2000

Value Engineering: Final Report- Bear River Migratory Bird Refuge Headquarters and Education Complex

U.S. Bureau of Reclamation

Value Engineering

Final Report

Bear River Migratory Bird Refuge Headquarters and Education Complex - FWS

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December 26, 2000

Conducted for the Fish and Wildlife Service, Mountain-Prairie Region
in Cooperation with the National Park Service, Denver Service Center

au of Reclamation, Technical Service Center, Denver, Colorado

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Executive Summary

The Value Study Team met on December 11, 2000, for a 5-day study of the proposed Bear River Migratory Bird Refuge Headquarters and Education Complex (at the 95 percent Title 1 submittal stage). The estimated construction cost of the baseline concept is $6,060,000. The Team developed 12 proposals which are summarized below. If all the savings proposals are accepted, their maximum savings potential is $1,400,000 (1A+2+4+5A+7A below). Note that in calculating the maximum potential savings, the cost of the study ($25,000) was deducted only once.

Independent Proposals: The following proposals are generally independent of all other proposals and could be accepted or rejected individually without affecting other proposals. Proposal Nos. 2 and 4 could be combined for increased savings.

Proposal No. 2. Lower Building Finish Floor to Near Grade Level. The estimated savings of this proposal are $215,300 before deducting any study and/or implementation costs.

Proposal No. 3. Change Road Materials of Unsurfaced Road. This proposal did not change the estimated cost of the unsurfaced road.

Proposal No. 4. Change Thickness of Asphalt and Road Base and Add Base Layer of Pit Run Gravel. The estimated savings of this proposal are $62,000 before deducting any study and/or implementation costs.

Proposal No. 6. Replace Interior Basement Foundation Walls With Space Frame. The estimated added costs of this proposal are $829,500 before adding any study and/or implementation costs.

Dependent Proposals: The following proposals are interdependent. Within the same number (such as Proposal Nos. 1A, 1B, or 1C) only one of the proposals could be implemented.

Proposal No. 1A. Relocate Parking - Switch With Maintenance. The estimated savings of this proposal are $430,600 before deducting any study and/or implementation costs.

Proposal No. 1B. Relocate Parking - Combined Bridges (Culvert Construction). The estimated savings of this proposal are $353,250 before deducting any study and/or implementation costs.

Proposal No. 1C. Bridge Type - Culvert Construction. The estimated savings of this proposal are $230,000 before deducting any study and/or implementation costs.

Proposal No. 5A. Geofoam Foundation - Partially Compensated. The estimated savings of this proposal are $580,000 before deducting any study and/or implementation costs.

Proposal No. 5B. Geofoam Foundation - Fully Compensated. The estimated savings of this proposal are $304,898 before deducting any study and/or implementation costs.

Proposal No. 7A. Exterior Wall Type - Stucco. The estimated savings of this proposal are $128,600 before deducting any study and/or implementation costs.

Proposal No. 7B. Exterior Wall Type - Wood Siding. The estimated savings of this proposal are $112,480 before deducting any study and/or implementation costs.

Proposal No. 7C. Exterior Wall Types - Foam Core. The estimated savings of this proposal are $173,557 before deducting any study and/or implementation costs.

Other Ideas: The Team identified 49 additional ideas for further consideration and development that are listed in the "Disposition of Ideas" table near the end of this report.

Value Study Team Members

Name/Title/Discipline	Address/Phone Number
Norm Hyndman Value Study Team Leader General Engineer	Bureau of Reclamation, Technical Service Center PO Box 25007 (D-8170), Denver CO 80225-0007 Phone: 303-445-3251 FAX: 303-445-6475 E-mail: nhyndman@do.usbr.gov
Al Trout Refuge Manager	Bear River Migratory Bird Refuge 866 So. Main, Brigham City, Utah 84302 Phone: 435-723-5887, Ext.11 FAX: 435-723-8873 E-mail: atrout@do.fws.gov
Gene Goldberg Architect	National Park Service, Denver Service Center PO Box 25287, Denver CO 80225 Phone: 303-969-2475 FAX: 303-987-6608 E-mail: ggoldberg@nps.gov
Bernie Lajimodiere Structural Engineer	Bureau of Reclamation, Technical Service Center PO Box 25007 (D-8110), Denver CO 80225-0007 Phone: 303-445-2996 FAX: 303-445-6490 E-mail: blajimodie@do.usbr.gov
Dave Miedema Geotechnical Engineer	Bureau of Reclamation, Technical Service Center PO Box 25007 (D-8311), Denver CO 80225-0007 Phone: 303-445-3034 FAX: 303-445-6472 E-mail: dmiedema@do.usbr.gov
Gary Rood Mechanical Engineer	Bureau of Reclamation, Technical Service Center PO Box 25007 (D-8420), Denver CO 80225-0007 Phone: 303-445-3102 FAX: 303-445-6469 E-mail: grood@do.usbr.gov
Keith Copeland Cost Estimator	Bureau of Reclamation, Technical Service Center PO Box 25007 (D-8170), Denver CO 80225-0007 Phone: 303-445-3079 FAX: 303-445-6475 E-mail: kcopeland@do.usbr.gov

Acknowledgment of Design Team and Consultant Assistance

The Value Study Team wishes to express their thanks and appreciation to Mr. Al Bevilacqua, Regional Engineer, Fish and Wildlife Service; Mr. Thomas Roberts, the Design Team Leader, of Sellards and Grigg; and the members of the design team, who fully and cordially provided all requested information and consultation on the conceptual design. The team would not have been as successful without the design team's cooperation and assistance.

The Value Study Team wishes also to express thanks and appreciation to those listed on the Consultation Record of this report. Their cooperation and help contributed significantly to the technical foundation and scope of the team's investigation and final proposals.

The goal of the value method is to achieve the most appropriate and highest value solution for the project. It is only through the efforts of a diverse, high performing team, including all those involved, that this goal can be achieved. This study is the product of such an effort.

Value Method Process

The Value Method is a decision making process, originally developed in 1943 by Larry Miles, to creatively develop alternatives that satisfy essential functions at the highest value. It has many applications but is most often used as a management or problem-solving tool.

The study process follows a Job Plan that provides a reliable, structured approach to the conclusion. Initially, the team examined the component features of the program, project or activity to define the critical functions (performed or desired), governing criteria, and associated costs. Using creativity (brainstorming) techniques, the team suggested alternative ideas and solutions to perform those functions, consistent with the identified criteria, at a lower cost or with an increase in long term value. The ideas were evaluated, analyzed and prioritized, and the best ideas were developed to a level suitable for comparison, decision making and adoption.

This report is the result of a "formal" Value Study, by a team comprised of people with the diversity, expertise, and independence needed to creatively attack the issues. The team members bring a depth of experience and understanding of the disciplines they represent, and an open and independent enquiry of the issues under study, to creatively solve the problems at hand. Ideally, the team members have not been notably involved in the issues prior to the study. The team applied the Value Method to the issues and supporting information, and took a "fresh look" at the problems to create alternatives that fulfill the client's needs at the greatest value.

Current Description

The Bear River Migratory Bird Refuge is located three miles west of Brigham City, Utah, at the mouth of the Bear River. Interfacing with the northeast corner of the Great Salt Lake. It covers 74,000 acres of marshland, mudflats, and grasslands. The Refuge mission is for "the resting, feeding and breeding of migratory birds."

Congress established the refuge in 1928 and it was developed into a showcase wildlife management area through the 1970's. Refuge lands were inundated in the mid 1980's by a 12-foot rise of the Great Salt Lake. At that time all existing facilities were destroyed by high water and ice floes. In the early 1990's, a long range plan was approved to restore and enhance the water management, public use, and administrative support facilities. This project is for restoring the public use and administrative facilities.

The current design is for a 30,000-square-foot building for administrative offices and an education complex, access roads, and parking areas. Interpretive exhibits are excluded from this study. The construction cost estimate includes $1,330,000 for roads and parking areas plus $4,730,000 for the Headquarters and Education Complex building, a total of $6,060,000.

Roadway plans include both unsurfaced and asphalt pavement surfaced options. Also planned is a 24-foot top width, including shoulders and a length of about 3,300 feet, including the driveways within the parking lots. The parking area is designed for 115 cars and 9 to 18 recreational vehicles and busses. The design also includes a 70-foot-long timber bridge and a 300-foot-long boardwalk/pedestrian bridge.

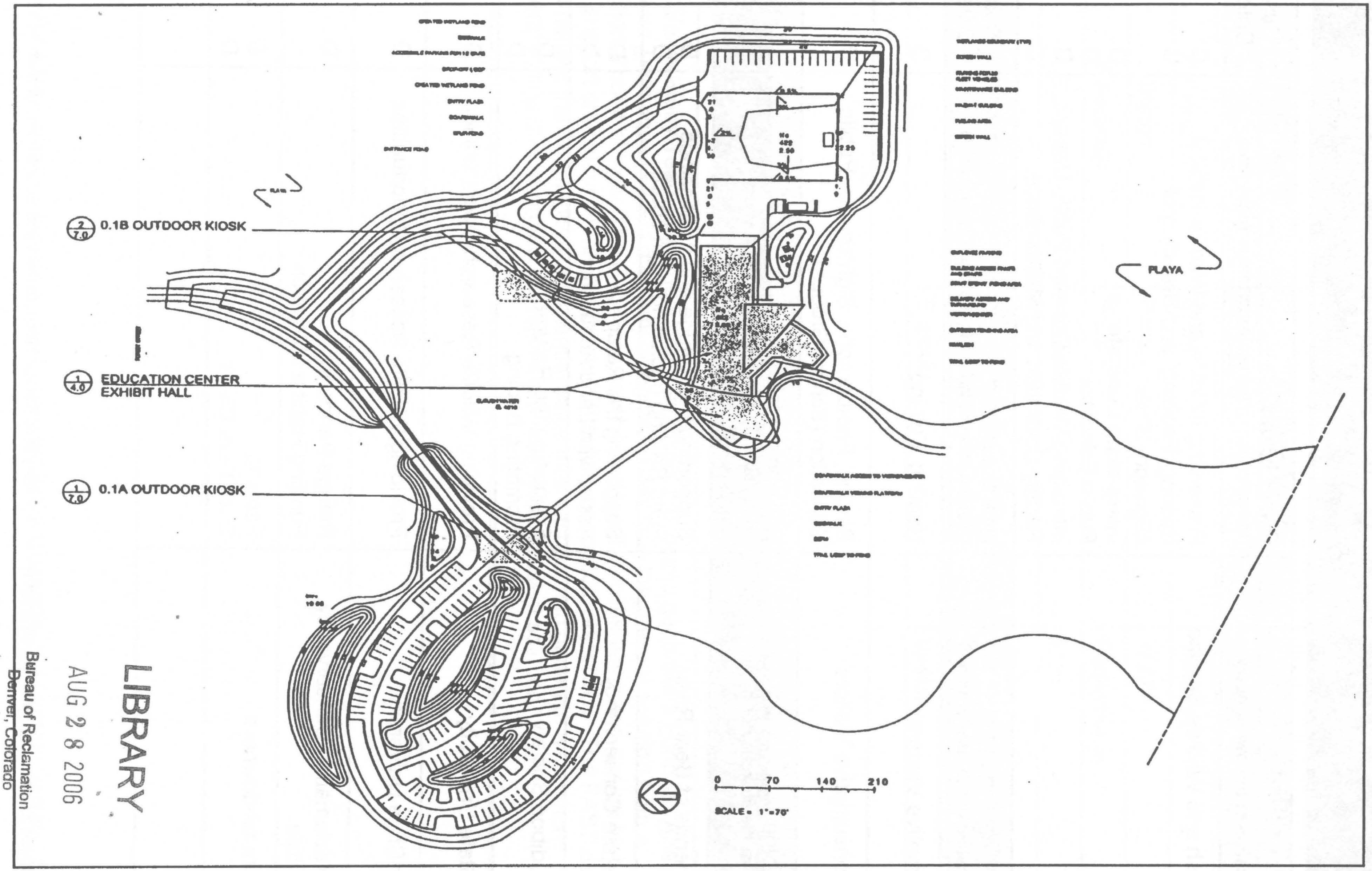
Key features of the education center include a 196 seat auditorium/theater, a 5,500 square foot exhibit area, a gift shop, information desk, teaching lab/classroom, restrooms, and storerooms. The administrative area (about 9,000 square feet) includes staff areas, offices, conference rooms, a research lab, a break room/kitchen, mailroom, restrooms, lockers, secure and general storage areas.

The current site was selected within the Refuge, in part, due to its proximity to I-15 and Forest Road, the entrance road to the refuge. The high local water table, interspersed wetlands, and poorly consolidated soils limit suitable building site alternatives and building design. See Figure Nos. 1 and 2 for a location plan and site layout.

The current schedule calls for award of the roads and parking lot work in the Spring of 2001 (Notice to Proceed in April or May 2001). The Headquarters and Educational Complex would be bid in the summer and under construction by September 2001. The road work proceeds the building work to provide better on-site access for the building contractor.

The high seismic design loading (due to the nearby Wasatch Fault), high groundwater and low strength soils led to the current foundation approach using a partially compensated design, with a thick mat slab (about 5 feet below grade) and interior concrete stiffening walls.

Figure 2. Site layout



Owner, Users, and Stakeholders List

Identification and Issues Determination

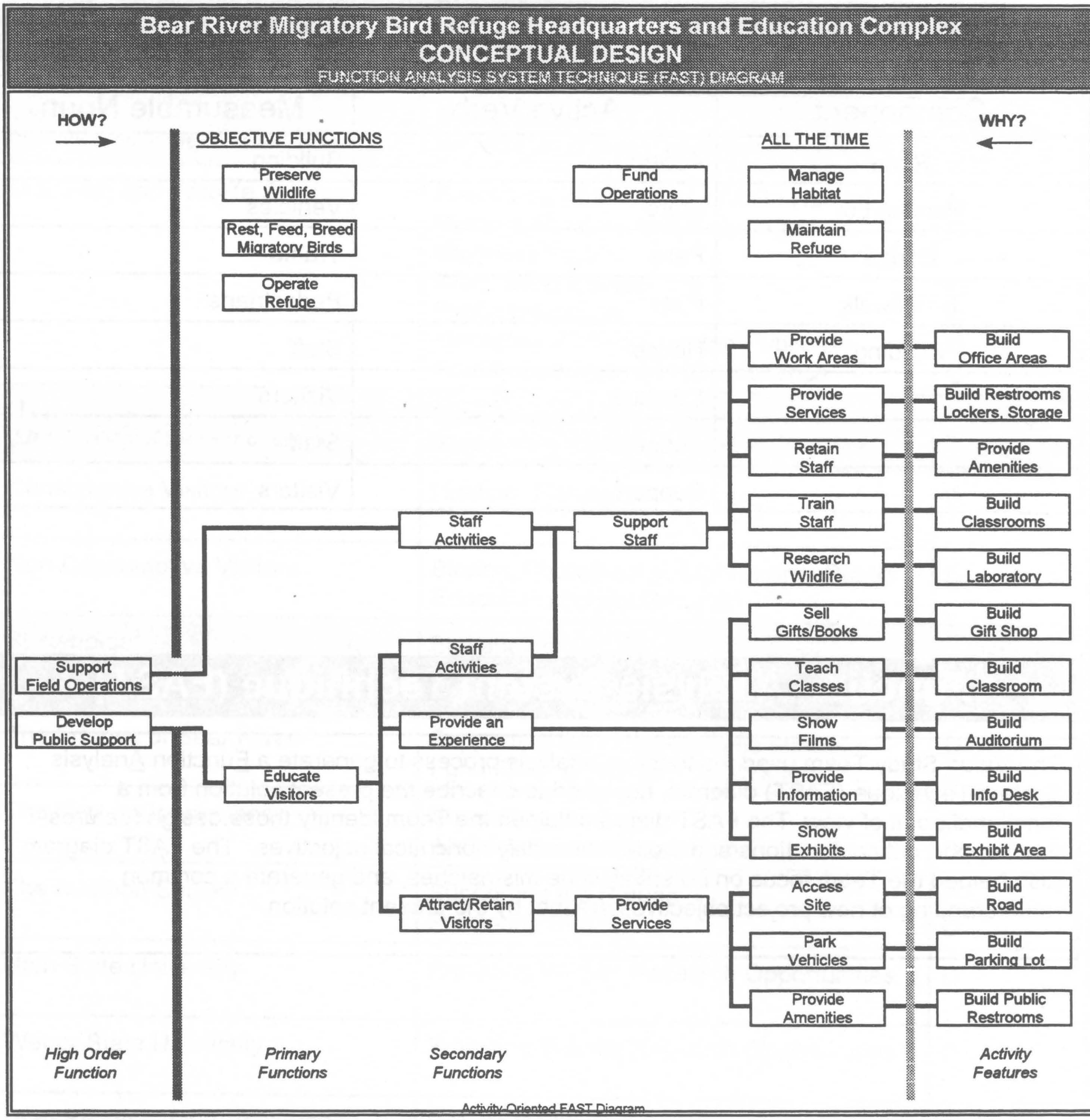
Owner (Identification of the owner or owners)	Owner Issues (Identification of issues important to every owner)	Desire/ Criteria?
U.S. Fish and Wildlife Service	Preserving Wildlife and Wildlife Habitat Resting, Feeding, and Breeding of Migratory Birds Interpreting Ecosystems Public Education Managing Wildlife Oriented Public Use Facility Operation and Maintenance	C C D D D C
User (Identification of the user or users)	**User Issues** (Identification of issues important to every user)	**Desire/ Criteria?**
Consumptive Visitors	Hunting, Fishing	D
Non-Consumptive Visitors	Birding, Photography, Sightseeing, Public Education (School Groups)	D
Stakeholder (Identify of the stakeholder or stakeholders)	**Stakeholder Issues** (Identification of issues important to every stakeholder)	**Desire/ Criteria?**
The Friends of Bear River	Supporting the Refuge and its Missions, Fund Raising (including a gift shop)	D D
The Nature Conservancy	Supporting the Refuge, Assist with Land Acquisition	D D
The Audibon Society	Supporting the Refuge Promoting Birding	D D
Utah State University	Providing Wildlife Research Opportunities	D
Weber State University	Providing Wildlife Research Opportunities	D
Utah Reclamation Conservancy Committee	Refuge Partnering Funding Habitat Mitigation	D
Adjacent landowners	Farming Duck Hunt Clubs	D D

Function Analysis

Component	Active Verb	Measurable Noun
Road	Access	Building
Parking Lot	Store	Vehicles
Bridge	Pass	Traffic
Boardwalk	Pass	Pedestrians
Building	House	Staff
	Educate	Visitors
	Support	Staff
	Support	Visitors

Function Analysis System Technique (FAST)

The Value Study Team used the function-analysis process to generate a Function Analysis System Technique (FAST) diagram, designed to describe the present solution from a functional point of view. The FAST diagram helped the Team identify those design features that support critical functions and those that satisfy noncritical objectives. The FAST diagram also helped the Team focus on potential value mismatches, and generate a common understanding of how project objectives are met by the present solution.

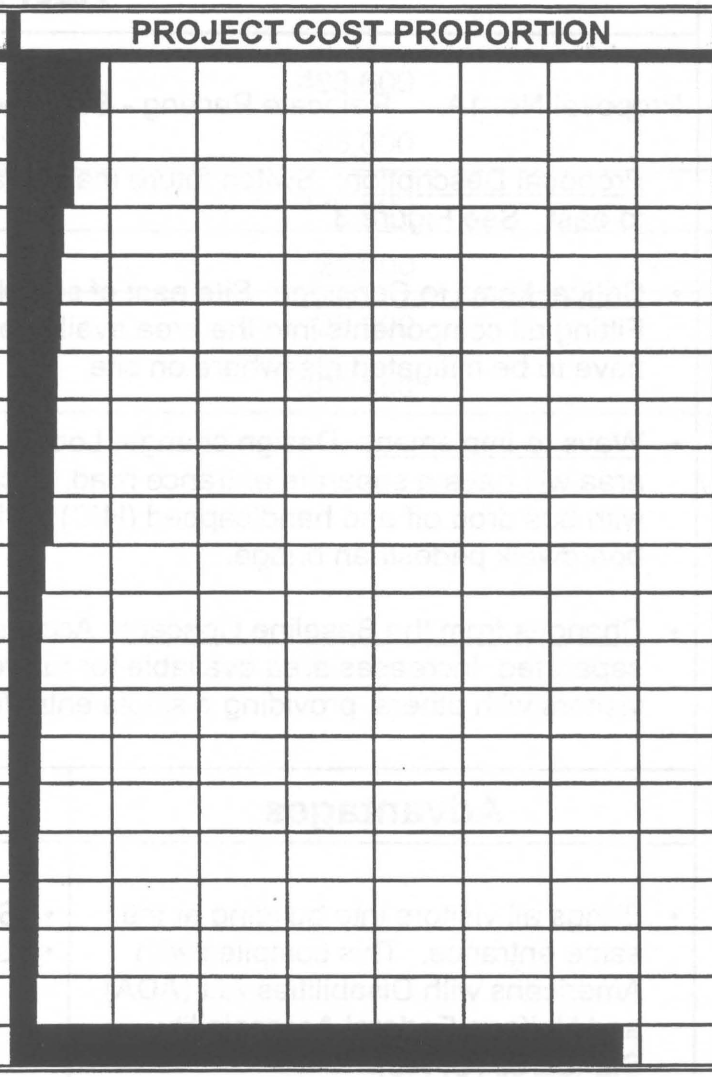

Bear River Migratory Bird Refuge Headquarters and Education Complex
CONCEPTUAL DESIGN
FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM
HOW?
WHY?
OBJECTIVE FUNCTIONS
ALL THE TIME
Preserve Wildlife
Rest, Feed, Breed Migratory Birds
Operate Refuge
Fund Operations
Manage Habitat
Maintain Refuge
Provide Work Areas
Build Office Areas
Provide Services
Build Restrooms Lockers, Storage
Retain Staff
Provide Amenities
Train Staff
Build Classrooms
Research Wildlife
Build Laboratory
Staff Activities
Support Staff
Sell Gifts/Books
Build Gift Shop
Support Field Operations
Staff Activities
Teach Classes
Build Classroom
Develop Public Support
Provide an Experience
Show Films
Build Auditorium
Educate Visitors
Provide Information
Build Info Desk
Show Exhibits
Build Exhibit Area
Attract/Retain Visitors
Provide Services
Access Site
Build Road
Park Vehicles
Build Parking Lot
Provide Amenities
Build Public Restrooms
High Order Function
Primary Functions
Secondary Functions
Activity Features
Activity Oriented FAST Diagram

Bear River Migratory Bird Refuge Headquarters and Education Complex

VALUE STUDY

COST MODEL

COMPONENT/PERCENT PROJECT COST	
Concrete Foundation Wall	(6.6%)
Traffic Bridge	(4.9%)
Concrete Mat Slab	(4.4%)
Precast Double T's	(3.5%)
Road Base	(3.3%)
Steel Roof Beams	(3.2%)
Foundation Waterproofing	(2.9%)
Boardwalk/Pedestrian Bridge	(2.9%)
Structural Studs	(2.6%)
Cultured Stone for Exterior	(2.6%)
Branch Circuitry	(1.9%)
Earthwork	(1.7%)
Sheet Metal Duct Work	(1.6%)
Air Handling Unit	(1.5%)
Waterline	(1.5%)
Interior Gypsum Walls	(1.4%)
HVAC System Controls	(1.3%)
Asphalt, Main Parking	(1.3%)
Membrane Roof	(1.3%)
Rigid Insulation, Roof	(1.1%)
All Other Items	(48.8%)



COST MODEL AND ESTIMATE INFORMATION

The Value Study Team cost model is based on the conceptual design estimates provided by the design team for the preferred project design. The cost model was developed by the Value Study Team and was used to focus on features with the greatest potential for savings and to highlight areas of value mismatch. Unit prices were reviewed by the Cost Estimator and Value Study Team members, to ensure reliability and applicability.

Cost avoidances/savings and the original design concept estimates are of the same general level of development, although these costs may vary as final designs are pursued.

Proposal No. 1A

Description

Proposal No. 1A. Relocate Parking - Switch with Maintenance.

- Proposal Description: Switch future maintenance area to west side of site and public parking to east. See Figure 3.
- Critical Items to Consider: Site east of slough has minimal area required for this program. Fitting all components into the area available may require some loss of wetlands which would have to be mitigated elsewhere on site.
- Ways to Implement: Design change. Locate future maintenance area west of slough. This area will have a separate entrance road. Locate public parking on east side of slough along with bus drop off and handicapped (H/C) parking. Eliminate both the vehicular bridge and the boardwalk pedestrian bridge.
- Changes from the Baseline Concept: Access routes for maintenance and public are separated. Increases area available for future maintenance functions. Integrates disabled visitors with others, providing a single entry for the public.

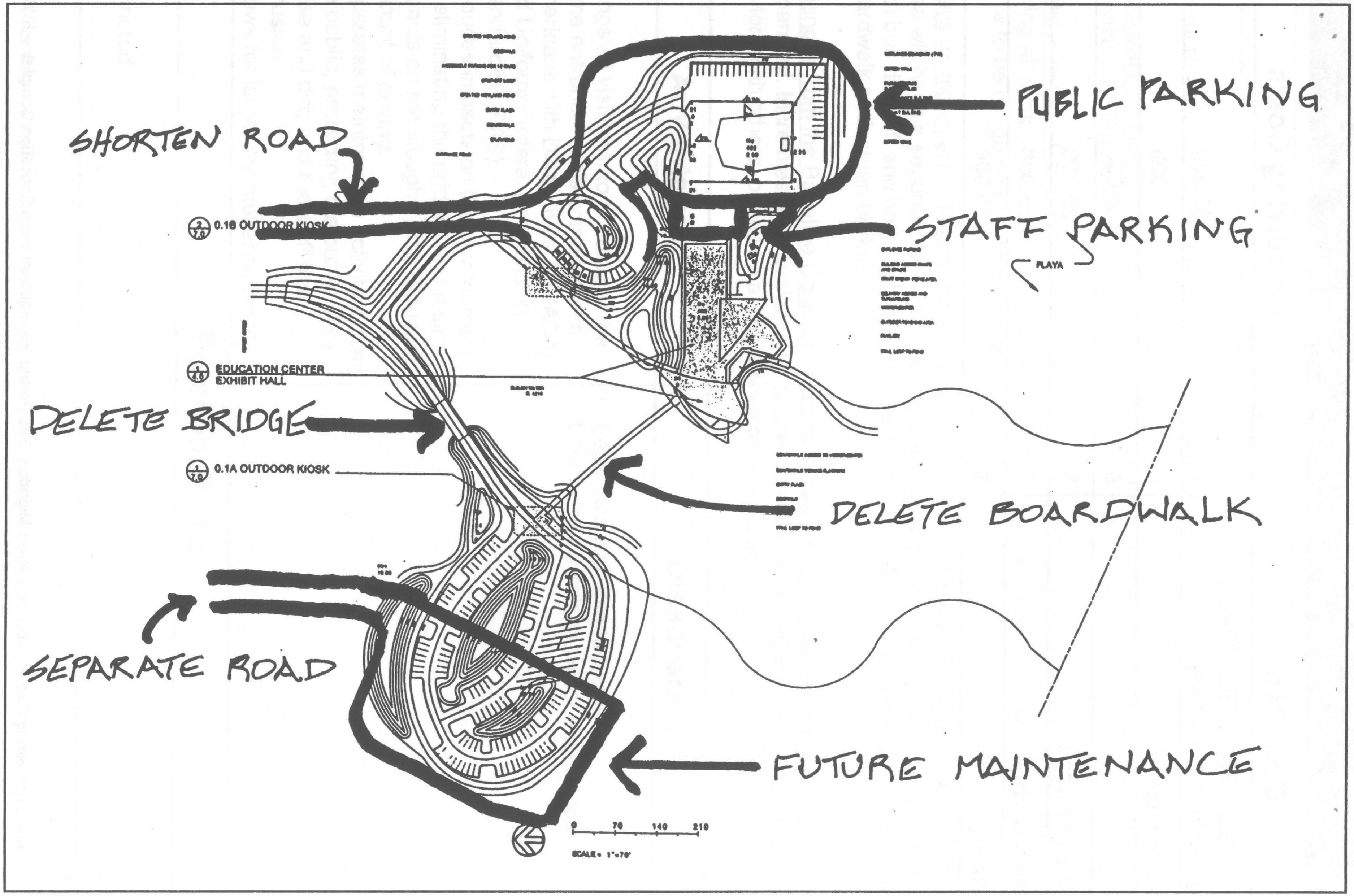
Advantages	Disadvantages
• Brings all visitors into building at the same entrance. This complies with Americans with Disabilities Act (ADA) and Uniform Federal Accessibility Standards (UFAS). • Reduces impacts on the environment by eliminating the bridges and their impacts on the slough. Also reduces amount of paving. • Separates maintenance activities from the public, protecting the public from noise and dirt, and the staff from intrusion. • Allows for larger maintenance facility.	• Separates staff into two areas. • Loss of boardwalk as visitor experience.

Potential Risks

None noted.

Proposal No. 1A		
Cost Items	**Nonrecurring Costs**	
Original Baseline Concept (Timber Bridge and most boardwalk)	$	463,600
Value Concept	$	33,000
Savings	$	430,600
Value Study Costs	$	25,000
Implementation Costs	$	25,000
Net Savings	**$**	**380,600**

Figure 3. Switch Parking and Maintenance



Proposal No. 1B

Description

Proposal No. 1B. Relocate Parking - Combined Bridges (Culvert Construction).

- Proposal Description: Relocate auto bridge and combine pedestrian bridge (boardwalk). Use culverts instead of standard bridge construction. See Figure 4.

- Critical Items to Consider: Road alignments, pedestrian use of bridge, change in bridge construction.

- Ways to Implement: Design change. Re-route incoming traffic to pass by the current bus drop-H/C parking area, then cross the slough to the public parking. Delete the separate boardwalk pedestrian bridge, routing visitors to a pedestrian lane on the bridge.

- Changes from the Baseline Concept: Access route is changed, bringing visitors in the same route they will walk from parking to the building. Costs for a separate pedestrian bridge are eliminated. The visitor experience of the slough, while walking to the visitor center, is reduced since one side of the pedestrian lane will face traffic on the bridge. All visitors would enter the building at the same entrance.

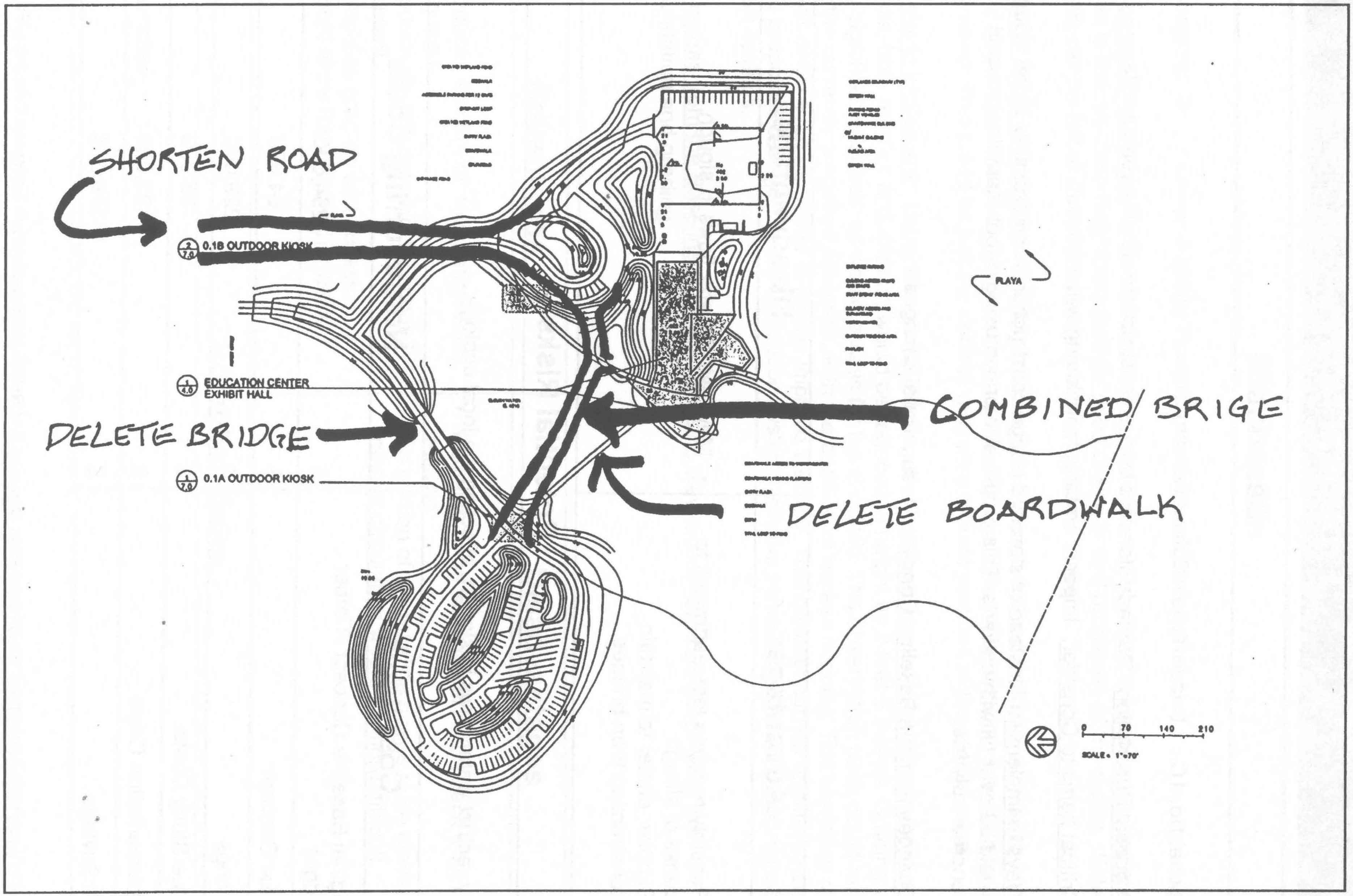
Advantages	Disadvantages
• Brings all visitors into building at the same entrance. • Reduces impacts on the environment by reducing the amount of paved area. • Reduces impacts on the environment by eliminating one bridge. • Creates a clearer circulation pattern for visitors.	• Walkway is along road at bridge, affecting visitor experience and safety. • Culverts may interfere some with water flows in the slough.

Potential Risks

Adjacent pedestrians and vehicular traffic.

Proposal No. 1B	
Cost Items	**Nonrecurring Costs**
Original Baseline Concept (Timber Bridge and most boardwalk)	$ 431,607
Value Concept	$ 78,360
Savings	$ 353,247
Value Study Costs	$ 25,000
Implementation Costs	$ 25,000
Net Savings	**$ 303,247**

Figure 4. Combined Bridge



Proposal No. 1C

Description

Proposal No. 1C. Bridge Type - Culvert Construction.

- Proposal Description: Replace standard bridge construction with fill over culverts.
- Critical Items to Consider: Impacts on slough, including water flows.
- Ways to Implement: Instead of standard bridge construction, road crossing of the slough would be over fill with culverts. This proposal is priced using 5-foot-diameter pre-cast concrete culverts.
- Changes from the Baseline Concept: No functional changes.

Advantages	Disadvantages
• Possibly requires less earthwork to banks of slough. • Simpler, easier to maintain construction than bridges.	• May restrict water flows in slough.

Potential Risks

May restrict water flows in slough, affecting the local ecology.

Cost Items	Nonrecurring Costs	
Original Baseline Concept (Timber Bridge)	$	294,000
Value Concept	$	64,936
Savings	$	229,064
Value Study Costs	$	25,000
Implementation Costs	$	25,000
Net Savings	**$**	**179,064**

Proposal No. 2

Description

Proposal No. 2. Lower Building Finish Floor To Near Grade Level.

- Proposal Description: Lower the finish floor elevation to only 6 inches above existing grade. This is the minimum height required for good drainage and protection of the siding. Exterior deck can be left at three feet above grade to maintain views.
- Critical Items to Consider: Grading and surface drainage around building. Access to building and observation deck. Only those areas from which visitors will be viewing the site need to be elevated. This could be just the deck or may also include portions of the exhibit area.
- Ways to Implement: Using the construction method of the current design, the foundation walls, both exterior and interior, would be reduced in height by 2 feet 6 inches. Grading would be significantly easier, as would access for the disabled. The observation deck could remain at the currently proposed elevation, with the addition of access ramp(s). The elevation of the deck could even be raised to further improve visibility. This concept can be applied to any of the proposed changes to the foundation system, with the same benefits and proportionate cost savings.
- Changes from the Baseline Concept: Building elevation is lowered, simplifying the foundation and grading.

Advantages	Disadvantages
• Reduces amount of foundation walls required. • Reduces building weight by about 7 percent. • Simplifies grading and access. • Could allow for even higher deck.	• Requires ramp up to observation deck from building. • If a portion of the building needs to be elevated, internal circulation would be more difficult.

Potential Risks

None noted.

Proposal No. 3

Description

Proposal No. 3. Change Road Materials of Unsurfaced Road.

- Proposal Description: Reduce the amount of road base from 19 inches to 6 inches and add 18 inches of pit run gravel to stabilize the base. See Figure 5.
- Critical Items to Consider: The need for soil stabilization.
- Ways to Implement: Use standard road building practices of the Utah Highway Department. Soil stabilization is applied and mixed into the soil before applying base and finish materials. Stabilization may be lime or potash. After stabilization, pit gravel is rolled into road bed, then road base is applied.
- Changes from the Baseline Concept: Refines current concepts.

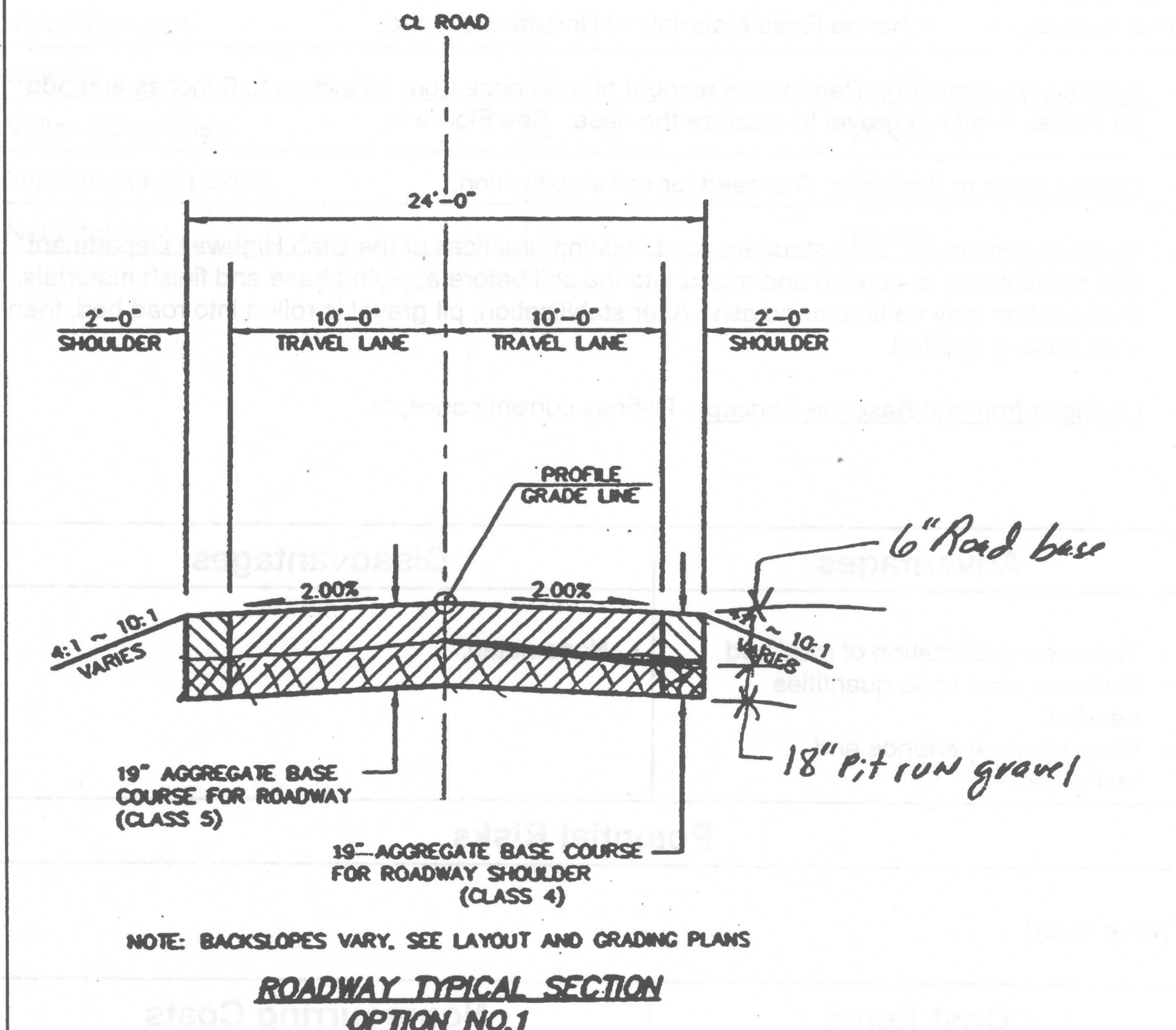
Advantages	Disadvantages
• Improves stabilization of road bed. • Reduces road base quantities needed. • Uses local experience and techniques.	• None noted.

Potential Risks

None noted.

Cost Items		Nonrecurring Costs
Original Baseline Concept	$	295,720
Value Concept	$	295,720
Savings	$	0
Value Study Costs	$	25,000
Implementation Costs	$	25,000
Net Savings	**$**	**(50,000)**

Figure 5. Typical Road Section, Unsurfaced



Proposal No. 4

Description

Proposal No. 4. Change Thickness of Asphalt and Road Base and Add Base Layer of Pit Run Gravel.

- Proposal Description: Reduce the thickness of asphalt and road base materials to be closer to Utah Highway Department standard practice. Add pit run road base to stabilize soil before adding aggregates and asphalt surface. See Figure 6.
- Critical Items to Consider: Soil should be stabilized before construction by using lime or potash.
- Ways to Implement: Use standard road construction methods.
- Changes from the Baseline Concept: Refinement of current proposed materials and methods. Adds pit run gravel and reduces base course aggregate.

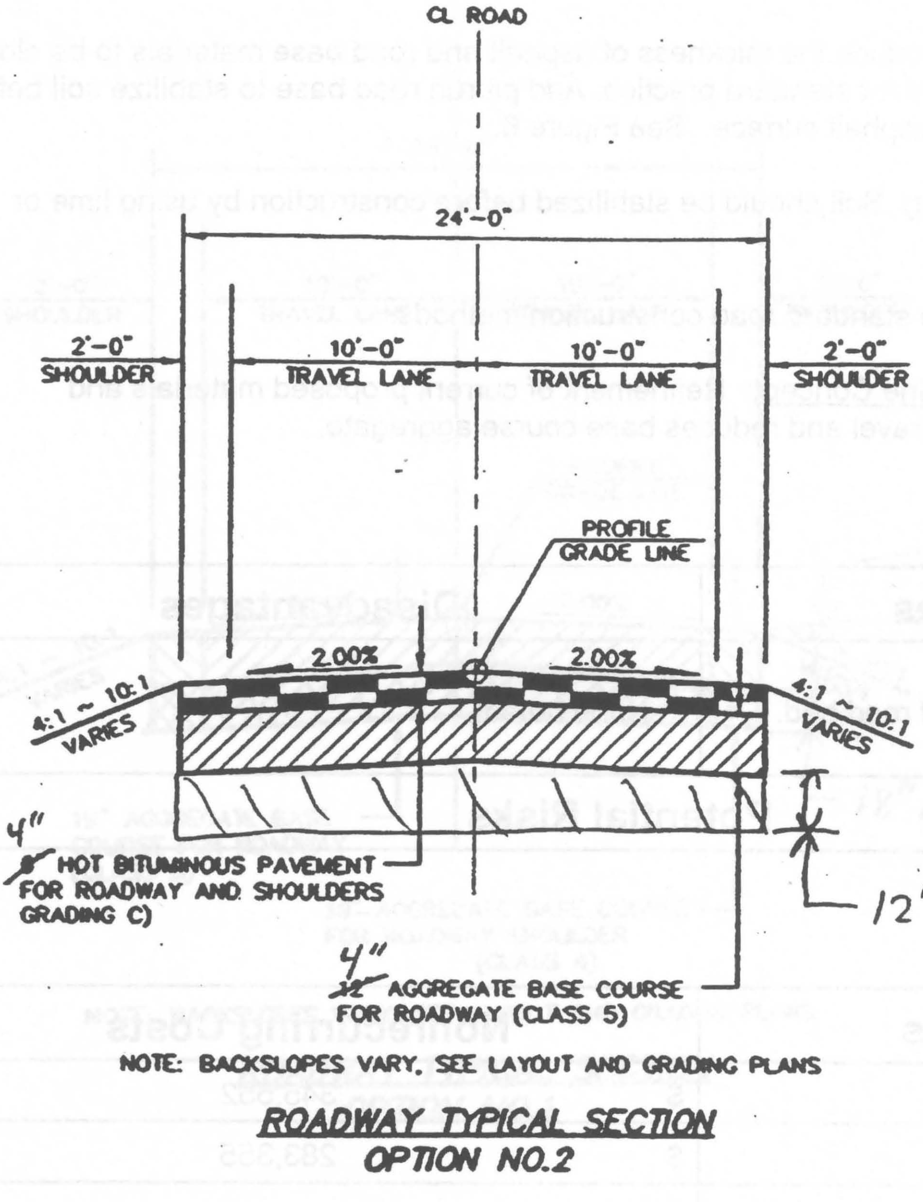
Advantages	Disadvantages
• Improved stabilization of road bed. • Less material waste.	• None noted.

Potential Risks

None noted.

Cost Items	Nonrecurring Costs
Original Baseline Concept	$ 345,552
Value Concept	$ 283,355
Savings	$ 62,197
Value Study Costs	$ 25,000
Implementation Costs	$ 5,000
Net Savings	**$ 32,197**

Figure 6. Typical Road Section, Surfaced



Proposal No. 5A

Description

Proposal No. 5A. Geofoam Foundation - Partially Compensated.

- Proposal Description: Current plans call for supporting the building with a basement 8 feet deep under the entire building. The excavated hole will be about 5 feet below existing grade, displacing soil (the weight of soil removed in the excavation partially compensates for the weight of the building). To strengthen the foundation and provide support for concrete double tee floor decking, a series of interior concrete crosswalls are planned. This design is strong; however, it is costly and heavy due to the large amount of concrete needed. The current design does not include dewatering, which may be needed. To be consistent, this proposal does not include dewatering. See Figure 7.

- This proposal partially compensates for the building weight as does the current design. It supports the building with Geofoam, a rigid and very lightweight foam product capable of transferring the weight of the building evenly and directly to the ground surface. A 3-foot-deep hole would be excavated below grade under the entire building (excluding the basement area below the mechanical room, where a concrete foundation would be constructed similar to the current design). The surface of the excavation would then receive a leveling blanket of sand fill. Geofoam blocks would then be layered in successive lifts until the interior of the foundation is filled up to the elevation of the bottom of the floor. The floor would be constructed by pouring a concrete pad upon the Geofoam. No interior support walls are needed because the Geofoam provides sufficient support to carry all the weight.

- Critical Items to Consider: Product longevity, behavior during earthquakes, and possible damage by environmental conditions (including insects). This proposal and the current design assumes water can be controlled (by upstream diversions) to keep construction "in the dry". However, due to the poor apparent transmissivity of the soils, construction site dewatering may be required in either approach.

- Ways to Implement: Excavate the foundation hole as now planned, except 2 feet shallower. Place Geofoam instead of concrete walls and pad. Cast floor over Geofoam instead of concrete double tee sections now planned.

- Changes from the Baseline Concept: The currently planned foundation is a reinforced concrete mat and walls supporting a concrete double-tee floor decking. It contains a basement area with numerous compartments formed by concrete crosswalls that provide structural stability and suspension points for the overhead concrete floor. Use of Geofoam replaces the basement with a solid 5-foot-thick foam bed. Also eliminated are the interior crosswalls, concrete floor decking, and foundation waterproofing.

Proposal No. 5A

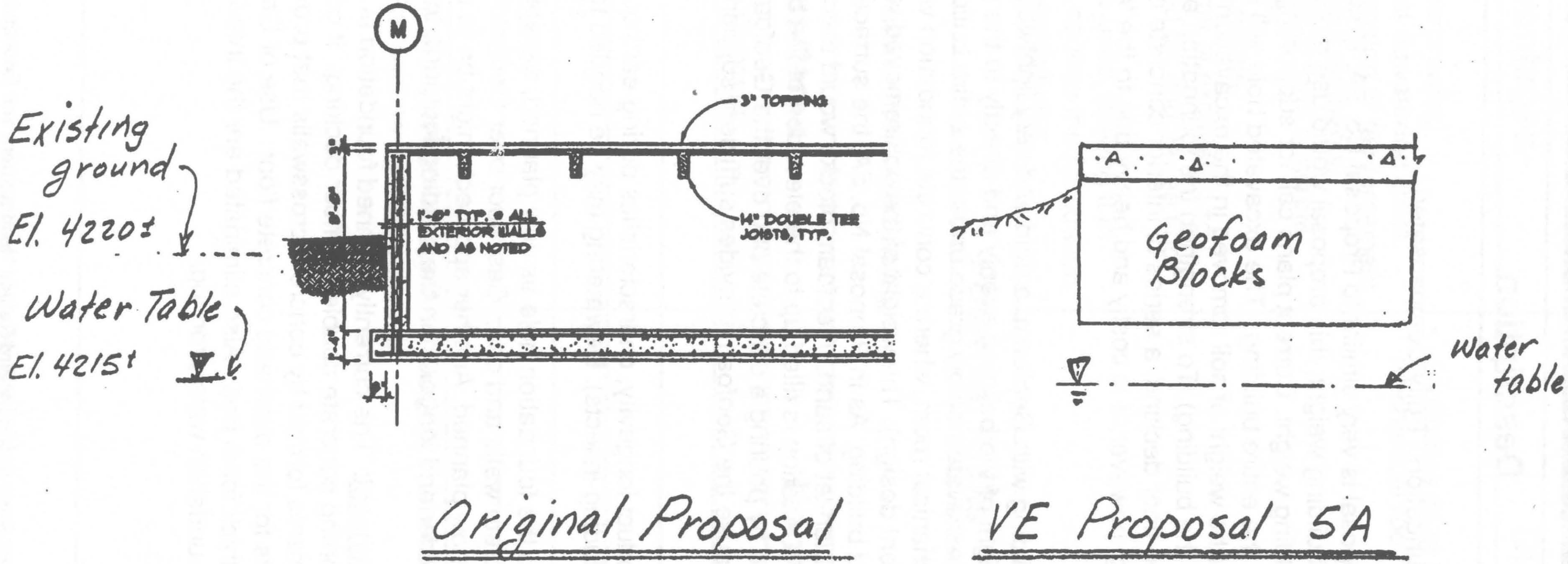
Advantages	Disadvantages
• Reduces cost and effort • Eliminates waterproofing. • Eliminates need to form concrete foundation walls. • Lighter than concrete. • Reduces volume of excavated soil for compensation of building weight. • Eliminates need for double tee floor decking. • If sheetpiling is used, leaving it in place will help confine the foundation in event of an earthquake.	• Eliminates most of basement storage (except mechanical room)

Potential Risks

Acceptance of somewhat new technology.

Cost Items	Nonrecurring Costs	
Original Baseline Concept	$	825,200
Value Concept	$	242,840
Savings	$	582,360
Value Study Costs	$	25,000
Implementation Costs	$	25,000
Net Savings	**$**	**532,360**

Figure 7. Geofoam Foundation - Partially Compensated



Proposal No. 5B

Description

Proposal No. 5B. Geofoam Foundation - Fully Compensated.

- Proposal Description: This proposal is very similar to Proposal No. 5A. However, instead of partially compensating for the building weight, this proposal would use more light weight foam to fully compensate for the building weight. Current plans call for supporting the building with a basement 8 feet deep under the entire building. The excavated hole will be 5 feet below existing grade, displacing soil (the weight of soil removed in the excavation partially compensates for the weight of the building). To strengthen the foundation and provide support for concrete double-tee floor decking, a series of interior concrete crosswalls are planned. This design is strong; however, it is costly and heavy due to the large amount of concrete needed.

- This proposal supports the building with Geofoam, a rigid and very lightweight product capable of transferring the weight of the building evenly and directly to the ground surface. An 8-foot-deep hole would be excavated below grade under the entire building (excluding the basement area below the mechanical room, where a concrete foundation would be constructed similar to the current design). The weight of the soil removed would be equal to the weight of the Geofoam and building. As in Proposal No. 5A, the surface of the excavation would then receive a leveling blanket of sand. Geofoam blocks would then be placed in layers until the interior of the foundation is filled up to the elevation of the bottom of the floor. The floor would be constructed by pouring a concrete pad over the Geofoam. No interior support walls are needed because the Geofoam provides sufficient support to carry all the weight. See Figure 8.

- Critical Items to Consider: Product longevity, characteristics during earthquakes, damage by environmental conditions (including insects). Dewatering may be needed for this proposal.

- Ways to Implement: Excavate the foundation hole as now planned, except 3 feet deeper. Place Geofoam in lieu of concrete walls and pad. Cast floor over Geofoam instead of concrete double tee sections now planned. Another approach might be to make the Geofoam block shallower, but slightly wider and longer than the building footprint, to avoid dewatering.

- Changes from the Baseline Concept: The currently planned foundation is a reinforced concrete mat and walls supporting concrete double tee-floor decking. It contains a basement area with numerous compartments formed by concrete crosswalls that provide structural stability and suspension points for the overhead concrete floor. Use of Geofoam replaces the basement with a solid 5-foot-thick foam bed. Also eliminated are the interior crosswalls, concrete floor decking, and foundation waterproofing.

Proposal No. 5B

Advantages	Disadvantages
• Eliminates waterproofing. • Eliminates most dewatering costs. • Eliminates corrosion of reinforcement steel in basement elements. • Eliminates need to form concrete foundation walls. • Lighter than concrete. • Reduces volume of excavated soil. • Eliminates need for double-tee floor decking. • If sheetpiling is used, leaving it in place will help confine the foundation in event of an earthquake.	• Eliminates most basement storage (except for mechanical room).

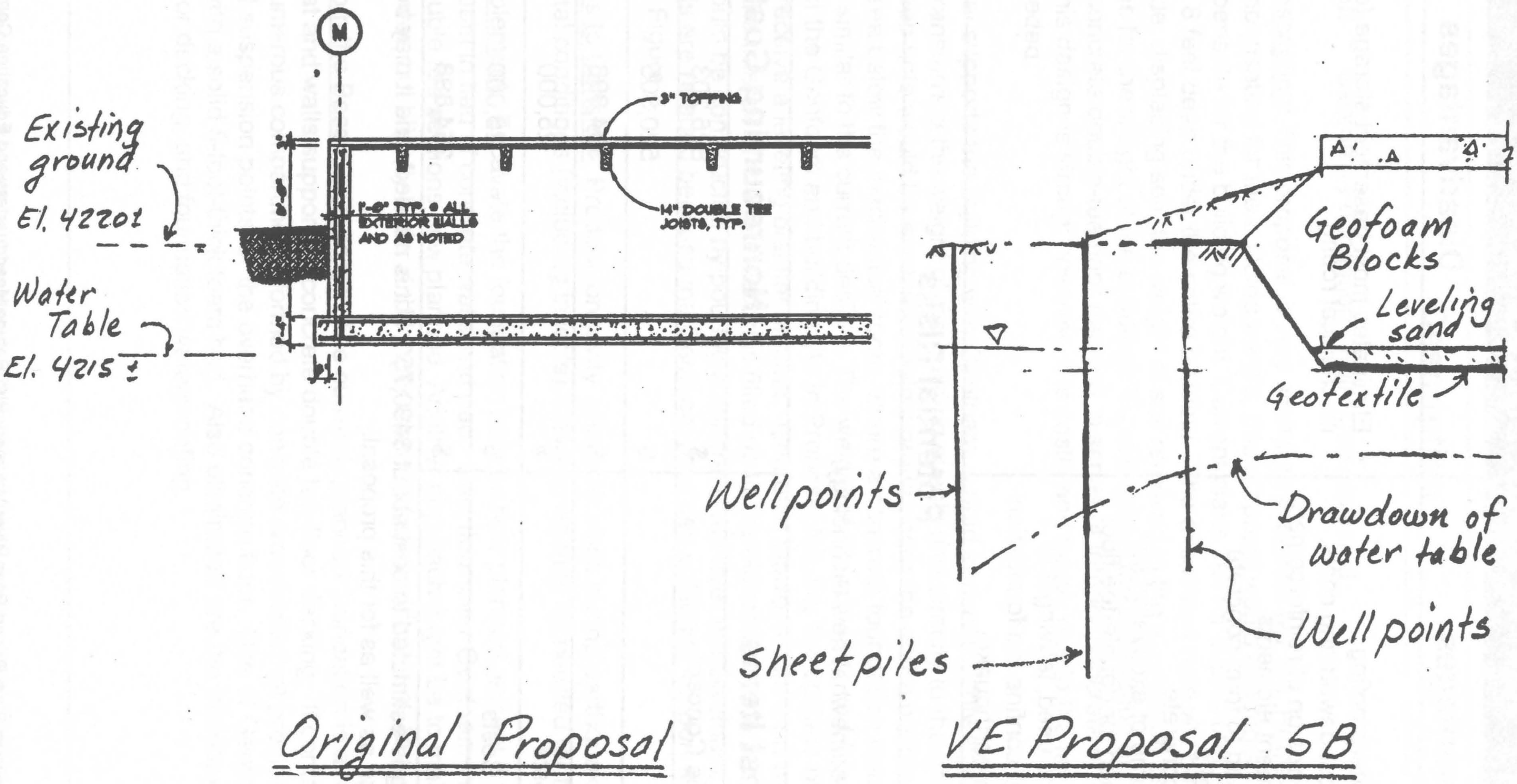
Potential Risks

Acceptability of somewhat new technology.

Cost Items	Nonrecurring Costs
Original Baseline Concept	$ 825,203
Value Concept	$ 520,305
Savings	$ 304,898
Value Study Costs	$ 25,000
Implementation Costs	$ 25,000
Net Savings	**$ 254,898**

Note: Dewatering is estimated to cost about $490,750, if it is needed, and it may be needed with the current design as well as for this proposal.

Figure 8. Geofoam Foundation - Fully Compensated



Proposal No. 6

Description

Proposal No. 6. Replace Interior Basement Foundation Walls With Space Frame.

- Proposal Description: Use a space frame to stiffen the foundation mat and walls and support the internal loads.
- Critical Items to Consider: Stiffness of foundation/floor system. Structural support of main floor. Note that the concept of floor support by the space frame (without the double tees) may also be applicable to proposals for the use of foam filled foundations.
- Ways to Implement: Removing the interior foundation wall lightens the total building weight. The space frame can be structurally tied to both the foundation mat and the first floor deck. Because the space frame provides closely spaced support for the first floor, the double tee supports can be eliminated, resulting in further lightening and cost savings. By tying the space frame to the mat and floor, the foundation is further stiffened. The space frame has sufficient open areas to allow duct routing to remain in the basement.
- Changes from the Baseline Concept: Traditional concrete foundation walls are replaced with space frame structure.

Advantages	Disadvantages
• Stiffens foundation system. • Lightens building weight. • Distributes building loads more evenly.	• May be more difficult to design and erect.

Potential Risks

As this may be an untested application of space frame technology, there may be unforseen difficulties.

Proposal No. 6	
Cost Items	**Nonrecurring Costs**
Original Baseline Concept	$ 404,183
Value Concept	$ 1,233,687
Savings	$ (829,504)
Value Study Costs	$ 25,000
Implementation Costs	$ 25,000
Net Savings	**$ (879,504)**

Proposal No. 7A

Description

Proposal No. 7A. Exterior Wall Types - Stucco.

- Proposal Description: Change exterior wall finish from cultured stone to stucco.
- Critical Items to Consider: Change in aesthetics. Finish color and texture need to be selected. Type of lathing and material thickness.
- Ways to Implement: Design change. Eliminate cultured stone facing on exterior walls, replace with lath and synthetic stucco.
- Changes from the Baseline Concept: Cost, building weight, and aesthetics.

Advantages	Disadvantages
• Less expensive. • Lighter; reduces building weight by 1 percent, lowering foundation costs. • Easier to repair; cracks can be filled instead of having to replace panels. • Integral coloring means no re-painting or other finish maintenance.	• Change in aesthetics from smaller scale appearance of cultured stone to more monolithic stucco.

Potential Risks

May suffer from extensive cracking if not applied correctly.

Cost Items	Nonrecurring Costs
Original Baseline Concept	$ 155,490
Value Concept	$ 26,809
Savings	$ 128,681
Value Study Costs	$ 25,000
Implementation Costs	$ 3,000
Net Savings	**$ 100,681**

Proposal No. 7B

Description

Proposal No. 7B. Exterior Wall Types - Wood Siding.

- Proposal Description: Change exterior wall finish from cultured stone to wood siding.
- Critical Items to Consider: Change in aesthetics. Finish color and texture need to be selected. Relation to other siding materials - since wood siding is already in use for part of the building, the two (or more) different sidings need to be coordinated for the desired aesthetic effect. Designer may want to consider cementitious siding (such as Hardi-Plank) instead of wood to improve durability or achieve a different aesthetic.
- Ways to Implement: Design change. Delete cultured stone facing and replace with wood siding.
- Changes from the Baseline Concept: Cost and aesthetics.

Advantages	Disadvantages
• Less expensive. • Lighter, saves over 1 percent of building weight, lowering foundation costs. • Easier to repair; individual damaged boards can be replaced.	• Less contrast to other siding, eliminating some of the architectural interest in the building. • Increased maintenance; requires painting or staining every few years, eventual replacement of wood.

Potential Risks

Wood may suffer shortened life-span in this climate.

Cost Items	Nonrecurring Costs
Original Baseline Concept	$ 155,490
Value Concept	$ 43,010
Savings	$ 112,480
Value Study Costs	$ 25,000
Implementation Costs	$ 2,000
Net Savings	**$ 85,480**

Proposal No. 7C

Description
Proposal No. 7C. Exterior Wall Types - Foam Core. • <u>Proposal Description</u>: Change exterior wall finish from cultured stone to foam core with spray-on stucco or concrete. • <u>Critical Items to Consider</u>: Interaction with tube steel columns. Structural performance of the selected system. Change in aesthetics. Weight. Finish color and texture. Selection of system from several proprietary systems that are available. • <u>Ways to Implement</u>: Design change. Delete metal stud wall. Build wall of foam block and apply stucco or concrete finish to both sides. Some systems also have cored blocks, allowing the creation of concrete columns within the wall system. • <u>Changes from the Baseline Concept</u>: Replaces standard construction method with a more innovative method. Creates a monolithic exterior.

Advantages	Disadvantages
• Less expensive. • Easier to repair.	• Less character in appearance. • Proprietary products.

Potential Risks
Subject to significant cracking if not applied correctly. May not have the same resistance to earthquake damage.

Cost Items	Nonrecurring Costs
Original Baseline Concept	$ 244,658
Value Concept	$ 71,101
Savings	$ 173,557
Value Study Costs	$ 25,000
Implementation Costs	$ 5,000
Net Savings	$ **143,557**

Disposition of Ideas

Value Study Elements Considered as Potential Proposals and Their Disposition	
Idea	**Disposition**
Specify low volatile organic compound (VOC) paints and glues.	Refer to design team to consider.
Delete the two $1,000 picnic tables from the contract, acquire under local purchase.	Refer to design team to consider.
Use a tent roof (like Denver International Airport).	Refer to design team to consider..
Use precast wall panels with exposed aggregate or wood grain finish in lieu of the cultured stone and structural studs.	Determined by study team to have limited potential.
Use tip-up construction methods/products.	Determined by study team to have limited potential.
Combine the vehicle and pedestrian bridges.	Developed as Proposal No. 1B.
Switch the maintenance and main parking areas, eliminate the bridges.	Developed as Proposal No. 1A.
Use a permanent wood foundation.	Refer to design team to consider.
Use foam block or foam core walls with a spray cement coating.	Developed as Proposal 7C.
Use a common or select fill to reduce the road base thickness.	Developed as Proposal Nos. 3 and 4.
Shorten bridges and rearrange parking lot.	Refer to design team to consider.
Move the building closer to Forest Road to shorten water and other utility lines.	Refer to design team to consider.
Use drainage wells to lower the water table around the building before, during, and/or after construction.	Developed as part of Proposal No. 5B.
Use vinyl sheetpiling around the building for water cutoff.	Developed as part of Proposal No. 5B.
Build a construction road with pit run material. Use construction traffic to proof-roll the roadway, then build the permanent road over it.	Developed as part of Proposal Nos. 3 and 4.
Use a pillow or balloon foundation.	Refer to design team to consider.

Disposition of Ideas

Use swamp coolers instead of air conditioning.	Refer to design team to consider.
Use a "wet wall" for cooling.	Refer to design team to consider.
Eliminate the "acoustic canopy". It may be a value mis-match (worth/cost).	Refer to design team to consider.
Use a flexible or plastic piling.	Determined by study team to have limited potential.
Use large diameter soil mix columns 20-40 feet below grade; insert concrete piles into them; use structural steel for the building support.	Determined by study team to have limited potential.
Support the structure on light-weight fill, foam blocks, or foam peanuts.	Developed as part of Proposal Nos. 5A and 5B.
Use pile or column footings and building jacking points to occasionally relevel the building if the footing settles.	Determined by study team to have limited potential.
Use earthquake isolation techniques, shock absorbers or viscous dampers.	Refer to design team to consider.
Turn the basement into a truss, like a box girder, eliminate the double T's and the thick slab.	Refer to design team to consider.
Replace asphalt with square corduroy road planks.	Determined by study team to have limited potential.
Replace the traffic bridge with a Plate Pipe Arch or arches.	Refer to design team to consider.
Replace the traffic bridge with reinforced box culverts.	Refer to design team to consider.
Replace the traffic bridge with inverted U's supported on pin piles abutments.	Refer to design team to consider.
Replace the traffic bridge with corrugated metal or concrete pipes.	Developed as Proposal No. 2.
Replace the double T's with composite concrete floor with steel beams or prestressed hollow core panels.	Determined by study team to have limited potential.
Use off-the-shelf pedestrian bridge to replace some of the boardwalk.	Refer to design team to consider.

Disposition of Ideas

Change the entrance to the building from the parking lot to eliminate the pedestrian bridge.	Refer to design team to consider.
Reroute traffic to combine the bridges and make a single entry point for the public.	Refer to design team to consider.
Build an outdoor auditorium with a tent roof.	Refer to design team to consider.
Replace the auditorium with Audio/Visual Stations.	Refer to design team to consider.
Use more frequent programs and a smaller auditorium.	Refer to design team to consider.
Have mobile chairs in the auditorium.	Refer to design team to consider.
Combine the small and big auditoriums.	Refer to design team to consider.
Replace the small auditorium with audio/visual stations.	Refer to design team to consider.
Eliminate the basement - it is wasted space, and heavy.	Developed as part of Proposal Nos. 5A and 5B.
Do not waterproof the basement.	Refer to design team to consider.
Use bentonite sheets for waterproofing.	Refer to design team to consider.
Eliminate some interior walls to create more open space.	Refer to design team to consider.
Explosive compaction to improve bearing and reduce settlement.	Refer to design team to consider.
Use volunteer labor for labor intensive work.	Refer to design team to consider.
Use more skylights or sola tubes.	Refer to design team to consider.
Replace library with audio/visual stations.	Refer to design team to consider.
Simplify lighting scheme especially in the exhibit room.	Refer to design team to consider.
Regrade the road to reduce curb and gutter.	Refer to design team to consider.
Provide shuttle tours for education.	Outside the scope of this study.
Square up the gift shop storage area.	Refer to design team to consider.
Use a thin bath tub foundation and ballast to prevent uplift.	Refer to design team to consider.
Chemically stabilize the road subgrade.	Refer to design team to consider.

Disposition of Ideas

Use light weight siding in lieu of cultured stone.	Refer to design team to consider.
Change cultured stone to metal panels; stucco (e.g., Dryvit); second type of wood; zonalite.	Developed as Proposal Nos. 7A and 7B.
Have a summer jobs program.	Outside the scope of this study.
Have school/youth design duck stamps, etc.	Outside the scope of this study.
Have work study programs.	Outside the scope of this study.
Display photos/artwork to attract visitors.	Refer to design team to consider.
Use plastic interlocking panels for the road surface.	Refer to design team to consider.
Use plastic "chain-link" material like Geogrid, for the road.	Refer to design team to consider.
Use Grass-crete for the road surface .	Refer to design team to consider.
Use a geomembrane in the road subgrade.	Refer to design team to consider.
Rework the toilets - conflict between toilets and information desk.	Refer to design team to consider.
Change glass wall in gift shop into a rollup grille (like the current shop entrance).	Refer to design team to consider.
Specify recycled content in materials such as concrete, concrete blocks, plastics, insulation.	Refer to design team to consider.
Use remote pick-ups to pipe sight and sound into the building.	Refer to design team to consider..
Use wood floors and joists/beams.	Refer to design team to consider.
Use a lighter weight roof system to reduce the seismic acceleration mass above ground.	Determined by study team to have limited potential.
Use a shallow post tensioned foundation slab.	Refer to design team to consider.
Redesign the large auditorium to be more flexible, multi-use space.	Refer to design team to consider.
Replace the interior concrete foundation walls and double T's with a space frame.	Refer to design team for consideration.

List of Consultants

Consultant or Contact	Topic or Information
Dave Paul Civil Engineer Bureau of Reclamation, D-8160 Building 67, Denver Federal Center 303-445-3296	Dewatering of foundation; excavation support; sheetpiles.
Pete Shaffner Geologist Bureau of Reclamation, D-8321 Building 67, Denver Federal Center 303-445-3152	Geology of area; Wasatch fault; liquifaction.
AMF Corporation Manufacturer of EMS Geofoam Excelsior, MN 800-255-0176	EPS Geofoam properties.
Terry Meier Utah area representative of EMS Geofoam Murry, Utah 877-775-8847	Use of Geofoam beneath structures and in seismic areas; cost data.
John Collom County Roads Supervisor, Boxelder County Tremounton, Utah 435-257-5450 cell 435-279-6541	Typical road sections and construction practices in this area.

Data and Documents Consulted

Title, Author, and Date	Information
Title 1 - 95-Percent Submittal, Bear River Migratory Bird Refuge, Brigham City, Utah, Headquarters and Education Complex, Sellard and Griggs, December 1, 2000	Project design, two 3-ring binders, one spiral binder, two sets drawings.

Design Team Presentation Attendance List
December 11, 2000 - 8 a. m.

Name/Title/Discipline	Address/Phone Number
Norm Hyndman Value Study Team Leader General Engineer	Bureau of Reclamation, Technical Service Center PO Box 25007 (D-8170), Denver CO 80225-0007 Phone: 303-445-3251 FAX: 303-445-6475 E-mail: nhyndman@do.usbr.gov
Al Trout Refuge Manager	Bear River Migratory Bird Refuge 866 So. Main, Brigham City, Utah 84302 Phone: 435-723-5887, Ext. 11 FAX: 435-723-8873 E-mail: atrout@do.fws.gov
Gene Goldberg Architect	National Park Service, Denver Service Center PO Box 25287, Denver, CO 80225 Phone: 303-969-2475 FAX: 303-987-6608 E-mail: ggoldberg@nps.gov
Bernie Lajimodiere Structural Engineer	Bureau of Reclamation, Technical Service Center PO Box 25007 (D-8110), Denver CO 80225-0007 Phone: 303-445-2996 FAX: 303-445-6490 E-mail: blajimodie@do.usbr.gov
Dave Miedema Geotechnical Engineer	Bureau of Reclamation, Technical Service Center PO Box 25007 (D-8311), Denver CO 80225-0007 Phone: 303-445-3034 FAX: 303-445-6472 E-mail: dmiedema@do.usbr.gov
Gary Rood Mechanical Engineer	Bureau of Reclamation, Technical Service Center PO Box 25007 (D-8420), Denver CO 80225-0007 Phone: 303-445-3102 FAX: 303-445-6469 E-mail: grood@do.usbr.gov
Ed Chamberlin President Architect	Chamberlin Architects 437 Main Street, Grand Junction, CO 81501 Phone: 970-242-6804 FAX: 970-245-4303 E-mail: echamberlin@chamberlinarchitects.com
Diane E. Orf Architect	U.S. Fish and Wildlife Service 134 Union Boulevard, Lakewood, CO 80228 Phone: 303-236-5320, Ext. 242 FAX: 303-236-4759 E-mail: diane_orf@fws.gov
Al Bevilacqua Regional Engineer	U.S. Fish and Wildlife Service, Mountain-Prairie Region 134 Union Boulevard, Lakewood, CO 80228 Phone: 303-236-5320, Ext. 229 FAX: 303-236-4759 E-mail: al_bevilacqua@fws.gov

Design Team Presentation Attendance List
December 11, 2000 - 8 a. m.

Mark Cornyn Mechanical Engineer	U.S. Fish and Wildlife Service, Mountain-Prairie Region 134 Union Boulevard, Lakewood, CO 80228 Phone: 303-336-5320, Ext. 240 FAX: 303-236-4759 E-mail: mark_cornyn@fws.gov
Larry Shanks Region Manager, Utah	U.S. Fish and Wildlife Service, Mountain-Prairie Region 134 Union Boulevard, Lakewood, CO 80228 Phone: 303-336-5320, Ext. 225 FAX: 303-236-4759 E-mail: larry_shanks@fws.gov
Paul Thomas Landscape Architect	Wenk Associates 1035 Cherokee Street, Denver, CO 80204 Phone: 303-628-0003 FAX: 303-628-0004 E-mail: pthomas@wenkla.com
Thomas W. Roberts	Sellards and Grigg 390 Union Boulevard #630, Lakewood, CO 80225 Phone: 303-986-1444 FAX: 303-986-0994 E-mail: sandginc@earthlink.com
Tom Terry Geotechnical Engineer	GEI Consultants, Incorporated 6950 South Potomac St., Suite 200, Englewood, CO 80112 Phone: 303-662-0100 FAX: 303-662-8757 E-mail: tterry@geiconsultants.com
Pete Gaby Structural Engineer	Lonco, Inc. 1700 Broadway, Suite 800, Denver, CO 80290 Phone: 303-620-0098 FAX: 303-620-9397 E-mail: pgaby@lonco.com
Kirsten Cremona Electrical Engineer	RMH Group 12600 West Colfax Avenue, Lakewood, CO 80215 Phone: 303-239-0909 FAX: 303-235-0218 E-mail: kcremona@rmhgroup.com
Scott Martin	RMH Group 12600 West Colfax Avenue, Lakewood, CO 80215 Phone: 303-239-0909 FAX: 303-235-0218 E-mail: smartin@rmhgroup.com
Chad Tidd	RMH Group 12600 West Colfax Avenue, Lakewood, CO 80215 Phone: 303-239-0909 FAX: 303-235-0218 E-mail: ctidd@rmhgroup.com

Value Study Team Presentation Attendance List
December 15, 2000 - 10:30 a. m.

Diane E. Orf Architect	U.S. Fish and Wildlife Service 134 Union Boulevard, Lakewood, CO 80228 Phone: 303-236-5320, Ext. 242 FAX: 303-236-4759 E-mail: ofr_diane@fws.gov
Al Bevilacqua Region Engineer	U.S. Fish and Wildlife Service, Mountain-Prairie Region 134 Union Boulevard, Lakewood, CO 80228 Phone: 303-236-5320, Ext. 229 FAX: 303-236-4759 E-mail: bevilacqua_al@fws.gov
Larry Shanks Region Manager, Utah	U.S. Fish and Wildlife Service, Mountain-Prairie Region 134 Union Boulevard, Lakewood, CO 80228 Phone: 303-336-5320, Ext. 225 FAX: 303-236-4759 E-mail: larry_shanks@fws.gov
Thomas W. Roberts	Sellards and Grigg 390 Union Boulevard #630, Lakewood, CO 80225 Phone: 303-986-1444 FAX: 303-986-0994 E-mail: sandginc@earthlink.com