



THE STATE OF WYOMING

Water Development Office

6920 YELLOWTAIL ROAD TELEPHONE: (307) 777-7626 CHEYENNE, WY 82002
FAX: (307) 777-6819



TECHNICAL MEMORANDUM

TO: Water Development Commission **DATE:** November 7, 2011
FROM: Dave K. Myer, P.E. **REFERENCE:** Snake/Salt River Basin Plan Update, 2012
SUBJECT: Irrigated Acreage – *TabVI (2012)*

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1.0 Introduction

The purpose of this technical memorandum is to summarize the assessment of irrigated lands performed as part of the 2012 Snake/Salt River Basin Plan Update (2012 Update). Irrigated acreages quantified for the previous Snake/Salt River Basin Plan (previous Basin Plan) were used as a basis for this study (Sunrise, 2003a). The methods used to tally the 2003 irrigated acres were documented in *Technical Memorandum, Irrigated Lands Mapping and Permit GIS Data* (Sunrise, 2003b). Additional information pertaining to irrigated lands within the Snake/Salt River Basin was presented in the *Wyoming Framework Water Plan* (WWC, 2007). As part of the 2012 Update, the irrigated acres within the Snake/Salt River Basin were reassessed and further quantified as described in this memorandum.

Some discrepancies were noted between the 2007 Wyoming Framework Water Plan's GIS mapped acreages and the tabulations of irrigated lands reported in the previous Basin Plan. Other uncertainties were noted in terms of the spatial association of the GIS mapped acreages to specific demand nodes within the spreadsheet models. It was decided, however, that a comprehensive reassessment of irrigated lands along with an association of these lands to model nodes was beyond the scope of this update. Rather, these discrepancies and uncertainties were left as noted to be addressed in the future.

2.0 Quantification of Irrigated Acreage

The quantification of irrigated acreage for the 2012 Update was based on the following three sources, each of which is discussed below:

- Reported acreages from the previous Basin Plan.
- GIS mapped acreages from the Wyoming Framework Water Plan.
- Back-Calculated acreages from the previous Basin Plan.

2.1 Reported Acreages from Previous Basin Plan

The acreages that were reported within the previous Basin Plan are summarized in Table 1. These quantities were extracted from both the *Snake/Salt River Basin Plan Final Report* (Sunrise, 2003a) and *Technical Memorandum, Basin Water Use Profile – Agriculture* (Sunrise, 2002). The table shows the irrigated lands by sub-basin and tallies the lands by the new irrigation zones that were established for the 2012 Update. (For information on the new irrigation zones, refer to *Technical Memorandum, Tab VII: Crop Water Requirements.*)

Table 1: Acreages Reported in Previous Basin Plan

Description		2003 Reported Acreages
Sub-Basin	Salt (excluding Greys Sub-Basin)	65,584
	Snake (including Hoback Sub-Basin)	28,840
	Teton	4,647
	Greys ₁	--
	Total	99,071
Irrigation Zone	Zone 1: Teton	4,647
	Zone 2: Upper Snake	6,813
	Zone 3: Lower Snake	18,043
	Zone 4: Hoback	3,984
	Zone 5: Lower Salt	33,810
	Zone 6: Upper Salt	31,774
	Zone 7: Greys ₁	--
	Total	99,071

1. Irrigated lands in the Greys Sub-Basin were not quantified in the previous Basin Plan.

2.2 GIS Mapped Acreages

The acreages extracted from the GIS mapping prepared for the Wyoming Framework Water Plan are summarized in Table 2. The acreages again are tabulated by both sub-basin and by the irrigation zones that were established for the 2012 Update.

Table 2: GIS Mapped Acreages from State Framework Plan

Description		GIS Mapped Acreages
Sub-Basin	Salt (excluding Greys Sub-Basin)	65,527
	Snake (including Hoback Sub-Basin)	29,079
	Teton	4,642
	Greys ₁	--
	Total	99,248
Irrigation Zone	Zone 1: Teton	4,642
	Zone 2: Upper Snake	6,809
	Zone 3: Lower Snake	18,031
	Zone 4: Hoback	4,239
	Zone 5: Lower Salt	33,783
	Zone 6: Upper Salt	31,774
	Zone 7: Greys ₁	--
	Total	99,248

1. Irrigated lands in the Greys Sub-Basin were not quantified in the Wyoming Framework Water Plan.

2.3 Back-Calculated Acreages

The previous Basin Plan did not present a tabulation of the irrigated acreages assigned to each individual demand node in the spreadsheet models. Therefore, for the 2012 Update, it was necessary to back-calculate these acreages based on the formula used in the previous Basin Plan where diversions for each node were calculated as the product of the irrigated acres, monthly crop irrigation requirement (CIR), and the fraction of month in which the diversions were practiced:

Equation 1

$$\text{Diversion} = \text{Acres} \times \text{CIR} \times \text{Fraction}$$

where,

Acres = Irrigated Acres by Node

CIR = Consumptive Irrigation Requirement (varied for each hydrologic condition in the previous Basin Plan) (ft/month)

Fraction = Fraction of Month in which the Diversion is Practiced

By rearranging Equation 1, the acres assigned to each demand node were determined as the Diversion divided by the product of CIR and Fraction. The CIR and the Fraction values from the previous Basin Plan were used in this calculation. Back-calculations were performed on each demand node in the spreadsheet models. Compiling the results into sub-basin and irrigation zone yielded the acreages presented in Table 3. Note that since the Teton Sub-Basin was not analyzed in a spreadsheet model, demand nodes did not exist and therefore, back-calculations were not possible. Also, back-calculations were not possible for the Greys Sub-Basin since the previous Basin Plan did not address any irrigated lands in that basin.

Table 3: Back-Calculated Acreages

Description		Back-Calculated Acreages
Sub-Basin	Salt (excluding Greys Sub-Basin)	62,639
	Snake (including Hoback Sub-Basin)	28,963
	Teton ₁	--
	Greys ₂	--
	Total	91,602
Irrigation Zone	Zone 1: Teton ₁	--
	Zone 2: Upper Snake	6,967
	Zone 3: Lower Snake	18,017
	Zone 4: Hoback	3,979
	Zone 5: Lower Salt	31,259
	Zone 6: Upper Salt	31,380
	Zone 7: Greys ₂	--
	Total	91,602

1. Teton Sub-Basin was not analyzed in spreadsheet models; therefore, back-calculations were not possible.

2. Irrigated lands in the Greys Sub-Basin were not quantified in the previous Basin Plan; therefore, back-calculations were not possible.

2.4 Comparison of Acreages

For comparison purposes, Table 4 summarizes the tally of irrigated lands from the three sources described above. Table 5 compares the difference and percent difference from the 2003 reported acreages and the GIS and back-calculated acreages.

Table 4: Comparison of Acreages

Description		GIS Mapped Acreages	2003 Reported Acreages	Back-Calculated Acreages
Sub-Basin	Salt (excluding Greys Sub-Basin)	65,527	65,584	62,639
	Snake (including Hoback Sub-Basin)	29,079	28,840	28,963
	Teton ₁	4,642	4,647	--
	Greys ₂	--	--	--
	Total	99,248	99,071	91,602
Irrigation Zone	Zone 1: Teton ₁	4,642	4,647	--
	Zone 2: Upper Snake	6,809	6,813	6,967
	Zone 3: Lower Snake	18,031	18,043	18,017
	Zone 4: Hoback	4,239	3,984	3,979
	Zone 5: Lower Salt	33,783	33,810	31,259
	Zone 6: Upper Salt	31,744	31,744	31,380
	Zone 7: Greys ₂	--	--	--
	Total	99,248	99,071	91,602

1. Teton Sub-Basin was not analyzed in spreadsheet models; therefore, back-calculations were not possible.

2. Irrigated lands in the Greys Sub-Basin were not quantified in the previous Basin Plan or the Wyoming Framework Water Plan; back-calculations were not possible.

Table 5: Acreage Differences

Description		2003 Reported Acreages vs. GIS Mapped Acreages		2003 Reported Acreages vs. Back-Calculated Acreages	
		Difference (Acres)	Percent	Difference (Acres)	Percent
Sub-Basin	Salt (excluding Greys Sub-Basin)	57	0.09%	2,945	4.49%
	Snake (including Hoback Sub-Basin)	-239	-0.83%	-123	-0.43%
	Teton ₁	--	--	--	--
	Greys ₂	--	--	--	--
Irrigation Zone	Zone 1: Teton ₁	--	--	--	--
	Zone 2: Upper Snake	4	0.06%	-154	-2.26%
	Zone 3: Lower Snake	12	0.07%	26	0.14%
	Zone 4: Hoback	-255	-6.40%	5	0.13%
	Zone 5: Lower Salt	27	0.08%	2,551	7.55%
	Zone 6: Upper Salt	30	0.09%	394	1.24%
	Zone 7: Greys ₂	--	--	--	--

1. Teton Sub-Basin was not analyzed in spreadsheet models; therefore, back-calculations were not possible.

2. Irrigated lands in the Greys Sub-Basin were not quantified in the previous Basin Plan or the Wyoming Framework Water Plan; back-calculations were not possible.

As shown on Table 5, differences between the 2003 reported acreages and the GIS mapped acreages are minimal. With the exception of Lower Salt irrigation zone (Zone 5), the differences between the 2003 reported acreages and the back-calculated acreages are less than 2.5 percent. However, for the Lower Salt irrigation zone (Zone 5), the difference of 2,551 acres was significant.

2.4.1 Adjustment to Back-Calculated Acreages for Lower Salt

The 2,551 acre difference between the 2003 reported acreages and the back-calculated acreages within the Lower Salt irrigation zone can most likely be attributed to errors in the back-calculating procedure. These errors are thought to stem from discrepancies in reported CIR numbers along with the numbers presented for the fraction of month irrigated in the previous Basin Plan. Therefore, adjustments to the back-calculated acreages for the Lower Salt irrigation zone (Zone 5) were made to help reconcile this difference.

The adjustments involved weighting the back-calculated acreages of each of the eleven demand nodes in the Lower Salt irrigation zone against the total acreage that was back-calculated for this zone. Then for each node, the weighting factor (which was a number from 0 to 1) was multiplied by the total adjustment of 2,551 acres which provided the adjusted acreage for each node. The adjusted acreage was then added to the original back-calculated acreage for each node. This procedure is detailed in Table 6.

Table 6: Adjustment to Acreages in Lower Salt Irrigation Zone

2012 Basin Node No.	2012 Node Description	Original Back-Calc'd Acres₁	Weighting Factor₂	Adjustment₃	Adjusted Back-Calc'd Acres₄
Salt_16.04	Upper diversions on Willow Creek	1,386	0.04	113.08	1,499
Salt_16.06	Lower diversions on Willow Creek	1,328	0.04	108.42	1,437
Salt_17.06	East Side Canal	5,050	0.16	412.12	5,462
Salt_18.04	Diversions on Strawberry Creek	8,179	0.26	667.49	8,847
Salt_19.04	Aggregated Diversions on/near Salt River between Strawberry and Cedar	7,649	0.24	624.23	8,273
Salt_20.04	Diversions on Cedar Creek	1,583	0.05	129.19	1,712
Salt_21.04	Aggregated Diversions on/near Salt River between Cedar and Lee	1,440	0.05	117.49	1,557
Salt_22.02	Lee Creek	1,041	0.03	84.99	1,126
Salt_24.02	Birch Creek	1,410	0.05	115.04	1,525
Salt_25.04	Aggregated Diversions on/near Salt river between Birch Creek and Gage	927	0.03	75.63	1,002
Salt_26.02	Stewart Creek	1,266	0.04	103.33	1,370
Total		31,259	1.00	2551.00	33,810

1. Original back-calculated results for each node (see Section 2.3).

2. Weighting factor for each node = Original Back-Calc'd Acres / Total Back-Calc'd Acres in Lower Salt (31,259 acres).

3. Adjustment for each node = Weighting Factor * Total Adjustment (2,551 acres).

4. Adjusted Back-Calc'd Acres for each node = Adjustment + Original Back-Calc'd Acres.

3.0 Greys River Sub-Basin Irrigated Lands

Irrigated lands within the Greys River Sub-Basin were not quantified in the previous Basin Plan. However, as part of the 2012 Update, an assessment of actively irrigated lands within the basin was performed.

A water rights search conducted by the State Engineer's Office (SEO) returned a total of approximately 540 permitted acres within the Greys Sub-Basin. These included lands irrigated from tributaries and lands irrigated from the mainstem of the Greys River. Scanned geo-referenced maps were also acquired for most of these permits. Water Resources Data System (WRDS) correlated the geo-referenced maps with aerial photography in order to ascertain whether these lands were under active irrigation. Those lands determined to be actively irrigated were tallied and digitized in GIS. Remaining lands, despite having permits, were eliminated because they either lacked evidence of active irrigation or are located in areas where irrigation no longer takes place. For instance, some permits are associated with lands that are now situated within the Town of Alpine and are now occupied by homes and businesses.

The permitted lands that were found to be actively irrigated are summarized in Table 7. Figure 1 shows the approximate delineation of these lands that have been digitized in the GIS. In order to account for these lands in this analysis, a new reach and node was added to the spreadsheet models to represent the Greys River and the irrigation that was found to be actively occurring. The new model node, "28.02, Headwaters of Greys River" was associated with the 228.90 total permitted acres that is shown in the table.

Table 7: Actively Irrigated Lands within the Greys Sub-Basin

Permit No.	Source	Description	Permitted Acres
17756	Greys River Tributary	Meadows R.S. Irrigation Ditch (Meadow Creek)	18.00
18201	Greys River	Young Ditch No. 1	42.80
18202	Greys River Tributary	Young Ditch No. 2 (Dead Man Creek)	14.50
18205 & 21291	Greys River Tributary	Low Ditch (Meadow Creek)	153.60
<i>Total</i>			228.90

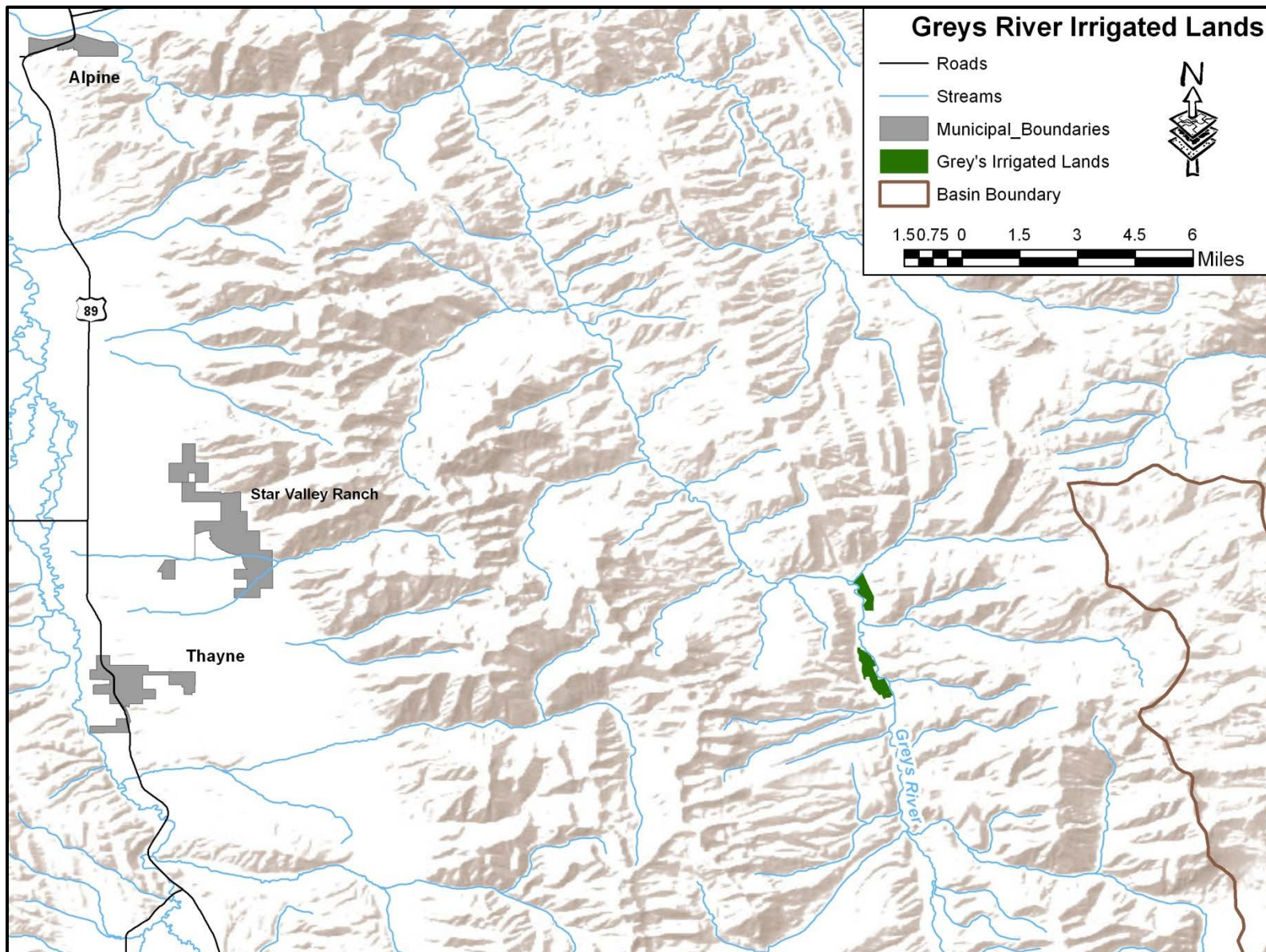


Figure 1: Irrigated Lands within the Greys River Sub-Basin

4.0 Irrigated Lands Summary

The final tally of irrigated lands determined as part of this study is presented in Table 8. With the exception of the Teton Sub-Basin which was not analyzed in the spreadsheet models, these acreages correspond with those used in the analysis of crop water requirements and subsequent input to the spreadsheet models.

Table 8: Irrigated Acreages for the 2012 Update

Description		2012 Acreages
Sub-Basin	Salt (excluding Greys Sub-Basin)	65,190
	Snake (including Hoback Sub-Basin)	28,963
	Teton	4,647
	Greys	229
	<i>Total</i>	99,029
Irrigation Zone	Zone 1: Teton	4,647
	Zone 2: Upper Snake	6,967
	Zone 3: Lower Snake	18,017
	Zone 4: Hoback	3,979
	Zone 5: Lower Salt	33,810
	Zone 6: Upper Salt	31,380
	Zone 7: Greys	229
	<i>Total</i>	99,029

4.1 Acreages Assigned to Model Nodes

Table 9 shows the final acreages that were assigned to each demand node within the spreadsheet models for the 2012 Update. With the exception of the nodes within the Lower Salt irrigation zone and the Greys irrigation zone, the quantities presented in the table represent the direct results of the back-calculations as described in Section 2.3. The acreages for the nodes within the Lower Salt irrigation zone were adjusted as described in Section 2.4.1. In the table, Node 28.02 represents the irrigated lands within the Greys Sub-Basin which were excluded in the spreadsheet models from the previous Basin Plan and therefore not back-calculated. Rather, the acreage within the Greys Sub-Basin was determined during this study as described in Section 3.0. Note also that the irrigation zones in the table depict the addition of the Hoback and Greys irrigation zones that have been added for the 2012 Update. Also, since the Teton Sub-Basin was not modeled in either the previous Basin Plan or for this study, acreage quantities are not represented in the table.

Table 9: Irrigated Acreages Assigned to Demand Nodes in Spreadsheet Models

2012 Basin Node No.	2012 Irrigation Zone	2012 Node Description	2012 Assigned Acres ₁
Salt_1.02	Upper Salt	Headwaters of Salt River	1,015
Salt_1.06	Upper Salt	Diversions on Salt u/s of Cottonwood Creek	3,061
Salt_2.04	Upper Salt	Diversions on Cottonwood Creek	4,725
Salt_4.04	Upper Salt	Diversions on Dry Creek	3,401
Salt_5.04	Upper Salt	Diversions on Salt River between Dry Creek and Swift Creek	466
Salt_6.04	Upper Salt	Upper Diversions on Swift Creek	5,635
Salt_6.06	Upper Salt	Afton Canal	1,965
Salt_8.02	Upper Salt	Headwaters of Spring Creek (trib. To. Crow Creek)	212
Salt_10.04	Upper Salt	Diversions on Crow Creek	3,075
Salt_11.04	Upper Salt	Diversions on Salt River between Crow Creek and Stump Creek	384
Salt_12.04	Upper Salt	Upper Diversions on Stump Creek	773
Salt_12.06	Upper Salt	Lower Diversions on Stump Creek	2,269
Salt_13.04	Upper Salt	Diversions on Salt River between Stump Creek and Toms Creek	3,208
Salt_14.02	Upper Salt	Inflow to Toms Creek	1,193
Salt_16.04	Lower Salt ₂	Upper Diversions on Willow Creek	1,499
Salt_16.06	Lower Salt ₂	Lower Diversions on Willow Creek	1,437
Salt_17.06	Lower Salt ₂	East Side Canal	5,462
Salt_18.04	Lower Salt ₂	Diversions on Strawberry Creek	8,847
Salt_19.04	Lower Salt ₂	Aggregated Diversions on/near Salt River between Strawberry and Cedar	8,273
Salt_20.04	Lower Salt ₂	Diversions on Cedar Creek	1,712
Salt_21.04	Lower Salt ₂	Aggregated Diversions on/near Salt River between Cedar and Lee	1,557
Salt_22.02	Lower Salt ₂	Prater, Green, and Lee Creek	1,126
Salt_24.02	Lower Salt ₂	Birch Creek	1,525
Salt_25.04	Lower Salt ₂	Aggregated Diversions on/near Salt river between Birch Creek and Gage	1,002
Salt_26.02	Lower Salt ₂	Stewart Creek	1,370
Salt_28.02	Greys ₃	Headwaters of Greys River	229
Total Acres Assigned in Salt Spreadsheet Models:			65,419
Snake_5.04	Upper Snake	Lava Creek ditches	216
Snake_8.04	Upper Snake	Wolff Ranch ditches	1,302
Snake_8.06	Upper Snake	Lower Spread Creek and Brush Creek ditches	1,478
Snake_10.04	Upper Snake	Upper Ditch Creek ditches	283
Snake_10.06	Upper Snake	Lower Ditch Creek and Mud Springs ditches	1,190
Snake_12.04	Upper Snake	North bank ditches above Kelly	1,799
Snake_12.06	Upper Snake	Hot Springs Ditch	700
Snake_11.06	Lower Snake	Granite Creek Supplemental and other ditches	1,904
Snake_12.10	Lower Snake	South Park Supply Ditch	1,432
Snake_12.12	Lower Snake	North bank ditches below Kelly	2,141
Snake_12.14	Lower Snake	South bank ditches below Kelly	2,326
Snake_13.04	Lower Snake	East bank ditches	850
Snake_13.06	Lower Snake	West bank ditches	568
Snake_15.04	Lower Snake	Granite Creek ditches	1,587
Snake_16.04	Lower Snake	Lake Creek ditches below Granite Creek	496
Snake_17.04	Lower Snake	Fish Creek ditches above Lake Creek	371
Snake_18.04	Lower Snake	Fish Creek ditches above Wilson gage	157
Snake_18.08	Lower Snake	Fish Creek west side tributaries ditches	260
Snake_18.10	Lower Snake	Lower Fish Creek ditches	128
Snake_19.04	Lower Snake	Snake River ditches between Fish and Spring Creeks	547
Snake_20.04	Lower Snake	West bank Spring Creek ditches	1,197
Snake_20.06	Lower Snake	East bank Spring Creek ditches	80
Snake_22.04	Lower Snake	Flat Creek ditches above Cache Creek	1,801
Snake_23.04	Lower Snake	Miller Ditch	102
Snake_24.04	Lower Snake	South Park ditches above Jackson gage	276
Snake_24.08	Lower Snake	South Park ditches below Jackson gage	1,225
Snake_25.04	Lower Snake	Snake River ditches below Flat Creek	337
Snake_30.04	Lower Snake	Snake River Canyon ditches	233
Snake_26.04	Hoback ₄	Hoback River ditches above Bondurant	3,979
Total Acres Assigned in Snake Spreadsheet Models:			28,963
Total Acres Assigned in Spreadsheet Models:			94,382

1. Tabulations do not include acreage quantities within the Teton Sub-Basin.

2. Acreages for Lower Salt reflect adjustments made to back-calculations.

3. Acreages in Greys River Sub-Basin were not back-calculated; instead, these acreages were determined separately during the 2012 Update. Greys irrigation zone was added during the 2012 Update.

4. Formerly the Lower Snake irrigation zone; Hoback irrigation zone was added during the 2012 Update.

References

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