Value Engineering

FINAL REPORT

PROJECT:

STANFIELD RELIFT PUMPING PLANT

CONCEPTUAL DESIGN

DATE: July 11, 1995

Conducted Under Cooperative Agreement with:
Bureau of Reclamation

UNITED STATES
DEPARTMENT OF THE INTERIOR
Bureau of Reclamation
Pacific Northwest Region

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STANFIELD RELIFT PUMPING PLANT

CONCEPTUAL DESIGN

VE TEAM MEMBERS

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GENERAL DISCUSSION OF VALUE ENGINEERING, ITS PURPOSE, AND THIS STUDY

Value Engineering (VE) is a problem-solving methodology originally developed by Larry Miles in 1943. In general, features from a project or process are examined to determine pertinent functions, governing criteria, and associated costs. Then, through creativity techniques, resulting idea analysis, and development of the remaining best ideas, alternative methods that fully meet necessary requirements at a lower cost, or with an increase in the long-term value, are proposed for adoption by the parties responsible for the feature studied.

This progress report is the result of a "formal" VE study. A formal VE study team is comprised of people with the desired expertise who are not notably involved in the project or process. The VE study team takes a "fresh look" at the concept to see if this examination, using VE methodology applied to the current collected data, can create alternatives which can better fulfill the client needs.

Value Engineering (also known as Value Management, Value Analysis, and Value Planning) has been extremely successful for both private and Governmental entities. As a result, Government has mandated its use, through its regulatory powers, in all Governmental operations. This VE report has the substance required to demonstrate that quality VE methodology was used throughout this study, as stipulated under the mandated Governmental VE program (as recommended by the Department of Interior and Bureau of Reclamation guidance) and respected recommendations of the VE profession.

VEDISCUS.APP

VE STUDY TEAM ACKNOWLEDGMENT OF DESIGN TEAM AND CONSULTANTS

The VE Study Team wishes to express thanks and appreciation to the design team staff, who fully and cordially provided all requested information and consultation on the present operations and proposals. The success of the VE effort is not possible without the full cooperation shown by the design team staff. Additionally, the study team wishes to thank all those listed in the consultation records who helped the team through their additional information and expert assistance.

The aim of VE is to achieve a high-value product. It is only with the full team effort, as shown by all involved, that this goal can be achieved. This report represents the product of such an effort.

VETHANKS.CIT

EXECUTIVE SUMMARY OF PROPOSALS

General:

The Value Engineering Study Team (VEST) consisted of expertise from mechanical, civil and other engineering specializations. The team had their first full team meeting on June 20, 1995. The VEST concluded the full formal team efforts on June 23, 1995, with a presentation to the design team and other interested parties.

The team made two formal recommendations (developed to the point that they were complete enough for formal alternative recommendation presentation at the completion of the study). The VEST also presented two additional items for further study, that have the potential for increasing the value of the project, but were not developed by the VEST into a formal recommendation due to time constraints or other factors.

Summary of Recommendations:

Formal recommendations are ideas which were examined by the VEST and determined to have significant potential to generate technical and/or economical advantages to the owners, users, and/or others affected by the project. These recommended alternatives are respectfully submitted for consideration by the involved parties.

The **maximum estimated first year construction savings**, if the recommendations are accepted, is **$700,000**. The estimated cost to conduct the Value Engineering study is about $18,000. The estimated costs of implementation are $22,000. Therefore, the estimated maximum net potential savings resulting from the study is **$660,000**.

A very brief description and the potential value of the recommendations are:

1. Use four vertical turbine pumps and relocate pumping plant over the canal alignment. Estimated initial cost savings are **$660,000**.

2. Move pumping plant towards the edge of the canal. Estimated initial cost savings are **$272,000**.

EXECUTIVE SUMMARY OF PROPOSALS

Summary of Additional Items for Further Study.

Another two items for further study were presented. These are items that, due to time constraints, the lack of apparent significant savings or value added, complexity, or scope of the idea (as compared to the study scope) made further investigation by the VEST inadvisable. They are respectfully submitted for consideration for further development to add value to the project, but have not been developed to the detail of the previous alternative recommendations. Briefly the ideas are:

- Rotated plant layout. Potential preliminary estimated savings $28,000.

- Increase entrance velocity due to automatic trash raking. Potential preliminary estimated savings $6,000.

Within the time constraints of the study, the initial potential savings in excess of $34,000 was identified to warrant further investigation of these ideas.

STANFIELD RELIFT PUMPING PLANT
GENERAL DESCRIPTION

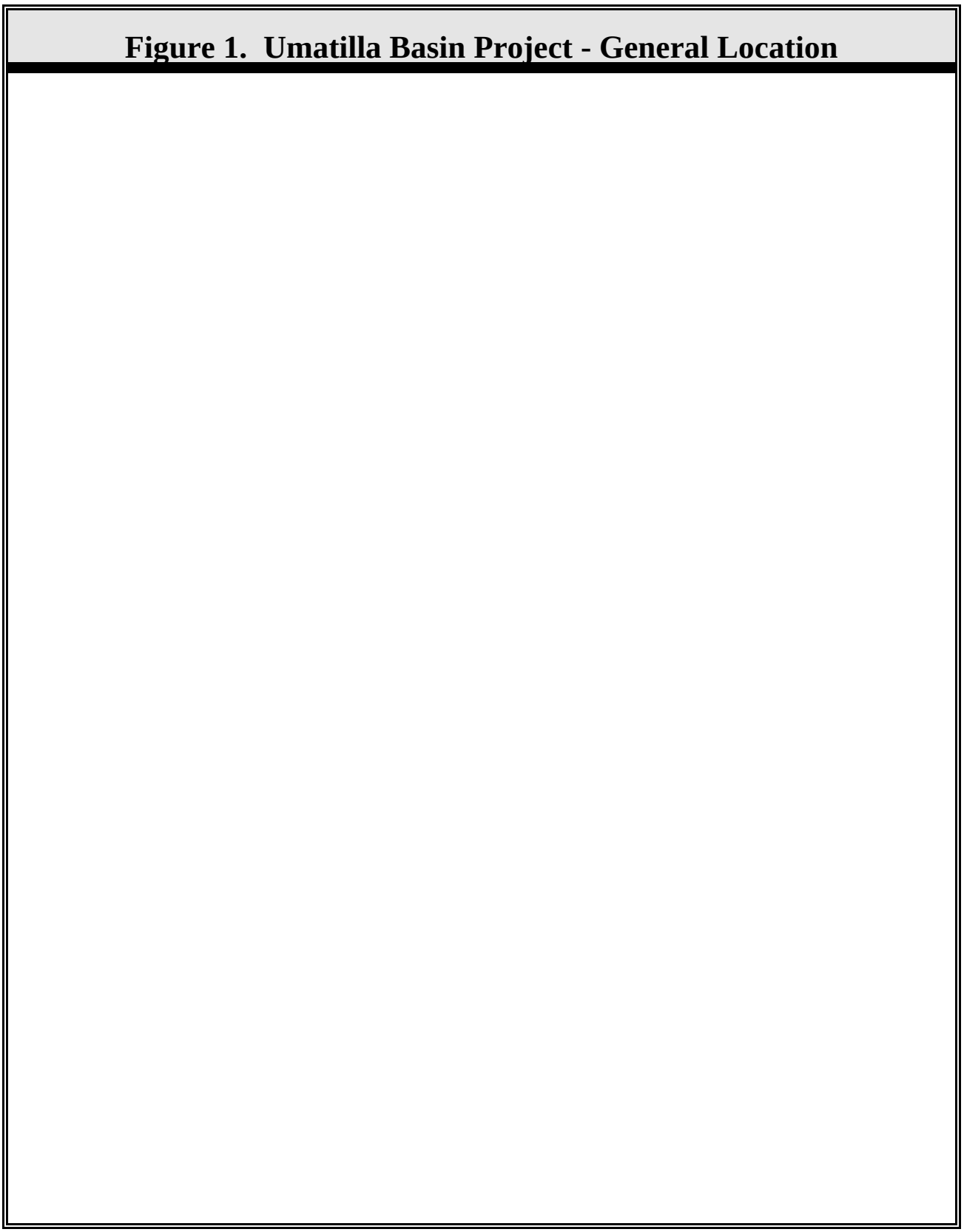
General Description

The Stanfield Relift Pumping Plant and Discharge Line are key components in the Umatilla Basin Project. The basic features of the project are water exchange and anadromous fish passage facilities. Umatilla River water now diverted or stored for irrigation would be retained in the Umatilla River providing instream flow for anadromous fish passage. Columbia River waters will be diverted to serve established irrigation demands in the Umatilla River Basin in exchange for Umatilla River water left instream as shown in Figure 1. In addition, improvements are being made to the fish ladders and screens at existing major irrigation diversions.

Stanfield Relift Pumping Plant will lift irrigation water from the Stanfield Branch Furnish Canal into Furnish Ditch. See Figure 2. The average annual pump delivery is estimated to be 9,000 to 11,000 acre-feet.

GENRDESC.SIT

Figure 1. Umatilla Basin Project - General Location



GENLOC.PCX

Figure 2. Stanfield Relift Pumping Plant - Discharge Outlet Location

LOCATION.PCX

DESCRIPTION OF PRESENT DESIGN

Project - Stanfield Relift Pumping Plant

The Stanfield Relift Pumping Plant includes the following features:

- Discharge capacity is 90 ft^3/s, static head lift of about 23 feet.
- Construct a remotely operated indoor (prefab steel building) plant.
- Construct an inlet structure sized for 140 ft^3/s for future considerations; inlet box culvert, trashrack, automatic trash rake, and removable stoplogs.
- Install the following six horizontal split case, constant-speed pumps as shown in Figures 3, 4, and 5:

  Three - 22.5 ft^3/s (1/4 capacity) pumps

  Three - 7.5 ft^3/s (1/12 capacity) pumps

- Install 8,000 feet, 42-inch-inside-diameter discharge pipeline.
- Install an outlet structure at the Furnish Ditch.
- Many features will be similar to the Cold Springs Pumping Plant.

PRESDESC.DES

Figure 3. Pumping Plant - Plan

PLAN.PCX

Figure 4. Pumping Plant - Sections

SECTIONS.PCX

Figure 5. Pumping Plant - Layout

LAYOUT.PCX

SPECIAL CRITERIA SUMMARY

USERS:
● Reclamation is responsible for construction, and operation and maintenance (O&M) until construction is complete.
● Stanfield Irrigation District is the end user of the irrigation system.
CODES:
RESTRICTIONS:
● Discharge pipeline - typical options for pipeline material are allowed.
● Bonneville Power Administration has advised the project that steel or cylinder pipe will have a special grounding requirement due to proximity of their transmission line.
DESIGN HISTORY: (RESPONSIBILITIES, COMMITMENTS, STATUS, ETC.)
● The Denver Technical Service Center (TSC) is responsible for design of the pumping plant excluding the building.
● The building design and drawings will be done by the PN Regional Office concurrent with the pumping plant design.

SPECCRIT.TAB

COST MODEL - STANFIELD RELIFT PUMPING PLANT

COST MODEL AND ESTIMATE INFORMATION

The VE Study Team cost model was based on the conceptual design estimates provided by the design team for the preferred project design. This cost model was developed by the VE Study Team and was used to focus on features with the greatest potential for savings and to highlight potential instances of value mismatch.

Unit prices were reviewed by the VE Study Team and Construction Estimators to ensure reliability and applicability.

Cost savings and the original design concept estimates are of the same general level of development. It should be recognized that unit costs and estimates may vary as final designs are pursued and refined.

COSTPAGE.PG

FUNCTION ANALYSIS

PROJECT: **UMATILLA RIVER BASIN**

STUDY ITEM: **STANFIELD RELIFT PUMPING PLANT**

COMPONENT	VERB (ACTIVE)	NOUN (MEASURABLE)
Discharge Pipe	Supply Convey Direct	Water Flow Flow
Pump Units	Pump Induce Input	Water Flow Energy
Electrical Equipment	Control Power	Motors Equipment
Trash Rake	Remove	Debris
Plant Structure	Hold	Alignment
Foundation	Support	Loads
Manifold	Discharge Concentrate	Water Water
Gates and Valves	Isolate Facilitate	Pumps Maintenance
Heating and Ventilation	Control	Temperature

FUNCANAL.TAB

Function Analysis System Technique (FAST)

The VE Study Team used the function analysis process to generate a Function Analysis System Technique (FAST) diagram designed to show the present conceptual design preferred alternative from a functional point of view. The function analysis and resulting FAST diagram aided the VE Study Team in identifying design features that are critical to meeting requirements that support the critical functions, and those that meet noncritical design objectives.

FASTDIAG.PG

FUNCTIONAL ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM

VALUE ENGINEERING - DISPOSITION OF IDEAS

PROJECT: STANFIELD RELIFT PUMPING PLANT

OTHER VE ELEMENTS CONSIDERED AS POTENTIAL PROPOSALS	
IDEA	**DISPOSITION**
● Relocate plant toward canal centerline.	Incorporated into VE Proposals No. 1 and No. 2.
● Use vertical turbine pumps.	Incorporated into VE Proposal No. 1.
● Use four pumps, two constant speed, and two variable speed.	Incorporated into VE Proposals No. 1 and No. 2.

IDEASDIS.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Stanfield Relift Pumping Plant

PROPOSAL NO. 1. USE VERTICAL TURBINE PUMPS AND RELOCATE PUMPING PLANT.

Background:

The original concept uses six horizontal pump units in a plant structure located on the other side of the maintenance road from the canal.

Proposal:

- Relocate plant over the canal alignment as shown on Figure 6.
- Use canal as part of the pumping plant sump.
- Use four 23 ft^3/s capacity vertical turbine pumps as shown on Figure 7.
- Two of the pumps will be constant speed and two pumps will be variable speed.

VEALTDES.TAB

Figure 6. VE Proposal No. 1 - Plan

OVEPRPAG.HOR

Figure 7. VE Proposal No. 1 - Pump Data Sheet

VE1PUMP.PCX

VALUE ENGINEERING
ALTERNATIVE EVALUATION PROPOSAL NO. 1

PROJECT: Stanfield Relift Pumping Plant

COMPONENT: Pumping Plant

FUNCTION: Pump Water

ALTERNATIVE DESCRIPTION

- Relocate plant over the canal alignment.
- Use canal as part of the pumping plant sump.
- Use four 23 ft^3/s capacity vertical turbine pumps.
- Two of the pumps will be constant speed and two pumps will be variable speed.

BENEFITS	DISADVANTAGES
● Reduced costs due to smaller footprint of pumping plant.	● Maintenance on the pump bowls, impellers and columns will require draining the sump, or lifting the pumps out of the sump.
● Reduced concrete, excavation, and backfill quantities.	● Top of pumping plant building will be more visible.
● May eliminate need to purchase land outside of 50-foot canal right-of-way.	● Vertical turbine pumps may be susceptible to vibration at a critical speed within the operating range.

VEALTEVL.ALT

VALUE ENGINEERING PROPOSAL NO. 1

PROJECT: Stanfield Relift Pumping Plant	
COMPONENT: Pumping Plant	**FUNCTION:** Pump Water

ORIGINAL CONCEPT	VE CONCEPT
● Use six horizontal pumps with plant located on other side of maintenance road.	● Use four vertical turbine pumps and relocate pumping plant over canal alignment.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 3,600,000	
VE CONCEPT (-)	$ 2,900,000	
SAVINGS	$ 700,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 700,000	
VE STUDY COSTS (-)	$ 18,000	
IMPLEMENTATION COSTS(-)	$ 22,000	
NET SAVINGS	**$ 660,000**	

* CHOOSE ONE METHOD-USE NONRECURRING IF LIFE CYCLE COSTING DOES NOT APPLY.

VEALTMON.TAB

IMPLEMENTATION OF PROPOSAL NO. 1

CRITICAL ITEMS TO CONSIDER:

- Pump maintenance requires lifting pump columns or dewatering sump.
- Top of pumping plant is more visible.
- Potential for pump vibration within the operating range.

PROBLEMS AND HOW THEY CAN BE OVERCOME:

- To provide for pump maintenance, incorporate hatches into building roof and use mobile crane to lift pumps.
- Visibility could be improved by architectural treatments and planting trees.
- Vibration potential can be eliminated or reduced with proper pump and foundation design. The discharge head can be reinforced. The shafts can be provided with additional supports.

PROCEDURES: (WHO DOES WHAT)

- Project decides if the proposal is acceptable and gets water district concurrence.
- Technical Service Center proceeds with final design.

SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:

Benefits: Simplicity and reduced construction costs.

Disadvantages: Pump maintenance requires lifting pump columns or dewatering sump. Top of pumping plant is more visible.

VEIMPLEM.TAB

VE PROPOSAL DESCRIPTION

PROJECT: Stanfield Relift Pumping Plant

PROPOSAL NO. 2. MOVE PUMPING PLANT TOWARDS EDGE OF THE CANAL.

Background:

The original concept uses six horizontal pump units in a plant structure located on the other side of the maintenance road from the canal.

Proposal:

- Move plant toward edge of the canal.
- Use canal as part of the pumping plant sump.
- Use four 23 ft^3/s capacity horizontal pumps as shown of Figures 8 and 9.
- Two of the pumps will be constant speed and two pumps will be variable speed.

VEALTDES.TAB

Figure 8. VE Proposal No. 2 - Plan

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Figure 9. VE Proposal No. 2 - Section

OVEPRPAG.HOR

VALUE ENGINEERING
ALTERNATIVE EVALUATION PROPOSAL NO. 2

PROJECT: Stanfield Relift Pumping Plant	
COMPONENT: Pumping Plant	**FUNCTION:** Move Water

ALTERNATIVE DESCRIPTION

- This alternative relocates the pumping plant into the canal alignment by incorporating the canal sump into the plant structure and reduces the overall structure size by using four pumps instead of six.

BENEFITS	DISADVANTAGES
● Reduced excavation for pumping plant and sump structure.	● Increased backfill and compaction quantities.
● Reduced intake manifold piping.	● Increased concrete and steel reinforcement quantities.
● Reduces additional right-of-way requirements.	● Detours operation and maintenance (O&M) road around pumping plant structure.
● Allows installation of a roof instead of a complete engineered building.	● Increases costs due to variable speed controllers for pumps
	● No floor level vehicle access.

VEALTEVL.ALT

VALUE ENGINEERING PROPOSAL NO. 2

PROJECT: Stanfield Relift Pumping Plant	
COMPONENT: Pumping Plant	**FUNCTION:** Move Water
ORIGINAL CONCEPT	**VE CONCEPT**
● Use six horizontal pumps with plant located on other side of maintenance road.	● Use four horizontal pumps with plant located in canal right-of-way.

COST ITEMS	NONRECURRING*	LIFE CYCLE*
ORIGINAL CONCEPT	$ 3,600,000	
VE CONCEPT (-)	$ 3,300,000	
SAVINGS	$ 300,000	
NUMBER OF UNITS (X)	1	
TOTAL SAVINGS	$ 300,000	
VE STUDY COSTS (-)	$ 18,000	
IMPLEMENTATION COSTS(-)	$ 10,000	
NET SAVINGS	**$ 272,000**	

* CHOOSE ONE METHOD-USE NONRECURRING IF LIFE CYCLE COSTING DOES NOT APPLY.

VEALTMON.TAB

IMPLEMENTATION OF PROPOSAL NO. 2

CRITICAL ITEMS TO CONSIDER:
● Ventilation needs to be reevaluated.
PROBLEMS AND HOW THEY CAN BE OVERCOME:
● To allow proper ventilation for equipment cooling add additional louvers and ducting.
PROCEDURES: (WHO DOES WHAT)
● Project decides if the proposal is acceptable and gets water district concurrence.
● Technical Service Center proceeds with final design.
SUMMATION OF BENEFITS AND DRAWBACKS OF THE VE PROPOSAL:
Benefits: Combined structure and reduced construction costs.
Disadvantages: No floor level vehicle access.

VEIMPLEM.TAB

VALUE ENGINEERING

ADDITIONAL ITEMS FOR STUDY

(A LISTING OF ITEMS WITH POTENTIAL FOR COST IMPROVEMENT)

PROJECT: Stanfield Relift Pumping Plant

DESCRIPTION	ESTIMATE OF DOLLARS INVOLVED	REMARKS
● Relocate horizontal pumps along the canal alignment as shown on Figures 10 and 11.	$28,000 based only on pipe and concrete in sump quantities.	Reduces cost by reducing the volume of the concrete in the sump, building area, and perhaps eliminating the need for a land purchase. May prevent a possible pump intake problem by eliminating a change in flow direction where the water enters the pump intake pipes. For this layout, the angle between the manifold and the canal center line may need to be increased so that there are no bends in the pipes just prior to the pumps and so the flow does not change directions when it enters the pump intake pipes. The angle in the manifold can be reduced or eliminated by rotating the plan view about the canal centerline. Other features of VE Proposal No. 2 would remain essentially the same.
● Increase trashrack velocity from 1 ft/s to 2 ft/s.	$6,000 based only on trashrack steel quantity	Reduces cost by reducing the trashrack area in half. The tashrack velocity can be doubled to 2 ft/s when an automatic trashrake is added which was in the original preliminary design.

VEOTHER.STY

Figure 10. Alternate Plant Layout - Plan

OVEPRPAG.HOR

Figure 11. Alternate Plant Layout - Section

OVEPRPAG.HOR

CONSULTATION RECORD

CONSULTANT (Name,Title, Company)	CONTACT INFO (Telephone, address)	MAIN TOPIC DISCUSSED AND INFORMATION RECEIVED
Steve Robertson D-8150, Civil Engineering	(303) 236-3999 Extension 543 Bureau of Reclamation PO Box 25007, Denver, CO 80025-0007	Design criteria and comments on alternatives.
James Lacey, D-8420 Hydraulic Equipment	(303) 236-6868 Extension 240 Bureau of Reclamation PO Box 25007, Denver, CO 80025-0007	Pump and sump design criteria.
Plastics Inc.	(303) 289-2557	Cost and availability of HDPE pipe.
Bob Sund, D-8410 Mechanical Equipment	(303) 236-8410 Extension 260 Bureau of Reclamation PO Box 25007, Denver, CO 80025-0007	Increased velocity through trash rack because of automatic trash raking.
Rick Christensen, D-8410, Mechanical Equipment	(303) 236-8410 Extension 274 Bureau of Reclamation PO Box 25007, Denver, CO 80025-0007	Increased velocity through trash rack because of automatic trash raking.

CONSULT.REC

INFORMATION/DATA DOCUMENTS CONSULTED

DOCUMENT (Name, Author, Dates, etc.)	INFORMATION RECEIVED/USED
Specification Design Data for Stanfield Relift Pumping Plant - May 1995	Design Data
American National Standard for Centrifugal Pumps, Hydraulic Institute - 1994	Pump and Sump Design Criteria
American National Standard for Vertical Pumps, Hydraulic Institute - 1994	Pump and Sump Design Criteria

DOCUMENT.REC

STANFIELD RELIFT PUMPING PLANT

CONCEPTUAL DESIGN

DESIGN TEAM PRESENTATION ATTENDANCE LIST

8:30 a.m., June 20, 1995

Bureau of Reclamation, Denver, Colorado

Building 67, Trinity Room

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John Walp	D-8410, Mechanical Equipment Group, VE Team Member	(303) 236-8410 Extension 265
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Larry Soderlind	PN-3428, Pacific Northwest Regional Office, VE Team Member	(208) 378-5214
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Gary Snyder	D-8120, Structural and Architectural Group	(303) 236-9100 Extension 235
Jerry Wright	D-8430, Plant Electrical Group	(303) 236-6871
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Richard Fehr	D-8410, Mechanical Equipment Group	(303) 236-8410 Extension 227
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