# PLATTE RIVER BASIN PLAN
# FINAL REPORT

Wyoming Water Development Commission
May 2006

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## Final Report
## May 2006

**PREPARED FOR:**
Wyoming Water Development Commission
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Cheyenne, Wyoming 82002

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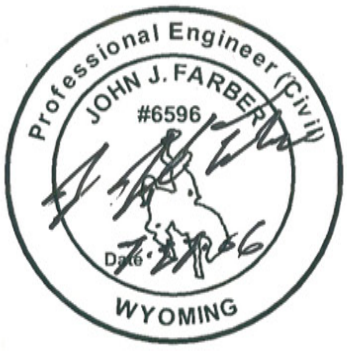


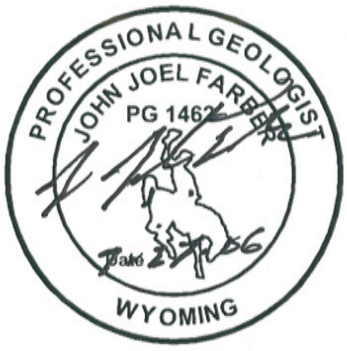


Trihydro CORPORATION

*The Platte River Basin Plan is a planning tool developed for the Wyoming Water Development Office. It presents estimated current and estimated future uses of water in Wyoming's Platte River Basin. The Plan is not used to determine compliance with or administration of state law, federal law, court decrees, interstate compacts, or interstate agreements.*

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# GLOSSARY

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| abutment | The face of a valley wall against which a dam is constructed; defined in terms of left and right as looking downstream. |
| acre-foot | A unit of measurement for water equal to a volume of water covering a surface area of one acre to a depth of one foot (equal to about 326,000 gallons). |
| active capacity | Reservoir capacity normally usable for storage and regulation of reservoir inflows to meet established reservoir operating requirements. (U.S. Bureau of Reclamation). |
| additional supply groundwater | A Wyoming State Engineer's Office (SEO) designation indicating that groundwater irrigation water supplements a surface water irrigation water supply source. |
| allocation year | Years during which the U.S. Bureau of Reclamation (USBR) estimates that available North Platte River water is not adequate to fully meet the combined demands of four major North Platte Project irrigation districts and the Warren Act irrigation districts, thereby requiring USBR to "allocate" or divide available water between these irrigation districts. |
| aquiclude | A relatively impermeable, water-saturate, geologic unit that cannot yield a usable quantity of groundwater. |
| Aquifer | A body of earth material saturated with groundwater that can yield useable quantities of groundwater for human uses; a zone of freely-extractable groundwater in sediment or rock. |
| aquitard | A body of earth material (sediment or rock) of intrinsically low hydraulic conductivity (low permeability) which prevents significant flow of groundwater, either upward or downward; an aquitard is less permeable that an aquifer. |
| arch dam | A concrete or masonry dam which, in plan view, is curved upstream in order to transmit the major part of the water load on the dam to the abutments and to keep the dam in a state of compression. |

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| artesian condition | When the groundwater level rises above the top of the aquifer in a well (or borehole, fracture, etc.) due to the presence of a low permeability layer of earth and/or rock above the aquifer. |
| auxiliary spillway | A reservoir spillway, usually in a saddle or depression along the reservoir rim, which leads to a natural or excavated waterway that is located away from the dam which permits the safe, planned release of excess flood flow that exceeds the discharge capacity of the reservoir service spillway; the auxiliary spillway crest is set at the maximum water surface elevation for a 100-year flood or some other specific frequency flood; the auxiliary spillway is thus used infrequently; any secondary spillway which is designed to be operated very infrequently and possibly to avoid some degree of structural damage or erosion to the spillway during operation discharge. |
| capillary fringe (zone) | The thickness of earth material lying directly above the saturated sub-surface zone in which some moisture from groundwater or surface water is held by capillary forces and does not flow freely. |
| charge, charging a canal | The process of transforming a dry, empty irrigation canal to a flowing irrigation canal during the irrigation season |
| check dam or structure | A structure designed to raise or control the water surface in an irrigation canal or ditch; check dams are typically used to maintain a pre-determined water surface above canal outlets or take-out structures. |
| coal bed methane use | Water produced in the production of coal bed methane gas via wells; wells used for the production of coal bed methane require a permit from the Wyoming Oil and Gas Conservation Commission. |
| community public water supply system | A U.S. Environmental Protection Agency (USEPA) designation for a public water supply system that provides water year-round for at least 15 service connections or at least 25 residents, such as the public water supply system for an incorporated municipality. |
| conduit flow | Groundwater flow through caves, dissolution channels, or open pipes through bedrock lithologies. |
| confined conditions or confined aquifer | Groundwater occurring in a condition such that a low permeability zone is present above the water-bearing zone; when the overlying low permeability zone is penetrated, the groundwater level rises to the potentiometric surface (equal pressure level) of the water-bearing zone. |

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| conjunctive use | The coordinated use of surface water and groundwater resources. |
| cubic feet per second (cfs or $ft^3/s$) | The rate of water flow representing a volume of one cubic foot of water passing a given point in one second; is equivalent to flow rates of 7.48 gallons per second, 448.8 gallons per minute, or 0.02832 cubic meters per second. |
| datum | An elevation above mean sea level to which all site-specific height or elevation readings are referenced. |
| discharge | The volume of water that passes a given point in a given period of time; for example, one cubic foot of water passing a given point in one second equals a discharge or flow rate of 1 cubic foot per second (cfs). |
| diversion dam | A dam whose functions are to raise the water level of a stream enough to support discharge from the river down one or more irrigation canals or ditches, the upstream ends or origins of which are located at the diversion dam. |
| domestic water use (residential water use) | Use of water from a single source in three single family dwellings or less, including noncommercial watering of lawns and gardens totaling one acre or less in area. |
| drainage area | The surface area around a stream as typically plotted and measured on a horizontal plane (on a map) that has a single surface water runoff and/or stream flow discharge point. |
| drainage divide | High points on the ground surface that separate drainage areas and where, if a drop of water lands, part will flow in one direction and part in another direction, typically to adjacent but different surface water drainage areas. |
| earth fill structure | A dam constructed primarily of earth, sand, or rock with a core of impervious material such as clay or concrete. |
| emergency gate | A standby or auxiliary water flow control gate used when the normal means of water control in a channel or canal is not available; the first or upstream gate in a series of water flow control structures which typically remains open while downstream gates or valves are operating. |
| ephemeral stream | A creek or stream that flows briefly only in direct response to precipitation and whose channel is above the local groundwater table. |

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| fixed wheel gate | A water flow control gate consisting of a flat, rectangular, structural steel gate leaf made up of a skin plate, beams, and girders mounted on steel wheels that carry the hydraulic load from the gate leaf to tracks embedded in the concrete on either side of a flow channel; a gate having wheels or rollers mounted on the end posts of the gate, with the wheels bearing against rails fixed in side grooves or gate guides; installed in controlled dam spillways to regulate water releases under relatively low heads and as emergency gates in high-head situations. |
| flood control capacity | Reservoir storage capacity assigned to the sole purpose of regulating flood inflows and reducing flood damage downstream of the reservoir. |
| forebay | A reservoir feeding water to the penstocks, conduits that convey water under pressure to the generating turbines, in a hydroelectric power generating plant. |
| fully appropriated stream | A body of surface water to which the entire allocation of a state’s water rights has been distributed among existing water users. |
| fuse plug spillway | A form of auxiliary reservoir spillway consisting of a low embankment designed to be overtopped and washed away during an exceptionally large flood, thereby protecting the dam and other reservoir structures during the large flood. |
| geohydrology | An engineering field concerning the study of subsurface fluid hydrology. |
| gravity dam | A dam constructed of concrete and/or masonry which relies on its weight and internal strength for stability; gravity dams are generally constructed where the dam foundation is rock and earthfill construction materials in proper quality and quantity are not available. |
| groundwater | Water that flows or seeps downward and saturates soil or rock, supplying springs and wells; the upper level or surface of the saturated zone is called the water table; water stored underground in rock crevices and in the pores of geologic materials that make up the earth's crust; that part of the subsurface water which is in the zone of saturation; phreatic water; water found beneath the ground surface in porous rock strata and soils, as in a spring; generally, all subsurface water, as distinct from surface water; specifically that part of the subsurface water in the saturated zone where the water is under pressure greater than atmospheric pressure. |

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| groundwater flow direction | The direction of potential or actual groundwater flow through subsurface materials. |
| groundwater recharge | The flow to groundwater storage of precipitation, infiltration from streams, and other above-ground sources of water. |
| groundwater surface | The uppermost surface of groundwater as representative of the uppermost aquifer when under either unconfined or confined conditions and when the water level is allowed to reach a static level. |
| groundwater table | The upper boundary or surface of groundwater where water pressure is equal to atmospheric pressure, i.e., the stationary water level in a bore hole. |
| head | Differential pressure causing flow in a fluid system, usually expressed in terms of the height of a liquid column. |
| headwaters | The source and upstream part of a stream; water upstream of a dam or powerhouse. |
| hydrogeology | The study of water and interrelated geologic materials and processes. |
| hydrologic cycle | Seasonal variation in elevation of the groundwater surface; when graphed over time, approximates a sine wave and is variable throughout each seasonal year between years; groundwater levels are constantly changing in response to the hydrologic cycle and variations in groundwater recharge or discharge. |
| hydrology | The study of water. |
| industrial use | One type of Wyoming State Engineer's Office (SEO) "beneficial use" of water; permitted long-term use of water for the manufacture of a product or production of oil/gas or other minerals, including oil field water flood operations, power plant water supplies, etc. |
| instream bypass | Federal regulations requiring minimum stream flow rates immediately below specific water facilities located on U.S. Forest Service land. |
| instream flow | A Wyoming water right that is owned by the State and that guarantees a minimum rate(s) of flow along specified stream segments. |

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| intermittent stream | A stream which flows part of the time, in direct response to runoff from a rainstorm. |
| inverted siphon (in canal) | A pipeline crossing a depression or passing under a structure and having, in section view, a V or U shape; flow in an inverted siphon is under positive pressure. |
| irrigation laterals | Irrigation ditches that branch off larger irrigation canals and convey water to individual irrigators and fields. |
| irrigation season | The months of April through September, inclusive. |
| irrigation use | One type of Wyoming State Engineer's Office (SEO) "beneficial use" of water; permitted watering of commercially grown crops, including large-scale lawn watering of golf courses, cemeteries, recreation areas, etc. |
| leaky conditions or leaky aquifer | A subsurface condition such that groundwater passes through or "leaks" through low permeability zones adjacent to an aquifer, thus recharging groundwater in the receiving aquifer. |
| maximum water surface (maximum pool) | The highest acceptable water surface elevation in a reservoir with all factors affecting the safety of the structure considered; the highest water surface elevation resulting from a computed routing of the reservoir inflow design flood through the reservoir under established operating criteria; the reservoir water surface elevation corresponding to the top of the reservoir surcharge capacity. |
| miscellaneous use | One type of Wyoming State Engineer's Office (SEO) "beneficial use" of water; any permitted use of water not defined under another SEO beneficial use definition such as stock water, pipelines, subdivisions, mine dewatering, mineral/oil exploration drilling, potable supplies, etc.; includes water use by subdivisions, mobile home parks, service stations, campgrounds, churches, schools, temporary drilling activities, etc. |
| monitoring or observation well | A well from which water is not withdrawn or from which water is withdrawn for sampling purposes only. |
| municipal use | One type of Wyoming State Engineer's Office (SEO) "beneficial use" of water; permitted use of water in and by the citizens of incorporated towns and cities |

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| needle valve | Any of a family of valves which regulate water flow through the use of a needle moving into and out of an orifice; movement of the needle regulates the flow of water through the valve and effects valve opening or closing; needle movement is accomplished by varying the water pressure in counterbalancing chambers within the valve or by an electric motor drive that supplies required force to move the needle; needle valves are often intended to operate at the downstream end of a reservoir outlet pipe under free discharge conditions and to regulate high-velocity flows under high head (high flow pressure) conditions. |
| non-point source pollution | A contributing factor to water pollution that cannot be traced to a specific spot; man-made or man-induced alteration of the chemical, physical, biological, or radiological integrity of water, originating from any source other than a point source; pollution which comes from diffuse sources such as urban and agricultural runoff, including stormwater runoff containing excess farm and lawn nutrients that move through the soil into the groundwater or enter local surface water. |
| non-transient, non-community public water supply system | A U.S. Environmental Protection Agency (USEPA) designation for a public water supply system that provides water to at least 25 of the same persons for more than six months of the year where those persons are not full-time residents, such as at a rural school, a factory, or a mine. |
| normal water surface | The highest reservoir water surface elevation at which water is normally stored; that elevation below which the reservoir should be operated for conservation purposes; typically the water surface elevation corresponding to the active reservoir conservation storage capacity; the maximum water surface elevation to which the reservoir may rise under normal operating conditions exclusive of flood control capacity. |
| ogee crest | The shape of a concrete reservoir spillway crest that represents the natural lower profile of a jet of water flowing over a sharp-crested weir at a specific depth. |
| original supply groundwater | A Wyoming State Engineer's Office (SEO) designation indicating that groundwater is the primary (first in time) irrigation water supply source |
| outlet works | A combination of reservoir structures and equipment required for the safe operation and control of water released from the reservoir to serve various purposes, i.e., regulate stream flow water quantity and quality; release floodwater; and provide irrigation, municipal, and/or industrial water; a device to provide controlled water releases from a reservoir. |

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| Parshall flume | A specially-shaped structure that is placed in a flow channel and through which water flows at an increased and known velocity, allowing determination and recording of rates of flow (volume of flow per time increment, such as cubic feet per second) through the flume based on water depth at a specific point in the flume. |
| penstock | A pipeline or conduit that is designed to withstand pressure surges and that conveys water from a forebay or reservoir to power producing turbines or pump units in a hydro-electric power generating plant. |
| perched groundwater | A condition under which groundwater is trapped by subsurface geologic conditions at a location above the major local groundwater potentiometric surface or water table; perched groundwater is usually underlain by a low permeability layer that separates the perched groundwater from lower groundwater. |
| perennial | A stream that typically flows continually throughout the year. |
| phreatophyte | A deep-rooted plant that obtains water from a permanent groundwater supply. |
| piezometric surface | The level or top surface of groundwater in an aquifer under an unconfined condition. |
| point source pollution | Any discernable, confined, or discrete conveyance from which pollutants are or may be discharged, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, container, rolling stock, concentrated animal feeding operation, vessel, or other floating craft; a stationary location or fixed facility from which pollutants are discharged or emitted into groundwater or surface water. |
| porous flow | Groundwater flow through intergranular pore spaces in earth material, typically sediment or rock. |
| potentiometric surface | The surface level of groundwater in an aquifer under a confined condition; a contour map of a potentiometric surface indicates the elevations of the groundwater surface and the direction of groundwater flow. |
| powerhouse | The main structure of a hydroelectric power generating plant which houses the generating units and associated control equipment. |

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| public water supply system | A U.S. Environmental Protection Agency (USEPA) designation for a water supply system that provides potable water for at least 15 service connections or 25 people per day for a minimum of 60 days per year. |
| recharge | Water flow into an area, aquifer, or well, typically from a surface water source to groundwater in an aquifer. |
| recharge area | The land area(s) over which recharge of an aquifer, typically by infiltration of surface water, occurs. |
| regulating gate | A gate used to regulate the rate of flow through a reservoir outlet works or spillway. |
| restricted release ring seal gate | A water flow control gate in which sealing of the gate to stop water flow is accomplished by means of a moveable seal which is extended by water pressure when the gate is closed. |
| ring-follower gate | A water flow control gate consisting of a rectangular leaf and an opening equal in diameter to that of the adjacent pipe or conduit that forms an unobstructed water flow passageway when the gate leaf is in the raised or open position. |
| saturated zone | The water-saturated sub-surface zone; a sub-surface zone of earth material containing freely-extractable groundwater. |
| second aquifer | A second sequence of groundwater-saturated earth material underlying a higher or first aquifer and separated from the first aquifer by an aquitard. |
| spillway | A reservoir structure that conveys normal and/or flood flows around or past the dam in a manner that protects the structural integrity of the dam; a controlled spillway contains mechanical flow control structures; an uncontrolled spillway does not contain mechanical flow control structures and controls discharge by means of the spillway geometry. |
| stock watering use | One type of Wyoming State Engineer's Office (SEO) "beneficial use" of water; permitted water appropriation including normal livestock use at up to four tanks and within one mile of the well or spring source of water supply. |
| supplemental irrigation water surcharge capacity | Reservoir storage capacity between the maximum water surface elevation and the highest of the following water surface elevations: (1) top of exclusive flood control capacity, (2) top of joint use capacity, or (3) top of active conservation capacity. |

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| surface water | Water on the surface of the earth; an open body of water, such as a river, stream, or lake. |
| tailwater | The water in the natural stream channel immediately downstream from a dam. |
| Transient, non-community public water supply system | A U.S. Environmental Protection Agency (USEPA) designation for a public water supply system that provides water for a transient, non-residential population of at least 25 different people over a period of at least 60 days per year, such as at a highway rest area or resort. |
| transmissivity | The rate of groundwater flow in an aquifer in gallons per minute of flow through a one foot wide vertical section of the entire aquifer thickness under a hydraulic gradient of one foot. |
| Triangle (groundwater) | A wedge of land in eastern Wyoming bounded by Whalen Diversion Dam on the west, the Wyoming-Nebraska State Line on the east, a line parallel to and offset by 300 feet south of the Gering/Fort Laramie Canal on the south, and a line parallel to and offset by one mile north of the Interstate Canal on the north. |
| unconfined condition | Groundwater present in an aquifer without an overlying low permeability bed or upward water pressure. |
| uppermost aquifer | The uppermost body of groundwater that is present below the ground surface; the term may or may not include perched groundwater. |
| vadose zone | A sequence of earth materials overlying the uppermost aquifer; this zone may contain moisture, but is not saturated with water. |
| waste (irrigation) | Water which is diverted from a river in a canal or ditch for irrigation use but which, because of conveyance system limitations, is not diverted from the canal or ditch to irrigate land and is discharged to a drain or stream via wasteways along the irrigation canal. |
| wasteway (in canal) | An emergency spillway structure located along an irrigation canal that discharges excess canal flow to prevent overtopping of the canal; typically include manually controlled gates (checked and operated daily by ditch rider) and discharges into a man-made drain channel or natural drainage channel. |

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| water level | The water-surface elevation or stage of the free surface of a body of water above or below any datum or the surface of standing water in a well, usually indicative of the position of the groundwater surface (the "water table") or other potentiometric groundwater surface. |
| water table | An archaic term from the 1800s that is now superseded in modern technical use by the term "groundwater surface;" use of the term "water table" should be discontinued in technical documents. |
| water year | October 1 - September 30 (e.g., Water Year 2005 begins October 1, 2004, and ends September 30, 2005). |
| wicket gate | A water flow control gate typically located in hydroelectric generating system which pivots open around the periphery of a turbine or pump to allow water to enter. |

# ACRONYMS AND ABBREVIATIONS

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| ac-ft | acre-feet |
| AFO | animal feeding operations |
| AML | abandoned mine lands |
| BAG | Basin Advisory Group |
| BEPC | Basin Electric Power Cooperative |
| BURP | Beneficial Use Reconnaissance Program (of the State of Wyoming) |
| BMP | best management practice |
| CAFO | concentrated animal feeding operation |
| CBM | coal bed methane (natural gas) |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act (federal) |
| $CU_W$ | consumptive use of irrigation water, usually in units of inches per acre per month |
| CWA | Clean Water Act (federal) |
| cfs | cubic feet per second |
| DEIS | draft environmental impact statement |
| DEQ | Department of Environmental Quality (of the State of Wyoming) |
| DOI | United States Department of the Interior |
| EA | environmental assessment |
| EIS | environmental impact statement |
| EQA | Environmental Quality Act (of the State of Wyoming) |
| ESA | Endangered Species Act |
| ft | feet |
| GIS | Geographic Information System |
| gal | gallons |
| gpd | gallons per day |
| gpcd | gallons per capita per day |
| GW | groundwater |
| HPRCC | High Plains Regional Climate Center (at the University of Nebraska, Lincoln) |

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| HUC | hydrologic unit code |
| LQD | Land Quality Division (of the Wyoming Department of Environmental Quality) |
| MCL | maximum contaminant level |
| mgd | million gallons per day |
| NAS | National Academy of Sciences |
| NASS | National Agricultural Statistics Service |
| NEPA | National Environmental Policy Act |
| NPDES | National Pollutant Discharge Elimination System |
| NIWQP | National Irrigation Water Quality Program |
| NPS | non-point source (of pollution) |
| NRCS | Natural Resource Conservation Service |
| OGCC | Oil and Gas Conservation Commission (of the State of Wyoming) |
| PRESP | Platte River Endangered Species Partnership |
| PRRIP | Platte River Recovery and Implementation Program |
| PS | point source (of pollution) |
| QA/QC | quality assurance/quality control |
| RCRA | Resource Conservation and Recovery Act (federal) |
| SDWA | Safe Drinking Water Act (federal) |
| SEO | Wyoming State Engineer’s Office |
| SHWD | Solid and Hazardous Waste Division (of the Wyoming Department of Environmental Quality) |
| SMP | State Management Plan (of the State of Wyoming) |
| SW | surface water |
| TDS | total dissolved solids (in water, in units of milligrams per liter, mg/L) |
| TMDL | total maximum daily load (of pollutants in a water body) |
| USBR | United States Bureau of Reclamation |
| USBLM | United States Bureau of Land Management |
| USCOE | United States Army Corps of Engineers |
| USEPA | United States Environmental Protection Agency |
| USFS | United States Forest Service |

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| USFWS | United States Fish and Wildlife Service |
| USGS | United States Geological Survey |
| UST | underground storage tank |
| WACD | Wyoming Association of Conservation Districts |
| WGF | Wyoming Game and Fish Department |
| WQD | Water Quality Division (of the Wyoming Department of Environmental Quality) |
| WRDS | Water Resources Data System (at the University of Wyoming) |
| WWDC | Wyoming Water Development Commission |
| WYPDES | Wyoming Pollutant Discharge Elimination System |