CDM

Memorandum

To: *Mike Livak, Royal Gorge*

From: *Andria Loutsch, Paula Hansen*

Date: *May 17, 2007*

Subject: *Royal Gorge – Overview of Potential Water Supply Alternatives*

As set forth in the accompanying memorandum on water demand, the uses proposed for the Royal Gorge project are expected to have a total water demand of 235 acre-feet per year (AFY), based on initial occupancy rates. This memorandum provides a preliminary overview of potential sources of water supply to meet this demand.

In the following discussions of water supply available from each source, CDM has divided the potential available annual water supply into two time periods: March through June, the snowmelt season; and July through February, when water would need to be used from storage. Based on historical SLCWD water use, about 70 percent of annual water use occurs from July through February, and 30% occurs March through June. For Royal Gorge's annual demand of 235 AFY, that translates to 165 AF in July through February and 70 AF in March through June.

Potential Water Supply Alternatives

Royal Gorge is evaluating several potential alternatives for water supply. The status of each of these potential sources is summarized below.

Groundwater

Royal Gorge retained ECO:LOGIC Engineering (Ecologic) of Rocklin, California, to evaluate the potential to develop groundwater supply. Ecologic did not identify a significant groundwater supply at the explored sites.

Ecologic carried out a hydrogeologic study of the Royal Gorge property area to evaluate sites for development of groundwater supply. Ecologic determined that the property is almost entirely covered by relatively flat lying volcanic rock underlain by older granitic rock. The volcanic rock generally consists of rhyolite-dacite tuffs, underlain by andesite agglomerate, which is in turn overlain by basalt. These tuffs are relatively impermeable unless fractured. Even though the area receives a significant amount of snowfall, most of the snowmelt ends up as runoff due to the impermeable bedrock layer. Ecologic concluded that, if groundwater is

found, aquifers might be of relatively low productivity and could contain naturally-occurring manganese or arsenic.

The most reliable method for targeting locations of potential wells in these volcanic rock type areas is locating faults or fractures where secondary permeability or drilling may be feasible. Although large faults or fractures were not found on the property, the possibility exists of other unrecognized, unmapped or older faults in the study area.

Ecologic performed exploratory drilling at several sites through the tuff layers and continued at least fifty feet into the underlying granite layers. The borings did not locate groundwater or were drilled into areas considered to be of very low potential productivity. Based on initial results, groundwater supply identified by the exploratory drilling was deemed infeasible.

Based on this work, Royal Gorge is currently focusing on other potential sources of water supply to serve the project.

Extension of Service from SLCWD

According to preliminary evaluation, a significant portion of the water needed for the Royal Gorge development could be supplied by the Ice Lakes system. Based on a meeting between SLCWD and Royal Gorge consultants in February 2006, recent demand for the Serene Lakes development has averaged around 110 AFY. SLCWD's reported water use indicates that average monthly demand has varied from approximately 5.5 to 8.5 AF per month over the life of the system.

SLCWD has expressed interest in dredging Ice Lakes as a means of increasing the availability and reliability of water supplies. In light of this interest, Royal Gorge has requested us to provide a preliminary estimate of the dredging that would be required in order to provide sufficient supplies for the Royal Gorge project, while maintaining the historic surface area of the existing lake so as to avoid impacts to existing aesthetic and recreational uses of the lake.

Existing information available for Ice Lakes provided by SLCWD includes an informal bathymetric survey performed for SLCWD in the mid-1990s. CDM used the bathymetric survey data to create an elevation-capacity curve representing the estimated existing capacity conditions, shown on Figure 1. This information was used to estimate the volume of water available between particular lake elevations.

Based on available historical data, the majority of the inflow to the Ice Lakes system occurs during the snowmelt season, which occurs from March/April through June. Royal Gorge's demand during March through June is estimated to be 70 AF. Direct diversion from Ice Lakes to supply all of Royal Gorge's demand during this period would likely be possible without significantly affecting the system's current operating level. The period beginning in approximately June/July (when snowmelt decreases) through February of the next season

(when snowmelt resumes) is when lake storage is used for supply. From July through February, Royal Gorge's estimated demand is 165 AF.

Based on information provided by SLCWD, the current distance from the spillway top to the intake piping (at an elevation of 6,868.5 feet) is approximately 4.8 feet. The lake levels vary by approximately 2.5 feet from spillway elevation of 6,873.3 feet down to 6,870.8 feet, according to SLCWD information on water levels for 2005 and 2006. Figure 2 shows the maximum water surface and the approximate level of the 2.5-foot regular operating range.

Dredging the outer edge of Ice Lakes may be a feasible method to increase the storage volume available within the upper elevation of the lakes, minimizing the need for modifying operating levels to obtain additional water supply. The spillway elevation would remain at 6,873.3 feet. Dredging would increase the volume of water that can be stored in Ice Lakes during the snowmelt season, for later use during the July-through-February period. CDM obtained from Stoel Rives LLC an undated survey drawing completed for SLCWD by T.H. McGuire & Son of Grass Valley, California, when the district was previously considering a 4,000-unit development. McGuire had represented dredging a portion of the lake from an elevation of 6,865 feet to 6,873.3 feet.

Based on a typical design of dredging about half of the lake perimeter, CDM estimated the potential capacity increase gained from dredging to be about 60 AF if the water surface was lowered to the intake at its current elevation of 6,868.5 feet. Figure 2 presents an approximate water surface area at the 6,868.5-foot water level based on the dredged lake design. Figures 3 and 4 present a conceptual cross section of Lake Serena with dredging down to 6,868.5 feet.

The McGuire drawing indicated a significantly higher volume gained from their dredging plan. CDM reviewed the contours of the lake shown in the McGuire figure and estimated volume based on dredging half the perimeter of the lake at the same 4:1 slope. A current bathymetric survey and geotechnical study are needed to more accurately evaluate dredging feasibility and potential lake capacity volume gained from dredging.

Depending upon actual conditions and the extent of dredging, it may be possible to gain sufficient capacity to supply Royal Gorge without significant change to current operating lake surface area. If lake operations lower water surface elevations to the existing intake and half of the lake perimeter is dredged to a depth of the existing intake structure at 6,868.5 feet, Ice Lakes could provide about 160 AFY. This total represents 97% of Royal Gorge's demand during the July-through-February time period. As shown in Figure 2, this option would likely increase the lake surface area compared to current conditions during the dry months.

Supply of additional water from Ice Lakes would require a new water treatment facility and piping to convey finished water into Royal Gorge's distribution system due to capacity constraints of SLCWD's existing treatment facility. For preliminary evaluation purposes, the

raw water treatment has been assumed to include chemical addition, membrane filtration, ultraviolet treatment and chlorination. This treatment process satisfies the requirements of recently enacted drinking water regulations.

A hydrologic study of the Ice Lakes watershed evaluating inflow during normal and drought conditions is needed to confirm the expected watershed production assumed in this study. CDM understands that SLCWD has retained Jones & Stokes to evaluate the water supply under different climate conditions, among other tasks. Royal Gorge should coordinate with SLCWD on the development of this information. CDM anticipates that if the hydrology analysis shows sufficient dry year supplies available in the lakes for both the existing demand patterns of SLCWD and the new Royal Gorge demand, then Royal Gorge's storage requirements could be met by Ice Lakes.

Purchase of Extracted Groundwater from SLCWD

Part of the water needed for the Royal Gorge development could be supplied by groundwater from wells owned by SLCWD. Based on information from SLCWD, two groundwater wells within the Serene Lakes property area have been reported to produce a combined flow rate of approximately 105 gallons per minute of water. If the flow is sustainable, the wells would produce a total of approximately 170 AFY on an annual basis. The volume of groundwater available from the two wells could supply about 72% of the annual water demand for Royal Gorge, which is estimated at 235 AFY. Flow testing would be needed to determine the sustainable yield.

The extracted groundwater would require treatment for removal of the naturally-occurring arsenic and manganese to meet Department of Health Services requirements.

Extension of Service from Donner Summit Public Utility District (DSPUD)

Royal Gorge is exploring the feasibility of serving a portion of the Royal Gorge demand with DSPUD's water from Lake Angela. During the March through June period when inflow to Lake Angela is greatest, enough water may be available for direct diversion to serve Royal Gorge's demand for that period, which is estimated at 70 AF.

During the remainder of the year, water stored in Lake Angela would be used for supply. However, DSPUD staff indicated that the approximately 110 AFY of water stored in Lake Angela not currently used annually is expected to serve build-out population in DSPUD's existing service area. This 110 AF could, pending approval by DSPUD, provide about 67% of the July through February demand on a short-term basis, prior to build-out within DSPUD's service area.

Extending service from DSPUD to Royal Gorge would involve diversion of flow from Lake Angela and construction of expanded or new raw water treatment and conveyance facilities for the treated water.

Construction of Onsite Water Storage Reservoir

The feasibility of construction of an onsite reservoir for water storage is being explored. Based on evaluation of the existing topographic contours for the Royal Gorge property, the location considered most feasible to construct an onsite water storage reservoir is west of the existing Serene Lakes neighborhood. The preliminary land use plan indicates two small lake areas fed by ephemeral streams. Based on a cut and fill approach involving excavation of an approximately 10-acre area to form a reservoir, and the use of the excavated material to construct an earthen dam/berm along the western side of the impoundment area, the estimated maximum storage capacity would be approximately 85 AF. The maximum water depth would be about 20 feet, with a usable depth of about 15 feet.

Snowfall, rainfall, and diversion of winter/spring runoff from the surrounding watershed area into the reservoir would supply water to the reservoir, or water could be pumped from Ice Lakes during March to June if local drainage requires supplementation. This type of reservoir capacity could provide storage for a portion of the water required for the development, meeting 36% of the annual demand, or 51% of the development's July-through-February demand. New surface water treatment facilities and conveyance piping into Royal Gorge's drinking water distribution system would be required.

Potential Alternative

CDM estimates that a combination of SLCWD sources could adequately provide the Royal Gorge demand of 235 AFY. One potential alternative to meet Royal Gorge's water supply needs consists of the combination of supply from sources shown in Table 2. More analysis is needed to confirm the available supply from each of these sources. Until that is complete, CDM has used available information to develop estimates of potential volumes available from each SLCWD source. The overall estimated supply capacity should meet Royal Gorge's estimated demand.

When more detail is available on the current bathymetry and hydrology of the Ice Lakes system, sustainable yield of the groundwater wells, and potential runoff supply for an onsite reservoir, the potential supply from various sources can be more precisely identified.

Table 2 Potential Water Supply Alternative				
Source	**Potential Supply Available**			
	March through June		**July through February**	
	Supply	**% of Demand (70 AF)**	**Supply**	**% of Demand (165 AF)**
Dredge half of Ice Lakes perimeter to 6,868.5 feet, lower surface water level to 6,868.5 feet (existing intake elevation), without decreasing lake surface area	70 AF	100%	160 AF	97%
Purchase water from SLCWD groundwater wells	57 AF	81%	113 AF	68%
Divert water from Ice Lakes when reservoir spills, store in new onsite reservoir, use in July-February	0	0%	85 AF	51%
Seasonal Totals	**127 AF**	**181%**	**358 AF**	**217%**
Total of Supply Potentially Available ~ 485 AFY, >207% of total annual demand				

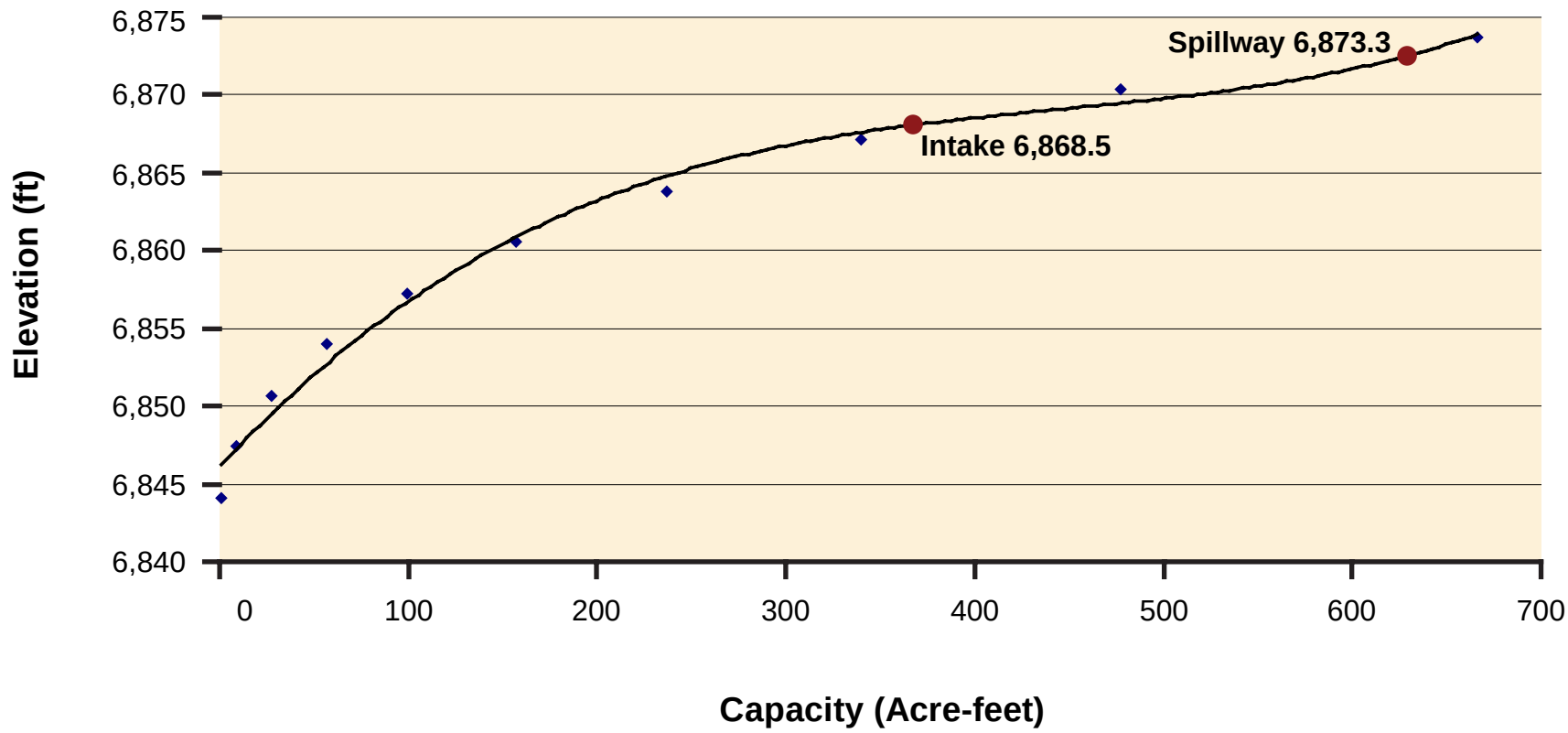

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Figure 1

Existing Serene Lakes Elevation-Capacity Curve

(Based on 1990s Bathymetric Survey)

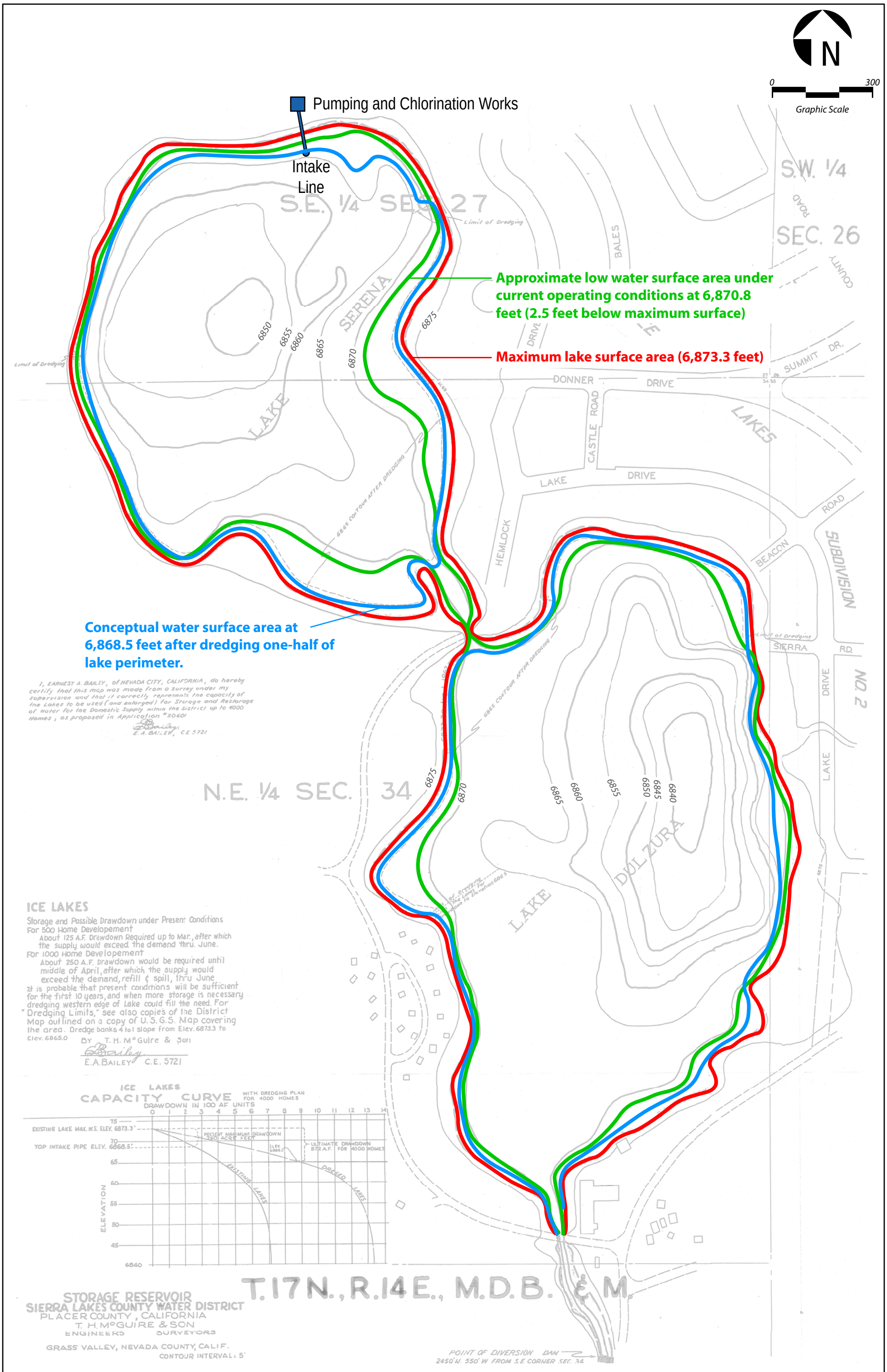

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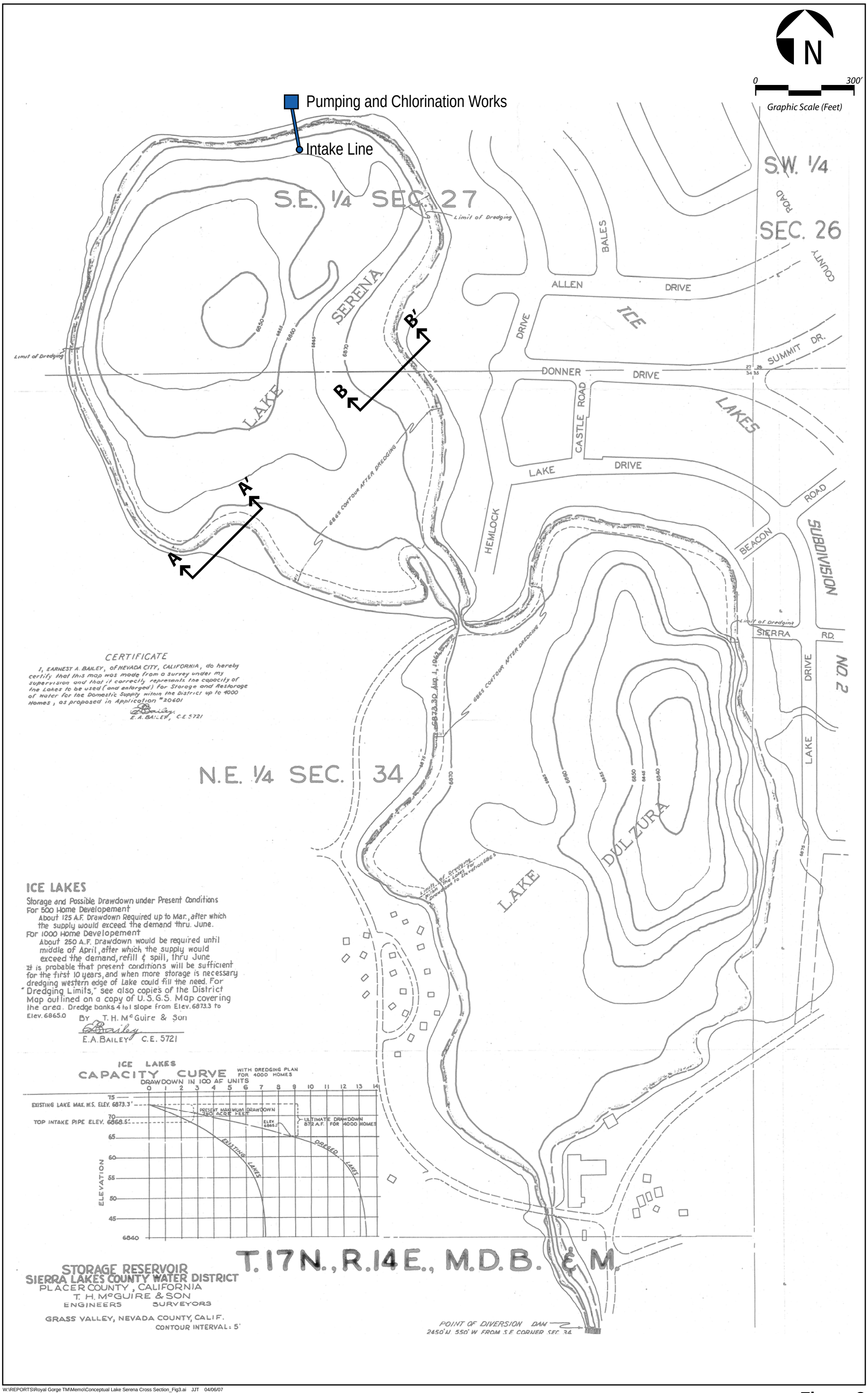
Figure 2

Conceptual Water Levels for Ice Lakes Water Supply Options



CERTIFICATE

I, EARNEST A. BAILEY, of NEVADA CITY, CALIFORNIA, do hereby certify that this map was made from a survey under my supervision and that it correctly represents the capacity of the Lakes to be used (and enlarged) for Storage and Reservage of water for the Domestic Supply within the District up to 4000 Homes, as proposed in Application #20601

E. A. Bailey
E. A. BAILEY, C.E. 5721

ICE LAKES

Storage and Possible Drawdown under Present Conditions

For 500 Home Developement
About 125 A.F. Drawdown Required up to Mar., after which the supply would exceed the demand thru. June.

For 1000 Home Developement
About 250 A.F. Drawdown would be required until middle of April, after which the supply would exceed the demand, refill & spill, thru June

It is probable that present conditions will be sufficient for the first 10 years, and when more storage is necessary dredging western edge of Lake could fill the need. For "Dredging Limits," see also copies of the District Map outlined on a copy of U.S.G.S. Map covering the area. Dredge banks 4 to 1 slope from Elev. 6873.3 to Elev. 6865.0

BY T. H. McGuire & Son
E. A. Bailey
E.A. BAILEY C.E. 5721

ICE LAKES
CAPACITY CURVE WITH DREDGING PLAN FOR 4000 HOMES

STORAGE RESERVOIR
SIERRA LAKES COUNTY WATER DISTRICT
PLACER COUNTY, CALIFORNIA
T. H. McGUIRE & SON
ENGINEERS SURVEYORS
GRASS VALLEY, NEVADA COUNTY, CALIF.
CONTOUR INTERVAL: 5'

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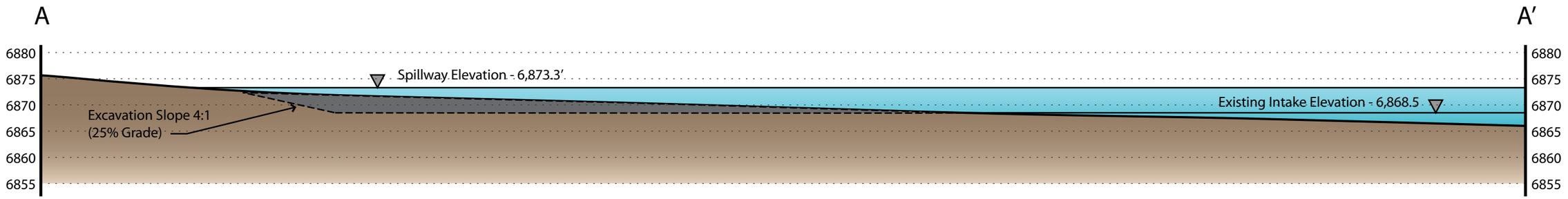
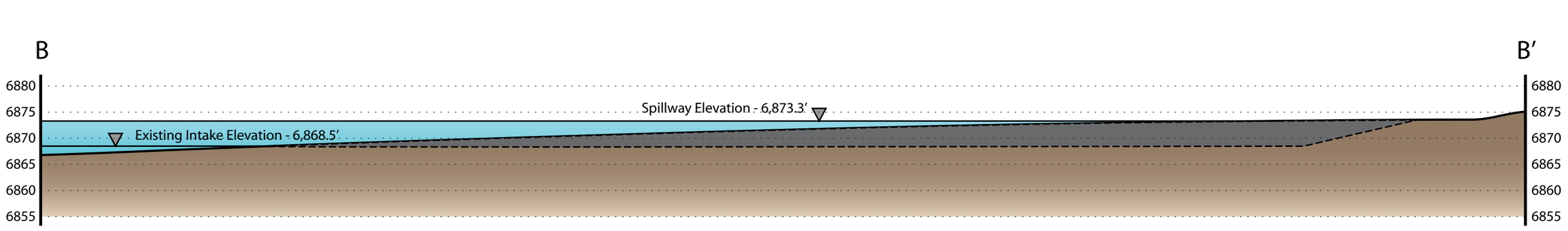
Figure 3
Conceptual Lake Serena Cross Section with Proposed Dredging





0 20

Horizontal Scale - 1″=20′

0 20

Vertical Scale - 1″=20′

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Figure 4

Conceptual Lake Serena Cross Section with Proposed Dredging