Trinity River Restoration Program Performance Measure:

Restoration Water Volume Accounting

Hypothesis: Annual water forecasts inaccurately predict the water year type on occasion, but total water volume allocations for restoration balance out over the long term.

Importance: The flow releases recommended by the Trinity River Record of Decision (ROD) are intended to accomplish a wide variety of objectives, from promoting fluvial process, to temperature control, to habitat improvement. The recommended releases attempt to mimic snowmelt hydrology, create a more natural cycle of flow variability, promote alluvial processes, and provide water temperature and habitat benefits. The annual restoration water allocation for release to the Trinity River is based on the forecast water year type. The wetter the forecast water year, the more water is released. An analysis in the Environmental Impact Statement for the Trinity River Mainstem River Restoration indicates that, taken as whole, the ROD's water volume allocations are sufficient to meet the restoration goals of the program. That analysis is based on the volume and frequency of actual, not forecast, water year types.

The actual water year type is not known when the annual release schedules are developed, so water forecasts are used. The water forecast is computed by adding the observed inflow to Trinity Reservoir from October 1 through March 30 to the predicted inflow (based on a 50-percent exceedance probability) from April 1 through September 30. The water year forecast occasionally over or under predicts the actual water year type, resulting in more or less water being released. On average, these differences should balance out. This performance measure tracks the long-term balance of the actual releases versus the water allocation determined using actual, not forecast, water year types.

Objective: Provide a simple water accounting metric indicating whether actual restoration releases are in balance with the allocation targeted by the ROD.

Targets, Predicted or Desired Response: The target value of the restoration water volume ratio is 1.0. A value of 1.0 indicates that overall water releases are consistent with the targeted allocation for restoration. Values greater or less than 1.0 indicate that overall water releases are, respectively, greater or less than the target allocation.

Technical Approach: The restoration water volume ratio compares the water volume released for restoration purposes with the volume that would have been allocated based on the actual, not forecast, water year type over a span of several years. Specifically, we chose a 10-year time span to balance out the over- and under-predictions of the water year type in any given year.

Actual Water Volume Released for Restoration Purposes:
Releases from Lewiston Dam to the Trinity River are conducted for a variety of purposes including: restoration, "safety of dams," tribal ceremonies, and others. The actual water volume released for restoration purposes is computed based on the final record from the Trinity River at Lewiston stream gage (#11525500) operated by the U.S. Geological Survey. Non-restoration releases that are over and above those scheduled for restoration purposes are not considered.

Restoration Water Volume Allocation:
The annual water allocation for restoration flow releases for various water year types is shown in Table 1. The official water year type and the associated restoration water allocation are determined by the April 1

water year forecast, which estimates the annual basin runoff for the current water year. The actual water releases should equal the allocation, within the margin of error of the stream gage used to measure the releases (typically 5 to 8 percent).

Table 1. Water-Year Type and Restoration Release Water Volume[1]

Water-Year Class	Annual Basin Runoff [2] (thousand acre-feet)	Restoration Release Water Allocation (thousand acre-feet)	Probability of Occurrence
Extremely Wet	> 2,000	815	0.12
Wet	1,350 – 2,000	701	0.28
Normal	1,025 – 1,350	647	0.2
Dry	650 – 1,025	453	0.28
Critically Dry	< 650	369	0.12

[1] Source: US Fish and Wildlife Service; Hoopa Valley Tribe. 1999. Trinity River Flow Evaluation Final Report. Department of Interior. Probability of occurrence based on data from 1912 to 1994.

[2] The official water-year type is based on the April 1 forecast (50 percent exceedance) of inflow to Trinity Reservoir for the entire water year (Oct.-Sept.). The water forecast is jointly developed by the National Weather Service and the California Department of Water Resources. Identical forecasts are published on the Water Supply Outlook by the National Weather Service and Bulletin 120 by the California Department of Water Resources. Forecasts are not generally available until about the 8th day of the month.

Restoration releases are intended to mimic snowmelt hydrology and create a more natural cycle of flow variability. The primary determinant of the flow variability is the forecast water year type, because it sets the restoration water volume allocation. However, the forecast water year type occasionally over- or under-predicts the actual water year type. Therefore, this performance measure is based on the water allocations that would have been determined using the actual, not forecast, water year type. The actual water year type is determined by computing the actual annual basin runoff based on observed inflow to Trinity and Lewiston Reservoirs over the course of the entire water year.

Restoration Water Volume Ratio:

The restoration water volume ratio is 0.925 for the time period 2001 to 2010 and is less than the target value of 1.0. The water volume ratio of 0.925 is computed by dividing the cumulative restoration release volume by the cumulative water allocation (based on the actual water year type) for the time period of interest. See Table 2. Court-ordered release restrictions between 2001 and 2004 resulted in a cumulative reduction of 540,600 acre-feet during that time period, as compared to full Record of Decision flow releases. These release restrictions dropped the water volume ratio below the target value. Excluding the 2001 to 2004 time period when court ordered restrictions were in place increases the restoration water volume ratio to 1.024, which would have met the target value. This is notable because the forecast and actual water year types diverged in 2005 (under-predicted), 2008 (over-predicted), and 2010 (under predicted), thus indicating that restoration water volumes from inaccurate water year forecasts balance out over time.

Sources of Information: A detailed account of all restoration and non-restoration releases and diversions is available on the Trinity River Restoration Program website (http://www.trrp.net/). Starting in 2012, the detailed accounting of all releases will also be available in the annual flow implementation report, which will also be accessible through the Trinity River Restoration Program website. Table 2 only provides a subset of this information.

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Table 2. Water Volume Accounting

Water Year	Forecast Water Year Type	Actual Water Year Type	Restoration Releases[1,2] (acre-feet)	Allocation based on Actual Water Year Type (acre-feet)	Volume Difference (acre-feet)
2001	Dry	Dry	379,600	453,000	(73,400)
2002	Normal	Normal	482,700	647,000	(164,300)
2003	Wet	Wet	448,100	701,000	(252,900)
2004	Wet	Wet	651,000	701,000	(50,000)
2005	Normal	Wet	647,600	701,000	(53,400)
2006	Ex. Wet	Ex. Wet	809,900	815,000	(5,100)
2007	Dry	Dry	453,700	453,000	700
2008	Normal	Dry	648,700	453,000	195,700
2009	Dry	Dry	445,500	453,000	(7,500)
2010	Normal	Wet	656,700	701,000	(44,300)
Total for 2001 - 2010			**5,623,500**	**6,078,000**	**(454,500)**

[1] Restoration release volume based on average daily flow records for the Trinity River at Lewiston streamgage (#11525500) operated by the U.S. Geological Survey. Measurement error is typically ± 5% to ± 8%.

[2] Restoration water allocation limited by Court order 2001-2004. Court ordered volumes varied by year.