Upper San Joaquin River Basin Storage Investigation

Yokohl Valley Reservoir

Surface Storage Option Technical Appendix to the Phase 1 Investigation Report

A Joint Study by:

Bureau of Reclamation
Mid-Pacific Region

California Department
of Water Resources

In Coordination with:

The California Bay-Delta Authority

October 2003

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SURFACE WATER STORAGE OPTION TECHNICAL MEMORANDUM

YOKOHL VALLEY RESERVOIR

UPPER SAN JOAQUIN RIVER BASIN STORAGE INVESTIGATION

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Acronyms and Abbreviations List

CEQA	California Environmental Quality Act
cfs	cubic feet per second
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
Corps	United States Army Corps of Engineers
elevation	number of feet above mean sea level
HEP	Habitat Evaluation Procedure
Investigation	Upper San Joaquin River Basin Storage Investigation
MCY	million cubic yards
MW	megawatt
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
PCB	polychlorinated biphenyl
Reclamation	Bureau of Reclamation
ROD	Record of Decision
TAF	thousand acre-feet
TCP	Traditional Cultural Place
TM	Technical Memorandum
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

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EXECUTIVE SUMMARY

A prefeasibility review of a potential new reservoir in Yokohl Valley was completed as part of the Upper San Joaquin River Basin Storage Investigation (Investigation). Yokohl Valley Reservoir would be a new surface water storage facility approximately 15 miles east of Visalia, California, and just east of the Friant-Kern Canal. This off-stream storage facility would be operated in coordination with other facilities in the Central Valley Project Friant Division to allow for capture of additional water in Millerton Lake on the San Joaquin River.

The reservoir would be operated as a pump-back storage facility, storing water from Millerton Lake conveyed by the Friant-Kern Canal. Reclamation originally considered a variation of this option in a study of the Mid-Valley Canal. An alternative configuration would entail water diversions from Lake Kaweah and subsequent operations to support water exchanges between Kaweah River water users and Friant Division water users. Both options would also capture natural runoff in Yokohl Creek. Although both options were initially considered in the Investigation, only the pump-back option was retained for evaluation.

As evaluated, Yokohl Valley Reservoir would be a 450 thousand acre-feet (TAF) reservoir formed by a 260-foot high earthfill dam, with a crest length just under 3,000 feet, and two small saddle dams. Site characteristics appear to pose no barriers to dam construction. Underlying rock conditions would be adequate for a dam foundation; sufficient impervious, pervious, and riprap materials exist within 2 miles of the dam site; and potential staging and lay-down areas are located immediately upstream and downstream. An improved road provides access directly to the dam site and electrical power would likely be available from sources in Exeter or along Highway 198.

Field costs for dam construction only are estimated at $280 million, based on updated prices from a design and estimate originally prepared in 1975. These costs do not include relocation, clearing, lands, mitigation, investigation, design, construction management or interest during construction.

Water supply operations, as described in the Hydrology and Modeling Technical Appendix, suggest that a larger size reservoir should be considered in Yokohl Valley. Initial operations simulations considered sizes up to 800 TAF. A power analysis was made based on output from the water operations analysis to estimate energy use and generation for an 800 TAF reservoir. As summarized in Table ES-1, Yokohl Valley Reservoir would use more power to pump water into storage than could be generated with releases. A similar conclusion would apply to smaller reservoir sizes, although both energy use and generation would be less.

TABLE ES-1. ESTIMATED PUMPING REQUIREMENT AND GENERATING POTENTIAL FOR YOKOHL VALLEY RESERVOIR

Storage (TAF)	Operating Scenario	Avg. Annual Energy Generation (GWh/yr)	Avg. Annual Pumping Energy Requirement (GWh/yr)
800	WQ	80 – 110	180 – 220
	RF	80 – 110	180 – 220

Key:
GWh/yr – gigawatt-hours per year
RF – restoration flow single-purpose analysis scenario
TAF – thousand acre-feet
WQ – water quality single-purpose analysis scenario

Environmental review of the potential reservoir area considered elevations that would be associated with a reservoir capacity up to and exceeding 800 TAF. Most of the inundated area would be common grassland in Yokohl Valley. However, the valley may also support substantial wetland habitat, including vernal pools. Populations of a listed plant species are known to have occurred historically in Yokohl Valley. Other special status plants are also likely to be present. Impacts to wildlife would be low and no fish were observed in Yokohl Creek during a field visit completed as part of the Investigation.

Numerous cultural resources are known to be present and there may be additional sites not yet recorded. Further site investigations and research regarding significance and mitigation requirements will be necessary. No recreational resources would be affected. Land use impacts would be relatively low, and would be limited to relocating scattered existing residences.

No significant technical issues were identified related to the physical ability to construct the potential storage facility. This option was retained for further consideration in the Investigation. Additional sizes will be evaluated, with a total storage capacity of up to 800 TAF.

CHAPTER 1. INTRODUCTION

The Bureau of Reclamation, in cooperation with the California Department of Water Resources, is completing the Upper San Joaquin River Basin Storage Investigation (Investigation) consistent with the CALFED Bay Delta Program Record of Decision (ROD), August 2000. The Investigation will consider opportunities to develop water supplies to contribute to restoration of the San Joaquin River and to water quality improvements in the river, and to enhance conjunctive management and exchanges to provide high-quality water to urban communities. The ROD indicated that the Investigation should consider enlarging Friant Dam or developing an equivalent storage program to meet Investigation objectives.

The Investigation identified several potential surface storage sites to be initially considered through prefeasibility-level studies of engineering and environmental issues. This Technical Memorandum (TM), which was prepared as a technical appendix to the Phase I Investigation, presents findings from those studies related to a potential reservoir in Yokohl Valley.

STORAGE OPTION SUMMARY

Yokohl Valley Dam and Reservoir would be located in Tulare County, near the community of Exeter, about 15 miles east of Visalia (Figure 1-1). The option evaluated in this TM includes a 260-foot-high earthfill dam, with a crest length of nearly 3,000 feet, which would create a 450 thousand acre-foot (TAF) reservoir. Two small saddle dams in the hills west of the main dam site would be required.

The reservoir would operate as a pump-back storage reservoir served by the Friant-Kern Canal, as shown in Figure 1-2. This is a variation of an option that was described initially in a study of the Mid-Valley Canal by Reclamation (1964). Supplementary flows would come from natural runoff in Yokohl Creek. Stored water would be released to Yokohl Creek and directed to the Friant-Kern Canal.

SUMMARY OF PREVIOUS INVESTIGATIONS

In April 1958, Reclamation prepared reconnaissance-level cost takeoffs for possible dams located within Yokohl Valley. The contemplated reservoirs varied in size from 100 TAF to 440 TAF. The site of the largest structure contemplated is the same as that of the option evaluated in this TM.

In February 1964, Reclamation prepared a cost estimate for the 440 TAF project, followed in 1972 with a reconnaissance flood hydrology evaluation and a new cost estimate indexed to 1972 price levels.

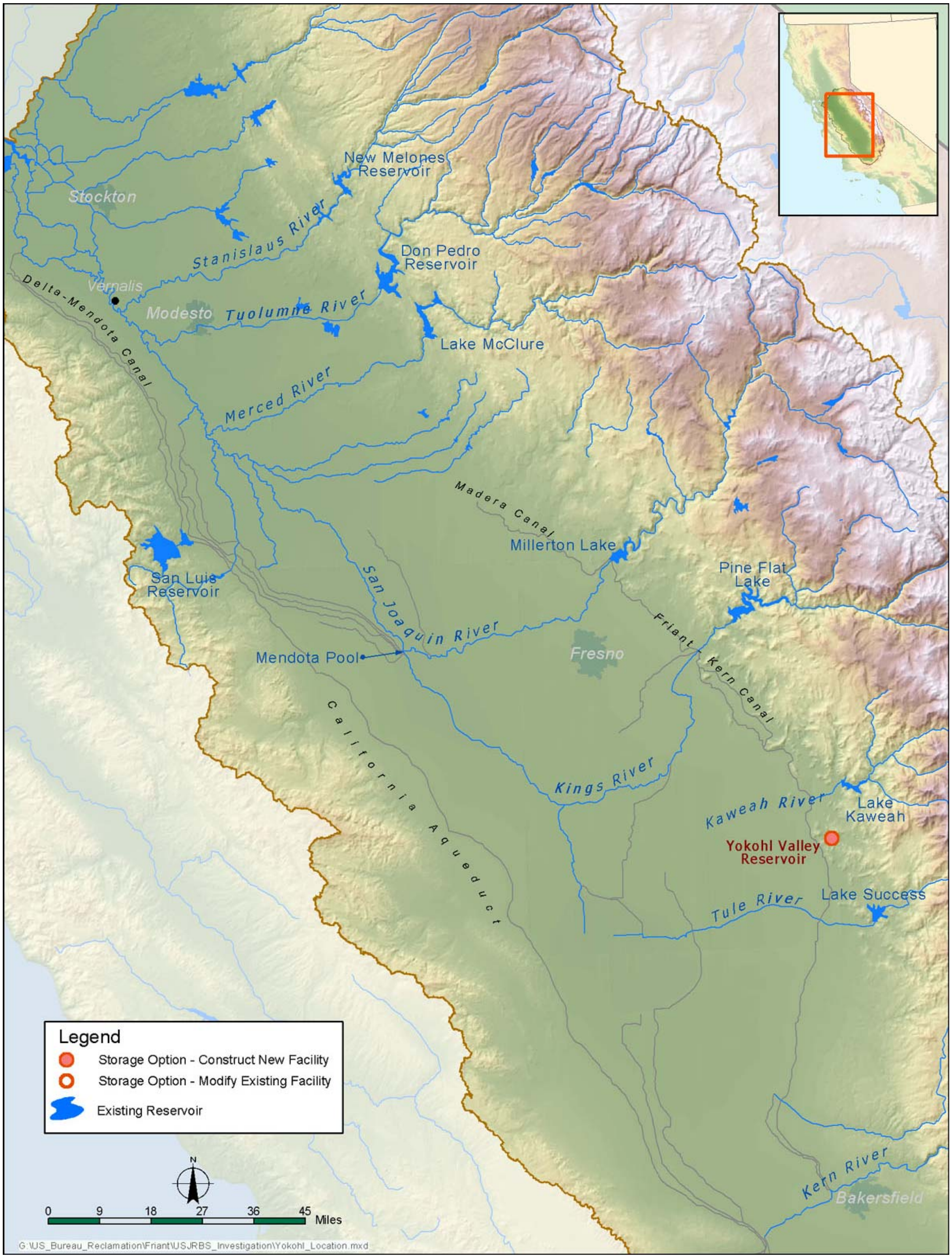


FIGURE 1-1. YOKOHL VALLEY RESERVOIR LOCATION MAP

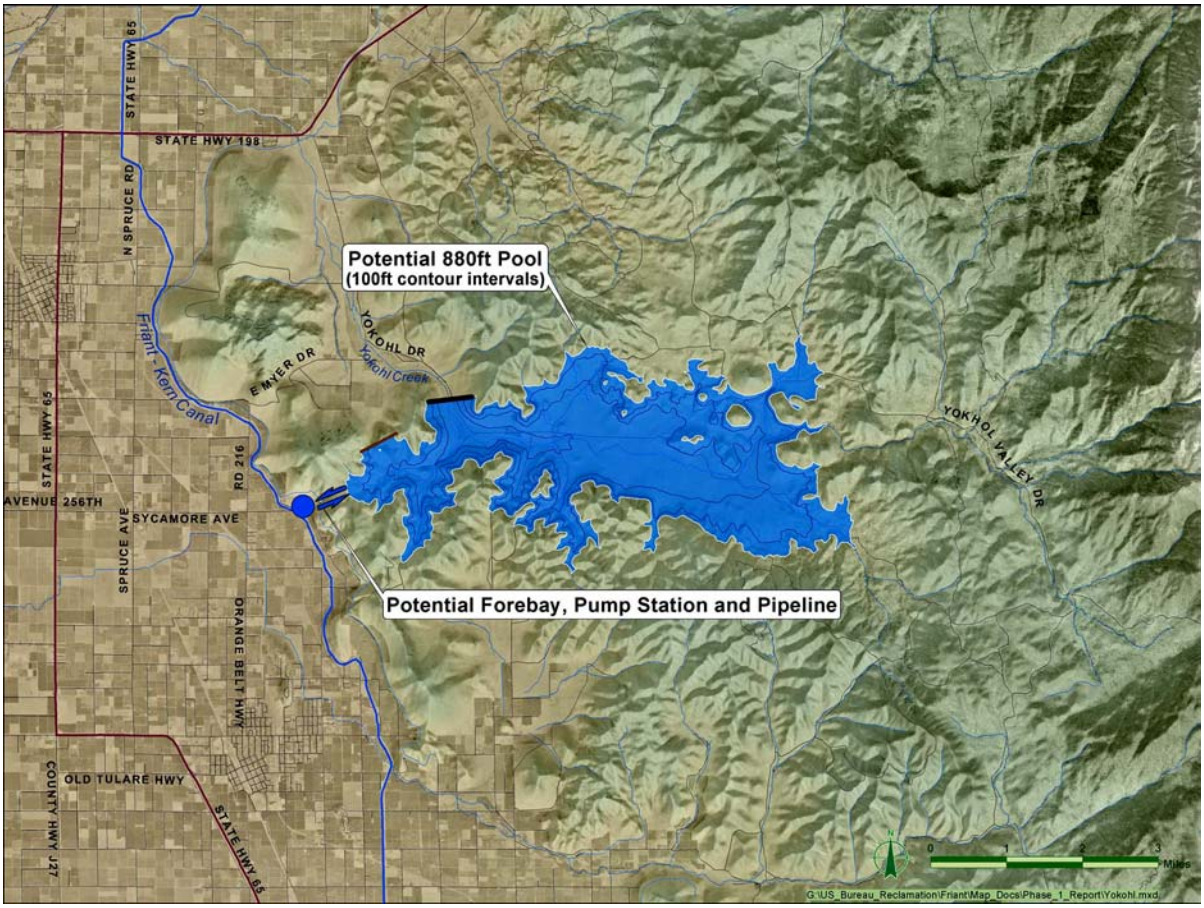


FIGURE 1-2. YOKOHL VALLEY RESERVOIR

In February 1975, Reclamation prepared a cost estimate for Yokohl Reservoir with a capacity of about 450 TAF, with preliminary supporting design drawings. As part of the 1975 study, a borehole was drilled, geologic mapping and evaluation were conducted, and a draft geologic report was prepared.

In June 1980, Reclamation produced maps illustrating potential borrow areas for dam construction and surface geology for the reservoir and its tunnel alignment.

Hydrologic conditions were evaluated by the United States Army Corps of Engineers (Corps) in the Kaweah River Basin – Hydrology Report in August 1990.

In 2000, a study for the Friant Water Users Authority and Natural Resources Defense Council Coalition considered the concept of a dam up to 320 feet high at Yokohl Valley with an 8-mile-long, 10-foot-diameter diversion tunnel to divert excess water from Lake Kaweah. The report indicated that such a reservoir could store nearly 950 TAF of water (URS, 2000). The study contained limited technical information for this larger dam option and no designs.

POTENTIAL IMPROVEMENTS

This TM focuses on the option of storing water from the Friant-Kern Canal, which is consistent with the 1975 Reclamation study. The engineering analysis in Chapter 3 pertains only to the 260-foot dam option. The hydropower analysis in Chapter 4 considers a larger reservoir based on output from water operations modeling described in the Hydrology and Modeling Appendix to the Phase 1 Report; the review of potential environmental effects presented in Chapter 5 encompasses the larger reservoir size.

Reclamation documents from 1975 evaluated a 260-foot zoned earthfill dam with a crest 30 feet wide and 2,960 feet in length at an elevation of 805 feet above mean sea level (elevation 805). The 1975 design shows the axis of the dam extending east—west across Yokohl Creek, and two small saddle dikes southwest of the dam (Figure 1-2). The reservoir would cover about 4,550 acres and have a storage capacity of approximately 450 TAF. The maximum water surface would be at elevation 791 under normal operating conditions and elevation 798 under surcharge conditions. The spillway would be an ungated ogee type with a capacity of 1,220 cubic feet per second (cfs). Outlet works, under the left abutment, would consist of a 2,590-foot-long, 9-foot-diameter horseshoe tunnel and 48-inch-diameter, 1,320-foot-long penstock. The outlet works were designed to release 700 cfs for flood control.

Various options for conveying water to Yokohl Valley Reservoir have been considered in previous studies. In the 1975 Reclamation study, the reservoir would be integrated with operation of the potential Mid-Valley Canal project via an 18-mile-channel/canal that would include a 1½-mile long tunnel and pumping plants. In 1972, the reservoir was considered for reregulation of water supply associated with the then-proposed Cross Valley Canal, via a connection with the Friant-Kern Canal. As an adaptation of that plan, the option evaluated in this TM involves storing water from the Friant-Kern Canal in Yokohl Valley Reservoir. This would require constructing a tie-in with the Friant-Kern Canal (including adequate forebay and afterbay facilities), and a pump-generation plant to lift the water into the reservoir and generate hydroelectric power when water is released to the canal. Local runoff from the Yokohl Creek watershed would supplement the water pumped from the canal.

The report that suggested the option of a dam up to 320 feet high with a 950 TAF reservoir assumed a diversion tunnel would be constructed from Lake Kaweah to allow excess flood flows now released from Terminus Dam to be captured (URS, 2000). Local runoff from the Yokohl Creek watershed would supplement the water diverted from Lake Kaweah. This option is not considered in this TM because it would require pumping for a reservoir larger than 120 TAF (the pool of Lake Kaweah is at elevation 694; water conveyed by gravity from Lake Kaweah could produce a reservoir with a storage capacity of about 120 TAF). Given that pumping would be required, it was considered more prudent to evaluate the pump-back storage option from the Friant-Kern Canal. This option would involve less tunneling, pumping over a shorter distance, and avoidance of the institutional complexities involved in exchanging water from the Kaweah River. Consequently, the option evaluated in this TM is the 450 TAF reservoir with a primary source of water from the Friant-Kern Canal.

APPROACH AND METHODOLOGY

This TM was prepared from information developed by reviewing previous studies and conducting field reconnaissance excursions.

Engineering and Geology

An engineering and geology field reconnaissance of the potential dam and reservoir area was conducted on 13 June 2002 (Appendix A.1). Locations of existing and potential structures were visually assessed. Topography, geology, geotechnical conditions, and utilities were noted. Access routes and possible borrow, staging, and lay-down areas were considered.

The seismotectonic evaluation conducted by Reclamation for this study (2002) was based on readily available information and is considered appropriate for prefeasibility-level designs only. Detailed, site-specific seismotectonic investigations have not been conducted, nor was remotely sensed imagery evaluated. More detailed, site-specific studies would be required for higher-level designs.

As indicated above, a preliminary design was completed by Reclamation in 1975. For prefeasibility-level studies, designs and analyses are typically quite general. Extensive efforts to optimize the design were not conducted, and only limited value engineering techniques were used.

Cost Estimation

Estimates of field construction costs are based on the 1975 Reclamation design and cost estimate, updated to 2003 price levels. Field costs involve direct costs to construct the dam and appurtenant features, and include provisions for uncertainties. The updated cost estimate is summarized in Chapter 3 with detailed worksheets contained in Appendix C.

Costs of road and powerline relocations, reservoir clearing, lands, easements, rights-of-way, environmental mitigation, investigations, designs, construction management, administration, and interest during construction are not included in the estimated field costs.

Hydropower Analysis

Hydropower specialists conducted a field reconnaissance trip in June 2003, viewing the potential dam site (Appendix A.2). Preliminary estimates of potential energy generation and use were produced using a spreadsheet approach based on output from the CALSIM hydrologic water balance model. In the spreadsheet analysis, assumptions were made regarding turbine, generator, and pump efficiencies, restrictions on minimum and maximum heads and flows, and head losses in conduits and equipment. From these data and assumptions, preliminary estimates were made of energy generated and used on an annual basis. Results reflect assumptions made at this level of study, and therefore give a preliminary indication of possible energy generation and use only.

Environmental Review

An environmental field reconnaissance trip of the potential dam and reservoir area was made on 29 May 2002 (Appendix B). During the field visit, specialists in botany, wildlife, aquatic biology, recreational resources, and cultural resources visually assessed existing environmental resources. Additional research was conducted, making use of prior studies and available literature, the California Natural Diversity Database (CNDDB), and topographic maps.

This information was used to preliminarily identify the extent to which potential environmental impacts might constrain the storage options under consideration. Where evident, opportunities for improving environmental resources or mitigating adverse effects were also noted. Surveys were not conducted and consultations with external resource management or environmental agencies were not held.

CHAPTER 2. PHYSICAL SETTING

This chapter describes elements of the physical setting, including topography, geology and seismicity, hydrology, existing facilities, and the environment.

TOPOGRAPHIC SETTING

Regional topography consists of the nearly level floor of the San Joaquin Valley rising abruptly to moderately steep, northwest-trending foothills with rounded canyons. Elevations in the immediate area range from about elevation 530 to over elevation 1,300.

Farther east, the terrain steepens and the canyons become more incised. The canyons have been cut by southwest- to west-flowing rivers and associated large tributaries. The Kaweah River is the main river in the area. Yokohl Creek is a west- to northwest-flowing tributary to the Kaweah River; its confluence with the Kaweah River is about 8 miles downstream of Terminus Dam.

The potential dam site is located about 4 miles south-southeast of the mouth of Yokohl Valley. The streambed at the dam site lies at approximately elevation 550, and the valley floor is relatively broad (about 2,000 feet). The left abutment rises at a moderately steep 3:1 slope (horizontal:vertical), while the right abutment is about 5:1, steepening to 3:1 above the proposed crest elevation. The left ridge rises to about elevation 1,200 and the right ridge to about elevation 1,500.

Available Topographic Mapping

Topographic mapping other than that available publicly from the United States Geological Survey (USGS) is not known. Base maps used by Reclamation in prior studies appear to be based on USGS maps.

Available Aerial Photography

Aerial photography of various scales and imagery is available from the archive files of USGS. Additional aerial imagery may also be available from the United States Department of Agriculture, Reclamation, and the Corps. A specific search of the available photography was not conducted for this TM and historic aerial photographs were not reviewed.

GEOLOGIC AND SEISMIC SETTING

Yokohl Valley is located near the boundary of the Sierra Nevada Geomorphic Province and the San Joaquin Valley portion of the Great Valley Geomorphic Province. The Great Valley basin is filled with thick accumulations of marine (at depth) and non-marine sediments shed largely from the Sierra Nevada mountain range. Recent alluvium of lake and river origin blanket most of the present-day surface, while dissected remnants of Pleistocene alluvial fans rim the valley margin.

The Sierra Nevada range is characterized by batholiths of Mesozoic granitic rock and Paleozoic roof pendants of the Calaveras Complex and related rocks. The Sierra Nevada foothills take the form of outliers of low to irregular hills of Mesozoic granitic, and late Paleozoic to Mesozoic basic and ultrabasic rock (ophiolites) of the "serpentine belt" of the Kings-Kaweah suture, as well as other associated Mesozoic metamorphic rocks.

The west- to northwest-trending Yokohl Valley is located in what may be an erodible zone along a geologic contact between granitic rocks and a roof pendant of pre-Cretaceous metasedimentary rock. At the dam site, an undated Reclamation geologic map shows that pre-Cretaceous metagabbro and Mesozoic ultrabasic intrusive (serpentenite and talcose serpentenite) rocks are found in both proposed dam abutments. Pre-Cretaceous amphibolite is also found in the right abutment.

The perimeter of the potential reservoir is surrounded by Mesozoic granitics (quartz diorite), basic and ultrabasic intrusive rocks, and pre-Cretaceous metasedimentary rocks. Clayey slopewash (colluvium) and talus blanket much of the lower valley slopes.

Relatively thick Pleistocene and recent river alluvium deposits of sand, gravel, and possible silt are found beneath the floor of Yokohl Creek. Alluvium in the lower Yokohl Valley (downstream of the dam site) ranges from 170 to 275 feet thick. At Gill Ranch (upstream of the dam site), the alluvium is about 30 to 50 feet thick. The borehole advanced under the downstream toe of the potential dam, as part of the geologic investigation, extended to a depth of 87 feet below ground surface without encountering bedrock.

Site Geotechnical Conditions

Geologic mapping conducted as part of the geologic investigation shows that the dam site, the two saddle dikes, and the tunnel would be founded largely on ultrabasic rocks variably altered to serpentine. The serpentine is dark green and massive, and was considered sound. It locally grades to dark to light green schistose to sub-schistose serpentinized rock. In the abutment areas, the serpentinite forms bold to inconspicuous outcrops that are lightly to moderately weathered and moderately jointed.

Jurassic meta-gabbro is found in both abutments and as a cap to the right abutment ridge. It is found as irregular to crudely linear, north- to northwest-trending, steeply to moderately eastward-dipping intrusive bodies. Minor amounts of talcose serpentine, talc, talc schist, chert, and amphibolite are found as inclusions in the serpentine, or along serpentine contacts. The softer talcose/schistose materials occur as infrequent, variably sheared stringers that are typically covered by slopewash.

Pre-Cretaceous metavolcanics rocks consisting mostly of metabasalt and amphibolite are also found near the dam site. The metabasalt is hard, gray to dark green, and fine-textured to locally porphyritic, forming lightly weathered to fresh craggy outcrops. The amphibolite is hard, dark green, lightly weathered, mostly fine-textured, and massive to locally schistose. It is typically found as lenses in, or associated with, other rock types.

Seismic Hazard Analysis

No significant faults have been identified in the vicinity of the potential dam and reservoir sites. Overall, potential seismic hazard potential at the site is low. Preliminary earthquake loading analysis for this prefeasibility-level evaluation considered two types of potential earthquake sources: fault sources and aerial/background sources (Reclamation, 2002).

Twenty-two potential fault sources for the site were identified, including those faults associated with the San Andreas fault, seven western Great Valley faults, seven eastern Sierra Nevada faults, the White Wolf fault of the southern San Joaquin Valley, and six faults of the Sierra Nevada Foothills fault system. No major through-going or shear zones have been identified in this area of the Sierra Nevada and historic seismicity rates are low.

The aerial/background seismic source considered was the South Sierran Source Block, the region surrounding the site. This region possesses relatively uniform seismotectonic characteristics.

Probabilistic seismic hazard analysis performed shows that the peak horizontal accelerations to be expected at the site are 0.13g with a 2,500-year return period, 0.18g with a 5,000-year return period, and 0.23g with a 10,000-year return period.

HYDROLOGIC SETTING

Yokohl Creek is one of three main tributaries to the Kaweah River, downstream of Terminus Dam. The Dry Creek tributary is on the north side of the Kaweah River, while Mehrten Creek and Yokohl Creek are both on the south side of the Kaweah River.

Yokohl Creek extends for about 22 miles and drains approximately 74 square miles. Elevations within the Yokohl Creek watershed range from about elevation 400 at its confluence with the Kaweah, to about elevation 5,000 in its headwaters.

Rainfall

Normal annual precipitation over the Yokohl Creek watershed averages 20 inches, ranging from about 11.5 inches at its confluence with the Kaweah River to about 30 inches in its headwaters.

Runoff and Flood Data

Soils in the drainage basin are medium and fine-textured, developed in alluvium weathered from igneous and metamorphic rocks. Permeability ranges from slight to moderate. Soil cover below elevation 5,000 is moderately deep. Medium to coarse soils appear to be present within the stream channel a few miles upstream and downstream of the potential dam site.

Flows in Yokohl Creek are the result of rainfall only, since the watershed is below elevations where significant snow accumulates. Winter rain floods generally occur from November through April and are characterized by sharp peaks with most of the volume occurring within a few days. Sedimentation rates were not evaluated by Reclamation for the potential Yokohl Valley Reservoir, nor were downstream sedimentation issues.

Average annual runoff from Yokohl Creek was not reported. The modeled Standard Project Flood for Yokohl Creek was reported as 10,400 cfs, with a maximum 1-day flow of 9,111 cfs (Corps, 1990b). Detailed flood data were not identified in the documents reviewed.

EXISTING FACILITIES

No water storage facility presently exists at the site. Sparse rural development occurs within the valley about 1 mile upstream of the potential dam site. Yokohl Drive runs the length of Yokohl Valley. Yokohl Valley Drive diverges from Yokohl Drive to the north and east. Overhead power and buried telephone lines were noted along Yokohl Drive. A high voltage electric transmission line crosses the reservoir area from north to south.

Terminus Dam and Lake Kaweah on the Kaweah River are located north by northeast of the dam site, approximately 8 miles upstream of the river confluence with Yokohl Creek. The Friant-Kern Canal passes within a mile and a half of the potential reservoir margin, to the west of Yokohl Valley.

ENVIRONMENTAL SETTING

This section describes the environmental setting at the potential Yokohl Valley Reservoir site, including botany, wildlife, aquatic biology and water quality, recreation, cultural resources, land use, and mineral resources.

Botany

Annual grassland, meadow, and possibly oak woodland habitats are found in the site area. USGS mapping shows riparian vegetation along the upper stretches of Yokohl Creek. In addition, the possibility of vernal pools in the flatter valley bottoms is very high.

Four special-status species occur around this site: spiny-sepaled button-celery, Tulare pseudobahia, Kaweah brodiaea, and recurved larkspur. Two of these (Tulare pseudobahia and Kaweah brodiaea) are State- or Federally listed as endangered species. Both have moderate to high probability of being present. Populations of Tulare pseudobahia are known to have occurred historically in Yokohl Valley. Vernal pool spiny-sepaled button-celery grows in Yokohl Creek downstream from the potential dam site. The presence of ultrabasic and metagabbro rock makes serpentine-specific plants possible, although none were reported from the CNDDB query.

Wildlife

The wide Yokohl Valley hosts a relatively well-developed mesic grassland habitat. The adjacent foothills are vegetated with grasslands, and foothill pine and oak woodland habitats.

Western pond turtle, foothill yellow-legged frog, and the San Joaquin kit fox are known to inhabit the area. The California condor nests in the Blue Ridge Reserve, several miles away.

Aquatic Biology/Water Quality

Yokohl Creek had little or no flow at the time of the May 2002 field reconnaissance, and is likely dry during summer months. The creek likely contains no fish populations, but this should be verified with resource agencies.

Recreation

The potential dam and reservoir would be situated on private property. No developed recreation facilities occur in Yokohl Valley, and dispersed use along Yokohl Creek is unlikely, owing to the predominance of private property.

Cultural Resources

Yokohl Creek is named after the Yokol or Yokod Yokuts, a band of Foothill Yokuts people who lived in the area. One of the most important natural resources for the Yokod was a diatomaceous earth used for white pigment, found on Rocky Hill (Hawshaw Shido, "Paint Place") northwest of the potential dam site. Another important resource was steatite, mined near Lindsay Peak immediately south of the potential reservoir (Heizer and Treganza, 1944; Latta, 1949; Varner and Stuart, 1975). Information on Indian trails in the Yokohl Valley area is available in von Werlhof (1961a). The majority of Southern Valley and Foothill Yokuts people now live on the Tule River Indian Reservation, near Porterville.

An archaeological survey of Yokohl Valley was undertaken in 1975 covering an area of approximately 5,000 acres below the 800-foot elevation contour. The survey documented polychrome pictographs at 2 sites, as well as 33 gathering and processing sites, most of the latter being defined by bedrock milling features. The locations with pictographs were probably semi-permanent occupation sites (Varner and Stuart, 1975). The sites have been badly damaged by agricultural activities (ibid.; Moratto, 1984).

Spanish soldiers and missionaries entered Yokohl Valley, and oral history suggests Spanish mining occurred in the area. Cattle and sheep were grazed in the valley as early as the 1850s, and permanent settlement began by the 1860s. Talc, magnetite, and granite were mined or quarried; oaks were cut and made into charcoal; and much historic activity was related to mixed farming and ranching (Varner and Stuart, 1975). During site reconnaissance in May 2002, a historic marker was seen noting that the Jordan Toll Trail ran through Yokohl Valley, providing access across the Sierra to Owens Lake and silver mines in the Coso Range. Rock walls were observed on the lower slopes of Rocky Hill, and piles of quarried granite and mounds of soil were seen closer to the stream. An archaeological survey by Varner and Stuart (1975) documented six historic sites, including the 1880s Daly Ranch House, remnants of a school, and four homesteads.

Land Use

The area of the dam location includes many substantial ranch houses with established vegetation along Yokohl Drive. Two parallel transmission lines traverse Yokohl Valley.

A large new hillside housing development would overlook the dam off of Route 217.

Mineral Resources

There is no evidence of metals mining in the area. Talc, magnetite, and granite were mined or quarried in the area in the 1800s; however, no active mining activities were noted during the May 2002 reconnaissance visit.

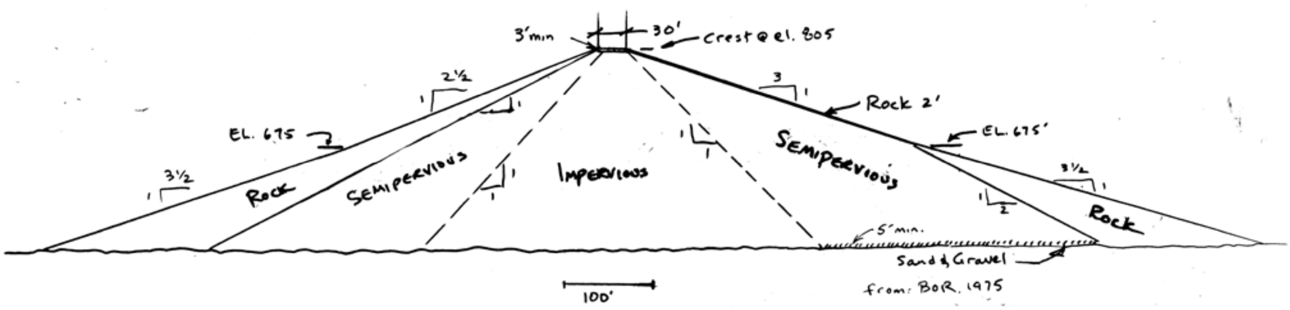
CHAPTER 3. STORAGE STRUCTURES AND APPURTENANT FEATURES

This chapter describes the technical aspects of designing and constructing a potential dam, reservoir, and appurtenant features in Yokohl Valley. It addresses considerations regarding constructibility, and presents estimated field costs for dam construction.

STORAGE STRUCTURE

In 1975, Reclamation considered the potential construction of a 260-foot zoned earthfill embankment dam at Yokohl Valley. The dam would have a 30-foot-wide and 2,960-foot-long crest at elevation 805, extending east-west across Yokohl Valley. The upper portion of the upstream dam face would be sloped at 2.5:1, while the lower portion would be at 3.5:1. The downstream dam face would be at 3:1 in the upper portion and 3.5:1 in the lower portion. Two saddle dams would be required at the western edge of the reservoir.

Approximately 12.6 million cubic yards (MCY) of earth materials would be required to construct the embankment and associated small dikes. Of that, about 9.6 MCY of impervious material would be needed, 2.8 MCY of rockfill, 0.1 MCY each of sand/gravel blanket materials, and rock slope protection material. Figure 3-1 is a cross section of the potential dam from the 1975 Reclamation study.



Source: Conceptual dam cross section traced from Reclamation 1975 documents.

FIGURE 3-1. YOKOHL VALLEY DAM CROSS SECTION

RESERVOIR AREA AND STORAGE

As envisioned by Reclamation in 1975, Yokohl Valley Reservoir would have a total storage capacity of about 450 TAF. Of this amount, 40 TAF would be inactive storage, 397 TAF would be active conservation storage, and 13 TAF would be joint use storage, which would be left available for flood control during the winter and then made available for conservation storage in the spring. These volumes exclude surcharge storage above the spillway crest during flood conditions. Yokohl Valley Reservoir total storage capacity and area curves are shown in Figure 3-2, based on USGS digitized topographic data.

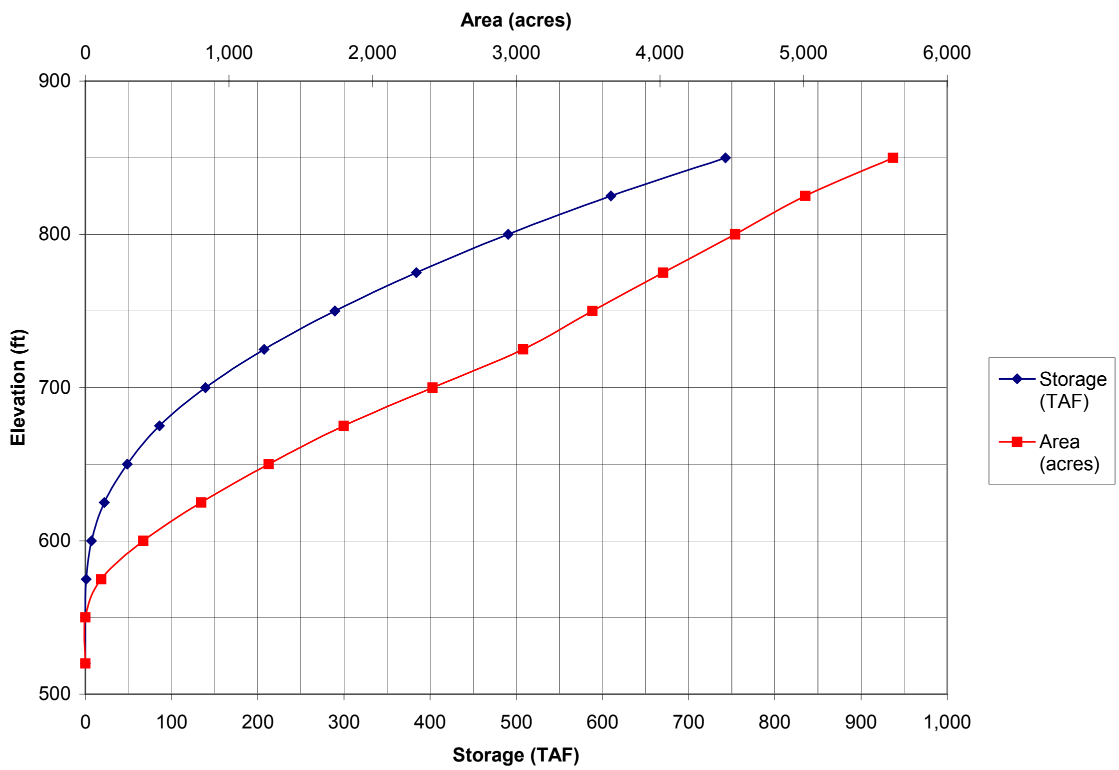


FIGURE 3-2. ELEVATION VS. STORAGE AND AREA

APPURTENANT FEATURES

This section discusses major appurtenant features associated with the potential dam and reservoir.

Spillway

The uncontrolled ogee spillway would be 15 feet wide, with a crest at elevation 791. An upstream approach apron would commence at elevation 783; a stilling basin would be constructed on the downstream side. The inflow design flood used for spillway design had a 3-day volume of 53 TAF and a peak discharge of 19,600 cfs.

Outlet Works

Outlet works for flood releases of up to 700 cfs to Yokohl Creek were included in the 1975 design. A 1,480-foot-long, 6.5-foot-diameter tunnel would connect to a gate chamber, from which flow through a 4-foot-diameter penstock would be controlled with a slide gate. The penstock would extend 210 feet to a control house, equipped with a 10-inch-diameter needle valve for releases of up to 45 cfs, and a 4-foot-diameter slide gate for flood control releases. Releases would proceed through a stilling basin to the downstream portion of Yokohl Creek.

Conveyance

Yokohl Valley Reservoir would be filled with water from the Friant-Kern Canal. This would require constructing an intake channel or forebay to connect with the Friant-Kern Canal, a pump-generation station, switchyard, and a lined tunnel.

As considered by Reclamation in 1972, an intake channel would be 300 feet in length, with a 20 foot bottom width. A pumping plant would contain four units, each capable of operating at 250 cfs with 400 feet of pumping head. A 7,600-foot-long, 11-foot-diameter, concrete-lined tunnel would convey the pumped water to the reservoir. A potential location for a forebay is discussed in Chapter 4.

The current cost estimate assumes an intake channel would be constructed, but differs in pumping capacity and tunnel diameter. The current assumption is that a pumping and generating station would be constructed that is capable of delivering 2,000 cfs and generating at 2,800 cfs. The tunnel connecting to the reservoir would be 15 feet in diameter.

CONSTRUCTIBILITY

This section discusses issues of concern related to constructing the potential dam, reservoir, and appurtenant features.

Land, Rights-of Way, and Easements

Land requirements for the reservoir were estimated in 1975 at 9,280 acres.

From 1974 correspondence, required road relocations were estimated at 7 miles.

It is expected that an easement similar to a pipeline easement would be required for tunnel construction.

Costs for land and relocations will be updated in future phases of the Investigation and are not included in cost estimates presented in this TM.

Access

Access to the dam site is available via Yokohl Drive, a paved road.

Borrow Sources and Materials

It is not clear whether detailed evaluations of borrow source volumes were completed in previous studies; however, a 1980 map illustrating potential borrow sources suggests that sufficient impervious, pervious, and riprap materials are located within 2 miles upstream and downstream of the potential dam site.

Portland cement is available from nearby commercial sources, including six producers within a few hundred miles of the site. Bulk transport to the site can be conducted either by truck or, preferably, railcar. Pozzolan is available from producers in Stockton or Sacramento.

Foundation

It is anticipated that the dam foundation would be in relatively hard rock with relatively tight, medium to closely spaced fractures and joints. Pre-split drilling and light blasting might be required for excavation. Some soft, sheared zones could be encountered, but they could be backfilled with lean concrete for minor dental preparation of the foundations.

The spillway would be founded in generally sound serpentine alternating with hard metagabbro. Spillway excavation would be in material composed of about 75 percent rock consisting of lightly to moderately weathered, moderately jointed rock with occasional intensely fractured zones. Slopewash and residual soils are expected to be about 2 to 5 feet thick. The apron of colluvium at the base of the slope is expected to be about 4 to 15 feet thick.

Staging and Lay-Down Areas

Potential staging and lay-down areas are located immediately upstream and downstream of the site.

Power Sources

Electrical power is likely to be available from sources in Exeter or along Highway 198.

Contractor Availability and Resources

There are several local general engineering contractor or regional-based general engineering contractors capable of performing the rock excavation, concrete forming and placement, rock berm construction, and general grading and excavation.

Construction Schedule and Seasonal Constraints

At the elevation of the potential dam, construction would not depend on seasonal variations. Placing the clay core could be difficult during the wet season (November through April), but other construction activities would be expected to proceed year-round.

Flood Routing During Construction

During construction, Yokohl Creek would be diverted through a 6.5-foot diameter concrete-lined tunnel in the left abutment. The diversion inlet would be at elevation 560. A 50-foot cofferdam would be required for flood diversion, later to be incorporated into the main dam.

Reclamation notes indicate the diversion design was based on a 10-year flood hydrograph with 2,400 cfs peak discharge and 3-day volume of 4.8 TAF. It might be possible to use the outlet works for flood routing during construction.

Environmental Impacts During Construction

Environmental impacts during construction can be mitigated with proper planning and implementation of best management practices. The county road would require re-routing. Access by the general public could be restricted, except for those property owners with lands upstream and Native Americans requiring access to their tribal lands.

Blasting in the spillway would require both noise and vibration monitoring on the dam. A cultural survey should be conducted to identify any ancestral American Indian historic artifacts, and construction activities would be restricted in those areas.

Importing rock from distant quarries would cause traffic impacts, but with proper planning and coordination with CALTRANS, major impacts could be mitigated. Truck traffic for importing rock and the excavation equipment would discharge exhaust to the local air basin. Air quality issues could be mitigated by dust control measures for both the spillway excavation and berm construction.

All construction equipment should have spark arresters and fire control equipment should be keep readily accessible during construction. Construction water would have to be controlled and provisions made for runoff and erosion control. A spill control plan would be needed to control any construction-related fuels, lubricants, and other materials.

Permits

Federal projects are not subjected to the same level of permitting required for non-Federal projects; however, after relevant potential environmental and cultural impacts have been identified, at a minimum, certain permits could be required from the permitting agencies listed in Table 3-1.

In addition, the following agencies could be involved in reviewing permit conditions:

- Bureau of Indian Affairs
- Bureau of Land Management
- State Historic Preservation Office
- Advisory Council on Historic Preservation
- United States Fish and Wildlife Service (USFWS)

TABLE 3-1. POSSIBLE PERMITS REQUIRED

Permit	Permitting Agency
Permit to Construct	DSOD, Tulare County
Encroachment	Caltrans, Tulare County
Air Quality	CARB, Tulare County
Low/No Threat NPDES	RWQCB
Waste Discharge	RWQCB
401 Certification	SWRCB
Blasting	Tulare County
Stream Bed Alteration	CDFG
Fire/Burn	CDF, Tulare County

Key:

CARB	California Air Resources Board
CDF	California Department of Forestry
CDFG	California Department of Fish and Game
DSOD	Department of Safety of Dams
FERC	Federal Energy Regulatory Commission
NPDES	National Pollutant Discharge Elimination System
RWQCB	Regional Water Quality Control Board
SWRCB	State Water Resources Control Board

In obtaining these various permits, several plans would have to be prepared and submitted to the responsible agencies for review and approval:

- Construction Plan and Summary Documents
- Quality Control Inspection Plan
- Highway Notification Plan
- Blasting Plan
- Noise Monitoring Plan
- Water Quality Monitoring Plan
- Noxious Weed Control Plan
- Bat Protection Plan
- Management Plan for Avoidance and Protection of Historic and Cultural Properties
- Storm Water Pollution Prevention Plan
- Spill Prevention/Containment Plan
- Visual Quality Control Plan
- Dust Control and Air Quality Plan

Another important regulatory requirement involves compensation/mitigation for habitat loss. In October 1998, USFWS issued its draft Coordination Act Report and Habitat Evaluation Procedure (HEP Analysis). The HEP Analysis delineates how compensation for adversely affected baseline habitat and wildlife conditions is to be determined.

In addition, if power generation is included in a project or is modified for an existing project, the Federal Energy Regulatory Commission may become involved in the permitting process.

COSTS

Estimated features include the dam and spillway, intake channel, pump station, switchyard, tunnel to convey water from canal to reservoir, and outlet works.

Construction Costs

Field costs for constructing Yokohl Valley Dam and Reservoir were estimated using 2003 price levels and include direct costs to construct the dam and appurtenant features, plus allowances for uncertainties. Field costs represent the estimated cost to construct listed items, plus allowances for mobilization (5 percent), unlisted items (15 percent), and contingencies (25 percent).

The 1975 Reclamation cost estimate (the construction field cost estimate for the Yokohl Valley Dam and Reservoir) was updated to 2003 price levels. Costs were modified to reflect current material costs and standards of practice. Costs for items not detailed in the 1975 Reclamation cost estimate (i.e., intake channel, pump station, switchyard, and tunnel) were estimated based on knowledge of similar types of projects and general project conditions.

Costs of road and powerline relocations, reservoir clearing, lands, easements, rights-of-way, environmental mitigation, investigations, designs, construction management, administration, and interest during construction are not included in the estimated field costs, consistent with the methodology used for the TMs prepared for other surface storage options considered in the Investigation.

The estimated field cost of constructing Yokohl Valley Dam and Reservoir with conveyance from the Friant-Kern Canal is $280 million. Estimate details are included in Appendix C.

Operations and Maintenance Costs

Operations and maintenance costs were not evaluated in any of the previous studies of the Yokohl Valley Reservoir and have not been estimated for this TM.

SYSTEMS OPERATIONS

Water stored in Yokohl Valley Reservoir would be conveyed to Friant-Kern Canal to supplement deliveries from Millerton Lake or to offset releases from Millerton Lake to the San Joaquin River.

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CHAPTER 4. HYDROELECTRIC POWER OPTIONS

Yokohl Valley Reservoir would be a pump-back project. Water would be pumped at the Friant-Kern Canal to the reservoir and released to the Friant-Kern Canal to supplement deliveries from Millerton Lake or to offset releases from Millerton Lake to the San Joaquin River. Electricity would need to be supplied to power the pump-turbines when pumping. This energy requirement would be partially offset by generation of electricity from the pump-turbine when the water was conveyed back to the Friant-Kern Canal.

This chapter explains the methodology used to estimate the potential electric energy generation and use by a Yokohl Valley reservoir, and presents the estimation results.

HYDROPOWER ANALYSIS METHODOLOGY

Preliminary estimates of potential energy generation and potential energy required for pumping were made using a spreadsheet approach based on data from the CALSIM hydrologic water balance model. CALSIM simulates the operation of major water projects throughout California and is widely used to identify how potential projects and actions would affect system-wide water operations. During Phase 1 of the Investigation, CALSIM was revised to reflect the decision-making process used to allocate water supplies at Friant Dam, and then used to estimate the amount of water available for release to the San Joaquin River or diversion to the Friant-Kern and Madera canals. Details regarding CALSIM can be found in the Investigation Phase 1 Hydrologic Modeling TM.

The amount of energy generated is a function of the net head available (gross head less hydraulic losses), water flows available from the Yokohl Valley Reservoir, efficiency of the pump-turbine equipment as a generator, and the period of time under consideration (often, monthly, or annually). Similarly, energy required for pumping is a function of the pumping head (gross head plus hydraulic losses plus requirements for submergence), flow of water to be pumped, efficiency of the pump, and the period of time under consideration.

Monthly CALSIM data included flows to be pumped into Yokohl Valley Reservoir from the Friant-Kern Canal and releases to be made from the Yokohl Valley Reservoir to the Friant-Kern Canal. Flows along the Friant-Kern Canal upstream and downstream of the canal diversion location, and water volumes and evaporation at Yokohl Valley Reservoir were also supplied, along with tables of reservoir areas and volumes with respect to reservoir elevations for Yokohl Valley Reservoir. Output from the CALSIM program took into account flood storage and dead storage requirements. From this information, water levels in the Yokohl Valley Reservoir were calculated. The water elevation at the Friant-Kern Canal was assumed to be constant at 410 feet; therefore, heads required for pumping and heads available for power generation were determined.

Operating scenarios emphasized water management objectives, not hydropower production objectives. Specifically, estimates were made for CALSIM single-purpose analysis operating scenarios that would release water to the San Joaquin River for water quality and restoration purposes. These scenarios were chosen because together they provide a range of water demands on the reservoir. The water quality single-purpose analysis scenario holds new water yield in storage until it is released to the San Joaquin River in the late irrigation season. In contrast, the restoration flow single-purpose analysis scenario makes peak releases of water to the San Joaquin River in the spring. No modifications were made to the CALSIM single-purpose analysis scenarios to enhance potential energy generation or potential net energy sales revenue.

In all cases, a Yokohl Valley Reservoir with water storage capacity of 800 TAF was considered to allow reasonable comparisons to be made to estimates produced for potential reservoirs of similar size at Fine Gold Creek and the Temperance Flat area. (Results for those surface storage options are reported in their respective TMs.)

In the spreadsheet analysis, assumptions were made regarding pump-turbine and motor-generator efficiencies, head losses in water passages, submergence, and minimum and maximum heads and flows for pumping and generating. From the above-mentioned data and assumptions, preliminary estimates of the energy required for pumping and energy generated on an annual basis were made.

FACILITIES

The hydropower project would consist of a pumping-generating station linked to the Friant-Kern Canal by a forebay or intake canal, an approximately 1- to 1.5-mile-long tunnel to the Yokohl Valley Reservoir, and an inlet-outlet structure at Yokohl Valley Reservoir.

A potential site for the forebay is located on the east side of the Friant-Kern Canal, about ¾ mile northeast of the small community of Tonyville. It is a relatively level, roughly triangular parcel of agricultural land within a small valley at the base of the adjacent low mountains. Based on USGS topographic maps (20 -foot contour intervals), it appears that the forebay could potentially cover about 15 to 20 acres. This would be adequate for the required submergence on the pump/generator equipment to ensure good inflow and outflow conditions at the pump/generating station and in the Friant-Kern Canal, and to maintain the hydraulic grade in the Friant-Kern Canal. Requirements for emergency dewatering of the tunnel without disturbing the hydraulics and hydraulic gradient of the Friant-Kern Canal were not considered in this analysis. Notes on the geology of the tunnel alignment that would be required for pumping from the forebay are included in the 2003 Hydropower Team Trip Report (Appendix A.2).

ASSUMPTIONS

An overall constant pump-motor efficiency of 0.85 and an overall turbine–generator efficiency of 0.80 were assumed for the pump-turbine equipment for this prefeasibility-level analysis to take into account the efficiencies of the pump-turbine, motor-generator, and step-up transformers, and also the effects of unscheduled downtime.

The installed capacity of generating units is assumed to be approximately 125 megawatts (MW) to 145 MW. It is assumed this capacity would be provided by three or four units so that the pumping-generating station could operate at low as well as high discharges.

Releases at heads below 100 feet were assumed not to generate energy. No restrictions were placed on higher heads. To account for head losses in waterway passages during generation, a deduction of 6 percent was made on gross head. To obtain the pumping head, an amount equivalent to 20 percent was added to the gross head.

ESTIMATED GENERATION

A summary of the range of potential pumping energy required and energy potentially generated for a Yokohl Valley Reservoir of 800 TAF capacity is shown in Table 4-1. Results indicate the pumping energy required and offsetting energy that might be generated. Further study is needed to determine the cost of the pump-back facilities and to ascertain the preferred facility layout. Further study also may be warranted on water storage requirements and of pump-turbine and motor-generator equipment in view of the wide variation in head and flows available for generation in the water supply scenarios.

An example of flow and head variations is seen in the 800 TAF reservoir with water quality single-purpose analysis. Maximum and average generation heads obtained are 644 feet, and 500 feet, respectively, and maximum and average generation flows obtained are 3,242 cfs and 349 cfs, respectively.

TABLE 4-1. ESTIMATED PUMPING REQUIREMENT AND GENERATING POTENTIAL FOR YOKOHL VALLEY RESERVOIR

Storage (TAF)	Operating Scenario	Avg. Annual Energy Generation (MWh)	Avg. Annual Pumping Energy Requirement (MWh)
800	WQ	80,000 – 110,000	180,000 – 220,000
	RF	80,000 – 110,000	180,000 – 220,000

Key:
MWh – megawatt-hour
RF – restoration flow single-purpose analysis scenario
TAF – thousand acre-feet
WQ – water quality single-purpose analysis scenario

POTENTIAL FOR PUMPED STORAGE

Yokohl Valley Reservoir is presently planned as a water storage reservoir that would operate as a pump-back hydroelectric energy project. Water would be pumped into the reservoir when supply in the Friant-Kern Canal and the potential forebay would be adequate, and water would be released from the reservoir when water requirements dictate. The timing of pumping and generating would be governed by water management operating objectives. Conversely, a pumped storage project would be governed by hydroelectric energy production objectives. A pumped storage operation typically pumps water into an upper reservoir during non-peak energy price periods and generates when the energy can be sold at peak period prices or when power system requirements make it advantageous for generation capacity to go on-line.

Yokohl Valley Reservoir, as described in this TM, would not meet one of the parameters typically encountered in pumped storage. Specifically, the water conduit length to generation head ratio appears high for a conventional pumped storage operation. Assuming a 1.5 mile long tunnel and an average head of 500 feet, the length to head ratio is nearly 16. Generally, this ratio is not greater than 10 for economic pumped storage projects.

If Yokohl Valley Reservoir were designed for pumped storage, the forebay size would need to be increased depending on the amount of pumped storage contemplated. Additionally, hydropower facilities would need to be decoupled from the hydraulics of the Friant-Kern Canal.

TRANSMISSION

Two major power lines are near the site; one about 3 miles west of the potential pumping-generating station and the other about 5 miles east of the station. It is anticipated that pumping power would be obtained from one or both of these power lines, and generation delivered there. Therefore, one or more suitable interconnection points would need to be established and connecting lines built.

CHAPTER 5. ENVIRONMENTAL CONSIDERATIONS

This chapter qualitatively describes potential environmental effects of creating a Yokohl Valley Reservoir, indicating the extent to which expected or potential effects might pose a constraint to development of the reservoir. Where evident, opportunities for improving environmental resources or mitigating adverse effects have been noted.

The environmental review focused on botany, terrestrial wildlife, aquatic biology, water quality, recreational resources, cultural resources, and existing land uses. Mining activities that could affect site conditions are also briefly discussed, along with the potential presence of hazardous or toxic materials. Temporary construction-related disruptions and impacts are discussed in Chapter 3.

Identification of constraints was conducted at a preliminary, prefeasibility level of planning, consistent with the current phase of the Investigation. Criteria considered were based, in part, on criteria commonly used to evaluate environmental impacts of projects under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). Application of criteria that may be used for NEPA or CEQA evaluation does not imply that the analysis is at a level necessary to support an Environmental Impact Statement or Environmental Impact Report.

Considerations for potential constraints included the presence of special status species (e.g., species listed as endangered or threatened), species of concern, or sensitive habitats; relative amounts of affected riparian or wetland habitat; effects on native or game fish; conflict with established recreational uses or land uses; presence of nationally registered historic places, sacred Native American sites, or Traditional Cultural Places (TCPs); permanent disruption or division of established communities; and loss of use of major existing infrastructure.

The preliminary environmental analysis initiated in May 2002 was designed to address both the larger dam concept (up to 950 TAF of potential storage) and the smaller dam (450 TAF of storage) identified in previous studies. Accordingly, the discussion in this chapter encompasses potential effects of both reservoir sizes. Where necessary, distinction is made between the larger and smaller sizes. However, no distinction between reservoir sizes, is needed for qualitative descriptions.

BOTANY

Annual grassland, meadow, and possibly oak woodland habitats are found in the site area and riparian vegetation occurs along the upper stretches of Yokohl Creek. Vernal pools are very likely to be present in the flatter valley bottoms.

Constraints

The majority of the habitat loss would be annual grassland, which is common with no special status. However, the loss of riparian habitat and vernal pools could pose a constraint to reservoir development and require mitigation measures. Specific identification of vernal pools would require additional study and documentation.

Two endangered species, Tulare pseudobahia and Kaweah brodiaea, could pose constraints. Populations of Tulare pseudobahia are known to have occurred in Yokohl Valley and Kaweah brodiaea has a moderate to high probability of being present.

WILDLIFE

A few special status wildlife species are found in Yokohl Valley. California condors nest in the Blue Ridge Reserve, several miles away.

Constraints

Few constraints appear to be associated with special status terrestrial wildlife species. However, foothill yellow-legged frog and western pond turtle are known to inhabit the area, and these species would require field review to ascertain potential sensitivities and associated constraints. The San Joaquin kit fox inhabits the area but loss of habitat for this species can generally be mitigated. California condor nests would not likely be affected due to their distance from the potential site.

AQUATIC BIOLOGY/WATER QUALITY

Yokohl Creek may lose all its water in the dry season and likely contains no fish populations, but this should be verified with resource management agencies.

Constraints

Assuming that Yokohl Creek has no permanent water and no fish, no aquatic biological resource constraints would be expected.

Opportunities

The principal opportunity afforded by this measure would be the substantial new fish habitat created by the reservoir. For the larger reservoir option, water in the reservoir would likely stratify each summer because of its depth. Therefore, the reservoir might provide excellent conditions for both cold-water and warm-water fisheries. Most fisheries would probably be self-sustaining, but production could be increased by regular stocking.

RECREATION

The potential new dam and reservoir would be on private property, making dispersed use unlikely along Yokohl Creek. No developed recreation facilities are present in Yokohl Valley.

Constraints

Construction of the Yokohl Valley Dam and Reservoir would not result in adverse impacts to existing recreation resources because a reservoir of either size would not inundate dispersed recreation areas or developed recreation facilities.

Opportunities

Developing Yokohl Valley Reservoir would not be expected to result in adverse impacts to existing recreation resources; thus, no mitigation would be required. However, the larger reservoir size would probably draw substantial numbers of recreation visitors, creating demand for new facilities. Therefore, consideration should be given to providing a variety of developed day and overnight facilities at various locations around a new reservoir.

CULTURAL RESOURCES

Numerous cultural resources are known to be present, and there may be additional sites not yet recorded.

Constraints

Numerous archaeological sites could be adversely affected by construction of Yokohl Valley Dam and Reservoir. Inundation of archaeological sites (prehistoric or historic) can result in the loss of important scientific data.

Varner and Stuart (1975) documented many cultural resources in their 1975 survey, both prehistoric and historic, but made no recommendations regarding the potential eligibility of the sites they identified for the National Register of Historic Places (NRHP). It seems likely that future studies would result in some sites being considered NRHP-eligible.

Two TCPs have been identified in the vicinity of the potential reservoir: Hawshaw Sido (“Paint Place”) at Rocky Hill, northwest of the dam site, and the steatite quarry near Lindsay Peak. Direct or indirect impacts to these TCPs may be of concern to Yokod Yokuts people.

Opportunities

Inundation damage to archaeological sites can be mitigated with scientific data recovery programs. Reservoir projects also provide an opportunity for public interpretation of the past. Impact to archaeological sites from ancillary facilities, such as roads, power lines, or other structures, might be avoided or minimize through facility placement or design.

LAND USE

The area of the potential reservoir includes many substantial ranch houses along Yokohl Drive with established vegetation, and two parallel transmission lines. A large new hillside housing development is located off Route 217, north and west of the dam site.

Constraints

Approximately 6 miles of Yokohl Drive and 1 mile of Yokohl Valley Drive would be inundated by a 450 TAF reservoir. Houses along Yokohl Drive also would be inundated. In addition, the two transmission lines would have to be relocated. Houses in the new hillside development would be at a distance from the reservoir, and would not be directly affected, although views of farmlands and open fields would be replaced by views of the reservoir.

MINERAL RESOURCES

There is no evidence of past metals mining in the area. Talc, magnetite, and granite were mined or quarried in the area in the 1800s; however, no active mining activities were noted during the May 2002 site reconnaissance.

Constraints

No constraints have been identified.

HAZARDOUS AND TOXIC MATERIALS

Underground or aboveground petroleum hydrocarbon storage tanks, septic tanks, or electrical transformers containing polychlorinated biphenyls (PCBs) may have been present on rural properties.

Constraints

Potential impacts to the site from fuel or lubricant hydrocarbons, septic systems, or electrical transformers may exist at the site and could require remediation.

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CHAPTER 6. FINDINGS AND CONCLUSIONS

This TM described a prefeasibility review of Yokohl Valley Reservoir. The reservoir would be operated as a pump-back storage facility, storing water from Millerton Lake conveyed by the Friant-Kern Canal. As evaluated, Yokohl Valley Reservoir would be a 450 TAF reservoir that would be formed by a 260-foot high earthfill dam, with a crest length just under 3,000 feet, and two small saddle dams.

Site characteristics appear to pose no barriers to dam construction. Underlying rock conditions would be adequate for a dam foundation; sufficient impervious, pervious, and riprap materials exist within 2 miles of the dam site, and potential staging and lay-down areas are located immediately upstream and downstream. An improved road provides access directly to the dam site and electrical power would likely be available from sources in Exeter or along Highway 198.

Field costs for dam construction only are estimated at $280 million, based on updated prices from a design and estimate originally prepared in 1975. These costs do not include relocation, clearing, lands, mitigation, investigation, design, construction management, or interest during construction.

Water supply operations, as described in the Hydrology and Modeling Technical Appendix, suggest that a larger size reservoir should be considered in Yokohl Valley. Initial operations simulations considered sizes of up to 800 TAF. A power analysis was made based on output from the water operations analysis to estimate energy use and generation for an 800 TAF reservoir. Findings show that required pumping energy would be approximately two times the potential energy generation.

Environmental review of the potential reservoir area considered elevations that would be associated with a reservoir capacity up to and exceeding 800 TAF. Most of the inundated area would be common grassland in Yokohl Valley. However, the valley may also support substantial wetland habitat, including vernal pools. Populations of a listed plant species are known to have occurred historically in Yokohl Valley. Other special status plants are also likely to be present. Impacts to wildlife would be low and no fish were observed in Yokohl Creek during a field visit completed as part of the Investigation.

Numerous cultural resources are known to be present and there may be additional sites not yet recorded. Further site investigations and research regarding significance and mitigation requirements would be necessary. No recreational resources would be affected. Land use impacts would be relatively low, and would be limited to relocating scattered existing residences.

No significant technical issues were identified related to the physical ability to construct the potential storage facility. This option was retained for further consideration in the Investigation. Additional sizes will be evaluated, with a total storage of up to 800 TAF.

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