Garden Bar Reservoir

GARDEN BAR RESERVOIR PRELIMINARY STUDY

JULY 2011

SOUTH SUTTER WATER DISTRICT

CITY of NAPA

AMERICAN CANYON CITY OF INCORPORATED 1992

SAN BERNARDINO Valley MUNICIPAL WATER DISTRICT

PALMDALE WATER DISTRICT PWD ESTABLISHED 1918

CASTAIC LAKE WATER AGENCY

Garden Bar Reservoir Preliminary Study

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List of Acronyms and Abbreviations

AF	Acre-feet
CAISO	California Independent System Operator
CEQA	California Environmental Quality Act
Corps	United States Army Corps of Engineers
DWR	Department of Water Resources
FERC	Federal Energy Regulatory Commission
HEC	Hydrologic Engineering Center
JPA	Joint Powers Authority
MW	Megawatt
NEPA	National Environmental Policy Act
O&M	Operations and Maintenance
Project	Garden Bar Reservoir Project
Project Partners	South Sutter Water District, Cities of Napa and American Canyon, Castaic Lake Water Agency, Palmdale Water District, and San Bernardino Valley Municipal Water District
ResSim3	Reservoir Simulation Model

Executive Summary

ES-1 Introduction

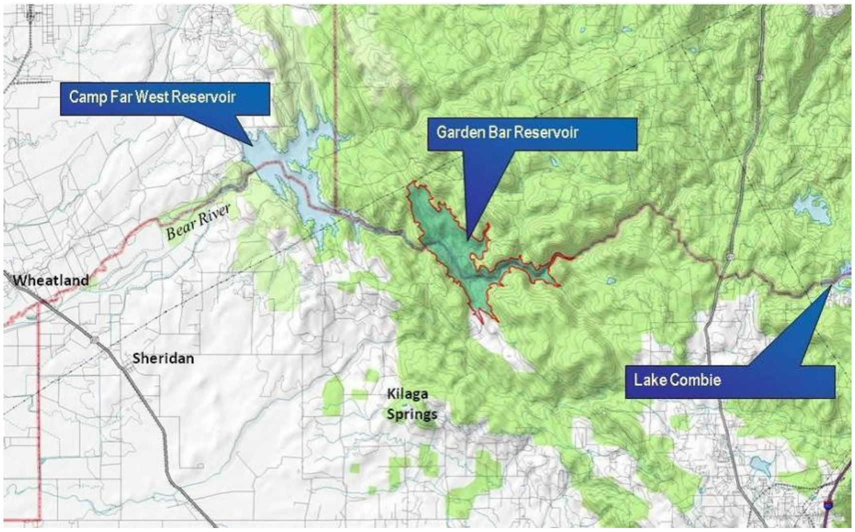
The South Sutter Water District, in association with the Castaic Lake Water Agency, the Palmdale Water District, the San Bernardino Valley Municipal Water District, and the Cities of Napa and American Canyon (referred to collectively as "Project Partners"), is considering development of a new water supply project to provide an incremental water supply to meet their water supply needs. The Garden Bar Reservoir Project has been identified as a project that could provide an incremental water supply.

The Garden Bar Reservoir Project has been previously evaluated in numerous studies over several decades. The purpose of this Preliminary Study is to update those previous studies with information regarding the potential incremental water supply that could be provided by the project, along with information regarding capital and annual operating costs in order to provide an estimate of the cost of development of an incremental water supply project.

ES-2 Background

The Garden Bar Reservoir Project (Project) would be located on the Bear River upstream of the existing Camp Far West Dam and Reservoir, a facility owned and operated by the South Sutter Water District. The Project would consist of a new dam and associated hydropower facilities, including power transmission facilities. The new facility that would form Garden Bar Reservoir would be located approximately 4.5 miles upstream of Camp Far West. The preliminary study evaluates four (4) reservoir sizes, to include a 245,000 acre-foot reservoir, a 265,000 acre-foot reservoir, 310,000 acre-foot reservoir, and a 400,000 acre-foot reservoir so that varying costs and benefits can be estimated and interpolated.

Figure ES 1: Location Map



ES-3 Project Economics

Estimating project yield and water costs requires making assumptions about reservoir operations, hydrology, facility capital and operating costs, and the value of power generated. Based on the analysis presented in this study, it appears that a Garden Bar Reservoir Project at the four sizes studied could produce an average of approximately 90,000 to 149,000 acre-feet of water per year. Utilizing existing electric power values, the average value of the supplemental water supply provided by the Project would be approximately $292 to $343 per acre-foot, delivered at or north of the Delta. Of the four sizes evaluated, a 400,000 acre-foot Garden Bar Reservoir Project would provide the greatest incremental water supply. A reservoir size of approximately 310,000 acre-feet would provide water supply at the lowest average cost per acre-foot. This analysis is based on current conditions and existing available unimpaired flows on the Bear River. It is recognized that the state of Delta operations is under review, and there are numerous issues that would need to be resolved to confirm the availability of this water and the ability to convey a portion of it through the Delta, if so desired.

Table ES 1: Summary of Project Economics

Reservoir Size	245,000 AF	265,000 AF	310,000 AF	400,000 AF
Average Yield	90,000 AF	99,000 AF	117,000 AF	149,000 AF
Total Capital Cost*	$415,500,000	$436,375,000	$483,425,000	$674,440,000
Average Cost* of Water	$320/AF	$307/AF	$292/AF	$343/AF

* all costs are in 2010 dollars

ES-4 Strategic Planning

Development of a Garden Bar Reservoir Project would take 10 or more years to complete and could cost up to approximately $675 million based on 2010 costs. Development of a Project would require numerous future activities, including;

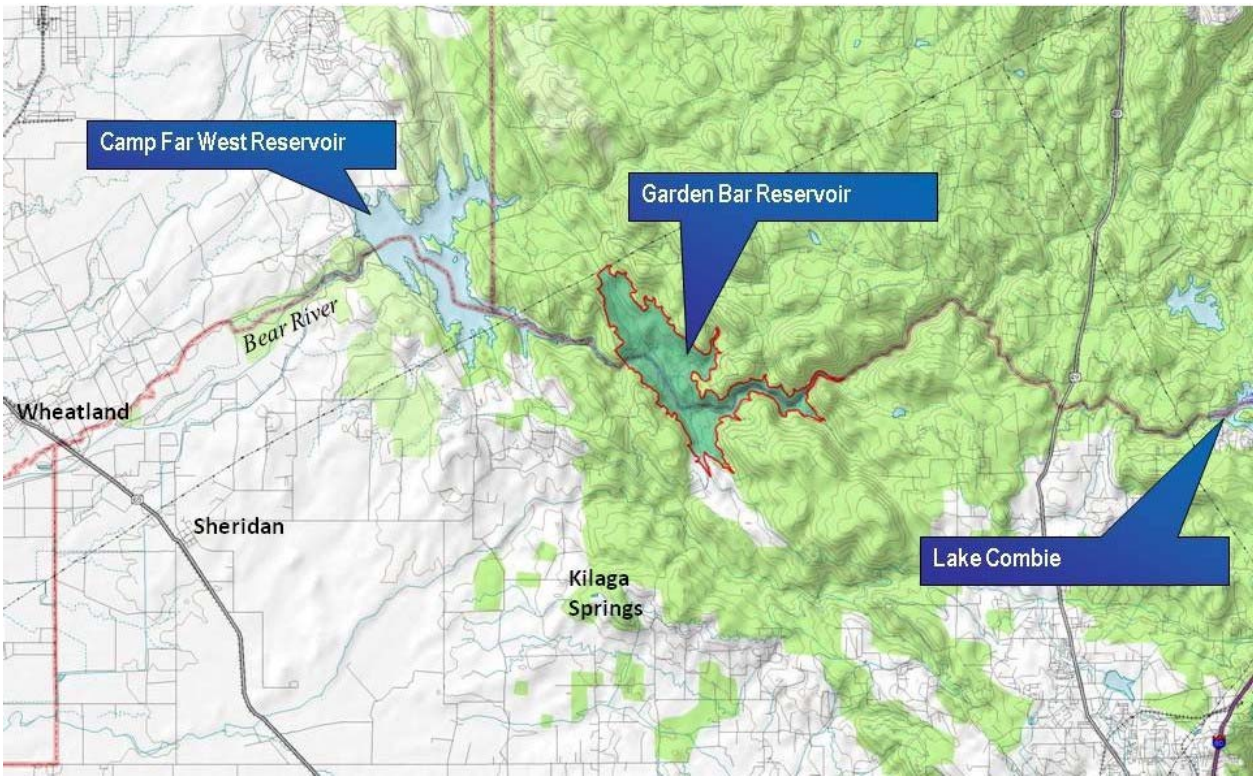
- Making a determination to proceed with additional project evaluations and feasibility-level studies that would be required prior to implementation;
- Formalizing the arrangements between the Project participants;
- Determining the basis for financing the studies and activities prior to any project approvals;
- Conducting stakeholder outreach and public participation processes;
- Filing for water rights and hydropower permits and licenses;
- Completing environmental review and compliance activities associated with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA);
- Completing preliminary design activities;
- Obtaining regulatory approvals, including water rights, Corps of Engineers permits, certification of the environmental documents, and compliance with any endangered species requirements;
- Securing Project financing; and
- Undertaking and completing final design and construction activities.

Chapter 1 Background

The South Sutter Water District, in association with the Cities of Napa and American Canyon, Castaic Lake Water Agency, the Palmdale Water District and the San Bernardino Valley Municipal Water District (referred to collectively as "Project Partners"), is considering development of a new water supply project to provide an supplemental water supply to meet their water supply needs. The Garden Bar Reservoir Project has been identified as a project that could provide a supplemental water supply.

As shown in Figure 1-1, the Garden Bar Reservoir Project (Project) would be located on the Bear River upstream of the Camp Far West Reservoir, a facility owned and operated by the South Sutter Water District. The new facilities would be located approximately 4.5 miles upstream of Camp Far West. The Proposed Project would consist of a new dam and associated hydropower facilities, including power transmission facilities.

Figure 1-1: Project Location



The proposed site for developing the Garden Bar Reservoir and associated hydroelectric power facilities has been studied and documented on numerous occasions, as indicated below:

- **U. S. Army Corps of Engineers Flood Control Study, 1971 –** During this study, the Corps studied a Garden Bar Reservoir Project with a capacity of 200,000 acre-feet as part of the Bear River Investigation.

- **U. S. Army Corps of Engineers Multi-Purpose Project Study, 1981 –** In 1978, South Sutter Water District requested that a Garden Bar Reservoir Project be re-analyzed with emphasis on full coordination with their existing Camp Far West Reservoir. The scope of this study included hydropower generation, recreation, water supply and flood control. This study utilized the

200,000-acre-foot reservoir size as determined during the Bear River investigation in 1971. An optimization analysis indicated that a 23-megawatt (MW) plant would maximize net benefits.

- **Federal Energy Regulatory Commission (FERC) Application, 1985 –** South Sutter Water District submitted an application to FERC in January 1985. As part of this application process, the water district performed a study with a 250,000-acre-foot reservoir size and a 79-MW of hydropower plant.

- **Project Prospectus, South Sutter Water District, 1987 –** Parsons Brinckerhoff, on behalf of South Sutter Water District, prepared a project prospectus with 250,000 acre-feet of storage capacity at Garden Bar and 210 MW installed capacity of hydropower plant.

- **Draft Environmental Impact Report, South Sutter Water District, 1988 –** Parsons Brinckerhoff, on behalf of South Sutter Water District, prepared a Draft Environmental Impact Report, which studied the Garden Bar Water Power Project with 265,000 acre-feet of storage capacity and a 219 MW hydroelectric power plant.

- **FERC Application, 1991 –** South Sutter Water District re-submitted an application to FERC in 1991. As part of this application process, the District performed a study with a 265,000 acre-feet capacity reservoir size and a 290 MW hydroelectric power plant.

The scope of services for this effort was developed to support the evaluation of options for developing a supplemental water supply for the Project Partners. Of critical importance is determining the potential viability of the Project in today's economic, institutional, and environmental settings. Significant additional studies and evaluations will be required prior to any final decisions regarding project implementation, including but not limited to additional engineering and operational studies, completion of environmental analyses, submittal of an application for water rights, submittal of an application for a FERC license, and solidifying agreements between the Project Partners. Because access to the project site was not possible due to easement constraints, no site-specific analyses were conducted for this preliminary study. The scope of services covered three major tasks, including:

- Estimating the amount of water (firm and intermittent yield) and electric power generation that a project could produce;
- Estimating the construction, capital and operations and maintenance (O&M) costs for a project;
- Developing an approach to CEQA/NEPA, project permitting, project financing, and institutional approval processes.

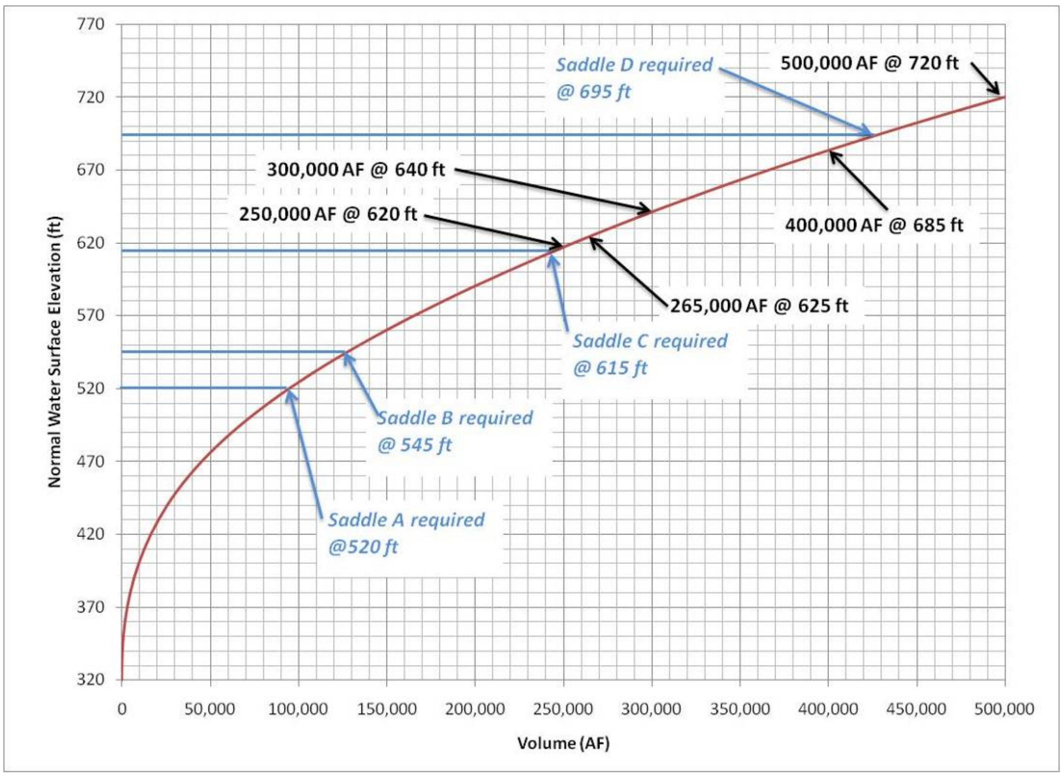
Chapter 2 Reservoir Alternatives

The intent of this preliminary study is to evaluate four (4) reservoir sizes that bracket the range of likely reservoir sizes so that costs and benefits can be identified. Based on preliminary analyses and discussions with the Project Partners, it was determined that the reservoir sizes to be evaluated in this preliminary study would include a 245,000 acre-foot reservoir, a 265,000 acre-foot reservoir, a 310,000 acre-foot reservoir, and a 400,000 acre-foot reservoir.

As the water surface elevation exceeds 470 feet at mean sea level, the volume of the proposed Garden Bar Reservoir increases quickly with a capacity of approximately 95,000 acre-feet at 520 feet, 130,000 acre-feet at 545 feet, 240,000 acre-feet at 615 feet, 400,000 acre-feet at 685 feet, and 430,000 acre-feet at 695 feet. Due to the topography, a water surface elevation in excess of 520 feet (95,000 AF reservoir) would require saddle dams to be constructed in the low spots around the reservoir. A Saddle Dam (A) would be needed at 520 feet, a second Saddle Dam (B) would be needed at 545 feet, a third Saddle Dam (C) would be needed at 615 feet, and a fourth Saddle Dam (D) would be needed at 695 feet. As storage exceeds 400,000 acre-feet, the saddle dams would become contiguous. (GEI 2011a)

Figure 2-1 provides a reservoir capacity curve at the potential dam site. No other dam site locations were evaluated in this preliminary study.

Figure 2-1: Capacity Curve



Figures 2-2 thru 2-5 provide a layout and the potential inundation zone of each reservoir at their respective high water levels.

Figure 2-2: 245,000 AF Reservoir

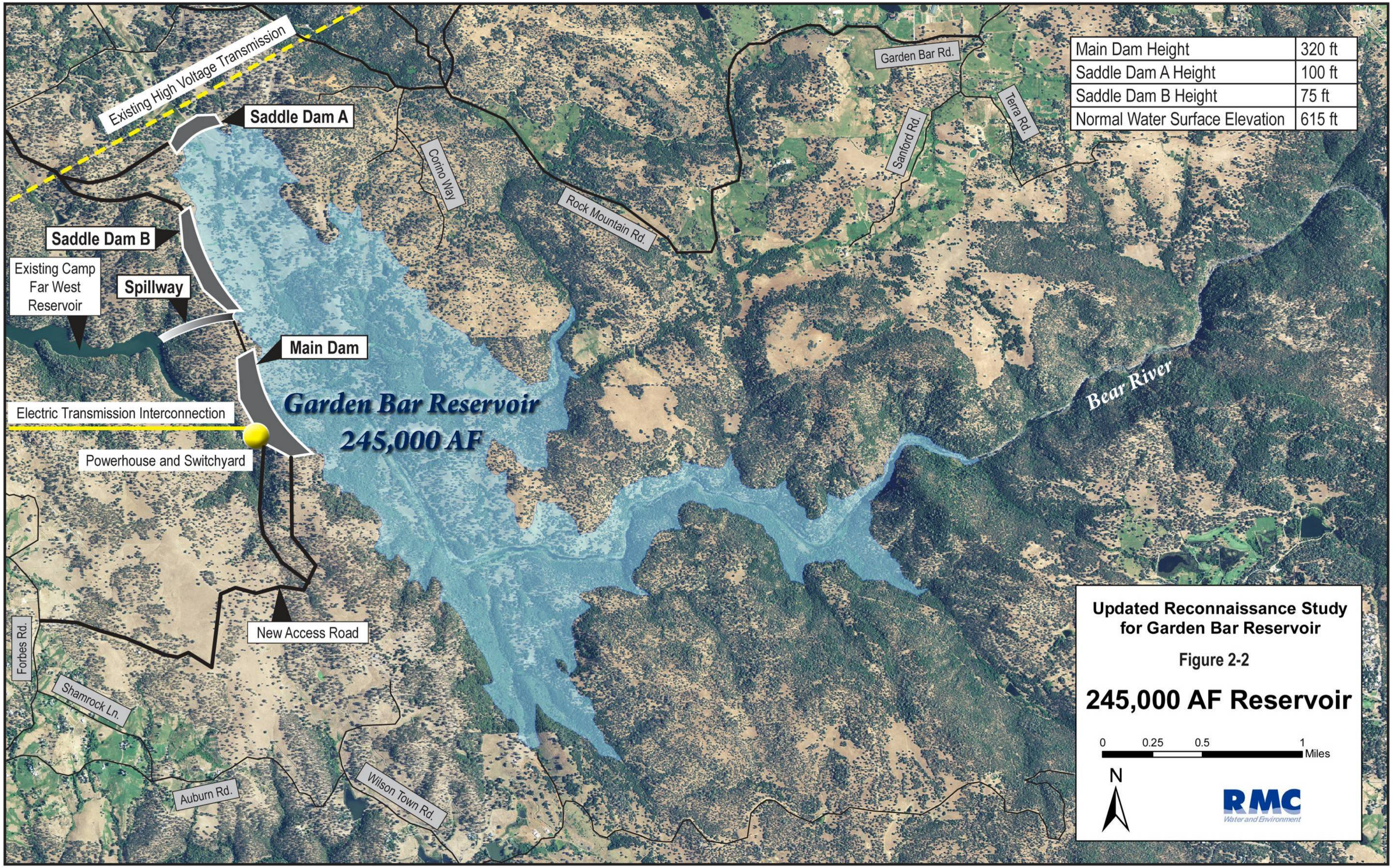


Figure 2-3: 265,000 AF Reservoir

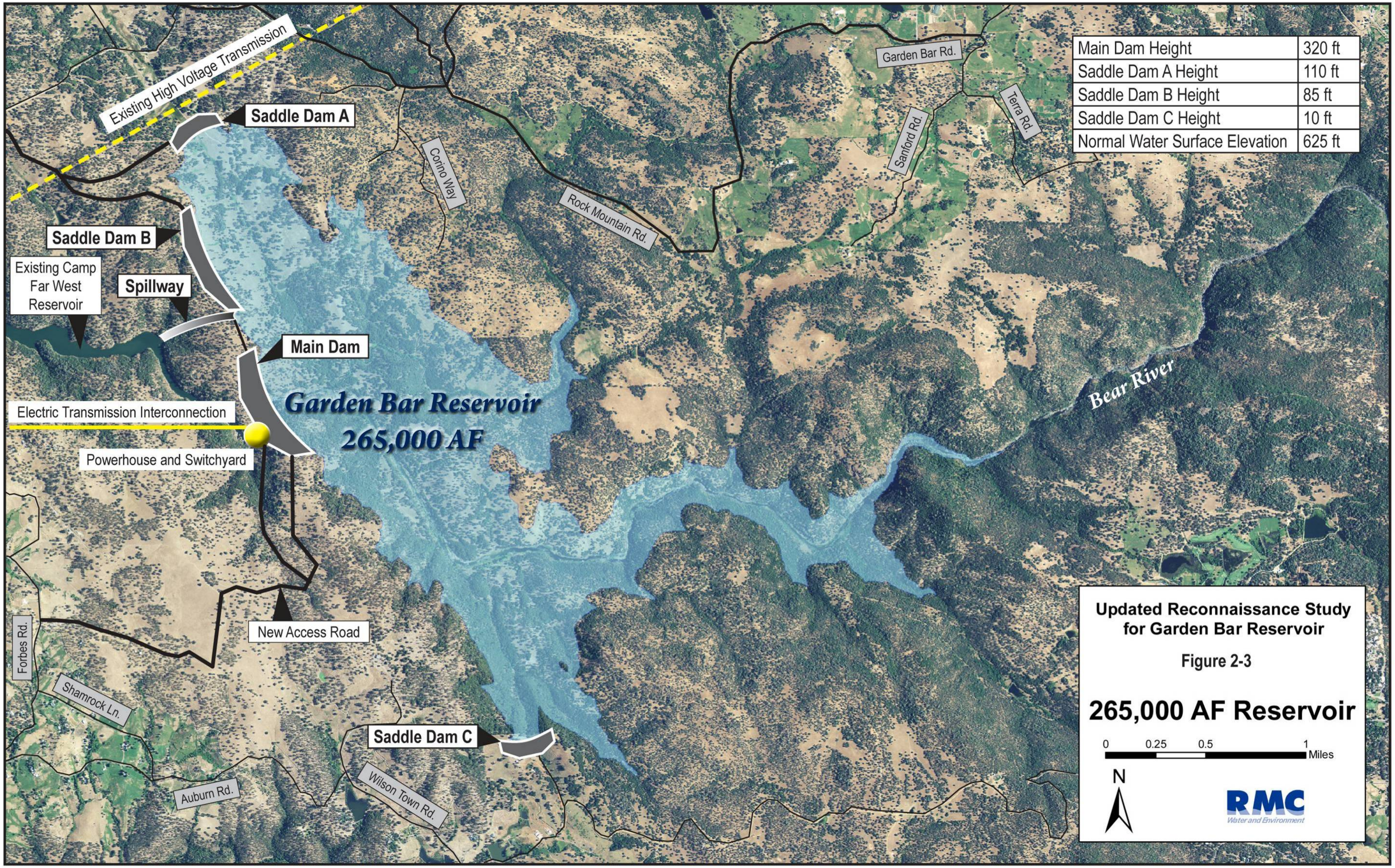


Figure 2-4: 310,000 AF Reservoir

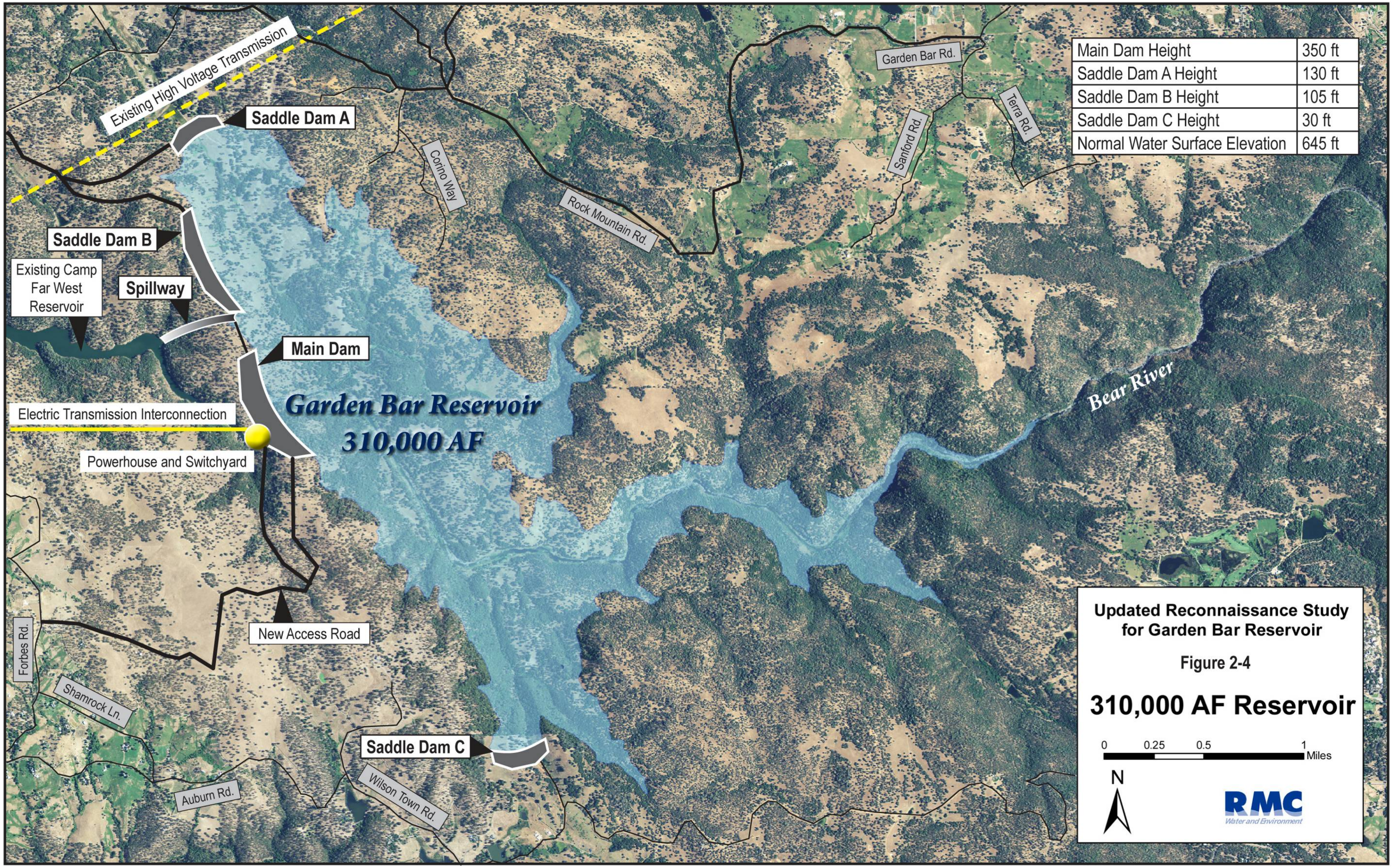
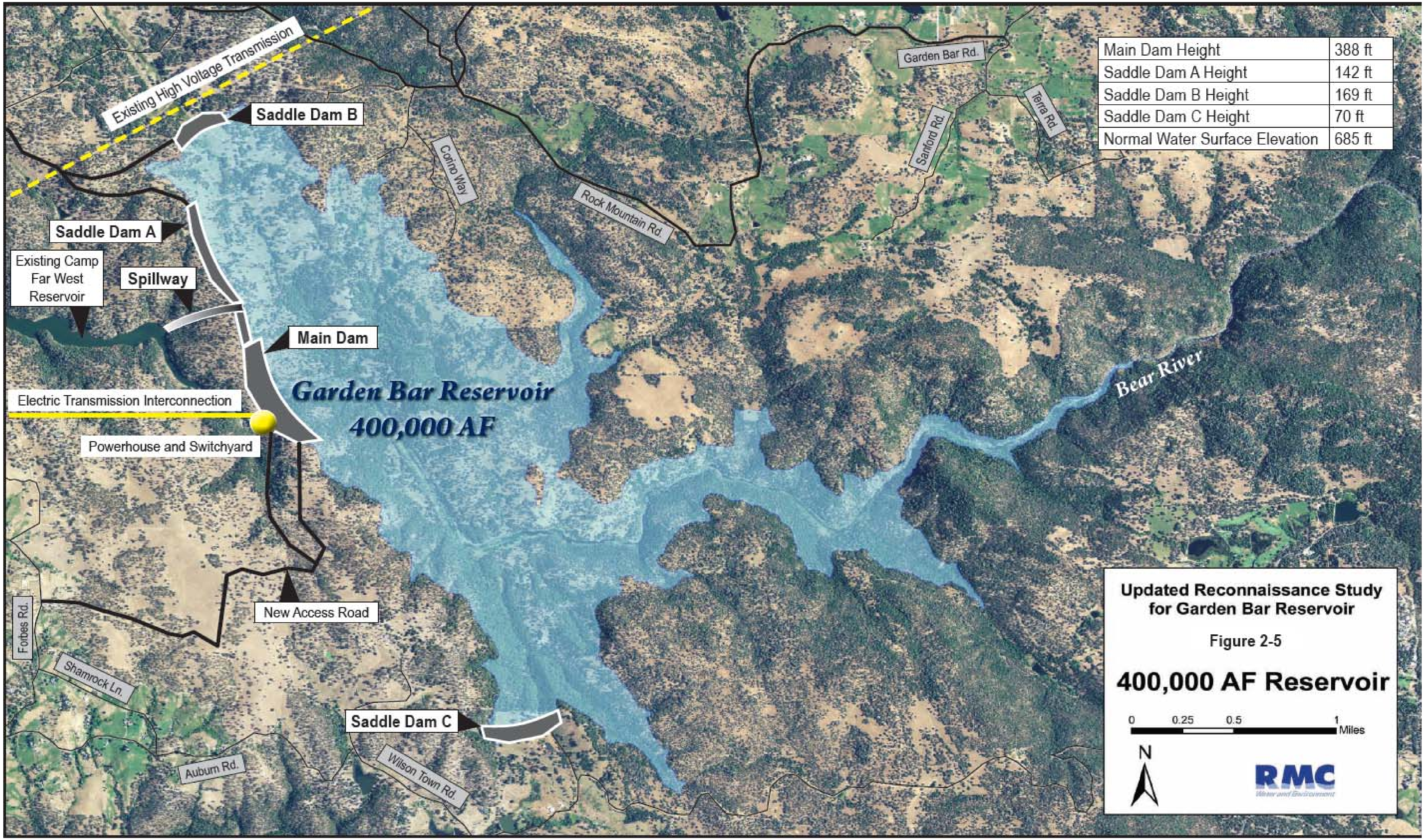


Figure 2-5: 400,000 AF Reservoir



Chapter 3 Water Supply Evaluation

3.1 Background

Four sizes of reservoirs for the Garden Bar site on the Bear River were evaluated with three modes of operation to capture the full range of operational scenarios for each. This analysis is intended to be used to establish the bookends of the potential water supply benefits that can be achieved and assist the Project Partners in their decision making process regarding the size and capacity of a potential reservoir, and how to potentially operate a Garden Bar Reservoir Project. Further and more detailed analyses will be required once a preferred size and operational scenario have been established. What follows is a summary of the water supply simulations and results.

3.2 Reservoir Sizes

Four reservoir sizes evaluated included a 245,000 acre-foot reservoir, a 265,000 acre-foot reservoir, a 310,000 acre-foot reservoir, as a 400,000 acre-foot reservoir as depicted in Figures 2-2, 2-3, 2-4, and 2-5 respectively. Each reservoir size and the three operational scenarios were analyzed based on the 1922-2006 historic hydrologic record.

3.3 Operational Scenarios

The modes of operations for each reservoir ranged from prioritizing "firm" yield, a supply that would be available in nearly all situations – 95 percent of the time, to "intermittent" yield, a supply developed from emptying the reservoir each year without regard for carry-over storage. The firm yield operation produced some intermittent yield during above normal years that augmented the supply without sacrificing the firm element. The dry-period selected for developing the firm yield criteria was the historic 1928-1934 period. A "hybrid" yield operation developed one-half the firm yield, but increased intermittent supply. Each of these modes of operations is further described below.

3.3.1 Firm Yield

For this study, the term "firm yield" was defined as the additional water produced every year during all historical droughts, with the exception of the 1975–1977 historic drought. This is the most conservative operational "bookend" of the evaluated operational alternatives. For this priority of operation, the Garden Bar and Camp Far West reservoirs are operated to reserve sufficient carryover storage for dry-period delivery as a first priority, releasing stored water to the inactive pool elevations defined by the storage elevations present at the end of the 1928–34 droughts. Additional yield (complimentary intermittent yield) is derived by annually releasing stored water to the equivalent of the low point of 1928 (138,000 acre-foot level), ensuring regular exercise of the reservoirs without sacrificing the defined firm yield.

3.3.2 Hybrid Yield

The hybrid operation reserves or maintains sufficient water in storage to supply half of the dry-period firm yield described above. This operation is a mid-point in the priority of operations. For this study, annual deliveries were set at one-half the firm yield amount, plus a minimum annual release of storage to develop an increased intermittent supply relative to the full firm yield while preserving the one-half firm yield annual supply.

3.3.3 Intermittent Yield

An intermittent supply is purely opportunistic. This supply scenario would empty Garden Bar Reservoir to the inactive pool every year and reserve no carry-over storage for dry periods. This is the most aggressive "bookend" operation of the alternatives and produces the highest exercise of the reservoir with the highest volatility of supply, but also produces the highest long-term average supply.

3.4 Methodology

The reservoir operation simulations were based on the historical 1922-2006 hydrologic period. The hydrologic data used for these simulations rely on data supplied from the California Department of Water Resources' (DWR) statewide operations model known as CALSIM and United States Geologic Survey stream gage data obtained at several locations on the Bear River upstream of the potential Garden Bar Reservoir site.

The data obtained from DWR were incomplete. As a result, adjustments were made to the data to be consistent with other DWR data used in statewide simulations. The operations conformed to restricted storage ability as required by water rights Term 91, which limits operations upstream of the Delta in order to meet Delta outflow requirements. These periods are referred to as "Balanced Conditions." Conversely, when the Delta is not in Balanced Conditions, "Excess Conditions" exist and that is when diversions to storage can occur without impacting existing water rights holders.

A Reservoir Simulation Model (ResSim3), a product of the Hydrologic Engineering Center (HEC) of the U.S. Army Corps of Engineers (Corps), was adapted to evaluate the reservoir sizes that the Bear River and Delta hydrology are capable of supporting, based on known operating constraints (e.g. Term 91). This model allows the amount of water leaving the Bear River basin to be calculated with different conditions imposed upon the basin. These data use measured flow plus unimpaired flow (reversing the operations and diversions) to test and evaluate the system.

A base case simulation was conducted and presumed that Bear River operation at Camp Far West would meet existing demands and developed outflows to the Feather River without a Garden Bar Reservoir Project. During balanced conditions, these flows, along with existing minimum in-stream flows, were used to establish a baseline condition of minimum outflows to the Feather River, assuring that yield from a Garden Bar Reservoir project would not reduce DWR supplies and thus avoid over estimating potential yield.

In-stream requirements for these studies rely on existing conditions. Currently, the California Department of Fish and Game (, in cooperation with the State Water Board, U.S. Fish and Wildlife Service , and the National Marine Fisheries Service is reviewing priority streams, including the Bear River below Camp Far West, for in-stream flow assessments. Future studies will need to address potential changes in in-stream flow requirements.

All simulations produced any incremental supply equally over the three months of July, August, and September (RBI 2011a). However, historically, sometimes during the months of July, August and September, the Delta is in "Excess Conditions." During such times, the new supply is not counted as yield and therefore the resulting supply is not equal for the three months.

Power supply simulations were based on water supply operations, and did not constrain the water supply operations. In addition, at this time there is no basis for placing value on downstream flood control benefits. Therefore, the operational simulations did not allocate space for flood storage.

In general, these assumptions are considered to be appropriate for this level of preliminary study. Upstream operations may change as a result of a number of items presently under consideration. These include modification of operations due to changing water needs and/or changes in operations that may result from FERC relicensing of upstream facilities. These flows could add to the hydropower generation potential at Garden Bar Reservoir. Any additional upstream flows that would remain in the system as a result of FERC licensing could also contribute to any additional downstream flow requirements that might result from Project licensing.

3.5 Results

Table 3-1 summarizes the potential annual water supply results for each of the reservoir sizes under each of the three modes of operational scenarios. These results are based on current conditions and available unimpaired flows on the Bear River. It is recognized that the Delta is in a state of flux and there are numerous issues that would need to be resolved in the future to make this water available and to be able to move a portion of it through the Delta.

For purposes of this study, the average hybrid yield results were used as the basis for evaluating project economics. More refined analyses will need to be undertaken if the Project Partners decide to further evaluate the Project feasibility.

Table 3-1: Annual Water Supply Summary for Alternative Sizes and Operational Priority

(1,000 acre-feet)

Reservoir Size	245,000 AF			265,000 AF			310,000 AF			400,000 AF		
Supply/ Operational Priority	Firm	Hybrid	Inter-mittent	Firm	Hybrid	Inter-mittent	Firm	Hybrid	Inter-mittent	Firm	Hybrid	Inter-mittent
High - Supply exceeded 5% of the time	86	144	181	91	160	201	97	195	239	110	271	328
Normal - Supply exceeded 50% of time	55	105	141	60	119	153	65	144	162	78	154	162
Low - Supply exceeded 95 percent of time	55	27	0	59	30	0	65	33	0	78	39	0
Lowest - the least annual supply (1977)	4	0	0	12	0	0	37	0	0	73	0	0
Average - average of all years	60	90	109	65	99	119	71	117	137	84	149	167

Source: RBI 2011a

Chapter 4 Power Supply Alternatives and Evaluation

The potential for hydropower generation was evaluated for each of the reservoir/water supply scenarios for the Garden Bar Reservoir Project. The hydropower analysis is intended to be used in conjunction with the water supply benefits to establish the range of potential benefits and associated revenues that could be realized from the Project. As previously stated, the power supply simulations did not constrain the water supply operations in any way. Further and more detailed analyses will be required prior to determining a preferred project configuration. What follows is a summary of the power supply simulations and results.

4.1 Power Pricing

The power market in California is continually evolving. The price of power by time of day and by month of the year for energy and capacity varies over time (seasonally and annually) to reflect the relative availability of supply and system demand. For these, and other reasons, it is important to recognize that the analysis of potential power generation potential and associated revenues should be analyzed in greater detail as a part of future studies.

After initiation of the California Independent System Operator (CAISO) in 1998, the power crisis of 2000 and 2001 lead to a reorganization that finally manifested itself as "Market Redesign and Technology Upgrade" in April of 2009.

The CAISO operates several markets with multiple elements and numerous constraints for scheduling power generation and transmission. For purposes of this evaluation, it was assumed that the scheduling would conform to the day-ahead market with allowance for real-time adjustments. The corollary is there is no presumption of a fixed contract for power supply. This is consistent with water delivery having the first priority for Project operation, and power production being incidental.

One of the merits of a tandem reservoir operation, i.e. operating the new Garden Bar Reservoir in conjunction with the existing Camp Far West Reservoir, is that releases can be coordinated between the two reservoirs without impacting the total amount of water being released downstream of Camp Far West. In order to estimate the value of the power produced, the time of day (hourly) energy price and the price for capacity attributes were evaluated. This resulted in the concept of maintaining the ability to adjust power generation to change by either operator controls (spinning reserve) or by automatic signals (regulation). Additionally, units that are not running, but can start within two hours, can provide non-spinning reserves.

4.2 Power Plant Sizing

Previous studies by the Corps and South Sutter Water District evaluated a wide range of power generation facilities under different operational scenarios and priorities and power market conditions. Those capacities ranged from 23 to 290 MW. Preliminary analyses in this study tested various turbine sizes for production revenue relative to estimated facility construction costs and without compromising water supply. That is, the goal of the power supply operations is to generate power supply benefits that are incidental and complementary to generating water supply.

Results of the power plant evaluations indicate that the optimal size varies from 30 to 35 MW at Garden Bar for the evaluated reservoir sizes. While the focus of the analysis was hybrid yield operations, a change from firm to intermittent operation would have a negative 20-30 percent effect on the net revenue; a change from firm to hybrid operation results in a 4-8 percent reduction in revenue, depending on reservoir size (RBI 2011b). For purposes of this preliminary study, the 30 MW size was selected to provide results for all reservoir sizes and operational evaluations. Note that this is nominal capacity and that when the reservoir is above average elevations and high flows, the output exceeds the nominal rating. In addition, an additional 3 MW of installed capacity would need to be added to the existing Camp Far West power generation capacity to take advantage of increased downstream releases.

4.3 Power Plant Operations

As with the water supply operation simulations, the power operation simulations were based on the 1922–2006 hydrologic period for each of the yield priorities and reservoir sizes. In each case, the evaluation included power generation at a potential Garden Bar Reservoir plus changes in the existing and new power house operations at Camp Far West Reservoir. Power production at Garden Bar employed a peaking operation where, depending on the outflow requirement as compared to the generating capacity, releasing the water was simulated during peak price periods to the extent possible. In order to accommodate this operational scenario, Camp Far West Reservoir was maintained at a level of 10 feet below the spillway to serve as an after bay to regulate the flows to the river. The Camp Far West releases to the Bear River were constant for each month – hourly and daily.

4.4 Power Production and Revenue

4.4.1 Incremental Power Production

The estimated incremental annual energy production for each of the reservoir sizes and operational scenarios is summarized in Table 4-1. These values represent the total incremental Project related annual energy production, including the incremental power production from the increased generation at Camp Far West.

Table 4-1: Summary of Incremental Energy Production (MWh).

Reservoir Size	245,000 AF			265,000 AF			310,000 AF			400,000 AF		
Supply / Operational Priority	Firm	Hybrid	Inter-mittent	Firm	Hybrid	Inter-mittent	Firm	Hybrid	Inter-mittent	Firm	Hybrid	Inter-mittent
High - Supply exceeded 5% of the time	143,855	150,255	139,938	150,705	153,949	144,048	162,516	161,072	146,213	178,507	163,777	135,084
Normal - Supply exceeded 50% of time	60,785	63,402	53,717	62,665	63,872	52,800	66,609	67,936	49,290	69,771	63,738	43,667
Low - Supply exceeded 95 percent of time	16,863	8,751	3,803	17,918	9,150	3,803	25,235	9,543	3,803	32,136	13,341	3,803
Lowest - the least annual supply (1977)	0	0	0	0	0	0	0	0	0	6802	0	0
Average - average of all years	73,259	72,266	65,261	75,903	74,561	65,761	81,115	77,960	65,045	90,563	77,993	58,223

Source: RBI 2011b

4.4.2 Incremental Power Revenues

Total revenues include revenues from energy sales and revenues from sales of capacity-related power attributes called "ancillary services." The pricing for power is based on an estimated average project energy price beginning in 2025. Typical power markets only address pricing about five years into the future. The pricing used in this evaluation reflects the current market operated by CAISO as adjusted by judgment to reflect a market beginning 15 years in the future.

The CAISO market is new as of April 2009. As a result, there is little historical data to base projections of future potential revenues. Accordingly, rather than extending older market data, lower pricing was used to reflect current slow economic conditions. Therefore, these revenue estimates are considered to be conservatively low, relative to what might occur. All estimated revenues have been adjusted to be in 2010 dollars.

Due to the Project operations being based primarily on water-supply considerations, power production would cease during periods when the water surface elevations in Garden Bar Reservoir dropped below the minimum head required for power generation. Similarly, projected power revenues would be reduced as operations shift from firm (when storage is retained) to intermittent (when storage is cycled annually).

Table 4-2 shows the summary of estimated incremental annual revenues from power sales. As noted above, these revenues include ancillary services developed from the capacity attributes of the Garden Bar generation as well as from energy generation; the ancillary services account for approximately 17 percent of the total average revenue.

Table 4-2: Summary of Potential Power Revenues ($1,000)

Reservoir Size	245,000 AF			265,000 AF			310,000 AF			400,000 AF		
Supply / Operational Priority	Firm	Hybrid	Inter-mittent	Firm	Hybrid	Inter-mittent	Firm	Hybrid	Inter-mittent	Firm	Hybrid	Inter-mittent
High - Supply exceeded 5% of the time	15,526	15,837	14,589	16,268	16,245	14,959	17,320	17,007	15,511	19,670	17,534	14,532
Normal - Supply exceeded 50% of time	7,625	7,302	6,007	7,910	7,300	5,925	8,115	7,668	5,706	8,703	7,438	5,141
Low - Supply exceeded 95 percent of time	2,205	1,155	504	2,343	1,247	504	3,395	1,301	504	4,321	1,800	504
Lowest - the least annual supply (1977)	0	0	0	0	0	0	0	0	0	973	0	0
Average - average of all years	8,370	8,051	7,105	8,707	8,316	7,191	9,394	8,672	7,158	10,637	8,725	6,532

Source: RBI 2011b

Chapter 5 Reservoir and Dam Scenarios and Evaluation

Four preliminary reservoir scenarios were evaluated for configuration, cost and constructability considering current dam safety requirements. The scenarios include: a 245,000 acre-foot reservoir, a 265,000 acre-foot reservoir, a 310,000 acre-foot reservoir, and a 400,000 acre-foot reservoir.

5.1 Dam Configuration

The main dam for each of the scenarios would be located just above the high water elevation of Camp Far West Reservoir. Each of the identified scenarios includes a main dam and two or more saddle dams or dikes. The dam configurations for each of the identified scenarios are shown in Figures 5-1 thru 5-4. A summary of the embankment sizes for each reservoir scenario is provided in Table 5-1.

Table 5-1: Dam Embankment Comparison

Reservoir Size		245,000 AF	265,000 AF	310,000 AF	400,000 AF
Crest Elevation		630	640	660	700
Nominal Water Surface Elevation		615	625	645	685
	Existing Ground Elevation	Embankment Height (Based on existing ground elevation below crest centerline)			
Main Embankment	312 Feet	318	328	348	388
Dike A	558 Feet	72	82	102	142
Dike B	531 Feet	99	109	129	169
Dike C	630 Feet		10	30	70

Note: All dimensions in feet, and all elevations in feet above sea level.
Source: GEI 2011a

Dam elements related to the scenarios include: main embankment and saddle dikes, spillway, outlet works, foundation seepage mitigation, and a low-flow bypass to maintain minimum flows in the river past the dam. Previous documents related to Garden Bar Reservoir and Camp Far West Dam and Reservoir were reviewed for the geotechnical and hydraulic analyses. Hydrological data developed in Section 3 of this report was used in sizing the dam, power systems and appurtenant facilities. No on-site preliminary studies were performed for this study.

The data review and evaluations performed for this study did not identify any technical issues or constraints that would prohibit continued development of the project. Based on available information, the geologic conditions at the site appear favorable for construction of a reservoir.

5.2 Cost Estimates

Preliminary estimates of construction costs were developed for the four identified scenarios. Construction cost estimates were developed based on previous experience on similar projects and evaluation of the major construction items appropriate to complete the work. For unit price items, quantity estimates were developed from preliminary layouts. Estimated unit prices and costs for the listed major work items were derived from published and non-published bid price data for similar work; prior experience on similar construction projects; and price quotes from local and regional suppliers and contractors. The estimated construction cost is referenced to the March 2010 construction cost index, and includes an estimate for contractor overhead and profit. Lump sum prices are based on estimates of the work required and the corresponding cost.

All costs include the following allowances:

- 8% for mobilization, bonds and insurance
- 20% for engineering contingency
- 15% estimating contingency
- 10% for engineering design and an additional 10% for construction engineering and administration

The total estimated cost for the dam elements of each of the reservoir scenarios are summarized in Table 5-2.

Table 5-2: Summary of Dam Elements and Unit Costs (2010 dollars)

Reservoir Size	245,000 AF	265,000 AF	310,000 AF	400,000 AF
Dam Crest Elevation	630 feet	640 feet	660 feet	700 feet
Dam Height	345 feet	355 feet	375 feet	415 feet
Embankment Volume	7,018,000 CY	7,952,000 CY	10,085,000 CY	17,422,00 CY
Estimated Capital Cost	$243,799,000	$261,220,000	$300,241,000	$453,047,000
Unit Cost of Storage	$995/AF	$986/AF	$969/AF	$1133/AF

Source: GEI 2011a

It should be noted that the construction cost estimates do not include allowances for interest during construction, cost of financing, environmental review, permitting, legal and administrative costs, land acquisition, or environmental mitigation. These additional costs are addressed in Section 7, Project Economics.

The estimated construction costs presented in this report are based on professional opinions of the cost to develop and construct the project as described. Actual project construction and development costs will be affected by a number of factors. Conditions and factors that arise if the Project proceeds through construction may result in construction costs that differ from the estimates documented in this report.

Figure 5-1: 245,000 AF Reservoir

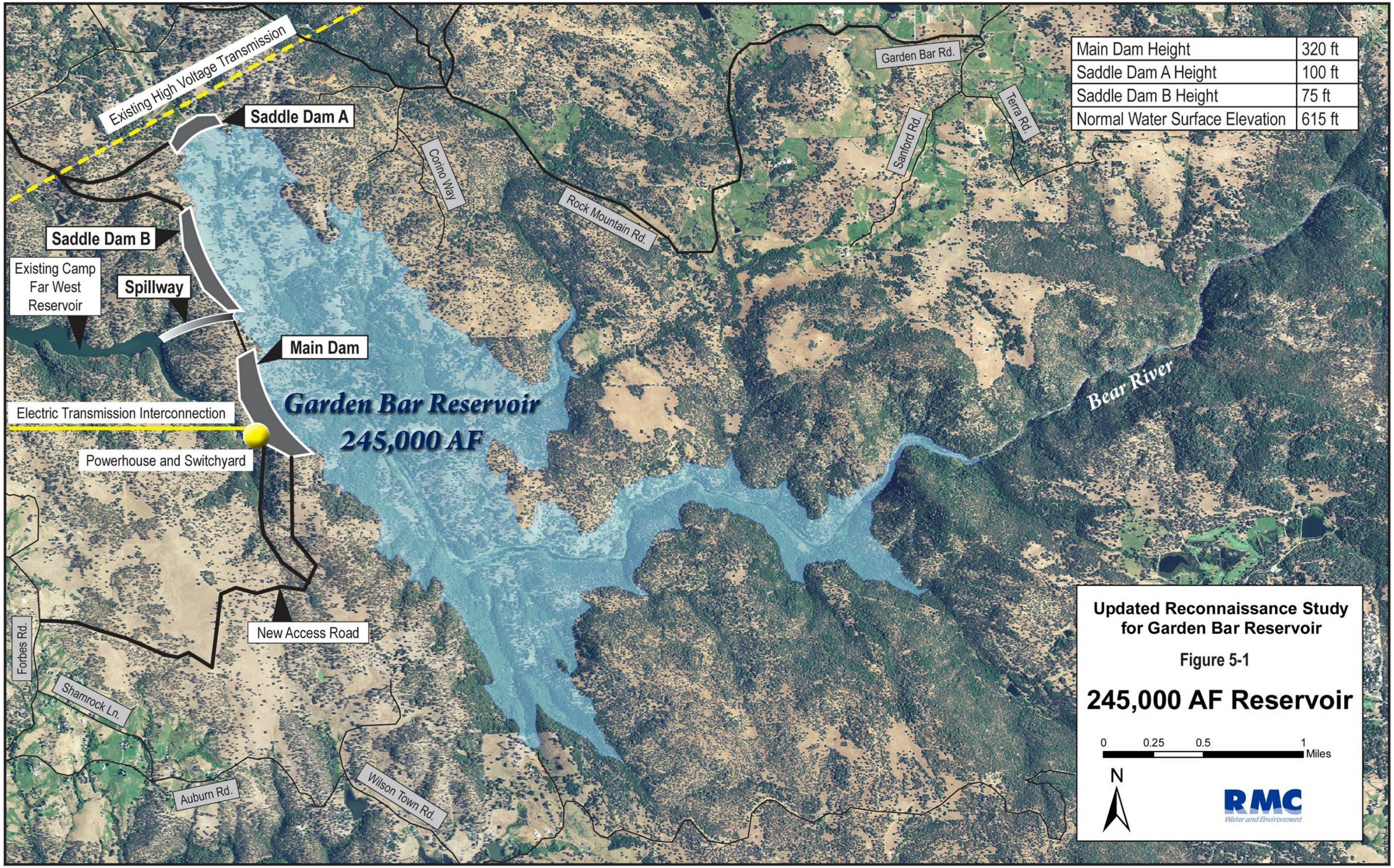


Figure 5-2: 265,000 AF Reservoir

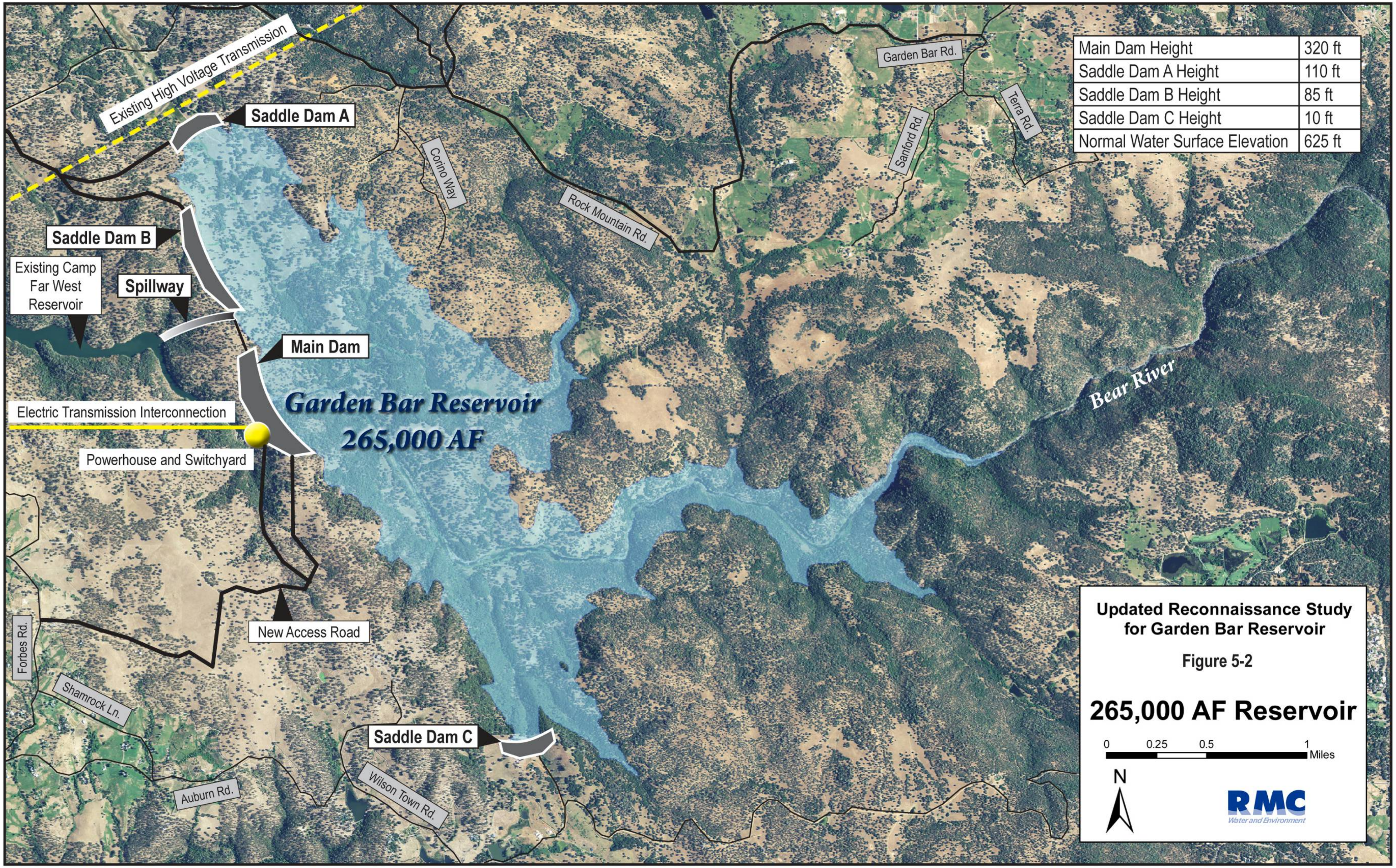


Figure 5-3: 310,000 AF Reservoir

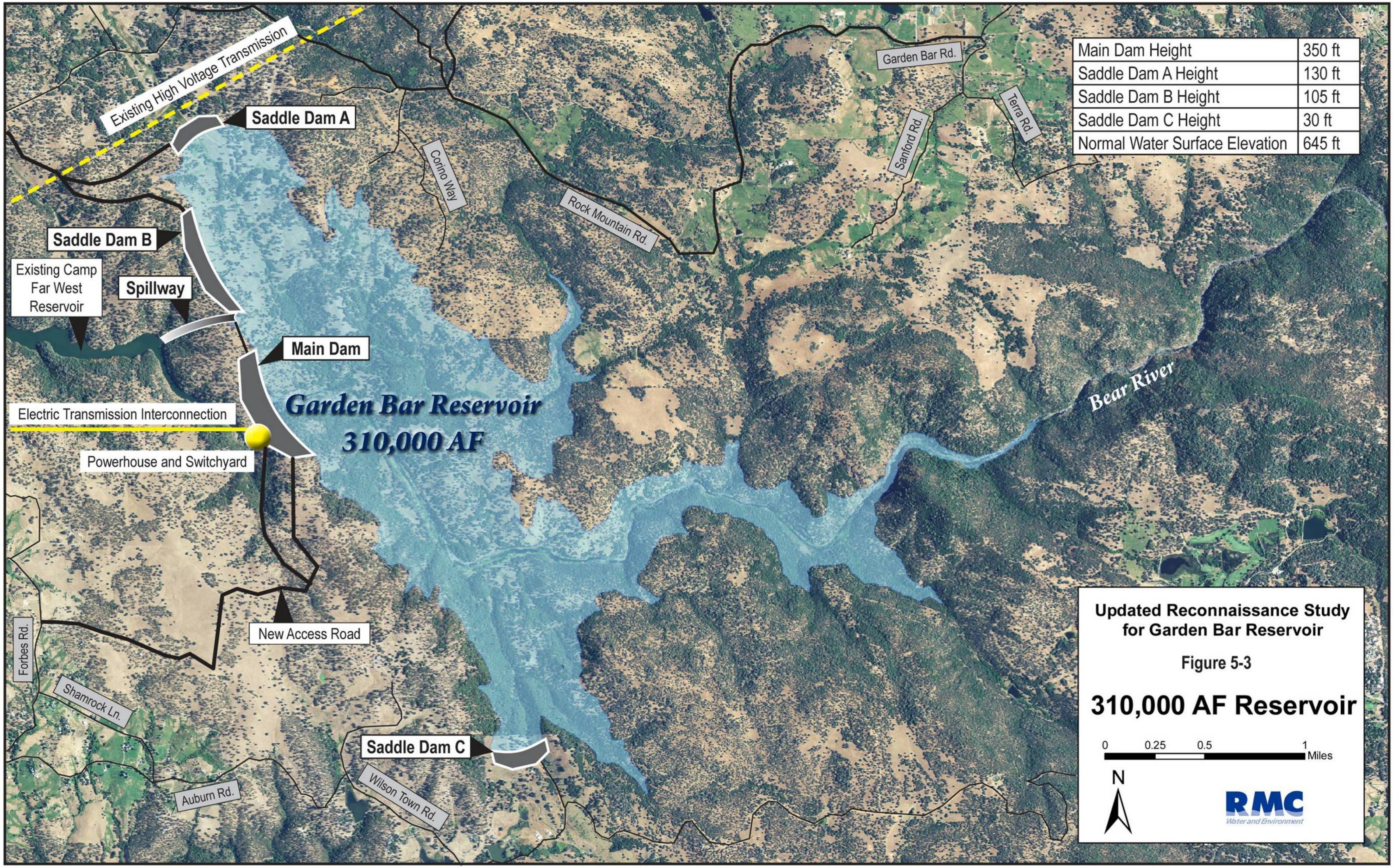
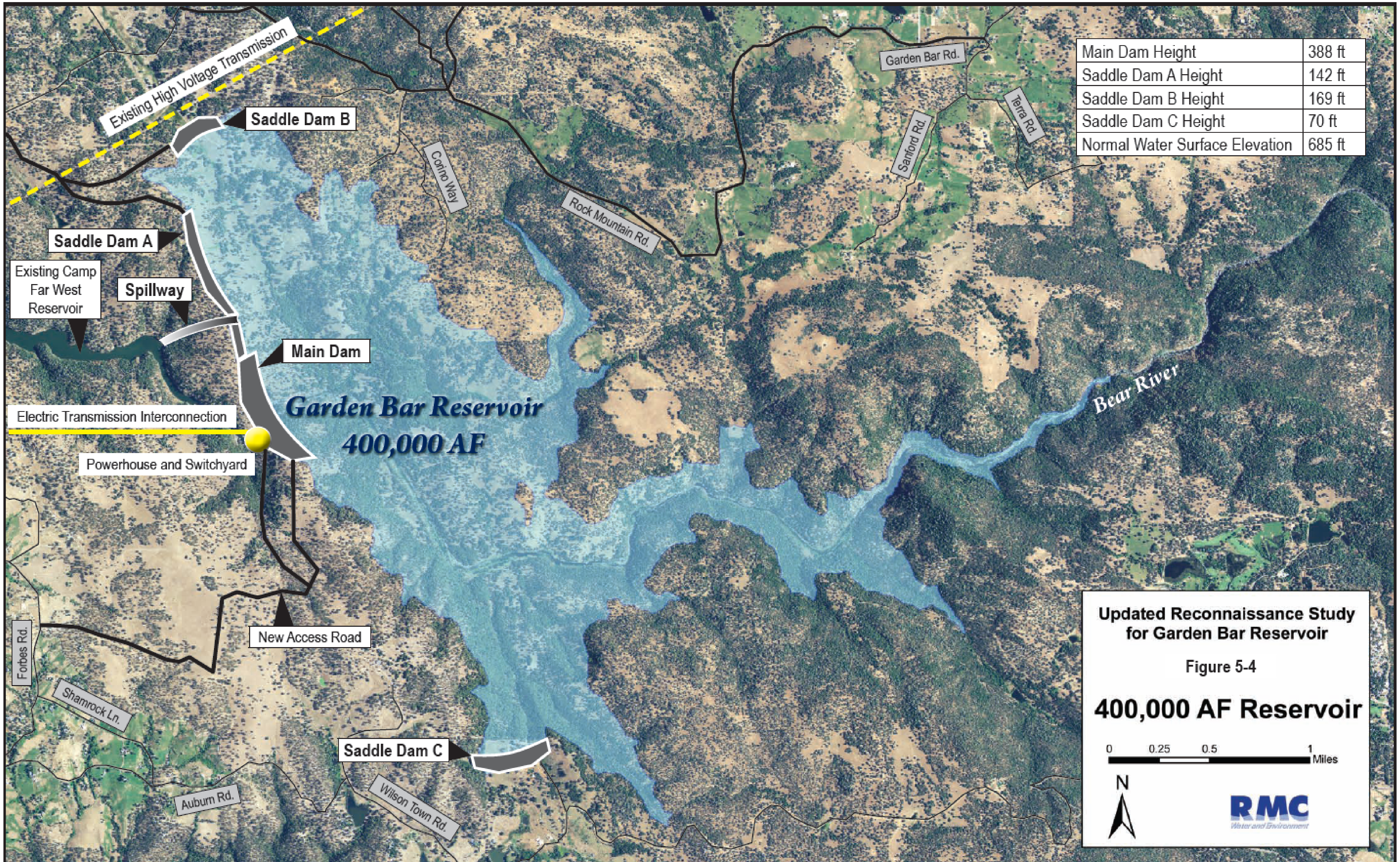


Figure 5-4: 400,000 AF Reservoir



Chapter 6 Power Systems

Development of a new Garden Bar Reservoir provides the opportunity to generate hydroelectric power as an added benefit to the development of an supplemental water supply. Power generating facilities could be included as a part of the Garden Bar Reservoir, and increased power generation facilities may also be beneficial at the existing Camp Far West Reservoir. These potential power generation configurations are described in this chapter.

6.1 Power Generating Scenarios

Multiple power system scenarios were developed to evaluate constructability, cost-benefits, and dam safety. The scenarios include four power system sizes - 20, 30, 79, and 290 MW facilities, and a 79 MW pumped storage scenario evaluated for the 265,000 acre-foot reservoir. The power generation scenarios are summarized in Table 6-1.

Table 6-1: Summary of Power Generation Scenarios

Hydropower System Installed Capacity		
245,000 AF Reservoir	265,000 AF Reservoir	310,000 AF Reservoir
20 MW	30 MW	30 MW
30 MW	79 MW	79 MW
	290 MW	290 MW
	79 MW Pumped Storage	

Source: GEI 2011b

6.2 Hydropower System Evaluation

The power system elements related to the scenarios include: reservoir storage and head, intake structure, water conductors, gate shaft, powerhouse, turbines and generators, and the tailrace channel. Previous documents related to Garden Bar Dam and Reservoir and Camp Far West Dam and Reservoir were reviewed. Hydrologic data developed in Section 3 of this report were used in sizing the power systems and appurtenant facilities. No site investigations were performed for this study.

The data review and evaluations performed for this study did not identify any technical issues or constraints that would prohibit continued development of the project. Based on available information, the hydrologic and geologic conditions at the site appear suitable for construction of the hydropower facilities.

6.3 Construction Cost Estimates

Preliminary estimates of construction costs were developed for the scenarios included in Table 6-1, expressed in March 2010 construction cost index. The construction costs include the hydropower generation facilities, all ancillary facilities, and power transmission facilities to connect to the northern California electric grid. Construction cost estimates were developed based on previous experience on similar projects and evaluation of the major construction items appropriate to complete the work. For unit price items, quantity estimates were developed from preliminary layouts. Estimated unit prices and costs for the listed major work items were derived from published and non-published bid price data for similar work; prior experience on similar construction projects; and price quotes from local and regional suppliers and contractors. The estimated construction cost is referenced to the March 2010 construction cost index, and includes an estimate for contractor overhead and profit.

Similar to the cost estimating for the dam facilities, the cost estimates for the hydropower facilities include the following allowances:

- 8% for mobilization, bonds and insurance
- 20% for engineering contingency
- 15% estimating contingency
- 10% for engineering design and an additional 10% for construction engineering and administration

The total estimated cost for the hydropower elements of each of the reservoir scenarios are summarized in Table 6-2.

Table 6-2: Summary of Power Generation Construction Cost Estimates

	Estimated Cost			
Power System Capacity	245,000 AF	265,000 AF	310,000 AF	400,000 AF
20 MW	$85.2 M			
30 MW	$88.6 M	$87.9 M	$86.5 M	$86.5 M
79 MW		$191.3 M	$182.5 M	$178 M
290 MW		$516.9 M	$501.2 M	$479.3 M
Pumped Storage				
79 MW		$241.8 M		

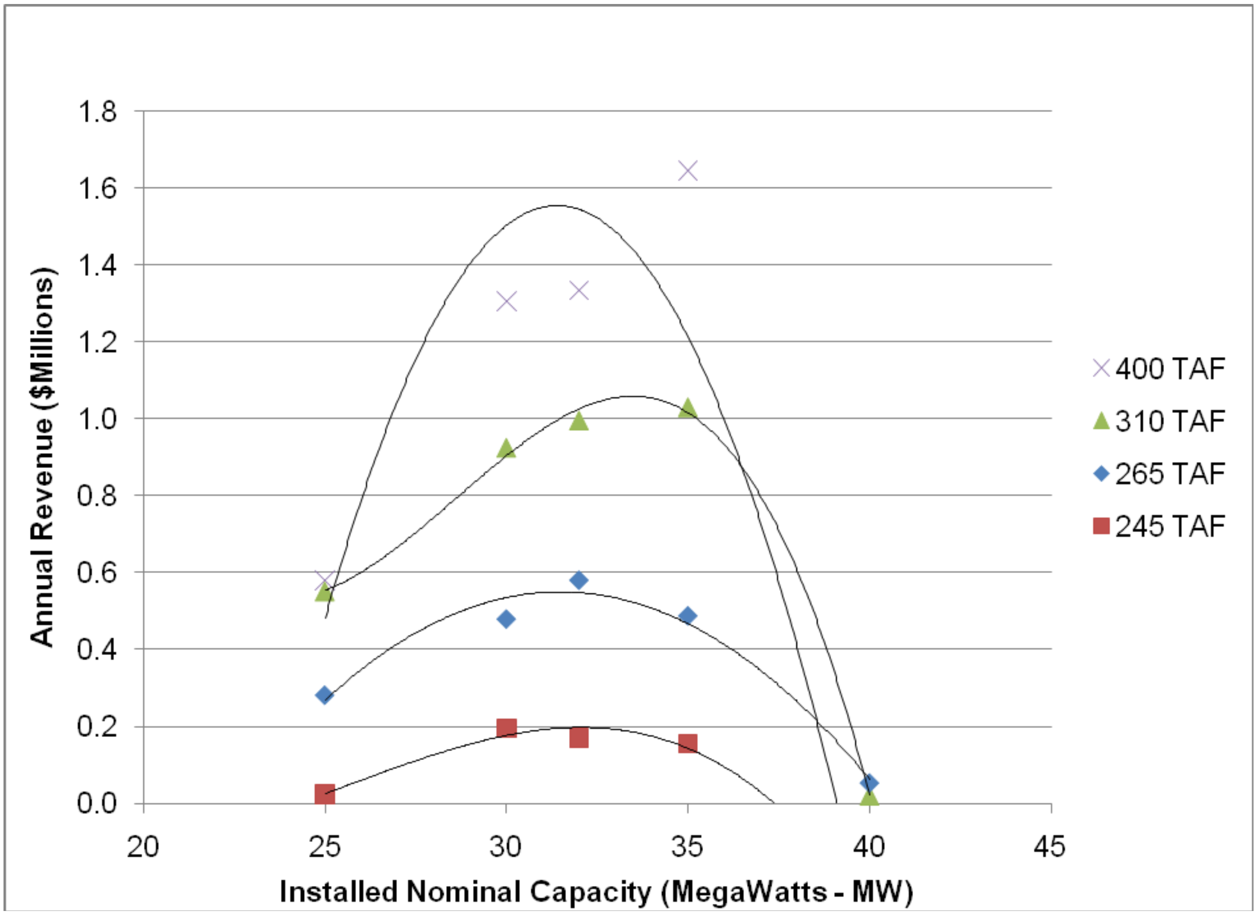
Source: GEI 2011b

It should be noted that the construction cost estimates do not include allowances for interest during construction, cost of financing, environmental review, permitting, legal and administrative costs, land acquisition, or environmental mitigation. These additional costs are addressed in Section 7, Project Economics.

6.4 Hydropower Benefits Analysis

The annual benefits of hydropower generation, in the form of revenues, were evaluated against the annualized cost of constructing and operating the hydropower facilities. The initial step in this analysis was to estimate annual revenues for each of the identified hydropower scenarios. The results of that analysis are presented in Figure 6-1.

Figure 6-1: Estimate of Annual Hydropower Revenue Potential



Source: RBI 2011b

Based on the estimate of hydropower revenue potential versus installed hydropower generating capacity, it would appear that an installed hydropower capacity of approximately 30 to 35 MW is the most cost effective sizing. A 30 MW hydropower facility has been assumed for purposes of evaluating overall Project economics, however further studies are needed during design to optimize the size of the powerplant.

6.5 Pumped Storage

Evaluation of a pumped-storage facility at Garden Bar Reservoir indicates that the projected power market will not support the additional capital investment required for a pumped-storage operation. While a full-fledged analysis was beyond the scope of this study, the data available for real-time operations in 2009 indicate a cycled 30-MW plant could develop a present value of an additional $16 million in power sales revenue. This, coupled with the dispatchable load present value from down-regulation of approximately $11 million, yields approximately $27 million in the present value of increased power sales, which is approximately one-half of the additional $50 million capital cost required for construction of pumped-storage facilities (RBI 2011b). While the CAISO and others indicate the value of capacity will rise beyond projections of existing markets, there is no clear evidence of markets supporting those indications. The CAISO markets are ever evolving to fit perceived needs; therefore, subsequent studies of this site should revisit this opportunity.

Chapter 7 Project Economics

This section presents reconnaissance-level economics for developing, implementing, and maintaining a Garden Bar Reservoir Project on the Bear River as discussed in Sections 1-6. A project is considered economically feasible if its total benefits exceed the total costs associated with implementing and maintaining the Project. For this study, the two sources of potential benefits being considered are water supply and power generation. There are additional potential benefits such as flood control and recreation, but these have not been evaluated for purposes of this study. Reservoir Size and Water Supply

The four reservoir sizes analyzed in this economic analysis includes a 245,000 acre-foot reservoir, a 265,000 acre-foot reservoir, a 310,000 acre-foot reservoir, and a 400,000 acre-foot reservoir. All four reservoir sizes appear economically and technically feasible.

For purposes of this study, the economic evaluation focuses on the average hybrid yield results as the basis for evaluating Project economics. It is projected that on average, approximately 90,000 acre-feet of water per year can be supplied under a hybrid yield operation for a 245,000 acre-foot reservoir; 99,000 acre-feet for a 265,00 acre-foot reservoir; 117,000 acre-feet for a 310,000 acre-foot reservoir, and 149,000 acre-feet for a 400,000 acre-foot reservoir.

Table 7-1: Summary of Garden Bar Reservoir Scenarios

Reservoir Size	Average Yield (Hybrid)	Hydropower Capacity
245,000 AF	90,000 AFY	30 MW
265,000 AF	99,000 AFY	30 MW
310,000 AF	117,000 AFY	30 MW
400,000 AF	149,000 AFY	30 MW

7.1 Land, Environmental, Permitting, Legal, and Financing Costs

The cost of obtaining the Project permits, completing environmental compliance, providing legal support, administrating the overall Project effort, and obtaining lands and rights-of-ways could be expected to cost in the range of 20 to 25 percent of the total construction cost. It is recognized that not all these costs will scale linearly with the size of the reservoir. However, for the purposes of this reconnaissance-level analysis, a simplifying assumption of a factor of 25 percent of total construction cost has been included as an allowance for these elements in this preliminary study General cost ranges for these items can be found in Section 8.

The cost of financing the Project will be a function of the method of project financing. Costs such as the cost of issuance, debt reserves, and interest during construction could add an additional 5 to 10 percent to the overall cost of the project.

The cost of each of these items will be refined as further studies are completed.

7.2 Construction Costs

As described in Sections 5 and 6, the cost of constructing the Project, including the dam elements and power systems, ranges on the order of approximately $330 million for the 245,000 acre-foot reservoir, to approximately $675 million for the 400,000 acre-foot reservoir.

Table 7-2: Summary of Project Cost Estimates (2010 dollars)

Items	245,000 AF	265,000 AF	310,000 AF	400,000 AF
Yield (Hybrid, in AF/YR)	90,000	99,000	117,000	149,000
Construction Cost Elements				
Dam Elements	$ 243,800,000	$ 261,200,000	$ 300,240,000	$ 453,050,000
Hydro Power Elements (30MW)	$ 88,600,000	$ 87,900,000	$ 86,500,000	$ 86,500,000
Subtotal Construction Costs	$ 332,400,000	$ 349,100,000	$ 386,740,000	$ 539,550,000
Land, Environ, Legal, Water Rights, etc.	$ 83,100,000	$ 87,275,000	$ 96,685,000	$ 134,887,500
Total Capital Cost	$ 415,500,000	$ 436,375,000	$ 483,425,000	$ 674,437,500

7.3 Total Annual Costs

The annual costs for the potential Garden Bar Reservoir Project include annual financing costs and annual operation and maintenance costs. The annual financing costs were derived using an annual interest rate of 6 percent for 30 years on the total capital costs. The annual operations and maintenance costs were derived using a factor of 2 percent of total construction costs which is adequate for a multipurpose dam and reservoir of this size and for this level of study. The total anticipated annual cost to finance, operate and maintain the reservoir range from approximately $30 to $33 million per year, depending on the size of the reservoir, as shown in Table 7-3.

Table 7-3: Summary of Annual Project Costs

Items	245,000 AF	265,000 AF	310,000 AF	400,000 AF
Yield (Hybrid, in AF/YR)	90,000	99,000	117,000	149,000
Total Capital Cost	$415,500,000	$436,375,000	$483,425,000	$674,437,500
Annual Financing Cost (6%, 30 Years)	$30,186,000	$31,703,000	$35,121,00	$48,998,000
Annual O&M (2% of Construction Costs)	$6,648,000	$6,982,000	$7,735,000	$10,791,000
Total Annual Costs	$36,834,000	$38,685,000	$42,856,000	$59,789,000

7.4 Break Even Average Value of Water

For the Garden Bar Reservoir Project to be economically viable the value of water and power must be equal to or greater than the total annual costs. The market for a new water supply in California is widely varied. Many factors come into play when trying to put a monetary value on water as a new supply. For instance and generally speaking, the value of an intermittent water supply is much lower than the value of a firm or dry year supply. Also, water for agricultural purposes is valued at much less than water for municipal and industrial uses. In addition, the value of water is generally lower north of the Delta than water south of the Delta.

The power revenues will provide income to reduce the overall cost of water from the Project. The total potential annual power revenues that can be generated to help offset annual costs range from approximately $8 to $9 million dollars, depending on the size of reservoir. As shown in Table 7-4, this results in the need to generate approximately $29 to $51 million in annual revenue from water supply to break even from an annual revenue standpoint.

Table 7-4: Summary of Project Economics

Items	245,000 AF	265,000 AF	310,000 AF	400,000 AF
Yield (Hybrid, in AF/YR)	90,000	99,000	117,000	149,000
Total Capital Cost	$415,500,000	$436,375,000	$483,425,000	$674,437,500
Total Annual Costs	$36,834,000	$38,685,000	$42,856,000	$59,789,000
Power Revenue Elements				
Camp Far West	$784,000	$821,000	$844,000	$739,000
Garden Bar	$7,267,000	$7,496,000	$7,829,000	$7,986,000
Total Power Revenue	$8,051,000	$8,317,000	$8,673,000	$8,725,000
Subtotal Resulting Annual Cost	$28,783,000	$30,368,000	$34,183,000	$51,063,884
Break Even Average Value of Water	$320	$307	$292	$343

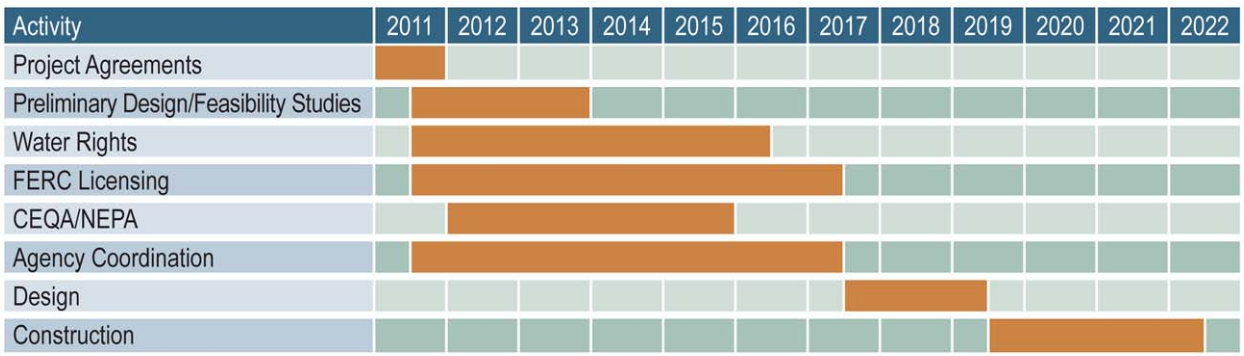
An average value of water necessary to achieve a break even economic condition was calculated based on the average amount of water (Hybrid Yield) provided by the Project. The result is an average value of water that ranges between approximately $292 and $343 per acre foot, as shown in Table 7-4.

It is recognized that Delta operations are in a state of review and there are numerous issues that would need to be resolved to make the new yield from a Garden Bar Reservoir Project available and to be able to move a portion of it through the Delta.

Chapter 8 Strategic Planning

This section is intended to serve as a "road map" for conducting the additional levels of project evaluation beyond completion of this Preliminary Study, including steps necessary to further evaluate the Project feasibility. However, it is not intended to be a comprehensive or detailed analysis of each step. The incremental steps necessary to further evaluate and establish technical, economic, environmental, and institutional feasibility of the Garden Bar Reservoir Project will take on the order of 10 years. Actual facilities design and construction could add an additional three to five years. What follows are the major activities required for implementing the Project. Many of these activities are interrelated and contingent upon complying with CEQA and NEPA. A summary of the timeline and steps necessary to determine project feasibility is shown in Figure 8-1.

Figure 8-1: Project Timeline



8.1 Decision on Next Steps

Based on the results of this reconnaissance-level preliminary study, the Project Partners need to determine whether to proceed with future feasibility and Project implementation activities. Each of the Project Partners needs to:

1. Determine their desire to continue forward to the next Project steps;
2. Determine how much water their agencies would want to obtain from the Project;
3. Determine the level of reliability of supply (i.e. firm versus hybrid versus intermittent yield) they would need or want from the Project.

It is understood that those decisions are a factor of many elements including economics, timing, and ability to convey the water. However, it is necessary to start the dialog to determine where those quantities, economics, sensitivities, and other issues are in order to determine the next steps associated with the Project

For purposes of this study, it is assumed that the power supply would be sold on the open market. However, any power supply needs by the Project Partners should also be determined or discussed at this time as well.

8.2 Formalize Ownership/Partnership Organization

In conjunction with any level of decision to proceed toward additional feasibility activities, a more formal organizational structure maybe appropriate to lead and conduct the studies and evaluations necessary to complete the feasibility studies, permitting, environmental documentation, water rights and FERC application processes. Currently, the Project Partners are organized through a Memorandum of Understanding, and a more formal arrangement may be more appropriate.

One example of a more formal arrangement would be a Joint Powers Authority (JPA), although scenario arrangements could also meet the needs of the Project. An arrangement such as a JPA would have an authorizing agreement with the participating agencies to establish its authority. Many options and alternatives exist as to how a JPA or similar relationship is formed, managed, and how it would work. The primary advantages are that there would be a single and formal entity to secure financing, conduct necessary engineering and environmental studies and public involvement activities, and make day-to-day decisions on behalf of the participating agencies.

8.3 Preliminary Design and Final Feasibility Studies

The next phase of work will require building on this reconnaissance-level preliminary study and completing feasibility-level engineering analyses to refine the alternatives and develop a preliminary design, update the cost estimates, and more clearly identify the benefits of the Project in light of the water and power supply needs of the Project Partners and any third parties. This work is also necessary to support the water rights application and FERC hydropower licensing application processes. Site-specific studies will be required to take this study to the preliminary design and feasibility level. These studies will build upon this and previous work and will include collecting on-ground and site specific data; surveying and mapping; identifying land costs, further refining and designing alternatives; refining the hydrology, water supply and power evaluations; refining operations, maintenance, and monitoring plans; refining construction, operation, and maintenance cost estimates; and developing financial plans and implementation schedules.

In addition, the Delta is in a state of flux and there are numerous issues that would need to be resolved in the future to make this water available and to be able to move a portion of it through the Delta. The results will allow for the final economic and financial feasibility to be determined and will provide additional detailed information useful for the environmental review process as well as the water rights and hydro licensing process as described below. It is estimated that this process could take up to 5 years and cost on the order of approximately $5 to $10 million.

8.4 Water Rights

Implementation of a Garden Bar Reservoir Project will require obtaining a water right permit and license from the California State Water Board, Division of Water Rights. A water right permit is an authorization to develop a water diversion and use project. The right to use water is obtained through actual use of water within the limits described in the permit. After receiving a water right permit, construction of the project, and use of the water, the Division of Water Rights will inspect the project to make sure that the water is being used beneficially and in compliance with all of the permit conditions before a water rights license is issued. The water right license is a vested right that confirms actual use and only applies to water that has been reasonably and beneficially used.

A fully completed application will need to be submitted to the Division of Water Rights along with the application fee which could be on the order of $500,000, with an annual cost of tens of thousands of dollars for a project of this size and magnitude. The water rights application must be supported by a CEQA document, demonstrating and disclosing all of the potential environmental impacts and mitigation strategies. The Division of Water Rights has in excess of 500 pending water right applications. Once they have all of the necessary information, it may take three to four years at a minimum to obtain a permit. For planning purposes, it should be expected to take 8 to 10 years before a water right permit could be issued for a Garden Bar Reservoir Project and at a cost of approximately $5 to $10 million.

8.5 FERC Licensing

As the proposed Garden Bar Reservoir Project has a hydropower component, it must file for a hydropower license which is regulated by FERC. The filing for a FERC hydropower license is a significant undertaking. It will require numerous detailed engineering and environmental studies as well as consultation with numerous federal, state, and local entities, landowners, and stakeholders. This process will take on the order of 8-10 years to complete and at a cost of approximately $5 to $10 million. In addition, economies of scale may also be achieved by integrating the water rights and FERC licensing/relicensing processes together. However, the Division of Water Rights and FERC have different protocols and requirements, so coordination between the requirements of the two agencies, their processes, and timing could be challenging.

8.6 Environmental Compliance

This project will need to comply with both CEQA and NEPA . It is envisioned that the South Sutter Water District or some designee through the ownership establishment would be the Lead Agency for CEQA and FERC would be the Lead Agency under NEPA. There are many environmental issues associated with the construction and operation of a new dam and reservoir. These include the potential for the project to affect fisheries and aquatic resources, terrestrial and sensitive species, water quality, groundwater, recreation, cultural resources, and other sensitive environmental resource areas. In addition, the proposed Garden Bar Reservoir Project would potentially inundate lands that are either in a conservation easement or in the process of becoming a public land trust. There are also many other permits and regulatory approvals that will be required for the implementation of this Project. It is recommended to try to integrate the CEQA and NEPA process along with the requirements of the water rights application and hydropower licensing processes, if possible. The CEQA and NEPA process could take on the order of 5 to 7 years and at a cost of approximately $5 to $8 million to complete.

8.7 Agency Coordination and Public Involvement

Agency coordination and public involvement is a critical part of studying and implementing water resources projects. There will be many individuals, agencies, and entities interested in the project for a variety of technical, philosophical, political, legal, institutional, and environmental reasons. It is imperative that a public involvement plan is prepared and properly implemented to coordinate and manage the agency coordination and public involvement activities. These activities will include, but are not limited to:

- Consulting with the resource agencies and stakeholders;
- Conducting scoping meetings and public hearings; responding to the media; and
- Developing outreach materials that contain clear, accurate, and consistent information about the Project and the activities, and inform stakeholders of opportunities for involvement.

The agency coordination and public involvement activities will need to be ongoing throughout the development of the Garden Bar Reservoir Project and integrated with the CEQA and NEPA process and the water rights and hydropower license applications. As a result, the agency coordination and public involvement activities could conservatively take 10 to 15 years to complete and at a cost of approximately $3 to $5 million.

8.8 Project Implementation

Project implementation would include completing final design, preparing construction bid documents, contractor selection, construction activities and training operation and maintenance staff to take over the operations throughout the project’s life cycle. Implementing a Garden Bar Reservoir Project at one of the four sizes evaluated will conservatively take 10 to 15 years to complete and cost between approximately $450 and $725 million, including construction and implementation studies. Neither SSWD nor any of the potential project partners can or will make any commitment to implement any project until full environmental review of the proposed project is completed.

References

GEI Consultants, Inc. (2011a). Garden Bar Reservoir Studies Technical Memorandum – Dam Elements, Prepared for RMC Water and Environment, Inc., May.

GEI Consultants, Inc. (2011b). Garden Bar Reservoir Studies Technical Memorandum – Power Systems, Prepared for RMC Water and Environment, Inc., May.

Robertson-Bryan, Inc. (2011a). Garden Bar Reservoir Studies Technical Memorandum - Water Supply Simulation, Prepared for RMC Water and Environment, Inc., April.

Robertson-Bryan, Inc. (2011b). Garden Bar Reservoir Studies Technical Memorandum - Power Supply and Revenue Simulation, Prepared for RMC Water and Environment, Inc., April.

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