

## **SECTION D**

### **1. Diverter is seeking alternative compliance from the following requirements.**

#### **Measuring Device Location**

PID wheels and treats water for Del Oro Water Company. PID cannot measure the water introduced to Little Butte Creek by PG&E nor can it measure the amount of this water that arrives at Paradise Lake. As an alternative compliance measure PID proposes to assume that the measurement made by PG&E meets the accuracy standard and that the entire volume of water sent downstream arrives at Paradise Lake.

PID has a diversion dam located between its two storage reservoirs. This point of diversion does not have a measuring device. Water diverted at the diversion dam and water diverted at the downstream Magalia dam enter the treatment plant and are measured by the same magnetic meter before being sent to distribution. PID estimates the relative quantities of water diverted at the two locations. This is appropriate since the water diverted is from the same watershed, is diverted under the same water rights, and there are no other users between the two points of diversion.

#### **Required Accuracy**

PID is requesting alternative compliance from the requirement to provide the required measurement accuracy under low flow conditions. As flows decline the ability to effect the same level of measurement accuracy is diminished.

#### **Installation and Maintenance**

Chapter 2.8 §933(g): "A measuring device shall be installed, maintained, operated, inspected, and monitored to ensure the accuracy standards of subdivision (d) of this section are met." Since it is not possible with available technology to meet the accuracy standards of subdivision (d), PID does not propose to comply with the installation and maintenance standard with respect to device installation.

#### **Monitoring Frequency**

PID will make hourly measurements of reservoir levels. However, since hourly monitoring, as required by the regulation, effectively eliminates the ability to measure anything but the very largest flows (those exceeding approximately 4,000 cfs) with the required level of accuracy, PID proposes to do monthly monitoring of its direct diversions, diversions to storage and withdrawals from storage.

#### **Other - Verification of Measuring Device / Accessibility**

Paradise Irrigation District wheels water for Del Oro Water Company. This water enters Little Butte Creek upstream of Paradise Lake, is wheeled and treated by PID and metered at the intertie to the Del Oro Paradise Pines District. The measurement of the inflow of this water is outside PID control. Measurement occurs at a secure PG&E facility. PID makes every effort to account for this water in our

water rights reporting. However, PID cannot provide any assurance of compliance by third parties with Water Board requirements.

## **2. Provide justification for "not feasible"**

Please refer to the attachment titled "Figure 1. PID Source Water Configuration."

Measurement of the movement of water into and out of reservoir storage can basically be done by two methods. In the first, the rate of flow of water into and out of the reservoir is measured by a metering device of some sort. In the second, the volume of water storage in the reservoir is measured and the flow is calculated from the net change in reservoir storage over time and other known components of flow using a mass balance calculation.

The first method is not feasible for use by PID because there is no way to physically channel the flow of water going into the reservoir to make it pass through a measuring device. Over 20 percent of PID's watershed area drains directly to the two reservoirs without first being channeled into a stream (identified by  $F_3$  and  $F_{12}$  in Figure 1.). It is not feasible to place a dam of sorts around the miles of shoreline that forms the perimeter of the two reservoirs in order to concentrate the water for measurement. While it is conceivable that stream gages could be constructed for each of the tributary streams that flow to the reservoirs, the absence of over twenty percent of the drainage area from the flow measurement assures that the measurement error will exceed the acceptable level of accuracy. This error would be introduced regardless of flow rate or time scale. We conclude that this method is not feasible.

The second method, involving the measurement of change in reservoir storage volume, does not require installation of a flow measurement device in a location that is infeasible. All flows that naturally make their way to the reservoir are captured by the measurement. Reservoir level can be determined with reasonable accuracy and a determination of reservoir volume at any point in time can be made that is well within the accuracy standards imposed by the rule. PID currently measures diversions and withdrawals using the second method.

However, there is a limitation to the accuracy with which the flow measurement can be made. This is due to the fact that the smallest increment of change in measured reservoir level is still a fairly large change in volume of water because of the large areal extent of a reservoir. When the time increment is small the opportunity to effect a measurable change in reservoir level between the beginning and end of a time step is limited to periods with extremely large flow rates. When flows are smaller than some threshold value multiple time steps will be required to see a change in reservoir level. When three or more time steps are required to effect a measurable change in reservoir level the measurement error will always be greater than or equal to 100%.

The inability to measure vanishingly small changes in reservoir level means that making measurements of flow for short time increments is not feasible. The hourly reporting interval required in the rules effectively precludes being able to meet the required measurement accuracy for inflows less than

4,000 cfs at Paradise Lake. In the data recorded over the last 20 years a flow this large has not been observed.

Because shorter time intervals cannot be feasibly measured with the required accuracy PID has proposed providing measurements on a monthly basis. This will permit acceptable accuracy for flow measurements down to about 5 cfs. To provide the required accuracy for smaller flows is not feasible even at monthly time increments. The accurate measurement of very small quantities is rarely feasible without use of a different measuring technology. We would prefer not to proceed too far toward a methodology which resembles: "shoot it with a laser, mark it with chalk, cut it with an ax."

### **3. Alternative Compliance Categories**

#### **Highly Variable Flow Rate**

Over the past 20 years flow rates at the point of diversion have ranged from 2,400 cfs to less than 1 cfs.

**There is an existing measuring device or measurement method in use.**

Paradise Irrigation District maintains level measuring devices at each of its two reservoirs. Water delivered to customers is measured with a magnetic meter as it leaves the water treatment plant. Water diverted from Little Butte Creek at the Diversion Dam is metered. Water released downstream for environmental purposes is metered. Spillway flows and downstream releases to control Magalia Reservoir level are estimated by hydraulic calculations. The data from these measurements is used to calculate direct diversions, diversions to storage and withdrawals from storage on a monthly basis.

**The diversion is measured by another entity (identify entity and method of measurement used).**

PID makes measurements that are used to determine the quantity diverted. However, the water that PID wheels for Del Oro Water Company is introduced to Little Butte Creek upstream of all PID facilities. The natural stream flow is estimated by deducting the Del Oro flow. PG&E controls the introduction of this water to the creek. The method used by PG&E for measuring the flow and the accuracy of the measurement is unknown.

At least one other water user is located between the location of the PG&E delivery to the creek and the PID reservoir. It is not possible to ascertain what portion of the PG&E release even arrives at the PID reservoir.

#### **Other**

Two other significant issues underlie PID's request for alternative compliance. The first is that diversions to storage are made to two open reservoirs. Each of these reservoirs has miles of shoreline with a significant portion of the watershed area draining directly to the reservoir by overland flow, without being first concentrated in a creek channel. In fact over 20 percent of the combined watershed area drains directly to the two reservoirs. The infeasibility of measuring the water that flows directly into the reservoirs is an obstacle to any methodology that involves reservoir inflow measurements.

The second significant issue is that the two reservoirs operate in tandem, with one reservoir upstream of the other, and each reservoir has differing water rights. Layering the administrative complexities of two reservoirs, three water rights, and three points of diversion onto the already challenging issues of highly variable flow, the limitations on measurement accuracy, and diversion flows that occur across miles of shoreline only serves to further convolute the calculations and increase the chance of analytical errors.

**4. Describe the measurement or alternative to measurement that will be used at each point of diversion... to achieve closest attainable compliance.**

PID will comply with the requirements of the Measurement and Reporting Rule with the following exceptions:

Alternative compliance measures:

Data Submittal: PID will submit to the Board raw data readings made on an hourly basis from each measuring device as required by Chapter 2.7 of Division 3 of the title. Diversion data will be calculated for submittal on a monthly basis. Monthly diversion data for each water right will be submitted pursuant to any request or order by the Water Board on the first business day following 30 days after the last reading date for the month.

Required accuracy: PID will perform reservoir volume measurements that meet the applicable standard. PID will use a measurement method that meets the  $\pm 15\%$ -by-volume accuracy standard (for devices installed before January 1, 2016) for average monthly reservoir inflows and outflows exceeding 5.5 cfs. For flows less than this threshold value the measurement error may exceed the  $\pm 15\%$  standard.

Measuring device location: PID wheels and treats water for Del Oro Water Company. PID cannot measure the water introduced to Little Butte Creek by PG&E nor can it measure the amount of this water that arrives at Paradise Lake. As an alternative compliance measure PID proposes to assume that the measurement made by PG&E meets the accuracy standard and that the entire volume of water sent downstream arrives at Paradise Lake.

Measuring device location: PID has a diversion dam located between its two storage reservoirs. This point of diversion does not have a measuring device. Water diverted at the diversion dam and water diverted at the downstream Magalia dam enter the treatment plant and are measured by the same magnetic meter before being sent to distribution. PID estimates the relative quantities of water diverted at the two locations. This is appropriate since the water diverted is from the same watershed, is diverted under the same water rights, and there are no other users between the two points of diversion.

## SECTION E

### 1. Provide a general description of the area served by the Alternative Compliance Plan.

The area served by the Alternative Compliance Plan is the Place of Use described in the PID permits. More specifically, that is the lands listed in the following table. Please see the map in "Paradise Irrigation District Place of Use.pdf", attached.

640 acres in Section 28	T 22 N, R 3 E, M.D.B. & M.
640 acres in Section 27	T 22 N, R 3 E, M.D.B. & M.
640 acres in Section 26	T 22 N, R 3 E, M.D.B. & M.
640 acres in Section 25	T 22 N, R 3 E, M.D.B. & M.
640 acres in Section 24	T 22 N, R 3 E, M.D.B. & M.
640 acres in Section 23	T 22 N, R 3 E, M.D.B. & M.
640 acres in Section 22	T 22 N, R 3 E, M.D.B. & M.
640 acres in Section 21	T 22 N, R 3 E, M.D.B. & M.
320 acres in SE ½ of Section 16	T 22 N, R 3 E, M.D.B. & M.
640 acres in Section 15	T 22 N, R 3 E, M.D.B. & M.
640 acres in Section 14	T 22 N, R 3 E, M.D.B. & M.
640 acres in Section 13	T 22 N, R 3 E, M.D.B. & M.
640 acres in Section 12	T 22 N, R 3 E, M.D.B. & M.
320 acres in S ½ of Section 11	T 22 N, R 3 E, M.D.B. & M.
160 acres in NE ¼ of Section 11	T 22 N, R 3 E, M.D.B. & M.
80 acres in S ½ of the NW ¼ of Section 11	T 22 N, R 3 E, M.D.B. & M.
40 acres in SE ½ of the N ½ of the NW ¼ of Section 11	T 22 N, R 3 E, M.D.B. & M.
160 acres in SE ¼ of Section 10	T 22 N, R 3 E, M.D.B. & M.
80 acres in SE ½ of the SW ¼ of Section 10	T 22 N, R 3 E, M.D.B. & M.
40 acres in SE ½ of the S ½ of the NE ¼ of Section 10	T 22 N, R 3 E, M.D.B. & M.
20 acres in SE ½ of the SE ¼ of the SE ¼ of Section 2	T 22 N, R 3 E, M.D.B. & M.
480 acres in the southeasterly portion of Section 1	T 22 N, R 3 E, M.D.B. & M.
160 acres in SW ¼ of Section 6	T 22 N, R 4 E, M.D.B. & M.
160 acres in W ½ of the NW ¼ of Section 6	T 22 N, R 4 E, M.D.B. & M.
160 acres in SW ½ of the E ½ of the NW ¼ of Section 6	T 22 N, R 4 E, M.D.B. & M.
320 acres in W ½ of Section 7	T 22 N, R 4 E, M.D.B. & M.
320 acres in W ½ of Section 18	T 22 N, R 4 E, M.D.B. & M.
80 acres in SW ½ of the W ½ of the E ½ of Section 18	T 22 N, R 4 E, M.D.B. & M.
320 acres in W ½ of Section 19	T 22 N, R 4 E, M.D.B. & M.
160 acres in W ½ of the E ½ of Section 19	T 22 N, R 4 E, M.D.B. & M.
160 acres in NW ¼ of Section 30	T 22 N, R 4 E, M.D.B. & M.
80 acres in W ½ of the NE ¼ of Section 30	T 22 N, R 4 E, M.D.B. & M.
11,100 acres	

### 2. Describe all diversion and conveyance works covered by the alternative compliance plan.

Paradise Irrigation District operates two raw water storage reservoirs: Paradise Lake and Magalia Reservoir. These are impounded by Paradise Dam and Magalia Dam, respectively. Paradise Lake has a

capacity of 11,497 acre-feet and Magalia Reservoir has a capacity of 2,574 acre-feet. Magalia Reservoir is currently under restriction by DWR Division of Safety of Dams to operate at a maximum water level of 2,200 feet elevation for a capacity of 796 acre-feet.

Water is conveyed from Paradise Lake by the natural channel of Little Butte Creek. Before reaching Magalia Reservoir, water in Little Butte Creek encounters the Magalia Bypass Diversion Dam. Water diverted by the dam enters a 36-inch diameter pipeline and is conveyed to the Raw Water Storage tank at the Water Treatment Plant. Water not diverted by the dam continues downstream to Magalia Reservoir. Water impounded in Magalia Reservoir is delivered to the Water Treatment Plant by the Raw Water Pump Station. Treated water enters a 42-inch diameter transmission pipeline and is delivered by gravity to PID's distribution system.

Points of diversion:

Magalia Dam: Permit 271 (Application 476) point of diversion and direct diversion, and point of direct diversion for Pre-1914 right. California Coordinates 6,678,875 2,423,248 NAD 83 Zone 2, being within the SE 1/4 of the SE 1/4 of Section 25, T23N R3E, M.D.B. & M.

Raw Water Bypass Dam: Point of diversion and re-diversion to be added to Permits 271 and 16040, and point of direct diversion for Pre-1914 right. California Coordinates 6,679,213 2,429,872 NAD 83 Zone 2, being within the NE 1/4 of the SE 1/4 of Section 24, T23N R3E, M.D.B. & M.

Paradise Dam: Permit 271 (Application 476) and Permit 16040 (Application 22061) point of diversion and direct diversion. California Coordinates 6,680,884 2,436,502 NAD 83 Zone 2, being within the SW 1/4 of the NW 1/4 of Section 18, T23N R4E, M.D.B. & M.

## SECTION F

### 3. Describe how the accuracy of the alternative compliance plan was calculated.

PID has level sensors at each of its reservoirs. These sensors have a measurement range of 40 feet and a level measurement accuracy of  $\pm 0.2$  feet. This equates to a level measurement accuracy of  $\pm 0.5\%$ .

Tables 1 and 2, below, show the accuracy of reservoir volume measurements resulting from this error in level measurement at some representative reservoir operating conditions. (In the past twenty years Paradise Lake has not operated outside this range.) These calculations verify that the level sensors currently installed at each reservoir meet the storage volume accuracy requirements of Section 933, Subdivision d, under typical operating conditions.

**Table 1. Paradise Lake**

Reservoir Condition	Water Surface Area (acres)	Reservoir Volume (acre-feet)	Volume Error at $\pm 0.2$ feet Level Error (acre-feet)	Percent Error in Reservoir Volume (percent)
Full	244	11,497	$\pm 48.8$	$\pm 0.4\%$
40 feet below full	126	4,207	$\pm 25.2$	$\pm 0.6\%$

**Table 2. Magalia Reservoir**

Reservoir Condition	Water Surface Area (acres)	Reservoir Volume (acre-feet)	Volume Error at $\pm 0.2$ feet Level Error (acre-feet)	Percent Error in Reservoir Volume (percent)
Restricted Level	51	796	$\pm 10.2$	$\pm 1.3\%$
1/4 restricted Volume	32	199	$\pm 6.4$	$\pm 3.2\%$

Calculations of average rate of flow into and out of each reservoir are made using the change in reservoir storage from the beginning to the end of each time interval. The flow calculations are least accurate when the reservoir is full since a given error in water level is multiplied by a larger reservoir area.

The accuracy of the reservoir level measurement is  $\pm 0.2$  feet. Assuming Paradise Lake is full, with a 244 acre surface area, the accuracy of the volume measurement is:

$$244 \text{ acres} \times \pm 0.2 \text{ feet} = \pm 48.8 \text{ acre} - \text{feet}$$

converting to cubic feet:

$$\pm 48.8 \text{ acre} - \text{feet} \times \frac{43,560 \text{ cubic feet}}{1 \text{ acre} - \text{foot}} = \pm 2,126,000 \text{ cubic feet}$$

Making average flow rate calculations on a monthly basis means that a typical time interval,  $t$ , is:

$$t = \text{time, seconds} = 30 \text{ days} \times \frac{24 \text{ hours}}{1 \text{ day}} \times \frac{3600 \text{ seconds}}{1 \text{ hour}} = 2,592,000 \text{ seconds}$$

Then the accuracy of the average rate of flow measurement is:

$$Q_a = \frac{V}{t} = \frac{\pm 2,126,000 \text{ cubic feet}}{2,592,000 \text{ seconds}} = \pm 0.82 \text{ cfs}$$

The magnitude of the smallest flow measurement that can be made while not exceeding 15% error is:

$$Q_{min} = \frac{0.82 \text{ cfs}}{0.15} = 5.47 \text{ cfs}$$

For flows of 5.47 cfs or more the accuracy of the measurement is 15% or better. For flows less than 5.47 cfs the accuracy of the measurement will not meet the 15% standard when Paradise Lake is full.

The minimum flow providing 15% accuracy is reduced with declining reservoir level. For the minimum lake level experienced at Paradise Lake over the last 20 years the surface area of the pool was 156 acres. Under this condition the minimum average flow rate that can be measured to 15% accuracy on a monthly basis is 3.5 cfs.