be regressive. First, meters are often an invitation to cities to charge higher rates for water deliveries in the name of water conservation. This would, at first glance, suggest economic efficiencies. By having citizens pay a higher price for water, water may be conserved. However, as noted in an earlier study, these water savings are often modest, relative to the price that is charged to achieve this efficiency in use.[23] Furthermore, water metering comes with expensive maintenance costs. Water rates in many municipalities have increased by 500 percent or more since 1972, and much of this increase appears related to the operation and maintenance costs of metering alone, with only modest water conservation.

Second, any water conservation policy has important regional economic tradeoffs, particularly the use of meters for water conservation. Increased water charges from metering can have an affect on people with fixed income, while overall disposable income for the rest of the community is reduced. What is spent on metered water cannot go to dinner out on Friday night, or to local shopping. Furthermore, there are implications for local lifestyles. Lawns, trees, attractive ornamentals and gardens clearly add value to peoples' lives. Conservation through metering should be balanced with sound economics and concern for quality of life. It may be questioned whether communities are always well served by water metering, at least in term of the opportunity costs for disposable income potentially allocated to other uses in the local and regional economy.

Third, as indicated earlier, as much as 50 percent or more of residential water use typically returns to a river basin as treated effluent for others to use. The consumptive use of indoor residential water usage is small. Therefore, people can be unnecessarily burdened by the metering of water that, for the most part, returns to the hydrologic system for others to use. Water conservation has many facets to it. It includes not only the amount of water used, but also when this water is used, and finally, whether or not the water being used can be reused. Water conservation strategies should address all three conservation measures at the same time. Secondary systems show capabilities in all three conservation areas. Secondary systems are an important part of an overall drought mitigation policy for the region (Chapter 10).

Pressurized secondary water supply has a potentially significant role to play in improving economic inefficiencies associated with water management and use, improving equity in the distribution of water costs associated with metering, and improving water conservation. It is true that secondary systems result in a portion of agricultural water supplies being diverted for new residential use. However, this is done in a way that gives something back to irrigators through a revenue stream that can be used to modernize their canal systems and, potentially, lower their agricultural water assessments.

Because farm income is low, this new revenue stream can help canal companies and irrigation districts move to the technologically higher side of water management, including pressurization of main canal agricultural water deliveries, structural improvements, and even SCADA.[24] In turn, improved main canal water deliveries allow farmers to move to the technologically higher side of on-farm water management. Irrigation techniques such as gated pipe, surge valves and sprinkler systems are often made possible by improvements in water management at the level of the main irrigation canal. The revenue to these traditional agricultural water suppliers from secondary water management can initiate an important movement toward water conservation practices that would not otherwise be possible with current farm income. In many respects, everyone in the community can benefit from canal companies and irrigation districts becoming involved in secondary water supply management.

Table 12- Water Use and Cost by Tap Size for Rural Domestic Systems

North Weld County Water District			East Larimer County Water District			Little Thompson Water District		
Tap Size	Water Use	$ Per AF (acre foot)	Tap Size	Water Use	$ Per AF (acre foot)	Tap Size	Water Use	$ Per AF (acre foot)
5/8”	2451af	$575/af	All Meters*	2907af	$554/af	5/8”	4239af	$474/af
¾” to 3”	964af	$464/af	Wholesale	370af	$219/af	2”	188af	$336/af
Wholesale	2023af	$399/af (with pump)				4”	877af	$219/af
Wholesale	1784af	$377/af (no pump)				6”	41af	$265/af

* All Metered Sales

Rural Domestic Water Systems

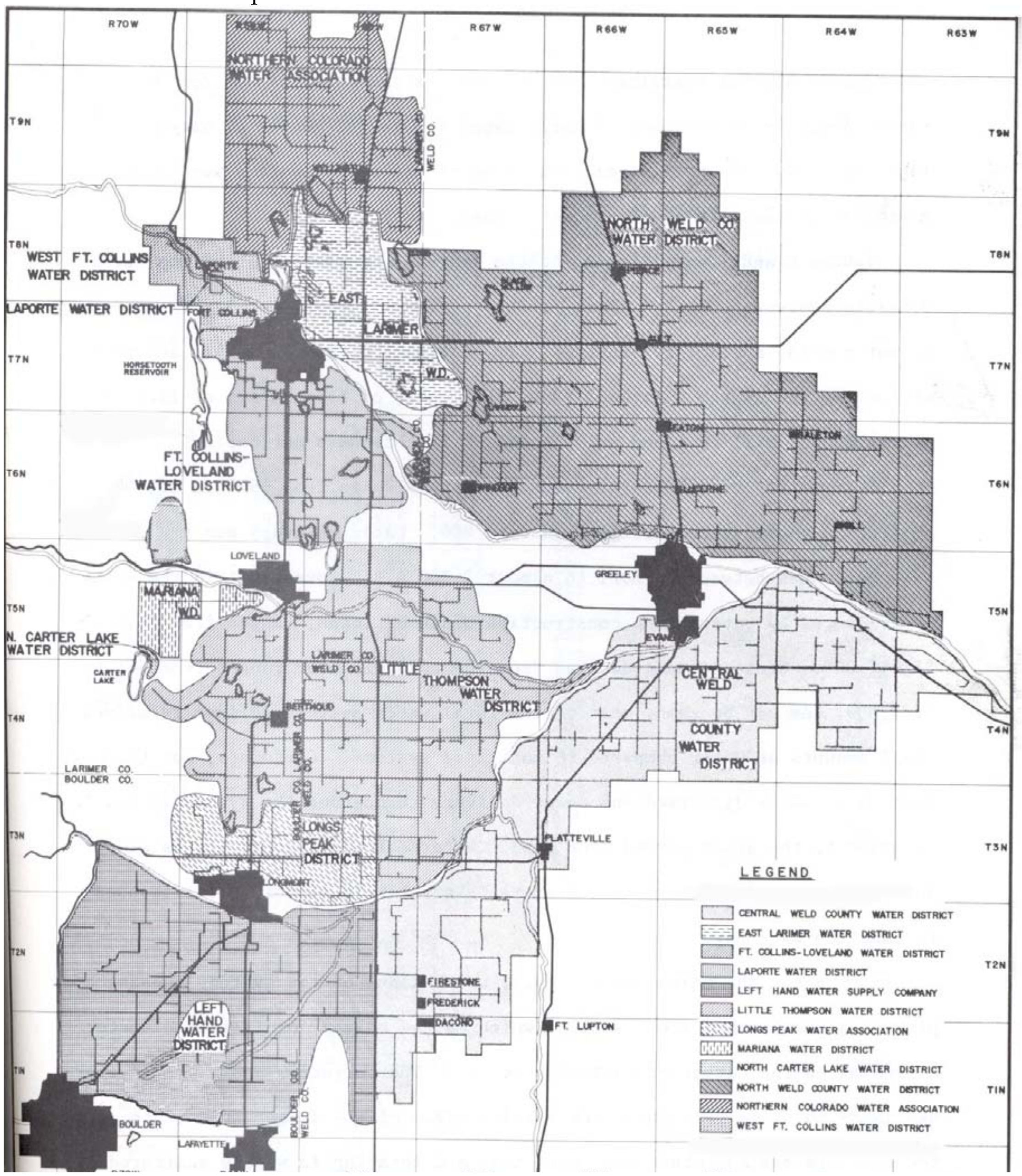
Some of the other key players in regional water management are the rural domestic water supply systems. These are the Title 32 districts in the state, and they are somewhat unique to Colorado. There are 14 of these districts in northern Colorado. All of them were organized in the 1960s to serve rural residences with potable water supply needs. There are many along the Colorado Front Range (Figure 39). Examples of water usage and cost per acre-foot under these systems are shown in Tables 11 and 12.

The current operation of rural domestic water districts provides important information about water rates and usage in more rural areas where at least some of the pressurized secondary water supply will likely be located. In both the rural context, as in the more urbanized areas, the provision of pressurized secondary water supply service will likely need to demonstrate relatively little change in overall residential water bills currently being experienced by homeowners, and will at a minimum be required to meet the current residential outdoor use and possibly provide more water for landscape use to accommodate somewhat larger lot sizes. Some of the information presented earlier on municipal use suggests that this can be accomplished in many instances where canal company and irrigation district service areas overlap developed or developing residential areas.

Although rural domestic water districts and pressurized secondary water supply systems will likely overlap each other in many instances, particularly in unincorporated areas, it is not expected that

FIGURE 39

Map of domestic water districts in the Northern Colorado



these services will compete with each other for revenue derived from residential users in the rural or urban fringe. Today, rural domestics in northern Colorado are hard pressed to secure water and expand their systems to meet both indoor and outdoor use at a cost that can be supported by residential water users. For instance, rural domestic water suppliers are routinely reporting as much as a 400 percent increase in the cost of raw water that developers are being required to dedicate to the rural domestic system for subdivision development in unincorporated areas.[25]

This is a dramatic increase in the cost of subdivision raw water turnover requirements for the region and, in some instances, has made it necessary for subdivision builders to design increased densities for their subdivisions. In addition, tap fees to hook up rural domestic water systems to residential lots have risen exponentially in recent years. Three rural districts in northern Colorado report tap fees in excess of $16,000 for a 5/8" tap, generally the typical residential tap size in these districts (Tables 13, 14 and 15).[26] This includes the basic tap fee, the plant investment fee, installation and the dollar value of the raw water turnover requirement. Meanwhile, the annual water charges for residential water service noted earlier have increased dramatically as well.

Despite increased tap costs, rural residential lot size and water use may be expected to continue to be somewhat greater than residential lot size and water use in the cities, thus placing continued pressure on rural domestic districts to require larger dedications of raw water from developers.[27] Given these circumstances, it is easy to understand why rural domestic water districts are turning more to lot size and/or tap size as the principal criterion for setting raw water turnover requirements for development as well as for annual water fees and surcharges for treated water, if they are expected to continue to provide inside and outside water.

Water Use in Rural Residential Areas

Water use in rural residential areas may vary considerably, depending upon the lot sizes, and whether or not the tap is serving agricultural uses as well. There is a wide range of rural residential patterns of usage, including homes with recreational livestock, large lots with ample space for gardens, planned unit development (PUD) subdivisions with lots on the average larger than those found in incorporated areas, rural residential subdivisions with special water use covenants, and large and expensive estate parcels.

Figures on current rural domestic water use have been obtained from three sample districts in northern Colorado (Table 11). The North Weld County Water District has provided rural domestic water service since 1962. As with the other rural domestics in the area, formation of this water district was contingent upon soliciting enough subscribers in the proposed service area to finance the initial startup of the district. It is anticipated that the involvement of canal companies and irrigation districts in pressurized secondary water supply may well require similar solicitation procedures. In the year 2000, 3,543 acre-feet were delivered to 2,997 customers, excluding wholesale water delivered to customers in the towns of Ault, Eaton, Pierce, Nunn and Windsor. This amounted to approximately 1.2 acre-feet/year for each tap, many of these taps being agricultural/livestock in nature. A portion of the district's service area overlaps the service area of one of the canal companies participating in the study, affording opportunities for these two entities to work together on a secondary system for the canal company.

The East Larimer County Water District also was organized in 1962 (Table 11). In the year 2000, the East Larimer County Water District delivered approximately 2,907 acre-feet of water to 4,200 customers. This amounted to approximately 0.69 AF per tap, many of these taps being residential or hobby farms, rather than serving full agricultural enterprises.

TABLE 13 - Tap Fee Schedules for Services in East Larimer County Water District (2002)

Lot Sizes	Tap Size	Plant Investment Fee	Installation	Raw Water RWQ*
3000-9000	5/8”	$4,3000 per lot	$1500	0.5 to 1 C-BT unit**

* Raw Water Requirement
** C-BT unit Valued @ $10,000 to $12,000

Example: Residential on 9000sq ft lot
(P.I.=$4,300 + Install=$1,500 + 1 unit C-BT=$11,000) = $16,800

TABLE 14 - Tap Fee Schedules for Services in North Weld County Water District (2002)

Tap Size	Plant Investment Fee	Line Cost	Water Supply
5/8”	$5,000	$200/mile*	$10,000

* From Supply Tank

Example: Residential lot 10 miles from Supply Tank
(P.I.=$5,000 + 10 miles of pipe=$2,000 + Water Supply=$10,000) = **$17,000**

TABLE 15 - Tap Fee Schedules for Services in Little Thompson Water District (2002)

Tap Size	Plant Investment Fee	Install	C-BT units	Water Right	Total
5/8”	$6,000	$1,500	1	$11,000	$18,500
¾”	$9,000	$1,500	1.5	$16,500	$27,000
1”	$15,000	$1,775	2.5	$27,500	$44,275
1.5”	$30,000	$10,175	5	$55,000	$95,175
2”	$48,000	$10,700	8	$88,000	$146,700

Table 16 – Residential Water Use in Utah

Treated Water Use in Utah Cities with Secondary Supply			
CITY	# of Taps	Winter gal/capita/day	Summer gal/capita/day
Kaysville	5500	61.1 gal	69.6 gal
Roy	8278	68.3 gal	73.0 gal
Hurricane	1226	68.5 gal	97.8 gal
Treated Water Use in Utah Cities without Secondary Supply			
CITY	# of Taps	Winter gal/capita/day	Summer gal/capita/day
American Fork	5100	64.4 gal	228 gal
Orem	17,332	70.7 gal	317 gal
Salt Lake City	70,362	68.7 gal	257 gal

The Little Thompson Water District was organized in 1960 (Table 11). It currently holds 7,870 units of C-BT water, and in the year 2000 processed 5,054 acre feet of treated water to 5,838 taps (0.87 acre-feet per tap) ranging in size from 5/8" to 2". This usage amounts to about 0.87 acre-feet/year for each tap. The majority of accounts have 5/8" taps. These 5/8" taps are believed to use approximately 200 gallons per capita/day for lot sizes ranging up to 10,000 square feet.

Water use in such residential rural areas may be somewhat more difficult to estimate for pressurized secondary water supply systems, particularly those that may be provided through canal companies or irrigation districts. It is possible that there will be two classes of pressurized secondary water supply users in Colorado in the future: 1) the more restricted zoning of smaller residential lots in more densely populated areas (at the urban fringe or within current municipalities), and 2) residential lots in unincorporated areas, and perhaps in small towns, where the zoning of lot size is more liberal. If pressurized secondary systems are designed to serve agricultural production, then larger tap sizes will likely be more appropriate and frequent, such as they are with the North Weld County Water District.

Information on 5/8" residential water taps (i.e., excluding the larger agricultural and estate taps) for the rural domestic suppliers suggests that indoor and outdoor use is similar to that found in municipalities. For instance, Little Thompson Water District shows a usage of approximately 185,000 gallons a year for a typical 5/8" connection, or approximately 0.56 AF/per tap. It is not known what percentage of the annual rural residential water use currently goes to indoor and outdoor use. However, a recent study by the East Larimer County Water District indicates that the total annual water used by single-family customers is clearly a function of their lot size. As the lot size increases, more water is used, up to two acres. Furthermore, as lot size increases, one would expect more of the tap water going to outdoor use, since the family indoor consumption would not vary with lot size. Based on internal studies by this same district, lot sizes up to 4,999 square feet are issued a basic annual water allotment of 114,000 gallons. This allotment would typically be delivered through a 5/8 inch pipe. As residential lot sizes increase, the annual water allotment increases at a rate of about 18,000 gallons for each additional 2,000 square feet of lot size.

Water Charges in Rural Residential Areas

As previously mentioned, existing rural domestic water districts typically charge a raw water dedication fee, a one-time installation or hookup fee, and monthly charges (Tables 13, 14 and 15). These monthly charges for water use may also include water conservation charges in excess of the residential water user's annual water allotment or account, fire protection fees, routine or special service charges, pipeline transmission charges based on mileage, and delinquency charges.

The raw water dedication fee is often paid by the subdivision developer, or in the case of a landowner building his own home, by the landowner himself. In northeastern Colorado, raw water requirements are currently running at about $10,000 to $16,000 per acre-foot ($10,000 for an 8,500 square foot residential lot). The initial hookup fee for rural domestic service varies with tap size and/or lot size, and can range from $16,800 for 5/8" tap to $$44,000 for 1" tap in northern Colorado. Again, these tap sizes typically range from 5/8 inches to a few at 3" and 6." The designation of the appropriate tap size is generally based on the size of the lot and this sizing becomes an indirect delivery limit on the water.

Secondary Water Systems in Utah

A recent report published by the Utah Department of Natural Resources, Division of Water Resources, provides data on metered indoor water use for three communities served at the same time by unmetered pressurized secondary systems.[28] The report also provides data on a highly controlled sample of metered household indoor water use for the City of Bountiful, Utah. In Bountiful, all households sampled had unmetered pressurized secondary water supply for outdoor use. Because of the presence of pressurized secondary supply, although unmetered, the data in these studies would appear to be fairly definitive in regards to indoor use for residential areas in the Rocky Mountain region. However, as with most of these kinds of studies, it should be remembered that lifestyle, climate and family size can affect indoor water use in ways that will always make residential water use somewhat difficult to pin down.

Three other Utah cities having secondary systems are Kaysville, Roy and Hurricane. Two of these communities are located in Davis County north of Salt Lake City. Hurricane is located in southern Utah, a few miles from the Nevada state line. The study shows that indoor water use in the summer is somewhat higher, and this might be expected with comfort factors associated with increased temperatures (Table 16). The supplemental study on the City of Bountiful showed a metered winter and summer indoor water use of 75 gal. per capita/day and 80 gal. per capita/day respectively. These data comparing summer use of treated water (not total water use) in cities having secondary systems and those not having these systems give some indication of the savings in treated water that a municipality might experience with the introduction of pressurized secondary water supply.

The Utah study arrives at important conclusions in regard to residential water use. They are:

1. Indoor water use is approximately 68 gal. per capita/day.
2. Indoor water use is affected slightly by income.
3. Sprinkler systems controlled by automatic controllers appear to result in over-irrigation of residential lawns, relative to known irrigation requirements. This appears to be because people tend not to adjust their timers to reflect changes in evapotranspiration rates over the course of the irrigation season.[29]

<u>Conclusion</u>

Definitive studies of residential indoor water use, controlling for the effects of climate, lifestyle and income, are in short supply. However, from available studies in the Rocky Mountain region at least, indoor water use tends to average 70 to 75 gal. per capita/day across the entire calendar year.

Definitive studies on outdoor water use are also in short supply. The approach taken in the Utah studies, those that extrapolate outdoor water use using the difference between metered winter and summer water use, is probably adequate for the purposes of this report. This method was used in Utah for a large number of communities in varying sub-climates and with varying incomes within the region. All that we would add is that the extrapolated outdoor use determined in this way should probably have subtracted from it an additional 5 percent to 10 percent to account for increased indoor use for summer bathing. A ten percent reduction in estimated outdoor water use, based on the Utah study, suggests 103 gal. per capita/day for outdoor water use.

In terms of what a canal company or irrigation district might consider as a safe estimate of the water supply needed for a secondary system, and using our earlier Colorado figures for household size, we estimate that it would be approximately 0.90 acre-foot/Acre. This is based on a residential lot density of four units per acre. At $200/yer per household, it would potentially provide a revenue stream in the neighborhood of $800 to $1000 per acre-foot of water diverted to pressurized secondary use, based on what canal companies and irrigation districts are charging in the region where these systems have been installed (i.e., Utah and Idaho). Again, usage and revenue figures will vary with the lot size served by the secondary system, as well as the cost of developing and operating the secondary system.

In addition to the financial benefits of secondary water service to canal companies and irrigation districts, there are benefits to municipalities in terms of the reduced amount of treated water used. The Utah studies in particular would show a benefit to municipalities of approximately 1.0 acre-feet/acre of treated water that could be reallocated to additional new residences, without necessarily increasing the treatment capacity of the municipality's current treatment facilities. A treated water usage of only 70 to 75 gal. per capita/day, as opposed to 175 to 225 gal per capita/day (for both indoor and outdoor use) would effectively more than double the current treated water capacity of most municipalities along the northern Colorado Front Range, and elsewhere in the state, without any appreciable additional expenditures by these municipalities for treatment facilities.

Conservation will always be in the picture. Secondary systems are designed to maintain a desirable lifestyle, while effectively reducing the cost of treated water to residential users. At the same time, secondary systems can strengthen the economic position of traditional agricultural water suppliers, while providing opportunities for these irrigation systems and their users to conserve water by moving to higher end technologies for irrigating their crops.

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[1] Again, as stated in an earlier chapter, municipalities are attempting to avoid canal company stock in lieu of this raw water turnover requirement, because state law normally permits only a transfer of consumptive use. Under a standard irrigation district, not even the consumptive use can be transferred off the land. C-BT water does not have these limitations, hence the municipal interest in C-BT water for the raw water turnover requirement.

[2] This is the Henrylyn Irrigation District in southern Weld County.

[3] City of Fort Collins Utilities Annual Operating Reports.

[4] Raymond L. Anderson, *Trends in the Price and Delivery of Water in the Northern Colorado Front Range*. Colorado State University Cooperative Extension, 1977 (pg. 10)

[5] Administrative documents of the Davis and Weber Counties Canal Company.

[6] City of Fort Collins 2000 Annual Operating Report, pg 49.

[7] Supra note 4, page 9.

[8] Personal communication with city water utility staff.

[9] Evans, Robert G., *Hydrologic Budget of the Poudre Valley*. Completion Report. Environmental Research Center, Colorado State University. September, 1971.

[10] Wilkins-Wells, J and Anderson, R.L, Irrigation Enterprise Management Practice Study. Final Report. U.S. Bureau of Reclamation, Science and Technology Program (website at http://watertlab.colostate.edu).

[11] Bureau of Reclamation Annual Summary Statistics. Water, Land, and Related Data. U.S. Department of Interior, Bureau of Reclamation

[12] This may support a theory that the native late season water supplies for a given farm or ditch company service may be adequate under an urbanization scenario even after C-BT water is parted off to meet the potable water purveyor's water turn over requirement.

[13] A previous study reported on water costs for thirty-six canal companies and irrigation districts in the Rocky Mountain region. There were no instances where the cost of irrigation exceeded $30 to $40 per acre-foot. Supra note 10.

[14] *Identifying Residential Water Use: Survey Results and Analysis of Residential Water Use for Thirteen Communities in Utah.* State of Utah Natural Resources, Division of Water Resources.

[15] Special Report (internal rate study) obtained from the East Larimer County Water District (2002).

[16] Derived from City of Ft. Collins Utilities Annual Operating Reports (2001)

[17] Derived from City of Ft. Collins Utilities Annual Operating Reports (1999-2001).

[18] *Supra note* 14, *Identifying Residential Water Use*.

[19]AWWA, *Residential End Uses of Water*. AWWA Research Foundation, Denver, Colorado, Ed. 2000.

[20] These figures are slightly different from those in the report published by the Utah Division of Water Resources in January 2001. The figures reported here were provided by a staff member of the agency, and reported as an update to the published study.

[21] Personnel Communication with Highland Ditch Company, Longmont, Colorado.

[22] Personnel interview with developers in Davis County, Utah.

[23] *Supra note* 14, page 29.

[24] SCADA stands for site control and data acquisition, a generic and non-proprietary term for a class of control

systems that allow for remote monitoring of canal inflows and outflows and, even more importantly, remote actuation of canal checks and gates.

[25] Report on raw water dedication requirements for single-family lots in the East Larimer County Water District service area.

[26] Reports from the East Larimer County Water District, the North Weld County Water District and the Little Thompson Water District.

[27] New development criteria in the City of Fort Collins are forcing lot sizes down to the 9,000 to 6,000 square foot range.

[28] *Identifying Residential Water Use: Survey Results and Analysis of Residential Water Use for Thirteen Communities in Utah*. State of Utah Department of Natural Resources (January 2001).

[29] There is an interesting development in irrigation control. A new class of residential irrigation controller has been introduced by multiple manufacturers that will encourage closer adherence to the local evapotranspiration rate. These controllers will receive real time evapotranspiration rates and rainfall to be used automatically (without homeowner adjustments) in the daily irrigation scheduling.

CHAPTER 6

CASE STUDIES OF SECONDARY WATER SYSTEMS

This chapter reports on two case studies of secondary water systems in the West that are believed to be excellent models for canal companies and irrigation district involvement in this innovative service. The Davis and Weber Counties Canal Company (D&W) of Sunset, Utah, has been drawn upon heavily for information on how secondary systems are initiated, carried out, and the various administrative requirements of these systems. Administrative materials adapted from D&W archives are included in this chapter. The Kennewick Irrigation District (KID), although organized somewhat differently than the D&W secondary system, is viewed as a model appropriate to irrigation districts. Both case studies are informative to the development of these systems, and cover a variety of circumstances.

In addition, photos of portions of the D&W secondary water system are shown in Figures 9 through 16 in Chapter 2. Several other photos of secondary systems in Utah, not discussed in the report, can be found in Figures 40 through 50 (starting from next page). These include the Pine View Water Users Association serving North Ogden, Utah, and the secondary system for the City of Highland, Utah, that serves a population of 10,000.

Surprisingly, secondary water service is an old tradition in the West. Irrigation districts and canal companies in California and Utah were providing lawn and garden water on a limited basis as early as the turn-of-the-century, in addition to their normal service of supplying water to irrigated agriculture. Often secondary service was provided through open ditches, but occasionally it was piped.[1] The two case studies presented in this chapter, along with the information provided in Figures 40 through 50, will show the level of sophistication that these systems have achieved today.

It is believed that secondary water supply management by traditional agricultural water suppliers will provide much needed revenue to improve current irrigation facilities (canals, structures, headgates, etc.). Meanwhile, it will greatly enhance the business operation of these traditional enterprises, allowing them to adjust more effectively to urban encroachment. We have argued in earlier chapters that secondary systems reduce the pressure on municipalities to seek and transfer water out of productive agricultural areas, in their effort to meet potable water demands, much of which is applied to landscapes. Often this occurs in areas where traditional agricultural water suppliers could provide secondary supply for this landscape irrigation. Finally, each year it costs more and more money to treat water, and with the provision of secondary water service, municipalities will be greatly benefited by not having to see this expensive treated water used for outdoor purposes.

Admittedly, in interviewing canal company and irrigation district representatives today, some mixed feelings were voiced about the secondary supply concept. Some growers stated that secondary systems may promote even faster urban encroachment onto irrigated lands. However, urban growth onto irrigated lands may have more to do with county and municipal land use policies and codes than it does with a new innovative water service provided by traditional irrigation enterprises. Let us briefly review the issue of urban encroachment onto irrigation systems before examining our two case studies of secondary supply systems. It has a bearing on the value of these systems to the community.

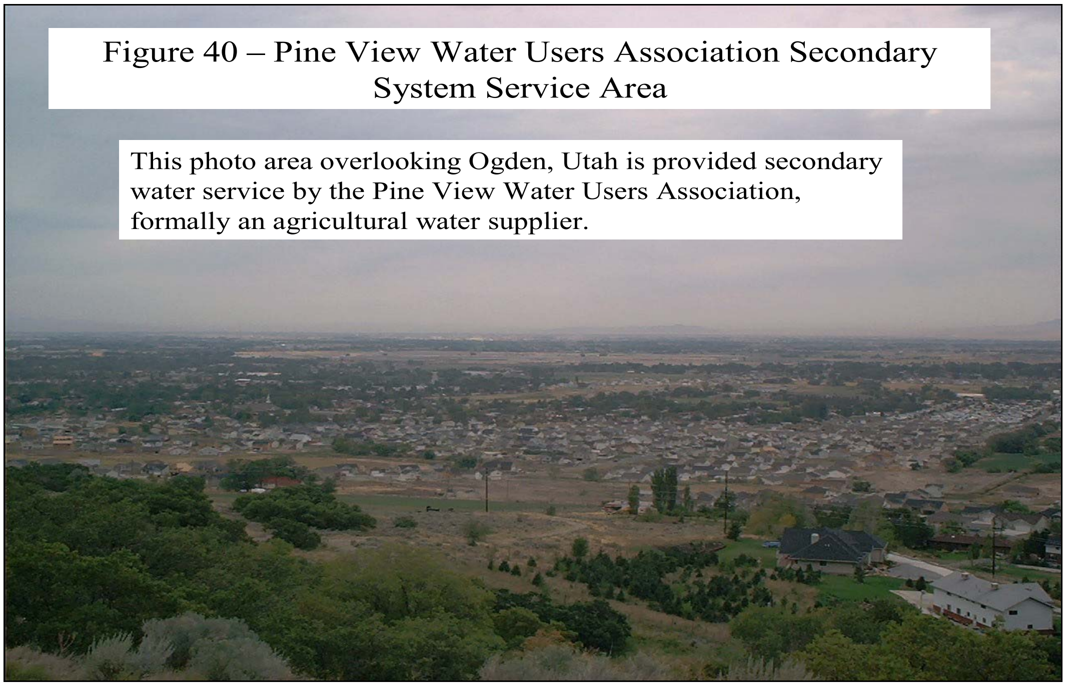

Figure 40 – Pine View Water Users Association Secondary System Service Area

This photo area overlooking Ogden, Utah is provided secondary water service by the Pine View Water Users Association, formally an agricultural water supplier.

Figure 41 – Small Storage Facility that Pressurizes Secondary Water Delivery in the North Ogden Area, under the Pine View Water Users Association

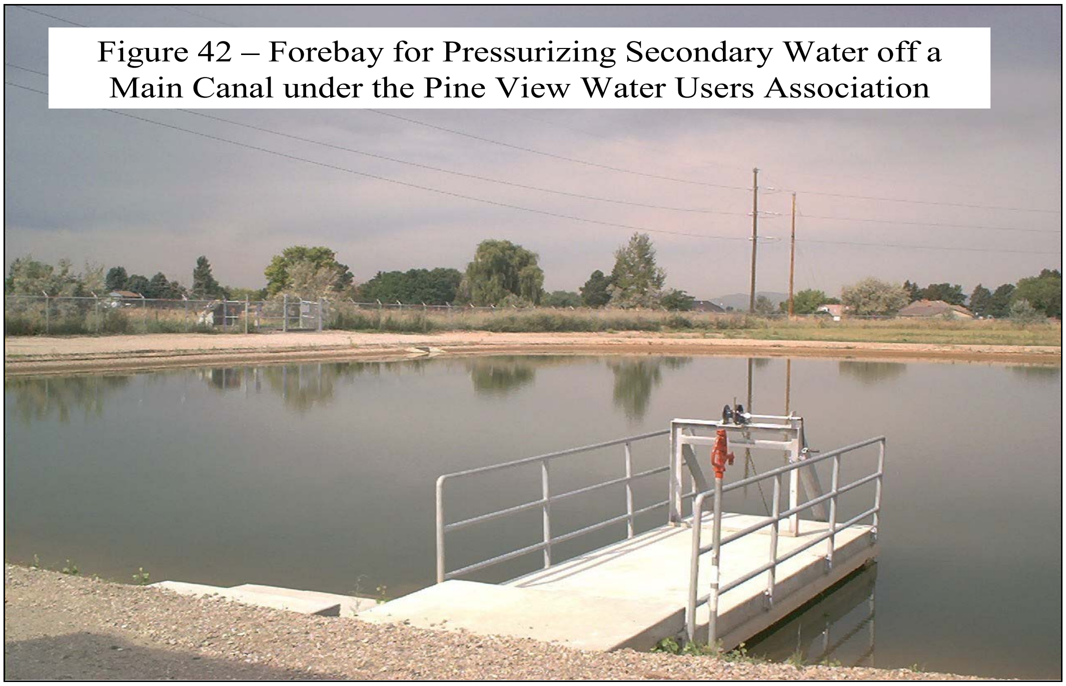

Figure 42 – Forebay for Pressurizing Secondary Water off a Main Canal under the Pine View Water Users Association

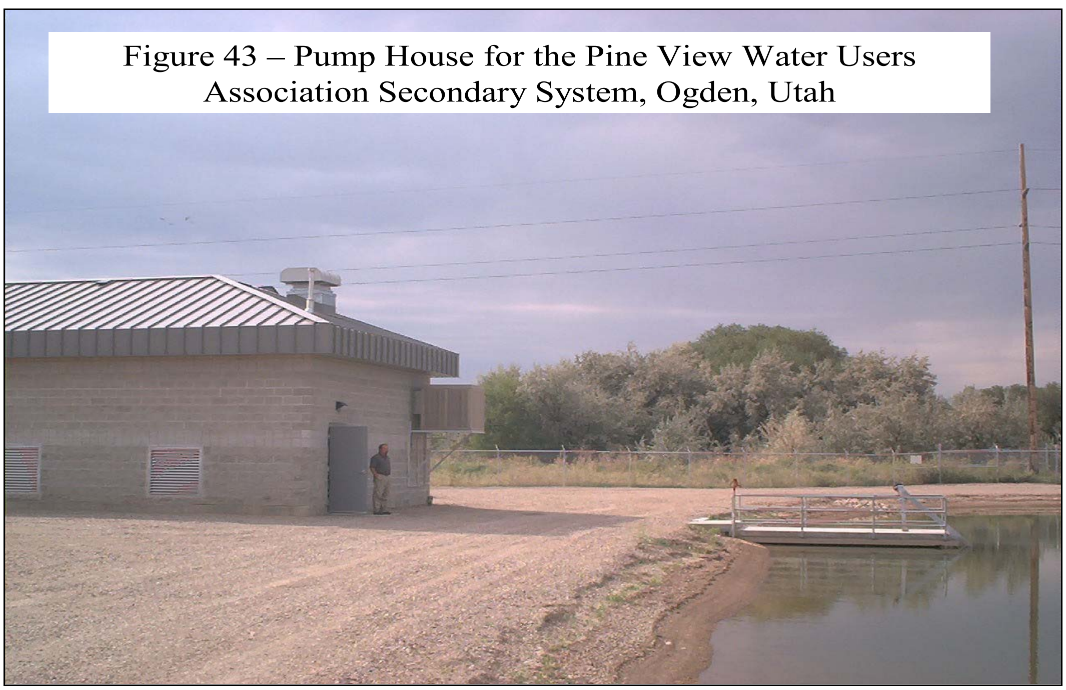

Figure 43 – Pump House for the Pine View Water Users Association Secondary System, Ogden, Utah

Figure 44 – Pump System that Filters and Pressurizes the Pine View Water Users Association Secondary System

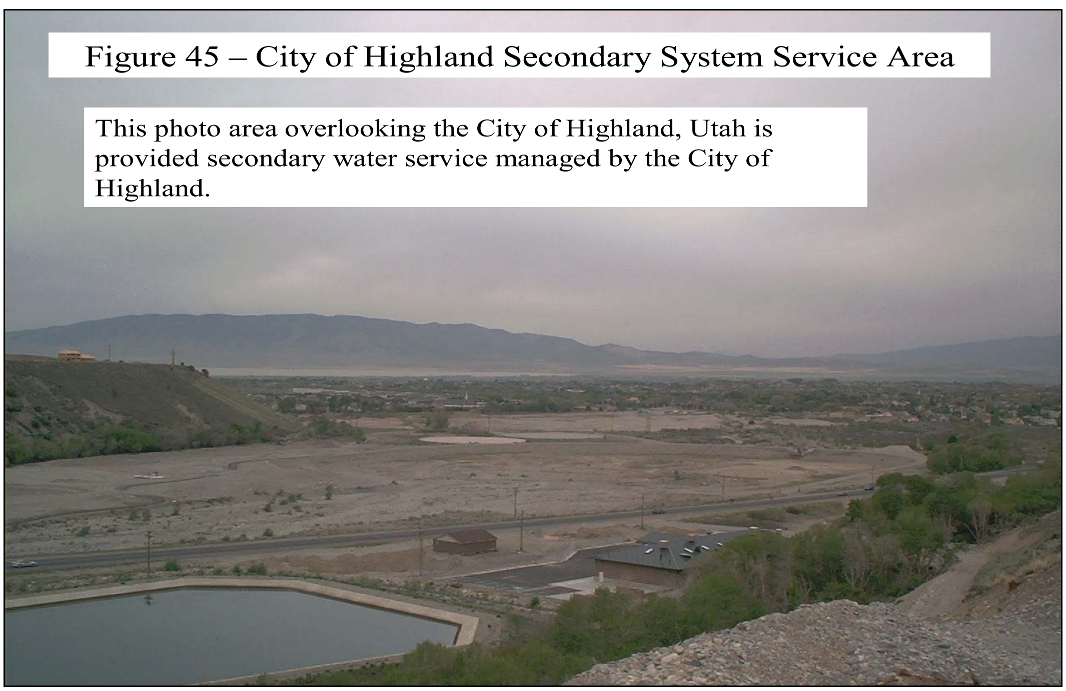

Figure 45 – City of Highland Secondary System Service Area

This photo area overlooking the City of Highland, Utah is provided secondary water service managed by the City of Highland.

Figure 46 – Small Storage Facility that Pressurizes Secondary Water Delivery in the City of Highland, Utah

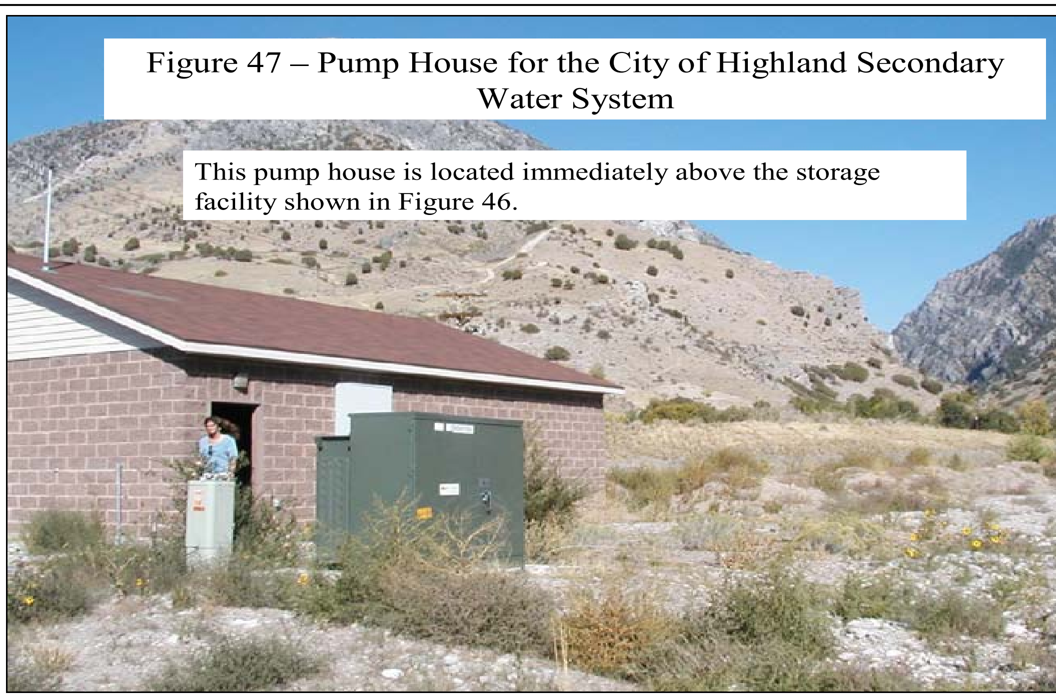

Figure 47 – Pump House for the City of Highland Secondary Water System

This pump house is located immediately above the storage facility shown in Figure 46.

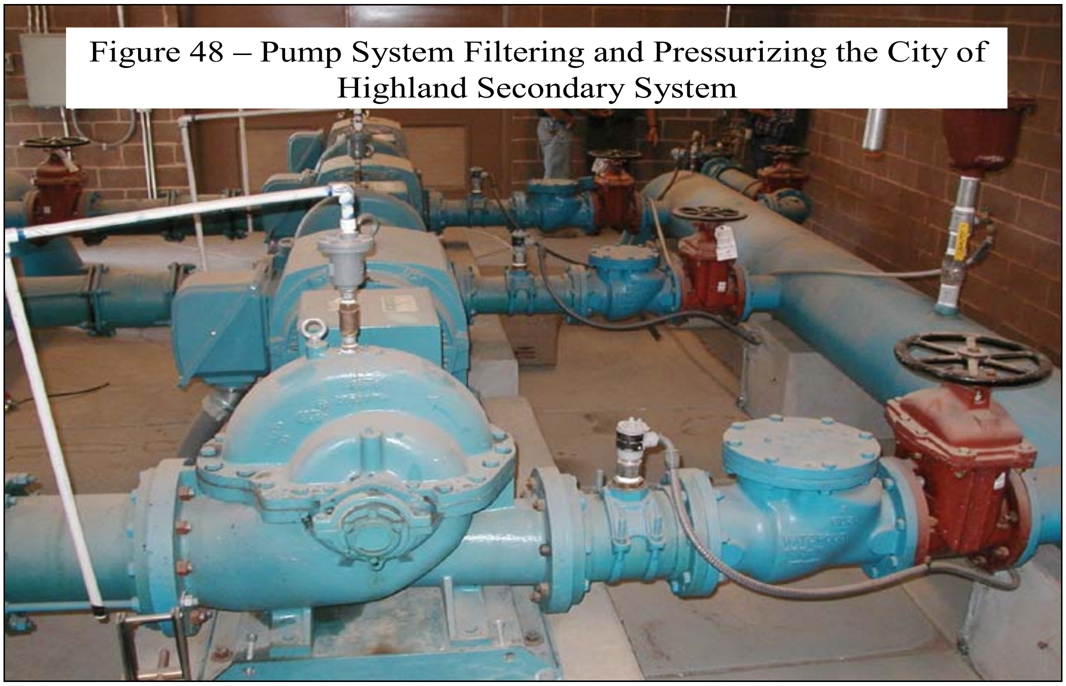

Figure 48 – Pump System Filtering and Pressurizing the City of Highland Secondary System

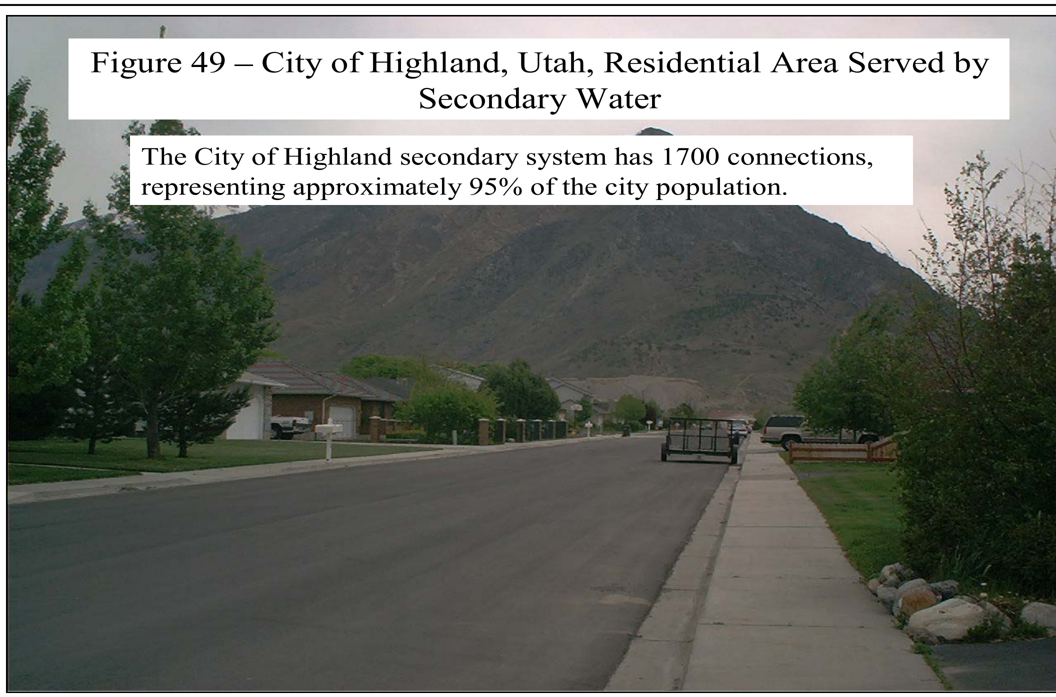

Figure 49 – City of Highland, Utah, Residential Area Served by Secondary Water

The City of Highland secondary system has 1700 connections, representing approximately 95% of the city population.

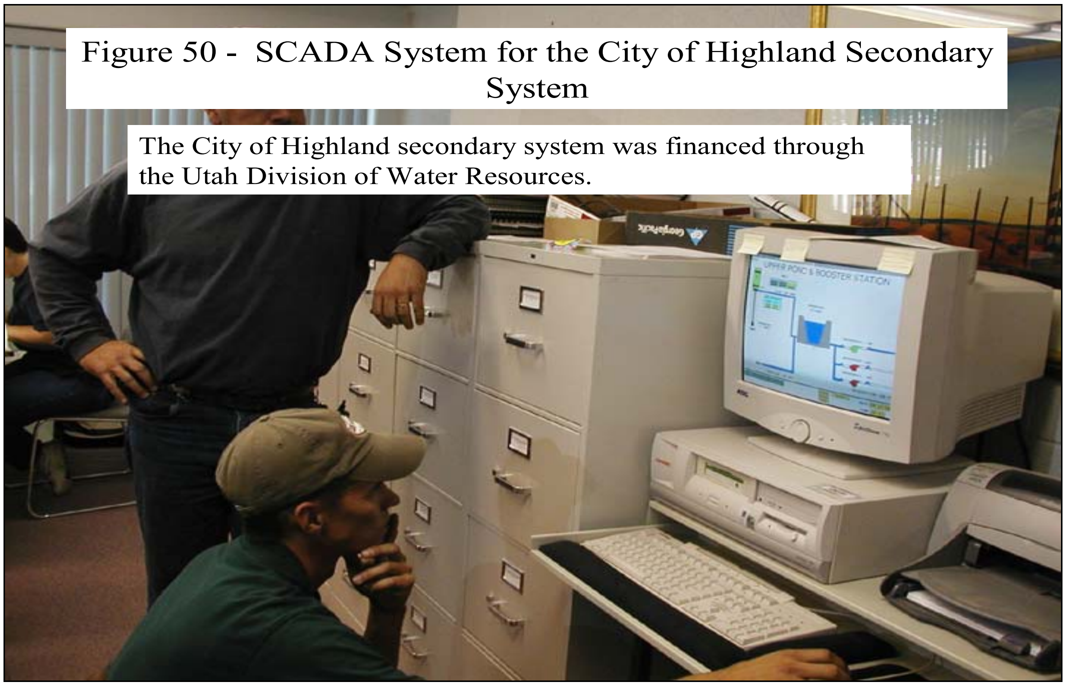

Figure 50 - SCADA System for the City of Highland Secondary System

The City of Highland secondary system was financed through the Utah Division of Water Resources.

Urban Encroachment onto Irrigation Systems

Managing urban growth continues to be a major issue for county and municipal governments throughout the nation.[2] In irrigated areas, urban encroachment is contributing significantly to the cost of operating a canal company or irrigation district today. Although long an issue for the more populous West Coast states, many prime irrigation counties in the Rocky Mountain region are now facing rapid urbanization onto valuable irrigated lands, leading to rising agricultural production costs. One observer has concluded that such practices as tax incentives, right-to-farm legislation, acquisition and/or transfer of development rights, agricultural zoning and various combinations of such policies still lack proven effectiveness in minimizing some of the more negative aspects of urban growth, particularly its impact on agricultural production.[3]

One factor that links urban encroachment to the increased costs of agricultural production is the effect that it has on the operation of irrigation districts and canal companies. These irrigation enterprises can be said to have four kinds of operating costs today. They are: (1) traditional annual costs borne by these enterprises to operate and maintain water delivery systems; (2) bond, loan or federal repayment contracts for infrastructure development and/or major improvements; (3) costs imposed on canal delivery systems as a result of urban encroachment, but which canal companies and irrigation districts can receive or charge some form of reimbursement fees (i.e., pass-through costs), and; (4) costs that are imposed on these enterprises by urban encroachment, but for which reimbursement fees are difficult to design and collect (non-pass-through costs).

Examples of the fourth category of costs include those associated with increased irrigation enterprise liability directly tied to subdivision development, and problems of maintaining, protecting and ensuring routine access to canal rights-of-way. Other costs in this category include removing urban trash from canals, damage to canal systems from urban storm runoff, urban-related vandalism to irrigation enterprise equipment and facilities, vehicle and pedestrian trespass, and pressures to move or pipe open irrigation ditches to accommodate subdivision needs.

These and a host of other costs--by and large absent from irrigation enterprise budgets twenty years ago--are now routinely borne by irrigators, in whole or in part, through the water assessments, or in the case of irrigation districts, district land taxes, that these irrigators annually pay to operate and maintain their irrigation facilities. County and municipal land use codes often provide little protection to irrigation district and canal company lands and rights-of-way. Development plans submitted to county planning offices frequently affect irrigation enterprises very negatively, and without any real means of compensating irrigation enterprises for impacts associated with subdivision development.

It is true that urbanization around irrigated lands can clearly improve the equity of farms in many instances through increased land values, and this is desirable to many growers. Elsewhere, some canal companies have benefited from municipal takeover in return for promises guaranteeing reductions in annual water assessments for irrigators. However, lowered farm income due to the many subtle effects of urbanization on the farm operation may encourage growers to exit production earlier than they might desire under more favorable circumstances. This process may be, in part, ameliorated by traditional irrigation enterprises entering into secondary water supply management. Entering into secondary water service allows these traditional enterprises to exercise more oversight over the urban encroachment process and potentially enjoy the benefits. This will be shown in the following case studies.

Two enterprises are informative in this regard. Both are predominately agricultural in the traditional sense of the word. They are attempting to accommodate urban development in the best way possible. They do so by ensuring that costs associated with urban encroachment are pass-through costs rather than non-pass-through costs. This will become apparent in viewing how these secondary supply systems are organized, financed, and operated. The first is the Davis and Weber Counties Canal Company (D&W) of Sunset, Utah. The second is the Kennewick Irrigation District (KID) of Yakima, Washington.

The Davis and Weber Counties Canal Company

The Davis and Weber Counties Canal Company (D&W) was established in 1894. A predecessor organization goes back to the early 1870s. The company was conceived and constructed with one purpose in mind, to provide reliable irrigation water supplies to farmers. It has been fulfilling this goal for over 100 years. Davis and Weber counties have always been important diary, fruit and grain producing counties in the intermountain region. Approximately 20,000 acres of the original 40,000 acres of prime irrigated land under this canal company is still being farmed today, additionally contributing to a highly valued rural lifestyle on the outskirts of Ogden and Salt Lake City. However, change has occurred in recent years. Since the late 1970s, the area surrounding the canal company has become largely urbanized. The area experienced a three percent or greater annual growth rate throughout most of the 1990s.

In 1985 the canal company’s board of directors and management began to investigate the potential for alternative uses of irrigation water within the service area. This was greatly driven by the need to find additional sources of revenue to improve the agricultural water delivery system. In addition, water assessments had been rising continuously due to the many costs associated with urban encroachment onto the canal system, most of which were caused by the failure of citizens and even local government to respect traditional rights-of-way. More employees were hired to address urban encroachment issues. Farmers were simply not able to afford continued increases in their assessments to pay for these non-pass-through costs.

Clearly, first and foremost in the minds of farmers was to keep existing water rights attached to the canal company service area. Given the subdivision development in the area, providing raw water delivery for lawns and gardens could produce valuable new sources of revenue for the canal company to upgrade its aging irrigation system. In April 1985, a local firm that provided D&W with engineering services for many years was hired to prepare a feasibility study on raw water delivery for lawns and gardens within the canal company's service area. During this study, a series of meetings were held with local cities and developers. These meetings were designed to acquaint them with possible new options in coping with their growing demand for expensive treated water, much of which was being applied for landscape irrigation of lawns and ornamentals.

Meanwhile, due to the precedent of some local traditions of providing secondary water supply through open ditches to older residential areas in local towns, the state water agency responsible for funding water infrastructure projects decided to promote pressurized secondary system development by setting aside monies to fund these systems throughout the state. D&W commissioned a feasibility study for a pressurized secondary water system in its service area that would serve local communities. A secondary system proposal involving several project phases was submitted to the state agency. The agency responded by setting aside $37 million for the project. The D&W secondary system would be developed in phases, each phase requiring a portion of the set-aside monies to be allocated to the canal company for construction. In this way, D&W would gradually be able to bring secondary water service to thousands of homes in the Kaysville-Sunset-Westpoint-Roy-Riverdale area of Utah as development occurred.

A major selling point to the state agency funding the project was the dedication by the D&W stockholders of 5,000 acre-feet of water for the secondary system. This amounted to 0.5 acre-foot of water for each of the 10,000 shares of stock in the company. The historical water yield for D&W stock had been good, averaging about 7 acre-feet/share. Consequently, asking the stockholders to dedicate a small fraction of the water normally allocated to each share of stock was not overly burdensome. In addition, about 1000 shares of stock annually had been allocated for a water rental pool for the company service area, further indicating that there was some flexibility in this company's water supply to provide secondary water service.

Getting Started

The stockholders initially floated the idea of using the water rental pool for the secondary system, rather than having to permanently dedicate a fraction of a share of water to secondary use. However, the state agency rejected the use of the less-permanent rental pool water to underwrite a secondary system. Subsequently, the canal company stockholders decided to permanently dedicate 0.5 acre-foot per share to the secondary system, with the provision that as the secondary system developed over time, the canal company would be committed to replacing this water to the shareholders. This plan was a positive signal to the state agency that the secondary system would have an adequate water supply for the future. Additional water for the secondary system, as it expanded over time, would be assured through a water turnover requirement imposed on the developers of subdivisions, and of a sufficient amount to supply expansion of the secondary system as urban buildout occurred on irrigated land in the canal company service area.

Although it took several years to convince the stockholders of the benefits of expanding the canal company's activities to include secondary supply, it was a very popular idea once the stockholders fully understood the benefits of the concept. Only one percent (1%) of those present voted against the 1988 board resolution authorizing the go-ahead for the project, indicating that it was a very popular idea.

To place lawn and garden watering under non-potable sources would greatly relieve the cities in this part of Utah from the increasing cost of using treated water for the same purpose. Municipal water treatment systems were of necessity designed to accommodate the peak demand for outdoor water use during the summer months, as well as for fire suppression needs. The cost of potable water treatment is even more of a factor today because of new drinking water standards. The idea of a canal company providing raw water to alleviate the need to design potable water systems for the peak summer usage looked like a win-win situation for everyone. However, even here, the cities were somewhat slow to see the big picture. Once they were convinced that D&W was serious about its effort, once the state agency development funds were in place, and once the developers saw the benefit of secondary water for their subdivisions and could communicate their interest to the cities, the concept was on its way. It should be mentioned at this point that there was never any consideration about D&W meeting fire suppression needs through its secondary supply design, and to this day, canal companies in Utah entering into pressurized secondary system management have not ventured into providing fire suppression through their secondary systems.

Agreement was reached in the early stages between D&W and the cities that the secondary system to be developed in the area would provide water only during the canal company's traditional irrigation season. This policy was based on the fact that the water supply would only be needed for the normal growing season, which the traditional agricultural irrigation season adequately covered, and which ran from April to November. If drought conditions were to occur during the winter, which occasionally happens in the area, some watering of more expensive ornamentals could occur by hand via the potable supply system. It was considered that lawn grass had sufficient restorative powers to withstand winter drought conditions, particularly if vigorous root growth was promoted during the normal growing season.

In April 1988, D&W officially applied to the Division of Water Resources for funding. In August of the same year, the agency approved funding for the D&W secondary water project in the amount of $38,000,000, including the first phase of the project that would serve the City of Kaysville, Utah. An agreement was signed between D&W and the City of Kaysville, in effect ensuring D&W of its secondary supplier role to the city. Construction contracts were awarded in September 1989 for a small secondary system feeder reservoir east of Highway 89, along with the secondary supply pipelines to serve Kaysville. In December 1989, the City of Layton, Utah was included in the project and land was purchased for a small reservoir site. In May 1990, the City of Sunset was included, and D&W purchased property for another one-acre reservoir. Additional construction was completed through 1992. As of 2002, three surrounding communities now receive some secondary water supply service from D&W.

<u>Working With Local Municipalities</u>

The agreement entered into by D&W with each of these cities spelled out ordinances, mutual covenants, canal company maintenance procedures, city obligations, fees and assessments, and rate adjustments for future users. Presently, the cities collect and remit fees to the canal company by first billing the secondary supply water user (homeowner) an initial connection fee, and then the annual water fee, the latter of which is paid in monthly installments as part of the homeowner's utility bill. The cities also collect a nominal fee per homeowner account to administer the secondary supply billing. The canal company does not have to bill the secondary supply water users. It receives a periodic check from the cities for the service.

Cooperation from the cities involves more than this, however. In order for the secondary supply system project to be successful, several city initiatives had to support it. These included the requirement that <u>all</u> residents within the city boundary pay the secondary connection fee and annual user fee, and that subdivision developers be required to construct the subdivision's secondary system, but under the design guidelines and supervision of the canal company.

The cities assisted the canal company with ensuring that a portion of all water remaining on the land and used in the area be transferred to the secondary system. As subdivisions were built in the D&W service area, developers were given options for meeting the water turnover requirement of three acre-feet/acre for the secondary system. The developer could pay D&W the equivalent dollar value at the going rate of canal company stock sufficient to meet the water turnover requirement. Alternatively, the developer could bring the water to the canal company at his own expense, or the developer could bring a combination of cash and water stock to the canal company. All of this is routinely accomplished today before permits are issued by the cities or county for development. This policy is enforced through local ordinances. The water stock so accumulated for the secondary system is then earmarked as "treasury stock" of the canal company, dedicated to the secondary system.

In the process of developing this new service and relieving the burden on local municipalities to expand their own potable water supply for lawn and garden use in an arid environment, the canal company has developed a new source of revenue to help finance a much needed and long overdue rehabilitation of its entire irrigation system. This has greatly benefited the agricultural water users as well. The secondary water supply tap fees are used not only to pay back the loan obtained from the state agency, but also to continually upgrade the canal company's agricultural water supply system. Approximately 80% of the revenue from secondary system tap fees covers the state agency repayment contract, while the remaining 20% goes to financing canal company O&M and system-wide improvements, including upgrading open ditches and older irrigation infrastructure.

The original contract with the state agency called for a loan repayment schedule based on a projected population growth rate for the area of three percent per annum. If this growth rate was exceeded in any given year, revenue generated from secondary service in excess of this three percent growth rate could be held in reserve or used to finance canal company improvements as needed. This happened for several years in the 1990s, the local area experiencing growth in excess of three percent.

Given the many costs previously mentioned that are associated with urban encroachment in the area, including the increased cost of liability insurance, the supplemental revenue from the secondary system has greatly strengthening the economic position of the canal company, and has allowed the annual assessment for agricultural water users to remain constant, and relatively low, over the years. This has greatly aided agricultural production in the area. Farm income has not been eroded through increased water assessments associated with urban encroachment.

In summary, secondary water service is a good way to increase income necessary to pay for all of the costs of managing a canal system through an urban corridor today. Again, D&W still provides agricultural water service to nearly 20,000 acres of prime irrigated land. This land is being kept in production despite considerable urban development in the county. Farmers continue to farm, and the irrigated lands are much valued for their production, open space qualities, and the mixed economy that they provide to the counties.

Secondary Service Connections

Several examples of administrative documents pertaining to secondary systems are provided at the end of this chapter. These can be reviewed for pertinent information on the various considerations going into secondary service. Typical secondary service infrastructure consists of a pipeline in the residential street serving a small housing subdivision (Chapter 2, Figures 13, 14 and 15). An extension to each house is then tapped into this street pipeline from the planter strip along the curb. One inch pipelines are then extended from this planter strip water connection to individual households. A ¾ inch riser, painted red and tagged as non-potable water, is the raw water and irrigation system service connection for the household. Valve box access lids in the streets are clearly distinguishable from the valve box access lids of the culinary system (Figure 14).

Education programs in the use of outdoor raw water connections are organized by the cities. One gentleman that grew up in this area of Utah remembers somewhat keenly the admonition as a child to not drink from the secondary supply.

In the D&W service area, initial service connection hookup costs are commonly linked to lot size, the connection size then determining the monthly water charge. This is a flat rate service charge, water use and conservation being governed by the combined factors of pipe size and lot size. For instance, lot sizes of ½ acre or less are normally serviced by a ¾ inch connection, while lots larger than ½ acre are serviced by a 1 inch connection. Lots larger than one acre may require a service connection to be determined on a case-by-case basis. Meanwhile, large acreages associated with farm operations have lower rates, reflecting their water needs and ability to pay. However, most of the secondary systems that have been installed as part of the D&W system have limited the service to lots less than two acres in size.

Initially, there was some concern that the cost of secondary water to homeowners would not be affordable. It would have to be shown that hooking up to a secondary system would, at the very most, not increase a homeowner's water bill, and would ideally reduce it, if not immediately, at least over time. As these systems began to be installed in the area, it became apparent that even if water costs were not reduced initially in some instances, they would be reduced over time. The capital costs of the secondary system were fixed for the repayment period of the loan from the state agency, while the cost of potable water from the municipality could be expected to increase over time due to rising water treatment costs and inflation. Since as much as 60% of the water used on lots was for landscape purposes, a fixed rate for such water would almost invariably result in reduced costs in future years.

Metering of water deliveries was discussed initially, but it was observed that the technology was not available for raw water. More important was the fact that the cost of installing, reading, and maintaining meters, and managing the data on water use would be prohibitive. One might as well go ahead and continue putting treated water on lawns and gardens. Besides, it was felt that there was a limit to the amount of water one could put on residential lots, without actually utilizing metered rates purposefully to change the landscapes people used, rather than simply using metering to conserve water. In any event, the use of meters could not be found justifiable on economic grounds.

Cities cooperating with D&W have passed local ordinances that protect as well as help to govern the overall management of the secondary water supply system. These ordinances protect the canal company from liability. As stated earlier, under these ordinances, the developers are responsible for acquiring the water to develop their subdivision. New secondary service must be pre-approved in writing by the canal company prior to a city issuing a building permit to the developer and approving a subdivision plat. All construction drawings of the secondary supply system must be in accordance with the canal company's standards and approval as well. Finally, once installed and made operational, the pressure irrigation facilities constructed for delivery of raw water to new subdivisions are transferred to the canal company by the developer with a twelve (12) month warranty. In other words, this process is very similar or identical to the requirements and design and construction approach of other subdivision utilities.

In the development of these secondary systems, communities were given informational brochures on guidelines and rules and regulations associated with utilizing the system. These included guidelines for property and sprinkler connections, the process to be followed in applying for secondary service, a service inspection checklist to ensure that the homeowner was in compliance with the rules, fees for service calls, and health safety concerns. Although there was some tradition in the D&W service area with open ditch secondary supply, pressurized secondary service was new to most people, and most assuredly to newcomers to the area. Each new homeowner, or any home being connected to the secondary system, was educated through written materials and visits by the D&W staff about the precautions required of homeowners. In addition, secondary taps were specially marked and painted red to identify their source relative to potable water systems. In any event, today, only indoor connections are potable. All outdoor taps and risers are indicated as non-potable, and simple hose bibs that might encourage human consumption are prohibited on the secondary supply.

In the development of the secondary systems under the D&W regime, it was decided that meters would not be used. Instead, a standard covenant was drawn up for the landowner to sign indicating the acreage, or fraction thereof, to be irrigated by the secondary system tap. This covenant was subsequently used to determine the tap size for the homeowner. The canal company visually verifies the covenant. If additional acreage is to be irrigated at some future date, or if the acreage is split for further development, the property owner is required to pay all applicable fees for additional taps, and to comply with the requirements of the canal company's flat rate structure.

Finally, one of the long-term concerns of secondary system management was water conservation. In recent years, there has been an increased emphasis on metering water deliveries to homes. This has come about as a result of the need to conserve high cost treated water. Although the idea is commendable, and likely to prevail in the future, there are some equity issues that involve the potential cost of residential water to different income groups. In other words, low-income groups may be expected to carry more of the burden in the future, as metering becomes the norm. However, D&W has no evidence to this date that the flat rate structure based on lot size and pipe size has resulted in excessive water consumption for landscape purposes. In addition, the avoidance of potential costs associated with initial provision, reading, and replacing meters has kept water affordable to lower and fixed income groups.

The Kennewick Irrigation District

Irrigation in the area now served by the Kennewick Irrigation District, Yakima, Washington began in the late 1800s. The district was officially organized in 1917. Farmers are still the primary customers in the irrigation district operations plan.

The district has 88 miles of canal, four ditch riders, and a maintenance crew of 6. There are 19,171 water accounts in the district. Some household non-potable water is from wells, and some water is pumped directly from the Columbia River. However, the district draws its main water supply from the Yakima River, as do 7 other neighboring districts. Like a typical irrigation district, Kennewick delivers only raw water. It is not involved in managing a potable domestic water supply system for anyone in its service area.

Water users who have been managing small amounts of raw water for lawns and gardens at an old open ditch irrigation turnout or lateral, approach the district about forming their own Local Improvement District to pressurize their irrigation system. These are referred to locally as "LIDs." A LID is like a small incorporated lateral or homeowners association, but in this case it is organized for the purpose of obtaining a reliable pressurized raw water supply for irrigating lawns and gardens. In reality, it is a subdivision that is organized into a LID.

Upon a subdivision or homeowner's request to consider the organization of a LID, a determination is made by the Kennewick Irrigation District (the "mother" district if you will) as to the feasibility and desirability of such a small improvement district within its service area. A vote is then taken of the people affected by the proposed improvement district. The "voting public" in this case might consist of a small subdivision of 50 households.

If the resolution passes among the water users (e.g., homeowners), Kennewick then assists the small improvement district in finalizing its membership. However, the newly proposed LID must be approved by the Kennewick Irrigation District board of directors for the cost, because the mother district (Kennewick, that is) finances the cost of developing the LID. In one example, Kennewick I.D. lent $100,000 to a new local improvement district to develop its secondary supply system, amortizing the cost for the LID homeowners and charging some interest.

The development costs and annual operation costs of the pressurized secondary supply system for the local improvement district is obviously tied to the number of members in the LID. These operation costs are prorated across all members. Generally, the more people there are in a LID, the cheaper the raw water for each homeowner. Thus, the cost of untreated water service varies from one LID to the next.

The Kennewick Irrigation District system delivers water to the local improvement district by running a waterline down the subdivision street, and then connecting each residence with a ¾ inch valve to supply untreated water to the property. The LID can have this connection installed above or below the ground. Changes or breakage are billed back to the Kennewick Irrigation District, not to the individuals within the LID. Again, these local improvement districts are like small affiliated homeowners associations, or incorporated laterals in irrigated areas. The Kennewick Irrigation District only interacts with the LID as an association, not with single individuals in the association. The LID also pays for its own street cutting and road repairs. If a line breaks in the road, the local improvement district pays for those repairs too.

Conclusion

In summary, canal companies and irrigation districts are entering into several new forms of agreements with cities to make more efficient use of water and to accommodate urban growth in innovative ways. Farmers express a strong desire to remain in business as long as their water supply can be guaranteed, and as long as their irrigation district or canal company can effectively work with city or county planners, developers and new homeowners. Pressurized secondary water supply systems represent a major new form of business venture for traditional irrigation enterprises that can be used to address these challenges. In addition, these systems are capable of generating new revenue to upgrade existing irrigation facilities for agricultural water use and to meet new environmental concerns.

The entry of traditional irrigation districts and canal companies into secondary water supply management has been a revenue generator in most instances. It is financing the upgrading of agricultural irrigation systems in a way that could not be achieved otherwise. In addition, it often allows the agricultural water district or canal company to have more control over its water rights. However, it also raises new concerns and new demands for water service that are not common in irrigation districts and canal companies. It is certain that secondary water delivery to subdivisions and other fractional water users for non-agricultural purposes is not possible for all irrigation enterprises. However, it is clear that the potential is there for additional revenue sources to meet future agricultural water delivery needs for some time to come for those that can accommodate secondary systems.

Most of all, secondary water supply management provides a means of formalizing the responsibilities that county and municipal governments have toward the irrigation facilities, and in a way that allows the irrigation enterprise to be reimbursed for most non-pass-through costs. In fact, the process converts or upgrades non-pass-through costs into pass-through costs, as well as improving the liability protection of these enterprises. The down side to this practice is the continued urbanization of the irrigated area, an almost inevitable process today. However, when managing secondary systems, these irrigation enterprises are role-players and stakeholders in the urbanization process, rather than simply disgruntled bystanders. To the degree that control over the enterprise's destiny is minimally guaranteed, secondary water supply management has its distinct benefits to irrigated agriculture in the face of increasing urbanization.

Postscript

In July 1999, a major break occurred in the main canal of the D&W system, seriously damaging seventy residential homes under the canal. Contrary to the advice of the canal company, and despite the service it provided in meeting the costs of inexpensive municipal supplies for lawn and garden use, thereby saving county and municipal taxpayers the cost of building more extensive water treatment facilities, the canal company was facing a lawsuit for its supposed negligence in managing its canal system.

Like mudslides, earthquakes and other natural disasters, nature can take its toll on aging irrigation infrastructure. The problem is exacerbated by inadequate and often shortsighted county and municipal land use codes that place homeowners in harm's way through unrestricted urban sprawl into flood plains and near man-made waterways. A recently passed county land use code in a neighboring state, and one designed with all of the current state-of-the art practices of conservation easements, development transfer credits, and the like, showed only one sentence in a 258 page document pertaining to the business needs, liability concerns and interests of irrigation districts and canal systems. It is a testament of the times.

Meanwhile farm income continues to decline, and water supplies to the farm represent a major crop production cost leading to this decline in farm income. Not only does farm income subsidize urban sprawl through a growing number of non-pass-through costs not addressed by county and municipal land use codes, but the overall process leads to a feeling of impermanence on the part of growers, and to sell when the price is right, rather than face continued costs and liability concerns.

Secondary water supply management can certainly lead to the strengthening of partnerships between traditional irrigation enterprises, and counties and municipalities, and in a way that allows continued multi-purpose land use and open agricultural space. However, to accomplish this, counties and municipalities must be committed to protecting the economic interests of farmers and the traditional irrigation enterprises that serve them.

COMMUNITY FACT SHEET
(Courtesy of a Canal Company in Utah)

DRY DITCH CANAL COMPANY AND NEW METROPOLIS CITY

PRESSURE IRRIGATION (SECONDARY WATER) SYSTEM

COOPERATION BETWEEN NEW METROPOLIS CITY AND
THE DRY DITCH CANAL COMPANY

Introduction

The Dry Ditch Canal Company has provided water to agriculture since 1881 for an area covering approximately 30,000 acres. Our Canal Company has recently developed a program to construct pressure systems for irrigating lawns and gardens in any part of our service area where the residents of New Metropolis City (or unincorporated areas around New Metropolis City or rural residential subdivisions) are willing to support such a project. The secondary water system serving the outskirts of New Metropolis City is only one phase of our overall system and future plans.

A number of factors must be taken into consideration when approaching the initial cost to develop a secondary water system. In order to qualify for low interest loan funds from the State (or bonding agent), the developer of a secondary system, such as ourselves, must first purchase or otherwise dedicate water to serve the system. In addition, it is necessary to provide the funds to pay the local share of 15% of the capital cost to develop and construct the project. The 15% is an agreement between our Canal Company and the State funding agency. The cost to purchase water and pay the local share for a project the size of our New Metropolis City project will be in the range of 1.5 to 2.0 million dollars.

The shareholders of our Canal Company have set aside a "bank" of water to initiate secondary water projects in our traditional service area. Our Canal Company water right is a high priority right - one of the best in the State. The shareholders will receive no financial return for the use of this bank of water. They have been willing to contribute to this bank of water because it will provide a beneficial use for our Canal Company water right and stabilize our Canal Company as the area converts from agricultural to residential use.

The initial water supply for the pressurized secondary system in New Metropolis City will come from this bank of water. Water for future users as the system grows will come from shares owned or purchased by the Company. This becomes our “treasury stock” for the secondary water system.

The ability of the Canal Company to make the initial water supply available for the project is a significant factor in lowering the initial cost of the project and thereby making the project feasible. Even if enough water is available to purchase today, it would be very costly to purchase enough water and to pay the local cost to start our secondary supply project.

The Proposed Project

The New Metropolis City project includes the construction of a storage reservoir, a transmission pipeline, and the pressurized secondary supply distribution system. Our storage reservoir for our new pressurized system, recently completed, is located quite near to our Canal Company office and our main irrigation canal. The capacity of the reservoir is about 25 acre-feet. It is constructed of native earth material at the site and covered with a 5-inch thick reinforced concrete liner. The concrete liner will help keep the water from seeping from the reservoir, and will also provide a hard surface so that our equipment can get into the reservoir to clean out sediment and other material after the water is turned out at the end of the irrigation season. Remember, our pressurized secondary supply system only provides water to residences during our traditional irrigation season, but of course, this has not been a limitation to our efforts.

A network of open joint pipelines underlies the concrete liner to drain away any water that seeps through the liner of our reservoir and to keep the natural water table below the level of the reservoir. If the water table were allowed to rise above the level of the bottom of the reservoir, it might "float" and damage the concrete liner. The combination of the concrete liner and the underdrain system also provides protection to homes in the area from potential high groundwater in basements coming from the reservoir. The reservoir is set at the same elevation as our main canal so that it is not possible to overflow the banks of the reservoir and cause flooding or damage to surrounding properties. The reservoir is sized to provide storage for the secondary supply system that serves New Metropolis City, and also surrounding areas as other distribution systems are added.

The transmission pipeline delivers water from the storage reservoir to the New Metropolis City area. The pipeline is mortar-lined and coated steel pipe and ranges in size from 30-inches to 24-inches in diameter. The distribution system is made up of plastic (PVC) pipelines in all of the existing streets in New Metropolis City (and surrounding unincorporated areas or rural residential subdivisions). The system also includes service lines from the main line to the property line of each user (residential parcel). Distribution pipelines will be sized so that, together with properly sized lines added in future subdivision construction, the entire service area can be served when fully developed. The pipelines are installed with a constant slope so that they can be drained during the winter months to prevent freezing. It will be necessary for property owners to do the same with the sprinkler systems they install on their own property.

Project Costs

The probable cost of the project is approximately $5,000,000. This includes the construction cost for storage, transmission, distribution system, service to the property line of each user, street repair, etc, for a complete and workable system. Each user will be responsible for whatever he chooses to do for residential parcel sprinkler lines, valves, etc. on his own property.

The Annual User Fee

The annual cost to the user is determined as follows:

First, it is of course necessary to provide enough income to repay the capital cost of construction of our secondary supply system. The money to pay for the cost of construction is in the form of a low interest loan from the State funding agency. The terms of the loan are 5% interest, with a 35-year repayment period.

Secondly, the State requires that, in order to qualify for the low interest loan funds, the users of the system must pay a minimum fee for water service. Using this criterion, the State has determined for our project that the users must pay a minimum of $13.00 per month or $156.00 per year for repayment of the loan.

In addition, the Canal Company must collect enough to pay for operation and maintenance of the system, including a share of the cost of maintaining our traditional agricultural main canal system. It is estimated that the system can be effectively operated and maintained for $44.00 per year, per user. Thus the annual user fee is $156.00 plus $44.00 or $200.00 per year.

The One-Time Connection Fee

The Canal Company is committed to eventually replace the water to the shareholders that was dedicated by them and set aside to start the secondary system. In addition, the Canal Company must purchase water to serve all future users of the secondary system as it expands. A one-time connection fee will be used to finance the purchasing of additional water, which is $200.00 for up to 0.50 acre. This will be increased for those who come onto the system after construction is completed. A copy of the proposed rate structure follows:

Pipe Size	Lot Size	**Connection Fee for Early Subscribers**
¾″	Up to 0.50 Acres	$200.00
1″	Over 0.50 Acre to 1.00 Acre	$300.00
	Over 1.00 Acre	$300.00 plus $75.00 per 0.25 Acre or part thereof over 1 Acre

Initial connection fees are due by April 1, 1993. Initial connection fees can be paid in full or in installment payments beginning June 1992. Connection fees for all new construction shall be paid with the building permit. We are requesting that you consider paying the connection fee as soon as possible. Early subscribers will qualify for a rate cheaper than subsequent subscribers. Payment of the annual service charge will be made in twelve (12) equal monthly installments with the regular City utility bill.

Pipe Size	Lot Size	**Connection Fee for Late Subscribers**
¾″	Up to 0.50 Acre	$500.00
1″	Over 0.50 Acre to 1.00 Acre	$750.00
	Over 1.00 Acre	$750.00 plus $187.50 per 0.25 Acre or part thereof over 1 Acre

What Will the Canal Company Do?

The Canal Company will provide the funding and the water and construct the project.

The Canal Company will own, operate and maintain the system after it is installed.

The Canal Company will purchase water from the property owners when they develop their land and transfer their farm irrigation water to the secondary system.

The Canal Company will operate and maintain the main storage facilities and canal system so that the water supply will be properly safeguarded.

What Will “New Metropolis” Do?

This proposed project cannot be accomplished without a cooperative effort between the Canal Company and New Metropolis City. In order for the project to work it will be necessary for the City to take the following measures:

The City will require, (1) all residents to pay the connection fee and the annual user fee, and (2) all developers to construct the required secondary water works in future subdivisions.

The City will work with the Canal Company to ensure that the water that is now used in the area remains on the land and is transferred to the secondary system.

Pipe Size	Lot Size	Annual Fee
¾”	Up to 0.50 Acre	$200.00
1”	Over 0.50 Acre to 1.00 Acre	$300.00
1”	Over 1.00 Acre	$156.00 plus $36.00 per 0.25 Acre or part thereof over 1 Acre
2”	Over 1.00 Acre	$624.00 plus $36.00 per 0.25 Acre or part thereof over 1 Acre
3”	Over 1.00 Acre	$1,404.00 plus $36.00 per 0.25 Acre or part thereof over 1 Acre
4”	Over 1.00 Acre	$2,469.00 plus $36.00 per 0.25 Acre or part thereof over 1 Acre

The City will collect all fees as a part of their regular utility billing system and transmit the funds to the Canal Company.

How Will I As a Homeowner Get Into the System?

Application to use the irrigation water is to be made at the City Administration Building. It will be necessary to know the total acreage of land and the acreage that is to be watered if that is less than the total. The fee will be calculated and you will be asked to sign the Application-Agreement form.

Once the application has been signed and approved, connection can be made to the service line installed by the Contractor at your property line.

When the construction is completed and the system is ready to go into operation, the City or Canal Company will inspect your connection to the system and turn on the water to your property.

Summary Comments

1. Non-treated water is generally considerably less expensive and more readily available than treated water.

2. Approximately 50-60% of the water used in a community will be used "out-of-doors".   All of

this water can be non-treated or secondary water.

3. If an existing community is provided with a secondary water system, the present potable system will then have the capacity to serve approximately double the population that it could serve before.

4. While the cost to the user is very reasonable, it is probable that, in the early years of the Project, there will be those who have small areas to water who will pay more for their total water bill than they are now paying. However, the cost for the secondary water will be quite stable since the capital cost is fixed for the repayment period of 35 years, while it is very probable that the cost for treated water will increase substantially over the coming years.

Thank You

ACREAGE DESIGNATION FOR WATER TAP
(Courtesy of a Canal Company in Utah)

DESIGNATION OF PROPERTY TO BE SERVED BY OUR CANAL COMPANY (or irrigation district) PRESSURIZED SECONDARY SUPPLY SYSTEM

____________________(Name of homeowner or property owner) of the (city), (hereinafter referred to as "Applicant") and the Dry Ditch Canal Company, (hereinafter referred to as the Canal Company), hereby mutually agree as follows:

1. Applicant is an owner of real property located at (location of property), said property being situated within the service area of the Dry Ditch Company Pressurized Irrigation System. There are ordinances in force in (city) which require pressure Irrigation for all new development.

2. Applicant has designated_______________(number of acres or fraction thereof) of his property to be served by the secondary supply system and requested that the pressure irrigation fees be calculated on that area. The Canal Company has reviewed the request and verified that the area so designated is correct. The remaining Acre(s) of Applicant's property shall not be irrigated by the pressure irrigation system, but will be watered from_______________________(list source of water).

If at any point in the future, the Applicant desires to irrigate the remainder of his/her property by means of the pressure irrigation system, or if the property is divided and developed further as residential property, Applicant shall pay all applicable fees and comply with the requirements of the Canal Company.

3. This Agreement shall run with the land and be binding on the parties hereto, their successors or assigns. Should the services of an attorney be required to enforce the Agreement, the defaulting party agrees to pay a reasonable attorney fee.

In Witness Whereof…………………………………………

CITY ORDINANCE PERTAINING TO SECONDARY SUPPLY SERVICE
(Courtesy of a Canal Company in Utah)

ORDINANCE NO.__________

Whereas, the City Council (**City**) has determined it is in the best interest of the City to use irrigation water instead of treated water to meet the irrigation needs of the citizens; and,

Whereas, the City has entered into an agreement with the Dry Ditch Canal Company (**Enterprise**) to install, maintain and operate a pressure irrigation system within the City; and,

BE IT ORDAINED BY THE CITY COUNCIL OF CITY, STATE:

1. Pressure Irrigation System.

(a) A Pressure Irrigation System shall be defined as a piped water distribution system of non-treated water, for the purposes of irrigation only.

(b) All building lots shall be served by pressure irrigation.

(c) The developer shall install the pressure irrigation system and provide a connection for the building lot concurrent with construction of the other off-site improvements pertaining to that building lot.

(d) For undeveloped land that has water rights as of (date), including land now being served by the Enterprise and /or The Last Chance Canal Company (an affiliate of the Enterprise), the developer shall convey to the Enterprise, and upon payment of fair market value by the Enterprise for such water rights, a minimum of three (3) acre feet of water, per gross acre (the total area of the lot prior to any improvements or development) of newly developed land served by the pressure irrigation system.

(e) All new connections to the pressure irrigation system as well as the pressure irrigation construction plans, must be pre-approved in writing by the Enterprise prior to issuance of a building permit by the City.

(f) All construction and drawings of the pressure irrigation system shall be in accordance with the Enterprise's standards and approval.

(g) The pressure irrigation water facilities constructed for delivery of irrigation water to the new development shall, upon approval by the Enterprise, be transferred to the Enterprise with a twelve (12) month warranty by the developer. Subsection X-X of the City Subdivision Ordinance applies to this warranty.

(h) This Ordinance applies to all development which does not have final plat approval as of the passage of this Ordinance.

This Ordinance shall become effective on the_____day of________1996.

ADDITIONAL ADMINISTRATIVE MATERIALS FOR SECONDARY WATER SUPPLY

(Courtesy of a Canal Company in Utah)

STATEMENT (LETTER) FROM THE CANAL COMPANY OR IRRIGATION DISTRICT TO THE RESIDENT RECEIVING SECONDARY WATER SUPPLY

Dear Resident:

The first phase of the Dry Ditch Irrigating Company (DDIC) Lawn and Garden Irrigation Project, No-Name town (or rural subdivision) Phase I, is under construction. We expect to have service available to Phase I users by (date). Phase 2 should be complete by (date) and Phase 3 by (date).

We have enclosed the following materials to familiarize you with the project:

1. Guidelines for Property Owner Connection

2. Rules and Regulations of the DDIC Pressure Irrigation System

3. Application for Service

4. Inspection Checklist

You will note that very careful consideration has been given to protecting the public health. Although we have had very few problems with pressurized secondary water supply in our community (or subdivision), the potential exists for improper use of the system. Please educate your families and monitor the use of this water by small children.

Fees for this service will be:

ACCESS FEE $__________________

This is a one-time fee and must be paid in full by (date).

SERVICE CHARGE $__________________

This is an on-going fee and will be billed in 12 equal monthly payments on your utility bill.

The above charges are for property located at_____________________________________

(1) GUIDELINES FOR PROPERTY OWNER CONNECTION

The following notes are presented for your information regarding the water service from your new pressure irrigation system.

1. **General**. In most instances a service line will run from a water main (down the middle of the street) to a valve box located behind your curb (in the planter strip), or if there is no curb, near your property line. For service lines that serve two water users, the line will "tee" inside the service box and a separate line will run to your and your neighbor’s property line. The line from the main to the service box will be 1 1/2 inch diameter pipe and the line from the service box to the property line will be either ¾ inch or 1-inch diameter depending on lot size. For single services, a 1-inch diameter pipe will be used from the main to the service box.

2. **Shut-off Valves**. There will be a valve on each service line inside the service box. This valve is for use by DDIC personnel only. It is required that you install a shut-off valve on the service line to your property at the time you connect to the system. This will provide a means for you to shut off the water to your lines.

3. **Filters**. Provisions have been made by DDIC for both screening and settling of solid material from the water before it enters the pipeline system. However, there will be foreign material such as small sticks, pieces of leaves and water weed, etc. that will find its way into the secondary supply system. An additional filter should be installed on the property side of the shut-off valve required in item 2 above.

4. **Use of the System**.

a) The water in the pressure irrigation system is not suitable for drinking. It is required that all faucets or other exposed parts of this system be painted red so as to alert people that it is not clean water. Handles must be removable to prevent access by small children. Pressure irrigation water shall not be piped into any home or accessory building.

b) There are sprinkler heads and other water system equipment designed for use with water containing some debris. Sand and grit, even small amounts, may cause excessive wear in some equipment. Careful selection of the equipment used throughout your system will greatly reduce future problems.

5. **Pressure**. System pressure will vary depending on your location and the usage in the system. Minimum pressure will be about 50 psi.

6. **Connection to Existing Sprinkler Systems**. When connecting the pressure irrigation water to an existing sprinkling system the following steps should be taken:

a) Physically disconnect the existing sprinkling system from the treated water service line. A valve is not adequate separation regardless of the condition of the valve.

b) Call the City Public Works office at xxx-xxx for an inspection. A minimum of 24 hours advance notice must be provided. The City will use the checklist provided in this packet.

(2) RULES AND REGULATIONS OF THE PRESSURE IRRIGATION SYSTEM

PLEASE OBSERVE THE FOLLOWING RULES:

1. WATER IS A BASIC COMMODITY REQUIRED FOR HUMAN SURVIVAL

   a) Use only the amount of water you need to adequately irrigate your land.

   b) Think of others, and realize our water resources are limited. When you use more than the amount of water allotted to your land you are using water that belongs to your neighbors.

2. DO NOT WASTE WATER

   a) Water must not be left running unattended.

   b) Adjust sprinklers so water will not get into streets and gutters.

   c) Use only what water is needed. Too much water can damage lawns and crops.

   d) Repair leaky valves and broken lines.

3. THE FOLLOWING REGULATIONS AND ORDINANCES ARE APPLICABLE:

   a) It is unlawful to use the untreated water from the pressure system for other than irrigation purposes. REMEMBER -- THIS WATER IS UNTREATED AND NOT FOR HUMAN CONSUMPTION.

   b) It is unlawful to interconnect the pressure irrigation lines with the potable water system in any way.

   c) It is unlawful to install irrigation and potable water lines in the same trench.

   d) It is unlawful to connect or extend the irrigation lines into any building or connect same to a fire hydrant.

   e) It is unlawful to expose any service line valve or tap above ground without identifying it by painting and maintaining any such exposed portions bright red to distinguish same from the treated water system.

   f) It is unlawful to contaminate any water supply or distribution lines.

   g) It is unlawful to operate hydrants or sprinkling control valves without a removable key unless valves are of the quick coupling type, or without removing such keys or valves when not in use. Handles must be removable to prevent access by small children.

4. FOR THE WASTEFUL USE OF WATER OR FAILURE TO COMPLY WITH THESE RULES AND REGULATIONS, DDIC AND THE CITY MAY:

   a) Discontinue water service for the remainder of the season.

b) Impose a charge for disconnection of service line and for reconnection as may be established from time to time by DDIC and approved by the City Council.

c) Purchase and install, at the property owner's expense, an individual water meter, and assess the additional annual cost of reading, operating and maintaining the same.

5. RULES AND REGULATIONS MAY BE AMENDED AT ANYTIME TO PROVIDE FOR MORE EQUITABLE DISTRIBUTION OF WATER

a) Emergency and special time of use of water may be required in which event appropriate notice will be given.

6. AN APPROVED APPLICATION FOR SERVICE IS REQUIRED FROM DDIC BEFORE CONNECTING INTO THE PRESSURE IRRIGATION SYSTEM

a) Every effort will be made to correct misunderstandings that exist before water is turned off, or meters installed, or fines imposed.

b) Please contact DDIC if you have any questions regarding the operation of the pressure irrigation system or the above rules and regulations.

c) Phone xxx-xxxx.

(3) APPLICATION FOR SERVICE

DRY DITCH IRRIGATION COMPANY (DDIC) PRESSURE IRRIGATION SYSTEM – PHASE I

Name: Address:
Telephone:

The undersigned hereby applies for an irrigation water connection to the DDIC irrigation system in accordance with the PLAN SHOWN AT THE BOTTOM OR REVERSE SIDE OF THIS SHEET. (PLAN MUST SHOW location of service lines, valves, valve boxes, filters and taps.)

Applicant has read the rules and regulations and hereby agrees, in the event this application is granted, that he will:

a) Comply strictly with the rules and regulations of DDIC and the City as above set forth, or hereafter amended or adopted, and stated in the application agreement.

b) Consent to let representatives of DDIC and the City enter his premises at any reasonable time for the purpose of inspecting his irrigation distribution system.

c) Consent to the discontinuance of his water service in the event he should violate any rule or regulation related to use of the pressure irrigation.

d) Notify the City when installation of his pressure irrigation system or any future alterations thereto, is complete and ready for inspection, and not connect to the system nor cover any trenches until such facilities, alterations or additions are inspected and approved.

Permit granted . 19 Dated this day of .19

BY
Applicant
Inspection made 19 BY

DRAWING (Use Reverse Side if Necessary)

(4) INSPECTION CHECKLIST

DDIC PESSURE IRRIGATION SYSTEM – CITY PROPERTY OWNERS INSPECTION

Name of owner/Date/Address

YES/NO

1. Is the master valve adequate, properly located and installed?

2. Is the irrigation distribution system interconnected to any culinary distribution system?

3. Are any of the irrigation distribution lines installed in the same trench as culinary lines (Min. 5 ft. horiz. separation)?

4. Do any of the irrigation distribution lines connect or extend into buildings or connect to a fire hydrant?

5. Are all the exposed service lines painted bright red?

6. Are all the hydrants and sprinkling control valves controlled with removable keys or quick coupling removable connections?

7. Is the system providing irrigation water to any adjoining property that has no irrigation water allotted?

8. Is the system installed in a manner that will prevent unnecessary waste of water?

9. Are the pipes and valves used in the system adequate for pressure?

10. Is there any other problem with the system not noted above?

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[1] Hutchins, W.A., *Mutual Irrigation Companies*. U.S.D.A., Technical Bulletin No. 82, January, 1929. See also, Hutchins, W.A., *Mutual Irrigation Companies in California and Utah*. U.S.D.A., Farm Credit Administration, Bulletin No. 8, October, 1936.

[2] *Saving American Farmland: What Works*. The American Farmland Trust (1999).

[3] Nelson, A.C., *Economic Critique of U.S. Prime Farmland Preservation Policies*, in Journal of Rural Studies (6:2:1990).

CHAPTER 7

LEGAL CONSIDERATIONS FOR MUTUAL DITCH AND RESERVOIR COMPANIES IN THE DEVELOPMENT OF SECONDARY WATER SUPPLY SYSTEMS

The potential for mutual ditch and reservoir companies to provide pressurized secondary water supplies to residential landscapes, within their existing service areas, opens up important benefits to these traditional water suppliers for agriculture. These include the ability to protect ditch company water rights, maintain water within ditch company control, improve delivery systems, generate needed revenue and perhaps increase available water supplies to shareholders. However, as with any attempt to develop new uses for the enterprise's water decree, there comes a certain amount of legal uncertainty. While it is generally accepted that a ditch company may supply water to provide domestic irrigation supplies to developed land within its system (particularly land that was formerly irrigated with ditch company shares), there are several legal issues that should be considered before any ditch company undertakes the responsibilities of owning and operating a secondary system. This chapter is intended to highlight some of the major legal issues associated with secondary supply systems, particularly pressurized systems of this nature.[1]

<u>Organizational Matters</u>

Ditch companies are generally organized as non-profit corporations pursuant to sections 7-42-101 et. seq. of the Colorado Revised Statutes. Section 7-42-101 provides that a mutual ditch or reservoir company can be formed for "the purpose of constructing a ditch, reservoir, pipeline … to convey water from a natural or artificial stream, channel, or source whatever to … lands or for storing the same …" There are no other statutory limitations on the purposes for which mutual ditch and reservoirs can be formed and therefore ditch companies can own, operate and manage a secondary supply system provided, as with all water rights, that the water diverted is put to beneficial use and in accordance with its water right decree(s).

A stumbling block may arise in the ditch company's organizing documents—its articles and/or bylaws. Section 7-42-101 requires that a ditch company must designate in its articles of incorporation the "use to which the water is intended to be applied." Further clarification/limitation as to the ditch company's purpose may be found in its bylaws. At the time that most ditch companies were organized, the only use typically contemplated was agricultural irrigation. In some instances, ditch company articles or bylaws limit the use of water to "agricultural purposes" or "agricultural irrigation." It is a matter of some debate whether "agricultural irrigation" (irrigation of crops) is a distinct type of use from "domestic irrigation" (the irrigation of lawns, gardens, etc. on developed property). The obvious solution for any ditch company with such a limitation in its organizational documents is to amend its articles or bylaws to allow for domestic irrigation as a use of the company's water. However, this may prove to be a problem if a sufficient number of shareholders or directors (depending upon how the articles and/or bylaws are amended in a particular ditch company) are opposed to the change.

Such opposition is likely to come from shareholders who do not see the need for a secondary system, or are unwilling to shoulder potential risks. A simple solution would be to have the shareholders who are in favor of the secondary system make the necessary commitments to move the project forward.

These may include dedicating a fraction of their stock or something like that. Here a second potential problem arises in the statutory requirement that all shareholders in a mutual ditch company be assessed on a "pro rata" basis—meaning that like classes of stock must be assessed equally. Most ditch companies only have one class of stock. Therefore, a ditch company that wants to assess only some of its shareholder, or assess certain shareholders differently, may need to issue a second class of stock to do so.[2] A way around this limitation may be for a ditch company to organize a separate corporation consisting of only those shareholders who are willing to shoulder the fiscal responsibilities of loan repayment to the state or other funding source, even if the loan is paid through service charges to residential water users served by the pressurized secondary supply system.

Any ditch company that is considering a secondary supply system as a way of generating income should also be aware that the company is limited in how much "profit" it can derive from supplying secondary water to non-shareholders. To maintain nonprofit status, ditch companies must derive at least 85% of their income from shareholders for the purpose of meeting losses and expenses or the company risks losing its nonprofit status.[3] Of course, a ditch company could forego its non-profit tax status if it determines that the benefits of doing so outweigh the lost tax benefits. However, in the examples discussed in earlier chapters, the secondary water users are served by water stock that has, for all intents and purposes, been simply converted into canal company treasury stock. In effect, the revenue earned from providing secondary water service is used to pay the annual assessments on this company treasury stock.[4]

Potential Limitations on the Use of Water in Secondary Supply Systems

A ditch company must also review the terms of its water right decrees when considering using the water in a secondary system. Ditch decrees typically have several explicit and implicit limitations as to how the water can be used. If the contemplated secondary supply uses conflict with any of these decree limitations, the ditch company will need to amend its decree(s) in water court to allow the use of its water in a secondary supply system.

A typical water decree will limit the water right in various ways including the types of uses to which the water can be put (e.g. irrigation), the amount of water that can be used, the place where the water can be used, and the time of year during which the water can be used. The time of year can be stated explicitly in the decree, or implied from the type of use. Irrigation use generally implies that the water can be used during the irrigation season. In addition, the priority, vis-à-vis other water rights in the same stream system, will dictate how reliable the water right is.

1. Type of Use

Water decrees always specify the purpose to which the water right is to be used. The water right owner is limited to using the water for the purpose stated in the decree. Ditch companies are typically quite old and were originally organized solely for the purpose of supplying water to irrigate farmland, and typically their water right decrees were obtained for "irrigation" only. As mentioned above, it is generally accepted that the decreed use of "irrigation" allows for the "domestic irrigation" of lawns, gardens, trees and shrubs on developed property, but there appears to be as yet no court case that specifically addresses the issue and there are those in the water bar who would argue the point. The current policy of the State Engineer is that "irrigation" includes both agricultural and domestic irrigation, and until a court rules otherwise, this may generally be regarded as sound policy.

In rare cases, ditch companies may have decrees that specifically state that the water is to be used for "agricultural irrigation" or "agricultural use," rather than simply for "irrigation." In such situation, the ditch companies are on less secure legal ground because, in the view of many, water decreed for agricultural use does not include domestic irrigation. If a ditch company finds itself in a situation where its water is specifically decreed for agricultural uses, it may want to consider changing the purpose of use in the decree to allow for domestic irrigation, which will involve a water court change proceeding.

2. Place of Use

Ditch decrees, particularly the older decrees, are typically rather vague as to the lands upon which the water right can be used. For instance, many older decrees indicate that the place of use is "lands under the ditch." While vague, such a provision does serve to limit the lands upon which a water right can legally be used, although one may have to "look behind" the decree to determine exactly what areas were intended to be irrigated by the applicant when he/she applied to obtain the decree. Prior to the adoption of the 1969 Act (section 37-92-101, C.R.S. et. seq.) it was required that an applicant file a map and statement which, if located in the court files, could go a long way in determining what area was intended as the place of use for the decree. The lands that have been historically irrigated may provide some evidence, but not conclusive evidence, as to what lands were intended to be irrigated by the decree when it was filed.

The point here is that a secondary system cannot legally be used as a vehicle to supply water to lands outside the decreed place of use. While this is a concern, the issue will not arise in the typical situation where the developed property that is intended to be served by the secondary system was historically irrigated by water from the ditch company, but the limitation should not be overlooked when planning a secondary system.

3. Season of Use

Another issue to consider is the season of use associated with the typical irrigation decree. Although usually not explicitly stated in the decree, the growing season of the crops is the season of use implied in all irrigation decrees. If the water demands for the landscaping on the developed property extend beyond the historical agricultural growing season, the ditch company may have to look elsewhere to provide water to its secondary system during the "shoulder" seasons.

4. Storage of Direct Flow Water

In order to pressurize a secondary system, the ditch company will likely need to impound water in some fashion to provide a head to the system. Often a ditch company will already have existing storage capacity (and the decree(s) therefore) to allow water to be impounded. However, it is often the case that mutual ditch companies only have "direct flow" irrigation rights that do not allow for the storage of water. The State Engineer has a policy that direct flow water rights cannot be "impounded" for more than 72 hours without a storage decree.[5] Therefore, if it is envisioned that water will need to be impounded for a longer time to serve the secondary system, the ditch company will need to consider changing its direct flow decree to allow for storage or otherwise seek storage capability for this purpose.

5. Priority of the Ditch Company Water Rights

All water rights have a priority that is based upon the date of appropriation and date of adjudication. The priority of a water right determines its reliability, although as observed through the recent drought, even the most senior water rights may not yield well in extremely dry years. In determining whether to embark on the creation and management of a secondary supply system, the ditch company should consider the reliability of its water rights, bearing in mind that domestic water users may be less understanding of water use limitations and shortages. Further, a secondary supply system may mean less operational flexibility for the ditch company (e.g. inability to bunch deliveries, and the need to continuously supply the pressurizing storage facility, etc.).

6. Expanded Use

Any time that the use of a water right is converted from one use to another or from one place to another, whether or not such conversion requires a change application in water court, the possibility of "expanded use" of the water must be considered. Expanded use may occur when the amount of water diverted and consumed when put to a new use or put to use on new lands is greater than the amount actually diverted and consumed in the original use.

In the typical secondary supply situation, where the development to be served is located on farm ground historically irrigated with ditch company shares, generally it can be expected that the amount of water historically diverted and consumed in irrigation on the farm will adequately supply the domestic irrigation needs of the developed property. This has been discussed in an earlier chapter. This will not be the case, however, if the domestic "crops" (lawns, shrubs, etc.) consume more water than the historically irrigated agricultural crop. In such a situation, the river may receive less return flow than historically, but in the view of most, the change does not result in a legal recognizable injury, provided more water is not physically diverted to the farm. The rationale is that farmers have long been free to change the crops they grown on their farms without regard to the consumptive water needs of the different crops. While this issue is likely to receive more attention as secondary systems become more prevalent, the same rationale should hold for a change from agricultural crops to domestic "crops."

Another potential legal issue arises when the now developed farm was historically "water short," meaning that a farmer did not have enough ditch water to adequately irrigate the crops on the farm and, in order to do so, had to look elsewhere (typically well water) for a supplemental supply to finish the crop. With the efficiency improvements associated with secondary systems, however, the ditch shares alone may be adequate to irrigate the now developed property (see Chapter 10).[6] The legal question in this situation is whether the improved efficiency of the secondary system results in a legal expansion of use of the ditch shares on the historically watered short farm. It is believed that the answer to this question will generally be "No," even if irrigation of the property through the secondary system will result in a greater overall consumptive use of the water represented by the ditch shares, provided the amount of water diverted into the secondary system is no greater than the amount historically diverted.[7] The basis for this conclusion is that, generally speaking, on-farm efficiency improvements (for instance a change from flood to sprinkler irrigation methods) are permitted even though such improvements may, on a water short farm in particular, result in increased consumptive use and reduced return flows. One would expect that efficiency improvements associated with secondary supply systems would be treated no differently from ordinary farm efficiency improvements.

The issue of expanded use may also arise when the secondary supply system is designed to provide water to lands that have not historically been irrigated by ditch company shares. In this situation, the first issue will be whether the new lands are within the decreed place of use in the ditch company decrees (see the discussion concerning "Place of Use" above). If so, the new lands can be irrigated provided that the water right is not legally expanded. If the ditch company can show a "dry up" of an equivalent amount of irrigated land in the ditch company's system, (i.e. an acre is dried up for each new acre irrigated), then there is likely no expanded use, for much the same reason as stated in the paragraph above.

The issue is a bit more complicated if the secondary system, while diverting the same amount of water (ditch shares), irrigates more acres (again, likely because of efficiency improvements) than were historically irrigated. While some would argue that expansion has occurred in this situation, for the same reasons that system improvements can be used to better irrigate a water short parcel, it is believed that the water saved through improved irrigation efficiency can be used to irrigate additional acreage—even if the result is increased overall water consumption and potentially reduced return flow made back to the river. There are those who would debate this point, but as a practical matter, because no water court change proceeding would likely be necessary, the irrigation of the additional acreage would probably go unnoticed, although it would be possible for a water user who considered himself injured to bring a court action in an effort to enjoin the irrigation of the additional acres.[8]

7. Use of "Salvaged Water"

Looking at this issues on a ditch company-wide scale, a secondary supply system may be only part of an overall improvement to a ditch company's conveyance infrastructure (for instance, a ditch company may want to pipe and pressurize its entire ditch system to improve agricultural water deliveries, in addition to the secondary supply possibilities). To make such an investment economical, it may be important that the ditch company's shareholders be able to make use of the water conserved through the system improvements. Here again one runs into the issue of expanded use.

Earthen irrigation ditches seep and this seep typically becomes return flow by which other water users' water rights are supplied. By replacing an earthen ditch with a piped conveyance system, the seepage can be reduced or eliminated altogether. What, if anything, can the ditch company do with the "salvaged" water?

While it is legal for ditch companies to improve conveyance by lining and piping ditches, it is generally accepted that a ditch company cannot sell salvaged water to a third party for use elsewhere. However, if the ditch company can put the water to beneficial use on the lands already under irrigation in the system, the salvaged water can be used to supplement existing water supplies.

Can salvaged water be used in a way that results in a greater number of acres being irrigated under the system? In my view, again, the answer is yes.[9] However, in this instance the ditch company may have to be prepared to defend against a claim that it has abandoned the right to irrigate any new ground it intends to irrigate under the ditch. As mentioned previously, ditch companies quite often have very old water rights that allow for the irrigation of "all lands under the ditch." If indeed the new land to be irrigated was intended to be irrigated when the ditch company's original decree was obtained (see "Place of Use" discussion above), a question might arise as to why it has taken the ditch company so long to bring this land into production. An aggrieved water user could argue that the ditch company's delay or failure to do so is evidence of its intent to abandon the right to irrigate the property. Abandonment is difficult to prove, but a ditch company faced with an abandonment argument may need to be prepared to prove that it never intended to abandon the right to irrigate the additional ground.

Ditch Company Liability

Because it is still the case in nearly all residential areas in Colorado that both indoor and outdoor water supplies are potable, the provider of a secondary system (which, of course, provides nonpotable water) may be subject to liability if people or animals become sick from drinking the water. As the provider of a potentially hazardous "product," the ditch company should be aware that it may have certain legal obligations to notify and warn its "customers" in residential areas of the potential hazards of the water it supplies. The ditch company should seek legal guidance concerning the necessary legal requirements for properly warning customers, and should take other precautions (e.g. insurance) to minimize its legal exposure from death or injury resulting from the ingestion of the nonpotable water.

Conclusion

Secondary supply systems present intriguing possibilities for ditch companies faced with urbanization in their systems. As is often the case, innovation outruns the law and definitive legal conclusions cannot be provided to many of the legal issues raised by construction and use of secondary systems. Still, as should be evident, there is reason to be optimistic that the legal challenges associated with secondary supply systems can be overcome and should not preclude the development of secondary systems by mutual ditch companies in Colorado.

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[1] The particular issues faced by each ditch company for any given secondary supply system will be unique, and many legal issues related to secondary supply systems are as yet unresolved. Individuals and ditch companies are therefore encouraged to seek the advice of counsel before considering the development of a secondary supply system.

[2] While a ditch company can issue more than one class of stock, issuing a new class of stock may involve recalling all outstanding stock in the company, then reorganizing and re-issuing two classes of stock to existing shareholders. See Robinson v. Booth-Orchard Grove Ditch Co., 94 Colo. 515, 31 P.2d 487 (Colo. 1934). This could result in serious capital gains and other tax consequences to a ditch company, and should only be pursued after careful consideration.

[3] See Section 501(c)(12) of the United States Tax Code.

[4] Treasury stock is a long-standing concept. A noted authority on the history of canal companies states that "Treasury stock is stock which has been issued and disposed of for a valuable consideration and later found its way back into the company treasury, or which has been issued but is being held by the company pending its sale. It is ordinarily nonassessable and therefore nonproductive. Organizations to which shares have reverted through nonpayment of assessments have sometimes resold these shares at very low figures in order to get them into private ownership again, subject to assessment; while others have canceled such forfeited stock in order to improve the proportional water supply of stockholders in good standing. Individual circumstances necessary govern such action." Hutchins, W., *Mutual Irrigation Companies in California and Utah*. U.S.D.A., Farm Credit Administration, Bulletin No. 8, Oct. 1936. Currently, canal companies in Utah are simply putting shares of stock acquired as part of the water turnover requirement for subdivision development into the company portfolio as treasury stock. This practice has not resulted in any adverse consequences for the nonprofit status of the canal company.

[5] However, it appears that no court case in Colorado has yet dealt with this issue.

[6] It is important to note that efficiency improvements may not be the only reason why the ditch shares alone are adequate to irrigate a historically water short farm. For instance the consumptive use of the new crops (lawns, gardens, etc.) could be less than the consumptive use of the historically irrigated crops. Also, the amount of acreage irrigated may be reduced because by the construction of houses, sidewalks and streets. For purposes of this discussion, it is assumed that it is the efficiency improvements that allow the adequate irrigation of the developed farm ground.

[7] Note, however, that the ability to alter the way in which a water right has historically been used may be limited by specific water court rules and compact provisions that vary from place to place in the State. For instance, the Arkansas River Compact, Article IV, Section D states that "[t]his compact is not intended to impede or prevent future beneficial development of the Arkansas river basin … which may involve construction of dams, reservoirs …, as well as the improved or prolonged functioning of existing works: Provided, that the waters of the Arkansas River, … , shall not be materially depleted in usable quantity or availability for use to the water users in Colorado and Kansas …" (emphasis added). This provision of the Arkansas Compact casts serious doubt on the ability of an irrigator or ditch company to make efficiency improvements that will have the effect of changing the regimen of the river.

[8] But see footnote 5 above.

[9] That said, there is very little law on the use of salvaged water and the issue could prove to be rather controversial. The opposing view would be that most, if not all salvaged water "belongs to the stream," meaning other water users are entitled to this water because it has historically made up a component of their water rights. See also footnote 5 above.

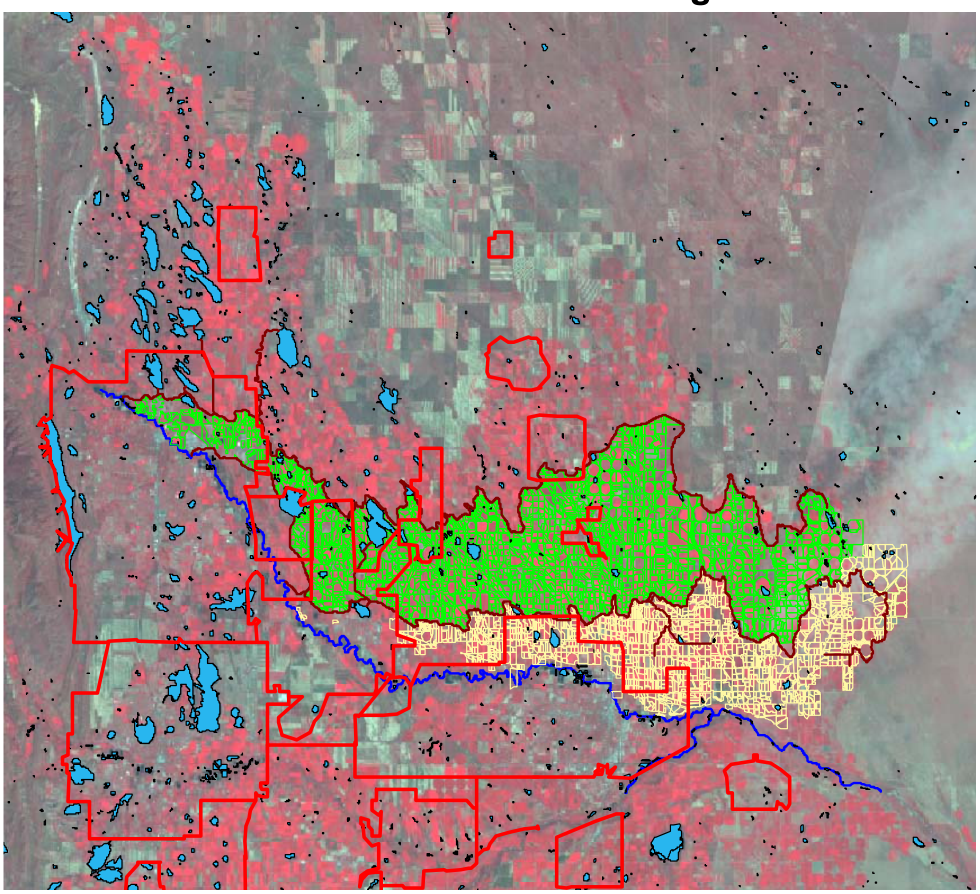
CHAPTER 8

FINANCIAL FEASIBILITY MODELING FOR PRESSURIZED SECONDARY SYSTEMS

Suburban development can occur rapidly. Colorado is searching for innovative water management ideas relating to growth. Secondary supply may be an important positive aspect of future water policy. Canal companies need a method to quickly determine if they should enter into negotiations with developers and local jurisdictions regarding secondary water supply. Engineering feasibility studies are necessary, but if a canal company waits for the results of an engineering feasibility study, which can take months or years, opportunities for partnering with developers and local water providers may pass. Hence, the importance of the model presented here.

The satellite photo (below) shows the configuration of two major canal companies (in green and brown) along the northern Colorado Front Range, relative to projected urban growth boundary areas (in red outlines) of surrounding municipalities in the immediate region.

Northern Colorado Front Range



Both of these enterprises are clearly configured to provide pressurized secondary water service in the future if they desire to do so. The photo below shows a new subdivision being built alongside the main canal of one of these companies. When this degree of development is occurring in a canal company service area, it is probably time to begin asking questions about the benefits of secondary water service.

This chapter shows a general procedure that an irrigation company or irrigation district can use to assess its potential as a provider of pressurized secondary water to residential and commercial property. A spreadsheet model is used to discuss several residential development scenarios in an agricultural water supplier service area. Through the procedures, information can be obtained on water needs and the financial feasibility of the enterprise. The model is a guide that most canal company or irrigation district staffs can conduct "in house."

The model is not intended to replace a formal engineering feasibility study. Rather, it is intended to function as an initial evaluative tool to determine whether a canal company should consider a full engineering feasibility study. A CD Rom containing the model's spreadsheet and directions for its use are found in the Appendix. We appreciate the assistance of the New Cache La Poudre Irrigating Company for allowing us to use their service area to evaluate various secondary system development scenarios with the model.

Methodology

The development of the financial feasibility model involved analyzing the following elements.

1. Water supply.
2. Water demand.
3. Estimating costs of secondary systems.
4. Estimated revenue from secondary water service.

1. Water Supply

Our case study example, the New Cache La Poudre Irrigating Company, is located in northeast Colorado, in Weld County, north of the City of Greeley (Map I, II, page 121-122). The majority of the area is agricultural. New Cache has been in operation since 1894. New Cache has decrees for 650 cfs (approximately 1300 AF/day) of direct flow rights. Direct flow rights are only available while the Cache La Poudre River maintains sufficient flow to meet the company's water rights under the prior appropriation system.

New Cache supplies water to irrigators from two main water sources. These include direct river flow rights from the Cache La Poudre River, and Colorado-Big Thompson project water units. New Cache normally receives approximately 37,500 AF of water for its shareholders. River water rights must be used from the river and cannot be stored for more than 72 hours. Those rights are dictated by the flow of the river. C-BT units and modest winter flows in the river for which the canal company has decreed storage rights can be stored in existing company reservoirs. New Cache normally operates its irrigation system using direct flow rights in May and June. During the remainder of the irrigation season, reservoirs are used to provide water to irrigators.

Many of the farmers within the service area own shares of both river water and storage water. New Cache has indicated that it would probably require that individual parcels of land taken out of agriculture and developed into residential lots have storage water rights associated with them. If the parcel could only be served by direct flow, a trade and/or purchase of storage rights would be required of the parcel owner/developer.

This would relieve New Cache of potentially overburdening its ability to supply water to residential subdivisions late in the irrigation season. The irrigation company is also in the initial stages of developing additional off-canal storage. Alternatively, it is possible that if owners of parcels did not have water rights, they could purchase shares from New Cache, as it is anticipated that surplus water will be available when land moves out of agriculture and into residential uses. As indicated in several discussions earlier in the report, this scenario would probably hold true for most canal companies considering secondary water service.

This financial feasibility modeling, and the engineering appraisal discussed in Chapter 9, may be financed through state agencies. The Colorado Water Conservation Board awards up to a $5000 grant to canal companies and irrigation districts, if they match funds for such feasibility studies. Currently, and as part of this study, two canal companies in Colorado are pursuing this approach.

2. Secondary Water Demand

Determining the potential demand for secondary supply involves the following steps:

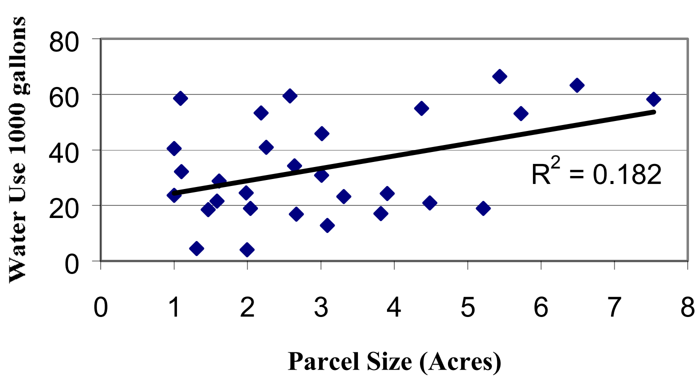
A. Determining residential landscape water use.
B. Developing land use and land development scenarios for a particular locality.
C. Determining the water use of the proposed residential and commercial-industrial development.

Step A: Determining Residential Landscape Water Use

There are many ways to determine landscape water use. One method is to apply an approximate percentage of total domestic potable water use in areas where potable water is being used for landscapes. For example, the Environmental Protection Agency states that 40 to 60 percent of U.S. residential water use occurs outside of the home, although this figure averages many regional differences in residential water use. A local study conducted by Aqua Engineering of Fort Collins, Colorado on outdoor water use in the City of Evans, Colorado, showed an average of 60% of annual water use was for outdoor purposes. Additional information on estimating outdoor water use is provided in Chapters 5 and 10.

To determine a residential water demand figure relevant to the conditions of a particular canal company service area, canal company staff can collect data from a potable water provider located nearby the service area of the canal company. This study used information kindly provided by the North Weld County Water District. This district provides potable water for both indoor and outdoor use. Map II (page 122) shows that the service area of the canal company actually overlaps the pipeline system (in green) of the North Weld County Water District. This suggested that water use on lots served by the North Weld County Water District would be reflective of future use under a secondary system, if the outdoor portion of their water use could be roughly estimated.

Figure 52 - Outdoor Water Use in the Front Range by Parcel Size



Lots were analyzed in groups of 1 acre, 1.5 acres, 2 acres, 2.5 acres, 3 acres, 4 acres, 5 acres, and 6 acres. Based on information provided, correlation between lot size and water use showed a low value of R^2 = 0.182 when fitted with a linear trend line (Figure 52). After careful consideration, it was decided to use an outdoor water figure of .57 AF per household per year. This estimate was derived from taking a number of factors into account, and is consistent with some of the outdoor water usage rates discussion in Chapter 5.

Step B: Developing Land Use Scenarios

This step in the modeling utilized the software ArcView 3.2 to determine future areas of potential residential development within the canal company service area. ArcView 3.2 is a Geographical Information System (GIS) software that provides data visualization, query, analysis, and integration capabilities along with the ability to create and edit geographic data. It can be purchased for about $1000, and is an excellent tool for monitoring changes in land use in a canal company or irrigation district service area.

The canal company and the rural domestic (potable) water district were contacted for information regarding locations of upcoming residential developments in their respective service areas. County land use data were also examined for parcels of land owned by development companies, possibly indicating future residential development. Three study areas inside the current service area of the canal company were identified with the assistance of the company's staff (Map I, black circles). Study areas were selected based on their probability of developing into residential lots.

Step C: Determining Water Use per Development

Estimated parcel [lot] water use was applied to the projected residential developments to determine the amount of water needed for secondary supply for those developments. Some additional working assumptions for the model were that the canal company would generally only provide pressurized secondary water to residential development in its service area, and on irrigated agricultural land taken out of production. Each canal company assessing its potential for secondary supply will approach Step C a little differently.

According to the New Cache staff, and the manager of the North Weld County Water District, the following water requirements were associated with agricultural use and residential use. In general, to irrigate farmland requires 3 acre feet of water per acre. Several sources indicate that irrigated land in the Front Range uses an average of 2.5 to 2.9 AF per acre (see Chapter 5, page 57). High density residential property may require as little as 0.5 AF per acre for outdoor irrigation. Therefore, there could be a net saving of 2.5 AF per acre as land is converted from agriculture to high density residential use. Of course, additional water will continue to be needed to provision potable use. This will be discussed below.

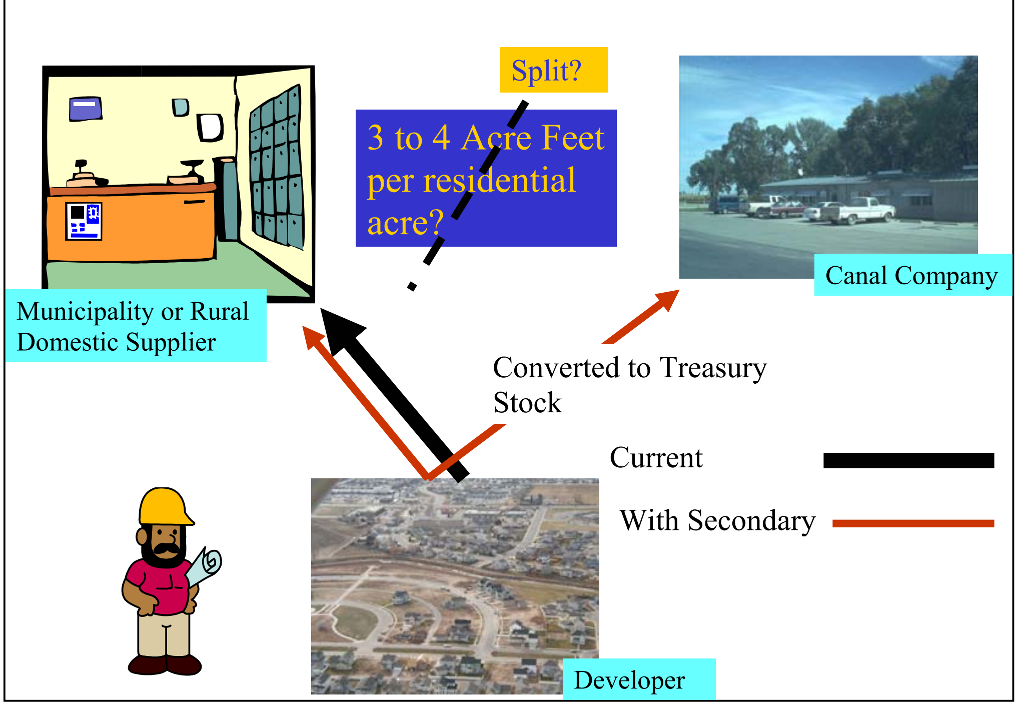
Although larger lots have less paved surface, there is an envelope of landscaping generally not dependent upon lot size. In an earlier chapter it was reported that a total of 256 residential parcels [lots] were studied by the East Larimer County Water District. The results showed that up to a lot size of 0.5 acre, increased water use was positively correlated with increased lot size. Thereafter, lot sizes greater than 0.5 acre, up to 5 acres, tended to show fairly constant levels of water usage. This suggests a possible optimal size for turf and landscaping areas on larger lots served by potable water systems. Canal companies can be assisted in this assessment of potential secondary water needs by consulting local potable water providers.

The potential or actual raw water turnover requirement for potable water providers should also be considered. In the Front Range of Colorado, this raw water turnover requirement is normally 3 AF of raw water per acre of land developed. An earlier chapter discussed a possible adjustment to the current approach taken by municipalities in regard to this water turnover requirement. In brief, when ditch companies provide valuable secondary supply, the water turnover requirement could be shared between the canal company and the municipality. This would involve cooperation between canal companies and municipalities.

Figure 53 and Figure 54 show slightly different scenarios for sharing the standard municipal raw water turnover requirement. Figure 53 shows a scenario that would be typical for most canal companies throughout Colorado. In this situation, canal companies and municipalities would split the raw water turnover requirement more of less equally, in order that secondary systems could secure water and prosper. Figure 54 shows a version of the scenario that is perhaps more typical of the northern Colorado Front Range. In this situation, potable water providers are much more interested in acquiring Colorado-Big Thompson units of water. The raw water turnover requirement might need to be slightly increased in this situation to accommodate the strong desire that municipalities have in acquiring these C-BT units. Meanwhile, the canal companies could focus on acquiring so-called “native” water for their secondary systems.

As noted in an earlier discussion, native water supplies have many more restrictions on them when it comes to diverting them off developing agricultural land and into municipal or rural domestic treatment facilities. Filings for alternate points of diversion for native supplies can be difficult under state water law, and generally only the consumptive use of the native water supply can be diverted into treatment plants. In contrast, with regard to the C-BT units, virtually all of the annual water allotment per unit can be diverted into municipal and rural domestic treatment facilities. Hence, the current practice

Figure 53 -Raw Water Turnover Requirement for Residential Lots

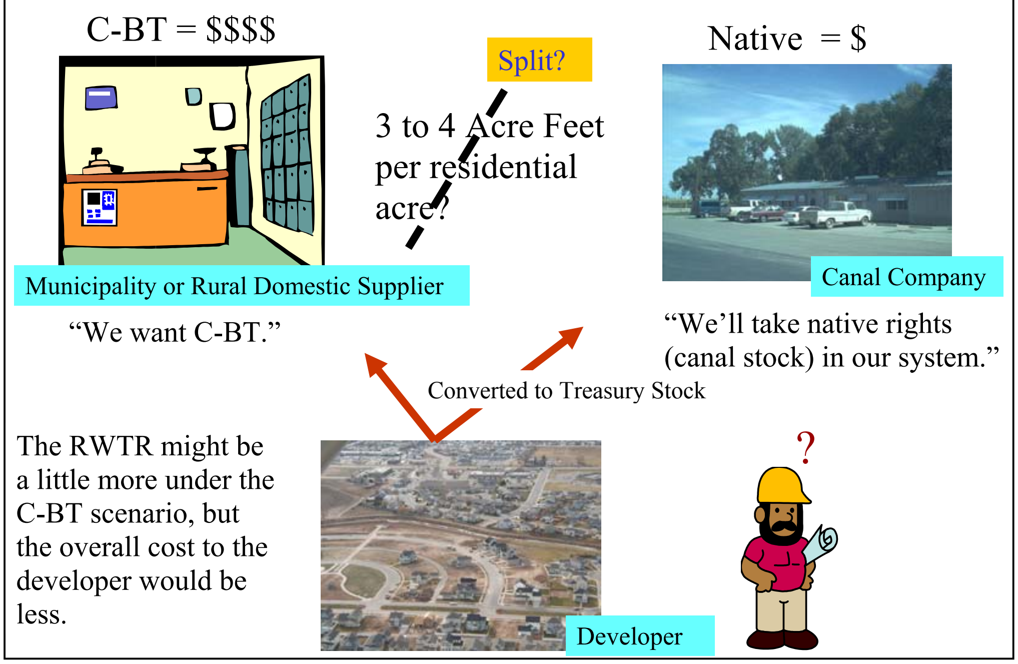


that sees most potable water purveyors requesting C-BT units from developers, rather than native water supplies.

Very briefly, the current raw water turnover requirement demanded by potable water providers in the study area, which is normally 3 AF per acre of land being developed, would be split between the potable water purveyor and the secondary water provider (i.e., the canal company). Although it is notable that the Davis and Weber Counties Canal Company in Sunset, Utah requests 3 AF per acre for its secondary system turnover requirement, this probably would not be acceptable to developers in the Colorado Front Range. Such an amount is probably not required for pressurized secondary water service anyway. So as not to detract from developing the kinds of secondary systems discussed in this report, local potable water purveyors would have to agree to split the current 3 AF per acre requirement with the canal company (Figure 53; and then Figure 54 for the C - BT scenario).

However, in doing so, it is argued that the larger community would be greatly benefited. The potable provider would be required to provide much less potable water to the lot, perhaps as much as a fifty percent reduction, while the secondary water provider, a canal company or irrigation district under the scenario suggested in this report, would convert its share of the water turnover requirement into company treasury stock, thus developing the future water portfolio that is needed to guarantee the success of the secondary system over time. Without such cooperation between local potable purveyors and canal companies, and without the assured success of the secondary system, it is doubtful that the state can move forward with this innovative policy, and doubtful whether sustainable pressurized secondary water service in the region can be achieved at all.

Figure 54 - Raw Water Turnover Requirement for Residential Lots under the Colorado-Big Thompson Project



3. <u>Estimating Costs of Secondary Systems</u>

An approximate cost for implementing a secondary water supply system is based upon practical experience in Utah and the Front Range of Colorado. Consistently, for secondary systems, the development cost per lot of a 7,000-10,000 sq ft lot (0.15 to 0.25 acres), with a point of connection of ¾"-1" has been in the range of $2,000 to $3,000. This cost assumes the following:

- The pipe is not buried below the frost line (assumed burial depth of 24"-30").
- Special pipe is not used (pipe designated as non-potable is purple, and using this pipe increases costs by 10-15%).
- Construction costs for the pump, filters, distribution system and storage are included in the estimate.
- Residential meters are not included in the estimate.

Violation of these assumptions would increase the costs reviewed here. For the purpose of this example modeling of New Cache, a mid-range value of $2,500 per lot was chosen for secondary water development costs. Construction costs for lots of one acre were assumed to be $3,000. Lots equaling 1.5 acres were assumed to cost $4,000 per lot, while 2 acre lots were assumed to cost $4,500 for secondary supply. The greater costs for larger lots were derived from construction data in the Front Range of Colorado and in Utah. The overall assumption was made that $2,500 per lot was a good baseline figure to develop a secondary system. Costs above that include extra pipe and assume a larger point of connection to the property.

New Cache generally anticipates utilizing the main canal as a large ("pencil-thin") reservoir, thereby avoiding additional capital costs for temporary (72 hour) storage and water storage filings with the State

Engineer's Office to provision and pressurize the secondary system. Incidentally, the issue of filing for storage rights for the secondary systems being developed in Utah has not been a deterrent to the development of these systems, presumably because the state is promoting the policy, but also because return flow issues are not as paramount along the Wasatch Front Range as they are along the Colorado Front Range. This is due to the configuration of the Wasatch Front Range next to the Great Salt Lake. Most canal return flows tend to empty directly into the Great Salt Lake, rather than being picked up and reused several times by ditch companies downstream, as is common in the South Platte drainage and other river basins in Colorado.

A potential secondary system funding agency in Colorado was consulted, and it was determined that, upon approval of such a project, the irrigation company could conceivably obtain a 20 year loan at 2.7% interest to construct a secondary system. Loan payments were calculated using the following capital recovery equation. This equation assumes annual compounding.

$$A = P \left[\frac{I(1+I)^N}{(1+I)^N - 1} \right]$$

A = Annual Repayment
P = Principle
I = Interest Rate
N = Number of Time Periods (in years)

Table 17 – Estimated Operation and Maintenance Cost	
Operating Cost	Cost Assumption/acre-foot
Lateral Charge	$2.00
Storage, Conveyance and Administration	$17.00
Pump Station Maintenance	$52.00
Pump Electricity	$18.00

Source: City of Greeley. Draft Non-Potable Utility Master Plan, July 1995.

Maintenance and operation costs were also determined. Cost figures were based upon operation and maintenance costs experienced by the City of Greeley for a secondary water system on one of the older canal passing through the town. Information in Table 17 was derived from the City of Greeley's Draft Non-Potable Utility Master Plan. Again, when canal companies are conducting such an assessment, they should consult similar local sources for information to put into the model's computation, if they are available.

Choosing an appropriate operation and maintenance cost procedure entailed analyzing several different methods. The Davis and Weber Counties Canal Company in Davis County, Utah has a very well developed pressurized secondary system, serving some 8,000 homes. This canal company estimates an annual secondary system O&M cost of $75 per lot. However, this is only for smaller lots. Greeley bases its costs on water usage. It was felt that usage per AF was a more appropriate way to calculate operation and maintenance cost in order to account for a range of lot sizes. Consequently, these data were entered in the spreadsheet.

4. Estimating Revenue from Secondary Water Service

Revenues are determined using a rate structure similar to the one used by the Davis and Weber Counties Canal Company in Utah (Table 18, page 119). Analyzing the lot composition of proposed development within the modeled canal company service area and applying the Davis and Weber Counties Canal Company rate structure provides good estimates. A modeling of this revenue stream is included on the CD in the Appendix.

The New Cache Case Study

Three locations within the New Cache La Poudre Irrigating Company service area were chosen as case studies (Map I, page 121). The case study analysis applied development scenarios utilizing the methodology discussed above. The service area is experiencing a change in composition from agricultural to rural residential development. The majority of the development is located in the western portion of the canal company's service area near the cities of Timnath and Windsor. Increased residential development is also occurring around the reservoirs in the service area.

Study Area #1

Study Area #1 is currently in the planning stages of development from agricultural use to residential lots. A 119 acre site is expected to be developed into a 317 lot residential area. Developers are already discussing the feasibility of a secondary supply system for this development.

Construction costs for this secondary water development were calculated at $871,750. The following assumptions were made in the calculation:

- Assume 317 lots multiplied by $2,500 per lot.
- Include infrastructure requirements such as storage, pipelines, pumps and filters.
- Utilizing a company canal as a storage facility instead of constructing off-canal storage ponds. The $2,500 per lot figure assumes that New Cache elected to do this.
- The annual loan payment was calculated using the assumptions of a 20 year loan, at an interest rate of 2.75%.

The annual payment, including principal and interest was calculated at $57,249. Operation and maintenance costs for the secondary system were estimated at $17,717. This figure was based upon the operation and maintenance costs experienced by the City of Greeley's secondary supply system (Table 17). Again, this assumes an outdoor water use of 0.5 AF per acre of residential land. A replacement and depreciation factor was added to the operation and maintenance cost. The City of Greeley added 1% of the annual operation and maintenance cost to account for system replacement costs. The estimated capital cost for the study area was arbitrarily increased by an additional 1% to account for unknown operating and construction cost overruns.

The figure used in the City of Greeley Non-Potable Utility Master Plan did not appear to include operation and maintenance costs for a larger system-wide secondary system infrastructure. Consequently, operation and maintenance costs for Study Area #1 were increased by an additional factor of 0.1 to accommodate for system-wide secondary systems costs. Total annual system-wide costs were estimated to be $14,967.

Revenue from providing secondary water service to the study area was calculated using the Davis and Weber Counties Canal Company rate structure. The New Cache staff approved this structure for study purposes, since the company does not have an existing rate structure for secondary supply. The Davis and Weber rate structure is shown in Table 18. Fees are based upon tap size, since Davis and Weber does not meter its secondary supply customers.

The study area was divided into lots of approximately 0.33 acres. Davis and Weber charges $200 per year for lots of this size. Therefore, following a similar rate structure, New Cache would collect $63,400 in fees per year from the study area. Ignoring collection of one time development or tap fees, the model shows that the secondary system for the study area would operate with an annual deficit of $11,567. However, it should be noted that New Cache would collect $229,825 in development fees, based upon the Davis and Weber Canal Company development fee structure. This Utah canal company requires a $725 development fee for 0.3 acre lots. It is assumed that development would occur within one year's time and all development fees would be collected within this time frame. If developments are phased, adjustments would need to be made in estimating revenue calculations, which the model is capable of doing.

It should be noted that the water service fee for secondary systems calculated here for 1-inch taps ($200 to $280/year), as well as for the 2-inch taps ($888 to $921/year) are quite modest compared to potable water rates in the larger municipalities along the Colorado Front Range. One city charges $722 per acre foot for customers who use 13,000 gallons/per month. This represents a water bill of $360 for one-half acre-foot of water. For tap owners that use 33,000 gallons/per month, the charge in the same municipality is $1,160/acre-foot or a total annual bill of $1,403. Even 50% of these charges is nearly 100% higher than any of the reported rates for secondary water service in other parts of the Rocky Mountain region.

Factoring in development fees, and assuming that New Cache followed the annual Colorado Water Conservation Board repayment schedule, shortfalls in annual operating costs for the study area would be met through the development fees. This is determined by dividing the amount collected in development fees by the deficit in annual secondary service fees (i.e., $11,567). The addition of the development fee to the annual revenue allows the company to make full loan payments in 19.8 years, before operating with a deficit. Since the repayment schedule was for 20 years, this would not be a constraint. Also, this scenario does not factor in potential interest income obtained from the development fees during the years that they are not needed for loan repayment.

Study Area #2

Study Area #2 provides different, and perhaps more favorable, results. It was comprised of two large undeveloped parcels within an existing residential area. The parcels were 96 and 112 acres respectively. The existing residential lots adjacent to the undeveloped parcels average 2.25 acres in size. This study area was analyzed with the assumption that it would develop in a similar manner to the already existing parcels.

The existing lots currently obtain their landscape water from several wells. However, they have approached New Cache regarding the use of ditch water, as the wells are not providing adequate supply for the area. This, coupled with the projected new development, makes this study area a prime location for retrofitting the residential area with a secondary supply system. Retrofit scenarios are currently outside the scope of the model, but should be included in future modeling as the costs of retrofitting are gradually better understood. For instance, more information is needed on the cost of utility crossings and potential borings to determine whether it is economical to engage in an area retrofit.

Construction costs for Study Area #2 were calculated at approximately $410,850. The following assumptions were made in this calculation:

- Assume 83 lots of 2.25 acres. This is derived from the combined parcel size of 208 acres, less 10% of the land for streets, divided by 2.25.
- Include infrastructure requirements such as storage, pipelines, pumps and filters.
- The base cost of $4,500 per lot was used to accommodate the larger lots, as well as offset the loss of economies of scale.
- The annual loan payment was calculated using the assumptions of a 20 year loan at 2.75% interest.

If New Cache were to tie into the existing wells serving the study area, the initial construction cost would be higher. However, less water would be required from the ditches to supply the area. Again, these costs do not include costs for retrofitting the neighboring residential parcels. Using the loan figures provided by the Colorado Water Conservation Board, the annual payment would be $26,981. Using the method described for the first study area that was discussed, operation and maintenance costs were calculated at $6,465. Total annual cost for the system was estimated at $33,446.

Revenue was determined using the Davis and Weber rate structure. Davis and Weber charges $921 dollars per lot per year for lots of this size (Table 18). Therefore, following a similar rate structure, New Cache would collect $76,433 in fees per year. Ignoring collection of one time development or tap fees, the loan for the study area would be repaid in approximately ten years. It should be noted, however, that New Cache would collect $443,675 in development fees, which covers the cost of the loan. The tap/development fee used by Davis and Weber for a 2.25 acre lot ($5,049) is lower than the average fee of $6,500 currently used by the North Weld County Water District for potable water supply.

<u>Study Area #3</u>

Study Area #3 was located further to the east and south of the first two study areas. It is located about one and one-half miles south of the New Cache main canal. A development company currently owns the area. The study area borders a lake that is currently surrounded by one acre residential lots. Other existing lots in the area are larger than one acre.

This study area was analyzed under two different development scenarios. In the first scenario, it was assumed that the parcel would develop into one acre residential lots. The second scenario assumed two acre lots. This third study area provided the opportunity to examine the cost increase associated with a parcel located off the main canal system. Costs were expected to be higher due to additional water conveyance lines and pumping costs.

Study Area #3 One Acre Scenario

Construction costs for Study Area #3 under the one acre scenario were calculated at approximately $2.2 million dollars. This cost included the following assumptions:

- $3,000 construction cost per lot.
- Include infrastructure requirements such as storage, pipelines, pumps and filters.
- Ten percent of the land was removed from calculations to accommodate for streets and public utilities. An estimated 606 lots were used for calculation purposes.
- The annual loan payment was calculated using the assumptions of a 20 year loan at 2.75% interest.
- Additional pipe cost added $204,120 to the capital cost. Additional cost was determined from current construction costs of laying 8" line at $24 per linear foot. It is estimated that 7,920 additional feet of pipe would be needed to supply the study area with secondary water.

Using the loan figures provided by the Colorado Water Conservation Board, the annual payment would be $146,076. Operation and maintenance costs were estimated at $39,448 per year. Total annual estimated cost was $185,525.

Revenue was estimated at $174,528. Davis and Weber, our Utah example, charges $288 per year for one acre lots. Assuming that revenue can be collected from all of the lots beginning in the first year after construction, there is a revenue shortfall of $10,996 per year. When development fees are considered in the model, New Cache would collect $1,393,800 in development fees for the development. If development fees were applied to the annual deficit, revenue from the secondary system could easily cover its development costs.

Study Area #3 Two Acre Scenario

Construction costs for Study Area #3, but now under the two acre scenario, were calculated at approximately 1.7 million dollars. This provides a good comparison between larger lot versus smaller lot costs. The construction cost contains the same assumptions as in the previous examples, except that the base figure of $4,500 per lot was used to accommodate for the larger lot size, and only 303 lots were used for calculation purposes.

Using the loan figures provided by the Colorado Water Conservation Board, the annual payment was calculated at $113,243. Operation and maintenance was calculated at $25,846 per year. Total estimated annual system cost was $139,089.

The Davis and Weber Counties Canal Company requires a $4,529 fee for two-acre lots. Hence, annual revenue for the two-acre scenario was calculated at $269,064. Excluding revenue collected in development fees, the two-acre scenario collects more revenue than it expends. It should be noted that the canal company would also collect $1,372,136 in development fees. Table 18 (page 119) summarizes some of the calculations for the different scenarios.

<u>Conclusion</u>

The main objective of this chapter was to discuss the output of a model (see the CD in the Appendix) that analyzes the financial viability of secondary supply systems for an existing canal company undergoing some degree of urbanization. The model was applied to several development scenarios within a canal company service area. Evaluating the case studies shows that secondary supply is a viable option for the canal company, although careful consideration of the fee structure is necessary. The success of the case studies was often dependent upon the additional revenue provided by the development fee for each lot. Therefore, care is needed in devising the overall fee structure. The modeling relied upon the fee structure used by Davis and Weber Counties Canal Company in Utah (see Chapter 6 for a discussion of this canal company).

Economies of scale would lead one to believe that the smaller lots are generally more economical for secondary supply systems, although substantial development fees for larger lots can make the provision of secondary water to these lots financially viable as well. In the model, the larger lots covered costs without need to operate in a deficit due to higher annual fees and larger development costs per lot. The Davis and Weber fee structure appears to be designed to entice smaller lot development and discourages larger lots in the Utah Front Range. This was confirmed after discussing this issue with the manager of the Davis and Weber Counties Canal Company.

However, for the purposes of this analysis, it is sufficient to observe that canal companies will be able to devise a fee structure that promotes smart land use and is applicable to local conditions. Canal companies, therefore, may need to alter some of the cost and revenue amounts in the model to accommodate local conditions, and to accommodate possible ordinances that local government wishes to enforce regarding land development and use. Overall, it is recommended that canal companies develop a fee structure that will encourage the developers toward smaller lots and more compact residential development. This will further protect the water supply of agricultural water users.

Another item that may need alteration due to actual conditions is the "contingency factor" for system-wide development costs. The cost of start-up of the system was estimated to be an extra 10 percent of the total cost of each scenario. However, if costs to construct the major infrastructure of a larger and more widely available secondary system in the canal company service area are higher (i.e., not associated with a particular subdivision development), the "contingency factor" will need to be changed in the model. Also, if developments are phased in and the phases are known, this should be taken into consideration in regards to revenue and development fee collection. The other factor that may affect the viability of the system is maintenance costs. Maintenance costs for this study were based upon a nearby city's cost structure. The canal company or irrigation district using the model may want to consult other sources.

Table 18

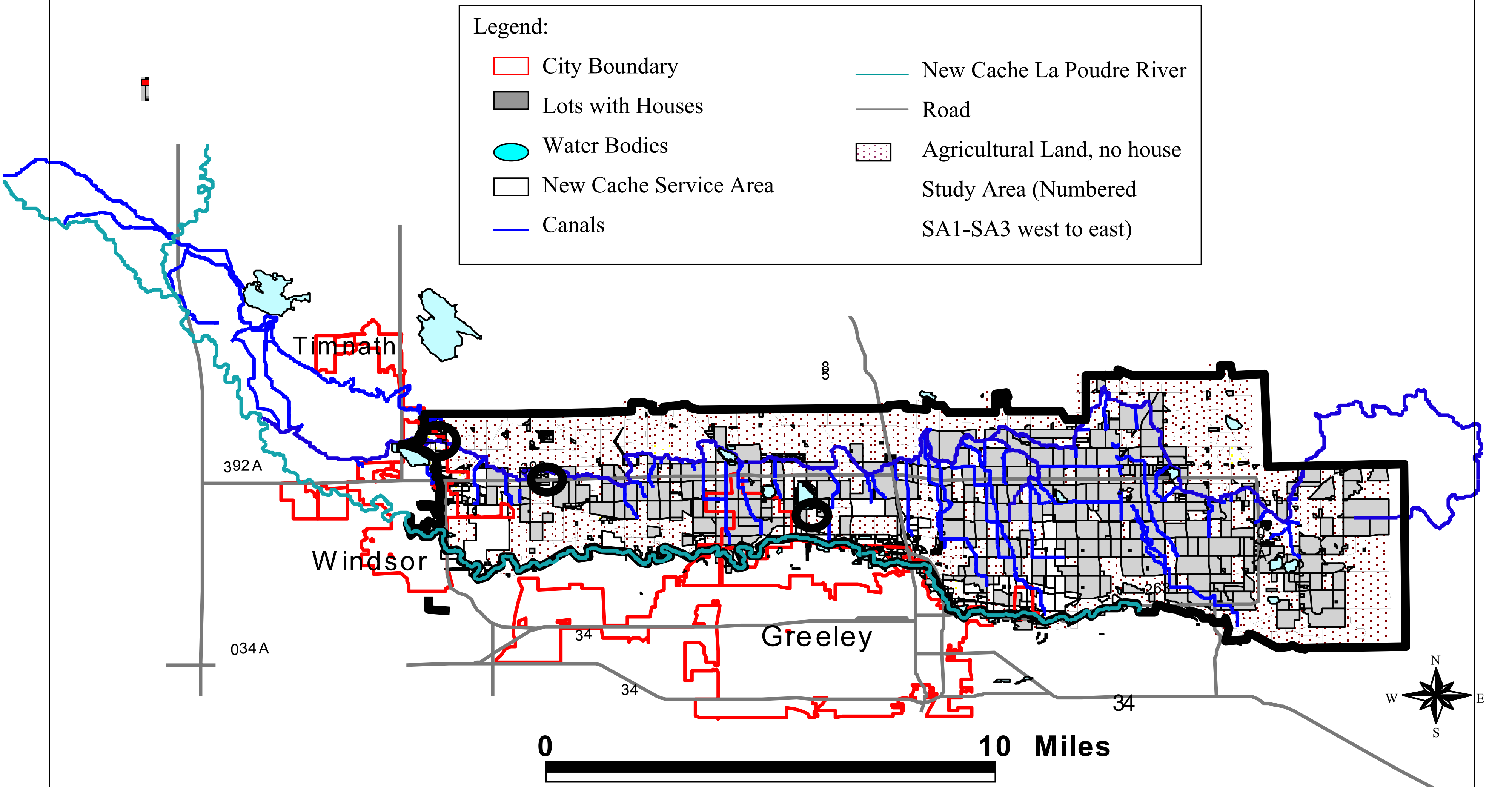
Potential revenue from secondary supply system study areas located within the New Cache La Poudre Irrigating Company, based upon Davis and Weber Counties Canal Company fee schedule.

				Development Unit Fee	Total Fee	Annual Service Fee		Annual Revenue		Cost Analysis			
Study Area	Lot Size (Acres)	# of Parcels	Total Size (acres)			1 inch Connection	2 inch Connection	1 inch Connection	2 inch Connection	Estimated Annual Loan Payment	Estimated Annual O&M cost	Estimated Total Annual Cost	Difference
1*	0.3	317	112.00	$725	$229,825	$200		$63,400		$57,249	$17,717	$74,966	-$11,566
2	2.25	83	208.00	$5,225	$433,675		$921		$76,443	$26,981	$6,465	$33,446	$42,997
3-1	1	606	674.00	$2,300	$1,393,800	$288		$174,528		$146,076	$39,448	$185,524	-$10,996
3-2	2	303	674.00	$4,529	$1,372,136		$888		$269,064	$113,243	$25,846	$139,089	$129,975

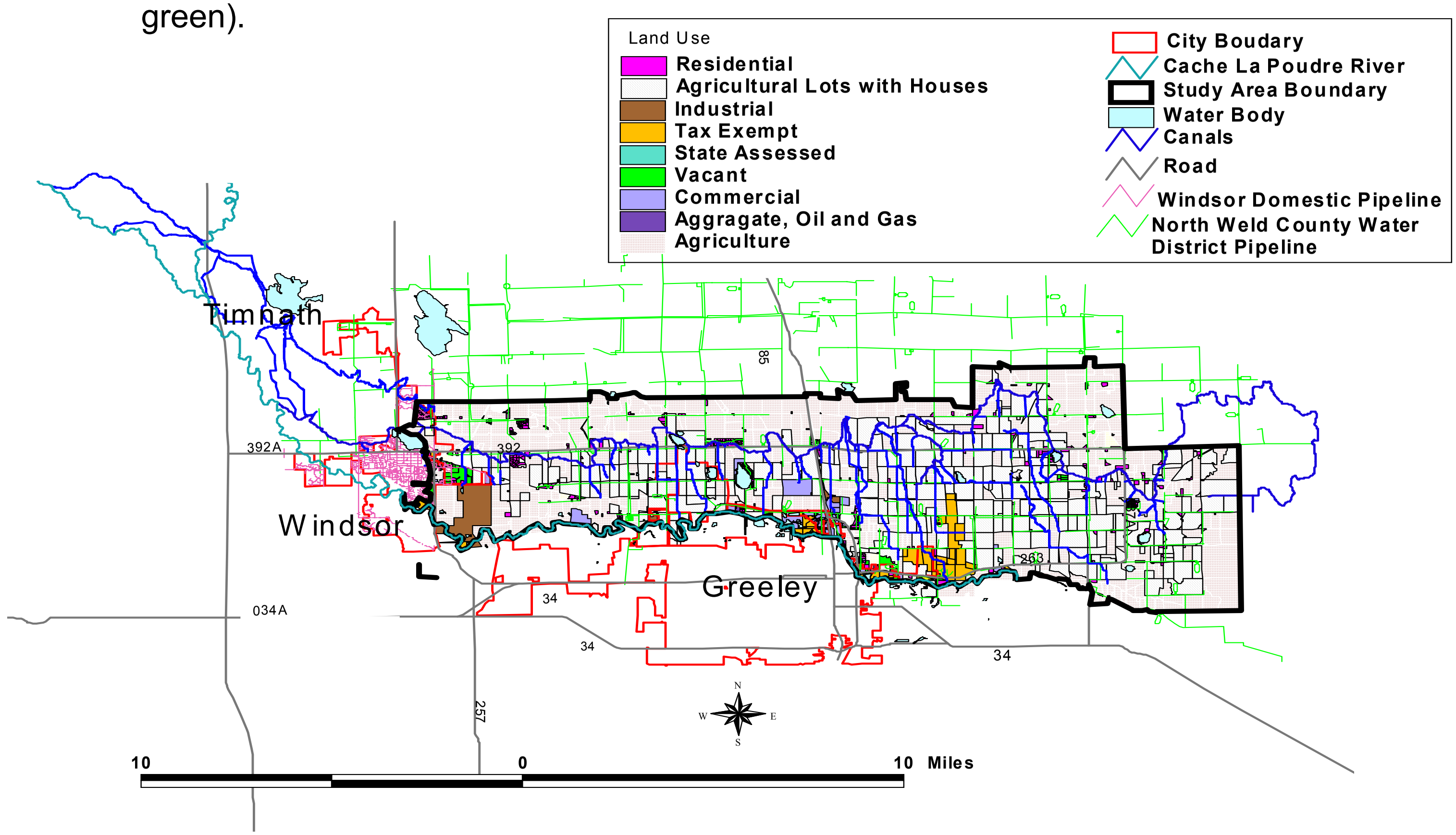
Parcel calculation assumes that only 90% of the land is developed into residential lots. The remaining is used for streets and utilities.

* This does not apply to Study Area one; since the lot size and number is based upon approved development plans.

Map I - Map of Secondary Supply Case Study Areas (circles)



Map II – Showing Overlap of New Cache La Poudre Irrigating Company and North Weld County Water District Pipeline System (in green).



CHAPTER 9

ENGINEERING APPRAISAL FOR IRRIGATION ENTERPRISES

In order for canal companies and irrigation districts to properly assess their potential to provide pressurized secondary water, certain baseline data can be collected as part of an internal engineering appraisal. This appraisal is an excellent accompaniment to the financial feasibility modeling discussed in Chapter 8. The irrigation enterprise should test not only the potential market for pressurized secondary water, but also assess the readiness of its infrastructure, water rights, finances, and its corporate structure. Such an internal appraisal could be performed by the staff of the enterprise, although it may be helpful to hire an experienced water rights appraiser to conduct such an assessment. The format of the engineering appraisal is shown at the end of this chapter.

Where to begin? Many of these enterprises are not familiar with the procedures involved in initiating such a project. Materials provided in this chapter act as a guideline to getting started. State agencies may request some of this information when applications are made for feasibility study grants and loans.

Preliminary engineering and water rights appraisals of this nature might be financed through a state agency grant. The Colorado Water Conservation Board has a grant program that can assist a canal company in assembling the information set out in this chapter. Other potential funding sources for preliminary engineering appraisals may be the Colorado Department of Local Affairs, the U.S. Department of Agriculture's Rural Development Program, the Colorado Water Quality Control Division, and the Colorado Water Resources and Power Development Authority. The canal company/district will have to explore the various options available.

The engineering appraisal involves a checklist process whereby the enterprise can collect certain baseline information about its assets and operation. It represents a stepping stone on the way to formal loan application, design studies, and business plans. The results will highlight potential weaknesses or problem areas that the enterprise will need to address, should it wish to develop a secondary systems as an adjunct to its current operations.

To develop the engineering appraisal methodology, two irrigation enterprises were studied as test cases. These were the Highland Ditch Company ("Highland") and the New Cache la Poudre Irrigating Company ("New Cache"). Both enterprises serve highly productive agricultural areas, and are historically important to the region. The photo to the left shows the headgate of the New Cache La Poudre Irrigating Company taking water off the Cache La Poudre River southeast of Fort Collins. The photo on the next page shows some of the urban development occurring around the water storage facilities in the company service area.

Before looking at these two examples, we will briefly outline the methodology.
The basic elements of the engineering appraisal are:

- Corporate Information – providing an overview of the company/district structure and ownership,
- Financial Information – providing an overview of the company/district financial situation (last 10 years worth of data),
- Water Rights Ownership – providing an inventory of the company/district water rights ownership,
- Water Supply – providing an overview of the historical yield of the company/district water rights (last 20 years worth of data),
- Condition of Infrastructure – providing an inventory of the company/district infrastructure assets and their physical condition.

Corporate Information

The corporate information section of the engineering appraisal provides at-a-glance summary information about the enterprise.

1. Corporate Identity – this part provides the legal business name of the enterprise, contact information, including address and telephone number for a contact person, bylaws and articles of incorporation.

2. Corporate Structure - this part describes the specific enterprise business type and its term of operation (i.e., mutual ditch and irrigation company, "carriage company," reservoir company, etc.). A few relevant statistics, such as the number of full- and part-time employees and the number of shareholders, can give a general indication as to the workload associated with operating the company. Higher numbers of employees and shareholders naturally result in higher administrative and overhead costs, but also present possibilities added operational efficiencies.

3 General Information - this part gives an overview of how the company is operated. Typically, this will include information about the number of acres served by the system, the cropping patterns within the system, and operational practices such as use of computers in water user accounting, water delivery procedures under both normal and drought conditions, and water measurement or other management practices.

Most of the data included in this section of the appraisal are either well known to company officials or readily obtained from company files. For both the Highland and New Cache systems, the financial summary data are routinely presented in the company's annual report to its shareholders.

Financial Information

Of critical importance to irrigation enterprises is the potential financial burden placed on shareholders or landowners when considering pressurized secondary water management. In addition, in order to maintain nonprofit status, ditch companies must derive at least 85% of their income from assessments on shareholders or the company risks losing its nonprofit status (see Chapter 7). However, there is some agreement that ditch companies tend to be more successful when they can reach beyond their shareholders for supplemental operating income, such as income from property rental or the use of its irrigation facilities by municipalities, recreation groups or other neighboring water supply entities. One of the reasons for considering pressurized secondary water is to benefit from increased income by providing secondary water to residential areas within the traditional service area boundaries of the enterprise.

Brief but good quality financial information highlights the degree to which the enterprise's financial obligations are met solely by its shareholders. Financial ratios are most informative when they are based on ten years worth of data, obtained from annual enterprise financial reports:

- *Ratio of assessment income to total operating expenses (excluding debt payments)* shows what percentage of the normal operating expenses are met by assessments on shares of company stock, or in the case of irrigation districts, acreage assessments. Ratios very close to 1.0 indicate that the company is very reliant on shareholder assessments for operational requirements and that added expenses for any kind of operational improvement (whether infrastructural or administrative) will likely result in increased assessments.

- *Ratio of debt payment (and interest) to income other than assessments* shows what percentage of the annual debt payment is covered by non-assessment income. Debts can derive from infrastructure improvements and legal costs. Non-assessment income typically comes from property rental and services provided, such as conveying stormwater, leasing reservoir storage space, and running ditch water for other entities. Although these other sources of income are valuable, when combined with a low assessment to total expense ratio, a high non-assessment income to debt payment ratio may indicate somewhat over reliance on non-assessment income to cover expenses. This non-assessment income can be highly variable. A low non-assessment income to debt payment ratio suggests that the enterprise has taken on much less debt than it might otherwise be able to. Enterprises may use non-assessment income to build up cash reserves to cover emergencies, although income tax may be charged on this non-assessment income.

- *Ratio of employee compensation to total income (assessments and other)* shows what percentage of the total annual income goes to employee salaries, employee benefits and directors fees. A high employee compensation to total income ratio indicates that most of the resources of the enterprise are going toward employee compensation rather than annual O&M costs and infrastructure improvements.

It is useful to remember that any of these ratios can be severely distorted by one-time occurrences and so should not be used exclusively as barometers of financial health for a given company. Rather, they are general indicators concerning the financial history of the enterprise. It is not necessary to force data into any sort of standard chart of accounts for analysis, but rather using the annual revenue and expense statement and balance sheet of the enterprise. Simple pie charts can give a graphical representation of the company's reliance on outside sources of income, the allocation of its expenses to labor, and administrative and operational/maintenance costs.

Water Rights Ownership Information

An inventory of the company's water rights ownership is the first step in quantifying the company's water supply. Water rights ownership is usually *not* straightforward for most ditch companies. Company assets may be jointly owned by other entities. Untangling the complicated water rights ownership picture is a necessary step in quantifying the total water supply available to company shareholders.

Obtaining this information is usually a more complicated task than might be expected. Few companies maintain a list or inventory of their water rights assets. The following checklist may help consultants working with the company/district staff to assess water rights that may be potentially involved in developing the secondary system:

- ❑ Meet with company staff and/or board to identify their working understanding of their water rights ownership and local water commissioners.
- ❑ Cross-reference the board/staff information with the State Engineer's Office official tabulation. Check for refill decrees, enlargements, or any other water rights that share the same name.
- ❑ Consult the company's financial statements for ownership of shares in other companies.
- ❑ Obtain previous studies or reports pertinent to the company.
- ❑ Consult a system map and discuss water supply sources with company officials to clarify ownership of all assets shown on the map, such as ponds, small lakes, and laterals.

Many companies allow the importation of "foreign" water into their systems. Such "foreign" water may include shares of stock in other companies, federal project water, and rented supplies. Also, many shareholders may have private sources of water, including high-capacity wells. While the "foreign" water sources are external to the company, identifying these alternative supplies helps complete the overall water supply picture for the company's shareholders.

Water Supply Information

The engineering appraisal presents a general overview of the system's water supply and may highlight problem areas to be addressed in later phases of secondary system development. Of interest will be the total annual supply available to the system, as well as data related to peak flows, length of irrigation season, and therefore availability of water during the shoulder months of the irrigation season.

Appraising water supply is least amenable to a standardized approach, and must be customized depending on the nature of the company's supply and the availability of records for particular water rights assets. For direct flow water rights, the official diversion records of the State Engineer's Office provide the best starting point. Many of these records are available online and require a low degree of additional analysis. For example, the New Cache direct flow decrees were straightforward to analyze, and even yielded solid information about the start and end date of the canal's irrigation season.

For storage rights, the state's records may be more difficult to retrieve and will require considerable analysis to be useful. For example, the Water Commissioner in District 5 recorded more than a dozen different types of water diverted at the Highland headgate during a 20-year period. To retrieve and analyze these records was costly and time-consuming. Most of the historical records were not available online and had to be retrieved from microfilm.

For water systems that combine both direct flow and storage rights, the amount of water supplied to a given shareholder often cannot be reliably determined using the state's official records.

Company records are potentially invaluable and yet are often either not preserved or not easily retrieved from company files.

The following checklist provides a starting point for developing a useful picture of a company's water supply:

- ❑ Collect diversion records for direct flow decrees. Tabulate flows and bracket the start and end date of the company's irrigation season. Monthly values are most useful.
- ❑ Collect records for storage rights and tabulate the total amount stored and used each year.
- ❑ Compare the state's official tabulations with the quota or yield per acre reported in company records.
- ❑ Compute the amount of water provided per share of stock in the company.

Due to the wide variation to be expected in the type and quality of records retrieved, the staff or consultant will have to rely upon his or her own ingenuity in developing useful presentations of the data.

<u>Condition of Infrastructure</u>

The final section of the engineering appraisal addresses the status of the company's infrastructure. The company's physical assets should be inventoried, and basic quantitative data should be displayed with regard to rates and volumes.

<u>Infrastructure Checklist</u>

- ❑ Original construction of main canal and canal capacity at selected locations along its length,
- ❑ Construction date and description of other principal delivery structures (tunnels, lift pumps, etc.),
- ❑ Miles of canals,
- ❑ Miles of drains,
- ❑ Storage facilities (including inlet/outlet capacities, length of inlet/outlet canals),
- ❑ Number of headgates or turnouts,
- ❑ Lateral inventory: name of lateral, incorporation status, capacity, number of shares delivered.

NOTE: On the following pages is a generic example of an engineering appraisal. As part of the study, two major irrigation companies in the Colorado Front Range were assessed relative to their potential as providers of secondary water. Engineering appraisals, as set out in this chapter, were conducted as part of developing this methodology. The results were then shared with each of the companies. These companies are currently being assisted by the research team in exploring secondary supply options. One company, the New Cache La Poudre Irrigating Company, has an affiliate company (Lake Canal) that has submitted a proposal to the Colorado Water Conservation Board for a feasibility study on pressurized secondary water service. The Highland Ditch Company, the other company participating in the study, will be assessing its options for secondary service in the near future. In order to maintain a certain degree of privacy, the following information contains a mixture of data from these two companies for demonstration purposes.

SECTION 1: CORPORATE DATA

IDENTIFYING DATA

Name of System:	The Dry Gulch Irrigation Company
Contact Name, Title:	James Smith, Superintendent
Mailing Address:	P.O. Box 94, Farmland, CO 80600
Phone Number:	(970) 491-0000
Email/Website:	info@drygulch.com

CORPORATE STRUCTURE

When Incorporated:	1872
Corporate Type:	Mutual Ditch and Irrigation Company
Stock Issuance:	2,499.69 shares outstanding
	Approximately 280 shareholders
Employees:	6 full-time
Corporate By-laws:	attached

FINANCIAL SUMMARY

Cash in hand:	$367,465
Total Expenses:	$290,743
Total Income	$475,378
Assessment Income	$100,784
Long-term Debt:	$178,283

RATIOS:

Assessments/Expenses	0.53
Debt/Other Income	0.17
Salaries and Benefits/Total Income	0.28

GENERAL INFORMATION

Acres Served: 35,000

General crop types: grass hay, alfalfa, corn, pinto beans, sugar beets, grains (including brewing barley), sunflowers, and others.

Water Allocation: The Dry Gulch irrigation system was originally designed on the basis of delivery of 1,000 inches (50 acre-feet) per share. In actual operation, this delivery is usually not realized without supplemental water from outside sources. When all of the reservoirs are full, each share will deliver 15 acre-feet per year of storage water under present storage capacities. Direct flow decrees have a highly variable yield with the average being approximately 22 acre-feet per share. The Dry Gulch system is a ‘demand’ system; that is, users call water from individual water user accounts according to their needs on any particular day. The Dry Gulch office maintains computerized accounts for each shareholder, tracking ‘quota water’ (from storage), ‘river water’ (from direct flow decrees), and all other outside sources of water (for which special ditch running charges may apply.) The Dry Gulch system does not make deliveries until the sum of all water ordered by shareholders equals at least 40 cfs. In addition to the 700 shares outstanding, there are also 25½ “contract shares” that are entitled to direct flow deliveries only. These shares are non-voting. Dry Gulch shares are not attached to specific land parcels, and there is an active market for the purchase and lease of company stock.

Foreign Water Deliveries: The Company will deliver foreign (non-Dry Gulch) water to its shareholders with payment of a canal running fee set by the board of directors. Non-shareholders may also take delivery of water on a space-available basis and with higher running fees than those paid by shareholders. Owners of small reservoirs within the system do not pay running fees for the initial fill of their reservoirs if they are shareholders.

Groundwater Resources: There are no significant groundwater resources within the Dry Gulch system.

Urbanization: Urbanization is taking place in some parts of the system, particularly in the vicinity of the Town of Farmland. The local county Open Space program has acquired substantial tracts of land in the upper part of the system, ensuring a perpetual agricultural use for a large number of shares.

SECTION 2: FINANCIAL DATA

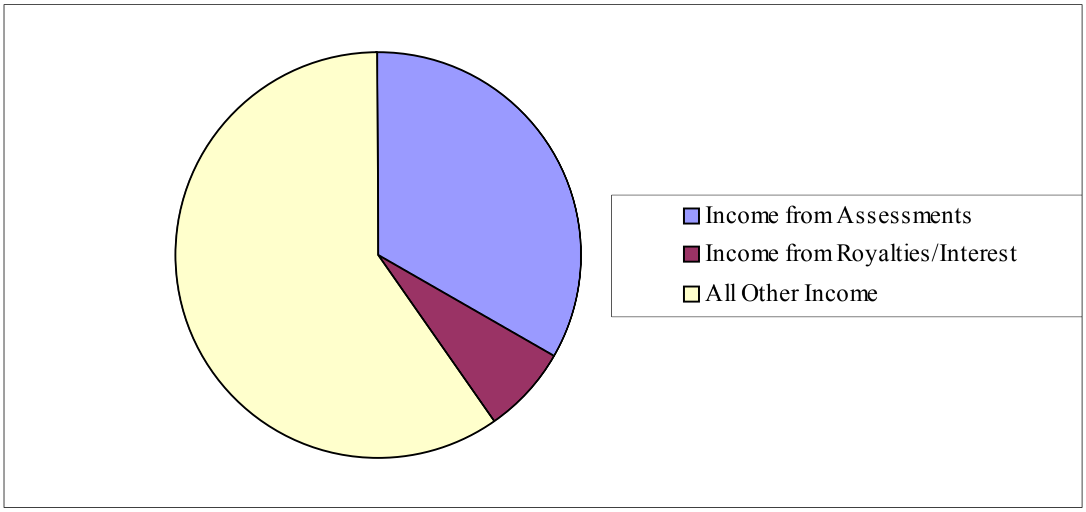
BALANCE SHEET

	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993
ASSETS										
CURRENT ASSETS										
Cash	$367,465.00	$602,118.00	$523,203.00	$508,143.00	$420,246.00	$344,230.00	$341,725.00	$236,624.00	$139,676.00	$128,487.00
PROPERTY & EQUIPMENT (at cost)										
Land Building and Improvements	1,298,965	1,287,024	688,740	688,740	688,740	668,123	647,806	627,187	616,461	584,678
Less Accumulated Depreciation	(321,429)	(280,214)	(270,955)	(264,132)	(255,064)	(223,548)	(214,489)	(188,340)	(171,928)	(153,218)
Total Property and Equipment	977,536	1,006,810	417,785	424,608	433,676	444,575	433,317	438,847	444,533	431,460
INVESTMENTS (at cost)										
Blue Lake Reservoir Company stock (299 shares)	14,950	14,950	14,950	14,950	14,950	14,950	14,950	14,950	14,950	14,950
Colorado Big Thompson Project (20 units)	26,750	26,750	26,750	26,750	26,750	26,750	26,750	26,750	26,750	13,250
Consolidated Extension Irrigation Company (2 shares)	900	900	900	900	900	900	900	900	900	900
Big Bend Irrigation Company stock (2 shares)	40	40	40	40	40	40	40	40	40	40
Total Investments	42,640	42,640	42,640	42,640	42,640	42,640	42,640	42,640	42,640	29,140
TOTAL ASSETS	1,387,641	1,651,568	983,628	975,391	896,562	831,445	817,682	718,111	626,849	589,087
LIABILITIES AND STOCKHOLDERS' EQUITY										
CURRENT LIABILITIES										
Payroll Taxes Withheld	2,711	1,385	917	0	689	0	722	0	0	0
LONG-TERM LIABILITIES										
Loan Payable – State Agency	178,283	598,283								
Total Liabilities	180,994	599,668	917	0	689	0	722	0	0	0
STOCKHOLDERS' EQUITY										
Common Stock -- No Par; 700 shares authorized, issued and outstanding	26,871	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000
Retained Earnings	1,179,776	1,016,900	947,711	940,391	860,873	796,445	781,960	683,111	591,849	554,087
Total Stockholders' Equity	1,206,647	1,051,900	982,711	975,391	895,873	831,445	816,960	718,111	626,849	589,087
TOTAL LIABILITIES AND STOCKHOLDERS' EQUITY	$1,387,641	$1,651,568	$983,628	$975,391	$896,562	$831,445	$817,682	$718,111	$626,849	$589,087

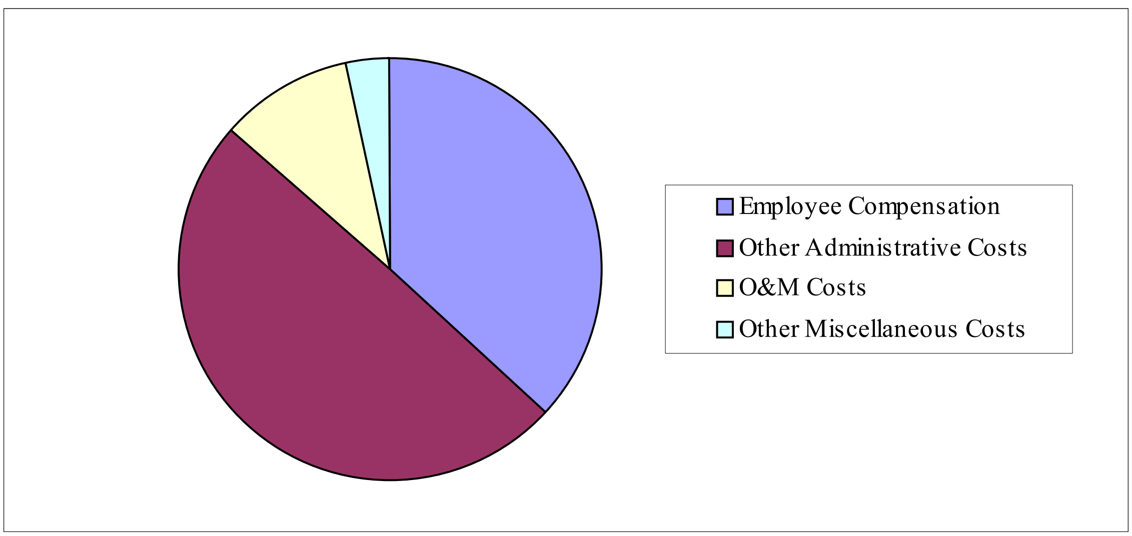
INCOME & EXPENSE

REVENUES										
Assessments	100,784	107,367	100,318	117,103	119,610	115,769	131,687	113,022	113,996	113,977
Recreation Lease Income	111,890	129,325	124,000	121,317	109,000	86,000	62,000	69,000	58,500	36,000
Excess Charges	30,407	70,121	36,310	44,691	2,787	16,617	26,711	3,974	5,435	8,426
Interest Income	6,826	36,036	27,554	22,194	17,874	11,620	11,679	6,424	2,679	2,716
Royalties	15,906	22,711	11,024	9,646	2,034	9,165	9,454	4,781	2,970	3,853
Project Water Charges	106,335	81,296	69,570	78,420	62,320	7,506	75,660	56,723	61,471	34,150
Transfer Fees	2,730	2,257	2,625	2,000	3,000	2,600	1,550	1,590		
Ditch Crossing Fees	500	3,000	10,500	1,000	9,000	1,000	3,000	9,500	5,000	550
Other	100,000		10,185	7,953	13,018	3,832	109	14,322	3,361	28,083
Total Revenues	475,378	452,113	392,086	404,324	338,643	254,109	321,850	279,336	253,412	227,755
EXPENSES										
Salaries and Wages	109,622	100,529	100,273	89,435	92,502	87,633	83,326	78,828	57,633	56,571
Insurance Expense	26,440	21,607	21,404	18,861	17,931	19,868	16,047	14,379	17,007	16,742
Ditch Maintenance	10,518	8,175	7,908	9,195	10,061	12,713	9,280	11,716	17,826	5,721
Depreciation Expense	41,215	9,259	6,823	9,068	31,516	12,559	26,149	16,412	22,848	12,761
Vehicle Expense	15,389	14,411	15,248	10,882	5,703	9,042	10,632	7,994	8,622	10,424
Legal and Accounting	20,749	30,209	13,682	11,900	17,867	8,862	15,199	19,942	30,046	12,819
Taxes and Licenses	8,733	5,914	8,695	7,449	5,979	7,912	7,514	(2,201)	9,068	10,234
Directors' Fees	12,100	13,400	12,080	7,080	6,070	5,250	5,800	8,570	4,240	4,380
Rent Expense	5,650	5,675	6,050	6,650	4,800	4,800	4,800	3,100	1,800	1,650
Surveying and Consulting Fees	2,132	20,947	5,293	4,714	4,400	3,816	5,874	4,705	6,062	4,748
Telephone Expense	7,149	9,648	9,250	10,846	5,432	3,604	3,621	2,347	1,570	1,889
Utilities Expense	5,094	5,109	4,060	4,669	3,831	3,443	2,675	2,553	2,119	1,934
Office Supplies and Expense	9,917	5,734	4,699	4,670	9,704	2,870	2,863	2,950	2,361	3,137
Building and Equipment Maintenance	7,889	7,616	4,964	15,771	4,695	1,701	3,928	510	1,009	2,533
Carryover Program	4,880	13,084								
Dam Repair @ at Big Bend		79,891	124,049	90,672	50,000					
Other	1,576	3,688	2,162	2,087	3,249	2,527	3,504	9,631	20,111	18,486
Interest	1,690	27,500						7		
Total Expenses	290,743	382,396	346,640	303,949	273,740	186,600	201,212	181,443	202,322	164,029
EXCESS OF REVENUES OVER EXPENSES PRE-TAX	184,635	69,717	45,446	100,375	64,903	67,509	120,638	97,893	51,090	63,726
Income Tax Expense	21,759	528	38,126	20,857	475	53,024	21,789	6,631	13,328	5,283
NET INCOME - INCOME TAX BASIS	162,876	69,189	7,320	79,518	64,428	14,485	98,849	91,262	37,762	58,443
RETAINED EARNINGS - Beginning	1,016,900	947,711	940,391	860,873	796,445	781,960	683,111	591,849	554,087	495,644
RETAINED EARNINGS - Ending	$1,179,776	$1,016,900	$947,711	$940,391	$860,873	$796,445	$781,960	$683,111	$591,849	$554,087

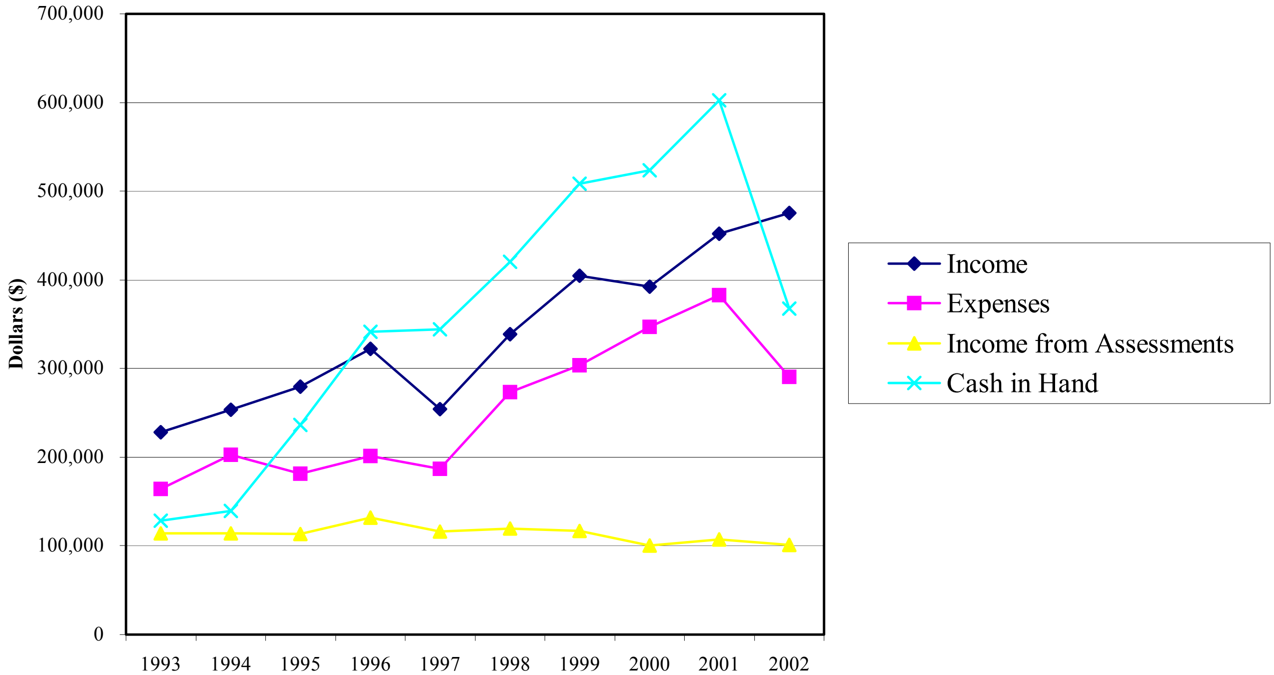
SOURCES OF REVENUE



ALLOCATION OF EXPENSES



10-YEAR FINANCIAL TRENDS



SECTION 3: WATER RIGHTS OWNERSHIP

DIRECT FLOW WATER RIGHTS (DRY GULCH CANAL)

Priority Number	Appropriation Date	Amount
37	October 25, 1870	110.0 cfs
44	September 15, 1871	170.0 cfs
72	November 10, 1874	184.0 cfs
83	September 15, 1877	121.0 cfs
161*	April 3, 1893	7.0 cfs

*Sources of water for this right are the Deadman, Pine Creek and Iron Sloughs.

STORAGE WATER RIGHTS (BLUE LAKE RESERVOIR)

The following water rights are owned by the Dry Gulch Irrigation Company, but are used exclusively by shareholders of the New Cache la Poudre Irrigating Company.

Priority Number	Appropriation Date	Amount
25	March 17, 1892	8,379 af
28	April 15, 1867	60 cfs*
61	December 1, 1902	1,740 af
136-T	December 31, 1923	5,947 af**
136-T	December 31, 1923	**

*This is the 'Old Farmland Mill Race' decree that the court ruled could be stored in Blue Lake Reservoir between the dates of 12/1 and 4/1 of each winter.

**Refill decree

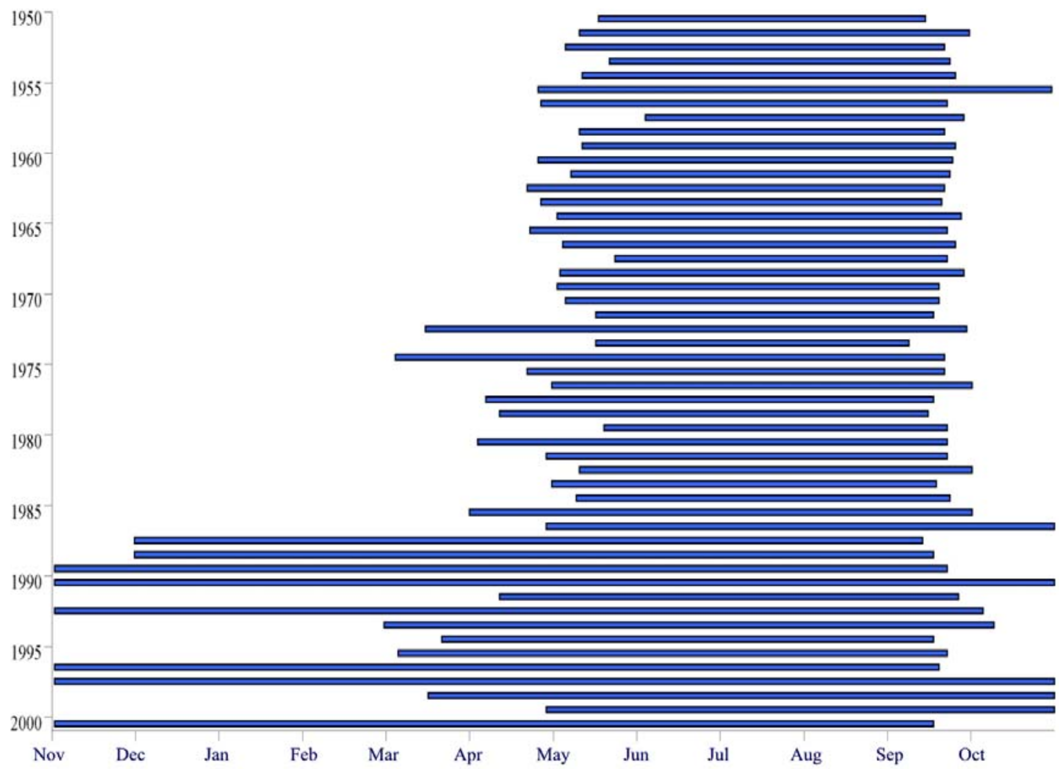
SUPPLEMENTAL WATER RIGHTS

Shareholders of the Dry Gulch Irrigation Company own the following rights:

Name	Ownership	Typical Yield
Big Fork Reservoir Company	89 Preferred Rights	23 af/right
Lone Tree Reservoir and Canal Company	125.5 Shares	1.25 af/share
Colorado-Big Thompson Project	4,926 Units	0.7 af/unit

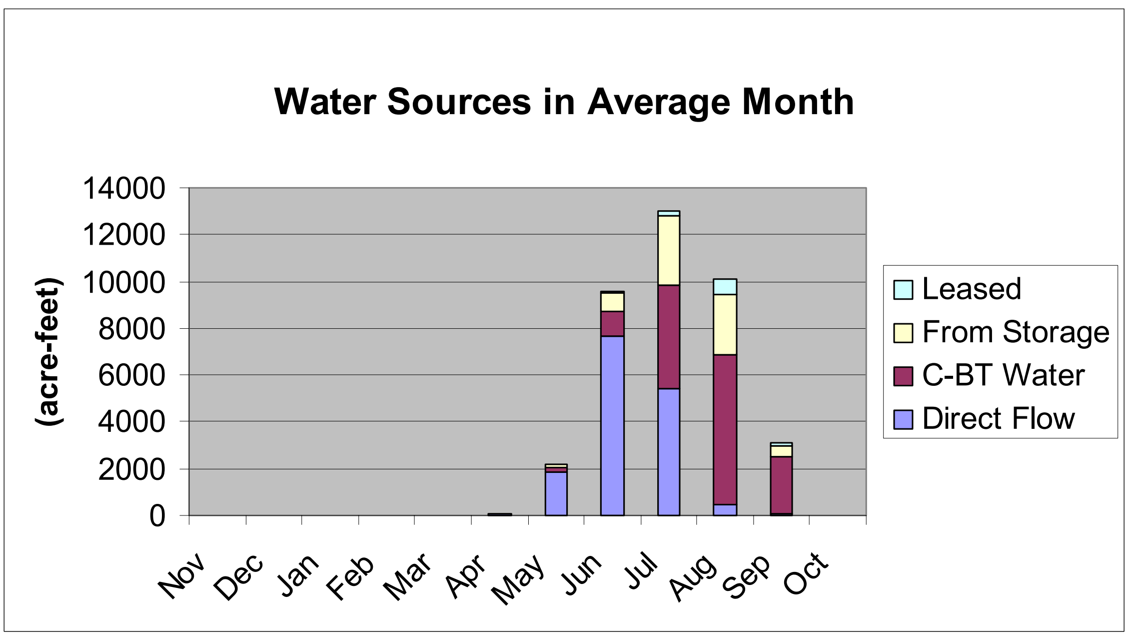
SECTION 4: WATER SUPPLY

PERIOD OF CANAL OPERATION



For the period 1950 through 1986, the average start of season was April 30. For the period 1950 through 1985, the average end of season was September 23.

Monthly Averages, in acre-feet					
	Direct Flow	***Federal Project Water***	***From Storage***	***Leased***	***Total Supply***
Apr	35	53	0	0	89
May	1,846	191	135	0	2,171
Jun	7,633	1,083	810	18	9,545
Jul	5,388	4,479	2,970	168	13,005
Aug	474	6,369	2,596	687	10,126
Sep	78	2,404	477	168	3,127
Oct	0	1	7	0	8
Total	15,454	14,580	6,994	1,042	38,071
Per Share	22	21	10	1	54
Per Acre	0.62	0.58	0.28	0.04	1.52



SECTION 5: INFRASTRUCTURE

MAIN CANAL STATISTICS

Capacity at river diversion headgate:	600 cfs
Number of headgates served by main canal:	115

SUBDIVISIONS OF MAIN CANAL

	Upper Division	Middle Division	Lower Division
Spillways/Wasteways	None	Cooper Spillway Deadman Ditch	Buffalo Lake Pine Creek
Headgates	4	20	60
Length of Canal	5	10	10

LATERALS

Name	Status	Capacity	Headgates Served
A Lateral	incorporated	<10 cfs	<10
B Lateral	unincorporated	<10 cfs	<10
C Lateral	unincorporated	<10 cfs	<10
D Lateral	incorporated	35 cfs	14
E Lateral	incorporated	<10 cfs	<10
F Lateral	unincorporated	<10 cfs	<10
G Lateral	incorporated	<10 cfs	<10
H Lateral & Ditch Company	incorporated	<10 cfs	<10
I Lateral	incorporated	200 cfs	50
J Extension Lateral	incorporated	100 cfs	50

BLUE LAKE RESERVOIR

Capacity	approximately 10,000 af
Max. inflow	200 cfs
Max. outflow	575 cfs
Length of inlet	8 miles
Length of outlet	2 miles

CHAPTER 10

SECONDARY SUPPLY INFRASTRUCTURE AND DROUGHT MITIGATION

The background and potential for secondary supply or dual systems has been thoroughly described in previous chapters. The purpose of this chapter is to describe the engineering criteria and the structural elements of a pressurized secondary supply system that lead to effective drought mitigation in the region. Using a model, the chapter addresses several questions regarding anticipated changes in regional and canal company/irrigation district water supply, as land is converted from agricultural to residential and commercial acreage. The chapter concludes with a discussion of (1) the potential for overall mutual ditch and irrigation company and irrigation district canal modernization throughout Colorado, in conjunction with the development of pressurized secondary water systems, and (2) how this further contributes to important drought mitigation for the state. Examples are taken from conditions in northeast Colorado.

A sound engineered approach to secondary water management includes a detailed design of the infrastructure piping and the irrigation system, and due consideration to long-term system operation and management. The provision of secondary supply may also afford significant opportunities for the ditch or canal company to modernize its 100-year-old plus canal infrastructure. Modernization may include structural or operational improvements, or a combination of these, the benefits of which can complement the ditch company's provision of secondary supply for urbanization. This is expected to materially benefit the larger community in terms of the water conserved in agricultural uses.

Key engineering design criteria for a secondary system include annual landscape and crop water requirements, water delivery alternatives and constraints, water storage requirements, determination of peak demand flows, pump station and control requirements, primary distribution system layout, service connections for residential/commercial customers, system operation including supervisory control and data acquisition (SCADA) monitoring and control, and system maintenance. These engineering criteria can enhance the overall secondary supply scheme, or conversely, detract from it if they are not properly addressed. Design considerations and contingency operational plans for drought management are also important.

<u>Review of Regional Water Development</u>

Reviewing briefly, when water was first diverted from streams and rivers in northeast Colorado, it was typically by direct diversion off the river, hence the terms "direct flow right" or "river decree." These earliest decrees were typically not suitable to meet irrigation requirements for the full duration of the growing season. Consequently, storage reservoirs were built to store water for use in the late season. Late season storage decrees extended the practical irrigation season, but even so, irrigation of many crops remained marginal. Because of this, the Colorado-Big Thompson (C-BT) project was conceived and commissioned in the 1950's to provide insurance against drier years and drought, and to meet the late season water requirements of the "allotees." Ninety percent of these project allotees were farmers at the time that the project was authorized by Congress.[1]

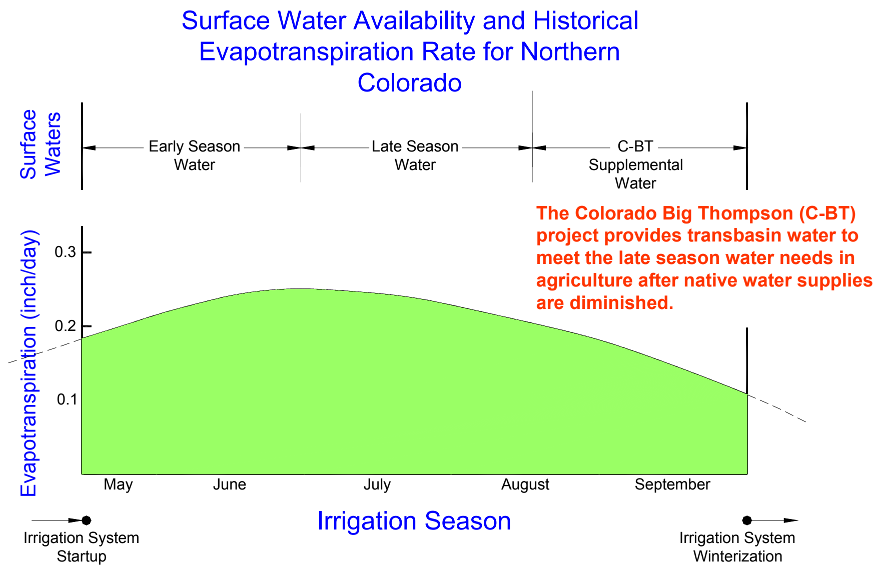


Figure 55. The typical northern Colorado irrigation season is from May through September. With agriculture, river decrees typically meet the early season requirements. Storage decrees typically meet a portion of the late season requirements. As evapotranspiration begins to decline, C-BT water helps to finish the growing season and provide insurance against drought.

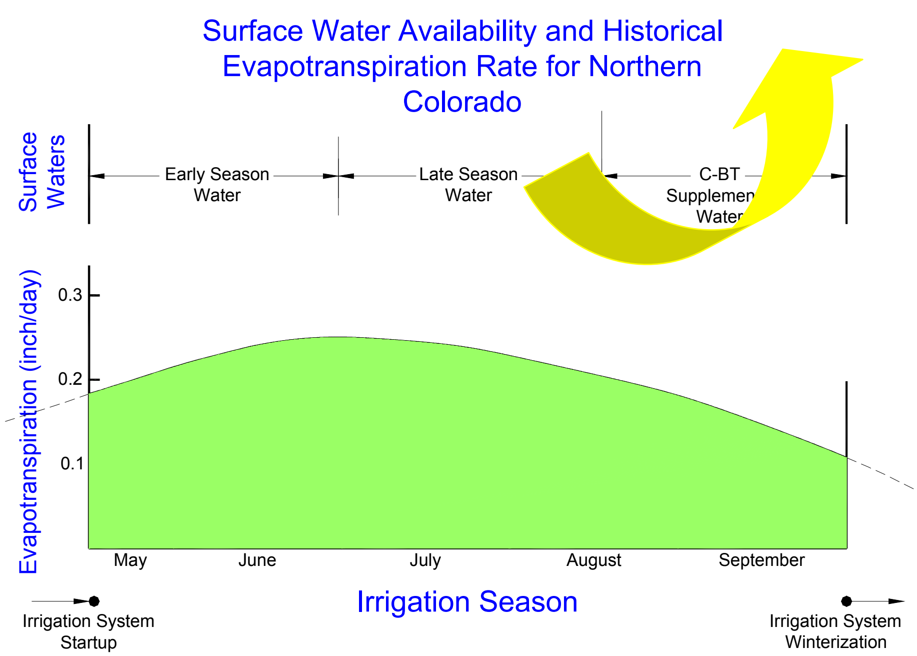


Figure 56. As land, some of it marginal, is taken out of agricultural production, C-BT units are transferred out of agriculture to meet the potable water purveyor's water turnover requirement. The C-BT project was originally designed to provide about 15% of agriculture's water requirement in the C-BT service area.

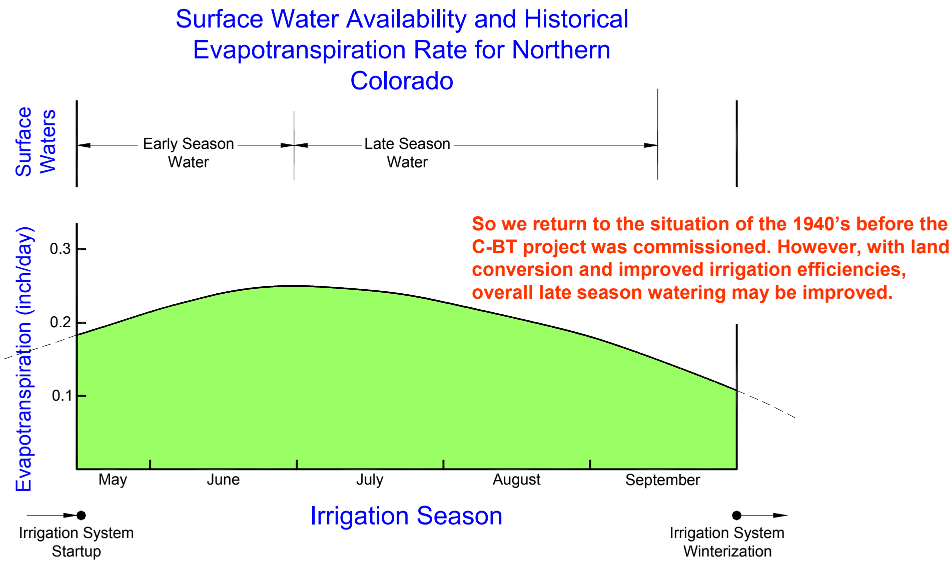


Figure 57. Loss of C-BT water for late season agricultural use is partially offset by reduced acreage in irrigated agriculture due to urbanization. When combined with the historic evapotranspiration curve and improvements in irrigation efficiency in both agricultural and urban uses, net improvements in overall late season water supply may be expected to occur.

Figure 58. With urbanization, irrigation application efficiency is improved dramatically. There is a change from surface methods used in agriculture to modern sprinkler and drip irrigation used in landscapes. Furthermore, more landscape irrigation systems are being automated, providing water management in accordance with real time plant evapotranspiration.

Figure 60. Typical landscape irrigation components of raw water irrigation systems. These components must be compatible with the quality of raw water.

Figure 61. SCADA equipment was installed at this rated section on a canal system in northern Colorado. The existing house for a Stevens recorder was used and a solar panel and remote terminal unit (RTU) was added. Communication is via radio. The equipment is all solar powered.

Figure 62. The gate structure and the check structure shown in the photographs have been automated using SCADA. Gate actuators allow for the gates to be raised and lowered from a centralized location.

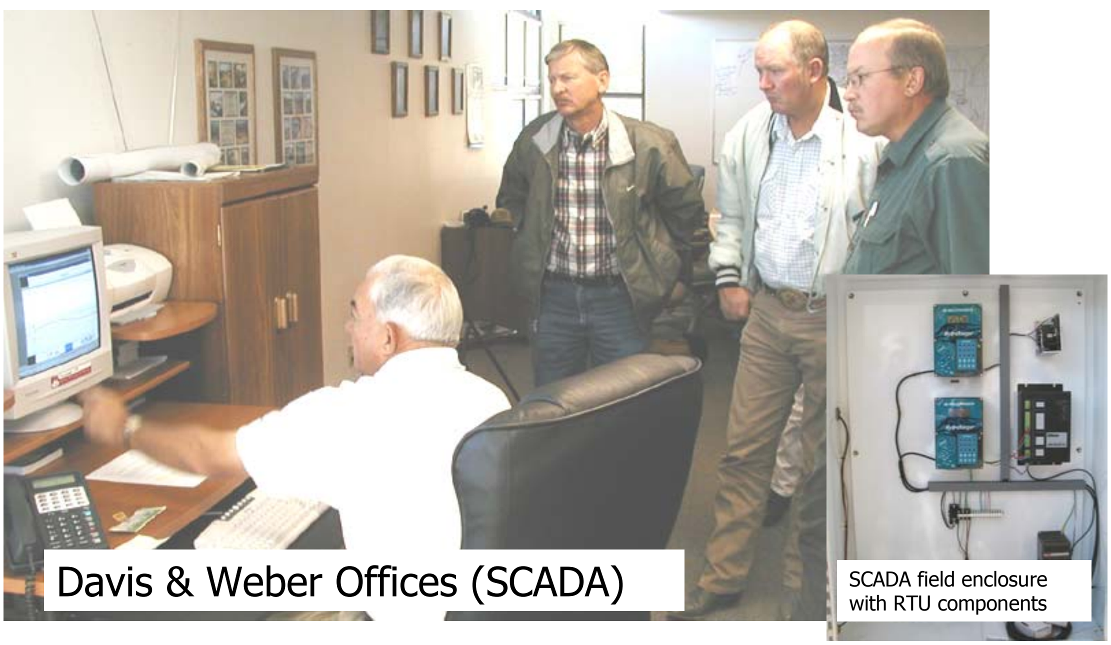


Figure 63. The Davis & Weber Canal Company in Utah, an innovator in pressurized secondary water, utilizes a SCADA system. The central computer in the company's office is used to monitor flows at field sites which utilize equipment such as that shown in the insert photograph.

Figure 64. A check structure of this type which consists of long crested overflow weirs and a sluice gate has gained notoriety as a modern and effective check structure that can be easily automated.

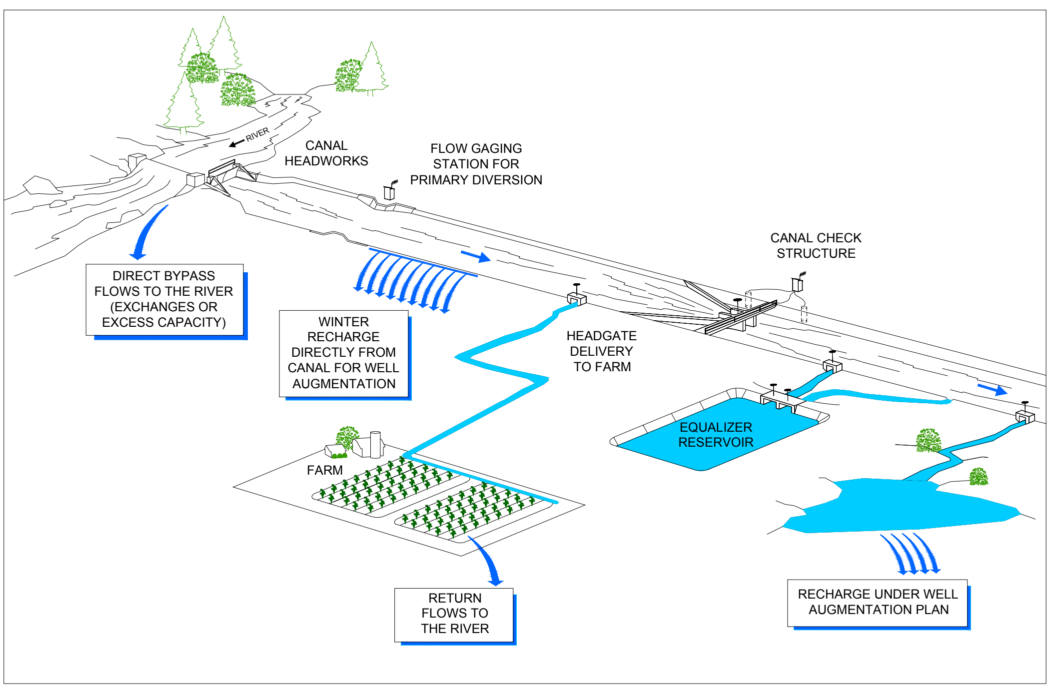


Figure 65. Concepts of diversion, delivery, return flow, and groundwater recharge to contribute to well augmentation plans under the ditch.

As urbanization occurred in the region, the potable water purveyors began to prefer, or even insist, that C-BT units be turned over to them in order to meet the raw water requirements for residential and commercial development (see Chapter 8, page 111-13). As noted in earlier chapters, once treated, much of this raw water continues to be used to irrigate landscapes today. It is estimated that one-half of the annual water treated for potable use is applied to the residential areas of northeast Colorado for outdoor use on landscapes. This does not appear to be practical as a long-term policy. Furthermore, it appears to contribute significantly to municipal perceptions of "water scarcity," further driving municipalities to artificially inflate the economic value of the region's water supply.

Today, C-BT water is the most desirable supply for municipal potable water needs because these water rights are the most predictable and dependable from a municipal standpoint. This demand has increased the market value of C-BT water over the years, and has caused the unit price to more than quadruple in the last decade of growth. Each year the Northern Colorado Water Conservancy District determines an allotment associated with this acre-foot. Dry years have a high allotment (70 to 100%) and wet years generally experience a low allotment (50 to 70%).[2] The 2002-3 market price for C-BT water continues to hold within a range of $12,000 to $14,000 per unit. One C-BT unit represents approximately one acre-foot of water.

For native water supplies, the historic annual yield and, therefore, the relative "wet water" value of shares of stock in the ditch companies, varies between companies and varies by year according to the priority of the company's river decree. A common scenario for many ditch companies is that their river decree is beneficially used to meet the early season water requirements through a certain average date, generally in July. These ditch companies then use storage decrees, when they are available, to complete the irrigation season. In addition, C-BT units owned by farmers and ditch companies are frequently used to finish the late irrigation season.

The Transition from Agricultural to Urban Use

The generalized water situation during a transition from agriculture to urbanization is best seen graphically in Figures 55, 56, and 57. Figure 55 shows the traditional agriculture scenario in northeast Colorado. As other water sources are exhausted, C-BT water helps to finish the growing season. This is facilitated by a declining rate of evapotranspiration as the irrigation season moves into the Fall season.

With urbanization (Figure 56), the C-BT waters are withdrawn from the agricultural equation as municipalities require landowners and developers to turn over C-BT water for potable supply. However, as shown in Figure 57, the net water supply for the region for both agriculture and urban needs may be improved in the process. Why? This improvement occurs when land conversion to residential use is combined with improved irrigation efficiencies from modern water management technologies for both agricultural and urban use. Consolidation of crop production on more highly productive land, improved irrigation techniques on this land, and more financially viable canal companies and irrigation districts as a result of providing pressurized secondary water service, all contribute to a strengthening of irrigated agriculture's economic position in the community. Improved irrigation efficiencies in agriculture benefit potable water purveyors, for it is clearly understood that, in the absence of additional water development in the region, future municipal water needs will have to come from agriculture. This will not be as readily possible if agriculture's use of water is not modernized. Again, it is believed that the modernization of agriculture's use of water will not occur if dependence on this change is left to being financed solely through current levels of farm income, rather than being assisted through secondary supply revenue earned by the canal company to modernize canal infrastructure.

The contributions from urban irrigation, by way of the use of secondary systems, that help to better utilize the native late season water supply and strengthen agriculture's position in the region, include:

- Residential acreage on less productive agricultural lands may increase the availability of water for more highly productive agricultural lands. This does not imply that less productive agricultural lands will always be the first to be developed, but only that there may be a tendency for growers to hold onto the more productive lands as late season water supply is improved in the canal company service area due to the provision of secondary water service and canal modernization.

- More and more over the years, new residential landscapes are likely to be irrigated with sprinkler systems or drip emitters. If pressurized secondary water systems do not result in this happening, higher municipal water rates in the future will accomplish it. Either way, if properly managed, these types of irrigation systems dramatically improve application efficiencies (Figure 58). In addition, traditional surface irrigation for agriculture is often assumed to have an application efficiency of 50%, meaning that only 50% of the applied water is beneficially used by the plant. By contrast, managed sprinkler irrigation may have an application efficiency of 80 to 85%. Drip irrigation may have an application efficiency of 90% or more. The pressurization of irrigated agriculture, in conjunction with the canal company's entry into secondary water service, will materially improve late season water supply.

- Overall irrigation management is likely to be improved. Many large urban landscapes are controlled by a central irrigation control system (a specific type of SCADA system) and sometimes day-to-day management is tied to an on-site weather station which provides for monitoring of real time evapotranspiration rates (Figure 59, next page). These same technologies can be used by the canal company, not only in the process of providing pressurized secondary water to residential property in its service area, but for optimizing agricultural water deliveries as well.

Taken together, improved irrigation efficiency and canal modernization can have a beneficial overall effect on lengthening the portion of the irrigation season in the region that is currently met using the native water supplies, whether direct flow or stored water. Furthermore, there is another important strategy that can be brought to bear, namely appropriate landscape plantings. A full discussion of appropriate plants and landscape treatments is beyond the scope of this report. However, it is viewed as an important part of the policy pertaining to pressurized secondary water supply. Some sustainable landscape strategies can be effectively implemented to complement secondary supply, many of which can be promoted by the canal company throughout its service area. These strategies include:

- Xeriscape design techniques and xeric plantings of native trees and shrubs.

- Open space plantings in drought tolerant or native turf grass varieties.

- Manicured and intensively irrigated bluegrass areas being confined to parks, sports fields, and areas of frequent and practical public use for sports and picnicking needs.

- Deficit irrigation of portions of the landscape to match available water. This can be on a year-to-year basis or for a portion of the season in a given year.

- Drip irrigation of all trees and shrubs. Separate laterals within the irrigation system can be used to irrigate the high-value trees and shrubs in the landscape. This strategy can also include trees and shrubs planted within turf areas that are sprinkler irrigated.


Figure 59. On-site weather stations.

These strategies are each in vogue in the field of landscape architecture as suitable for the creation of "sustainable landscapes." Provision of secondary supply, in and of itself, is a factor in sustainable landscapes. More importantly, the pressurized secondary supply provided by canal companies and irrigation districts is more sustainable because it can generate a revenue stream for these entities to modernize their canal infrastructure and, therefore, not only provide a more orderly transition of agricultural lands to urban uses than is occurring today, but also improve irrigation efficiencies in agricultural water use. No secondary supply, or better yet, a secondary supply provided by other than a traditional agricultural water supplier, such as by a homeowner's association or a municipality, although possible, will likely have no material effect on agriculture's use of water, and therefore, no water conservation potential for the larger community from improved agricultural water use.

An Analytical Model

As a part of this study, several data analysis modules have been developed to assist canal companies in assessing their potential as providers of pressurized secondary water. Chapter 8 presented a module on assessing the canal company or irrigation district's economic benefits from secondary water service. Chapter 9 discussed a standard engineering appraisal for canal companies and irrigation districts. The following module was developed to better understand how water use may be expected to change as build-out occurs in the canal company's service area, what water supply benefits may be expected to accrue to the canal company over time, and what the canal company should consider in the way of canal modernization as it enters into secondary water service.

It is important to note that the span of time between initiating secondary water service and full build-out of the canal company's service area will vary greatly. Canal companies and irrigation districts located in high impact urban development areas may be expected to see build-out occurring very rapidly, perhaps over a decade or less. Other enterprises may commence secondary water delivery to small residential subdivisions in the unincorporated areas of the county, but not experience full build-out for several decades. These build-out scenarios will depend on regional economic and demographic factors. In the interim, agriculture must adapt to change in the most economically competitive way possible. The way suggested in this report is to strengthen the financial and water management position of the agricultural water provider through secondary water service, and in the process of doing so, adopting new water management technologies to attain better irrigation efficiencies.

Since the example company considered here is privately held, the name has been changed herein to Hill Valley Ditch & Reservoir Co. We will assume that the Hill Valley Ditch & Reservoir Company is in a rapid growth area. C-BT units being utilized by farmers in the Hill Valley service area are regularly being handed over to the potable water purveyor as farmland is converted to residential subdivisions. As a result, the future of the ditch is looking somewhat bleak because it is difficult, if not impossible, to grow many crops without native water supplies and/or C-BT units. But more importantly, as water is withdrawn from the ditch, it will become more and more difficult to get water to the tail-enders of the ditch, where coincidentally, most of the development would probably not occur for yet many more years.

The Board of Hill Valley wants to consider the "what if" scenario of a future total build out of the company's service area. What might the company's water rights and ditch infrastructure look like in the near and distant future? Will people be farming in the area by the end of the decade? Should Hill Valley Ditch & Reservoir Company consider becoming the future raw water purveyor for residential and commercial developments within the service area of the ditch? Is there enough Hill Valley water, without C-BT units owned by individual irrigators or the canal company, to transition those farmers who still want to stay in agriculture through the long-term build-out process?

Each of these questions carries import to the Board and the Company. The module helps answer the question of the suitability of the company's native water supply for future urbanization. The answers help to understand whether the demise of the company is in the offing or, conversely, if there is a suitable future role of delivering raw water for landscape irrigation. If the latter is feasible, it would be a "repackaging" of the historic role of the ditch company (Figure 5, Chapter 1, page 5). Much could be gained by the company, those remaining in agriculture, the future urban irrigators, and the region.

Table 19 in the model calculates acreage to be served by the pressurized secondary system. This acreage is based on the predicted types of non-agricultural landscapes that will be developed in the canal company service area over a set period of time, say in the next 5 years.

TABLE 19

Hill Valley Ditch & Reservoir Co.

SERVICE AREA AND LANDSCAPE TREATMENT ASSUMPTIONS

Total Service Area =	**7,000**	**acres**
Landscaped Area as % of Gross Area =	**40%**	
Probable Irrigated Area with Urbanization =	**2,800**	**acres**
	IRRIGATED AREA (acres)	
Irrigated Landscape Treatments:		
Greenbelts	200	
Open Space	500	
Golf course	200	
Schools	30	
Parks	20	
Res. Landscape	1,400	
Com. Landscape	300	
Streetscape	150	
TOTAL	**2,800**	

Table 20 (next page) provides a calculation of the annual yield from a variety of different water rights. This water right summation can then be compared to what is historically needed by agricultural water users under the canal system. The difference between the two might represent water rights available to supply an initial pressurized secondary service area. Additional water savings can be calculated for various canal modernization efforts as well. These might include canal lining, piped pressurization of water deliveries, improved water measurement, and groundwater augmentation programs (Figure 65).

Table 21 (page 151) presents a review of bluegrass water requirements as a conservative estimate of residential landscape water requirements in northeastern Colorado. Manicured, lush bluegrass is the most water consuming plant grown in area landscapes, and therefore the "worst case" scenario as far as future residential water demand is concerned.

Table 22 shows results of the analysis, given the inputs from Tables 19, 20, and 21. In this scenario and with these inputs, Hill Valley Ditch & Reservoir Co. has adequate, and even more than adequate, early season water for irrigation in a normal year. This particular analysis shows that there is also sufficient late season water in a normal year. It should be pointed out that this conclusion is based on the landscape treatment assumption that 500 acres of the 2,800 landscape acres irrigated in its service area are planted in drought tolerant native grasses rather than bluegrass.

TABLE 20

Hill Valley Ditch & Reservoir Co.
HISTORICAL ANNUAL WATER RIGHTS

Direct Flow Water Rights			
		Historic Annual Yield/Share (acre feet)	**Historic Annual Yield (acre feet)**
shares	260	30	7,800
Reservoir Water Rights			
		Historic Annual Yield/Share (acre feet)	**Historic Annual Yield (acre feet)**
shares	160	8	1,280
Additional Reservoir Water Rights			
		Historic Annual Yield/Share (acre feet)	**Historic Annual Yield (acre feet)**
shares	370	3	1,110
Colorado Big Thompson Project (C-BT) Water Rights			
		Historic Annual Allocation (acre feet)	**Historic Annual Yield (acre feet)**
units	1,700	0.6	0
(presumption of no annual yield on C-BT as these units are turned over to the potable water purveyor)			
Well Water Rights			
quantity	10	100	1,000
Seasonal Total Available			**11,190**

Note the bold arrow in Table 22 highlighting the late season water consumption for the "Open Space" line item. In the module, the open space landscape irrigation treatment is presumed to occur mainly during the early season to ensure a good stand of native grasses in these areas. Open space irrigation could cease in a normal year as soon as the company's direct flow right was terminated. The remaining late season water supply would thus be preserved for the more important and heavily used public areas. The native grass open space areas would be allowed to go dormant (emulating the natural ecology of these grasses) during the July and August period.

The "Shoulder" Seasons

It is important for canal companies and irrigation districts to consider the so-called "shoulder season," a concept that is often applied to landscape irrigation. When water is available on demand to golf and park superintendents and homeowners, it is a common practice for them to irrigate in the springtime. This would be in April and early May before most ditch systems are operable. It is also common for landscape water users to irrigate well into October. However, in northeastern Colorado, the turf evapotranspiration rate is normally met by April precipitation. In May, only a small amount of irrigation is normally needed (3.70 inches) when ditch water is commonly available (Table 19). This suggests that for the northeast Colorado region, "shoulder season" irrigation is not as serious an issue as it might be in other areas of the state, such as in western Colorado or the Arkansas Valley.

Many ditch systems end their year about October 1st. Table 19 shows a small amount of "shoulder season" irrigation for landscapes in a typical October (1.57 inches). Most landscape irrigation systems are fully winterized by October 10th. It is frequently hard to justify acquisition of additional infrastructure or shoulder season water supply to meet this rather minor late season water requirement for landscapes. The benefit is largely aesthetic. There is no great risk of landscape loss, or even significant stress, when the shoulder season water requirements are not met.

Many golf courses and parks that are currently irrigated by raw surface water are adjusted to the operating periods of ditch companies. The shoulder season is not a significant problem to these landscape irrigators. In summary, the need for landscape irrigation during the shoulder season should not be a deterrent to a canal company or irrigation district providing pressurized secondary water supply in its service area.

Under some conditions it may be practical for the ditch to start up earlier in the spring and operate longer in the fall to accommodate changing shareholder makeup as urbanization occurs. Some ditch companies are known to start up their ditch when a certain cumulative minimum demand on the irrigation system is reached. Increased demands from the urban sector may make it practical to start the ditch somewhat earlier in the spring, or operate the ditch somewhat longer in the fall.

Severe Drought Response

The module (Tables 19, 20 and 21) clearly assumes a normal or historically typical year. For northeastern Colorado, 2002 was an eye-opening year for many long-time residents, and it would not be prudent to ignore the inevitable; namely, a future severe drought of the 100-year variety. As a community, we can expect future droughts and must be prepared with a workable response plan.

Drought response under the presence of pressurized secondary supply is not dramatically different from the present circumstances in the region, where potable water is used to irrigate landscapes. When it becomes necessary to reduce water applications on landscapes, it is generally necessary to curtail applications in proportion to the severity of the drought. If flexibility is available within the pressurized secondary supply system, and with the increased control and management of these systems, it becomes much easier to implement a drought mitigation strategy.

TABLE 21

Hill Valley Ditch & Reservoir Co.

IRRIGATED BLUEGRASS WATER REQUIREMENTS PER ACRE

	MAY	JUN	JUL	AUG	SEP	OCT	SEASON TOTAL
	--------	--------	--------	--------	--------	--------	------------
REFERENCE ET, INCHES	6.00	7.90	8.20	6.60	4.20	2.30	**35.20**
bluegrass							
EVAPOTRANSPIRATION, INCHES	4.80	6.32	6.56	5.28	3.36	1.84	**28.16**
NORMAL PRECIPITATION, INCHES	2.45	1.50	1.18	1.02	0.78	0.78	**7.71**
EFFECTIVE PRECIPITATION, INCHES	1.84	1.13	0.89	0.77	0.59	0.59	**5.78**
IRRIGATION REQUIRED, INCHES	2.96	5.20	5.68	4.52	2.78	1.26	**22.38**
OPERATING LOSSES, INCHES	0.74	1.30	1.42	1.13	0.69	0.31	**5.59**
IRRIGATION APPLICATION, INCHES	3.70	6.49	7.09	5.64	3.47	1.57	**27.97**

NOTES:

1) Effective precipitation is estimated at 75% of normal precipitation and presumes common wire sensors for rain shutdowns.
2) Overall irrigation operational efficiency is estimated at 80% under a presumed sprinkler irrigation system.
3) Analysis is based on average conditions. Year-to-year evapotranspiration may be 20% plus or minus.
4) The crop coefficient for irrigated bluegrass is assumed to be 0.80.

Under secondary water supply, drought response may fall entirely to the secondary system. It may not even be necessary to curtail indoor uses (bathing, culinary, laundry or sanitation) at all, but rather allowing the secondary system to absorb the drought mitigation entirely. This may provide increased insurance and increased confidence in existing potable water supplies, as buildout occurs in northeastern Colorado. Allowing the secondary system to absorb the drought mitigation may also provide opportunities for the public to better understand and accept drought response measures.

Drought response within a secondary supply system may require measures that gradually build to appropriate levels, as in the following sequence of increasingly severe response steps. These are policies that a canal company could institute when needed as part of its secondary service policy, and could be designed in such a way as to secure water as long as possible for the more valuable plants, ornamentals and trees.

1. Begin a deficit irrigation program for all turf grass plantings. Exempt drip irrigated trees and shrubs.

2. Discontinue irrigation of all drought tolerant or native plantings. Continue drip irrigating trees and shrubs within those areas.

3. Severely curtail, or even discontinue, irrigation of bluegrass plantings. Continue drip irrigating trees and shrubs within those bluegrass areas.

4. Curtail drip irrigation of trees and shrubs.

TABLE 22

Hill Valley Ditch & Reservoir Co.
IRRIGATION WATER REQUIRED v. WATER AVAILABLE
FOR IRRIGATED LANDSCAPES UNDER FULL URBANIZATION IN A NORMAL YEAR

Total Service Area = 7,000 acres

WATER REQUIREMENT

Treatment	Planting	IRRIGATED AREA (acres)	Early Season MAY ac-ft	Early Season JUN ac-ft	Late Season JUL ac-ft	Late Season AUG ac-ft	Late Season SEP ac-ft	canal out OCT ac-ft	SEASON TOTAL ac-ft
Greenbelts	bluegrass	200	62	108	118	94	58	26	**466**
Open Space	native grass	500	154	271	0	0	0	0	**425**
Golf course	bluegrass	200	62	108	118	94	58	26	**466**
Schools	bluegrass	30	9	16	18	14	9	4	**70**
Parks	bluegrass	20	6	11	12	9	6	3	**47**
Res. Landscape	bluegrass	1,400	432	758	828	658	405	183	**3,263**
Com. Landscape	bluegrass	300	93	162	177	141	87	39	**699**
Streetscape	bluegrass	150	46	81	89	71	43	20	**350**
Total irrigated area		**2,800**							
TOTAL →			864	1,515	1,360	1,082	665	301	**5,786**

Early season water requirement →	**2,379**
Late season water requirement →	**3,106**
ENTIRE SEASON WATER REQUIREMENT →	**5,485**

WATER AVAILABLE

Direct flow right →	**7,800**
Reservoir rights →	**2,390**
Augmented wells →	**1,000**
ENTIRE SEASON WATER AVAILABLE →	**11,190**

SEASONAL SURPLUS POTENTIAL

Bypassed Flow Potential or Potential for Well Adjudication / Recharge **5,421**

NOTES:
1) It is assumed that Hill Valley's direct flow right will be the water source during May and June in an average year. No direct flow right is anticipated in July.
2) It is assumed that reservoir water or well water will be the water source after July 1st and into August and September.
3) As a practical matter, Hill Valley D&R canal shuts down for the year at October 1st so no delivery is possible after that date.
Hence, water requirement for October is not included in the analysis. Most landscape irrigation systems are winterized by Oct. 10th.
4) Table 22 is based on a presumption of full build out into urbanization. Naturally, this process would take years but an analysis of full buildout is used for simplicity.

Clearly, these steps assume that a certain minimum flexibility is built into the main secondary supply system, and into the individual landscape irrigation systems on the residential and commercial lots. Under severe drought, it is more important to save the high value trees and shrubs. Turf grasses can be more easily replaced, or drought tolerant grasses can go into dormancy. Another important drought mitigation management component is centralized irrigation control, which can be used to irrigate in complete accordance with local evapotranspiration rates, or to more easily implement deficit irrigation programs.

One note is interesting in reference to bluegrass and bluegrass tolerance of drought. It was noted earlier that lush and manicured bluegrass is the most water consuming plant material found in northeastern Colorado landscapes. However, there is an important qualification to this. Bluegrass has been found to be quite drought tolerant. If bluegrass does not receive adequate precipitation or irrigation, it goes dormant and will vigorously reappear when water is available later in the season or the following year. Only small areas of bluegrass have required replanting in parks and open spaces that have suffered severe drought and stringent water restrictions. Other varieties of turf grass do not fare nearly as well as bluegrass under drought conditions.

Irrigation in Winter

Colorado experiences wintertime periods without snow, when trees and shrubs can be desiccated and stressed. Ideally, water would need to be applied during the winter months to meet this occasional need. However, most secondary supply systems will be designed to be closed down during the winter months.

At least two potential solutions come to mind. If the ground has warmed and the frost is largely out, as with most desiccation periods, the irrigation system could be activated, used, and then re-winterized in prolonged winter drought. This practice is known to occur in southern Utah where secondary systems have recently been installed. Another alternative is to use a single potable water hose bib on the residence or commercial building to irrigate trees and shrubs. This practice already occurs in residential and commercial landscapes irrigated entirely with potable water. Even without an external potable water hose bib, irrigation of desiccated trees and shrubs during the winter could be performed by hand from internal culinary supplies. The point is that designing pressurized secondary water service for the normal irrigation season, rather than designing it to accommodate highly variable shoulder seasons, has not been found to be a limiting factor to the success of these systems elsewhere, such as in Utah and Idaho.

Secondary Supply Infrastructure

Secondary supply for irrigation requires an additional water utility within the residential area. We have argued consistently in this report that canal companies and irrigation districts can operate as secondary supply providers, obviating the need for organizing a new water utility. In any event, each open space area and residential lot will have a completely separate pipe network and point-of-connection for raw irrigation water (Figure 60). The likely primary components of the secondary system are a diversion from the ditch or canal into a storage pond, a pump station, filters, pump controls, large distribution piping, and points of connection to the landscaped open spaces or residential lots. From a technical and engineering perspective, there are several nuances in how to approach dual systems in order to supply raw water for landscape irrigation.

The primary questions to answer relative to water rights are:

- Are the water rights suitable to the mature landscape needs in quantity, quality, and seasonal availability?
- Is water storage necessary?
- Are there local standards, imposed practices, or design guidelines to the approach or the equipment?
- Who will construct, manage, maintain, and ultimately replace the raw water system?
- Will potable water hose bibs be allowed on the structures? [3]

The primary questions related to delivery infrastructure are:

- Will the irrigation water be metered?
- Will the piping be located at the front or the back of the lot? If allowed at the front of the lot, will it be in the street?
- Are offsets from other utilities required, and if so, by which governing entities?
- Is the pipe network to be installed below the frost line?
- Are there signage or equipment color-coding (pipe or valve box lid) or education issues to be addressed?

Secondary raw water supply for irrigation involves constructing an additional utility within the residential development. It is estimated by this study that the cost to install a secondary water system ranges from $1,500 to $3,500 per lot, depending on the lot size, density, and system design guidelines (see Chapter 8). A typical pressurized secondary system for a residential development with 8,000 square foot lots would cost from $2,000 to $2,500 per lot.

System Sizing and Operation

There are three ways that secondary supply irrigation systems can be operated. They can be operated on-demand, on a fixed rotation, or some combination thereof. "On-demand" means that the residential or commercial user of the secondary system is allowed to irrigate at any time of the day or night. "On-rotation" means a fixed period of time in which certain tracts or divisions of the system are allowed to irrigate. A combination of these two would occur when the irrigation system is operated on demand, but within a fixed time window (night time hours, for instance).

As with any irrigation system, the system capacity is based upon the irrigated area, application efficiency, peak season evapotranspiration, days of operation per week, and the allowable daily irrigation window. The major difference between a secondary water system to individual home sites and a large golf course irrigation system is the number of irrigation system managers involved. In the case of a golf course, one irrigation manager is typically in charge of scheduling and operating the irrigation system. This allows the pump station and mainline pipe to be sized to operate at full capacity for a given window of time, say 8 hours per day. This type of user is very predictable and is represented by a relatively flat demand curve over time. The demand, and therefore the flow rate of the irrigation system, ramps up to full capacity over several minutes at the start of the irrigation window. It then runs at capacity until the demand drops at the end of the irrigation window.

By contrast, a secondary water system for a typical 80 acre housing development may have 200 to 400 individual lots, in addition to common open space areas. These systems must be designed to accommodate 200 to 400 individual water managers, most of whom are homeowners who have little or no experience in operating or managing irrigation systems.

One way to design and manage a secondary system for subdivisions is to impose tight irrigation watering windows for each lot. For example, group 1 lots would only be allowed to irrigate between the hours of 12 midnight and 3 a.m., Monday, Wednesday, and Friday. Group 2 lots would be allowed to operate between 3 a.m. and 6 a.m. Monday, Wednesday, and Friday, and so on. While this approach to system design can reduce the installation cost of the secondary water system and maximize pump station operating efficiency, it is generally difficult to manage and may impose overly restrictive conditions on homeowners.

What often happens is that the restrictions are not clearly indicated to new homeowners by real estate agents, builders, or original homeowners when they sell the home. Over time, the rules and order can break down leading to overall homeowner dissatisfaction with the secondary water system. This has been observed when homeowner's associations try to manage large secondary systems. Irrigation systems that require users to follow very narrow operating parameters are generally only successful when there are a small number of lots or customers, such as in estate lot residential development with a very strong and active homeowner's association in place.

Another approach is to design the secondary system based on lawn watering restrictions commonly imposed by potable water purveyors when potable water is used for irrigation. In northern Colorado, it is common to encourage homeowners to irrigate every other day, or every third day during a drought. Using this as a basis for design, the pressurized secondary water system would be designed to allow between one-half and one-third of the lots to irrigate on any given day.

It is common to limit the flow from an individual residential tap to 10 GPM, the typical flow allowed by systems using potable water under a typical 5/8" or ¾" water meter.[4] Sizing a secondary water system to allow the simultaneous operation of half of all irrigation services in a typical development consisting of 7,000 square foot lots is very conservative, and generally results in excessive pump station capacity and distribution pipe sizing

Whichever method is used for estimating peak flow, the pump station and distribution system must be sized to accommodate the peak flow. Hydraulic network analysis software is very useful in analyzing pipe sizing for secondary systems. Typically, the distribution pipe is sized to keep velocities below 5 feet per second. In many instances secondary water systems are installed in phases and some upsizing of the distribution pipe may be required to accommodate future project phasing.

The irrigation pump stations must be designed to provide consistent pressure over a wide variation in flow. Pump stations with variable frequency drives (also know as VFD pumps) are typically utilized because of the operational flexibility that VFD stations afford.

A typical system pumping water from a storage pond will include a pond intake screen, intake pipe, wet well, multi-pump prefabricated pump station, and automatic self-cleaning filter. Generally, a two or three pump system is adequate. However, three or four main pumps are provided on large secondary water systems, or where redundant pumps are required to meet maintenance or specific owner requirements. Figure 66 shows a large pump station serving several thousand homes in North Ogden, Utah under the Pine View Water Users Association. These large pump stations are believed to represent much more sustainable secondary systems than some of the smaller pumps being installed near excavated ponds in the middle of small subdivisions along the Colorado Front Range, or in some of the pressurized lateral secondary systems found in the back yards of Grand Junction, Colorado.

Figure 66 - Pump house of the Pine View Water Users Association, North Ogden, Utah

Where possible, the existing diversion structure and headgate that has been in place historically to control the delivery of water for agricultural use can be maintained for the secondary water system as well. However, frequently the existing diversion does not work with the site layout and grading. In these instances, a new diversion structure, headgate, flow measurement structure, and diversion ditch or pipe may be required. In some cases, pumps are required to lift water from the diversion structure to a storage pond. The lift pumps must be capable of diverting water to the storage pond within the constraints imposed by the ditch company. For example, the lift pumps may have to be designed to pump at the same delivery flow rate that was used historically with the gravity diversion system.

<u>The Landscape Irrigation System</u>

A full discussion of the landscape irrigation system and the components of these systems is beyond the scope of this report.[5] It should be noted however that the better quality commercially available equipment from all the major manufacturers is quite compatible with raw water sources as long as the raw water is filtered to the minimum level suitable to the equipment. Filtration levels meeting this need are necessary and routinely accomplished with many landscape irrigation systems today. Figure 60 shows photos of typical common area landscape irrigation systems that are quite compatible with pressurized secondary supply systems.

<u>The Role of Canal Modernization</u>

Canal modernization can include replacement, upgrades, or new construction of any or all of the following:

- Primary diversion headworks.
- Headgates.
- Check structures.
- Flow measurement flumes or weirs.
- SCADA implementation for monitoring of flumes and water surface elevations.
- SCADA implementation for gate actuation.
- Canal lining (concrete, membrane, PAM)
- Piping and pressurization.
- Reservoirs (equalizer, storage, or recharge reservoirs).

Many of these improvements can be financed through secondary water service. As discussed in an earlier chapter, the rate charged for secondary water service can be much greater than the rate for agricultural shares, but still substantially lower than the rate charged by the local potable water provider. So, all parties may benefit. The developer has saved money in terms of decreasing the amount of C-BT units required for his subdivision development, provided that the local potable water provider cooperates in this way to promote secondary water systems in the region. The potable water purveyor benefits additionally by being able to delay or even forgo expensive water treatment facility expansion. The mutual irrigation company has a new revenue stream from secondary water service in which to modernize its water delivery system. The State of Colorado will experience ongoing beneficial use of an accredited water right. Finally, the homeowner has a lower cost water source for irrigation as compared to the potable water source.

However, provision of secondary supply puts new infrastructure demands on the ditch or canal system. Increased operational flexibility, new storage, pump stations, filtration, and pressure piping are all components of the secondary system that have implications to the canal company. Canal modernization logically derives from new service demands on the irrigation system, but at the same time can be financed with revenue coming from providing secondary service. It may also greatly improve water use on the remaining agricultural lands in the canal company's service area.

"Canal modernization" is a catch-all term for any aspect of canal improvement that helps the canal company to better deliver water to shareholders and irrigators. Figures 61 through 64 show some of the major canal modernization efforts being undertaken by canal companies and irrigation districts in the region, including supervisory control and data acquisition or SCADA systems. Other canal modernization efforts include the use of more accurate weirs, lining of canals with new fabricated materials other than concrete, and water delivery and accounting packages.

Over the past five years, SCADA equipment has matured considerably as far as canal system operations are concerned. There are a number of successful projects built and operating, whether new SCADA systems or upgrades. From most canal or ditch company perspectives, it is a good time to implement SCADA because SCADA technical features have improved substantially in recent years while the implementation costs have generally decreased. Clearly, a SCADA system should allow for solar powered field sites (remote terminal units or RTUs, gate actuators, and communication equipment) as shown in Figure 61 and 63, and communication should be readily adaptable to all the anticipated field locations.

Some of the existing SCADA systems on canals allow for "remote manual control" wherein an operator is able to make gate adjustments from a centralized location. Some newer SCADA systems allow for either partial or full automation of canal operations. It is desirable to design a new SCADA system suitable to remote manual operation, while setting the stage for transition to full automation of the canal, with a suitable algorithm that meets operator confidence.

The SACMAN (Software for Automated Canal Management) program developed by the USDA-ARS Water Conservation Laboratory in Phoenix, Arizona is an alternative for fully automated canal operations. SACMAN is commercially available. The Central Arizona Irrigation and Drainage District (CAIDD) project is currently using this program after implementing a complete SCADA system replacement in 2002. The results of CAIDD's replacement and costs were reported recently in the irrigation literature. [6] The system has proved cost effective because of the use of 900 megahertz spread spectrum radios (no federal licensing required), use of a common and commercially available SCADA front-end software, and use of lower cost field equipment.

A demonstration of SCADA for a single site was recently completed for a local canal company in northeast Colorado. Figure 61 shows the site of a rated section of a ditch in the region. This location has historically been monitored by a Stevens recorder device and a float, in addition to a required manual reading twice a day. With SCADA, the water surface elevation through the rated section is recorded every few seconds and the data is posted to the ditch company's web site every half hour. As with most sites along a ditch, it would be uncommon to have telephone or 110 VAC power nearby. Therefore, most SCADA installations transmit flow data by radio and utilize solar panels to power the equipment. Reliability is quite high. Gate actuators that are powered by 12 or 24 volt DC power can be used to automate gates such as those shown in Figure 62.

Figure 63 shows the screen interface for a SCADA system inside a canal company office. It should be intuitive to the operators and the application software available today makes it possible to design both logical and flexible interfaces for the SCADA system.

Figure 64 shows a check structure that has gained favor and recognition as an effective and practical approach to checking the canal and control of water surface elevations. This structure is very easily actuated under a SCADA control system and upstream and downstream stilling basins can be utilized in further monitoring or even operation automation.

As a complementary and related aspect of canal modernization, some ditch companies are implementing recharge programs that allow the ditch company to augment wells (Figure 65). Well augmentation strategies are often a direct response to the legislative and legal issues that arose in 2002 regarding whether or not existing well augmentation programs were fully augmenting well depletions. A recharge program is another way in which the ditch company can add value to the company and to shareholders. It is anticipated that new recharge programs will be overseen by the State of Colorado under more stringent and more frequent reporting standards. SCADA monitoring of the groundwater operation plan may prove necessary under some circumstances because of the reporting demands that the state water court may impose.

Secondary supply considerations, if perceived favorably within the mutual irrigation company, afford many of these additional canal modernization opportunities to the ditch company. The mutual irrigation company may also develop an organizational mechanism to acquire additional native water supplies, much in the way that municipal water suppliers demand raw water from developers to meet residential needs. Such acquired water rights to provision the secondary system may become "treasury stock" in the canal company, or a different type or class of stock.[7] This water is then delivered to urban irrigators as pressurized, filtered, "on demand" water suitable for landscape irrigation. Such an approach expands the ditch company's role and infrastructure. It may require additional staff, new maintenance, and new repair requirements. It may be a somewhat dramatic change to "normal operations." However, this may be the only way in which these 100-year old enterprises can remain viable in the face of urbanization and other changes occurring around them.

[1] *Comprehensive Annual Financial Report 2001*. Finance & Accounting Dept. 2001. Northern Colorado Water Conservancy District, Loveland, Colorado.

[2] This is a reversal from what one would normally expect. The allotment is based on considerations of storing and delivering water to meet dry year and late season watering needs.

[3] Hose bibs are exterior valves or faucets on the residence or building for the connection of a hose for landscape irrigation or other incidental outdoor water requirements.

[4] It is interesting to note that a larger 1-inch tap and somewhat higher flow rate of 20 GPM is desirable for the homeowner because system cost is less due to fewer valves, less wiring, and a smaller controller. Taken together the cost of the irrigation system can be substantially less for a larger available flow.

[5] The reader is referred to Smith (1997) for information and details of drip and sprinkler irrigation appropriate to landscapes.

[6] Clemmens, A.J., et al. 2003. *Application of Canal Automation in Central Arizona*. Proceedings of the 2nd International Conference on Irrigation and Drainage, U.S. Committee on Irrigation and Drainage, Phoenix, Arizona. May.

[7] The term "treasury stock" is traditionally used to describe canal company stock "which has been issued and disposed of for a valuable consideration and later found its way back into the company treasury, or which has been issued but is being held by the company pending its sale." W.A. Hutchins, *Mutual Irrigation Companies in California and Utah*, Farm Credit Administration, Bulletin No. 8, October, 1936.

CHAPTER 11

CONCLUSIONS

This study was designed to provide new information on innovations occurring in the Rocky Mountain region in the area of secondary water management. These water systems, part of the so-called ”dual systems” trend occurring in the region and elsewhere in the West, are likely to be an important part of future water management and policy in the region. Although the concept is not new, what is perhaps new is the idea that these systems could be developed and operated by traditional canal companies and irrigation districts as a means of helping agriculture adapt to the inevitable urbanization occurring in the region.

Most of these agricultural water suppliers originated in the river bottom lands and bench lands of the region. This is where early settlement occurred, where agricultural production first took place, where the trees grow today, where the river now courses through old trade centers that have now become metropolises, and where the beaver dams have been replaced by river walks, romantic benches and ornamental light posts in turn-of-the-century style.

As subdivision development occurs in the unincorporated areas of counties, irrigation canals are beset with many problems having to do with this urban development. There are more than occasional cases of canal vandalism and drownings, and there is the ever present problem of trash in canals. Urban encroachment on canal rights-of-way occurs from thoughtless residential construction of fencing and other property improvements across or on canal systems. Finally, as water is acquired by municipalities for potable supplies, thereby diverting much water out of irrigation ditches to the point where it is often difficult to get water out to the remaining irrigated lands, the community is left with abandoned concrete and mosquito-infested ditches in the backyards of older residential areas.

It is true that many farmers realize great benefit from urban growth and land sales. However, many other farmers are left behind with the task of coping with what is left of their canal company and its water rights. Agricultural production in the unincorporated areas is diminished, and rural trade towns experience reduced economic activity as a result. Those remaining in agriculture often become discouraged with the future, sell the farm and move to more rural areas, or exit agriculture altogether. Everyone waits for the land developer to arrive. They wait, and wait, while radio talk shows and T.V. special reports lament the demise of farming, or criticize its practices.

Meanwhile, water conservation in agriculture is touted by environmental groups as an essential part of addressing future water shortages, rather than building more water development projects. However, water conservation in agriculture comes at a cost. It involves canal delivery improvements, as well as improvements in the use of water on the farm. To ask farmers to pay for conserving water, in order that water can be made more available for urban, recreation and wildlife uses, seems highly inequitable. By allowing, and promoting, the involvement of canal companies and irrigation districts in secondary water management, new agricultural water conservation technologies can be paid for by revenue earned from residential water users, rather than being paid for by already scarce farm income. This is a valuable income transfer to irrigated agriculture, but one that actually involves a reduced cost to residential water users as well. These reduced savings in residential water costs are transferred from financing additional treatment facilities to financing canal infrastructure improvements. Treatment facilities do not conserve water. Canal improvements and on-farm irrigation improvements do conserve water, but they must be financed by those who will use the conserved water, not farmers. The involvement of canal companies and irrigation districts in the provision of secondary water is an excellent way of accomplishing this water conservation goal in a more equitable way.

This study has proposed that canal company and irrigation district assets continue to remain valuable to the community, and perhaps can be used in such a way as to provide both opportunities for growth and opportunities for farmers to stay in agriculture for as long as they wish. It is not a planning approach to the issue. It does not involve land use controls. It does not infringe upon property rights in a negative way. It involves taking a 100 year old enterprise, often with several employees and machinery and equipment, and modifying it a bit in the direction of converting its assets into revenue streams sufficient to finance canal system upgrades, and to modernize irrigated agriculture in order to conserve water for other uses. In doing so, the pool of water in the region represented by agricultural water rights is diverted in an orderly way to urban uses, but in such a manner as to accommodate continued, and improved, agricultural production. In the process, there is an opportunity for the orderly transition of agricultural lands to urban uses.

In the ongoing dialogue about what to do about the region's future water supplies, it is often the more subtle approaches that make a difference, such as the one discussed in this study. It is argued in this report that it is short-sighted not to think about the future in a practical way. Water development must be blended with new approaches to utilizing this resource. The price of water in the future will probably govern whether the residential landscapes in the future continue to sport bluegrass, or begin to look more like residential areas in Santa Fe, New Mexico. Urban sprawl is a function of municipal zoning and county land use policy, not whether or not canal companies innovate by providing pressurized secondary water as a means of coping with encroachment on to their canal systems. This study is really not about this concern, although we have argued calmly that our society has always emphasized the provision of choices in lifestyles, rather than strictures, and therefore should accommodate some land development rather than simply packing people into dense, treeless, living spaces. On the contrary, the study is about how to ensure that agricultural production can be continued in the region safely, economically and beneficially to the larger community, as the inevitable process of urbanization continues.

It simply is not known what the future will hold in regard to agricultural production and food security.[1] Agricultural production, and income from agricultural production, two distinctly different economic issues, have their ups and downs. Global food reserves swing back and forth over the years between glut and scarcity, as does the general economy. With this said, let us take one more look at what is occurring in a small community in Utah, in an effort to maintain agricultural production, conserve water, and improve the quality of life in a small rural trade center. It is a humble example of the central theme of this study, but one that conveys a message that cannot easily be ignored.

Seminar on the Interstate

The City of Coalville, Utah, sits roughly at the intersection of Interstate 80 and Chalk Creek. The community is located a few miles east of Park City, Utah where some of the 2002 Winter Olympic activities were held. It has a population of about 1400 people, not including the outlying new subdivisions and farm residences spread throughout Chalk Creek Valley (Figure 67 and 68). One would tend to miss it while zipping along the Interstate. If anyone has ever served on the board of a ditch company, the water problems in Chalk Creek Valley will sound familiar. A new secondary water system for the community was an idea that unlocked carefully guarded ditch water rights serving a closely knit, water scarce, community of irrigators in the valley. By all accounts, it was not an easy sell.

This pressurized secondary water project involved the City of Coalville, Utah and six small irrigation companies in the valley. The irrigation companies were characterized by interlocking water

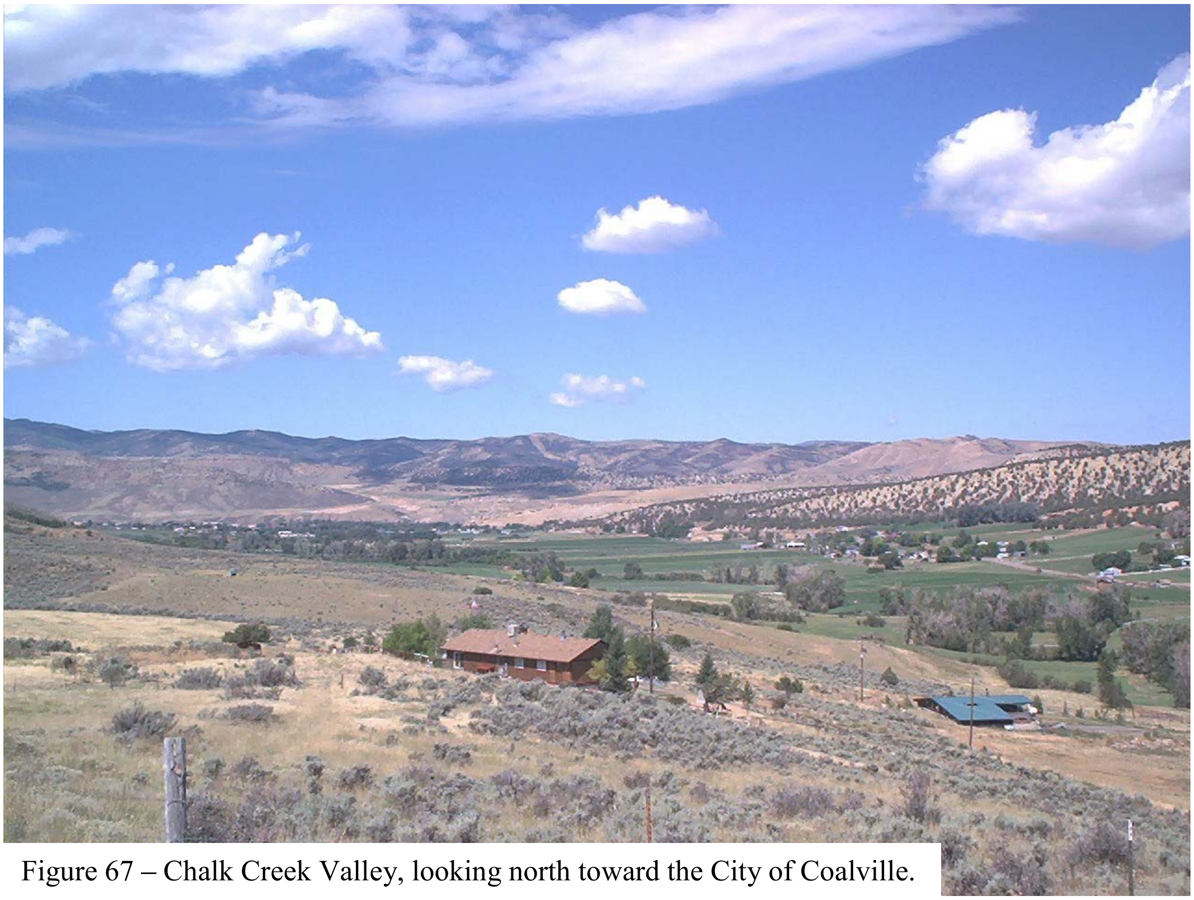


Figure 67 – Chalk Creek Valley, looking north toward the City of Coalville.

rights and use of return flows, suggesting a hornet's nest of potential problems to overcome in such a cooperative venture. Historically, the community and the irrigators in the valley had severe water shortages. This helped the effort to some degree. Irrigating for a third cutting of hay was certainly a rarity, most certainly not in August, as shown occurring in a recent photo (Figure 68). There were also some water quality problems with the valley's water supply.

These parties came together over a period of time to develop a pressurized irrigation system for the valley, for both the growers in the area and for lawn and garden water needs in the community of Coalville. All agricultural irrigation in the valley is now pressurized, where previously there were only open, leaky ditches. It is a small secondary system, but nevertheless demonstrates the importance of agricultural and municipal partnership in the development of these systems. The results of the project are very similar to those of the much larger Davis and Weber Counties Canal Company discussed in Chapter 6.

The pressurized system for agriculture delivers water to about 900 acres of small farms in primarily hay ground. Six separate canal diversions off Chalk Creek were consolidated into one pressurized diversion serving all of the valley farmers (Figure 69, page 166). In the process of developing the secondary system, a parent irrigation company, the Chalk Creek Narrows Irrigation Company, was formed to manage the pressurized water system for farms in the valley as well as the Coalville pressurized secondary system. In short, the water rights (stream diversions) of the six irrigation companies were pooled into one diversion point off Chalk Creek to pressurize the entire agricultural and municipal water supply in the valley.

Figure 68 – Irrigation in Chalk Creek Valley (Coalville to right), August 11, 2003.

Over the years, the city had acquired shares of stock in several of the irrigation companies to further develop its limited water supply of chlorinated wells. There were discussions about new, but expensive, water treatment facilities, if and when the city outstripped its chlorinated well supply. However, the possibility of working with the ditch companies in the valley would require that these entities be able to maintain their original identities. Of course, that is the way it is with ditch water in the West! The consolidated Chalk Creek Narrows Irrigation Company accomplished this by ensuring that a representative from each of the six ditch companies would have a seat on its board of directors, along with municipal representation. Although these smaller irrigation companies have maintained their identity, the newly formed Chalk Creek Narrows Irrigation Company now effectively manages the water rights of all entities in the valley, offering a smooth management scheme for the valley's agricultural needs as well as the municipal's secondary system.

As the valley widens down to the City of Coalville (Figure 68), the secondary system delivers water to approximately 1700 acres of residential, institutional and hobby farm ground in the incorporated community. There are about 450 lots with culinary water connections in town, 250 of which now have a separate pressurized secondary line into the lot. No meters are required for the residential connections, but every new home built must be connected to the secondary system and must have sprinklers installed to irrigate lawns and gardens. The plan is for all lots in the community, old and new, to eventually have pressurized secondary water. The project is in its initial stages.

The Utah Division of Water Resources was a major funding source for the project, and more of its role will be mentioned below. However, of particular importance in terms of the focus of this study is the role played by the U.S.D.A.'s Natural Resources Conservation Service (NRCS). This federal agency was instrumental in providing essential design work in support of pressurizing the agricultural irrigation system in the valley. NRCS was not a principal funding source. Rather, the agency contributed a substantial amount of "in-house" staff time to the engineering of the agricultural irrigation system. However, the on-farm irrigation improvements were funded through traditional NRCS/Farm Service Agency cost-sharing programs. The state's Assistant State Conservationist has been a leader in exploring innovative ways to link federal and state funding to improve agricultural production while providing opportunities for water conservation through new irrigation technologies. In short, as with the strategy put forward in Chapter 3 (page 33-34), there has been a significant "marriage" between the Utah Division of Water Resource's mission objectives and those of the Natural Resources Conservation Service in Utah.

There were no group lateral projects funded by federal cost-sharing programs, although this was presumably an option. Rather, improvements to the off-farm irrigation system in the valley were financed through a 0% interest, 25 year loan of $750,000 taken out by the irrigators. The lending agency was the Utah Division of Water Resources. The municipality then took out a 25 year loan from the Utah Division of Water Resources for $2.3 million at 1% interest to construct the pressurized secondary system for the town residents.

The Utah Division of Water Resources was reportedly somewhat skeptical about the potential success of the project. Bringing together six separate ditch companies with their own water decrees was viewed as a difficult task at best. However, the way in which the valley irrigators and community pulled together to make the project possible made it easy for the agency to lend money at low interest to such a potentially worthwhile project. The project not only addressed a long-standing water quality problem in the watershed, but contributed to water conservation, while improving agricultural production considerably. Finally, it infused in the town residents a spirit of commercial revitalization and hope in the community's future.

Figure 69 – Chalk Creek diversion for pressurization of both agricultural and residential water use.

There were a few extenuating circumstances that led to the success of the project, in addition to a few key local residents who spirited the project forward. Although the Coalville area did not qualify for Colorado River Basin Salinity Program funds, due to the fact that the Chalk Creek watershed is not in the Upper Basin of the Colorado River but rather drains westward toward the Great Salt Lake, an additional block of money to finance the project came from the Environmental Protection Agency's 319 program, which is a water quality program. One of the NRCS contacts for Summit County, Utah, felt that this was an important component in pulling the community and the project together.

The community and the agriculturalists had been having severe drought problems in recent years. In addition, there had been a general economic depression in the community for several years. The farms were not producing well and the limited culinary water supply was not adding to the quality of life in the community. The bottom line, as far as the community residents were concerned, was that developing the secondary system was going to be much cheaper than building additional water treatment facilities to improve the culinary supply.

Much as in the case of the Davis and Weber Counties Canal Company, the secondary system was built to serve all of the residents in the community. In the process of designing the water system in this way, they had to charge all households for secondary water, regardless of whether or not people wanted the secondary system. It was a revenue stream issue for the project. The argument was made very persuasively that households that did not want pressurized secondary water were going to be charged $18 a month regardless. This was going to be far cheaper in the long run to the recalcitrant homeowner than having to pay increased potable water rates for a new community treatment facility. Prior to the project, homeowners were paying $50 to $60 a month for potable water for both indoor and outdoor use. This would increase dramatically with the cost of a new water treatment facility for the community. The economic logic for the project was very solid and convincing.

Agricultural water use in the valley is partially subsidized through the fees charged to residential users for secondary service. Much as in the case of Davis & Weber, the City of Toquerville, and other secondary systems discussed in the report, agricultural water users pay a much lower rate for their pressurized agricultural water. As with many of the secondary systems being installed in Utah and Idaho, it is expected that agricultural water use will be free in the future. This is a big break for agriculturalists, who often struggle to make ends meet. It affords opportunities to engage in innovative production, such as organic farming, seed production, and produce production for local consumption. Farmers in the Chalk Creek Valley are reporting a 40% decrease in the amount of water applied to hay production, despite the irrigation season being extended an additional month beyond what was possible in the past. This water savings helps the community of Coalville nurse its potable water supply, by way of applying such savings to outdoor irrigation.

This type of agriculture-urban partnership is opening up more and more innovative strategies, including leveraging federal cost-sharing with state funds in a way that minimizes the cost of water conservation for agricultural water users. The argument is made that it is appropriate for urban dwellers to help pay for water conservation, if they are to benefit from it, rather than the cost of water conservation being solely borne by agriculture. This strategy is difficult to put together if municipalities simply turn to buying out canal company stock and diverting its consumptive use, a strategy which dries up agriculture and the communities its supports. Buying out irrigators and canal companies may be a more direct and simplified strategy to acquire water for municipal use, but somewhat of a selfish approach that the community of Coalville will fortunately not have to suffer through. The sprinkler side wheels moving across the Chalk Creek Valley, irrigating hay, were humming on August 11th, 2003, in the middle of a drought.

<u>General Observations</u>

Before taking a short tour of the state and then summarizing some of the key points of the study by chapter, it is important to comment on a few general observations that have come out of the study. A frank and sincere appraisal of the situation leads to the following observations, some of which are not necessarily shared by all of the researchers on the team:

1. Secondary systems are not new, and therefore one might ask why was such a research project necessary in the first place. Obviously, we have argued that there is a potentially important aspect of "dual systems" that relates to agriculture's present and future. We have found that approaches to secondary water management being taken in neighboring states may have valuable lessons for Colorado, with regard to agriculture. We should open our eyes to them.

2. Developers in Colorado have taken the lead in the construction of secondary systems for new subdivision projects. This is evident everywhere along the Colorado Front Range. Secondary water has been found to increase the value of new real estate considerably, particularly large lots in unincorporated areas. The increase in property values associated with secondary supply has been true for the Wasatch Front Range and the Boise Valley as well.

   However, the sustainability of the secondary systems being installed in Colorado may be suspect. Who will operate these systems in the future? Homeowners associations? Will the developer organize a special water district to operate them? What if these special fee districts fail as a profit-making enterprise? Who will pick them up? Can secondary systems survive without being supported by a general purpose tax district? Perhaps the study should be able to answer these questions. In fact it does. On several occasions, people interviewed in other states have simply shaken their head in disbelief at some of the things that are transpiring in Colorado with regard to secondary water.

3. Is there a state policy with regard to secondary water, as there appears to be in Utah? Probably not. This whole area of water management appears to be only on the periphery of the State's policy radar screen. Those seeking new approaches to water development in the state have focused on new water storage projects, which this study would endorse along with water conservation measures. But then, the conversation more often shifts to water banking, interruptible supply, conservation easements, water conservation, and other popular strategies.

   However, if agricultural production is the principal target of such strategies, what is the benefit for agriculture? Will water banking help agriculture, or is it only a ploy to divert water out of agriculture and into municipal storage facilities? Interruptible supply may be an important drought mitigation strategy, but it is not likely to help agriculture in wet years, and it often appears to represent only a stopgap for both municipalities and agriculture in dry years. What about conservation easements? These programs, although laudable, often appear to be driven more by "open space" advocates than by any particular desire to help agriculture, and their price tags tends to be quite high for these general purpose tax districts. [2]

4. Is the concept that is being put forward in this study appropriate for all canal companies and irrigation districts? Probably not, although many smaller ditch companies might benefit by an approach such as that taken by Chalk Creek Valley, Utah (see above). Irrigation ditch consolidation has long been discussed as a need in Colorado. It was estimated at one time that there were more than 750 incorporated irrigation ditches in Colorado, and many hundreds more unincorporated and affiliated ditches under these 750.[3] Ditch consolidation is not an easy endeavor. However, if supported by a sound program that combines the resources of state and federal agencies to modernize the State's irrigation infrastructure, there would appear to be many opportunities to work with canal companies and irrigation districts around the state to assess their capability as secondary water providers. This is not a "high visibility" approach, but rather a "grass roots" approach designed to give agriculture something in return for the water resources that have been secured through many generations of paying assessments for ditch riders, back hoes, drag lines, Parshall flumes and Stevens recorders.

<u>Observations from Around the State</u>

In keeping with the original objectives of the study, an effort was made to assess the status of pressurized secondary water development in other parts of the state. No attempt was made to collect data outside the Colorado Front Range. However, during the course of the study, conservations were held with many people around the state. These have provided a good assessment of trends. It is hoped that the observations presented here will not be viewed negatively by people from these areas, for they kindly shared information with us. It is not our intention to be critical, but rather to provide the state and the Colorado Water Conservation Board a frank assessment of trends in secondary water.

The West Slope

As indicated in Chapter 2 (page 17-18), the Montrose, Delta, and Grand Junction areas have some of the earliest secondary systems in the state, although most of these were not pressurized and not on the scale currently being seen in Utah and Idaho. As part of the Colorado River Basin Salinity Control Program, cost share funds were provided to line and pipe earthen laterals under several of the canal companies and irrigation districts diverting water from the Uncompahgre River, Surface Creek, the Colorado River and the Gunnison River. The objectives of this program were to reduce salinity loads in the Colorado River emanating from the Mancos shale geological formations underlying irrigated lands. This program has been successful and considerable water conservation has occurred in the process.

However, it is not clear how sustainable these small secondary systems are. There are already instances where the engineering life of the improvements to laterals serving residential lots has been exceeded, calling forth the need to further rehabilitate these systems utilizing another round of salinity program monies. In conversations with the Uncompahgre Valley Water Users Association, the Grand Valley Irrigation Company and the Grand Valley Water Users Association, three major irrigation enterprises on the West Slope, it was made clear to the researchers of this study that the small secondary lateral systems were never intended to be overseen by them. The policy was for these larger irrigation enterprises to deliver irrigation water to the historical headgates of individual laterals only, and then for these lateral associations to manage their own upkeep.

This policy is understandable, in light of the fact that the board of directors of these larger enterprises did not want to shoulder the costs of operating these laterals. However, this is generally not the policy under secondary systems observed in Utah and Idaho. In these instances, the canal company or irrigation district is delivering secondary water to homes through buried pipeline systems, and assuming operation and maintenance responsibility for the secondary system up to the planter strip connection on the residential lot. This is a significant difference from what is generally found on the West Slope. The one exception is the secondary system currently being constructed for Dove Creek, Colorado by the Southwest Colorado Water Conservancy District (i.e., the Dolores Project). This new secondary system, which will deliver pressurized water initially to approximately 200 taps in Dove Creek, conforms much more to what is being observed in Utah and Idaho.

It is not believed that the current practice of allowing small lateral associations, often managed by volunteers in the community, overseeing secondary systems designed incrementally throughout the valley, or allowing pumping of secondary water from main canal systems or small storage ponds, is a sustainable strategy for communities like Montrose, Delta or Grand Junction. This report would recommend that serious consideration be given to allowing such entities as the Ute Water Conservancy District and the major canal companies on the Grand Valley to reconsider the valley-wide strategy for secondary water, and perhaps allow for visitations to these new rural-urban systems in Utah and Idaho, or at least to examine this report, particularly the case studies discussed in Chapter 6.

It should be pointed out that several developers have installed pressurized secondary water systems for new subdivisions in Grand Junction, notable under the Grand Valley Water Users Association (GVWUA). It is not clear to the research team what the long-term intentions are for the management of these secondary systems. It is clear that, because the U.S. Bureau of Reclamation does not have a consistent policy with regard to secondary water, and because the board of directors of GVWUA have not indicated interest in constructing large pump stations and pipelines for secondary water in the GVWUA service area, there will be difficulties in the future if any of these homeowner association-operated systems opt to turn their systems over to someone else. The most pessimistic scenario in the future would be for these associations to request that the Ute Water Conservancy District assume responsibility for them. As stated in Chapter 2, this is the great fear that municipalities and rural domestic water suppliers in the state currently have (i.e., that these small secondary systems will be dumped on their doorstep in the future).

It is unclear why the U.S. Bureau of Reclamation has not developed a consistent policy with regard to secondary water systems in their project areas. As noted earlier in the report, several irrigation districts under Reclamation projects, notable the Nampa-Meridian Irrigation District (Idaho), the Strawberry Valley Water Users Association (Utah), the Southwest Colorado Water Conservancy District and others are proceeding with developing pressurized secondary systems that they intend to fully operate, maintain and realize the revenue from. The Bureau of Reclamation has a "small tract" policy, but there is no indication that there is any policy for pressurized secondary water. At most, there have been comments from Reclamation to the effect that the rate structure for secondary systems operated and maintained by irrigation districts or water users associations under federal projects would have to be approved by the agency. There is no indication that this is happening at present. Clearly, entities such as those mentioned above, as well as the Orchard Mesa Irrigation District in Palisade, Colorado, are very well positioned to enter into the kind of pressurized secondary service discussed in this report.

The San Luis Valley

Due to the level of funding for the study, no attempt was made to assess the potential for pressurized secondary water opportunities in the San Luis Valley. It is assumed that some developers may have installed pressurized systems, as they are doing along the Colorado Front Range. There are certainly many opportunities for pressurized secondary water in the valley, including Alamosa. Coalville, Hooper, Midway and other small communities in Utah offer excellent examples for the San Luis Valley to draw from. Several communities in the San Luis Valley, such as Center, Del Norte, Monte Vista and Blanca have canal companies and irrigation districts with fairly good water rights running through or just outside of these communities. It would appear to be, at the very minimum, worthy of discussion.

The Arkansas Valley

The Arkansas Valley offers excellent opportunities for pressurized secondary water of the sort discussed in this report. The study made presentations to the City of Rocky Ford, the Catlin Canal, the Town of Swink, and the City of Lamar. The study also organized a study tour for several people in Otero County, including one of the county commissioners. They visited the Davis and Weber Counties Canal Company, the City of Highland, the towns of Toquerville and Hurricane in southern Utah, and the Washington County Water Conservancy District (Utah). All of these communities have pressurized secondary systems, and the Washington County Water Conservancy District has assisted small communities in Washington County, Utah to develop secondary systems for the communities, much along the lines of the Coalville example discussed at the beginning of this chapter.

Although several communities and entities in the Arkansas Valley have water problems, due much to the drought, but also to the purchase of valley water by Greater Denver Metro municipalities, there has been little interest voiced regarding pressurized secondary water. Some of the small communities that have chlorinated wells for potable supply are letting residential lots irrigate with this supply. Other communities are looking to develop more treated water capacity. Meanwhile, local canal companies, such as the Catlin Canal, have expressed interest in working with local communities, if the communities would enter into dialogue with them. However, no action has been taken, except for the City of Lamar.

The City of Lamar has recently requested the Sociology Water Lab to work with Aqua Engineering, Inc., a firm in Fort Collins, Colorado, to conduct a feasibility study for them. An application has been submitted by Lamar to the Colorado Water Conservation Board, and it is expected that two major canal companies in the neighborhood of Lamar may eventually participate in the study. It is being discussed by city public works staff and the canal company boards.

The Front Range

It was mentioned in earlier chapters that several dynamic developers and builders in northeast Colorado are proceeding with fairly sophisticated subdivision projects that have water recreational facilities, golf courses, playgrounds and substantial greenspace. These are laudable projects, and are evidently a response to a growing market for more spacious living. Pressurized piped irrigation is usually installed in these developments, often being fed by small storage ponds excavated for both irrigation and recreational use.

Meanwhile, many other people in the community resent these development projects, claiming they represent the worst in urban sprawl. Debates occur in community meetings and the editorial pages of local newspapers. Some people have contended that this "secondary water thing" is just another example of urban sprawl, a ploy of the developers. Obviously, this is not the position taken in this study. Urban sprawl has to do with governmental land use policies, or a lack thereof, not whether a local canal company can or wants to provide pressurized secondary water as a means of renovating its canal system to conserve water and make agricultural water use more efficient in the process. The lesson of this study is lost if this is not properly perceived.

Northeast Colorado has several hundred mutual ditch companies, and hundreds more unincorporated laterals. Of particular interest to the region in terms of pressurized secondary water are the large companies, such as North Poudre Irrigation Company, the Larimer and Weld Canal Company, the Water Supply and Storage Company, and the New Cache La Poudre Irrigating Company in the Cache La Poudre River basin. The Big and Little Thompson river basins also have large companies. A few of these enterprises are now under the control of municipalities, for the most part, although a considerable amount of high quality irrigated agriculture still occurs in their service areas. Several of these enterprises are seeing substantial subdivision development in the western portion of their services areas, immediately to the east of Interstate 25. Their configuration offers substantial opportunities for pressurized secondary water, as the urban growth boundaries extend into their service areas.

Again, the Sociology Water Lab and Aqua Engineering, Inc. have teamed up with one of the local irrigation companies, Lake Canal, to conduct a feasibility study of their potential for secondary water service. Lake Canal is in a high growth area, and it is likely that agricultural production will not continue under the canal for very much longer. Regardless, if this project can be built, it will provide a showcase to the remainder of the irrigation companies. The lessons learned will be valuable in deciding how to better proceed.

Conclusion

In conclusion, it is helpful to review some of the key arguments and findings of the report. We will summarize these by chapters.

Chapter 1

It is argued in the opening chapter that involving traditional agricultural water suppliers in secondary water management is a way of strengthening the position of agriculture in the state. It protects irrigated agriculture from the more negative effects of urban encroachment, by allowing these traditional enterprises to be more effective players in the community as urbanization occurs. It secures previously developed water rights to agricultural land and local areas, while at the same time allowing for improved irrigation efficiencies by way of much needed revenue derived from secondary water service to modernize irrigation infrastructure and on-farm systems (i.e., pressurization of irrigated agriculture when it is appropriate to the production system).

Chapter 2

There are many options to the provision of pressurized secondary water, including provision by municipalities, homeowners' associations, special districts and the private sector. However, based on examples from the surrounding region, the provision of secondary water by agricultural water suppliers has been shown to be very successful and sustainable, provided there is support for this concept at the state level, and cooperation and encouragement from municipalities at the local level. However, presently in Colorado there is very little consensus on this issue. Until such time as there are the kinds of partnerships observed elsewhere in the Rocky Mountain region, particularly from the land development and homebuilding business community, it will be that much more difficult to encourage the participation of traditional agricultural water suppliers.

Chapter 3

In Chapter 3, an irrigated farm and canal modernization strategy is suggested, and involving the combination of other financial resources with the revenue generated by traditional agricultural water suppliers in providing secondary water to residential subdivisions in incorporated, but mostly unincorporated areas. These include funding through the Colorado Water Conservation Board and the new Farm Bill. This strategy represents a "development package" for the state in dramatically improving the economic position of irrigated agriculture over the next few years.

Chapter 4

Simply relying on the pool of water currently in agriculture for future municipal needs is probably short-sighted, and does not factor in the many repercussions that such a one-dimensional policy has on local hydrological systems that are more than 100 years old. Colorado has a history of cooperation in water development and use that is largely being overlooked. The provision of secondary water by canal companies and irrigation districts fits very well with these long-standing traditions.

Chapter 5

Are canal company and/or irrigation district water rights sufficient to become involved in secondary water service? The question can be answered in several ways. First of all, since municipal water charges have risen dramatically in recent years, it is very likely that canal companies can present an affordable and competitively-priced option to residential water users for secondary supply. This is demonstrated in the discussion on municipal water rates currently charged for potable water used indoors and on landscapes.

Second, although agricultural water rights per acre of land irrigated varies greatly from one canal company to the next, it has been found that water use per acre in municipal areas is generally no more than fifty percent of what is frequently available for irrigated agriculture. Therefore, the potential demand of secondary systems on average canal company and irrigation district water rights in the region appears to be modest.

Meanwhile, the difference in revenue obtained by canal companies from irrigators to operate and maintain these facilities is miniscule in comparison to what could affordably be charged to residential water users for the same amount of water. It is estimated that the potential revenue stream to canal companies and irrigation districts for providing secondary water might range anywhere from $800 to $1,000 per acre foot of water, compared to a range of $1.50 to $20.00 per acre foot charged to agricultural water users for typical canal deliveries.

Obviously, the denser the subdivisions served by secondary supply, the less water used outdoors, and the more revenue would be available to traditional agricultural water suppliers for providing this kind of service. Secondary system suppliers would therefore likely support zoning for higher densities in both incorporated and unincorporated areas, an issue that is important for urban planners and open space advocates, and a counter-argument to those who might perceive secondary systems as leading to more urban sprawl.

In summary, in terms of what a canal company or irrigation district might consider as a safe estimate of the water supply needed for a secondary system, the study estimates that it would be approximately 0.90 acre-feet/acre, with a normal residential lot density of four units per acre. At $200/year per household, it would potentially provide a revenue stream in the neighborhood of $800 to $1000 per acre-foot of water diverted to pressurized secondary use, based on what canal companies and irrigation districts are charging in the region where these systems have been installed (i.e., Utah and Idaho).

Chapter 6

The Davis and Weber Counties Canal Company case study is discussed, relative to how secondary systems managed by traditional agricultural water suppliers are initiated, carried out, and the various administrative requirements of these systems. This canal company kindly shared with the research team some of the important administrative and educational materials that are needed to make a project successful. There is also information on how to design equitable and profitable water rate structures for secondary water service. Of extreme importance to the success of these endeavors are adequate ordinances governing their role in the community, the responsibilities of residential water users, what the role of the municipality is in ensuring the success of such projects, and how the canal company or irrigation district can protect itself from potential liability.

Chapter 7

This chapter discussed important legal issues potentially affecting the role of canal companies and irrigation districts in secondary water supply. Although there are several issues that need to be examined carefully by any traditional agricultural water supplier, and although enterprises considering entering into this type of water service should consult professional legal advice, it appears that there are no major legal concerns. It appears that Colorado water law would tend to favorably interpret such endeavors, relative to organizational concerns, nonprofit status, limitations on the use of river decrees for irrigating residential landscapes, issues surrounding potentially expanded uses of irrigation water, impacts on return flows in the river basin, and canal company liabilities.

Chapter 8

This chapter shows a general procedure that an irrigation company or irrigation district can use to assess its potential as a provider of pressurized secondary water to residential and commercial property. A spreadsheet model is used to discuss several residential development scenarios in an agricultural water supplier service area. Through the procedures, information can be obtained on water needs and the financial feasibility of the enterprise. The model is a guide that most canal company or irrigation district staffs can use to conduct an appraisal "in house."

Some conclusions from application of the model on one canal company participating in the study are:

1. The way in which municipalities and secondary water providers cooperate with regard to the current raw water turnover requirement for subdivision development will greatly determine the success of secondary system development in the future. Two scenarios are discussed in detail, one for raw water turnover requirements involving so-called "native" Front Range water supplies, the other involving Colorado-Big Thompson Project transmountain diversion water. The latter has minimal restrictions on its use, and therefore has been aggressively sought after by municipalities along the Colorado Front Range. The conclusion is that the municipalities and canal companies will most likely have to split the current raw water turnover requirement, in order for canal company involvement in secondary water service to move ahead along the Front Range.

2. Most of the residential subdivision development situations examined in the case study, using figures derived from secondary systems in Utah, would suggest that although annual tap fees would probably not be sufficient to pay for the construction of the secondary system, the addition of tap development fees would allow more than adequate revenue for a development loan repayment to a state agency. Meanwhile, the annual tap fees for water service would more than cover annual operation and maintenance costs of these systems.

3. Canal companies should devise a fee structure that promotes smart land use and is applicable to local conditions. They will need to secure local ordinances to ensure that land development occurs in general accordance with the future success of the secondary system. Overall, it is recommended that canal companies develop a fee structure that will encourage the developers toward smaller lots and more compact residential development. This will further protect the water supply of agricultural water users and improve the revenue stream from secondary service.

Chapter 9

The previous chapter provided a means for canal companies and irrigation districts to assess the "market potential" for secondary water service in their traditional service area, and the possible development costs and revenue stream associated with it. This chapter was designed to provide a method for these enterprises to conduct an "in-house" assessment of their resources, prior to a formal engineering feasibility study. Perhaps it is more appropriate to state that information in this chapter might better assist state agencies in determining viable candidates for secondary service development loans, for it is recognized by the researchers that the experienced staff and board of directors of these enterprises will often be the best judges of their enterprise's capabilities. Information in this chapter offers a general roadmap to assessing enterprise resources. It offers a means of taking stock of the enterprise, and opening a dialogue with stockholders and/or landowners about a secondary water development project. It is a "checklist" of items that need to be considered in planning for the future in any event.

Chapter 10

This chapter was designed to bring to a closure the discussion of secondary water options, by focusing on the potential benefits such a project has to the canal modernization program emphasized throughout the report. As indicated earlier, the value of having these traditional water suppliers contemplate secondary water service is the potential improvements it might be expected to bring to irrigated agriculture in the area. It is also believed to be an important drought mitigation strategy, in that as water is conserved through the canal modernization process, paid for largely through the new revenue stream created by the secondary system, water is conserved and the latter part of the irrigation season is strengthened through the improved distribution of the enterprise's water decree (i.e., lengthening the portion of the irrigation season that is a currently met using "native" water supplies). This is shown graphically in a discussion of traditional irrigated agriculture's water demand and water use in northeast Colorado.

An orderly transition from agricultural to urban use is better assured by (1) promoting residential development on less productive agricultural lands, and (2) promoting more modern technologies for both irrigated agriculture and residential-landscape water uses. Generally, these options are only available, or alternatively, only have a greater opportunity of being realized, if traditional agricultural water suppliers provide secondary service. The whole concept tends to unravel if municipalities or private entities engage in this service. In that instance, agriculture is, for all intents and purposes, left out of the proposed "innovative development loop."

A model is presented in the chapter that allows agricultural water suppliers to assess (1) how long the irrigation season should be for secondary service, (2) how the secondary system will adjust to drought conditions, and (3) what are some of the more current technologies available to modernize the canal system to meet future demands and to secure its water rights into the future.

Canal modernization is the issue that drives the importance of the innovation. Canal modernization will be expensive, and current farm income cannot pay for all of the water conservation ideas being promoted by the general public for irrigated agriculture. However, the general public can help by promoting a policy that will strengthen these 100 year old enterprises, bringing them into a new era, providing them the opportunity to be an active player in the community, and thereby leveling the playing field. Secondary water management is a pre-eminent drought mitigation strategy as well. But one has to "think outside the box" a little.

Pressurized secondary water supply has a potentially significant role to play in improving economic efficiencies associated with water management and use in the State of Colorado, improving equity in the distribution of water costs, and improving water conservation. It is believed that this study has covered essential dimensions of an important additional component to the state's water policy. We hope that action will be taken in this direction soon.

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[1] McCalla, A., *Agricultural and Food Needs to 2025,* in Eicher, C.K., and Staatz, J.M., (eds.), International Agricultural Development. 3rd Edition. Johns Hopkins University Press (1998). See also, The U.S. Contribution to World Food Security. U.S. Position Paper Prepared for the World Food Summit. Committee on World Food Security, FAO (1996).

[2] Conovitz, P., Protecting and Managing Agricultural Water Resources Through Open Space Acquisitions in Boulder County, Colorado. Proceedings of the 2nd International Conference on Irrigation and Drainage. U.S. Committee on Irrigation and Drainage. (Phoenix, 2003).

[3] One Hundred Years of Irrigation in Colorado. No date.