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STATE OF WYOMING
WATER DEVELOPMENT COMMISSION

EXECUTIVE SUMMARY

PHASE II: Lake Adelaide Enlargement

SHELL VALLEY WATERSHED
Level III

Contract No. 8-05846

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EXECUTIVE SUMMARY
PHASE II: LAKE ADELAIDE ENLARGEMENT
SHELL VALLEY WATERSHED LEVEL III

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I. INTRODUCTION AND BACKGROUND

The Shell Valley Watershed Improvement District (SVWID), with assistance from the Wyoming Water Development Commission (WWDC), is proposing to enlarge Lake Adelaide Reservoir by replacement of the existing dam on Adelaide Creek with a larger and safer structure. The purpose of the enlargement is to provide critical late season irrigation to lands within the District in Shell Valley east of Greybull. Lake Adelaide is located on Adelaide Creek, a tributary to Shell Creek, high in the Big Horn Mountains approximately 40 miles east of Greybull as shown on Figure 1. The WWDC, functioning as overall project administrator as part of their agreement with the District, will be the agent for all state and federal construction related permits and approvals. The SVWID will operate the project and will be the designated applicant for all operational permits and holder of all assets associated with the project.

The SVWID was created in 1981 as a subdivision of the South Big Horn Conservation District in accordance with the Wyoming Watershed Improvement District Law (41-8-101 to 41-8-126 of the Wyoming Statues as amended in 1973). One of the primary purposes for forming the district was to consolidate all of the various water users and organizations of Shell Valley under one governing body to provide for a unified approach for the storage, conservation, development and use of water within Shell Valley. The District currently has over 150 individual and corporate members. Shell Valley contains over 10,000 acres of partially irrigated land, of which about 8,000 acres are within the boundaries of SVWID. This semi-arid land requires additional late season irrigation to supplement existing supplies to produce average to above average crops. Existing storage, diversion, and distribution facilities will supply 100 percent of the irrigation demand only about 52 percent of the time. The enlarged reservoir will provide enough increased yield to meet 100 percent of irrigation demands 73 percent of the time and meet 98 percent of demands 8 out of 10 years.

The existing dam was constructed in about 1915 and has supplied supplemental late season irrigation water to Shell Valley since its completion. The inflow to the reservoir from Adelaide Creek was later supplemented by a small diversion and ditch from Buckley Creek, an adjacent watershed to the east. A safety inspection of the existing dam by the U.S. Army Corps of Engineers in 1979 identified several problems including embankment stability, an inadequate spillway, and a deteriorating outlet pipe resulting in an unsafe dam. To date, these problems have not been resolved.

A need for additional water for late season irrigation in Shell Valley has long been recognized. A study by the USDA Soil Conservation Service in 1978 outlines water problems in Shell Valley and presents some potential solutions. Based on this information, the SVWID applied to the WWDC in 1982 for assistance with the preparation and implementation of a watershed development plan to meet water needs in Shell Valley. The District's application was accepted by the WWDC and the 1983 legislative session authorized the Shell Valley Watershed Project. Alternative supplemental irrigation supplies, including ground water, were considered and the preliminary analysis performed by WWDC indicated that the most cost-effective project was to enlarge Lake Adelaide. This was confirmed by a Level II feasibility study performed by HKM Associates of Billings, Montana, completed in January, 1985. Based on the favorable results of the Level II study, the WWDC entered into a contract with ESA Geotechnical Consultants (ESA) in June, 1985, to perform Level III design studies. Phase I of the Level III study was completed in January, 1986, and ESA was authorized to complete Phase II which is summarized herein.

The previous studies indicated that repair of the existing dam is not economically feasible unless the reservoir is enlarged to provide enough additional benefits to finance the construction. The only other alternative is to abandon and breach the dam, resulting in a loss of 1450 acre-feet of active storage capacity to Shell Valley. The Level II feasibility study indicated a reservoir with about 3270 acre-feet of active storage capacity would be economically feasible. Revised hydrological studies and detailed geotechnical analyses during the Level III, Phase I design studies, concluded that the most economical enlargement would be to increase the active storage capacity to 4320 acre-feet and a total storage capacity of 4550 acre-feet.

Based on the results of the Phase I, Level III studies, the WWDC directed ESA to proceed with final design, permit applications, plans and specifications for the larger reservoir as recommended in the Phase I report. Further, ESA was directed to design for the full Probable Maximum

Flood (PMF) event. The resulting design concept consists of a new earth and rockfill dam located immediately downstream from the old embankment. The new dam will have a crest elevation of 9287 feet (27 feet higher than the old dam) with a normal maximum pool elevation of 9280 feet. The new dam will incorporate a side channel service spillway capable of passing up to 1/2 of the PMF and an emergency spillway across the southwestern reservoir rim that will pass the remaining 1/2 of the PMF. A reinforced concrete cut-and-cover outlet pipe 30 inches in diameter will provide control for reservoir operation. The Buckley Creek Diversion will be re-constructed and enlarged to divert up to 50 cfs during normal high flows. Subsequent refinements during final design resulted in an increase in active storage capacity up to 4533 acre-feet and total storage capacity up to 4764 acre-feet, along with other refinements described in the following section. Table 1 below compares the dam and reservoir characteristics of the existing and the enlarged Lake Adelaide as proposed herein.

Table 1

Comparison of Existing and Proposed
Dam and Reservoir Characteristics

Parameter	Existing	Proposed
Structural Height (ft)	30	77
Dam Crest Elevation (ft)	9260	9287
Normal Water Surface Elevation (ft)	9256	9280
Water Surface Area at Normal Pool (acres)	92	145
Minimum Pool Elevation (ft)	9233	9233
Minimum Pool Area (acres)	38	38
Inactive Storage Capacity (ac-ft)	231	231
Active Storage Capacity (ac-ft)	1449	4533(1)
Total Storage Capacity (ac-ft)	1680	4764(1)
Spillway Design Flood (cfs)	500	5300

(1) Estimated storage capacities for the proposed structures have been adjusted to account for the required excavations in the borrow/emergency spillway areas.

II. PLAN OF DEVELOPMENT

The Phase II, Level III studies for the enlargement of Lake Adelaide consist of development of plans and specifications for the design selected as a result of the Phase I conceptual design studies. Also included in the Phase II scope of work was completion of permit applications and input to an Environmental Assessment. The status of permitting is described in Section III. The proposed enlargement of Lake Adelaide will require the construction of the dam and appurtenances described below. Except for the Buckley Creek Diversion which is located about one mile southeast of the reservoir, the major features of the project are shown on Figure 1.

A. Embankment

A completely new earth and rockfill embankment dam has been designed to replace the existing dam. The original intent was to raise the existing embankment, but design studies indicated that zones of low density existed within the old earthfill, due to poor compaction. As a result, it would be unsafe to incorporate the old embankment in the enlarged structure. However, the old fill will be used as a borrow source to top-out the new embankment.

The new embankment volume will be approximately 214,000 cubic yards, with about 40,000 cubic yards of rockfill and associated filter material. The rockfill will form a large toe berm to elevation 9260 or nearly 2/3 of the structural height of the dam. This rockfill section will provide extra strength and act as a large toe drain to control seepage through the embankment. The remainder of the embankment will be constructed from glacial till, a gravelly silty sand. The rockfill section will have 1.5:1 (horizontal to vertical) downstream slope and form a 10 feet wide berm at elevation 9260. The embankment above this downstream berm will have a 2:1 (horizontal to vertical) slope. The upstream embankment will have a 3:1 (horizontal to vertical) slope and will be faced with two feet of riprap and bedding for erosion protection. Stability analyses of this design indicated factors of safety well above minimums for all loading cases.

B. Construction Materials

Most of the fill material for the dam will come from a borrow area that includes the emergency spillway. This area was used for borrow during the 1915 construction and is already disturbed. However, essentially all of the borrow area will be below the high-water line of the normal maximum pool, except for the excavation required for the emergency spillway. Minus six-inches diameter material will be used for the main embankment zone and oversize cobbles and boulders in the glacial till will be used for rockfill and riprap. In addition, filter material and concrete aggregate will come from the same source, processed at the site to meet specifications. Excavations required for foundation preparation of the dam and service spillway will provide additional embankment materials, both rock and earth fill. Finally, the old dam will be used to top out the new embankment during the last stages of construction.

C. Spillways

The plan of development incorporates two spillways with combined capacities to pass the entire Probable Maximum Flood (PMF). The PMF flow routed through the reservoir is approximately 5300 cfs, more than ten times the existing spillway capacity. The primary structure will be a side-channel service spillway capable of passing slightly more than 1/2 of the PMF flow. The service spillway will be constructed in granitic bedrock across the left abutment ridge, discharging back to Adelaide Creek immediately below the outlet works of the new dam. Only the lower part of the spillway chute will be in unconsolidated glacial till. This portion of the channel will be protected against erosion by placement of rock from the excavation to stabilize the channel and plunge pool.

A secondary or emergency spillway will operate in tandem with the service spillway to pass the remainder of the PMF. The emergency spillway will be located across the southern reservoir rim adjacent to the borrow area. This spillway will consist of a broad crested weir up to 225 feet wide with the borrow area shaped to form an approach channel. The exit channel will be shaped to direct uncontrolled flows to Shell Creek downstream from Shell Reservoir. Some low dikes will be required to provide freeboard against spills into Shell Reservoir. The emergency spillway will be unlined except for grass cover. It will only spill after flows in the service spillway exceed about 1500 cfs. Therefore, the anticipated frequency of spills through the emergency spillway is less than about once in one thousand years. However, since all of the materials excavated to construct this structure can be used for dam construction, it is relatively inexpensive insurance against the extremely rare large flood events.

D. Outlet Control

Control for irrigation releases from the reservoir will be provided by an outlet works consisting of a cut and cover pipe, sluice gate, stilling basin and weir. The outlet pipe will be constructed of reinforced concrete placed in a trench on a concrete cradle at the base of the left abutment. The reinforced concrete pipe will be 30 inches in diameter and will have an inlet invert elevation of 9233 feet, the same as the existing outlet. Flow will be controlled by a sluice gate at the inlet to the pipe, stem operated (manually) from the top of the dam. A trash rack will be provided to protect the sluice gate. At the outlet, a concrete stilling basin will be provided that discharges through a Cipolletti weir to measure flows. The outlet pipe is designed to discharge up to 127 cfs at normal maximum pool.

E. Buckley Creek Diversion

The existing diversion is in poor condition and does not operate as designed because of a creek channel partially bypassing the structure. A new diversion structure will be constructed that will divert up to 50 cfs during normal runoff. A minimum of 1.4 cfs and a maximum of 2.4 cfs will be bypassed to Buckley Creek to maintain flows for the fishery downstream. Basically, the new diversion is designed to operate during the late spring-early summer run-off period. At other times all or most of the stream flows will be bypassed.

F. Access Road

Improvement of the existing access road is one of the more environmentally sensitive issues because of the proximity of the reservoir to the Cloud Peak Wilderness. The current plan of development includes a minimal upgrade of the existing route with relocation of the road only where necessary. The existing road is passable to 4-wheel drive vehicles. The existing route will have to be improved to permit passage of construction equipment and service vehicles. Further, the existing route around Lake Adelaide will be flooded and will have to be relocated. The present plan is to upgrade the access road to the extent necessary for construction and then degrade the road to a 4-wheel drive road similar to existing conditions.

G. Construction Schedule

A construction schedule of three years is planned because of the remote location of the site and a short, but variable construction season (approximately June 20 to September 30). Storms, including snow, that can cause delays can occur at any time during the construction season. The first year would be used to upgrade the access under a separate contract so that the primary contractor will be able to see conditions he will be working with prior to bidding. The primary risk with this approach is that bids for dam construction could be too high and the money used for the road upgrade irrecoverable.

The dam and appurtenances will be constructed in two seasons. The first season will be used to prepare the dam foundation, the borrow area, construct the outlet pipe, the service spillway, and the Buckley Creek Diversion. The second season will be used to construct the embankment, emergency spillway and finish the outlet works. The design will permit continued operation of the existing reservoir during construction.

III. PERMITTING STATUS

Applications for the various permits required for construction have been submitted. These include a U.S. Forest Service Special Use Permit, 404 Permit, 401 Certification and application to the State Engineer's Office for water rights and dam safety review. The Special Use and 404 permit applications triggered an Environmental Assessment (EA) under the NEPA process. A draft EA has been submitted by a third party contractor and is currently under review by the U.S. Forest Service (Paintrock District, Big Horn National Forest). It is anticipated that the final EA will be approved by about February 15, 1987.

Approval of the Special Use, 404, and 401 certification will then follow adoption of the EA. Provisions of these permits are not expected to change the plan of development in a significant manner. Through discussions with the regulatory agencies involved, requirements are expected such as sedimentation controls, spill prevention, revegetation of disturbed areas, protection of a cabin of potential historic value, and perhaps permanent pit toilets near the reservoir.

Application to the State Engineer's Office has established a priority date for water rights and an initial review made of the development plan. Final design revisions will be incorporated in the permit application and submitted in December, 1986 for final review.

During 1986, a potential major problem with the new boundary of the Cloud Peak Wilderness was resolved. When the new boundary was surveyed it was found that the lower part of the proposed service spillway would encroach on the wilderness. The boundary was adjusted by Congress with Forest Service input, based on a request by the WWDC. This adjustment was consistent with the Wyoming Wilderness Act of 1984 (P.L. 98-550) because the original intent of the Act was not to impede future development on the existing Shell and Adelaide water storage reservoirs.

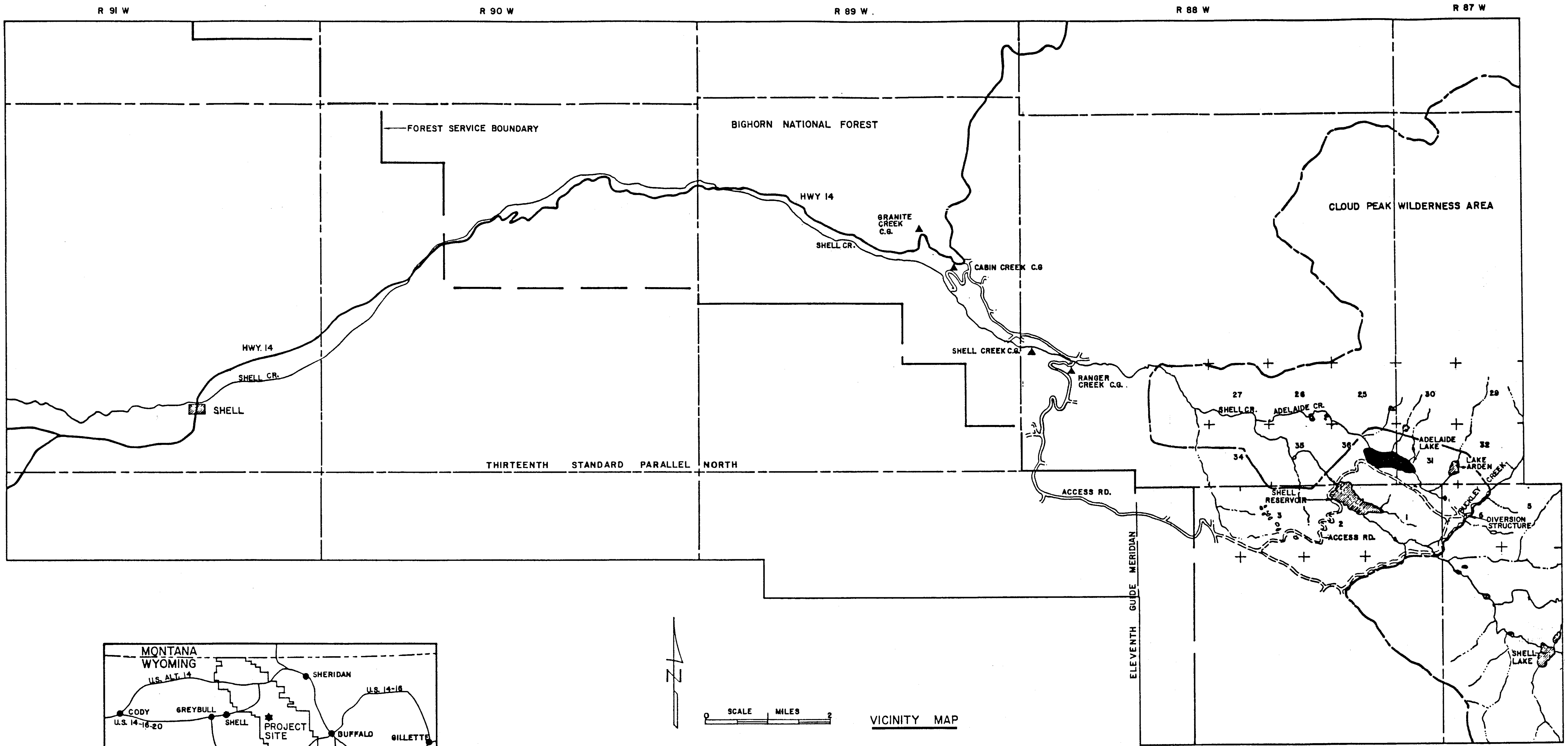
IV. COST ESTIMATES

The cost estimates prepared during Phase I have been revised to reflect refinements of design and anticipated environmental controls and mitigation measures. The total estimated cost of construction is $2,171,600 with contingencies, escalation and construction management and engineering as shown on Table 2. While the total cost is not significantly different than the 1985 estimate, there are several substantial changes in detail. The total direct cost in 1986 dollars increased about 11 percent which is partially compensated by reductions in contingencies to 10 percent and escalation to 10 percent. The total estimated construction cost is therefore, about one percent higher than the 1985 estimate.

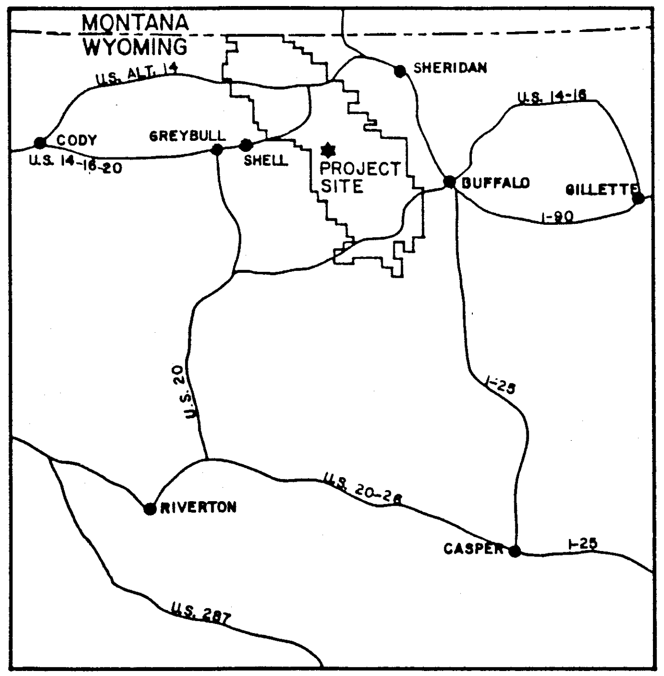
Table 2

Estimated Construction Costs

ITEM		TOTAL
Access Road		$ 60,000.00
Dam Construction:		
Mobilization		100,000.00
Foundation Clearing		26,600.00
Left Abutment Preparation		15,800.00
Right Abutment Preparation		60,000.00
Embankment Construction		1,013,800.00
Side Channel Spillway		103,300.00
Outlet Facilities		134,200.00
Buckley Creek Diversion		26,500.00
Final Grading and Revegetation		20,400.00
	December, 1986 Total Direct Cost	1,560,600.00
Contingency of 10%		156,100.00
	Subtotal	1,716,700.00
Escalation to 1988 (say 10%)		171,700.00
	Total 1988 Construction Cost	1,888,400.00
Future Engineering Costs		188,800.00
Construction Contract Administration		94,400.00
	TOTAL CONSTRUCTION COST	$2,171,600.00

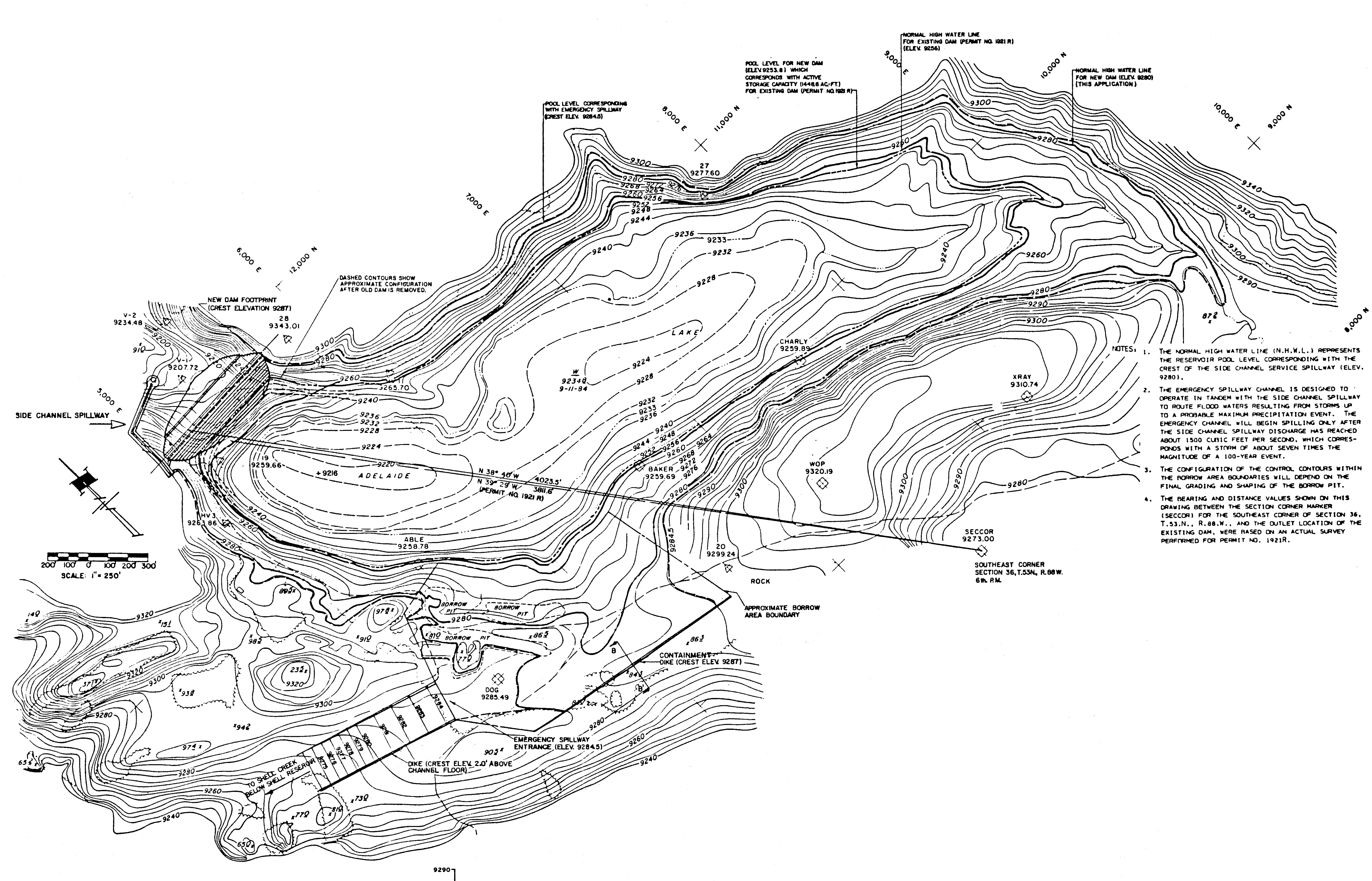


VICINITY MAP



GENERAL LOCATION MAP

FIGURE 1
PROJECT LOCATION MAP

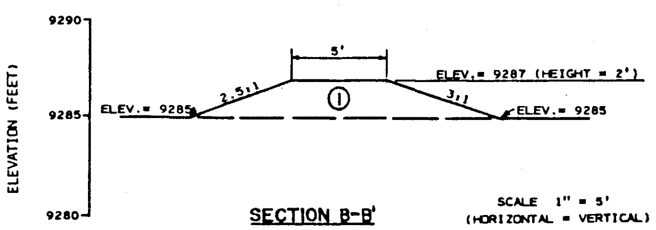


NOTES:

1. THE NORMAL HIGH WATER LINE (N.H.W.L.) REPRESENTS THE RESERVOIR POOL LEVEL CORRESPONDING WITH THE CREST OF THE SIDE CHANNEL SERVICE SPILLWAY (ELEV. 9280).
2. THE EMERGENCY SPILLWAY CHANNEL IS DESIGNED TO OPERATE IN TANDEM WITH THE SIDE CHANNEL SPILLWAY TO ROUTE FLOOD WATERS RESULTING FROM STORMS UP TO A PROBABLE MAXIMUM PRECIPITATION EVENT. THE EMERGENCY CHANNEL WILL BEGIN SPILLING ONLY AFTER THE SIDE CHANNEL SPILLWAY DISCHARGE HAS REACHED ABOUT 1500 CUBIC FEET PER SECOND, WHICH CORRESPONDS WITH A STORM OF ABOUT SEVEN TIMES THE MAGNITUDE OF A 100-YEAR EVENT.
3. THE CONFIGURATION OF THE CONTROL CONTOURS WITHIN THE BORROW AREA BOUNDARIES WILL DEPEND ON THE FINAL GRADING AND SHAPING OF THE BORROW PIT.
4. THE BEARING AND DISTANCE VALUES SHOWN ON THIS DRAWING BETWEEN THE SECTION CORNER MARKER (SECCOR) FOR THE SOUTHEAST CORNER OF SECTION 36, T.53.N., R.88.W., AND THE OUTLET LOCATION OF THE EXISTING DAM, WERE BASED ON AN ACTUAL SURVEY PERFORMED FOR PERMIT NO. 1921R.

ADELAIDE RESERVOIR ENLARGEMENT

ADELAIDE CREEK DRAINAGE AREA	3.58 SQ. MI.
MAXIMUM INFLOW FROM FIRST ENLARGEMENT OF ADELAIDE DITCH	50 C.F.S.
SURFACE AREA AT NORMAL HIGH WATER LINE (N.H.W.L.)	145.5 ACRES
TOTAL ACTIVE CAPACITY AT N.H.W.L.	4763.5 AC.-FT.
INCREASE IN ACTIVE CAPACITY ABOVE PERMIT NO. 1921R	3314.9 AC.-FT.



SECTION B-B'
CONTAINMENT DIKE
SOUTH SIDE OF BORROW AREA

FIGURE 2
ADELAIDE RESERVOIR PLAN