

Technical Memorandum

DRAFT

To: Mr. Bill LaHaye
City of Big Bear Lake
Department of Water and Power

From: Thomas Harder & Co.
Thomas Harder, P.G., CH.G.

Date: 24-Mar-10

Re: Perennial Yield Update – Division and North Shore Hydrologic Subunits

This technical memorandum summarizes a perennial yield update for the Division and North Shore Hydrologic Subunits within the Big Bear Lake Watershed. Previous estimates of perennial yield for these subunits were 540 acre-ft/yr and 240 acre-ft/yr, respectively¹. The City of Big Bear Lake Department of Water and Power (BBLDWP) has requested an update of the perennial yield of these subunits based on data collected since the last perennial yield study. For this technical memorandum, the perennial yield estimates for the Division Subunit includes North Shore Tributary Subarea F, as shown on Figure 1. Perennial yield estimates for the North Shore Subunit include North Shore Tributary Subareas A through E (see Figure 1).

Updated Perennial Yield Estimate – Division Subunit with North Shore F

Estimation of perennial yield for the Division Hydrologic Subunit, including North Shore Tributary Subarea F, was conducted through an evaluation of groundwater level changes and production history in the context of precipitation trends. Although historical groundwater production and groundwater levels for the entire period of record (1955 to present) were reviewed and considered, the primary focus of this evaluation was on the period of record between 1993 and the present. Precipitation patterns between 1993 and the present have

¹ Geoscience, 2006. Technical Memorandum, Perennial Yield Update for the City of Big Bear Lake Department of Water and Power Service Area. February 2, 2006.

included a relatively wet period (1993 to 1998), a relatively dry period (1999 to 2004), and mixed precipitation conditions between 2005 and the present, including a very wet year (2005), a very dry year (2007), and near average conditions otherwise (see Figure 2).

Groundwater production from the Division Subunit (including Subarea F) has varied between 1993 and the present. Between 1993 and 1998, average annual production from this area, which includes production from Division Wells 6 and 7, was 475 acre-ft/yr (see Figure 3). Between 1998 and 2004, average annual production increased to 722 acre-ft/yr. From 2005 to the present, average annual production has been approximately 668 acre-ft/yr. The average annual production since 2000 has exceeded the previous perennial yield estimate of 540 acre-ft/yr.

Groundwater level changes in the Division Subunit reflect the precipitation and production patterns observed during the period of record. Between 1993 and 1998, groundwater levels were relatively stable at historical highs. Available precipitation during this period was relatively high and groundwater production was less than the perennial yield. Between 1998 and 2004, groundwater levels dropped as production increased substantially during a period of below-normal precipitation. In the 2004-2005 above-normal precipitation year, groundwater levels recovered in Division Well No. 1 although not to historical highs (Figure 3). Since 2006, groundwater levels in Division Well No. 1 and the Riffenburgh Monitoring Well have not recovered to the previous year's high level. The declining levels occurred during a period of near average precipitation conditions and groundwater production amounts in excess of the previous perennial yield estimate of 540 acre-ft/yr.

It is noted that groundwater levels in Division Well Nos. 6 and 7 have recovered during the period from approximately 2004 to the present. However, the groundwater level rise has been associated with a significant decrease in groundwater production from these wells. Combined production from Wells 6 and 7 decreased from 362 acre-ft in 2001 to 210 acre-ft in 2008. Production between 2001 and 2004 ranged from approximately 296 acre-ft/yr to 362 acre-ft/yr while production between 2004 and 2008 ranged from approximately 206 acre-ft/yr to 262 acre-ft/yr.

Based on the groundwater level trends observed in the Division Subunit (including North Shore F), it is concluded that the groundwater production rates maintained since 2005 (average of 668 acre-ft/yr) exceed the perennial yield for this area. This is consistent with the findings from the previous perennial yield update (Geoscience, 2006). Thus, a significant refinement of the previous perennial yield estimate is not warranted. Nonetheless, given the uncertainties in

estimating the available groundwater supply, the perennial yield estimate should be expressed as a range of 500 to 600 acre-ft/yr.

It is noted that the perennial yield estimate is a long-term average. Periodic groundwater production in excess of the perennial yield is a normal part of groundwater basin management. However, it will be necessary to periodically reduce groundwater production to levels below the perennial yield in order to prevent excessive groundwater level decline.

Updated Perennial Yield Estimate – North Shore Subunit (Subareas A through E)

The perennial yield for the tributary subareas of the North Shore Subunit was originally estimated using a watershed model. For this Technical Memorandum, the available groundwater resources for individual tributary subareas (A through E) was reevaluated in the context of the number and potential yield of wells that could realistically be drilled within each of the subareas. The primary limiting factor to the number of potential wells was the relatively small amount of land in each tributary subarea that was not under U.S. Forest Service jurisdiction (see Figure 1).

Tributary Subarea A

The estimated perennial yield for Tributary Subarea A is approximately 30 acre-ft/yr. The entire perennial yield in this area is either being utilized through private well production or planned future groundwater production associated with the proposed Mooncamp Development.

Tributary Subarea B

In Tributary Subarea B, the estimated perennial yield is approximately 70 acre-ft/yr. Current groundwater production from the BBLDWP RV Park Well No. 1 is approximately 14 acre-ft/yr. There are also a few private wells in this subarea. As shown on Figure 1, there is private land along Big Bear Lake where additional future wells could be constructed. It is also feasible to construct another well within the tributary subarea near RV Park 1. Given the potential opportunities for future wells, it may be possible to utilize the perennial yield within Tributary Subarea B.

Tributary Subarea C

The estimated perennial yield for Tributary Subarea C is approximately 70 acre-ft/yr. The only known groundwater production within this subarea is from RV Park No. 2, which pumps approximately 6 acre-ft/yr. It may be possible to construct one additional well near RV Park No. 2. However, the only other private property in this subarea is on the eastern side of the subarea immediately north of Highway 38 (see Figure 1). From available maps, this property appears to correspond to the U.S. Forest Service Discovery Center and is not likely available for future production wells. Assuming that one additional well could be constructed near RV Park No. 2 and assuming the two wells could pump up to 20 acre-ft/yr, the available water resources from this area would be approximately 20 acre-ft/yr.

Tributary Subarea D

The estimated perennial yield for Tributary Subarea D is approximately 40 acre-ft/yr. There are two small areas of private non-U.S. Forest Service property in this subarea that may be available for future wells. One is on the west side of the subarea immediately north of Highway 38 (see Figure 1). The other area is on the southeast boundary of the subarea. Based on the geology of the areas of private land, the total potential groundwater yield from wells on these properties is expected to be similar to that of the RV Park Wells (up to 20 acre-ft/yr). Based on this assumption, the available water resources from Tributary Subarea D is estimated to be approximately 20 acre-ft/yr, or half of the estimated perennial yield of the subarea.

Tributary Subarea E

The estimated perennial yield for Tributary Subarea E is approximately 30 acre-ft/yr. There is no current groundwater production from this subarea. Unlike most of the other tributary subareas, the lower quarter of Subarea E is entirely non-U.S. Forest Service property. Although drilling and testing would be needed to verify the potential yield of the aquifers in this area, it is possible that the entire perennial yield from Subarea E could be utilized with production wells.

The following table summarizes the revised perennial yield and available groundwater resources from the North Shore Subunits:

Estimates of Available Groundwater Supplies – North Shore Subunit

Hydrologic Subunit	Tributary Subarea	Perennial Yield Geoscience, 2006	Estimate of Available Groundwater Supplies
		(acre-ft/yr)	This Study (acre-ft/yr)

North Shore	A	30	30
	B	70	70
	C	70	20
	D	40	20
	E	30	30

Totals: 240 170





City of Big Bear Lake
Department of Water and Power

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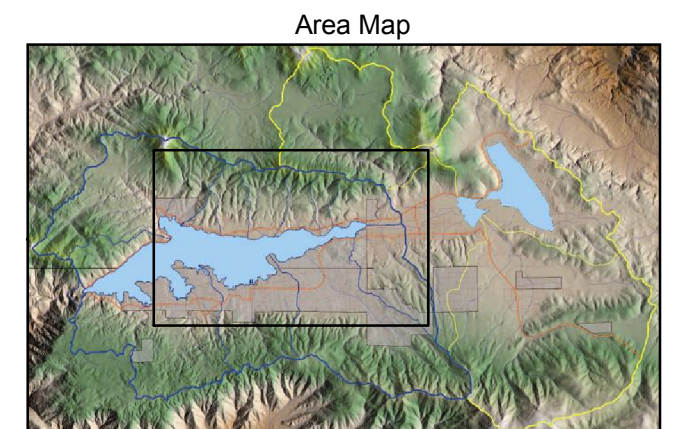


Perennial Yield Update
Division and North
Shore Subunits

Map Features

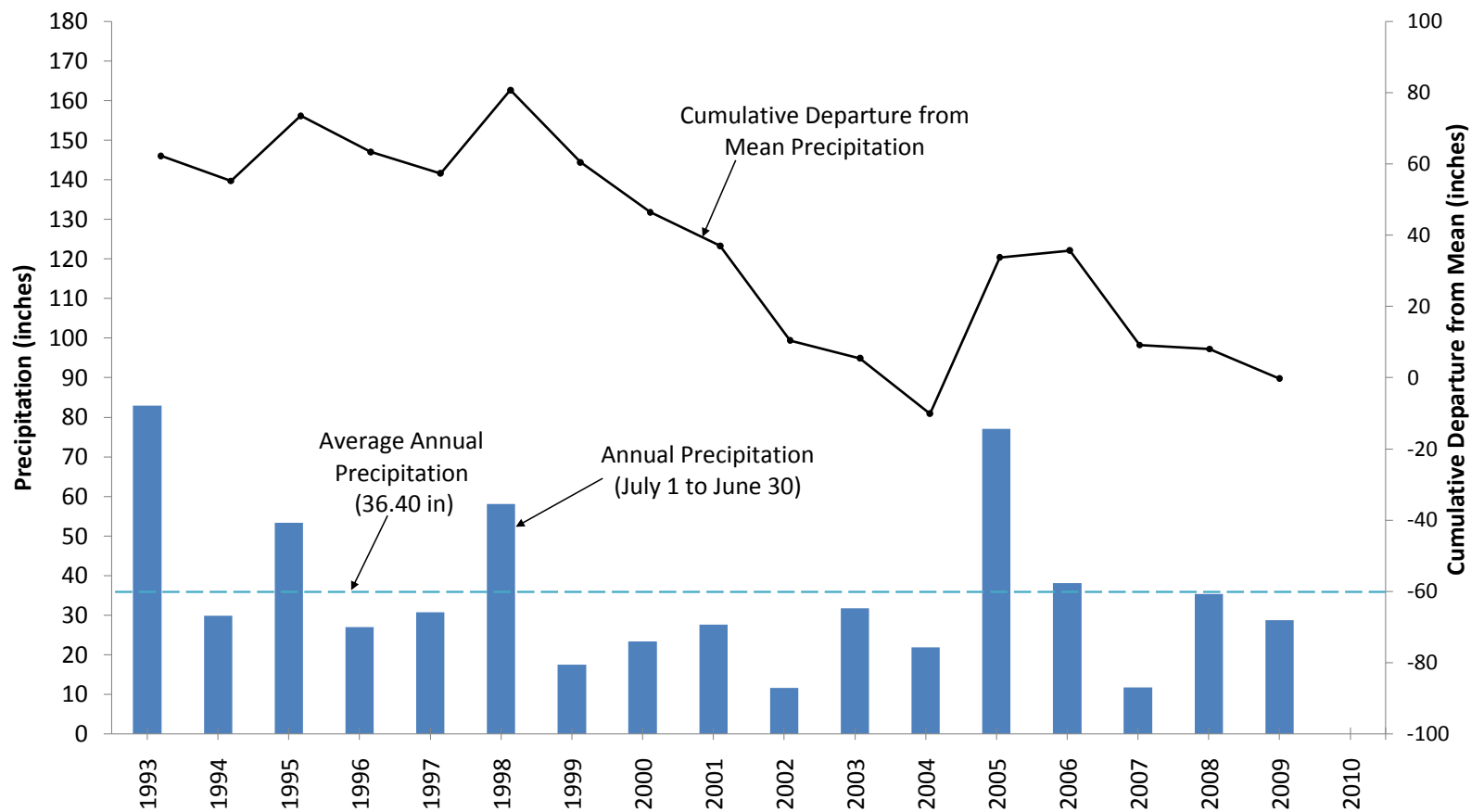
Production and Monitoring Wells

- Monitoring (Green triangle)
- Municipal (Blue dot)
- Big Bear Lake Watershed and Subunits (Blue outline)
- Forest Service Land (Green fill)
- Private Land (Orange fill)



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**Annual Precipitation at Big Bear Lake Dam
1993 to 2009 (Fiscal Year)**



Groundwater Levels - Division Subunit 1993 - Present

