EVALUATION OF THE "HEALTHY RIVERS ALTERNATIVE" PROPOSED BY SAVE THE POUDRE: POUDRE WATERKEEPER USING THE NISP ALTERNATIVES SCREENING CRITERIA

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ACRONYMS AND ABBREVIATIONS USED

AF	Acre-Feet (43,560 ft^3)
AFY	Acre-Feet per Year
ATM	Alternative Agricultural Transfer Methods
AWRPC	Annual Water Requirement per Capita
AWWA	American Water Works Association
BBC	BBC Research and Consulting
C-BT	Colorado-Big Thompson Project
CDM	Camp Dresser and McKee, Inc.
CDOT	Colorado Department of Transportation
CDSS	Colorado Decision Support System
Corps	United States Army Corps of Engineers
CU	Consumptive Use
CWCB	Colorado Water Conservation Board
CWCWD	Central Weld Colorado Water District (NISP Participant)
DDW	Development Displaced Water
DEIS	Draft Environmental Impact Statement
DWC	DiNatale Water Consultants
DWR	Division of Water Resources (Colorado)
ECCV	East Cherry Creek Valley
EIS	Environmental Impact Statement
FCLWD	Fort Collins – Loveland Water District (NISP Participant)
FHG	Farm Headgate
FPA	Future Planning Area
FRICO	Farmer's Reservoir and Irrigation Company
GPCD	Gallons per Capita per Day
GPTD	Gallons per Tap per Day
GW	Groundwater
HDR	HDR Engineering, Inc.
HE	Harvey Economics
HRA	Healthy Rivers Alternative (proposed by Save the Poudre)
IBCC	Interbasin Compact Committee
IPP	Identified Projects and Processes
IWR	Irrigation Water Requirements
LEDPA	Least Environmentally Damaging Practicable Alternative
LHWD	Left Hand Water District (NISP Participant)
LIRFs	Lawn Irrigation Return Flows
LRE	Leonard Rice Engineers
LULC	Land Use and Land Classification
M&I	Municipal and Industrial
MCQWD	Morgan County Quality Water District (NISP Participant)
MWH	MWH Americas, Inc.
NAA	No Action Alternative
NCWCD	Northern Colorado Water Conservancy District (Northern Water)
NEPA	National Environmental Policy Act
NISP	Northern Integrated Supply Project
NPIC	North Poudre Irrigation Company

ACRONYMS AND ABBREVIATIONS USED (CONTINUED)

PWP	Prairie Waters Project
RFO	Return Flow Obligation
RHG	River Headgate
SDEIS	Supplemental Draft Environmental Impact Statement
SMWSA	South Metro Water Supply Authority
SPDSS	South Platte Decision Support System (State of Colorado)
SPWCP	South Platte Water Conservation Project
STP	Save the Poudre
UWSD	United Water and Sanitation District
WSL CU	Water Supply Limited consumptive use
WSSC	Water Supply and Storage Company

1.0 INTRODUCTION

The development and evaluation of practicable alternatives is an important part of the United States Army Corps of Engineers' (Corps) environmental evaluation of the proposed Northern Integrated Supply Project (NISP). The Applicant for NISP is the Northern Colorado Water Conservancy District, acting by and through the Northern Integrated Supply Project Water Activity Enterprise (also known as the District, NCWCD or Northern Water), representing 15 participating municipalities and rural domestic water providers (water providers) in northern Colorado. The purpose of the alternatives analysis for the NISP Environmental Impact Statement (EIS) is to determine if there is a practicable alternative that achieves the Applicant's purpose and need of developing 40,000 acre-feet per year (AFY) of reliable new water supply while meeting the requirements of both the National Environmental Policy Act (NEPA) and the Clean Water Act 404(b)(1) Guidelines. It is the Corps' responsibility to determine if specific alternatives are reasonable and practicable and to determine if the applicant's proposal is the Least Environmentally Damaging Practicable Alternative (LEDPA).

During the 2008 public comment period on the NISP Draft EIS (DEIS), an alternative named the Healthy Rivers Alternative (HRA) was submitted to the Corps by the Save the Poudre Coalition (now known as Save the Poudre: Poudre Waterkeeper; hereafter referred to as STP). The purpose of this report is to screen the water supply concepts proposed in the HRA to determine if it should be evaluated in detail as a project alternative in the NISP Supplemental Draft EIS (SDEIS). This evaluation will consider:

1) Does the HRA meet the screening criteria developed and used to evaluate the water supply concepts and elements for NISP?
2) Are the basic elements of the HRA already reasonably being evaluated in detail by a similar alternative in the NISP DEIS or SDEIS?

The HRA includes several discussions related to environmental effects (HRA Table 8) and estimated costs that are outside the scope of the NISP alternatives screening criteria. Comments outside of the NISP alternatives analysis screening criteria will be addressed in the SDEIS with other comments on the DEIS.

The remainder of Section 1 of this report provides an overview of the HRA and the NISP DEIS alternatives evaluation process. Section 2 provides a brief background on water resources issues in Colorado pertinent to the evaluation of the HRA. Section 3 summarizes issues associated with agricultural-to-municipal water transfers in Colorado, as well as within the NISP study area specifically (Water Districts 1 through 6). Section 4 briefly discusses the HRA challenges to the NISP needs analysis and purpose definition as well as the Applicant and Corps' recent re-evaluation of the project need. Section 5 presents the evaluation of the HRA using the DEIS NISP screening criteria.

1.1 SUMMARY OF HEALTHY RIVERS ALTERNATIVE

The HRA was developed by STP and was originally submitted to the Corps as part of the organization's public comments on the DEIS in 2008. The alternative is presented in an undated document titled

"Healthy Rivers, Healthy Communities – A Balanced Proposal for the Cache la Poudre River in Colorado". The HRA is provided as Appendix A of this report.

The HRA is comprised of five principal sections, including a critique of the NISP Purpose and Need, a re-assessment of the projected future water demands for NISP Participants, an overview of alternative water supply options, a comparison of costs of the HRA and the NISP action alternatives, and a comparison of the environmental impacts of the HRA and the NISP action alternatives.

The NISP need of 40,000 AFY of annual firm yield has not changed since the DEIS was issued. The HRA report proposes a lower need of 35,000 AFY based on STP's analysis of the NISP Participants' future water demands and proposed reduction of system losses, and the options proposed in the HRA to meet this lower demand. Northern Water recently revisited the NISP Participant demands (Harvey Economics 2011), and the Corps has recently reviewed these demands in connection with the validity of the need (BBC 2011) and definition of the overall project purpose and found that 40,000 AFY of firm annual yield is still valid for NISP (see Section 4).

As defined by STP, the HRA would not meet the NISP need of 40,000 AFY. However, the water supply concepts and elements used in the development of the HRA may constitute viable components to an alternative or could be expanded to meet the full need of 40,000 AFY. Therefore, these individual components are evaluated using the DEIS screening criteria in Section 5 of this document. The HRA sets forth four agricultural water transfer concepts that could potentially provide additional water supply to the NISP Participants:

- Traditional agricultural transfers (also known as buy-and-dry transfers), in which a water provider purchases agricultural water rights or shares in a mutual irrigation company, changes the use to municipal use in water court, and the associated farmlands are permanently removed from irrigated agricultural production (HRA, page 15).
- Use of development displaced water (i.e., transfer of agricultural water rights from land that is developed as a municipality grows) (HRA, page 13)
- Rotational fallowing agreements (HRA, page 14)
- Transfer of Colorado-Big Thompson (C-BT) Project water to municipal use through the purchase of C-BT units from agricultural owners (HRA, pages 17, 18)

The HRA arranges combinations of these four agricultural transfer components into two alternative options to supply 35,000 AFY of firm yield to the NISP Participants. The two options presented in the HRA are as follows:

> **Option 1 (HRA, page 17)**: Purchase 13,500 C-BT units to generate 9,450 AFY firm yield based on assumed C-BT quota = 0.7 AF/unit. Acquire remaining 25,550 AFY of firm yield through phased traditional buy-and-dry agricultural to municipal water transfers.
>
> **Option 2 (HRA, page 18)**: Generate 12,000 AFY of firm yield through rotational fallowing; 7,200 AFY through the purchase of C-BT units; and 15,800 AFY through phased traditional buy-and-dry agricultural to municipal water transfers.

Use of water displaced by development is essentially the same concept as traditional transfers of agricultural water rights, but is specific to the transfer of water used to irrigate lands that could be developed through municipal expansion within the NISP Participants' future planning areas (FPAs).

Although the HRA proposes to meet 35,000 AFY yield only by transferring water from irrigated lands, STP claims that the diversion of water under the Grey Mountain right and South Platte Water Conservation Project (SPWCP), which are key components to the Applicant's proposed action for NISP, would result in a similar loss of irrigated acres due to increased salinity and the loss of irrigated acreage that currently relies on water that would be diverted by the Grey Mountain right and the SPWCP.

1.2 NISP ALTERNATIVES SCREENING CRITERIA

In the NISP DEIS, the Corps disclosed an alternatives evaluation that identified three practicable alternatives (plus sub-alternatives) that were carried forward for detailed impacts analyses. The associated report (NISP EIS Alternatives Evaluation; HDR, 2007) detailed the NISP alternatives evaluation criteria, including a discussion of the NEPA and 404(b)(1) Guidelines requirements. The Corps' alternatives evaluation process was designed to ensure "that identification and screening of alternative concepts and elements as well as alternatives formulation address NEPA requirements by including a reasonable range of alternatives and meeting the requirements of the 404(b)(1) Guidelines" (HDR, 2007).

The Corps' alternatives evaluation process began by identifying an extensive range of water supply concepts and storage elements[1] from the Applicant's previous work, scoping, as well as from concepts and elements identified in the alternatives analyses of other projects undergoing NEPA review in the region (Windy Gap Firming Project EIS, Moffat Collection System Project EIS). Concepts and elements were then combined to formulate alternatives that meet the entire project need and overall purpose. The NISP overall purpose statement is as follows (DEIS, pg. ES-2):

> *The purpose of NISP is to provide the Participants with approximately 40,000 AF of new reliable municipal water supply annually through a regional project coordinated by the District.*

For the alternatives report, three screening criteria categories were developed, each with a sub-set of criteria to evaluate each concept or element: (1) Purpose and Need, (2) environmental, and (3) practicability (logistics and technology). Requirements associated with determining the LEDPA under the 404(b)(1) guidelines heavily influence the framing and acceptability of the screening criteria. If a concept or element failed to pass any purpose and need or practicability screening criterion, it was deemed not practicable and eliminated from further analysis. If a concept or element failed an environmental screen it could not be found to be the least environmentally damaging option as required by the 404(b)(1) guidelines and it was eliminated. This same logic applies herein, whereby concepts and

[1] A concept is defined as a source of potential water supplies able to meet a portion of the NISP Participants' request. An element is defined as a structural facility used to store or transfer the water supply (HDR 2007, Volume II, pgs. 2-3)

elements that are not eliminated through the screening process advance to more detailed analysis. During the period in which the Corps' independent alternatives analysis was completed, a majority of NISP Participants had an immediate need for water because between 2005 and 2010, the total demand of all the Participants combined was projected to exceed their combined firm annual yield. This immediate need was reflected in a logistical screening criterion for timeliness. At the time of the release of the NISP DEIS in April 2008, the United States was already in a severe recession that began in 2007 and continues at the time of this report, which altered the timing of the Participants' future water demand increases. The Corps reevaluated the timeliness criterion for the SDEIS. At the time of this report, the Corps has not finalized the reevaluation. Table 1-1 presents the screening criteria from the NISP alternatives report (HDR 2007; Volume II, Table 3). The criteria shown in Table 1-1 are used to evaluate the HRA in this report (see Section 5). Because of the uncertainty regarding the outcome of the Corps' reevaluation of the timeliness criterion, it was not used in the screening in the HRA. Concepts that pass the screening criteria were advanced to the next level of screening in the NISP DEIS.

The no action alternative (NAA) and the three action alternatives were carried through the EIS process and evaluated in detail in the NISP DEIS and supporting technical reports. Since the DEIS was issued, Northern Water reconfigured the NAA (MWH 2010), and the Corps replaced Alternative 4 with a different action alternative configuration. The complete analysis of the modified NAA and the new action alternative will be provided in the SDEIS.

The HRA report disputes the components of the Purpose and Need criteria shown in Table 1-1, namely the 30 percent threshold for a concept to advance to the next screening level and the requirement of the regional nature of the project. The HRA report states that "the alternatives analysis provided no substantive basis for using a firm yield cutoff threshold value." The "regional project" screening criterion was included because NISP is being applied for by a coordinating entity (Northern Water) as a collaborative effort among the 15 NISP Participants, most of which are relatively small towns and districts. By working collaboratively, these small towns and districts are able to pursue a water supply project on a regional scale that would not be possible to pursue individually. The Participants' commitment to work collaboratively for a regional water supply project can be seen in the modified NAA (MWH 2010) that was revised, at the Participants' request, to be a regional collaborative project that would likely occur in the absence of NISP with no involvement of the applicant. Concepts and elements that fall below the cutoff thresholds (30 percent of the firm yield request for concepts and 15 percent of required storage capacity for elements) are not considered because, below these levels, the regional nature of the project would be lost and would effectively operate as individual local water supplies.

Additionally, NISP is projected to meet only a portion of the future demands of the NISP Participants. It is likely that individual Participants will continue to pursue local water supplies as their demands increase. The acquisition of local water supplies in concert with NISP supplies is a means to diversify each provider's water supply portfolio to meet projected future demands beyond the NISP planning horizon. In the interim between the release of the DEIS and the writing of this document, NISP water providers have pursued local water supplies as evidenced by their ongoing acquisition of C-BT units and

ongoing transfers of agricultural water within the region. Development of local water supplies is and will continue to be an integral piece of the water supply systems for NISP Participants.

Table 1-1 – NISP Alternatives Screening Criteria *(continued on the next page)*

Screening Category	Criterion	Criterion Description	Rationale for Screening Criterion
Purpose and Need[1]	**Firm Yield**	Water supply sources must provide a reliable firm yield.	Project components must be able to provide at least 30% of the total firm yield Participant requirement of 40,000 AF from a physically and legally available sustainable source. Less than 30% is not a significant contribution and therefore will be eliminated.
	Timeliness[1]	Must produce a solution within the necessary near-term timeframe	To advance, the solution must be implementable in the reasonably projected future in order to meet the Participant's current and near future water supply needs.
	Regional Project	Regional Project that serves all the Participants.	To advance, alternatives must be able to meet the Participant's water supply need with a regional project, eliminating the need for Participants to pursue separate solutions to meet their individual needs.
Environ-mental	**Wetlands**	Project facilities must not inundate substantial wetland areas.	To advance, new reservoir elements must not cause permanent loss to more than 60 acres of wetlands. Wetlands are aquatic habitats and therefore must be protected and/or mitigated to prevent permanent loss.
	Waterways	Must not involve new impoundments on major waterways or perennial streams.	To advance, new reservoir elements must not be located on a major waterway or a perennial stream. Construction of a new storage facility on a waterway would possibly produce permanent impacts to the aquatic habitat of that waterway. Enlargement or rehabilitation of an existing reservoir on a waterway may be considered. New reservoirs in the vicinity of an existing reservoir, provided that it doesn't more than double the surface area or length of the existing reservoir, will be considered.

1 –Because of the uncertainty regarding the outcome of the Corps' reevaluation of the timeliness criterion for the SDEIS, it was not used in the screening in the HRA

(continued) **Table 1-1 – NISP Alternatives Screening Criteria**

Screening Category	Criterion	Criterion Description	Rationale for Screening Criterion
Practicable	**Logistics**		
	Land Use	Concepts and elements in the following areas will be eliminated from further consideration: -Designated Wild and Scenic or Recreational segments of the Cache la Poudre River -North St. Vrain Creek above 6,550 feet in elevation, which is protected from dam construction by existing legislation -Designated or proposed Wilderness Areas -Designated hazardous materials sites (National Priority List, proposed NPL, CERCLA sites) -Landfills -Active or abandoned mineral or coal mines -National and State Parks	To advance, water sources or infrastructure components must not be located in designated wild and scenic or recreational areas, wilderness area, hazardous material sites, landfills, active or abandoned coal mines, national or state parks, county open space, or an interstate highway. National parks, state parks, and designated wilderness and scenic areas were established to create or preserve areas of common use, aesthetics, environmental values and ecosystems. Development of a water supply features in these areas would be prohibited or extremely difficult to accomplish. Due to the implications for municipal water quality, a contaminated site is not considered a practicable option and therefore will be eliminated.
	Element Capacity	Individual storage elements must provide a substantial portion of the total storage required.	To advance, storage elements must have a capacity greater than 25,000 AF, approximately 15% the total required capacity to meet a firm yield of 40,000 AF per year. A minimum storage facility capacity is needed to reduce the number of possible elements used in a practicable combination for alternative implementation. A minimum capacity of 25,000 AF would limit the number of elements required to a maximum of about six. Incorporating more than two or three storage sites into one alternative is too complex to reasonably implement and manage. Beyond six, the reservoirs effectively become local facilities, and NISP would no longer function as a regional project.
	Integral to Other Development Plans	Must be outside lands or sites known to be integral to development of other entities.	To advance, elements, concepts and alternatives must not lie within areas known to be integral to the development plans of other entities. The conflicts and costs associated with displacing a planned reservoir development will be avoided by elimination of that element, concept or alternative.
	Existing Technology		
	Proven Technology	Alternatives must be able to use existing technology for construction, operation and maintenance.	To advance, technological methods or management practices proposed must be tested and proven to minimize risks of failure to provide firm yield.

The revised NAA (MWH 2010) provides several reasons for the development of a regional project:

- a history of successful regional projects in Northern Colorado
- reduction in the amount of agricultural transfers
- reduced evaporation using larger, shared reservoirs
- efficiency of intra-Participant trades
- lower unit cost of a regional project
- access to higher quality water supplies for some Participants
- use of local supplies is already part of many Participants' plans to meet demands in excess of the NISP supply.

Cost is a valid criterion to determine practicability of an alternative under the 404(b)(1) Guidelines, but was not used to develop a reasonable range of practicable alternatives for NISP. Therefore, although the HRA report includes analysis of the costs of NISP presented in the DEIS and cost projections for the HRA, a cost criterion is not included in Table 1-1 and is not used in this report to screen any of the components of the HRA.

2.0 OVERVIEW OF COLORADO WATER RESOURCES

This section provides a brief background on water resources issues in Colorado pertinent to the concepts proposed in the HRA. Colorado water law governs the use, administration and transfer of use of water within the state as well as compliance with several interstate compacts that govern water sharing between Colorado and downstream states. Water rights are administered by the Division of Water Resources (DWR; also known as the State Engineer's Office). The DWR is organized into seven administrative Water Divisions that generally correspond to the major river basins within Colorado. Each Water Division is further subdivided into Water Districts that generally correspond to major tributary watersheds or regions within the larger Water Division. The proposed NISP is in Water Division 1 (South Platte River basin), and the NISP Participants are located in the South Platte River, Poudre River, Big Thompson River, St. Vrain Creek and Boulder Creek watersheds, which correspond to Water Districts 1 through 6. Figure 2-1 is a map of the project region and NISP Participants, and shows the Water District boundaries.

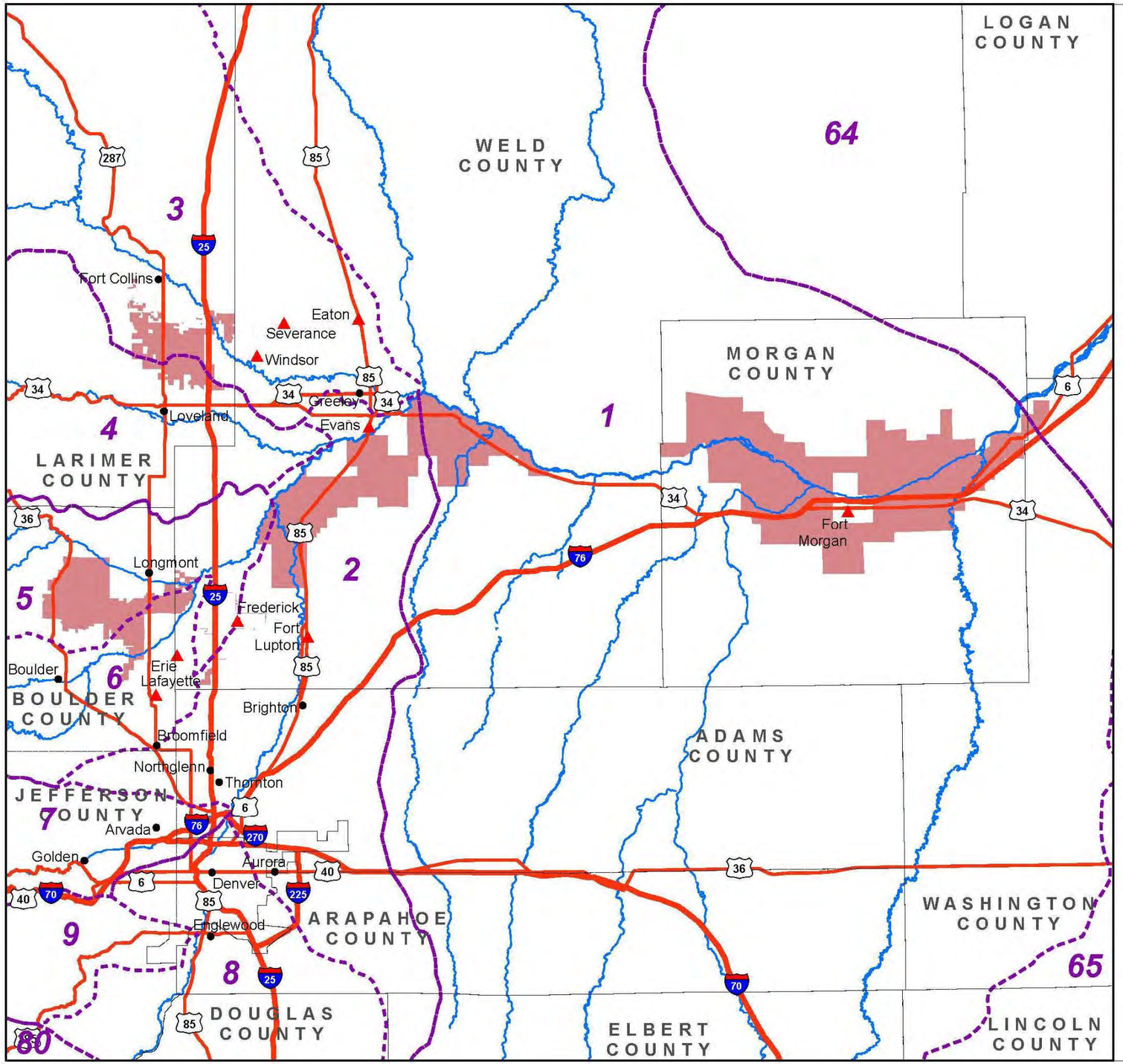
2.1 WATER ALLOCATION IN COLORADO

The Colorado Constitution specifies the Doctrine of Prior Appropriation for water rights administration. This means that each water right is assigned a priority date based on when the water was first put to beneficial use. A water right with a more junior (later) priority date may not divert water unless all senior (earlier) water rights are satisfied (provided that curtailing the junior water right will make water available to an unsatisfied senior water right). The Citizen's Guide to Colorado Water Law (3rd Edition) explains a conditional water right:

> *Most new water users can no longer appropriate water by simply going out to the stream and digging a diversion ditch. Modern water projects involve a complex process of planning, permitting, engineering, and financing.*
>
> *To allow time for these efforts, while also holding a date in the priority system, waters users apply for conditional water right decrees to unappropriated water, if any remains available. A conditional decree holds a date in the priority system, which is then finalized or made "absolute" when the water is actually put to beneficial use. (CFWE 2009, page 13)*

Most Colorado Front Range river basins developed with direct flow water rights first. These senior rights diverted all of the reliable flow of the rivers and streams, especially during the latter part of the irrigation season after the peak runoff. More junior water users did not have reliable irrigation supplies and developed reservoirs to supplement their junior direct flow rights in the late summer season. In the South Platte Basin, development of agriculture proceeded from locations on the tributaries west of the South Platte mainstem to locations farther east (downstream). Irrigators on the western tributaries (Bear, Clear, Boulder and St. Vrain Creeks and the Poudre River) and the South Platte mainstem between Denver and Platteville generally have the most senior direct flow water rights in the basin. Lagged return flows from these irrigation systems provided for river flows later in the irrigation season and allowed for irrigated agriculture to develop farther downstream. These lower irrigators rely on the

Figure 2-1
NISP Project Region



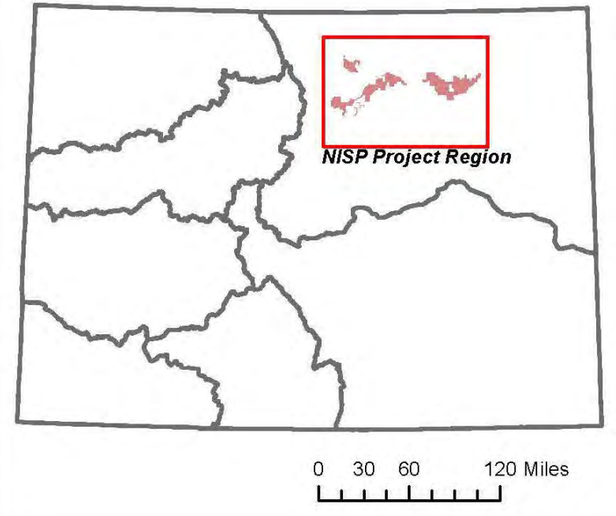
Legend

- DWR Water Districts
- NISP Participant Water District Service Outside of FPAs
- NISP Municipal Participants
- County Boundary
- Rivers
- Interstate Highway
- US Highway
- Cities

0 5 10 20 Miles

N W E S

State of Colorado



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maintenance of return flows from upstream users. Colorado water law requires that any change in use of a water right must ensure that historical return flows (location, type of use or timing of use) are maintained so that other water rights holders that have come to rely on return flows are not injured by the change in use.

In recent years, numerous recharge plans have been filed and/or decreed that divert from the lower South Platte River (below the confluence with the Poudre River.) Many of these recharge plans are junior to the conditional Grey Mountain right, one of the key water rights contemplated for NISP. The recharge decrees on the lower South Platte are largely for water users who rely on tributary groundwater wells for sole or supplemental irrigation supplies and have developed a recharge plan for augmentation of the associated groundwater pumping depletions. Development of the Grey Mountain right, which has a 1980 priority date, in any location or capacity may reduce the potential yields of the more junior recharge decrees on the lower South Platte. The development of the Grey Mountain right would not cause legal injury to the junior recharge decree holders because the Grey Mountain right is senior, and the junior recharge decrees were filed and developed with the knowledge that the Grey Mountain right could be developed at some point in the future with a senior priority date.

2.2 TRANSBASIN WATER SUPPLIES

In addition to the native water supply of a river basin from precipitation runoff, water users have constructed canals, ditches, pumps, and tunnels to divert water from other river basins (primarily the West Slope) into their basin of use. This water is referred to as transbasin, transmountain, or imported water. Transbasin water is a source of supply for many agricultural and municipal water users on the Front Range. Once imported from its native basin, in most cases it is simpler to change the location or type of use of transbasin water than native water rights because any return flows from the use of transbasin water are not considered part of the native water supply of the receiving basin and there is generally no requirement to maintain historical return flows from transbasin water.

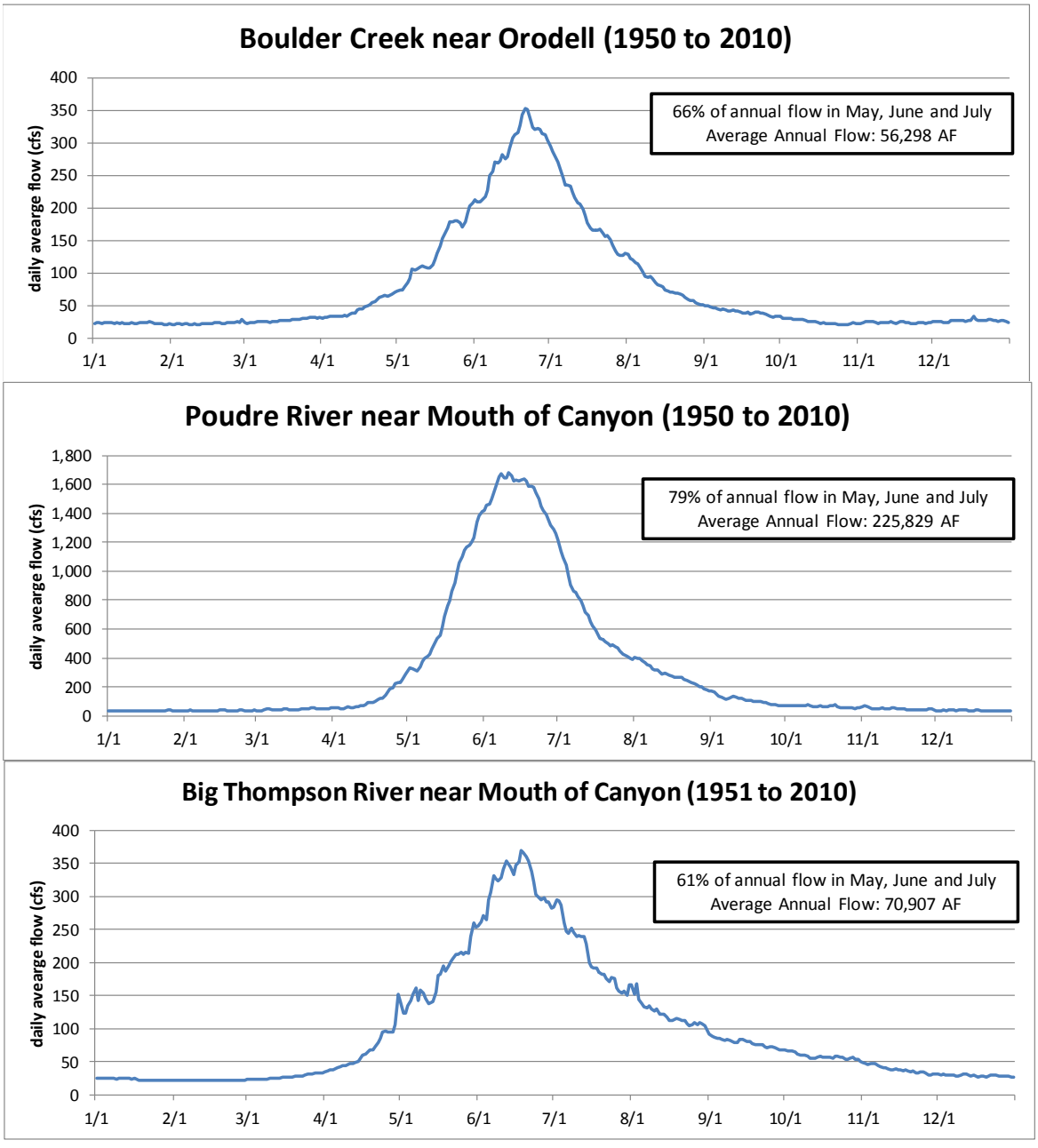
C-BT water is considered transbasin water, but carries more restrictions on its location, type of use and subsequent reuse of return flows than other transbasin sources. Nonetheless, there is no requirement to maintain historical return flows from C-BT water if the C-BT units are purchased from one user and then used in a different location. Due to the relative ease of changing the location and type use of transbasin water, significant amounts of transbasin water have been and continue to be transferred from agricultural to municipal use on the Front Range, and there is strong competition for transbasin water, including C-BT water.

2.3 MUNICIPAL WATER SUPPLIES

Municipal water providers have the task of providing water year-round to their customers. The normal stream runoff pattern in Colorado yields two-thirds to three-fourths of the annual flow in three months of the year (May through July). Streamflows in most Colorado streams peak in late spring and early summer from the melting snowpack in the mountains. By late summer, flows are generally low and remain low through the winter. Figure 2-2 shows the average flows in three major streams in the NISP

study area. During the low flow late summer months, only the most senior direct-flow water rights are in priority. Many water users rely on water previously stored in reservoirs through these months. As the irrigation season ends in the fall, water demand from direct-flow agricultural water rights holders diminishes, which allows junior direct flow water rights held by municipalities to be in priority more frequently. Depending on the seniority of the water right, some senior agricultural storage water rights may be in priority before municipal direct flow rights.

Figure 2-2 - Average Daily Hydrographs of Regional Streams



The water demand for a municipal system is higher in the summer than in the winter due to outdoor landscape irrigation, but unlike most agricultural operations, there is a still significant winter demand. In the winter, stream flows are usually low and most water providers rely on stored reservoir water as the primary water source or a supplemental source if the municipal system has senior direct flow rights.

The variable nature of the natural water supply in Colorado also creates challenges for water users. The total volume of streamflow from year to year often varies by as much as 50 percent above or below the long-term average, and in some years even more. A water right will generally yield more water in wetter years than in drier years because the length of time the water right is in priority is longer. The difference between wet-year and dry-year yields is greater for junior water rights than for senior water rights because the most senior rights remain in priority even in drier years. Some junior water rights, such as the Grey Mountain right (part of the NISP supply) may not yield at all except in high-flow months of years with average to above-average precipitation and runoff. Storage is used to regulate the water supply between years by storing water in times of higher flow and releasing the water when needed.

Most municipal water providers plan around the concept of firm yield. Firm yield is generally defined as the amount of water that can be reliably produced by the provider's water collection system through some critical drought period (e.g., a 1-in-50 year drought or a repeat of an historical drought such as the mid-1950s drought). System firm yield is a function of several factors including the seniority and rate of flow of direct flow water rights, the volume and seniority of storage facilities, the capacities of various conveyance infrastructure (e.g., pipelines, pumps or canals) and the flexibility to divert, move and treat water at different locations.

When evaluating the benefit of a potential new water supply, water providers strike a balance between yield, cost, water quality, timing and other factors. For example, a municipality that has identified a certain amount of firm yield that needs to be met could acquire and transfer water from a more senior agricultural water right holder or from a more junior water right holder. Often, ownership in a ditch company includes a pro-rata share of a portfolio of senior and junior direct flow rights and storage water rights, and the aggregate yield is considered. Junior water rights may not yield as much or as frequently as more senior water rights, perhaps only yielding water once every few years. In order to obtain a reliable supply from a junior water right, a large amount of water is stored when it is in priority, and then is released for the provider's use slowly over time. This process is known as firming a water right. The amount of storage needed to firm a junior water right is related to the priority of the water right and projected evaporation and seepage losses. As the frequency of the water right being in priority and associated yield decreases, the amount of storage needed increases so that as much of the yield of the right can be diverted and stored when it is in priority.

For example, the proposed NISP relies partially on the yield from the junior Grey Mountain water right. Hydrologic modeling and analysis of historical diversion records predict that this water right will, on average, yield water approximately one in four years. To firm this right, a reservoir is required to carry water over from wet years (when the water right yields much water) to dry years (when the water right yields little to no water). Without storage, the firm yield of the Grey Mountain water right would be zero since it does not yield in drought years, even though yields in wet years would be high. In contrast,

more senior water rights may have firm yield without any storage due to their seniority (i.e. the water right yields every year). The firm yield on even relatively senior water rights can be increased with storage, if the decree allows the senior water right to be stored. The average annual yield of a water right alone cannot be used to determine its firm yield; the analysis must consider the volume of storage (including scenarios with no additional storage).

3.0 TRANSFERS OF AGRICULTURAL WATER TO MUNICIPAL USE

Water historically used for agriculture can be transferred to municipal use through different processes. Traditionally, this has been accomplished through a change of use decree from the Water Court and generally includes a dry-up provision on the irrigated lands. This type of transfer can be referred to as a buy-and-dry transfer or a traditional agricultural transfer. More recently, there has been dialogue at the state, regional and local level about the need to reduce the dry-up of agricultural land from such transfers due to the economic and land use impacts to the rural areas where the dry-up occurs. As a result, water court transfer methods commonly termed "alternative transfers methods" (ATM) have been promoted and include concepts such as interruptible supply, water banking and rotational fallowing.

Both options in the HRA propose the use of agricultural transfers to meet the project Purpose and Need. Both HRA options include traditional agricultural transfers, and transfer of transbasin (C-BT) water. HRA Option 2 also incorporates the use of the rotational fallowing ATM method for a portion of the NISP yield.

3.1 LEGAL AND ENGINEERING REQUIREMENTS

The transfer and change in use of a native agricultural water right (or group of water rights as is often the case with the conversion of ditch company shares) to municipal use is a complex process that is under the jurisdiction of the Division Water Court. The Water Court will only allow a change in use if it can be shown by a technical analysis that the change in use will not result in injury to other vested water rights. The injury analysis includes an evaluation of historical diversions for the water right over a representative period of use (e.g. from 1950 to recent years), the determination of historical consumptive use (CU) of the diverted water by the various crops grown on the irrigated farm land, and the determination of the rates, volume, location, and timing of the return flows. The return flow is the portion of the diverted water that is not consumed by the crops and that returns to the stream through subsurface flow or surface runoff from the irrigated fields. Transfer of transbasin water is generally a simpler process than native water rights (see Section 2.2), but specific ditch company by-laws may complicate transfers of transbasin water.

The CU from municipal use of transferred agricultural water is limited to the historical CU from irrigation. Municipal use is often less consumptive than the historical irrigation CU, which can provide municipalities with consumable water as wastewater effluent or lawn irrigation return flows (LIRFs). The municipal consumption rate changes throughout the year, with lower consumption rates in the winter when there is little to no outdoor use, and higher consumption rates in the summer when there is outdoor irrigation water use. There are often restrictions in drier years reflecting the historical CU in dry years, which may be less than the average for most water rights. In addition, the historical seasonal diversions for irrigation, generally April to October, must also be followed when the water is diverted for municipal use. This, in most cases, will require that reservoir storage be available to store some of the transferred water for the year-round use by a municipal water provider as well as to provide carryover storage from wetter years to provide a firm water supply in drought years.

The no-injury test also requires that historical return flows are maintained in volume, rate, location, and seasonal variation in order to protect downstream water rights that rely on the return flows, including junior water rights. The maintenance of return flows after diversions are transferred from agricultural use to municipal use can be a complex process involving reservoirs to store a portion of the historical return flows and release the water later in the season to maintain return flows outside of the irrigation season. It can also include the use of recharge facilities to recharge a portion of the historical return flows into the alluvial aquifer so that return flow patterns are maintained and to keep the water table at an elevation to protect vested ground water rights.

In agricultural transfers that are located near the municipality, the municipality may be able to divert an amount of water in excess of the historical CU and use wastewater effluent and LIRFs to meet the historical return flows (often diverting the farm delivery or farm headgate [FHG], which is the amount of water delivered to individual farms after canal seepage losses). For example, on the Poudre River, some of Fort Collins's transferred water is used in this manner. Similarly, water providers with more dispersed service areas (such as the NISP Participant water districts) that do not have a wastewater treatment plant can use return flows from individual septic disposal systems (ISDS) to meet return flow obligations, provided the ISDSs are located on or near the historically irrigated lands. These types of transfers that provide that return flows are made at locations downstream may have adverse effects on aquatic resources due to sections of river being depleted due to the location of the return flows from the wastewater effluent, LIRFs, or ISDS return flows being located downstream from their historical point of return. However, provisions in the change decree require that no vested water rights, both senior and junior, be injured from the reduction of historical return flows. Depending upon the location of vested water rights, return flows may be required to be made near the historical location.

If the water provider is located distant from the historically irrigated lands, the water provider may only be permitted to divert and use the historical consumptive use and is still responsible for maintaining the historical return flows at the original location and timing. For example, the City of Thornton owns approximately half the Water Supply and Storage Company (WSSC) in the Poudre River basin, which is nearly 60 miles away and in a different river basin from Thornton's municipal boundaries, place of use and location of effluent returns and LIRFs. Since return flows from the historical irrigation accrue to the Poudre River basin, effluent from Thornton cannot be used to maintain these historical return flows. Transfers of local agricultural water may provide a better water supply than distant sources due to the ability to divert more than the historical CU and meet historical return flows with effluent and LIRFs, but still depend on other factors such as amount and seniority of the water right or ditch company share, irrigator's willingness to sell and ability to maintain the historical return flows. Figure 3-1 is a schematic showing the agricultural transfer process for a water provider near the historically irrigated lands and one distant from the historically irrigated lands.

A change in use application is often opposed by other water users that believe the change in use could injure their water rights or by those who want to ensure that the technical evidence is properly presented to the Water Court so that there will be no injury to other water rights. In some change cases, the trial before the Water Court can last many weeks. For example, the trial in the proposed change in use of the WSSC shares by the City of Thornton was 17 weeks. In most change in use cases,

the case is settled prior to the trial date but it involves many meetings with attorneys and engineers representing the various objectors and the applicant before a stipulated decree is presented the Water Court. In either case, settlement or a contested trial, the litigation costs for engineering and legal activities can be significant. A decree will contain terms and conditions to prevent injury to other water rights as well as administrative and accounting requirements for the applicant to comply with in order to implement the change in use. There will be requirements to assure that consumptive use of the changed water use no longer occurs on the historically irrigated lands, normally through dry-up provisions and weed and dust control measures are put in place for the land removed from irrigation. It is noted that environmental considerations, such as preservation of wetlands and maintenance on in-stream flows (except for vested CWCB in-stream flow rights) solely for environmental purposes are not specifically afforded weight in these proceedings.

In addition to the projected yield of a water right based on a change in use decree, the water provider must also consider the ability of its existing infrastructure to divert and potentially store and treat any new water supply in its system, the cost of any new infrastructure, and the water quality at the point of diversion. Municipal intakes are often located higher in the basin compared to the location of the transferred agricultural water in an effort to obtain generally higher quality water (i.e., generally upstream of wastewater treatment plants and ISDSs, stormwater discharges and runoff from irrigated lands). Through an exchange, water users can at times divert a downstream changed water right at their upstream diversion point if there is no injury to intervening water rights. However, an exchange reduces the streamflow between the original downstream point of diversion and upstream point of diversion.

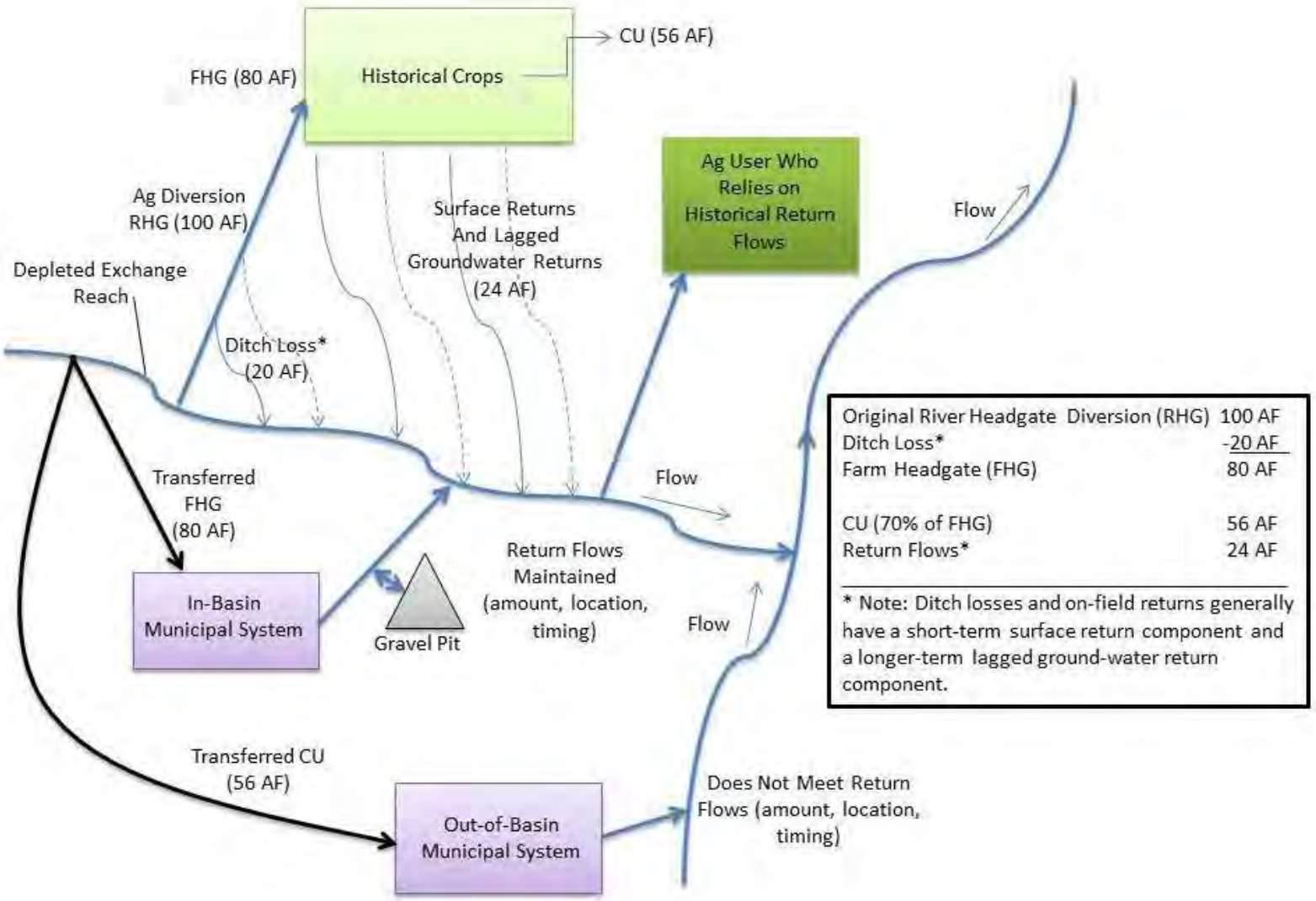
3.2 CONSUMPTIVE USE LIMITATION

Any change in use of an agricultural water right to a new use requires that the new use does not consume more water than the historical agricultural consumptive use. This restriction on the new use ensures that no more water is removed from the hydrologic system under the new use than would have occurred under the agricultural use, thereby protecting other decreed water rights.

The maximum potential consumption of irrigation water of a crop is defined as the irrigation water requirement (IWR). IWR is dependent on crop type, climate (e.g. temperature and precipitation), and hours of sunlight. In Colorado, many of the ditch systems do not have sufficient water supplies in volume, timing or both to meet the full IWR. The result is that historical CU is limited by the available water supply and is often referred to as a “water supply limited” condition (WSL). Consumption of transferred agricultural water is limited to the historical WSL CU, not the historical IWR.

The amount of transferable water is determined in large part from the quantification of the historical CU of the agricultural use. The State of Colorado, through activities of the Colorado Water Conservation Board (CWCB) and the Colorado DWR, has developed the Colorado Decision Support System (CDSS) for most river basins in Colorado. The South Platte River Decision Support System (SPDSS) is under development and has analyzed on a ditch-wide basis, the historical long term WSL CU (1950 to 2006) for the major ditches and canals in the South Platte River basin using a software program called StateCU

Figure 3-1 – Schematic of Agricultural Transfers



(LRE 2010). Quantification of the historical WSL CU is relevant to all four agricultural water transfer concepts presented in the HRA. The following sections discuss WSL CU determinations by STP as presented in the HRA and by the State of Colorado through the SPDSS.

3.2.1 CONSUMPTIVE USE ESTIMATES IN THE HRA

The HRA provides inconsistent information about the amount of water potentially available for transfer from an agricultural water source and fails to clearly distinguish between consumable water (WSL CU) and water used or diverted for irrigation use (FHG). The following data in quotations are presented in the HRA report with the calculation of transferable water per acre below:

> "*Irrigated agriculture occupies about 48,000 acres of that new land that would be developed on which about 33,300 AF of water is used for irrigation and should be available for M&I uses." (HRA, pg 14, footnotes cite USDA statistics)*
>
> 33,300 AF / 48,000 acres = **0.69 AF/acre**
>
> *"…the expansion plans [of NISP Participants] will lead to developing about 76,000 acres of agricultural land, of which about 48,000 is currently irrigated. This would free up about 60,000 AF of water supply for the participants." (HRA, pg 21)*
>
> 60,000 AF / 48,000 acres = **1.25 AF/acre**
>
> *"From Save The Poudre Coalition's analysis of the impacts of NISP on Agriculture, at 1.44 AF/acre, 15,800 AF of water would irrigate about 10,972 acres of land in the Poudre River basin." (HRA page 22, footnote 36 explaining amount of acreage lost under the HRA)*
>
> 15,800 AF / 10,972 acres = **1.44 AF/acre**

As described in Section 3.1, municipalities may be able to use more than the WSL CU, provided they can maintain historical return flows. However, on a regional basis, the transfer may be limited to only the WSL CU (see also Figure 3-1). The value of 0.69 AF/acre given in the HRA (page 14) is based on several assumptions about irrigated lands and amount of water used within the future NISP growth regions. In addition, it uses USDA statistics (Census of Agriculture and National Agricultural Statistics Service), which are not as thorough as the State of Colorado's efforts through the SPDSS dataset and model development of consumptive uses (LRE 2010). The value of 1.25 AF/acre also given in the HRA is not documented and appears to contradict the value of 0.69 AF/acre previously used since both statements were based on 48,000 acres.

The value of 1.44 AF/acre cited by STP appears to be the potential IWR for a typical crop mix in the NISP region. The majority of irrigation systems in the NISP region are water short (WSL CU less than IWR), and therefore do not consistently provide a full water supply to the crops. Therefore, the use of 1.44 AF/acre as transferable CU in the HRA projections of future dry-up of irrigated lands is incorrect and over-estimates the amount of transferable water available from an acre of irrigated land.

3.2.2 CONSUMPTIVE USE ESTIMATES BY THE STATE OF COLORADO

Through the SPDSSS, the State of Colorado developed ditch-wide estimates of WSL CU through analysis of the historical cropping patterns, climate and diversion records. Table 3-1 shows estimated surface water WSL CU per irrigated acre for each Water District in the NISP study area as computed in the SPDSS. The methods used to compute the WSL CU are documented in the associated report (LRE 2010) and are used by a variety of water users and planning agencies for planning level analysis of historical consumptive use. Because of the inconsistencies in the transferable water estimates presented in HRA and the documentation of the SPDSS methods and values, the SPDSS values will be used in this report.

The estimates in Table 3-1 are CU from surface water only and the per-acre estimates were calculated by dividing the total WSL CU by the average number of acres irrigated with a surface water source (surface water only or surface water supplemented by groundwater). Most groundwater use is junior in priority and therefore lands irrigated by groundwater only were not considered as part of the transferable supply from irrigated agriculture to municipal use for this analysis. The range for surface water WSL CU within the NISP study area is 0.93 AF/ acre to 1.18 AF/acre with the NISP regional average equal to the Poudre River basin average (Water District 3), estimated at 1.04 AF/acre.

The amounts of WSL CU shown in Table 3-1 include CU from transbasin water, including C-BT. In some cases, transbasin water (including C-BT) is sold independently from native water rights because transbasin water can legally be fully consumed and therefore does not involve determination of return flow obligations (see Section 2.2 and 3.1). Any quantification of the reduction in total irrigated acreage due to transfers to municipal use should consider that C-BT and other transbasin water is included in the per-acre WSL CU values presented in Table 3-1 and should not assume additional C-BT or transbasin supplies are available or that additional acreage would be dried up due to C-BT or transbasin transfers. The average WSL CU from the native water portion is lower than shown in Table 3-1 within the NISP study area, though actual amounts of WSL CU will vary by ditch system based on the water rights portfolio and C-BT use within the individual ditch system. Using some assumptions[2] on use and consumption of C-BT, the WSL CU from native agricultural water rights in the NISP study area could be 10 to 20 percent lower than shown in Table 3-1, though it would depend on actual historical use of C-BT within each water district and within each ditch system targeted for change in use.

For the revised NAA (MWH 2010), historical consumption from C-BT in three large ditch systems in northern Colorado was quantified from C-BT delivery records and removed from the each ditch's total WSL CU resulting in a 23 percent reduction of transferable WSL CU of for the Larimer and Weld Canal

[2] Assumes average annual C-BT delivery of 310,000 units at 70% quota (217,000 AF). Assuming 50% consumption of average C-BT delivery (108,500 AF of WSL CU) is equivalent to approximately 15% of the Water Districts 1 through 6 WSL CU. Since C-BT consumption varies widely by water user and time of year, a range of plus or minus 5% was used.

Table 3-1 - WSL CU per acre by Water District

	Water District	River Basin	Total Irrigated Acreage[1] [acres]	Surface Water Irrigated Acreage[2] [acres]	WSL CU from Surface Water[3, 4] [AF]	WSL CU from Surface Water per acre[4] [AF/acre]
NISP Study Area	1	South Platte River, Greeley to Balzac	241,369	142,960	168,498	1.18
	2	South Platte River, Denver Gage to Greeley	172,486	159,217	153,777	0.97
	3	Cache la Poudre River	215,810	209,598	217,022	1.04
	4	Big Thompson River	77,915	77,684	85,722	1.10
	5	St. Vrain Creek	62,925	62,732	60,058	0.96
	6	Boulder Creek	50,999	50,784	47,353	0.93
Outside NISP Study Area	*7*	*Clear Creek*	*13,213*	*13,085*	*20,719*	*1.58*
	8	*South Platte River, Cheesman to Denver Gage*	*6,600*	*2,590*	*3,102*	*1.20*
	9	*Bear Creek*	*2,135*	*2,135*	*3,053*	*1.43*
	23	*Upper South Platte River*	*18,133*	*18,133*	*15,315*	*0.84*
	48/76	*Laramie River/Sand Creek*	*4,226*	*4,226*	*4,619*	*1.09*
	64	*South Platte River, Balzac to State Line*	*98,226*	*69,107*	*78,092*	*1.13*
	80	*North Fork of South Platte*	*1,060*	*1,060*	*1,252*	*1.18*
Division 1 Total			***965,098***	***813,310***	***858,582***	*1.06*
NISP Study Area Total		**Water Districts 1 through 6**	**821,504**	**702,974**	**732,430**	**1.04**

1 Data from LRE (2010) Table 14

2 Acreage that is served by a surface water source, may also be supplied by groundwater source (acreage calculated from model input file "SP2008_crop.ipy" dated March 10, 2010).

3 Data from LRE (2010) Table 16

4 Includes CU from any transbasin sources (including C-BT) that would not necessarily be trasferable with the native water right. See text for discussion.

(Poudre Basin), 1 percent for the New Cache Irrigation Company (Poudre Basin), and 19 percent for the Home Supply ditch (Big Thompson Basin). This ditch-specific analysis of C-BT use and its impact on WSL CU per acre illustrates the variable nature of C-BT use between ditch systems. On a basin-wide perspective, the WSL CU amounts shown in Table 3-1 are a reasonable representation of the average amount of water available for transfer to municipal use (including C-BT and transbasin water).

3.3 AGRICULTURAL TRANSFER BY WATER DISTRICT

The following descriptions of the six water districts within the NISP study area (Larimer, Weld, Boulder, and Morgan Counties) include information from various sources including DWR and the SPDSS. Some of the information is derived from a report on the CWCB's ATM grant program (CWCB 2011a) and tailored to the context of NISP and the project Participants. The information presented is relevant to the assessment of the potential for agricultural to municipal water transfers in the area. To the extent possible, known agricultural water transfers completed or in progress by other water providers are summarized. From a reliability standpoint, more senior agricultural water rights are more desirable to municipal water providers because they are in priority more often and generally produce more reliable yields. Refer to Figure 2-1 for a regional map that includes the boundaries of the six water districts.

3.3.1 WATER DISTRICT 1, SOUTH PLATTE RIVER, GREELEY TO BALZAC

Water District 1 has 12 canals and ditches that divert water directly to irrigation use and 5 canals that divert water to off-channel storage for irrigation use. The earliest priority is one small right from 1868; the majority of the larger rights have priorities in the early- to mid-1880s. For the period 1950-2006, Water District 1 had an average total irrigated area of 241,369 acres with 52% of the WSL CU coming from surface water and 48% from groundwater (LRE 2010).

According to CWCB (2011a), the acquisition of irrigation water rights for municipal use is occurring at a slower pace in Water District 1 than in other water districts in the NISP Participant region. This is likely related to several factors, including water rights more junior than those in upstream water districts; diminished water quality (i.e., higher total dissolved solids [TDS] concentrations) relative to upstream reaches; and the lack of existing infrastructure to deliver water from the Lower South Platte River to centers of demand.

Ongoing actions to transfer water in District 1 include United Water and Sanitation District (UWSD) which has purchased land and water rights on the 70 Ranch near Hardin and has filed a change in use for some of the water rights. UWSD, East Cherry Creek Valley Water and Sanitation District (ECCV), and Arapahoe County Water and Wastewater Authority (ACWWA) have also filed for conditional water rights for municipal use, recharge, and irrigation on the South Platte River near the 70 Ranch. Water would be exchanged upstream to diversions on the South Platte River near Brighton; conditional exchange rights have been filed by these entities and many others in this reach. The water would be pumped from the South Platte River to Barr Lake for use by UWSD, ECCV, and ACWWA in the ECCV Northern Project.

CWCB (2011a) concluded that this reach of the South Platte is more likely to be included in ATMs such as rotational fallowing since the land is not as desirable for subdivision due to the rural character of the area. Statewide Water Supply Initiative 2 (SWSI 2) (CWCB 2007) reached a similar conclusion previously, stating the following:

> *[T]he areas that may have a high probability for implementing a successful rotational fallowing program would be areas that are not facing urbanization or other development pressures or acquisition by other water providers. [The required] amount of acreage in the South Platte…is located in the lower reaches of [the] basin…The most likely geographic areas for a rotational fallowing program in the South Platte appear to be in Water Districts 1 and 64.*

Water District 1 also has several large reservoirs that may be feasible to use for the storage of water from rotational fallowing under the canal systems served by the reservoirs. These include Riverside Reservoir that serves the Riverside Canal, Jackson Reservoir that serves the Ft. Morgan Canal, and possibly Empire Reservoir that serves the Bijou Canal[3]. There are also recharge projects under all three canal systems that are used to augment well depletions from wells under the canals. If these reservoirs could be used to store the CU from rotational fallowing or other ATM projects, these reservoirs could improve the exchange efficiency and the prospects for successful ATM implementation provided water can be released directly to the South Platte River for exchange purposes. However, as previously referenced, exchanges tend to have depletive effects to streams.

The only C-BT water delivered directly to Water District 1 is by a pipeline to the Fort Morgan area for use by municipal water providers. C-BT project return flows do accrue to the South Platte River and are diverted as if they were native river water.

3.3.2 WATER DISTRICT 2, SOUTH PLATTE RIVER, DENVER GAGE TO GREELEY

As described in the following paragraphs, CWCB (2011a) recognized that there is considerable activity in Water District 2 to acquire agricultural water rights and associated historical CU for municipal purposes. This water district relies heavily on return flows from the Denver metropolitan area as a source of supply. In many months, the majority of the flow of the South Platte in Water District 2 is derived from urban return flows including wastewater effluent, LIRFs and stormwater runoff. This reach of the river has over 2,270 cubic feet per second (cfs) of water rights decreed for irrigation with priorities equal or senior to November 20, 1885. The upper canal is the Burlington Canal with 377 cfs equal or senior to November 20, 1885. The lower canal is the Lower Latham Canal with 287 cfs equal or senior to October 24, 1881. In between there are 13 other canals with priorities as senior as April 1, 1860 and as junior as April 29, 1882. Between 1950 and 2006, Water District 2 averaged 172,486 acres irrigated with 76% of the WSL CU coming from surface water and 24% from groundwater (LRE 2010).

[3] Most of the Bijou system is located in an irrigation district and water cannot be transferred from the land. It is unknown if lands in this system could participate in a rotational fallowing program.

Many of the canals or ditches have priorities in the 1860s and 1870s and there are three dry up points on the river identified by the DWR below senior canals including the Burlington Canal, Jay Thomas Ditch (June 1, 1865), and Lower Latham. These dry-up points create impediments to exchanges of water upstream and would require some local storage of CU water from dry-up until exchange conditions develop with higher stream flows.

Some of the water rights associated with the 15 canals and ditches in Water District 2 have been acquired and the use changed to municipal use in previous water court actions; others have been acquired and are presently going through change in use proceedings. Additionally, some of the water rights that have been purchased are being leased back to farmers until a change in use to municipal use is needed to meet growing demands.

In this reach of the South Platte River, there is existing infrastructure in place to pump water from below Barr Lake to the area served by ECCV, located south of Aurora and east of Cherry Creek Reservoir. ECCV has also entered into an agreement with ACWWA to sell capacity in the ECCV Reverse Osmosis Water Treatment Plant located downstream of Barr Lake and a portion of the excess capacity in its Northern pipeline to ACWWA for delivery of water to its service area in Centennial. ACWWA has purchased water from UWSD, which has acquired the necessary senior water rights and will change them to municipal use. UWSD will also provide water to ECCV from changed irrigation rights for a total of 10,400 AF per year of consumptive use to be provided to ECCV and ACWWA. In addition, members of the South Metro Water Supply Authority also own capacity in the ECCV Northern pipeline, but do not currently have water rights to convey in this pipeline.

The City of Aurora's Prairie Waters Project (PWP) pumps water from the South Platte River near Brighton to the Binney Water Treatment Plant located adjacent to Aurora Reservoir. This project recovers reusable return flows controlled by Aurora in the South Platte River. The project will also be used to pump water acquired from senior water right owners in this reach of the South Platte. To facilitate these operations, Aurora has purchased water rights from a number of canals or ditches in Water District 2 and projects to acquire over 50,000 AF per year of average supply from ditches in District 2. In addition, it has an existing exchange decree that provides for the exchange of 10,600 acre-feet per year from ditches lower in Water District 2 upstream to the Prairie Waters points of diversion.

CWCB (2011a) anticipated that this reach of the South Platte River between the Denver Gage and Greeley will be subject to several more traditional water right changes in use—resulting in permanent dry-up—and is therefore not very amenable to ATMs such as rotational fallowing for use of irrigation water rights for municipal use. The land presently irrigated would be useful for gravel pits or subdivision since it is in the growth corridor of the Front Range. Moreover, the FRICO Barr and Milton systems are located in Water District 2, and the recent Supreme Court decision in the appeal of the ECCV change in use of FRICO shares under the Barr Lake system will limit the yield of those shares for municipal use.

Another significant activity occurring in this part of the basin is the Water Infrastructure and Supply Efficiency (WISE) Partnership where over the last several years, Aurora Water, Denver Water, and the SMWSA have been discussing and negotiating terms to provide water supplies to members of the

SMWSA by using excess system capacities, unused reusable water and potentially changed agricultural water rights. Denver Water and Aurora Water have identified interruptible, though significant, amounts of available reusable water in both systems as well as excess capacity in Aurora's PWP to convey and treat those supplies. The project could provide revenue to Aurora to defray costs of the PWP to the City's customers, provide a strategic reserve supply to Denver Water, and ultimately provide as much as 60,000 AFY in average annual yields to SMWSA entities in normal and wet years, although there may be zero deliveries in dry years, requiring SMWSA entities to store WISE deliveries. The first phase of WISE is scheduled to begin in 2013.

Lastly, C-BT water is delivered to the middle reach of Water District 2 via the Lower Boulder Ditch and Coal Ridge Ditch where it is stored in Sand Hill Lake and released to the South Platte for diversion by the Evans No. 2 Ditch and Meadow Island No. 2 Ditch. C-BT water is also delivered to the Towns of Ft. Lupton and Hudson by pipeline which then extends to the City of Ft. Morgan.

3.3.3 WATER DISTRICT 3, POUDRE RIVER BASIN

The Cache la Poudre (Poudre) River Basin defines the boundaries of Water District 3 and extends from the confluence of the Poudre River with the South Platte River near Greeley to its headwaters. Over the period 1950-2006, Water District 3 averaged 215,810 total irrigated acres with 88% of the WSL CU coming from surface water and 12% from groundwater (LRE 2010).

Water is imported into Water District 3 from several sources in adjoining river basins. Except for C-BT water, the largest amount is delivered from the Colorado River basin by the Grand River Ditch owned by WSSC. Deadman Ditch diverts water from the Laramie River basin to the Sand Creek basin and then is re-diverted by the Wilson Supply Ditch which delivers water into Sheep Creek, a tributary of the North Fork of the Poudre. It is owned by Divide Canal and Reservoir Company whose shares were owned by some shareholders in the Larimer Weld Canal, but have recently been bought by the Tri-Districts, municipal water providers in the Poudre basin. The Laramie Poudre Tunnel diverts water from the Laramie River basin to the Poudre River and is jointly owned by the WSSC (86 percent) and by the Tri-Districts and the City of Greeley (7 percent each). Cameron Pass Ditch diverts water from the Middle Fork of the Michigan River basin to the Poudre River basin and is owned by the WSSC. Skyline Ditch diverts water from the Laramie River basin into the Poudre Basin and is usually delivered through the Laramie Poudre Tunnel. It is also owned by the WSSC. Michigan Ditch diverts water from the Michigan River to the Poudre Basin and is owned by the City of Fort Collins. Bob Creek Ditch diverts water from the Laramie River basin and is owned by the City of Greeley. Outside of the C-BT project, the transbasin diversions into Water District 3 are the only transbasin diversions into the South Platte Basin that are still used for agricultural purposes. All other major transbasin diversions into the South Platte are controlled by municipal providers.

C-BT water and Windy Gap Project water is imported into Water District 3 via the two projects' shared infrastructure and some is stored in Horsetooth Reservoir (156,700 AF capacity) where it is delivered to agricultural users through the Hansen Supply Canal to the Poudre River near the mouth of Poudre

Canyon. Agricultural C-BT water is delivered to points downstream as well as by exchange upstream to the North Poudre Supply Canal. C-BT water for municipal users is also delivered out of Horsetooth Reservoir, either via the Hansen Supply Canal or directly to water treatment facilities below Soldier Canyon Dam.

From the North Poudre Supply Canal above the canyon mouth and the North Poudre Canal on the North Fork of the Poudre River, downstream to the confluence with the South Platte River, there are approximately 24 ditch systems and canals that divert water from the Poudre River. The four largest are the North Poudre Canal and North Poudre Supply Canal (combined serve NPIC lands), the Larimer County Canal (WSSC), the Larimer Weld Canal, and the New Cache Ditch (Greeley No. 2), that collectively comprise over 70 percent of the irrigated acreage in the Poudre Basin. Water District 3 has many senior direct flow water rights with priorities in the 1860s and 1870s. Most of these water rights are senior to those on the South Platte River and as a result, internal calls within Water District 3 generally control the use of water throughout the year and the Poudre does not pass water to the South Platte during the irrigation season except for periods of high flow or when all water rights, including reservoirs, in the Poudre basin have been satisfied.

According to CWCB (2011a), Water District 3 is thought to be more amenable to traditional agricultural change in use cases resulting in permanent dry-up rather than rotational fallowing. The value of the irrigated land for subdivision development is also quite attractive due to the location in the growth areas of Fort Collins, Greeley, the Tri-Districts and numerous smaller water providers. In the Poudre Basin, considerable water rights acquisition activities have been completed by Greeley, Thornton, and Fort Collins as well as some smaller water providers. For example, Thornton purchased nearly 50 percent of the shares in WSSC, and approximately 70 percent of the North Poudre Irrigation Company (NPIC) is owned by municipal or rural domestic water providers, with Fort Collins the largest shareholder at about 35 percent. In some acquisitions, the water is being leased back to the farmers until the water providers grow to the point where water needs require the land to be removed from irrigation. Some of the water rights have been changed to municipal use already—such as the Thornton purchase of the WSSC shares—and the land is being irrigated under leases to farmers before permanent dry-up and revegetation with native plant species.

Some previous change-in-use cases were able to use ditch-wide change procedures and this has encouraged the sale of remaining shares in these canals because the historical CU has been established. As long as the farmer has been using the owned shares efficiently and as historically identified in the initial change case, the sale of remaining shares is more attractive and will require less transaction costs.

3.3.4 WATER DISTRICT 4, BIG THOMPSON RIVER BASIN

The Big Thompson River basin defines the boundaries of Water District 4 and extends from the confluence of the Big Thompson River with the South Platte River near LaSalle to its headwaters in Rocky Mountain National Park. It is bounded on the north by the Poudre River basin and to the south by the

St. Vrain Creek basin. Water District 4 has averaged 77,915 total irrigated acres over the period 1950-2006, with 99% of the WSL CU coming from surface water and 1% from groundwater (LRE 2010).

Water is imported into Water District 4 only from the C-BT Project and the Windy Gap Project at the East Portal of the Adams Tunnel, which is located above Estes Park and delivers water from the two projects' West Slope collection system. Water is delivered through Lake Estes to the Olympus Tunnel for hydropower production at two power plants along the way to Flat Iron Reservoir where water is routed into the Hansen Feeder Canal for delivery to Carter Lake (112,700 AF capacity) and to Horsetooth Reservoir. C-BT and Windy Gap Project water can be delivered to the Big Thompson River above Loveland for diversion from the river for irrigation and municipal use. Water is also delivered to the Little Thompson River from the St. Vrain Supply Canal for irrigation users.

Below the Hansen Feeder Canal, there are fourteen canals and ditches that divert water from the Big Thompson River. The largest diverters include the Handy Ditch, Home Supply Ditch, Louden Ditch, Greeley-Loveland Canal, Big Barnes Ditch, and the Hillsborough Ditch moving from upstream to downstream direction.

Both the Big Thompson and Little Thompson Rivers have very senior water rights with many water rights in the 1860s and 1870s and the oldest having 1861 priorities. The water rights within Water District 4 normally control the use of water as internal calls with the Water District are generally senior to any call downstream on the South Platte River.

The City of Loveland diverts water from the Big Thompson River at a shared diversion structure with the Home Supply Ditch using various changed water rights from eight irrigation ditches. It also can divert C-BT water from the Hansen Supply Canal for delivery to its water treatment plant. The City of Greeley acquired shares in the Greeley-Loveland Canal and changed the use of these to municipal use. A water treatment plant below Boyd Lake is used to treat the water and deliver it by pipeline to the city.

Similar to Water District 3, CWCB (2011a) reports that Water District 4 is considered more desirable for traditional agricultural change in use processes with permanent dry-up rather than rotational fallowing. The value of the land for subdivisions to meet the expected population growth in the area along with the current market value for the water rights and current levels of water provider ownership in District 4 ditch systems makes rotational fallowing questionable.

3.3.5 WATER DISTRICT 5, ST. VRAIN CREEK BASIN

The St. Vrain Creek basin generally defines the boundaries of Water District 5 with the exception of the Boulder Creek basin which is tributary to the St. Vrain basin near Highway 119 west of I-25. The Boulder Creek basin is defined by DWR as Water District 6 and will be discussed in the following section. The St. Vrain Creek basin extends from its confluence with the South Platte River to its headwaters along the Continental Divide. As shown in Table 3-1, Water District 5 has averaged 62,925 total irrigated acres over the period 1950-2006 with with 98% of the WSL CU coming from surface water and 2% from groundwater (LRE 2010).

Water is imported into Water District 5 only from the C-BT and Windy Gap Projects using the St. Vrain Supply Canal that carries water south from Carter Lake. Water from the St. Vrain Supply Canal can be delivered into St. Vrain Creek just below the Town of Lyons.

Below the St. Vrain Supply Canal, there are approximately 33 canals and ditches that can divert water from the St. Vrain Creek for irrigation use and reservoir storage. The largest diverters are Supply Ditch, Highland Ditch, Rough and Ready Ditch, St. Vrain and Palmerton Ditch, Swede Ditch, Longmont Supply Ditch, Oligarchy Ditch, Zweck Turner Ditch, and Last Chance Ditch.

The City of Longmont diverts water from the South and North Forks of the Saint Vrain Creek above the Town of Lyons. It has transferred several senior water rights and changed the use of these in water court proceedings. Longmont also exchanges C-BT and Windy Gap water from the St. Vrain Supply Canal to its points of diversion above Lyons. The Left Hand Ditch Company diverts water from the South Fork of the Saint Vrain Creek and often dries up the creek in the summer months. It has a right for 40.77 cfs with an appropriation date of 6-1-1863.

Similar to Water Districts 3 and 4, Water District 5 is considered more desirable for traditional agricultural change in use processes with permanent dry-up of the rather than rotational fallowing. The value of the land for subdivisions to meet the expected population growth in the area along with the current market value for the water rights and current levels of water provider ownership in District 5 ditch systems makes rotational fallowing questionable.

3.3.6 WATER DISTRICT 6, BOULDER CREEK

The Boulder Creek basin from its confluence with St. Vrain Creek to the Continental Divide defines the boundaries of Water District 6. Averaged over the period 1950-2006, Water District 6 has 50,999 total irrigated acres with 98% of the WSL CU coming from surface water and 2% from groundwater (LRE 2010).

Water is imported into Water District 6 from the C-BT and Windy Gap Projects by the Boulder Feeder Canal which is supplied by the St. Vrain Supply Canal in Water District 5. The Boulder Feeder Canal delivers water into Boulder Reservoir for subsequent delivery to Boulder Creek. The ability to acquire and transfer C-BT water in other water districts to the north and deliver that water to Water District 6 is important to municipal water providers. Water is also imported into Water District 6 by Denver Water at the Moffat Tunnel which diverts water from the Fraser River basin (upper Colorado River basin) on the West Slope and delivers it to South Boulder Creek at the east portal of the tunnel. Water from the Moffat Tunnel is stored in Gross Reservoir which is located on the channel of South Boulder Creek. Denver Water then diverts its imported water out of Water District 6 south towards the City and County of Denver near the mouth of the Eldorado Canyon, where South Boulder Creek exits the mountains.

On South Boulder Creek, there are 20 active ditches that divert water with some of the largest, in upstream to downstream order, being the South Boulder Diversion Conduit to Denver Water's Ralston Reservoir, Community Ditch, South Boulder Coal Creek Ditch, Davidson Ditch, Goodhue Ditch, South

Boulder Canon Ditch, Leyner Cottonwood Ditch, Howard Ditch and Jones Donnelly Ditch. Shares in many of these ditches have been converted to municipal use for Boulder County communities.

On Boulder Creek, there are 25 active water rights that divert water with some of the largest in downstream order being the Boulder Power Pipeline, Anderson Ditch, Farmers Ditch, Boulder and White Rock Ditch, North Boulder Farmers Ditch, Lower Boulder Ditch, Boulder and Weld County Ditch, Godding Dailey and Plumb Ditch, Highland and South Side Ditch, and Rural Ditch. Similarly to South Boulder Creek, shares in many of these ditches have been converted to municipal use for Boulder County communities.

There have been a number of changes in use of senior irrigation water rights to municipal use to meet the needs of Boulder, Erie, Louisville, and Lafayette. However, Boulder County has an extensive open space and conservation easement program that is intended to prevent development on certain parcels of land. Many of these lands will continue to use water rights for irrigation and will not be available in the future for transfers to municipal use. See Section 5.2 for a more detailed analysis.

4.0 NISP PURPOSE AND NEED

The NISP overall purpose is to provide the Participants with approximately 40,000 AF of new reliable municipal water supply annually through a regional project coordinated by the District. The basis for NISP as a regional project is described in Section 1.2 and the DEIS, pg. ES-2. The project need is based on projected future water demands for the NISP Participants that were developed for the DEIS and finalized by Harvey Economics (HE) (HE 2006) and were reviewed in draft form for the Corps (BBC Research and Consulting 2005). At the time of these projections, population in the NISP Participant service area was increasing at a rapid pace and the long-term persistence of conservation measures adopted during the 2002 and 2003 drought were not known.

The HRA options were configured to meet a firm yield of 35,000 AF, which is less than the 40,000 AF stated in the NISP overall purpose statement and supported by the needs analysis. The HRA states that the analysis to support the NISP Purpose and Need is "fundamentally flawed and incapable of serving as the foundation for further analysis." To support this conclusion, the HRA challenges the population projections, per capita water use rates, and system losses used in the DEIS.

After the DEIS was published, and in large part due to the economic slowdown that began in 2007, Northern Water revisited the demand projections (HE 2011) and the Corps reviewed these projections (BBC 2011). The following sections provide a brief summary of the HE (2011) demand projections and conclusions from the Corps' review (BBC 2011) and describe the demands proposed in the HRA in the context of the latest update and Corps review of demands.

4.1 2011 UPDATE TO DEMANDS AND CORPS' REVIEW

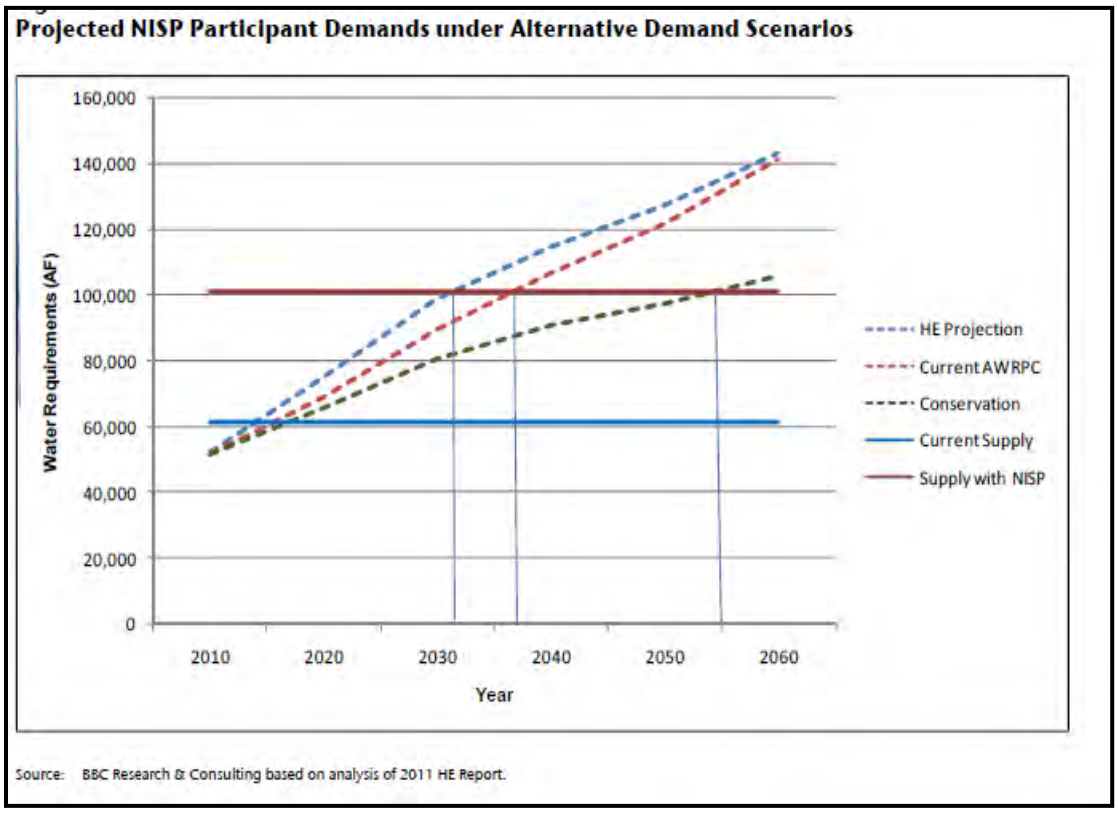
Northern Water commissioned Harvey Economics (HE 2011) to update the population projections for the NISP Participants. This document was reviewed by BBC (2011) for the Corps. BBC (2011) presents the following conclusions based on its review of updated HE (2011) demand projections:

- The HE (2011) overall methodology is reasonable (BBC 2011, pg 6).
- The HE (2011) population projections through 2040 are reasonable and consistent with projections from the State Demographer's Office and that there are no State projections beyond 2040 (BBC 2011, pg 7).
- The HE (2011) per capita water use rates increase from 2010 through 2030, then fall back to near current levels of per capita use by 2060 due to the following reasons (BBC 2011, pgs 8, 9).
    - Increase in non-potable demands from several NISP Participants.
    - Increase in demand from large customers such as dairies.
    - Increased commercial development within the NISP Participant boundaries.

- BBC (2011) found the HE (2011) increase in per capita water use less likely than a continued decrease in per capita use and recommended analysis of two water use scenarios in addition to the HE 2011 projections (BBC 2011, pgs 9, 10).
    - BBC's 'Current AWRPC' scenario applies the current per capita use scenario to the population projections and results in lower demands than HE 2011 through 2050, but similar demands by 2060.
    - BBC's 'Conservation' scenario applies a 25 percent reduction in per capita use by 2060. Results show an overall reduction in demand by 2060 compared to HE (2011).
    - All scenarios show that the NISP Participants' demand will surpass their collective current firm yield within a few years.
    - Both BBC (2011) scenarios (Current AWRPC and Conservation) and the HE (2011) projections show that NISP Participants will need at least 40,000 AFY of additional new firm yield within the planning horizon.
    - The timing of the need for NISP changes with different assumptions on per capita use rates (HE [2011], BBC's current scenario and BBC's conservation scenario).

BBC's (2011) Figure 5 (reproduced below as Figure 4-1) graphically depicts the report's conclusion that the need for 40,000 AFY has not changed, but only the timing differs depending on the assumed future per capita water use rates. Therefore, the NISP need for firm yield of 40,000 AFY is appropriate for inclusion in the overall purpose statement as well as for an assessment of the HRA.

Figure 4-1 – Reproduction of BBC (2011) Figure 5 Depicting Differences in Timing of Need for full NISP Yield under Different Demand Scenarios



4.2 REVIEW OF HRA PROPOSED FUTURE DEMANDS

The HRA report rejected the demands presented in the DEIS (based on HE 2006) because of claims of errors in population projections, per capita water use, and failure to reasonably reduce system losses. The HRA proposes a lower project need of 35,000 AFY based on these claims. The following sections respond to these claims; they are not intended to replace the Corps' review of future demands completed by BBC (2011).

4.2.1 POPULATION PROJECTIONS

The HRA report claims that the DEIS used inflated population projections in the demand analysis. Following the BBC (2011) review of the HE (2011) updated population and demands projections, the Corps adopted the HE (2011) population projections. As described in Section 4.1, the updated population projections in HE (2011) confirm the NISP need of 40,000 AFY even though they differ from the projections in the DEIS.

The HRA report states that re-calculating population projections "using the midline growth rates and respecting the listed build-out figures, total population in 2035 for the NISP Participants is 375,613; 11% less than listed in the DEIS. In 2050 the population is projected to reach 440,920; 27% less than the DEIS projects." Review of the DEIS and HE (2006) shows that total NISP population presented in the DEIS for 2035 is approximately 426,900 and for 2050 is approximately 481,600[4]. The HRA report's projected populations are therefore 12 percent lower than the DEIS projections in 2035, and 8 percent lower than the DEIS projections in 2050, but not 27 percent lower as claimed in the HRA.

Review of the HRA claims about incorrect population growth assumptions in the DEIS revealed that the average annual growth rates presented for Dacono, Firestone and Frederick in Table 1-4 of the DEIS were incorrect. The values presented ranged from 1 percent to nearly 2 percent, but associated appendices in HE (2006) indicate annual growth rates ranging from 3.5 to 4.5 percent. Nonetheless, the projected populations shown in Table 1-4 of the DEIS are consistent with the higher growth rates in the HE (2006) appendices and the water demands presented in the DEIS were based on the projected populations, not the projected growth rates. Therefore the error in the presentation of the growth rate in Table 1-4 of the DEIS did not carry through to the DEIS demand projections. Since the HRA recomputed populations using the annual growth rates presented in DEIS Table 1-4, their projections are likely low for Dacono, Firestone and Frederick due to the error identified above. However, the HE (2011) population projections now supersede the projections presented in the DEIS.

[4] 2035 and 2050 populations derived by using historical average people per tap values provided in HE 2006 for those participants reporting number of taps instead of population in DEIS Table 1-4.

4.2.2 PER CAPITA WATER USE RATES

The HRA claims that the DEIS used inappropriate per capita use rates. As described in Section 4.1, the BBC (2011) review of the HE (2011) updated demands projections indicates some questioning of the per capita water use rate used in HE (2011). However, even using a more aggressive reduction in per capita use rate in the conservation scenario than the HRA (HRA proposed 20 percent reduction, BBC analyzed a 25 percent reduction), BBC (2011) concluded that the increase in demand will exceed 40,000 AF and therefore the full 40,000 AFY Need is confirmed.

Review of the HRA per capita water use rates reveals errors in the HRA calculations. The resulting water demands presented in the HRA are therefore incorrect even if used with updated population projections. The following is a listing of the errors in the HRA calculations:

- Use of 2003 as a baseline is inappropriate because water use in 2003 was low due to drought restrictions in most communities. The HRA applies conservation assumptions to this already water-short use rate. Most Front Range water providers have seen lower water use rates persist after the 2002/2003 drought, but BBC (2011) explains that use rates "increased modestly after 2003, peaking in 2007."
- The HRA presents per capita water use values (in units of gallons per capita per day [gpcd]) developed from potable water use and omits non-potable demands (HRA Table 1). Non-potable demands comprise approximately 13 percent of the NISP Participant future demand. The per capita use values that omit non-potable demands are later used to compute total demands.
- The HRA demands double-count system losses by first incorporating system losses into the potable per capita water use value (HRA Table 1), then adding an additional 10 percent to account for losses (HRA page 12).

The use of incorrect population data, per capita use rates from 2003 when rates were low due to drought restrictions, omission of non-potable demands, and incorrect application of system loss calculations results in HRA projected demands that are not correct and are not suitable for the NISP planning or evaluation process.

4.2.3 WATER CONSERVATION

The HRA report correctly demonstrates that per capita water use values have been declining for several major water providers in the region. HE (2011) provides a comprehensive review of each NISP Participant's conservation plan and concluded that the water use rates of NISP Participants are not excessive and are well within the regional range. However, BBC (2011) computed per capita use rates (based on combined potable and non-potable demand and system losses) of the HE (2011) projected demands and found the use rate to increase in the near term, and then by 2060 fall back to current levels. BBC (2011) acknowledged that recent trends indicate decreases of per capita use rates and developed a demand scenario to include an aggressive conservation scenario. Based on the conservation scenario, BBC (2011) concluded that even under a conservation program more aggressive

than proposed in the HRA report, the future demand increases will exceed the 40,000 AFY requested yield of NISP.

4.2.4 SYSTEM LOSSES

The HRA report proposes that all NISP Participants should be able to attain system losses no greater than 10 percent based on a 1996 American Water Works Association (AWWA) Journal article. As shown in the DEIS and in the updated HE (2011) report, most of the NISP Participants already have losses under 10 percent and many have active conservation programs to locate and reduce system leaks (HE 2011). However, some of the Participants acquire water from wholesale water providers who charge 10 to 20 percent water surcharges as a water resource fee. Surcharges are set by the wholesale providers as part of a contractual agreement with the Participants and do not necessarily represent a physical system loss by the wholesale provider. The water resource surcharges are not considered as NISP Participant system losses. Table 4-1 shows the Participants' system losses and potential demand reductions for NISP Participants that currently have system losses currently greater than 10 percent. Depending on the demand scenario, total demands could be reduced by 1,500 AFY to 2,100 AFY. A reduction in total water requirements by the 1,500 to 2,100 AFY would still result in future demand increases in excess of 40,000 AFY more than current firm yield, even under the BBC (2011) 'conservation scenario' which is more conservative that the HRA proposed conservation measures. Reduction of system losses has the potential to reduce or delay the overall demand increases from the NISP Participants, but does not change the need for 40,000 AFY as defined in the overall purpose statement.

4.3 CONCLUSIONS REGARDING NISP DEMAND ASSESSMENTS

- The HE (2011) update to NISP Participant demands has been reviewed by the Corps (BBC 2011). The NISP need of 40,000 AFY has been found valid (Figure 4-1).
- HRA projected demands contained several errors including use of incorrect population growth data reported in the DEIS, incorrect per capita use assumptions, omission of non-potable demands, and incorrect application of system loss rates. The resulting HRA proposed demands are not suitable for NISP planning purposes.
- A water conservation scenario proposed by BBC (2011) is more aggressive than the proposed HRA conservation measures and results in future demand increases that exceed the NISP Purpose and Need of 40,000 AFY. Therefore, the need of 40,000 AFY should not be reduced as proposed in the HRA.
- Reduction of system losses as proposed in the HRA would reduce overall NISP Participant demand by 1,500 AFY to 2,100 AFY. However, even if such reductions are attainable, future demand increases exceed the NISP need of 40,000 AFY. Therefore, the overall purpose statement that reflects 40,000 AFY of need should not be reduced as proposed in the HRA due to potential reduction in system losses.
- Ongoing water conservation efforts and reductions in system losses will reduce overall NISP Participant demands and will delay or reduce the need for additional supplies in excess of the NISP yield.

Table 4-1 - Potential Demand Reduction from Reductions in System Losses

		Harvey Economics (2011) Demands			BBC (2011) Conservation Scenario Estimated Demands		
Participant	System Loss Percentage[1]	2060 Deliveries[2]	2060 Water Requirments[3]	**2060 Potential Demand Reduction at 10% loss**	2060 Deliveries[4]	2060 Water Requirments[4]	**2060 Potential Demand Reduction if 10% loss can be achieved**
	%	*(AF)*	*(AF)*	***(AF)***	*(AF)*	*(AF)*	***(AF)***
CWCWD	7.0	7,100	7,700	0	5,300	5,700	0
Dacono	5.0	3,100	3,220	0	2,300	2,400	0
Eaton	8.0	2,700	3,200	0	2,000	2,400	0
Erie	13.0	20,600	23,600	710	15,500	17,800	580
Evans	8.0	7,800	10,100	0	5,900	7,400	0
FCLWD	3.0	17,500	18,100	0	13,100	13,500	0
Firestone	0.0	7,400	8,200	0	5,600	6,200	0
Fort Lupton	10.0	4,800	5,300	0	3,600	4,000	0
Fort Morgan	17.0	8,700	10,400	730	6,500	7,800	580
Frederick	1.0	10,900	13,820	0	8,200	10,400	0
Lafayette	8.0	8,000	8,700	0	6,000	6,500	0
LHWD	14.0	10,100	11,900	680	7,600	8,800	360
MCQWD	3.0	4,600	4,700	0	3,500	3,600	0
Severance	5.0	3,200	3,800	0	2,400	2,800	0
Windsor	9.0	7,700	10,700	0	5,800	7,700	0
Total		**124,200**	**143,440**	**2,120**	**93,300**	**107,000**	**1,520**

1 - Source: HE (2011) Table II-3; excludes water resources surchage fees

2 - Source: HE (2011) Table II-2. Includes potable and non-potable deliveries.

3 - Source: HE (2011) Table IV-1; water requirements are equal to total deliveries plus system losses plus applicable water resource surcharges from wholesale providers

4 - BBC (2011) did not analyze individual providers. The conservation scenario represents a 25% reduction in per capita use relative to current use. Reduction applied to all participants

NISP Participant acronyms shown in Table 4-1 are as follows:

CWCWD – Central Weld County Water District
FCLWD – Fort Collins – Loveland Water District
LHWD – Left Hand Water District
MCQWD – Morgan County Quality Water District

5.0 EVALUATION OF HRA CONCEPTS USING NISP SCREENING CRITERIA

As described in Section 1.1, there are two options presented in the HRA use concepts that could provide additional water supply to the NISP Participants. The components proposed in the HRA are variations of transfers of water from agricultural use to municipal use. The NISP alternatives screening criteria described in Section 1.2 and Table 1-1 will be applied to the HRA concepts individually. The reduction of system losses as proposed in the HRA is considered a demand reduction and not a new source of supply and was considered in Section 4.2.4. The agricultural transfer concepts proposed in the HRA are:

1. Traditional agricultural transfers
2. Development displaced water
3. Transfer of C-BT water
4. Rotational fallowing agreements

As described in the introduction to this report, each of the four components are evaluated to answer the following questions:

1. Does the HRA concept meet the NISP screening criteria presented in Table 1-1 used to evaluate the water supply concepts and elements for NISP?
2. Are the basic elements of the HRA already reasonably being evaluated in detail by a similar alternative in the NISP DEIS or SDEIS?

A summary table of the results of the alternatives screening for the four agricultural transfer concepts is presented in Section 5.5, Table 5-5.

5.1 TRADITIONAL AGRICULTURAL TRANSFERS

Section 3 provided an overview of the technical and legal requirements of a traditional transfer of agricultural water to municipal use (sometimes referred to as buy-and-dry transfers). Table 3-1 shows that transferrable CU (water supply limited CU or WSL CU) in Water Districts 1 through 6 is 732,430 AFY on average, which corresponds to an average WSL of 1.04 AF/acre (based on the State's consumptive use model StateCU, LRE 2010). This value includes CU from CB-T and other transbasin sources. Acquisition of C-BT from agricultural users is discussed in Section 5.3 and is considered independently from other water supplies used for agriculture due to the relative ease of transferring this water compared to native agricultural water. To achieve close to the average annual yields shown in Table 3-1, storage would be required. Even senior agricultural direct flow water rights would likely require some amount of storage in order to provide for the historical lagged return flows that occur during the non-irrigation months. It should be noted that it is not possible to convert average yield completely into firm yield as storage required to convert average to firm yield will result in evaporation and potentially seepage losses, thus reducing the average yield. There are only a select few direct flow agricultural rights in the South Platte basin that are of sufficient seniority that the firm yield is the same as average yield.

Depending on the location of the historically irrigated lands, a water provider may be able to take advantage of the full farm headgate (FHG) delivery in a change of use decree (as described in Section 3.1 and Figure 3-1). In cases where the transferring water provider can meet historical return flow obligations (RFOs) from its wastewater effluent, the provider may divert more water than the historical consumptive use (1.04 AF/acre WSL CU divided by assumed 70% on-farm efficiency produces 1.49 AF/acre FHG transferable water), provided the provider's CU does not exceed the historical irrigation WSL CU as determined by the water court transfer. The ability to use the FHG delivery is not generally suited for a regional project due to the local geographic nature of RFOs. However, the concept aligns with the development displaced water concept proposed in the HRA and is evaluated further in Section 5.2.

5.1.1 EXISTING EVALUATION OF AGRICULTURAL TRANSFERS IN THE DEIS OR SDEIS ALTERNATIVES

Traditional agricultural transfers were previously evaluated as a partial supply for NISP as part of Alternative 4 in the DEIS. Additionally, the water source for the revised NAA (MWH 2010) is comprised primarily of agricultural transfers from three large ditch companies in the Poudre and Big Thompson basins and includes pro-rata use of storage within the existing agricultural reservoirs. The traditional agricultural transfers concept as proposed in the HRA does not differ fundamentally from previous analyses except in the likely amount of transferable water per acre (see Section 3.2).

The HRA proposes using development displaced water, which is conceptually the same as a traditional agricultural transfer, except that it targets the location of the agricultural dry-up to be within the new growth areas of the NISP Participants. Development displaced water is a narrower definition of traditional agricultural transfers and is evaluated further in Section 5.2.

5.1.2 APPLICATION OF NISP SCREENING CRITERIA TO TRADITIONAL AGRICULTURAL TRANSFERS

Purpose and Need Criteria

Table 3-1 estimates that there is greater than 730,000 AFY of WSL CU within the NISP study area. This amount is more than enough CU water in agriculture to meet 30 percent the NISP firm yield of 40,000 AF. In addition, substantial amounts of irrigated agriculture located throughout the region could reasonably provide a source of water that is regional in nature, though construction of common infrastructure such as treatment plants, firming storage reservoirs and pipelines would likely be required. Therefore, traditional agricultural transfers satisfy the Purpose and Need criteria.

Environmental Criteria

The environmental screening criteria evaluate new reservoir elements. Since traditional agricultural transfers are considered a water supply concept, the environmental criteria developed for elements are not applicable.

Practicable Criteria

Irrigated lands are generally not located in designated wild and scenic or recreational areas, wilderness area, hazardous material sites, landfills, active or abandoned coal mines, national or state parks, or an interstate highway. However, there is a significant amount of irrigated acreage in Boulder County (within in Water Districts 5 and 6) that is on county open space or is subject to a conservation easement (see Figure 5-1). As shown on Table 3-1, due to the large amount of water potentially available in the region, traditional agricultural transfers are still a practicable concept even if all irrigated lands in Water Districts 5 and 6 are excluded from consideration.

Many water providers in the region have and will continue to transfer agricultural water to meet their future demand. Many water providers through the course of normal planning purchase agricultural water rights from irrigators and lease water back until the supplies are needed (DiNatale Water Consultants [DWC], 2012). The municipal and industrial (M&I) supply gap (i.e., additional future supply needed) for the Front Range (Metro and South Platte basins only) as projected in SWSI 2010 (CWCB 2011b) ranges from 99,000 AF to 360,000 AFY depending on the success of identified projects and processes (IPPs), such as NISP. Even at the higher end of the range, Table 3-1 shows that there is still enough agricultural water in the NISP region that acquisition of additional agricultural water rights will not necessarily interfere with the plans of other water providers, though there is competition to acquire water rights that are highly desirable based on seniority, geography, water quality and other considerations.

Traditional agricultural transfers have been used in Colorado for decades and are considered a proven technology. Firming storage would likely be needed for agricultural rights especially when undertaken on a regional project basis. The amount of firming storage required would depend on the portfolio of water rights acquired through the transfer. Without specific water rights identified, it is speculative to determine the exact amount of storage needed. Overall, traditional agricultural transfers satisfy all of the Practicable screening criteria defined for NISP.

5.1.3 RESULTS OF TRADITIONAL AGRICULTURAL TRANSFER EVALUATION

Traditional transfers of agricultural water to municipal use have been used in the past throughout Colorado to provide a water supply to growing municipalities and water districts. Extensive engineering and legal work has been done by the CWCB through the CDSS to assist in quantification of water available for transfer to municipalities. Nonetheless, there are complex and legal and engineering requirements unique to each transfer designed to protect existing decreed water rights. The following are conclusions related to the previous evaluations of traditional agricultural transfers and application of the NISP screening criteria.

- Traditional agricultural transfers have been evaluated in detail as part of Alternative 4 in the DEIS and are the primary component of the revised NAA (MWH 2010) which is evaluated in detail in the SDEIS.
- All applicable NISP screening criteria (Table 1-1) are satisfied by traditional agricultural transfers.

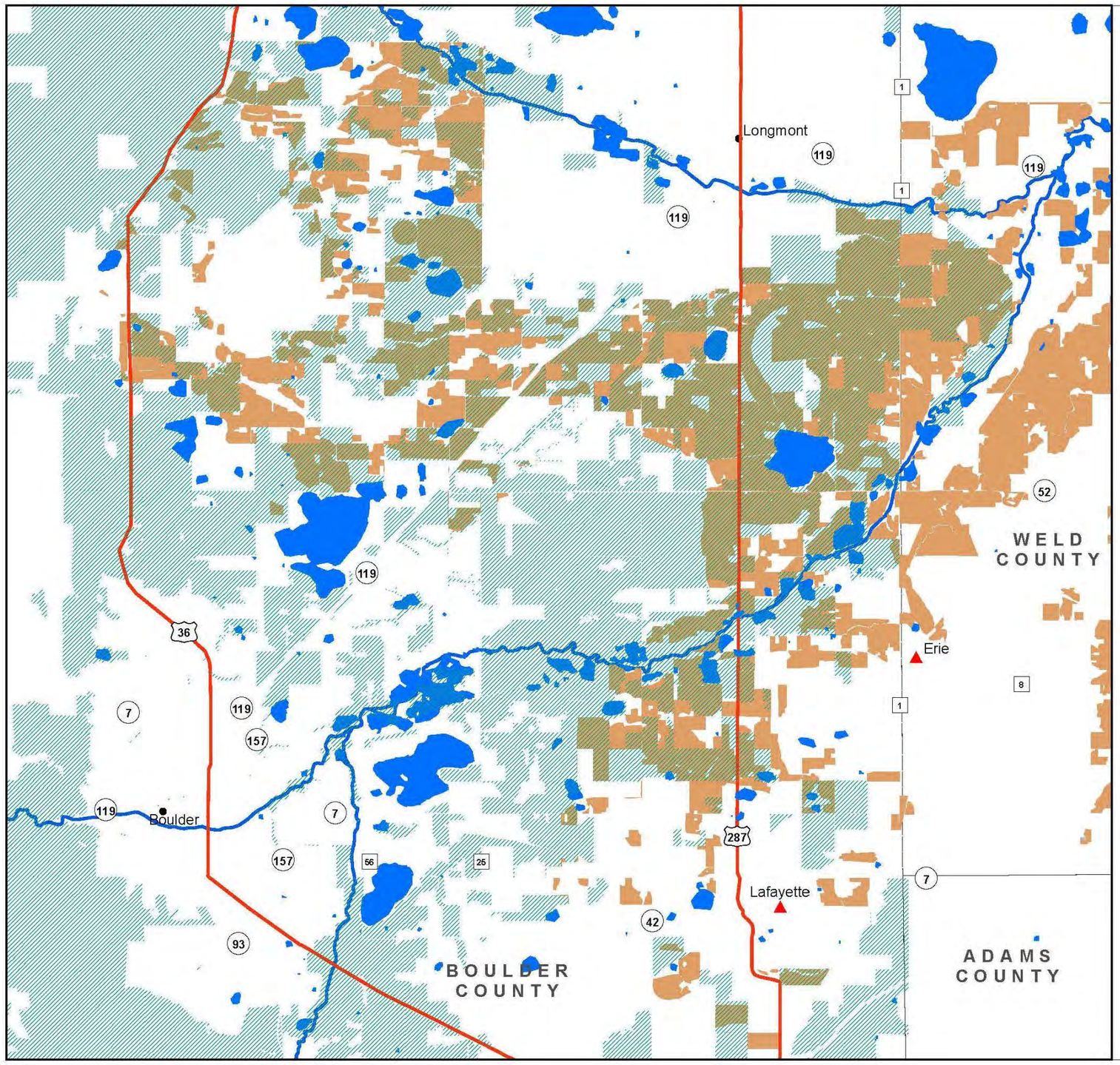


Figure 5-1
Boulder County Open Space and Conservation Easement Lands

- Boulder City and County Open Space/Consv Easmnt
- Lakes
- Streams and Rivers
- Current Irrigated Acreage
- Interstate Highway
- US Highway
- Cities
- NISP Municipal Participants

Boulder City and County Open Space and Conservation Easement Overlapping Irrigation Acreage	15,082

0 0.5 1 2 Miles

N W E S

Hydros Consulting

Based on the above evaluation, traditional agricultural transfers were considered in DEIS Alternative 4 and will be further evaluated in detail in the SDEIS as part of the revised NAA.

5.2 DEVELOPMENT DISPLACED WATER

Through the course of municipal growth along the Front Range, municipalities will expand onto land that historically was used for a different purpose, including historically irrigated and non-irrigated agricultural lands. Water that was historically used to irrigate these lands may be available for transfer to municipal use to meet a portion of the future municipal demands. STP (2008) defined this as 'development displaced water' (DDW) in the HRA report. For consistency, this term is used in this report. From a legal or water rights perspective, this type of transfer is conceptually identical to the traditional agricultural transfers described in Section 5.1 except that it is limited to a much smaller subset of historically irrigated lands that may be converted into municipal use in the future. In addition, since development displaced lands are by definition the conversion of local irrigated lands into municipal use, the likelihood of being able to use the FHG to meet future demands (instead of just the WSL CU) is much higher, provided the municipality can meet RFOs (see Section 3.1).

For the purposes of this document, analysis of DDW is undertaken at a feasibility level because there are not sufficient data to support the level of detail that would emerge from a Water Court transfer case decree specific to a particular ditch system. The feasibility-level analysis involves estimating the future growth area (in acres) of the NISP Participants and the amount of agricultural water potentially available from irrigated lands in those areas. The analysis also considers other factors that may limit that available water supply from local ditches, such as legal availability, water quality concerns, and infrastructure requirements. The results of the analysis are used in the application of the NISP alternatives screening criteria (Section 4.2.2).

To aid the analysis, Hydros developed maps for each NISP Participant (Figures 5-2 through 5-16, located at the end of Section 5) to show the spatial relationship between current municipal development, irrigated lands and other non-irrigated lands that could be converted into municipal use. The maps are not intended to predict the precise location of future development. The maps were developed from the State of Colorado's spatial datasets developed as part of the SPDSS including irrigated acreage and ditch service areas, current municipal boundaries (as mapped by Colorado Department of Transportation [CDOT], 2009), and a land use and land classification (LULC) geographic dataset compiled by Northern Water (2009). The LULC datasets show the NISP Participants' future land use planning, identifies lands that are currently developed for municipal use, and maps the geographic extents of the future planning areas (FPA) based on the each Participant's future land use classification (personal communication, K. Melander at Northern Water, 6/20/12).

The LULC dataset did not identify the developed municipal land use within the four NISP Participant water districts (CWCWD, FCLWD, LHWD, MCQWD). Except for FCLWD, these districts are primarily rural and new residential growth will likely be dispersed throughout the districts. No population density information for developed areas within the water districts was available from the LULC dataset, so an

estimate of future municipal acreage could not be developed in a similar manner to the other NISP Participant municipalities. Because of this limiting factor for the four water districts, the acreage estimates needed for the DDW analysis focuses on the 11 NISP municipalities (municipal Participants).

To project the future municipal acreage, it was assumed that current municipal development densities for the NISP Participants would remain relatively stable. Future municipal development acreage was estimated based on 2010 Census population, current municipal development density and future (2060) population projections for each of the 11 municipal Participants. An additional 30 acres per 1,000 new residents was also included as recommended in the Planner's Estimating Guide (Nelson 2004). Table 5-1 shows the estimates of new land area required for municipal development to accommodate the projected growth for NISP municipal Participants. By 2060, 59,000 acres of land is projected to be developed by NISP municipal Participants. This excludes any development of acreage in the more rural NISP Participant water districts (CWCWD, FCLWD, LHWD, MCQWD) because the LULC dataset does not identify developed areas within the districts. The HRA report estimates that NISP Participants will grow onto 76,000 acres of land. This increase is greater than the projected increase shown in Table 5-1, but includes growth from the four water districts (CWCWD, FCLWD, LHWD and MCQWD) that was excluded in Table 5-1. The HRA estimate of 76,000 acres is reasonable when applying rough estimates of growth for all NISP Participants (including the four water districts) based on population increases and regional population density.

To estimate the amount of the currently irrigated acreage that will be converted to municipal use, the amount of irrigated acreage served by a surface water source, the amount of acreage within conservation easements and county open space was determined for each FPA. From these data, Table 5-2 shows the acreage not currently developed for municipal use, developable acreage with transferable water, the other developable land within the FPA (without transferable water) and the ratio of irrigated developable land to total developable land. That ratio is multiplied by the projected future municipal acreage (from Table 5-1) to estimate the amount of irrigated acreage that will be converted to municipal use and potentially could provide agricultural water through a transfer of the historical use of the irrigation water.

Table 5-2 shows that the 11 municipal NISP Participants will affect an estimated 25,300 acres of irrigated land to accommodate the total municipal growth onto 59,000 acres of land. The estimate of 25,300 irrigated acres that will be developed assumes a pro-rata distribution of new municipal growth onto irrigated and non-irrigated lands. The table also shows that there is enough irrigated land (78,000 acres) that future growth could occur exclusively on irrigated land. Conversely, there is enough other developable land (108,500 acres) that growth could completely avoid the irrigated lands. At a feasibility level, the pro-rata growth assumption is appropriate, although specifics for each Participant will vary depending on the value of the irrigated land (and associated water rights if legally available and suitable for municipal use) relative to non-irrigated lands to future developers.

Table 5-1 - Estimated Land Area Required for Development to Accommodate Projected Growth for NISP Municipal Providers

Participant Name	Map Figure Number	Acreage within 2010 CDOT Municipal Boundary	Acreage of Current Development within CDOT Boundary	2010 Population	2010 Population Density [persons/developed acre]	Projected Population Increase 2010-2060	Projected Acres Required for Development 2010-2060	Potential Additional Acres for Parks and Open Spaces	Potential Additional Development Acres Including Parks/Open Spaces
Column No.	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Dacono	5-3	5,095	553	4,152	7.5	20,200	2,692	606	3,298
Eaton	5-5	1,502	758	4,365	5.8	23,608	4,098	708	4,806
Erie	5-5	11,251	2,194	18,135	8.3	56,631	6,851	1,699	8,550
Evans	5-6	6,714	2,201	18,537	8.4	17,200	2,042	516	2,558
Firestone	5-8	6,704	1,569	10,147	6.5	29,500	4,561	885	5,446
Fort Lupton	5-9	4,696	1,658	7,377	4.4	12,600	2,832	378	3,210
Fort Morgan	5-10	2,310	1,739	11,315	6.5	15,300	2,352	459	2,811
Frederick	5-11	8,590	1,552	8,679	5.6	38,600	6,902	1,158	8,060
Lafayette	5-12	5,676	3,382	24,453	7.2	8,700	1,203	261	1,464
Severance	5-15	3,976	1,272	3,165	2.5	12,100	4,864	363	5,227
Windsor	5-16	15,497	4,362	18,644	4.3	51,200	11,978	1,536	13,514
Total Municipal Participants		**72,010**	**21,240**	**128,969**	**6.1**	**285,639**	**50,375**	**8,569**	**58,944**

Explanation of Columns

1 - Maps located at the end of Section 5 (page 58)

2 - Source: CDOT "Cities" shapefile, modified 06/22/2010.

3 - Source: Data layers developed during NCWCD land use land classification (LULC) study (2009)

4 - Source: 2010 Census data provided by BBC

5 - (Column 4) / (Column 3)

6 - Source: Appendices to "Water Supplies and Demands for Participants in the Northern Integrated Supply Project" (HE 2011)

7 - (Column 6) / (Column 5)

8 - 30 acres of parks and open space per 1,000 new residents based on "Planners Estimating Guide: Projecting Land-Use and Facility Needs." Pages 81-82.

Table 5-2 - Estimates of Irrigated Acreage Converted to Municipal Use

Participant	Map Figure Number	2060 Additional Developed Land	FPA Acreage Not Currently Developed	Number of Ditches Systems within FPA	Developable Irrigated Acreage with Transferable Water Within FPA	Other Developable Acreage within FPA	Ratio of Developable Irrigated to Developable	Pro-Rata Projected Irrigated Acreage Dry-Up
Column No.	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Dacono	5-3	3,298	12,961	5	3,321	9,640	0.26	845
Eaton	5-5	4,806	3,035	1	2,150	885	0.71	3,405
Erie	5-5	8,550	24,048	10	4,887	16,990	0.22	1,910
Evans	5-6	2,558	21,519	10	12,417	9,101	0.58	1,476
Firestone	5-8	5,446	14,993	11	5,418	9,575	0.36	1,968
Fort Lupton	5-9	3,210	37,398	11	12,895	24,503	0.34	1,107
Fort Morgan	5-10	2,811	7,262	4	3,569	3,693	0.49	1,382
Frederick	5-11	8,060	12,080	18	4,338	7,166	0.38	3,039
Lafayette	5-12	1,464	6,425	11	1,128	3,518	0.24	355
Severance	5-15	5,227	19,936	4	13,238	6,698	0.66	3,471
Windsor	5-16	13,514	31,301	13	14,610	16,691	0.47	6,307
Total Municipal Participants		**58,944**	**190,958**	**66**	**77,971**	**108,460**	**0.42**	**25,266**

Explanation of Columns

2 - Source: Table 4-1; estimated land area required for development to accommodate projected growth to 2060

3 - Total FPA area less all areas identified as 'Currently Developed' in the LULC dataset; includes areas outside current municipal boundaries

4 - Source: use of SPDSS ditch service area dataset and LULC FPA dataset. Total excludes duplicate counts from a ditch that is in more than one FPA. See Appendix B for detailed listing

5 - Lands within FPA irrigated with surface water, excluding irrigated lands within conservation easement or county open space.

6 - Lands within FPA that are not 'Currently Developed' in the LULC dataset, not irrigated by a surface water source and not in a conservation easement or county open space

7 - (Column 4) / ((Column 4) + (Column 5)); represents percent of developable land that is irrigated with transferable agricultural surface water

8 - (Column 2) * (Column 6); assumes pro-rata distribution of future municipal development on irrigated or non-irrigated lands

Table 5-3 - Estimates of Water Supply from Developable Irrigated Acreage

Participant	Map Figure Number	2060 Additional Developed Land	Pro-Rata Projected Irrigated Acreage Dry-Up	Number of Ditches in FPA	WSL per Irrigated Acre (AF)	Available WSL for Transfer (AF)	Available FHG for Transfer (AF)	NISP Yield Request (AF)	2060 Participant Non-Potable Demands (AF)
Column No.	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Dacono	5-3	3,298	845	5	0.97	820	1,171	1,000	0
Eaton	5-5	4,806	3,405	1	1.04	3,541	5,059	1,300	950
Erie	5-5	8,550	1,910	10	0.93	1,776	2,537	6,500	8,100
Evans	5-6	2,558	1,476	10	0.97	1,432	2,046	1,600	1,070
Firestone	5-8	5,446	1,968	11	0.97	1,909	2,727	1,300	0
Fort Lupton	5-9	3,210	1,107	11	0.97	1,074	1,534	3,000	1,980
Fort Morgan	5-10	2,811	1,382	4	1.18	1,630	2,329	3,600	810
Frederick	5-11	8,060	3,039	16	0.97	2,948	4,211	2,600	2,530
Lafayette	5-12	1,464	355	11	0.93	331	472	1,800	730
Severance	5-15	5,227	3,471	4	1.04	3,610	5,157	1,300	510
Windsor	5-16	13,514	6,307	12	1.04	6,560	9,371	3,300	0
Total Municipal Participants		**58,944**	**25,266**	**66**	**1.04**	**25,630**	**36,614**	**27,300**	**16,680**

Explanation of Columns

2 - Source: Table 4-1; estimated land area required for development to accommodate projected growth to 2060

3 - Source: Table 4-2; estimated irrigated land converted to municipal use assumes pro-rata distribution on irrigated or non-irrigated lands

4 - Source: SPDSS 2005 irrigated acreage and FPA geographical extents. Excludes groundwater only acreage.
--Note total number of ditches is the number of unique ditches in all municipal Participant FPAs. When including NISP water district Participants, total number of ditches is 109

5 - Source: Table 2-1; Water District in which the majority of the FPA is located. Value include C-BT consumption and are likely 10 to 20 percent high (see Section 2.4.2)

6 - (Column 3) * (Column 4); represents consumptive use water only

7 - (Column 5) / 70%; represents WSL plus on-farm losses, accounting for estimated 70 percent farm efficiency and assumes historical return flows maintained by transferring municipality (see Section 2.4.1)

8 - Source: HE 2011, Table I-1

9 - Source: HE 2011 Table II-2 and Table IV-1 were used to add system losses to non-potable deliveries shown in Table II-2

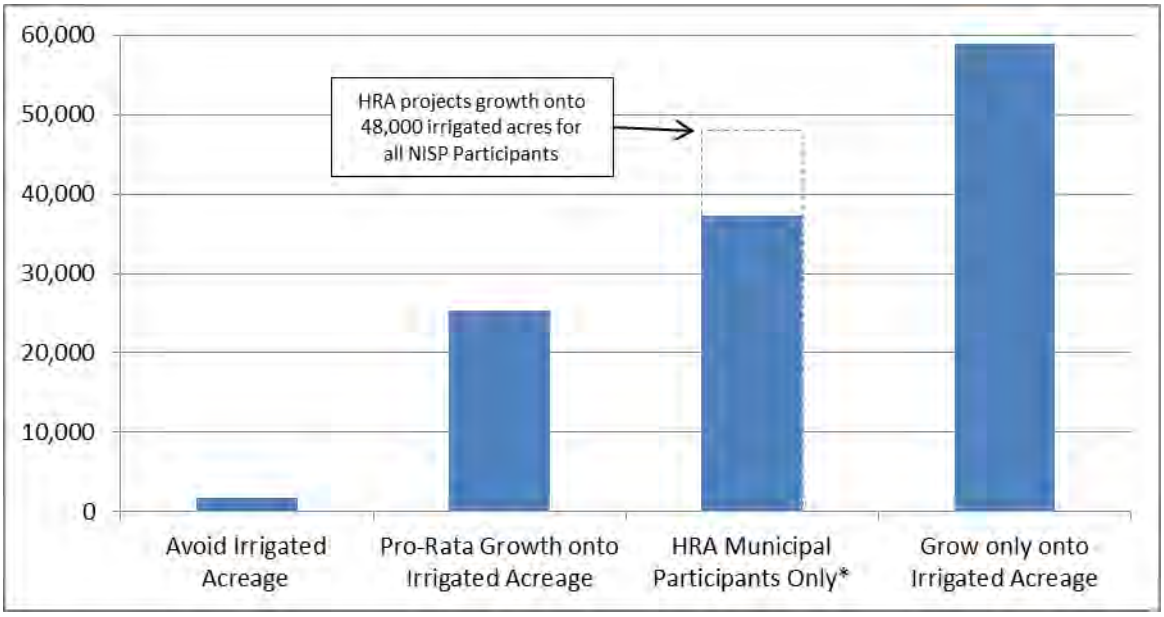
The HRA report estimates that 63 percent of the land that will be developed by NISP Participants is irrigated and would result in municipal development of 48,000 irrigated acres. This value is higher than the 42 percent shown on Table 5-2 and therefore likely over-estimates the amount of irrigated lands that will be developed (See also Figure 5-17). The difference in the ratio cannot be attributed to the exclusion of the NISP Participant water districts because the ratio of irrigated lands to all land within those districts is 43 percent (considering lands within the water district extent exclusive of lands within NISP municipal FPAs).

The estimated potential water supply available from the irrigated lands is shown on Table 5-3, along with the number of different ditches that supply the irrigated lands. The potential water supply was estimated using the WSL CU values from Table 3-1 (selecting the water district in which the majority of the FPA is located) and multiplying by the pro-rata estimate of irrigated acreage from Table 5-2. Since DDW by its nature is a local water supply, there is a higher probability that Participants would be able to transfer and use the FHG instead of being limited to only the WSL CU. To determine the FHG, an estimate of 70 percent farm efficiency was used as a representative value. Seventy percent is consistent with values used in the NISP hydrologic modeling of several ditch systems in the Poudre basin, but may vary widely between ditch systems in other areas in the region. Actual farm efficiency values are normally determined through a detailed change in use case and are beyond the scope of this feasibility analysis. The amount of water available shown on Table 5-3 is an average value and will require firming storage to achieve this amount of water as firm yield. Due to costs and limited availability of larger potential storage sites, some Participants may opt for a lower firm yield by constructing smaller firming storage facilities. A detailed listing of individual ditches and acreages within each FPA is provided in Appendix B.

Table 5-3 shows that there is potentially a significant amount of water available within most Participant FPAs. However, water quality concerns, infrastructure concerns, and ability to acquire ownership of water rights are all factors that may significantly reduce the amount of water available. In a Northern Water survey of the NISP Participants, only Erie, Lafayette and MCQWD indicated that water quality is sufficient to treat using conventional methods. Additionally, many of the Participants' water treatment plants are distant from the municipality itself (e.g. Frederick, Firestone and Dacono all receive treated water from the Central Weld County Water District's Carter Lake Filter plant located adjacent to Carter Lake nearly 30 miles to the north and west) which would require either new infrastructure and pumping to convey raw supplies to the treatment plant or construction of a new water treatment plant locally.

As described in Section 3, there is strong competition for agricultural water rights in the South Platte basin within the NISP region. Many water providers in the region, as a course of normal planning, purchase agricultural rights and lease the water back to the irrigator until demand increases to the point where conversion to municipal use is needed (DWC, 2012). The amount of such municipally owned water rights is not readily available, and no database of such transactions is maintained by the State (Dave Nettles, Division 1 Engineer personal communication with Hal Simpson 7/25/11). Ditches with

Figure 5-17 – Projected Growth onto Irrigated Lands Under Different Planning Scenarios



*HRA projections for NISP Municipal Participants estimated by using the ratio of the 2060 projected additional developed lands for Municipal Participants (58,944 acres, Table 5-1) to the HRA projected increase in total acreage (76,000 acres, HRA page 14) for all NISP Participants multiplied by the HRA projection of 48,000 acres of growth onto irrigated lands.

headgates in current municipal areas are more likely targets of municipal acquisition since the original point of diversion is within a municipal area. For example, there is irrigated acreage under the Famer's Reservoir and Irrigation Company (FRICO) system in eight of the NISP Participant FPAs, yet FRICO is about half municipally owned due in large part to its ability to deliver water to many water providers in the north Denver Metro area (DWC 2012). In Water District 3, two of the four largest ditch companies are more than half municipally owned, but a substantial portion of the land is still irrigated through lease agreements between the municipal owners and irrigators. At a feasibility level analysis, it is not possible to ascertain the amount of current municipal ownership in each of the ditch companies within the FPAs that may be able to provide DDW to NISP Participants.

Figure 5-18 is a map that shows the location of the headgates for ditches with service areas within the NISP Participant FPAs and the location of existing water treatment plants. The figure shows that several of the headgates are located near major urban areas, which further indicates the likelihood of municipal ownership in these ditches. Figure 5-18 also shows the difficulty for some of the NISP Participants would have in delivering water from a ditch system to its water treatment plant because the headgates are located distant from their water treatment plants. The figure also shows that there are several headgates near the NISP Participant service areas, but that many are located downstream of wastewater treatment plants where water quality is likely low due to the higher concentrations of effluent in the stream (e.g. all South Platte diversions downstream of Denver, Poudre River diversions east of I-25, Boulder Creek diversions below Erie).

As described in Section 1.2, NISP is projected to meet only a portion of the future demands of the NISP Participants. It is likely that individual Participants will continue to pursue local water supplies as their demands increase beyond their requested yield from NISP, and to diversify their water portfolio in order to reduce risk of shortages. A survey of the NISP Participants by Northern Water (2008) indicates that several NISP Participants have programs in place that require dedication of water rights to the municipality for annexation. This is further evidence that NISP Participants anticipate DDW as a supply of water in conjunction with NISP supplies to meet their future demands.

Table 5-3 also shows the 2060 projected non-potable demands for the municipal Participants. Use of DDW to meet non-potable demands would eliminate many of the infrastructure and water quality concerns. If Participants can acquire the water rights to irrigated lands that are developed into municipal use within their FPA, application to meet non-potable demands may be a more practicable option than using DDW for potable supply.

5.2.1 EXISTING EVALUATION OF DDW IN THE DEIS OR SDEIS ALTERNATIVES

The DEIS and SDEIS alternatives do not specifically incorporate DDW as a component. As described in Section 5.1.1, traditional agricultural transfers were considered in both the DEIS and the revised NAA (MWH 2010). The DDW concept would fall under the traditional agriculture transfers evaluations except that DDW is local in its nature and would not constitute a regional project.

5.2.2 APPLICATION OF NISP SCREENING CRITERIA TO DEVELOPMENT DISPLACED WATER

Purpose and Need Criteria

Tables 5-2 and 5-3 show that there is enough WSL CU water or FHG water used to irrigate lands within the municipal Participant FPAs and within the water district boundaries to meet 30 percent the NISP firm yield of 40,000 AF. However, the values presented in Tables 5-2 and 5-3 do not account for reductions from C-BT water or ditch ownership by other municipalities. Nonetheless, even reducing the totals by conservative estimates of 20 percent for C-BT acquisitions by others and 50 percent ownership by other municipalities, there would still be sufficient FHG or WSL CU water to meet the firm yield criterion.

The nature of the DDW concept as proposed in the HRA is a local water supply. Water is derived from lands within the individual Participants' FPAs as that municipality grows onto such lands. It is likely that municipalities on the Front Range (including NISP Participants) will acquire water rights to such lands as they grow in order to diversify their water portfolio. In particular, NISP Participants will likely add these supplies to meet demands in excess of their needed NISP supply, provided other legal and logistical challenges of water rights ownership, change of use cases, water quality concerns and infrastructure can be overcome. However, these acquisitions would amount to a collection of multiple local projects and would not operate as a regional project. Therefore, DDW fails the Regional Project criterion.

5.2.3 RESULTS OF DDW EVALUATION

Water derived from historically irrigated lands that are converted into municipal areas will likely play an important role in municipal water supply in the future. The use of those supplies by specific entities, including NISP Participants, however, is not straight-forward due to a number of factors. DDW will likely provide smaller amounts of water locally available to municipalities that may be better suited for non-potable needs than for incorporation into a regional or local potable water system. The following are conclusions related to the evaluation of use of DDW and application of the NISP screening criteria.

- The DDW water supply concept is essentially the same as traditional agricultural transfers, but limited to a smaller subset of lands that will developed into municipal use in the future and fails the Regional Project screening criterion.
- The amount of land required for development to accommodate projected growth for NISP municipal Participants totals nearly 59,000 acres (Table 5-2, excludes CWCWD, FCLWD, LHWD and MCQWD).
- Based on the State of Colorado's consumptive use model, StateCU, the amount of agricultural water potentially available from irrigated lands within the municipal Participant FPAs is approximately 36,600 AFY (FHG), of which approximately 25,600 AF is consumable WSL CU (Table 5-3).
    - These amounts include consumption of C-BT water. The native transferable yield may be up to 20 percent lower, depending on individual irrigators' use of C-BT

  - These amounts include lands that are irrigated by some ditch companies that are partially municipally owned. The actual ownership of ditch companies by municipalities is not readily available.
  - Storage will be required to attain these volumes as firm yield. Water providers may elect to firm less water than the average yield presented in Table 5-3 in order to reduce storage size and costs.
- The DDW concept is not specifically evaluated in the DEIS or the revised NAA.
- NISP Participants will likely acquire DDW as part of their water portfolio to diversify supply and meet demands in excess of the requested NISP yield.

Based on the evaluation above, DDW fails the Regional Project criterion.

5.3 ACQUISITION OF ADDITIONAL C-BT WATER

The two water supply options presented in the HRA involve acquisition of additional C-BT water by the NISP Participants. HRA Option 1 calls for 13,500 additional C-BT units, while HRA Option 2 calls for enough C-BT units to meet 7,200 AF of firm yield.

The C-BT project provides an average of 217,000 AFY from the West Slope of Colorado to Northern Colorado through a series of reservoirs, pumps, tunnels and pipelines and is operated by Northern Water. The project has 310,000 ownership units (C-BT units), each unit providing up to 1.0 AF of water per year based on the annual project quota that is set by Northern Water. Historically, the quota has varied from as little as 50 percent (0.5 AF/unit) to 100 percent (1.0 AF/unit), with an average of 0.7 AF/unit. The quota is determined by Northern based on project supplies and East Slope snowpack with a 70 percent quota to be set for average East Slope snowpack (Pineda 2005). C-BT project water was originally intended to be a supplemental irrigation supply because many agricultural ditch systems are water-short (see Table 3-1), and therefore the quota is generally set lower in years with high East Slope snow pack, and higher in years with low East Slope snow pack. During drought conditions, the quota has been reduced due lack of available C-BT supply and C-BT water in storage (50 percent quotas set in 1990 and 2003 due to low supply). Many municipalities now rely on C-BT water for a significant portion of their supply, including some NISP Participants that are 100 percent reliant on C-BT supply for their firm yield.

Northern Water analyzed the C-BT firm yield (Pineda 2005) and developed a C-BT projection tool for the EIS hydrologic modeling (Pineda 2009). The following present several key points with regards to the likely future operations of the C-BT project from those analyses:

- Municipal and industrial (M&I) users have been acquiring C-BT units since the project inception
  - In the late 1990s, M&I ownership exceeded agricultural ownership.
  - In 2009, 223,200 (72 percent) of C-BT units were owned by M&I water providers, including units acquired through municipal ownership of the North Poudre Irrigation Company (NPIC).

  - The rate of transfer to M&I water providers has been nearly 3,600 units per year (including units acquired through NPIC shares).
  - Despite the majority municipal ownership, deliveries continue to be greater to agricultural users (except in 2003) indicating a strong rental market from M&I owners to agricultural users.
  - Northern Water's municipal caps limit the number of units an entity may purchase based on current ownership, base water supplies and past water usage.
- Transfer of C-BT to M&I use was estimated to be limited to 263,500 units of the 310,000 units (85 percent of the total project) based on:
  - farm and water rights placed in conservation easements
  - open space and specialty farming operations within urban areas
  - mutual ditch company ownership
  - increasing price as number of available units decreases
  - municipal ownership caps established by NCWCD
- Approximately 34,000 C-BT units were estimated as available for transfer to M&I in 2009. Based on recent years, approximately 2,000 units per year are projected to be transferred to M&I ownership.
- Firm yield analysis conclusions
  - Pineda (2005) states that 60 percent (0.6 AF/unit) is the C-BT firm yield
  - Historical quotas have been as low as 50 percent (0.5 AF/unit) and as high as 100 percent (1.0 AF/unit)

C-BT users differ in approach in determining the firm yield of C-BT supplies. Since the quota has been as low as 50 percent historically, some water providers use 50 percent as the firm yield (e.g. Fort Collins and Greeley). Northern Water concluded that 60 percent (0.6 AF/unit) is the C-BT firm yield based on the amount of deliverable water through a drought (Pineda 2005). In addition, Northern Water has a carryover program that allows C-BT unit owners to carryover a portion of their C-BT supply from one year into the next. The carryover component was included in firm yield assumptions in the NISP Phase II Report (MWH 2004), which also estimated C-BT firm yield to be 0.6 AF/unit. However, since the carryover program can be modified or eliminated by the Northern Water Board (and has been changed in the past), some water providers do not consider C-BT carryover as part of their overall firm yield. The NISP Alternatives Report (HDR 2007), however, estimated C-BT firm yield at 0.5 AF/unit.

The HRA proposes a 70 percent quota (0.7 AF/unit) for firm yield, which is the average yield of C-BT supplies, not the firm yield. HRA Option 1 proposes 9,450 AFY of firm yield to be met by C-BT and Option 2 proposes 7,200 AFY of firm yield to be met by C-BT. The two HRA water supply options use an assumed 70 percent firm yield, resulting in 13,500 units for Option 1 and 10,286 units for Option 2. However, 70 percent is not a reasonable firm yield quota value because in years of lower quota, the yield from C-BT units is lower than 0.7 AF/unit. Northern Water allows providers to elect for a fixed quota of 0.7 AF/unit, but even the fixed quota allotment has been reduced under severe drought

conditions (personal communication A. Pineda of Northern Water 3/30/2012). The actual number of units required for Option 1 is 15,450 to 18,900 units (60 percent and 50 percent firm yield quota, respectively) and Option 2 would require 12,000 to 14,400 units (60 percent and 50 percent firm yield quota, respectively).

Based on the estimate of 34,000 C-BT units available in 2009 (Pineda 2009), the number of units available as of the date of this report is approximately 28,000. NISP Participants have continued to purchase C-BT units during the ongoing EIS process for the project, as shown in Table 5-4. C-BT units make up a significant portion of the NISP Participants' existing water supply portfolios. For example, more than 90 percent of the current firm yield for CWCWD, Dacono, Erie, FCLWD, Fort Lupton, Firestone, Severance, and Windsor comes from C-BT supplies). Between 2004 and 2010, the NISP Participants collectively acquired an additional 13,286 C-BT units to provide for near-term increases in demand, as well as to provide for future demands in excess of the amount that would be met by NISP. Acquisitions by NISP Participants alone in the 6-year period of 2004 to 2010 exceed the 2,000 unit/year assumption made by Pineda (2009), and do not include acquisitions by other water providers in the region. This indicates existing strong competition for the remaining C-BT units.

The CU from C-BT units used for agriculture is included in the WSL CU values in Table 3-1. Agricultural transfers considered in Sections 5.1 and 5.2 include the WSL CU available from C-BT on a basin-wide basis. As more units of C-BT are converted from agricultural use to municipal use, the overall WSL CU values for irrigated agriculture in the region will decline by 10 to 20 percent, dependent on individual use of C-BT on specific irrigated lands.

5.3.1 EXISTING EVALUATION OF ADDITIONAL ACQUISITION OF C-BT IN THE DEIS OR SDEIS ALTERNATIVES

The NAA configuration presented in the DEIS and supporting technical reports (HDR 2008b) identifies C-BT as a significant source of water for NISP Participants, estimating that the acquisition of 21,600 C-BT units would be required to meet the future need in addition to transfers of local agricultural supplies. The NAA was evaluated in the DEIS. In addition, C-BT was also contemplated as part of two DEIS water supply concepts for the NISP Alternatives Evaluation (HDR 2007): Agricultural Water Conservation and C-BT System Reoperation. Both C-BT components were eliminated based on the firm yield screening criterion.

The NAA was revised in 2010 (MWH 2010) in part due to concerns about the availability of C-BT units in the future. The revised NAA is evaluated in the SDEIS. The NISP revised NAA report (MWH 2010) cites Pineda (2009) for the number of units available for transfer and concludes that no additional (or at least no substantial amount) of C-BT units will be available to meet future demands for the NAA due to several key reasons:

Table 5-4 – C-BT Units Owned by Participants and C-BT as Percent of Firm Yield

Participant	C-BT Units Owned in 2004[1]	C-BT Units Owned in 2009 or 2010[2]	Increase in C-BT Units Owned	C-BT as Percent of 2009 or 2010 Firm Yield[2]
CWCWD	4,637	5,221	584	100%
Dacono	1,750	1,772	22	100%
Eaton[3]	1,603	1,660	57	60%
Evans	3,294	3,460	166	24%
Erie	3,353	7,279	3,926	95%
FCLWD[3]	13,301	17,747	4,446	91%
Fort Lupton	3,101	3,107	6	100%
Fort Morgan[4]	7,931	8,127	196	85%
Firestone	4,145	4,982	837	100%
Frederick	2,800	3,467	667	61%
Lafayette	143	455	312	6%
LHWD	6,340	6,750	410	70%
MCQWD	401	1,052	651	22%
Severance[3]	680	972	292	91%
Windsor[3]	4,154	4,868	714	100%
Total	**57,633**	**70,919**	**13,286**	**69%**

1 - Source: Appendix N of HE (2006)

2 - Source: Appendix P of HE (2011). Some inventories have updates through 2009 and others through 2010.

3 - Includes C-BT units owned through ownership of NPIC shares

4 - Includes leased C-BT units because units were considered in firm yield

Based on the expanded analysis conducted herein, the DEIS NAA likely overestimated the amount of C-BT units that will be available to fulfill the NISP demand...

There is expected to be competition for the remaining C-BT units. There are major non-NISP municipalities that would compete with the Participants for these units. In addition, several NISP Participants have indicated that C-BT units are the primary source of water to be used to fill the portion of future water supply not met by NISP. The 2004 Statewide Water Supply Initiative [SWSI] stated that many water providers plan to obtain additional shares of C-BT units to meet future demands (even with NISP and other on-going water development projects in place), and that "some caution is warranted, in that demand for C-BT water will likely exceed the available supply" (CDM 2004). Therefore, it is reasonable to conclude that in the future, only a minimal amount of agricultural C-BT units would be available to meet the NISP NAA yield requirements.

When developing the potential for future C-BT transfers, it is also important to understand Northern Water policies and restrictions regarding C-BT transfers. In 1995, the Northern Water Board of Directors passed a resolution regarding domestic and municipal C-BT ownership limitations (Northern Water 1995). These rules basically limit the amount of C-BT units that a domestic or municipal water provider can own to the amount of current demand minus the amount of yield that is provided by non-C-BT supplies. Demand is calculated based on the number of taps that the entity has a written commitment to serve. Therefore, "stock-piling" C-BT units to serve anticipated growth that a community is planning for but does not yet have written commitments to serve would be contrary to these rules.

Based on the number of units currently available, anticipated use of these units to serve a portion of un-met demand by NISP Participants, competition from non-NISP Participants, and current rules that discourage "stock-piling" of C-BT units for future growth, it was assumed that a minimal number C-BT units would be available to purchase and transfer for NAA purposes. Although the Participants could potentially meet a small amount of the NISP demand with C-BT, as a conservative assumption, C-BT water is not included as a possible source of supply in the NAA.

5.3.2 APPLICATION OF NISP SCREENING CRITERIA TO ACQUISITION OF ADDITIONAL C-BT

Purpose and Need Criteria

Assuming a 50 percent quota (0.5 AF/unit) for firm yield, the NISP Participants would need to acquire 24,000 of the remaining 28,000 C-BT units estimated to be available for transfer to municipal use in order to satisfy the firm yield screening criterion of 12,000 AFY. Assuming a 60 percent quota (0.6 AF/unit), the number of units required would be 20,000. Due to limited number of currently available units, the competition from other water providers, the rate of current C-BT acquisitions, the municipal caps on the number of units in place by Northern Water, further acquisition of 20,000 to 24,000 units by the NISP Participants is not likely. It is more likely that NISP Participants will be able to continue to acquire smaller amounts of C-BT to augment their overall supply portfolio. Therefore, acquisition of additional C-BT water fails the firm yield criterion.

5.3.3 RESULTS OF ADDITIONAL ACQUISITION OF C-BT EVALUATION

Acquisition of C-BT units to provide for municipal supply is a common practice among municipal water providers within the Northern Water district boundaries. C-BT can be bought, transferred and delivered to different locations within the Northern Water district with relative ease. However, the number of units available for municipal ownership is steadily declining, even though many municipalities lease water back to irrigators until the supplies are needed for municipal use. The following are conclusions related to previous evaluation of acquisition of additional C-BT units and application of the NISP screening criteria.

- The number of remaining C-BT units available for transfer to M&I use is estimated to be approximately 28,000 units.
- The HRA uses an inappropriate assumption of 0.7 AF/unit firm yield for C-BT units, even under the fixed quota program. Using a more appropriate value of 0.6 AF/unit or 0.5 AF/unit results in a higher number of units required to meet the yields proposed in the HRA Option 1 and Option 2 (between 12,000 and 18,900 units).
- The NAA presented in the DEIS assumed acquisition of 21,600 C-BT units, which would yield 10,800 AFY based on an assumed firm yield quota of 0.5 AF/unit. However, the revised NAA (MWH 2010) does not consider additional C-BT as a regional source due to the diminishing availability of C-BT units and caps on municipal purchases in place by Northern Water.
- Additional acquisition of C-BT units fails the firm yield criterion, but passes the Practicable criteria.

Based on the evaluation above, additional acquisition of C-BT units has already been evaluated as part of the NAA in the DEIS and fails the firm yield criterion.

5.4 ROTATIONAL FALLOWING

Rotational fallowing is a concept that transfers water from agricultural use without permanent dry-up of the land. A rotational fallowing program would involve an agreement between an irrigator (or group of irrigators) and a municipal water provider (or group of providers) whereby the irrigators would fallow their land on a rotating basis, not irrigating the fallowed portion. The municipal providers would then use the water that has historically been used on the fallowed land. The number of acres dried up in a given year would be similar under a rotational fallowing program as it would under a traditional agricultural transfer. However, under the rotational fallowing program, no one parcel is permanently dried up.

For the NISP EIS, rotational fallowing has been considered in several contexts. An analysis of rotational fallowing as a NISP concept was disclosed in the NISP EIS Alternatives Evaluation Report (HDR 2007, Appendix F). Appendix F was updated by HDR in a 2008 Memorandum that introduced newer information based on the progress of the rotational fallowing concept state-wide between 2005 and 2008 (HDR 2008a, included as Appendix C of this report). MWH (2010) also addressed rotational fallowing in its development of the NAA.

On a state-wide basis, the CWCB implemented a grant program to study ATMs and published a report in May 2011 summarizing the findings of six projects funded through the grant. In addition, a report prepared for the CWCB called Water Partnerships (DWC 2012) was recently released that includes the results of a survey of municipal providers' opinions and likelihood of utilizing rotational fallowing (among other ATMs) in the future.

5.4.1 EXISTING EVALUATIONS OF ROTATIONAL FALLOWING

Much effort has gone into evaluation of rotational fallowing both for the NISP EIS alternatives analysis and by other entities within the State of Colorado. The following is a summary of the key findings and conclusions from these studies.

Evaluation of Rotational Fallowing for the NISP EIS

The Corps evaluated rotational fallowing of irrigated farmland as a possible source of water for NISP in Appendix F of the NISP EIS Alternatives Evaluation Report (HDR 2007). The document provides an extensive history of agricultural transfers and evaluated different scenarios of providing the full 40,000 AFY of firm yield demand or a smaller 12,000 AFY portion of the need. The rotational fallowing concept that was evaluated was based on a purchase and leaseback approach to the agricultural-to-municipal water transfers. This approach would give NISP, and specifically Northern Water acting on behalf of project Participants, control over the water supply and would ensure that at least a portion of the NISP firm yield demands could be met each year. However, the analysis concluded that a reasonable and manageable rotational fallowing program could not be developed for NISP based on the purchase and leaseback model.

The HRA report criticizes the original NISP DEIS alternatives analysis (HDR 2007, Appendix F) as creating a contracting scenario of unrealistic complexity. The Corps and Northern Water agreed that the original rotational fallowing analysis was too complex and developed a revised memorandum (HDR 2008a, provided in Appendix C) on rotational fallowing. The HDR (2008a) memorandum discussed a rotational land fallowing and water leasing program known as the Super Ditch being considered by the Lower Arkansas Valley Water Conservancy District (LAVWCD). The HDR (2008a) memorandum evaluated a potential program similar to the Super Ditch in northeast Colorado. The most significant difference between the 2008 memorandum and the previous analysis disclosed in the DEIS is that the 2008 memorandum specifies that irrigators would maintain ownership of the water rights instead of the purchase-and-leaseback concept. The memorandum estimated that about 25,000 AFY of water could be available from several of the largest ditch companies for a rotating fallow program in the Poudre River basin. Similarly, the HRA report concluded that about 23,000 AFY of water could be available from the four largest ditches in the Poudre River basin, though both analyses neglected significant municipal ownership of two of the ditches considered (NPIC is more than 70 percent municipally owned, and WSSC is more than 50 percent municipally owned).

The 2008 HDR memorandum concluded that, after considering the new information, rotational fallowing is not a feasible water supply for NISP. The memorandum states that the concept would likely fail the

firm yield criteria because the perpetuity of the supply after the initial 40-year agreement period expires is not guaranteed because ownership of the water rights remains with the irrigators. The memorandum also states that the concept fails the proven technology criterion because rotational fallowing programs in Colorado are in pilot-stage development and there have not been any large-scale programs implemented in Colorado.

MWH (2010) evaluated the possibility of including a rotational fallowing program as part of the revised NAA. The report states that the amount of land that would be required for a program as large as NISP would be difficult given the number of acres required and that many irrigation companies already have agreements with other municipalities (i.e., are partially municipally owned) and that the cost of securing a rotating lease is likely more expensive than the outright purchase of the water rights. The NAA report concluded that rotational fallowing was not a feasible source for the NAA, but that "as part of any alternative that contains [agricultural] transfers, it is possible that a rotational fallowing concept could be implemented on a much smaller scale to supplement water supplies that are obtained through [agricultural] dry-up."

Evaluation of Rotational Fallowing on a State-wide Basis

Rotational fallowing was investigated by the State of Colorado through the "Alternative Agricultural Water Transfer Methods to Traditional Purchase and Transfer" technical roundtable, a component of SWSI 2 (CWCB 2007). The report identified several benefits and drawbacks of rotational fallowing, primarily centering on the multiple benefits of maintaining an agricultural economy and pointing out the high transactional costs of implementing such a program and logistics of conveying the fallowed water to the municipal water collection system. The description of a rotational fallowing program in the HRA does not address the drawbacks identified in SWSI 2 or in the DEIS analysis. After the HRA was released in 2008, the CWCB studied rotational fallowing in more detail, including identification of other barriers to the implementation of a rotational fallowing program in Colorado.

Additional information has recently become available regarding ATMs through a grant program implemented by the CWCB and authorized by the Legislature in 2007 through SB 07-122. Due to the likelihood that increased transfers of agricultural water rights will occur in the coming decades in order to satisfy M&I water demands, there is a desire to identify alternatives to traditional transfers resulting in permanent dry-up in order to minimize the negative socioeconomic impacts to rural communities that so often result from such transfers. The CWCB, Interbasin Compact Committee (IBCC), and the Colorado Water Congress have indicated their support for the facilitation of alternatives to traditional agricultural transfers that do not result in permanent dry-up.

The CWCB published a report (CWCB 2011a) that summarized the current status of the grant program that has funded six projects, five of which have been underway since 2009. These six projects evaluated several ATM concepts including rotational fallowing, interruptible water supply agreements, water banks, deficit irrigation, and changing crop types.

The Lower Arkansas Valley Water Conservancy District (LAVWCD) received a grant for continued economic and engineering analyses of the Super Ditch Company to evaluate the ATM of rotational fallowing and water leasing by irrigators associated with seven ditch and canal companies in the Lower Arkansas Valley. The Super Ditch has moved forward with various studies to support a water court application to change the use of irrigation water rights associated with participating shareholders under the seven ditches and canals. A water application to change the use of the irrigation water rights was filed in 2010 and has drawn a number of objectors to the proposal.

The recent report (CWCB 2011a) includes a discussion on the barriers to implementation of an ATM program:

1. Potentially high transaction costs associated with water rights transfers.
2. Water rights administration uncertainties and water rights accounting questions.
3. Certainty of long-term supply and desire for water providers to have permanence of long-term supply.
4. Infrastructure needs and water quality issues.

Solutions to reduce the high transaction costs would require legislation to allow a simplified water court process for a temporary lease program where there would be a "presumptive depletion" associated with the change that would keep the river whole and would not require the expensive "business as usual" engineering that requires individual farm analyses. Legislation was introduced that would streamline the required change in use process (HB 11-1068), but was withdrawn by its sponsors after a number of issues were raised.

The recently published report called 'Water Partnerships', prepared for FRICO and the CWCB (DWC 2012) includes a survey of municipal water providers in the South Platte basin regarding alternative agricultural transfers. The survey asked providers about their familiarity with each concept and the likelihood of incorporating the concept into their future water supply portfolio. The survey revealed that while 82 percent of the water providers had at least some familiarity with the concept of rotational fallowing, 68 percent said they were unlikely to use rotational fallowing in their future water supply portfolio. The top three factors given for this reluctance were 1) need a permanent water supply; 2) would prefer to own all agricultural water rights; and 3) unwilling to develop supplies that may not be permanent at end of agreement period. The result of the DWC (2012) survey of municipal water providers is an interesting contrast to the results of Pritchett and Thorvaldson (2008) which found that 63 percent of surveyed irrigators in the South Platte basin would be willing to participate in a rotational fallowing program if adequately compensated, and that the majority of surveyed irrigators believe water leases are more beneficial to rural communities than sale of water rights and are willing to lease rather than sell their water rights. The results of the two studies illustrate the desire by both municipal providers and irrigators to own the water rights instead of leasing the water due to the permanency of ownership and the temporary nature of leasing.

5.4.2 APPLICATION OF NISP SCREENING CRITERIA TO ROTATIONAL FALLOWING

Purpose and Need Criteria

For the NISP EIS, rotational fallowing was evaluated as both a purchase-and-leaseback configuration (HDR 2007, Appendix F) and as a long-term lease from irrigators (HDR 2008a). The purchase-and-leaseback configuration allows for permanent ownership of water rights, but requires large amounts of irrigated land. Using 1.04 AF/acre WSL CU for the NISP region (Table 3-1) and a 1-in-4 year rotation, approximately 46,000 acres of irrigated land would be required to yield 12,000 AF of water on an average basis. Additional firming storage and/or additional acres would be required to produce a firm yield of 12,000 AF. There are several significant challenges to implementation of such a program, including acquisition of quadruple the water rights needed compared to traditional buy-and-dry transfers, the associated administration of the fallowing program, water court proceedings, and infrastructure to firm the supply and deliver to the Participants. However, assuming these challenges could be overcome, Table 3-1 shows that there is sufficient acreage and transferable water in the NISP study area to produce at least 12,000 AFY of firm yield. If the water rights acquisition is configured as a purchase-and-leaseback, the permanence of the supply for the NISP Participants is guaranteed and the firm yield criterion is satisfied.

When rotational fallowing is configured as a long-term lease where irrigators maintain ownership of the water rights, the municipal providers do not have a permanent supply of water beyond the initial lease. This is the primary reason that municipal providers are not very likely to enter into rotational fallowing agreements (DWC 2012). For this reason, rotational fallowing configured with water rights ownership staying with irrigators fails the firm yield criteria.

Practicable Criteria

The rotational fallowing concept uses currently irrigated lands and therefore does not fail the land use criterion. Irrigated lands targeted for a rotational fallowing program may already have agreements with other municipalities (e.g. interruptible supply agreements, or municipal ownership), but those lands would not be included in the program. Therefore, a rotational fallowing program does not interfere with plans integral to other entities.

Although there has been increasing interest and effort put towards a rotational fallowing program from a variety of entities, including the State of Colorado, existing rotational fallowing concepts are still in pilot-stage or have encountered several challenges (water court requirements, infrastructure challenges, concern over permanence of supply) and currently there is no large-scale rotational fallowing program in Colorado. As a result, the rotational fallowing concept has not progressed to the point of being considered a proven technology and therefore fails the Proven Technology criterion.

5.4.3 RESULTS OF ROTATIONAL FALLOWING EVALUATION

There is much interest with the concept of rotational fallowing because it has the potential to provide benefits to municipalities by providing a firm water supply while helping preserve and maintain the agricultural and rural economies where the water has historically been used. The issues of ownership,

permanency of a rotational fallowing program and other institutional challenges associated with transferring water to municipalities have slowed progress towards large-scale implementation in Colorado. The following are conclusions related to previous evaluation of rotational fallowing and application of the NISP screening criteria.

- The rotational fallowing concept has been evaluated in detail for the NISP EIS and by other entities state-wide.
- The potential benefits of rotational fallowing have been identified by several studies and reports. These same reports have identified several impediments to large-scale implementation of rotational fallowing including high costs, infrastructure concerns and long-term ownership concerns.
- The HRA report and the updated analysis of rotational fallowing for the NISP EIS (HDR 2008a) conclude that about 25,000 AFY is potentially available from irrigated lands in the Poudre Basin, though both analyses neglected yield reductions that would be due to significant municipal ownership of the ditch companies evaluated.
- A rotational fallowing program configured such that municipal providers acquire ownership of the water rights and lease water back to irrigators does not fail the firm yield criterion.
- A rotational fallowing program configured such that irrigators retain ownership of the water rights and lease water to municipalities fails the firm yield criterion because the perpetuity of the supply lasts only as long as the initial lease.

Due to the multitude of challenges identified through the various investigations into rotational fallowing, no large-scale program has been successfully implemented in Colorado. Based on the evaluation above, rotational fallowing fails the proven technology criterion, and the firm yield criterion if configured such that irrigators retain ownership of the water rights.

5.5 SUMMARY OF RESULTS

Table 5-5 presents a summary of the results of the NISP alternatives screening process applied to the four water supply concepts presented in the HRA report. Traditional transfer of agricultural water to municipal use is the only water supply component of the HRA that passes the NISP screening criteria. This concept has been evaluated in other alternatives in the DEIS and will also be part of the revised NAA disclosed in the SDEIS. While many of the HRA concepts failed the NISP alternatives screening, the concepts are potentially feasible on a local scale. The NISP Participants may choose to adopt these strategies to meet demands in excess of the needed NISP supply and diversify their future supplies.

Table 5-5 - Summary of Results

	Purpose and Need		Environmental		Practicable					
HRA Concept	Firm Yield	Regional Project	Wetlands	Waterways	Land Use	Element Capacity	Integral Others' Development Plans	Proven Technology	Screening Result	Redundant Evaluation[1]
Traditional Agricultural Transfers									**PASS**	YES - DEIS Alternative 4 and revised NAA
Development Displaced Water		FAIL							**FAIL**	NO
Acquisition of Additional C-BT	FAIL								**FAIL**	YES - DEIS NAA; Revised NAA
Rotational Fallowing	PASS/FAIL[2]							FAIL	**FAIL**	YES - NISP Alternatives Report, Appendix F, HDR 2008 Memorandum, Revised NAA

1 - Identifies other NISP EIS alternatives or analysis where the concept has already been evaluated

2 - Rotational fallowing passes the firm yield criterion if municipal providers acquire ownership of the water rights, but fails if irrigators retain ownership of the water rights

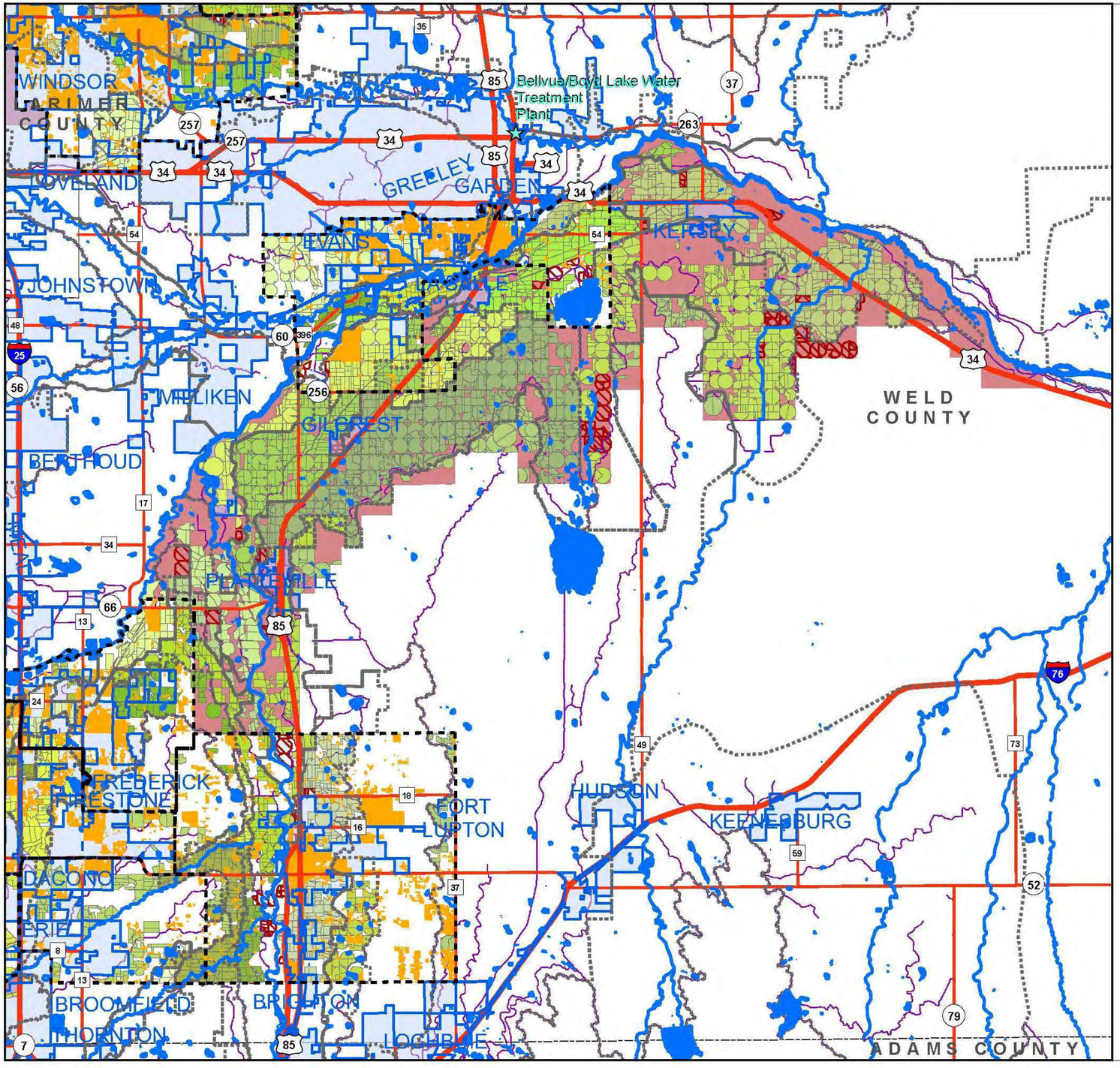


Figure 5-2
CWCWD Boundary Outside of FPAs and Irrigated Acreage

- Water Districts Outside Of FPAs
- Current Municipal Boundaries
- Future Planning Areas
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current District Boundary area	98,191
Area of potentially transferable irrigated land within current district boundary	55,618
Number of ditches serving irrigated lands (including LULC) in current district boundary	33

0 1.5 3 6 Miles

N W E S

Hydros Consulting

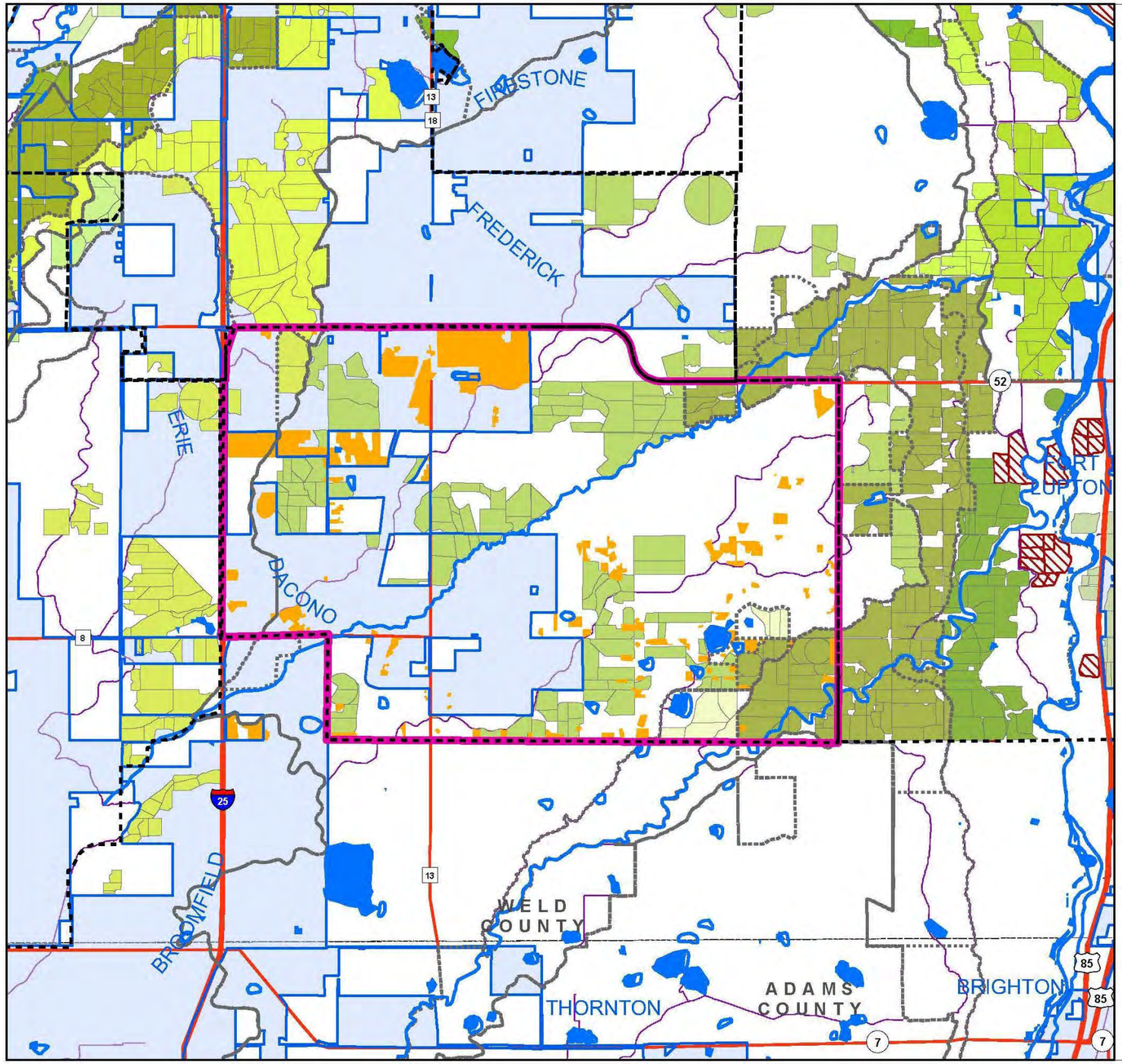


Figure 5-3
Dacono Current Municipal Development and Irrigated Acreage

- Current Municipal Boundaries
- Future Planning Areas
- Future Planning Area Dacono
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current developed acreage within future planning area	1,097
Projected additional development by 2060 including parks/open spaces	3,298
Future planning area	14,058
Area of total developable land within future planning area	12,961
Area of potentially transferable irrigated land within future planning area	3,321
Potentially developable land within future planning area (excluding transferable irrigated land)	9,640
Number of ditches serving irrigated lands (including LULC) in future planning area	5

0 0.5 1 2 Miles

N W E S

Hydros Consulting

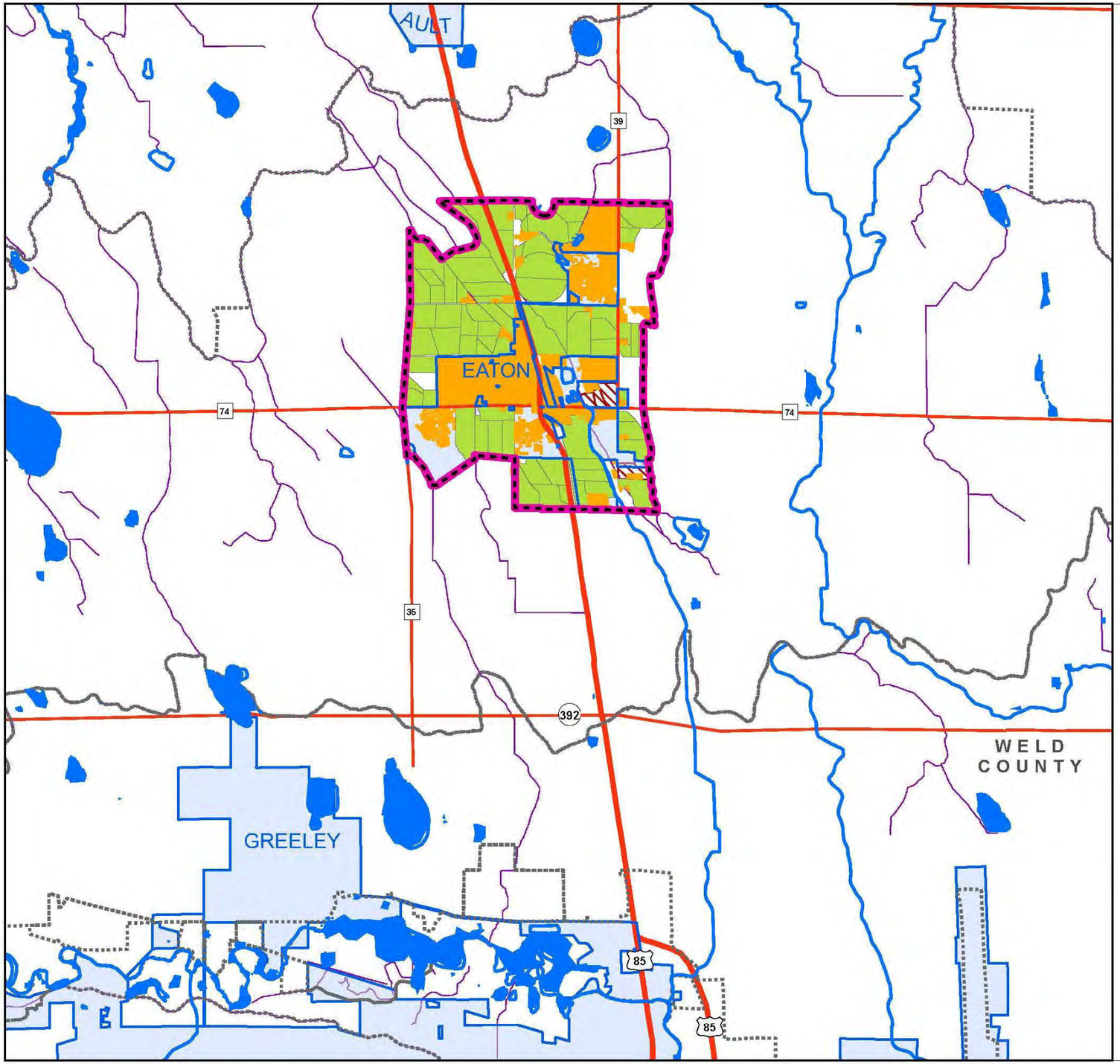


Figure 5-4
Eaton Current Municipal Development and Irrigated Acreage

- Current Municipal Boundaries
- Future Planning Areas
- Future Planning Area Eaton
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current developed acreage within future planning area	1,036
Projected additional development by 2060 including parks/open spaces	4,806
Future planning area	4,098
Area of total developable land within future planning area	3,062
Area of potentially transferable irrigated land within future planning area	2,150
Potentially developable land within future planning area (excluding transferable irrigated land)	911
Number of ditches serving irrigated lands (including LULC) in future planning area	1

0 0.5 1 2 Miles

N
W E
S

Hydros Consulting

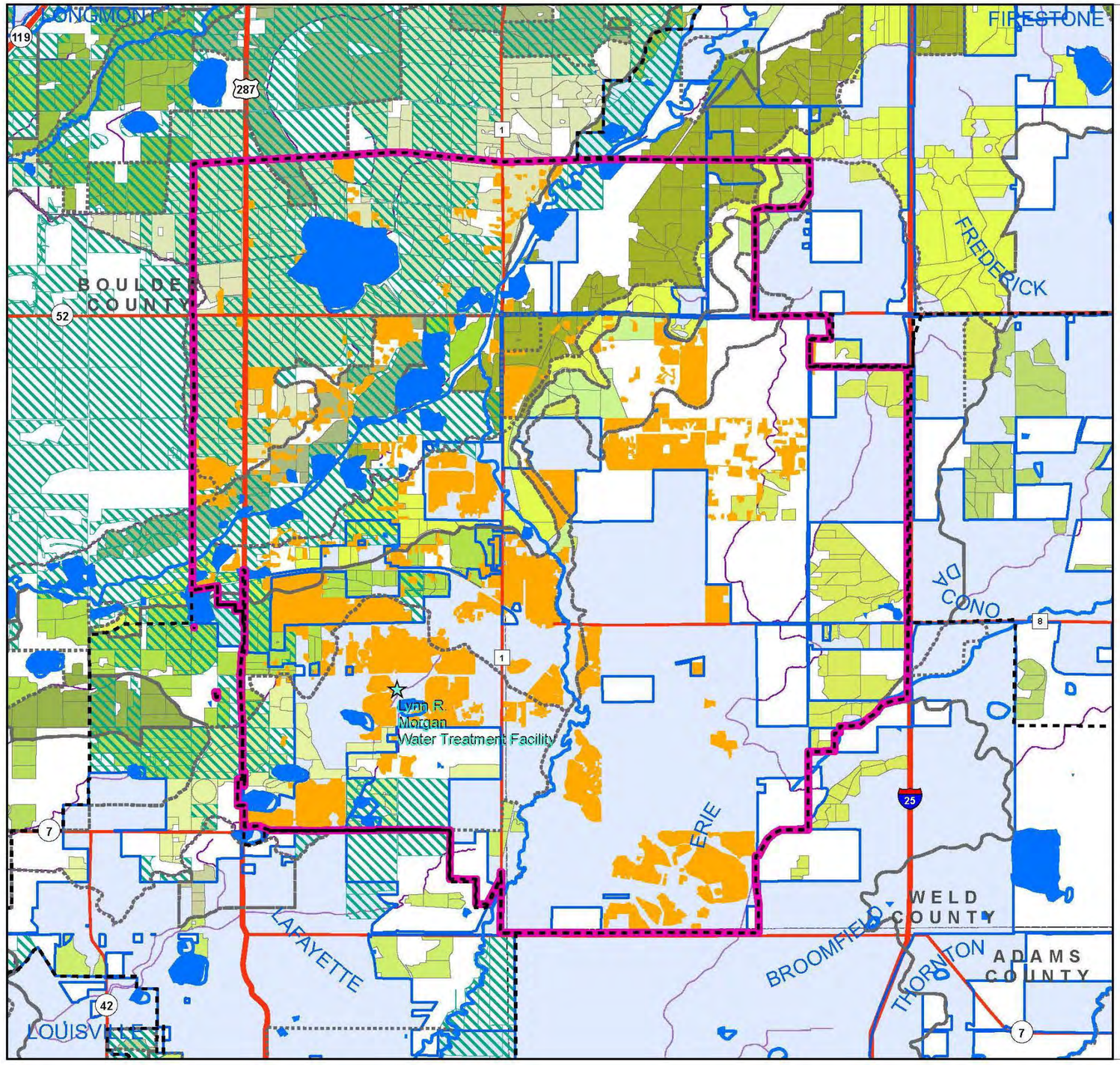


Figure 5-5
Erie Current Municipal Development and Irrigated Acreage

- Current Municipal Boundaries
- Future Planning Areas
- Future Planning Area Erie
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- Ground Water Only
- Div1 Ditch Service
- Lakes
- Streams and Rivers
- Canals

	acres
Current developed acreage within future planning area	3,897
Projected additional development by 2060 including parks/open spaces	8,550
Future planning area	27,946
Area of total developable land within future planning area	18,503
Area of potentially transferable irrigated land within future planning area	4,887
Potentially developable land within future planning area (excluding transferable irrigated land)	13,617
Number of ditches serving irrigated lands (including LULC) in future planning area	10

0 0.5 1 2 Miles

N W E S

Hydros Consulting

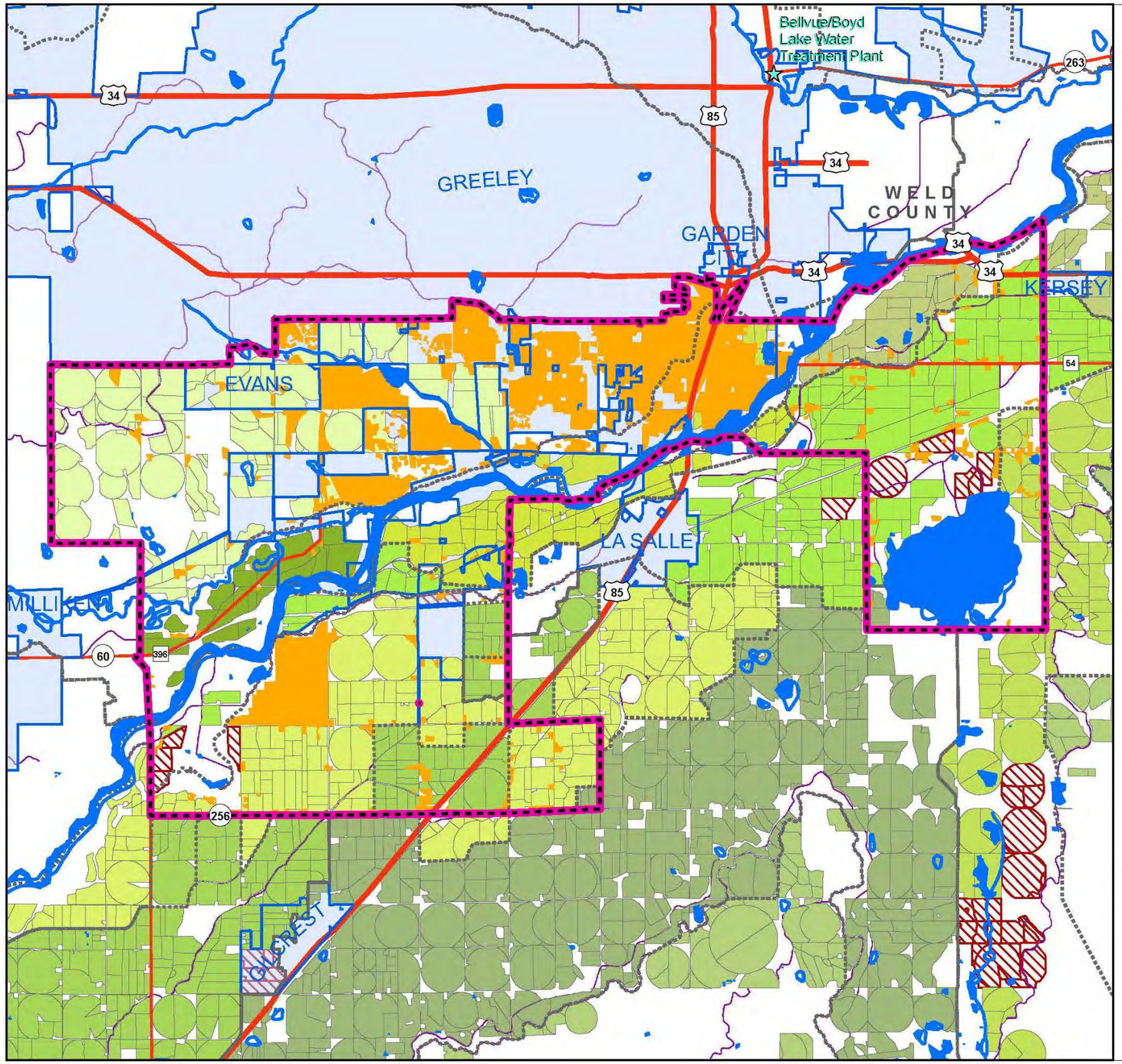


Figure 5-6
Evans Current Municipal Development and Irrigated Acreage

- Current Municipal Boundaries
- Future Planning Areas
- Future Planning Area Evans
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current developed acreage within future planning area	4,373
Projected additional development by 2060 including parks/open spaces	2,558
Future planning area	25,892
Area of total developable land within future planning area	21,519
Area of potentially transferable irrigated land within future planning area	12,417
Potentially developable land within future planning area (excluding transferable irrigated land)	9,101
Number of ditches serving irrigated lands (including LULC) in future planning area	10

0 0.5 1 2 Miles

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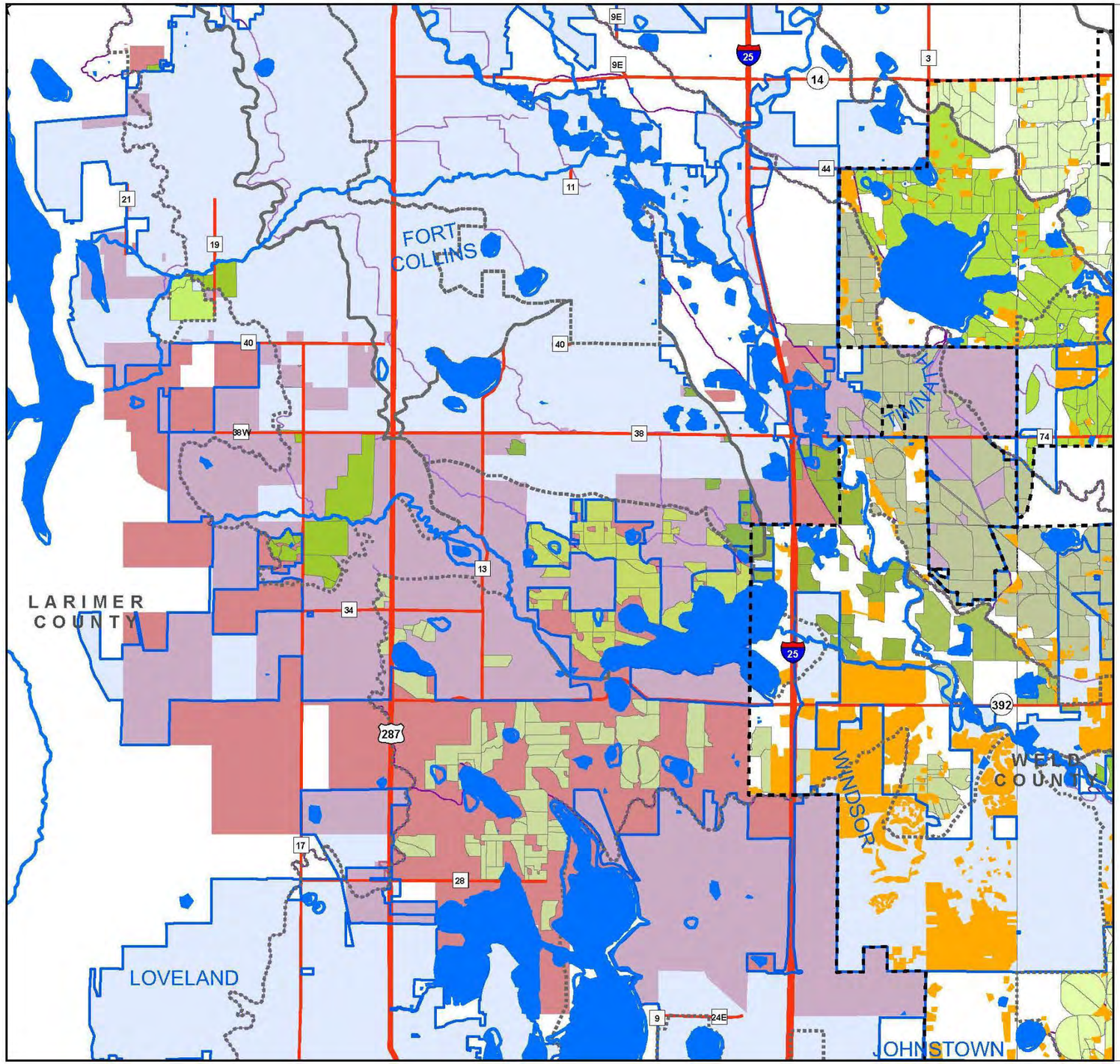

Figure 5-7
FCLWD Boundary Outside of FPAs and Irrigated Acreage

- Water Districts Outside Of FPAs
- Current Municipal Boundaries
- Future Planning Areas
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current District Boundary area	27,717
Area of potentially transferable irrigated land within current district boundary	4,752
Number of ditches serving irrigated lands (including LULC) in current district boundary	9

0 0.5 1 2 Miles

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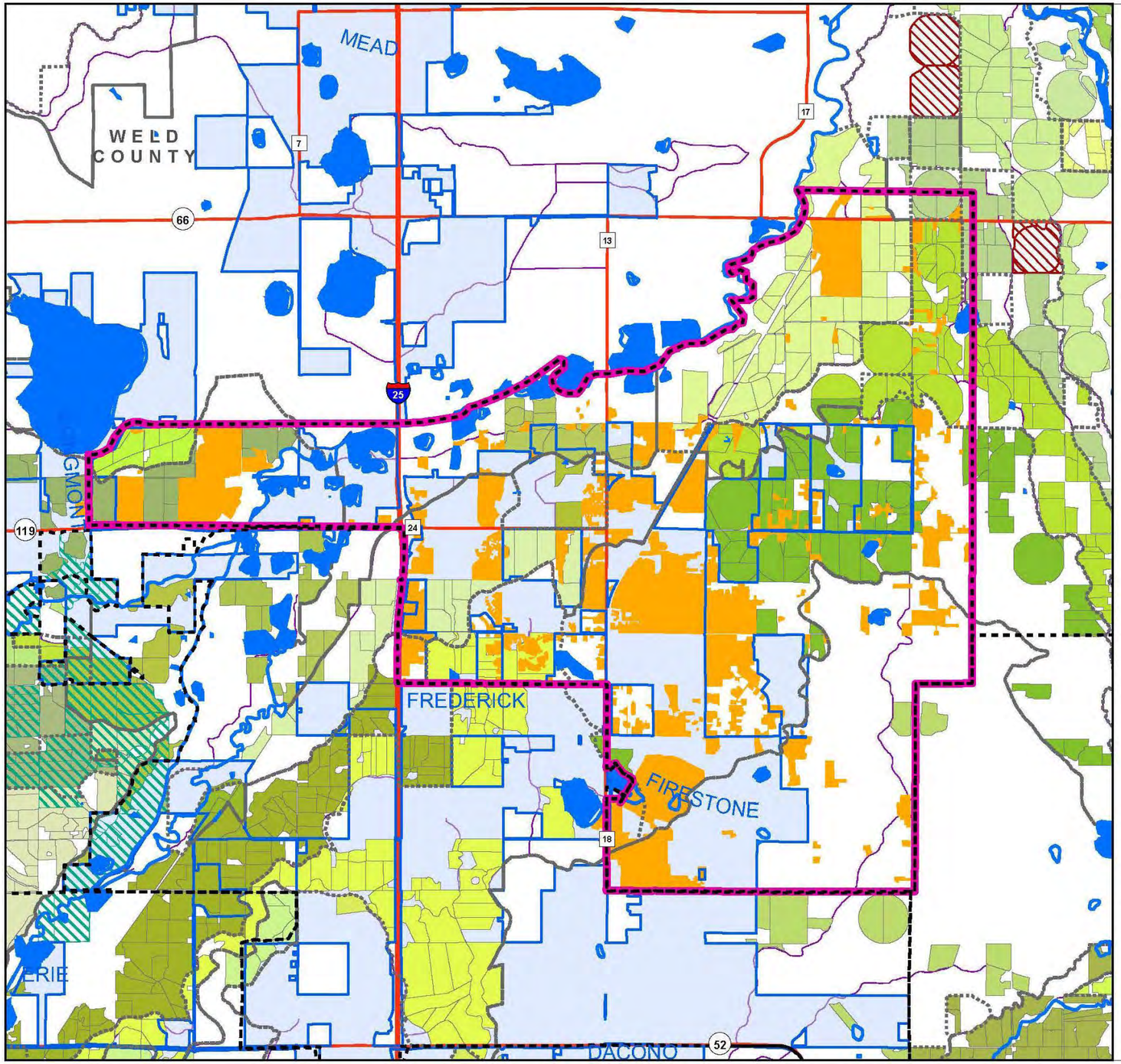

Figure 5-8
Firestone Current Municipal Development and Irrigated Acreage

- Current Municipal Boundaries
- Future Planning Areas
- Future Planning Area Firestone
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current developed acreage within future planning area	3,657
Projected additional development by 2060 including parks/open spaces	5,446
Future planning area	18,650
Area of total developable land within future planning area	14,993
Area of potentially transferable irrigated land within future planning area	5,418
Potentially developable land within future planning area (excluding transferable irrigated land)	9,575
Number of ditches serving irrigated lands (including LULC) in future planning area	11

0 0.5 1 2 Miles

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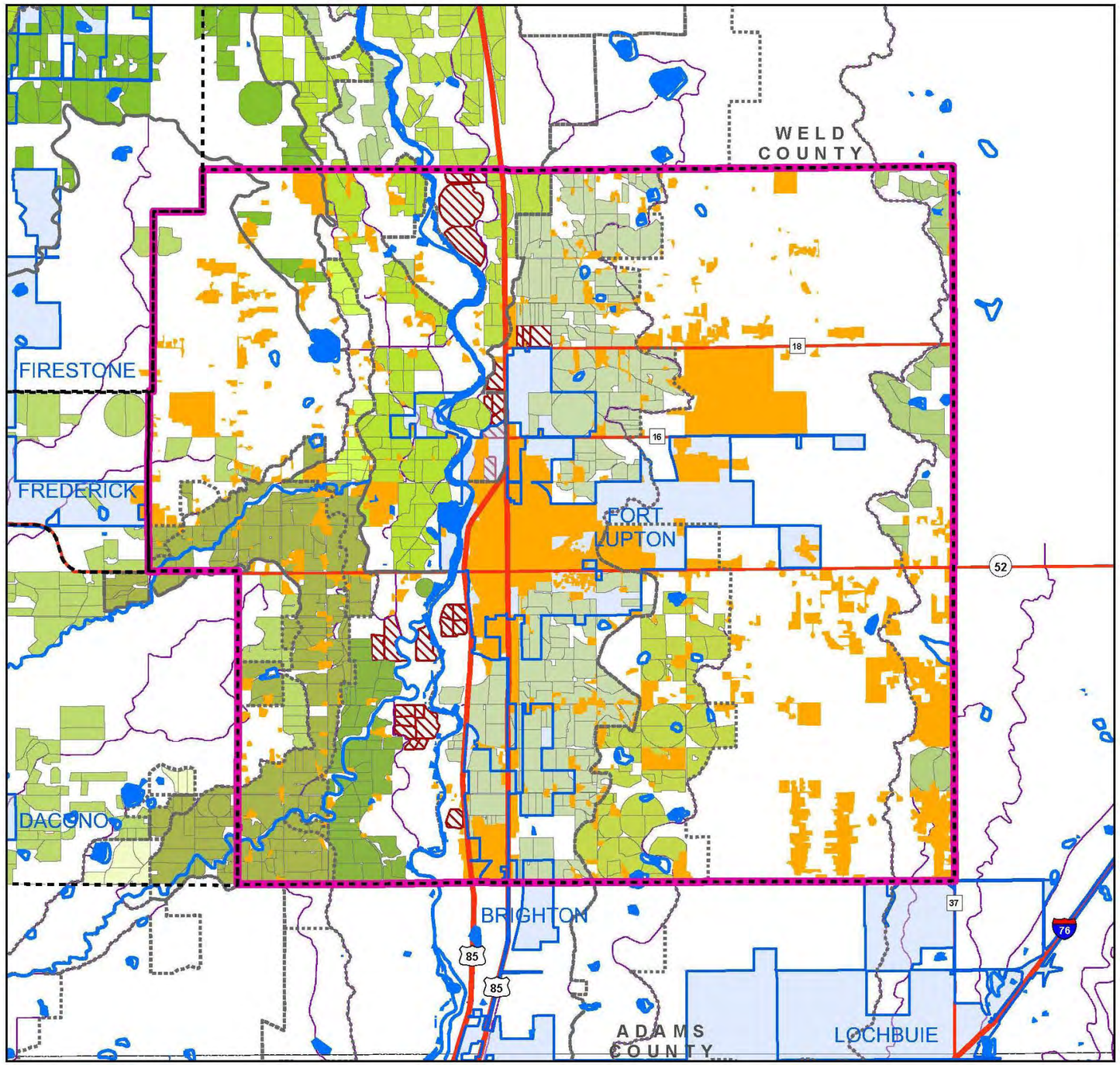
Figure 5-9
Fort Lupton Current Municipal Development and Irrigated Acreage



- Current Municipal Boundaries
- Future Planning Areas
- Future Planning Area Fort_Lupton
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current developed acreage within future planning area	6,331
Projected additional development by 2060 including parks/open spaces	3,210
Future planning area	43,729
Area of total developable land within future planning area	37,398
Area of potentially transferable irrigated land within future planning area	12,895
Potentially developable land within future planning area (excluding transferable irrigated land)	24,503
Number of ditches serving irrigated lands (including LULC) in future planning area	11

0 0.5 1 2 Miles

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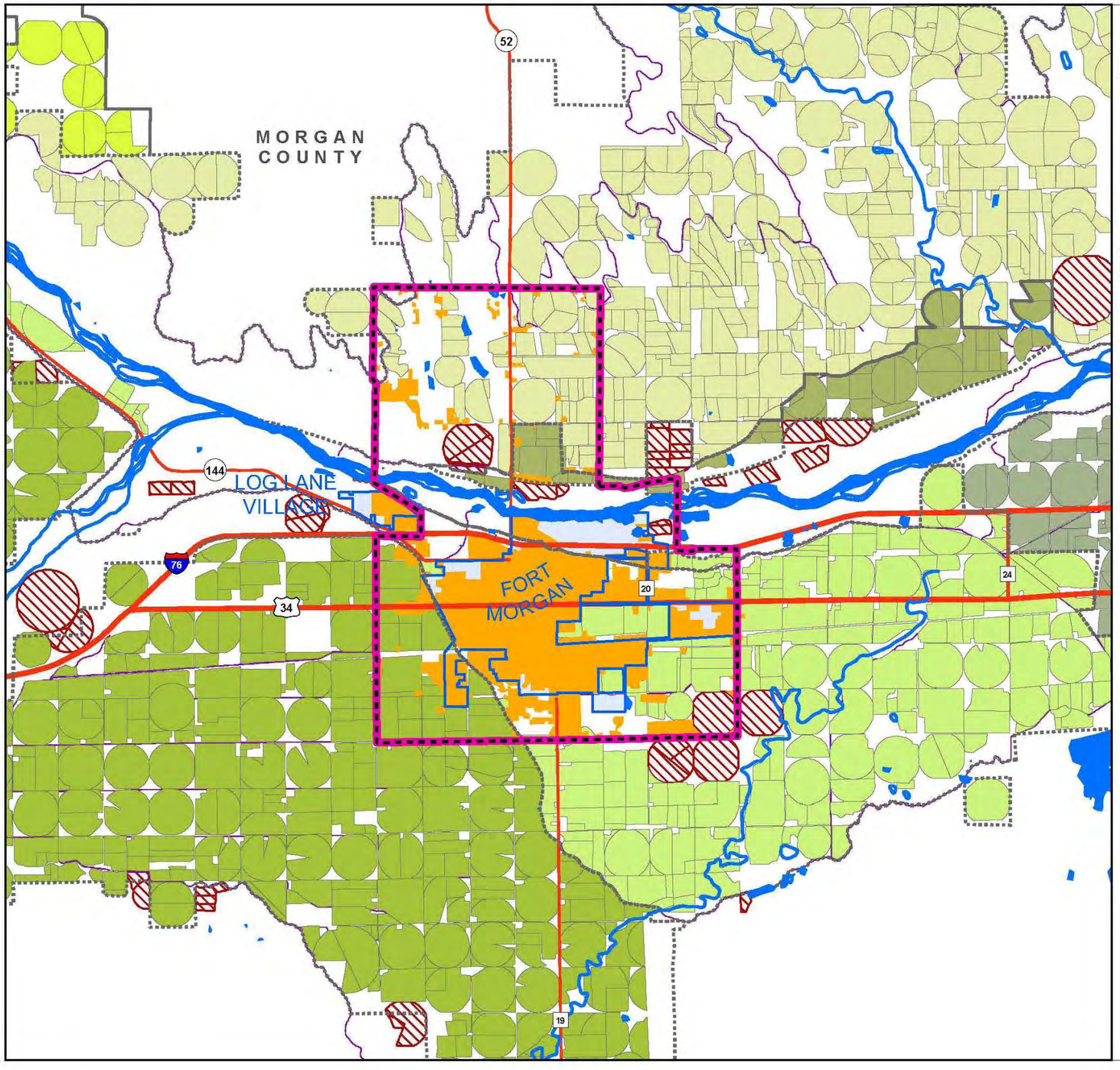

Figure 5-10
Fort Morgan Current Municipal Development and Irrigated Acreage

- Current Municipal Boundaries
- Future Planning Areas
- Future Planning Area Fort_Morgan
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current developed acreage within future planning area	3,007
Projected additional development by 2060 including parks/open spaces	2,811
Future planning area	10,270
Area of total developable land within future planning area	7,262
Area of potentially transferable irrigated land within future planning area	3,569
Potentially developable land within future planning area (excluding transferable irrigated land)	3,693
Number of ditches serving irrigated lands (including LULC) in future planning area	4

0 0.5 1 2 Miles

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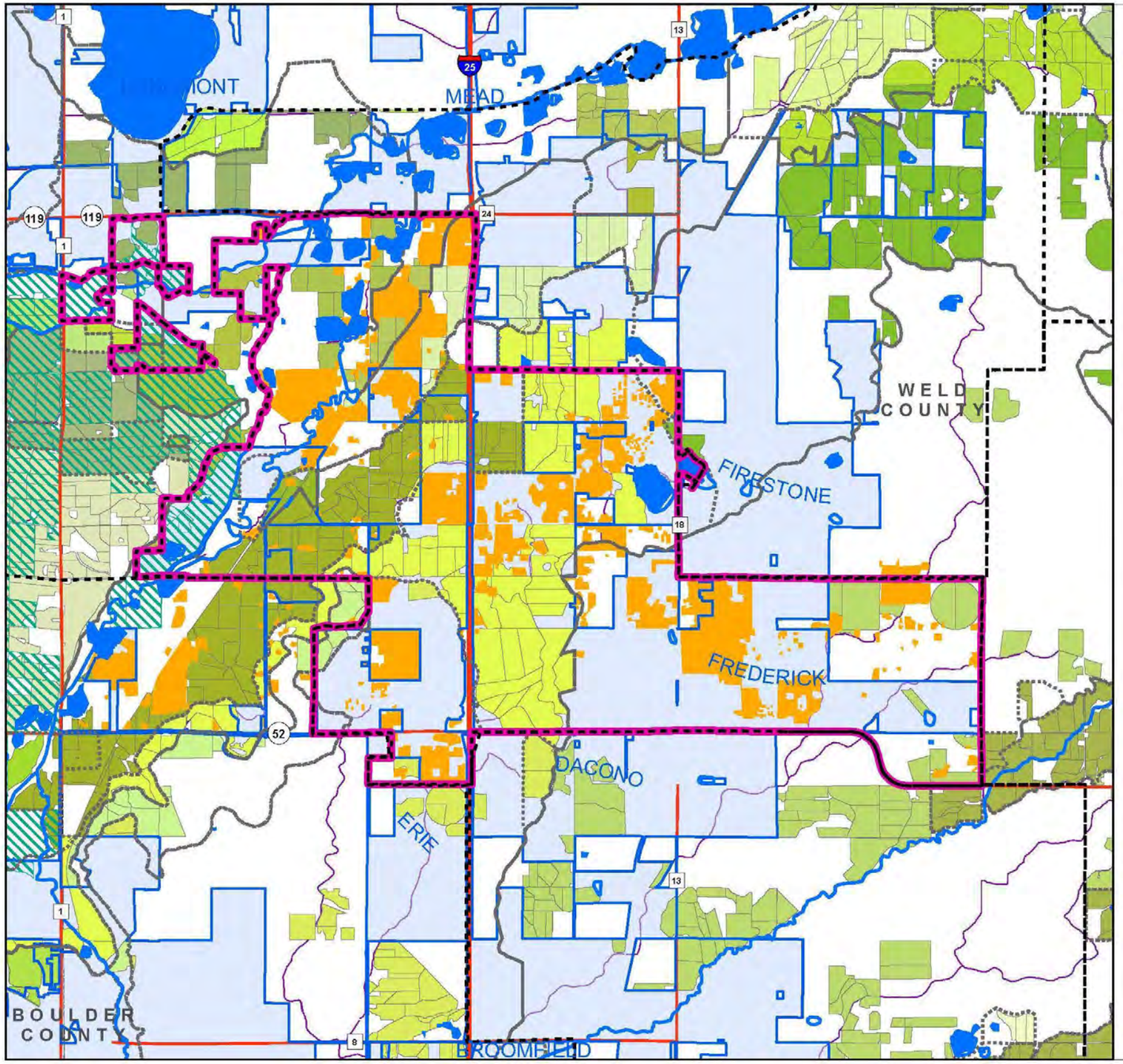

Figure 5-11
Frederick Current Municipal Development and Irrigated Acreage

- Current Municipal Boundaries
- Future Planning Areas
- Future Planning Area Frederick
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current developed acreage within future planning area	3,229
Projected additional development by 2060 including parks/open spaces	8,060
Future planning area	15,309
Area of total developable land within future planning area	11,309
Area of potentially transferable irrigated land within future planning area	4,338
Potentially developable land within future planning area (excluding transferable irrigated land)	6,972
Number of ditches serving irrigated lands (including LULC) in future planning area	18

0 0.5 1 2 Miles

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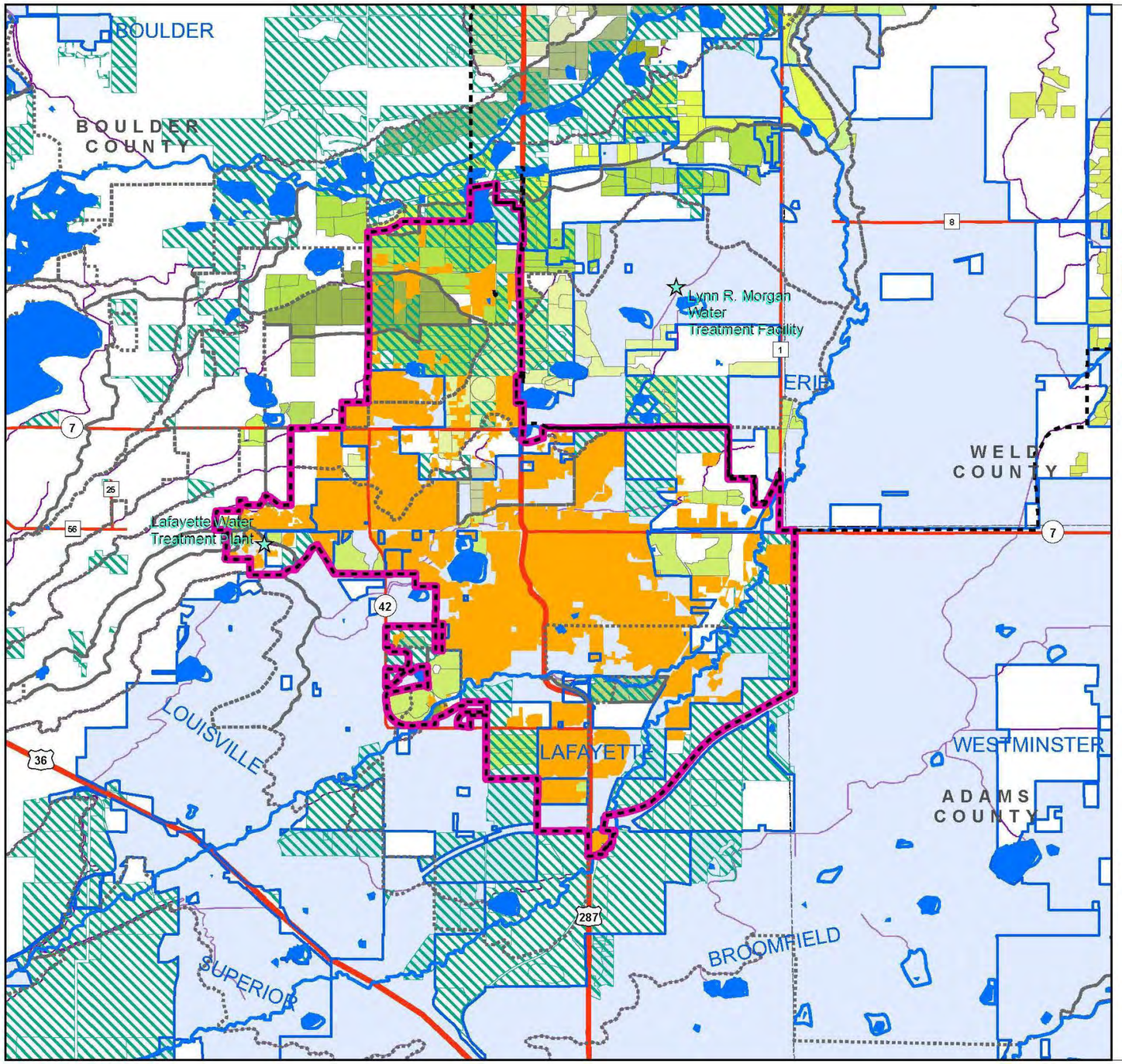

Figure 5-12
Lafayette Current Municipal Development and Irrigated Acreage

- Current Municipal Boundaries
- Future Planning Areas
- Future Planning Area Lafayette
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current developed acreage within future planning area	4,423
Projected additional development by 2060 including parks/open spaces	1,464
Future planning area	10,848
Area of total developable land within future planning area	3,641
Area of potentially transferable irrigated land within future planning area	1,128
Potentially developable land within future planning area (excluding transferable irrigated land)	2,514
Number of ditches serving irrigated lands (including LULC) in future planning area	11

0 0.5 1 2 Miles

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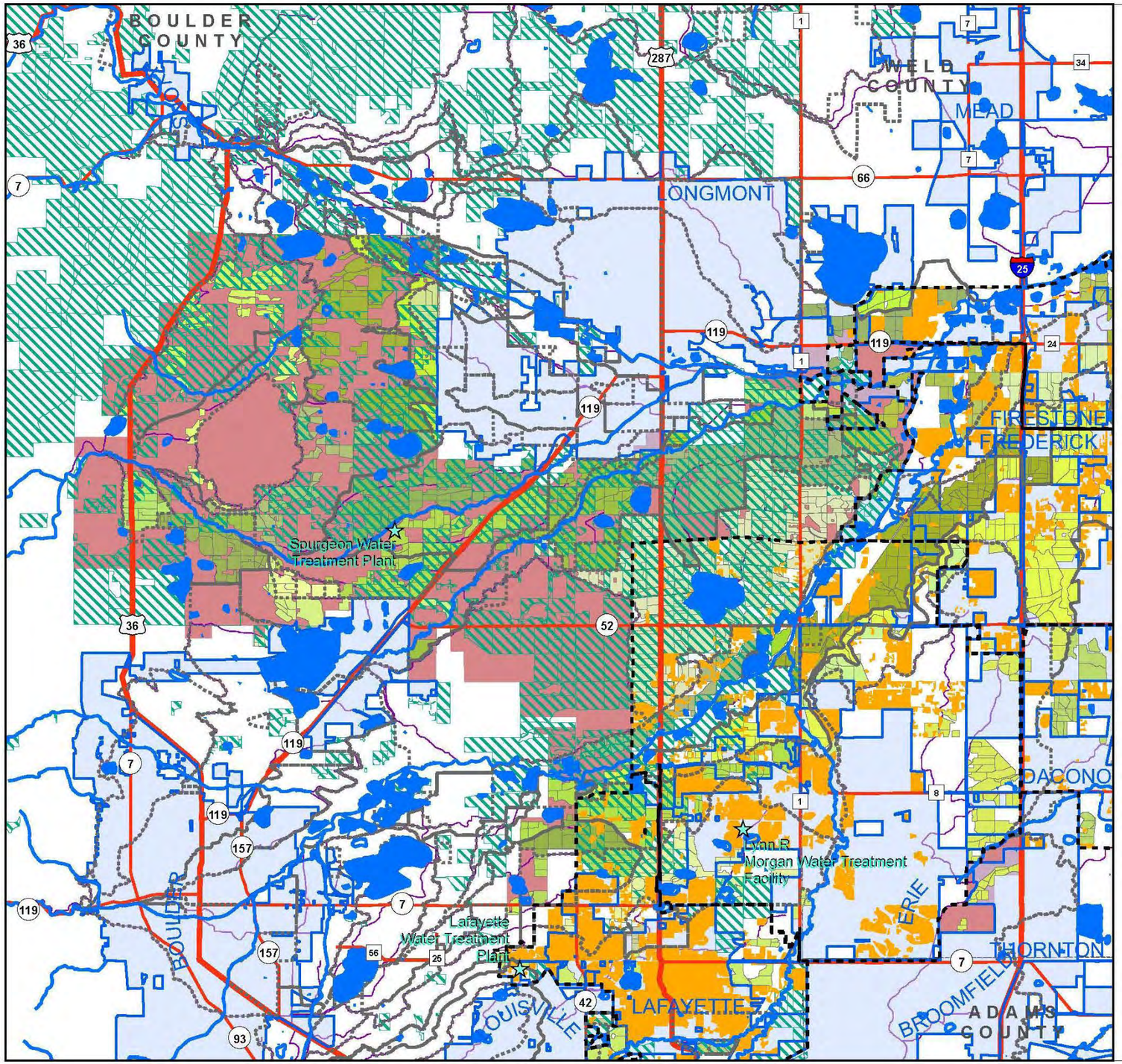
Figure 5-13
LHWD Boundary Outside of FPAs and Irrigated Acreage



Water Districts Outside Of FPAs
Current Municipal Boundaries
Future Planning Areas
Current Development
2005 Irr Lands by Ditch, NO GW
Open Space/Consv Easmnt
GW Only Irr
Div1 Ditch Service
Lakes
Rivers
Canals

	acres
Current District Boundary area	44,859
Area of potentially transferable irrigated land within current district boundary	6,823
Number of ditches serving irrigated lands (including LULC) in current district boundary	52

0 0.5 1 2 Miles

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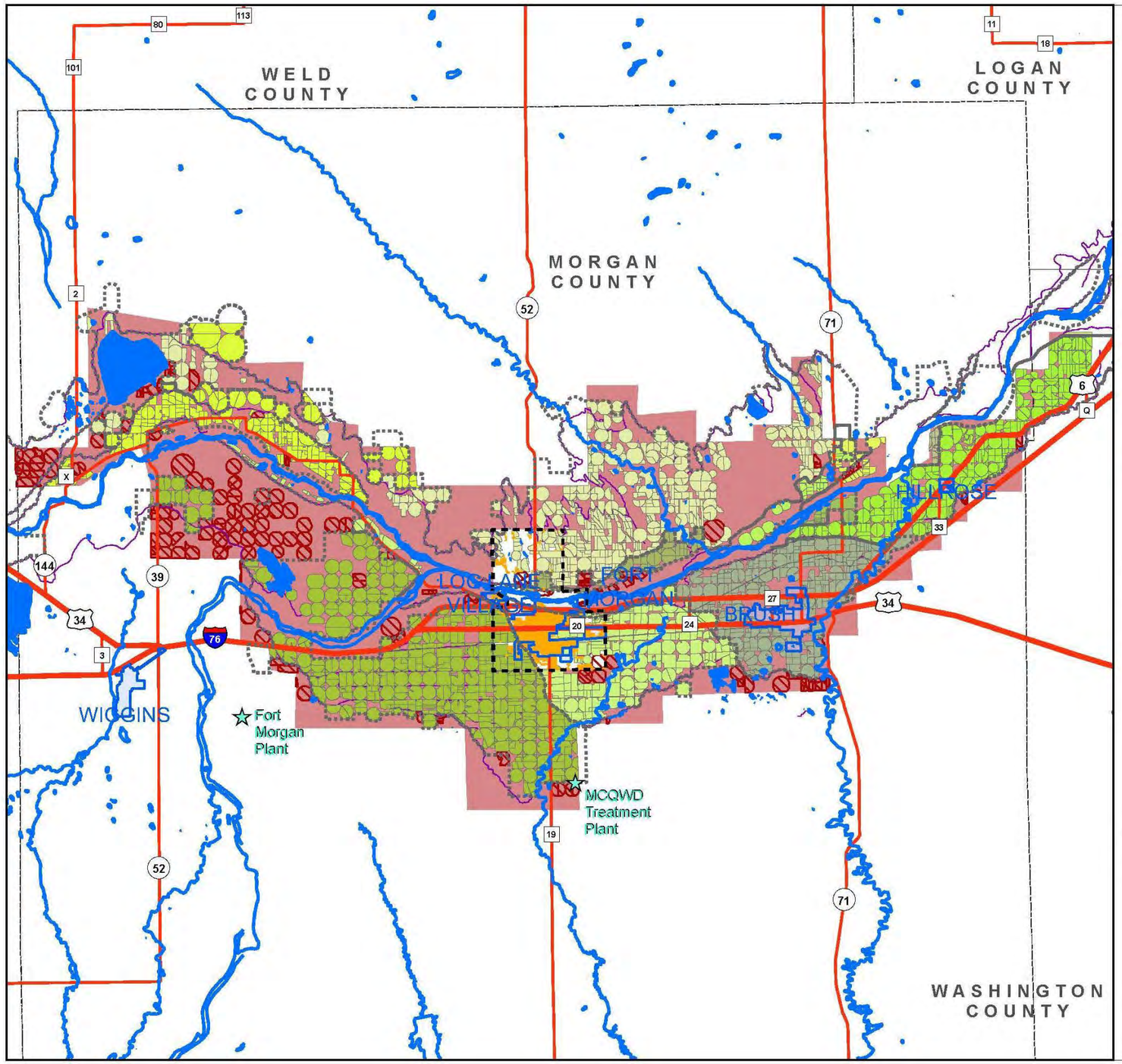
Figure 5-14
MCQWD Boundary Outside of FPAs and Irrigated Acreage



- Water Districts Outside Of FPAs
- Current Municipal Boundaries
- Future Planning Areas
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current District Boundary area	179,691
Area of potentially transferable irrigated land within current district boundary	80,474
Number of ditches serving irrigated lands (including LULC) in current district boundary	14

0 1.5 3 6 Miles

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Hydros Consulting

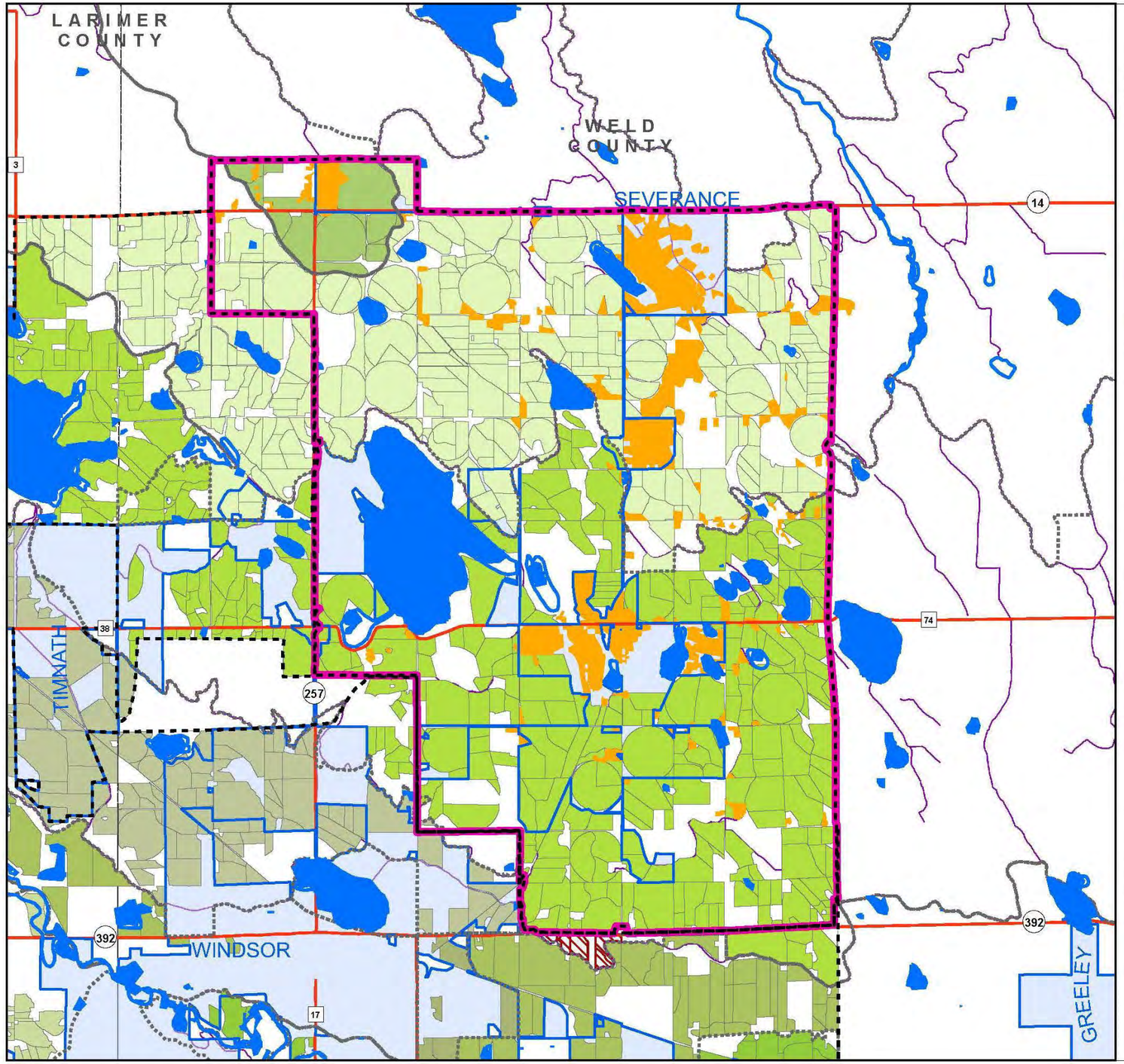

Figure 5-15
Severance Current Municipal Development and Irrigated Acreage

- Current Municipal Boundaries
- Future Planning Areas
- Future Planning Area Severance
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current developed acreage within future planning area	1,622
Projected additional development by 2060 including parks/open spaces	5,227
Future planning area	21,558
Area of total developable land within future planning area	19,936
Area of potentially transferable irrigated land within future planning area	13,238
Potentially developable land within future planning area (excluding transferable irrigated land)	6,698
Number of ditches serving irrigated lands (including LULC) in future planning area	4

0 0.5 1 2 Miles

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Hydros Consulting

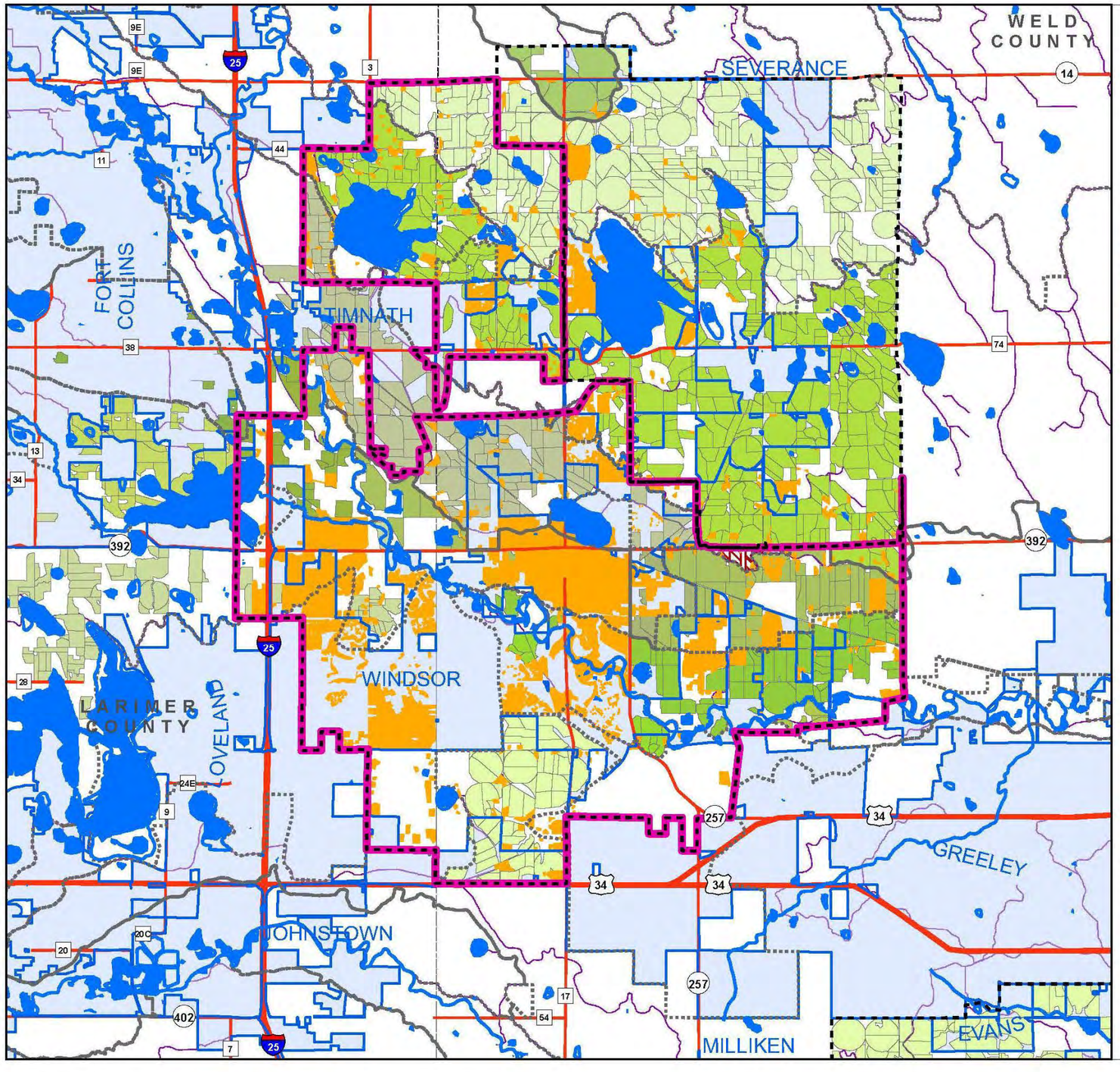

Figure 5-16
Windsor Current Municipal Development and Irrigated Acreage

- Current Municipal Boundaries
- Future Planning Areas
- Future Planning Area Windsor
- Current Development
- 2005 Irr Lands by Ditch, NO GW
- Open Space/Consv Easmnt
- GW Only Irr
- Div1 Ditch Service
- Lakes
- Rivers
- Canals

	acres
Current developed acreage within future planning area	7,843
Projected additional development by 2060 including parks/open spaces	13,514
Future planning area	39,144
Area of total developable land within future planning area	31,301
Area of potentially transferable irrigated land within future planning area	14,610
Potentially developable land within future planning area (excluding transferable irrigated land)	16,691
Number of ditches serving irrigated lands (including LULC) in future planning area	13

0 0.5 1 2 Miles

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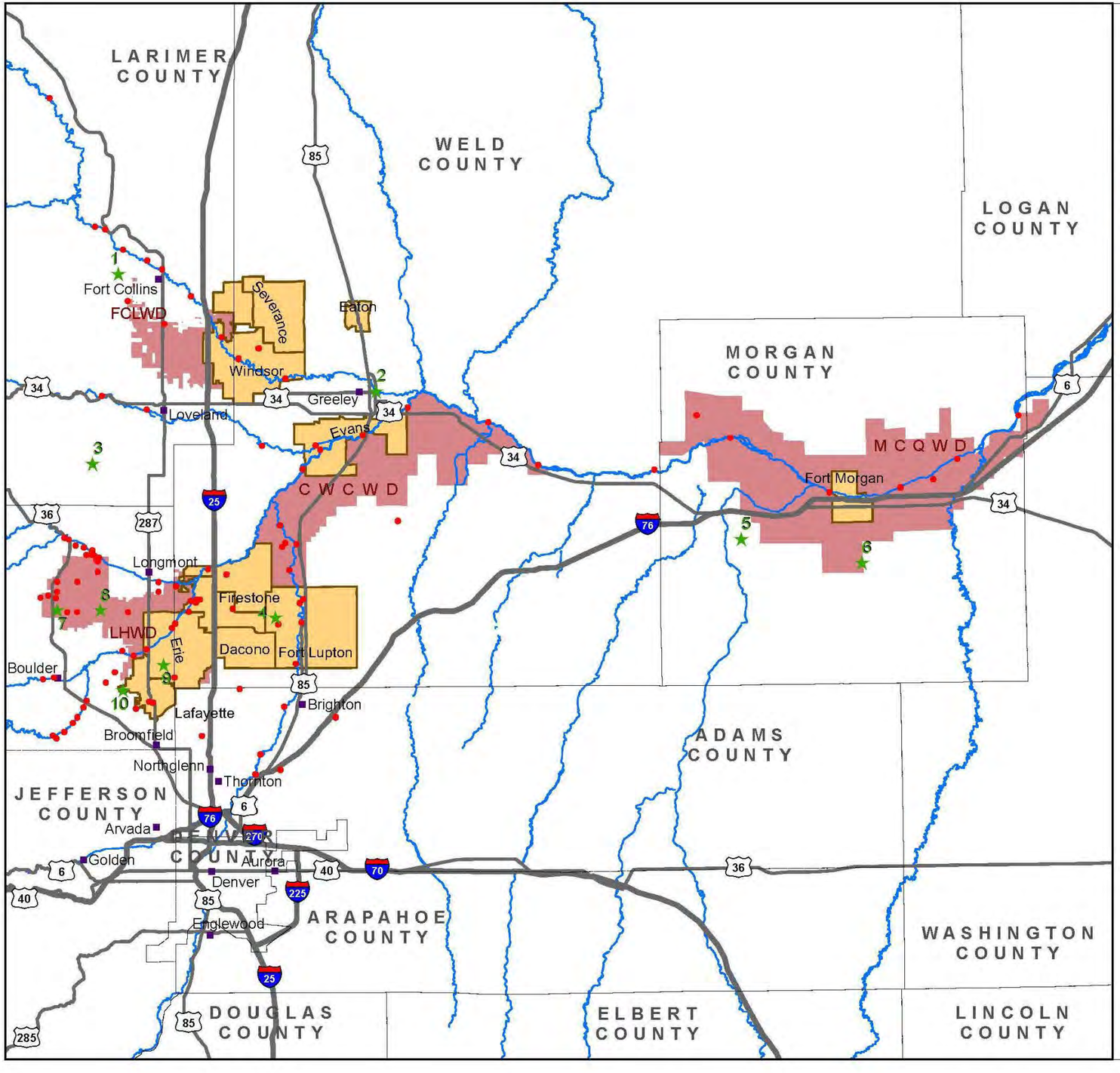
Figure 5-18
NISP Project Region



Legend

- NISP Participant Water District Service Areas Excluding Municipal Participant Future Planning Areas (FPAs)
- FPAs of NISP Municipal Participants
- WTPs Serving FPAs and WDs
- Headgates of Ditches within FPAs and NISP WDs
- County Boundary
- Rivers and Streams
- Interstate Highway
- US Highway
- Cities

0 5 10 20 Miles

N W E S

#	Treatment Plant	Participants
1	Soldier Canyon Filter Plant	Eaton, FCLWD, Severance, Windsor
2	Bellvue/Boyd Lake Water Treatment Plant	CWCWD, Evans, Windsor
3	Carter Lake Filter Plant	CWCWD, Dacono, Frederick, Firestone
4	Fort Lupton/Hudson WTP	Fort Lupton
5	Fort Morgan WTP	Fort Morgan
6	MCQWD Treatment Plant	MCQWD
7	Spurgeon Water Treatment Plant	Frederick, LHWD
8	Dodd Water Treatment Plant	Frederick, LHWD
9	Lynn R. Morgan Water Treatment Facility	Erie
10	Lafayette Water Treatment Plant	Lafayette

Hydros Consulting

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HEALTHY RIVERS ALTERNATIVE REPORT (STP 2008)

Healthy Rivers, Healthy Communities

A Balanced Proposal for the Cache la Poudre River in Colorado

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Water Supply Security that Preserves Our Rivers

In this document, the Save The Poudre Coalition, a grassroots effort built from a wide range of Local, Regional, State, and National organizations provides a ***Healthy Rivers Alternative*** to the proposed Northern Integrated Supply Project (NISP). NISP includes the proposed Glade and Galeton Reservoirs and would take water from both the Cache la Poudre and South Platte Rivers to support growth in service areas stretching from Larimer County south to the Denver metro area. Our alternative, in comparison to a proposal pursued by the NISP proponents, achieves both water supply security and river conservation for the citizens of northern Colorado, and it does so at a much reduced cost that supports agriculture and protects the environment.

In addition to the ***Healthy Rivers Alternative***, we outline long-term proposals for instream flows and river restoration and policy and legislative solutions that will provide for a sustainable future for the Cache la Poudre River and the residents of northern Colorado. Together, these short- and long-term steps set a course of action that will allow the citizens to control the fate of their rivers and communities. The steps are based on the following principles:

To provide for healthy rivers and communities in the short-term, we need the following right now:

1. **A realistic assessment of future water needs of the NISP participants.** An analysis of population growth and water demand that realistically portrays the future need for water in NISP participant communities is needed before any decisions on future investments can be made. The NISP Draft Environmental Impact Statement (DEIS) is inadequate in analyzing the growth, water need, and conservation potential for NISP participant cities. As a consequence, its justification for the project dramatically overstates the future need for water to be provided by the project. A revised Purpose and Need analysis for the NISP project provides the foundation for a proposal that will meet the participants' needs without unnecessarily draining the river.

2. **A full range of alternative water supply options for NISP participants.** A number of viable options exist (in addition to those discussed in the DEIS) that would allow the NISP participants to meet their needs without draining the Cache la Poudre River of its last flows. Although these options individually provide only a portion of the water needed, when combined they go well beyond the NISP participants needs.

3. **A full range of alternative water storage options for NISP participants.** As with supply, there are a number of storage options that, taken together, would make needed water available. A system of these options would eliminate need for construction of the unnecessary and tremendously expensive Glade and Galeton Reservoirs.

4. **An accurate and current revised cost estimate for all of the options that might be used to meet the needs of NISP participants.** Significant increases in infrastructure costs over the last few years have rendered the cost estimates prepared for the NISP DEIS inaccurate and obsolete. A revised look at both the proposed project and the options described in this document allows residents of northern Colorado and decision makers to thoughtfully approach major investments.

A Healthy Rivers Alternative to NISP/Glade

Responsible Demand Management and Small-Scale Supply Options Eliminate the need for NISP

The Save The Poudre Coalition has devoted more than a thousand hours to the analysis of the NISP DEIS. This work has been performed by research scientists, analysts, attorneys, qualified professionals, and community members with expertise in issues related to this issue. In the course of our work, we have discovered numerous problems with the NISP proposal, starting with the underlying justification for the project and continuing through the analysis and proposed mitigation

Our review made it clear that it was essential for us to carefully analyze the proposed NISP project and prepare a positive alternative that would meet the needs of the NISP participants while reducing water withdrawal-associated impacts on the Cache la Poudre River. This alternative, the ***Healthy River Alternative***, is explained in detail here.

While alternatives are typically composed solely of action steps, the fundamental flaws with the project's justification as presented in the NISP DEIS required us to take a step back and in essence start from square one. It is also necessary to critique a number of elements of the DEIS to fully explain the alternative and its rationale. Consequently, we present our discussion of the alternative in five parts:

- A critique of the Purpose and Need section of the proposed NISP project as presented in the DEIS, explaining why this project justification is fundamentally flawed and incapable of serving as the foundation for further analysis;

- A revised projection of future water demands that honestly and accurately states the needs of the NISP participants while incorporating realistic population growth scenarios, alternative water supply options, alternative storage, and industry standards for best management practices;

- An overview of alternative water supply options that can meet the actual needs of the NISP participants;

- Cost estimates for the NISP project and the Healthy Rivers Alternative scenarios;

- A comparison of the environmental impacts of the proposed NISP with the impacts of the Healthy Rivers Alternative.

The Justification for NISP Presented in the DEIS is Fundamentally Flawed

In reviewing the NISP DEIS we determined that the population growth and water demand estimates provided by the project's participants were poorly done. A large number of major inconsistencies point to a speculative and severely flawed analysis of current water use and projected demand. Key failures of the DEIS include:

- The DEIS does not evaluate the role of water conservation or efficiency either as a way to reduce demand. This is counter to the regional trend toward lowered water consumption rates.

- The DEIS arbitrarily removed major industrial users from the analysis, which artificially lowered estimates of gallons per capita daily (gpcd) water use for the participants. It then compared these estimates, which represent just a portion of the residential use, with the total industrial, residential, and municipal gpcd figures from other communities.

- Water use levels reported for several of the participants were inconsistent with other published reports on water use.

- Parts of the analysis combined water use data from one year with population data from another. Periods of high water use by the participants were arbitrarily removed from the analysis.

- Future projected population growth was inconsistent with current population trends.

These inconsistencies point to a severely flawed analysis. The results are water use estimates that are speculative and faulty, undermining the water demand analysis that the remainder of the document rests on.

An honest and accurate analysis of a community's projected water needs depends on an understanding of how the community uses water. An analysis of the distribution of water use sectors (residential, industrial, commercial and municipal/public safety) in future community growth, rational target water use goals for those water use sectors, and a clear understanding of existing water use are essential to demand projection.[1] To understand baseline needs and project water demand into the future, water providers must analyze water use over a period long enough to include droughts and other factors that influence water use.[2] It is not clear that the DEIS authors had access to such information, or if indeed the participants themselves had collected such information and done an analysis to project past and present water use by sector.

We do not believe that the decision makers tasked with reviewing and approving this project can make an informed decision into the actual purpose and need for the project unless these issues are addressed. The result is a severely flawed water use analysis that does not meet basic NEPA requirements under 40 CFR § Title 1502 et seq. The NISP DEIS does not divulge accurate information from which decision makers can accurately assess the purpose and need for the project, nor can the public adequately asses the efficacy of the analysis. We offer our revised water demand analysis below.

Reassessing Demand by Overhauling NISP Population Forecasts and Incorporating Cost-Effective Demand Management

Population Growth Projections in the NISP DEIS are Incorrectly Calculated

The annual percentage growth rates used in the NISP DEIS do not always correspond to the actual population estimates for the projected periods. Furthermore, the ranges provided for annual growth rates are far too broad. It would be more appropriate to calculate the population growth estimates based on the middle of the range growth rates for each participant. We believe that this is not only more accurate but even conservative (i.e., very unlikely to understate growth) given rising energy costs that are likely to slow growth rates in NISP project area and instead redirect growth to urban centers and transportation hubs.

Population Growth Projections in the NISP DEIS are Unachievably High

There is reason to question whether the growth rates projected in the NISP DEIS will be achieved by the NISP participants. A recent study of American housing trends analyzed the roots of the housing bubble and the mortgage foreclosure crisis, finding that high fuel costs were the largest contributing factor to the foreclosure

[1] One example that analyzes water use by industrial sector is the City of Aurora, Colorado *Water Conservation Plan* dated August 8, 2007. http://www.auroragov.org/stellent/groups/public/documents/article-publication/035857.pdf

[2] The city of Santa Fe has evaluated water demand going back to 1995 and has reduced water use by 4.2% per year through 2007. City of Santa Fe Water Conservation Office. http://www.santafenm.gov/DocumentView.asp?DID=2178

rate in suburban communities.[3] The work describes how the price of fuel is driving the U.S. housing market to restructure around transit and employment centers.

To see how this trend is affecting the NISP participants, we analyzed their foreclosure rates alongside new housing permits, and found the NISP participant regions have some of the highest foreclosure rates in the country (Figure 1 and Figure 2).[4] New housing permits in 2008 so far are half those in 1998,[5]when the population was significantly smaller. Gasoline price inflation is highly correlated with the foreclosure rate and drop in permits,[6, 7] as residents find they can no longer afford to commute by automobile long distances to work or to retail centers.

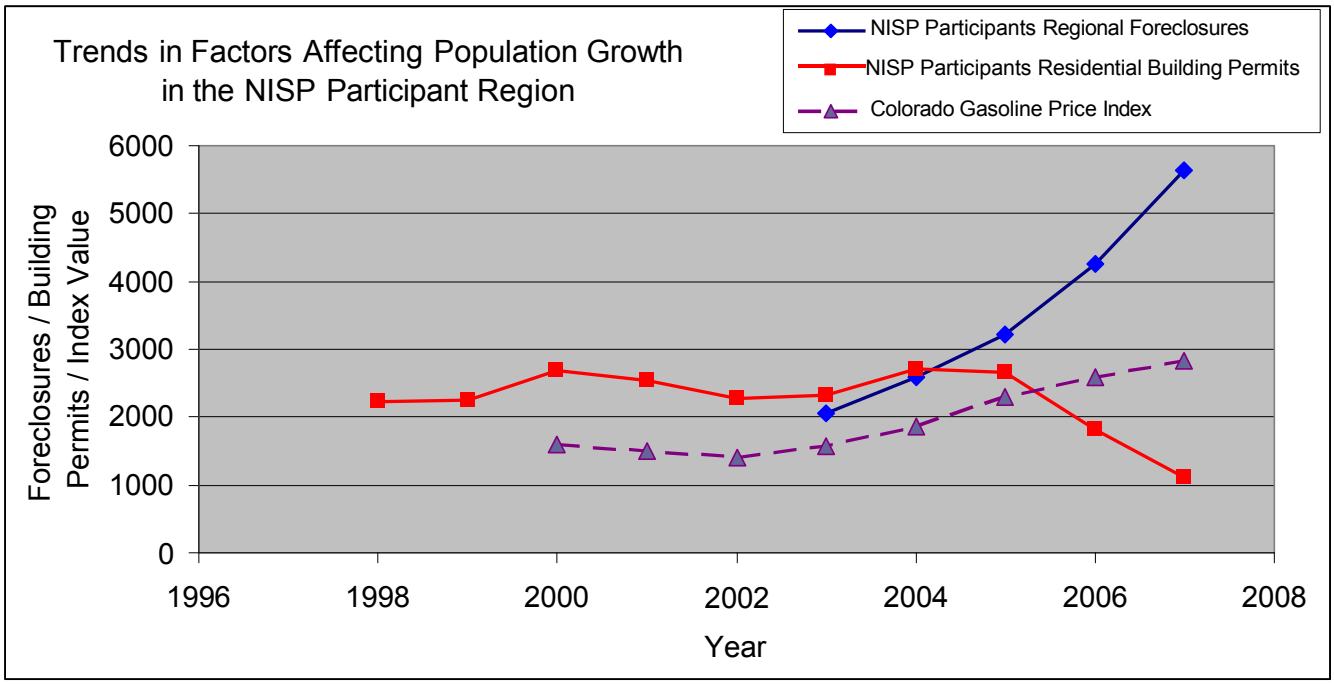

Figure 1. Indicators of significant uncertainty in population and water use growth projections for the NISP participants. As fuel price inflation soars, home mortgage foreclosures in the NISP participant region climbed well above the national average, and building permits sank to half that of recent levels. The foreclosure rate in Weld County is 1 out of every 29 homes.

[3] Joe Cortright. 2008. Driven to the Brink: How the Gas Price Spike Popped the Housing Bubble and Devalued the Suburbs. CEOs for Cities. http://www.ceosforcities.org/newsroom/pr/files/Driven%20to%20the%20Brink%20FINAL.pdf, viewed on 7/7/2008.
[4] Mortgage foreclosure data provided by RealtyTrac. http://www.realtytrac.com/ContentManagement/pressrelease.aspx?ChannelID=9&ItemID=3988&accnt=64847, viewed on 8/31/2008.
[5] Building permit data were provided by Boulder, Larimer, Morgan, and Weld Counties, and the NISP participants.
[6] U.S. Department of Energy. http://tonto.eia.doe.gov/oog/ftparea/wogirs/xls/pswrgvwsco.xls, viewed on 8/31/2008. Data are scaled for comparison purposes.
[7] Average yearly fuel costs in Colorado are 95% correlated with mortgage foreclosures, and 70% correlated with the drop in building permits.

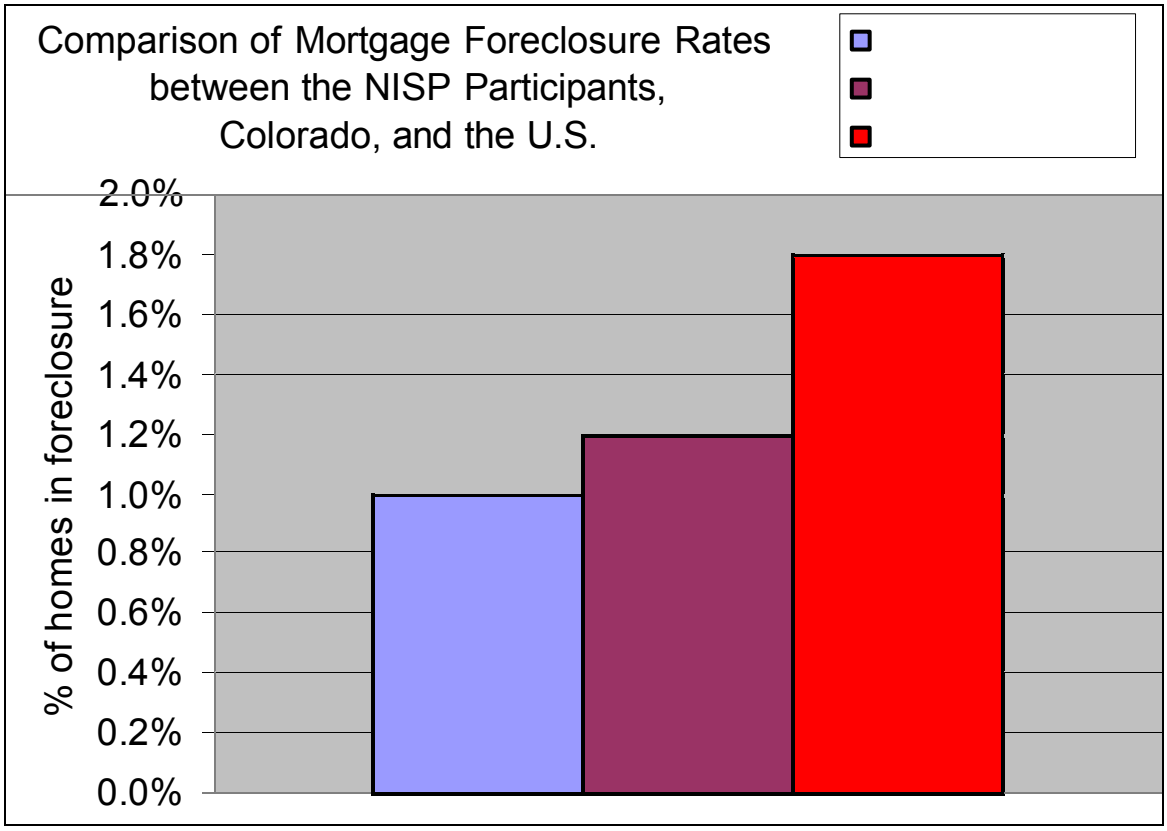

Figure 2. Population weighted mean percent in 2007 of all homes in Mortgage Foreclosure in the NISP participants region (Boulder, Larimer, Morgan, and Weld Counties) compared with the Colorado and U.S. statistics for home foreclosure.

For these reasons, we believe that the NISP participants are very unlikely to achieve the population growth scenario described in the NISP DEIS.

Revised Base Water Use Projections

In order to calculate a more reasonable and accurate water demand required by the NISP participants, we constructed revised scenarios of projected water demand over time. Population estimates were based on information in the NISP DEIS, using the mean average annual growth rate when a range was provided (Figure 3).[8] Build out figures from the DEIS were also observed. After population projections were re-calculated using the midline growth rates and respecting the listed build-out figures, total population in 2035 for the NISP participants is 375,613; 11% less than listed in the DEIS. In 2050 the population is projected to reach 440,920; 27% less than the DEIS projects.

[8] NISP DEIS, Table 1-4.

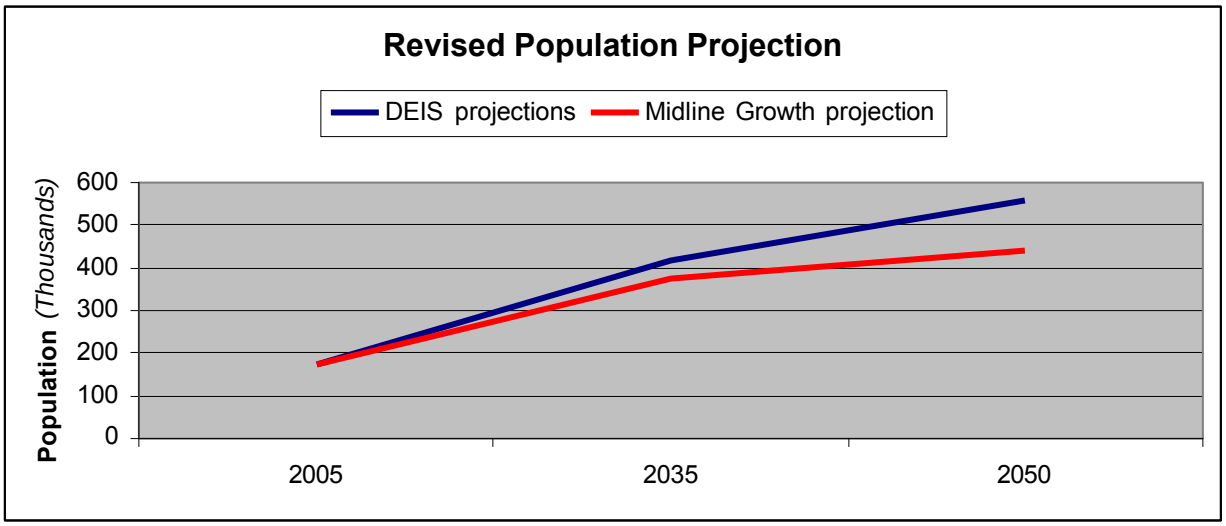

Figure 3. Projected midrange population trends in the NISP participants region.

Using these revised population projections we calculated the total required demand. Even with no decrease in levels of use, the lower population projection leads to decreased demand. We analyzed two modest conservation scenarios based on the following assumptions:

- We used current system-wide per capita figures as a basis for calculating future demand. Current per capita figures were calculated using data provided in the DEIS, Table1-3. These figures include all system-wide potable use and loss and thus is more reflective of where community use levels are than the GPCD figures provided in the DEIS that exclude large water users (Table 1).
- Final demand figures include a 10% system loss on top of the calculated potable demand. Ten percent is the level of system-wide loss that is deemed appropriate by the American Water Works Association.[9] Many NISP participants have loss levels much larger than 10%; reducing these losses will save a great deal of water and reduce overall demand.

Table 1. Recalculated 2003 Gallons Per Capita Per Day (GPCD) Figures for the NISP participants. Total population-weighted mean is 183 gpcd.

	Potable Deliveries	Total Potable Deliveries with Loss	2003 Population	System Wide GPCD
CWCWD	5,102	5,547	18,652	**265**
Eaton	577	698	3,702	**168**
Erie	1,474	1,706	9,039	**168**
Evans	1,572	2,465	11,754	**187**
FCLWD	5,732	6,368	30,189	**188**
Fort Lupton	866	1,158	7,071	**146**
Fort Morgan	2,619	2,867	10,994	**233**
Lafayette	3,478	3,754	24,996	**134**
LHWD	3,389	4,033	18,158	**198**
MCQWD	1,661	1,631	5,711	**255**
Severance	129	178	1,300	**122**
Windsor	1,609	2,040	13,984	**130**

[9] AWWA Leak Detection and Water Accountability Committee, "Committee Report: Water Accountability," Journal AWWA (July 1996): 108-111.

Water conservation, also known as demand management, in Colorado has changed dramatically over the past five years. After responding to the record drought of 2002, some water utilities have implemented widespread conservation programs, not just as a drought-management tool, but also as a means to secure permanent water conservation savings. These savings can increase system reliability, serve new growth, and decrease the need for new water development that can have detrimental impacts on Colorado's river environment, water recreation, and rural communities.

Demand Management Scenarios

Based on existing trends and examples from other Front Range water utilities, we next developed two straightforward, achievable demand reduction scenarios that utilize very modest conservation and efficiency measures to reduce the base water use projections described above.[10]

Conservation and efficiency represent a solid "no regrets" strategy – one that does not tie the utilities to expensive infrastructure or rising electricity costs, with no detrimental impacts on river systems or rural communities. While conservation programs come with a price tag, they are much smaller than the one for the proposed NISP components.[11]

Previous research has determined that many Front Range communities are planning to reduce use by 1% per year in the coming decade (Figure 4).[12] Savings will be largely realized through incentives to install more advanced and efficient fixtures, indoors and out; stronger water pricing; regulation; and behavioral changes. Based on observed conservation savings over the last decade 1% per year savings is not only achievable, but likely a conservative estimate. Moreover, many of these communities have significantly stronger and more established conservation programs in place than the NISP participants. They are also comparable to NISP participants in location, climate and quality of life. Consequently, a 1% per year reduction in water use is reasonable and in agreement with regional standards and has therefore been used to project more sensible demand requirement for NISP participants in each of the two scenarios below.

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[10] Two recent studies contain examples of widely used demand reduction measures from Colorado and the Western U.S.: The Colorado Water Conservation Board's *Statewide Water Supply Initiative (SWSI) Phase 2 Report* (http://cwcb.state.co.us/IWMD/SWSITechnicalResources/SWSIPhaseIIReport/, viewed on 8/31/2008) and Western Resource Advocates (2008) *Smart Water: A Comparative Study of Urban Water Use Efficiency Across the Southwest* (http://www.westernresourceadvocates.org/media/pdf/SmartWaterBrochure.pdf, viewed on 8/31/2008).

[11] Conservation and efficiency measures per yielded acre foot range from $55 to about $10,000, averaging about a tenth of the cost per acre foot of firm yield from NISP. Demand reduction can be achieved through incremental payments built into utility fee structures without having to finance the large capital costs of major projects like NISP.

[12] Western Resource Advocates. 2007. *Front Range Water Meter: Water Conservation Ratings and Recommendations for 13 Colorado Communities.* 2260 Baseline Road Suite 200, Boulder, CO 80302. http://www.westernresourceadvocates.org/watermeter/WaterMeterReport.pdf, viewed on 8/31/2008.

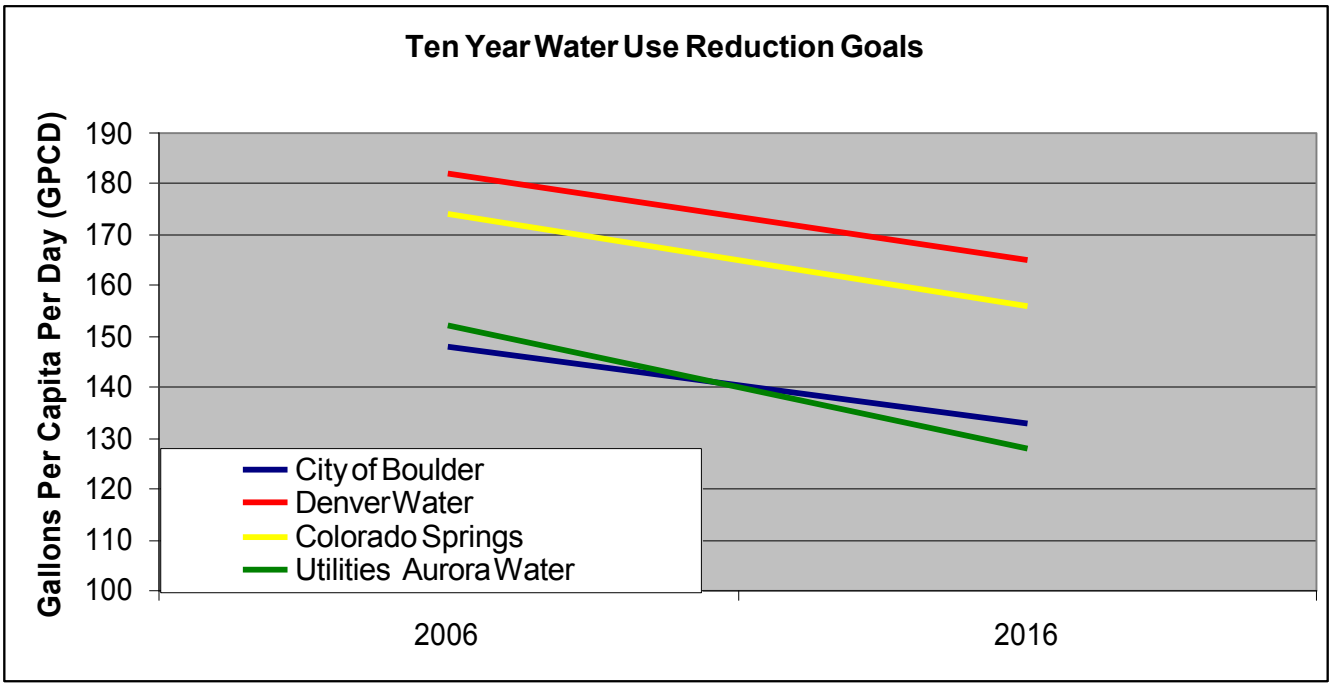

Figure 4. Ten year goals for reduction in system wide water use by various Front Range Water providers.

Our scenarios follow:

Scenario 1: In addition to the modified population projections above, scenario 1 assumes that integration of conservation and efficiency measures would lead to a 1% per year reduction in use, up to a total of 10%. For example, Fort Morgan, which in 2003 had a per capita demand of 233, would set a goal of reaching 210 GPCD system-wide. This demand-reduction figure would then be used to determine long term demand using the following formula.

$$\frac{\text{GPCD X POPULATION X 365days/year}}{\text{325,851Gallons/AF}} = \text{AF of Demand per year}$$

A 10% system-wide loss is added on top of the demand figure to yield TOTAL DEMAND.

Scenario 2: Using the 2003 use figures as a baseline, a higher level of conservation and efficiency is applied. This scenario assumes a 1% per year reduction, up to 20%. Fort Morgan, for example, which had a 2003 per capita demand of 233, would have a goal of reaching 184 GPCD, system-wide. This new GPCD figure would then be used to determine long term demand using the above formula. Again, a 10% system-wide loss is added on top of the calculated demand figure.

The result is a more refined and noticeably lower demand requirement to meet the needs of the NISP participants without sacrificing quality of life.

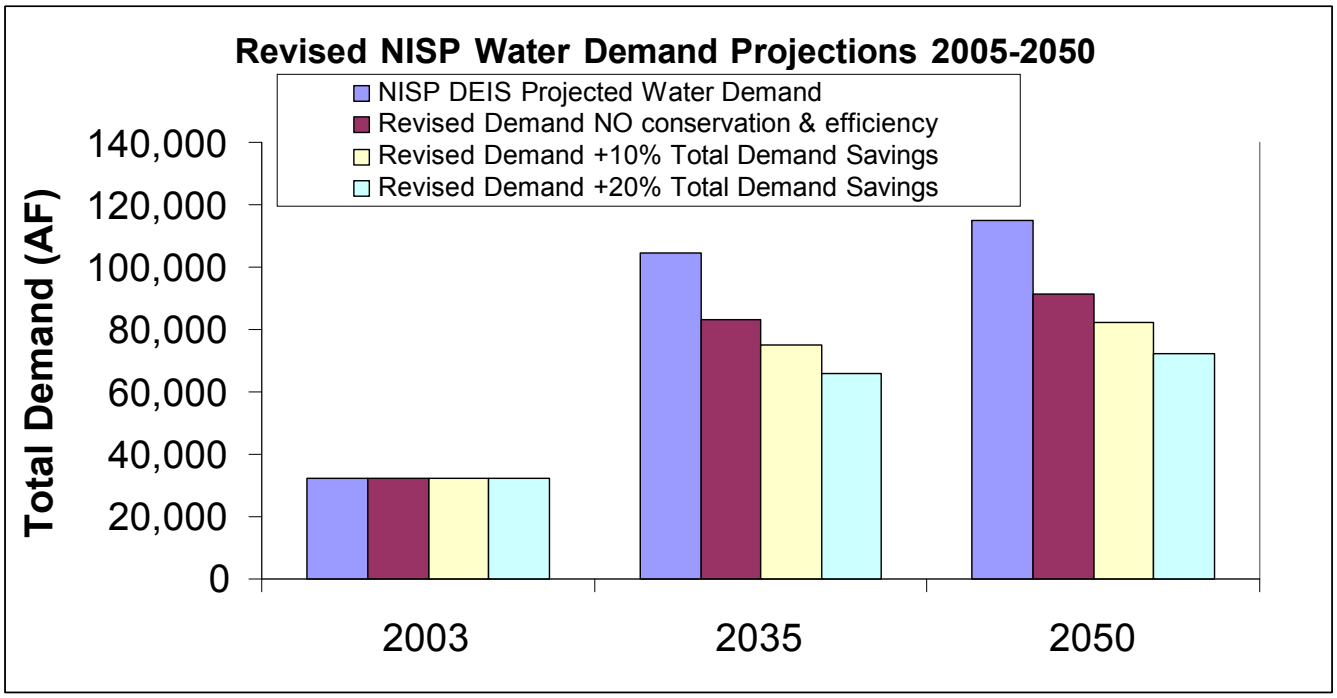

Figure 5. Revised NISP participants firm supply projections based on straightforward, achievable conservation and efficiency measures implemented over time to reduce demand.

According to the DEIS, Table1-2, current firm yield of NISP participants is 50KAF, projected to increase to more than 115,000 AF in 2050, which is 25,000 AF greater than the NISP proposed firm yield. Future demand, under the more conservative scenario 1 is projected to increase to nearly 85,000 AF annually, leaving 35,000 AF in additional water requirements above existing supply (Figure 5).

In summary, through conservative, realizable demand management scenarios the NISP participants will save themselves the cost to acquire, treat, deliver, and manage 30,000 AF of water. In the section that follows we show two recommendations for how to meet their projected water needs that won't require draining the Cache la Poudre River of any further water.

Alternative Water Supply Options

We evaluated three alternative water supply sources for the NISP participants. These supplies are "alternative" only in the sense that they do not require new water diversions from the Poudre River, building major debt-financed facilities, or relocating existing water diversions to new locations upstream. These alternative water sources utilize existing means practiced by water utilities around Colorado and the West.

After presenting potential sources for new water, we critique the NISP DEIS no-action alternative and present two possible scenarios for water supplies that meet the NISP participants' needs.

Development-Displaced Water

The NISP participants have developed major plans to expand their boundaries and dry up irrigated lands within their new growth boundaries. According to the 2002 U.S. Census of Agriculture conducted by the Department of Agriculture, and the Natural Resource Conservation Service (NRCS) National Resources Inventory (NRI), irrigated lands in the NISP participants region comprise 63-67% of the land onto which the participants intend to expand (Figure 6).

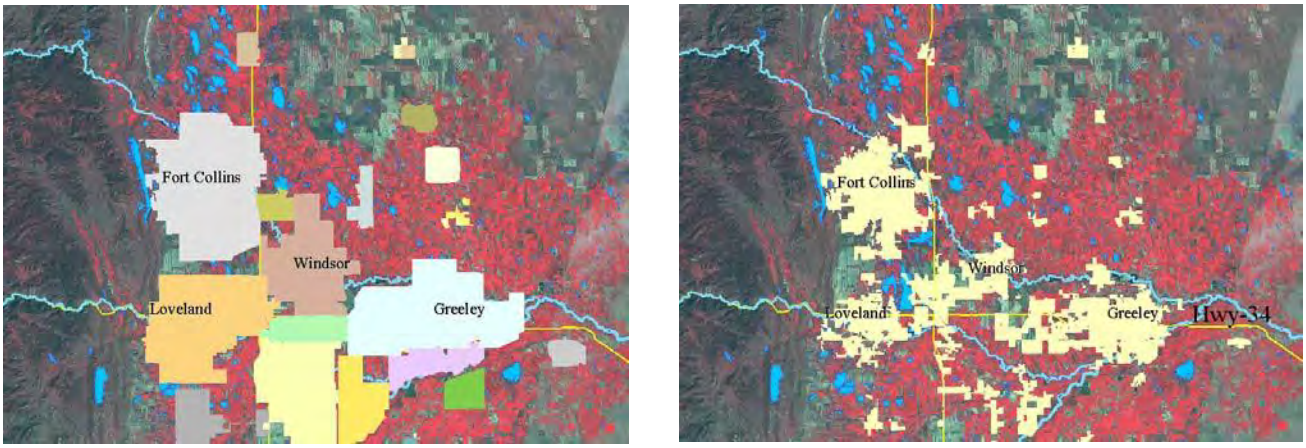

Figure 6. Projected development buildout in the Northern part of the NISP participant region by 2035 (left) compared with development in 2007 (right). The bright red circles and rectangles in the images are irrigated agricultural lands. Source: Northern Colorado Water Conservancy District.

Careful water use would allow them to use the water from these formerly irrigated lands to supply their needs. But the NISP DEIS does not address this critical source of supply. Why not?

If there is to be an open and honest discussion about helping agriculture and providing sources of water supply for the exurban expansion of the NISP participants, water supply projections must include irrigation water tied to lands developed within the NISP participants' annexations. This discussion must also include the measures that the participants are taking and, in most cases, not taking, to reduce their water supply requirements and therefore reduce the need to dry up irrigated land for municipal and industrial (M&I) development.

Based on the NISP DEIS population projections, we estimate the participant towns and water districts would occupy a developed land "footprint" or about 126,000 acres, which would be about 76,000 acres more land than they occupied in 2005 under the revised population growth scenario above. Irrigated agriculture occupies about 48,000 acres of that new land that would be developed,[13] on which about 33,300 AF of water is used for irrigation and should be available for M&I uses.[14, 15, 16]

It appears that nearly all of the water that would be provided by the NISP project would be available from the displacement of irrigation water off of newly developed lands.

Rotational Fallowing Agreements

Rotating Fallow Agreements are contracts between municipal and agricultural water uses whereby municipalities pay irrigators to regularly fallow some of their fields in return for contract payments equal to or exceeding the value the water would yield if used to irrigate crops. It has been successfully applied at large scales in California and other parts of the West.

Some advantages of rotating fallow agreements include but are not limited to:

- Provide financial stability to irrigators who are routinely affected by fluctuating crop prices.
- Irrigators remain in operation while M&I uses a portion of agricultural water supplies.

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[13] 76,000 acres x 63% (average proportion of ag land in irrigated agriculture) = about 48,000 acres of irrigated land.
[14] U.S. Department of Agriculture Census of Agriculture. http://www.agcensus.usda.gov/
[15] U.S. Department of Agriculture National Agricultural Statistics Service. http://www.nass.usda.gov/
[16] Broner, I. and J. Schneekloth. 2003. *Seasonal Water Needs and Opportunities for Limited Irrigation for Colorado Crops.* Extension Bulletin 4.718, Colorado State University Extension Service, Fort Collins, Colorado.

- Irrigators use cropland fallow intervals to rest cropland, benefitting soils and improving crop yields, while allowing for irrigation infrastructure improvements and critical maintenance operations that improve system efficiency.
- M&I users and irrigators establish long-term economic linkages that benefit the community and the region.
- Irrigators may choose to retire lands that are difficult to irrigate or suffer from soil salinity, compaction, erosion, declining crop yields, or other issues.

The NISP DEIS alternatives analysis features a rotating fallow agreement scenario that we believe artificially inflated implementation costs while creating a contracting scenario of unrealistic complexity.[20] The scenario required purchasing 103,000 AF of water and then leasing back 91,000 AF to irrigators, yielding 12,000 AF, only 10% of the purchased volume.

A recent survey of South Platte basin irrigators found that that 63% of interviewed farmers would be willing to participate in a rotational land fallowing program, if compensated adequately with a mode for compensation estimates of $400/ acre-foot.[17]

The four largest ditch operators in the Poudre River system are the North Poudre Canal, Larimer County Canal, Larimer & Weld Irrigation Canal, and the New Cache la Poudre Co. Ditch (aka Greeley No. 2). About 55% of the native and imported water in the river,[18] or 226,092 AF, is diverted by these ditches.[19] Rotating fallow agreements with just these four companies have the potential to yield at least 22,600 AF of water, assuming 50% consumptive use and fallowing intervals of once every five years. This represents just a small portion of the opportunities for rotating fallow agreements in the Poudre River, Big Thompson, Little Thompson, St. Vrain, and South Platte watersheds, when combined.

Alternative Water Supply Scenarios

The NISP DEIS conducted an alternatives analysis that sought to identify possible sources of water supply for the project.[20] The alternatives analysis set an arbitrary 30% threshold figure for the firm yield supply, whereby an alternative would be required to provide a minimum of 30% of the proposed 40,000 AF firm yield in order to be included in the project. The alternatives analysis provided no substantive basis for using a firm yield cutoff threshold value. We eliminate the threshold in this analysis in order to provide greater flexibility for lower cost supply options, in conjunction with the revised demand value, having corrected for errors in the population forecasts and per capita water use figures adjusted for cost-effective conservation measures. Based on the analysis presented in the above section on population growth and demand management, we assume that demand can be reduced by 5,000 AF from 40,000 AF to 35,000 AF, well within the range of reasonable reductions.

In our analysis, we first look at the NISP DEIS No Action Alternative (NAA), assuming that the NISP participants would purchase and transfer existing agricultural water rights and C-BT shares if NISP was not built. The primary changes to what is found in the DEIS will be to reduce the demand forecast from 40,000 AF to 35,000 AF in accordance with our revised estimates to assume that phase the purchase and development of agricultural rights and C-BT shares in accordance with their needs or that they will lease water back to irrigators

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[17] James Pritchett, Jennifer Thorvaldson, Neil Hansen, Ajay Jha. 2008. Water Leasing: Opportunities and Challenges for Colorado's South Platte Basin. Presented at WAEA Annual Meeting, June 26th, 2008, Big Sky, Montana. http://www.kysq.org/Lease.pdf, viewed on 8/31/2008.

[18] We use the word *native* to identify water that originates in the Cache la Poudre River Watershed. More than a hundred thousand acre feet of water is *imported* into the watershed from the Laramie River (via the Laramie River Tunnel), The Michigan River (Via the Michigan Ditch), and the Colorado River (via the Grand Ditch). Most of the *imported* water is diverted from the river for irrigation and M&I uses near the mouth of the Poudre River Canyon.

[19] NISP DEIS p. 3-11.

[20] HDR Engineering 2007. NISP Alternatives Analysis.

until needed, either of which will reduce the cost to the participants.[21] We then reexamine the assumptions of the NAA to incorporate modified estimates of what storage will actually be required by agricultural transfers and by what C-BT shares might yield and, finally, we incorporate rotational fallowing along with agricultural transfers and C-BT purchases.

These scenarios assume no changes in existing points of diversion, or that points of diversion are moved to the furthest possible point downstream to improve flows.

Re-evaluating the Cost of the NISP DEIS No Action Alternative

The basis for costing the NAA is Table 2.5 (DEIS, page 2-44). The NAA assumes: 1) individual participant acquisition of water *as needed over time* in response to growing demand for urban water; 2) that such supplies will be broadly available and are not dependent on a small number of select canals; and 3) that, with the exceptions of the Eastern Group and Ft. Lupton, every acre foot (AF) of purchased agricultural water will require an acre-foot of storage (an assumption we will examine below).[22] The table proposes (or implies) that the needed water would be provided by acquisition of 58,400 AF of agricultural water rights (to provide 29,200 AF of firm yield, i.e., a consumptive use estimate of 50 percent) and 21,600 units of C-BT (each share providing 0.5 AF of yield).[23]

According to Table 2.5, the DEIS assumes that the cost of acquiring the agricultural water will be $6,000 per acre-foot (of which 50 percent will be available for transfer) and that an acre-foot of storage will cost $4,000,[24] and that C-BT shares will be $11,000.

For purposes of assessing the effect of phasing on costs we will use the same assumptions that Charles Howe employed in his DEIS comments.[21] We assume that: 1) the water will be acquired in four equal increments of 8,750 AF; 2) the shares will be purchased at 10 year intervals, starting now; and 3) the ratio of agricultural shares to C-BT shares will be that of Table 2.5. Based on these assumptions, each increment, undiscounted, will cost $173.9 million. With all of these assumptions in place we estimate the present value of costs assuming inflation free discount rates of 4%, 5%, and 6%. The results appear in Table 2 below.

Table 2. Present Value (PV) of the NISP No Action Alternative, assuming need of 35,000 AF by 2050 and staging of development.

	Discount Rate, 4%	Discount Rate, 5%	Discount Rate, 6%
PV, 1st Increment	$173.9 million	$173.9 million	$173.9 million
PV, 2nd Increment	$117.5million	$106.7 million	$97.1 million
PV, 3rd Increment	$79.3 million	$65.6 million	$54.2 million
PV, 4th Increment	$53.6 million	$40.1 million	$30.3 million
TOTAL	$424.3 million	$386.3 million	$355.5 million

[21] For a fuller discussion of phasing and its impact on costs see Charles W. Howe letter to Chandler Peter, June 11, 2008.

[22] According to Table 2-5, the Eastern Group will only need 6,200 AF of storage of 9,800 AF of purchased agricultural rights and Ft. Lupton will need 3,000 AF of storage for 6,000 AF of purchased agricultural water rights.

[23] The 0.5 acre-foot figure seems very conservative since a quota of 0.5 is the lowest ever imposed by NCWCD and is typically imposed in wet years when outdoor water demands will be low.

[24] The NISP DEIS grossly underestimates the availability of alternative storage on the Poudre River and South Platte basins. Storage capacity is widely available in existing reservoirs and gravel pits, to the extent that there is a widely known and well-established cost for existing storage of $4,000/AF (Source – *Aggregates Manager* Magazine, June 2006). For a recent analysis of available storage, see Don W. Deere, P.E., Colby J. Hayden, P.E., and Glen G. Church, P.E. 2007. *Gravel Pit Reservoirs: Colorado's Water Storage Solution.* pp. 158-173 in Wiltshire, R.L., Parekh, M.L., and Gross, C.M. (editors), GEO-Volution: The Evolution of Colorado's Geological and Geotechnical Engineering Practice (Proceedings of the 2006 Biennial Geotechnical Seminar, Nov. 10, 2006, Denver, CO; Sponsored by The Geotechnical Group of the Colorado Section of ASCE, Rocky Mountain Section of the Association of Environmental and Engineering Geologists; and Colorado Association of Geotechnical Engineers). Reston, VA: ASCE / Geo Institute, 978-0-7844-0890-2, 2007, 215 pp., Geotechnical Practice Publication No. 4 (Barcode: RMI MK31592).

These costs are well below the costs of over $800 million for the NAA offered in the DEIS.

We believe these costs provide a good starting point for examining alternatives that will meet NISP participant needs and, at the same time, not further degrade the already stressed Cache la Poudre River.

Option 1: an Alternative with Modified Assumptions about Storage Needed for Agricultural Transfers and the Value of C-BT Shares

The DEIS assumes that agricultural water transfers generally provide 0.5 AF of transferrable water for every acre-foot purchased, but that the storage requirement is, as described above, equivalent to the AF purchased. It is true that agricultural water rights are usually limited to the months from May through October,[25] so that providing water for year-round urban need does require storage, but we challenge the need as assumed in the DEIS, i.e., one unit of storage for every unit of purchased water. We believe that the storage requirement should be adjusted both for the consumptive use component of the water that can be transferred and for the pattern of use. Urban demand follows a seasonal variation in which between 70% and 75% is used in the months from May through October and 25% to 30% from November through April.[26, 27] Between the consumptive use correction and the need to store water for winter use we assume that the storage requirement can be reduced by 60% of that which appears in Table 2-5 of the DEIS (i.e., from 51,800 AF to 21,000 AF) and by an additional 2,880 AF to account for the reduced future demand from 40,000 AF to 35,000 AF, leading to a storage requirement estimate of 18,120 AF.

The need for C-BT shares in the NAA is based on an assumed "quota" of 0.5 AF/unit/year to establish a "firm" yield. The latter figure seems unduly conservative to us since a quota of 0.5 is the lowest ever imposed by the NCWCD and is imposed in wet years when outdoor water demands are low. The long-term average share value is 0.7 and we think it is the more proper figure to use. The C-BT system has substantial storage and with this in mind we believe that "conservative assumption" about share value ignores this as well as the decision process used by the NCWCD to set a share value. We use 0.7 in this second alternative and based on this assumption approximately 13,500 shares would be needed to provide 9,450 AF of yield.

The first ten year increment of costs for this alternative would now be $138.8 million and the subsequent incremental costs would be discounted as they were above. The results, again assuming discount rates of 4%, 5%, and 6%, are shown in Table 3.

Table 3. Option 1: Present Value (PV) of Costs Assuming Need of 35,000 AF, Staging of Development, Reduced Storage Needs, and Higher C-BT Share Value. Dollar figures are in millions.

	No Discount	Discount Rate, 4%	Discount Rate, 5%	Discount Rate, 6%
PV, 1st Increment	$ 131.9	$ 131.9	$ 131.9	$ 131.9
PV, 2nd Increment	$ 131.9	$ 89.1	$ 80.9	$ 73.7
PV, 3rd Increment	$ 131.9	$ 60.2	$ 49.7	$ 41.1
PV, 4th Increment	$ 131.9	$ 40.7	$ 30.5	$ 23.0
TOTAL	$ 527.6	$ 321.9	$ 293.0	$ 269.7

These cost estimates represent a substantial reduction from the cost of the NISP DEIS proposed action alternative.

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[25] U.S. Geological Survey, National Water Information System. Stream flow data from station 06752260, Cache la Poudre River at Fort Collins, CO. http://waterdata.usgs.gov/co/nwis/uv/?site_no=06752260&PARAmeter_cd=00065,00060, viewed on 8/31/2008.

[26] Western Resource Advocates. 2007. *Front Range Water Meter: Water Conservation Ratings and Recommendations for 13 Colorado Communities.*

[27] City of Fort Collins. 2007. *Water Conservation Plan.* http://www.ci.fort-collins.co.us/water/pdf/conservation-plan-20071004.pdf, viewed on 9/10/2008.

Option 2: An Alternative that Incorporates Rotational Fallowing with Agricultural Transfers and C-BT Shares

For purposes of this alternative we assume that rotational fallowing can supply slightly more than a third of our estimate of demand or 12,000 AF/year and that two thirds (or 8,000 AF) of this will supplant the agricultural transfers component of our above alternatives and one-third the C-BT component. In other words, to meet a demand of 35,000 AF of demand, 12,000 AF will come from rotational fallowing, 15,800 AF from agricultural transfers, and 7,200 AF from C-BT shares (not unreasonable for C-BT, given the flexibility of share purchases).

Assuming that the fallowing will come with a storage requirement comparable to agricultural transfers, the storage will be increased from 18,120 AF to approximately 21,600 AF. Regarding costs of rotational water, we assume that the basic cost (i.e., compensation to irrigators) is $400/ acre-foot, that additional administrative costs will be 25% or $100/AF and that the present value of the time stream of costs ($500/year/acre-foot) is approximately (depending on the discount rate) $5,000/acre-foot. With these assumptions the first increment of costs is $112.3 million. With this as the incremental cost, the discounted present value for this alternative, again for three discount rates, is in Table 4.

Table 4. Option 2: Present Value (PV) of Costs Assuming Need of 35,000 AF, Staging of Development, Reduced Storage Needs, Higher C-BT Share Value, and Agricultural Fallowing.

	No Discount	Discount Rate, 4%	Discount Rate, 5%	Discount Rate, 6%
PV, 1st Increment	$ 112.3	$ 112.3	$ 112.3	$ 112.3
PV, 2nd Increment	$ 112.3	$ 75.8	$ 68.9	$ 62.7
PV, 3rd Increment	$ 112.3	$ 51.2	$ 42.3	$ 35.7
PV, 4th Increment	$ 112.3	$ 34.6	$ 26.0	$ 19.6
TOTAL	$ 449.2	$ 273.9	$ 249.5	$ 229.6

The introduction of rotational fallowing, given the cost assumptions we have made, leads to another alternative cost reduction.

Revised Cost Estimates for the NISP DEIS Action Alternatives

In their analysis of the cost projections for the NISP project,[28] Western Resource Advocates found that the NISP DEIS and technical reports did not include more than $350 million in costs associated with the project. These costs include: (a) construction costs inflation linked to the spike in energy and raw materials prices, (b) funds needed to renovate existing drinking water and wastewater treatment facilities affected by the project, and (c) finance costs not included in the project costs, discussed below.

Energy/Cement/Steel Price Inflation Impacts NISP

The construction cost estimates in the NISP DEIS and technical reports are based on reports from 2003 to 2006, before the recent spike in construction materials and energy prices. Since that time, price inflation for critical construction cost line items such as diesel fuel, cement, and steel have risen nearly 100%, leading to dramatically rising construction costs for major projects like reservoirs. Since 2006, major construction projects in Colorado have run over predicted budgets by 30 to 50%.[29, 30, 31] In their analysis of the NISP project costs,[28] Western Resource Advocates applied inflation indices used by the Corps of Engineers to previous costs

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[28] Western Resource Advocates. 2008. *Revised Construction Cost Estimates for the NISP Project.* 2260 Baseline Road, Suite 200, Boulder, CO 80302.

[29] Elkhead Reservoir construction costs increased by 50% from $20 million to $30 million. Source: Colorado River Water Conservation District, Elkhead Reservoir Enlargement Project website, http://www.crwcd.org/page_28, viewed August 31, 2008.

[30] FasTracks in Denver is expected to cost $1.8 billion more, a 30% increase. Source: *Fastbacks Price Tag Jumps.* Denver Post, August 21, 2008. http://www.denverpost.com/breakingnews/ci_10259704, viewed August 31 2008.

[31] Costs for the Lake Powell Pipeline escalated 22% between 2005 and 2008.

estimates done by the project proponents, finding that construction costs are likely to be at least $77 million (18%) higher than the DEIS estimate.

Renovations to Existing Drinking Water and Sewage Treatment Facilities

The City of Fort Collins reported in their summary of comments on the NISP DEIS that the city would incur additional costs of $75-125 million to upgrade water treatment facilities in order to meet post-NISP discharge permit conditions.[32] If the proposed pipeline is built between the existing Horsetooth Reservoir and the proposed Glade Reservoir, $50-90 million in additional costs to upgrade potable water treatment facilities would be required. Additional yearly operating costs of at least $3 million would be incurred. This represents a total cost burden (in 2008 dollars) to the City of Fort Collins of $125 - $215 million.

Several other utilities would be affected by the NISP project, but have not published estimates of the financial impacts of the NISP project would have on their facilities or operating costs. These include the Eastern Larimer County Water District and the Fort Collins-Loveland Water Districts, which use water from Horsetooth Reservoir, and the Boxelder Sanitation District and sewage treatment facilities for Timnath, Severance, Windsor, and Greeley, all of whom discharge treated sewage into the Poudre River and draw from the Poudre River for drinking water supplies.

Project Financing Costs

The NISP Master Financing Plan recommends that the Participants finance the NISP project using a combination of cash payments, revenue bonds, and a guaranteed loan from the Colorado Water Conservation Board's revolving loan fund.[33] Using the scenarios recommended in the plan, we project the financing costs to be $140 – $260 million (in present value).

Total Revised Cost for NISP

Tables 5 and 6 show the revised cost estimate for the NISP project based on the above analyses:

Table 5. Comparison of total costs (not discounted) of NISP, including financing costs, under the Draft EIS estimate and two revised estimates. Dollar figures are in millions. Financing assumes a down payment of $85,200,000 (20% of the Draft EIS cost projection), a 30 year term, and 4.45% bond rate. The third row includes cost of upgrades to the Fort Collins water and sewage treatment facilities, which range from $125,000,000 to $215,000,000.

Cost Category	Construction Costs	Financing Costs	Total Cost
Draft EIS Estimate	$ 426	$ 220	$ 646
Revised Construction Costs Estimate	$ 503	$ 269	$ 772
Revised Construction Costs + Upgraded Treatment Plants	$ 628-718	$ 350-408	$ 978-1,126

[32] City of Fort Collins. Agenda item #24 summary for September 2, 2008 City Council Meeting. http://citydocs.fcgov.com/?cmd=convert&vid=72&docid=1303915, viewed on 8/29/2008.

[33] Red Oak Consulting. November, 2006. NISP Master Financing Plan Final Report, prepared for the Northern Colorado Water Conservancy District.

Table 6. Comparison of total costs (discounted into 2008 dollars) of NISP, including financing costs, under the Draft EIS estimate and two revised estimates. All costs are in millions of dollars. Financing assumes a down payment of $85,200,000 (20% of the Draft EIS cost projection), a 30 year term, and 4.45% bond rate. The financing costs are discounted into present value (2008 dollars) based on a 5% discount rate. With a higher bond rate, financing costs will be more substantial.

Discount Rate	4%	5%	6%	Financing Costs	Total Cost assuming 5% discount rate
NPV - DEIS Estimate	$ 331	$ 311	$ 293	$ 140	$ 451
NPV - Revised Construction Costs, No Treatment Plant Upgrades	$ 390	$ 367	$ 346	$ 172	$ 539
Revised Construction Costs + Upgraded Treatment Plants	$ 493-567	$ 465-536	$ 440-507	$ 223-260	$ 688-796

Based on a total non-discounted project cost of $978 - $1,126 million, the cost per acre foot would be $24,450–28,150, at the upper end nearly three times that described in the NISP DEIS. The total discounted cost at 5% would be $688 – $796 million, or $17,200 – $19,900 per acre foot.

We wish to emphasize that these revised estimates are conservative. They are based on the low end of the range of bond interest and inflation rate figures that will likely apply to NISP if it is built. For example, cost overruns like those seen in other recent projects, which were 2.5 to 4 times higher than the Corps of Engineers inflation indices, would drive construction costs far higher than even these revised estimates. Higher revenue bond interest rates (possibly up to 5.5%) would drive financing costs higher. Either of these contingencies, either separately or combined, would drive the total project cost well over $1 billion.

Cost for the Healthy Rivers Alternative

We estimate the demand reduction measures will cost the NISP participants $28-92 million, based on the range of conservation and efficiency costs from the Colorado Statewide Water Supply Initiative (SWSI), Phase II report.[34] The actual costs would depend on the measures best suited for each NISP participant. Based on the preceding analysis, we estimate the non-discounted cost for the Healthy Rivers Alternative to be $449 - $528 million, or $11,225 - $13,200 per acre foot. Discounted costs would be $250 - $393 million, or $6,250 - $9,825 per acre foot.

Comparing NISP with the Healthy Rivers Alternative

The NISP DEIS projected devastating consequences for agriculture if the document's action alternatives were not enacted. Our own analysis and that of other expert reviewers indicates that the DEIS analysis was faulty, transparently flawed and subject to major revision.[35] Here is a summary of the problems in the analysis:

- Total agricultural lands impacted by the no-action alternative were artificially inflated upwards by the use of faulty calculations and incorrect equation factors. As a result the document proposed agricultural impacts from the no-action alternative that were more than twice what is likely.

[34] http://cwcb.state.co.us/NR/rdonlyres/C65D6406-3EE0-4E44-9C5E-E1655D814CB8/0/S2_ConservationEfficiency.pdf, viewed on 8/31/2008.

[35] Save The Poudre Coalition. 2008. *A Review of the Likely Agricultural Impacts from the Northern Integrated Supply Project.* http://www.SaveThePoudre.org.

- The action alternatives received a cursory analysis that did not include issues that affect tens of thousands of farmland. For example, diverting and storing the Grey Mountain Right (which is the last remaining peak flows left in the river) would harm hundreds of irrigators in the Lower Poudre and South Platte watersheds who depend on the Grey Mountain Right for well augmentation. The Grey Mountain Right is likely diverted for irrigation from the South Platte in Colorado and Nebraska, drying up at least 13,000 irrigated acres if NISP went forward.

- Thousands of acres of cropland served by the South Platte Water Conservation Project would likely become saline, and existing crops could require up to 60% more irrigation water just to maintain current yields because of the salinity of South Platte River water.

- The DEIS used a blatantly faulty method to estimate the farmland irrigation-associated wetlands affected by the no-action alternative, providing an estimate of wetlands affected (1,384 acres) that is probably at least ten times too large. It downplayed the poor habitat value of most irrigation-associated wetlands, while virtually ignoring most riparian-associated wetlands along the Poudre River.

- The DEIS failed to document the agricultural lands displaced by the expansion of the NISP participants, estimate at about 76,000 acres between now and 2050.

Our analysis of the NISP project impacts on irrigated agriculture suggest that the NISP no action alternatives would impact about the same amount of irrigated land as would the action alternatives. Table 7 indicates that all of the NISP project alternatives would affect roughly the same amount of irrigated land. The complexity of water use and water law in Colorado, and the high degree of demand in all sectors means that the Grey Mountain Right and virtually all other water that originates in the Poudre River basin is currently diverted and used either in the Poudre River or downstream on the South Platte.

The proponents of the NISP project are simply squeezing the water supply balloon — they claim NISP reduces pressure on Ag water supplies in the Poudre River basin, but in reality it increases pressure on irrigators drawing water from the South Platte River. And it places even greater pressure on South Platte Basin irrigators drawing from wells, who rely increasingly on the Grey Mountain right and existing flows in the Poudre for their well augmentation. We did not estimate those impacts, but including them would drive the NISP impacts on agriculture even higher.

We would also like to point out that the exurban expansion plans of the NISP participants may be the least agriculture-friendly aspect of this project. Whether they seek water supplies from NISP, the Healthy Rivers Alternative, or some other means, their expansion plans will lead to developing about 76,000 acres of agricultural land, of which about 48,000 is currently irrigated. This would free up about 60,000 AF of water supply for the participants.

The Healthy Rivers Option 2 offers the greatest potential to reduce the impact on agriculture. Adopting comprehensive conservation and efficiency measures and implementing rotating fallow agreements with farmers reduces demand for agricultural water transfers, while providing a reliable income stream to irrigators. Adopting very modest conservation measures to reduce water demand by 20% in 2050 would require 8,500 AF less water for the NISP participants in addition to the savings already in the Healthy Rivers Alternative. Doubling the proportion of their supply from rotating fallow agreements would require 12,000 AF less from agricultural water transfers.

Table 7. Summary of NISP DEIS irrigated cropland loss estimates compared with the Healthy Rivers Alternative.

Irrigated Agriculture	Irrigated Acreage Lost	Dryland Acreage Lost	Total Ag Acres Impacted
NISP DEIS No Action Alternative			
Ag Water Transfers	20.938	-	20.938
C-BT Transfers	6,563	-	6,563
total	**27,501**	-	**27,501**
Alternative 2-4 (Action Alternatives)			
Grey Mountain Right Diversion	13,889	-	13,889
Soil Salinity Impacts	1,600	-	1,600
Saline Irrigation Water Impacts	2,400	-	2,400
Reservoir Development	200	3,121 - 6,037	3,321 – 6,237
total	**18,089**	**3,121 - 6,037**	**21,210 – 24,126**
Healthy Rivers Alternative, Option 2[36]			
Ag Water Transfers	10,972	-	10,972
C-BT Transfers	5,000	-	5,000
Rotating Fallow Agreements	-	-	-
total	**15,972**	-	**15,972**

Based on expert reviewer analysis of the NISP DEIS, we offer the following comparison between the Healthy Rivers Alternative Option 2 with the NISP DEIS action alternatives (Table 8).

[36] From Save The Poudre Coalition's analysis of the impacts of NISP on Agriculture, at 1.44 AF/acre, 15,800 AF of water would irrigate about 10,972 acres of land in the Poudre River basin.

Table 8. Summary of impacts of the NISP DEIS action alternatives compared with the Healthy Rivers Option 2.

Impact Category	NISP Action Alternatives	Healthy Rivers Option 2
Water Quality	↓ Regulatory action by the State of Colorado and the Federal Environmental Protection Agency would be likely in order to protect public health and safety.	↔ Maintains the remaining peak flows in the Poudre river, supports restoration of base flows and addition to peak flows, greatly improving water quality and eliminating the need for regulatory actions.
Maintain and Support Agriculture	↓ Lead to the dry up at least 60,000 acres of irrigated land, and lead to increased salinity of irrigated soils in the farmland served by the proposed Galeton Reservoir. Crop yields would drop significantly and at least 6,000 acres of land likely would need to be retired because of salt buildup.	↑ Implementing conservation and efficiency measures though demand-side management while securing water supplies through rotating fallow agreements and development-displaced water reduces pressure for agriculture water transfers and provides a new secure income stream to farmers and ranchers, particular during drought years.
Riparian-associated wetlands	↓↓ Lost river flows would drop the water table, impacting existing cottonwoods and willows. Loss of peak flows would end the process that builds new seedbeds for cottonwoods and willows, leading to long-term decline of the riparian forest.	↔ Retaining peak flows makes river restoration efforts possible and much more likely to succeed.
Irrigation-associated wetlands	↓↓ NISP would dry-up more than 60,000 acres of irrigated farmland, leading to the loss of wetlands associated with the irrigation of those lands. The salinity of South Platte River water used to replace much cleaner Poudre River water would degrade existing irrigation- associated wetlands. Loss of irrigated lands through reduced flows on the South Platte would degrade existing irrigation-associated wetlands.	↔ Implementing water conservation and efficiency measures, and securing water through rotating fallow agreements with farmers will minimize the impacts of irrigated land dry-up. Pursuing aggressive conservation and efficiency measures and rotational fallowing agreements could mean relatively little irrigated land dry-up. Depending on the mix of water supply options the NISP participants choose, agricultural water transfers and purchasing C-BT units from agriculture would impact irrigation-associated wetlands.
Aquatic ecosystem	↓↓ Peak flows are critically important to the Poudre River aquatic ecosystem. Loss of peak flows would lead to a cascade of impacts leading to a likely collapse of the current aquatic ecosystem. River Restoration efforts that would improve the aquatic ecosystem would be much less likely to succeed.	↔ Retaining peak flows maintains the existing aquatic ecosystem and water quality levels, while making river restoration efforts possible and much more likely to succeed.
Riparian ecosystem	↓↓ Peak flows are critically important to the Poudre River riparian ecosystem. Loss of peak flows would lead to a cascade of impacts leading to the long-term, highly visible decline of the riparian ecosystem. River Restoration efforts that would improve the riparian ecosystem would be much less likely to succeed.	↔ Retaining peak flows maintains the existing riparian ecosystem on the river, while making river restoration efforts possible and much more likely to succeed.
Recreation	↓ Loss of peak flows likely to lead to the collapse of the existing aquatic ecosystem due to silt buildup, higher water temperatures, buildup of algae, loss of native plants, and channel constriction. Existing quality trout fishery between the Poudre River Canyon mouth and I-25 would be highly degraded. Whitewater sports downstream of the Poudre River Canyon	↔ Retaining peak flows sustains the existing trout fishery, supports water-based recreation such as kayaking, canoeing, tubing, and supports whitewater parks. Preserving the riparian and aquatic ecosystem will maintain current recreation and support current investments in open space, natural areas, and recreation infrastructure along the river. Successful

Impact Category	NISP Action Alternatives	Healthy Rivers Option 2
	mouth would be limited to a few weeks a year only in wet years. Whitewater parks in Bellvue, LaPorte, Fort Collins, Windsor, Greeley, or other locations downstream of NISP diversion dams would not be possible.	restoration efforts are highly likely to improve recreation substantially.
Total Cost	↑↑ Revised costs for NISP proposed action conservatively estimated at $ 688 - $ 796 million, or $17,200–19,900 per AF (discounted into present value). Estimate likely to rise as other utility districts evaluate NISP impacts on water supply and sewage treatment plant permit requirements. Additional construction cost inflation and revenue bond interest rate increases would raise costs much	↓ Costs conservatively estimated at $265 - $301 million, or $6,626 - $7,516 per AF. Construction cost inflation could raise costs of alternative storage options.
Protect threatened and endangered species	↓ The long-term survival of the Preble's meadow jumping mouse would be placed in jeopardy. Construction of the proposed Glade reservoir jeopardizes Bell's twinpod, a globally-imperiled plant species found only on the hogback at the Glade site and a very few other sites in Colorado.	↔ Helps to maintain existing populations of Preble's meadow jumping mouse. Prevents degradation of habitat for Bell's twinpod. Successful restoration efforts likely to improve existing habitat and may create new habitat for Preble's meadow jumping mouse as well as two threatened plant species found in Colorado (Ute ladies' tresses orchid and Colorado butterfly
Groundwater quality	↓ Removing peak flows will degrade the Poudre River alluvial aquifer, likely lead to reduced water quality, and hamper the efforts of downstream irrigators to continue irrigating from groundwater sources.	↔ Maintaining existing flows sustains existing alluvial aquifer levels and supports downstream irrigators' efforts to continue irrigating using groundwater sources. Successful restoration efforts are highly likely to improve aquifer levels and support well augmentation efforts by downstream irrigators.
Cleanup of superfund site under proposed Glade Reservoir	↓ The trichloroethylene (TCE) plume under the site for the proposed Glade Reservoir forebay would be much more difficult to clean up due to increased groundwater flow pressures from Glade, and water quality in the reservoir would be threatened by TCE contamination via the forebay.	↑ Existing proposed cleanup efforts are much more likely to succeed without groundwater flow pressure from Glade.

LISTING OF DITCHES AND ASSOCIATED IRRIGATED ACREAGE IN NISP PARTICIPANT FPAS

Appendix B - Listing of Ditches and Associated Irrigated Acreage in NISP Participant FPAs

Participant	Ditch Name	Ditch WDID	Acreage
CWCWD	***Total***		**55,618**
	COAL RIDGE DITCH	0200552	434
	LUPTON BOTTOM DITCH	0200812	844
	PLATTEVILLE DITCH	0200813	2,139
	EVANS NO 2 DITCH	0200817	13,832
	MEADOW ISLAND 1 DITCH	0200821	967
	MEADOW ISLAND DITCH	0200822	2,353
	FARMERS INDE PENDENT D,	0200824	6,011
	HEWES COOK DITCH	0200825	3,724
	UNION DITCH	0200828	1,948
	SECTION NO 3 DITCH	0200830	542
	LOWER LATHAM DITCH	0200834	9,494
	HIGHLAND DITCH	0200837	269
	WHIPPLE DITCH	0200871	2
	ABBETT DITCH	0200887	95
	HODGSON DITCH	0200888	175
	BARR LAKE	0203837	3,594
	MILTON RES	0203876	9,007
	LOVELAND GREELEY CANAL	0400532	1
	HIGHLAND DITCH	0500526	8
	LAST CHANCE DITCH	0500589	176
	LOWER BOULDER DITCH	0600538	1
Dacono	***Total***		**3,321**
	BRANTNER DITCH	0200809	691
	WHIPPLE DITCH	0200871	2,292
	BIG DRY CREEK DITCH	0200873	202
	LOWER BOULDER DITCH	0600538	11
	COMMUNITY DITCH	0600564	125
Eaton	***Total***		**2,150**
	LARIMER WELD IRR CANAL	0300919	2,150
Erie	***Total***		**4,887**
	BOULDER WELD CTY DITCH	0600515	1,126
	BOULDER WHITE ROCK DITCH	0600516	3,007
	HOWELL DITCH	0600536	93
	LEGGETT DITCH	0600537	615
	LOWER BOULDER DITCH	0600538	875
	COMMUNITY DITCH	0600564	972
	LEYNER COTTONWOOD DITCH	0600565	595
	S BOULDER CANYON DITCH	0600593	505
	ERIE COAL CR DITCH	0600610	418
	GOODHUE DITCH	0600650	53
	Irrigated Land within Conservation Easement or Open Space		*(3,373)*

Appendix B - Listing of Ditches and Associated Irrigated Acreage in NISP Participant FPAs

Participant	Ditch Name	Ditch WDID	Acreage
Evans	***Total***		***12,417***
	EVANS NO 2 DITCH	0200817	104
	FARMERS INDEPENDENT D	0200824	1,074
	HEWES COOK DITCH	0200825	2,713
	UNION DITCH	0200828	2,417
	SECTION NO 3 DITCH	0200830	662
	LOWER LATHAM DITCH	0200834	661
	MILTON RES	0203876	304
	BIG T PLATTE R DITCH	0400502	689
	EVANSTOWN DITCH	0400517	245
	LOVELAND GREELEY CANAL	0400532	3,548
Firestone	***Total***		***5,418***
	COAL RIDGE DITCH	0200552	1,476
	LUPTON BOTTOM DITCH	0200812	946
	MEADOW ISLAND 1 DITCH	0200821	134
	WHIPPLE DITCH	0200871	36
	HIGHLAND DITCH	0500526	230
	OLIGARCHY DITCH	0500547	320
	LAST CHANCE DITCH	0500589	1,193
	COLE SEEPAGE DITCH	0500942	70
	HIGHLAND S SIDE DITCH	0600532	404
	LOWER BOULDER DITCH	0600538	309
	RURAL DITCH	0600551	299
FCLWD	***Total***		***4,752***
	PLEASANT VALLEY LAKE CNL	0300910	564
	LAKE CANAL DITCH	0300922	1,316
	BOXELDER DITCH	0300926	151
	MAIL CREEK DITCH	0301142	982
	DIXON CANYON RESERVOIR	0303731	124
	WARREN LAKE RES FEED D	0305381	119
	LOUDEN DITCH	0400530	1,497
Fort Lupton	***Total***		***12,895***
	COAL RIDGE DITCH	0200552	99
	FULTON DITCH	0200808	4,464
	BRANTNER DITCH	0200809	2,701
	BRIGHTON DITCH	0200810	917
	LUPTON BOTTOM DITCH	0200812	1,383
	PLATTEVILLE DITCH	0200813	449
	MEADOW ISLAND 1 DITCH	0200821	14
	WHIPPLE DITCH	0200871	469
	SLATE DITCH	0200885	258
	LITTLE BURLINGTON CNL	0200915	1,424
	BARR LAKE	0203837	717
Fort Morgan	***Total***		***3,569***
	RIVERSIDE CANAL	0100503	1,338
	BIJOU CANAL	0100507	992
	FT MORGAN CANAL	0100514	939
	DEUEL SNYDER CANAL	0100517	300

Appendix B - Listing of Ditches and Associated Irrigated Acreage in NISP Participant FPAs

Participant	Ditch Name	Ditch WDID	Acreage
Frederick	***Total***		***4,338***
	COAL RIDGE DITCH	0200552	13
	WHIPPLE DITCH	0200871	417
	OLIGARCHY DITCH	0500547	54
	COFFIN DAVIS DRY CR DIVR	0500831	7
	BOULDER WELD CTY DITCH	0600515	1,091
	BOULDER WHITE ROCK DITCH	0600516	10
	DELEHANT DITCH	0600523	95
	GODDING DAILEY PLUMB D	0600527	202
	HIGHLAND S SIDE DITCH	0600532	253
	HOUCK 2 DITCH	0600534	10
	LEGGETT DITCH	0600537	28
	LOWER BOULDER DITCH	0600538	1,864
	RURAL DITCH	0600551	151
	SMITH EMMONS DITCH	0600553	226
	COMMUNITY DITCH	0600564	55
	ERIE COAL CR DITCH	0600610	55
	Irrigated Land within Conservation Easement or Open Space		*(194)*
Lafayette	***Total***		***1,128***
	LOWER BOULDER DITCH	0600538	20
	LEYNER COTTONWOOD DITCH	0600565	435
	DAVIDSON DITCH	0600567	76
	DRY CREEK DAVIDSON DITCH	0600569	262
	MARSHALVILLE DITCH	0600585	3
	MCGINN DITCH	0600586	249
	S BOULDER CANON DITCH	0600593	336
	HARRIS DITCH	0600611	35
	KERR DITCH NO 2	0600613	10
	T N WILLIS DITCH	0600622	61
	GOODHUE DITCH	0600650	646
	Irrigated Land within Conservation Easement or Open Space		*(1,003)*

Appendix B - Listing of Ditches and Associated Irrigated Acreage in NISP Participant FPAs

Participant	Ditch Name	Ditch WDID	Acreage
LHWD	***Total***		***6,823***
	SWEDE DITCH	0500529	1,491
	CLOUGH PRIVATE DITCH	0500536	2
	WEBSTER MCCASLIN DITCH	0500537	130
	TRUE WEBSTER DITCH	0500538	15
	JAMES DITCH	0500539	502
	DAVIS DOWNING DITCH	0500542	257
	CHAPMAN MCCASLIN DITCH	0500546	18
	OLIGARCHY DITCH	0500547	189
	RUNYAN DITCH	0500549	36
	RENNER DITCH	0500555	19
	NELSON DITCH	0500556	17
	BONUS DITCH	0500563	283
	LAKE DITCH	0500564	683
	HALDI DITCH	0500565	338
	CROCKER DITCH	0500568	657
	TABLE MOUNTAIN DITCH	0500569	750
	BADER DITCH 1 & 2	0500570	121
	JOHNSON DITCH	0500571	226
	STAR DITCH	0500572	353
	HOLLAND DITCH	0500574	1,027
	UPPER BALDWIN DITCH	0500583	29
	LOWER BALDWIN DITCH	0500584	60
	JOHN RICE DITCH	0500588	83
	ZWECK TURNER DITCH	0500601	4
	LEFT HAND DITCH	0500603	1,292
	TOLL GATE DITCH	0500648	276
	COFFIN DAVIS DRY CR DIVR	0500831	51
	BOULDER LEFT HAND DITCH	0600513	1,419
	BOULDER WHITE ROCK DITCH	0600516	2,066
	FARMERS DITCH	0600525	23
	GODDING DAILEY PLUMB D	0600527	384
	LEGGETT DITCH	0600537	2,393
	LOWER BOULDER DITCH	0600538	107
	COMMUNITY DITCH	0600564	146
	LEYNER COTTONWOOD DITCH	0600565	256
	DRY CREEK DAVIDSON DITCH	0600569	228
	MARSHALVILLE DITCH	0600585	36
	MCGINN DITCH	0600586	99
	Irrigated Land within Conservation Easement or Open Space		*(9,243)*

Appendix B - Listing of Ditches and Associated Irrigated Acreage in NISP Participant FPAs

Participant	Ditch Name	Ditch WDID	Acreage
MCQWD	***Total***		***80,474***
	RIVERSIDE CANAL	0100503	16,498
	BIJOU CANAL	0100507	22,901
	WELDON VALLEY DITCH	0100511	8,462
	FT MORGAN CANAL	0100514	8,865
	UPPER PLATTE BEAVER CNL	0100515	9,770
	DEUEL SNYDER CANAL	0100517	1,243
	LOWER PLATTE BEAVER D	0100518	10,155
	TREMONT DITCH	0100519	1,024
	GILL STEVENS DITCH	0100520	528
	SNYDER DITCH	0100523	637
	TROWELL DITCH	0100524	228
	JOHNSON EDWARDS DITCH	0100526	82
	JACKSON LAKE RESERVOIR	0103817	82
Severance	***Total***		***13,238***
	LARIMER COUNTY DITCH	0300911	5,627
	LARIMER WELD IRR CANAL	0300919	6,957
	LAKE CANAL DITCH	0300922	5
	NORTH POUDRE CANAL	0300994	648
Windsor	***Total***		***14.609***
	LARIMER COUNTY DITCH	0300911	1,943
	LARIMER WELD IRR CANAL	0300919	2,808
	LAKE CANAL DITCH	0300922	2,747
	BOXELDER DITCH	0300926	445
	NEW CACHE LA POUDRE CO D	0300929	2,046
	WHITNEY IRR DITCH	0300930	1,941
	B H EATON DITCH	0300931	225
	WILLIAM R JONES DITCH	0300932	74
	WINDSOR LAKE	0303770	205
	WARREN LAKE RES FEED D	0305381	29
	LOUDEN DITCH	0400530	334
	LOVELAND GREELEY CANAL	0400532	1,813
Grand Total			**225,639**

Acreage is area of irrigated land within NISP Municipal Participant FPA or NISP Water District Participant Boundary (excluding Municipal Participant FPAs)

Ditches with irrigated area less than one acre in the FPA or boundary were not reported in this table

Groundwater only acreage not included in acreage

HDR (2008A) MEMORANDUM: ALTERNATIVE AGRICULTURAL TRANSFERS – ROTATIONAL LAND FALLOWING REVISED CONCEPT EVALUATION. APRIL 30, 2008.

Northern Integrated Supply Project
MEMORANDUM
Alternative Agricultural Transfers – Rotational Land Fallowing
Revised Concept Evaluation
April 30, 2008

The concept of rotational land fallowing as a source of water supply for the proposed Northern Integrated Supply Project (NISP) was previously evaluated in Appendix F of the NISP EIS Alternatives Evaluation Report (HDR 2007a). The original rotational land fallowing proposal for NISP was initially formulated in November 2005 and described in terms of developing a partial supply and preserving agriculture. At the time, the concept was relatively new in Colorado and little published documentation was available. As proposed, the NISP concept involved a purchase-and-leaseback-with-rotating-fallow approach. This would give NISP, specifically the Northern Colorado Water Conservancy District (NCWCD) acting on behalf of the project Participants, control over the supply of water and would guarantee that the NISP firm yields demands could be met each year.

In order to meet the Project's requirement for a viable water supply concept, the proposed rotational land fallowing would need to produce 12,000 AF per year of firm yield. Based on historical headgate diversion data for canals associated with the Larimer-Weld Irrigation Company and the New Cache la Poudre Irrigation Company, it was estimated that approximately 103,000 AF of water was being used to irrigate crops that could potentially be fallowed (e.g., annual row crops and vegetables). Transferable consumptive use (CU) was computed as about 57,000 AF, of which 12,000 AF would be used to meet NISP firm yield demands. The remaining water would be leased back to the original owners in such a way as to ensure that the 46,000 AF of non-consumptive water was released back to the Poudre River consistent with historical return flow patterns. Fallowed land would be rotated in a three- or four-year cycle.

The analysis documented in Appendix F resulted in the following conclusion:

> *The EIS team concludes that a reasonable and manageable rotating fallow program cannot be developed for NISP. By extension, we also conclude that a partial firm supply for NISP cannot be developed through agriculture-to-municipal transfers while at the same time keeping the agricultural land from which the water is taken in production. This holds true even if the agricultural production is reduced from historical levels. Ultimately, the partial supply, preserve agriculture scenario is highly likely to fail the timeliness and firm yield screening criteria for the EIS.*

One of the shortcomings of this purchase-and-leaseback rotational land fallowing concept is its cost. It would require the NCWCD to purchase and transfer through water court 103,000 AF of agricultural water. In effect, and depending on the frequency of fallowing, the NCWCD would have to purchase 3 to 4 times the volume of firm yield needed in any single year. Equivalently stated, the NCWCD would have to acquire 3 to 4 times the volume they would be required to purchase under a traditional "buy-and-dry" agricultural transfer. Further, in leasing "excess" water back to irrigators in non-fallowed years, the NCWCD would likely receive relatively low lease payments from irrigation users.

Since the initial analysis for the NISP EIS, there has been an emerging interest in lease-type water transfers that allow irrigators/ditch company shareholders to maintain ownership of their water rights. This is associated with a strong desire to maintain robust economies in rural/agricultural communities, particularly on the plains of eastern Colorado.

To this end, the Colorado General Assembly passed House Bill 06-1124, which granted water court judges the authority to adjudicate "Rotational Crop Management Contracts" and assigned administrative duties to the State Engineer. The State Engineer may also approve temporary operation of such a contract. Field-scale studies of rotational land fallowing along the Lower South Platte River are presently being conducted jointly by the Parker Water and Sanitation District (Parker) and Colorado State University (CSU) (Lytle et al. 2008).

Between June 2006 and November 2007, the Lower Arkansas Valley Water Conservancy District (LAVWCD), examined the engineering and economic feasibility of a rotational land fallowing-water leasing program in the Lower Arkansas Valley. The premise of the proposed program is that a "Super Ditch" company would be formed to collectively represent the interests and manage the assets of seven participating ditch companies. The program is summarized by HDR (2007b) as follows:

> A rotational land fallowing program involves removing irrigated parcels from production on a periodic basis, once every three or four years for example, and transferring the associated water to an economically higher-valued use, such as municipal use. The intent of the rotating, or periodic, basis is to maintain the long-term production from agricultural land and minimize adverse regional impacts to rural communities. The adverse regional, or third party, impacts resulting from the historic rural to urban water transfers of the "buy and dry" variety are coming under increasing criticism for accelerating the demise of Eastern Colorado's rural communities. By annually rotating the impact across the region and across the involved ditch companies, it is hoped that the farm economy stays more or less "as is" and that the lease revenues generate much needed financial infusions into the local agricultural economy, resulting in an overall beneficial impact.
>
> In return for helping to provide this beneficial economic impact, municipalities will gain access to reliable water supplies on a long-term basis, at a market-based price. In addition, a water supply made available through rotational land fallowing likely represents the least environmentally damaging alternative for providing additional municipal water supply to the Colorado Front Range.

Several key factors differentiate the Lower Ark proposal from the original NISP concept:

- Under the Lower Ark proposal, irrigators maintain ownership of their water rights, with water made available to municipalities and other non-agricultural users through leases. Leases are anticipated to be approximately 40 years in duration, with possibilities of extensions.

- Water court proceedings are required under either alternative in order to change the allowable uses for the water supply. However, the Lower Ark proposal eliminates the need for large up-front municipal capital expenditures to acquire the water rights.
- The creation of an entity such as the Super Ditch company provides a means for the irrigators to control the program from their side, rather than having a special district or conglomeration of municipal interests managing a large-scale project that is ultimately leasing more water back to agriculture than is required to meet the municipal demands. In the example of the NISP concept, the project, NCWCD, or some other entity would be providing 12,000 AF of CU water to municipal users and managing the leaseback and/or re-operation of the remaining 91,000 AF (including both CU and non-CU water). This would likely create an administrative nightmare compared to the benefit received. Furthermore, as municipal demands increase over time, the irrigators may be restricted by reduced quantities of leaseback water, whether or not they were prepared to reduce crop production.

At this time, it is believed that opportunities may exist for developing a rotational land fallowing-water leasing program in northern Colorado analogous to that proposed in the Lower Ark. A recent news article in the *Pueblo Chieftain* (Woodka 2008) summarized a recent survey of South Platte River irrigators conducted by CSU agricultural economist James Pritchett. That article, which says that 63 percent of interviewed farmers would be willing to participate in such a rotational land fallowing program, if compensated adequately, is provided as an attachment to this memorandum.

Potential for Rotational Fallowing in Northeast Colorado

If the Lower Ark model was applied to northern Colorado, there are at least five potential areas where a Super Ditch-type concept may work:

- Cache la Poudre Basin (District 3)
- Big Thompson Basin (District 4)
- St. Vrain Basin (District 5)
- Lower South Platte, Greeley to Balzac (District 1)
- Lower South Platte, Balzac to Julesburg (District 64)

For the purposes of the present analysis, District 64 will be ignored, as this is the locale of the Parker/CSU study sites near Sterling.

For a rotational land fallowing-water leasing program to be successful, it is important to encourage the participation of the larger ditch companies in a particular region. This helps to create a much larger pool of available water supply and farmland that can be fallowed. In the Lower Ark analysis, the seven ditch companies evaluated diverted an average of nearly 600,000 AF over the 1950-2004 period. The amount of water available for leasing is then decreased by a series of multiplication factors:

- Consumptive use (typically in the range of 45-60 percent)
- Shareholder participation (assumed to be 65 percent for Lower Ark)

- Fallowing rate (assumed to be 25 percent for Lower Ark, equivalent to a 1-in-4 year rotation)

River exchange capacities, water quality, delivery points, and other factors also impact the amount of water that is ultimately available for leasing to non-agricultural users.
The following table presents the top eight ditches in the Poudre Basin, in terms of average annual diversions.

Major Irrigation Diversions from the Poudre River, 1950-2004[1]

Ditch	SEO Structure ID Number	Average Annual Diversion [AF]	Dry-Year Diversion [AF]
Larimer & Weld Irrigation Canal	919	76,322	21,815
Larimer County Canal	911	71,641	32,444
New Cache la Poudre Co. Ditch (aka Greeley No. 2)	929	47,168	19,510
Munroe Gravity Canal (aka North Poudre Supply Canal)[2]	905	33,967	19,957
North Poudre Canal	994	30,961	2,819
Canal No. 3 (aka Greeley No. 3)	934	19,003	10,880
Poudre Valley Canal	907	15,993	397
Ogilvy Ditch	937	15,842	8,912
TOTAL	--	310,897	116,734

[1]Based on CDSS HydroBase diversion records.
[2]The period of record for the Munroe Canal is WY 1954-2004.

In reality, several of these ditches may be precluded from participating due to considerable municipal ownership at the present time. The Munroe Gravity Canal and North Poudre Canal are owned by the North Poudre Irrigation Company. According to SPDSS (2005a),

> Currently, 70 percent of NPIC stock is owned by municipalities and individual municipal water districts including the towns of Fort Collins, Greeley, Ault, Nunn, Eaton, Windsor, and Severance and the Tri-Districts rural domestic water suppliers for Fort Collins – Loveland Water District, East Larimer County Water District, and North Weld County Water District. Of the remaining 30 percent, approximately 14 percent is owned by farmers irrigating cash crops and 16 percent is owned by ranchette farmers or "hobby farmers." Hobby farmers are those farmers owning a minimum of 5 acres, who typically use their land to raise horses and grow pasture grass for grazing. The goal of the Board of Directors for NPIC is to preserve a core agriculture component to NPIC as development in the area continues to expand.

The City of Thornton owns 283.354 out of 600 shares, or 47.2 percent, of the Water Supply and Storage Company (WSSC), which owns the Larimer County Canal (SPDSS 2005b). The City of Greeley "uses water from Canal No. 3 for non-potable uses in the northern and eastern portions of its service area" (SPDSS 2005c).

Nonetheless, for the present example, it will be assumed that the eight largest ditches in the Poudre Basin divert an average of 311,000 AF per year. Applying the Lower Ark multiplication factors would result in the following:

311,000 AF * 0.50 (CU factor) * 0.65 (shareholder participation factor) * 0.25 (fallowing rate) = 25,269 AF (initial estimate of water available for leasing)

While the volume of water potentially available for leasing is drastically reduced from the raw headgate diversions, it is by no means insignificant. Similar analyses could be performed for the major ditches in the Big Thompson, St. Vrain, and Lower South Platte (District 64) Basins.

Concerns Regarding Rotational Fallowing and NISP

At the present time, there is a growing desire to pursue alternative agricultural transfers such as rotational land fallowing as a means to provide water supply for municipalities and other non-agricultural users. However, whether this concept has evolved to the point that it can be a viable source of water supply for NISP is highly uncertain. A successful rotational land fallowing-water leasing program is going to require the creation of an irrigator-initiated managing/coordinating entity such as the Super Ditch proposed for the Lower Ark program.

The Statewide Water Supply Initiative (SWSI) report (CWCB/CDM 2004), projects that an additional 409,700 AF of water will be needed by the year 2030 in just the South Platte Basin. The proposed 40,000 AF firm yield demand for NISP represents less than 10 percent of the future basin-wide demand. Therefore, it appears that there may be many opportunities to pursue a rotational land fallowing-water leasing program as an independent project, as is being done in the Lower Ark.

After further review and consideration of new information, the rotational land fallowing-water leasing concept was determined not to be a feasible water supply for NISP. As described below, at least one and as many as three of the screening criteria established for water supply concepts in the NISP EIS Alternatives Evaluation Report (HDR 2007a) are violated.

- **Firm yield** – The firm yield screening criterion simply requires that viable water supply sources must be capable of providing a fixed (firm) amount of water yield *for every unit of time*. Based on information currently available, it is not possible to guarantee that lease water will be available to NISP in perpetuity. Lease terms of 40 years were suggested for the proposed Lower Ark program, which is consistent with the duration of most Federal water supply contracts. However, the fact that the irrigators and ditch companies maintain ownership of the water rights increases the uncertainty associated with future leasing arrangements when compared to traditional "buy-and-dry" transfers in which a municipality gains full control of its use of the former irrigation water. Of particular concern is what happens in year 41 and beyond, a generation or two removed from the present. The potential exists that, at that time, competing users may be able to pay more money for the leased water than the NISP Participants can or are willing to pay. Such a situation would leave the NCWCD, as representative of the NISP Participants, searching for new water supplies to meet firm yield demands in an era when finding those supplies is likely to be even more complicated than it is now.

Additionally, the threshold requirement for NISP is that viable water supply concepts must provide at least 30 percent, or 12,000 AF, of the 40,000 AF firm yield demand. The rough estimate of yield available for leasing in the Poudre Basin is about 25,250 AF, based on the math illustrated above. However, this water is only *potentially* available for leasing, and does not yet account for exchange potential, water quality considerations, or other factors which may further reduce the volume of water available for leasing. In addition, several of the larger ditches in the Poudre example (e.g., North Poudre, Munroe, Larimer County Canal, and Canal No. 3) are already subject to significant municipal ownership. From Table 1 in Appendix F, the 22 largest ditches in the Poudre Basin divert an average of 407,000 AF. That means, after the top eight, the next 14 ditches add only about 100,000 AF to the total diversions. If a number of the very large ditches are excluded from a rotational land fallowing-water leasing program, a greater number of increasingly smaller ditches would need to participate to make up the required yield.

- **Unproven technology** – There is an emerging preference for alternative agricultural transfers in Colorado, alternatives to traditional "buy-and-dry" transfers. House Bill 06-1124 granted authority to adjudicate and administer "Rotational Crop Management Contracts." Parker and CSU are evaluating rotational land fallowing through field-scale studies. The LAVWCD has evaluated the engineering and economic feasibility of a rotational land fallowing-water leasing program in the Lower Arkansas Basin. Negotiations in pursuit of establishing the Super Ditch company are ongoing. But to date, no large-scale programs have been tested and/or implemented in Colorado. As a result, the technology has not yet progressed to the point that it could be successfully applied to a regional water supply project with the certainty needed by NCWCD and the Participants for NISP to provide a reliable firm yield of 40,000 AF.
- **Timeliness** – A rotational land fallowing program for northern Colorado is only just now beginning to take shape, and it is highly unlikely that a *permanent* functioning program will be in place in the near-term time frame required for NISP. Over a year and a half was spent on the Lower Ark feasibility study. If funding can be secured, the proposed next step in the project is an application to the water court for approval of a temporary rotational fallowing program, to be implemented on a trial basis. In 2005, hundreds of wells along the lower South Platte River were shutdown for failure to meet the requirements of "temporary" augmentation plans that had been approved annually for over 20 years. As a consequence, it is not anticipated that any temporary rotational land fallowing program in the Lower Ark would be approved for an extended period of time. Assuming the trial program succeeds, subsequent steps toward a permanent program would likely involve a water court case to change the use of the water rights, and, if history can serve as a guide, such a large-scale transfer case may linger in court for many years. Thornton's transfer of WSSC shares, for example, took a decade or more to complete. At this point, it is simply not possible to reliably estimate the timeframe for implementing a permanent rotational land fallowing-water leasing program in northern Colorado.

Although alternative agricultural transfers such as rotational land fallowing may not be feasible for incorporation into NISP, there is great potential to apply such programs to meet other water demands in the South Platte Basin.

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