EVOLUTION OF TRANSMOUNTAIN WATER DIVERSIONS IN COLORADO

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ABSTRACT

Trans-basin water diversions exist all along Colorado's Front Range, constructed to provide increased reliability of water supplies. Subsequent experience with water yields has pointed out the advantages of trans-basin diversions both in firm yields and in the ability to repeatedly utilize imported water to exhaustion.

Four river systems (Rio Grande, Arkansas, Platte, and Colorado) originate within Colorado. The first three of these rivers receive trans-basin diversion water from the Colorado River basin, with some diversions between adjacent pairs of those basins. Front Range urbanization has been facilitated by the availability of large, reliable water supplies from trans-basin diversions. The relative ease of change-of-use, coupled with the ability to use supplies to exhaustion, have made trans-basin diversion projects prime targets for land developers in search of water supplies. Virtually all of the existing trans-basin projects have seen shifts of first-use yields from commodity-based industries to municipal water supplies. These shifts have been accompanied by changes in seasonal usage patterns, and increases in unit value of the water resource, thus favoring further investment in trans-basin diversion infrastructure to improve both reliability and ease of operation.

Future trends would indicate increased conversion of trans-basin diversions to municipal supply as first use. Further water wars can also be expected as new projects are sought to respond to Front Range municipal thirst. Any improvements to existing projects would likely further physically stabilize the source environment and improve operational characteristics. New proposals for trans-basin diversions will face substantial challenges from compact restrictions and environmental concerns in basins of origin. The net result will be growing economic pressures for change of use and physical improvements to existing trans-basin diversions.

INTRODUCTION

Trans-basin water diversions exist throughout Colorado, but also particularly all along the state's Front Range, from the southern to the northern state lines. Of

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particular interest to this paper are those trans-basin diversions between the largest river basins in the state—where water is rerouted to a different watercourse leaving the state at a different location—referred to as transmountain diversions by the State Engineer. This diverted water is then denoted as imported water in the receiving basin.

The primary objectives for the earliest projects were to provide increased reliability of water supplies. Water developers who arrived somewhat later in the settlement process typically found it necessary to look further into the mountain watersheds to secure adequate and reliable water supplies. Subsequent experience with water yields—especially during drought periods—has pointed out two notable advantages to transmountain diversions: (1) firm yields are not as susceptible to local drought effects as native water diversions; and (2) imported water may be utilized repetitively to exhaust the entire diverted volume.

Four river systems (Rio Grande, Arkansas, Platte, and Colorado) originate within Colorado. For management purposes within Colorado, the Colorado River is further divided into the Yampa, Colorado, Gunnison, and San Juan River basins. The Platte River is further divided into the North Platte and South Platte Rivers. The first three of these rivers receive trans-basin diversion water from the Colorado River basin, with some diversions also occurring between adjacent pairs of those basins. The earliest diversions were typically by open channels traversing high-altitude catchments over mountain passes to serve agricultural or mining projects. More recent diversions have been large-scale multi-purpose projects, typically featuring large-scale carry-over and compensatory storage reservoirs, in both the source areas and basins of importation. Diversion conveyances are typically large-capacity tunnels and penstocks with power generation facilities at discharge ends.

ORIGINAL DECREES

The following analysis was completed for transmountain diversions which are currently in use. Any diversions not reported on the annual Division Engineers' reports (Colorado State Engineer's Office, 1999) have been assumed to be abandoned and no longer in use. Each of the importing basins are addressed individually below. A schematic overview of the nature of the analyzed transmountain diversions between adjacent basins is shown in Figure 1.

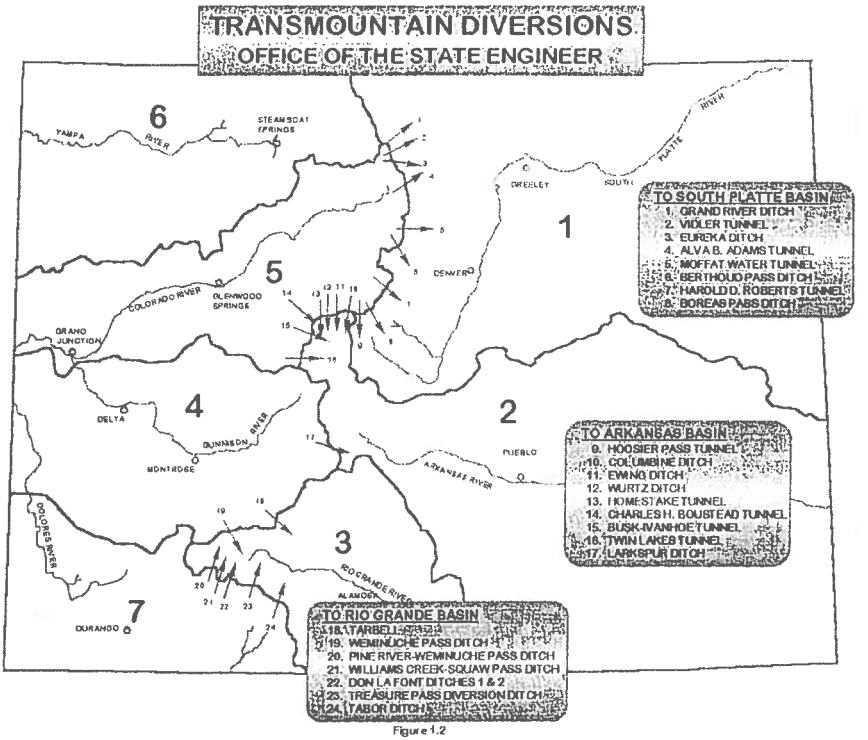

Figure 1 Transmountain Diversions in Colorado (Colorado State Engineer's Office, 2001)

For trend-spotting purposes, the myriad beneficial water uses were simplified into four categories for this analysis: Irrigation, Industrial (including mining), Municipal (including domestic, commercial, and fire), and Habitat (including recreation). A more detailed review of all of the pertinent decrees would likely result in different numerical values, but the trends would be consistent with those shown in this paper.

The South Platte River basin (Division 1) is the recipient of the greatest quantity of imported flow from the widest number of sources. Diversions to the South Platte basin are shown in Table 1. While a majority of the original decreed diversions into this basin were destined for irrigated agriculture, there were also several significant diversions—such as the Moffat and Roberts Tunnels—intended solely for municipal use. The South Platte basin is also the only basin within the state that does not export water to another basin.

Table 1: South Platte Import Diversions

Diversion	Exporting Division	Original Decree Use	Original Decree Quantity (cfs)
Adams Tunnel (CBT)	Colorado	municipal	0
Adams Tunnel (CBT)	Colorado	irrigation	550
Berthoud Pass Ditch	Colorado	irrigation	53
Boreas Pass Ditch	Colorado	irrigation	88
Grand River Ditch	Colorado	irrigation	525
Homestake Tunnel	Colorado	municipal	350
Hoosier Pass Ditch	Colorado	municipal	400
Moffat Tunnel	Colorado	municipal	100
Roberts Tunnel	Colorado	municipal	1000
Straight Creek Tunnel	Colorado	irrigation	10
Vidler Tunnel	Colorado	irrigation	52
Bob Creek Ditch	North Platte	irrigation	60
Cameron Pass Ditch	North Platte	irrigation	28
Columbine Ditch	North Platte	irrigation	20
Deadman Ditch	North Platte	irrigation	275
Laramie-Poudre Tunnel	North Platte	irrigation	442
Michigan Ditch	North Platte	irrigation	146

The Arkansas River basin (Division 2) is also a recipient of significant quantities of imported flow. Diversions to the Arkansas basin are shown in Table 2. Many of the early transmountain diversions were for mining purposes, although the more recent works have been for the benefit of municipal water supplies. A significant project is the Homestake Tunnel which provides carriage for municipal water for the City of Colorado Springs in the Arkansas basin, but also carries flows which are further diverted into the South Platte basin for the City of Aurora.

Table 2: Arkansas Import Diversions

Diversion	Exporting Division	Original Decree Use	Original Decree Quantity (cfs)
Hudson Ditch	Rio Grande	irrigation	1
Medano Ditch	Rio Grande	irrigation	21
Larkspur Ditch	Gunnison	irrigation	10
Boustead Tunnel (Fry-Ark)	Colorado	municipal	1800
Columbine Ditch	Colorado	irrigation	30
Ewing Ditch	Colorado	irrigation	18
Homestake Tunnel	Colorado	municipal	350
Ivanhoe Tunnel	Colorado	irrigation	35
Twin Lakes Tunnel	Colorado	irrigation	100

The Rio Grande River basin (Division 3) primarily received imported flow initially for use in limited agricultural operations. Diversions to the Rio Grande basin are shown in Table 3.

Table 3: Rio Grande Import Diversions

Diversion	Exporting Division	Original Decree Use	Quantity (cfs)
Tabor	Gunnison	irrigation	21
Tarbell	Gunnison	irrigation	25
Don LaFont #1 Ditch	San Juan	irrigation	4
Don LaFont #2 Ditch	San Juan	irrigation	6
Pine River-Weminuche Pass Ditch	San Juan	irrigation	40
Treasure Pass Ditch	San Juan	irrigation	7
Weminuche Pass Ditch	San Juan	irrigation	18
Williams Creek Squaw Pass	San Juan	irrigation	10

The Gunnison River basin (Division 4) received primarily irrigation flows for lands along the Uncompaghre River. Diversions to the Gunnison basin are shown in Table 4.

Table 4: Gunnison Import Diversions

Diversion	Exporting Division	Original Decree Use	Quantity (cfs)
Leon Lake Tunnel/Canal	Colorado	irrigation	54
Carbon Lake Ditch	San Juan	irrigation	30
Mineral Point Ditch	San Juan	irrigation	11
Red Mountain Ditch	San Juan	irrigation	6

The central Colorado River basin (Division 5) originally imported flows from adjacent basins for a variety of purposes, including irrigation, power, and municipal uses. Diversions to the central Colorado basin are shown in Table 5.

Table 5: Colorado Import Diversions

Diversion	Exporting Division	Original Decree Use	Quantity (cfs)
Arkansas Well (Stevens-Leiter)	Arkansas	municipal	2
Divide Creek Highline Feeder	Gunnison	irrigation	50
Fruita Pipeline/Water Works	Gunnison	municipal	0
Redlands Power Canal	Gunnison	industrial	850

Diversion	Exporting Division	Original Decree Use	Quantity (cfs)
Dome Creek Ditch	North Platte	irrigation	5
Sarvis Creek Ditch	North Platte	irrigation	43
Stillwater Ditch	North Platte	irrigation	31

Within Colorado, the North Platte River (a subset of Division 1), Yampa River (Division 6), and San Juan River (Division 7) basins are exporting basins only. Thus there is no analysis of imported flows for these basins in this paper.

CURRENT DECREES

Front Range urbanization has been facilitated by the availability of large, reliable water supplies from trans-basin diversions. The relative ease of change-of-use, coupled with the ability to use supplies to exhaustion, have made trans-basin diversion projects prime targets for land developers in search of water supplies. Virtually all of the existing trans-basin projects have seen significant shifts of first-use yields from commodity-based industries to municipal water supplies. These shifts have been accompanied by changes in seasonal usage patterns, and increases in unit value of the water resource, thus favoring further investment in trans-basin diversion infrastructure to improve both reliability and ease of operation.

Gross changes of decreed use for imported flows among all the basins are shown in Figure 2 and numerically in Table 6. Diversion-specific information is then discussed below; unchanged decrees are not presented in this discussion.

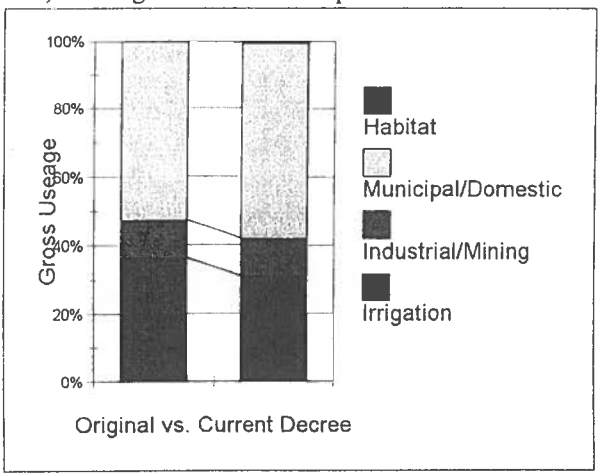

Figure 2 Composition of Use of Transmountain Diversions in Colorado

Table 6: Changes of Use

Use Change	Percentage
Irrigation	-17.1%
Industrial	0.0%
Municipal	8.2%
Habitat	100.0%

The South Platte River basin has experienced the largest population increase of the state's basins, and thus has demonstrated the greatest amount of incentive to change decreed uses toward municipal use. Gross changes in decreed diversions to the South Platte basin are shown in Table 7.

Table 7: South Platte Import Changes

Diversion	Original Use	Current Use	Gross Quantity (cfs)
Straight Creek Tunnel	irrigation	municipal	10
Michigan Ditch	irrigation	municipal	146

The Arkansas River basin has also experienced significant population growth, and is likewise seeing conversion of imported flows to municipal use, as well as conversions to protect environmental and habitat conditions. Changes in decreed diversions to the Arkansas basin are shown in Table 8.

Table 8: Arkansas Import Changes

Diversion	Original Use	Current Use	Gross Quantity (cfs)
Medano Ditch	irrigation	habitat	21
Twin Lakes Tunnel	irrigation	municipal	100

The Rio Grande River basin has not experienced comparable population growth as the Front Range basins (South Platte and Arkansas), but has still seen changes in use of imported flows. The most prominent changes have been from irrigation useage to habitat maintenance for wildlife refuges in the western portion of the Rio Grande River valley, as well as changes to municipal/domestic use within the valley. Changes in decreed diversions to the Rio Grande basin are shown in Table 9.

Table 9: Rio Grande Import Changes

Diversion	Original Use	Current Use	Gross Quantity (cfs)
Tabor	irrigation	municipal	21

Diversion	Original Use	Current Use	Gross Quantity (cfs)
Pine River-Weminuche Pass Ditch	irrigation	municipal	40
Weminuche Pass Ditch	irrigation	habitat	18
Williams Creek Squaw Pass	irrigation	municipal	10

With the Animas-La Plata project not yet constructed, the Gunnison River basin imports have remained largely unchanged. Changes in decreed diversions to the Gunnison basin are shown in Table 10.

Table 10: Gunnison Import Changes

Diversion	Original Use	Current Use	Gross Quantity (cfs)
Mineral Point Ditch	irrigation	habitat	11

The central Colorado River basin has also not experienced significant change in use of imported flows. Changes in decreed diversions to the central Colorado basin are shown in Table 11.

Table 11: Colorado Import Changes

Diversion	Original Use	Current Use	Gross Quantity (cfs)
Dome Creek Ditch	irrigation	municipal	5
Stillwater Ditch	irrigation	municipal	31

FUTURE TRENDS AND INDICATIONS

A case study in the useage conversion of a transmountain diversion, presented separately at this conference, is the Michigan Ditch which brings flows into the Cache la Poudre River within the South Platte basin. Originally permitted for irrigation uses, this facility is now wholly owned and operated by the City of Fort Collins for municipal uses. As with many of the other early transmountain diversions, the Michigan Ditch experienced a period of decreased useage before being revitalized with a new owner and decreed use.

Review of the annual reports show transmountain diversions in every importing basin with indications low or non-existent use. Owners of these diversions may be well-advised to maintain levels of flow through their facilities to establish value for any future change-in-use proceeding. As a corollary, municipal water

suppliers may desire to review these same facilities as potential investments for enhancing or diversifying urban water supplies in that same change-of-use venue.

Future trends would indicate increased conversion of transmountain diversions to municipal supply as first use. Further water wars can also be expected as new projects are sought to respond to Front Range municipal thirst. At the same time, conversion of transmountain diversions to habitat maintenance and wildlife refuge uses may also receive strong public support. Any improvements to existing transmountain diversion projects would likely further physically stabilize the source environment and improve operational characteristics. New proposals for transmountain diversions will face substantial challenges from compact restrictions and environmental concerns in basins of origin (Barry, 2001). The net result will be growing economic pressures for change of use and physical improvements to existing transmountain diversions, as well as growing public debate over the function and use of these diversions.

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