A4.1 DEFINITIONS USED IN WATER MECHANICS (For Determining the WATER RESOURCE PRODUCTION, the SYSTEM DEMANDS, and LEVEL of SERVICE STANDARD)

Water Mechanics is a system used to help a water company manager paint a clearer picture of the physical water demands, as well as supplies available and provided by the water system to meet the demand needs. This data is core to the systems's service ability currently and in the future, and as such, is core to developing strategies and capital facility projects to service the future. Standards, that may be unique to the system, are also developed from this data, and are used to determine the potential impact of a user on the infrastructure of the water supplier. This data is used to physically size relevant facilities, whether water source, water rights, distribution or piping systems, and storage. This data is also used in determining the fair and equitable buy-in cost for impact fee assessments, and water rate allocations to non-standard Finding a system typical ERC (Equivalent Residential Connection), as well as it's quantity in current and future projects, is a key step to developing an ability or strategy to plan for the future development impacts on the water company. Since this program deals with some rather complex calculations and theories, an appropriate but brief definition section is presented here.

Definitions:

1 **Volume Parameters.** Volume parameters include units such as gallons, or acre-feet, that relate water to a volume only. Volume is not always associated with specific time parameters, but may be integrated from flow parameters. (see 2 below)

2 **Flow Parameters.** Flow parameters include units such as gallons per minute (gpm) or Acre-Feet per Year, or Million Gallons per Day (MGD), and associate a volume with time, to derive a flow rate. Acre Feet per year are common units of water rights or average annual capacity elements. MGD or gpm are more related to peak flows, either factored over a day or over a minute, and are typical of source productions or user demands. Instantaneous flows may be derived (as a typical differential equation or derivative) from net changes in reservoir or storage volumes (see 1 above)

3 **Capacity Elements**. Water Capacity Elements refer to the methods used to measure water supply and demand, including and between the actual sources and the users. There are seven elements divided into two categories and each is defined below. Under the Supply Category are Source Capacity (Sc), Source Developed (Sd), Supply (S), and Production (P). Under the Demand Category are Demand (D), Consumption (C), and User (U). Each of these elements may have values associated with them, to measure the capacity whether a “real” measurable value, or a calculated “potential” value.

4 **Source Capacity (Sc)**: One of the seven (7) Capacity Elements (see 3 above) used to identify water system capacity. Source Capacity is the Physical Source as Tested or Measured, including any portion of the Source Capacity not entirely developed, and may be possibly developed in the future. This element is measured as peak gpm and is a physical water system asset, and may or may not actually have a capacity value associated with it.

5 **Source Developed (Sd)**: This is the physical source capacity, within (Sc) that is engineered, designed, tested, and equipped, and has real and usable developed water flow capacity of a water source in gallons per minute (gpm), as usable on a peak day. This measurement is the ultimate peak capacity of a water source such as a well. When the Source Capacity (Sc) of a source is submitted to the State or jurisdictional water authority over the same for approval, it is common practice for a reduction of capacity (typically 33%) to generally be applied to the developed or equipped rating (some exceptions may be granted when there is good historical records and reliable redundancy). This final rating of the source by the State or governing jurisdiction (Source or Sc, minus the percent reduction if applicable) equals the Developed Source, or Sd, as defined here. If the required reduction is a paper reduction only, it would be part of the Supply (S) rating instead. Pump sizing of a well typically equals

6 **Supply (S):** The real and approved source production rating (in gpm and acre-feet per year) of the Source as approved by any regulatory agencies, and the water supplier. This value may be described as the Safe Yield or Legal Rating of the water Source, and is Sc less Deductions imposed by State, Supplier, Conservation Reserves, or Other Reserves. Some of these deductions may be temporary to aid in the preservation of the source or aquifer. Typically, Water Rights as needed in the water supply will equal at least this supply volume, and are calculated as an annual average in acre-feet per year quantity. This value or rating is a peak period calculated or a potential value.

7 **Production (P):** Production is the Actual Production of Water Delivered from the Supply, and is typically less than the Supply rating. Production and Demand (below) are usually equal, where Production is a measurement of Supply Delivered into the system, Demand is a measure of the need of a user, region, or area, factoring in any system losses. This gpm calculation is a real value, and is taken from the source production logs, usually monthly or in some cases - daily.

8 **Demand (D):** Demand typically equals Consumption, plus any Demand Side reserves imposed by the water supplier or other regulatory agencies. This value is a planning number and is calculated or potential in nature. Demand includes any lost or unaccounted for water, plus other demand side reserves. Supply and Demand may be equal, especially if Production has reached the theoretical Supply rating limits, but more typically, Production and Demand are equal. Statistical Balance sheets, showing the Production of Sources, and the Demand of Users or areas and regions of a system are commonly used to determine the annual loads or demand patterns of a water system. Surpluses in this sheet (Production, or Supply less Demand) would be an indication of available growth capacity in certain areas. This value is a peak period calculated or potential number, and is used in planning and

9 **Consumption (C)**: The real component of the Demand (defined above) that is consumed by the user, and is recorded at the user premise entry by a customer meter. Billings for the water product sold are calculated from Consumption. Typically, the difference between Production and Consumption is "Unaccounted For" or lost water. The difference between Demand and Consumption is typically the loss factor (unaccounted for water) plus any Supply Reserves. Consumption is a real value and is obtained from customer or User meter readings, usually read monthly (in fair weather months).

10 **User (U)**: The Physical Customer or End User(s) that are metered and billed for the Consumption. A User's potential impact on the Water system during the peak period is the Demand. This value is a physical asset, and not calculated, assumed, or potential in nature, other than a customer or use quantity (as taken from the billing system). The only physical assets in this model are the source and user. The total consumption divided by the number of users – will generally generate a unit consumption per customer or in some cases an ERC consumption.

11 **ERC**: Equivalent Residential Connection. A common measurable unit of water capacity of a typical residential user on a water system. Systems can be characterized and compared by relating sizes and capacities to common ERC's. Likewise, each system may have their own ERC capacity uniquely defined, and non-relatable to any other water system. An ERC is derived by averaging some or all of a typical residential water user's characteristics (i.e. average annual flows, peak day flows, etc.) to arrive at a common ERC. Typically this total residential system annual volume, will be divided by it's relevant number of residential connections to arrive at this ERC unit volume. The ERC may be divided into subcategories or types, such as Production ERC's (ERC-P), or the ERC claim on the Production Capacity Element; Demand ERC's (ERC-D), or the ERC claim on the Demand Capacity Element; or Consumption ERC's (ERC-C), or the ERC claim on the Consumption Capacity Element.
Non-typical users, such as commercial, industrial, large residential, or irrigation users can be related to quantities of average residential connections or ERC's by dividing a standard ERC quantity or value, into the non-typical user's water data or profile. ERC's are a critical planning tool for a water system, to not only derive the potential impact on the system of future development proposals, but to also create a fair and equitable unit method of assessing impact or similarly related "buy-in" type costs. Water rates are often assessed on a per ERC basis as well to non-typical users of water.

12 **ADS**: Average Day Supply. The annual theoretical or potential Supply (S) rating of a water source(s) either evaluated individually or collectively, expressed as a unit of volume (i.e. acre-feet, gallons, or million gallons) produced by such source(s) (see AYS below), and divided by 365 to arrive at an Average Daily Supply, in flow, typically in gpm or gpd.

13 **ADP**: Average Day Production. The annual physical Production (P) of a water source(s) either evaluated individually or collectively, expressed as a unit of volume (i.e. acre-feet, gallons, or million gallons) produced by such source(s) (see AYP below), and divided by 365 to arrive at an Average Daily Production, in flow, typically in gpm or gpd.

14 **ADD**: Average Day Demand. The annual theoretical Demand (D) rating of water user(s) either evaluated individually or collectively, expressed as a unit of volume (i.e. acre-feet, gallons, or million gallons) consumed by such user(s) (see AYD below) including losses and unaccounted for water, and divided by 365 to arrive at an Average Daily Demand, in flow, typically in gpm or gpd.

15 **ADC**: Average Day Consumption. The annual real Consumption (C) of water user(s) either evaluated individually or collectively, expressed as a unit of volume (i.e. acre-feet, gallons, or million gallons) consumed by such user(s) at the user or customer meter (see AYC below), and divided by 365 to arrive at an Average Daily Consumption, in flow, typically in gpm, gpd, or gallons per month (for billing purposes).

16 **PDS**: Peak Day Supply. The peak day supply of water source(s) either evaluated individually or collectively, expressed as a unit of volume (i.e. acre-feet, gallons, or million gallons) produced by such source(s), over one peak supply day of the year. This data is typically an average day in the peak month of the year, using the monthly volume, divided by the days of the month to arrive at an assumed peak day supply, if actual daily volume records are unavailable. A more exact daily calculation can also be made in this instance by multiplying the assumed daily volume by 1.30. An average daily flow rate (i.e. gpm, acre-feet per year, MGD) may be derived from this data, by dividing the Peak Day Supply by a time value (such as 1440 for gpm).

17 **PDD**: Peak Day Demand. Similar calculation as PDS above, but Peak Day Demand is a demand side calculation, and includes system losses, of users.

18 **PDC**: Peak Day Consumption. Again a similar calculation as PDS above, but is the Peak Day Consumption of Customers at Meters.

19 **AYS**: Annual Yearly Supply. This is the Supply into the System of a Source, over a year. Water Rights typically match this value, and this calculation is presented normally as acre-feet per year.

20 **AYD**: Annual Yearly Demand. Calculated similarly to AYS above, but a demand side calculation and represents Demand of Users on a System, including losses, over a year. Usually expressed as acre-feet per year.

21 **PID**: Peak Instantaneous Demand. The Peak Flow of Demand on a system during the highest flow moment (usually an hour) in a peak day of the year. This figure is usually represented in gpm units and is calculated using State or other Drinking Water jurisdictional formulas. This data is important for sizing pipelines on a water distribution system, and is not normally used for impact fee calculations, since PDD is a more appropriate number. PID is absorbed or its impact is minimized through a properly designed storage system(s), which should hold typically an ADD to PDD daily volume of water.

22 **GPM**: Gallons per Minute. Gallons per Minute is a common and typical measurement of water flow.

23 **GPD**: Gallons per Day. Gallons per Day is also a flow element used more often in PDD and ADD calculations, and is also used as a daily reservoir storage average.

24 **Acre-Feet**: Acre Feet. A common unit of Annual Water Consumption, used mainly in water rights allocations and annual production or consumption calculations. This may be expressed as a volume element (acre-feet) or a flow element (acre-feet per year). An acre-foot is equal to a volume of water that covers an acre (43,560 square feet) with water – one foot deep. An acre foot also equates to 325,829 gallons.

25 **MGD**: Million Gallons per Day. Another common flow element. PDD is often portrayed as MGD in larger volumes or in larger water systems, and MGD is a very common treatment plant capacity element. Used also commonly as the standard unit of flow in wastewater collection and treatment facilities. One MGD equates to 694.44 gallons per minute or gpm.

26 **pf**: Peaking Factor. Peaking Factor is simply PDD divided by ADD, and is a measure of the impact of a user on a system capacity. Peaking Factor is very important for evaluating the size of a capital facility for a particular type of user. Peaking factors range from 1.8 to 3.0, and typically average 2.0.

27 **S-pf**: Supply Peaking Factor. Peaking Factor or pf (see above) as calculated or measured on the Supply side of the System.

28 **D-pf**: Demand Peaking Factor. Peaking Factor or pf (see above) as calculated or measured on the Demand side of the System.

29 **C-pf**: Consumption Peaking Factor. Peaking Factor or pf (see above) as calculated or measured on the Metered side of the System.

30 **ipf**: Instantaneous Peaking Factor. PID divided by ADD.

31 **SCM**: Standard Conservation Model. This is an area or region in a water system which represents a typical standard of conservation usage, demands, and peaking factors. This is usually a small subdivision where meters are read all year and demonstrates a real conservation model. This model is compared to more typical users to show the true effect of conservation practices, and to show the potential water savings to typical non-conserving customers.

32 **AAI**: Average Acres Irrigated. The Net area of Disturbed Land in a lot or development that is Irrigated.

33 **Lf**: Loss Factor. The percentage or factor of water lost or unaccounted for between the Supplies and the Demands of the system(s).

34 **df**: Demand Factor. A factor that relates peaking factor of a user to an ideal conservation model or normal standard. If the normal pf is 2.0 (and the system was designed for such) and a user was calculated to be 3.0, the demand factor would then be 1.5, or the user would have an impact 1.5 times greater on the system than it was designed to handle in PDD conditions. If known, this factor could be used as a multiple for impact fee or other similar assessments. A conservation oriented development may have a demand factor of 0.9 or less, while a snow making or other industrial user that requires peak demand primarily in an off season (winter) may have a demand factor as low as 0.5.