SPDSS Memorandum
Final

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Subject: SPDSS Task 84 – South Platte Alluvial Ground Water Budget Procedures and Results Memo

Date: April 20, 2009

Introduction

This memorandum summarizes the results of Task 84 of the Consumptive Use and Water Budget portion of the South Platte Decision Support System (SPDSS) effort. The objective of this task is as follows:

> *Update the initial average annual basin-wide water budget reports with information developed during Phase 3. Develop annual and monthly water budgets for the two basins in the SPDSS Study Area – South Platte and Laramie – and the areas represented by the South Platte Alluvial ground water model.*

StateWB is a generic water budget model that allows the user to develop a water budget for a wide variety of conditions and available data. For SPDSS, three water budgets and sets of input files were developed; The South Platte River Basin, The Laramie River Basin, and the South Platte Alluvial Ground Water Area. The South Platte Alluvial ground water area within the South Platte River basin is also shown in **Figure 1**. The water budget representing the South Platte Alluvial can only be used as a rough comparison to the SPDSS Alluvial Ground Water model effort because they represent different areas. As discussed in more detail under the Agricultural Consumptive Use section, the Water Budget presented herein estimates total crop consumptive use for structures that divert within the ground water model boundary even if a portion of their acreage lies outside the Ground Water Model area. An example of this is shown in Figure 1; a portion of the irrigated acreage served by South Platte River surface water diversions, originating within the Ground Water Model area, lie outside the Ground Water Model area in Water District 64. Therefore these lands are included in the South Platte Alluvial water budget, but do not reside directly within the Ground Water Model area.

Results

A monthly water budget analysis for the South Platte Alluvial area over the 1950 to 2006 time period was performed using StateWB. A description of each of the analyses components is included below the results. The StateWB analysis solved for the unknown components of the water budget based on the mass balance equation of *Inflows – Outflows = Change in Storage*. These unknown components include the native vegetation consumptive use (outflow component), ungaged surface water inflows, ground water inflows, ground water outflows, and

ground water change in storage. The unknown ground water components may be updated with values derived from the SPDSS Ground Water Model efforts. The average annual results of the water budget analysis are presented below in **Table 1**. **Figure 2** graphically depicts the results of the average annual water budget analysis for the South Platte Alluvial basin. A check of the residual components is presented in the Results section of this memorandum.

Table 1
South Platte Alluvial Ground Water Budget
Average Annual Water Budget Results
(1950 – 2006)
All values in acre-feet

Water Budget Components		South Platte Alluvial Area
Inflows	Imports	781,745
	Precipitation	2,842,900
	Gaged Surface Water Inflows	701,746
	Inflow Total	**4,326,391**
Change in Storage	SW Change in Storage	339
Outflows	Agricultural CU	1,462,530
	M/I CU	137,459
	Livestock CU	2,733
	Reservoir Evap.	190,367
	Surface Water Outflows	418,117
	Exports	23,478
	Outflow Total	**2,234,684**
Unknown 'Residual' Components	Native Veg. CU Winter Sublimation Ungaged Surface Water Inflows Ground Water Inflows Ground Water Outflows GW Change in Storage	2,091,368

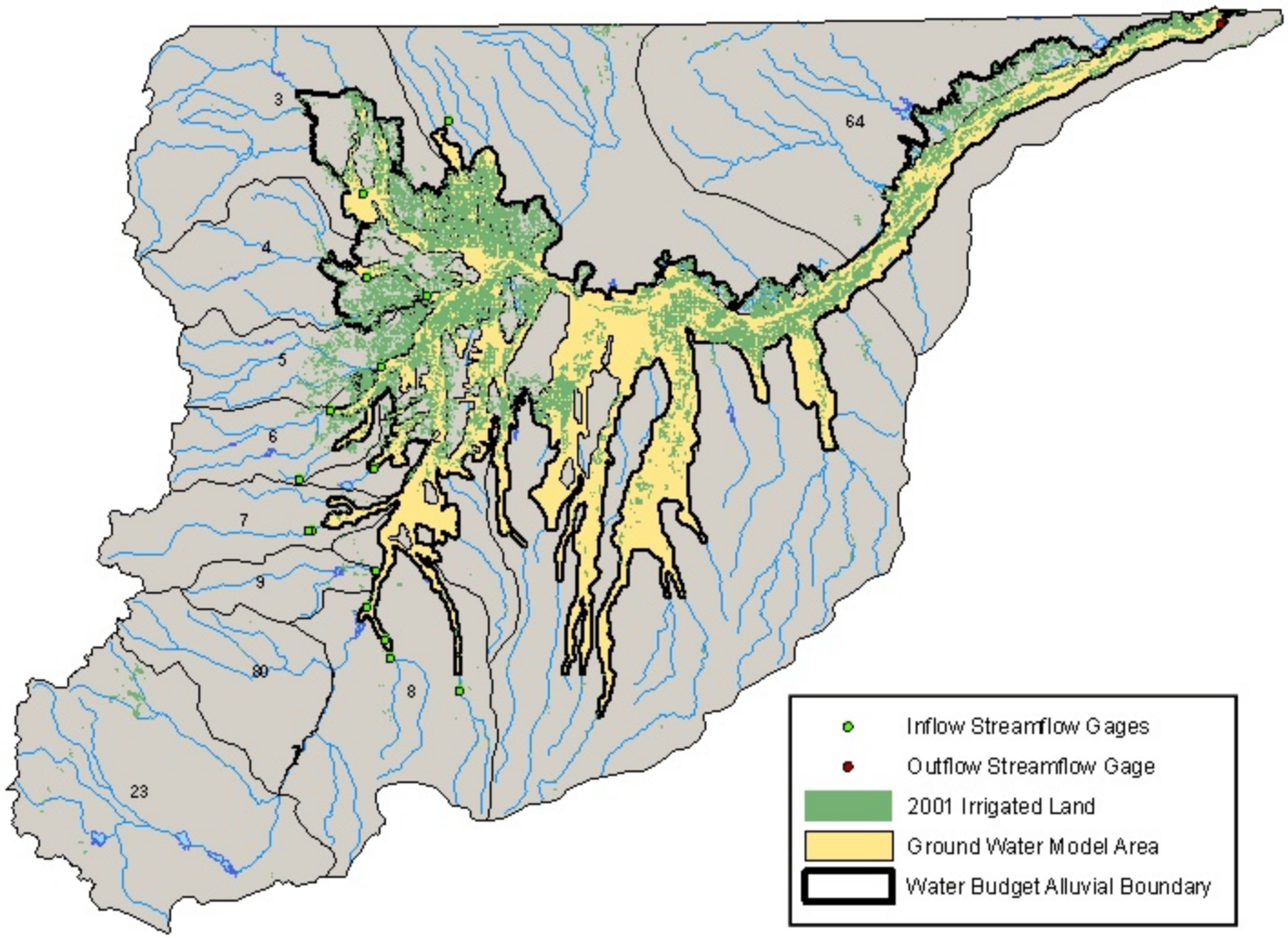
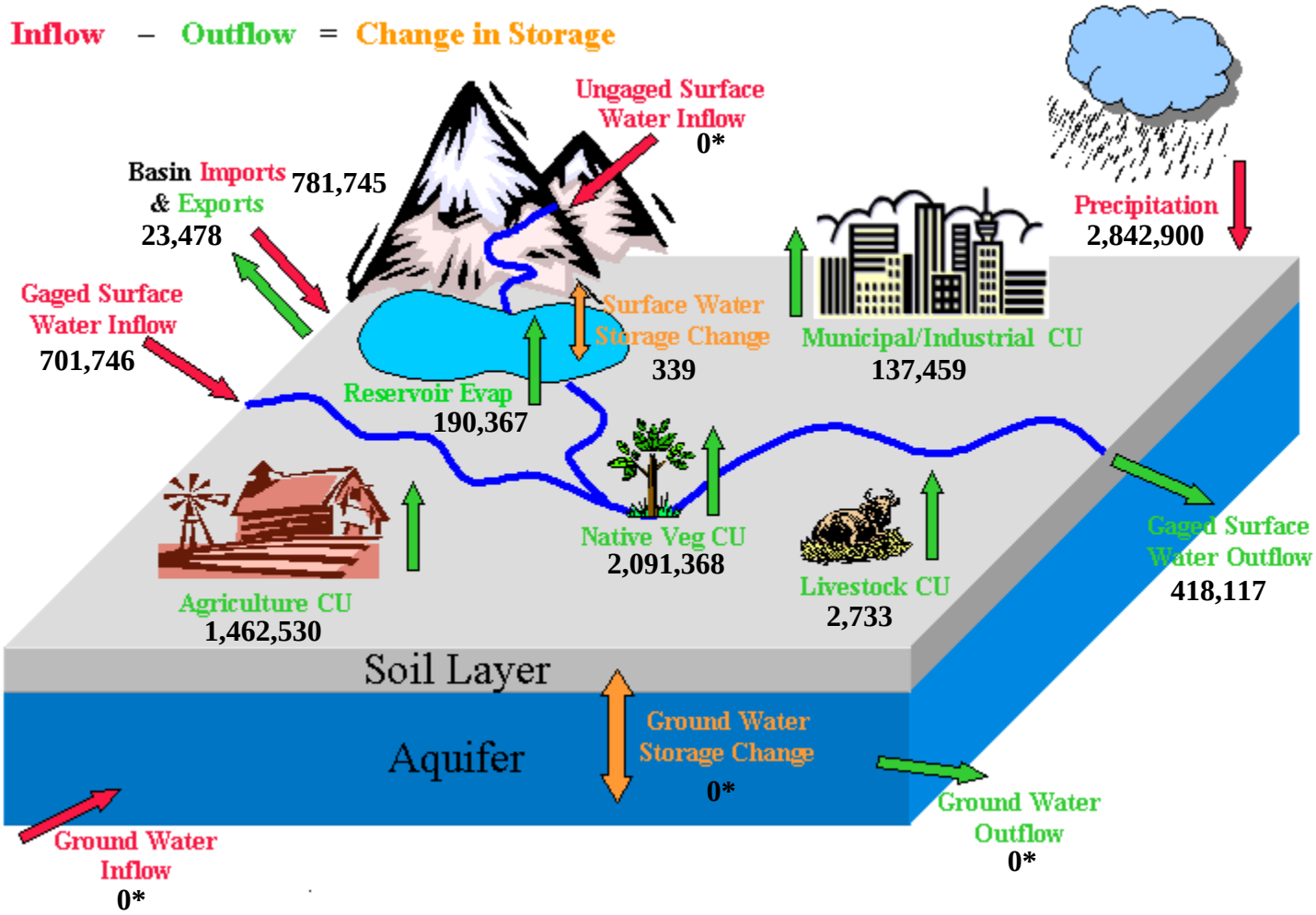


Figure 1 –South Platte Alluvial Boundary



Note: (*) Indicates input data was not provided and estimate is included in the Native Veg CU Residual.

Figure 2 – South Platte Alluvial Average Annual Water Budget Analysis (1950 – 2006)

Background

The overall Water Budget calculation maintains mass balance by assuring that inflows less outflows equal change in storage. The following list summarizes the inflow, outflow, and change in storage components of the water budget model.

Inflow components include:

- Precipitation
- Gaged Surface Water Inflows
- Ungaged Surface Water Inflows
- Imports
- Ground Water Inflows

Outflow components include:

- Agricultural Consumptive Use
- Municipal, Commercial, and Industrial Consumptive Use
- Livestock Consumptive Use
- Reservoir Evaporation
- Native Vegetation Consumptive Use
- Surface Water Outflows
- Exports
- Ground Water Outflows

Changes in Storage include:

- Surface Water Change in Storage
- Ground Water Change in Storage

Approach – Data Collection and Preparation

StateWB reads water budget components in standard StateMod format (*.stm). Most of the water budget components are created by extracting data directly from HydroBase and applying consumptive use factors using the CDSS DMI TSTool. The main exceptions are agricultural (crop) consumptive use and precipitation meeting crop demands (effective precipitation), which are calculated by StateCU and output in standard StateMod format for use by StateWB.

Basin-wide initial water budgets were developed in Task 83 of SPDSS Phase 2 to estimate the current and historical conditions in the SPDSS study area based on an average annual basis. The initial water budgets were expanded in this effort to include analyses carried out in subsequent SPDSS tasks. In addition, a water budget was developed to represent the South Platte Alluvial area. Model inputs were developed under separate individual tasks and documented in technical task memoranda, referenced herein. The approaches and summary tables from supporting SPDSS task memoranda are not repeated fully; however the task memoranda are available on the CDSS website <cdss.state.co.us>.

Monthly estimates for the final water budget components were developed to characterize variable conditions over the hydrology of the SPDSS study period (1950-2006), as discussed below.

Where to find more information

- Additional information on the initial water budget for the South Platte Basin is presented in Task 83 – Prepare Initial Water Budgets.
- A review of published reports regarding South Platte water budget analyses is presented in Task 82 – Review Published Reports on Water Budgets.

Inflows

Precipitation

The total volume of precipitation that falls on the basin is the major inflow component. Missing climate data from key climate stations in the SPDSS study area were filled and the key climate stations were associated with upper and lower elevations (above and below 6,500 feet respectively) of water districts in SPDSS Task 53.3. Orographic adjustments were made to climate stations assigned to an 'Upper' District, or a portion of a water district above 6500 feet. The climate stations were weighted per water districts based on proximity. **Table 2**, at the end of the memorandum, shows the climate stations and associated weights used in the South Platte Alluvial water budget. The average annual precipitation for the South Platte Alluvial area is 2,842,900 acre-feet over the 1950 through 2006 period.

Total monthly weighted precipitation was multiplied by the water district area in the South Platte Alluvial area. The precipitation by water district was summed by basin to provide the precipitation inflows to the South Platte Alluvial basin water budget, as shown in **Table 3** at the end of this memorandum.

Gaged Surface Water Inflows

Gaged surface water inflows to the South Platte Alluvial Water Budget were obtained from streamflow gages on tributaries that enter the ground water model area. The surface water inflow to the ground water model area was created by pulling monthly surface water flow records from HydroBase using TSTool and filling missing data based on the techniques outlined in the SPDSS Task 2 memorandum on streamgages and streamflow records. **Table 4**, at the end of this memorandum, lists the gaged surface water inflows included in the South Platte Alluvial water budget by water district.

Note that key streamflow gages were selected and missing data was filled in Task 2. The Task 2 memorandum identified several gages on tributaries to the South Platte for use in the South Platte Alluvial water budget based on the aquifer boundary provided by the Ground Water Contractor at the time of the task. The ground water boundary has since been revised and therefore, additional streamflow gage selection and filling was required to create the surface water inflow component to aquifer water budget.

Ungaged Surface Water Inflows

Ungaged surface water inflows from significant precipitation events are known to flow into the South Platte Alluvial boundary; however little data exists for support quantifying the inflows. The ungaged surface water inflow component is considered an unknown variable and is included with the native vegetation consumptive use 'residual' component. Ungaged surface water inflows may be provided later based on the SPDSS Ground Water Modeling efforts.

Imports

Imports into the South Platte Alluvial do not represent trans-basin diversions, instead they represent diversions that are removed from rivers above the streamflow gage inflows listed in **Table 4**, but are consumed within the South Platte Alluvial. The 'imports' can be characterized into two types; imports used to meet municipal demands in the ground water boundary and imports used to meet irrigation demands in the ground water boundary. Appendix I of the SPDSS Historic Crop Consumptive Use Analysis Report describes the methodology for developing diversion data for structures included in the crop consumptive use analyses and structures that divert for other purposes (reservoir storage, municipal, industrial, etc). The complete diversion data, formatted in the direct diversion file (SP2008.ddh), is used as the basis for this import data. **Table 5**, at the end of this memorandum, summarizes the imports and average annual diversions into the ground water model.

The following describes each municipal 'import' into the South Platte Alluvial:

- Fort Collins Pipeline (ID 0300906) – Fort Collins municipal demands are largely met by the Ft. Collins Pipeline, which diverts above the Cache la Poudre at Ft. Collins streamflow gage. Demands, and associated consumptive use, are met within the ground water model area.
- Greeley Filters Pipeline (0300908) – The Greeley Filters Pipeline diverts water from the Cache La Poudre River, conveys the municipal water to the Bellevue Treatment Plant, then ultimately to municipal use in the City of Greeley. The Greeley Filters Pipeline diverts above the Cache la Poudre at Ft. Collins streamflow gage, however serves demands and resulting consumptive use in Greeley, which is located within the ground water model boundary.
- Loveland Pipeline (0400511) - The Loveland Pipeline serves as the City of Loveland's major diversion structure from the Big Thompson River. The pipeline diverts above the Big Thompson River at Loveland streamflow gage, however serves municipal demands and resulting consumptive use within the ground water model.
- South Boulder Diversion Canal (ID 0600590) – Denver Water's Northern System diverts trans-basin water delivered through the Moffat Tunnel and native water supplies from outside the ground water boundary to serve approximately 20 percent of Denver Water's demands within the South Platte Alluvial area. South Boulder Diversion Canal diverts from South Boulder Creek and conveys water to Ralston Reservoir and Moffat Treatment Plant.
- Denver Conduit Nos. 20 & 26 (ID 0801002 & 0801017) – Denver Water's Southern System delivers trans-basin water via Robert's Tunnel, mountain reservoir storage releases and native water supplies from outside the ground water boundary to serve 80 percent of Denver Water's demands. Denver Conduit No. 26 diverts from Strontia Springs Reservoir, a regulating reservoir, and delivers raw water to the Foothills WTP.

The Denver Intake Dam is located approximately three miles downstream from Strontia Springs Reservoir on the South Platte River. Water is diverted through the Intake Dam (Conduit No. 8) and conveyed through Denver's Conduit No. 20, an underground pipeline, to Platte Canyon Reservoir and Marston Reservoir for eventual treatment at the Marston WTP. Denver Conduit No. 20 was the primary South System delivery structure, until Strontia Springs was constructed in 1983. Therefore diversions represented in the water budget have zero data for Denver Conduit No. 26 from 1950 to mid-1983, and HydroBase data from mid-1983 on. Denver Conduit No. 20 diversion data is continuous over the study period, although the magnitude of diversions decreases greatly in 1983 when diversions began through Conduit No. 26.

- Aurora Intake Pipeline (ID 0801001) – Located at Strontia Springs Reservoir, the City of Aurora takes delivery of its surface water supplies through the Aurora Intake Pipeline. The surface water supplies originate from outside the ground water boundary, however Aurora's municipal consumptive use occurs within the ground water boundary. The intake pipeline was constructed in the mid-1960's, and therefore the diversions represented in the water budget have zero data from 1950 to 1965, and HydroBase data from 1966 on.
- Diversions for the Cities of Thornton, Westminster and Northglenn – A majority of the Standley Lake Cities' supply is piped from Standley Lake directly to the water treatment plant to serve these cities. The releases to the cities are available on a limited basis, generally from 1995 through 2006, in HydroBase under Standley Lake PL structures (IDs 0200991, 992, 993, 994). There is insufficient data in the records to reasonably create a complete estimate for the 1950 to 2006 study period. Therefore, the municipal demands for the Cities of Thornton, Westminster and Northglenn, as developed in SPDSS Task 66 efforts, are used as an import to the ground water model.
- City of Boulder Return Flows - The City of Boulder's water supply is provided by sources that originate from outside the ground water model boundary. Likewise, the municipal consumptive use occurs outside the ground water model boundary. The return flows from the 75th Street Wastewater Plant are released back to Boulder Creek within the ground water model area. These releases are not seen in the Boulder Creek at North 75th Street near Boulder inflow gage, therefore the municipal return flows from the wastewater treatment plant are included as an import to the South Platte Alluvial water budget. The municipal demand and consumptive use estimates for Boulder were developed in SPDSS Task 66.2. The difference between Boulder's indoor demands and consumptive use are imported into the model.

Ground Water Inflows

Although ground water inflow estimates were developed in the Task 83 initial water budgets, the estimates were not incorporated into the final water budget analyses. Very little data exists to support the estimates, and monthly values were difficult to determine from the annual estimates. The ground water inflow component is considered an unknown variable and is included with the native vegetation consumptive use 'residual' component. Ground water inflow estimates may be provided later based on the SPDSS Ground Water Modeling efforts.

Where to find more information

- Additional information regarding climate station assignment and orographic adjustments to precipitation data is presented in Task 53.3 - Assign Key Climate Information to Irrigated Acreage and Reservoirs.
- Additional information regarding the selection of key streamflow gages, streamflow data filling techniques, and the original selection of ground water model streamflow gages is presented in Task 2 - Identify Key Streamflow Gages and Estimate Streamflows for Missing Records.
- General operation of each trans-mountain diversion is presented in structure-specific Task 5 memoranda. Information on trans-mountain diversion records, including filling techniques of missing data, is presented in Task 4 - Identify and Fill/Resolve Conflicting Records for Key Trans-mountain Diversion Structures.
- The SPDSS Historic Crop Consumptive Use Report, Appendix I presents the methodology for developing complete diversion records for structures in the South Platte Basin.
- Additional information regarding the indoor/outdoor consumptive use of key and aggregated municipalities is presented in Task 66.2 - Collect and Develop Municipal and Industrial Consumptive Use Estimates.

Outflows

Agricultural Consumptive Use

The agricultural consumptive use component includes the crop consumptive use from surface and ground water supplies as well as the consumptive use met by precipitation (termed effective precipitation). Agricultural consumptive use was estimated using data developed in several SPDSS tasks and the CDSS StateCU consumptive use model. The SPDSS Historic Crop Consumptive Use Report discusses input components and results of the consumptive use analyses. Agricultural consumptive use estimates for the South Platte Alluvial water budget includes the crop consumptive use associated with the irrigated acreage located in the ground water model area or acreage served by structures diverting within the ground water model area. **Table 6**, included at the end of this memorandum, lists the structures whose irrigated acreage is included in the ground water agricultural consumptive use component. The average annual crop consumptive use in the South Platte Alluvial from both diversions and precipitation is 1,462,530 acre-feet for the period 1950 through 2006.

Municipal, Commercial, and Industrial Consumptive Use

Municipal, commercial and industrial (M&I) consumptive use was estimated in Task 66 based on historical population data for municipalities and counties, per capita demand rates, indoor and outdoor usage percentages, and indoor and outdoor consumptive use rates. Self-supplied industrial (SSI) (e.g., Coors Brewery, power plants, and ski areas) uses were also estimated in Task 66.2. M&I and SSI consumptive use were then aggregated by water district to aid in summarizing the consumptive use for each basin model. M&I consumptive use for key

municipalities and SSI users was spatially inspected to determine if the consumptive use occurs inside or outside of the South Platte Alluvial. M&I consumptive use for aggregated unincorporated populations (AUP structures) was distributed based on the percentage of the water district within the ground water model area. M&I consumptive use for aggregated incorporated populations (AMP structures) was distributed based on the year 2000 population that resided in the ground water boundary. **Table 7**, at the end of this memorandum, lists the key M&I and SSI entities, the percentages of the aggregated populations included in the South Platte Alluvial water budget, and the total M&I consumptive use component.

Livestock Consumptive Use

Livestock consumptive use was estimated based on historical county agricultural statistics, per-head use rates of 10, 3, and 2 gallons per head per day for cattle, hogs, and sheep, respectively, at a 100 percent consumptive use rate. Agricultural statistical inventory data for counties in Colorado is developed by the National Agricultural Statistical Service and is stored in HydroBase. The inventory data was accessed via the State's DMI's, and missing data was filled using linear interpolation. The complete inventory data was then multiplied by the consumptive use rates and pro-rated based on the portion of the county within the ground water model area. The consumptive use identified as being consumed in the ground water area was then summed to serve as the livestock consumptive use component of the ground water model. **Table 8**, at the end of this memorandum, provides the percentage of each county located in the ground water model boundary and the total livestock consumptive use.

Reservoir Evaporation

Gross evaporation estimates based on free water surface area were developed for the key reservoirs in Task 5 and smaller reservoirs and stock ponds in Task 69. Gross evaporation represents the total annual amount lost to evaporation from the reservoir free water surface. Compared to net evaporation which is gross evaporation less precipitation on the reservoir surface area. Note that gross evaporation is used in this analysis because the total amount of evaporation is considered an 'outflow', and the total precipitation that falls on the reservoir is considered an 'inflow'. The annual difference between these inflow and outflow components is the net reservoir evaporation. For key reservoirs, surface area was estimated based on monthly end-of-month contents and area-capacity curves. Monthly surface area data was then multiplied by gross evaporation rates, developed in Task 53.3, to produce monthly evaporation estimates. Smaller reservoirs and stock ponds were aggregated and applied an evaporation rate based on 75 percent of the full surface area, as outlined in the Task 69 memo. The reservoirs and stock ponds were then aggregated by water district to aid in summarizing the evaporative consumptive use for each basin model.

Key reservoirs were spatially inspected to determine if the consumptive use occurs inside or outside of the South Platte Alluvial water budget area. Evaporation from reservoirs supplying irrigation water to meet demands and consumptive use within the ground water model area are included in the South Platte Alluvial water budget, even through some of the reservoirs are physically located outside the ground water model area. **Table 9**, at the end of the memorandum, lists the key reservoirs included in the South Platte Alluvial water evaporative consumptive use component. The Task 69 memorandum recommends aggregated reservoirs and stock ponds to be modeled at specific modeling streamflow gages. The evaporation from these

water bodies was included in the reservoir evaporation component of the ground water model if the modeling streamflow gage was located in the ground water model area. Based on this premise, aggregated reservoirs and stock ponds in Water District 1, 2, 3, 4, 5, 6, 7 and 64 are included in the model. The average annual evaporative consumptive use in the South Platte Alluvial water budget is 190,367 acre-feet for the period 1950 through 2006.

Native Vegetation Consumptive Use

The native vegetation consumptive use component is one of the unknown variables solved for in the water budget models. Therefore, no estimate of this component is input to the water budgets. It is the primary 'residual', in that all unknowns are combined and reported under the native vegetation consumptive use category. For the Alluvial Ground Water Budget, this 'residual' component is combined with the other unknown water budget components, including the ground water inflows, ground water outflows and change in ground water storage.

Surface Water Outflows

Task 2 identified the appropriate surface water outflow gages for the water budget models. Surface water outflow from the South Platte Alluvial water budget is provided by the South Platte River at Julesburg, CO streamflow gage. Monthly surface water flow records are available in HydroBase for the outflow gage and any missing streamflow gage data was filled using techniques outlined in Task 2 through TSTool. The locations of the outflow streamflow gage is shown on **Figure 1**. The average annual surface water outflow for the South Platte Alluvial water budgets is 418,117 acre-feet for the period 1950 through 2006.

Exports

Exports from the South Platte Alluvial water budget represent diversions that are used to meet demands and resulting consumptive use outside of the ground water model area. The diversions are located downstream of the surface water inflow streamgages (**Table 4**) but none of the irrigated acreage or municipal use is located in the ground water model area, therefore these diversions need to be counted as an export from the water budget. As discussed above in the Import section, Appendix I of the SPDSS Historic Crop Consumptive Use Report discusses the methodology for developing complete diversion data for structures in the consumptive use analysis. The diversion data, formatted in the direct diversion file (SP2008.ddh), is used as the basis for this export data. **Table 10**, at the end of the memorandum, lists the irrigation and municipal exports, with average annual flow, from the ground water model. As presented, the average annual volume exported out of the South Platte Alluvial is 23,478 acre-feet for the period 1950 through 2006.

As presented in **Table 10**, the single municipal export from the South Platte Alluvial is Croke Canal (ID 0700553). Croke Canal diverts below the Clear Creek near Golden streamflow gage and is the primary source of water stored in Standley Lake. Therefore the diversions take place within the ground water model area, but the storage and evaporative consumptive use takes place outside of the ground water model area. Standley Lake water is then released to serve the demands of the Standley Lake Cities (see the Municipal Imports section).

Ground Water Outflows

Although ground water outflow estimates were estimated in the Task 83 initial water budgets, the estimates were not incorporated into the final water budget analyses. Very little data exists to support the estimates, and monthly values were difficult to determine from the annual estimates. The ground water outflow component is considered an unknown variable and is included with the native vegetation consumptive use 'residual' component. Ground water outflow estimates may be provided later based on the SPDSS Ground Water Modeling efforts.

Changes in Storage

Surface Water Change in Storage

Positive changes in storage indicate water put into storage while negative changes in storage indicate a release of stored water for use by municipal entities or irrigated acreage. End-of-month contents were developed for key reservoirs in Task 5. By subtracting the previous months' contents from the following months' contents, a monthly change in storage time series was developed for each key reservoir. The resulting monthly change in storage data was aggregated to represent the overall change in storage in the South Platte River basin. Note that net losses to evaporation, as discussed the *Reservoir Evaporation* section, are represented through gross evaporation outflow and precipitation inflow components. As outlined in Task 69, change in storage estimates were not developed for smaller reservoirs or stock ponds.

Key reservoirs were spatially inspected to determine if the change in storage occurs inside or outside of the South Platte Alluvial. As discussed in the *Reservoir Evaporation* section and shown in **Table 9**, the change in storage from reservoirs supplying irrigation water to meet demands and consumptive use within the South Platte Alluvial area are included in the ground water model, even if reservoir is physically located outside active ground water model cells. The change in storage from these reservoirs was aggregated to represent the overall change in storage within the ground water model area. The average annual change in surface water storage over the 1950 to 2006 study period is 339 acre-feet in the South Platte Alluvial water budget.

Ground Water Change in Storage

Change in storage of ground water was not identified in the initial water budgets or the final water budgets discussed herein. This component of the water budget is considered an unknown variable and is included with the native vegetation consumptive use 'residual' component. Change in ground water storage may be provided later based on the SPDSS Ground Water Modeling Efforts.

Where to find more information

- Additional information regarding agricultural use and effective precipitation in the South Platte Basin, including irrigated acreage and efficiency information, is presented in the SPDSS Crop Consumptive Use Report.
- Additional information regarding the indoor/outdoor consumptive use of key and aggregated municipalities, as well as consumptive use estimates for major industrial water users, is presented in Task 66.2 - Collect and Develop Municipal and Industrial Consumptive Use Estimates.
- General operation of major reservoirs is presented in structure-specific Task 5 memoranda. Information regarding evaporation estimates and end-of-month contents for key reservoir is presented in the Task 5 Summary - Key Reservoirs, and for aggregated reservoirs and stock ponds in Task 69 – Estimate Reservoir and Stock Pond Evaporation.
- Additional information regarding the selection of key streamflow gages and streamflow data filling techniques is presented in Task 2 - Identify Key Streamflow Gages and Estimate Streamflows for Missing Records.
- Appendix I of the SPDSS Historic Crop Consumptive Use Report presents the methodology for developing complete diversion records for structures in the South Platte Basin.

Results

These water budget components, excluding the 'residual' components, were input to the StateWB model for the South Platte Alluvial model. The water budget analysis was performed and the balancing residual reported under the native vegetation consumptive use category. The results of these analyses were presented in **Table 1** at the beginning of this memorandum.

South Platte Alluvial Water Budget Residual Comparison

The native vegetation consumptive use 'residual' component includes the unknowns of ground water inflow, ground water outflow, change in ground water storage, and ungaged surface water inflow. In addition, the outflow of winter precipitation due to sublimation is also grouped with the residual. Although the 'residual' components are not estimated as part of the basin water budgets, many of the components have been estimated on an average annual basis for the South Platte Alluvial water budget.

Winter Sublimation Component

Winter sublimation is the amount of winter precipitation (snowfall) that evaporates or sublimates and is not available for runoff, deep percolation, or for use by native vegetation. A study performed in the vicinity of Akron, Colorado (Greb, 1980), estimated that 38 percent of the total monthly precipitation during the non-irrigation season is available for deep percolation and/or

storage in the soil moisture reservoir; the remainder was considered to be losses to runoff, evaporation, or sublimation. Based on Task 64 rainfall/runoff estimates, it is estimate that approximately 3 percent is attributed to runoff, therefore winter sublimation for the South Platte Alluvial water budget was estimated to be 59 percent of winter precipitation (November through March). This amounts to an average annual 307,298 acre-feet per year of outflow for the 1950 through 2006 study period over the South Platte Alluvial area.

Ground Water Components

Based on preliminary estimates from CDM; ground water inflow is estimated to be 42,000 acre-feet per year. This includes underflow in the alluvium through defined modeled drainages plus discharge to the alluvium from the Denver Basin Bedrock Aquifer as estimated by the USGS. Underflow leaving the alluvium boundary at the Stateline is estimated to be 14,000 acre-feet per year. Over the study period from 1950 through 2006, the change in ground water storage is estimated to be negligible.

Native Vegetation Evapotranspiration Component

When average annual winter sublimation and ground water components are considered in the water budget, the remaining 'residual' components of native vegetation consumptive use and ungaged surface water inflow are as follows:

Water Budget Residual =
Native Vegetation Consumptive Use + Ground Water Outflow + Winter Sublimation Outflow – Ungaged Surface Water Inflow – Ground Water Inflow

Source	**Analysis Component**	**acre-feet/year**
Water Budget	Total Residual	2,091,368
Estimated	Ground Water Outflow	(-) 14,000
Estimated	Ground Water Inflow	(+) 42,000
Estimated	Winter Sublimation	(-) 307,298
Calculated	Native Vegetation CU & Ungaged Surface Water Inflow	1,812,070

Precipitation effective in meeting native vegetation evapotranspiration is estimated to be total precipitation over native lands (approximately two-thirds of the land within the Alluvial area) less winter sublimation, runoff, and deep percolation. Based on an estimated runoff of 3 percent and deep percolation of 2 percent of precipitation (SPDSS Task 64), the average annual estimated native vegetation consumptive use from precipitation is 1,593,076 acre-feet per year over the 1950 through 2006 period.

For non-phreatophyte vegetation, effective precipitation is the only source of water to meet evapotranspiration. Phreatophytes, by definition, also consume water directly from the alluvial aquifer. The phreatophyte consumptive use from ground water was estimated to be approximately 255,000 acre-feet in 2001 (SPDSS Task 65). If we estimate that this value can be used to represent the long-term phreatophyte use of ground water, then native vegetation consumptive use 'outflow' component can be estimated as follows:

Native Vegetation Consumptive Use = Native CU from Precipitation + Native CU from GW
Native Vegetation Consumptive Use = 1,593,076 + 255,000 = 1,848,076

The remaining 'residual' component of Ungaged Surface Water Inflow is estimated to be 36,006 acre-feet/year as follows:

Ungaged Surface Water Inflow = 1,848,076 – 1,812,070 = 36,006 acre-feet/year

Ungaged Surface Water Inflow Component

Minimal streamflow data is available in HydroBase for streamgages in Water District 1 on Box Elder Creek, Crow Creek, Kiowa Creek and Bijou Creek. The sum of the average annual streamflow from gages on these intermittent drainages is approximately 15,000 acre-feet per year – about half of the estimated Ungaged Surface Water Inflow Component estimated above. Streamflow data in Water District 64 for intermittent drainages is not available in HydroBase, however it seems reasonable to estimate the ungaged inflow in Water District 64 to be similar in magnitude to that of Water District 1. Therefore, the estimated ungaged inflow of 36,006 acre-feet is reasonable.

Where to find more information

- Additional information regarding winter sublimation, precipitation runoff, and deep percolation is presented in Task 64 - Review and Develop Precipitation Recharge Estimates.
- Additional information regarding the 2001 estimate of phreatophyte consumptive use from surface water and ground water is presented in Task 65 – Estimating South Platte Phreatophyte Ground Water Evapotranspiration.

Comments and Concerns

The Alluvial Water Budget developed herein can only be used as a rough comparison to the Ground Water Model. As discussed, estimates of total crop consumptive use include consumptive use from structures that divert within the ground water model boundary even if a portion of their acreage lies outside the ground water model area. Therefore, as shown in Figure 1, the area represented by the Alluvial Water Budget and the area included in the Ground Water Model differ.

Although initial water budget analyses were performed for the river basin models, there was not an initial water budget performed for the Alluvial Water Budget area.

References

Greb, B.W. December 1980. *Snowfall and its Potential Management in the Semiarid Central Great Plains,* Prepared for the U.S. Department of Agriculture. Agricultural Reviews and Manuals, ARM-W-18.

Supporting Tables

Table 2
South Platte Alluvial Ground Water Budget
Climate Station Weights and Average Annual Precipitation
(1950 – 2006)

Water District	Climate Station ID and Name	Climate Station Weight	Average Annual Weighted Precip. (inches)	Average Annual Precip. by District (inches)
1	0945 Briggsdale	0.51	6.57	13.6
	1179 Byers 5 ENE	0.31	4.67	
	3038 Fort Morgan	0.08	1.03	
	3553 Greeley – combined	0.10	1.33	
2	1179 Byers 5 ENE	0.11	1.66	15
	2220 Denver Stapleton Intl Airport	0.58	8.98	
	3553 Greeley – combined	0.13	1.73	
	6323 Parker – combined	0.18	2.65	
3	0945 Briggsdale	0.19	2.45	14.1
	3005 Fort Collins	0.45	6.85	
	3553 Greeley – combined	0.36	4.78	
4	0848 Boulder	0.11	3.28	15
	3005 Fort Collins	0.53	8.04	
	3553 Greeley – combined	0.14	1.92	
	5116 Longmont 2 ESE	0.22	2.89	
5	0848 Boulder	0.14	2.76	14.5
	2220 Denver Stapleton Intl Airport	0.06	0.87	
	3005 Fort Collins	0.10	1.51	
	3553 Greeley - combined	0.13	1.72	
	5116 Longmont 2 ESE	0.57	7.66	
6	0848 Boulder	0.43	8.20	16.4
	4762 Lakewood - combined	0.18	3.03	
	5116 Longmont 2 ESE	0.39	5.20	
7	0848 Boulder	0.16	3.09	16.4
	2220 Denver Stapleton Intl Airport	0.09	1.39	
	4762 Lakewood – combined	0.69	11.15	
	5116 Longmont 2 ESE	0.06	0.08	
8	1401 Castle Rock	0.29	4.99	16.4
	2220 Denver Stapleton Intl Airport	0.22	3.39	
	4762 Lakewood - combined	0.49	7.98	
9	1401 Castle Rock	0.28	4.87	16.5
	4762 Lakewood - combined	0.72	11.64	
64	7515 Sedgwick 5S	0.27	4.79	15.9
	7950 Sterling	0.73	11.11	

Table 3
South Platte Alluvial Ground Water Model
Average Annual Precipitation Volume
(1950 - 2006)

Water District	South Platte Alluvial	
	Area (acres)	Precipitation Volume (acre-ft)
1	1,111,633	1,258,454
2	384,090	480,779
3	322,211	377,713
4	115,575	144,410
5	22,757	27,536
6	23,292	31,874
7	13,617	18,659
8	49,360	67,328
9	405	557
64	328,766	435,590
Total	2,371,706	2,842,900

Table 4
South Platte Alluvial Water Budget
Gaged Surface Water Inflows
(1950 - 2006)

Water District	Gage ID [1]	Streamflow Gage Name	Average Annual Flow (acre-feet)
1	06753500	Lonetree Creek near Nunn [4]	575
2	06720820	Big Dry Creek at Westminster [4]	11,160
3	06752260	Cache La Poudre River at Ft. Collins [4]	119,935
4	06741510	Big Thompson River at Loveland [4]	54,144
4	06743500	Little Thompson River at Milliken [4]	26,837
5	06725450	St. Vrain Creek below Longmont [4]	81,879
6	06730200	Boulder Creek at N. 75th Street nr. Boulder [2, 4]	80,258
6	06730300	Coal Creek near Plainview [4]	2,884
7	06719505 & 06719500	Clear Creek near Golden & Clear Creek at Golden [3, 4]	138,411
8	06712000	Cherry Creek near Franktown [4]	6,318
8	PLACHACO	South Platte River below Chatfield Reservoir [4]	121,331
8	06709000 & 06709500	Plum Creek near Louviers & Plum Creek near Sedalia	23,029
9	06711500	Bear Creek at Sheridan	34,985
		Total	701,746

Source: HydroBase & SPDSS Task 2

Notes: [1] Multiple IDs indicate two gages were combined

[2] Gage is located downstream of Boulder CBT deliveries from Boulder Res. & upstream of City of Boulder's WWTP discharge point

[3] Church Ditch (0700540) diverts between the locations of these two gages therefore the diversions were subtracted before the gages were combined

[4] These gages differ from those originally identified as ground water gages the SPDSS Task 2 memo

Table 5
South Platte Alluvial Water Budget
Irrigation and Municipal Imports
(1950 – 2006)

No.	Structure ID	Diversion Structure Name	Average Annual Flow (acre-feet)
1	0300905	North Poudre Supply Canal (aka Munroe Gravity Canal)	39,703
2	0300907	Poudre Valley Canal	23,054
3	0300911	Larimer County Ditch	77,372
4	0300912	Dry Creek Ditch	5,829
5	0300913_D	New Mercer Ditch Diversion System	19,051
6	0300915	Cache La Poudre Ditch	15,711
7	0300919	Larimer Weld Irrigation Ditch	83,256
8	0300921	Josh Ames Ditch	589
9	0300922	Lake Canal Ditch	11,536
10	0300923	John G. Coy Ditch	942
11	0300994_D	North Poudre Canal Diversion System	43,849
12	0301029	Taylor Gill Ditch	2,913
13	0400501	Barnes Ditch	41,604
14	0400503	Big Thompson Ditch	4,576
15	0400519	Farmers Irrigation Canal	5,561
16	0400520	George Rist Ditch	4,668
17	0400521	Handy Ditch	16,659
18	0400524	Home Supply Ditch	26,855
19	0400530	Louden Ditch	13,859
20	0400532	Loveland Greeley Canal	49,145
21	0400534	Mariana Ditch	318
22	0400541	Rist Goss Ditch	480
23	0400588	Boulder Larimer Co Irrigation Mfg Ditch	9,911
24	0400596	Jim Eglin Ditch	435
25	0400599	Miner Longan Ditch	545
26	0400600	Osborne Caywood Ditch	749
27	0400601	Rockwell Ditch	850
28	0600518	Butte Mill Ditch	1,186
29	0600528	Green Ditch	1,792
30	0600565	Leyner Cottonwood Ditch	3,585
31	0600582	Jones Donnelly Ditch	1,284
32	0300906	Fort Collins Pipeline (Municipal)	9,955
33	0300908	Greeley Filters Pipeline (Municipal)	13,447
34	0400511	Loveland Pipeline (Municipal)	6,257
35	0600590	South Boulder Diversion Canal (Municipal)	57,317
36	0801002	Denver Conduit No. 20 (Municipal)	77,162

37	0801017	Denver Conduit No. 26 (Municipal)	58,662
38	0801001	Aurora Intake Pipeline (Municipal)	24,443
39	NA	Diversions for Thornton, Westminster & Northglenn (Municipal)	17,911
40	NA	City of Boulder Return Flows (Municipal)	8,724
	Total		781,745

Table 6
South Platte Alluvial Water Budget
Diversion Structures included in the Ground Water Model

Structure ID	Diversion Structure Name
01_AWP002	South Platte River Below Weldona Co North
01_AWP003	Wd 1 Upper Beaver Creek
01_AWP004	Wd 1 Main Stem Beaver Creek
01_AWP007	South Platte River Below Weldona Co South 2
01_AWP008	Upper Kiowa Bijou Designated Basin
01_AWP009	Upper Kiowa Bijou Designated Basin
01_AWP010	Lower Kiowa Bijou Designated Basin East 1
01_AWP011	Lower Kiowa Bijou Designated Basin East 2
01_AWP012	Lower Kiowa Bijou Designated Basin East 4
01_AWP013	Lower Kiowa Bijou Designated Basin East 5
01_AWP014	Lower Kiowa Bijou Designated Basin East 6
01_AWP015	Lower Kiowa Bijou Designated Basin East 7
01_AWP016	Lower Kiowa Bijou Designated Basin East 8
01_AWP017	Lower Kiowa Bijou Designated Basin East 9
01_AWP018	Lower Kiowa Bijou Designated Basin East 10
01_AWP019	Lower Kiowa Bijou Designated Basin West 1
01_AWP020	Lower Kiowa Bijou Designated Basin West 2
01_AWP021	Lower Kiowa Bijou Designated Basin West 3
01_AWP022	Lower Lost Creek Designated Basin 1
01_AWP023	Lower Lost Creek Designated Basin 2
01_AWP024	Lower Lost Creek Designated Basin 3
01_AWP025	Upper Lost Creek Designated Basin

Structure ID	Diversion Structure Name
0300932	William R Jones Ditch
0300934	Canal 3 Ditch
0300935	Boyd Freeman Ditch
0300937	Ogilvy Ditch
0300994_D	North Poudre Canal
0300994_I	North Poudre Demand
0301029	Taylor Gill Ditch
0301203	Platte R Pwr Pmg Divr
0301321	Graham Seep Ditch
04_AWP005	Little Thompson Above Big Thompson Confluence
0400501	Barnes Ditch
0400502_D	Big T Platte R Ditch
0400503	Big Thompson D Mfg
0400517	Evanstown Ditch
0400519	Farmers Irr Canal
0400520	George Rist Ditch
0400521	Handy Ditch
0400522	Hill Brush Ditch
0400523	Hillsborough Ditch
0400524	Home Supply Ditch
0400524_I	Home Supply Demand
0400530	Louden Ditch

01_AWP026	South Platte River Above Weldona Co South 1
01_AWP027	South Platte River Above Weldona Co South 2
01_AWP028	South Platte River Above Weldona Co South 3
01_AWP029	South Platte River Above Weldona Co South 4
01_AWP030	South Platte River Above Weldona Co South 5
01_AWP031	South Platte River Below Riverside Canal South
01_AWP032	Wd 1 Lower Boxelder Creek
01_AWP033	South Platte River Above Weldona Co North
01_AWP035	Wd 1 Upper Boxelder Creek
01_AWP042	South Platte River Below Kersey Co South
0100501	Empire Ditch (Inlet Canal)
0100503_D	Riverside Canal Divsys
0100503_I	Riverside Canal Demand
0100507_D	Bijou Canal Demand
0100507_I	Bijou Canal Demand
0100511	Weldon Valley Ditch
0100513	Jackson Lake Inlet Ditch
0100514	Ft Morgan Canal
0100515	Upper Platte Beaver Cnl
0100517	Deuel Snyder Canal
0100518	Lower Platte Beaver D
0100519_D	Tremont Ditch
0100520	Gill Stevens Ditch
0100524	Trowell Ditch
0100525	Tetsel Ditch
0100526	Johnson Edwards Ditch
0100687	North Sterling Canal
0100687_I	North Sterling Demand
0100688	Union Ditch
0100829	Prewitt Inlet Canal
0103817_I	Jackson Reservoir Demand
02_ADP003	South Platte River Below Ft Lupton West
02_AWP001	Wd 2 Beebe Draw 1
02_AWP002	Wd 2 Beebe Draw 2
02_AWP003	South Platte River Below Ft Lupton West
02_AWP004	Sand Creek Basin And Burlington System
02_AWP005	South Platte River Below Clr Crk Confluence West

0400532	Loveland Greeley Canal
0400532_I	Loveland Greeley Demand
0400534	Mariana Ditch
0400541	Rist Goss Ditch
0400587	Beeline Ditch
0400588	Bould Larim Co Irr Mfg D
0400588_I	Bould Larim Co Irr Mfg Demand
0400596	Jim Eglin Ditch
0400599	Miner Longan Ditch
0400600	Osborne Caywood Ditch
0400601	Rockwell D Rockwell P P
05_AWP004	Saint Vrain Creek Below Lyons Co
0500589	Last Chance Ditch
0500942	Cole Seepage Ditch
06_AWP003	Boulder Creek To South Platte Confluence
0600515_D	Boulder Weld Cty Ditch
0600518	Butte Mill Ditch
0600523	Delehant Ditch
0600527	Godding Dailey Plumb D
0600528	Green Ditch
0600532	Highland S Side Ditch
0600534	Houck 2 Ditch
0600536	Howell Ditch
0600537	Leggett Ditch
0600538_D	Lower Boulder Ditch
0600551	Rural Ditch
0600553	Smith Emmons Ditch
0600565	Leyner Cottonwood Ditch
0600582	Jones Donnelly Ditch
0600610	Erie Coal Cr Ditch
0600611	Harris Ditch
0600612	Kerr Ditch No 1
0600613	Kerr Ditch No 2
0600622	T N Willis Ditch
07_ADP001	Clear Creek Below Golden Co
07_AWP001	Clear Creek Below Golden Co
0700527_D	Slough Or Bijou Ass'N D

0200800	Farmer And Gardners Ditch
0200802	Burlington D River Hg
0200805	Denver-Hudson Cnl
0200805_I	Denver-Hudson Cnl
0200806	Gardners Ditch
0200808	Fulton Ditch
0200809	Brantner Ditch
0200810	Brighton Ditch
0200812	Lupton Bottom Ditch
0200813	Platteville Ditch
0200817	Evans No 2 Ditch
0200817_I	Evans No 2 Demand
0200821	Meadow Island 1 Ditch
0200822	Meadow Island Ditch
0200824	Farmers Independent D
0200825	Hewes Cook Ditch
0200826	Jay Thomas Ditch
0200828	Union Ditch
0200828_I	Union Irrigation Demand
0200830	Section No 3 Ditch
0200834	Lower Latham Ditch
0200834_I	Lower Latham Demand
0200836	Patterson Ditch
0200837	Highland Ditch
0200871	Whipple Ditch
0200872	German Ditch
0200873	Big Dry Creek Ditch
0200874	Yoxall Ditch
0200915	Little Burlington Cnl
0200922	Goosequill Pump Station
0203837_C	Frico-Barr Lake Demand
0203837_I	Frico-Barr Lake Demand
0203876_I	Frico-Milton Lake Demand
03_AWP001	Cache La Poudre River Above Greeley Co
03_AWP002	Cache La Poudre River Above Fort Collins Co
0300905	North Poudre Supply Canal
0300907	Poudre Valley Canal

0700547	Clear Cr Platte River D
0700549	Colo Agricultural D
0700551	Cort Graves Hughes Ditch
0700569	Farmers Highline Cnl
0700597	Kershaw Ditch
0700601	Lee Stewart Eskins Ditch
0700614	Manhart Ditch
0700632	Ouelette Ditch
0700647	Reno Juchem Ditch
0700652_D	Rocky Mountain Ditch
0700698	Wannemaker Ditch
08_AWP001	South Platte River Below Chatfield Reservoir
08_AWP005	Cherry Creek Above Chatfield Reservoir
0801008	City Ditch Pl
0801009_D	Nevada Ditch
0801013	Englewood Intake
0801014	Arapahoe Power Plant
0801015	Epperson Ditch/Pump
0801016	Lacombe Power Plant
0801017	Denver Foothills Pl 26
64_AWP004	Water District 64 Sedgwick County Gw 1
64_AWP005	Water District 64 Sedgwick County Gw 2
64_AWP007	Water District 64 Lower Logan County South 1
64_AWP008	Water District 64 Lower Logan County South 2
64_AWP009	Water District 64 Lower Logan County South 3
64_AWP012	Wd 64 Logan County S Of Pawnee Canal
64_AWP013	Wd 64 Logan County N Of Pawnee Canal
64_AWP014	Wd 64 Logan County North Blw Sterling No 1
64_AWP017	Wd 64 Logan County North Blw Tetsel
6400501	Carlson Ditch
6400502	Liddle Ditch
6400503	South Reservation Ditch
6400504	Peterson Ditch
6400506	Red Lion Supply Ditch
6400507	Long Island Ditch
6400508	Settlers Ditch
6400511_D	Harmony Ditch 1

0300911	Larimer County Ditch
0300911_I	Larimer County Demand
0300912	Dry Creek Ditch
0300913_D	New Mercer Divsys
0300915	Cache La Poudre Ditch
0300915_I	Cache La Poudre Demand
0300919	Larimer Weld Irr Canal
0300919_I	Larimer Weld Irr Demand
0300921	Josh Ames Ditch
0300922	Lake Canal Ditch
0300923	John G Coy
0300924	Cache La Poudre Res In Cnl
0300925	Chaffee Ditch
0300926	Boxelder Ditch
0300929	New Cache La Poudre Co D
0300929_I	New Cache La Poudre Demand
0300930	Whitney Irr Ditch
0300931	B H Eaton Ditch

6400511_I	Harmony Ditch 1 Demand
6400513	Chambers Ditch
6400514	Ramsey Ditch
6400516	Powell Blair Ditch
6400518	Lone Tree Ditch
6400519	Jud Brush Ditch
6400520	Iliff Platte Valley D
6400522_D	Bravo Ditch
6400524	Lowline Ditch
6400525	Henderson Smith Ditch
6400526	Sterling Irr Co Ditch 2
6400528	Sterling Irr Co Ditch 1
6400530	Springdale Ditch
6400531	Schneider Ditch
6400532	Davis Bros Ditch
6400533	Pawnee Ditch
6400535	South Platte Ditch
6400599	Rice Ditch

Table 7
South Platte Alluvial Water Budget
Municipal, Commercial and Industrial Consumptive Use
(1950 – 2006)

Structure ID	Diversion Structure Name	Percentage of M&I in the GW boundary	Average Annual Consumptive Use
01_AMP001	WD 1 Aggregated Municipal Population	75.7 %	2,326
01_AUP001	WD 1 Aggregated Unincorporated Population 1	19.5 %	2,054
01_AUP002	WD 1 Aggregated Unincorporated Population 2	19.5 %	439
02_AMP001	WD 2 Aggregated Municipal Population 1	93.9 %	2,839
02_AMP002	WD 2 Aggregated Municipal Population 2	63.5 %	946
02_AUP001	WD 2 Aggregated Unincorporated Population	43.1 %	890
03_AMP001	WD 3 Aggregated Municipal Population	100 %	1,242
03_AUP001	WD 3 Aggregated Unincorporated Population 1	12.9 %	164
03_AUP002	WD 3 Aggregated Unincorporated Population 2	12.9 %	308
04_AMP001	WD 4 Aggregated Municipal Population 1	0 %	0
04_AMP002	WD 4 Aggregated Municipal Population 2	58.1 %	394
04_AUP001	WD 4 Aggregated Unincorporated Population 1	3.9 %	28
04_AUP002	WD 4 Aggregated Unincorporated Population 2	3.9 %	30
05_AMP001	WD 5 Aggregated Municipal Population	77.8 %	213
05_AUP001	WD 5 Aggregated Unincorporated Population	4.1 %	105
06_AMP001	WD 6 Aggregated Municipal Population	77.8 %	1,765
06_AUP001	WD 6 Aggregated Unincorporated Population	6.4 %	145
07_AMP001	WD 7 Aggregated Municipal Population 1	0 %	0
07_AMP002	WD 7 Aggregated Municipal Population 2	85.3 %	713
07_AUP001	WD 7 Aggregated Unincorporated Population	4.3 %	121

08_AMP001	WD 8 Aggregated Municipal Population 1	0 %	0
08_AMP002	WD 8 Aggregated Municipal Population 2	78.3 %	2,870
08_AUP001	WD 8 Aggregated Unincorporated Population 1	4.9 %	110
08_AUP002	WD 8 Aggregated Unincorporated Population 2	4.9 %	127
09_AMP001	WD 9 Aggregated Municipal Population	0 %	0
09_AUP001	WD 9 Aggregated Unincorporated Population	0.3 %	7
64_AMP001	WD 64 Aggregated Municipal Population	98.4 %	1,216
64_AUP001	WD 64 Aggregated Unincorporated Population	11.8 %	204
02Northgl	City of Northglenn	100 %	1,310
02Thornton	City of Thornton	100 %	2,515
02Westmin	City of Westminster	100 %	3,110
03FtCollin	City of Fort Collins	100 %	6,220
03Greeley	City of Greeley	100 %	5,993
04Loveland	City of Loveland	100 %	2,404
08Aurora	City of Aurora	100 %	11,303
08Denver	City of Denver	100 %	69,354
01_PawnPP	Pawnee Power Plant	100 %	2,597
02_ChrkPP	Cherokee Power Plant	100 %	5,541
02_VrnPP	St. Vrain Power Plant	100 %	549
03_RawhPP	Rawhide Power Plant	100 %	2,063
07_Coors	Coors Brewery	100 %	3,286
0801014	Arapahoe Power Plant	100 %	1,958
Total			137,459

Table 8
South Platte Alluvial Water Budget
Livestock Consumptive Use
(1950 – 2006)

County Name	Percentage of County in the GW Boundary	Consumptive Use
Adams	41 %	236
Arapahoe	21 %	36
Denver	50 %	21
Douglas	4 %	8
Elbert	12 %	73
Jefferson	4 %	5
Larimer	3 %	29
Logan	14 %	244
Morgan	36 %	707
Sedgwick	14 %	44
Washington	3 %	25
Weld	22 %	1,306
Total		2,733

Table 9
South Platte Alluvial Water Budget
Key Reservoirs

No.	Structure ID	Structure Name
1	0103400	Vancil Reservoir
2	0103551	North Sterling Reservoir
3	0103552	Prewitt Reservoir
4	0103570	Bijou Reservoir 2
5	0103651	Riverside Reservoir
6	0103816	Empire Reservoir
7	0103817	Jackson Lake Reservoir
8	0203592	Horse Creek Reservoir
9	0203609	Prospect Reservoir
10	0203837	Barr Lake
11	0203858	Lower Latham Reservoir
12	0203876	Milton Reservoir
13	0303690	North Poudre Reservoir 1
14	0303694	Mountain Supply Reservoir 8
15	0303695	Mountain Supply Reservoir 9
16	0303696	Mountain Supply Reservoir 10
17	0303697	North Poudre Reservoir 2
18	0303698	North Poudre Reservoir 5
19	0303699	North Poudre Reservoir 6
20	0303702	North Poudre Reservoir 3
21	0303704	North Poudre Reservoir 4
22	0303707	Mountain Supply Reservoir 16
23	0303715	Park Creek Reservoir
24	0303716	North Poudre Reservoir 15
25	0303717	Boxelder Reservoir 1
26	0303719	Boxelder Reservoir 2
27	0303725	Douglas Reservoir
28	0303727	Reservoir No 8
29	0303728	Reservoir No 8 Annex
30	0303729	Elder Reservoir
31	0303730	Cobb Lake Reservoir
32	0303735	Curtis Lake Reservoir
33	0303736	Water Supply And Storage Res 1 (aka Rocky Ridge)
34	0303737	Water Supply And Storage Reservoir 2&3
35	0303738	Windsor Reservoir
36	0303739	Water Supply And Storage Reservoir 4
37	0303740	Kluver Reservoir
38	0303741	Water Supply And Storage Res 6 (aka Richards Lake)
39	0303742	Water Supply And Storage Res 5 (aka Long Pond)
40	0303743	Lindenmeir Lake
41	0303744	Black Hollow Reservoir

42	0303765	North Poudre Reservoir 13
43	0303774	Fossil Creek Reservoir
44	0303775	Cache La Poudre Reservoir (aka Timnath)
45	0303805	Larimer Weld Reservoir
46	0403659	Loveland Municipal Res (aka Green Ridge Lake)
47	0404110	Boyd Lake Reservoir
48	0404123	Horseshoe No 2
49	0404131	Loveland Greeley Reservoir
50	0404134	Mariano Reservoir
51	0404136	Lon Hagler Reservoir
52	0404137	Lone Tree Reservoir
53	0404156	Boulder Larimer Reservoir (aka Ish Res)
54	0803501	Marston Reservoir
55	0803532	Cherry Creek Reservoir
56	0803832	McLellan Reservoir
57	6403906	Julesburg Reservoir

Table 10
South Platte Alluvial Water Budget
Irrigation and Municipal Exports
(1950 - 2006)

Structure ID	Diversion Structure Name	Average Annual Flow (acre-feet)
0700502	Agricultural Ditch	8,244
0600606	Church Ditch (Upper)	146
0600608_D	Eggleston No. 1 Diversion System	149
0600615	Last Chance Ditch	615
0600621	William C. Hake Ditch	273
0700553	Croke Canal (Municipal Demand)	14,050
Total		23,478