TECHNICAL MEMORANDUM

TO:	*WWDC*	DATE:	*May 16, 2010*
FROM:	*MWH*	REFERENCE:	*Wind-Bighorn Basin Plan*
SUBJECT:	*Task 4B – Spreadsheet Model and Hydrologic Database*		

The purpose of this technical memorandum is to provide a summary of the spreadsheet model updates and the development of a hydrologic database developed as part of the Wind-Bighorn Basin Plan Update (Basin Plan Update). The memorandum provides a brief review of the spreadsheet models, describes changes to the spreadsheet models made as part of this work, and describes and documents the new hydrologic database developed to store and process hydrologic, diversion and reservoir data for use in the spreadsheet models. The document fulfills the reporting requirements for a portion of Task 4B of the consultant scope of work for the Wind-Bighorn Basin Plan Update. The remaining documentation requirements of Task 4B and the results of the spreadsheet models are contained in Technical Memorandum 4C – Surface Water Availability and Technical Memorandum 6 - Future Water Use Project Opportunities and Program Strategies. Additional information pertaining to hydrology can be found in Technical Memorandum 4A – Surface Water Hydrology, while surface water diversions, consumptive use, return flows, and reservoir operations are contained in Task 3 memoranda.

This technical memorandum contains the following sections. Within each section are tables and figures containing the data for each of the main study area basins.

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Section 1 – Introduction

The spreadsheet models developed for the previous Wind-Bighorn Basin Plan (previous Basin Plan) were used for the Basin Plan Update. These spreadsheet models were documented in Technical Memorandum 3B/3C – Spreadsheet Model Development and Calibration (MWH 2003) of the previous Basin Plan. Except for updates to input data sets (documented in other technical memoranda as part of the Basin Plan Update) and the changes documented within the text of this memorandum, the spreadsheet models remain mostly unchanged from the previous Basin Plan. Because most of the

model description and operations remain the same as the previous Basin Plan, rather than repeating information, previous Technical Memorandum 3B/3C is included as Appendix A of this document.

The most extensive modification to the spreadsheet models is the development of a hydrologic database that is incorporated directly into the spreadsheet model by being dynamically queried to populate the spreadsheet model input datasets. Previous versions of the spreadsheet model incorporated "cut-and-paste" methods from separate spreadsheet data sources to populate the spreadsheet models. The updated methods provide a much quicker and more reliable method for populating the spreadsheet models, and maintain a historical documentation of calculation methods. The database was configured to allow migration to other basin plans.

Section 2 – Hydrologic Database

A hydrologic database entitled "WindBig_Hydro.mdb" was developed using the Microsoft Access database platform to house all of the hydrologic datasets required by the spreadsheet models. Macros coded in Visual Basic for Applications (VBA) were developed within the database program to process raw data into full monthly datasets, and to develop the dry-average-wet year hydrologic datasets used by the spreadsheet models. The remainder of the calculations required to process datasets use standard Microsoft Access query techniques.

The database contains the following general datasets required by the model:

- Streamflow Data – Includes daily USGS gage data, monthly State of Wyoming, Wyoming State Engineer's Office (WSEO) gage data, daily Bureau of Reclamation Hydromet data, and regression equation information used to fill missing streamflow data (see Technical Memorandum 4A – Surface Water Hydrology for description of specific data)
- Natural Flow Data – Natural flow data nodes and site data (imported from GIS layers), and equations used for natural flow calculations (see Technical Memorandum 4A – Surface Water Hydrology for description of specific data)
- Historical Diversion Data – WSEO Division III daily spot data and monthly continuous flow data (see Technical Memorandum 3A – Agricultural Water Use for description of specific data)
- Crop Irrigation Requirements (CIR) and Diversion Requirements (DR) – Input data and calculations for CIR and DR, including irrigated acres polygons (imported from GIS layers), cropping pattern information (imported from USDA database) and efficiencies
- Reservoir Data – Historical reservoir data, including end-of-month storage contents, evaporation and estimated releases.
- Spreadsheet Model Data – Model nodes and descriptions

Because of the complex calculations required to calculate the input datasets from raw data, the number of tables and queries contained within the database, and the inter-relationship between the tables and queries is rather complicated. Key data tables in the database are shown in Table 1, while a general schema of the database including key queries and macros is shown in Figure 1.

The following sub-sections describe in more detail the types of data developed by the database, raw datasets required for its construction and techniques used to develop model input datasets. The text and descriptions included are intended to provide a basic level of instruction for updating datasets in the future and applying the database to other basin planning studies.

Table 1. WindBighorn_Hydro Database Key Input Data Tables

Type	Table	File Source	Original Source	Data Type[1]	When to Update[2]	Description
All	tblDates	NA	NA	Info	N/A	Correlates water years, water months and water days to calendar years, calendar months and calendar days. Has data through 2080.
All	tblDates_DaysInMonth	NA	NA	Join	N/A	Indicates the number of days in each month as used by the calculations.
All	tblNodes	model_nodes.xls	Model Setup	Info	With New Model	Contains a list of model nodes and serves as a master table to link many types of data.
Diversions	tblDiv_Continuous	div_dat_daily_load2.xls	Division III Engineer	Raw	Study Period Update	SEO continuous diversion data records.
Diversions	tblDiv_Master	divnode_master.xls	Model Setup	Info	With New Model	Master table for measured diversion data. Matches diversion data sets to model nodes.
Diversions	tblDiv_Spot	div_dat_daily_load2.xls	Division III Engineer	Raw	Study Period Update	SEO spot diversion data records.
Diversions	tblGrowSeas	divnode_master.xls	Model Setup	Info	With New Model	Growing season by CIR station. Used to exend spot diverison data.
Hydrology	tblHydro_Gages	WindBighorn_Hydro.xls	USGS NWIS website and model data	Info	With New Model	Master list of gages that are included in the study, including gage names, whether the gage is a key gage, the key gage that it depends on. Used for developing DAW year hydrology.
Hydrology	tblHydro_Hydromet_Daily	WindBighorn_Hydro.xls	USBR Hydromet website	Raw	Study Period Update	Daily Reclamation Hydromet data.
Hydrology	tblHydro_KeyGageDAW	Access macro	Constructed by "BuildDAW" macro	Const	Study Period Update	Dry-Avg-Wet year delineation for key gages in study period. Must be build after new data is imported and extended.
Hydrology	tblHydro_KeyGageDAW_POR	Access macro	Constructed by "BuildDAW_POR" macro	Const	Study Period Update	Dry-Avg-Wet year delineation for key gages for data period-of-record. Must be build after new data is imported and extended.
Hydrology	tblHydro_Misc_Month	N/A	N/A	Raw	Study Period Update	Miscellaneous monthly data required for model.
Hydrology	tblHydro_RegEqn	WindBighorn_Hydro.xls	Model Setup	Info	With New Model	Contains regression equations used to fill monthly streamflow data.
Hydrology	tblHydro_SEO_Month	WindBighorn_Hydro.xls	Division III Engineer	Raw	Study Period Update	Contains monthly streamflow data from Division III continuous flow records.
Hydrology	tblHydro_Streamflow_Month	N/A	Constructed by "BuildDat" macro	Const	Study Period Update	Filled monthly streamflow for the study area. Constructed by running the "BuildDat" macro, which applies regression equations to raw data to build datasets for the study period.
Hydrology	tblHydro_Tables	N/A	N/A	Join	With New Model	Contains linkages between raw data tables and associated queries for use by the "BuildDat" macro. Would only require updating if a new data source table were added.
Hydrology	tblHydro_USGS_Daily	WindBighorn_Hydro.xls	USGS NWIS website	Raw	Study Period Update	Daily USGS streamflow data.
Hydrology	tblPrecip	WindBighorn_Hydro.xls	Western Regional Climate Center	Raw	Study Period Update	Contains raw monthly precipitation data for any stations that are used to fill or extend streamflow datasets.
Irrigation	tblIrrig_CIR	CIR Data_Updated.xlsx	Irrigated Lands GIS overlain on CIR	Raw	With Change in Data	CIR data for irrigated lands polygons. From GIS overlay of irrigated lands polygons on monthly CIR raster images.
Irrigation	tblIrrig_Crops_USDA_Pochop	N/A	N/A	Join	With New Model	Relates crops in the USDA tables to crops used by Pochop in CIR estimates.
Irrigation	tblIrrig_Eff	model_nodes.xls	Varies	Info	With Change in Data	Irrigation efficiency by month.
Irrigation	tblIrrig_GrassElev	N/A	N/A	Info	With New Model	Contains the elevation within each county for which above the elevation, crops grown assumed to be grass hay only.
Irrigation	tblIrrig_Land	County Overlay.xls; GIS layer	Model Setup	GIS	With Change in Data	Irrigated lands polygons and associated data.
Irrigation	tblIrrig_USDA 1927-2007 Cropping Patterns	USDA 1927-2007 Cropping Patterns.xlsx	http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/	Raw	With Change in Data	Contains USDA National Ag Statistics Service data. Used to develop cropping patterns.
Natural Flow	tblNatFlow_Eqn	N/A	Varies	Info	With New Model	Equations used for natural flow data.
Natural Flow	tblNatFlow_Key	N/A	N/A	Join	With New Model	Links return interval for natural flow equations to Dry, Avg and Wet year hydrologic scenarios.
Natural Flow	tblNatFlow_Sites	Updated_NFB_withPrecipfinal.xls; GIS Layer	N/A	GIS	With New Model	Natural flow basins and associated data.
Reservoirs	tblRes_EOM	res_dat.xls	Varies	Raw	With Change in Data	Historical end-of-month reservoir data. For all but Reclamation reservoirs, estimated based on calibration. Reclamation reservoirs based on historical data.
Reservoirs	tblRes_Evap	res_dat.xls	Varies	Raw	With Change in Data	Reservoir evaporation data.
Reservoirs	tblRes_Gages	model_nodes.xls	N/A	Info	With New Model	Links reservoirs with data in tables other than the standard tables (tblRes_EOM, tblRes_HistRel) to those nodes.
Reservoirs	tblRes_HistRel	res_dat.xls	Varies	Raw	With Change in Data	Historical reservoir release data. For all but Reclamation reservoirs, estimated based on calibration. Reclamation reservoirs based on historical data.
Reservoirs	tblRes_Nodes	res_dat.xls	N/A	Info	With New Model	Reservoir nodes.

Notes
[1] Data Type key: Info – General Information; Raw – Raw Data; Join – Join/link table between other tables; Const – Constructed from Macros
[2] When to Update key: Study Period Update – When study period is updated; With new model – No update unless a new model is developed or if models are modified; Change in Data – When underlying data is modified.

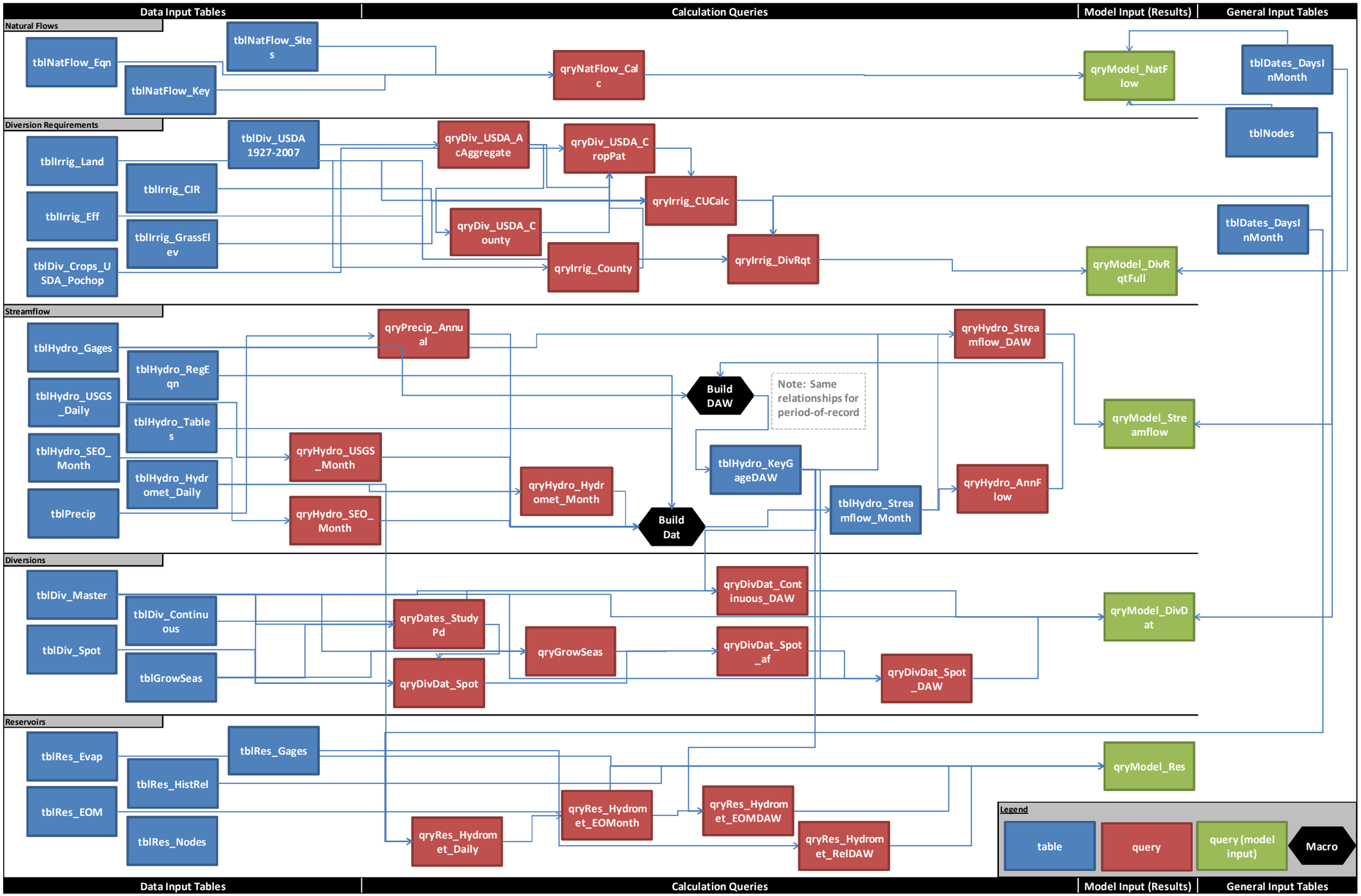


Figure 1. WindBighorn_Hydro Database Schema

Streamflow Data

The hydrologic models require monthly streamflow data for dry, average and wet year hydrologic conditions. The primary source of raw streamflow data used to build the streamflow datasets is United States Geological Survey (USGS) National Water Information System (NWIS) daily streamflow data available from the internet. This data is automatically loaded from the internet to the WindBighorn_Hydro database using macros in the Microsoft Excel file "WindBighorn_Hydro.xls." Data is stored in the "tblHydro_USGS" database table.

Several other raw datasets are used to supplement the USGS streamflow data, including monthly continuous flow data from the WSEO Division III Superintendent ("tblHydro_SEO_Month"), Bureau of Reclamation Hydromet daily data ("tblHydro_Hydromet_Daily"), and monthly precipitation data ("tblPrecip"). Division III data and Hydromet data can be loaded directly from the "WindBighorn_Hydro.xls" spreadsheet file. Precipitation data is simply loaded "by hand" into the database table. One final table, "tblHydro_Misc_Month," can be used to store any additional data. For the Wind-Bighorn Basin Plan Update, this table stores a dataset that was calculated in the previous Basin Plan, and cannot be replicated in the database because the data is no longer available.

The first step in processing streamflow data for use in the spreadsheet models is filling missing data and extending data sets for the entire study period. Correlations with other datasets are developed outside of the database tool, with the resulting independent data set identification and correlation equations input in the "tblHydro_RegEqn" table. The format of the correlation equations must match those of the other equations in the table. All correlations and data filling are performed on a monthly basis. A VBA macro is run to perform the actual data filling. This macro can be accessed and run in the "Macros" object by running the "BuildDAW" button. Filled monthly streamflow data is stored in the "tblHydro_Streamflow_Month" database table. The study period is changed in the "qryDates_StudyPd" query using the selection criteria. If the study period is changed, the macro must be re-run.

The next step in the streamflow data production process is to determine which years within the study period are averaged within the dry, average and wet year hydrologic conditions. "Key Gages," or the gages that are used to make these determinations, are specified in the "IAmKeyGage" field of the "tblHydro_Gages" database table. Classification of each year within the study period for the key gages is performed by running the "BuildDAW" macro. Results from this classification are stored in the "tblHydro_KeyGageDAW" table. An additional macro and table can be developed for the entire period-of-record at key gages using the "BuildDAW_POR" macro.

The final steps in processing streamflow data are to average data for all gages within each of the hydrologic study periods. This is performed automatically using built-in queries once the datasets are built. The "tblHydro_Gages" table specifies which key gage is used to process dry, average and wet year flows for each streamflow gage. The "qryHydro_Streamflow_DAW" query table stores the processed streamflow data. The "qryModel_Streamflow" query, which adds model node numbers to the previous query, stores the final streamflow data set that is accessed by the spreadsheet models.

For the Basin Plan Update, all streamflow data sources, periods-of-record, regression equations and results are discussed in the Technical Memorandum 3A – Surface Water Hydrology.

Natural Flow Data

Natural flow is used in the basin planning models to estimate natural inflows to streams upstream of diversions and gages within the Wind-Bighorn Basin (Basin). Natural flows are estimated using basin characteristics such as basin area, average annual precipitation, mean basin elevation, slope, etc. All of the parameters used for the calculations are static variables (i.e. the variables don't change over

time) except for precipitation. Equations are taken from previous studies, with the equations entered into the "tblNatFlow_Eqn" table.

Natural flow basin data is stored in the GIS layer "Updated_NFB_withPrecipfinal". The database for this layer can be directly imported into the "tblNatFlow_Sites" table within the WindBighorn_Hydro database. Precipitation for the Wind-Bighorn Basin was updated using GIS overlays of the natural flow basin polygons on PRISM precipitation data. Once this data is entered, no additional steps are required to produce final natural flow results – the results are calculated directly by the "qryNatFlow_Calc" query. The query "qryModel_NatFlow," which adds node numbers to the dataset calculated in the previous query, stores the final values that are imported directly into the model.

For the Wind-Bighorn Basin Plan Update, all natural flow basin data, equations and results are discussed in the Technical Memorandum 4A – Surface Water Hydrology.

Historical Diversion Data

Historical diversion data is available from the WSEO Division III Superintendent in two types of formats: continuous data and spot data. Continuous data originates from continuous data recorders at major diversions (and streamflow gage stations for streamflow data) throughout the Basin. This continuous flow data is then processed by Division III into average daily flow at the stations. These datasheets are eventually stored in annual Commissioners' Reports. Through 2008, the only useable electronic form of the data is the pdf files that are included in the Commissioners' Report. Therefore, monthly summary values are hand input into the database. Data through 2001 was available from the previous Basin Plan. Data from 2002 through 2008 was input as part of the Basin Plan Update. An intermediate spreadsheet file "div_dat_daily_load2.xls" was used to load the data. All continuous data is stored as monthly data in the table "tblDiv_Continuous." Unlike streamflow data, diversion data is not filled or extended.

Spot data is data that is recorded during periodic visits by commissioners to smaller diversions scattered throughout the study period. Depending upon the number of times that headgate adjustments are required, the amount of regulation needed on particular reaches of streams, and hydrologic conditions, the number of data points can vary from several per year to several per week. This data is currently stored by Division III in database files that are easily imported into the WindBighorn_Hydro database as daily flow values. Data prior to 2001 was hand input during the previous Basin Plan process and imported to the database using the intermediate spreadsheet file "div_dat_daily_load2.xls." Data for 2002 was hand input through the same spreadsheet as part of the Basin Plan Update. Databases for 2003 through 2008 were imported directly into the database. Daily spot flow data is stored in the "tblDiv_Spot" table.

Summarizing spot data can be a more complex process than summarizing continuous flow data. In the previous Basin Plan, spot data was summarized using a fairly complex method of estimating initial start-up of each dataset based upon the start of the growing season, and linearly interpolating daily flow values between daily flow measurements. As discussed in Technical Memorandum 3A – Agricultural Water Use, instantaneous flow data points were simply averaged through the month. Starting and ending dates for irrigation seasons were taken from Consumptive Use and Consumptive Irrigation Requirements in Wyoming (Pochop, 1992), and used to average monthly values for the first and last months of the growing season (e.g. if there were only 15 days in the first month of the growing season, then the average flow values were averaged only during those days). The daily flow values were then converted to monthly volumes and summed for each month. It was determined that this method was as accurate or more accurate than that used in the previous plan because typically, diversions do not change linearly from day to day as assumed in the previous Basin Plan. Reductions of daily spot flow data is contained in the query "qryDivDat_Spot_af." As with continuous flow data, spot diversion data is not filled or extended.

Both types of historical diversion data are then processed into dry, average and wet year average historical diversions in the queries “qryDivDat_Continuous_DAW” and “qryDivDat_Spot_DAW”. Key streamflow gages used for this reduction are contained in the table “tblDiv_Master.” Finally, the two data tables are combined into a single query “qryModel_DivDat” that is used to import data into the spreadsheet models.

For the Wind-Bighorn Basin Plan Update, all diversion data is described and summarized in Technical Memorandum 3A – Agricultural Water Use and Technical Memorandum 3B – Municipal and Domestic Water Use.

Irrigation Requirements

Consumptive Irrigation Requirements and Division Requirements are calculated directly in the WindBighorn_Hydro database using several different input datasets, including irrigated lands, CIR GIS overlays and resulting database, cropping patterns, and efficiencies. The calculations are described in Technical Memorandum 3A – Agricultural Water Use. The storage of raw data sets and the steps used for various calculations are described below.

Data on irrigated lands is imported from the irrigated lands GIS layer. This layer contains information including irrigated area for each polygon, county, county_study (which allows the small amount of irrigated land in Natrona County to use data for Fremont County in the analysis), polygon elevation, model node, facility name and source, and land cover, including a determination of whether the polygon is currently irrigated or a Tribal Futures Project. The irrigated lands layer is based upon the Framework Water Plan irrigated lands layer with the modification described in Tech Memo 3A, with the additional overlay for the required information. The irrigated lands database is contained in the table “tblIrrig_County.” Any additional irrigated lands polygons need to be inserted into this table.

As described in Tech Memo 3A, spatially variable Consumptive Irrigation Requirements for crops grown in the Basin were developed by the Water Resources Data System (WRDS) in GIS format. Those GIS layers were used as part of the Basin Plan Update to estimate monthly CIR for each crop for each irrigated lands polygon. Simple GIS overlays were performed in ArcGIS 9.3. The resulting data table for each overlay is combined into a single large data table that is imported and stored in the WindBighorn_Hydro database table “tblIrrig_CIR.” Fields in this table include the unique irrigated land polygon identifier, the crop type, month and CIR.

To determine the actual CIR for each irrigated land polygon, a cropping pattern is required. Cropping pattern percentages are multiplied by the CIR for each crop, then added together to get total CIR for the irrigated land polygon. Cropping pattern data calculations are based on USDA historical crop irrigation data for the counties within the Basin. This data is stored in the table “tblIrrig_USDA 1927-2007 Cropping Patterns”, which is a direct import of the data tables available from the USDA (USDA, 2009). This data is then processed into cropping patterns for each county in the query “qryDiv_USDA_CropPat.” The query is currently set up to use the average of 2004 through 2006 crop data for the cropping patterns used in the model, but can easily be modified by changing the query criteria in the query design.

As described in Tech Memo 3A, because the USDA crop data does not include data for the entire study area, and because most of the unreported acreage is likely grass hay, an elevation was established above which all irrigated lands are assumed to be grass hay, and below which all lands assume the USDA cropping patterns. These elevations are stored in the table “tblIrrig_GrassElev.” The query “qryIrrig_CUCalc” then determines which cropping pattern to apply, multiplies the cropping pattern, CIR for each crop, and irrigated acreage to determine total CIR in acre-feet for each irrigated land polygon.

Diversion requirements depend upon irrigation efficiencies. Monthly irrigation efficiencies are stored in the table "tblIrrig_Eff," and are assigned based upon "Efficiency Stations" throughout the study area. More description of these stations and development of the data is presented in Tech Memo 3A. Irrigated land polygons are joined to efficiency stations by assigning each node in the model to one of the efficiency stations. Diversion requirements are then calculated in the table "qryIrrig_DivRqt" by multiplying monthly CIR by monthly efficiencies.

CIR and diversion requirement calculations do not vary by hydrologic condition. Therefore, no additional processing is required to use this data in the spreadsheet models. The final query "qryModel_DivRqtFull" processes the diversion requirements into a format that is useable by the model and is imported directly into the model as described below.

Reservoir Data

Reservoir data includes data that is calculated using historical end-of-month reservoir contents and releases, evaporation data and reservoir nodes. Monthly evaporation data in inches is stored in the table. For the Wind-Bighorn Basin Plan, this data was loaded using the "res_dat.xls" spreadsheet. This evaporation data is then loaded in the model table and used directly by models.

The database can load end-of-month contents from either the Hydromet daily data file (which also contains streamflow data) "tblHydro_Hydromet_Daily", or from data that is already formatted for end-of-month contents contained in the table "tblRes_EOM". The table "tblRes_Gages" contains a table indicating which datasets and variables in the Hydromet table comprise the data for end-of-months contents. Two queries "qryRes_Hydromet_EOMonth" and "qryRes_Hydromet_EOMDAW" are used to transform daily Hydromet data in the dry-average-wet year end-of-month contents used in the model. Data in the "tblRes_EOM" is loaded as preformatted data from "res_dat.xls" and used directly in the model.

The database can load reservoir releases as gaged flow from any other node in the model (used when a USGS gage is located directly downstream of a reservoir) or as preformatted data in the "tblRes_EOM" table which is populated from the "res_dat.xls" file. The table "tblRes_Gages" is used to specify which gage data is used for releases.

A listing of reservoir nodes, which ties reservoirs to specific model nodes, is contained in the table "tblRes_Nodes." All reservoir data, including end-of-month contents, reservoir releases and evaporation, is compiled for use in the model in the query "qryModel_Res."

For the Wind-Bighorn Basin Plan Update, all reservoir data is described and summarized in Technical Memorandum Task 3F – Water Use from Storage.

Spreadsheet Model Data

The database includes several tables that contain general information utilized by several other tables and queries within the database. The primary table is the "tblNodes" table, which primarily serves to tie several of the tables to model nodes used in the spreadsheet models. Primary key fields include the field "BNodeNo" which contains the unique model node number within the Basin (a single letter indicating the model basin, and node in the numeric form ##.####), node description, reach, basin, model, gage number and efficiency station. This data was loaded into the model using the spreadsheet file "model_nodes.xls." However, in the future, changes can be made directly in the table. Any additional model nodes need to be inserted into this table.

Two other tables are used to track dates within the model. The table "tblDates" contains all dates within the study period and several years beyond, and relates these dates to calendar years, calendar

months, water years and water months. A second table "tblDates_DaysInMonth," contains the number of days in each month for use in converting values in cubic feet per second (cfs) to acre-feet (ac-ft).

Section 3 – Spreadsheet Model Improvements

As previously stated, the spreadsheet model construction remains mostly the same as the previously developed spreadsheet models. These models are fully documented in the previous Technical Memorandum 3B/3C, which is included as Appendix A of this document. The remaining portion of this section discusses those changes that were made to the spreadsheet models as part of the Basin Plan Update. These changes include the incorporation of dynamic hydrologic database queries directly into the spreadsheet models, the development of a single spreadsheet model file rather than separate spreadsheet files for each hydrologic condition, and the development of a new model interface spreadsheet file that allows running all models at the same time rather than running each model individually. Each of these improvements is inter-related, and entirely dependent upon the new database connection. These improvements are described below.

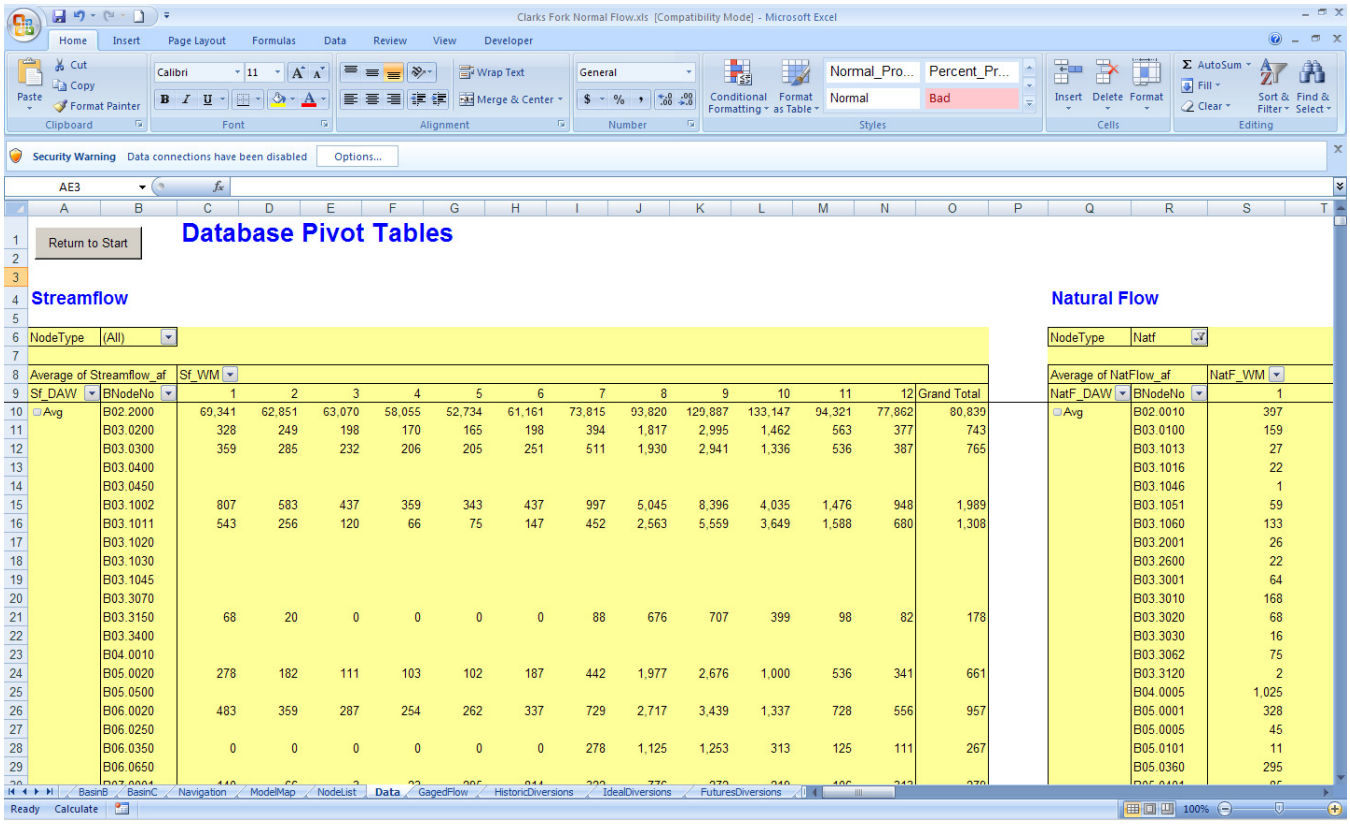
It should be noted that although the models continue to be save as Microsoft Excel 97-2003 workbooks (*.xls), some of the functions used to make the modifications are only available in Microsoft Excel 2007 or newer versions. Thus, the models must be opened and run in Microsoft Excel 2007 or newer versions.

Integration of Hydrologic Database

A new worksheet was inserted into each model that contains pivot table reports which query data directly from the WindBighorn_Hydro database. Separate pivot table reports were set up to query each type of data used by the model from the database. Table 1 presents a summary of the pivot table queries contained on the "Data" worksheets in the model, while Figure 2 presents a screen capture of the "Data" worksheet.

Table 2. Spreadsheet Model Pivot Tables

Pivot Table Query	WindBighorn_Hydro Database Table	Worksheet Where Data is Used in Model
Streamflow	qryModel_Streamflow	GagedFlow
Natural Flow	qryModel_NatFlow	GagedFlow
Historical Diversions	qryModel_DivDat	HistoricDiversions
Diversion Requirements	qryModel_DivRqtFull	IdealDiversions
Reservoir Data	qryModel_Res	Evaporation



Return to Start

Database Pivot Tables

Streamflow

NodeType	(All)

Average of Streamflow_af	Sf_WM												
Sf_DAW	BNodeNo	1	2	3	4	5	6	7	8	9	10	11	12	Grand Total
Avg	B02.2000	69,341	62,851	63,070	58,055	52,734	61,161	73,815	93,820	129,887	133,147	94,321	77,862	80,839
	B03.0200	328	249	198	170	165	198	394	1,817	2,995	1,462	563	377	743
	B03.0300	359	285	232	206	205	251	511	1,930	2,941	1,336	536	387	765
	B03.0400													
	B03.0450													
	B03.1002	807	583	437	359	343	437	997	5,045	8,396	4,035	1,476	948	1,989
	B03.1011	543	256	120	66	75	147	452	2,563	5,559	3,649	1,588	680	1,308
	B03.1020													
	B03.1030													
	B03.1045													
	B03.3070													
	B03.3150	68	20	0	0	0	0	88	676	707	399	98	82	178
	B03.3400													
	B04.0010													
	B05.0020	278	182	111	103	102	187	442	1,977	2,676	1,000	536	341	661
	B05.0500													
	B06.0020	483	359	287	254	262	337	729	2,717	3,439	1,337	728	556	957
	B06.0250													
	B06.0350	0	0	0	0	0	0	278	1,125	1,253	313	125	111	267
	B06.0650													

Natural Flow

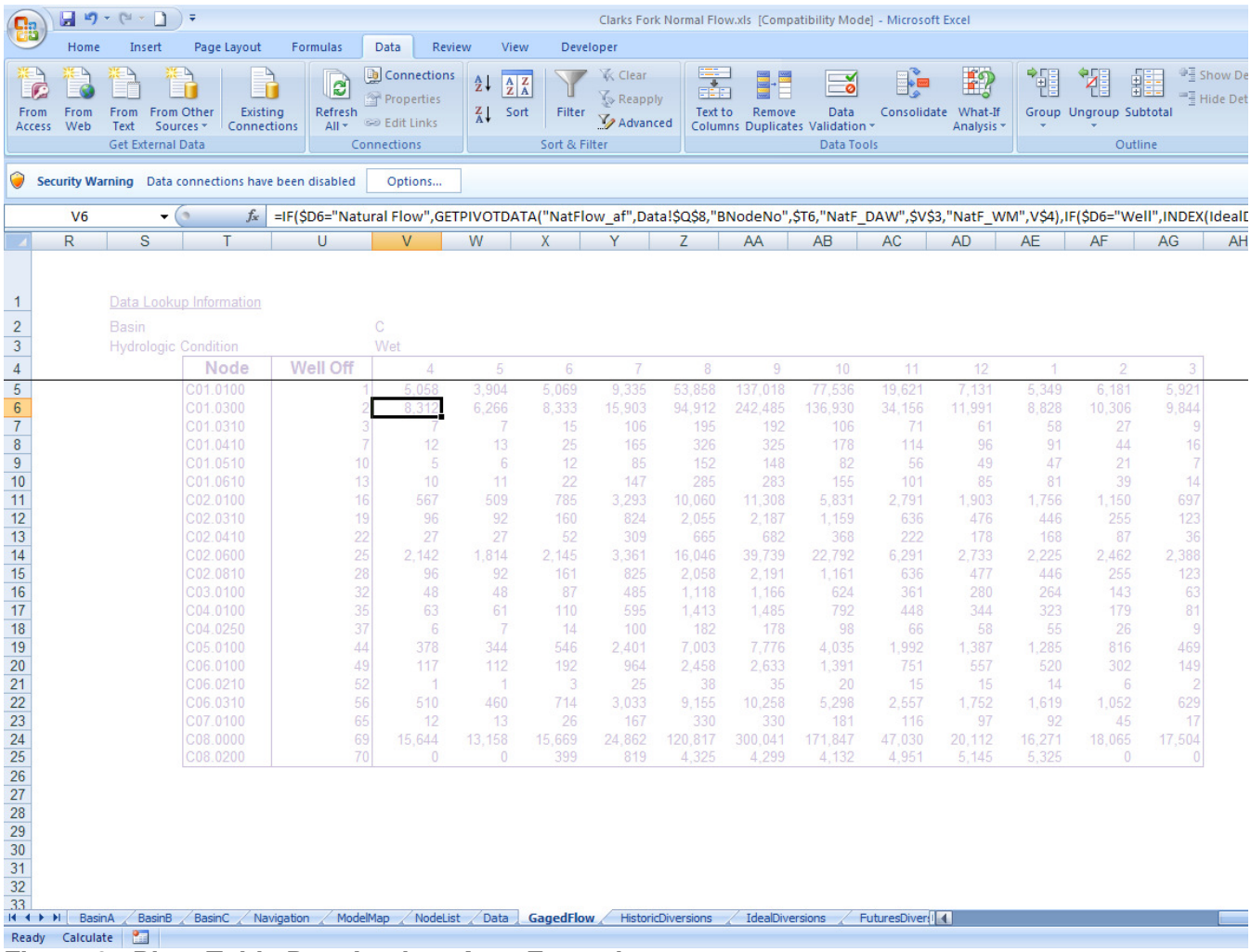
NodeType	Natf

Average of NatFlow_af	NatF_WM
NatF_DAW	BNodeNo	1
Avg	B02.0010	397
	B03.0100	159
	B03.1013	27
	B03.1016	22
	B03.1046	1
	B03.1051	59
	B03.1060	133
	B03.2001	26
	B03.2600	22
	B03.3001	64
	B03.3010	168
	B03.3020	68
	B03.3030	16
	B03.3062	75
	B03.3120	2
	B04.0005	1,025
	B05.0001	328
	B05.0005	45
	B05.0101	11
	B05.0360	295

Figure 2. Spreadsheet Model "Data" Worksheet

To update the pivot tables, they first must be linked back to the database on the local computer. Once this link is established, it remains intact unless the database file is moved. Furthermore, each pivot table contains a separate link to the database, so the link must be updated for each pivot table. The link can be updated using the pull down menu sequence "Data\Connections\Properties\Definition" and browsing for the correct location of the database. The user must ensure that the correct table is loaded from the database file. The name of the table for each pivot table connection is contained in the "Command Text" window for each pivot table definition. Once the connections are established, the data in the tables can be updated by simply selecting either "Refresh" or "Refresh All" from the "Data" menu. Links only need to be refreshed if data in the database has been modified.

Data from the pivot tables is loaded into worksheets in the model where data is used (see Table 2) using the "GETPIVOTDATA" function in Microsoft Excel. This function is formatted to automatically load the correct data for the model node and month indicated in the table. A separate area within each spreadsheet has been established for loading this data. An example of this table for gaged flow data in the Clarks Fork model is presented in Figure 1. Light purple text has been used in the data lookup tables to indicate their function. These tables are then simply referenced by the main data tables within each worksheet. All of these references are automatically tied to the pivot tables, including the hydrologic condition. As described in the following sub-section, the automated data queries have allowed the same spreadsheet file to run all three hydrologic conditions rather than loading data for each condition into separate model files. This automation significantly reduces the possibility of cut-and-paste errors when inputting new data into the models.



Node	Well Off	4	5	6	7	8	9	10	11	12	1	2	3
C01.0100	1	5,058	3,904	5,069	9,335	53,858	137,018	77,536	19,621	7,131	5,349	6,181	5,921
C01.0300	2	8,312	6,266	8,333	15,903	94,912	242,485	136,930	34,156	11,991	8,828	10,306	9,844
C01.0310	3	7	7	15	106	195	192	106	71	61	58	27	9
C01.0410	7	12	13	25	165	326	325	178	114	96	91	44	16
C01.0510	10	5	6	12	85	152	148	82	56	49	47	21	7
C01.0610	13	10	11	22	147	285	283	155	101	85	81	39	14
C02.0100	16	567	509	785	3,293	10,060	11,308	5,831	2,791	1,903	1,756	1,150	697
C02.0310	19	96	92	160	824	2,055	2,187	1,159	636	476	446	255	123
C02.0410	22	27	27	52	309	665	682	368	222	178	168	87	36
C02.0600	25	2,142	1,814	2,145	3,361	16,046	39,739	22,792	6,291	2,733	2,225	2,462	2,388
C02.0810	28	96	92	161	825	2,058	2,191	1,161	636	477	446	255	123
C03.0100	32	48	48	87	485	1,118	1,166	624	361	280	264	143	63
C04.0100	35	63	61	110	595	1,413	1,485	792	448	344	323	179	81
C04.0250	37	6	7	14	100	182	178	98	66	58	55	26	9
C05.0100	44	378	344	546	2,401	7,003	7,776	4,035	1,992	1,387	1,285	816	469
C06.0100	49	117	112	192	964	2,458	2,633	1,391	751	557	520	302	149
C06.0210	52	1	1	3	25	38	35	20	15	15	14	6	2
C06.0310	56	510	460	714	3,033	9,155	10,258	5,298	2,557	1,752	1,619	1,052	629
C07.0100	65	12	13	26	167	330	330	181	116	97	92	45	17
C08.0000	69	15,644	13,158	15,669	24,862	120,817	300,041	171,847	47,030	20,112	16,271	18,065	17,504
C08.0200	70	0	0	399	819	4,325	4,299	4,132	4,951	5,145	5,325	0	0

Figure 3. Pivot Table Data Lookup Area Example

Single Spreadsheet Model Files

The previous Basin Plan, and all other basin plans, used separate model files to house model runs for each hydrologic condition (dry, average and wet), and separate model files to house each of the two (or three in the case of the Wind River Basin model) scenarios that are run with the models (Calibration and Full Supply). This results in six separate model files for most model basins, and nine separate model files for the Wind River Basin models, which include an additional run for the Full Supply with Futures Projects scenario. Predictably, with the amount of data that is required for each model run, errors can easily occur in the models.

The establishment of automated data queries from the WindBighorn_Hydro database allows the models to be reconfigured so that a single spreadsheet file can be used to run all hydrologic conditions and all scenarios. The data used to make these runs is always contained within the model, so absent an update of the queries from the database, the same data is always used for each run, and all results are reproducible.

To allow selection of various scenarios, the “Navigation” worksheet within each model has been modified with two sets of “radio buttons.” A screen capture of the modified “Navigation” screen is presented in Figure 4. The first set of buttons is located within the frame below the “Model Settings” label, and allows selection of the following scenarios:

- Calibration (Historical)

- Full Supply for Existing Irrigated Lands
- Full Supply for Existing Irrigated Lands and Futures Project (Riverton East)
- Full Supply for Existing Irrigated Lands and Futures Projects (All)

The second set of buttons located within the frame under the Hydrologic Settings label contains radio buttons (buttons that can be selected to change values) that allow the user to select a dry, average or wet year run. This information is then stored on the Navigation worksheet, and the information is referenced by the pivot table functions in the data storage worksheets (e.g. “GagedFlow”, “HistoricalDiversions”, “IdealDiversions”, etc.) to select the correct data for the run.

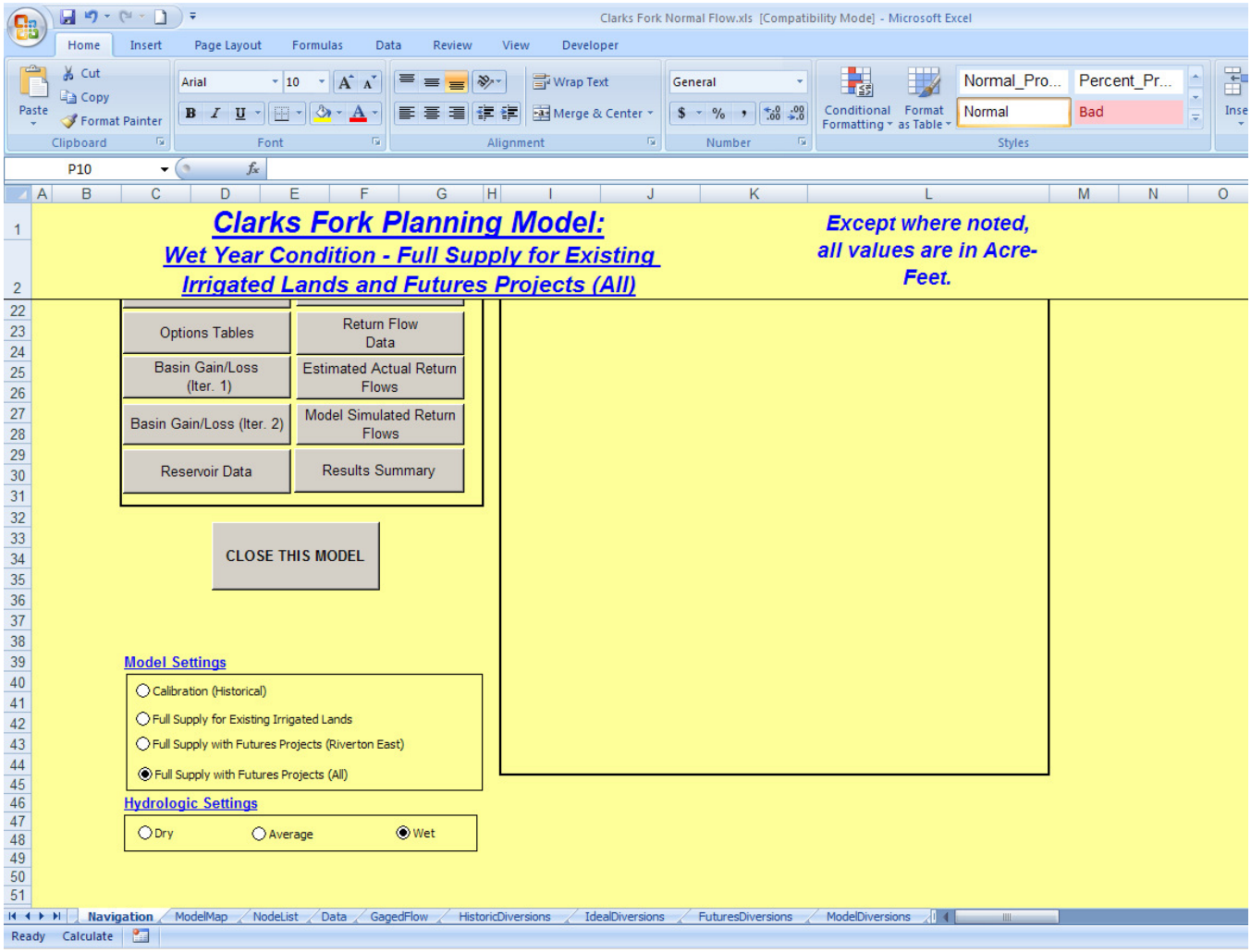


Figure 4. Modified Navigation Worksheet for Spreadsheet Models

The exception to the discussion above is the Popo Agie Basin models. Further information on changes to the Popo Agie models is contained in later sub-sections.

Calibration Automation

As discussed in the calibration section of the original spreadsheet model documentation (See Section 7 in Appendix A), one of the primary variables used in model calibration is the percentage of full supply diversions that are used in the model. In many cases, especially for smaller diversion on tributaries, the full diversion requirement is not met. If the model incorrectly assumes that the full diversion requirement is met, then the model will incorrectly compute ungaged gains and losses in the reach.

Therefore, when natural flow or historical streamflow data is modified in the model, the percentage of historical diversions met must also be recalculated.

Because there are over 500 diversion nodes in the model, recalibration of percent of diversions met on a monthly basis can be time intensive. Therefore, for purposes of the recalibration procedure, an automated procedure was developed that steps through each month, each model node and each hydrologic condition and automatically calculates these percentages. The buttons used to run these macros are shown in Figure 5. The first button labeled “Calibration Selection” can be used to calibrate only those nodes and hydrologic conditions that are selected. When selecting a node using this procedure, only one hydrologic condition can be selected and all months for the node must be selected. The hydrologic condition on the Navigation worksheet must match that for the nodes selected. The second button labeled “Calibrate All” automatically calibrates all nodes for all hydrologic conditions. For both buttons, when calibrating, the “Calibration (Historical)” model setting must be selected on the Navigation worksheet. All calibrations are performed on the datasets in columns V through BE.

All models except the Popo Agie models were recalibrated using the updated automated calibration method for percent of historical streamflow. No other calibration parameters were modified as part of the calibration process.

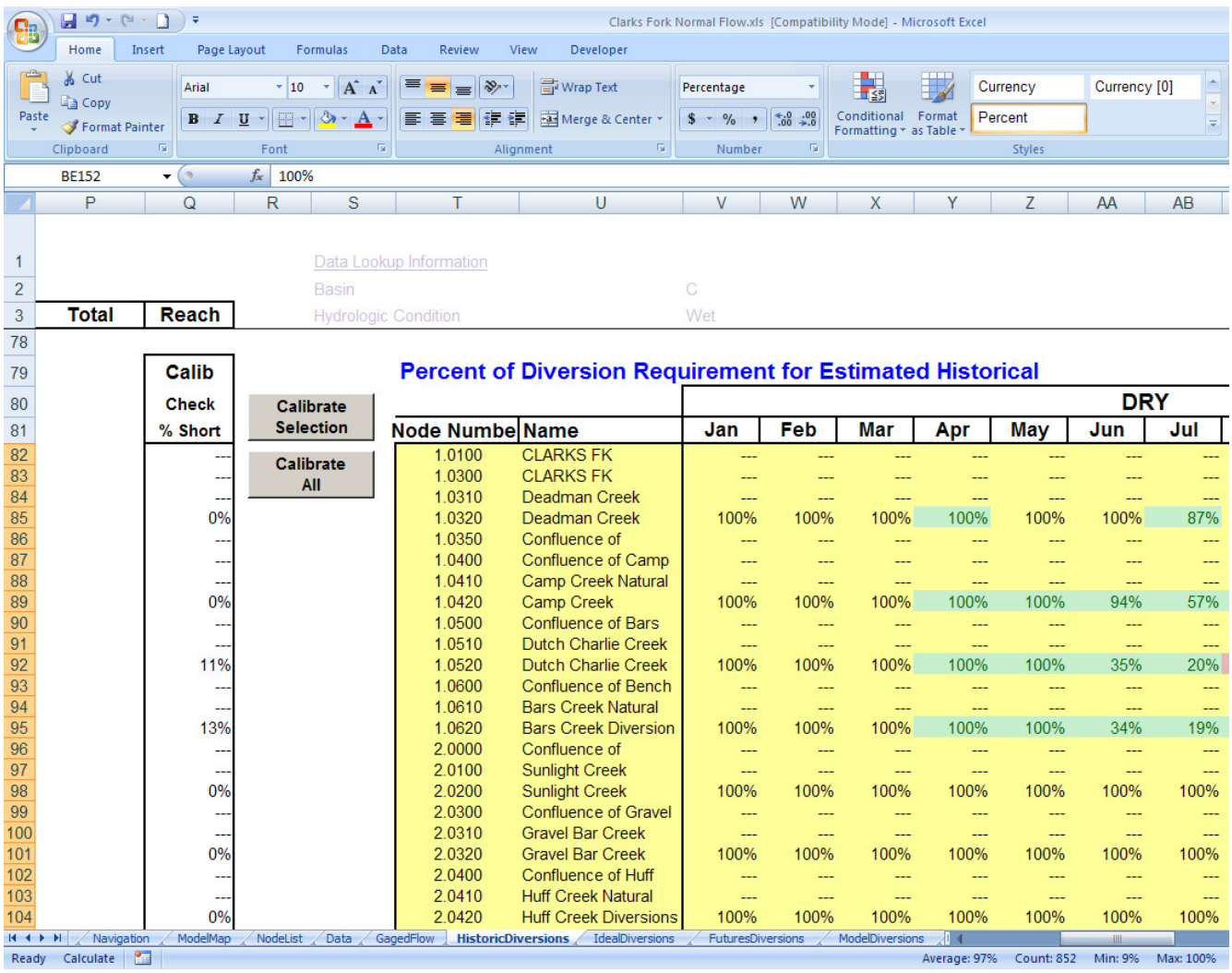


Figure 5. Model Calibration Automation Section

Run Automation

The original basin model setup was designed for river basin planning activities that involved running one model for two different scenarios. In the Wind-Bighorn Basin study area, this involves 14 different basin models. Additionally, all of the models in the Wind and Bighorn basins are linked together because water flows from one model to another. Therefore, performing a single model run for the entire Basin was a time-consuming process and subject to potential error.

To streamline running all models for a single scenario, a new batch model run spreadsheet was developed that allows input of the model scenario and hydrologic condition variables, and running up to three of these scenarios for all models at a single time. This dramatically speeds running the models and avoids errors that can be caused by running the models one at a time. Currently, this file is entitled "TM4C – model_results_sum.xls." A screen capture of the "Run_Mod" worksheet within this file is presented in Figure 6. The file contains the following sections:

- Runs – Contains radio buttons to select hydrologic conditions and the scenario for each model run. Up to three model runs can be performed at a single time. In addition, cells are included that allow specification of the output file name that is used to store output for this run.

- Settings – Currently, the only option in this portion of the worksheet is to automatically update the pivot tables within each model.

- Files - This section specifies the directory and models that are run in this batch. In addition, columns are included that allow specification within each model where the hydrologic condition is specified and the scenario is specified. Additionally, a "yes/no" column allows specification of whether separate files are used for each hydrologic condition. This was inserted for specification of the separate Popo Agie models.

- Run Models – When this button is pushed, a macro is started that runs all of the models for the specified number of runs and associated settings.

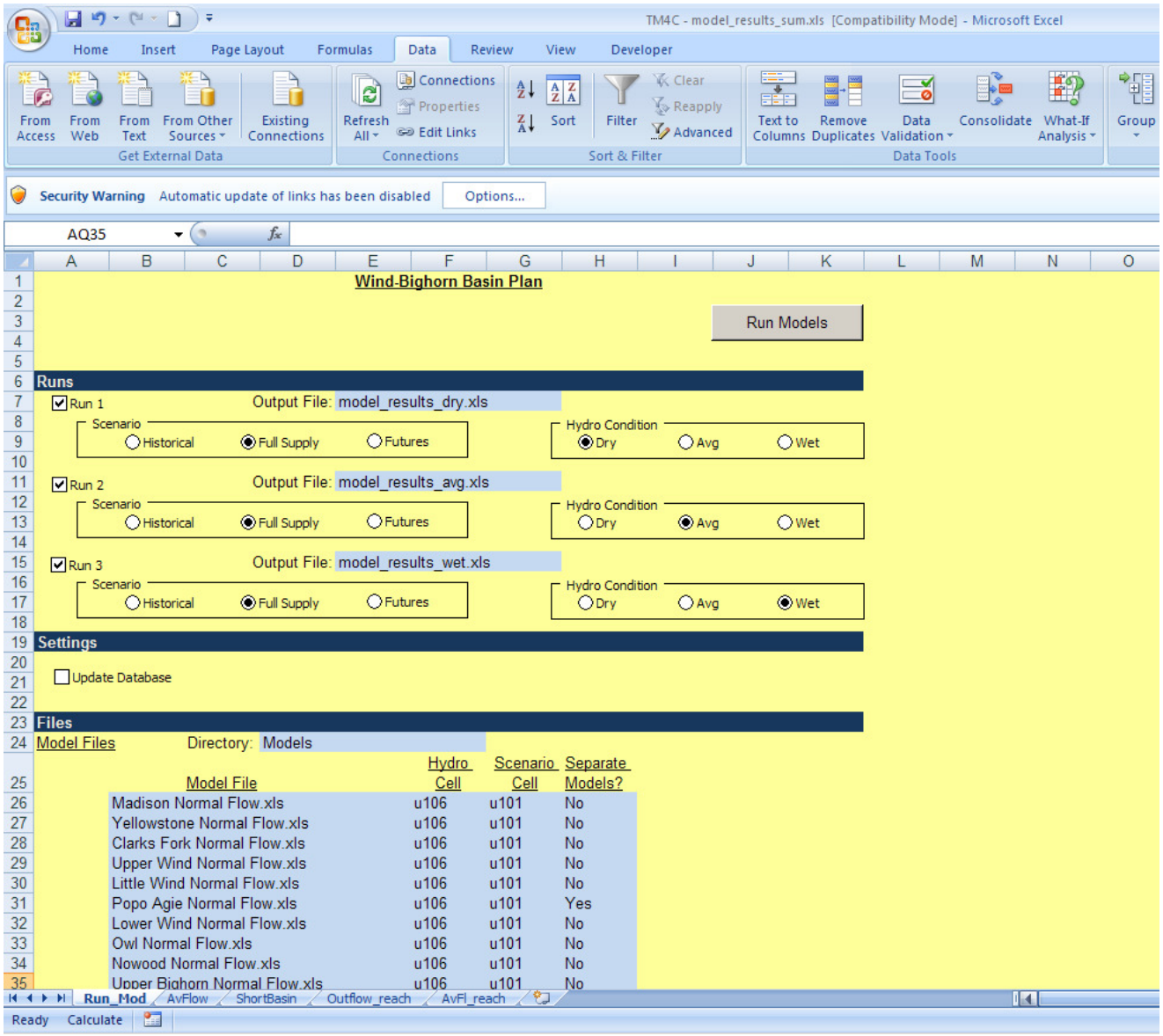


Figure 6. Run_Mod Worksheet from Batch Model Run Excel File

In addition to containing an input page that allows input settings for each run, the new spreadsheet also loads general results for each model from the output files that are specified for each run. These results are stored in the remaining worksheets in the file.

Popo Agie Model Modifications

The Popo Agie models were developed in a different format as part of the Popo Agie Watershed Plan (ACE, 2003) and have a series of spreadsheet files for data import. Rather than completely reconfiguring these models to match the format of the remaining Wind-Bighorn Basin models, the model formats were left as is, maintaining their ability to be used with the Graphical User Interfaces developed as part of the Popo Agie Watershed Plan. However, during incorporation of the models into the Wind-Bighorn Basin Plan Update, some changes were made to the models. These changes were as follows:

- The reach worksheet for reach 4.1 contained 2 occurrences of node 4.1.12 Snavely – Grant Young. This resulted in double-accounting of this diversion node in the model. To remedy this issue, the second occurrence was deleted.
- The diversion summary sheet was modified to properly sum reach 4.1. These changes are noted in the models.
- The "Data" worksheet was inserted into the Popo Agie models. The only data used from the "Data" worksheets in the Popo Agie models is streamflow. All other data in the Popo Agie models was not modified as part of the Basin Plan Update.
- The Basin Plan Update maintains separate models for Futures Projects. However, in order to be consistent with other Futures Projects simulations, the "Diversion Data" worksheet was modified to query the "Data" worksheet for the Futures Project, and to add this to the nodes that simulate Futures Projects within the model.

Unlike the remaining models in the Wind-Bighorn Basin Plan, these models continue to have separate models for each hydrologic condition, and separate models for "Full Supply" and "Futures" scenarios.

It is recommended that in future Basin Plan updates, consideration be given to transferring the Popo Agie Basin Model to the same spreadsheet model and database connections as the remaining models for the Basin. Tasks required to perform this update include:

- Updating the Popo Agie model to a version that is consistent with the other spreadsheet models in the basin
- Validating assignment of polygons to each model node
- Updating hydrology and diversion requirements
- Recalibrating of the model
- Rerunning the model for the planning scenarios described in the report
- Updating tech memos 3A, 4B and 4C with the new information
- Updating the report with the new information

Other Modifications

The following adjustments were made to specific other models in the Basin:

- Greybull River Model – The previous models contained a node for Greybull Valley Reservoir (Roach Gulch Reservoir). However, the reservoir was not simulated for Full Supply conditions. Furthermore, long-term average EOM storage contents and release data are not available for the reservoir because it is new. Therefore, additional data blocks were added to the "Evaporation" worksheet in the Greybull model to provide operational data for Greybull Valley Reservoir. Reservoir release data for the reservoir was estimated based on shortages simulated without the reservoir in place.

Section 4 – Use of Spreadsheet Models for Basin Plan Update

Two of the main uses of the model for the Basin Plan Update are the available surface water determination and the Basin shortages. Summary calculations for these two measures are performed in the model results workbooks "model_results_dry.xls", "model_results_avg.xls", and "model_results_wet.xls". These summary workbooks are accessed from the "TM 4C – model results_sum.xls" workbooks. Within the model results workbooks, the following calculations are performed:

- Available Flow: By definition in this Basin Plan Update, available flow is the amount of flow that could be diverted from the river without affecting other diversions, meeting compact requirements and meeting permitted instream flows. Therefore, the available flow calculations

look at available flow in all reaches downstream of the reaches being calculated as well as available flow within the compact and the available flow given instream flow permits. Data is contained on the “FlowDat” worksheet in the results workbook, while calculations are performed in the “Compact” worksheet and “AvFlow” worksheets in the results workbook.

- Shortages: Shortage calculations are performed by subtracting actual simulated diversions from full supply diversion requirements for each model reach. Full supply diversion requirements are contained on the “ModelDiversions” worksheet in the models while simulated diversions are contained on the “DiversionSummary” worksheet in the models. The model results data is contained on the “MaxDiv” worksheet, “ModDiv” while calculations are performed on the “Shortage” worksheet in the results workbook. Calculations are not performed for individual model nodes, although this calculation could be performed using the same methodology if desired.

The results workbooks also contain calculations and graphs that compare available flow to shortages, simulated flow with instream flow targets and simulated flow with boating targets. Additional summary comparisons are contained in the “TM 4C – model_results_all.xls” workbook.

Section 5 – Summary

The spreadsheet models developed as part of the previous Basin Plan were used as a basis for the work completed in the Basin Plan Update. The models were updated to include updated hydrology and diversions, improvements in data storage and access, and the ability to automate calibration and multiple model runs.

The most extensive modification to the spreadsheet models was the development of a hydrologic database entitled “WindBig_Hydro.mdb” using the Microsoft Access database platform to house all of the hydrologic datasets required by the spreadsheet models. Macros coded in Visual Basic for Applications (VBA) were developed within the database program to process raw data into full monthly datasets, and to develop the dry-average-wet year hydrologic datasets used by the spreadsheet models. The remainder of the calculations required to process datasets use standard Microsoft Access query techniques. The database contains historical streamflow, natural flow estimations, historical diversion data, full supply diversion requirements, and reservoir data. The database is linked directly into the spreadsheet models using external “Pivot Table” links.

In addition to the hydrologic database, several other improvements were made to the spreadsheet models, including conversion of the models to a single model containing switches for each hydrologic condition and each model run scenario, automation of the percent of full supply diversions for model calibration, and the ability to perform batch model runs for all models for several different model settings. Each of these improvements was designed to make the models more user friendly, easier to update in the future, and quicker to run. Most of the changes made to the other basin models were not made to the Popo Agie Basin models so that they remain consistent with past work in the Popo Agie River Watershed Plan. Some minor corrections were made to the models and streamflow was updated with the current model study period.

Results of the models are contained in separate technical memoranda including Technical Memorandum 4C – Available Surface Water Determination and Technical Memorandum 6 - Future Water Use Project Opportunities and Program Strategies.

Section 6 – References

Anderson Consulting Engineers, Inc. (ACE). 2003. Popo Agie River Watershed Plan supporting documentation and spreadsheets. Accessed from file Popo-Agie-Spreadsheet-Navigator.xls.

MWH. 2003. Technical Memorandum Task 3B/3C – Spreadsheet Model Development and Calibration. Wind/Bighorn River Basin Plan. March.

Appendix A –Technical Memorandum 3B/3C from Original Basin Plan

Notes:

1. Only includes main text and Appendix A. Appendix B, calibrated streamflows and gain/losses are no longer valid because models were recalibrated. See individual models for calibrated streamflows and gains/losses.

2. Irrigated acreages shown in table “Diversion Node Summary Table” no longer valid. See WindBighorn_Hydro database for summary.

3. Document is embedded as an Adobe Acrobat object. If file is open in Microsoft Word, right click on document page, and click “Open Adobe Acrobat Object”.

TECHNICAL MEMORANDUM

MWH

Subject: **Wind/Bighorn River Basin Plan**

Task 3B/3C – Spreadsheet Model Development and Calibration

Date: **January 2003 (Revised March 2003)**

Prepared By: **MWH Americas, Inc.**

This Technical Memorandum reviews the development and calibration of spreadsheet models used to investigate general surface water availability for the Wind/Bighorn River Basin Plan. The document fulfills the reporting requirements of the remaining portion of Task 3B from the original contract not included in the Task 3A/3B Technical Memorandum and Task 3C from the contract.

This technical memorandum contains the following sections. Within each section are tables and figures containing the data for each of the main study area basins.

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Section 1 - Spreadsheet Model Introduction

The Guidelines for Development of Basin Plans (WWDC, 2001) and WWDC required that the river basin planning models be consistent with the other models that have already been developed. The original spreadsheet model was developed by Anderson Consulting Engineers for the Bear River Basin, which was the initial pilot study for the river basin planning process. That model was utilized as a base model for the Green River Basin Plan by Boyle Engineering, which was subsequently used by HKM as a base model for the Powder-Tounge and Northeast River Basin Plans. Improvements in the model were made upon each successive iteration of the model, including improvements in data entry, calculation methodologies and the Graphical User Interface (GUI). Consequently, this model documentation closely resembles documents prepared for the projects above, both in regards to document layout and document contents. Because the previous reports and models were used as templates for the Wind/Bighorn River Basin models, there may be portions of this documentation that are identical to the previous reports. This is not specifically noted in every instance with a reference, but credit is given to the previous consultants for the guidance that their documents provided.

The WWDC dictated that the models developed for the various river basins across the state be consistent and that the models be developed using software available to the average citizen. The Bear River basin plan was the first to be performed. Anderson Consulting Engineers, the model developer for this plan, selected Excel as the software to be used for model development. The spreadsheet model developed for the Bear River basin then defined the software and the modeling approach to be used for all subsequent Basin Plans (Anderson, 2000). The Bear River model was passed onto Boyle Engineering, the model developer for the Green River basin, to be used as a template for model development in that basin (Boyle, 2001). The Green River basin models were subsequently passed on to HKM to be used as a template for the Powder/Tongue River models (HKM, 2001). It should be recognized that the models are quite general in nature and although they provide a reasonable indication of water availability on any given stream,

caution should be exercised in drawing conclusions from the results about individual diversions or water uses.

A map of the Wind/Bighorn River Basin Plan study area is shown in Figure 1-1. The study area includes those Missouri River basins located in northwestern Wyoming, including those portions of the Madison River Basin, Gallatin River Basin, Yellowstone River Basin and Wind/Bighorn River Basin located within the State of Wyoming. Table 1-1 shows the USGS Hydrologic Unit classifications that are included in the plan and the models that are associated with each of the Hydrologic Units. As shown, the study area has been divided into 12 models. The models generally follow the same areas as the study sub-basins, with the following exceptions:

- the Madison and Gallatin sub-basins have been combined into one model;
- the Little Wind sub-basin includes the outflow gage from the Popo Agie sub-basin. The Popo Agie sub-basin has been modeled as part of the Popo Agie River Watershed Study and is not modeled as part of this work or discussed further in this document;
- the Lower Wind model includes the Lower Wind and Badwater sub-basins;
- the Lower Bighorn model includes the Bighorn Lake and Dry Creek sub-basins.

Table 1-1. USGS Hydrologic Units and Associated Models Included in Study Area

Model	Study Basin	Study Sub-Basin
Madison/Gallatin	Madison/Gallatin	Madison
		Gallatin
Yellowstone	Yellowstone	Yellowstone
Clarks Fork	Clarks Fork	Clarks Fork
Upper Wind	Wind	Upper Wind
Little Wind	Wind	Little Wind
		Popo Agie[1]
Lower Wind	Wind	Lower Wind
		Badwater
Owl Creek	Big Horn	Upper Bighorn [2]
Nowood	Big Horn	Nowood
Upper Bighorn	Big Horn	Upper Bighorn
Greybull	Big Horn	Greybull
Shoshone	Big Horn	Shoshone
Lower Bighorn	Big Horn	Bighorn Lake
		(Dry)

Notes:

(1) The Popo Agie River basin is modeled in the Popo Agie River Watershed study. This model contains an inflow node for the Popo Agie River that incorporates these results.

(2) The Upper Bighorn sub-basin was split between the Owl Creek model and the Upper Bighorn model.

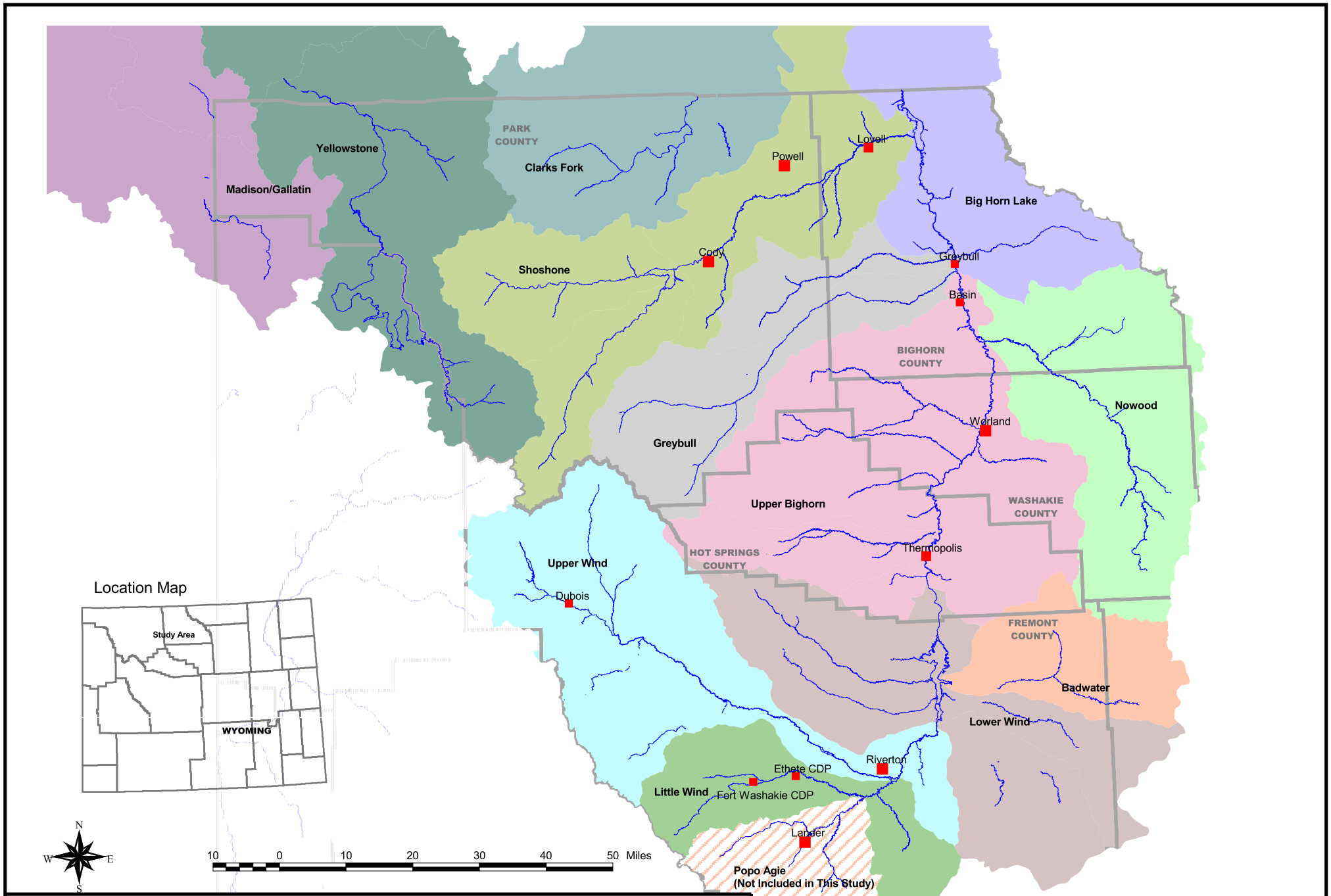

Figure 1.1
Study Area Map

January 2003

Wyoming Water Development Commission

Wind/Bighorn Basin Advisory Group

BRS ENGINEERING

MWH MONTGOMERY WATSON HARZA
Denver, Colorado

1.1 Model Overview

The models are intended to simulate existing river operations for dry, average and wet year hydrologic periods. In general, existing operations are reflected in the historical operations within the study period. As discussed in the Task 3A/3B Technical Memorandum Surface Water Hydrology (MWH, 2002), this was the basis for selecting the study period, 1973-2001. In a few instances where existing conditions are different that either a portion or all of the historical conditions, special provisions in the data input and modeling calibration were required and are documented within the calibration section of this technical memorandum.

The primary data required for the spreadsheet models are streamflow, actual (or estimated actual) diversions, full supply diversions, irrigation returns and reservoir operations. For each of these, the data within the study period was reduced into dry, average and wet year data. The reduction of streamflow data, including the calculation of natural flow data for those tributaries that do not contain diversions, is described in the Surface Water Hydrology Technical Memorandum (MWH, 2002). Development and reduction of actual diversion data is discussed Technical Memorandum Irrigation Diversion Operation and Description (BRS, 2003) Task 2A Technical Memorandum Agricultural Water Use and Diversion Requirements (MWH, 2003a), while the estimation of actual diversion for those diversions without actual measurements is discussed later in this Technical Memorandum.

The model is run on a monthly timestep for the given calendar year of the hydrologic condition (dry, average, and wet). Starting reservoir levels are the same as the historical end-of-month contents on the last day for that hydrologic condition (i.e., the dry year model starting contents in January is the historical dry year end-of-month contents in December).

The basic model calculation procedure is shown in Figure 1-2. Natural flows for each main channel and tributary are either taken from gage data (preferred but not normally available) or estimated using the regional regression techniques as describe in the Task 3A/3B Technical Memorandum Surface Water Hydrology (MWH, 2002). Then, the incremental gains and losses are calculated for each reach. This is performed by locating the first downstream gaged node and constructing a "basin" containing all of the known upstream inflows, diversions and reservoir operations. The basins often contain many tributaries to the gaged node. Once the ungaged gains and losses are calculated, they are distributed to each reach within the basin by pro-rating the gains and losses based upon the reach's contribution to the gage flow. Ungaged gains are applied at the top of the reach to allow for diversion, while the ungaged losses are applied to the bottom of the basin to allow diversion of computed inflows.

Once the ungaged gains and losses are calculated, a mass balance (or water budget) is computed at each node. At nodes other than storage nodes, the amount of flow available to the next downstream node is calculated as the difference between known inflows, such as tributary inflows, return flows, basin gains and imports, and outflows, such as diversions, basin losses and exports. At storage nodes, the losses due to evaporation and the gains/losses due to change in storage are included in the calculations. Diversions are limited to the lesser of the full supply diversion and the physical streamflow. The mass balance is performed from upstream to downstream for each node in the reach, and for each reach in the model.

Model output includes the following:

- comparisons of the full supply diversion to the model simulated diversion at each of the diversion nodes;
- calculation of streamflow at each node in the model;
- available flow for each reach.

The model has been modified as explained in later sections of this technical memorandum to allow estimation of impacts on streamflow and diversions of various water projects, including Tribal Futures projects and storage projects. The model can also be modified to estimate impacts due to storage projects, instream flow water rights, or other water development projects.

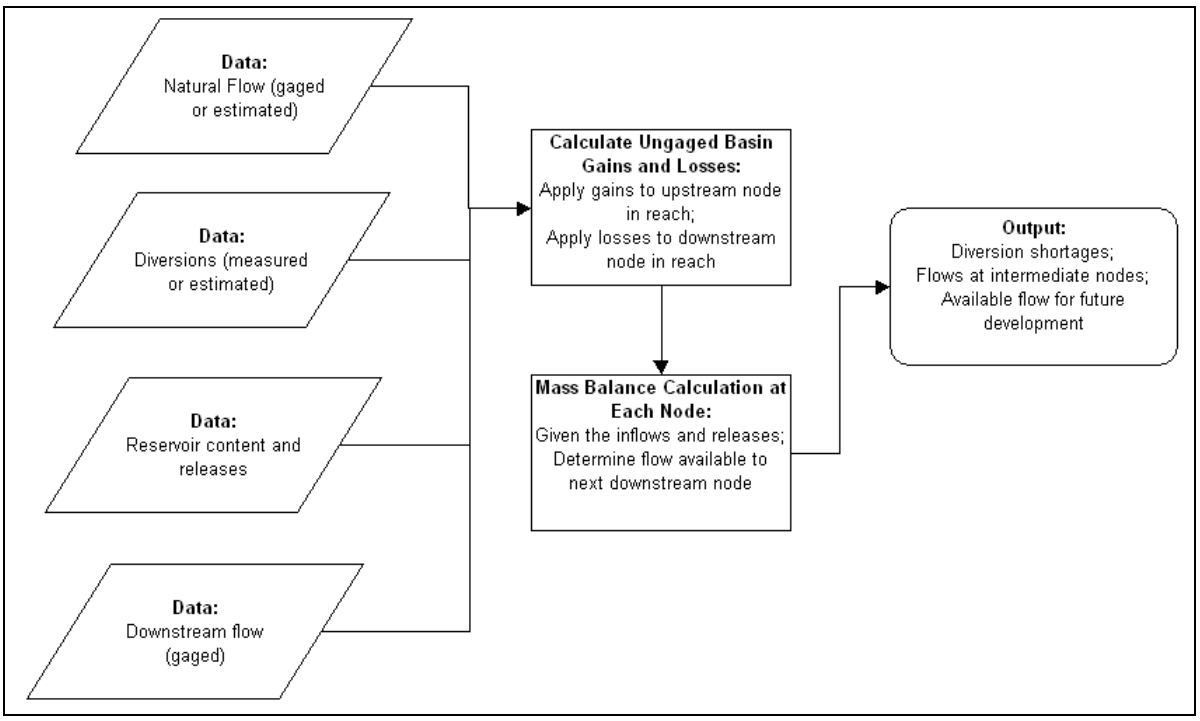

Figure 1-2. Generalized Model Flowchart

The limitations of the model should be noted:

- The model does not explicitly account for water rights, appropriations or compact allocations and is not operated on these legal principals. For instance, the model cannot forego a diversion to an upstream junior water right to satisfy a downstream senior water right. However, due to the construction and calibration procedure, if this situation happened historically, it would be reflected in the model construction (the junior would show a shortage).

- The model does not "operate" storage reservoirs to meet downstream demands, nor can the model differentiate between different owners of storage accounts. The model only uses historical reservoir releases and satisfies the diversions in order of their physical location on

the stream. However, as with water rights, the historical operations and diversion of stored water is normally reflected in the historical records.

- Because the model does not contain time-series hydrology, it does not perform a detailed analysis of carryover storage. This is important when a dry year is followed by a dry year. As the model is constructed, it shows the starting reservoir level as the September end-of-month contents during an normal year, which does not necessarily simulate a drought (although this specific scenario could be at least partially analyzed in the model by varying starting storage contents). However, the importance of filling and emptying large reservoirs over a number of years is not explicitly analyzed in the model.

1.2 Model Development

As with the previous river basin plans, the models for the Wind/Bighorn River basin plans were developed using Microsoft® Excel 97. All computations within the workbooks are performed using formulas written in the cells of the workbooks. The workbooks also contain macros that are used only for navigation between the various worksheets in the workbooks. The model calculations are completely automated so that when data is changed in any cell, the entire model is updated. The one exception is when data is shared between models. The procedures for sharing data between models is discussed in more detail later in this document.

As requested by WWDC, the models were developed for the novice Excel user. Basic proficiency in spreadsheet usage is required to view results and to make minor changes to input data and variables. However, to input additional nodes or reaches in the model, a more advanced level of proficiency is required. Interactive buttons have been placed throughout the spreadsheets to allow for easier navigation between the spreadsheets. All “tabs” and “row-column headers” within the model have been activated ad it was found that for most users, this information is useful to view. Also, due to the size and calculation time of the models, “manual calculation” has been selected as the calculation procedure. In this mode, model calculations are not performed until the users hits the “F9” key on the keyboard. Extreme caution should be exercised by those wishing to made construction changes to the model construction.

1.3 Model Structure and Components

Each of the models contains spreadsheets (or workbooks) consisting of several worksheets (or pages). Each worksheet either contains specific data related to the model, performs a related portion of the calculations, or contains output data. Consistent with the previous basin models, there are five basic types of worksheets, each containing a set of named worksheets.

- Navigation Worksheets: Contain the Graphical User Interface buttons and “home” level for the navigation system. The worksheets include:

  Navigation
  ModelMap
  SummaryNavigation

- Input Worksheets: Contain the raw data for the model, such as streamflow, measured diversions, full supply diversions and return flows. This group also contains a worksheet that pulls data from other models. The worksheets include:

  Node List
  Gaged Flow
  HistoricDiversions
  IdealDiversions
  FuturesDiversions
  ModelDiversions
  Evaporation
  Options
  RFData
  ImportExport
  ModelImport

- Computation Worksheets: Computes ungaged basin gains and losses, return flows and reservoir evaporation. The worksheets include:

  HistoricReturns
  ModelReturns
  GainLossCalcs
  ModGainLossCalcs
  GainLossSummary

- Reach/Node Worksheets: Perform the mass-balance (or water budget) calculations. The worksheets include:
  - an individual worksheet for each reach named "Reach###" where ### is the reach number;
  - charts for each basin named "Basin$" where $ is the basin alphanumeric label.

- Results Worksheets: Tabulate and present model output. In addition, a worksheet that contains data transferred to other models is contained in this group of worksheets.

  OutflowSummary
  DivrersionSummary
  ModelExport

Within the remainder of this technical memorandum, each component of the models is discussed in greater detail. The following notes are included where deemed appropriate:

Engineering Notes: Detailed discussion of methodologies, assumptions, and sources used in the development of that component;

Calibration Notes: Discussion on how this component of the model was used during model calibration;

User Notes: Instructions for model users.

The final main section of this technical memorandum contains programmers' notes. These notes are specifically targeted at those users who are seeking to make modifications to the model construction, such as adding nodes, analyzing alternatives or updating data.

Section 2 - Model Schematics

The physical structure of each model is represented in the river basin schematics and the reach schematics. Separate schematics have been developed for each model. The development of these schematics is discussed in the following paragraphs. Because of their size, the river basin schematics are included in the map pockets at the rear of this document, and labeled as Plates 1 through 12. The reach schematics are shown in Figure 2-1 through Figure 2-12.

2.1 River Basin Schematics

The river basin schematics are detailed link-node representations of the river basins. The schematics include nodes representing streamflow gages, natural flow nodes, diversion nodes, lumped diversion nodes, points of confluence and specific points of return flows if not already represented by a node. The nodes are connected by a series of links that represent the actual flow of water (normally in a stream) between the nodes. It should be noted that for visual clarity, the schematics are connected by straight links and are not to scale. Normally, the general flow direction through the schematic mirrors the actual flow direction, with north pointing towards the top of the schematic.

The following guidelines were used in developing the schematics:

- Streamflow gages have been included on the schematics and in the model even if they were not used as streamflow nodes in the model. The model simply calculated flow at these nodes.

- All diversions that diverted 10 cfs or more as shown in the 2000 Division 3 Hydrographer's Report (SEO, 2001) were explicitly included as a node and explicitly modeled. Diversions less than 10 cfs were lumped together into one node unless they were the only diversion on a tributary, the only diversion between two larger diversions, or the only diversion between two other types of nodes. The names of the diversions included in each node are shown on the schematics. The modeling of diversions is discussed later in this document.

- Only reservoirs with permitted capacities of 500 acre-feet or greater have been included in the model and shown on the schematics.

River basin schematics were initially constructed by MWH, then sent to a list of schematic reviewers who had either volunteered or were selected based on their knowledge of the river basins. Comments were received from these reviewers and incorporated into the schematics as appropriate.

2.2 Reach Schematics

The reach schematics are simplified versions of the river basin schematics that are developed on a "reach" basis. Reaches are a group of nodes that represent an entire tributary or a portion of the main river. As discussed in later sections, the model calculations and water availability are generally performed and reported on a reach basis. The reach schematics are also used for navigational purposes within the model Graphical User Interface (GUI).

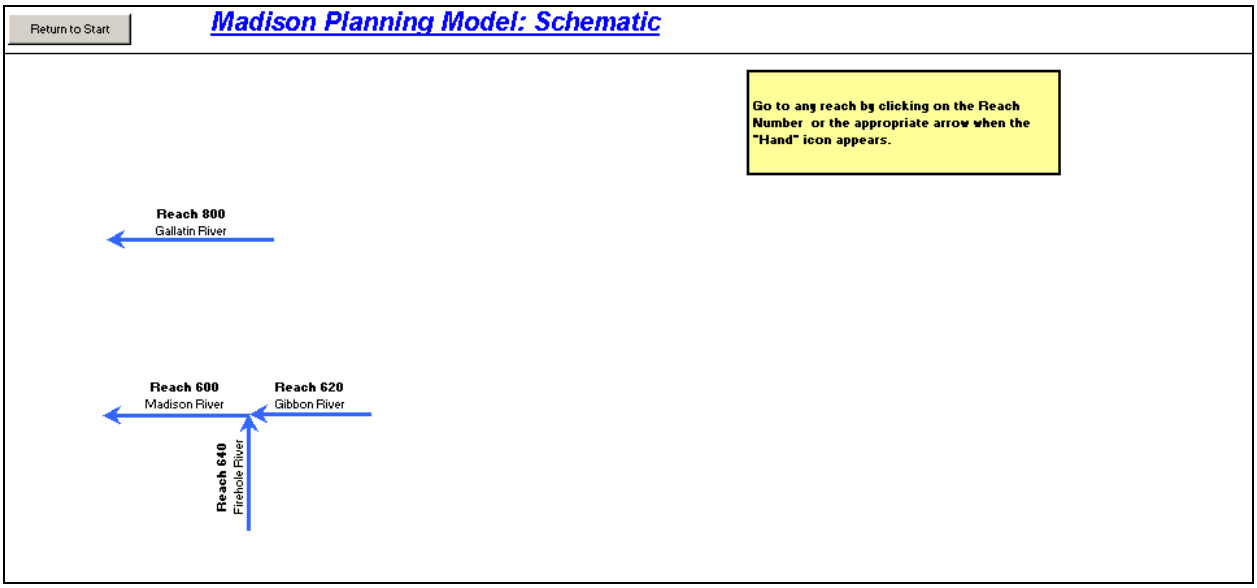

Figure 2-1. Reach Schematic - Madison/Gallatin Model

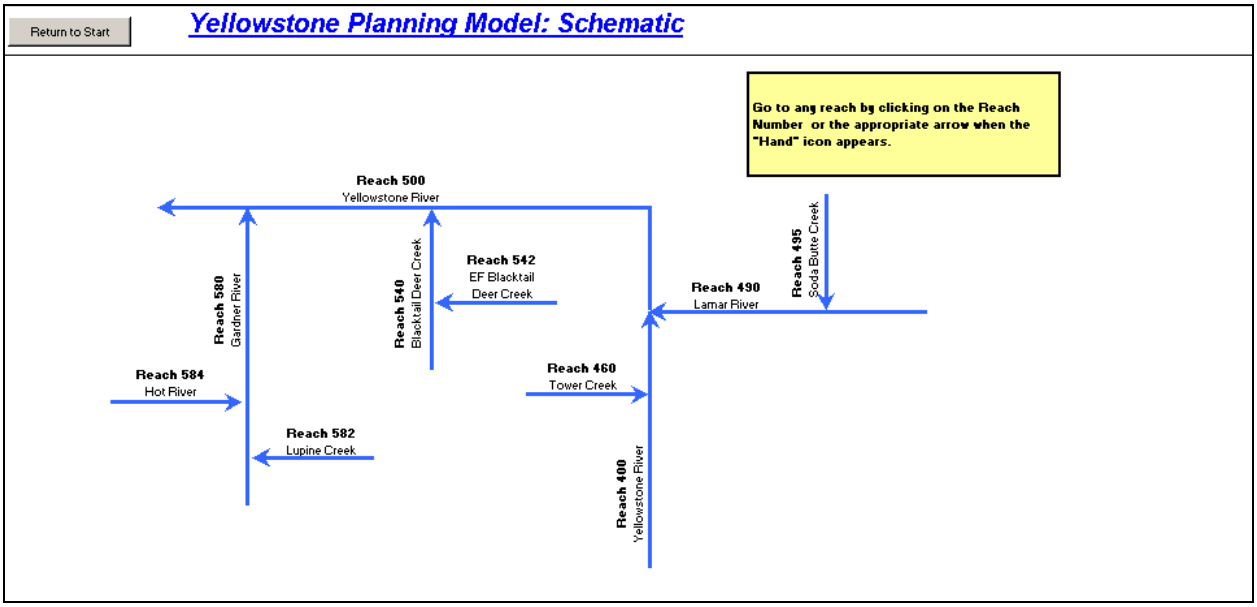

Figure 2-2. Reach Schematic - Yellowstone Model

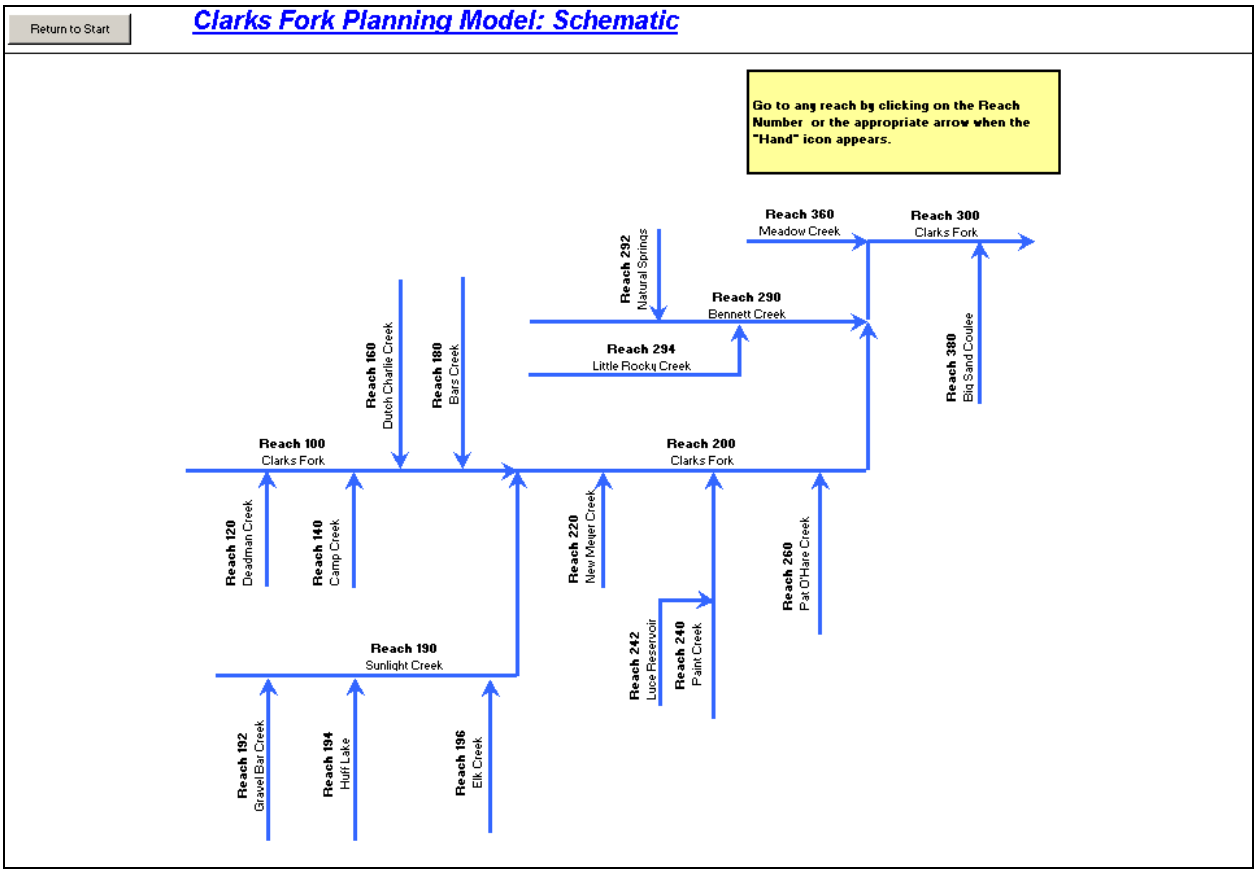

Figure 2-3. Reach Schematic – Clarks Fork Model

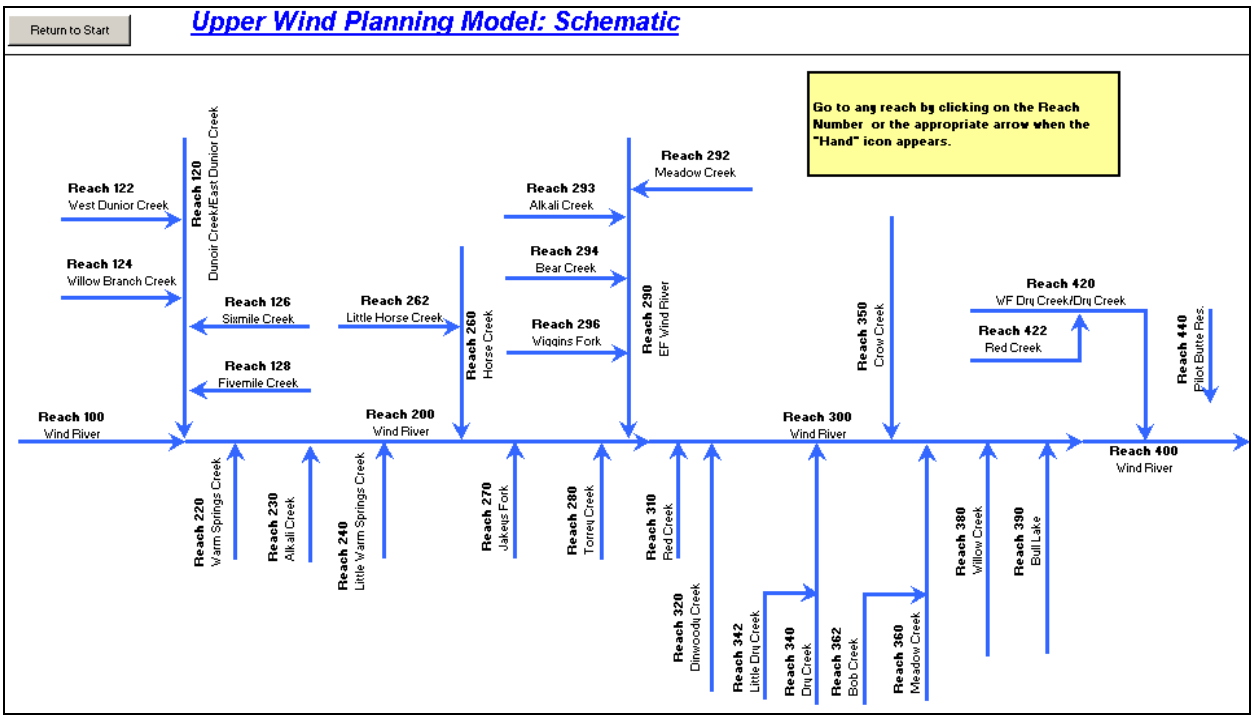

Figure 2-4. Reach Schematic – Upper Wind Model

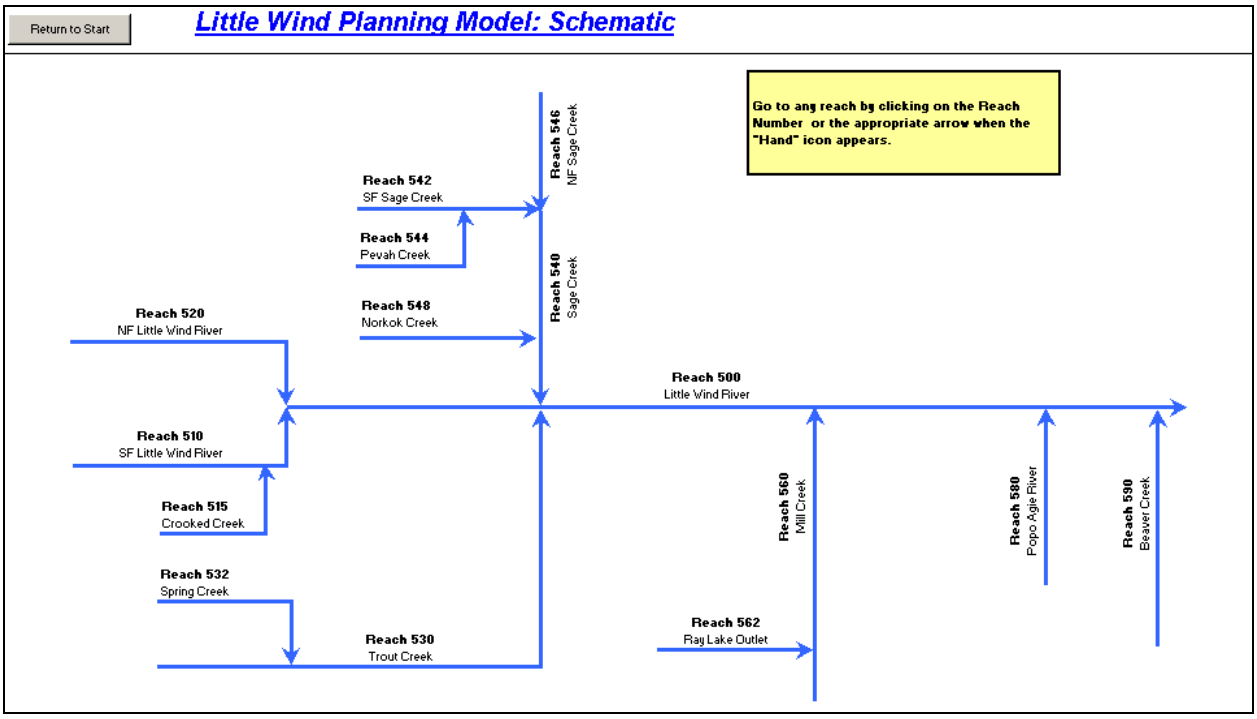

Figure 2-5. Reach Schematic – Little Wind Model

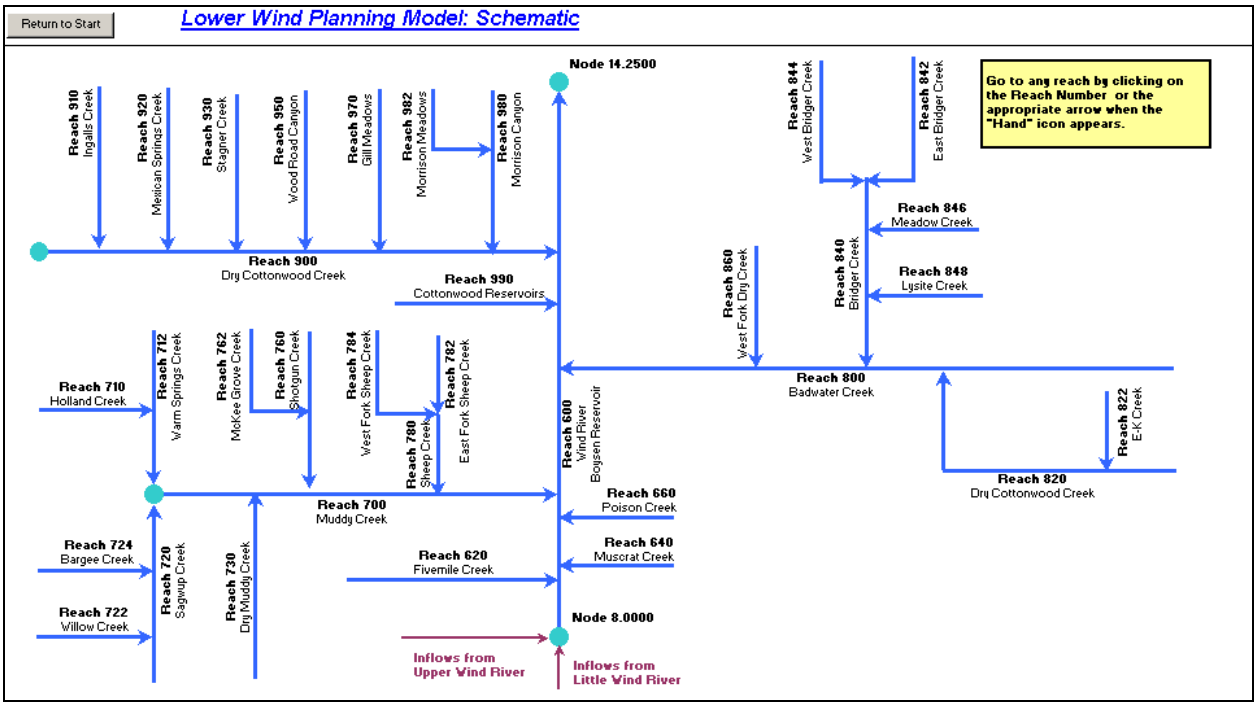

Figure 2-6. Reach Schematic – Lower Wind Model

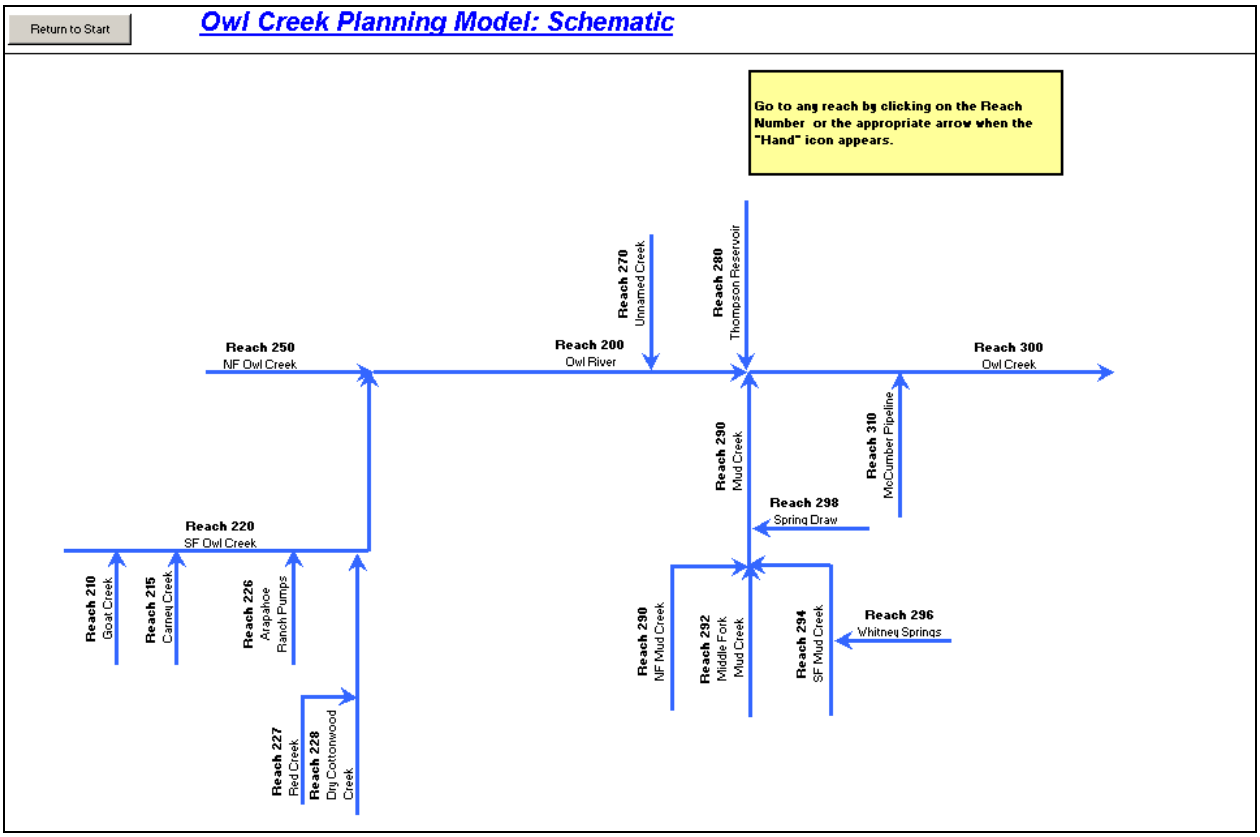

Figure 2-7. Reach Schematic – Owl Creek Model

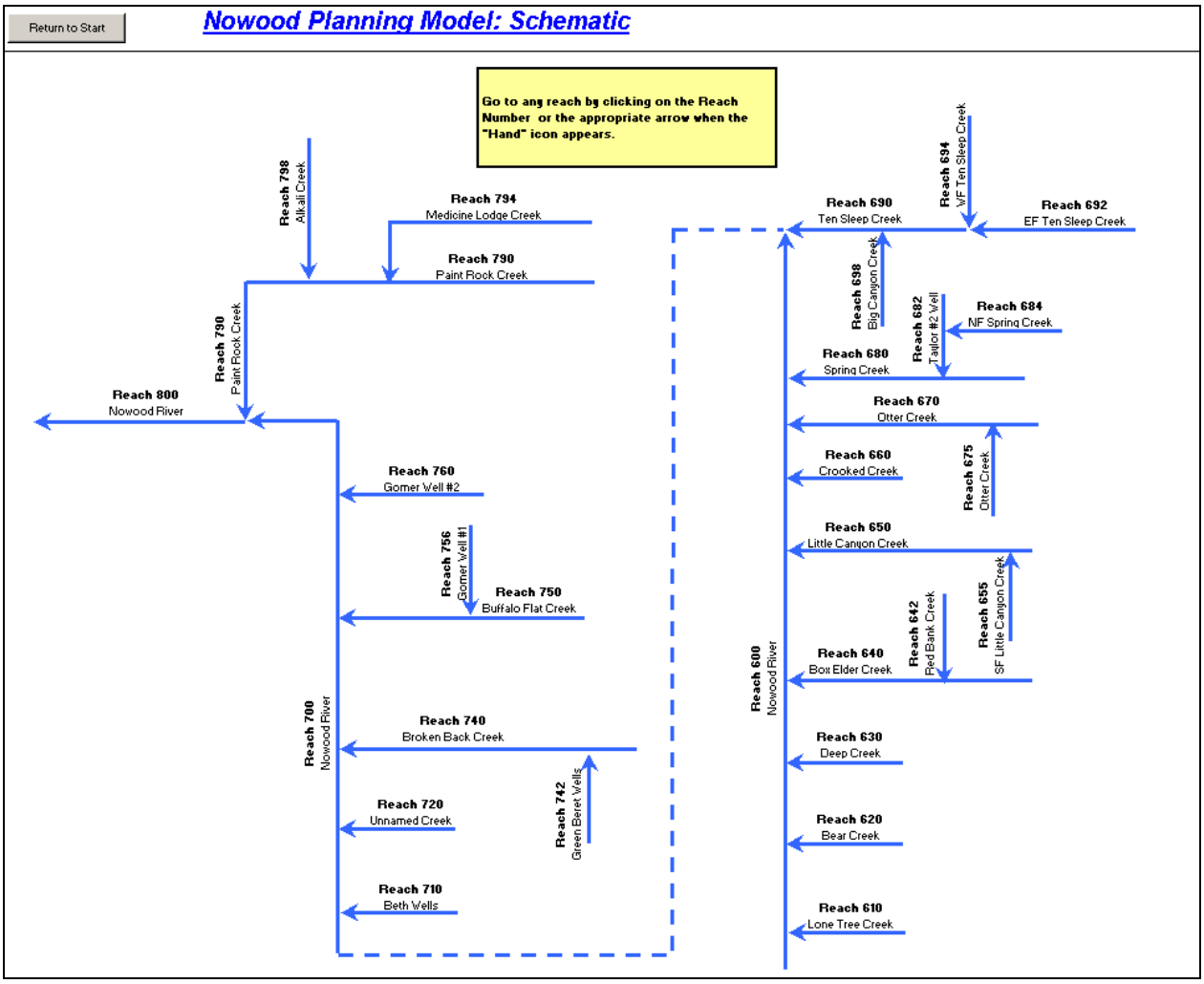

Figure 2-8. Reach Schematic – Nowood Model

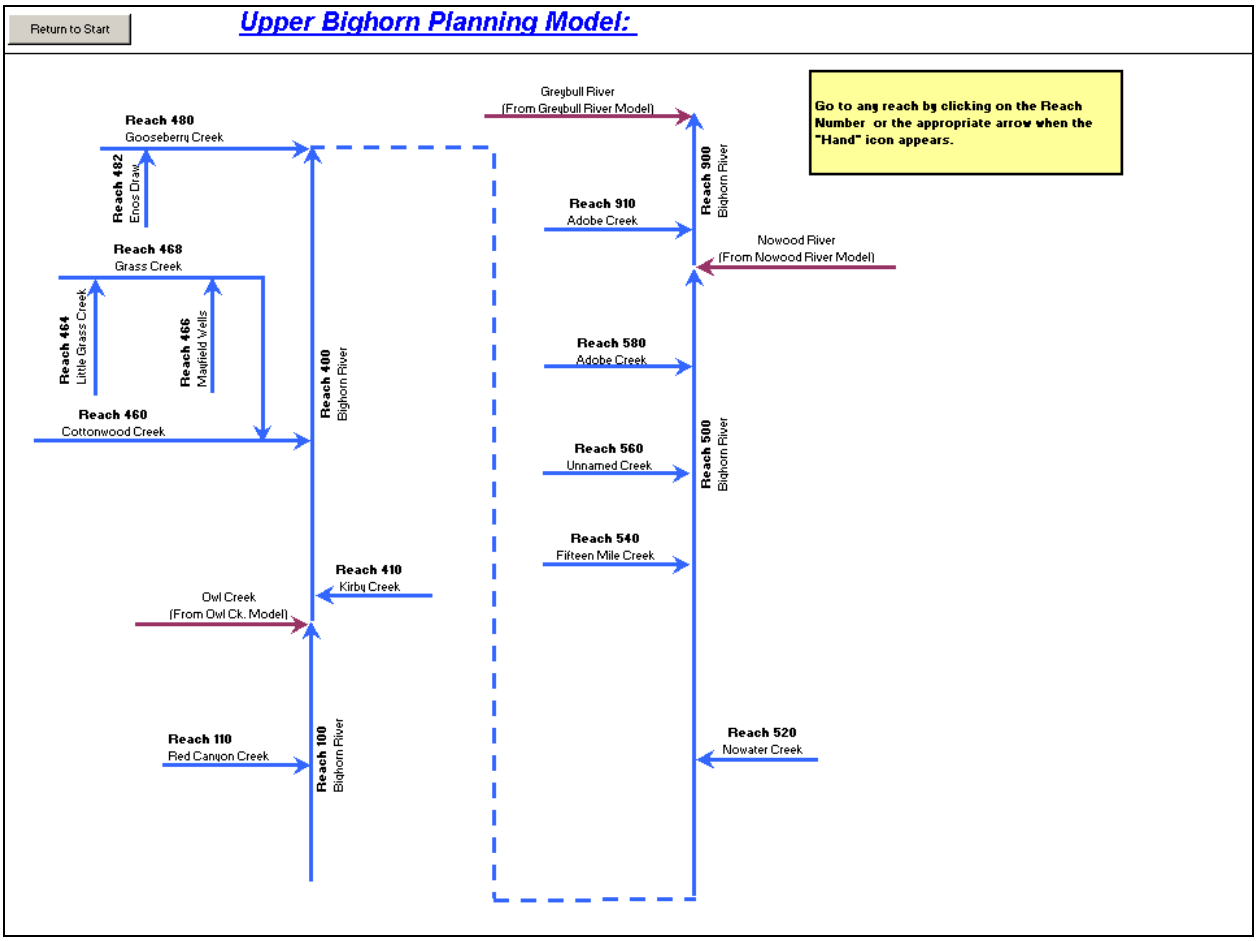

Figure 2-9. Reach Schematic – Upper Bighorn Model

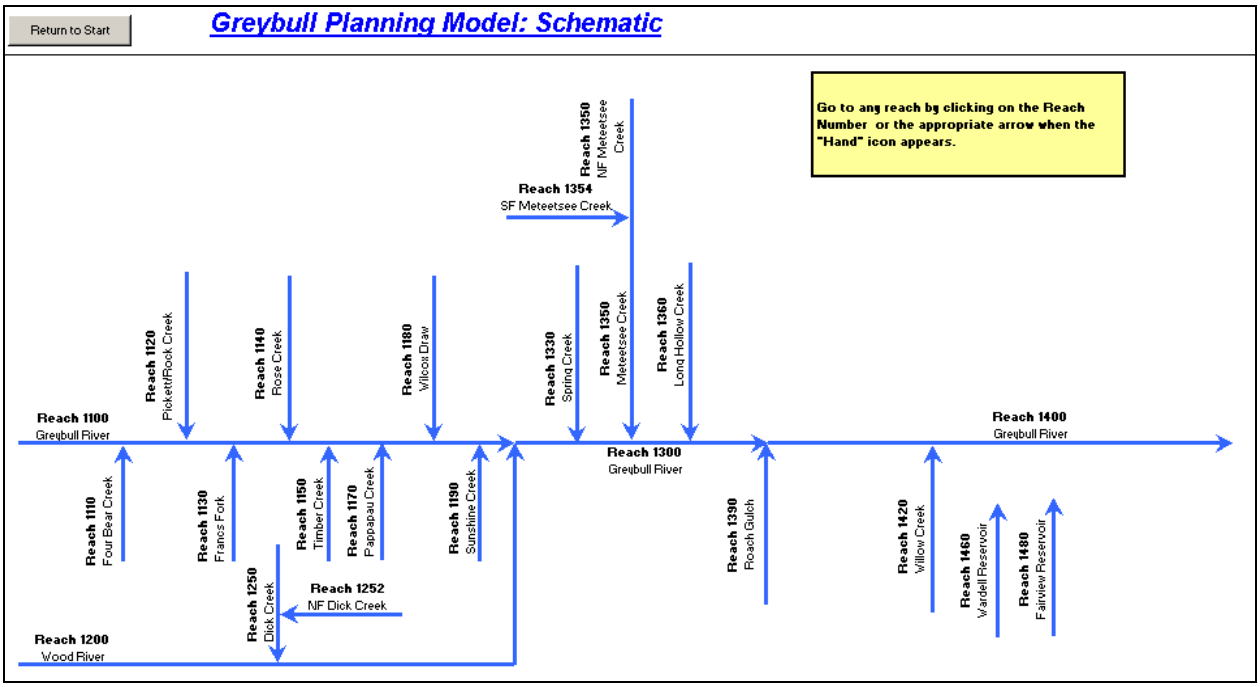

Figure 2-10. Reach Schematic - Greybull Model

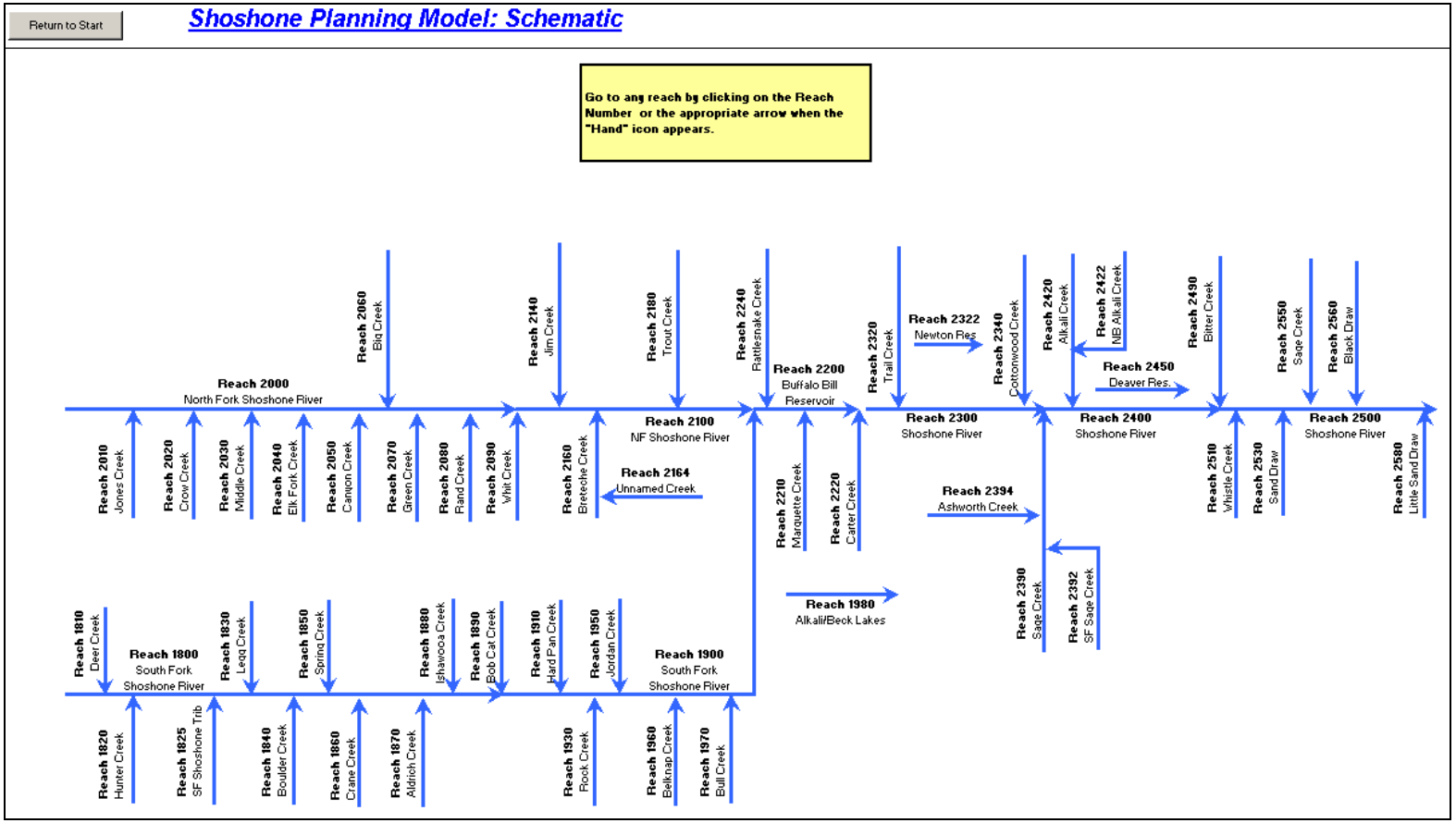

Figure 2-11. Reach Schematic - Shoshone Model

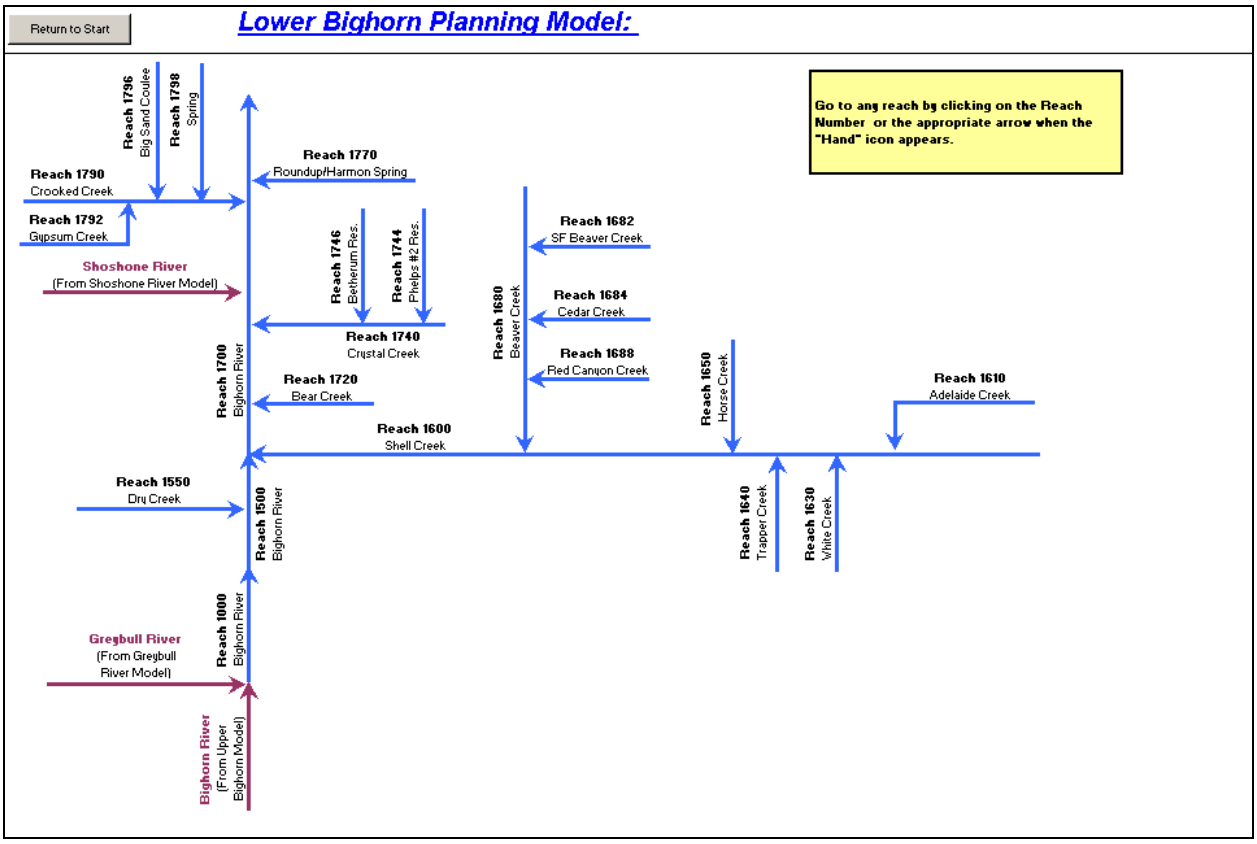

Figure 2-12. Reach Schematic – Lower Bighorn Model

Section 3 - Navigation Worksheets

The navigation worksheets are the primary components of the model Graphical User Interface (GUI). The GUI allows easier navigation between the different workbooks (or spreadsheet files) that make up the complete model, as well as easier navigation within each workbook. Each of the model GUIs worksheets, as well as the navigation to and from the calculation worksheets, are discussed in this section.

3.1 Main Model GUI

To start a sub-basin model, the user opens the main model spreadsheet. This workbook presents a GUI that allows the user to learn about the model structure, run a brief tutorial or navigate to the dry, normal and wet year models. As shown in Figure 3-1, the main model file is called $$$$$$_Model.xls, while the individual hydrologic year models are called $$$$$$_dry.xls, etc. (Note that in this figure and in the following text, $$$$$$ represents the name of an individual model. Figure 3-1 shows the Upper Wind model as an example.) The main workbook GUI is shown in Figure 3-2. The main model workbook does not perform any of the model calculations.

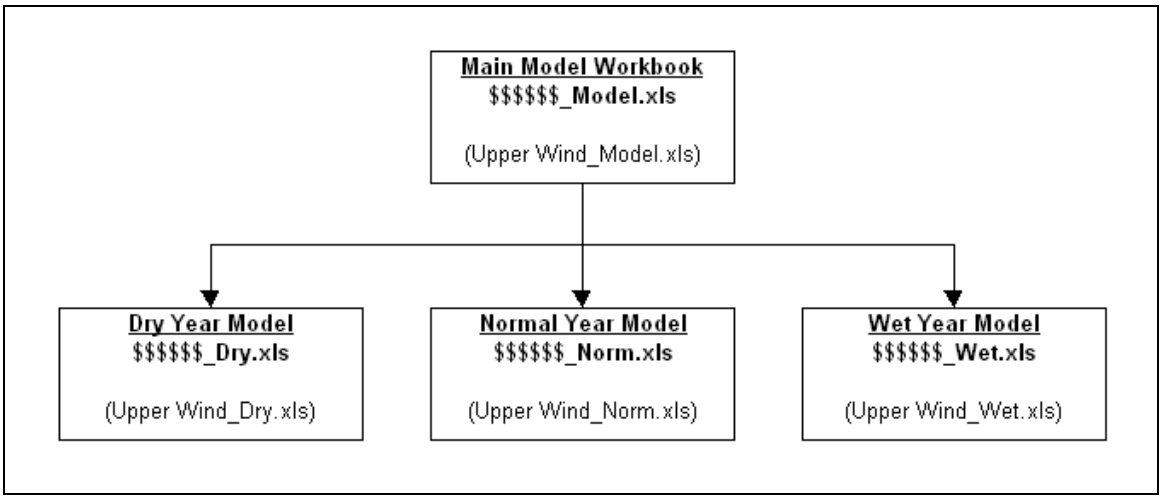

Figure 3-1. Typical Model Workbook Structure

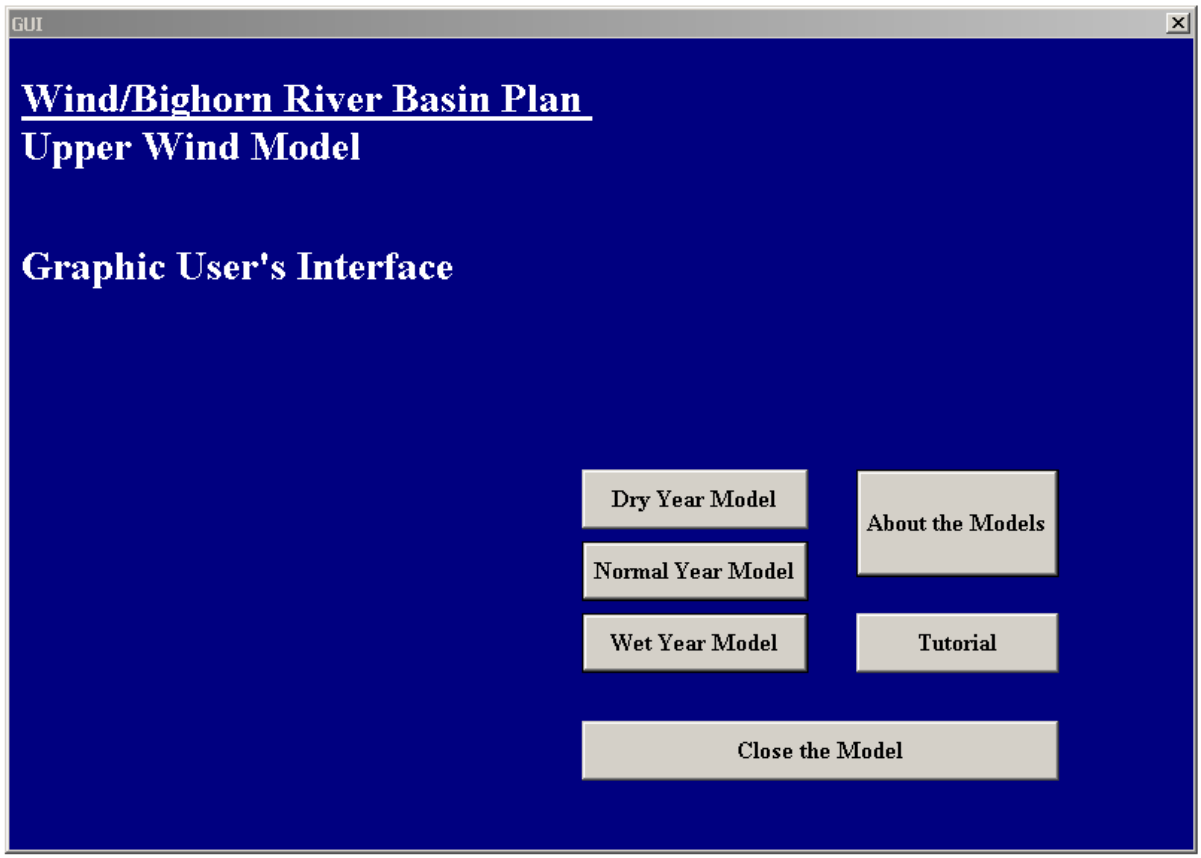

Figure 3-2. Main Model GUI

User Notes

The following options are available from the GUI:

Dry Year Model: Opens the Dry Year Model workbook,

Normal Year Model:	Open the Normal Year Model workbook,
Wet Year Model:	Opens the Wet Year Model workbook,
About the ($$$$$$) Model:	Obtain information pertaining to the current version of the model,
Tutorial:	Opens a brief tutorial that describes the general structure of a spreadsheet workbook
Close the ($$$$$$) Model:	Closes all open workbooks.

3.2 Central Navigation Worksheet

The central navigation worksheet is located in each of the dry, normal and wet year model workbooks, and is the worksheet that first appears when the individual model workbooks are opened. The central navigation worksheet allows the user to navigate to different areas of the workbook, and contains data regarding the reaches contained in the model. An example worksheet is shown in Figure 3-3.

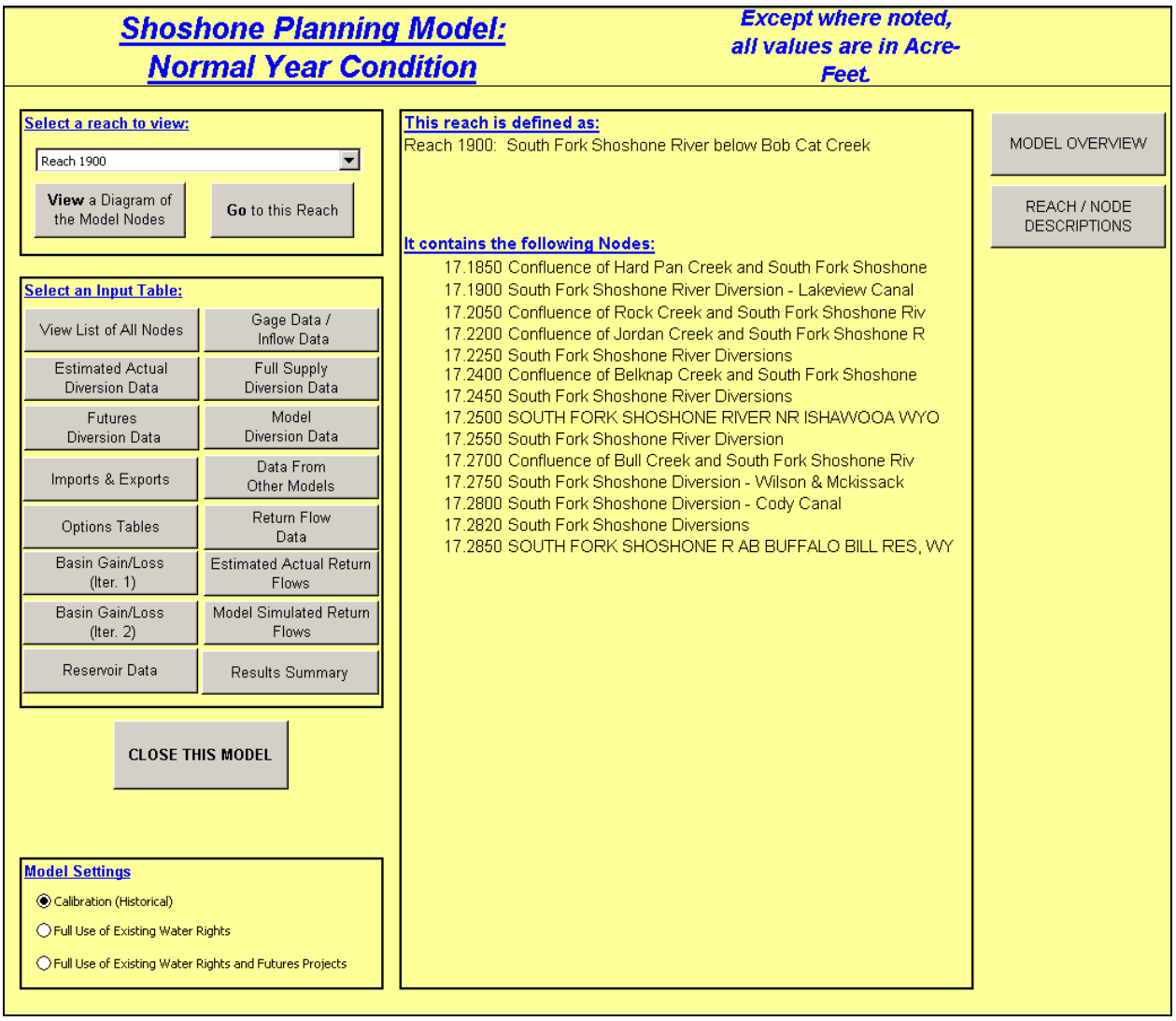

Figure 3-3. Central Navigation Worksheet

User Notes

This is the worksheet that first appears when the individual model workbooks are opened. In addition, nearly every other worksheet in the model has a button that allows the user to navigate back to this worksheet. The following buttons are located on this worksheet:

Reach Views:

View A Diagram of the Model Nodes	The sub-basin diagram (View a Diagram of the Model Nodes);
Go to this Reach	Navigate to the reach worksheet shown in the pull-down menu;

Input Tables:

View List of All Nodes	Navigate to the node list worksheet;
Gage Data/ Inflow Data	Navigate to the worksheet containing gage data and natural flow data;
Estimated Actual Diversion Data	Navigate to the worksheet containing the actual diversion data and estimated actual diversion data for each node;
Full Supply Diversion Data	Navigate to the worksheet containing full supply diversion data for each node;
Futures Diversion Data	Navigate to the worksheet containing the diversion data including futures projects for each node;
Modeled Diversion Data	Navigate to the worksheet showing the diversion data for each node used in the model run, which is based on the selected run type;
Imports & Exports	Navigate to the worksheet containing imports & exports for each node;
Data From Other Models	Navigate to the worksheet containing data imported from other models;
Options Tables	Navigate to the worksheet containing optional data, such as irrigation return flow values and lag patterns.
Return Flow Data	Navigate to the worksheet containing return flow locations and table values for each node;
Basin Gain/Loss (Iter. 1)	Navigate to the worksheet containing the first iteration of basin gain/loss calculations;
Estimated Actual Return Flows	Navigate to the worksheet containing the actual return flow calculations.
Basin Gain/Loss (Iter 2)	Navigate to the worksheet containing the second iteration of basin gain/loss calculations;

Model Simulated Return Flows	Navigate to the worksheet containing the model simulated return flow calculations.
Results Summary	Navigate to the Results Summary worksheet that leads in turn to several summaries of output.

Model Settings:

The model settings radio buttons select the run type as described by the buttons.

3.3 Summary Navigation

The summary navigation worksheets assist the user in navigating through the summary worksheets. A view of the summary navigation worksheet is shown in Figure 3-4.

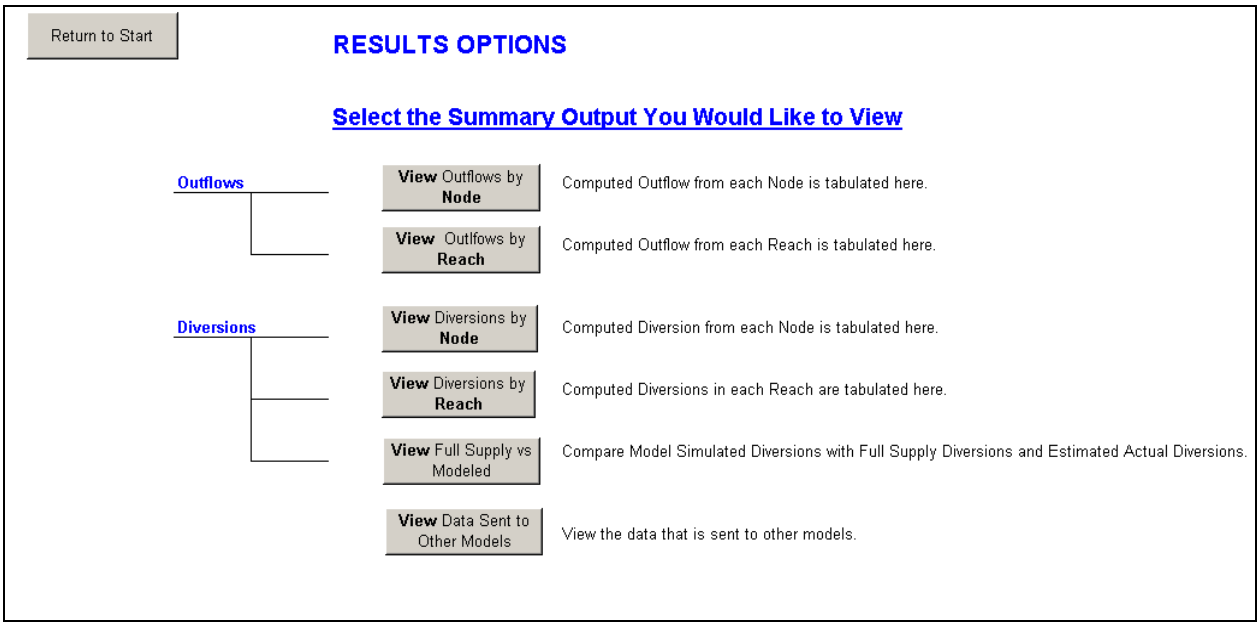

Figure 3-4. Summary Navigation Worksheet

3.3.1 User Notes

As shown in the figure, the worksheet is divided into two sections, outflows and diversions, which correspond to the summary worksheets. The following buttons are located on this worksheet.

View Outflows by Node	Navigate to the table in the outflows worksheet that contains a summary of outflows by node;
View Outflows by Reach	Navigate to the table in the outflows worksheet that contains a summary of outflows by reach;

View Diversions by Node	Navigate to the table in the diversions worksheet that contains a summary of diversions by node;
View Diversions by Reach	Navigate to the table in the diversions worksheet that contains a summary of diversions by reach;
View Full Supply vs Modeled	Navigate to the table in the diversions worksheet that contains a summary of the full supply versus modeled diversions for each node;
View Data Sent to Other Models	Navigate to the worksheet that contains the data sent to other models.
Return to Start	Navigate to the navigation worksheet.

Section 4 - Data Input Worksheets

As shown in the river basin and reach schematics, the model performs calculations at reaches that represent physical points along the rivers and their tributaries. Natural flow nodes, gage nodes, diversion nodes and reservoir nodes all contain input data to the model. The following sub-sections review the data entry worksheets for each of the node types.

4.1 Master List of Nodes

The Master List of Nodes worksheet presents a master list of all nodes included in the models. In addition, the worksheet contains data indicating the reach in which the node is contained. The nodes correspond to those nodes shown on the reach and river basin schematics. A comprehensive list of nodes is shown in the appendices. A sample of the worksheet is shown in Figure 4-1.

Return to Start

Master List of Node Numbers and their Names

Reach	Node	Name
400	1.0200	Yellowstone River at Yellowstone Lk Outlet YNP
400	1.0300	Yellowstone River near Canyon Hotel YNP
460	1.0350	Tower Creek at Tower Falls YNP
400	1.0400	Confluence of Tower Creek and Yellowstone River
400	1.0500	Confluence of Lamar River and Yellowstone River
495	2.0100	Soda Butte Cr at Park Bndry at Silver Gate
490	2.0150	Lamar River Natural Flow
495	2.0200	Soda Butte Cr nr Lamar Ranger Station YNP
490	2.0300	Confluence of Soda Butte Creek and Lamar River
490	2.0400	Lamar River nr Tower Falls Ranger Station YNP
580	3.0100	Gardner River Natural Flow
582	3.0200	Lupine Creek near Mammoth YNP
580	3.0300	Confluence of Lupine Creek and Gardner River
584	3.0500	Hot River at Mammoth YNP
580	3.0600	Confluence of Hot River and Gardner River
580	3.0700	Gardner River near Mammoth YNP
540	4.0100	Blacktail Deer Creek nr Mammoth YNP
542	4.0200	E F Blacktail Deer Cr nr Mammouth YNP
540	4.0300	Confluence of Blacktail Dear Creek and E.F. Blacktai
500	4.0600	Confluence of Blacktail Deer Creek and Yellowstone R
500	4.0700	Confluence of Gardiner River and Yellowstone River
500	4.0800	Yellowstone River at Corwin Springs MT

Figure 4-1. Master List of Node Worksheet

Engineering Notes

The nodes and reaches were developed based upon the locations of data, locations of diversions and key tributary inflows. The node number system was developed to allow insertion of additional nodes as the model continues to be used for other purposes. Nodes are generally numbered from upstream to downstream. Similarly, reaches were designated and numbered to allow insertion of additional reaches without the need to renumber existing reaches. In general, those reaches labeled on the even 100's are main channels. Those reaches labeled in the 110's are tributary reaches while reaches labeled in the 111's are secondary and tertiary tributary channels.

User Notes:

The Master List of Nodes allows the User to view a simple, comprehensive listing of all nodes within the model, organized by reach and node number. This master list governs naming and numbering conventions on many worksheets, so changes to the list must be done with great care. Many of the calculations within the spreadsheet are dependent on the proper correlation of node names and numbers.

4.2 Gage and Natural Flow Data

The gage and natural flow data contains the actual and estimated gaged flow data and natural flow data. Gage data is from USGS, SEO or USBR gaging stations that was filled based on regression equations when necessary for the study period. The data was then reduced to dry, normal and wet year flows. Natural flow data is necessary at the headwaters and tributary inflows where gage data does not represent natural flows. These flows were developed using regional basin regression equations that are dependent upon various basin characteristics. The development of this data is detailed in the Task 3A/3B Technical Memorandum Surface Water Hydrology (MWH, 2002). A sample of the worksheet is shown in Figure 4-2.

Return to Start

USGS Gaging Station Data and Estimated Headwater Inflows

Average Monthly Streamflow (Acre-Feet): Normal Year Conditions

Node Number	Name	Gage Number	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1.0200	Yellowstone River at Yellowstone Lk Outlet YNP	6186500	26,466	23,269	28,557	34,889	72,358	215,536	262,896	142,677	74,195	51,632	37,956	31,156	1,001,588
1.0300	Yellowstone River near Canyon Hotel YNP	6187000	39,211	36,051	41,278	47,537	84,571	226,088	272,898	154,074	86,386	64,086	50,567	43,847	1,146,594
1.0350	Tower Creek at Tower Falls YNP	6187500	1,119	1,072	1,136	1,549	6,396	15,471	7,983	2,785	1,689	1,483	1,283	1,179	43,145
2.0100	Soda Butte Cr at Park Bndry at Silver Gate	6187915	124	115	117	848	9,826	19,750	7,133	1,599	656	505	325	214	41,211
2.0150	Lamar River Natural Flow	Natural Flow	4,713	4,099	5,039	8,210	35,781	51,295	24,132	11,083	7,462	6,980	6,125	5,170	170,090
2.0200	Soda Butte Cr nr Lamar Ranger Station YNP	6187950	1,246	952	1,278	3,337	20,028	39,079	23,022	8,569	4,277	3,346	2,190	1,561	108,886
2.0400	Lamar River nr Tower Falls Ranger Station YNP	6188000	6,081	5,452	6,699	22,910	92,082	123,131	46,492	15,666	9,733	10,404	8,080	6,948	353,678
3.0100	Gardner River Natural Flow	Natural Flow	1,260	1,096	1,427	2,636	11,711	16,000	7,748	3,880	2,689	2,444	1,752	1,423	54,068
3.0200	Lupine Creek near Mammoth YNP	6190000	84	66	86	175	791	1,209	552	220	147	140	117	107	3,694
3.0500	Hot River at Mammoth YNP	6190540	1,605	1,404	1,554	1,593	1,809	1,706	1,706	1,667	1,555	1,662	1,551	1,605	19,417
3.0700	Gardner River near Mammoth YNP	6191000	5,994	5,398	6,071	9,018	29,426	43,270	21,514	10,502	8,097	7,845	7,080	6,753	160,968
4.0100	Blacktail Deer Creek nr Mammoth YNP	6189000	149	115	157	436	1,890	2,509	1,129	431	282	270	224	203	7,795
4.0200	E F Blacktail Deer Cr nr Mammouth YNP	6188500	32	20	34	97	640	1,112	417	129	76	71	55	48	2,732
4.0800	Yellowstone River at Corwin Springs MT	6191500	53,606	47,341	56,135	101,698	400,045	703,118	454,153	204,840	117,171	95,899	73,898	61,504	2,369,407

Figure 4-2. Gage and Natural Flow Worksheet

Engineering Notes

The development of this data is detailed in the Task 3A/3B Technical Memorandum Surface Water Hydrology (MWH, 2002).

User Notes

The Gage Data Table presents the average historical monthly gage and natural flow data for each hydrologic condition used in the model. Only the data pertaining to the hydrologic condition being modeled are included in each respective model. In addition, this worksheet only contains nodes that have hydrologic data. Nodes that do not contain hydrologic data are not included in this list.

4.3 Diversion Data

The Wind/Bighorn model can be run in three different modes:

- Calibration (Historical) – Models actual historical diversions. This mode is primarily used for model calibration.

- Full Supply for Existing Irrigated Lands – Models full supply, based on computed Diversion Requirements, for irrigated lands with water rights mapped as part of the planning process.

- Full Supply for Existing Irrigated Lands and Futures Projects - Models full supply, based on computed Diversion Requirements, for irrigated lands with water rights mapped as part of the planning process and Tribal futures projects.

The model utilizes the appropriate data associated with these three modes. Each set of data is stored on a separate worksheet, with a fourth worksheet used to store the set of data actually used by the calculations.

The Wind/Bighorn basin planning model simulates diversion in two different steps.

1. The historical diversions or estimated historical diversions are compared to gaged flows to determine ungaged gains and losses for each reach in the model;

2. The modeled diversions (whether they be Historical, Full Supply or Futures diversions) are then used to determine the amount and timing of shortages at each diversion.

As shown on the basin schematics, diversions were generally divided into two categories: those greater than 10 cfs and those less than 10 cfs. Those diversions that are greater than 10 cfs were individually modeled while those less than 10 cfs were modeled as “lumped” diversions. All diversions were explicitly modeled – the model considered either their actual diversion or an estimate of their actual diversion, their required diversion and their return flow locations. Some small diversions (those less than 10 cfs) are modeled individually because it is the only diversion located on a tributary, because it is the only diversion between two other model nodes or because it is the only diversion in a significantly long reach of the river. Diversion data and estimated diversion data were divided into dry, average and wet years. Required diversion volumes were not separated into dry, average and wet years.

Municipal diversion data is also included on these spreadsheets. For those municipalities that use surface water diversions, both diversions and return flows were included in the model. For those municipalities that use groundwater, only surface water return flows were included in the model. Any groundwater depletions caused by pumping or groundwater returns from outdoor water use are implicitly calculated in the gain-loss portion of the model.

Data regarding diversions are shown on three worksheets: the Estimated Actual Diversion Data (Historic Diversions) worksheet and Full Supply Diversion Data (Ideal Diversions) worksheet, and the Futures Diversion Data worksheet. The Model Diversion Data worksheet compiles the correct data for use in the simulation based on the run type. The worksheets are essentially the same in the appearance and data entry, except that the Estimated Actual Diversion Data worksheet contains two intermediate tables that allow adjustment of the estimated data based upon the hydrology. Samples of the worksheets are shown in Figure 4-3, Figure 4-4, Figure 4-5 and Figure 4-6.

Return to Start | View Estimated Div. by Node | View Percent of Estimated Div. | View Adjusted Est. Div. by Node | View Adjusted Est. Div. by Reach

Estimated Actual Diversion Data (Normal Year)

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Reach

Estimated Actual Diversion Data: Monthly Total By Node (Acre-Feet)

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Est. Dat
1.0000	Wind River Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.3000	Wind River Diversions	0.0	0.0	0.0	0.0	434.7	435.5	418.2	317.4	59.9	0.0	0.0	0.0	1,665.6	1
1.4000	East DuNoir Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.4100	East DuNoir Creek Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.4150	West DuNoir Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.4155	Confluence of West DuNoir Creek and East DuNoir Cree	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.4156	DuNoir Creek Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.4160	Willow Branch Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.4165	Willow Branch Creek Diversions	0.0	0.0	0.0	0.0	601.0	602.0	578.2	438.9	82.8	0.0	0.0	0.0	2,302.9	1
1.4170	Confluence of Willow Branch Creek and DuNoir Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.4180	Sixmile Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.4185	Sixmile Creek Diversions	0.0	0.0	0.0	0.0	1,233.8	1,236.0	1,186.9	900.9	170.1	0.0	0.0	0.0	4,727.7	1
1.4200	Confluence of Sixmile Creek and DuNoir Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.4300	Du Noir Creek Diversion	0.0	0.0	0.0	0.0	438.9	439.7	422.2	320.5	60.5	0.0	0.0	0.0	1,681.8	1
1.4320	Fivemile Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.4350	Fivemile Creek Diversions	0.0	0.0	0.0	0.0	260.1	260.6	250.2	189.9	35.9	0.0	0.0	0.0	996.7	1
1.4400	Confluence of Fivemile Creek and DuNoir Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1.4500	Du Noir Creek Diversions	0.0	0.0	0.0	0.0	90.5	90.6	87.0	66.1	12.5	0.0	0.0	0.0	346.7	1
2.0000	Confluence of DuNoir Creek and Wind River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2.1000	Wind River Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2.2000	WIND RIVER NEAR DUBOIS, WYO.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
2.2500	Wind River Diversions	0.0	0.0	0.0	0.0	75.7	75.8	73.8	55.3	10.4	0.0	0.0	0.0	290.1	1

Figure 4-3. Estimated Actual Diversion Data Worksheet – Data

Return to Start | View Estimated Div. by Node | View Percent of Estimated Div. | View Adjusted Est. Div. by Node | View Adjusted Est. Div. by Reach

Estimated Actual Diversion Data (Normal Year)

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Reach

Percent of Diversion Requirement for Estimated Historical

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.0000	Wind River Natural Flow	---	---	---	---	---	---	---	---	---	---	---	---
1.3000	Wind River Diversions	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
1.4000	East DuNoir Creek Natural Flow	---	---	---	---	---	---	---	---	---	---	---	---
1.4100	East DuNoir Creek Diversions	---	---	---	---	---	---	---	---	---	---	---	---
1.4150	West DuNoir Creek Natural Flow	---	---	---	---	---	---	---	---	---	---	---	---
1.4155	Confluence of West DuNoir Creek and East DuNoir Cree	---	---	---	---	---	---	---	---	---	---	---	---
1.4156	DuNoir Creek Diversions	---	---	---	---	---	---	---	---	---	---	---	---
1.4160	Willow Branch Creek Natural Flow	---	---	---	---	---	---	---	---	---	---	---	---
1.4165	Willow Branch Creek Diversions	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
1.4170	Confluence of Willow Branch Creek and DuNoir Creek	---	---	---	---	---	---	---	---	---	---	---	---
1.4180	Sixmile Creek Natural Flow	---	---	---	---	---	---	---	---	---	---	---	---
1.4185	Sixmile Creek Diversions	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
1.4200	Confluence of Sixmile Creek and DuNoir Creek	---	---	---	---	---	---	---	---	---	---	---	---
1.4300	Du Noir Creek Diversion	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
1.4320	Fivemile Creek Natural Flow	---	---	---	---	---	---	---	---	---	---	---	---
1.4350	Fivemile Creek Diversions	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
1.4400	Confluence of Fivemile Creek and DuNoir Creek	---	---	---	---	---	---	---	---	---	---	---	---
1.4500	Du Noir Creek Diversions	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
2.0000	Confluence of DuNoir Creek and Wind River	---	---	---	---	---	---	---	---	---	---	---	---
2.1000	Wind River Diversions	---	---	---	---	---	---	---	---	---	---	---	---
2.2000	WIND RIVER NEAR DUBOIS, WYO.	---	---	---	---	---	---	---	---	---	---	---	---
2.2500	Wind River Diversions	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Figure 4-4. Estimated Actual Diversion Data Worksheet – Percent of Diversion Requirement

Return to Start | View Estimated Div. by Node | View Percent of Estimated Div. | View Adjusted Est. Div. by Node | View Adjusted Est. Div. by Reach

Estimated Actual Diversion Data (Normal Year)

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Reach

Adjusted Estimated Actual Diversion Data: Monthly Total By Node (Acre-Feet)

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Reach
1.0000	Wind River Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100
1.3000	Wind River Diversions	0.0	0.0	0.0	0.0	434.7	435.5	418.2	317.4	59.9	0.0	0.0	0.0	1,665.6	100
1.4000	East DuNoir Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120
1.4100	East DuNoir Creek Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120
1.4150	West DuNoir Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	122
1.4155	Confluence of West DuNoir Creek and East DuNoir Cree	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120
1.4156	DuNoir Creek Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120
1.4160	Willow Branch Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	124
1.4165	Willow Branch Creek Diversions	0.0	0.0	0.0	0.0	601.0	602.0	578.2	438.9	82.8	0.0	0.0	0.0	2,302.9	124
1.4170	Confluence of Willow Branch Creek and DuNoir Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120
1.4180	Sixmile Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	126
1.4185	Sixmile Creek Diversions	0.0	0.0	0.0	0.0	1,233.8	1,236.0	1,186.9	900.9	170.1	0.0	0.0	0.0	4,727.7	126
1.4200	Confluence of Sixmile Creek and DuNoir Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120
1.4300	Du Noir Creek Diversion	0.0	0.0	0.0	0.0	438.9	439.7	422.2	320.5	60.5	0.0	0.0	0.0	1,681.8	120
1.4320	Fivemile Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	128
1.4350	Fivemile Creek Diversions	0.0	0.0	0.0	0.0	260.1	260.6	250.2	189.9	35.9	0.0	0.0	0.0	996.7	128
1.4400	Confluence of Fivemile Creek and DuNoir Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120
1.4500	Du Noir Creek Diversions	0.0	0.0	0.0	0.0	90.5	90.6	87.0	66.1	12.5	0.0	0.0	0.0	346.7	120
2.0000	Confluence of DuNoir Creek and Wind River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100
2.1000	Wind River Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200
2.2000	WIND RIVER NEAR DUBOIS, WYO.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200
2.2500	Wind River Diversions	0.0	0.0	0.0	0.0	75.7	75.8	72.8	55.3	10.4	0.0	0.0	0.0	290.1	200

Figure 4-5. Estimated Actual Diversion Data Worksheet – Adjusted Estimated Actual Diversion Data by Node

Return to Start | View Estimated Div. by Node | View Percent of Estimated Div. | View Adjusted Est. Div. by Node | View Adjusted Est. Div. by Reach

Estimated Actual Diversion Data (Normal Year)

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Reach

Adjusted Estimated Actual Diversion Data: Monthly Total By Reach (Acre-Feet)

Reach Number	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
100	0.0	0.0	0.0	0.0	434.7	435.5	418.2	317.4	59.9	0.0	0.0	0.0	1,665.6
120	0.0	0.0	0.0	0.0	529.4	530.3	509.3	386.6	73.0	0.0	0.0	0.0	2,028.5
122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
124	0.0	0.0	0.0	0.0	601.0	602.0	578.2	438.9	82.8	0.0	0.0	0.0	2,302.9
126	0.0	0.0	0.0	0.0	1,233.8	1,236.0	1,186.9	900.9	170.1	0.0	0.0	0.0	4,727.7
128	0.0	0.0	0.0	0.0	260.1	260.6	250.2	189.9	35.9	0.0	0.0	0.0	996.7
200	11.5	10.2	10.4	13.9	1,642.8	1,657.4	1,596.9	1,224.5	255.0	15.6	10.4	8.5	6,457.2
220	0.0	0.0	0.0	0.0	191.0	191.3	183.7	139.5	26.3	0.0	0.0	0.0	731.8
230	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
240	0.0	0.0	0.0	0.0	77.2	77.3	74.2	56.3	10.6	0.0	0.0	0.0	295.6
260	0.0	0.0	0.0	0.0	1,342.5	1,344.8	1,291.4	980.3	185.0	0.0	0.0	0.0	5,144.0
262	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
270	0.0	0.0	0.0	0.0	466.1	466.9	448.3	340.3	64.2	0.0	0.0	0.0	1,785.8
280	0.0	0.0	0.0	0.0	1,189.1	1,191.1	1,143.9	868.3	163.9	0.0	0.0	0.0	4,556.2
290	0.0	0.0	0.0	0.0	108.7	108.9	104.5	79.4	15.0	0.0	0.0	0.0	416.4
292	0.0	0.0	0.0	0.0	139.6	139.8	134.3	101.9	19.2	0.0	0.0	0.0	534.9
293	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 4-6. Estimated Actual Diversion Data Worksheet – Adjusted Estimated Actual Diversion Data by Reach

Engineering Notes

Collection of agricultural diversion data is discussed in the Technical Memorandum Irrigation Diversion Operation and Description (BRS, 2003).

The estimated consumptive irrigation requirement (CIR), duration of irrigation, actual historic diversions and full supply diversions is described in the Task 2A Technical Memorandum Agricultural Water Use and Diversion Requirements (MWH, 2003a).

Municipal diversions were taken from the Technical Memorandum Municipal Basin Water Use Profile (LA, 2002). Values reported in this memorandum represent the consumptive use portion as well as the entire historical diversion amount of the municipal diversions. No attempts were made to develop dry, normal and wet year municipal diversions. There were no industrial uses significant enough to be modeled. For those municipalities using groundwater, only surface water returns were included in the model.

User Notes

The diversion data worksheets contain only input data for each node for an average dry, normal, or wet year. Note that all nodes are listed in the tables, even if no diversions occur at them. At the top of the worksheets are buttons that will take the User to the table summarizing the total monthly diversions in each reach. With the exception of these summary tables, no computations occur within these worksheets. It should be noted that both node number and node name are required to be manually input by the user.

4.4 Return Flows

To provide more expedient data entry and to allow easier comparison between return flow values, in the Wind/Bighorn River basin models, return flows are entered on a separate worksheet called the "Return Flow Data" worksheet. The return flow worksheet documents the spatial and temporal return flow patterns, as well as the efficiency patterns for each node in the model. A sample of the worksheet is shown in Figure 4-7.

Return to Start

Return Flow Data

Node Number	Site Name	RFNode_1	RFPerc_1	RFNode_2	RFPerc_2	RFNode_3	RFPerc_3	RFNode_4	RFPerc_4	Efficiency Pattern	Lag Pattern
6.0000	SF L WIND R AB WASHAKIE RE NR FT WASHA		0%		0%		0%		0%	1	4
6.1000	Washakie Reservoir		0%		0%		0%		0%	1	4
6.1100	SOUTH FORK LITTLE WIND RIV BEL WASHAKIE		0%		0%		0%		0%	1	4
6.1200	South Fork Little Wind River Diversions	6.3500	100%		0%		0%		0%	50	2
6.1400	South Fork Little Wind River Diversions	6.4000	100%		0%		0%		0%	50	2
6.1600	South Fork Little Wind Diversions	6.7000	100%		0%		0%		0%	50	2
6.3000	South Fork Little Wind Diversions	6.4000	100%		0%		0%		0%	50	2
6.3500	LITTLE WIND R NR FORT WASHAKIE, WYO.		0%		0%		0%		0%	1	4
6.4000	South Fork Little Wind Diversion - Ray Canal	6.7000	20%	6.8000	30%	7.0000	30%	6.5000	10%	50	3
6.4100	Crooked Creek Natural Flow		0%		0%		0%		0%	1	4
6.4200	Crooked Creek Diversions	6.4800	100%		0%		0%		0%	50	2
6.4300	Spring Creek Natural Flow		0%		0%		0%		0%	1	4
6.4400	Spring Creek Diversions	6.4700	100%		0%		0%		0%	50	2
6.4500	TROUT CREEK NEAR FORT WASHAKIE, WY		0%		0%		0%		0%	1	4
6.4600	Trout Creek Diversions	6.4700	100%		0%		0%		0%	50	2

Figure 4-7. Return Flow Data Worksheet

Engineering Notes

Spatial return flow patterns are estimated based upon the location of the irrigated lands associated with each node and the next downstream node. More accurate information was available in some cases, where previous information was available or where water users had information.

Efficiency patterns were developed based on available existing data. These data sources included the Wind River On-Farm Report, the Shell Creek report and the Water Use profiles report. Efficiency patterns can vary greatly from diversion to diversion, and have a significant impact on the amount of water that is required for a diversion. However, it is not the intent of this study to provide an in-depth analysis of efficiencies. Therefore, only data available from previous studies was used in the analysis.

Lag patterns for diversion return flows are a key element in the model calibration process. Initially, lag patterns are set so that all return flows return in the same month that they are diverted. Then, through the calibration process, lag patterns are modified. A standard set of lag

patterns has been developed, and is discussed in the "Options" worksheet portion of this document.

User Notes

The return flow spreadsheet contains information for each node regardless of whether it contains diversions. In order for the Excel calculations to perform correctly, the return flow percentage columns must contain a value. Therefore, if the node does not have return flows, a value of 0% must be entered for the return flow percentage. The table does not need to have return flow nodes entered in each cell.

During the calibration process, any changes to return flow lag patterns are made in this worksheet.

4.5 Import and Export Data

Imports and exports pertain to the physical import or export of water from one basin to another through a transbasin diversion facility. Imports and exports should not be confused with simple data transfers between models, as further described below. Flows available for export were determined using the same methodology for other diversions as described in the Task 3A/3B Technical Memorandum Surface Water Hydrology (MWH, 2002). A sample of the worksheet is shown in Figure 4-8.

Return to Start

Import/Export Data (Acre-Feet)

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
9.0001	Nowood River Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0100	Confluence of Nowood River and Lone Tree Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0110	Lone Tree Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0150	Lone Tree Creek Diversion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0200	Nowood River Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0300	Confluence of Bear Creek and Nowood River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0310	Bear Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0350	Bear Creek Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0400	Nowood River Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0500	Confluence of Deep Creek and Nowood River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0510	Deep Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0550	Deep Creek Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0600	Nowood River Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0700	Confluence of Box Elder Creek and Nowood River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0710	Box Elder Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0720	Box Elder Creek Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0730	Red Bank Creek Natural Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0740	Red Bank Creek Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0760	Confluence of Red Bank Creek with Box Elder Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.0790	Box Elder Creek Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 4-8. Import/Export Data Worksheet

Engineering Notes:

The only imports or exports modeled in the Wind/Bighorn basin planning models occur in the Greybull and Shoshone models. Flow from the North Fork of Meteetsee Creek in the Greybull Model is exported to Foster Reservoir in the Sage Creek basin of the Shoshone Model.

User Notes:

The Imports/Exports Table summarizes the monthly imports to or exports from other basins. As noted above, only the Greybull River/Shoshone River imports were explicitly modeled as such.

However, the node water balance tables in the Reach/Node Worksheets are set up to incorporate imports to or exports from any node.

4.6 Reservoir Data

Although referred to in the model as the Reservoir Evaporation Loss worksheet, the worksheet contains all data for reservoirs within the model, including evaporation and precipitation data that are used to calculate net evaporation, historical end-of-month contents, historical releases and the stage-area-capacity curves. The volume of water lost to the system through evaporation is calculated by interpolating the water surface area for each reservoir based on the end-of-month contents. This evaporation data, as well as releases from the reservoir, are used in the reach mass balance calculations. A sample of the worksheet is shown in Figure 4-9.

Return to Start

Reservoir Evaporative Losses

		Mean Monthly Evaporation (Inches)												
Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
3.6200	Dinwoody Lakes	0.88	0.53	1.75	2.63	3.85	5.25	6.65	5.95	3.50	2.10	1.05	0.88	35.00
4.7200	Bull Lake Reservoir	0.88	0.53	1.75	2.63	3.85	5.25	6.65	5.95	3.50	2.10	1.05	0.88	35.00
5.0480	Teapot Reservoir	0.88	0.53	1.75	2.63	3.85	5.25	6.65	5.95	3.50	2.10	1.05	0.88	35.00
5.1200	Pilot Butte Reservoir	0.93	0.56	1.86	2.79	4.09	5.58	7.07	6.32	3.72	2.23	1.12	0.93	37.20

		Historical End-of-Month Contents (Acre-Feet)												
Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
3.6200	Dinwoody Lakes	1,050	1,200	1,350	1,950	3,000	3,000	2,400	1,800	1,200	600	750	900	1,600
4.7200	Bull Lake Reservoir	87,001	86,781	86,506	84,575	98,164	137,389	141,936	117,629	88,054	86,836	86,690	86,961	99,044
5.0480	Teapot Reservoir	552	631	710	1,025	1,578	1,578	1,262	947	631	316	394	473	841
5.1200	Pilot Butte Reservoir	12,110	13,840	15,570	22,490	34,600	34,600	27,680	20,760	13,840	6,920	8,650	10,380	18,453

		Historical Releases (Acre-Feet)												
Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
3.6200	Dinwoody Lakes	0	0	0	0	0	0	600	600	600	600	0	0	200
4.7200	Bull Lake Reservoir	2,281	1,851	2,135	4,684	13,353	20,425	48,820	46,468	40,360	6,602	3,068	2,277	16,027
5.0480	Teapot Reservoir	0	0	0	0	0	0	316	316	316	316	0	0	105
5.1200	Pilot Butte Reservoir	0	0	0	0	0	0	6,920	6,920	6,920	6,920	0	0	2,307

		Surface Area (Acres)												
Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
3.6200	Dinwoody Lakes	461	470	478	513	574	574	539	504	470	435	444	452	493
4.7200	Bull Lake Reservoir	2,599	2,596	2,591	2,558	2,710	3,036	3,070	2,880	2,617	2,597	2,594	2,599	2,704
5.0480	Teapot Reservoir	120	137	154	167	185	185	175	164	137	69	86	103	140
5.1200	Pilot Butte Reservoir	292	334	375	542	834	834	667	500	334	167	209	250	445

		Mean Monthly Evaporation (Acre-Feet)												
Node Number		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
3.6200	Dinwoody Lakes	33.61	20.55	69.75	112.24	184.16	251.13	298.81	250.10	136.97	76.09	38.81	32.97	1,505.2
4.7200	Bull Lake Reservoir	189.54	113.56	377.85	559.66	869.33	1,328.04	1,701.43	1,427.98	763.32	454.40	226.98	189.49	8,201.6
5.0480	Teapot Reservoir	8.75	6.00	22.50	36.51	59.35	80.94	96.80	81.48	39.99	12.00	7.50	7.50	459.3
5.1200	Pilot Butte Reservoir	22.62	15.51	58.17	126.04	284.39	387.81	392.98	263.71	103.42	31.02	19.39	19.39	1,724.5

Area-Capacity Curves

Node Name	Dinwoody Lakes				Bull Lake Reservoir				Teapot Reservoir				Pilot Butte Reservoir			
Node Number	3.6200		Offset		4.7200		Offset		5.0480		Offset		5.1200		Offset	
	Area Capacity (AF)	Surface Area (Acres)	Area Capacity (AF)	Surface Area (Acres)	Area Capacity (AF)	Surface Area (Acres)	Area Capacity (AF)	Surface Area (Acres)	Area Capacity (AF)	Surface Area (Acres)	Area Capacity (AF)	Surface Area (Acres)	Area Capacity (AF)	Surface Area (Acres)	Area Capacity (AF)	Surface Area (Acres)
	0	400	3,000.0	574.0	0	1,573	4,770.0	1607.0	0	0	722.5	157.0	0	0	34,600.0	834.0
	3,000	574	0.0	0.0	4,770	1,607	13,080.0	1716.0	723	157	1,577.5	185.0	34,600	834	0.0	0.0
					13,080	1,716	21,935.0	1826.0	1,578	185	0.0	0.0				
					21,935	1,826	31,345.0	1937.0								

Figure 4-9. Reservoir Data Worksheet

The model explicitly models all reservoirs greater than 500 acre-feet. Any reservoirs less than 500 acre-feet are implicitly included in the gage flows and gain-loss calculations. Historical storage and release data was not available for many of the reservoirs. In addition, not all reservoirs contain stage-area-capacity curves.

Engineering Notes

Monthly gross evaporation, precipitation data and area-capacity data for each of the modeled reservoirs was obtained from the Technical Memorandum Water Use From Storage (LA, 2002).

Historical end-of-month reservoir contents, diversions, and releases were obtained from the water users or the US Bureau of Reclamation. Dry, normal and wet year end-of-month contents were determined for each reservoir based upon the same methodology as described in the Task 3A/3B Technical Memorandum Surface Water Hydrology (MWH, 2002).

For those reservoirs that did not contain a rating curve, the rating curve was assumed as a two-point curve, which assumes a linear interpolation between empty and full stage-storage.

Calibration Notes

Because reservoir data was not available for a majority of the reservoirs, initially, estimated contents were assumed for each of the reservoirs based on filling in the spring months and drawdowns later in the summer. Then, releases and the subsequent end-of-month contents were modified so that they were reasonably calibrated with the gain-loss calibrations.

User Notes

Monthly gross evaporation (inches) and total precipitation (inches) data are included in the table. The net evaporation in inches is then calculated within the worksheet. The end-of month surface area is calculated from the area-capacity table and used to determine the mean monthly evaporative loss in acre-feet. As with other tables in the model spreadsheet, cells that require an entry are highlighted in yellow.

4.7 Irrigation Return Patterns and Lag Tables

Two tables are shown on the Options worksheet and are described as follows:

1. Irrigation Return Patterns – This worksheet tabulates the percent of the diversion in a given month that returns to the river. Absent deep percolation to the groundwater table, this is the inverse of irrigation efficiency.

2. Irrigation Return Lags – This worksheet provides the temporal distribution of return flows to the river. Some inefficiencies are temporarily stored in shallow groundwater before accruing to surface water flows.

A sample of these two tables is shown in Figure 4-10.

Return to Start

Irrigation Return Pattern (Amount of the diversion that returns to the river)

Type No.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Notes
1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	All Returns
10	100%	100%	100%	100%	82%	74%	66%	66%	66%	66%	100%	100%	Dubois
20	100%	100%	100%	83%	83%	76%	63%	65%	78%	78%	100%	100%	Lander
30	100%	100%	100%	81%	81%	73%	58%	60%	75%	75%	100%	100%	Other
40	100%	100%	81%	81%	79%	72%	64%	59%	79%	83%	100%	100%	Owl Creek
50	100%	100%	100%	82%	82%	75%	67%	66%	79%	79%	100%	100%	Reservation
60	100%	100%	100%	80%	76%	61%	48%	48%	73%	73%	100%	100%	Riverton
99	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	Zero Returns

Irrigation Return Lags

Pattern No.	0	1	2	3	4	5	6	Total
1	30.0%	21.0%	14.0%	11.0%	9.0%	8.0%	7.0%	100.0%
2	40.0%	23.0%	14.0%	9.0%	6.0%	4.0%	4.0%	100.0%
3	50.0%	25.0%	13.0%	6.0%	3.0%	2.0%	1.0%	100.0%
4	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
5	70.0%	11.5%	7.0%	4.5%	3.0%	2.0%	2.0%	100.0%

Note: "0" means proportion that returns in same month as diverted
"1" means returns in next month
"2" means returns in two months
etc.

Figure 4-10. Irrigation Return Patterns and Lags

Engineering Notes

The unused, or inefficiency portion of diversions is returned to the river over the course of one or more months either by direct surface runoff, or through the alluvial aquifer. For modeling purposes, an estimate must be made of amount, location, and timing of returns. The Options Table addresses amount and timing of return flows. The points of diversion (service area) GIS theme contains the information designating the Return Pattern and Return Lags for each model node.

The Irrigation Return Pattern table provides the monthly return fractions (inefficiencies) for every diversion in the model. One pattern is characterized by zeros in all months, which is applicable to all intra-basin diversion nodes, such as the diversion of water through Dinwoody Canal, which is a feeder canal to the Upper Bench Canals. Monthly efficiencies for irrigation diversions were developed by comparing historical diversion records to the theoretical maximum diversion requirement (based on CIR) as discussed in the Task 2A Technical Memorandum Agricultural Water Use and Diversion Requirements (MWH, 2003a). The return flow fraction is defined as (1.0 – Efficiency).

Lags for irrigation diversions were patterned after similar previous projects and adjusted based on the type of irrigation system defined in the irrigated lands mapping (i.e. conventional irrigation systems as opposed to spreader dikes or intermittent diversions from ephemeral streams). Irrigation Return Lags for municipal nodes were set to 100 percent during the month of diversion.

Calibration Notes

Efficiencies and return lags are an important step in the calibration process. The efficiencies and return lags initially selected were further calibrated to fit the conditions of the sub-basins using the magnitude and monthly pattern of the Ungaged Basin Gain/Loss term as a reasonableness check.

User Notes

The Options Tables incorporate the information used in the computation of irrigation return flow quantities and their timing. The data in the first table, "Irrigation Return Patterns," consist of the percentages of water diverted which eventually will return to the river and be made available to downstream users.

The second worksheet table, "Irrigation Return Lags", controls the timing of these returns. Flows diverted in any month can be lagged up to six months beyond the month in which they are diverted. An example pattern is:

Month	0	1	2	3	4	5	6
Percent	30	21	14	11	9	8	7

By way of example, for a diversion occurring in July, 30 percent of the Total Irrigation Returns (i.e., that portion not lost to consumptive use, evaporation, etc.) will return in July, 21 percent in August, 14 percent in September, 11 percent in October, 9 percent in November, 8 percent in December, and the remaining 7 percent will return in January.

4.8 Data Transfer From Other Models

Because of the size of the Wind and Bighorn basins, the river basins were separated into several sub-basin models. As a consequence, there are several occasions when data is required to pass between the models. Examples of this include:

1. When a downstream model requires data at the confluence with another model;
2. When diversions occur in one model and the return flows return to another model;

These types of interactions differ from imports and exports because imports and exports between basins are intended to model physical transbasin export from one basin to another. Data transfer between models is necessary when data must be transferred simply because the basins have been subdivided into one or more models.

A sample of the data transfer worksheet is shown in Figure 4-11.

Return to Start

Imports from Other Models

Streamflow (ac-ft)

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
14.25 NET Flow (In - Out)		64,700	59,400	68,617	86,167	96,522	117,048	153,137	100,230	82,624	82,139	68,595	68,633	1,047,812
3.35 NET Flow (In - Out)		1,113	934	687	14	5,774	16,280	3,606	326	975	4,363	3,180	1,842	39,095
9.31 NET Flow (In - Out)		15,493	15,899	17,225	17,200	63,555	72,476	20,845	18,916	14,588	18,728	19,288	16,751	0

Estimated Actual Irrigation Returns (ac-ft)

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
3.0000		15	7	3	53	176	249	272	228	223	126	64	31	0
4.0000		48	23	9	162	569	810	887	742	726	410	209	101	0
4.5000		60	28	11	203	711	1,013	1,109	928	907	512	261	127	0
9.0000		50	29	15	85	211	282	295	297	298	221	139	85	0
10.0000		9	5	3	16	41	54	57	56	55	40	26	16	0

Model Simulated Irrigation Returns (ac-ft)

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
3.0000		15	7	3	53	176	249	272	228	223	126	64	31	0
4.0000		48	23	9	162	569	810	887	742	726	410	209	101	0
4.5000		60	28	11	203	711	1,013	1,109	928	907	512	261	127	0
9.0000		50	29	15	85	211	282	295	297	298	221	139	85	0
10.0000		9	5	3	16	41	54	57	56	55	40	26	16	0

Ungaged Gain and Loss Calculations: Iteration One (Acre-Feet)

Basin D & E Gain/Loss

D & E

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
From Owl Creek Model Basin D:												
Upstream Gages	1,005.2	1,014.8	1,217.0	3,887.9	16,074.4	24,224.5	9,443.7	3,671.3	2,761.9	2,100.1	1,564.6	1,209.2
Total Diversions	0.0	0.0	582.1	4,889.2	15,736.4	18,287.6	16,737.7	10,675.7	9,048.8	1,432.1	0.0	0.0
Total Returns	468.9	218.0	321.8	1,886.0	6,533.8	9,260.6	9,517.8	7,611.5	7,011.6	4,090.2	2,090.9	1,011.5
Change in EOM Storage	147.1	46.0	22.9	217.0	312.2	(193.2)	(214.0)	(195.0)	(99.0)	(88.0)	25.0	19.0
Reservoir Evaporation	1.5	1.0	3.6	8.4	18.7	20.1	18.0	10.0	4.0	1.5	0.9	0.8
From Nowood Model:												
Upstream Gages	19,155.7	19,549.9	11,591.4	19,749.2	73,933.1	97,955.6	37,919.4	33,293.5	16,293.2	13,276.2	11,273.2	19,433.2

Figure 4-11. Upstream Flows From Other Models Worksheet

Engineering Notes

This worksheet does not perform any calculations.

User Notes

Data on this worksheet is linked directly to the spreadsheet from which it originates. Therefore, if changes are made in the source worksheet, then the links must be updated. In addition, if any lines are inserted or deleted, the links must be relinked to ensure that the correct data is imported.

When any of the sub-basin models with links is opened, it will ask the user if the links should be updated. If the user is only using the model to investigate impacts with the model sub-basin, then the links do not need to be opened. However, if the user is determining impacts of changes to the model on all downstream users, then the links need to be updated when opening the downstream sub-basin models.

Section 5 - Model Computation Worksheets

The model computation worksheets are the heart of the sub-basin models. The primary model calculations are performed within these worksheets, including the calculation of return flows, the calculation of ungaged basin gains and losses, and the water balance for each reach.

5.1 Irrigation Returns

The unused portion of a headgate diversion either returns to the river as surface runoff during the month it is diverted, percolates into the alluvial aquifer or deep percolates into sub-alluvial aquifers. The portion that percolates into the alluvial aquifer returns to the river through sub-surface flow, but generally lags the actual diversion by several months. In general, unless there is information that is contradictory, it is assumed that all sub-surface return flows are to the alluvial aquifer and thus return to the river. The location of the return flow's re-entry to the surface water system is an important factor in modeling the basin, and depends on the specific topography and layout of the irrigation system. The location of irrigation return flows were determined through the irrigated lands mapping task and are specified as a GIS attribute for each irrigated service area.

There are two Irrigation Return worksheets:

- Estimated Actual Return Flows – Calculates historical return flows from historical diversions.
- Model Simulated Return Flows – Calculates simulated return flows from the modeled diversions, whether they be historical, full supply, or full supply with Futures projects.

Each of these Irrigation Return worksheets has three tables and are described as follows:

1. Calculates the amount of return flow resulting from each month's diversion at each node, and distributes it in time and place according to the information in the Options Table. 2. Figure 5-1 shows the calculation tables for each return flow worksheet.

2. Table tabulates all the incoming return flows for each month at each node, from the various sources. This table produces the return flow component of inflow at each node.

3. Summarizes return flows by reach.

Return to Start | View Individual Nodes | View Node Totals Summary | Help with Return Tables | View Reach Totals Summary | View Modeled Return Tables

Estimated Actual Irrigation Return Tables (Acre-Feet)

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Estimated Actual Irrigation Returns: Node Evaluation															
Reach 1100 Nodes			**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Total**
11.0100	**Greybull River Natural Flow**			**Efficiency Pattern =**			**1**								
Reach 1100	Total Diversions =		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Total Irrigation Returns =		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TO:	**TO:**	**Percent**		**Return Lag Pattern =**			**4**								
		0.0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		0.0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		0.0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		0.0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		0.0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11.0110	**Greybull River Diversions**			**Efficiency Pattern =**			**31**								
Reach 1100	Total Diversions =		0.0	0.0	0.0	1.8	310.0	412.8	399.9	353.3	244.0	24.5	0.0	0.0	
	Total Irrigation Returns =		0.0	0.0	0.0	1.4	249.8	299.7	231.0	212.2	182.7	18.3	0.0	0.0	
TO:	**TO:**	**Percent**		**Return Lag Pattern =**			**2**								
Four Bear Creek Diversion	11.03	90.0%	27.3	15.2	7.2	1.2	90.2	159.8	176.8	182.3	176.6	115.1	76.3	47.7	
Confluence of Graybull River and Pickett Creek	11.04	10.0%	3.0	1.7	0.8	0.1	10.0	17.8	19.6	20.3	19.6	12.8	8.5	5.3	
		0.0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		0.0%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
		100.0%	30.3	16.9	8.0	1.3	100.3	177.6	196.5	202.5	196.3	127.9	84.7	53.0	####
11.0400	**Confluence of Graybull River and**			**Efficiency Pattern =**			**1**								
Reach 1100	Total Diversions =		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Total Irrigation Returns =		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

Figure 5-1. Estimated Actual Returns Worksheet

Engineering Notes

The following describes the terms and calculation procedures found in the irrigation return flow worksheets.

Efficiency Pattern: The value entered here is used to look up the Irrigation Return Pattern found in the Options Table. These values are referenced from the return flow worksheets.

Total Diversions:

Estimated Actual Return Flows worksheet: values are referenced from the Estimated Actual Diversion Data input worksheet.

Model Simulated Return Flows worksheet: values are referenced from the "Summary of Diversion Calculations: By Reach" table on the Diversion Summary worksheet.

Total Irrigation Returns: These values are computed by multiplying the Total Diversions by the selected Irrigation Return Pattern for the month. For example, for a month with Total Diversions of 1000 acre-feet and an irrigation return fraction of 80%, the Total Irrigation Returns from that diversion for that month will be 800 acre-feet.

Return Pattern: The value entered here is used to look up the Irrigation Return Lag found in the Options Table. These values are referenced from the return flow worksheets.

To and Percent: This feature allows the User to define the node(s) in the model where irrigation returns will return and in what percentages. These values are referenced from the Return Flow worksheet.

Irrigation Returns: Node Totals Table: This table lists all of the irrigation returns that have been directed to each Node and provides their sum.

Irrigation Returns: Reach Totals Table: This table lists all of the irrigation returns that have been directed to each Reach and provides their sum.

User Notes

This worksheet computes the return flows from irrigation diversions. The User should modify only those cells highlighted in yellow. In general, the user will not modify values on this worksheet. It has been designed to be "self-computing" wherein values are referenced from other worksheets, primarily the Irrigation Diversion worksheets and the Return Flow worksheets.

Buttons at the top of the worksheet take the User directly to each of the three tables in the Irrigation Return Worksheet.

View Individual Nodes: takes the User to the first table, which calculates return flows from each node and distributes them in time and place.

View 'Node Totals' Summary Table: takes the User to the second table, the Node Totals Table.

View 'Reach Totals' Summary Table: takes the User to the Reach Totals Table.

5.2 Gain-Loss Calculations

The sub-basin models simulate the major inflows, storage facilities, diversions and other major elements of the river basin system. However, many more minor elements of the river basin system, such as small tributaries, small reservoirs, stock ponds, groundwater accretions/depletions, etc., are not explicitly included in the schematics or in the computer simulation of the physical system. To account for these elements in the model, their impacts are estimated through gain-loss calculations between known points of flow (i.e. streamflow gage nodes, natural flow nodes or reservoir releases). These impacts are then added back into the reaches represented in the model. These ungaged gains and losses account for all water in the budget that is not explicitly accounted for and includes ungaged tributaries, groundwater/surface water interactions, or any other process not explicitly modeled. Two iterations are performed for historical and simulated flows. Samples of each calculation are shown in Figure 5-2. Calculations are summarized in the gain-loss summary tables, which are shown in Figure 5-3.

Return to Start | View Reach Summaries | View Gain / Loss Calcs (Iter. 2)

Ungaged Gain and Loss Calculations: Iteration One (Acre-Feet)

Basin A Gain/Loss — View Basin A Chart

			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Upstream Gage at:	11.0100	Greybull River Natural Flow	2,807.7	2,442.1	3,070.5	5,255.3	23,076.7	32,463.0	15,446.8	7,339.5	4,998.3	4,622.3	3,746.9	3,115.0
	11.0200	Four Bear Creek Natural Flow	8.5	7.4	11.9	35.4	169.3	192.7	104.1	72.4	56.0	45.6	15.2	10.7
	11.0900	Francs Fork Natural Flow	333.3	289.9	400.2	838.4	3,797.8	4,942.7	2,464.2	1,346.8	961.0	848.2	496.0	387.4
	11.0500	Pickett/Rock Creek Natural Flow - Ashworth No. 2	201.7	175.4	247.5	543.9	2,482.0	3,171.6	1,598.7	903.1	651.5	568.7	307.9	237.0
Downstream Gage at:	11.1200	GREYBULL RIVER NEAR PITCHFORK, WYO.	1,247.2	953.8	1,348.2	2,497.9	16,055.8	31,010.4	30,416.5	19,628.4	11,477.8	3,325.2	1,881.8	1,471.1
		Gage Difference	**(2,104.0)**	**(1,961.0)**	**(2,381.9)**	**(4,175.1)**	**(13,469.9)**	**(9,759.6)**	**10,802.7**	**9,966.6**	**4,810.9**	**(2,759.6)**	**(2,684.1)**	**(2,279.0)**
	Node	**Diversions**												
	11.0110	Greybull River Diversions	0.0	0.0	0.0	1.8	310.0	412.8	399.9	353.3	244.0	24.5	0.0	0.0
	11.0300	Four Bear Creek Diversion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	11.0950	Francs Fork Diversions	0.0	0.0	0.0	3.3	575.0	765.8	741.8	655.5	452.6	45.4	0.0	0.0
	11.0600	Pickett/Rock Creek Diversions	0.0	0.0	0.0	136.1	469.5	716.4	746.2	586.8	241.8	72.9	0.0	0.0
	11.1100	Greybull River Diversion - Greybull Ditch	0.0	0.0	0.0	112.9	447.9	777.5	661.1	617.1	276.0	56.8	0.0	0.0
		Basin Total Diversions	**0.0**	**0.0**	**0.0**	**254.1**	**1,802.3**	**2,672.5**	**2,549.0**	**2,212.8**	**1,214.4**	**199.6**	**0.0**	**0.0**
		Returns												
	11.0110	Greybull River Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	11.0300	Four Bear Creek Diversion	27.3	15.2	7.2	1.2	90.2	159.8	176.8	182.3	176.6	115.1	76.3	47.7
	11.0950	Francs Fork Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	11.0600	Pickett/Rock Creek Diversions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	11.1100	Greybull River Diversion - Greybull Ditch	47.0	25.5	11.2	19.6	163.6	288.9	324.2	329.3	297.1	199.6	131.2	82.4
	11.0400	Confluence of Graybull River and Pickett Creek	21.9	11.5	4.6	18.6	80.7	141.9	161.6	161.7	134.7	93.7	61.0	38.6
	11.0700	Confluence of Greybull River and Rock Creek	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	11.1000	Confluence of Francs Fork and Greybull River	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Basin Total Returns	**96.2**	**52.3**	**23.0**	**39.4**	**334.5**	**590.6**	**662.6**	**673.3**	**608.5**	**408.4**	**268.5**	**168.6**
			Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
BASIN NAME =	Basin A	Net Gain/Loss	**(2,200.2)**	**(2,013.3)**	**(2,404.9)**	**(3,960.4)**	**(12,002.1)**	**(7,677.7)**	**12,689.0**	**11,506.1**	**5,416.8**	**(2,968.5)**	**(2,952.6)**	**(2,447.7)**

Figure 5-2. Ungaged Gain-Loss Calculations Iteration 1

Return to Start | View Gain / Loss Calcs (Iter. 1) | View Gain / Loss Calcs (Iter. 2)

Ungaged Basin Gains (Acre-Feet)

Basin Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Basin A	0	0	0	0	0	0	12,689	11,506	5,417	0	0	0
Basin B	0	0	0	0	0	1,189	787	0	0	0	0	0
Basin C	1,027	974	1,035	1,911	10,503	16,897	13,923	8,673	5,439	1,624	938	1,091
Basin D	988	1,025	1,220	1,013	0	146	3,656	3,747	2,208	705	863	814
Basin E	0	0	0	0	0	725	0	0	0	0	0	0
Basin F	0	158	243	6,304	15,862	34,183	20,973	2,893	0	0	0	0
Basin G	0	7,290	16,404	9,943	14,678	19,728	0	0	0	6,760	4,427	0
Basin S1	1,233	1,118	1,694	90	2,285	3,940	190	211	45	6,651	1,262	1,290
Basin S2	507	1,018	1,614	2,331	1,119	2,781	0	0	0	9,826	3,399	534
NA	0	0	0	0	0	0	0	0	0	0	0	0

Ungaged Basin Losses (Acre-Feet)

Basin Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Basin A	2,200	2,013	2,405	3,960	12,002	7,678	0	0	0	2,968	2,953	2,448
Basin B	147	136	150	176	103	0	0	8	270	197	161	152
Basin C	0	0	0	0	0	0	0	0	0	0	0	0
Basin D	0	0	0	0	89	0	0	0	0	0	0	0
Basin E	294	121	109	165	143	0	4,936	10,705	3,229	1,762	1,059	616
Basin F	1,225	0	0	0	0	0	0	0	2,244	8,356	6,154	3,258
Basin G	2,549	0	0	0	0	0	56,594	28,691	7,582	0	0	3,065
Basin S1	0	0	0	0	0	0	0	0	0	0	0	0
Basin S2	0	0	0	0	0	0	3,781	9,002	5,977	0	0	0
NA	0	0	0	0	0	0	0	0	0	0	0	0

Figure 5-3. Gain Loss Summary Worksheet

Engineering Notes

Ungaged gains and losses are computed between gages using a water budget approach as described in the following equation:

$$Q_{gain} = \{Q_{downstream} - \sum Q_{upstream}\} + \sum Q_{diversions} - \sum Q_{return\ flows} - \Delta\ \text{EOM Storage} + Q_{Evaporation}$$

All terms are supplied from the Input Worksheets, the Computation Worksheets, or the Summary Worksheets. Each gain-loss calculation is divided into a basin. Basins are defined by a gaged downstream node. Then, each known flow upstream of that node (gaged flows and natural flows), diversions, return flows and storage contents are used according to the equation above.

Calibration Notes

Two computational iterations are performed in establishing the ungaged gain/loss, with the following differences:

Iteration 1 - Uses the Estimated Actual Diversion Data and Historical Return Flows

Iteration 2 - Uses the Model Simulated Diversions and Model Return Flows.

The second iteration accounts for reductions in return flows resulting from diversion shortages and is necessary to achieve closure in the water balance calculations. Basin gains are equated to positive values, while basin losses are equated to negative values. The basin gain/loss charts are used to visually verify the reasonableness of the gain/loss pattern and magnitude. Model assumptions, input data, and schematic representations of the physical system were adjusted as necessary until the magnitude and monthly distribution of the gain/loss term appeared reasonable given the inherent limitations of the model and data deficiencies.

User Notes

The worksheet uses positive values from iteration one as Basin Gains and negative values from iteration two as Basin Losses. Mathematical closure in the water balance calculations is accomplished through adjustments made in the second iteration.

Basin Summary – takes the user to the Basin Summary Tables

View Basin $ Chart – allows the user to view the chart for that basin. $ is the Basin alphanumeric number.

5.3 Reach Water Balance Calculations

The water balance at each node is contained in the Reach Water Balance worksheets. Each node is represented in the spreadsheet by an inflow section, which includes inflow from the upstream node, irrigation returns, ungaged gains, and imports, if applicable; and an outflow section, which includes ungaged losses and diversions, if applicable. Storage nodes have the additional gains/losses due to storage releases or diversions, and losses due to evaporation. The algebraic sum of these flows is then the net outflow from the node. A sample of a non-storage node calculation table is shown in Figure 5-4, while a sample of a storage node calculation is shown in Figure 5-5.

Return to Start | View Previous Reach | View Next Reach

Reach 2500: Shoshone River below Bitter Creek

All values in Acre-Feet.

17.66 Diversions	0	0	0	0	0	0	0	0	0	0	0	0
Total 17.66 Outflow	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
17.66 NET Flow (In - Out)	**33,071**	**30,794**	**37,145**	**35,667**	**51,639**	**92,994**	**104,752**	**54,912**	**54,231**	**44,237**	**39,537**	**36,407**

17.6650 Shoshone River Diversions - Globe Canal

Inflow To This Node	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
17.665 Node Inflow	33,071	30,794	37,145	35,667	51,639	92,994	104,752	54,912	54,231	44,237	39,537	36,407
17.665 Irrigation Returns	0	0	0	0	0	0	0	0	0	0	0	0
N/A Ungaged Gains	0	0	0	0	0	0	0	0	0	0	0	0
17.665 Import/Export	0	0	0	0	0	0	0	0	0	0	0	0
Total 17.665 Inflow	**33,071**	**30,794**	**37,145**	**35,667**	**51,639**	**92,994**	**104,752**	**54,912**	**54,231**	**44,237**	**39,537**	**36,407**
Outflow From This Node												
N/A Ungaged Losses	0	0	0	0	0	0	0	0	0	0	0	0
17.665 Diversions	0	0	0	643	2,311	2,803	3,373	3,240	2,684	1,031	0	0
Total 17.665 Outflow	**0**	**0**	**0**	**643**	**2,311**	**2,803**	**3,373**	**3,240**	**2,684**	**1,031**	**0**	**0**
17.665 NET Flow (In - Out)	**33,071**	**30,794**	**37,145**	**35,024**	**49,329**	**90,191**	**101,379**	**51,672**	**51,546**	**43,205**	**39,537**	**36,407**

17.6690 Confluence of Sand Creek and Shoshone River

Inflow To This Node	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
17.669 Node Inflow	33,308	31,008	37,449	35,578	51,585	93,076	102,811	52,461	52,117	43,741	39,882	36,682
17.669 Irrigation Returns	342	205	118	290	1,054	1,562	1,629	1,698	1,909	1,476	934	577
N/A Ungaged Gains	0	0	0	0	0	0	0	0	0	0	0	0
17.669 Import/Export	0	0	0	0	0	0	0	0	0	0	0	0
Total 17.669 Inflow	**33,650**	**31,213**	**37,567**	**35,868**	**52,639**	**94,638**	**104,439**	**54,160**	**54,026**	**45,218**	**40,816**	**37,259**
Outflow From This Node												
Basin L Ungaged Losses	0	0	0	0	2,845	664	0	7,601	6,472	431	0	0
17.669 Diversions	0	0	0	0	0	0	0	0	0	0	0	0
Total 17.669 Outflow	**0**	**0**	**0**	**0**	**2,845**	**664**	**0**	**7,601**	**6,472**	**431**	**0**	**0**
17.669 NET Flow (In - Out)	**33,650**	**31,213**	**37,567**	**35,868**	**49,794**	**93,975**	**104,439**	**46,559**	**47,554**	**44,786**	**40,816**	**37,259**

17.6700 SHOSHONE RIVER NEAR LOVELL, WY

Inflow To This Node	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
17.67 Node Inflow	33,650	31,213	37,567	35,868	49,794	93,975	104,439	46,559	47,554	44,786	40,816	37,259
17.67 Irrigation Returns	1,035	618	352	1,027	3,342	4,816	5,053	5,291	5,916	4,464	2,822	1,741
Basin M Ungaged Gains	6,437	7,605	7,799	6,656	1,755	0	1,854	0	0	0	357	4,154
17.67 Import/Export	0	0	0	0	0	0	0	0	0	0	0	0
Total 17.67 Inflow	**41,122**	**39,436**	**45,718**	**43,551**	**54,891**	**98,791**	**111,346**	**51,850**	**53,470**	**49,250**	**43,995**	**43,154**
Outflow From This Node												
N/A Ungaged Losses	0	0	0	0	0	0	0	0	0	0	0	0
17.67 Diversions	0	0	0	0	0	0	0	0	0	0	0	0
Total 17.67 Outflow	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
17.67 NET Flow (In - Out)	**41,122**	**39,436**	**45,718**	**43,551**	**54,891**	**98,791**	**111,346**	**51,850**	**53,470**	**49,250**	**43,995**	**43,154**

17.6750 Shoshone River Diversions - Hunt Canal

Inflow To This Node	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**

Figure 5-4. Reach Water Balance Worksheet

Return to Start | View Previous Reach

Reach 2200: Buffalo Bill Reservoir

All values in Acre-Feet.

17.5000 Buffalo Bill Reservoir

Inflow To This Node	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
17.5 Node Inflow	16,378	14,333	18,843	34,305	142,088	296,774	211,244	56,808	32,363	28,780	23,589	18,641
17.5 Irrigation Returns	782	426	217	554	2,896	5,290	5,513	5,290	5,159	3,437	2,239	1,417
N/A Ungaged Gains	0	0	0	0	0	0	0	0	0	0	0	0
17.5 Import/Export	0	0	0	0	0	0	0	0	0	0	0	0
Total 17.5 Inflow	**17,160**	**14,759**	**19,059**	**34,858**	**144,983**	**302,064**	**216,757**	**62,098**	**37,523**	**32,217**	**25,829**	**20,058**
Outflow from Reservoir												
N/A Ungaged Losses	0	0	0	0	0	0	0	0	0	0	0	0
17.5 Diversions	0	0	0	0	0	0	0	0	0	0	0	0
17.5 Historical Release	20,889	19,119	23,056	48,359	99,042	165,110	191,002	114,684	80,786	40,642	22,401	22,307
17.5 Reservoir Evaporation	461	273	901	1,308	2,150	3,481	4,414	3,679	2,006	1,139	568	467
Reservoir 17.5 Total Outflow	**21,350**	**19,392**	**23,957**	**49,667**	**101,192**	**168,591**	**195,416**	**118,364**	**82,792**	**41,780**	**22,969**	**22,774**
Calculation of Reservoir End-of-Month Contents												
Calculated Change in Storage	(4,191)	(4,633)	(4,898)	(14,809)	43,792	133,473	21,341	(56,266)	(45,269)	(9,563)	2,860	(2,716)
Starting End-of-Month Contents	299,559		**Max Storage Capacity**			644,540		**Inactive Storage Pool**		0		
EOM Content (w/o max capacity limitation)	285,949	281,316	276,417	261,608	305,400	438,873	460,213	403,947	358,678	289,996	292,856	290,140
17.5 Model Release	20,889	19,119	23,056	48,359	99,042	165,110	191,002	114,684	80,786	40,642	22,401	22,307
17.5 Spill	0	0	0	0	0	0	0	0	0	0	0	0
17.5 End-of-Month Contents	**285,949**	**281,316**	**276,417**	**261,608**	**305,400**	**438,873**	**460,213**	**403,947**	**358,678**	**289,996**	**292,856**	**290,140**
17.5 NET Flow (In - Out)	**20,889**	**19,119**	**23,056**	**48,359**	**99,042**	**165,110**	**191,002**	**114,684**	**80,786**	**40,642**	**22,401**	**22,307**

Figure 5-5. Reach Water Balance Worksheet - Reservoir Node

Engineering Notes

This is the heart of the spreadsheet model where water budget calculations are performed for each node represented in the model. Water balance is maintained in each river reach through the

use of the Ungaged Basin Gain/Loss term. The total basin gain or loss is pro-rated based upon the known contribution of the particular reach to the overall river flow. Basin gains are added to the most upstream node on the reach while basin losses are accounted for at the node just upstream of the most downstream gage for the basin. This allows full diversion of the ungaged gain/loss by diversions within the reach.

The calculations are a mass balance at the node. The following equation describes the calculation:

$$Q_{net\ flow} = Q_{inflow} - Q_{outflow}$$

where:

$$Q_{inflow} = Q_{node\ inflow} + Q_{irrigation\ returns} + Q_{ungaged\ gains} + Q_{imports}$$

$$Q_{outflow} = Q_{ungaged\ losses} + Q_{diversions} + Q_{historical\ releases} + Q_{evaporation}$$

For nodes that have flow data, the node inflow is the flow data. Otherwise, this is the sum of the upstream node (or nodes if the node is a junction node).

At reservoir nodes, simulated end-of-month contents is also calculated. The following equation is used in the calculations:

$$S_{eom} = S_{eom\text{-}previous} + Q_{inflows} - Q_{model\ releases} - Evap - Q_{div} - Q_{ungaged\ losses}$$

Obviously, end-of-month storage is limited to the actual storage contents of the reservoir. It should be noted that to avoid iterating between start-of-month and end-of-month contents to calculate evaporation, the historical or estimated historical evaporation is used for the evaporation term.

User Notes

The Node Tables compute the flow available to downstream users (NET flow) using a water budget approach.

The nodes must be organized in an upstream-to-downstream order within each reach. Diversion demands at each node are referenced from the Full Supply Diversion Data worksheet. Model simulated diversions are the lesser of full supply diversion requirements and available flow. In the event that the full supply demand cannot be met, a warning is provided to inform the User that the diversion has been shorted.

The following subsections contain miscellaneous notes about specific nuances within the Reach/Node tables in the six sub-basin models. See the “Model Node Map” and Node list within each model for the locations of the reaches and nodes discussed below.

Madison/Gallatin Model

- The Gallatin River is represented by only one node, which is the Gallatin River at Gallatin Gateway (node 2.0000).

- There are no diversions in the model.

Yellowstone Model

- Because Yellowstone Lake is a natural lake, it was not explicitly modeled. Instead, the first node in the model on the Yellowstone River is at the Yellowstone Lake outlet (node 1.0200).

- The model does not contain any diversion nodes.

Clarks Fork Model

- The Clarks Fork river basin begins in Montana. However, the first gage on the river is in Wyoming (node 1.0100). For purposes of the model, this gage is considered a natural flow node (any changes in flow in Montana are automatically incorporated into the gage flow).

Upper Wind Model

- The Upper Bench portion of the Wind River Irrigation Project consists of Dinwoody Canal (node 3.6300), Dry Creek Canal (node 4.2400), Meadow Creek Canal (node 4.4500) and Willow Creek Canal (node 4.6500). Dinwoody Canal is a feeder canal only (no irrigated lands) that delivers water from Dinwoody Creek to the Dry Creek Canal diversion. Dry Creek Canal is both a feeder canal for Meadow Creek and a delivery system for irrigated lands. Similarly, Meadow Creek Canal is a feeder canal for Willow Creek Canal and serves irrigated lands. The diversion volume for Dinwoody Canal is set at its maximum capacity of 200 cfs. Then, each of the feeder portions of these canals is represented in the model by return flows occurring to the receiving canal. Return flow patterns are adjusted accordingly.

- The Lower Bench portion of the Wind River Irrigation Project consists of Upper 'A' Canal (node 3.9000) and Lower 'A' Canal (node 4.2600). Upper 'A' Canal serves as a feeder canal for Lower 'A' canal and serves irrigated lands. The feeder portion of the canal is represented by return flows to Lower 'A' Canal. Return flow patterns are adjusted accordingly.

- Wyoming Canal (node 5.0000) conveys a portion of its diversion to Pilot Reservoir (node 5.1200). However, lands served by Pilot Canal (node 5.1250) have not been separated from those served by Wyoming Canal. To avoid a circular reference, inflows to Pilot Reservoir are estimated. Then, outflows from Pilot Reservoir via Pilot Canal are directly connected back into the Wyoming Canal diversion.

- There are significant volumes of return flows that return to the Lower Wind model. As a default, the Upper Wind model calculates the return flows to those nodes and exports them to the Lower Wind model. However, if the model is modified so that different return flow

nodes are used, the user needs to ensure that those return flows are correctly calculated and made available for the Lower Wind model.

Little Wind Model

- Ray Canal (node 6.4000) conveys a portion of its diversion to Ray Lake (node 6.4900). However, to accurately simulate the timing of these deliveries, the inflows to Ray Lake are estimated separately from Ray Canal inflows and entered directly into the Reservoir table.

- The North Fork Diversion Canal (node 6.6150) is a feeder canal from the North Fork Little Wind River to the South Fork. The model is constructed with a return flow from the diversion point in the North Fork to the return flow point in the South Fork. The diversion amount is set at the canal capacity of approximately 40 cfs.

Lower Wind Model

- Return flows from Wyoming Canal in the Upper Wind model are shown to fill Middle Cottonwood Reservoir (node 12.0001) and Cameahwait Reservoir (node 12.1001). No separate inflows are shown for these reservoirs.

Upper Bighorn Model

- Throughout the model diversion nodes are encountered where the means of meeting the diversion demand is by obtaining water from a well. In these cases the natural flow node located directly upstream of these nodes is operated to simulate a pump. The flow coming from the upstream natural flow node exactly matches the diversion demand of the node containing the wells.

Owl Creek Model

- Capacity for Anchor Dam (node 3.1005) is set at the level that it historically has been able to store for short periods of time (approximately 7,800 acre-feet).

Nowood Model

- Throughout the model diversion nodes are encountered where the means of meeting the diversion demand is by obtaining water from a well. In these cases the natural flow node located directly upstream of these nodes is operated to simulate a pump. The flow coming from the upstream natural flow node exactly matches the diversion demand of the node containing the wells.

Lower Bighorn Model

- Betherum Reservoir (node 15.0700) and Phelps #2 Reservoir (node 15.0300) are filled to capacity assuming all the water filling the reservoirs is pumped from groundwater. Natural flow nodes are not used.

Greybull Model

- Due to the recent construction of Greybull Valley Reservoir (node 11.6550), its capacity is set to zero for calibration purposes. However, it is operated with a simulated drawdown in the Ideal diversion case.

- Thomas Reservoir (node 11.3950) is filled to capacity assuming all the water filling the reservoir is pumped from groundwater. A natural flow node is not used.

- Node 11.5450 exports water to Foster Reservoir in the Shoshone River Basin.

Shoshone Model

- Garland Canal (node 17.5800) irrigates lands within its service area and serves as a feeder canal for Frannie-Deaver Canal (node 17.6100). Therefore, a portion of the return flows from the canal return to the Frannie-Deaver diversion, and return flow patterns are adjusted accordingly.

- The Frannie-Deaver Canal (node 17.6100) outflows into Sage Creek, then re-diverts downstream. A node is shown representing this. However, the diversion amount for this node is set to zero, assuming that all water discharged into Sage Creek is rediverted by the canal downstream. Related to this, the natural flow for Sage Creek (node 17.6820) is equal to the gaged flow of Sage Creek at Sidon Canal (gage no. 06285400, node 17.6850). Similarly, this assumes that all water discharged into Sage Creek is rediverted by the Frannie-Deaver Canal.

- Beck Lake and Alkali Lake are filled by diversions from the South Fork Shoshone River. The diversions needed to fill the reservoirs were added to the irrigation diversions for the Cody Canal (node 17.0280) and are reflected in the model.

- Foster Reservoir and Perkins & Kinney Reservoir are filled by imports from the Greybull River Basin.

- Sage Creek Reservoir and Wiley Reservoir are filled by diversions from Sage Creek. The diversions needed to fill the reservoirs were added to the irrigation diversions for Sage Creek Canal (node 17.0570) and are reflected in the model.

Section 6 - Results Worksheets

The outflow worksheets allow the model user to view summarized output from the model, either by node, reach or overall model. The output worksheets simply tabulate information as calculated in other worksheets.

6.1 Outflow Summary Worksheet

The outflow summary worksheet presents the monthly outflow of each node and reach in the model as calculated in the reach calculation worksheets. Two sets of tables are shown on this worksheet. The first set of tables shows the outflow for each node in the model, grouped by reach. The second table summarizes this information for each reach. The reach outflow table is subsequently used to perform the available surface water calculations as detailed in Task 3D Technical Memorandum Available Surface Water Determination (MWH, 2003b). A view of the worksheet is shown in Figure 6-1.

Return to Start | Return to **Results** | **View** Outflows by **Node** | **View** Outlfows by **Reach**

Outflow Summary Worksheet (Acre-Feet)

Summary of Outflow Calculations: By Node Run Type: Calibration (Historical)

Reach 1000 NET Flow (In - Out) Summary Table

NODE	Reach	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
11 NET Flow (In - Out)	1000	91,622	92,888	115,935	111,925	163,448	238,896	214,467	122,776	110,370	119,213	102,535	98,998

Reach 1500 NET Flow (In - Out) Summary Table

NODE	Reach	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12 NET Flow (In - Out)		92,554	93,826	116,937	113,113	166,126	242,755	217,866	125,455	112,459	120,645	103,722	100,011
13 NET Flow (In - Out)	1500	98,036	98,657	121,746	116,589	186,641	293,750	225,374	128,886	117,015	127,344	113,243	107,064

Reach 1550 NET Flow (In - Out) Summary Table

NODE	Reach	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
12.001 NET Flow (In - Out)		7,186	6,250	7,542	11,807	51,138	74,448	34,703	15,502	10,342	9,763	9,140	7,810
12.005 NET Flow (In - Out)		584	694	1,301	998	3,023	3,213	2,281	3,312	2,735	1,767	947	582
12.01 NET Flow (In - Out)		1,134	996	1,446	1,418	5,188	6,683	6,072	7,127	6,470	4,120	2,488	1,541
12.05 NET Flow (In - Out)		854	831	850	957	2,062	2,973	2,726	2,080	1,537	1,005	908	867
12.06 NET Flow (In - Out)	1550	870	906	986	1,074	2,317	3,317	2,865	2,204	1,651	1,139	997	897

Reach 1600 NET Flow (In - Out) Summary Table

NODE	Reach	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
13.01 NET Flow (In - Out)		2,626	2,543	2,471	3,809	19,373	26,265	8,204	4,697	3,675	2,141	3,256	2,869
13.02 NET Flow (In - Out)		2,623	2,540	2,461	3,788	19,326	26,201	8,139	4,653	3,658	771	3,253	2,866
13.028 NET Flow (In - Out)		2,623	2,540	2,461	3,788	19,326	28,928	9,210	5,688	4,610	1,724	3,253	2,866
13.03 NET Flow (In - Out)		2,623	2,540	2,461	3,659	18,989	28,506	8,870	5,456	4,432	1,703	3,253	2,866
13.04 NET Flow (In - Out)		2,623	2,753	2,867	3,935	20,386	30,469	8,870	5,456	4,432	1,910	3,389	2,866
13.05 NET Flow (In - Out)		2,623	2,753	2,867	3,860	19,982	29,916	8,357	5,068	4,204	1,840	3,389	2,866
13.08 NET Flow (In - Out)		2,912	3,010	3,174	4,426	22,866	35,547	10,072	6,117	4,845	2,365	3,775	3,194
13.11 NET Flow (In - Out)		3,562	3,587	3,843	5,100	27,001	45,033	12,297	7,440	5,607	3,406	4,733	3,967
13.115 NET Flow (In - Out)		3,566	3,589	3,844	3,492	19,004	36,838	3,665	49	311	1,190	4,743	3,974
13.15 NET Flow (In - Out)		3,777	3,746	4,006	3,624	19,824	40,814	4,508	766	873	1,708	5,153	4,268
13.16 NET Flow (In - Out)		3,777	3,746	4,006	3,624	19,824	40,814	4,508	766	873	1,708	5,153	4,268
13.17 NET Flow (In - Out)		3,900	3,817	4,046	3,486	18,966	40,308	4,098	197	745	1,934	5,508	4,480
13.175 NET Flow (In - Out)		3,900	3,817	4,046	3,486	18,966	40,308	4,098	197	745	1,934	5,508	4,480

Figure 6-1. Outflow Summary Worksheet, Reach Tables

6.2 Diversion Summary Worksheet

The diversion summary worksheet presents the summary of diversion calculations for each node in the model as calculated in the reach worksheets. The diversion summary worksheet contains three sets of table. The first set of tables summarizes the simulated diversion for each node, grouped by reach. A sample of this table is shown in Figure 6-2. The second table summarizes the simulated diversions for each reach. The third table presents a summary of modeled versus full supply diversions. A sample of this worksheet is shown in Figure 6-3.

Return to Start | Return to **Results** | **View** Diversions by **Node** | **View** Diversions by **Reach** | **Diversion Summary Worksheet (Acre-Feet)** | **View** Full Supply vs Model Simulated

Summary of Diversion Calculations: By Node Run Type: Calibration (Historical)

Reach 1000 Diversions Summary Table

NODE		Reach	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
11 Diversions	Confluence of Greybull River and Bighor	1000	0	0	0	0	0	0	0	0	0	0	0	0	0

Reach 1500 Diversions Summary Table

NODE		Reach	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
12 Diversions	Confluence of Dry Creek and Bighorn Ri	1500	0	0	0	0	0	0	0	0	0	0	0	0	0
13 Diversions	Confluence of Shell Creek and Bighorn F	1500	0	0	0	0	0	0	0	0	0	0	0	0	0

Reach 1550 Diversions Summary Table

NODE		Reach	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
12.001 Diversions	Dry Creek Natural Flow	1550	0	0	0	0	0	0	0	0	0	0	0	0	0
12.005 Diversions	Dry Creek Diversion - Agrarian Ditch	1550	0	0	0	391	1,273	1,703	2,064	1,993	1,246	462	0	0	9,133
12.01 Diversions	DRY CREEK NEAR GREYBULL WY	1550	0	0	0	0	0	0	0	0	0	0	0	0	0
12.05 Diversions	Dry Creek Diversions	1550	0	0	0	456	1,192	1,491	1,203	822	631	74	0	0	5,868
12.06 Diversions	DRY CREEK AT GREYBULL, WY	1550	0	0	0	0	0	0	0	0	0	0	0	0	0

Reach 1600 Diversions Summary Table

NODE		Reach	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
13.01 Diversions	SHELL CREEK ABOVE SHELL CREEK RE	1600	0	0	0	0	0	0	0	0	0	0	0	0	0
13.02 Diversions	Shell Reservoir	1600	0	0	0	0	0	0	0	0	0	0	0	0	0
13.028 Diversions	Confluence of Adelaide Creek and Shell	1600	0	0	0	0	0	0	0	0	0	0	0	0	0
13.03 Diversions	Shell Creek Diversion	1600	0	0	0	129	337	422	340	233	178	21	0	0	1,659
13.04 Diversions	SHELL CREEK NEAR SHELL, WY	1600	0	0	0	0	0	0	0	0	0	0	0	0	0
13.05 Diversions	Shell Creek Diversion - Kershner Ditch	1600	0	0	0	75	404	553	513	387	228	70	0	0	2,230
13.08 Diversions	Confluence of White Creek and Shell Cre	1600	0	0	0	0	0	0	0	0	0	0	0	0	0
13.11 Diversions	Confluence of Trapper Creek and Shell (	1600	0	0	0	0	0	0	0	0	0	0	0	0	0
13.115 Diversions	Shell Creek Diversion - Shell Canal	1600	0	0	0	1,610	8,012	8,220	8,658	7,416	5,318	2,232	0	0	41,466
13.15 Diversions	Confluence of Horse Creek and Shell Cr	1600	0	0	0	0	0	0	0	0	0	0	0	0	0
13.16 Diversions	SHELL CREEK AT SHELL WYO	1600	0	0	0	0	0	0	0	0	0	0	0	0	0
13.17 Diversions	Shell Creek Diversion - Whaley Ditch	1600	0	0	0	244	1,381	1,217	1,119	1,262	831	326	0	0	6,379
13.175 Diversions	Shell Creek Diversion	1600	0	0	0	0	0	0	0	0	0	0	0	0	0
13.28 Diversions	Confluence of Beaver Creek and Shell C	1600	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 6-2. Summary of Diversions by Node Table

Return to Start | Return to **Results** | **View** Diversions by **Node** | **View** Diversions by **Reach** | **Diversion Summary Worksheet (Acre-Feet)** | **View** Full Supply vs Model Simulated

Comparison of Model Simulated Diversions vs Full Supply Diversions (Shortage) and vs Estimated Actual Diversions (Calibration Check)

Run Type: Calibration (Historical)

Node	Name	Modeled Diversion	Simulated Diversion	Estimated Actual Diversion	Calibration Difference	% Calib. Difference	Shortage	% Short
11.0000	Confluence of Greybull River and Bighorn River	0	0	0	0	0.0%	0	0.0%
12.0000	Confluence of Dry Creek and Bighorn River	0	0	0	0	0.0%	0	0.0%
12.0010	Dry Creek Natural Flow	0	0	0	0	0.0%	0	0.0%
12.0050	Dry Creek Diversion - Agrarian Ditch	9,133	9,133	9,133	0	0.0%	0	0.0%
12.0100	DRY CREEK NEAR GREYBULL WY	0	0	0	0	0.0%	0	0.0%
12.0500	Dry Creek Diversions	5,868	5,868	5,868	0	0.0%	0	0.0%
12.0600	DRY CREEK AT GREYBULL, WY	0	0	0	0	0.0%	0	0.0%
13.0000	Confluence of Shell Creek and Bighorn River	0	0	0	0	0.0%	0	0.0%
13.0100	SHELL CREEK ABOVE SHELL CREEK RESERVOIR, WYO.	0	0	0	0	0.0%	0	0.0%
13.0200	Shell Reservoir	0	0	0	0	0.0%	0	0.0%
13.0220	Adelaide Creek Natural Flow	0	0	0	0	0.0%	0	0.0%
13.0230	Adelaide Reservoir	0	0	0	0	0.0%	0	0.0%
13.0280	Confluence of Adelaide Creek and Shell Creek	0	0	0	0	0.0%	0	0.0%
13.0300	Shell Creek Diversion	1,659	1,659	1,659	0	0.0%	0	0.0%
13.0400	SHELL CREEK NEAR SHELL, WY	0	0	0	0	0.0%	0	0.0%
13.0500	Shell Creek Diversion - Kershner Ditch	2,230	2,230	2,230	0	0.0%	0	0.0%
13.0600	White Creek Natural Flow	0	0	0	0	0.0%	0	0.0%
13.0700	White Creek Diversion	0	0	0	0	0.0%	0	0.0%
13.0800	Confluence of White Creek and Shell Creek	0	0	0	0	0.0%	0	0.0%
13.0900	Trapper Creek Natural Flow	0	0	0	0	0.0%	0	0.0%
13.1000	Trapper Creek Diversions	2,776	2,776	2,776	0	0.0%	0	0.0%
13.1020	Trapper Creek Diversion - Highline Ditch	2,433	2,433	2,433	0	0.0%	0	0.0%
13.1040	Trapper Creek Diversion - Hatten Ditch	1,452	1,452	1,452	0	0.0%	0	0.0%
13.1100	Confluence of Trapper Creek and Shell Creek	0	0	0	0	0.0%	0	0.0%
13.1150	Shell Creek Diversion - Shell Canal	41,466	41,466	41,466	0	0.0%	0	0.0%
13.1300	Horse Creek Natural Flow	0	0	0	0	0.0%	0	0.0%

Figure 6-3. Diversion Summary Worksheet, Diversion Comparison Table

User Notes

The following definitions apply to the calculations shown in the diversion comparison table.

Modeled Diversion The total annual full supply diversion as given in the Full Supply Diversion spreadsheet.

Simulated Diversion The total annual calculated diversion from the reach calculations.

Estimated Actual Diversion The total annual diversion as given in the Estimated Actual Diversion spreadsheet.

Calibration Difference and Percent Calibration Diff. The calibration difference is the Estimated Actual Diversion minus the Modeled Diversion. This value gives an indication as to how close the model simulates historical diversions. Previous River Basin Planning reports have considered values within 35 percent to be considered reasonable, with some values greater than 35 percent primarily due to a lack of information. There are several reasons for the variation between simulated and modeled diversions.

- lack of information concerning irrigation practices (efficiencies, return lags, and historical diversion records);
- the exclusion of some lands served by spreader dikes and intermittent diversions on ephemeral streams;
- approximations used for some surface water hydrology estimation techniques;
- generalities used by the model for water right priorities and other legal constraints;
- generalities used by the model for supplemental reservoir releases to the appropriate diversions.

Shortage Percent Shortage The difference between Full Supply Diversions and Model Simulated Diversions.

6.3 Data Transfer to Other Models

This worksheet is similar to the Upstream Flows from Other Models worksheet. Because of the size of the Wind and Bighorn basins, the river basins were separated into several sub-basin models. As a consequence, there are several occasions when data is required to pass between the models. Examples of this include:

1. When a downstream model requires data at the confluence with another model;
2. When diversions occur in one model and the return flows return to another model;
3. When basins used for basin gain/loss calculations encompass more than one model.

These types of interactions differ from imports and exports because imports and exports between basins are intended to model physical transbasin export from one basin to another. Data transfer between models is necessary when data must be transferred simply because the basins have been subdivided into one or more models.

A sample of the data transfer worksheet is shown in Figure 6-4.

Return to Start | Return to **Results**

Exports to Other Models

Streamflow (ac-ft)

Node Number	Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
10.3000	BIGHORN R AT BASIN WY	85,674	80,494	94,788	95,758	128,796	165,135	176,722	110,918	101,466	104,068	90,868	92,442	1,327,128

Ungaged Gain and Loss Calculations: Iteration One (Acre-Feet)

Basin D Gain/Loss

D

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
To Owl Creek Model from Basin D:												
Upstream Gages	68,785.2	64,148.0	74,001.3	85,022.4	107,654.6	132,030.2	154,698.9	106,543.0	90,773.5	84,881.5	71,887.9	73,896.8
Downstream Gage	48,946.8	43,919.1	53,008.6	62,749.6	75,933.3	98,180.7	131,907.5	86,061.4	70,228.9	64,218.7	51,608.6	53,928.8
Total Diversions	7.9	7.9	229.3	34,212.6	76,483.9	85,504.4	91,446.6	79,442.8	64,677.5	10,997.1	379.6	6.0
Total Returns	0.8	0.8	222.2	9,162.1	22,710.9	23,124.9	16,478.0	13,339.5	15,472.2	2,743.9	372.4	0.6
To Nowood River Model												
Upstream Gages	49,048.2	44,078.9	53,222.3	63,649.0	76,989.7	98,438.6	131,910.3	86,062.2	70,232.5	64,267.0	51,664.8	53,969.9
Downstream Gage	85,674.4	80,493.6	94,787.7	95,758.2	128,795.5	165,134.7	176,722.1	110,917.9	101,465.6	104,067.7	90,868.5	92,442.1
Total Diversions	0.0	0.0	0.0	2,313.0	6,200.0	7,330.3	5,700.4	3,836.5	2,922.8	350.7	0.0	0.0
Total Returns	7.9	7.9	7.9	13,711.8	30,311.5	28,836.7	21,044.3	19,656.9	22,339.5	3,622.5	7.9	6.0

Ungaged Gain and Loss Calculations: Iteration Two (Acre-Feet)

Basin D Gain/Loss

D

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
To Owl Creek Model from Basin D:												
Upstream Gages	68,785.2	64,148.0	74,001.3	85,022.4	107,654.6	132,030.2	154,698.9	106,543.0	90,773.5	84,881.5	71,887.9	73,896.8
Downstream Gage	48,946.8	43,919.1	53,008.6	62,749.6	75,933.3	98,180.7	131,907.5	86,061.4	70,228.9	64,218.7	51,608.6	53,928.8

Figure 6-4. Exports to Other Models Worksheet

User Notes

Data on this worksheet is linked directly to the spreadsheet from which it originates. Links between models have been maintained as dynamic links. If changes are made to this model, then the data needs to be updated to models that are affected by the exports.

Section 7 - Calibration

Model calibration is required to adjust input parameters so that the model best matches real conditions. The Wind/Bighorn sub-basin models are full simulation models, wherein flow at each gage is simulated based on system inflows and losses. The one exception to this rule is reservoirs, which take into account historical contents and releases when calculations are made.

Two measures were primarily used for calibration of the models

1. The simulated flow should match the historical flow when using historical diversion data.
2. The historical diversions must be fully satisfied, or nearly fully satisfied. (Gain/loss calculations are not performed correctly if there are historical shortages).

Several input parameters were adjusted to most fully meet the calibration measures described above. These include:

1. Percent of estimated historical diversion that is simulated in the calibration run;
2. Return flow locations;
3. Return flow lag patterns;

4. For reservoirs with historical data, estimated historical end-of-month contents and releases;
5. Actual model construction.

Normally, because ungaged gains and losses are part of the model, the historical and simulated flow should match very closely. However, because of the reservoir calculations (especially for reservoirs with estimated data), not all basins are perfectly calibrated. In addition, because the model does not "look downstream" to see if all diversion requirements are met, the model basically "resets" itself at each mainstem reservoir.

The model calibration charts (basin charts from each model) are shown in appendices.

Section 8 - Programmers' Notes

The Wind-Bighorn River Basin Plan Spreadsheet Models were written assuming that they may be modified for other more specific projects within the Wind/Bighorn River Basins and for use in future investigations of other Wyoming river basins. Instructions are incorporated throughout this document providing notes and suggestions to the Programmer. For portions of the model that are not significantly different than the Powder-Tounge River Basin Spreadsheet Models, much of the information contained herein has been taken directly from the Powder-Tongue Spreadsheet Model Development and Calibration Memo (HKM, 2001). Where changes have been made from that model, additional notes have been provided.

8.1 Differences from Previous River Basin Planning Models

As previously indicated, in general, the Wind/Bighorn River Basin Planning models are consistent with those developed for previous basins. However, some improvements to the previous models were incorporated to fit the needs of the Wind/Bighorn River Basin plan. The primary difference is that previous models ran the calibration and simulation modes simultaneously. However, in the Wind/Bighorn River Basin Plan, historical diversions were significantly different than full supply diversions. Therefore, calibration was not possible because the model was attempting to divert a ful supply diversion, but calibrating to historical streamflows. Therefore, the following additions were made to the model.

- The model can be run in three different modes: Calibration (or historical), Full Supply diversions, and Futures diversions. The run mode is selected using buttons on the Navigation worksheet. The definition of these modes is give in sub-section 4.3.

- In calibration mode, diversion amounts for those diversions without historical data can be modified so that no shortages occur. This is important because gain/loss calculations become incorrect if shortages are shown for historical diversions. (The model assumes during the gain/loss calculations that gains are made to make up for the shortages. Therefore, streamflows are artificially inflated.)

As noted, the model can be run in full supply or futures diversion modes. This requires a slightly different calculation methodology than previously used. In previous models, reach losses at the ends of the reaches are calculated based on the downstream gage, so that the simulated gage

always matches the calculated gage flow (the ungaged loss calculated in the gain/loss calculations was not used). However, in the Wind/Bighorn models, the streamflows are fully simulated, meaning that the reach loss calculated in the gain/loss calculations is used in the reach calculations. The model is then calibrated using gaged flow versus simulated flow.

Because the Wind and Bighorn basins were separated into several models, the "Exports to Other Models" and "Imports from Other Models" worksheets were added to facilitate exchange of data between the models. In addition, the "RFData" worksheet was added to facilitate easier modification of return flow patterns in the calibration process.

8.2 Modification of the River Basin Models

Overall suggestions are included here for consideration of the Programmer.

- As a general rule, whenever rows need to be added to any table (e.g. adding a node within an existing Reach), the Programmer should create a template for the new information using existing cells/tables. Existing worksheet rows containing the type of information to be inserted should be copied and "inserted" where needed instead of adding them to the bottom of the table. The Wind/Bighorn River sub-basin models use "lookup" functions extensively. By "inserting" rows, Excel will automatically modify the formulas in cells referencing a table. If rows are added to a table without insertion, the lookup functions will not "find" the new information.

- The workbooks have been provided with the "protection mode" enabled for each worksheet. No password has been used, therefore, the Programmer may turn the protection feature off if changes are required (Tools - Protection - Unprotect Worksheet).

- When entering data such as historic diversions, historic USGS gage data, etc., the Programmer should use a "paste special" command to protect the existing format and formulas by inserting only data values (Edit - Paste Special - Values).

- When copying existing formulas or tables, the Programmer should copy and paste entire rows of existing tables (or entire tables where appropriate), in lieu of copying a single cell formula and using it to fill a table. The reason for this is that many of the "lookup" formulas may not copy to adjacent columns correctly.

- Whenever copying and pasting anything in the workbook, the Programmer should ensure that Excel has been set to copy in the "relative address" mode.

Additional detailed information has been provided to the Programmer in this document with the discussion of each worksheet.

For various sections of the Excel spreadsheet model, programmers' notes have been prepared to assist or guide modifications in future modeling efforts.

8.3 Graphical User Interface (GUI)

The GUI was developed using Visual Basic for Applications within Microsoft® Excel. Modification of the GUI requires an understanding of the Visual Basic programming language. When the User opens the sub-basin model files - the GUI - the model is informed where on the User's computer the file is located. All files must be located in the same folder for the model to operate properly. Once the GUI is initialized, the model will look in the same location for any additional files.

Future revisions of the sub-basin models will require the following minor modifications to the GUI:

1. The names of the Wind/Bighorn model files must be replaced with future file names in the programming code associated with each of the three model selection buttons.

2. Text in the forms presented in the GUI must be modified to reflect the future version.

8.3.1 Navigation Worksheets

Excel programmers modifying the spreadsheet model will need to modify the Reach/Node Description table located to the right of the visible screen (see Figure 8-1), for the Navigation Worksheet to work properly. If new reaches must be entered, INSERT columns and renumber the header accordingly. Then, delete the same number of columns at the end of the table. This will cause formulas referencing this table to change accordingly. Also, if the table must be expanded vertically (i.e., more nodes must be added than the table currently accommodates), the same practice should be followed, with the same number of rows deleted. That is, always INSERT rows, columns, or cells within the existing table, but the overall size of the table must remain the same. This allows the Programmer to avoid modification of formulas influenced by the table.

Reach / Node Description Table

NOTE TO PROGRAMMERS:

1 *Modification of the model must include completion of this table. If new reaches must be entered, INSERT columns and renumber the header. This will cause formulae which reference this table to change accordingly. Also, if the table must be expanded vertically, i.e., more nodes must be added than the table currently accomodates, the same practice should be followed. That is, always INSERT rows or columns within the existing table. This allows the programmer to avoid modification of formulae which use the table.*

2 *The programmer can also fill the empty rows below a node list with "-" to avoid errors in the lookup table displayed to the user.*

3 *The programmer must also modify the macro associated with the pulldown menu to include all reaches. Begin by naming a cell in the upper left of any additional Reach worksheets. Then modify the Visual Basic code to include a "GoTo" reference for that worksheet.*

12
240 **This number is the currently selected reach.**

Enter your nodes under the appropriate reach number

	Dynamic Link	*Enter your list of reaches below*	*Enter your reach descriptions*	100	120	140	160	180	190	192	194	19
100	4.0100	Reach 100	Reach 100: Clarks Fork River above Sunlight Creek Confl	1.0100	1.0310	1.0410	1.0510	1.0610	2.0100	2.0310	2.0410	2.0
120	4.0200	Reach 120	Reach 120: Deadman Creek	1.0300	1.0320	1.0420	1.0520	1.0620	2.0200	2.0320	2.0420	2.0
140	4.0300	Reach 140	Reach 140: Camp Creek	1.0350					2.0300			
160	4.0400	Reach 160	Reach 160: Dutch Charlie Creek	1.0400					2.0400			
180		Reach 180	Reach 180: Bars Creek	1.0500					2.0500			
190		Reach 190	Reach 190: Sunlight Creek	1.0600					2.0600			
192		Reach 192	Reach 192: Gravel Bar Creek	2.0000					2.0700			
194		Reach 194	Reach 194: Huff Creek						2.0800			
196		Reach 196	Reach 196: Elk Creek									
200		Reach 200	Reach 200: Clarks Fork River from Sunlight Creek to Bennett Creek									
220		Reach 220	Reach 220: New Meyer Creek									
240		Reach 240	Reach 240: Paint Creek									
242		Reach 242	Reach 242: Luce Reservoir									
260		Reach 260	Reach 260: Pat O'Hare Creek									
290		Reach 290	Reach 290: Bennett Creek									
292		Reach 292	Reach 292: Natural Springs									
294		Reach 294	Reach 294: Little Rocky Creek									
300		Reach 300	Reach 300: Clarks Fork River below Bennett Creek Confluence									
360		Reach 360	Reach 360: Line Creek									
380		Reach 380	Reach 380: Big Sand Coulee									

Figure 8-1. Reach/Node Description Table

The Programmer does not need to modify the macros associated with the pull down menu and reach navigation menus at the top of each worksheet. However, the programmer does need to modify the macros associated with the reach maps. A sample of the macro is shown in Figure 8-2. The user simply changes the macro name and reference to match the reaches required. These macros are referenced by the lines in the reach maps.

```
Sub GOTOReach100()
Application.Goto Reference:="Reach100"
End Sub
Sub GOTOReach120()
Application.Goto Reference:="Reach120"
End Sub
```

Figure 8-2. Reach Map Navigation Menu

8.3.2 Results Navigator

This portion of the worksheet must be customized to correlate with any future versions of this model. Different river basins will have different compact allocation computations and formats. When incorporated into this model, the Summary Navigator worksheet should be modified to allow the User to "jump" directly to the new tables.

8.3.3 Diagram of the Basin

The model node diagrams are dynamically linked to the Reach/Node worksheets. It is also included as a visual reference for orientation to the basin, helping the user understand locations of nodes and connectivity of reaches. The Wind/Bighorn sub-basin diagrams were created in Excel using autoshapes with the appropriate navigational macros assigned to the reach arrows, node circles, and text descriptions so the user may "jump" directly to the desired Reach/Node worksheet.

8.4 Data Input

8.4.1 Master Node List

This list is referenced throughout the workbook by "lookup" functions. The "lookup" functions primarily associate the name of a node with the node number when it is entered at certain locations. This eases input of information in tables such as the Node Tables, Return Flow Tables, etc. In those tables, the Programmer can simply enter the Node number and the Name is filled in automatically. Therefore, whenever a Node is added to a Reach, it must be inserted in this table.

Because the model frequently uses "lookup" functions, it is highly recommended that the Programmer use Excel's "INSERT ROWS" command whenever adding information to this or other data tables. When information is added this way, formulas referencing the table automatically update to refer to the newly expanded range. If rows are added to the bottom of a listing, the referenced formula will not "find" the new data.

Due to the method of lookup in the node worksheet by other worksheets, the list should be sorted by increasing node numbers.

8.4.2 Diversion Data

These tables are referenced by several other worksheets in the Wind/Bighorn sub-basin models via "lookup" functions and by direct reference.

It is important to note that ALL nodes are included in this table, even if no diversions occur at that node (e.g. gaging station nodes). This simplifies the spreadsheet logic used in the Node Tables. By including all nodes in this table, the Node Tables are all identical and can generally be copied as many times as are needed without modification (see User and Programmer Notes pertaining to the node/reach worksheets for exceptions to this rule). Therefore, if no diversions occur at a node, simply leave the data columns blank or insert zeros.

Because the model uses "lookup" functions to retrieve data from this table, it is highly recommended that the Programmer use Excel's "INSERT ROWS" command whenever adding information to this or other data tables. When information is added this way, formulas referencing the table automatically update to refer to the newly expanded range. If rows are added to the bottom of a listing, the referring formula will not "find" the new data. After rows are inserted, the Programmer can copy the formulas in the "Name" column to retrieve gage

names automatically. The Programmer can also copy the formulas in the "Reach" column to retrieve the reach number automatically from the "Reach/Node Description Table" on the Navigation worksheet.

8.4.3 Import and Export Data

This table is referenced by several other worksheets in the Wind/Bighorn sub-basin models via "lookup" functions. Any imports or exports must be entered here. No computations are conducted within this worksheet.

It is important to note that ALL nodes are included in this table, even if no imports or exports occur there (e.g. gaging station nodes). This simplifies the spreadsheet logic used in the Node Tables. By including all nodes in this table, the Node Tables are identical and can be copied as many times as needed without modification. Therefore, if no diversions occur at a node, simply leave the data columns blank or insert zeros.

Because the model uses "lookup" functions to retrieve data from this table, it is highly recommended that the Programmer use Excel's "INSERT ROWS" command whenever adding information to this or other data tables.

8.4.4 Return Flow Data

This table is referenced by several other worksheets in the Wind/Bighorn sub-basin models via "lookup" functions. Return flow data for each node must be entered here. No computations are conducted within this worksheet.

It is important to note that ALL nodes are included in this table, even if no imports or exports occur there (e.g. gaging station nodes). This simplifies the spreadsheet logic used in the Node Tables. By including all nodes in this table, the Node Tables are identical and can be copied as many times as are needed without modification. Therefore, if no diversions occur at a node, simply leave the data columns blank or insert zeros.

Because the model uses "lookup" functions to retrieve data from this table, it is highly recommended that the Programmer use Excel's "INSERT ROWS" command whenever adding information to this or other data tables.

8.5 Model Computation Worksheets

8.5.1 Return Flow

All nodes where diversions occur must be included in the Return Flows worksheet. The worksheet automatically assigns data to the blocks according to the order shown in the reach table on the Navigation sheet. If nodes are added, the Programmer should use Excel's "INSERT ROWS" command immediately after the last block to insert the appropriate number of new blocks. Once rows are inserted for new nodes, the Programmer can copy an existing "Node Evaluation" table as many times as needed. When the Programmer changes the Node Number,

the Node Name and Total Diversions will update automatically with a "lookup" to the Master Node List and the Diversions Data worksheets, respectively. The Programmer modifies the return flow data used on the worksheets in the return flow data worksheet.

To update the "Irrigation Returns: Node Totals Table", the Programmer must first be certain that all nodes are included in the list of nodes. For simplicity, the Programmer can copy the Node Number column from the Master Node List and paste it here. Then the Programmer can copy the remaining portion of a row including Name, Monthly Summation, and Reach number as many times as needed. The Programmer should be cautioned to verify that the ranges referenced in the monthly summation columns span the entire range of Node Evaluation tables following addition of nodes. The Programmer should also be sure to INSERT new rows within the table when they are needed rather than adding rows to the end of the table.

To update the "Irrigation Returns: Reach Totals Table" the Programmer must enter all reach numbers in the appropriate columns and then copy the formulas in the January through December columns. Verify that the range referenced in the monthly summation cells span the entire range of the "Irrigation Returns: Node Totals Table" after it was modified.

8.5.2 Options Table

Incorporation of an "Irrigation Return Pattern" or "Irrigation Return Lag" relationship which differs from those included in this model can be done by either over-writing one of the existing lines or by inserting a new line within the existing table. If irrigation returns are determined to require longer than six months before returning to the river system, a column may be inserted in the Irrigation Return Lags table. However, it is important to note that the formulas of the Irrigation Returns worksheet will need modification to reflect any additional months.

8.5.3 Basin Gain/Loss

Ungaged Basin Gain/Losses must be computed on a Basin-by-Basin basis in a manner as shown in the "Gain/Loss" worksheet. To do this, the Programmer must reference the appropriate gage data, diversion data (iteration 1: estimated actual; iteration 2: simulated diversions on diversion summary sheet), return flow data (iteration 1: estimated actual; iteration 2: model simulated), and reservoir data; building a budget as shown in the worksheet. Each Basin requires construction of an individual table with that Reach's specific conditions incorporated. At the bottom of each computation table, the Programmer must enter a Basin Name corresponding to the Basin(s) for which the Gains/Losses will be applied. New Basin Gain/Loss tables may be created by copying another table and entering the new node numbers and basin name.

The Basin Names must then be entered into the Summary Table and the tables will automatically update. The Programmer should verify that the lookup formulas in the Basin Gain Table span the entire Basin Gain/Loss Calculation Iteration One tables. The Basin Loss Table is updated by subtracting the downstream gage data from the total inflow to the most downstream basin node. New Basins should be added to the Summary tables by INSERTING new rows as needed.

Ungaged Reach gains are added to the upstream end of a Reach to make them available to diversions within the Reach. Ungaged Reach losses are subtracted at the downstream end. To

facilitate this feature, the Programmer must enter the Reach Name in the Reach Gains line at the upstream node of a reach and the Node Table will automatically update. The Reach Name must also be entered in Ungaged Losses line of the Reach's downstream node and the Node Table will automatically update.

By incorporating Ungaged Gains and Losses, the spreadsheet model is calibrated to match historic gaging data at each gage node.

8.5.4 Node Tables

Adaptation of the Wind/Bighorn sub-basin models for other river basins will require reconstruction of the Reach/Node worksheets on a node-by-node basis. Because all values in the Node tables are obtained via "lookup" functions, this is a relatively easy task.

The Node Inflow to any Node Table is referenced in one of three ways:

1. If the node is the upstream end of the model, or upstream node of a modeled tributary, the inflow is retrieved from the Gage Data worksheet using a "vlookup" function. Refer to the Upper Wind Model node 3.2100 for an example of this method.

2. If the node is located at the upstream end of any other reach, the Node Inflow is referenced as the NET Flow from the Reach that feeds it. In this case, cell references must be manually modified. Refer to the Upper Wind Model node 3.3200 for an example of this method.

3. If the node is located at any midpoint within a Reach, the Node Inflow is simply the NET Flow from the Node upstream of it. Refer to the Upper Wind Model node 3.5000 for an example of this method.

Most nodes will be built using the third method described above. In this case, once the Node Inflow cells have been modified as in the example (i.e., Node 80.06), the Node Table may be copied as many times as needed and the Reach can be constructed in a sequential manner.

The Programmer must enter the Node Number in the cell at the top of each Node Table cell and the worksheet will return the Node Name and all corresponding data from the worksheets referenced.

8.6 Summary Worksheets

8.6.1 Outflow Summary

The "Outflow Calculations: By Node" tables were generated using lookup functions which reference the corresponding Reach worksheets. The values in the "Node" column were entered manually and the lookup tables constructed accordingly. If a reach is inserted, then a new block should be inserted within the list at the appropriate location. Formulas will then need to be modified accordingly for the block and the next downstream block in order for the formulas to work correctly.

The “Outflow Calculations: By Reach” table simply references the downstream limit of each “Outflow Calculations: By Node” table.

8.6.2 Diversions Summary

The “Summary of Diversion Calculations: By Node” tables were generated using lookup functions which reference the corresponding Reach worksheets. The values in the “Node” column were entered manually and the lookup tables constructed accordingly. Formulas will then need to be modified accordingly for the block and the next downstream block in order for the formulas to work correctly.

The “Summary of Diversion Calculations: By Reach” table references the “Summary of Diversion Calculations: By Node” tables using SUMIF functions.

The “Comparison of Model Simulated Diversions vs. Full Supply Diversions (Shortage) and vs. Estimated Actual Diversions (Calibration Check)” table looks up Estimated Actual Diversions and Full Supply Diversions for each node from the Estimated Actual Diversions Data and the Full Supply Diversions Data worksheets. It also looks up the Model Simulated Diversions from the “Summary of Diversion Calculations: By Node” tables and computes the shortage and the calibration check.

8.7 Specific Instructions for Adding a Single Node to a Model

The Wind/Bighorn sub-basin models have been constructed such that new nodes, representing a new point of diversion, a reservoir, a streamflow gage, an instream flow segment or any other point at which the user needs to evaluate, can be added. The process for adding a new node is described below. Worksheets need to be modified in the order given here.

8.7.1 General

The workbooks have been provided with the “protection mode” enabled for each worksheet. No password has been used, therefore the user must turn the protection feature off to make changes (Tools/Protection / Unprotect Worksheet).

The user may also find it helpful to turn on the row and column headers and the sheet tabs on each worksheet to be modified (Tools/Options/View).

It is recommended that the user make any modifications to the model in the order that is presented below.

8.7.2 Master List of Nodes Worksheet

There are two ways of modifying the Master List of Nodes:

- Enter the node number and name immediately below the last node in the table and above the line labeled “Insert new nodes above”.
- INSERT a row at the location where you want to add a new node, then type in the node number and name.

It is recommended that the user use the second approach so that the list remains in numerical sequence.

8.7.3 The Central Navigation Worksheet

The Reach/Node Description table located to the right of the visible screen must be modified. Go to the column containing the reach that you wish to modify. Type in the node number that you wish to add. If this is not the last node in the reach, it is simplest to retype the subsequent nodes in the rows below rather than inserting a cell.

8.7.4 Gage Data/Inflow Data Worksheet

If the new node to be added represents a gage or an inflow point to the model, the Gage Data/Inflow Data worksheet must be modified. As with the Master List of Nodes, the user can add the new node and relevant data in the next available unused row in the table (as defined by the borders and shading). Alternatively, the user can INSERT a row in the appropriate location to maintain the reach/node sequence, then add the new node and data.

8.7.5 Diversion Data Worksheet

All nodes MUST be included in this table even if no diversion occurs at the node. The user may simply enter the new node and relevant data in the next available unused row in the table (as defined by the borders and shading) or the user can INSERT a row in the appropriate location to maintain the reach/node sequence, then add the new node and data. As a default, there are no unused rows in the table, therefore, the data must be inserted. All four of the diversion worksheets (historical data, full supply data, futures data and the modeled data) must be modified.

8.7.6 Import and Export Data Worksheet

All nodes MUST be included in this table even if no import or export occurs at the node. The user may simply enter the new node and relevant data in the next available unused row in the table (as defined by the borders and shading) or the user can INSERT a row in the appropriate location to maintain the reach/node sequence, then add the new node and data. As a default, there are no unused rows in the table, therefore, the data must be inserted.

8.7.7 Return Flow Data

All nodes MUST be included in this table even if no diversions occur at the node. The user may simply enter the new node and relevant data in the next available unused row in the table (as defined by the borders and shading) or the user can INSERT a row in the appropriate location to

maintain the reach/node sequence, then add the new node and data. As a default, there are no unused rows in the table, therefore, the data must be inserted.

The user must then update the "Efficiency Pattern", "Return Pattern", "TO" and "Percent" cells (shaded yellow) to represent conditions associated with the diversions from the new node.

8.7.8 Return Flows Worksheet

All nodes where diversions occur MUST be included in the Return Flows worksheets (both the Estimated Actual Return Flows and the Model Simulated Return Flows must be updated). As a default, all nodes have been included in this list. Select an entire Irrigation Return table and COPY the selected cells. Then, immediately downstream of the last table, select INSERT COPIED CELLS and select SHIFT CELLS DOWN. All data will be updated (note that the new block will contain data for the last node in the model.

To update the "Irrigation Returns: Node Totals Table", the user must first be certain that all nodes are included in the list of nodes. For simplicity, the user can copy the Node Number column from the Master Node List and paste it here. Be sure that the Master Node List does not extend past the yellow shaded area. Then the user can copy the Monthly Summation and Reach number equations as many times as needed. The user should be cautioned to verify that the ranges referenced in the monthly summation columns span the entire range of Node Evaluation tables following addition of nodes.

As currently constructed, the "Irrigation Returns: Reach Totals Table" requires no modification for the simple addition of a node.

8.7.9 Options Table Worksheet

Incorporation of an "Irrigation Return Pattern" or "Irrigation Return Lag" relationship which differs from those included in this model can be done by either over-writing one of the existing lines or by inserting a new line within the existing table. If irrigation returns are determined to require longer than six months before returning to the river system, a column may be inserted in the Irrigation Return Lags table. However, it is important to note that the formulas of the Irrigation Returns worksheet will need modification to reflect any additional months.

8.7.10 Evaporative Losses Worksheet

If the new node is a storage node, COPY the rows containing the "Mean Monthly Evaporation (inches)", "Historical End-of-Month Contents (acre-feet)" and "Surface Area (acres)" tables and insert the rows above the "Mean Monthly Evaporation (acre-feet)" table. Update the node number and the node name will automatically update. Enter gross evaporation and precipitation for the new node. Enter the historical end-of-month contents for the reservoir. If the gross evaporation and precipitation are the same for the new node as for any existing nodes, only the "Historical End-of-Month Contents" and "Surface Area" tables need to be copied (or rows inserted in the existing tables).

Select and COPY the rows containing the existing area-capacity table, then paste the rows below the existing table. Update the node number and area-capacity information.

The reservoir surface area is calculated by looking up historical end-of-month content and interpolating the surface area from the area-capacity table. The "vlookup' portion of the equation must be updated to correspond to the new area-capacity table.

Enter a new node number and the equation to calculate the mean monthly evaporation within the "Mean Monthly Evaporation (acre-feet)" table. If there is no room available in the table, INSERT a row within the table and add the necessary information.

8.7.11 Basin Gain/Loss Worksheet

Determine the ungaged basin gain/loss table that the new node is within. Locate the corresponding table in the Basin Gain/Loss Worksheet. Select the row in the diversion portion of the table either above or below where the new node needs to be inserted. COPY the selected cells, then INSERT COPIED CELLS in the appropriate location. Update the node number in the yellow shaded cell. The node name and diversions associated with the new node will automatically update. Repeat these steps in the return flow portion of the table. This should be done to both the Iteration One and the Iteration Two worksheets.

8.7.12 Reach/Node Worksheet

Select the rows containing an entire Node table. COPY the selected rows, then move to the new location in the workbook and select INSERT COPIED CELLS. Update the node number in the yellow shaded cell. The node name, diversions, irrigation returns, ungaged gains/losses and import/exports will automatically update if all the above steps have been completed.

The Node Inflow to any Node Table references one of three sources:

- If the node is the upstream end of the model, or upstream node of a modeled tributary, the inflow is retrieved from the Gage Data worksheet using a "vlookup" function.
- If the node is located at the upstream end of any other reach, the Node Inflow references the NET Flow from the Reach(s) that feed it. In this case, cell references must be manually modified.
- If the node is located at any midpoint within a Reach, the Node Inflow is simply the NET Flow from the Node upstream of it.

Most nodes will be built using the third method described above.

If the Reach/Node table represents a reservoir, the user will need to manually update the cells shaded yellow.

As a precautionary measure, it is best to check the Node Inflow in the Reach/Node table below where the new node has been inserted to ensure that the appropriate cells are referenced.

Section 9 - References

Anderson Consulting Engineers. 2000. "Bear River Basin Plan Task 3B. Surface Water Spreadsheet Model Development." Technical Memorandum, Fort Collins, Colorado. September 18.

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BRS, Inc. 2003. "Wind/Bighorn River Basin Plan Irrigation Diversion Operation and Description." Technical Memorandum, Riverton, Wyoming.

HKM Engineering Inc. 2001. "Powder-Tongue River Basin Plan Spreadsheet Model Development and Calibration, Task 3B." Technical Memorandum. December.

Lidstone and Associates (LA). 2002. "Wind/Bighorn River Basin Plan Water User From Storage." Technical Memorandum.

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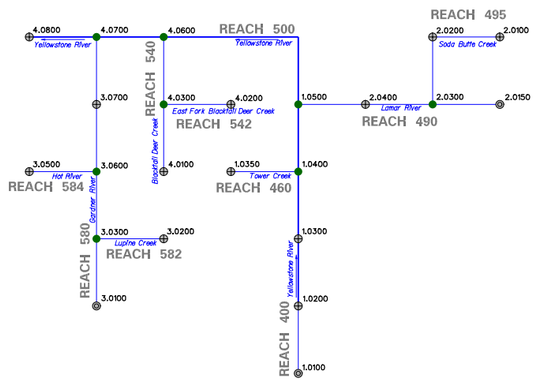
MWH. 2003a. "Wind/Bighorn River Basin Plan Task 2A – Agricultural Water Use and Diversion Requirements." Technical Memorandum. Denver, Colorado.

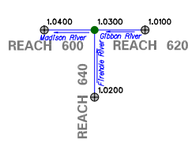
MWH. 2003b. "Wind/Bighorn River Basin Plan Task 3D – Available Surface Water Determination." Denver, Colorado.

Appendix A
Model Schematics

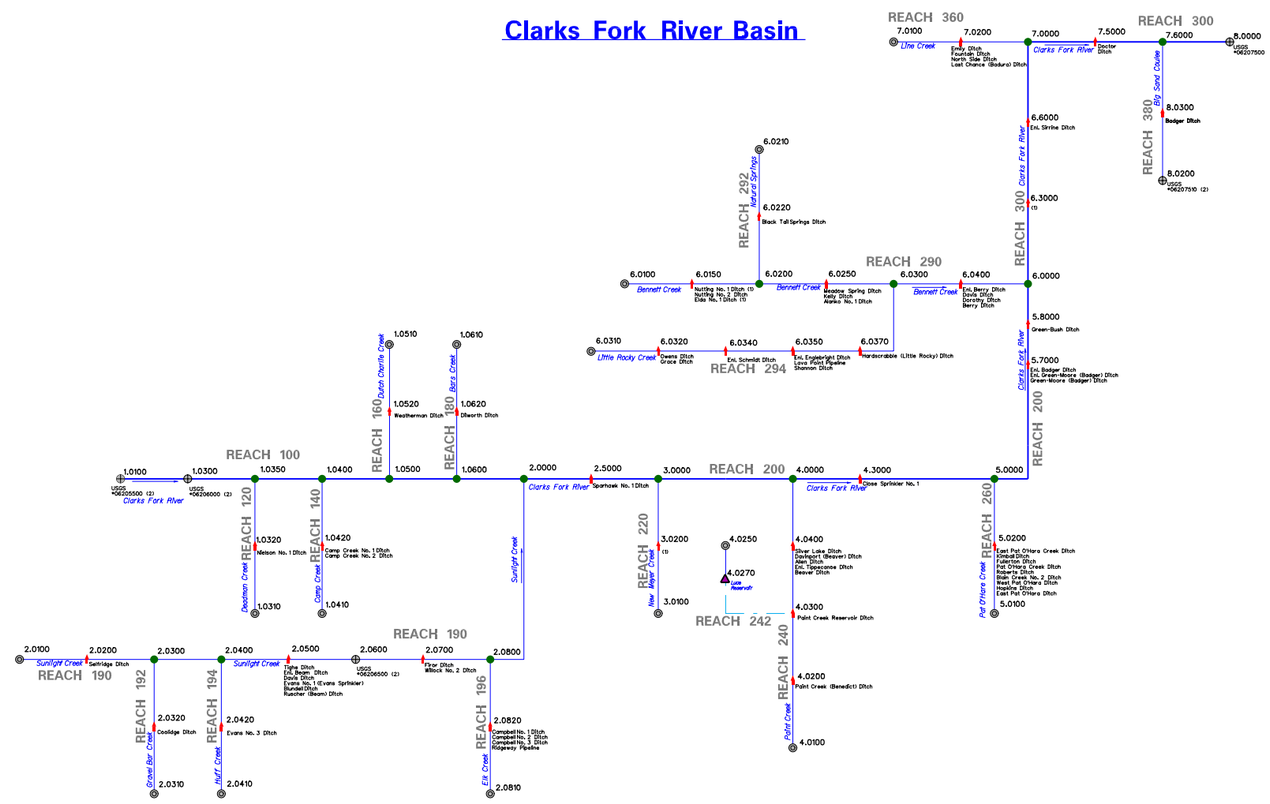
Yellowstone River Basin



Madison River Basin



Clarks Fork River Basin



Wind/Bighorn River Basin Plan
Clarks Fork, Yellowstone, & Madison River Basin Model Schematics
January 2003

Wyoming Water Development Commission
Wind/Bighorn Basin Advisory Group

MWH
MONTGOMERY WATSON HARZA
Denver Colorado

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Please refer to the Diversion Node Summary Table located in this Appendix for diversion names.

Full size diagram may be downloaded from the Wyoming State Water Planning website.

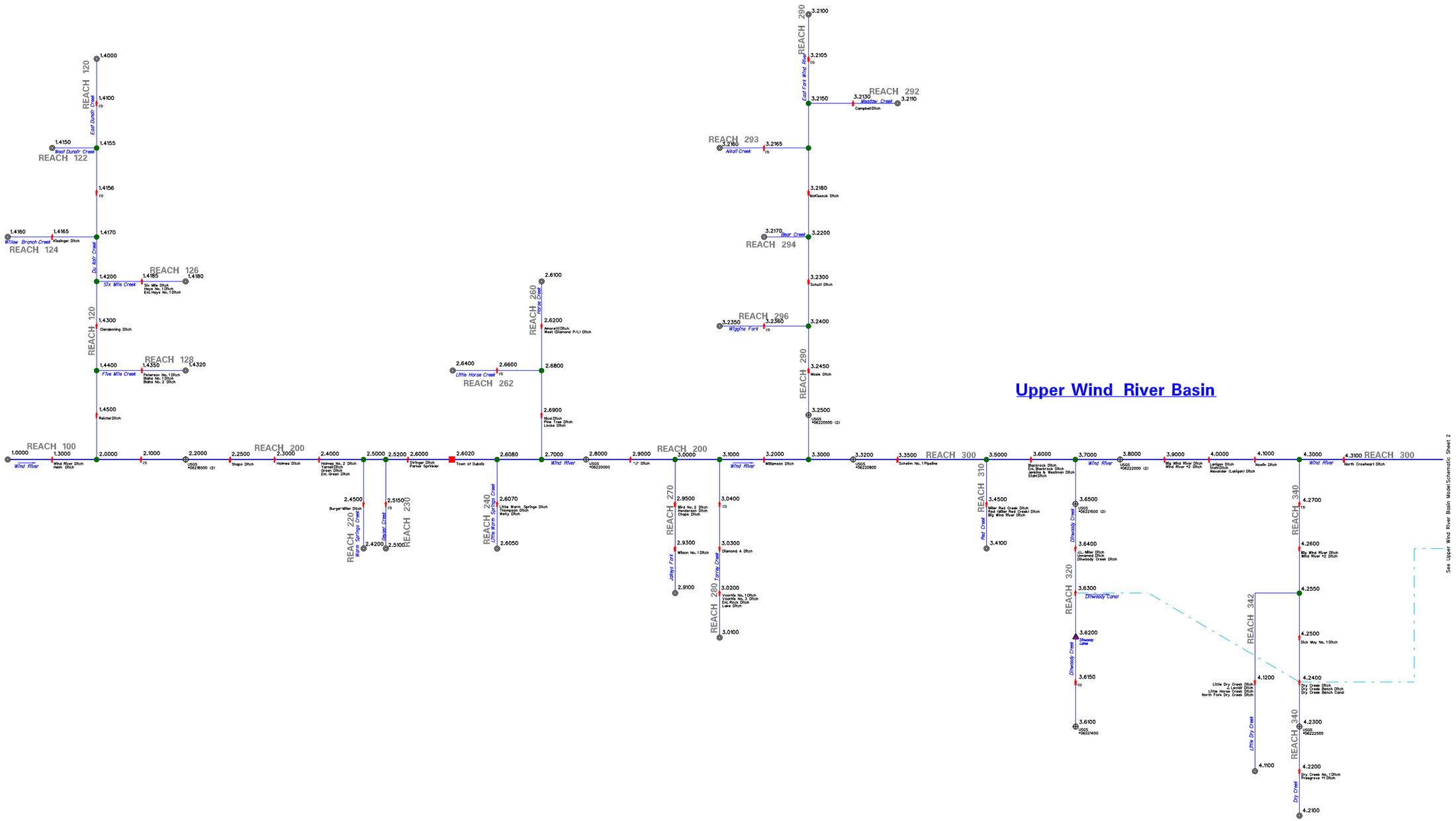
Diagram Notes

(1) No data associated with node. For future use.

(2) Inactive gage. Data reconstructed for use in model or serves as a node for flow accumulation.

Legend

Network Nodes	Network Links
Confluence	River
Diversion	Canal
Municipal Diversion	
Natural Flow	
Gage	
Reservoir	



Legend

Network Nodes	Network Links
Confluence	River
Diversion	Canal
Municipal Diversion	
Natural Flow	
Gage	
Reservoir	

Diagram Notes

(1) No data associated with node. For future use.

(2) Inactive gage. Data reconstructed for use in model or serves as a node for flow accumulation.

Please refer to the Diversion Node Summary Table located in this Appendix for diversion names.

Full size diagram may be downloaded from the Wyoming State Water Planning website.

Wind/Bighorn River Basin Plan
Upper Wind River Basin Model Schematic Sheet 1
January 2003

Wyoming Water Development Commission
Wind/Bighorn Basin Advisory Group

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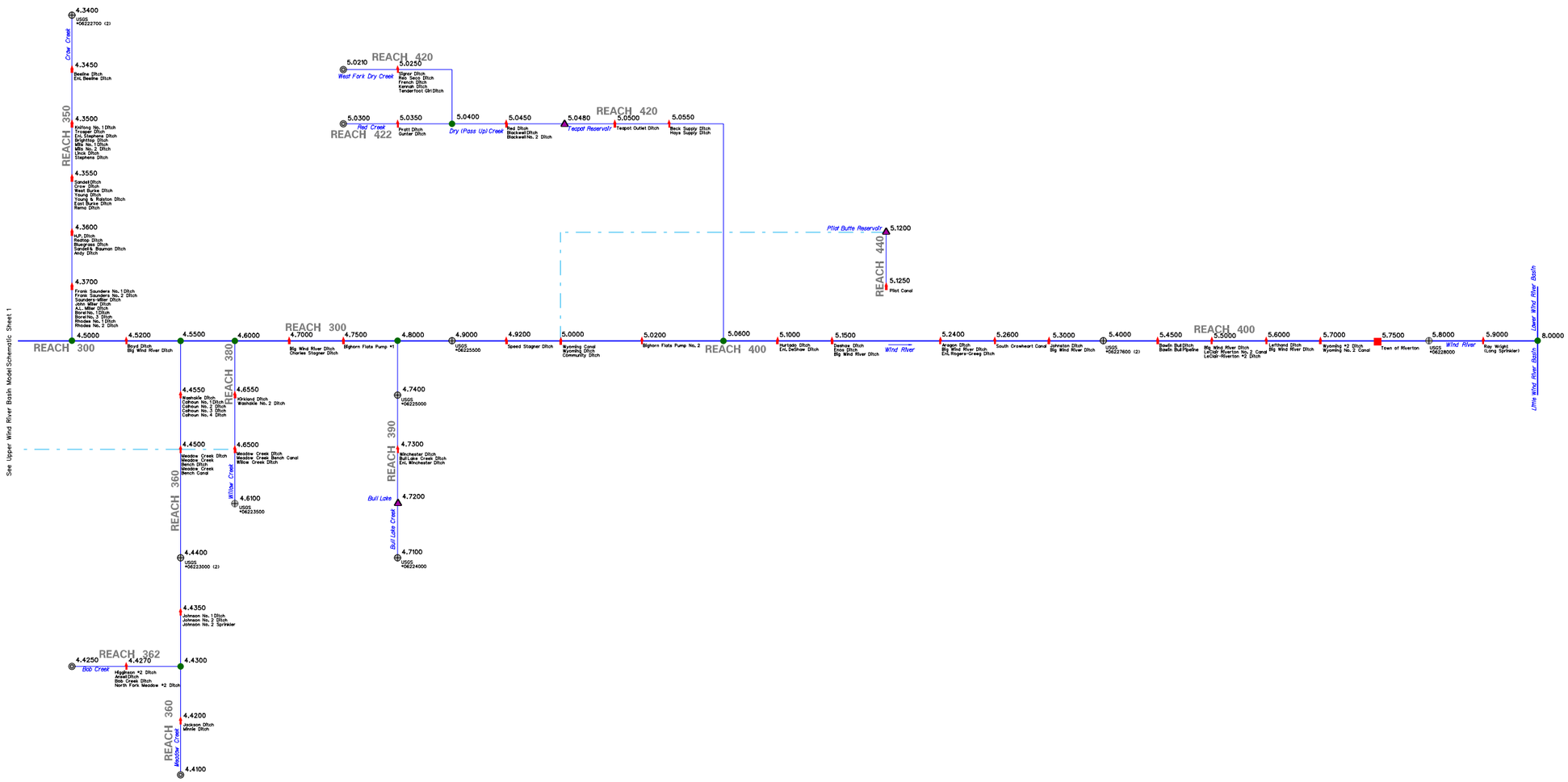

Wind/Bighorn River Basin Plan
Upper Wind River Basin Model Schematic Sheet 2
January 2003

Wyoming Water Development Commission
Wind/Bighorn Basin Advisory Group

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Denver Colorado

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Please refer to the Diversion Node Summary Table located in this Appendix for diversion names.

Full size diagram may be downloaded from the Wyoming State Water Planning website.

Diagram Notes

(1) No data associated with node. For future use.
(2) Inactive gage. Data reconstructed for use in model or serves as a node for flow accumulation.

Legend

Network Nodes	Network Links
Confluence	River
Diversion	Canal
Municipal Diversion	
Natural Flow	
Gage	
Reservoir	

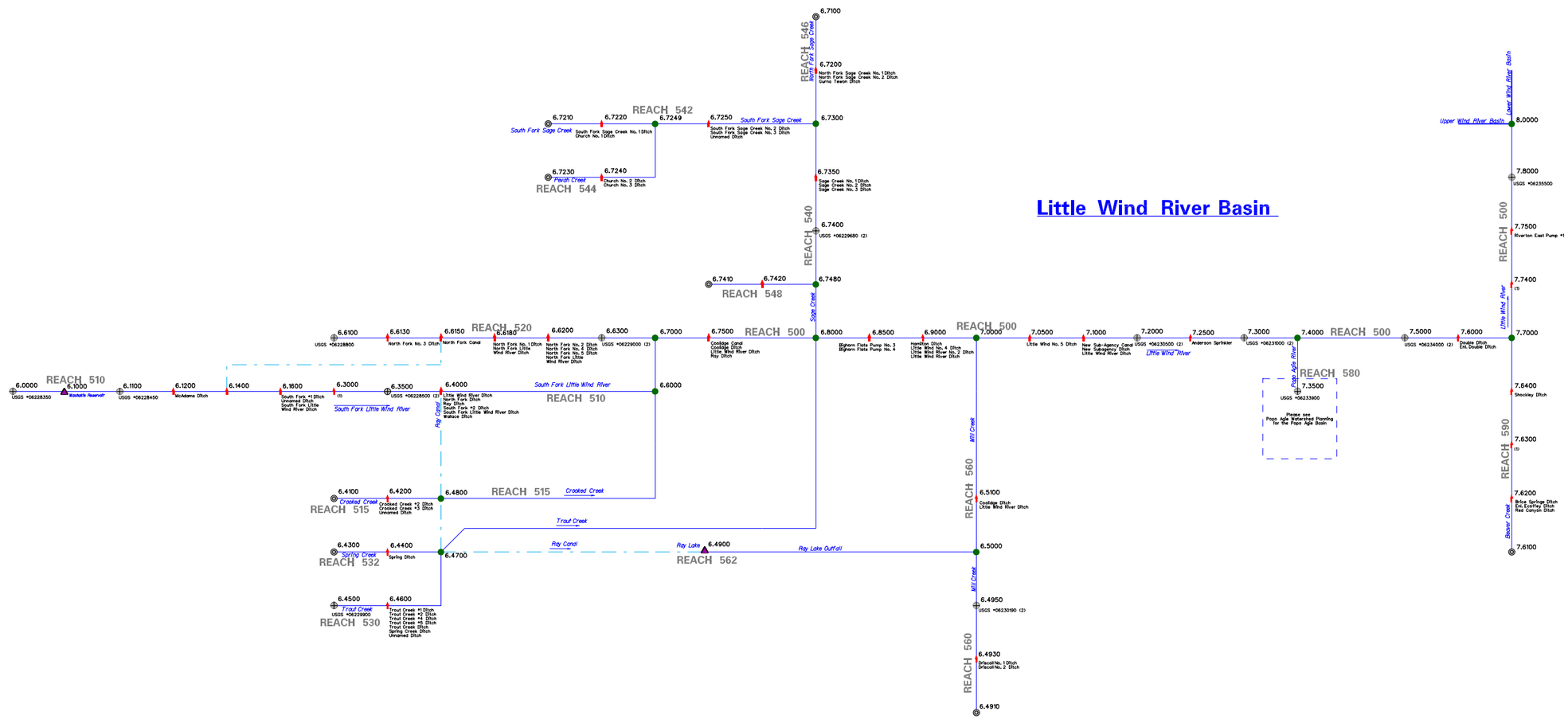

Diagram Notes

(1) No data associated with node. For future use.

(2) Inactive gage. Data reconstructed for use in model or serves as a node for flow accumulation.

Please refer to the Diversion Node Summary Table located in this Appendix for diversion names.

Full size diagram may be downloaded from the Wyoming State Water Planning website.

Wind/Bighorn River Basin Plan

Little Wind River Basin Model Schematic

January 2003

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Wind/Bighorn Basin Advisory Group

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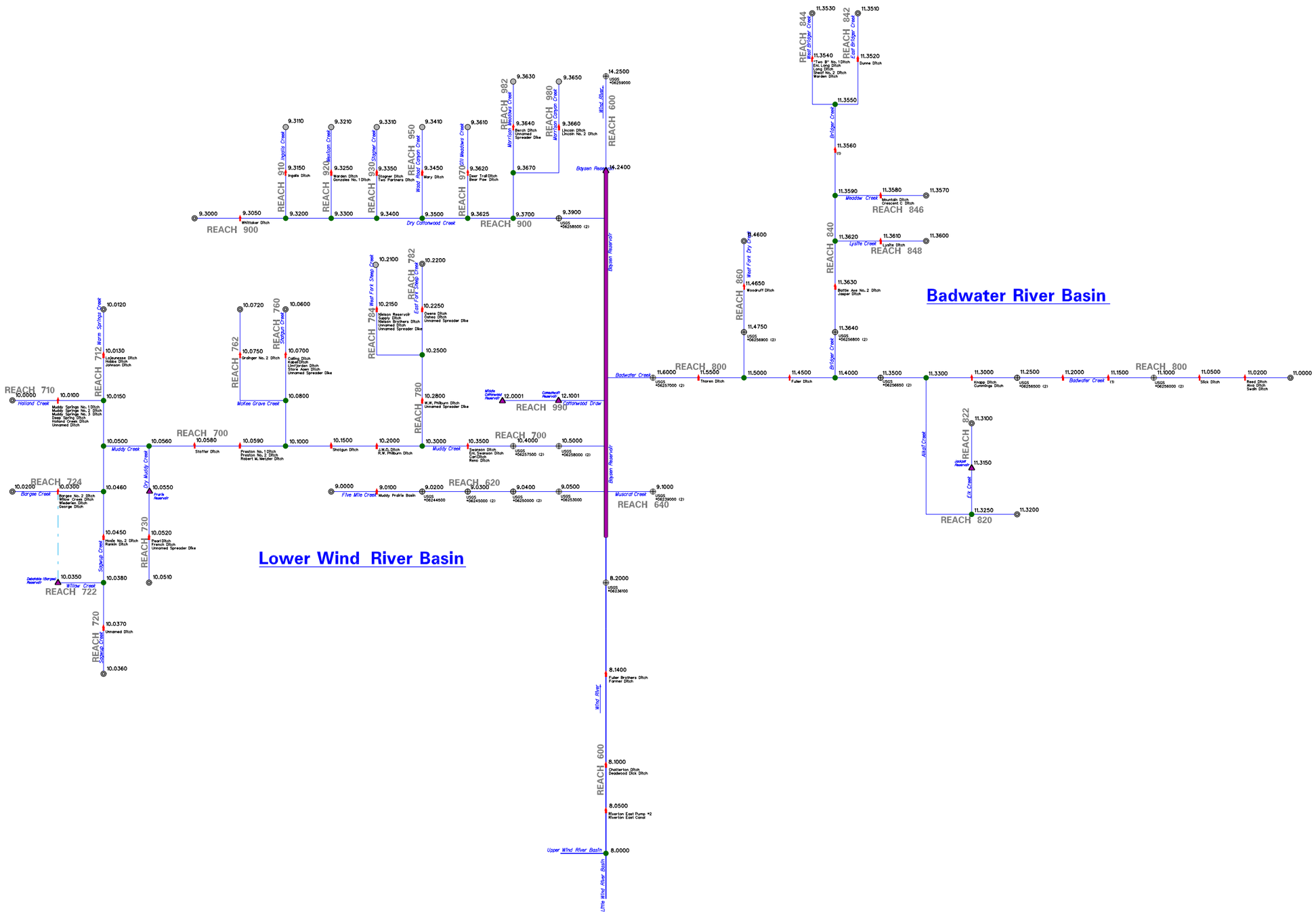

Diagram Notes

(1) No data associated with node. For future use.

(2) Inactive gage. Data reconstructed for use in model or serves as a node for flow accumulation.

Please refer to the Diversion Node Summary Table located in this Appendix for diversion names.

Full size diagram may be downloaded from the Wyoming State Water Planning website.

Wind/Bighorn River Basin Plan
Lower Wind River Basin Model Schematic

January 2003

Wyoming Water Development Commission
Wind/Bighorn Basin Advisory Group

MWH
MONTGOMERY WATSON HARZA
Denver
Colorado

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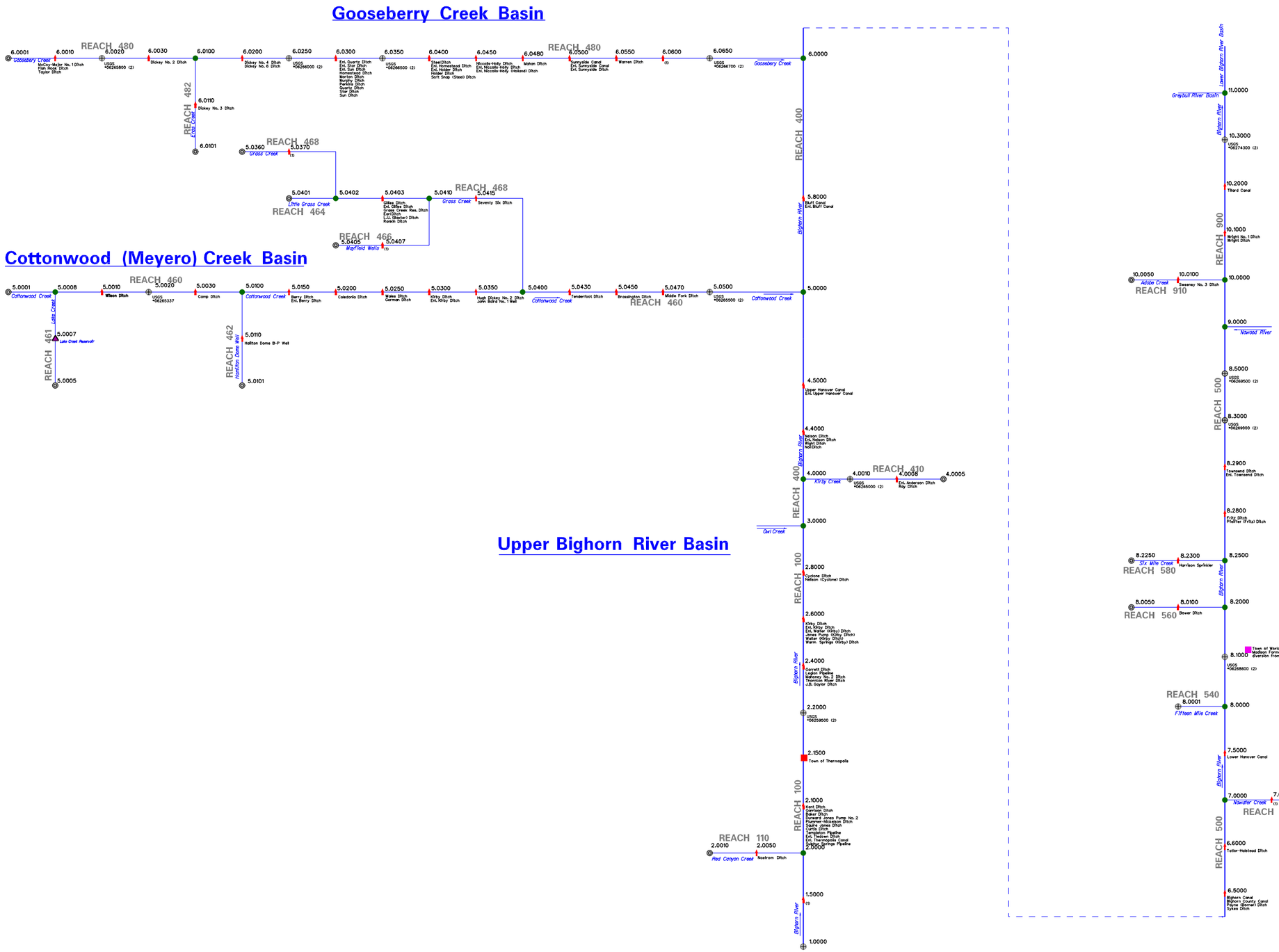

Please refer to the Diversion Node Summary Table located in this Appendix for diversion names.

Full size diagram may be downloaded from the Wyoming State Water Planning website.

Diagram Notes

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(2) Inactive gage. Data reconstructed for use in model or serves as a node for flow accumulation.

Wind/Bighorn River Basin Plan

Upper Bighorn River Basin Model Schematic

January 2003

Wyoming Water Development Commission

Wind/Bighorn Basin Advisory Group

MWH MONTGOMERY WATSON HARZA

Denver Colorado

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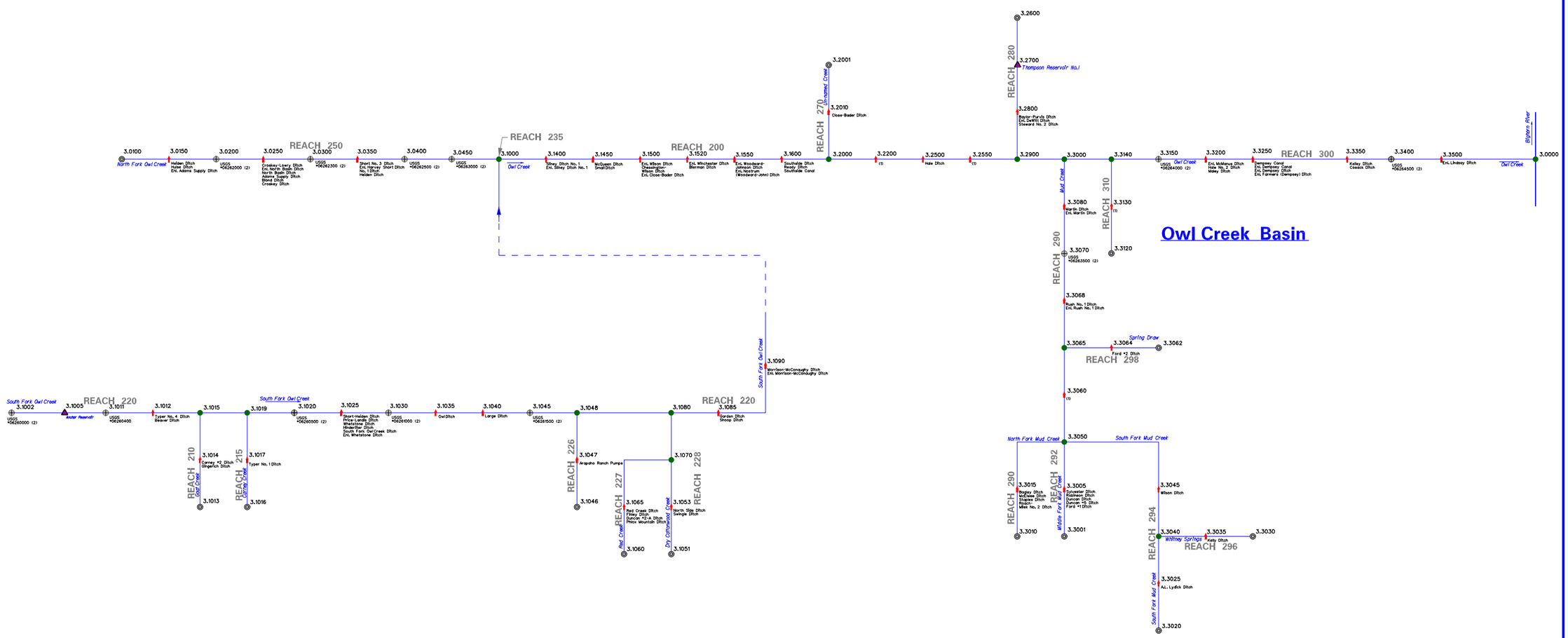

Wind/Bighorn River Basin Plan
Owl Creek Basin Model Schematic

January 2003

Wyoming Water Development Commission
Wind/Bighorn Basin Advisory Group

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Full size diagram may be downloaded from the Wyoming State Water Planning website.

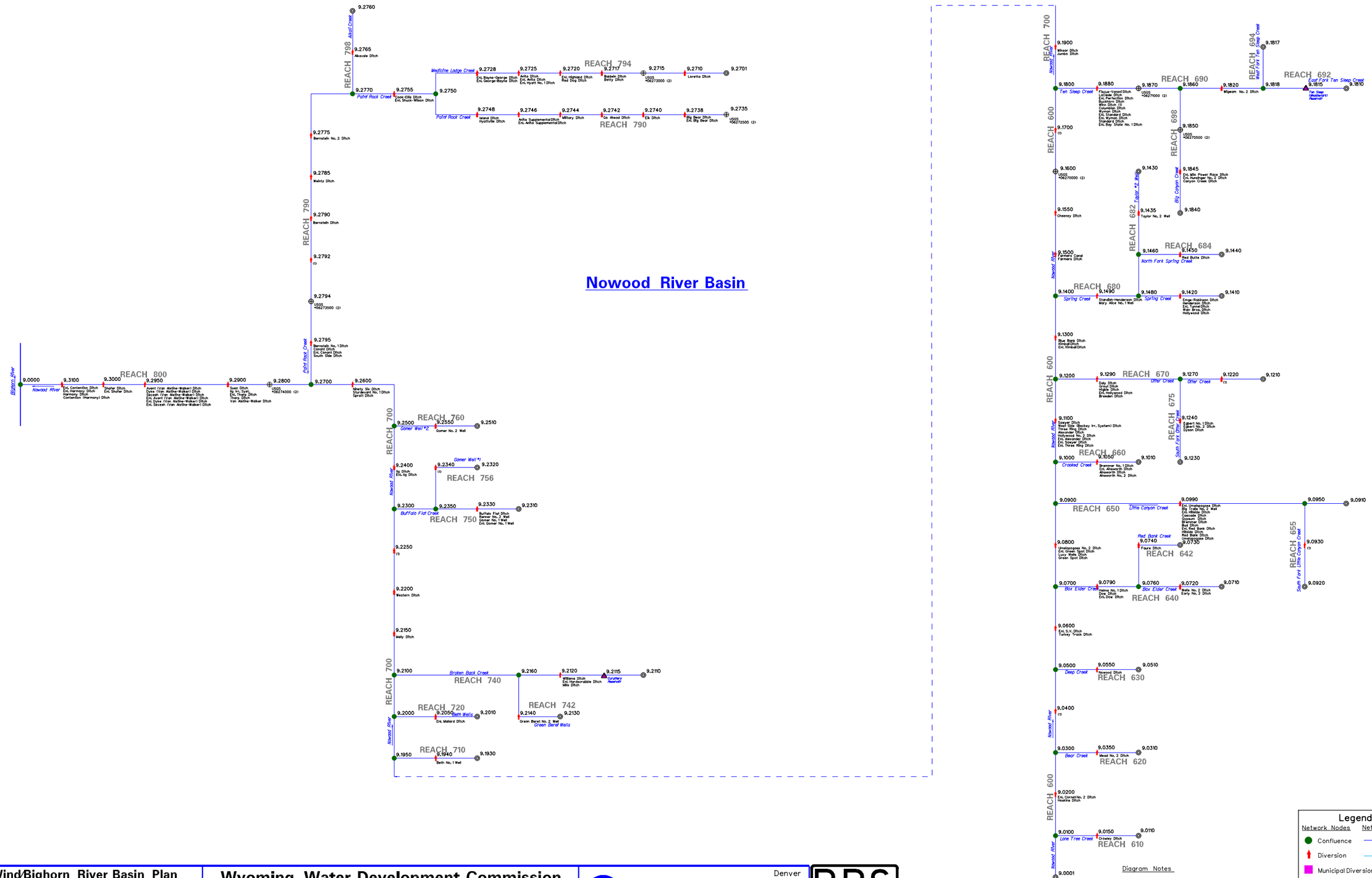
Diagram Notes

(1) No data associated with node. For future use.

(2) Inactive gage. Data reconstructed for use in model or serves as a node for flow accumulation.

Legend

Network Nodes	Network Links
Confluence	River
Diversion	Canal
Municipal Diversion	
Natural Flow	
Gage	
Reservoir	



Please refer to the Diversion Node Summary Table located in this Appendix for diversion names.

Full size diagram may be downloaded from the Wyoming State Water Planning website.

Wind/Bighorn River Basin Plan
Nowood River Basin Model Schematic

January 2003

Wyoming Water Development Commission
Wind/Bighorn Basin Advisory Group

MWH
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Denver Colorado

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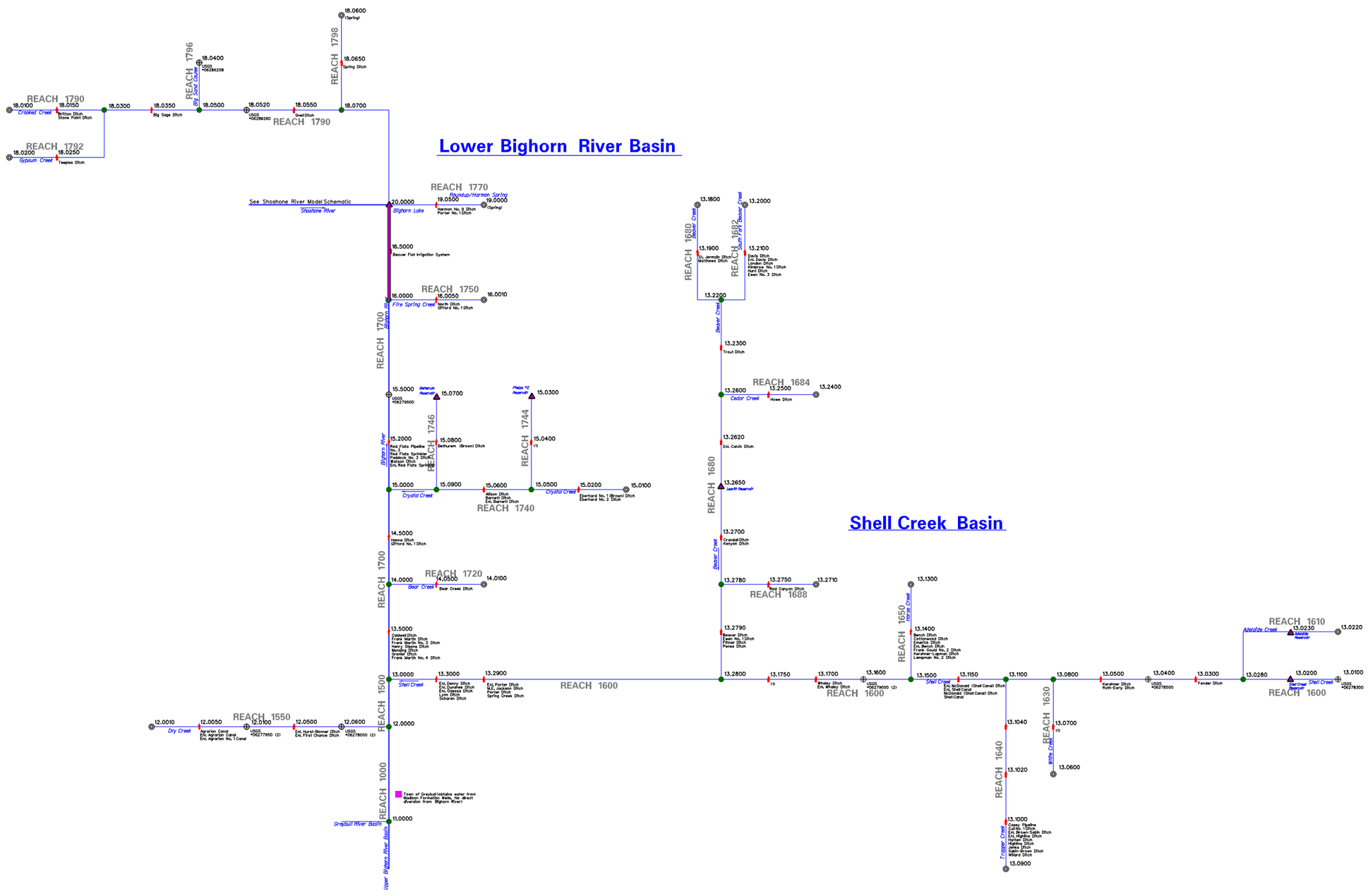

Diagram Notes

(1) No data associated with node. For future use.

(2) Inactive gage. Data reconstructed for use in model or serves as a node for flow accumulation.

Please refer to the Diversion Node Summary Table located in this Appendix for diversion names.

Full size diagram may be downloaded from the Wyoming State Water Planning website.

Wind/Bighorn River Basin Plan

Lower Bighorn River Basin Model Schematic

January 2003

Wyoming Water Development Commission

Wind/Bighorn Basin Advisory Group

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Denver Colorado

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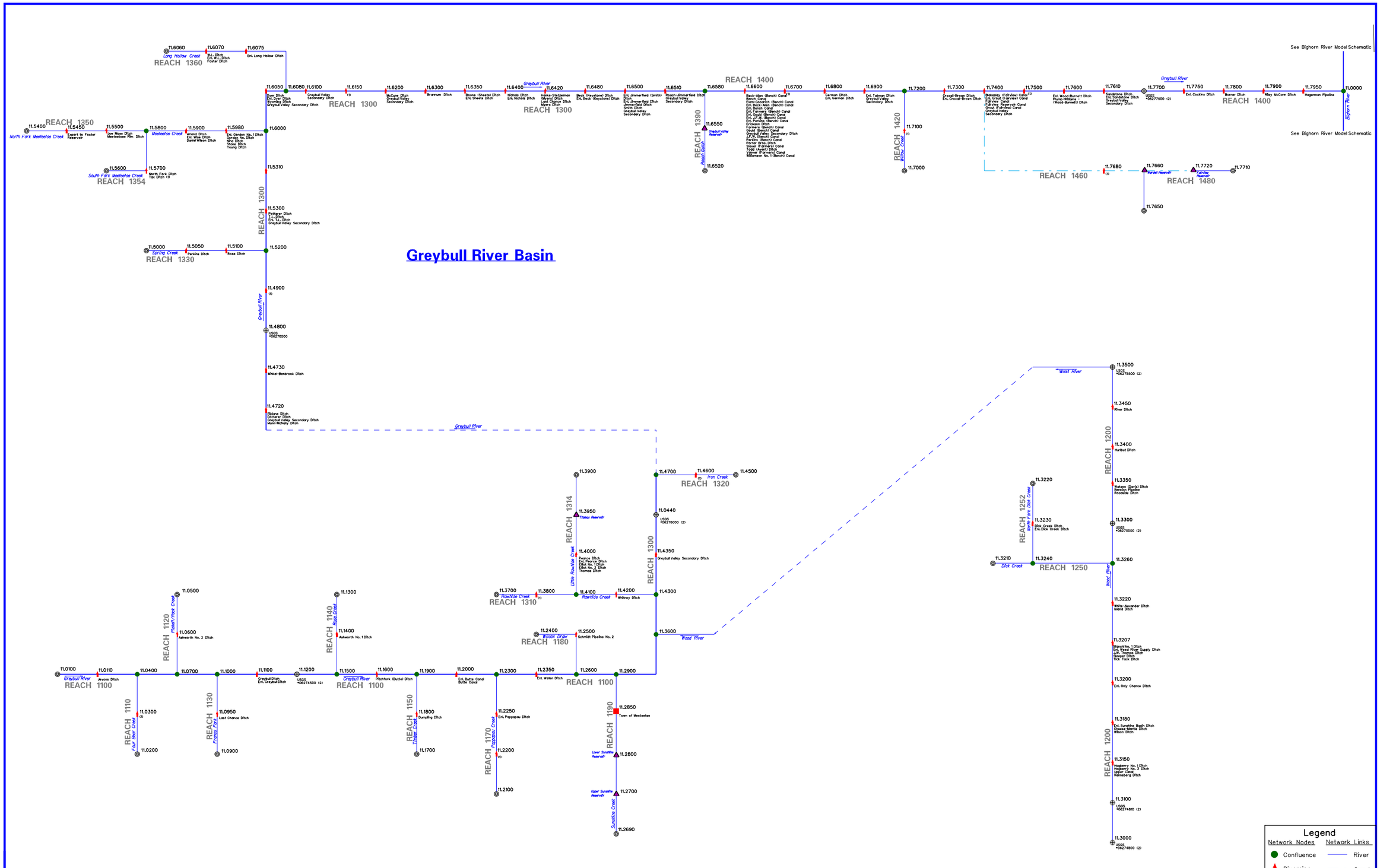
Greybull River Basin
See Bighorn River Model Schematic
REACH 1350
REACH 1354
REACH 1360
REACH 1300
REACH 1400
REACH 1390
REACH 1420
REACH 1460
REACH 1480
REACH 1330
REACH 1320
REACH 1314
REACH 1310
REACH 1180
REACH 1100
REACH 1120
REACH 1140
REACH 1150
REACH 1170
REACH 1190
REACH 1110
REACH 1130
REACH 1252
REACH 1250
REACH 1200
Greybull River
Wood River
Bighorn River
North Fork Meeteetse Creek
South Fork Meeteetse Creek
Meeteetse Creek
Spring Creek
Long Hollow Creek
Nichols Creek
Willow Creek
Wood Gulch
Fallview Reservoir
Thomas Reservoir
Iron Creek
Little Sunshine Creek
Rawhide Creek
Wilcox Draw
Pappapau Creek
Lower Sunshine Reservoir
Upper Sunshine Reservoir
Sunshine Creek
Pickett Rock Creek
Four Bear Creek
Frosty Eye
Timber Creek
North Fork Dick Creek
Dick Creek
11.6060
11.6070
11.6075
11.6050
11.6080
11.6100
11.6150
11.6200
11.6300
11.6350
11.6400
11.6420
11.6480
11.6500
11.6510
11.6580
11.6550
11.6520
11.6600
11.6700
11.6800
11.6900
11.7200
11.7100
11.7000
11.7300
11.7400
11.7500
11.7600
11.7610
11.7700
11.7750
11.7800
11.7900
11.7950
11.0000
11.7680
11.7660
11.7720
11.7710
11.7650
11.5400
11.5450
11.5500
11.5800
11.5900
11.5980
11.6000
11.5600
11.5700
11.5310
11.5300
11.5000
11.5050
11.5100
11.5200
11.4900
11.4800
11.4730
11.4720
11.3900
11.3950
11.4000
11.4100
11.4200
11.3700
11.3800
11.4700
11.4600
11.4500
11.0440
11.4350
11.4300
11.3600
11.2400
11.2500
11.2900
11.2850
11.2800
11.2700
11.2690
11.0100
11.0110
11.0400
11.0700
11.1000
11.1100
11.1200
11.1300
11.1400
11.1500
11.1600
11.1900
11.2000
11.2300
11.2350
11.2600
11.0500
11.0600
11.0300
11.0200
11.0950
11.0900
11.1800
11.1700
11.2250
11.2200
11.2100
11.3500
11.3450
11.3400
11.3350
11.3300
11.3260
11.3220
11.3210
11.3240
11.3230
11.3207
11.3200
11.3180
11.3150
11.3100
11.3000
Greybull River Secondary Ditch
Greybull Valley Secondary Ditch
Wood River
Bighorn River
Legend
Network Nodes
Network Links
Confluence
Diversion
Municipal Diversion
Natural Flow
Gage
Reservoir
River
Canal
Diagram Notes
(1) No data associated with node. For future use.
(2) Inactive gage. Data reconstructed for use in model or serves as a node for flow accumulation.
Please refer to the Diversion Node Summary Table located in this Appendix for diversion names.
Full size diagram may be downloaded from the Wyoming State Water Planning website.
Wind/Bighorn River Basin Plan
Greybull River Basin Model Schematic
January 2003
Wyoming Water Development Commission
Wind/Bighorn Basin Advisory Group
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Denver
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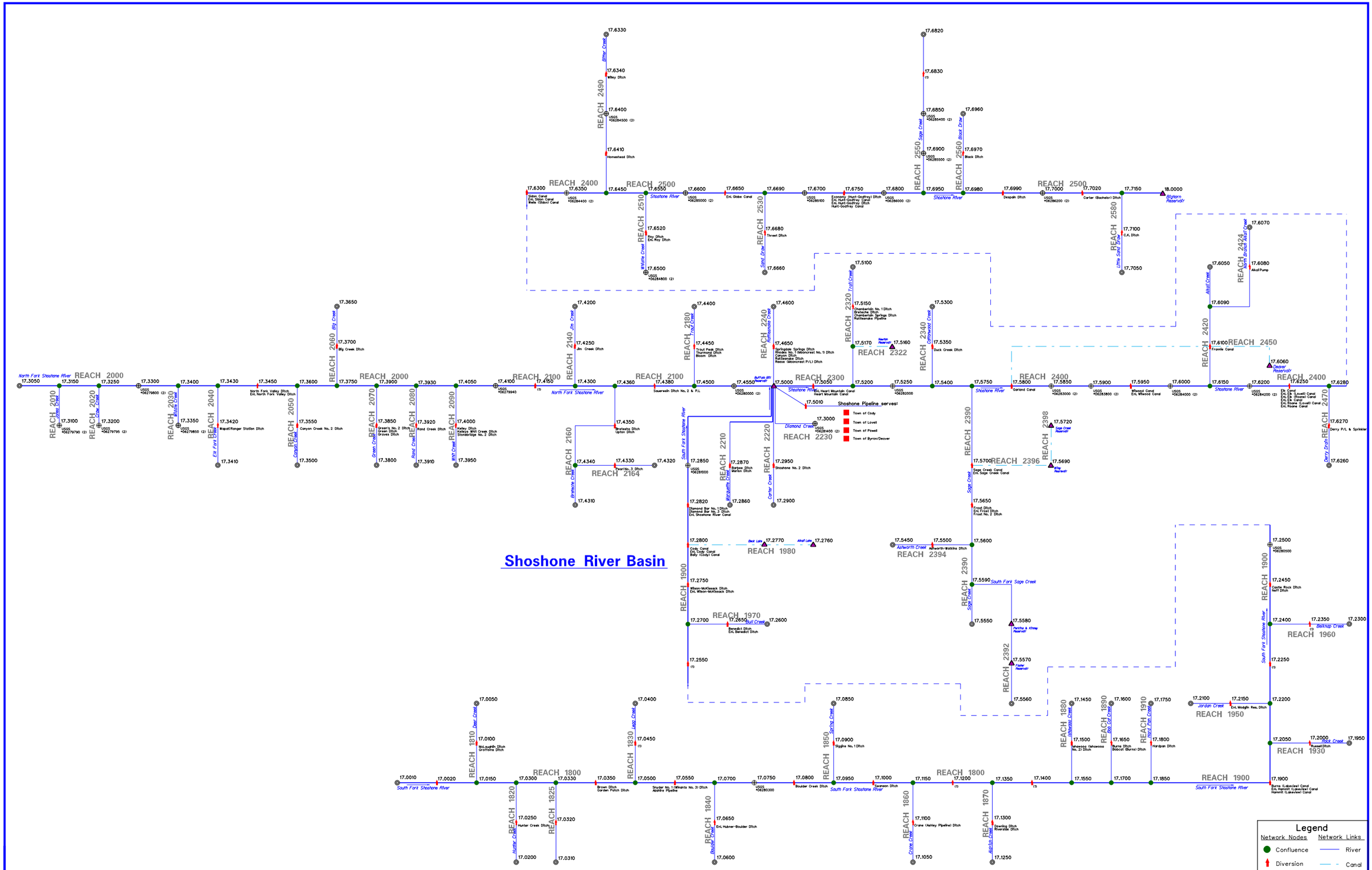

Diagram Notes

(1) No data associated with node. For future use.

(2) Inactive gage. Data reconstructed for use in model or serves as a node for flow accumulation.

Please refer to the Diversion Node Summary Table located in this Appendix for diversion names.

Full size diagram may be downloaded from the Wyoming State Water Planning website.

Wind/Bighorn River Basin Plan
Shoshone River Basin Model Schematic

January 2003

Wyoming Water Development Commission
Wind/Bighorn Basin Advisory Group

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Model Nodes
Yellowstone Models

Node Number	Diversion Names	Type	Reach	Schematic
1.0100	CLARKS FK YELLOWSTONE R AB SQUAW C NR PAINTER,WY(06205500)	Gage	100	Clarks Fork
1.0300	CLARKS FK YELLOWSTONE R BL CRANDAL C NR PAINTER(06206000)	Gage	100	Clarks Fork
1.0310	Deadman Creek Natural Flow	Natf	120	Clarks Fork
1.0320	Deadman Creek Diversions	Div	120	Clarks Fork
1.0400	Confluence of Camp Creek and Clarks Fork River	Conf	100	Clarks Fork
1.0410	Camp Creek Natural Flow	Natf	140	Clarks Fork
1.0420	Camp Creek Diversion	Div	140	Clarks Fork
1.0500	Confluence of Bars Creek and Clarks Fork River	Conf	100	Clarks Fork
1.0500	Confluence of Deadman Creek and Clarks Fork	Conf	100	Clarks Fork
1.0510	Dutch Charlie Creek Natural Flow	Natf	160	Clarks Fork
1.0520	Dutch Charlie Creek Diversion	Div	160	Clarks Fork
1.0600	Confluence of Bench Creek and Clarks Fork River	Conf	100	Clarks Fork
1.0610	Bars Creek Natural Flow	Natf	180	Clarks Fork
1.0620	Bars Creek Diversion	Div	180	Clarks Fork
2.0000	Confluence of Sunlight Creek and Clarks Fork	Conf	100	Clarks Fork
2.0100	Sunlight Creek Natural Flow	Natf	190	Clarks Fork
2.0200	Sunlight Creek Diversion	Div	190	Clarks Fork
2.0300	Confluence of Gravel Bar Creek and Sunlight Creek	Conf	190	Clarks Fork
2.0310	Gravel Bar Creek Natural Flow	Natf	192	Clarks Fork
2.0320	Gravel Bar Creek Diversions	Div	192	Clarks Fork
2.0400	Confluence of Huff Creek and Sunlight Creek	Conf	190	Clarks Fork
2.0410	Huff Creek Natural Flow	Natf	194	Clarks Fork
2.0420	Huff Creek Diversions	Div	194	Clarks Fork
2.0500	Sunlight Creek Diversions	Div	190	Clarks Fork
2.0600	SUNLIGHT CREEK NEAR PAINTER, WYO.(06206500)	Gage	190	Clarks Fork
2.0700	Sunlight Creek Diversions	Div	190	Clarks Fork
2.0800	Confluence of Elk Creek and Sunlight Creek	Conf	190	Clarks Fork
2.0810	Elk Creek Natural Flow	Natf	196	Clarks Fork
2.0820	Elk Creek Diversions	Div	196	Clarks Fork
2.5000	Clarks Fork River Diversions	Div	200	Clarks Fork
3.0000	Confluence of New Meyer Creek and Clarks Fork River	Conf	200	Clarks Fork
3.0100	New Meyer Creek Natural Flow	Natf	220	Clarks Fork
3.0200	New Meyer Creek Diversions	Div	220	Clarks Fork
4.0000	Confluence of Paint Creek and Clarks Fork	Conf	200	Clarks Fork
4.0100	Paint Creek Natural Flow	Natf	240	Clarks Fork
4.0200	Paint Creek Diversions	Div	240	Clarks Fork
4.0250	Luce Reservoir Natural Flow	Natf	242	Clarks Fork
4.0270	Luce Reservior	Res	242	Clarks Fork
4.0300	Paint Creek Diversions	Div	240	Clarks Fork
4.0400	Paint Creek Diversions	Div	240	Clarks Fork
4.3000	Clarks Fork River Diversions	Div	200	Clarks Fork
4.6000	Confluence of Lake Creek and Clarks Fork River	Conf	200	Clarks Fork
4.6500	Lake Creek Diversion	Div	294	Clarks Fork
5.0000	Confluence of Pat O'Hare Creek and Clarks Fork River	Conf	200	Clarks Fork
5.0100	Pat O'Hare Creek Natural Flow	Natf	260	Clarks Fork
5.0200	Pat O'Hare Creek Diversions	Div	260	Clarks Fork
5.1000	CLARKS FORK YELLOWSTONE RIVER NEAR CLARK WYO(06207000)	Gage	200	Clarks Fork
5.8000	Clarks Fork River Diversions	Div	200	Clarks Fork
6.0000	Confluence of Bennett Creek and Clarks Fork	Conf	200	Clarks Fork
6.0100	Bennett Creek Natural Flow	Natf	290	Clarks Fork
6.0150	Bennett Creek Diversions	Div	290	Clarks Fork
6.0200	Confluence of Natural Springs and Bennett Creek	Conf	290	Clarks Fork
6.0210	Natural Springs Natural Flow	Natf	292	Clarks Fork
6.0220	Natural Springs Diversion	Div	292	Clarks Fork
6.0250	Bennett Creek Diversions	Div	290	Clarks Fork
6.0300	Confluence of Little Rocky Creek and Bennett Creek	Conf	290	Clarks Fork
6.0310	Little Rocky Creek Natural Flow	Natf	294	Clarks Fork
6.0330	Little Rocky Creek Diversions	Div	294	Clarks Fork
6.0340	Split between Lake Creek and Little Rocky Creek	Div	294	Clarks Fork

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Model Nodes
Yellowstone Models

Node Number	Diversion Names	Type	Reach	Schematic
6.0350	Little Rocky Creek Diversions	Div	294	Clarks Fork
6.0370	Little Rocky Creek Diversion - Little Rocck Ditch	Div	294	Clarks Fork
6.0400	Bennett Creek Ditch Diversions	Div	290	Clarks Fork
6.3000	Clarks Fork River Diversions	Div	300	Clarks Fork
6.6000	Clarks Fork River Diversions	Div	300	Clarks Fork
7.0000	Confluence of Line Creek and Clarks Fork River	Conf	300	Clarks Fork
7.0100	Line Creek Natural Flow	Natf	360	Clarks Fork
7.0200	Line Creek Diversions	Div	360	Clarks Fork
7.5000	Clarks Fork River Diversions	Div	300	Clarks Fork
8.0000	Clarks Fork Yellowstone River nr Belfry MT(06207500)	Gage	300	Clarks Fork
8.0100	BIG SAND CL AB ST DITCH NR BADGER BASIN, WY(06207507)	Gage	380	Clarks Fork
8.0200	BIG SAND CL AT WY-MONT STATE LINE(06207510)	Gage	380	Clarks Fork
1.0100	Gibbon River near West Yellowstone MT(06037000)	Gage	620	Madison/Gallatin
1.0200	Firehole River near West Yellowstone MT(06036905)	Gage	640	Madison/Gallatin
1.0300	Confluence of Gibbon River and Firehole River	Conf	600	Madison/Gallatin
1.0400	Madison River near West Yellowstone MT(06037500)	Gage	600	Madison/Gallatin

Model Nodes
Wind River Basin

Node Number	Diversion Names	Type	Reach	Schematic
1.0000	Wind River Natural Flow	Natf	100	Upper Wind
1.3000	Wind River Diversions	Div	100	Upper Wind
1.4000	East DuNoir Creek Natural Flow	Natf	120	Upper Wind
1.4100	East DuNoir Creek Diversions	Div	120	Upper Wind
1.4150	West DuNoir Creek Natural Flow	Natf	122	Upper Wind
1.4155	Confluence of West DuNoir Creek and East DuNoir Cree	Conf	120	Upper Wind
1.4156	DuNoir Creek Diversions	Div	120	Upper Wind
1.4160	Willow Branch Creek Natural Flow	Natf	124	Upper Wind
1.4165	Willow Branch Creek Diversions	Div	124	Upper Wind
1.4170	Confluence of Willow Branch Creek and DuNoir Creek	Conf	120	Upper Wind
1.4180	Sixmile Creek Natural Flow	Natf	126	Upper Wind
1.4185	Sixmile Creek Diversions	Div	126	Upper Wind
1.4200	Confluence of Sixmile Creek and DuNoir Creek	Conf	120	Upper Wind
1.4300	Du Noir Creek Diversion	Div	120	Upper Wind
1.4320	Fivemile Creek Natural Flow	Natf	128	Upper Wind
1.4350	Fivemile Creek Diversions	Div	128	Upper Wind
1.4400	Confluence of Fivemile Creek and DuNoir Creek	Conf	120	Upper Wind
1.4500	Du Noir Creek Diversions	Div	120	Upper Wind
2.0000	Confluence of DuNoir Creek and Wind River	Conf	100	Upper Wind
2.1000	Wind River Diversions	Div	200	Upper Wind
2.2000	WIND RIVER NEAR DUBOIS, WYO.(06218500)	Gage	200	Upper Wind
2.2500	Wind River Diversions	Div	200	Upper Wind
2.3000	Wind River Diversions	Div	200	Upper Wind
2.4000	Wind River Diversions	Div	200	Upper Wind
2.4200	Warm Springs Creek Natural Flow	Natf	220	Upper Wind
2.4500	Warm Springs Creek Diversion	Div	220	Upper Wind
2.5000	Confluence of Warm Springs Creek and Wind River	Conf	200	Upper Wind
2.5100	Geyser Creek Natural Flow	Natf	230	Upper Wind
2.5150	Geyser Creek Diversion - Geyser Ditch	Div	230	Upper Wind
2.5200	Confluence of Geyser Creek and Wind River	Conf	200	Upper Wind
2.6000	Wind River Diversions	Div	200	Upper Wind
2.6020	Dubois Municipal Diversion and Return Flow	DivM	200	Upper Wind
2.6050	Little Warms Springs Creek Natural Flow	Natf	240	Upper Wind
2.6070	Little Warms Springs Creek Diversions	Div	240	Upper Wind
2.6080	Confluence of Little Warm Springs Creek and Wind Riv	Conf	200	Upper Wind
2.6100	Horse Creek - Natural Flow	Natf	260	Upper Wind
2.6200	Horse Creek Diversions	Div	260	Upper Wind
2.6400	Little Horse Creek - Natural Flow	Natf	262	Upper Wind
2.6600	Little Horse Creek Diversions	Div	262	Upper Wind
2.6800	Confluence of Little Horse Creek and Horse Creek	Conf	260	Upper Wind
2.6900	Horse Creek Diversions	Div	260	Upper Wind
2.7000	Confluence of Horse Creek and Wind River	Conf	200	Upper Wind
2.8000	WIND RIVER AT DUBOIS WYO(06220000)	GageN	200	Upper Wind
2.9000	Wind River Diversions	Div	200	Upper Wind
2.9100	Jakeys Fork - Natural Flow	Natf	270	Upper Wind
2.9300	Jakeys Fork Diversions	Div	270	Upper Wind
2.9500	Jakeys Fork Diversions	Div	270	Upper Wind
3.0000	Confluence of Jakeys Fork and Wind River	Conf	200	Upper Wind
3.0100	Torrey Creek Natural Flow	Natf	280	Upper Wind
3.0200	Torrey Creek Diversions	Div	280	Upper Wind
3.0300	Torrey Creek Diversions	Div	280	Upper Wind
3.0400	Torrey Creek Diversions	Div	280	Upper Wind
3.1000	Confluence of Torrey Creek and Wind River	Conf	200	Upper Wind
3.2000	Wind River Diversions	Div	200	Upper Wind
3.2100	East Fork Wind River Natural Flow	Natf	290	Upper Wind
3.2105	East Fork Wind River Diversion	Div	290	Upper Wind
3.2110	Meadow Creek Natural Flow	Natf	292	Upper Wind
3.2130	Meadow Creek Diversions	Div	292	Upper Wind
3.2150	Confluence of Meadow Creek and East Fork Wind River	Conf	290	Upper Wind
3.2160	Alkali Creek Natural Flow	Natf	293	Upper Wind
3.2165	Alkali Creek Diversions	Div	293	Upper Wind
3.2170	Confluence of Alkali Creek and East Fork Wind River	Conf	290	Upper Wind

Model Nodes
Wind River Basin

Node Number	Diversion Names	Type	Reach	Schematic
4.7000	Wind Above Bull Lake Creek	Div	300	Upper Wind
4.7100	BULL LAKE CREEK ABOVE BULL LAKE, WY(06224000)	Gage	390	Upper Wind
4.7200	Bull Lake	Res	390	Upper Wind
4.7300	Bull Lake Creek Diversion - Winchester Ditch	Div	390	Upper Wind
4.7400	BULL LAKE CREEK NEAR LENORE, WY(06225000)	Gage	390	Upper Wind
4.7500	Wind River Diversion - Big Horn Flats Pump #1	Div	300	Upper Wind
4.8000	Confluence of Wind River and Bull Lake Ck.	Conf	300	Upper Wind
4.9000	WIND RIVER NEAR CROWHEART, WY(06225500)	Gage	400	Upper Wind
4.9200	Wind River Diversions	Div	400	Upper Wind
5.0000	Wind River Diversion - Wyoming Canal	Div	400	Upper Wind
5.0200	Wind River Diversions	Div	400	Upper Wind
5.0210	West Fork Dry Pasup Creek Natural Flow	Natf	400	Upper Wind
5.0250	West Fork Dry Pasup Creek Diversions	Div	420	Upper Wind
5.0300	Red Creek Natural Flow	Natf	422	Upper Wind
5.0350	Red Creek Diversions	Div	422	Upper Wind
5.0400	Confluence of Red Creek and West Fork Dry Pasup Cree	Conf	420	Upper Wind
5.0450	Dry Pasup Creek Diversions	Div	420	Upper Wind
5.0480	Teapot Reservoir	Res	420	Upper Wind
5.0500	Dry Pasup Creek Diversions	Div	420	Upper Wind
5.0550	Dry Pasup Creek Diversions	Div	420	Upper Wind
5.0600	Confluence of Dry Pasup Creek and Wind River	Conf	400	Upper Wind
5.1000	Wind River Diversions	Div	400	Upper Wind
5.1200	Pilot Butte Reservoir	Res	440	Lower Wind
5.1250	Pilot Butte Reservoir Diversions - Pilot Canal	Div	440	Lower Wind
5.1500	Wind River Diversions	Div	400	Upper Wind
5.2400	Wind River Diversion - Aragon Ditch	Div	400	Upper Wind
5.2600	Wind River Diversion - South Crowheart Ditch	Div	400	Upper Wind
5.3000	Wind River Diversion - Johnstown Canal	Div	400	Upper Wind
5.4000	WIND RIVER NEAR KINNEAR, WY(06227600)	Gage	400	Upper Wind
5.4500	Wind River Diversions	Div	400	Upper Wind
5.5000	Wind River Diversion - LeClair Canal	Div	400	Upper Wind
5.6000	Wind River Diversion - Lefthand Canal	Div	400	Upper Wind
5.7000	Wind River Diversion - Riverton Valley Canal	Div	400	Upper Wind
5.7500	Riverton Municipal Diversion and Return Flow	DivM	400	Upper Wind
5.8000	WIND RIVER AT RIVERTON, WY(06228000)	Gage	400	Upper Wind
5.9000	Wind River Diversions	Div	400	Upper Wind
6.0000	SF L WIND R AB WASHAKIE RE NR FT WASHAKIE WY(06228350)	Gage	510	Little Wind
6.1000	Washakie Reservoir	Res	510	Little Wind
6.1100	SOUTH FORK LITTLE WIND RIV BEL WASHAKIE RES, WY(06228450)	Gage	510	Little Wind
6.1200	South Fork Little Wind River Diversions	Div	510	Little Wind
6.1400	South Fork Little Wind River Diversions	Div	510	Little Wind
6.1600	South Fork Little Wind Diversions	Div	510	Little Wind
6.3000	South Fork Little Wind Diversions	Div	510	Little Wind
6.3500	LITTLE WIND R NR FORT WASHAKIE, WYO.(06228500)	GageN	510	Little Wind
6.4000	South Fork Little Wind Diversion - Ray Canal	Div	510	Little Wind
6.4100	Crooked Creek Natural Flow	Natf	515	Little Wind
6.4200	Crooked Creek Diversions	Div	515	Little Wind
6.4300	Spring Creek Natural Flow	Natf	532	Little Wind
6.4400	Spring Creek Diversions	Div	532	Little Wind
6.4500	TROUT CREEK NEAR FORT WASHAKIE, WY(06229900)	Gage	530	Little Wind
6.4600	Trout Creek Diversions	Div	530	Little Wind
6.4700	Confluence of Trout Creek and Spring Creek	Conf	530	Little Wind
6.4800	Confluence of Ray Canal and Crooked Creek	Conf	515	Little Wind
6.4900	Ray Lake	Res	562	Little Wind
6.4910	Mill Creek Natural Flow	Natf	560	Little Wind
6.4930	Mill Creek Diversions	Div	560	Little Wind
6.4950	MILL CR AB RAY LAKE OUTLET CANAL, NR FT WASHAKIE(06230190)	Gage	560	Little Wind
6.5000	Confluence of Mill Creek and Ray Lake Outlet	Conf	560	Little Wind
6.5100	Mill Creek Diversion - Coolidge Canal	Div	560	Little Wind
6.6000	Confluence of Crooked Creek and SF Little Wind River	Conf	510	Little Wind

Model Nodes
Wind River Basin

Node Number	Diversion Names	Type	Reach	Schematic
6.6100	NORTH FORK LITTLE WIND RIVER NR FORT WASHAKIE, WY(06228800)	Gage	520	Little Wind
6.6130	North Fork Little Wind Diversions	Div	520	Little Wind
6.6150	North Fork Little Wind Diversion - North Fork Canal	Div	520	Little Wind
6.6180	North Fork Little Wind Diversions	Div	520	Little Wind
6.6200	North Fork Little Wind Diversions	Div	520	Little Wind
6.6300	N FK LITTLE WIND R AT FORT WASHAKIE, WYO.(06229000)	GageN	520	Little Wind
6.7000	Confluence of NF and SF Little Wind	Conf	510	Little Wind
6.7100	North Fork Sage Creek Natural Flow	Natf	546	Little Wind
6.7200	North Fork Sage Creek Diversions	Div	546	Little Wind
6.7210	South Fork Sage Creek Natural Flow	Natf	542	Little Wind
6.7220	South Fork Sage Creek Diversions	Div	542	Little Wind
6.7230	Pevah Creek Natural Flow	Natf	544	Little Wind
6.7240	Pevah Creek Diversions	Div	544	Little Wind
6.7249	Confluence of Pevah Creek and South Fork Sage Creek	Conf	542	Little Wind
6.7250	South Fork Sage Creek Diversions	Div	542	Little Wind
6.7300	Confluence of North Fork and South Fork Sage Creek	Conf	542	Little Wind
6.7350	Sage Creek Diversions	Div	540	Little Wind
6.7400	SAGE CR AB NORKOK MEADOWS CR, NR FT WASHAKIE, WY(06229680)	Gage	540	Little Wind
6.7410	Norkok Creek Natural Flow	Natf	548	Little Wind
6.7420	Norkok Creek Diversions	Div	548	Little Wind
6.7480	Confluence of Norkok Creek and Sage Creek	Conf	540	Little Wind
6.7500	Little Wind River Diversions - Coolidge Canal	Div	500	Little Wind
6.8000	Confluence of Little Wind, Trout Creek and Sage Cree	Conf	500	Little Wind
6.8500	Little Wind River Diversions - Big Horn Flats Pumps	Div	500	Little Wind
6.9000	Little Wind River Diversions	Div	500	Little Wind
7.0000	Confluence of Little Wind and Mill Creek	Conf	500	Little Wind
7.0500	Little Wind River Diversion	Div	500	Little Wind
7.1000	Little Wind River Diversion - Sub-Agency Canal	Div	500	Little Wind
7.2000	LITTLE WIND RIVER NR ARAPAHOE WYO(06230500)	GageN	500	Little Wind
7.2500	Little Wind River Diversions	Div	500	Little Wind
7.3000	LITTLE WIND R ABOVE ARAPAHOE, WYO.(06231000)	Gage	500	Little Wind
7.3500	POPO AGIE RIVER NR ARAPAHOE WY(06233900)	Gage	580	Little Wind
7.4000	Confluence of Little Wind and Popo Agie	Conf	500	Little Wind
7.5000	LITTLE WIND RIVER BELOW ARAPAHOE WYO(06234000)	GageN	500	Little Wind
7.6000	Little Wind Diversions	Div	500	Little Wind
7.6100	Beaver Creek Natural Flow	Natf	590	Little Wind
7.6200	Beaver Creek Diversions	Div	590	Little Wind
7.6300	Beaver Creek Diversions	Div	590	Little Wind
7.6400	Beaver Creek Diversions	Div	590	Little Wind
7.7000	Confluence of Little Wind and Beaver Creek	Conf	500	Little Wind
7.7400	Little Wind River Diversions	Div	500	Little Wind
7.7500	Little Wind River Diversion - Riverton East Pump #1	Div	500	Little Wind
7.8000	LITTLE WIND RIVER NEAR RIVERTON, WY(06235500)	Gage	500	Little Wind
8.0000	Confluence of Wind River and Little Wind	Conf	600	Upper Wind
8.0500	Wind River Diversion - Riverton East	Div	600	Upper Wind
8.1000	Wind River Diversions	Div	600	Upper Wind
8.1400	Wind River Diversions	Div	600	Upper Wind
8.2000	WIND RIVER AB BOYSEN RESERVOIR, NR SHOSHONI, WY(06236100)	Gage	600	Upper Wind
9.0000	Five Mile Creek Natural Flow	Natf	620	Lower Wind
9.0100	Five Mile Creek Diversions	Div	620	Lower Wind
9.0200	FIVEMILE C AB WYO CA NR PAV WYO(06244500)	Gage	620	Lower Wind
9.0250	Wyoming Canal Diversion at Fivemile Creek	Div	620	Lower Wind
9.0300	FIVEMILE CREEK NR PAVILLION WYO(06245000)	GageN	620	Lower Wind
9.0400	FIVEMILE CREEK NEAR RIVERTON, WY(06250000)	Gage	620	Lower Wind
9.0500	FIVEMILE CREEK NEAR SHOSHONI, WY(06253000)	Gage	620	Lower Wind
9.1000	MUSCRAT CREEK NEAR SHOSHONI, WY(06239000)	Gage	640	Lower Wind
9.2000	POISON CREEK NEAR SHOSHONI, WY(06255500)	GageN	660	Lower Wind
9.3000	Dry Cottonwood Creek Natural Flow	Natf	900	Lower Wind

Model Nodes
Wind River Basin

Node Number	Diversion Names	Type	Reach	Schematic
3.2180	East Fork Wind River Diversion	Div	290	Upper Wind
3.2190	Bear Creek Natural Flow	Natf	294	Upper Wind
3.2200	Confluence of Bear Creek and East Fork Wind River	Conf	290	Upper Wind
3.2300	East Fork Wind River Diversion	Div	290	Upper Wind
3.2350	Wiggins Fork Natural Flow	Natf	296	Upper Wind
3.2360	Wiggins Fork Diversion	Div	296	Upper Wind
3.2400	Confluence of Wiggins Fork and East Fork Wind River	Conf	290	Upper Wind
3.2450	East Fork Wind River Diversion	Div	290	Upper Wind
3.2500	EAST FORK WIND RIVER NR DUBOIS WYO(06220500)	Gage	290	Upper Wind
3.3000	Confluence of Wind River and East Fork Wind River	Conf	200	Upper Wind
3.3200	WIND RIVER ABOVE RED CREEK, NEAR DUBOIS, WY(06220800)	Gage	300	Upper Wind
3.3500	Wind River Diversions	Div	300	Upper Wind
3.4100	Red CreekNatural Flow	Natf	310	Upper Wind
3.4500	Red Creek Diversions	Div	310	Upper Wind
3.5000	Confluence of Red Creek and Wind River	Conf	300	Upper Wind
3.6000	Wind River Diversions	Div	300	Upper Wind
3.6100	DINWOODY CREEK ABOVE LAKES, NEAR BURRIS, WYO.(06221400)	Gage	320	Upper Wind
3.6150	Dinwoody Creek Diversions	Div	320	Upper Wind
3.6200	Dinwoody Lakes	Res	320	Upper Wind
3.6300	Dinwoody Creek Diversions - Dinwoody Canal	Div	320	Upper Wind
3.6400	Dinwoody Creek Diversions	Div	320	Upper Wind
3.6500	DINWOODY CREEK NEAR BURRIS, WYO.(06221500)	GageN	320	Upper Wind
3.7000	Confluence of Wind River and Dinwoody Creek	Conf	300	Upper Wind
3.8000	WIND RIVER NEAR BURRIS, WY(06222000)	GageN	300	Upper Wind
3.9000	Wind River Diversion - Upper Wind River A Canal	Div	300	Upper Wind
4.0000	Wind River Diversions	Div	300	Upper Wind
4.1000	Wind River Diversion	Div	300	Upper Wind
4.1100	Little Dry Creek Natural Flow	Natf	342	Upper Wind
4.1200	Little Dry Creek Diversions	Div	342	Upper Wind
4.2100	Dry Creek Natural Flow	Natf	340	Upper Wind
4.2200	Dry Creek Diversions	Div	340	Upper Wind
4.2300	DRY CREEK NEAR BURRIS, WYO.(06222500)	Gage	340	Upper Wind
4.2400	Dry Creek Diversion - Dry Creek Canal	Div	340	Upper Wind
4.2500	Dry Creek Diversions	Div	340	Upper Wind
4.2550	Confluence of Little Dry Creek and Dry Creek	Conf	340	Upper Wind
4.2600	Wind River Diversion - Lower Wind River A Canal	Div	340	Upper Wind
4.2700	Dry Creek Diversions	Div	340	Upper Wind
4.3000	Confluence of River Wind and Dry Creek	Conf	300	Upper Wind
4.3100	Wind River Diversion - North Crowheart Canal	Div	300	Upper Wind
4.3400	CROW C NR TIPPERARY WYO(06222700)	Gage	350	Upper Wind
4.3450	Crow Creek Diversions	Div	350	Upper Wind
4.3500	Crow Creek Diversions	Div	350	Upper Wind
4.3550	Crow Creek Diversions	Div	350	Upper Wind
4.3600	Crow Creek Diversions	Div	350	Upper Wind
4.3700	Crow Creek Diversions	Div	350	Upper Wind
4.4100	Meadow Creek Natural Flow	Natf	360	Upper Wind
4.4200	Meadow Creek Diversions	Div	360	Upper Wind
4.4250	Bob Creek Natural Flow	Natf	362	Upper Wind
4.4270	Bob Creek Diversions	Div	362	Upper Wind
4.4300	Confluence of Bob Creek and Meadow Creek	Conf	360	Upper Wind
4.4350	Meadow Creek Diversions	Div	360	Upper Wind
4.4400	MEADOW CREEK NR LENORE WYO(06223000)	GageN	360	Upper Wind
4.4500	Meadow Creek Diversion - Meadow Creek Canal	Div	360	Upper Wind
4.4550	Meadow Creek Diversions	Div	360	Upper Wind
4.5000	Confluence of Wind River and Crow Creek	Conf	300	Upper Wind
4.5200	Wind River Diversions	Div	300	Upper Wind
4.5500	Confluence of Meadow Creek and Wind River	Conf	300	Upper Wind
4.6000	Confluence of Wind River and Willow Creek	Conf	300	Upper Wind
4.6100	WILLOW CREEK NEAR CROWHEART, WYO.(06223500)	Gage	380	Upper Wind
4.6500	Willow Creek Diversion - Willow Creek Canal	Div	380	Upper Wind
4.6550	Willow Creek Diversions	Div	380	Upper Wind

Model Nodes
Bighorn River Basin

Node Number	Diversion Names	Type	Reach	Schematic
1.0000	Bighorn River Basin Inflow	Gage	100	Upper Bighorn
1.5000	Bighorn River Diversions	Div	100	Upper Bighorn
2.0000	Confluence of Red Creek and Bighorn River	Conf	100	Upper Bighorn
2.0010	Red Canyon Creek Natural Flow	Natf	110	Upper Bighorn
2.0050	Red Canyon Creek Diversions	Div	110	Upper Bighorn
2.1000	Bighorn River Diversions	Div	100	Upper Bighorn
2.1500	Thermopolis Municipal Diversion and Return Flow	DivM	100	Upper Bighorn
2.2000	BIGHORN RIVER AT THERMOPOLIS, WYO.(06259500)	Gage	100	Upper Bighorn
2.4000	Bighorn River Diversions	Div	100	Upper Bighorn
2.6000	Bighorn River Diversions - Kirby Canal	Div	100	Upper Bighorn
2.8000	Bighorn River Diversion	Div	100	Upper Bighorn
3.0000	Confluence of Owl Creek and Bighorn River	Conf	100	Upper Bighorn
3.0100	North Fork Owl Creek Natural Flow	Natf	250	Upper Bighorn
3.0150	North Fork Owl Creek Diversion	Div	250	Upper Bighorn
3.0200	NORTH FORK OWL CREEK NEAR ANCHOR, WY(06262000)	Gage	250	Upper Bighorn
3.0250	North Fork Owl Creek Diversions	Div	250	Upper Bighorn
3.0300	NORTH FORK OWL CR AB BASIN RANCH NR ANCHOR WYO(06262300)	Gage	250	Upper Bighorn
3.0350	North Fork Owl Creek Diversions	Div	250	Upper Bighorn
3.0400	N.F. OWL CREEK AT CRANN RANCH NR THERMOPOLIS, WY(06262500)	Gage	250	Upper Bighorn
3.0450	NORTH FORK OWL CREEK NR THERMOPOLIS WYO(06263000)	Gage	250	Upper Bighorn
3.1000	Confluence of North Fork and South Fork Owl Creek	Conf	235	Upper Bighorn
3.1001	MIDDLE FORK OWL CREEK ABOVE ANCHOR RESERVOIR, WY(06260200)	Gage	221	Upper Bighorn
3.1002	SOUTH FORK OWL CREEK NEAR ANCHOR, WY(06260000)	Gage	220	Upper Bighorn
3.1005	Anchor Reservoir	Res	220	Upper Bighorn
3.1011	SOUTH FORK OWL CREEK BELOW ANCHOR RESERVOIR, WY(06260400)	Gage	220	Upper Bighorn
3.1012	South Fork Owl Creek Diversions	Div	220	Upper Bighorn
3.1013	Goat Creek Natural Flow	Natf	210	Upper Bighorn
3.1014	Goat Creek Diversions	Div	210	Upper Bighorn
3.1015	Confluence of Goat Creek and South Fork Owl Creek	Conf	220	Upper Bighorn
3.1016	Carney Creek Natural Flow	Natf	215	Upper Bighorn
3.1017	Carney Creek Diversions	Div	215	Upper Bighorn
3.1019	Confluence of Carney Creek and South Fork Owl Creek	Conf	220	Upper Bighorn
3.1020	S F OWL CREEK AB CURTIS RANCH, NR THERMOPOLIS, WY(06260500)	Gage	220	Upper Bighorn
3.1025	South Fork Owl Creek Diversions	Div	220	Upper Bighorn
3.1030	SF OWL C A C RN N THERMOPOLIS WYO(06261000)	Gage	220	Upper Bighorn
3.1035	South Fork Owl Creek Diversions	Div	220	Upper Bighorn
3.1040	South Fork Owl Creek Diversion	Div	220	Upper Bighorn
3.1045	SOUTH FORK OWL CREEK NR THERMOPOLIS WYO(06261500)	Gage	220	Upper Bighorn
3.1046	Arapaho Ranch Pumps Natural Flow	Natf	226	Upper Bighorn
3.1047	Arapaho Ranch Pumps	Div	226	Upper Bighorn
3.1048	Confluence of Arapaho Pumps and South Fork Owl Creek	Conf	220	Upper Bighorn
3.1051	Dry Cottonwood Creek Natural Flow	Natf	228	Upper Bighorn
3.1053	Dry Cottonwood Creek Diversions	Div	228	Upper Bighorn
3.1060	Red Creek Natural Flow	Natf	227	Upper Bighorn
3.1065	Red Creek Diversions	Div	227	Upper Bighorn
3.1070	Confluence of Red Creek and Dry Cottonwood Creek	Conf	228	Upper Bighorn
3.1080	Confluence of Dry Cottonwood Creek and South Fork Ow	Conf	220	Upper Bighorn
3.1085	South Fork Owl Creek Diversions	Div	220	Upper Bighorn
3.1090	South Fork Owl Creek Diversions	Div	220	Upper Bighorn
3.1400	Owl Creek Diversions - Sliney Ditch	Div	200	Upper Bighorn
3.1450	Owl Creek Diversions	Div	200	Upper Bighorn
3.1500	Owl Creek Diversions - Chessington-Wilson	Div	200	Upper Bighorn
3.1520	Owl Creek Diversions	Div	200	Upper Bighorn
3.1550	Owl Creek Diversions - Woodward-Johnson	Div	200	Upper Bighorn
3.1600	Owl Creek Diversions	Div	200	Upper Bighorn
3.2000	Confluence of Unnamed Creek and Owl Creek	Conf	200	Upper Bighorn
3.2001	Unnamed Creek Natural Flow	Natf	270	Upper Bighorn

Model Nodes
Bighorn River Basin

Node Number	Diversion Names	Type	Reach	Schematic
3.2010	Well Diversions	Div	270	Upper Bighorn
3.2200	Owl Creek Diversions	Div	200	Upper Bighorn
3.2500	Owl Creek Diversions - Hale Ditch	Div	200	Upper Bighorn
3.2550	Owl Creek Diversions	Div	200	Upper Bighorn
3.2600	Thompson Reservoir #1 Natural Flow Node	Natf	280	Upper Bighorn
3.2700	Thompson Reservoir #1	Res	280	Upper Bighorn
3.2800	Thompson Reservoir Diversions - Baylor-Purvis-Thomps	Div	280	Upper Bighorn
3.2900	Confluence of Thomson Reservoir and Owl Creek	Conf	200	Upper Bighorn
3.3000	Confluence of Mud Creek and Owl Creek	Conf	200	Upper Bighorn
3.3001	Middle Fork Mud Creek Natural Flow	Natf	292	Upper Bighorn
3.3005	Middle Fork Mud Creek Diversion	Div	292	Upper Bighorn
3.3010	Mud Creek Natural Flow	Natf	290	Upper Bighorn
3.3015	Mud Creek Diversion	Div	290	Upper Bighorn
3.3020	South Fork Mud Creek Natural Flow	Natf	294	Upper Bighorn
3.3025	South Fork Mud Creek Diversion	Div	294	Upper Bighorn
3.3030	Whitney Spring Natural Flow	Natf	296	Upper Bighorn
3.3035	Whitney Spring Diversions	Div	296	Upper Bighorn
3.3040	Confluence of Whitney Spring and South Fork Mud Cree	Conf	294	Upper Bighorn
3.3045	South Fork Mud Creek Diversion	Div	294	Upper Bighorn
3.3050	Confluence of Middle Fork Mud Creek and Mud Creek	Conf	290	Upper Bighorn
3.3060	Mud Creek Diversions	Div	290	Upper Bighorn
3.3062	Spring Draw Natural Flow	Natf	298	Upper Bighorn
3.3064	Spring Draw Diversions	Div	298	Upper Bighorn
3.3065	Confluence of Spring Draw and Mud Creek	Conf	290	Upper Bighorn
3.3068	Mud Creek Diversions	Div	290	Upper Bighorn
3.3070	MUD CREEK NR THERMOPOLIS WYO(06263500)	Gage	290	Upper Bighorn
3.3080	Mud Creek Diversions	Div	290	Upper Bighorn
3.3120	McCumber Spring Natural Flow	Natf	310	Upper Bighorn
3.3130	McCumber Spring Diversions	Div	310	Upper Bighorn
3.3140	Confluence of McCumber Spring and Mud Creek	Conf	300	Upper Bighorn
3.3150	OWL CREEK NEAR THERMOPOLIS, WY(06264000)	Gage	300	Upper Bighorn
3.3200	Owl Creek Diversions	Div	300	Upper Bighorn
3.3250	Owl Creek Diversions	Div	300	Upper Bighorn
3.3350	Owl Creek Diversions	Div	300	Upper Bighorn
3.3400	OWL CREEK NEAR LUCERNE, WYO.(06264500)	Gage	300	Upper Bighorn
3.3500	Owl Creek Diversions	Div	300	Upper Bighorn
4.0000	Confluence of Kirby Creek and Bighorn River	Conf	400	Upper Bighorn
4.0005	Kirby Creek Natural Flow	Natf	410	Upper Bighorn
4.0008	Kirby Creek Diversions	Div	410	Upper Bighorn
4.0010	KIRBY CREEK NR LUCERNE WYO(06265000)	Gage	410	Upper Bighorn
4.4000	Bighorn River Diversions	Div	400	Upper Bighorn
4.5000	Bighorn River Diversion - Upper Hanover Canal	Div	400	Upper Bighorn
5.0000	Confluence of Cottonwood Creek and Bighorn River	Conf	400	Upper Bighorn
5.0001	Cottonwood Creek Natural Flow	Natf	460	Upper Bighorn
5.0005	Lake Creek Natural Flow	Natf	460	Upper Bighorn
5.0007	Lake Creek Reservoir	Res	460	Upper Bighorn
5.0008	Confluence of Lake Creek and Cottonwood Creek	Conf	460	Upper Bighorn
5.0010	Cottonwood Creek Diversions	Div	460	Upper Bighorn
5.0020	COTTONWOOD C AT HIGH ISLAND RNCH NR HAMILTON DOME(06265337)	Gage	460	Upper Bighorn
5.0030	Cottonwood Creek Diversions	Div	460	Upper Bighorn
5.0100	Confluence of Hamilton Dome Well and Cottonwood Cree	Conf	460	Upper Bighorn
5.0101	Hamilton Dome Well Natural Flow	Natf	462	Upper Bighorn
5.0110	Hamilton Dome Well Diversions	Div	462	Upper Bighorn
5.0150	Cottonwood Creek Diversions	Div	460	Upper Bighorn
5.0200	Cottonwood Creek Diversions	Div	460	Upper Bighorn
5.0250	Cottonwood Creek Diversions	Div	460	Upper Bighorn
5.0300	Cottonwood Creek Diversions	Div	460	Upper Bighorn
5.0350	Cottonwood Creek Diversions	Div	460	Upper Bighorn
5.0360	Little Grass Creek Natural Flow	Natf	468	Upper Bighorn
5.0370	Little Grass Creek Diversions	Div	468	Upper Bighorn
5.0400	Confluence of Grass Creek with Cottonwood Creek	Conf	460	Upper Bighorn

Model Nodes
Bighorn River Basin

Node Number	Diversion Names	Type	Reach	Schematic
5.0401	Grass Creek Natural Flow	Natf	464	Upper Bighorn
5.0402	Confluence of Little Grass Creek and Grass Creek	Conf	468	Upper Bighorn
5.0403	Grass Creek Diversions	Div	468	Upper Bighorn
5.0405	Mayfield Wells Natural Flow	Natf	466	Upper Bighorn
5.0407	Mayfield Wells Diversions	Div	466	Upper Bighorn
5.0410	Confluence of Grass Creek and Mayfield Wells	Conf	468	Upper Bighorn
5.0415	Grass Creek Diversions	Div	468	Upper Bighorn
5.0430	Cottonwood Creek Diversion - Tenderfoot Ditch	Div	460	Upper Bighorn
5.0450	Cottonwood Creek Diversion - Brassington Ditch	Div	460	Upper Bighorn
5.0470	Cottonwood Creek Diversions	Div	460	Upper Bighorn
5.0500	COTTONWOOD CREEK AT WINCHESTER WYO(06265500)	Gage	460	Upper Bighorn
5.8000	Bighorn River Diversion - Bluff Canal	Div	400	Upper Bighorn
6.0000	Confluence of Gooseberry Creek and Bighorn River	Conf	400	Upper Bighorn
6.0001	Gooseberry Creek Natural Flow	Natf	480	Upper Bighorn
6.0010	Gooseberry Creek Diversions	Div	480	Upper Bighorn
6.0020	GOOSEBERRY CREEK AT DICKIE, WYO.(06265800)	Gage	480	Upper Bighorn
6.0030	Gooseberry Creek Diversions	Div	480	Upper Bighorn
6.0100	Confluence of Gooseberry Creek and Enos Creek	Conf	480	Upper Bighorn
6.0101	Enos Creek Natural Flow	Natf	482	Upper Bighorn
6.0110	Enos Creek Diversions	Div	482	Upper Bighorn
6.0200	Gooseberry Creek Diversions	Div	480	Upper Bighorn
6.0250	GOOSEBERRY CREEK NEAR GRASS CREEK, WYO.(06266000)	Gage	480	Upper Bighorn
6.0300	Gooseberry Creek Diversions	Div	480	Upper Bighorn
6.0350	GOOSEBERRY CREEK NR DICKIE WYO(06266500)	Gage	480	Upper Bighorn
6.0400	Gooseberry Creek Diversions	Div	480	Upper Bighorn
6.0450	Gooseberry Creek Diversions	Div	480	Upper Bighorn
6.0480	Gooseberry Creek Diversions	Div	480	Upper Bighorn
6.0500	Gooseberry Creek Diversions	Div	480	Upper Bighorn
6.0550	Gooseberry Creek Diversions	Div	480	Upper Bighorn
6.0600	Gooseberry Creek Diversions	Div	480	Upper Bighorn
6.0650	GOOSEBERRY CREEK AT NEIBER, WYO.(06267000)	Gage	480	Upper Bighorn
6.5000	Bighorn River Diversion - Bighorn Canal	Div	500	Upper Bighorn
6.6000	Bighorn River Diversions	Div	500	Upper Bighorn
7.0000	Confluence of Nowater Creek and Bighorn River	Conf	500	Upper Bighorn
7.0001	EAST FORK NOWATER CREEK NEAR COLTER, WYO.(06267400)	Gage	520	Upper Bighorn
7.0050	Bighorn River Diversion - Highland Hanover Canal	Div	520	Upper Bighorn
7.5000	Bighorn River Diversion - Lower Hanover Canal	Div	500	Upper Bighorn
8.0000	Confluence of Fifteen Mile Creek and Bighorn River	Conf	500	Upper Bighorn
8.0001	FIFTEEN MILE CREEK NEAR WORLAND, WYO.(06268500)	Gage	540	Upper Bighorn
8.0050	Unnamed Creek Natural Flow	Natf	560	Upper Bighorn
8.0100	Unnamed Creek Diversions	Div	560	Upper Bighorn
8.1000	BIGHORN R AT WORLAND WYO(06268600)	Gage	500	Upper Bighorn
8.2000	Confluence of Unnamed Creek and Bighorn Draw	Conf	500	Upper Bighorn
8.2250	Sixmile Creek Natural Flow	Natf	580	Upper Bighorn
8.2300	Sixmile Creek Diversions	Div	580	Upper Bighorn
8.2500	Confluence of Sixmile Creek and Bighorn River	Conf	500	Upper Bighorn
8.2800	Bighorn River Diversions	Div	500	Upper Bighorn
8.2900	Bighorn River Diversions	Div	500	Upper Bighorn
8.3000	BIGHORN RIVER NEAR MANDERSON, WY(06269000)	Gage	500	Upper Bighorn
8.5000	BIGHORN R AT MANDERSON WYO(06269500)	Gage	500	Upper Bighorn
9.0000	Confluence of Nowood River and Bighorn River	Conf	500	Upper Bighorn
9.0001	Nowood River Natural Flow	Natf	600	Nowood
9.0100	Confluence of Nowood River and Lone Tree Creek	Conf	600	Nowood
9.0110	Lone Tree Creek Natural Flow	Natf	610	Nowood
9.0150	Lone Tree Creek Diversion	Div	610	Nowood
9.0200	Nowood River Diversions	Div	600	Nowood
9.0300	Confluence of Bear Creek and Nowood River	Conf	600	Nowood
9.0310	Bear Creek Natural Flow	Natf	620	Nowood
9.0350	Bear Creek Diversions	Div	620	Nowood
9.0400	Nowood River Diversions	Div	600	Nowood
9.0500	Confluence of Deep Creek and Nowood River	Conf	600	Nowood
9.0510	Deep Creek Natural Flow	Natf	630	Nowood

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Model Nodes
Bighorn River Basin

Node Number	Diversion Names	Type	Reach	Schematic
9.0550	Deep Creek Diversions	Div	630	Nowood
9.0600	Nowood River Diversions	Div	600	Nowood
9.0700	Confluence of Box Elder Creek and Nowood River	Conf	600	Nowood
9.0710	Box Elder Creek Natural Flow	Natf	640	Nowood
9.0720	Box Elder Creek Diversions	Div	640	Nowood
9.0730	Red Bank Creek Natural Flow	Natf	642	Nowood
9.0740	Red Bank Creek Diversions	Div	642	Nowood
9.0760	Confluence of Red Bank Creek with Box Elder Creek	Conf	640	Nowood
9.0790	Box Elder Creek Diversions	Div	640	Nowood
9.0800	Nowood River Diversions	Div	600	Nowood
9.0900	Confluence of Little Canyon Creek with Nowood River	Conf	600	Nowood
9.0910	Little Canyon Creek Natural Flow	Natf	650	Nowood
9.0920	South Fork Little Canyon Creek Natural Flow	Natf	655	Nowood
9.0930	South Fork Little Canyon Creek Diversions	Div	655	Nowood
9.0950	Confluence of South Fork Little Canyon Creek with Li	Conf	650	Nowood
9.0990	Little Canyon Creek Diversions	Div	650	Nowood
9.1000	Confluence of Crooked Creek and Nowood River	Conf	600	Nowood
9.1010	Crooked Creek Natural Flow	Natf	660	Nowood
9.1050	Crooked Creek Diversions	Div	660	Nowood
9.1100	Nowood River Diversions	Div	600	Nowood
9.1200	Confluence of Otter Creek with Nowood River	Conf	600	Nowood
9.1210	Otter Creek Natural Flow	Natf	670	Nowood
9.1220	Otter Creek Diversions	Div	670	Nowood
9.1230	South Fork Otter Creek Natural Flow	Natf	675	Nowood
9.1240	South Fork Otter Creek Diversions	Div	675	Nowood
9.1270	Confluence of South Fork Otter Creek with Otter Cree	Conf	670	Nowood
9.1290	Otter Creek Diversions	Div	670	Nowood
9.1300	Nowood River Diversions	Div	600	Nowood
9.1400	Confluence of Spring Creek and Nowood River	Conf	600	Nowood
9.1410	Spring Creek Natural Flow	Natf	680	Nowood
9.1420	Spring Creek Diversions	Div	680	Nowood
9.1430	Taylor #2 Well Natural Flow	Natf	682	Nowood
9.1435	Taylor #2 Well Diversions	Div	682	Nowood
9.1440	North Fork Spring Creek Natural Flow	Natf	684	Nowood
9.1450	North Fork Spring Creek Diversions	Div	684	Nowood
9.1460	Confluence 0f Taylor #2 Well and North Fork Spring	Conf	684	Nowood
9.1480	Confluence of North Fork Spring Creek and Spring Cre	Conf	680	Nowood
9.1490	Spring Creek Diversions	Div	680	Nowood
9.1500	Nowood River Diversions	Div	600	Nowood
9.1550	Nowood River Diversions	Div	600	Nowood
9.1600	NOWOOD RIVER NEAR TENSLEEP, WY(06270000)	Gage	600	Nowood
9.1700	Nowood River Diversions	Div	600	Nowood
9.1800	Confluence of Tensleep Creek and Nowood River	Conf	600	Nowood
9.1810	Ten Sleep Creek Natural Flow	Natf	692	Nowood
9.1815	Ten Sleep (Meadowlark) Reservoir	Res	692	Nowood
9.1817	West Fork Tensleep Creek Natural Flow	Natf	694	Nowood
9.1818	Confluence of East and West Forks Tensleep Creek	Conf	690	Nowood
9.1820	Ten Sleep Creek Diversions	Div	690	Nowood
9.1840	CANYON CREEK BELOW COOKS CANYON, NEAR TENSLEEP,(06270450)	Gage	698	Nowood
9.1845	Big Canyon Creek Diversions	Div	698	Nowood
9.1850	CANYON CREEK NR TEN SLEEP WYO(06270500)	Gage	698	Nowood
9.1860	Confluence of Canyon Creek and Tensleep Creek	Conf	690	Nowood
9.1870	TENSLEEP CREEK NEAR TENSLEEP, WYO.(06271000)	Gage	690	Nowood
9.1880	Ten Sleep Creek Diversions	Div	690	Nowood
9.1900	Nowood River Diversions	Div	700	Nowood
9.1930	Beth Wells Natural Flow	Natf	710	Nowood
9.1940	Beth Wells Diversions	Div	710	Nowood
9.1950	Confluence of Beth Wells and Nowood River	Conf	700	Nowood
9.2000	Confluence of Unnamed Creek and Nowood River	Conf	700	Nowood
9.2010	Unnamed Creek Natural Flow	Natf	720	Nowood
9.2050	Unnamed Creek Diversions	Div	720	Nowood

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Model Nodes
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Node Number	Diversion Names	Type	Reach	Schematic
9.2100	Confluence of Brokenback Creek and Nowood River	Conf	700	Nowood
9.2110	Brokenback Creek Natural Flow	Natf	740	Nowood
9.2115	Curuthers Reservoir	Res	740	Nowood
9.2120	Brokenback Creek Diversions	Div	740	Nowood
9.2130	Green Beret Wells Natural Flow	Natf	742	Nowood
9.2140	Creen Beret Wells Diversions	Div	742	Nowood
9.2150	Nowood River Diversions	Div	700	Nowood
9.2160	Confluence of Green Beret Wells and Brokenback Creek	Conf	740	Nowood
9.2200	Nowood River Diversion - Western Ditch	Div	700	Nowood
9.2250	Nowood River Diversions	Div	700	Nowood
9.2300	Confluence of Buffalo Flat Creek and Nowood River	Conf	700	Nowood
9.2310	Buffalo Flat Creek Natural Flow	Natf	750	Nowood
9.2320	Gomer Well #1 Natural F.ow	Natf	756	Nowood
9.2330	Buffalo Flat Creek Diversions	Div	750	Nowood
9.2340	Gomer Well #1Diversion	Div	756	Nowood
9.2350	Confluence of Gomer Well #1 and Buffalo Flat Creek	Conf	750	Nowood
9.2400	Nowood River Diversions	Div	700	Nowood
9.2500	Confluence of Gomer Well #2 and Nowood Creek	Conf	700	Nowood
9.2510	Gomer Well #2 Natural F.ow	Natf	760	Nowood
9.2550	Gomer Well #2 Diversions	Div	760	Nowood
9.2600	Nowood River Diversions	Div	700	Nowood
9.2700	Confluence of Paint Rock Creek and Nowood River	Conf	700	Nowood
9.2701	Medicine Lodge Creek Natural Flow	Natf	794	Nowood
9.2710	Medicine Lodge Creek Diversions	Div	794	Nowood
9.2715	MEDICINE LODGE CREEK NEAR HYATTVILLE, WYO.(06273000)	Gage	794	Nowood
9.2717	Medicine Lodge Creek Diversions	Div	794	Nowood
9.2720	Medicine Lodge Creek Diversion - Highland Ditch	Div	794	Nowood
9.2725	Medicine Lodge Creek Diversion - Anita Ditch	Div	794	Nowood
9.2728	Medicine Lodge Creek Diversion - Bayne-George Ditch	Div	794	Nowood
9.2730	PAINTROCK CREEK BELOW LAKE SOLITUDE, WY(06271500)	Gage	790	Nowood
9.2735	PAINTROCK CREEK NEAR HYATTVILLE, WYO.(06272500)	Gage	790	Nowood
9.2738	Paint Rock Creek Diversion - Big Bear Ditch	Div	790	Nowood
9.2740	Paint Rock Creek Diversion - Elk Ditch	Div	790	Nowood
9.2742	Paint Rock Creek Diversion - Go-Ahead Ditch	Div	790	Nowood
9.2744	Paint Rock Creek Divesions	Div	790	Nowood
9.2746	Paint Rock Creek Diversion - Anita Supplemental	Div	790	Nowood
9.2748	Paint Rock Creek Divesions	Div	790	Nowood
9.2750	Confluence of Medicine Lodge Creek and Paint Rock Cr	Conf	790	Nowood
9.2755	Paint Rock Creek Diversions	Div	790	Nowood
9.2760	Hamilton and Walters Wells Natural Flow	Natf	798	Nowood
9.2765	Hamilton and Walters Wells Diversions	Div	798	Nowood
9.2770	Confluence of Hamilton and Walters Wells and Paint R	Conf	790	Nowood
9.2775	Paint Rock Creek Diversions	Div	790	Nowood
9.2785	Paint Rock Creek Diversions	Div	790	Nowood
9.2790	Paint Rock Creek Diversion - Bernstein Ditch	Div	790	Nowood
9.2792	Paint Rock Creek Diversion	Div	790	Nowood
9.2794	PAINTROCK CREEK NEAR MOUTH BELOW HYATTVILLE WY(06273500)	Gage	790	Nowood
9.2795	Paint Rock Creek Diversions	Div	790	Nowood
9.2800	NOWOOD RIVER AT BONANZA WYO(06274000)	Gage	800	Nowood
9.2900	Nowood River Diversions	Div	800	Nowood
9.2950	Nowood River Diversion - VanAlstine-Walker Ditch	Div	800	Nowood
9.3000	Noowood River Diversions - Shafer Ditch	Div	800	Nowood
9.3100	Nowood River Diversion - Harmony Ditch	Div	800	Nowood
10.0000	Confluence of Adobe Creek and Bighorn River	Conf	900	Upper Bighorn
10.0050	Adobe Creek Natural Flow	Natf	910	Upper Bighorn
10.0100	Adobe Creek Diversions	Div	910	Upper Bighorn
10.1000	Bighorn River Diversions	Div	900	Upper Bighorn
10.2000	Bighorn River Diversions	Div	900	Upper Bighorn
10.3000	BIGHORN R AT BASIN WY(06274300)	Gage	900	Upper Bighorn
11.0000	Confluence of Greybull River and Bighorn River	Conf	1,000	Lower Bighorn
11.0100	Greybull River Natural Flow	Natf	1,100	Greybull

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Model Nodes
Bighorn River Basin

Node Number	Diversion Names	Type	Reach	Schematic
11.0110	Greybull River Diversions	Div	1,100	Greybull
11.0200	Four Bear Creek Natural Flow	Natf	1,110	Greybull
11.0300	Four Bear Creek Diversion	Div	1,110	Greybull
11.0400	Confluence of Graybull River and Pickett Creek	Conf	1,100	Greybull
11.0500	Pickett/Rock Creek Natural Flow - Ashworth No. 2 Dit	Natf	1,120	Greybull
11.0600	Pickett/Rock Creek Diversions	Div	1,120	Greybull
11.0700	Confluence of Greybull River and Rock Creek	Conf	1,100	Greybull
11.0900	Francs Fork Natural Flow	Natf	1,130	Greybull
11.0950	Francs Fork Diversions	Div	1,130	Greybull
11.1000	Confluence of Francs Fork and Greybull River	Conf	1,100	Greybull
11.1100	Greybull River Diversion - Greybull Ditch	Div	1,100	Greybull
11.1200	GREYBULL RIVER NEAR PITCHFORK, WYO.(06274500)	Gage	1,100	Greybull
11.1300	Four Bear Creek Natural Flow	Natf	1,140	Greybull
11.1400	Rose Creek Diversions	Div	1,140	Greybull
11.1500	Confluence of Rose Creek and Greybull River	Conf	1,100	Greybull
11.1600	Greybull River Diversion	Div	1,100	Greybull
11.1700	Timber Creek Natural Flow	Natf	1,150	Greybull
11.1800	Timber Creek Diversion	Div	1,150	Greybull
11.1900	Confluence of Timber Creek and Greybull River	Conf	1,100	Greybull
11.2000	Greybull River Diversion - Butte Ditch	Div	1,100	Greybull
11.2100	Pappapau Creek Natural Flow	Natf	1,170	Greybull
11.2200	Pappapau Creek Diversions	Div	1,170	Greybull
11.2250	Pappapau Creek Diversion - Pappapau Ditch	Div	1,170	Greybull
11.2300	Confluence of Pappapau Creek and Greybull River	Conf	1,100	Greybull
11.2350	Greybull River Diversions	Div	1,100	Greybull
11.2400	Wilcox Draw Natural Flow	Natf	1,180	Greybull
11.2500	Wilcox Draw Diversion	Div	1,180	Greybull
11.2600	Confluence of Wilcox Draw and Greybull River	Conf	1,100	Greybull
11.2690	Sunshine Creek Natural Flow	Natf	1,190	Greybull
11.2700	Upper Sunshine Reservoir	Res	1,190	Greybull
11.2800	Lower Sunshine Reservoir	Res	1,190	Greybull
11.2850	Town of Meteetsee	DivM	1,190	Greybull
11.2900	Confluence of Sunshine Creek and Greybull River	Conf	1,100	Greybull
11.3000	WOOD RIVER NEAR KIRWIN, WYO.(06274800)	Gage	1,200	Greybull
11.3100	WOOD R AT KIRWIN WYO(06274810)	Gage	1,200	Greybull
11.3150	Wood River Diversions	Div	1,200	Greybull
11.3180	Wood River Diversions	Div	1,200	Greybull
11.3200	Wood River Diversion - Only Chance Ditch	Div	1,200	Greybull
11.3203	Wood River Diversions	Div	1,200	Greybull
11.3207	Wood River Diversions	Div	1,200	Greybull
11.3210	Dick Creek Natural Flow	Natf	1,250	Greybull
11.3220	North Fork Dick Creek Natural Flow	Natf	1,252	Greybull
11.3230	North Fork Dick Creek Diversion	Div	1,252	Greybull
11.3240	Confluence of North Fork Dick Creek and Dick Creek	Conf	1,250	Greybull
11.3260	Confluence of Dick Creek and Wood River	Conf	1,200	Greybull
11.3300	WOOD RIVER AT SUNSHINE, WYO.(06275000)	Gage	1,200	Greybull
11.3350	Wood River Diversions	Div	1,200	Greybull
11.3400	Wood River Diversions - Hurlbut Ditch	Div	1,200	Greybull
11.3450	Wood River Diversions	Div	1,200	Greybull
11.3500	WOOD RIVER NEAR MEETEETSE, WYO.(06275500)	Gage	1,200	Greybull
11.3600	Confluence of Wood River and Greybull River	Conf	1,100	Greybull
11.3700	Rawhide Creek Natural Flow	Natf	1,310	Greybull
11.3800	Rawhide Creek Diversions	Div	1,310	Greybull
11.3900	Little Rawhide Creek Natural Flow	Natf	1,314	Greybull
11.3950	Thomas Reservoir	Res	1,314	Greybull
11.4000	Little Rawhide Creek Diversions	Div	1,314	Greybull
11.4100	Confluence of Little Rawhide Creek and Rawhide Creek	Conf	1,310	Greybull
11.4200	Rawhide Creek Diversion - Whitney Ditch	Div	1,310	Greybull
11.4300	Confluence of Rawhide Creek and Greybull River	Conf	1,300	Greybull
11.4350	Greybull River Diversions	Div	1,300	Greybull
11.4400	GREYBULL RIVER NR MEETEETSE WYO(06276000)	GageN	1,300	Greybull
11.4500	Iron Creek Natural Flow	Natf	1,320	Greybull

Model Nodes
Bighorn River Basin

Node Number	Diversion Names	Type	Reach	Schematic
11.4600	Iron Creek Diversions	Div	1,320	Greybull
11.4700	Confluence of Iron Creek and Greybull River	Conf	1,300	Greybull
11.4720	Greybull River Diversions	Div	1,300	Greybull
11.4730	Greybull River Diversion - Winkle-Benbrooke Ditch	Div	1,300	Greybull
11.4800	GREYBULL RIVER AT MEETEETSE, WYO.(06276500)	Gage	1,300	Greybull
11.4900	Greybull River Diversions	Div	1,300	Greybull
11.5000	Spring Creek Natural Flow	Natf	1,330	Greybull
11.5050	Spring Creek Diversion - Perkins Ditch	Div	1,330	Greybull
11.5100	Sping Creek Diversions	Div	1,330	Greybull
11.5200	Confluence of Spring Creek and Greybull River	Conf	1,300	Greybull
11.5300	Greybull River Diversion - T.L. Ditch	Div	1,300	Greybull
11.5310	Greybull River Diversions	Div	1,300	Greybull
11.5400	Meeteetse Creek Natural Flow	Natf	1,350	Greybull
11.5450	Export to Foster Reservoir	DivE	1,350	Greybull
11.5500	North Fork Meeteetse Creek Diversion	Div	1,350	Greybull
11.5600	South Fork Meeteetse Creek Natural Flow	Natf	1,354	Greybull
11.5700	South Fork Meeteetse Creek Diversions	Div	1,354	Greybull
11.5800	Confluence of Meeteetse Creek and Short Fork Meeteet	Conf	1,350	Greybull
11.5900	Meeteetse Creek Diversions	Div	1,350	Greybull
11.5980	Meteetsee Creek Diversions	Div	1,350	Greybull
11.6000	Confluence of Meeteetse Creek and Greybull River	Conf	1,300	Greybull
11.6050	Greybull River Diversion - Dyer Ditch	Div	1,300	Greybull
11.6060	Long Hollow Creek Natural Flow	Natf	1,360	Greybull
11.6070	Long Hollow Creek Diversion	Div	1,360	Greybull
11.6075	Long Hollow Creek Diversion - Long Hollow Ditch	Div	1,360	Greybull
11.6080	Confluence of Long Hollow Creek and Greybull River	Conf	1,300	Greybull
11.6100	Greybull River Diversions	Div	1,300	Greybull
11.6150	Greybull River Diversions	Div	1,300	Greybull
11.6200	Greybull River Diversions	Div	1,300	Greybull
11.6300	Greybull River Diversions	Div	1,300	Greybull
11.6350	Greybull River Diversions	Div	1,300	Greybull
11.6400	Greybull River Diversion - Nichols Ditch	Div	1,300	Greybull
11.6420	Greybull River Diversions	Div	1,300	Greybull
11.6450	Greybull River Diversions	Div	1,300	Greybull
11.6480	Greybull River Diversion - Keystone Ditch	Div	1,300	Greybull
11.6500	Greybull River Diversion - Jimmerfield Ditch	Div	1,300	Greybull
11.6510	Greybull River Diversion - Roach Jimmerfield Ditch	Div	1,300	Greybull
11.6520	Roach Gulch Natural Flow	Natf	1,390	Greybull
11.6550	Greybull Valley Reservoir	Res	1,390	Greybull
11.6580	Confluence of Roach Gulch and Greybull River	Conf	1,300	Greybull
11.6600	Greybull River Diversion - Bench Canal	Div	1,400	Greybull
11.6700	Greybull River Diversion	Div	1,400	Greybull
11.6800	Greybull River Diversion - German Ditch	Div	1,400	Greybull
11.6900	Greybull River Diversion - Tatman Ditch	Div	1,400	Greybull
11.7000	Willow Creek Natural Flow	Natf	1,420	Greybull
11.7200	Confluence of Willow Creek and Greybull River	Conf	1,400	Greybull
11.7300	Greybull River Diversion - Brown and Croxall	Div	1,400	Greybull
11.7400	Greybull River Diversion - Fairview Canal	Div	1,400	Greybull
11.7500	Greybull River Diversions	Div	1,400	Greybull
11.7600	Greybull River Diversion - Woods and Burnett Ditch	Div	1,400	Greybull
11.7610	Greybull River Diversion - Sandstone Ditch	Div	1,400	Greybull
11.7650	Wardell Reservoir Natural Flow	Natf	1,460	Greybull
11.7660	Wardell Reservoir	Res	1,460	Greybull
11.7680	Wardell Reservoir Release Diversion	Div	1,460	Greybull
11.7700	GREYBULL RIVER NEAR BASIN, WYO.(06277500)	Gage	1,400	Greybull
11.7710	Dorsey Creek Natural Flow	Natf	1,480	Greybull
11.7720	Fairview Reservoir	Res	1,480	Greybull
11.7750	Greybull River Diversion - Cockins Ditch	Div	1,400	Greybull
11.7800	Greybull River Diversion - Payne-Borner Ditch	Div	1,400	Greybull
11.7900	Greybull River Diversions	Div	1,400	Greybull
11.7950	Greybull River Diversions	Div	1,400	Greybull
12.0000	Confluence of Dry Creek and Greybull River	Conf	1,500	Lower Bighorn

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Model Nodes
Bighorn River Basin

Node Number	Diversion Names	Type	Reach	Schematic
12.0010	Dry Creek Natural Flow	Natf	1,550	Lower Bighorn
12.0050	Dry Creek Diversion - Agrarian Ditch	Div	1,550	Lower Bighorn
12.0100	DRY CREEK NEAR GREYBULL WY(06277950)	Gage	1,550	Lower Bighorn
12.0500	Dry Creek Diversions	Div	1,550	Lower Bighorn
12.0600	DRY CREEK AT GREYBULL, WY(06278000)	Gage	1,550	Lower Bighorn
13.0000	Confluence of Shell Creek and Bighorn River	Conf	1,500	Lower Bighorn
13.0100	SHELL CREEK ABOVE SHELL CREEK RESERVOIR, WYO.(06278300)	Gage	1,600	Lower Bighorn
13.0200	Shell Reservoir	Res	1,600	Lower Bighorn
13.0220	Adelaide Creek Natural Flow	Natf	1,610	Lower Bighorn
13.0230	Adelaide Reservoir	Res	1,610	Lower Bighorn
13.0280	Confluence of Adelaide Creek and Shell Creek	Conf	1,600	Lower Bighorn
13.0300	Shell Creek Diversion	Div	1,600	Lower Bighorn
13.0400	SHELL CREEK NEAR SHELL, WY(06278500)	Gage	1,600	Lower Bighorn
13.0500	Shell Creek Diversion - Kershner Ditch	Div	1,600	Lower Bighorn
13.0600	White Creek Natural Flow	Natf	1,630	Lower Bighorn
13.0700	White Creek Diversion	Div	1,630	Lower Bighorn
13.0800	Confluence of White Creek and Shell Creek	Conf	1,600	Lower Bighorn
13.0900	Trapper Creek Natural Flow	Natf	1,640	Lower Bighorn
13.1000	Trapper Creek Diversions	Div	1,640	Lower Bighorn
13.1020	Trapper Creek Diversion - Highline Ditch	Div	1,640	Lower Bighorn
13.1040	Trapper Creek Diversion - Hatten Ditch	Div	1,640	Lower Bighorn
13.1100	Confluence of Trapper Creek and Shell Creek	Conf	1,600	Lower Bighorn
13.1150	Shell Creek Diversion - Shell Canal	Div	1,600	Lower Bighorn
13.1300	Horse Creek Natural Flow	Natf	1,650	Lower Bighorn
13.1400	Horse Creek Diversions	Div	1,650	Lower Bighorn
13.1500	Confluence of Horse Creek and Shell Creek	Conf	1,600	Lower Bighorn
13.1600	SHELL CREEK AT SHELL WYO(06279000)	Gage	1,600	Lower Bighorn
13.1700	Shell Creek Diversion - Whaley Ditch	Div	1,600	Lower Bighorn
13.1750	Shell Creek Diversion	Div	1,600	Lower Bighorn
13.1800	Beaver Creek Natural Flow	Natf	1,680	Lower Bighorn
13.1900	Beaver Creek Diversion	Div	1,680	Lower Bighorn
13.2000	South Fork Beaver Creek Natural Flow	Natf	1,682	Lower Bighorn
13.2100	South Fork Beaver Creek Diversions	Div	1,682	Lower Bighorn
13.2200	Confluence of Beaver Creek and South Fork Beaver Cre	Conf	1,680	Lower Bighorn
13.2300	Beaver Creek Diversion	Div	1,680	Lower Bighorn
13.2400	Cedar Creek Natural Flow	Natf	1,684	Lower Bighorn
13.2500	Cedar Creek Diversions	Div	1,684	Lower Bighorn
13.2600	Confluence of Cedar Creek and Beaver Creek	Conf	1,680	Lower Bighorn
13.2620	Beaver Creek Diversions	Div	1,680	Lower Bighorn
13.2650	Leavitt Reservoir	Res	1,680	Lower Bighorn
13.2700	Beaver Creek Diversions	Div	1,680	Lower Bighorn
13.2710	Red Canyon Natural Flow	Natf	1,688	Lower Bighorn
13.2750	Red Canyon Diversions	Div	1,688	Lower Bighorn
13.2780	Confluence of Red Canyon and Beaver Creek	Conf	1,680	Lower Bighorn
13.2790	Beaver Creek Diversions	Div	1,680	Lower Bighorn
13.2800	Confluence of Beaver Creek and Shell Creek	Conf	1,600	Lower Bighorn
13.2900	Shell Creek Diversion - Porter Canal	Div	1,600	Lower Bighorn
13.3000	Shell Creek Diversions	Div	1,600	Lower Bighorn
13.5000	Bighorn River Diversions	Div	1,700	Lower Bighorn
14.0000	Confluence of Bear Creek and Bighorn River	Conf	1,700	Lower Bighorn
14.0100	Bear Creek Natural Flow	Natf	1,720	Lower Bighorn
14.0500	Bear Creek Diversions	Div	1,720	Lower Bighorn
14.5000	Bighorn River Diversions	Div	1,700	Lower Bighorn
15.0000	Confluence of Crystal Creek and Bighorn River	Conf	1,700	Lower Bighorn
15.0100	Crystal Creek Natural Flow	Natf	1,740	Lower Bighorn
15.0200	Crystal Creek Diversions	Div	1,740	Lower Bighorn
15.0300	Phelps Reservoir #2	Res	1,744	Lower Bighorn
15.0400	Phelps Reservoir #2 Diversion	Div	1,744	Lower Bighorn
15.0500	Confluence of Crystal Creek and Phelps Reservoir #2	Conf	1,740	Lower Bighorn
15.0600	Crystal Creek Diversions	Div	1,740	Lower Bighorn
15.0700	Bethurem Reservoir	Res	1,746	Lower Bighorn

Model Nodes
Bighorn River Basin

Node Number	Diversion Names	Type	Reach	Schematic
15.0800	Bethurem Reservoir Diversions	Div	1,746	Lower Bighorn
15.0900	Confluence of Betherum Reservoir and Crystal Creek	Conf	1,740	Lower Bighorn
15.2000	Bighorn River Diversions	Div	1,700	Lower Bighorn
15.5000	BIGHORN RIVER AT KANE, WY(06279500)	Gage	1,700	Lower Bighorn
16.0000	Confluence of Fire Spring and Bighorn River	Conf	1,700	Lower Bighorn
16.0010	Fire Spring Creek Natural Flow	Natf	1,750	Lower Bighorn
16.0050	Fire Spring Creek Diversions	Div	1,750	Lower Bighorn
16.5000	Bighorn River Diversions	Div	1,700	Lower Bighorn
17.0010	South Fork Shoshone River Natural Flow	Natf	1,800	Shoshone
17.0020	South Fork Shoshone Diversions	Div	1,800	Shoshone
17.0050	Deer Creek Natural Flow	Natf	1,810	Shoshone
17.0100	Deer Creek Diversons	Div	1,810	Shoshone
17.0150	Confluence of Deer Creek and South Fork Shoshone Riv	Conf	1,800	Shoshone
17.0200	Hunter Creek Natural Flow	Natf	1,820	Shoshone
17.0250	Hunter Creek Diversions	Div	1,820	Shoshone
17.0300	Confluence of Hunter Creek and South Fork Shoshone R	Conf	1,800	Shoshone
17.0310	SF Shoshone Tributary Natural Flow	Natf	1,825	Shoshone
17.0320	SF Shoshone Tributary Diversions	Div	1,825	Shoshone
17.0330	Confluence of Tributary and South Fork Shoshone	Conf	1,800	Shoshone
17.0350	South Fork Shoshone River Diversions	Div	1,800	Shoshone
17.0400	Legg Creek Natural Flow	Natf	1,830	Shoshone
17.0450	Legg Creek Diversions	Div	1,830	Shoshone
17.0500	Confluence of Legg Creek and South Fork Shoshone Riv	Conf	1,800	Shoshone
17.0550	South Fork Shoshone River Diversions	Div	1,800	Shoshone
17.0600	Boulder Creek Natural Flow	Natf	1,840	Shoshone
17.0650	Boulder Creek Diversions	Div	1,840	Shoshone
17.0700	Confluence of Boulder Creek and South Fork Shoshone	Conf	1,800	Shoshone
17.0750	SOUTH FORK SHOSHONE RIVER NEAR VALLEY, WY(06280300)	Gage	1,800	Shoshone
17.0800	South Fork Shoshone River Diversions	Div	1,800	Shoshone
17.0850	Spring Creek Natural Flow	Natf	1,850	Shoshone
17.0900	Spring Creek Diversions	Div	1,850	Shoshone
17.0950	Confluence of Spring Creek and South Fork Shoshone R	Conf	1,800	Shoshone
17.1000	South Fork Shoshone River Diversions	Div	1,800	Shoshone
17.1050	Crane Creek Natural Flow	Natf	1,860	Shoshone
17.1100	Crane Creek Diversions	Div	1,860	Shoshone
17.1150	Confluence of Crane Creek and South Fork Shoshone Ri	Conf	1,800	Shoshone
17.1200	South Fork Shoshone River Diversions	Div	1,800	Shoshone
17.1250	Aldrich Creek Natural Flow	Natf	1,870	Shoshone
17.1300	Aldrich Creek Diversions	Div	1,870	Shoshone
17.1350	Confluence of Aldrich Creek and South Fork Shoshone	Conf	1,800	Shoshone
17.1400	South Fork Shoshone River Diversions	Div	1,800	Shoshone
17.1450	Ishawooa Creek Natural Flow	Natf	1,880	Shoshone
17.1500	Ishawooa Creek Diversions	Div	1,880	Shoshone
17.1550	Confluence of Ishawooa Creek and South Fork Shoshone	Conf	1,800	Shoshone
17.1600	Bob Cat Creek Natural Flow	Natf	1,890	Shoshone
17.1650	Bob Cat Creek Diversions	Div	1,890	Shoshone
17.1700	Confluence of Bob Cat Creek and South Fork Shoshone	Conf	1,800	Shoshone
17.1750	Hard Pan Creek Natural Flow	Natf	1,910	Shoshone
17.1800	Hard Pan Creek Diversions	Div	1,910	Shoshone
17.1850	Confluence of Hard Pan Creek and South Fork Shoshone	Conf	1,900	Shoshone
17.1900	South Fork Shoshone River Diversion - Lakeview Canal	Div	1,900	Shoshone
17.1950	Rock Creek Natural Flow	Natf	1,930	Shoshone
17.2000	Rock Creek Diversions	Div	1,930	Shoshone
17.2050	Confluence of Rock Creek and South Fork Shoshone Riv	Conf	1,900	Shoshone
17.2100	Jordan Creek Natural Flow	Natf	1,950	Shoshone
17.2150	Jordan Creek Diversions	Div	1,950	Shoshone
17.2200	Confluence of Jordan Creek and South Fork Shoshone R	Conf	1,900	Shoshone
17.2250	South Fork Shoshone River Diversions	Div	1,900	Shoshone
17.2300	Belknap Creek Natural Flow	Natf	1,960	Shoshone
17.2350	Belknap Creek Diversions	Div	1,960	Shoshone
17.2400	Confluence of Belknap Creek and South Fork Shoshone	Conf	1,900	Shoshone
17.2450	South Fork Shoshone River Diversions	Div	1,900	Shoshone

Model Nodes
Bighorn River Basin

Node Number	Diversion Names	Type	Reach	Schematic
17.2500	SOUTH FORK SHOSHONE RIVER NR ISHAWOOA WYO(06280500)	GageN	1,900	Shoshone
17.2550	South Fork Shoshone River Diversion	Div	1,900	Shoshone
17.2600	Bull Creek Natural Flow	Natf	1,970	Shoshone
17.2650	Bull Creek Diversions	Div	1,970	Shoshone
17.2700	Confluence of Bull Creek and South Fork Shoshone Riv	Conf	1,900	Shoshone
17.2750	South Fork Shoshone Diversion - Wilson & Mckissack	Div	1,900	Shoshone
17.2760	Alkali Lake	Res	1,900	Shoshone
17.2770	Beck Lake	Res	1,900	Shoshone
17.2800	South Fork Shoshone Diversion - Cody Canal	Div	1,900	Shoshone
17.2820	South Fork Shoshone Diversions	Div	1,900	Shoshone
17.2850	SOUTH FORK SHOSHONE R AB BUFFALO BILL RES, WY(06281000)	Gage	1,900	Shoshone
17.2860	Marquette Creek Natural Flow	Natf	2,210	Shoshone
17.2870	Marquette Creek Diversions	Div	2,210	Shoshone
17.2900	Carter Creek Natural Flow	Natf	2,220	Shoshone
17.2950	Carter Creek Diversions	Div	2,220	Shoshone
17.3000	DIAMOND CREEK NR MOUTH NR CODY WY(06281400)	Gage	2,230	Shoshone
17.3050	North Fork Shoshone River Natural Flow	Natf	2,000	Shoshone
17.3100	JONES CREEK AT MOUTH, NEAR PAHASKA, WY(06279790)	Gage	2,010	Shoshone
17.3150	Confluence of Jones Creek and N. Fk. Shoshone River	Conf	2,000	Shoshone
17.3200	CROW CREEK AT MOUTH, AT PAHASKA, WY(06279795)	Gage	2,020	Shoshone
17.3250	Confluence of Crow Creek and N. Fk. Shoshone River	Conf	2,000	Shoshone
17.3300	NORTH FORK SHOSHONE RIVER AT PAHASKA, WY(06279800)	Gage	2,000	Shoshone
17.3350	MIDDLE CR AT E ENTRANCE YNP WY(06279850)	Gage	2,030	Shoshone
17.3400	Confluence of Middle Creek and N. Fk. Shoshone River	Conf	2,000	Shoshone
17.3410	Elk Fork Creek Natural Flow	Natf	2,040	Shoshone
17.3420	Elk Fork Creek Diversion	Div	2,040	Shoshone
17.3430	Confluence of Elk Fork Creek and NF Shoshone River	Conf	2,000	Shoshone
17.3450	North Fork Shoshone River Diversion - NF Valley Ditc	Div	2,000	Shoshone
17.3500	Canyon Creek Natural Flow	Natf	2,050	Shoshone
17.3550	Canyon Creek Diversions	Div	2,050	Shoshone
17.3600	Confluence of Canyon Creek and North Fork Shoshone R	Conf	2,000	Shoshone
17.3650	Big Creek Natural Flow	Natf	2,060	Shoshone
17.3700	Big Creek Diversions	Div	2,060	Shoshone
17.3750	Confluence of Big Creek and North Fork Shoshone Rive	Conf	2,000	Shoshone
17.3800	Green Creek Natural Flow	Natf	2,070	Shoshone
17.3850	Green Creek Diversions	Div	2,070	Shoshone
17.3900	Confluence of Green Creek and North Fork Shoshone Ri	Conf	2,000	Shoshone
17.3910	Rand Creek Natural Flow	Natf	2,080	Shoshone
17.3920	Rand Creek Diversions	Div	2,080	Shoshone
17.3930	Confluence of Rand Creek and N. Fk. Shoshone River	Conf	2,000	Shoshone
17.3950	Whit Creek Natural Flow	Natf	2,090	Shoshone
17.4000	Whit Creek Diversions	Div	2,090	Shoshone
17.4050	Confluence of Whit Creek and North Fork Shoshone Riv	Conf	2,000	Shoshone
17.4100	NORTH FORK SHOSHONE RIVER AT WAPITI, WY(06279940)	Gage	2,000	Shoshone
17.4150	North Fork Shoshone River Diversions	Div	2,100	Shoshone
17.4200	Jim Creek Natural Flow	Natf	2,140	Shoshone
17.4250	Jim Creek Diversions	Div	2,140	Shoshone
17.4300	Confluence of Jim Creek and North Fork Shoshone Rive	Conf	2,100	Shoshone
17.4310	Breteche Creek Natural Flow	Natf	2,160	Shoshone
17.4320	Unnamed Creek Natural Flow	Natf	2,164	Shoshone
17.4330	Unnamed Creek Diversions	Div	2,164	Shoshone
17.4340	Confluence of Unnamed Creek and Breteche Creek	Conf	2,160	Shoshone
17.4350	Breteche Creek Diversions	Div	2,160	Shoshone
17.4360	Confluence of Breteche Creek and NF Shoshone River	Conf	2,100	Shoshone
17.4380	North Fork Shoshone River Diversions	Div	2,100	Shoshone
17.4400	Trout Creek Natural Flow	Natf	2,180	Shoshone
17.4450	Trout Creek Diversions	Div	2,180	Shoshone
17.4500	Confluence of Trout Creek and North Fork Shoshone Ri	Conf	2,100	Shoshone
17.4550	NORTH FORK SHOSHONE RIVER NR WAPITI WYO(06280000)	Gage	2,100	Shoshone
17.4600	Rattlesnake Creek Natural Flow	Natf	2,240	Shoshone
17.4650	Rattlesnake Creek Diversions	Div	2,240	Shoshone
17.5000	Buffalo Bill Reservoir	Res	2,200	Shoshone

Model Nodes
Bighorn River Basin

Node Number	Diversion Names	Type	Reach	Schematic
17.5010	Shoshone Municipal Pipeline	DivM	2,200	Shoshone
17.5050	Shoshone River Diversion - Heart Mountain Canal	Div	2,300	Shoshone
17.5100	Trail Creek Natural Flow	Natf	2,320	Shoshone
17.5150	Trail Creek Diversions	Div	2,320	Shoshone
17.5160	Newton Reservoir	Res	2,322	Shoshone
17.5170	Trail Creek Diversions	Div	2,320	Shoshone
17.5200	Confluence of Trail Creek and Shoshone River	Conf	2,300	Shoshone
17.5250	SHOSHONE RIVER BELOW BUFFALO BILL RESERVOIR, WY(06282000)	Gage	2,300	Shoshone
17.5300	Cottonwood Creek Natural Flow	Natf	2,340	Shoshone
17.5350	Cottonwood Creek Diversions	Div	2,340	Shoshone
17.5400	Confluence of Cottonwood Creek and Shoshone River	Conf	2,300	Shoshone
17.5450	Ashworth Creek Natural Flow	Natf	2,394	Shoshone
17.5500	Ashworth Creek Diversions	Div	2,394	Shoshone
17.5550	Sage Creek Natural Flow	Natf	2,390	Shoshone
17.5560	South Fork Sage Creek Natural Flow	Natf	2,392	Shoshone
17.5570	Foster Reservoir	Res	2,392	Shoshone
17.5580	Perkins & Kinney Reservoir	Res	2,392	Shoshone
17.5590	Confluence of South Fork Sage Creek and Sage Creek	Conf	2,390	Shoshone
17.5600	Confluence of Ashworth Creek and Sage Creek	Conf	2,390	Shoshone
17.5650	Sage Creek Diversions	Div	2,390	Shoshone
17.5690	Wiley Reservoir	Res	2,396	Shoshone
17.5700	Sage Creek Diversions	Div	2,390	Shoshone
17.5720	Sage Creek Reservoir	Res	2,398	Shoshone
17.5750	Confluence of Sage Creek and Shoshone River	Conf	2,300	Shoshone
17.5800	Shoshone River Diversion - Garland Canal	Div	2,400	Shoshone
17.5850	SHOSHONE RIVER AT CORBETT DAM WYO(06283000)	GageN	2,400	Shoshone
17.5900	SHOSHONE R AB WILLWOOD DAM NR WILLWOOD WY(06283800)	Gage	2,400	Shoshone
17.5950	Shoshone River Diversion - Wildwood Canal	Div	2,400	Shoshone
17.6000	SHOSHONE RIVER AT WILLWOOD DAM WYO(06284000)	GageN	2,400	Shoshone
17.6050	Alkali Creek Natural Flow	Natf	2,420	Shoshone
17.6060	Deaver Reservoir	Res	2,450	Shoshone
17.6070	North Branch Alkali Creek Natural Flow	Natf	2,424	Shoshone
17.6080	North Branch Alkali Creek Diversions	Div	2,424	Shoshone
17.6090	Confluence of North Branch Alkali Creek and Alkali C	Conf	2,420	Shoshone
17.6100	Alkali Creek Diversion - Frannie-Deaver Canal	Div	2,420	Shoshone
17.6150	Confluence of Alkali Creek and Shoshone River	Conf	2,400	Shoshone
17.6200	SHOSHONE RIVER AT WILLWOOD, WY(06284200)	Gage	2,400	Shoshone
17.6250	Elk-Lovell Canal	Div	2,400	Shoshone
17.6260	Derry Drain Natural Flow	Natf	2,470	Shoshone
17.6270	Derry Drain Diversions	Div	2,470	Shoshone
17.6280	Confluence of Derry Drain and Shoshone River	Conf	2,400	Shoshone
17.6300	Shoshone River Diversions - Sidon Canal	Div	2,400	Shoshone
17.6350	SHOSHONE RIVER NEAR GARLAND, WY(06284400)	Gage	2,400	Shoshone
17.6400	Bitter Creek Natural Flow	Natf	2,490	Shoshone
17.6410	Bitter Creek Diversions	Div	2,490	Shoshone
17.6420	BITTER CREEK NEAR GARLAND, WY(06284500)	Gage	2,490	Shoshone
17.6450	Confluence of Bitter Creek and Shoshone River	Conf	2,400	Shoshone
17.6500	WHISTLE CREEK NEAR GARLAND, WY(06284800)	Gage	2,510	Shoshone
17.6520	Whistle Creek Diversions	Div	2,510	Shoshone
17.6550	Confluence of Whistle Creek and Shoshone River	Conf	2,500	Shoshone
17.6600	SHOSHONE RIVER AT BYRON, WYO.(06285000)	GageN	2,500	Shoshone
17.6650	Shoshone River Diversions - Globe Canal	Div	2,500	Shoshone
17.6660	Sand Creek Natural Flow	Natf	2,530	Shoshone
17.6680	Sand Creek Diversions	Div	2,530	Shoshone
17.6690	Confluence of Sand Creek and Shoshone River	Conf	2,500	Shoshone
17.6700	SHOSHONE RIVER NEAR LOVELL, WY(06285100)	Gage	2,500	Shoshone
17.6750	Shoshone River Diversions - Hunt Canal	Div	2,500	Shoshone
17.6800	SHOSHONE RIVER AT LOVELL WYO(06286000)	GageN	2,500	Shoshone
17.6820	Sage Creek Natural Flow	NatF	2,550	Shoshone
17.6830	Confluence of Sage Creek and Frannie/Deaver Canal	Conf	2,550	Shoshone
17.6850	SAGE CREEK AT SIDON CANAL, NEAR DEAVER, WY(06285400)	Gage	2,550	Shoshone

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Model Nodes
Bighorn River Basin

Node Number	Diversion Names	Type	Reach	Schematic
17.6900	SAGE CREEK NEAR LOVELL, WY(06285500)	Gage	2,550	Shoshone
17.6950	Confluence of Sage Creek and Shoshone River	Conf	2,500	Shoshone
17.6960	Black Draw Natural Flow	Natf	2,560	Shoshone
17.6970	Black Draw Diversions	Div	2,560	Shoshone
17.6980	Confluence of Black Draw and Shoshone River	Conf	2,500	Shoshone
17.6990	Shoshone River Diversions	Div	2,500	Shoshone
17.7000	SHOSHONE RIVER AT KANE, WY(06286200)	Gage	2,500	Shoshone
17.7020	Shoshone River Diversions	Div	2,500	Shoshone
17.7050	Little Sand Draw - Natural Flow	Natf	2,580	Shoshone
17.7100	Little Sand Draw Diversion	Div	2,580	Shoshone
17.7150	Confluence of Little Sand Draw and Shoshone River	Conf	2,500	Shoshone
18.0100	Crooked Creek Natural Flow	Natf	1,790	Lower Bighorn
18.0150	Crooked Creek Diversions	Div	1,790	Lower Bighorn
18.0200	Gypsum Creek Natural Flow	Natf	1,792	Lower Bighorn
18.0250	Gypsum Creek Diversions	Div	1,792	Lower Bighorn
18.0300	Confluence of Gypsum Creek and Crooked Creek	Conf	1,790	Lower Bighorn
18.0350	Crooked Creek Diversions	Div	1,790	Lower Bighorn
18.0400	BIG COULEE NEAR LOVELL, WYO.(06286258)	Gage	1,796	Lower Bighorn
18.0500	Confluence of Big Coulee and Crooked Creek	Conf	1,790	Lower Bighorn
18.0520	CROOKED C NR LOVELL WYO(06286260)	Gage	1,790	Lower Bighorn
18.0600	Sykes Spring Natural Flow	Natf	1,798	Lower Bighorn
18.0650	Sykes Spring Diversion	Div	1,798	Lower Bighorn
18.0700	Confluence of Sykes Spring and Crooked Creek	Conf	1,790	Lower Bighorn
19.0000	Roundup/Harmon Spring Natural Flow	Natf	1,770	Lower Bighorn
19.0500	Roundup/Harmon Spring Diversions	Div	1,770	Lower Bighorn
20.0000	Bighorn Lake	Res	1,700	Lower Bighorn

Diversion Node Summary Table

Schematic	Node Number	Irrigated Acreage	Diversion Names
Clarks Fork	1.0320	28	Nielson No.1 Ditch
	1.0420	73	Camp Creek No.1 Ditch, Camp Creek No.2 Ditch
	1.0520	88	Weatherman Ditch
	1.0620	176	Dilworth Ditch
	2.0200	56	Selfridge Ditch
	2.0320	81	Coolidge Ditch
	2.0420	55	Evans No.3 Ditch
	2.0500	976	Blundell Ditch, Davis Ditch, Enl. Beam Ditch, Evans No.1 (Evans Sprinkler), Ruscher (Beam) Ditch, Tighe Ditch
	2.0700	125	Firor Ditch, Willock No.2 Ditch
	2.0820	165	Campbell No.1 Ditch, Campbell No.2 Ditch, Campbell No.3 Ditch, Ridgway Pipeline
	2.5000	168	Sparhawk No.1 Ditch
	4.0200	167	Paint Creek (Benedict) Ditch
	4.0300	495	Paint Creek Res. Ditch
	4.0400	1,020	Allen Ditch, Beaver Ditch, Davinport (Beaver) Ditch, Enl. Tippecanoe Ditch, Silver Lake Ditch
	4.3000	21	Close Sprinkler No.1
	5.0200	1,187	Blain Creek No.2 Ditch, East Pat O'Hara Creek Ditch, East Pat O'Hara Ditch, Fullerton Ditch, Hopkins Ditch, Kimball Ditch, Pat O'Hara Creek Ditch, Roberts Ditch, West Pat O'Hara Ditch
	5.7000	1,804	Enl. Badger Ditch, Enl. Green-Moore (Badger) D., Green-Moore (Badger) Ditch
	5.8000	2,566	Green-Bush Ditch
	6.0220	34	Black Tail Springs Ditch
	6.0250	1,046	Alanko No.1 Ditch, Kelly Ditch, Meadow Spring Ditch
	6.0320	221	Grace Ditch, Owens Ditch
	6.0340	131	Lake Creek Ditch, Schmidt Ditch
	6.0350	275	Enl. Englebright Ditch, Lava Point Pipeline, Shannon Ditch
	6.0370	112	Hardscrabble (Little Rocky) D.
	6.0400	1,860	Berry Ditch, Davis Ditch, Dorothy Ditch, Enl. Berry Ditch
	6.6000	1,459	Enl. Sirrine Ditch
	7.0200	1,394	Emily Ditch, Fountain Ditch, Last Chance (Badura) Ditch, North Side Ditch
	7.5000	419	Doctor Ditch
	8.0300	2,136	Badger Ditch

Diversion Node Summary Table

Schematic	Node Number	Irrigated Acreage	Diversion Names
Upper Wind	1.3000	334	Helm Ditch, Wind River Ditch
	1.4165	461	Kissinger Ditch
	1.4185	947	Enl. Hays No.1 Ditch, Hays No.1 Ditch, Six Mile Ditch
	1.4300	337	Clendenning Ditch
	1.4350	200	Blaha No.1 Ditch, Blaha No.2 Ditch, Peterson No.1 Ditch
	1.4500	69	Reichel Ditch
	2.2500	58	Shapo Ditch
	2.3000	139	Holmes Ditch
	2.4000	808	Enl. Green Ditch, Green Ditch, Holmes No.2 Ditch, Yarnell Ditch
	2.4500	147	Burgel-Miller Ditch
	2.6000	121	Parker Sprinkler, Stringer Ditch
	2.6070	59	Little Warm Springs Ditch, Thompson Ditch, Welty Ditch
	2.6200	497	Amoretti Ditch, West (Diamond P/L)
	2.6900	533	Locke Ditch, Nicol Ditch, Pine Tree Ditch
	2.9000	85	"J" Ditch
	2.9300	91	Wilson No.1 Ditch
	2.9500	266	Bird No.2 Ditch, Chapo Ditch, Henderson Ditch
	3.0200	213	Enl. Rock Ditch, Lake Ditch, Voorhis No.1 Ditch, Voorhis No.3 Ditch
	3.0300	699	Diamond A Ditch
	3.2000	29	Williamson Ditch
	3.2105	10	Campbell No.2 Ditch
	3.2130	107	Campbell, Campbell Ditch
	3.2180	52	McKissock, McKissock Ditch
	3.2300	9	Schutt Ditch
	3.2450	23	Mosle
	3.3500	36	Schwinn No.1 Pipeline
	3.4500	276	Big Wind River, Miller Red Creek Ditch, Red (Miller Red Creek) Ditch,
	3.6000	887	Black Rock, Enl. Black Rock Ditch, Jenkins & Westman, Stahl Ditch
	3.6300	103	Dinwoody Bench
	3.6400	307	Dinwoody Creek, J.L. Miller, J.L. Miller Ditch, Unnamed,
	3.9000	735	Big Wind River, Wind River #2
	4.0000	427	Alexander (Lanigan) Ditch, Lanigan, Lanigan Ditch, Stahl,
	4.1000	356	Nowlin,
	4.1200	139	J. LeClair, Little Dry Creek, Little Horse Creek Ditch, North Fork Dry Creek
	4.2200	41	Dry creek No.1 Ditch, Presgrove #1
	4.2400	7,884	Dry Creek (1-4N-4W), Dry Creek Bench, Dry Creek Bench Canal,
	4.2500	20	Dick May #1
	4.2600	2,170	Big Wind River, Wind River #2, Wind River No.2 Ditch,
	4.3450	360	Beeline, Enl. Beeline Ditch
	4.3500	479	Brighttop, Enl. Stephens Ditch, Knifong #1, Linck, Miles No.1 Ditch, Mills #2, Stephens, Trosper
	4.3550	650	Crow, Crow Ditch, East Burk, Rema, Sandell, West Burk, Young, Young & Ralston
	4.3600	349	Andy, Blue Grass, H.P., Redtop, Sandel & Bauman
	4.3700	911	A.L. Miller, Borel #1, Borel #3, Frank Saunders #1, Frank Saunders #2, John Miller, Rhodes #1, Rhodes #2, Saunders-Miller
	4.4200	137	Jackson, Minnie, Minnie Ditch,
	4.4270	206	Ansell, Bob (or North Fork Meadow) Creek, Higginson #2, North Fork Meadow #2,
	4.4350	123	Johnson #1, Johnson #2, Johnson No.2 (Sprinkler),
	4.4500	1,289	Meadow Creek, Meadow Creek Bench, Meadow Creek Bench Canal,
	4.4550	460	Calhoun #1, Calhoun #2, Calhoun #3, Calhoun #4, Washakie,
	4.5200	432	Big Wind River, Boyd, Boyd Ditch
	4.6500	2,353	Meadow Creek, Meadow Creek Bench Canal, Willow Creek,
	4.6550	116	Kirkland, Washakie #2,
	4.7000	649	Big Wind River, Charles Stagner
	4.7300	418	Bull Lake Creek, Enl. Winchester Ditch, Winchester
	4.7500	1,031	Big Horn Flats Pump #1
	4.9200	676	Speed Stagner,
	5.0200	719	Big Horn Flats Pump #2
	5.0250	254	French, Kennah, Reo Seco, Signor, Tenderfoot Girl
	5.0350	117	Gunter, Pratt
	5.0450	320	Blackwell, Blackwell #2, Red
	5.0500	541	Teapot Outlet
	5.0550	381	Beck Supply, Hays Supply
	5.1000	959	Hurtado, Hurtado Ditch
	5.1500	912	Big Wind River, DeShaw Ditch, Enl. DeShaw Ditch, Enos
	5.2400	1,248	Aragon, Big Wind River,
	5.3000	1,515	Big Wind River, Johnstown, Johnstown Ditch
	5.4500	310	Baldwin Bull Pipeline, Bawlin Bull
	5.5000	29,191	Big Wind River, LeClair Riverton No.2 Canal, LeClair-Riverton #2,
	5.7000	3,425	Wyoming #2, Wyoming No.2 Canal
	5.9000	84	Ray Wright (Long Sprinkler)
	8.0500	3,902	Riverton East Canal, Riverton East Pump #2,
	8.1000	167	Chatterton Ditch, Deadwood Dick
	8.1400	90	Farmer Ditch, Fuller Brothers

Diversion Node Summary Table

Schematic	Node Number	Irrigated Acreage	Diversion Names
Little Wind	5.2600	5,025	South Crowheart Canal
	5.6000	1,818	Big Wind River, Left Hand, Left Hand Ditch,
	6.1200	143	McAdams,
	6.1400	209	South Fork #2
	6.1600	623	South Fork #1, South Fork Little Wind River, Unnamed,
	6.4000	14,512	Little Wind River, Ray, Ray Ditch, South Fork Little Wind River,
	6.4200	73	Crooked Creek #2, Crooked Creek #3, Unnamed,
	6.4400	253	Spring, Wallace,
	6.4600	285	Spring Creek Ditch, Trout Creek, Trout Creek #1, Trout Creek #2, Trout Creek #4, Trout Creek #5, Unnamed,
	6.4930	29	Driscoll #1, Driscoll #2
	6.5100	3,228	Coolidge, Little Wind River,
	6.6130	1,373	North Fork #3, North Fork No.3 Ditch
	6.6150	49	North Fork Diversion Canal
	6.6180	1,240	North Fork #1, North Fork Little Wind River, North Fork No.1 Ditch
	6.6200	731	North Fork #2, North Fork #4, North Fork #5, North Fork Little Wind River, North Fork No.2 Ditch,
	6.7200	1,027	Gurna Tewon, N.F. Sage Creek No.1 Ditch, North Fork Sage Creek #1, North Fork Sage Creek #2
	6.7220	92	Church #1, South Fork Sage Creek #1
	6.7240	68	Church #2, Church #3,
	6.7250	422	South Fork Sage Creek #2, South Fork Sage Creek #3, Unnamed
	6.7350	445	Sage Creek #1, Sage Creek #2, Sage Creek #3,
	6.7420	83	0
	6.7500	8,932	Coolidge, Coolidge Ditch, Little Wind River
	6.8500	1,007	Big Horn Flats Pump #3, Big Horn Flats Pump #4
	6.9000	1,556	Hamilton, Little Wind #4, Little Wind River, Little Wind River No.2 Ditch
	7.0500	336	Little Wind #5
	7.1000	5,774	Little Wind River, New Sub-Agency, New Subagency Ditch,
	7.2500	30	Anderson Sprinkler
	7.6000	792	Double, Double Ditch, Enl. Double Ditch,
	7.6200	544	Brice Springs Ditch, Enl. Ecoffey Ditch, Red Canyon Ditch
	7.6400	2,752	Shockley Ditch
	7.7400	163	Buffalo Fat
	7.7500	157	Riverton East Pump #1
	#VALUE!	215	Unnamed spreader dike,

Diversion Node Summary Table

Schematic	Node Number	Irrigated Acreage	Diversion Names
Lower Wind	10.0100	173	Deep Spring, Holland Creek, Muddy Springs #1, Muddy Springs #2, Muddy Springs #3, Unnamed
	10.0130	195	Hobbs, Johnson, Lajeunesse
	10.0300	170	Bargee #2, George, Wiederien, Willow Creek
	10.0370	39	Unnamed
	10.0450	281	Hosie #2, Rankin
	10.0520	705	French, Pearl, Unnamed spreader dike
	10.0580	21	Stoffer
	10.0590	161	Preston #1, Preston #2, Robert M. Metzler
	10.0700	248	Calling, Kabbel, Limfjorden, Limfjorden Ditch, Store Aaen Ditch, The Store Aaen, Unnamed spreader dike
	10.0750	40	Granger #2
	10.1500	89	Shotgun
	10.2000	422	J.W.O., J.W.O. Ditch, R.W. Philburn,
	10.2150	523	Nielson, Nielson Brothers, Supply ditch for Nielson Reservo, Unnamed, Unnamed spreader dike
	10.2250	333	O'Shea, Owens, Unnamed spreader dike
	10.2800	160	R.W. Philburn Ditch, Unnamed spreader dike, W.W. Philburn
	10.3500	228	Carl, Enl. Swanson Ditch, Reno, Swanson, Swanson Ditch
	11.0200	551	Alva Ditch, Reed Ditch, Swain Ditch
	11.0500	1,239	Slick Ditch
	11.3000	2,138	Cummings Ditch, Knapp Ditch
	11.3520	6	Dunne Ditch
	11.3540	454	"Two B" No.1 Ditch, Enl. Long Ditch, Long Ditch, Sheaf No.2 Ditch, Warden Ditch
	11.3580	182	Crescent C Ditch, Mountain Ditch
	11.3610	1,306	Lysite Ditch
	11.3630	770	Battle Axe No.2 Ditch, Jasper Ditch
	11.4500	372	Fuller Ditch
	11.4650	524	Woodruff Ditch,
	11.5500	25	Thoren Ditch
	4.3100	40,901	North Crowheart Canal
	5.0000	68,690	Community Ditch, Wyoming, Wyoming Canal,
	9.0100	427	Muddy Prairie Basin
	9.3050	46	Whittaker
	9.3150	9	Ingalls
	9.3250	51	Gonzales #1, Warden
	9.3350	255	Bean #1, Stagner, Two Partners
	9.3450	40	Mary
	9.3620	78	Bear Paw, Deer Trail
	9.3640	169	Berch, Unnamed spreader dike
	9.3660	71	Lincoln, Lincoln #2, Two Mile Springs,

Diversion Node Summary Table

Schematic	Node Number	Irrigated Acreage	Diversion Names
Upper Bighorn	2.0050	24	Nostrom Ditch
	2.1000	936	Baker Ditch, Curtis Ditch, Durward Jones Pump No.2, Enl. Thermopolis Canal, Enl. Tiedown Ditch, Garrison Ditch, Kent Ditch, Plummer-Nickelson Ditch, Squier Jones Ditch, Sulphur Spring Pipeline, Tempelton Pipeline,
	2.4000	328	Garrett Ditch, J.B. Gaylor Ditch, Legion Pipeline, Mahoney No.2 Ditch, Thornton River Ditch,
	2.6000	2,291	Enl. Kirby Ditch, Enl. Walter (Kirby) Ditc, Jones Pump (Kirby Ditch), Kirby Ditch, Walter (Kirby) Ditch, Warm Springs (Kirby)
	2.8000	322	Cyclone Ditch, Neilson (Cyclone) Ditch
	4.0008	635	Enl. Anderson Ditch, Enl. Roy Ditch, Ray Ditch
	4.4000	737	Enl. Nelson Ditch, Nelson Ditch, Noll Ditch, Wight Ditch
	4.5000	19,356	Enl. Upper Hanover Canal, Upper Hanover Canal,
	5.0010	65	Wilson
	5.0030	112	Camp Ditch
	5.0110	73	Halilton Dome B-P Well
	5.0150	137	Berry Ditch, Enl. Berry Ditch
	5.0200	607	Caledonia Ditch, Enl. Caledonia Ditch
	5.0250	408	German Ditch, Wales Ditch
	5.0300	493	Enl. Kirby Ditch, Kirby Ditch
	5.0350	334	Hugh Dickey No.2 Ditch, John Baird No.1 Well,
	5.0403	938	Earl Ditch, Enl. Gillies Ditch, Gillies Ditch, Grass Creek Res. Ditch, L.U. (Baxter) Ditch, Rankin Ditch
	5.0415	57	Seventy Six Ditch
	5.0430	274	Enl. Tenderfoot Ditch, Tenderfoot Ditch
	5.0450	181	Brassington Ditch
	5.0470	15	Middle Fork Ditch
	5.8000	2,495	Bluff Canal, Enl. Bluff Canal,
	6.0010	150	Fish Hook Ditch, McCoy-Major No.1 Ditch, Taylor Ditch
	6.0030	16	Dickey No.2 Ditch
	6.0110	85	Dickey No.3 Ditch
	6.0200	85	Dickey No.4 Ditch, Dickey No.6 Ditch
	6.0300	1,341	Enl. Quartz Ditch, Enl. Star Ditch, Enl. Sun Ditch, Homestead Ditch, Morton Ditch, Murphy Ditch, Perkins Ditch, Quartz Ditch, Star Ditch, Sun Ditch,
	6.0400	434	Enl. Holder Ditch, Enl. Homestead Ditch, Holder Ditch, Soft Snap (Steel) Ditch, Steel Ditch
	6.0450	722	Enl. Niccolls-Holly (Holland), Enl. Niccolls-Holly Ditch, Niccolls-Holly Ditch,
	6.0480	123	Mahan Ditch
	6.0500	383	Enl. Sunnyside Canal, Enl. Sunnyside Ditch, Sunnyside Canal
	6.0550	192	Warren Ditch
	6.0600	633	Blake-Denton Ditch
	6.5000	13,536	Big Horn Canal, Big Horn County Canal,
	6.6000	172	Taylor-Halstead Ditch
	7.5000	9,835	Lower Hanover Canal
	8.0100	374	Bower Ditch
	8.2300	83	Harrison Sprinkler
	8.2800	1,663	Fritz Ditch, Pfeiffer (Fritz) Ditch
	8.2900	556	Enl. Townsend Ditch, Townsend Ditch
	9.2900	1,144	Enl. Tharp Ditch, Ilg Irr. Syst., Suez Ditch, Tharp Ditch, Van Alstine-Walker Ditch
	10.0100	11	Sweeney No.3 Ditch
	10.1000	168	Wright Ditch, Wright No.1 Ditch
	10.2000	2,020	Sykes Ditch, Tillard Canal
	11.7800	6,962	Borner Ditch, Payne (Borner) Ditch
	11.7900	335	Riley McConn Ditch

Diversion Node Summary Table

Schematic	Node Number	Irrigated Acreage	Diversion Names
Owl Creek	3.0150	334	Enl. Adams Supply Ditch, Heiden Ditch, Hulse Ditch
	3.0250	843	Adams Supply Ditch, Blond Ditch, Croskey Ditch, Croskey-Lowry Ditch, Enl. North Basin Ditch, North Basin Ditch
	3.0350	358	Enl. Harvey Short Ditch, Heiden Ditch, No.1 Ditch, Short No.3 Ditch,
	3.1012	57	Beaver, Typer No.4 Ditch
	3.1014	85	Carney #2, Gingerich
	3.1017	8	Typer #1
	3.1025	1,308	Enl. Whetstone Ditch, Hinderliter Ditch, Price-Landis Ditch, Short-Heiden Ditch, South Fork Owl Creek, Whetstone Ditch,
	3.1035	305	Owl Ditch
	3.1040	122	Large, Large Ditch
	3.1047	280	Arapahoe Ranch Pumps
	3.1053	585	North Side, Swingle Ditch
	3.1065	278	Duncan #2-A, Finley, Phlox Mountain, Red Creek (34-9N-2E)
	3.1085	408	Garden Ditch, Shoop, Shoop Ditch,
	3.1090	507	Enl. Morrison-McConaughy D., Morrison-McConaughy, Morrison-McConaughy Ditch
	3.1400	1,252	Enl. Sliney No.1 Ditch, Sliney Ditch No.1 Ditch
	3.1450	250	McQueen, Small Ditch
	3.1500	811	Chessington-Wilson, Chessington-Wilson Ditch, Enl. Close-Bader Ditch, Enl. Wilson Ditch
	3.1520	386	Enl. DeWitt Ditch
	3.1550	390	Enl. Nostrum (Woodard-John), Enl. Woodard-Johnson Ditch
	3.1600	1,410	Ready Ditch, South Side Canal, Southside Ditch
	3.2010	807	Close-Bader Ditch
	3.2500	199	Hale Ditch
	3.2550	128	Rocky Point
	3.2800	2,268	Baylor-Purvis Ditch, Hale Ditch, Steward No.2 Ditch
	3.3005	539	Duncan, Duncan #5, Ford #1, Robinson, Sylvester Ditch
	3.3015	189	Bagley, McElwee, Roach-Milek No.2 Ditch, Staples
	3.3025	61	A.L. Lydick
	3.3035	27	Kelly
	3.3045	64	Wilson Ditch
	3.3064	6	Ford #2
	3.3068	131	Enl. Rush No.1 Ditch, Rush No.1 Ditch
	3.3080	292	Enl. Martin Ditch, Martin Ditch
	3.3200	224	Enl. McManus Ditch, Hale No.2 Ditch, Maley Ditch
	3.3250	2,602	Dempsey Canal, Enl. Dempsey Canal, Enl. Dempsey Ditch, Enl. Farmers (Dempsey),
	3.3350	316	Cosack Ditch, Enl. Southside Ditch, Kelley Ditch
	3.3500	24	Enl. Lindsay Ditch

Diversion Node Summary Table

Schematic	Node Number	Irrigated Acreage	Diversion Names
Nowood	9.0150	17	Crowley Ditch
	9.0200	258	Enl. Cornell No.2 Ditch, Hoskins Ditch
	9.0350	24	Mead No.2 Ditch
	9.0550	250	Nowood Ditch
	9.0600	144	Enl. S.V. Ditch, Turkey Track Ditch,
	9.0720	59	Early No.2 Ditch, Wells No.2 Ditch,
	9.0740	60	Faure Ditch
	9.0790	135	Dow Ditch, Enl. Dow Ditch, Helms No.1 Ditch
	9.0800	114	Enl. Green Spot Ditch, Green Spot Ditch, Lucy Wells Ditch, Umslopogass No.2 Ditch
	9.0990	666	Bremmer Ditch, Bud Ditch, Cascade Ditch, Enl. Hillside ditch, Enl. Red Bank Ditch, Enl. Umslopogass Ditch, Gypsum Ditch, Hillside Ditch, Red Bank Ditch, Umslopogass Ditch
	9.1050	281	Ainsworth Ditch, Ainsworth No.2 Ditch, Bremmer No.1 Ditch, Enl. Ainsworth Ditch
	9.1100	610	Alexander Ditch, Enl. Alexander Ditch, Enl. Sawyer Ditch, Enl. Three Ring Ditch, Hollywood No.2 Ditch Sawyer Ditch, Three Ring Ditch, West Side (Beckey Irr. Syst.)
	9.1240	47	Dyson Ditch, Egbert No.1 Ditch, Egbert No.2 Ditch
	9.1290	340	Breeden Ditch, Daly Ditch, Enl. Hollywood Ditch, Grout Ditch, Higbie Ditch
	9.1300	741	Blue Bank Ditch, Enl. Kimball Ditch, Kimball Ditch
	9.1420	391	Emge-Robinson Ditch, Enl. Tunnel Ditch, Henderson Ditch, Hollywood Ditch, Waln Bros. Ditch
	9.1435	93	Taylor No.2 Well
	9.1450	166	Red Butte Ditch
	9.1490	237	Mary Alice No.1 Well, Standish-Henderson Ditch
	9.1500	172	Farmers Canal, Farmers Ditch
	9.1550	15	Cheeney Ditch
	9.1820	7	Wigwam No.2 Ditch
	9.1845	767	Canon Creek Ditch, Enl. Hunsinger No.2 Ditch, Enl. Milo Power Race Ditch
	9.1880	1,995	Buckhorn Ditch, Columbian Ditch, Enl. Bay State No.1 Ditch, Enl. Perfection Ditch, Enl. Standard Ditch Enl. Wyman Ditch, Fiscus-Vanoni Ditch, LaClede Ditch, Standard Ditch, Wyman Ditch
	9.1900	639	Jumbo Ditch, Winsor Ditch
	9.1940	514	Enl. Mallard Ditch,
	9.2050	104	Beth No.1 Well
	9.2120	258	Enl. Hardscrable Ditch, Mills Ditch, Williams Ditch,
	9.2140	26	Green Beret No.2 Well
	9.2150	400	Melley Ditch
	9.2200	383	Western Ditch
	9.2330	747	Buffalo Flat Ditch, Enl. Gomer No.1 Well, Gomer No.1 Well, Renner No.3 Well,
	9.2400	406	Enl. Ilg Ditch, Ilg Ditch
	9.2550	346	Gomer No.2 Well
	9.2600	358	Ninety Six Ditch, Spratt Ditch, Sturdevant No.1 Ditch,
	9.2710	411	Loretta Ditch
	9.2717	387	Baldwin Ditch, Betty Ditch, Red Dog Ditch
	9.2720	376	Enl. Highland Ditch
	9.2725	2,566	Anita Ditch, Enl. Anita Ditch
	9.2728	244	Bayne-George Ditch, Enl. Bayne-George Ditch, Enl. George-Bayne Ditch
	9.2738	600	Big Bear Ditch, Enl. Big Bear Ditch
	9.2740	101	Elk Ditch
	9.2744	720	Military Ditch
	9.2746	209	Anita Supplemental Ditch, Enl. Anita Supplemental Ditch
	9.2748	140	Enl. Hyatt No.1 Ditch, Hyattville Ditch, Island Ditch
	9.2755	372	Cook-Ellis Ditch, Enl. Shuck-Wilson Ditch, Shuck-Wilson Ditch
	9.2765	31	Alkavale Ditch
	9.2775	12	Bernsteen No.2 Ditch
	9.2785	171	Weintz Ditch
	9.2790	152	Bernstein Ditch
	9.2795	403	Bernstein No.1 Ditch, Conant Ditch, Enl. Conant Ditch, South Side Ditch
	9.2950	1,143	Avent (Van Alstine-Walker D.), Dyke (Van Alstine-Walker) D., Enl. Avent (Van Alstine-W.), Enl. Avent (Van Alstine-Walker), Enl. Dyke (Van Alstine-Walker) D, Enl. Secesh (Van Alstine W.), Enl. Secesh (Van Alstine-Walker), Secesh (Van Alstine-Walker) D.
	9.3000	239	Enl. Shafer Ditch, Shafer Ditch
	9.3100	518	Contention (Harmony) Ditch, Enl. Contention Ditch, Enl. Harmony Ditch, Harmony Ditc

Diversion Node Summary Table

Schematic	Node Number	Irrigated Acreage	Diversion Names
Greybull	11.0110	414	Meyers No.4 Ditch
	11.0600	1,136	Ashworth No.2 Ditch, Jevons Ditch
	11.0950	767	Last Chance Ditch
	11.1100	1,499	Enl. Greybull Ditch, Greybull Ditch
	11.1400	75	Ashworth No.2 Ditch
	11.1600	189	Pitchfork (Butte) Ditch
	11.1800	92	Crane No.1 Ditch, Dumpling Ditch
	11.2000	361	Butte Canal, Enl. Butte Canal
	11.2250	1,172	Enl. Pappapau Ditch
	11.2350	732	Enl. Weller Ditch, Weller Ditch
	11.2500	228	Schmidt Pipeline No.2
	11.3150	536	Hagberry No.1 Ditch, Hagberry No.3 Ditch, Renneberg Ditch, Upper Canal,
	11.3180	496	Chees-Mantle Ditch, Enl. Sunshine Basin Ditch, Wilson Ditch
	11.3200	493	Enl. Only Chance Ditch
	11.3203	459	Island Ditch, White-Alexander Ditch
	11.3207	899	Bianchi No.1 Ditch, Enl. Wood River Supply Ditch, J.W. Thomas Ditch, Sleeper Ditch, Tick Tack Ditch
	11.3230	466	Dick Creek Ditch, Enl. Dick Creek Ditch
	11.3350	602	Bennion Pipeline, Roadside Ditch, Watson (Davis) Ditch
	11.3400	109	Hurlbut Ditch
	11.3450	133	River Ditch
	11.4000	1,074	Elliot No.1 Ditch, Elliot No.3 Ditch, Enl. Pearce Ditch, Pearce Ditch, Thomas Ditch
	11.4200	397	Whitney Ditch,
	11.4350	848	Greybull Valley Secondary D.
	11.4720	1,199	Biplane Ditch, Dotterer Ditch, Greybull Valley Secondary D., Mann-McNally
	11.4730	330	Winkel-Benbrook Ditch
	11.5050	55	Perkins Ditch
	11.5100	260	Rose Ditch
	11.5300	568	Enl. T.L. Ditch, Greybull Valley Secondary D., T.L. Ditch
	11.5310	642	Wyoming Ditch
	11.5500	110	Joe Moss Ditch, Meeteetse Rim Ditch
	11.5700	46	North Fork Ditch, Tax Ditch
	11.5900	319	Arland Ditch, Daniel Wilson Ditch, Enl. Wise Ditch
	11.5980	1,015	Enl. Gordon No.1 Ditch, Gordon No.2 Ditch, Nina Ditch, Stone Ditch, Young Ditch
	11.6050	1,253	Dyer Ditch, Enl. Dyer Ditch, Greybull Valley Secondary D.
	11.6070	747	Enl. W.L. Ditch, Foster Ditch, W.L. Ditch
	11.6075	249	Enl. Long Hollow Ditch
	11.6100	322	Greybull Valley Secondary D.
	11.6200	1,713	Greybull Valley Secondary D., McCune Ditch
	11.6300	106	Brannum Ditch
	11.6350	427	Boone (Sheets) Ditch, Enl. Sheets Ditch
	11.6400	870	Enl. Nichols Ditch, Nichols Ditch
	11.6420	811	Hanks-Stetzelman (Myers) D., Last Chance Ditch, Myers Ditch
	11.6480	1,024	Beck (Keystone) Ditch, Enl. Beck (Keystone) Ditch
	11.6500	1,613	Enl. Jimmerfield (Smith) Ditch, Enl. Jimmerfield Ditch, Greybull Valley Secondary D., Jimmerfield Ditch Smith Ditch
	11.6510	1,102	Greybull Valley Secondary D., Roach-Jimmerfield Ditch
	11.6600	45,279	Beck-Allen (Bench) Canal, Bench Canal, Elam-Goodrich (Bench) Canal, Enl. Beck-Allen (Bench) Cana Enl. Bench Canal, Enl. Farmers (Bench) Canal, Enl. Gould (Bench) Canal, Enl. J.F.W. (Bench) Canal, Enl. Perkins (Bench) Canal, Erickson Ditch, Farmers (Bench) Canal, Gould (Bench Canal), Greybull Valley Secondary D., J.F.W. (Bench) Canal, Perkins (Bench) Canal, Porter Bros. Ditch, Slover (Farmers) Canal, Todd (Avent) Ditch, Volmer (Farmers) Canal, Williamson No.1 (Bench),
	11.6800	2,450	Enl. German Ditch, German Ditch
	11.6900	2,494	Enl. Tatman Ditch, Greybull Valley Secondary D.
	11.7300	807	Croxall-Brown Ditch, Enl. Croxall-Brown Ditch
	11.7400	5,741	Blakesley (Fairview Canal), Enl. Grout (Fairview) Canal, Fairview Canal, Fairview Reservoir Canal, Greybull Valley Secondary D., Grout (Fairview) Canal
	11.7600	1,986	Enl. Wood-Burnett Ditch, Plumb-Williams(Wood-Bennett)
	11.7610	3,285	Enl. Sandstone Ditch, Greybull Valley Secondary D., Sandstone Ditch
	11.7750	540	Enl. Cockins Ditch
	11.7950	297	Hagerman Pipeline

Diversion Node Summary Table

Schematic	Node Number	Irrigated Acreage	Diversion Names
Lower Bighorn	12.0050	1,487	Agrarian Canal, Enl. Agrarian Canal, Enl. Agrarian No.1 Canal
	12.0500	804	Enl. First Chance Ditch, Enl. Hurst-Bonner Ditch
	13.0300	227	Fender Ditch
	13.0500	381	Kershner Ditch, Rath-Early Ditch
	13.1000	380	Casey Pipeline, Cull No.1 Ditch, Enl. Brown-Sabin Ditch, Jenks Ditch, Sabin-Brown Ditch, Willard Ditch
	13.1020	379	Enl. Highline Ditch, Highline Ditch
	13.1040	91	Hatten Ditch
	13.1150	5,474	Enl. McDonald (Shell Canal), Enl. Shell Canal, McDonald (Shell Canal), Shell Canal
	13.1400	860	Bench Ditch, Cottonwood Ditch, Emerick Ditch, Enl. Bench Ditch, Frank Gould No.2 Ditch, Kershner-Lapman Ditch, Lampman No.2 Ditch
	13.1700	2,363	Enl. Whaley Ditch, M.E. Jackson Ditch, Spring Creek Ditch, Whaley Ditch
	13.1900	177	Mathews Ditch, St. Jermain Ditch
	13.2100	162	Davis Ditch, Enl. Davis Ditch, Kimbrow No.1 Ditch,
	13.2300	762	Trout Ditch
	13.2500	225	Howe Ditch, Hunt Ditch
	13.2620	506	Enl. Calvin Ditch
	13.2700	497	Crandall Ditch, Kenyon Ditch
	13.2750	455	Ewen No.3 Ditch, London Ditch
	13.2790	1,509	Beaver Ditch, Ewen No.1 Ditch, Flitner Ditch, Pense Ditch
	13.2900	1,374	Enl. Porter Ditch, Porter Ditch
	13.3000	1,192	Enl. Denny Ditch, Enl. Dunshee Ditch, Enl. Odessa Ditch, Lynn Ditch, Scharen Ditch
	13.5000	1,042	Caldwell Ditch, Frank Martin Ditch, Frank Martin No.3 Ditch, Frank Martin No.4 Ditch, Grenier Ditch, Henry Olson Ditch, Mensing Ditch
	14.0500	801	Bear Creek Ditch
	14.5000	264	Gifford No.1 Ditch, Hanna Ditch
	15.0200	339	Eberhard No.1 (Brown) Ditch, Eberhard No.2 Ditch
	15.0600	351	Allison Ditch, Barnett Ditch, Enl. Barnett Ditch,
	15.0800	292	Bethurem (Brown) Ditch
	15.2000	1,025	Enl. Red Flats Sprinkler, Paddock No.3 Ditch, Red Flats Pipeline No.3, Red Flats Sprinkler, Watson Ditch
	16.0050	665	Gifford No.1 Ditch, North Ditch
	16.5000	526	Nebel (Beaver Flat Irr. Syst.)
	17.5700	1,118	Enl. Sage Creek Canal, Sage Creek Canal
	17.7020	222	Carter (Bachelor) Ditch
	18.0150	548	Britton Ditch, Stone Point Ditch,
	18.0250	181	Teeples Ditch
	18.0350	220	Big Sage Ditch, Dew-Duffield (Stone Pt., Snell Ditch
	18.0650	136	Spring Ditch
	19.0500	165	Harmon No.9 Ditch, Porter No.1 Ditch

Diversion Node Summary Table

Schematic	Node Number	Irrigated Acreage	Diversion Names
Shoshone	17.0020	480	Nelson Ditch, Wilde Ditch,
	17.0100	208	Groffoms Ditch, McLaughlin Ditch
	17.0250	17	0
	17.0320	15	0
	17.0350	253	Brown Ditch, Garden Patch Ditch,
	17.0550	142	Abshire Pipeline, Snyder No.1 (Winants No.3)
	17.0650	60	Enl. Hubner-Boulder Ditch
	17.0800	377	Boulder Creek Ditch
	17.0900	71	Siggins No.1 Ditch
	17.1000	257	Swanson Ditch,
	17.1100	179	Crane(Ashley Pipeline)
	17.1300	198	Downing Ditch, Riverside Ditch
	17.1500	499	Ishawooa (Ishawooa No.2) D.
	17.1650	710	Bobcat (Burns) Ditch, Burns Ditch
	17.1800	355	Hardpan Ditch
	17.1900	10,266	Burns (Lakeview Canal), Enl. Hammit (Lakeview) Canal, Hammit (Lakeview) Canal
	17.2000	91	Russell Ditch
	17.2150	112	Modglin Res. Ditch
	17.2450	980	Castle Rock Ditch, Neff Ditch
	17.2650	826	Benedict Ditch, Enl. Benedict Ditch
	17.2750	1,105	Enl. Wilson-McKissak Ditch, Wilson-McKissak Ditch
	17.2800	9,404	Bailey (Cody) Canal, Cody Canal, Enl. Cody Canal,
	17.2820	1,305	Diamond Bar No.1 Ditch, Diamond Bar No.3 Ditch, Enl. Shoshone River Canal
	17.2870	506	Barbee Ditch, Marion Ditch
	17.2950	628	Shoshone No.2 Ditch
	17.3420	40	Wapiti Ranger Station Ditch
	17.3450	688	Enl. North Fork Valley Ditch, North Fork Valley Ditch
	17.3550	71	Canyon Creek No.2 Ditch,
	17.3700	320	Big Creek Ditch, Enl. Big Creek Ditch
	17.3850	234	Graves Ditch, Green Ditch, Green's No.2 Ditch
	17.3920	145	Rand Creek Ditch
	17.4000	476	Kelley Ditch, Kelleys Whit Creek Ditch, Stonebridge No.2 Ditch
	17.4250	45	Jim Creek Ditch
	17.4330	21	Pearl No.3 Ditch
	17.4350	354	Bretesha Ditch, Upton Ditch
	17.4380	238	Sauerwein Ditch No.2 & PL
	17.4450	418	Bloom Ditch, Thurmond Ditch, Trout Peak Ditch
	17.4650	359	Canyon Ditch, Rattlesnake Ditch, Reese (Mooncrest P/L), Rhodes No.1(Mooncrest No.1), Springdale Springs Ditch,
	17.5050	31,329	Enl. Heart Mountain Cana, Enl. Heart Mountain cana, Enl. Heart Mountain Cana, Enl. Heart Mountain cana, Enl. Heart Mountain Cana, Heart Mountain Canal,
	17.5150	175	Breteche Ditch, Chamberlin No.1 Ditch, Chamberlin Springs Ditch, Rattlesnake Pipeline,
	17.5350	23	Duck Creek Ditch
	17.5500	246	Ashworth-Watkins Ditch,
	17.5650	473	Enl. Frost Ditch, Frost Ditch, Frost No.2 (Frost) Ditch
	17.5800	33,696	Garland Canal,
	17.5950	12,259	Enl. Willwood Canal, Willwood Canal,
	17.6080	448	Alkali Pump
	17.6100	15,126	Frannie Canal,
	17.6250	11,297	Elk Canal, Enl. Elk (Lovell) Canal, Enl. Elk (Roane) Canal, Enl. Elk Canal, Enl. Roane (Lovell) Cana, Enl. Roane (Lovell) Canal, Enl. Roane Canal,
	17.6270	207	Derry P/L & Sprinkler -
	17.6300	9,751	Enl. Sidon Canal, Sidon Canal, Wells (Sidon Canal),
	17.6340	534	Willey Ditch
	17.6410	20	Homestead Ditch
	17.6520	458	Enl. Roy Ditch, Roy Ditch,
	17.6650	1,422	Enl. Globe Canal,
	17.6680	72	Threet Ditch
	17.6750	4,778	Economy (Hunt-Godfrey), Enl. Hunt-Godfrey Canal, Enl. Hunt-Godfrey Ditch, Hunt-Godfrey Canal,
	17.6970	102	Black Ditch
	17.6990	1,934	Despain Ditch, Enl. Wardwell, Enl. Wardwell Ditch, Wardwell Ditch,
	17.7100	66	C.K. Ditch