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Technical Memorandum | Final

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Subject:	**CRWAS Phase I | Task 3.1 | Glossary of Terms**
Date:	**June 23, 2009**

The objective of the Colorado River Water Availability Study (CRWAS or Study) Task 3.1 is to *provide website-ready Glossary of Terms to facilitate communications with BRT members and others involved in the Study.* This document provides a glossary of standard water resources and water rights terms extended to include terms related to paleo-hydrology and climate change topics. References used to generate this glossary (noted by reference number after each definition) are listed below.

1. CWCB Online Glossary and CDSS Supporting Documentation:
   - http://cwcb.state.co.us/nr/rdonlyres/4950bc4a-bbba-430b-89ad-75785ddf003a/0/glossary.pdf
   - http://cwcb.state.co.us/WaterInfo/CRWAS/CDSSSupportingDocumentation/
2. CDWR Online Glossary: http://water.state.co.us/wateradmin/terms.asp
3. CRWCD Online Glossary: http://www.crwcd.org/page_100
4. CFWE Online Glossary and "Citizen's Guides":
   - http://cfwe.org/schoolprograms/glossary.asp
   - http://cfwe.org/CitGuides/CitGuides.asp
5. Garnaut Online Glossary: http://www.garnautreview.org.au/glossary.htm
6. EPA Online Glossary: http://www.epa.gov/climatechange/glossary.html
7. NOAA Online Glossary: http://www.cdc.noaa.gov/enso/glossary
8. IPCC Online Glossary: http://www.ipcc.ch/glossary/index.htm
9. Ray, Andrea J., Joseph J. Barsugli, and Kristen B. Averyt. Climate Change in Colorado, A Synthesis to Support Water Resources Management and Adaptation, A Report for the Colorado Water Conservation Board. University of Colorado at Boulder. Boulder, CO: CU-Boulder University Communications, 2008.

1041 Permit	The 1041 Land Use authorities give counties and municipalities control over "projects of statewide interest," such as pipelines and water projects, within their boundaries. These powers were granted through House Bill 1041 (1974).[3]
1922 Compact	See *Colorado River Compact*
1948 Compact	See *Upper Basin Compact*
Abandonment	Loss of whole or part of a water right by intent to permanently discontinue use.[1]
Absolute Water Right	A water right that has been placed to *beneficial use*.[1, 9]
Acre-Foot	The amount of water it would take to cover an acre of land to a depth of 1 foot, approximately 325,851 gallons.[1]
Adaptation	An adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of *adaptation* can be distinguished, including anticipatory, autonomous, and planned *adaptation*.[9]
Adaptation Assessment	The practice of identifying options to adapt to *climate change* and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency, and feasibility.[8]
Adaptation Benefits	The avoided damage costs or the accrued benefits following the adoption and implementation of *adaptation* measures.[8]
Adaptation Costs	Costs of planning, preparing for, facilitating, and implementing *adaptation* measures, including transition costs.[8]
Adaptive Capacity (adaptability)	The ability of a system to adjust to *climate change* (including *climate variability* and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.[8]
Adjudication	A judicial decree dating and defining a water right.[1]
Administration	*Administration* is the action taken by the State Engineer's Office when there is not enough water physically available to meet the demands of all water rights holders within a river *basin*. Through the process of *administration*, senior water rights are satisfied by shutting off water supplies to junior water rights, beginning with the most recent priority dates and moving back chronologically, until the all the supply of water available for diversion is expended.[3]
Alpine	The biogeographic zone made up of slopes above the tree line characterized by the presence of rosette-forming herbaceous plants and low, shrubby, slow-growing woody plants.[8]
Appropriation	The right to take water from a stream and put it to *beneficial use*. Considered property rights and may be bought, sold, leased, and exchanged. *Appropriation* establishes a water right by diversion, due diligence, and *beneficial use*. The right to withdraw water from its source.[1]
Aquifer	A stratum of permeable rock that bears water. An unconfined *aquifer* is recharged directly by local rainfall, rivers, and lakes, and the rate of recharge will be influenced by the permeability of the overlying rocks and soils.[8] A subsurface water-bearing geological structure capable of storing and yield water to streams, springs or wells.
Aquifer Storage and Recovery (ASR)	Underground water storage in a suitable *aquifer* that is recovered when needed.[1]
Artesian Well	An *artesian well* taps underground water which is under sufficient pressure that water rises to the surface naturally.[3]

Augmentation	Supplementing the water supply of a stream affected by well depletion, in order to protect senior water rights on a stream. *Augmentation* puts no water in the well. It is not designed to recharge the *aquifer*[1] Replacing the quantity of water depleted from a stream system caused by an out of priority diversion.
Augmentation Plan	A way for junior appropriators to obtain water supplies through terms and conditions approved by a water court that protect senior water rights from the depletions caused by the new diversions. Typically involve storing junior water when in priority and releasing that water when a *call* comes, purchasing stored waters from federal entities or others to release when a river *call* comes, or purchasing senior irrigation water rights and changing the use of those rights to off-set the new users injury to the stream[.1, 9]
Average-Day Demand	A water system's average daily use based on total annual water production (total annual gallons or cubic feet divided by 365); multiple years can be used to account for yearly variations[.1]
Baseflow	As used in the Colorado Decision Support System. A flow volume or flow rate that represents streamflows absent man's influence, including diversions, return flows, reservoir operations and pumping. Synonymous with "naturalized flow". If all of anthropogenic influence is removed, baseflows are often called virgin flows or natural flows.[1]
Baseline	An established value or trend used for comparison when conditions are altered, as in the introduction of water *conservation* measures[.1] As used in CDSS, a baseline data set is intended as a generic representation of recent conditions to be used for "what-if" analyses. It represents one interpretation of current use operating and administrative conditions as though they prevailed throughout the modeling period. The data set is a starting point which the user may choose to add to or adapt for a given application or interpretation of probable demands and near-term conditions. Typically the investigator wants to understand how a river regime would change under a new use or different operations. The change needs to be quantified relative to how a river would look today absent the new use or different operation, which maybe quite different from the historical record. The Baseline data set provides a basis against which to compare future scenarios.[1]
Basin	A region drained by a single river system[.1]
Beneficial Use	Defined statutorily as "the use of that amount of water that is reasonable and appropriate under reasonably efficient practices to accomplish without waste the purpose for which the *appropriation* is lawfully made [.]" In Colorado, water must be diverted for a *beneficial use*, which is the use of a reasonable amount of water necessary to accomplish the purpose of the *appropriation* without waste[.1] or Water in Colorado must be diverted for a purpose and used beneficially to get a water right. Beneficial use is the use of a reasonable amount of water necessary to accomplish the purpose of the appropriation, without waste. Some common types of beneficial use are: irrigation, municipal, wildlife, recreation, mining, household use.[2]
Best Management Practice (BMP)	A measure or activity that is beneficial, empirically proven, cost-effective, and widely accepted in the professional community[.1]
Blaney-Criddle Consumptive Use Method	Method developed by the Soil Conservation Service (SCS) and employed in the CDSS Consumptive Use Model (StateCU) for estimating crop consumptive use (evapotranspiration).[1]
Blue Line	Defines the area within which a district's blanket *augmentation plan* might benefit[.1]

Budget (Water-Use)	An accounting of total water use or projected water use for a given location or activity.[1]
Bureau of Reclamation	The U.S. *Bureau of Reclamation* (USBR, BOR, BuRec) is a federal agency within the U.S. Department of the Interior whose historical purpose was to open the lands of the western U.S. to settlement through the construction of water projects to irrigate arid lands. They were responsible for building many of the west's major water projects, dams, reservoirs, tunnels and canals, building over 180 projects in 17 western states. Their primary mission has recently evolved into the role of water managers, rather than builders of new water projects.[3]
Call	See *River Call*.
Capital Facilities	Physical facilities used in the production, transmission, treatment, and distribution of water or the collection, treatment, and disposal of wastewater.[1]
Carry-Over Storage	The amount of water carried over from season to season through both wet and dry cycles in storage facilities.[1]
CFS	*CFS* is an acronym for cubic feet per second. A cubic foot per second is one cubic foot of water passing by a single point for one second. *CFS* is the standard unit of measure for water that is in motion, such as water flowing in rivers and streams. A flow rate of one *cfs* would mean that 7.48 gallons passed by a point of reference in one second or 448.8 gallons of water in one minute. Over the course of 24 hours, a flow of one *cfs* would produce 646,317 gallons or almost the equivalent of two acre-feet per day.[3]
Change of Water Right	Any change in the way a water right is used. Can be change in type, place or time of use, change in point of diversion, adding points of diversion, etc. It is not a change in use if a farmer changes the type of crop grown. Changes of water rights must be approved by the water court to assure that no injury occurs to other water rights.[2]
Check Structure	A device used to control the flow, pressure, or direction of water through a canal or irrigation system. *Check structure*s allow for more efficient use of water in a canal by regulating flows in a manner where less water is needed to accomplish a *beneficial use*.[3]
Chronology	The time-series of annual ring-width indices derived from measuring actual tree-ring widths and filtering for age and geometry related growth trends for one site is called a chronology.[1]
Climate	*Climate* in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation, and wind. *Climate* in a wider sense is the state, including a statistical description, of the *climate system*.[9]

Climate Change	*Climate change* refers to a change in the state of the *climate* that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. *Climate change* may be due to natural internal processes or external forcings, or to persistent *anthropogenic* changes in the composition of the *atmosphere* or in land use. Note that the Framework Convention on Climate Change (UNFCCC), in its Article 1, defines *climate change* as: 'a change of *climate* which is attributed directly or indirectly to human activity that alters the composition of the global *atmosphere* and which is in addition to natural *climate variability* observed over comparable time periods'. The UNFCCC thus makes a distinction between *climate change* attributable to human activities altering the atmospheric composition, and *climate variability* attributable to natural causes.[8]
Climate Divisions	The five NOAA National Climatic Data Center (NCDC) official *climate divisions* group Colorado *climate* data into regions by river *basin*s, but these divisions are not necessarily representative of the complex regional *climate*s in the state. A new set of *climate divisions* has been developed (Wolter and Allured 2007). These new divisions are based on groups of observing stations that vary in a similar manner for year to year, and are thought to reflect similar regional *climate* processes.[9]
Climate Model	A numerical representation of the *climate system* based on the physical, chemical, and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties. The *climate system* can be represented by models of varying complexity (i.e., for any one component or combination of components a hierarchy of models can be identified, differing in such aspects as the number of spatial dimensions, the extent to which physical, chemical, or biological processes are explicitly represented, or the level at which empirical parameterizations are involved. Coupled *atmosphere*/ocean/sea-ice General Circulation Models (*AOGCM*s) provide a comprehensive representation of the *climate system*. More complex models include active chemistry and biology. *Climate model*s are applied, as a research tool, to study and simulate the *climate*, but also for operational purposes, including monthly, seasonal, and inter-annual *climate prediction*s.[8]
Climate Prediction	A *climate prediction* or *climate* forecast is the result of an attempt to produce an estimate of the actual evolution of the *climate* in the future, for example, at seasonal, inter-annual, or long-term time scales. Since the future evolution of the *climate system* may be highly sensitive to initial conditions, such predictions are usually probabilistic in nature.[8]
Climate Projection	A projection of the response of the *climate system* to emission or *concentration* scenarios of greenhouse gases and *aerosols*, or radiative forcing scenarios, often based upon simulations by *climate model*s. *Climate projection*s are distinguished from *climate prediction*s in order to emphasize that *climate projection*s depend upon the emission/*concentration*/radiative forcing scenario used, which are based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized and are therefore subject to substantial uncertainty.[8]

Climate Scenario	A plausible and often simplified representation of the future *climate*, based on an internally consistent set of climatological relationships that has been constructed for explicit use in investigating the potential consequences of *anthropogenic climate change*, often serving as input to impact models. *Climate projection*s often serve as the raw material for constructing *climate scenario*s, but *climate scenario*s usually require additional information such as about the observed current *climate*. A *climate change* scenario is the difference between a *climate scenario* and the current *climate*.[8]
Climate Scenario A1B	The A1 storyline and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are *convergence* among regions, *capacity building*, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into three groups that describe alternative directions of technological change in the energy system. The three A1 groups are distinguished by their technological emphasis: fossil intensive (A1FI), non-fossil energy sources (A1T), or a balance across all sources (*A1B*) (where balanced is defined as not relying too heavily on one particular energy source, on the assumption that similar improvement rates apply to all energy supply and end use technologies).[9]
Climate Scenario A2	The *A2* storyline and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing population. Economic development is primarily regionally oriented and per capita economic growth and technological change more fragmented and slower than other storylines.[9]
Climate Scenario B1	The *B1* storyline and scenario family describes a convergent world with the same global population, that peaks in mid-century and declines thereafter, as in the A1 storyline, but with rapid change in economic structures toward a service and information economy, with reductions in material intensity and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional *climate* initiatives.[9]
Climate (change) Scenario	A plausible and often simplified representation of the future *climate*, based on an internally consistent set of climatological relationships and assumptions of radiative forcing, typically constructed for explicit use as input to *climate* change impact models. A '*climate change scenario*' is the difference between a *climate scenario* and the current *climate*.[8]
Climate System	The *climate system* is the highly complex system consisting of five major components: the *atmosphere*, the hydrosphere, the cryosphere, the land surface and the *biosphere*, and the interactions between them. The *climate system* evolves in time under the influence of its own internal dynamics and because of external forcings such as volcanic eruptions, solar variations and *anthropogenic* forcings such as the changing composition of the *atmosphere* and land use change.[8]
Climate Variability	*Climate variability* refers to variations in the mean state and other statistics (such as standard deviations, statistics of extremes, etc.) of the *climate* on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the *climate system* (internal variability), or to variations in natural or *anthropogenic* external forcing (external variability).[9]

Colorado Decision Support System (CDSS)	State of Colorado's water resources planning system being developed by the Colorado Water Conservation Board and the Colorado Division of Water Resources. The goal of this system is to assist in making informed decisions regarding historic and future use of water.[1]
Colorado Decision Support System (CDSS) Consumptive Use Model (StateCU)	State of Colorado's model developed to estimate/report both crop and non-crop consumptive use within the state. It consists of a FORTRAN based computer program and an associated graphical user interface. The primary crop consumptive use method employed in the program and the user interface is modified Blaney-Criddle consumptive use method with calculations on a monthly basis. Other crop consumptive use methods available when the FORTRAN program is operated independently of the interface include the Penman-Monteith and Modified Hargreaves methods, both operated on a daily time step.[1]
Colorado Decision Support System (CDSS) Data Management Interface (DMI)	State of Colorado's model utilities that provide an interface between the HydroBase database and other applications.[1]
Colorado Decision Support System (CDSS) HydroBase	State of Colorado's relational database, containing streamflow, diversion, water rights, and other data.[1]
Colorado Decision Support System (CDSS) Stream Simulation Model (StateMod)	State of Colorado's monthly and daily water allocation and accounting model capable of making comparative analyses of various historic and future water management policies and water supply scenarios in a river basin. It is designed to be applied to any river basin through appropriate input data preparation.[1]
Colorado Revised Statutes (CRS)	The annual compilation of Colorado statutes and court rules published by the Colorado General Assembly. Also called "the red books." [4]
Colorado River Compact	Water allocation problems along the full length of the Colorado River prompted the 1922 *Colorado River Compact* between Colorado, Wyoming, Utah, New Mexico, Nevada, Arizona, and California. The Colorado River was split into Upper Basin and Lower Basin segments, with Lee's Ferry in Arizona serving as the dividing point and it was agreed to apportion the waters of the Colorado River to these two *basin*s. Each *basin* would then allocate water among its states. In 1948, the Upper Basin states of Colorado, Wyoming, Utah, and New Mexico agreed on apportioning the Upper Basin's share.[3]
Colorado River Simulation System (CRSS)	U.S. Bureau of Reclamation's long-term planning and operations model of the Colorado River Basin hydrology (including 21 natural flow stations in the Upper Colorado River Basin and 8 natural flow stations in the Lower Colorado River Basin) and facilities throughout Colorado, Wyoming, Utah, New Mexico, Arizona, Nevada, and California.

Colorado River Water Conservation District (CRWCD)	The *Colorado River Water Conservation District* (*CRWCD*), also known as the River District, is a governmental entity formed in 1937. It evolved from the Western Colorado Protective Association, which was a group dedicated to protecting the Colorado River from threats of out-of-*basin* diversions. The present day River District's mission is to protect and conserve the waters of the Colorado River within Colorado for *beneficial use*. It is a policy-making entity that can hold water rights, fund water projects, litigate, lobby for legislation, and mediate disputes affecting the district. The River District represents all or part of 15 West Slope counties, including: Grand, Summit, Eagle, Pitkin, Routt, Garfield, Moffat, Rio Blanco, Gunnison, Mesa, Delta, Montrose, Ouray, Hinsdale, and Saguache counties. Each county has one representative seated on the River District's Board of Directors appointed by the county's Board of Commissioners for three-year terms. The River District is principally funded by a tax assessment based on value of a land owner's property mill levy.[3]
Colorado Water Conservation Board (CWCB)	A division of the Colorado Department of Natural Resources, the *CWCB* was created in 1937 for the purpose of aiding in the protection and development of the waters of the state. The Mission Statement of the *CWCB* is to conserve, develop, protect and manage Colorado's water for present and future generations.[1]
Compact	A *compact* is an agreement among states, approved by Congress, resolving interstate matters. When *compact*s are made concerning rivers, the *compact* establishes how states along a river allocate its water. Colorado has entered into nine interstate *compact*s agreeing to terms and conditions of water allocation.[3]
Compensatory Storage	*Compensatory storage* is a concept pioneered by the Western Colorado Protective Association, an organization that became the *Colorado River Water Conservation District* in 1937. This principle contends that transmountain diversions should provide a stored water supply to the *basin* of origin to compensate, or mitigate, for the effects of the diversion. Transmountain diversions reduce the potential for future in-*basin* water use, growth, and development, and *compensatory storage* is designed to protect the *basin* of origin. This principle was first applied to the *C-BT* Project and resulted in the construction of Green Mountain Reservoir. Ruedi Reservoir is the compensatory portion of the Fryingpan - Arkansas project.[3]
Conditional Water Right	This water right allows an appropriator to secure a priority before water has been applied to *beneficial use* by showing that the "first step" towards the *appropriation* has been taken. The "first step" includes the intent to appropriate, plus a sufficient demonstration of that intent. Once the appropriator actually places the water to *beneficial use*, a final decree may be issued with a priority date relating back to the initiation of the *appropriation*.[1] or A right obtained through the water court which fixes the priority of the water right with a certain date, even though the appropriation has yet to be completed. It gives the holder of that right time to complete the appropriation as long as they diligently pursue completion of the project. Every six years the court reviews what progress has been made toward completion of the project (called "diligence"). Once the right has been perfected by use, the holder of the conditional right must then ask the court to make it an absolute water right (See definition for absolute water right.).[9]
Confidence	The level of *confidence* in the correctness of a result.[8]

Confidence Interval	The range around a survey result for which there is a high statistical probability that it contains the true population parameter. This is commonly referred to as the margin-of-error.[1]
Conjunctive Use	Combined use of surface and ground water in a coordinated manner.[1]
Conservancy District	A conservancy district is a taxing body created for the purpose of constructing, paying for, and operating water projects. A conservancy district can cover a very large area of the state or a very small one, depending upon how many people agree to be included and the area benefiting from the project or projects.[3]
Conservation District	A *conservation district* is a policy-making body that is chartered by the General Assembly of Colorado for the purpose of protecting and developing the water resources of a portion of the state. Many conservancy districts can be located within the boundaries of a *conservation district*. There are four water *conservation district*s in Colorado: The *Colorado River Water Conservation District* (*CRWCD*) covers northwest and west central Colorado, The Southwestern Water Conservation District (SWCD) covers the southwest corner of the state, the Rio Grande Water Conservation District (RGWCD) covers the San Luis Valley and the recently (2004) formed Republican River Water Conservation District that represents the Republican River Basin in eastern Colorado.[3]
Conservation Easement for Water Rights	Legal provision under 2003 statute allowing owners of water rights to covenant for keeping the water in use for open space, wetlands, recreation, ecological diversity, or farming.[4]
Consumptive Use	Use that results in water being unavailable for recapture within a local or regional water system: e.g., evapotranspiration of irrigation water into the air.[1]
Cooperative Agreements	Methods for sharing water resources in cases of scarcity, which include legal agreements such as, for example, dry year leasing, transfers, *augmentation plan*s, water *conservation* easements, water *banking*, and substitute water supply plans.[1]
Correlation	Generally refers to a measure of the linear relationship between two populations. In *climate*, it most often refers to the relationship between two time-series.[7]
Cubic Feet per Second (cfs)	Measurement of flow rate of water in running stream or taken as direct diversion from the stream. Water flowing at 1 *cfs* will deliver 448.8 gallons per minute, or 648,000 gallons per day.[4]
Curtailment	Actions that forego or reduce desired water uses; e.g., prohibitions on lawn watering or car washing during a drought water emergency.[1]
Decree	An official document issued by the court defining the priority, amount, use, timing, and location of a water right.[3]
Deforestation	Natural or *anthropogenic* process that converts forest land to non-forest.[8]
Demand Forecast	A projection of future demand that can be made on a system-wide or customer-class basis.[1]
Demand Management or Demand-Side Management	Measures, practices, or programs deployed by water utilities to permanently reduce the level or change the pattern of demand for a utility service.[1]
Dendrochronology	The analysis of the annual growth rings of trees, leading to the calculation of significant indices of climate and general chronology of the past. The width of a tree-ring is determined by the temperature and/or moisture that prevailed during the year of its formation. Since stress from temperature and/or moisture variations reduces the width of the seasonal growth of a tree ring, dendrochronology has important application in the study of long-term climatic variations.[1]

Depletion	Depletion is the amount of water lost to a river system or *aquifer* when water is diverted from it.[3]
Designated Groundwater	Groundwater areas not adjacent to a continuously flowing natural stream, where groundwater has been the principal water supply for at least fifteen years preceding the designation of the groundwater *basin*. Eight designated groundwater *basin*s exist on Colorado's eastern high plains. Use of designated groundwater requires a permit from the Colorado Groundwater Commission.[4]
Devegetation	This is loss of vegetation density within one land-cover class.[8]
Developed Water	See *Imported Water*.
Diligence	Reasonable progress towards making a *conditional water right* absolute by putting unappropriated water to a *beneficial use*. Must be proved in a water court proceeding through an application initiated every six years after entry of the conditional decree or most recent diligence decree. Acts demonstrating diligence include engineering, permitting, financing, and construction of water facilities needed to complete water diversion and delivery to the place of use.[4]
Direct Flow Water Right	A right or legal claim to withdraw a specified rate of water in a specified time frame for a specified beneficial use.
Distribution Facilities	Pipes, treatment, storage and other facilities used to distribute drinking water to end users.[1]
Disturbance Regime	Frequency, intensity, and types of disturbances, such as fires, insect or pest outbreaks, floods, and droughts.[8]
Ditch Rider	"Ditch rider" is the nickname applied to anyone who manages a ditch system, canal network or water distribution system and is responsible for ensuring that senior water rights are met first or that ditch company members receive the amount of water owned.[3]
Diurnal	Diurnal describes the fluctuations of streamflow throughout the day. The rate of snowmelt increases with periods of sun exposure and increased temperature. Streamflows increase after the sun exposure of daylight hours and corresponding decrease after periods of darkness.[3]
Diurnal Temperature Range	The difference between the maximum and minimum temperature during a 24-hour period.[8]
Diversion / Divert	Removing water from its natural course or location, or controlling water in its natural course or location, by means of a water structure such as a ditch, pipeline, pump, reservoir, or well. The *Colorado Water Conservation Board* may appropriate instream flows without diversion, and local governmental agencies may make recreational in-channel diversions, under specified statutory procedures.[4]
Division Engineer	Head of staff for a water division, supervising a staff of water commissioners, whose primary job is to distribute the waters of the state by monitoring headgates, responding to water *call*s, issuing orders to reduce or cease diversions, and collecting data on diversions.[1]
Division of Water Resources	A division of the Colorado Department of Natural Resources, the Division of Water Resources administers and enforces all surface and ground water rights throughout the State of Colorado, issues water well permits, approves construction and repair of dams, and enforces interstate *compact*s. It is also the agency responsible for implementing and enforcing the statutes of the Ground Water Management Act passed by the Legislature as well as implementing applicable rules and policies adopted by the Colorado Ground Water Commission and the State Board of Examiners of Water Well Construction and Pump Installation Contractors.[1]
DMI	See *Colorado Decision Support System (CDSS) Data Management Interface (DMI).*

Downscaling	Downscaling is a method that derives local- to regional-scale (10 to 100 km) information from larger-scale models or data analyses. Two main methods are distinguished: dynamical downscaling and empirical/statistical downscaling. The dynamical method uses the output of regional *climate model*s, global models with variable spatial resolution or high-resolution global models. The empirical/statistical methods develop statistical relationships that link the large-scale atmospheric variables with local/regional *climate variable*s. In all cases, the quality of the downscaled product depends on the quality of the driving model.[9]
Drawdown	The lowering of reservoir water levels by releasing stored water or pumping ground water. A reservoir may be drawn down during the winter months to make room for spring flood flows caused by melting snows.[3]
Drought	Defined as three separate terms, drought is 1) Meteorological Drought: A period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area; 2) Agricultural Drought: A climatic excursion involving a shortage of precipitation sufficient to adversely affect crop production or range production; 3) Hydrologic Drought: A period of below average water content in streams, reservoirs, ground-water *aquifer*s, lakes and soils.[1]
Drought Management Plan	A document that indicates how an entity or set of entities will manage impacts of water shortages over the short or long term. It may contain information on coordinated drought monitoring, impact assessment, response to emergency drought problems, and mitigation of drought impacts.[1]
Drought Mitigation	Actions taken before a drought that reduce the occurrence and severity of water supply shortfalls.[1]
Drought Response	Actions taken during a drought to manage water supplies and water demand appropriately.[1]
Drought Trigger	A typically quantitative threshold at which an entity declares that a drought has been entered. This may be reservoir levels, precipitation levels or other such measurements and are often set to indicate droughts of mild, moderate and severe levels.[1]
Dry-Year Leasing	Negotiation of temporary water transfers for specific hydrologic and climatic conditions.[1]
Dynamic Global Vegetation Model (DGVM)	Models that simulate vegetation development and dynamics through space and time, as driven by *climate* and other environmental changes.[8]
Dynamical Climate Models	*Climate Model*s that use explicit physics (mechanisms). The physics can be simple or complex. Sometimes it is possible to model processes exactly; more often parameterizations are needed to describe processes that are too detailed, not well understood or too small scale for the model to resolve.[7]
East Slope	The East Slope of Colorado is the portion of the state that lies east of the Continental Divide. The East Slope includes the North Platte, South Platte, Arkansas, and Rio Grande River *basin*s. Most of Colorado's population lives on the East Slope, though most of the precipitation falls on the West Slope or the portion of Colorado west of the Continental Divide.[3]
Ecosystem	A system of living organisms interacting with each other and their physical environment. The boundaries of what could be called an ecosystem are somewhat arbitrary, depending on the focus of interest or study. Thus, the extent of an ecosystem may range from very small spatial scales to, ultimately, the entire Earth.[8]
End User	Residential, commercial, industrial, governmental, institutional or other water user that applies water to *beneficial use*.[1]

Ensemble	A group of parallel model simulations used for *climate projection*s. Variation of the results across the ensemble members gives an estimate of uncertainty. Ensembles made with the same model but different initial conditions only characterize the uncertainty associated with internal *climate variability*, whereas multi-model ensembles including simulations by several models also include the impact of model differences. Perturbed parameter ensembles, in which model parameters are varied in a systematic manner, aim to produce a more objective estimate of modeling uncertainty than is possible with traditional multi-model ensembles.[8]
Ensemble Forecasts	Instead of running a numerical weather model once, they can be run multiple times using slightly different initial conditions and the average of the runs used as a forecast. This method tried to correct for the fact the initial conditions cannot be entirely known and that this relatively small uncertainty can grow into large forecast errors. By repeating the runs, it is hoped the most probable future state of the *atmosphere* can be determined.[7]
Evaporation	The transition process from liquid to gaseous state.[8]
Evapotranspiration	Loss of water from plant transpiration and evaporation from soils and water bodies. Contributes to water losses from water systems. Water losses from the surface of soils and plants.[1]
Exchange	An exchange is an agreement between parties that water can be diverted or stored at one point, in exchange for an equivalent amount of water to be released or bypassed at another point on a river system In an exchange, the diversion or storage of water and the release or bypass of water from another point must occur simultaneously to prevent injury to other water users. Exchanges must be approved by the State Engineer's Office, which will shepherd the exchanged water downstream to meet the needs of the senior water rights.[3]
Exempt Well	Small residential and livestock wells are considered to be exempt from administration. To obtain this type of exemption, strict criteria must be met as set forth by the legislature and administered by the State Engineer. For further information see Colorado Revised Statutes section 37-92-602.[2]
Extreme Weather Event	An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of the observed probability density function. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. Single extreme events cannot be simply and directly attributed to *anthropogenic climate change*, as there is always a finite chance the event in question might have occurred naturally. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme *climate* event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).[8]
Federal Reserved Water Right	The federal government has claimed that whenever it reserves a portion of land, for instance Indian reservations and national parks, that an implied water right is attached to that land to fulfill the purpose of the land's reservation. These rights were first established in the landmark Winters v. U.S. (1908) case. The claim to these water rights is very contentious, because these rights are in many cases not asserted at the time of the land's reservation, instead coming later with large senior claims.[3]

First In Time, First In Right	"First in time, first in right" is a term synonymous with the prior *appropriation* system. This phrase denotes how those with the oldest and therefore most senior *appropriation*s of water have priority over other younger, or more junior, water rights during times of insufficient water supply.[3]
Forecast	Projected outcome from established physical, technological, economic, social, behavioral, etc. patterns.[8]
Free River	Free river conditions occur when there is more water than all perfected water rights on a river system, enabling any water user, with or without water rights, to use water from that waterway. A free river is most likely to occur during the spring runoff or on streams that have few water users.[3]
Frequency	A measure of how often an event occurs; a count of the number of subjects falling in the different categories.[1]
Front Range	Front Range refers to the band of large municipalities that sit along the eastern foothills of the Rocky Mountains in Colorado. This region is marked by intense development and harbors a majority of the state's population. The Front Range stretches from the northern communities of Fort Morgan, Fort Collins, and Greeley, near the Colorado-Wyoming border, through the Denver metropolitan area and south to Colorado Springs and Pueblo. The term "I-25 corridor" is synonymous with the Front Range, since these communities are all in close proximity to this traffic artery. The Front Range generally lacks the surface water resources necessary to support its population, agriculture, and industries and has become increasingly reliant upon transmountain diversions to augment its natural water supplies.[3]
Futile Call Doctrine	Under this doctrine, junior water users are curtailed only if such curtailment makes water available at the time and place of injury to a senior. This allows juniors to continue diverting in times of scarcity, even if a senior is not receiving its whole entitlement, where curtailment of the junior would not allow any additional water to reach the senior.[1]
General Circulation	The large-scale motions of the *atmosphere* and the ocean as a consequence of differential heating on a rotating Earth, which tend to restore the energy balance of the system through transport of heat and momentum.[8]
General Circulation Models	*Climate model*: (spectrum or hierarchy) A numerical representation of the *climate system* based on the physical, chemical and biological properties of its components, their interactions and feedback processes, and accounting for all or some of its known properties. The *climate system* can be represented by models of varying complexity, that is, for any one component or combination of components a spectrum or hierarchy of models can be identified, differing in such aspects as the number of spatial dimensions, the extent to which physical, chemical or biological processes are explicitly represented, or the level at which empirical parameterizations are involved. Coupled Atmosphere-Ocean General Circulation Models: (*AOGCM*s) provide a representation of the *climate system* that is near the most comprehensive end of the spectrum currently available. There is an evolution towards more complex models with interactive chemistry and biology. *Climate model*s are applied as a research tool to study and simulate the *climate*, and for operational purposes, including monthly, seasonal, and interannual *climate prediction*s.[9]
Groundwater	Water beneath the earth's surface, often between saturated soil and rock, that supplies wells and springs.[1]

Groundwater Recharge	The process by which external water is added to the zone of saturation of an *aquifer*, either directly into a formation or indirectly by way of another formation.[8]
Head	Head is the force (pressure) created by a volume of water. The more water captured over a given location, the more head. Head represents potential energy which is realized when that water is released. Flowing water creates more head as the distance and/ or angle of its fall increases.[3]
Headgate	A headgate is a structure that controls the amount of water entering a diversion. A headgate can completely shut off a diversion, reduce the flow of water to a measured amount, or permit the free flow of water. Headgates can be located at the top of a diversion or along a ditch or canal that serves multiple diversions.[3]
Headwaters	The small streams, generally in the mountains, which are the sources of a river; the first and smallest tributaries of a river.[4]
Heuristic	A common sense rule or rules adopted to solve a problem, e.g. "a rule of thumb".[1]
Historic Use	Historic use documents the physical diversion and *consumptive use* of a water right over a period of time. Private diversion records or State Engineer's office records typically document a water user's historic use.[3]
Historic Users Pool (HUP)	The Historic Users Pool, or HUP, is a group of western Colorado water users that have historically benefit from releases of water out of Green Mountain Reservoir.[3]
HydroBase	See *Colorado Decision Support System (CDSS) HydroBase.*
Hydroelectric	Hydroelectric power generation is the production of electricity from running or falling water, either from free-running watercourses or releases from a dam.[3]
Hydrograph	A hydrograph is the graphic depiction of varying water levels at a given measuring point over a period of time. A hydrograph can record fluctuations over the course of one day, showing the diurnal fluctuations of flows, over the period of days, weeks, months, or years.[3]
Hydrologic Cycle	The hydrologic cycle is the *circulation* of water from the earth's surface to its *atmosphere* and back to earth again by taking on different forms such as snow, rain, or vapor. The earth has a constant amount of water present. However, water moves from place to place and from one form to another through evaporation, transpiration (the release of water by plants), condensation and precipitation.[3]
Hydrologic Drought	Hydrologic drought is related to below-normal streamflow, lake, and groundwater levels.[9]
Hydrosphere	The component of the *climate system* comprising liquid surface and subterranean water, such as oceans, seas, rivers, fresh water lakes, underground water, etc.[8]
Impact Assessment (Climate Change)	The practice of identifying and evaluating, in monetary and/or non-monetary terms, the effects of *climate change* on natural and human systems.[8]
Impacts (Climate Change)	The effects of *climate change* on natural and human systems. Depending on the consideration of *adaptation*, one can distinguish between potential impacts and residual impacts: Potential impacts: all impacts that may occur given a projected change in *climate*, without considering *adaptation*. Residual impacts: the impacts of *climate change* that would occur after *adaptation*.[8]

Imported Water	Water brought into a stream system from another, unconnected source, for example transmountain diversion water or nontributary well water. This type of water can be reused and successively used to extinction, and is often used in *augmentation* or exchange plans. In contrast, native *basin* water is subject to one use, and the return flow belongs to the stream system to fill other *appropriation*s, unless a decree was obtained for the right to reuse and successively use return flows.[4]
Infrastructure	The basic equipment, utilities, productive enterprises, installations, and services essential for the development, operation, and growth of an organization, city, or nation.[8]
Injury	The action of another that causes, or may cause, the holders of decreed water rights to suffer loss of water at the time, place, and amount they would be entitled to use under their water rights if the action had not occurred. Injury is a significant issue in any water court proceeding, and in determinations of the State and Division Engineers.[4]
Instream Flow	River and stream waters that maintain stream quality, aquatic life, and recreational opportunities.[1]
Instream Flow Rights	In Colorado, the *CWCB* is authorized to appropriate or acquire water rights, subject to the priority system, that contribute to minimum stream flows or natural surface water levels or volumes in lakes to preserve the natural environment to a reasonable degree.[1]
Integrated Resource Planning	An open and participatory planning process emphasizing least-*cost* principles and a balanced consideration of supply and demand management options for meeting water needs.[1]
Interannual	Referring to variations from year to year.[7]
Interdecadal	Referring to variations from decade to decade.[7]
Interruptible Supply Agreements	Water rights transferred on a temporary basis for specific needs.[1]
Interruptible Water Leasing	Authorization by 2003 statute to allow farmers to lease water to cities during drought emergencies.[4]
Interstate Compacts	Interstate waters are allocated under agreements between two or more states that govern specific interactions among those states, and require consent by the United States Congress. These *compact*s are intended to allow each state to exercise its own water law and to use its allocated water within its boundaries whenever it might choose.[9]
Intrannual	Referring to variations within a year.[7]
IPCC	The Intergovernmental Panel on Climate Change (IPCC) established by World Meteorological Organization (WMO) and United Nations Environmental Programme (UNEP) provides an assessment of the state of knowledge on *climate change* based on peer-reviewed and published scientific/technical literature in regular time intervals.[9]
Irrigation District	An irrigation district is a public organization that supplies water to residents of the district through diversions, canals, laterals, pipes and other water transport systems primarily for the purpose of agricultural irrigation.[3]
Irrigation Scheduling	A method for optimizing outdoor water use by matching the watering schedule to plant needs; can refer to manual or automated scheduling.[1]
Isohyet	A line on a map connecting locations that receive the same amount of rainfall.[8]
Isotherm	A *contour* of constant temperature.[7]
Junior Water Right	A water right that follows other rights in priority.[1]
Large-Volume User	A water customer, usually industrial or wholesale, whose usage is substantial relative to other users; large-volume users may present unique peaking or other demand characteristics.[1]

Leaf Area Index (LAI)	The ratio between the total leaf surface area of a plant and the ground area covered by its leaves.[8]
Likelihood	The likelihood of an occurrence, an outcome or a result, where this can be estimated probabilistically.[9]
Margin of Error	The range around a survey result for which there is a high statistical probability that it contains the true population parameter. Also referred to as *confidence interval*[1]
Maximum-Day Demand	Total production for the water system on its highest day of production during a year.[1]
Mean	The sum of the values for all observations of a variable divided by the number of observations.[1]
Median	The numerical observation that divides the distribution of observations in half. Sometimes referred to as the second quartile.[1]
Mexico Treaty	1944 Treaty between the United States and Mexico that (among other things) established guidelines for the International Boundary and Water Commission, Colorado River allocations to Mexico, construction of specific water infrastructure, and studies, investigations, and plans for flood control on the Lower Colorado River.
Minimum Stream Flow	Colorado recognizes the benefits of water flowing in the state's rivers and streams. The *Colorado Water Conservation Board* (*CWCB*) has been granted the exclusive authority to hold water rights for the minimum flows necessary to protect the natural environment.[3]
Model	A representation of a process. Models make certain assumptions. They can be statistical (relaying on past data), numerical or theoretical.[7]
Model Bias	Known systematic error of a *climate model*; biases can be assessed by comparing the temperature and precipitation (and other variables) at the model grid with a gridded observational dataset over a given period.[9]
Model Grid	Spatial scale represented in a *climate model*.[9]
Multiple Regression Analysis	Statistical procedure that studies multiple independent variables simultaneously to identify a pattern or patterns.[1]
Native Water	Water arising within a *basin* or drainage.[1]
Natural Flow	Also referred to as "baseflow" in *CDSS* documentation. In order to simulate river basin operations, the model must have the amount of water that would have been in the stream if none of the operations being modeled had taken place. These undepleted flows are called "baseflows". The term is used in favor of "virgin flow" or "naturalized flow" because it recognizes that some historical operations can be left "in the gage", with the estimation that those operations and impacts will not change in the hypothetical situation being simulated. ftp://dwrftp.state.co.us/cdss/swm/in/UColoUsers_20070101.pdf

Nearest-Neighbor Resampling	A form of regression based on pattern matching. Given a predictor object and a distinct population of values or objects, with both the predictor object and the population described or associated with the same set of attributes, a value from the population can be associated with the predictor object based on the similarity of the attributes between the predictor object and the members of the population. This similarity can be measured by the distance, in the space defined by the attributes, from the predictor object to each member of the population. In a case with two attributes, the distance between two points i and j is calculated as the conventional Euclidean distance, d = ((xi-xj)2+(yi-yj)2)½, but distance can be calculated in other ways. Rather than pick the member of the population that is nearest the predictor object, a member can be randomly selected from a subset of the population that is made up of the k members, called neighbors, that are nearest the predictor, a method referred to as the k-nearest neighbor or k-NN method. Selection from the neighbors can be unweighted, or can use a weight based on distance.[1]
Needle Peaks	Persistent levels of peak demand that drive the capacity needs of a water system despite reductions in average demand.[1]
Noise, Climate	The inherently unpredictable portion of the *climate*. Researchers try to separate the (potentially) predictable part of the *climate* signal from the noise.[7]
Nonconsumptive Use	Water withdrawn and returned to the source.[1]
Non-Linearity	A process is called 'non-linear' when there is no simple proportional relation between cause and effect.[8]
Nontributary Groundwater	Groundwater outside of the boundaries of any designated groundwater *basin*, the withdrawal of which will not, within one hundred years, deplete the flow of a natural stream at an annual rate greater than one-tenth of one percent of the annual rate of withdrawal.[4]
Normalization	Adjustment of a variable to a "normal" level based on averaging over an accepted period of time; used in forecasting.[1]
Not Nontributary Groundwater	Groundwater, the withdrawal of which will deplete the flow of a natural stream at an annual rate greater than one-tenth of one percent of the annual rate of withdrawal.[4]
Numerical Prediction Models	Models that represent atmospheric and/or ocean processes mathematically. They can be simple or complex and can be used for forecasting and studying weather and *climate*.[7]
Operating Agreements	Arrangements among water right holders for changes in *call* priority.[1]
Over-Appropriation	A stream or river is over-appropriated when it does not have enough water to meet the needs of all the water rights holders. Many rivers and streams in Colorado are over-appropriated, especially in dry years, in which case the system water rights system determines which water users have a right to use water.[3]
Paleoclimate	*Climate* during periods prior to the development of measuring instruments, including historic and geologic time, for which only proxy *climate* records are available.[9]
Parametrization	In *climate model*s, this term refers to the technique of representing processes that cannot be explicitly resolved at the spatial or temporal resolution of the model (sub-grid scale processes) by relationships between model-resolved larger-scale flow and the area- or time-averaged effect of such sub-grid scale processes.[8]
Peak Demand	The highest point of total water usage experienced by a system, measured on an hourly or a daily basis.[1]

Penman–Monteith Consumptive Use Method	Method developed by the American Society of Civil Engineers (ASCE) and employed in the CDSS Consumptive Use Model (StateCU) for estimating crop consumptive use (evapotranspiration).[1]
Per-Capita Use	Total use divided by the total population served.[1]
Percentile	A percentile is a value on a scale of one hundred that indicates the percentage of the data set values that is equal to or below it. The percentile is often used to estimate the extremes of a distribution. For example, the 90th (10th) percentile may be used to refer to the threshold for the upper (lower) extremes.[8]
Percolation	Percolation is the infiltration of water through porous soils. Water percolates through soils as it moves down to groundwater *basin*s or *aquifer*s.[3]
Perfected Right	A water right is considered perfected when water is actually put to *beneficial use*.[3]
Phreatophyte	A plant that obtains water from the water table or the unsaturated zone just above it. Often found along water supply canals, phreatophytes can consume significant quantities of water through evapotranspiration, reducing the availability of water to a water system and its users.[1]
Planned Adaptation	*Adaptation* that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.[8]
Potable Water	Potable water is water that is fit for human consumption either through its natural purity or due to treatment removing or neutralizing impurities.[3]
Predictability	The extent to which future states of a system may be predicted based on knowledge of current and past states of the system. Since knowledge of the *climate system*'s past and current states is generally imperfect, as are the models that utilize this knowledge to produce a *climate prediction*, and since the *climate system* is inherently nonlinear and chaotic, predictability of the *climate system* is inherently limited. Even with arbitrarily accurate models and observations, there may still be limits to the predictability of such a nonlinear system (AMS, 2000).[8]
Pre-Whitening	Tree-ring chronologies typically contain significant low-order (short-term) autocorrelation, which is either retained in the "standard" chronologies, or removed using autoregressive modeling in a process called pre-whitening to produce "residual" chronologies.[1]
Principal Component Analysis (PCA)	Principal Component Analysis is a transformation technique that is often used to reduce the dimensionality of data. That is, it can be used to extract and select a few principal components from a set of data explained by many variables. It can be thought of as a tool to reveal the internal structure of complex data that best explains the variance in the data. In the Colorado River Basin there may be many tens of tree-ring chronologies. Instead of using a statistical model that involves all of the relevant tree-ring chronologies, PCA can be used to generate the principal components from the entire data set, and then a model (e.g. a regression equation, or a non-parametric model) can be based on a few of the principal components. The number of PCs used in a model is usually the number that explains approximately 90% of the total variance in the data.[1]
Prior Appropriation Doctrine	Commonly described as "first in time first in right." Under this doctrine, rights to water are granted upon the *appropriation* of a certain quantity of water to a *beneficial use*, within a reasonable amount of time. The date of *appropriation* determines the priority of the water right, with the earliest *appropriation* establishing the most senior, or superior, right.[1]

Priority	The ranking of a water right in regards to all other water rights on the stream system. It is determined by the year in which the application was filed for the water right. The date the *appropriation* was initiated determines the relative priority of water rights for which the applications were filed in the same year. Priority determines who may divert and use water in time of short water supply.[1]
Priority Date	A priority date is the date assigned to a water right by the water court, reflecting the first time water was put to *beneficial use* or when a conditional right was secured. The older the priority date, the more senior a water right is and the more likely it will be entitled to water during dry periods. The more recent the priority date, the more junior a water right, and the less likely it will receive water in times of scarcity.[3]
Priority System	The relative seniority of a water right which determines the right to divert the water in relation to other rights in periods of limited supply.[1]
Probability Density Function (PDF)	A probability density function is a function that indicates the relative chances of occurrence of different outcomes of a variable. The function integrates to unity over the domain for which it is defined and has the property that the integral over a sub-domain equals the probability that the outcome of the variable lies within that sub-domain. For example, the probability that a temperature *anomaly* defined in a particular way is greater than zero is obtained from its PDF by integrating the PDF over all possible temperature anomalies greater than zero. Probability density functions that describe two or more variables simultaneously are similarly defined.[8]
Project Water	Water from the transmountain diversion from the Fryingpan River to the Arkansas River Basin, officially called the Fryingpan Arkansas Project.[1]
Proxy	A proxy *climate* indicator is a local record that is interpreted, using physical and biophysical principles, to represent some combination of *climate* related variations back in time. *Climate* related data derived in this way are referred to as proxy data. Examples of proxies include pollen analysis, tree ring records, characteristics of *coral*s and various data derived from ice cores.[8]
Public Trust Doctrine	A common law doctrine that holds that it is the legal right of the public to use certain lands and waters and the responsibility of the state to preserve and protect the right of the public to the use of these lands and waters. Colorado does not have a public trust doctrine.[1]
Raw Water	Untreated Water.[1]
Reclamation	Treatment of used water to make it available for beneficial reuse.[1]
Reconstruction	The use of *climate* indicators to help determine (generally past) *climate*s.[8]
Recreational In-Channel Diversion (RICD)	Recreation is the most recent use of water that is eligible for a water right in Colorado. In a RICD, a quantified amount of water is permitted to remain in the stream for recreational uses and will be protected from uses that would diminish the decreed flow under the priority system. This use of water does not require the diversion of water outside of its normal course, but must show a measure of capture and control of the flow for the beneficial purpose. Kayak and other whitewater recreation courses are the most popular form of RICDs and are non-consumptive in their use of water.[3]
Reforestation	Direct human-induced conversion of non-forested land to forested land through planting, seeding, and/or the human-induced promotion of natural seed sources, on land that was previously forested but converted to non-forested land.[8]
Regional Climate Models	These models typically input the global model grids surrounding their geographical domain and then simulate wind, temperature, clouds, evapotranspiration, and other variables on a much finer grid.[9]

Resampling	Repeatedly selecting a sub-set of values from a set of values typically with replacement following a weight distribution.[1]
Reserved Water Right	When the United States reserves public land for uses such as Indian reservations, military reservations, national parks, forest, or monuments, it also implicitly reserves sufficient water to satisfy the purposes for which the reservation was created. Reservations made by presidential executive order or those made by an act of Congress have implied reserved rights. The date of priority of a federal reserved right is the date the reservation was established. The federal reserved water rights doctrine was established by the U.S. Supreme Court in 1908 in Winters v. United States. In this case, the U.S. Supreme Court found that an Indian reservation (in the case, the Fort Belknap Indian Reservation) may reserve water for future use in an amount necessary to fulfill the purpose of the reservation, with a priority dating from the treaty that established the reservation. This doctrine establishes that when the federal government created Indian reservations, water rights were reserved in sufficient quantity to meet the purposes for which the reservation was established. Today, federal reserved water rights can be asserted on most lands managed by the federal government. Reserved rights are, for the most part, immune from state water laws and therefore, are not subject to diversion and beneficial use requirements and cannot be lost by non-use. The federal government, however, is required to submit all reserved water rights claims to the state's adjudication process, and is limited by the "primary purpose" and "minimal needs" requirements. In addition, federal reserved water rights are nontransferable. By law, these rights can only exist on lands owned by the federal government. If a land transfer occurs, any existing federal reserved water right becomes invalid. (http://www.blm.gov/nstc/WaterLaws/fedreservedwater.html)
Residual Chronology	Tree-ring chronologies for which low-order autocorrelation is removed typically using autoregressive modeling.[1]
Return Flow	Water that returns to streams and rivers after it has been applied to *beneficial use*. It may return as a surface flow, or as an inflow of tributary groundwater.[4]
Reuse (water)	*Beneficial use* of treated wastewater.[1]
Riffle	A riffle is a stretch of stream or river where the flow of water is disturbed by rocks, contributing to the oxygenation of water. Riffles are productive areas of a stream and are essential habitat for macroinvertebrates, fish, and other aquatic plant species.[3]
Riparian	Relating to or living or located on the bank of a natural watercourse (such as a river) or sometimes of a lake or a tidewater.[8]
Riparian Water Law	A legal system that permits water use only by those who own land along the banks of a stream or lake. The right is for reasonable use and is correlative with the right of every other property owner to prohibit unreasonable use that diminishes the instream quantity or quality of water. Colorado law does not recognize riparian rights.[4]
Risk Management	The process of evaluating risks that have the potential to adversely impact operations or conditions in an effort to either reduce risk to an acceptable level or avoid risk altogether.[1]
River Basin	A river *basin* is the land area that naturally drains into a particular water course. The eight largest river *basin*s in Colorado are the Colorado, South Platte, North Platte, Arkansas, Rio Grande, San Juan, White, and Yampa River *basin*s.[3]

River Call	Usually a written document filed with the Division Engineer stating that as of a certain date and time, a water right holder is not receiving all of the water they are entitled to by decree and requesting that the Division Engineer shut down (curtail) all upstream water rights junior to them until their senior right is satisfied.[2]
River Reach	A river reach is any segment of river that has a similar physical and/ or biological characteristic to it.[3]
Runoff	That part of precipitation that does not evaporate and is not transpired.[8]
Sample	A subset of the population of interest selected for a research study. It is a finite portion that is used to study the characteristics of concern in the population.[1]
Sampling Error	The estimated inaccuracy of the results of a study when a population sample is used to explain behavior of the total population.[1]
Scenario	A plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Note that scenarios are neither predictions nor forecasts, but are useful to provide a view of the implications of developments and actions.[8]
Senior Water Right	A water right that precedes others in priority.[1]
Sensitivity	Sensitivity is the degree to which a system is affected, either adversely or beneficially, by *climate variability* or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise).[8]
Sensitivity Analysis	An analysis of alternative results based on variations in assumptions; a "what if" analysis.[1]
Sequence	A particular ordering of annual flows. The observed record is one sequence. Re-ordering the observed annual flows creates a new sequence. Used instead of "trace" to emphasize that the annual flow magnitudes have not been changed.[1]
Service Area or Service Territory	The geographic area served by a water utility.[1]
Severe Weather Event	An event that is rare within its statistical reference distribution at a particular place. The characteristics of what is called 'severe weather' may vary from place to place. An 'extreme *climate* event' is an average of a number of weather events over a certain period of time—an average that is itself extreme (for example, rainfall over a season).[5]
Significant Difference	In mathematical terms, difference between tests of two or more variables. The significance difference varies with the *confidence* level desired.[1]
SNOTEL	Abbreviation for SNOwpack TELemetry. A west-wide system for obtaining snow water equivalent, precipitation, air temperature, and other hydrologic measurements from remote data sites via radio transmission.[9]
Snow Water Equivalent (SWE)	The amount of water contained within the snowpack. It can be thought of as the depth of water that would theoretically result if you melted the entire snowpack instantaneously.[9]
Snowpack	A seasonal accumulation of slow-melting snow.[8]
Soil Moisture	Water stored in or at the land surface and available for evaporation.[8]
Spatial Scales	*Climate* may vary on a large range of spatial and temporal scales. Spatial scales may range from local (less than 100,000 km2), through regional (100,000 to 10 million km2) to continental (10 to 100 million km2).[8]

Spring Runoff	Spring runoff is the increased stream and river flows occurring as snow melts with warmer spring and early summer temperatures. The vast majority, 80%, of Colorado's surface water comes from melting snows and the highest streamflows usually occur during the months of May, June and July. Spring runoff flows are often referred to as "flood flows" since historically runoff flows flooded lowlands and overtopped streambanks, especially prior to the construction of dams and reservoirs designed to capture these flood flows.[3]
SRES	The storylines and associated population, GDP and emissions scenarios associated with the Special Report on Emissions Scenarios (SRES) (Nakićenović et al., 2000), and the resulting *climate change* and sea-level rise scenarios. Four families of socio-economic scenario (A1, *A2*, *B1*, and B2) represent different world futures in two distinct dimensions: a focus on economic versus environmental concerns, and global versus regional development patterns.[8]
SRES Scenarios	SRES scenarios are emission scenarios developed by Nakićenović and Swart (2000) and used, among others, as a basis for some of the *climate projection*s shown in Chapter 10 of this report. The following terms are relevant for a better understanding of the structure and use of the set of SRES scenarios: Scenario family Scenarios that have a similar demographic, societal, economic, and technical change storyline. Four scenario families comprise the SRES scenario set: A1, *A2*, *B1*, and B2. Illustrative Scenario A scenario that is illustrative for each of the six scenario groups reflected in the Summary for Policymakers of Nakićenović and Swart (2000). They include four revised scenario markers for the scenario groups *A1B*, *A2*, *B1*, B2, and two additional scenarios for the A1FI and A1T groups. All scenario groups are equally sound. Marker Scenario A scenario that was originally posted in draft form on the SRES website to represent a given scenario family. The choice of markers was based on which of the initial quantifications best reflected the storyline, and the features of specific models. Markers are no more likely than other scenarios, but are considered by the SRES writing team as illustrative of a particular storyline. They are included in revised form in Nakićenović and Swart (2000). These scenarios received the closest scrutiny of the entire writing team and via the SRES open process. Scenarios were also selected to illustrate the other two scenario groups. Storyline A narrative description of a scenario (or family of scenarios), highlighting the main scenario characteristics, relationships between key driving forces and the dynamics of their evolution.[8]
Stakeholder	A person or an organization that has a legitimate interest in a project or entity, or would be affected by a particular action or policy.[8]
Standard Chronology	Tree-ring chronologies for which low-order autocorrelation is retained.[1]
State Engineer	The director of the Division of Water Resources.[1]
State Engineers Office (also Office of the State Engineer)	Division of Water Resources.[1]
StateCU	See *Colorado Decision Support System (CDSS) Consumptive Use Model (StateCU).*
StateMod	See *Colorado Decision Support System (CDSS) Stream Simulation Model (StateMod).*
Statute	A law enacted by a legislative body such as the US Congress or the Colorado General Assembly.[4]
Stochastic Process	A stochastic process is one that involves a random component (e.g. rainfall) with the result that there is more than one possible future outcome from the process as it evolves over time.[1]

Storage Water Right	A right to store water for later application to *beneficial use*.[1]
Stormwater Runoff	Rainfall or snowmelt that runs off over the land surface, potentially carrying pollutants to streams, lakes or reservoirs.[4]
Stream Depletion (evapo-transpiration)	Losses of water to a stream or river caused by well use, evaporation or otherwise.[1]
Streamflow	Water flow within a river channel, for example expressed in m3/s. Also a synonym for river discharge.[9]
Sub-Alpine	The biogeographic zone below the tree line and above the Montane zone that is characterized by the presence of coniferous forest and trees.[8]
Subordination	Subordination is the voluntary relinquishment of a water right's priority to selected or all junior water rights. A large water project or transmountain diversion may subordinate its water rights to protect in-*basin* water rights or to allow for an increment of new water development that otherwise would be precluded by a strict adherence to the priority system.[3]
Substitute Supply Plan	A State Engineer-approved temporary plan of replacement supply allowing an out-of-priority diversion while a plan for *augmentation* is proceeding through the water court. The State Engineer may also approve substitute supply plans for water exchanges, water uses that will not exceed five years, and limited emergency situations affecting public health or safety.[4]
Substitute Water Supply Planning	Planning for temporary transfers of water during periods of shortage or while looking for permanent sources.[1]
Substitution	Similar to an exchange, a substitution involves taking water from one point of diversion while releasing water from another source to satisfy downstream senior rights. In a substitution, the diversion and the release do not happen at the same time. Substitutions occur mostly between reservoirs. Instead of releases of water occurring at the same time as the diversion, releases will take place at specified times in the future or as calls come on the river and the demands necessitate releases. Substitutions must be approved by the State Engineer's Office, which administers these arrangements.[3]
Supplementation	Additional flows that would potentially be required in a river basin to meet projected water demands in that basin while simultaneously meeting the cumulative flow provisions associated with the river's legal administrative requirements.
Supply Management or **Supply-side Management**	Measures and programs deployed by the utility that improve the efficiency of production, transmission, and distribution facilities.[1]
Supply Substitution	Use of alternative supply sources to increase the productivity of water supplies; for instance, dry year leases from agricultural water rights holders, use of reclaimed wastewater, etc.[1]
Surface Runoff	The water that travels over the land surface to the nearest surface stream; runoff of a drainage *basin* that has not passed beneath the surface since precipitation.[8]
Surface Water	Water that flows in streams, rivers, lakes, wetlands and reservoirs.[1]
Surge Irrigation	A form of flood irrigation where pulses of water are sent down furrows to disperse irrigation water over a field. Using the impetus provided by the surges, a smaller volume of water is required to irrigate an entire field. In traditional flood irrigation, a large volume of water is needed to create the head (pressure) necessary to spread water over the entire irrigated area. Surge irrigation loses less water to deep percolation and reduces the amount of tailwater sent back to waterways.[3]
System (water)	A series of interconnected conveyance and treatment facilities owned and operated by a water supplier; some utilities operate multiple water systems.[1]

Temporal Scales	*Climate* may vary on a large range of spatial and temporal scales. Temporal scales may range from seasonal to geological (up to hundreds of millions of years).[8]
Time Series Analysis	Time series analysis, including trend analysis, uses statistical methods to analyze records from a period of time.[9]
TMD	Abbreviation for transmountain diversion.[3]
Trace	A single set of values from resampling, also referred to as a realization.[1]
Trans-Basin Diversions: (also Trans-mountain Diversions and Trans-Basin Water Rights)	The removal of water from its natural course to another *basin* such that none of the water returns to its *basin* of origin upon use.[1]
Transfers (water)	Exchange of water among willing buyers and sellers.[1]
Transit Loss	Transit loss is the amount of water lost as it flows from one place to another. A number of factors may contribute to transit loss, including: evaporation, seepage into the streambed, and uptake by vegetation in the riparian area, among others. Transit losses are charged against the quantity of water released from reservoirs as they make their way downstream to intended points of diversion or storage.[3]
Transmission Facilities	Pipes and canals used to transport raw or treated water to distribution facilities.[1]
Transmountain Water	Water whose source is from adjacent *basin* (e.g. Western Slope water).[1]
Transpiration	Evaporation of water vapor from the surfaces of leaves through stomata.[8]
Treated Water	Water treated to meet drinking water standards.[1]
Tree Rings	Concentric rings of secondary wood evident in a cross-section of the stem of a woody plant. The difference between dense, small-celled late wood of one season and wide-celled early wood of the following spring enables age of a tree to be estimated, and the ring widths or density can be related to *climate* parameters such as temperature and precipitation.[8]
Tributary Groundwater	All subsurface water hydraulically connected to a surface stream, the pumping of which would have a measurable effect on the surface stream within one hundred years.[4]
Unaccounted-for Water	The amount of nonaccount water less known or estimated losses and leaks.[1]
Unappropriated	Available water that is not yet claimed by an existing water right.[3]
Uncertainty	An expression of the degree to which a value (e.g., the future state of the *climate system*) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain projections of human behavior. Uncertainty can therefore be represented by quantitative measures (e.g., a range of values calculated by various models) or by qualitative statements (e.g., reflecting the judgment of a team of experts).[8]
Upper Basin Compact	In 1948, the states of the Upper Basin, which includes Colorado, Wyoming, Utah, and New Mexico, agreed to the Upper Colorado River Basin Compact. This interstate agreement first allocates 50,000 acre-feet of the Upper Basin's share to the portion of Arizona that resides in the Upper Basin then allocates 51.75% of the remainder to Colorado, 11.25% to New Mexico, 23% to Utah and 14% to Wyoming.[3]

Upper Colorado River Commission	The interstate administrative agency created by Article VII of the Upper Colorado River Basin Compact (1948) composed of one Commissioner, representing each of the States of the Upper Division, namely, the States of Colorado, New Mexico, Utah and Wyoming, designated or appointed in accordance with the laws of each such State. http://www.usbr.gov/lc/region/g1000/pdfiles/ucbsnact.pdf
Use It or Lose It	This often misapplied expression refers to the ability of the state to declare water rights that have fallen into disuse as abandoned. Before taking away all or portion of a water right, the state must show in water court that the owner no longer intends to use the water. A water rights owner can challenge the state's assertion and retain their rights by telling the court they still intend to put the water to use in the future. It is erroneously assumed that the "use it or lose it" rule forces water rights holders to wastefully use their full entitlement of water or risk having all or part of their rights taken away.[3]
Utility	An organization that provides a commodity or service, such as water supply, to end users.[1]
Validation	The process of ascertaining and recontacting respondents to confirm that interviews were conducted correctly.[1]
Validity	Whether what we tried to measure was actually measured.[1]
Variability	*Climate variability* refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the *climate* on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the *climate system* (internal variability), or to variations in natural or *anthropogenic* or external forcing (external variability).[9]
Variable	Any characteristic that can be measured on each unit of the population.[1]
Variable Infiltration Capacity (VIC) Model	The VIC model is a distributed gridded physical hydrology model with several applications to climate change studies and successful application to numerous basins around the world (Wood et al., 1992; Liang et al., 1994; Liang et al., 1996; Lohmann et al., 1998a; Lohmann et al., 1998b). A calibrated VIC model of the entire Colorado River Basin has been developed (Christensen et al., 2004, Christensen / Lettenmaier, 2007).[1]
Virgin Flow	Virgin flow is the streamflow quantity that would naturally exist in a waterway without diversions.[3] Also referred to as "*Natural Flow*".
Vulnerability	Vulnerability is the degree to which a system is susceptible to, and unable to cope with, adverse effects of *climate change*, including *climate variability* and extremes. Vulnerability is a function of the character, magnitude, and rate of *climate change* and variation to which a system is exposed, its sensitivity, and its *adaptive capacity*.[8]
Wastewater	Water that has been used and contains dissolved or suspended waste materials.[6]
Water Availability	As used for the Colorado River Water Availability Study Phase I: The amount of water from the Colorado River Basin System available to meet Colorado's water needs. Includes physical and legal supply considerations for current demands.[1]
Water Availability Task Force (WATF)	This governmental task force is comprised of Colorado's water supply specialists from state, local and federal governments, as well as experts in *climatology* and weather forecasting. The WATF monitors snow pack, precipitation, reservoir storage, and stream flow and provides a forum for synthesizing and interpreting water availability information. When the WATF determines that drought conditions are reaching significant levels, it notifies the Governor and recommends activation of the Drought Mitigation and Response Plan.[1]
Water Banking	Pooling of surplus water rights for rental to other water users.[1]

Water Conservancy District	A special taxing district, created by a vote of the district's electors, that has authority to plan, develop and operate water supply and potable water projects. There are 47 conservancy districts in Colorado.[1]
Water Consumption	Amount of extracted water irretrievably lost during its use (by evaporation and goods production).Water consumption is equal to water withdrawal minus return flow.[8]
Water Court	Water Court is the mechanism by which water rights are adjudicated and therefore officially recognized by the State of Colorado. Water judges are district judges appointed by the Colorado Supreme Court and have jurisdiction in the determination of water rights, the use and *administration* of water, and all other water matters within the jurisdiction of the water divisions.[3] or A District Court that hears matters related to water. To obtain a judicially recognized water right, change a water right or file an Augmentation Plan, persons or entities file applications requesting with one of these courts, and the court will issue a decree or order. There are seven water courts in the State located in each major drainage basin.[2]
Water Division	Colorado has seven water divisions determined by drainage patterns of major rivers in Colorado and established in the Water Right Determination and Administration Act of 1969. The Divisions are established as follows: 1) South Platte, 2) Arkansas, 3) Rio Grande, 4) Gunnison, 5) Colorado, 6) Yampa and White, and 7) San Juan and Dolores River Basins.[1]
Water Exchanges	Water taken at a time and place when it would otherwise be out of priority but other water rights that would be injured are satisfied with replacement from another.[1]
Water Reuse	Use of reclaimed water for a *beneficial use* constitutes water reuse. Direct water reuse involves treating wastewater and piping it directly into a water system without intervening dilution in natural water bodies. Indirect reuse involves an intermediate step between the generation of reclaimed water and reuse, which may be through discharge, retention, and mixing with another water supply.[1]
Water Right	A property right or legal claim to withdraw a specified amount of water in a specified time frame for a *beneficial use*.[1], or A property right to the use of a portion of the public's surface or tributary groundwater resource obtained under applicable legal procedures.[4]
Water Stress	A country is water-stressed if the available freshwater supply relative to water withdrawals acts as an important constraint on development. Withdrawals exceeding 20% of renewable water supply have been used as an indicator of water stress. A crop is water-stressed if soil-available water, and thus actual evapotranspiration, is less than potential evapotranspiration demands.[8]
Water Trade	A water trade is swapping of ownership of water stored in different reservoirs or from different "pools" within a reservoir. This does not involve diversions or releases to meet downstream needs.[3]
Water Transfers	Reallocation of water from one use to another through sale or lease, which can be a permanent or temporary legal arrangement.[1]
Water Use Efficiency	Technologies and practices that provide the same or better level of end-use service with less water.[1]
Water User Segment	For purposes of the Drought & Water Supply Assessment, water users were categorized into eight groups or segments: Power, federal agencies, state agencies, municipal entities, agricultural interests, water conservancy districts, industry and other. The segment “other” includes water user groups such as counties, tribes and farm bureaus.[1]

Water Year	The 12-month period, October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 1992, is called the "1992 water year".[2]
Waters of the State	All surface and subsurface water in Colorado, except water withdrawn from the environment for use.[4]
Watershed	A regional land area, defined by topography, soil, and drainage characteristics, within which raw waters collect and replenish supplies. The region draining into a river, river system or other body of water.[1]
Weather-Adjusted	Water demand, revenues, or other variables adjusted to a "normal" weather year; also known as weather normalization.[1]
Well	Any structure or device used for the purpose or with the effect of obtaining groundwater for *beneficial use* from an *aquifer*. Every well requires a State Engineer-issued permit.[4]
Well Permit	A permit to drill a well issued by Colorado Division of Water Resources.[1]
West Slope	"West Slope" is an informal geographic term describing the portion of Colorado west of the Continental Divide. The West Slope is in the Colorado River Basin. The West Slope of Colorado receives roughly 80% of the entire state's precipitation, yet its population is a fraction of that found in the metropolitan areas along Colorado's Front Range, or East Slope.[3]