

Appendix C2: Alternatives Development Cost Estimates

Section 3.4, Alternatives Eliminated from Detailed Study, in Chapter 3, Alternatives, describes alternatives and options that were analyzed to define the alternatives that are evaluated in detail in this EIS. The Purple and Orange Alternatives could be constructed using gravity flow from the LHPS Canal POD just below Second Dam or could use newly constructed pumps near the LN Canal POD just below First Dam to deliver water to the LHPS Canal near the Logan Golf & Country Club (golf course).

Section C2.1, Gravity-Flow and Pump Options, of this appendix describes the estimated costs for these options. Section C2.2, Alternatives Considered but Eliminated from Detailed Study, describes cost estimates for the alternatives (Green and Yellow Alternatives) that were considered but eliminated from detailed analysis in this EIS.

C2.1 Gravity-Flow and Pump Options

C2.1.1 Gravity-Flow Option

This option is the same as the Purple and Orange Alternative, Logan Canyon Segment, as described in Appendix C1, Action Alternative Cost Estimates. The approximate capital and annual operation and maintenance costs for the gravity-flow option are presented below.

Capital Costs. To estimate a *total* project cost for this option, the additional construction-related items and contingencies and the engineering and construction-management categories need to be applied to the materials and installation subtotal (\$7.1 million). The total capital cost of this option would be about \$9.4 million to \$10.3 million, as shown in Table C2-1, Gravity Option (Logan Canyon Segment) Cost Estimate.

Annual Operating Costs. Operational costs for this option are limited to labor costs to operate and maintain the diversion structure and box culvert. The assumed annual cost estimate for this option is about \$30,000.

C2.1.2 Pump Option

Logan City Light and Power operates hydropower-generation facilities along the Logan River. Historically, the City has diverted water from the river at Second Dam for power generation and then returned the water to the river just above the LN Canal POD, near First Dam. By moving the LN Canal water to the LHPS Canal POD, some of the water historically available for diversion by the City at Second Dam might not always be available for use by the City, since the Logan & Northern Irrigation Company has senior water rights. By taking

the water at the LHPS Canal POD, the water would need to bypass the City's diversion and, therefore, it would not be available for power generation. This option was included to evaluate an option that would avoid impacts to hydropower generation.

Section C2.1.2.1, Potential Hydropower Plant Impacts, describes the potential lost hydropower revenues that the hydropower plant could generate with those flows. Section C2.1.2.2, Cost Estimate for the Pump Option, presents the capital and operating costs for a new pump station.

C2.1.2.1 Potential Hydropower Plant Impacts

The Logan City Light and Power hydropower plant generates about 1 kilowatt (kW) for every 15 cubic feet per second (cfs) of water that run through its turbines. The maximum amount of additional water that would need to bypass the plant intakes at Second Dam and be delivered to the LHPS Canal is about 60 to 70 cfs. Note that this range is a *maximum* amount; the actual amounts of additional water would vary daily for irrigation demands and by season based on the flow rate of the Logan River. A rate of 60 cfs could generate about 900 kW. Over a 6-month period, the total amount of power would be 3,888 megawatts (MW). At an assumed rate of \$56 per MW, the total value of the lost revenue would be as high as \$218,000 (\$0.2 million) annually. See Table C2-2, Estimated Lost Hydropower Revenues, for detailed calculations.

C2.1.2.2 Cost Estimate for the Pump Option

The following paragraphs summarize the cost estimate for the pump option. Detailed costs are presented in Table C2-3, Pump Station Capital Costs Estimates, and Table C2-4, Pump Option, Annual Operation and Maintenance Costs.

Capital Costs. The capital costs for this option assume that five pumps would be needed. This would allow the pump station to operate over a wide range of flow rates, which would depend on daily irrigation demands and seasonal river conditions which dictate the amount of water that can be diverted. These pumps would need electrical equipment to supply power and control the pump motors (control panels, variable frequency drives, and switches). About 3,000 feet of 48-inch-diameter HDPE pipe would be needed to supply water to the LHPS Canal near the golf course, which is located about 200 feet in elevation above the pump station. Including installation labor, contractor overhead and profit, sales tax, and contingency, the total capital cost range for the pump option is about \$7.8 million to \$8.6 million as shown in Table C2-3, Pump Station Capital Cost Estimates.

Annual Operations. Most of the pump option operations and maintenance costs are a result of electricity costs to run the pumps. Energy costs include a monthly power-demand charge and electricity-use charge (per kilowatt-hours [kWh] consumed). The operations and maintenance calculation (1.5% of total capital) accounts for yearly pump maintenance (mostly labor and periodic smaller equipment replacement) and pump replacement after about 20 and 40 years. Table C2-4, Pump Option, Annual Operation and Maintenance Costs,

presents the annual operating costs of a pump station, which totals about \$483,000 (\$0.5 million) per year. This cost is greater than the value of lost hydropower as described in Section C2.1.2.1, Potential Hydropower Plant Impacts.

C2.1.2.3 Estimated Pumping Cost from the LN Canal

Adding together the horsepower associated with all individual shareholders' pumps, there would be about 1,000 horsepower in use between 1500 North and 3100 North. Because the total pumping power consists of several smaller pumps and the power source is not known, the assumed average power rate for pumping out of the LN Canal (\$0.0453 per kWh) is different than the rate that was assumed for the pump option. Assuming 1,000 horsepower in use for 8 hours per day over 6 months, the alternatives that include pressure pipes could avoid about \$49,000 (\$0.05 million) in annual pumping costs. See Table C2-5, Estimated Existing Pumping Costs, for the calculations of the existing LN Canal pumping costs.

C2.2 Alternatives Considered but Eliminated from Detailed Study

Section 3.4, Alternatives Eliminated from Detailed Study, describes the screening process that was used to determine alternatives that would be studied in detail in this EIS. This section presents cost estimates prepared for the action alternatives that were considered but eliminated from detailed analysis. No detailed hydraulic design or engineering analysis was conducted during this early stage of project development. The sizes of conveyance features, material types, construction quantities, and appurtenances (river-diversion facilities, cleanouts, pressure-control systems, and outlet controls) are based on preliminary analysis and conceptual engineering examination only. Unit costs are based on the experience of the project team and their involvement with other projects in Utah and around the country. Because of the preliminary nature of the analysis, the cost estimates include major assumptions and contingencies. Costs are presented as a range to account for currently unknown conditions in the project area.

C2.2.1 Green Alternative

As presented in Chapter 3, Alternatives, the Green Alternative would divert LN Canal water using the LHPS Canal POD just below Second Dam in Logan Canyon. Table C2-6, Green (US 89) Alternative Cost Estimate, itemizes the estimated costs associated with the Green Alternative to be about \$18.4 million to \$20.2 million. The following segments are defined from the POD:

- **Logan Canyon Segment.** Once the water is diverted, it would be conveyed within the LHPS Canal alignment down Logan Canyon to the golf course.
- **Pressure Pipe Segment.** From the golf course, the LN Canal water would be taken from the LHPS Canal and conveyed west to the LN Canal. The water would be conveyed in a pressure pipe running under US 89.

C2.2.1.1 Logan Canyon Segment

This option is similar to the Logan Canyon Segment of the Purple and Orange Alternatives as described in Appendix C1, Action Alternative Cost Estimates, and the gravity option presented in Section C2.1.1, Gravity-Flow Option. However, this alternative would extend the length of box culvert (530 feet) to reach a point in the golf course near an access road where the water would be diverted into the pressure pipe. The approximate capital costs are presented below.

Capital Costs. The costs for box culvert installation and miscellaneous features such as subgrade drainage, revegetation, and fencing are listed in Table C2-6, Green (US 89) Alternative Cost Estimate. The estimated construction cost for the Logan Canyon portion (\$7.1 million) and golf course portion (\$0.7 million) of this segment is about \$7.8 million.

C2.2.1.2 Pressure Pipe Segment

This section presents the major features and construction considerations for the Pressure Pipe Segment of the Green Alternative.

Water-Control Structures and Diversion Pipeline. From the LHPS Canal, LN Canal water would be diverted into a 42-inch-diameter HDPE pipeline¹ and would be conveyed west to the LN Canal. Pipeline construction would require cutting the roadway, trenching for the pipeline, and replacing roadway asphalt. There are three pedestrian tunnels under US 89. The project team assumes that the pressure pipe would have to be looped under these tunnels. This requires additional excavations to be made on both sides of the tunnels, the pipeline to be bored under these crossings, and trust blocking to be constructed at bends in the pipe.

¹ The water velocities in a 42-inch-diameter pipe would exceed 5 feet per second over a range of flow rates. A detailed surge analysis, which is required by NRCS when water velocities are greater than 5 feet per second, was not conducted for the preliminary pipeline sizing evaluation. Surge-protection measures would likely be required. Final pipe sizes and material selection would depend on the results of a detailed hydraulic design and surge analysis.

The costs for pressure pipe and miscellaneous features such as flow meters, air vents, and assumed future connections that would require individual pressure-reducing valves are listed in Table C2-6, Green (US 89) Alternative Cost Estimate. The total estimated cost for the Pressure Pipe Segment is about \$3.0 million.

C2.2.1.3 Property Purchases and Easements

The Green Alternative includes purchasing and demolishing structures on 14 properties along the north side of Canyon Road in Logan between about 750 East and 1100 East. NRCS is including the purchase of the structures to reduce the future risk to life and property. This purchase is consistent with the objective of the EWPP, which requires NRCS to implement recovery measures that “relieve imminent hazards to life and property created by a natural disaster that causes a sudden impairment of a watershed” (7 CFR 624.2). Temporary construction easements (TCEs) are also included in this category. TCEs are areas outside the alignment that are needed for hauling, material stockpile and staging areas, and utility connections. As shown in Table C2-6, Green (US 89) Alternative Cost Estimate, the total cost for property acquisition and structure demolition is about \$2.7 million.

C2.2.1.4 Additional Construction-Related Items and Contingency

Additional construction-related items include contractor mobilization, environmental permitting and compliance monitoring, minor utility relocations,² and a construction contingency. The cost for these items has been estimated by applying a percentage to the total construction materials, installation, and property purchases subtotal cost. The assumed percentages are included in Table C2-6, Green (US 89) Alternative Cost Estimate. The additional construction-related items subtotal for the Green Alternative is about \$3.7 million.

C2.2.1.5 Engineering and Construction Management

Costs for engineering and construction management include topographical surveys, geotechnical investigations and seismic analysis, final engineering analysis, final design plan production, bid document preparation, contractor procurement, and construction management. The cost for these items is also estimated by applying a percentage to the total construction estimate. These percentages are shown in Table C2-6, Green (US 89) Alternative Cost Estimate. The total cost for this category is about \$1.1 million.

² Because more utilities are assumed to be located in the US 89 right-of-way, the estimated percentage for the Green Alternative (7%) is greater than that for the other alternatives (2% to 5%).

C2.2.2 Yellow Alternative

As presented in Chapter 3, Alternatives, this alternative would use the existing LN Canal POD below First Dam. This alternative would have one main segment: a pressure pipe running west down Canyon Road, then turning north near Dugway Road and running along 600 East (Boulevard Street) to the existing LN Canal at about 400 North. Table C2-7, Yellow (Canyon Road Alternative) Cost Estimate, itemizes the estimated costs associated with the Yellow Alternative to be about \$20.8 million to \$22.8 million.

C2.2.2.1 Pressure Pipe Segment

This section presents the major features and construction considerations for the Pressure Pipe Segment of the Yellow Alternative.

Diversion Pipeline. LN Canal water would be diverted into a 72-inch-diameter pressure pipe to convey water (at a maximum flow rate of 80 cfs) west for about 8,600 feet under Canyon Road. Pipeline construction would require cutting and disposing of the existing roadway material, digging deep trenches for the pipeline, installing pipe bedding, compacting backfill, and replacing roadway asphalt.

Major Utility Relocations. There is an existing sewer line under Canyon Road. Most communities prefer a 5-foot to 10-foot horizontal separation between sewer and water pipelines to help prevent sewer main leaks from contaminating irrigation water and to provide room to make repairs to one pipeline without affecting the other. The addition of a pressure irrigation pipe would likely require relocating or replacing segments of the sewer line so that the two pipelines are adequately spaced and protected. Therefore, the cost estimates assume that the sewer line would have to be relocated along about half of the distance of the pressure pipe along Canyon Road. The cost estimates assume about that about 4,300 feet of sewer line would be relocated. The cost estimates also assume that the sewer line can be protected in place for the remainder of the distance along Canyon Road. There are also existing water mains that run from the City of Logan's Crockett Avenue Well westward under Canyon Road and two lines (10-inch and 16-inch) under Dugway Road. Similar to the pressurized segment, utility relocations would require roadway excavations, material disposal, excavated trenches, pipe bedding, compacted backfill, and replacing asphalt pavement.

The costs for the construction items listed above and the miscellaneous features such as inlet and outlet structures and air vents are listed in Table C2-7, Yellow (Canyon Road Alternative) Cost Estimate. The total estimated cost for the Pressure Pipe Segment (\$9.43 million) and major relocation (\$2.83 million) is about \$12.3 million.

C2.2.2.2 Property Purchases and Easements

The Yellow Alternative includes purchasing and demolishing structures on 14 properties along the north side of Canyon Road in Logan between about 750 East and 1100 East as described for the Green Alternative. TCEs are also included in this category. TCEs are areas outside the alignment that are needed for hauling, material stockpile and staging areas, and utility connections. The cost estimates for the Yellow Alternative assume that residents living along and near Canyon Road would need to be temporarily relocated during construction when water and sewer utilities are disconnected. As shown in Table C2-7, Yellow (Canyon Road Alternative) Cost Estimate, the total cost for property acquisition, structure demolition, and temporary relocations is about \$2.9 million.

C2.2.2.3 Additional Construction-Related Items and Contingency

Additional construction-related items include contractor mobilization, environmental permitting and compliance monitoring, minor utility relocations (5%), and a construction contingency. The cost estimates for the Yellow Alternative also assume that the construction contractor will encounter shallow groundwater during construction. Therefore, the cost estimates include costs to dewater the pipeline and sewer trenches.

The cost for these items is estimated by applying a percentage to the total construction materials, installation, and property purchases subtotal cost. The assumed percentages are included in Table C2-7, Yellow (Canyon Road Alternative) Cost Estimate. The additional construction-related items subtotal for the Yellow Alternative is about \$4.2 million.

C2.2.2.4 Engineering and Construction Management

Costs for engineering and construction management include topographical surveys, geotechnical investigations and seismic analysis, final engineering, design plan production, bid document preparation, contractor procurement, and construction management. The cost for these items is also estimated by applying a percentage to the total construction estimate. These percentages are shown in Table C2-7, Yellow (Canyon Road Alternative) Cost Estimate. The total cost for this category is about \$1.3 million.

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Table C2-1. Gravity Option (Logan Canyon Segment) Cost Estimate

HDR Engineering
Prepared by: Terry Warner
11/22/2010

Reviewed by: Norman Wagner
11/28/2010

Item	Quantity	Units	Unit Price	Total Cost
Irrigation Conveyance, Logan Canyon Segment (8,484 feet)				
Reconfigure LHPS point of diversion	1	Lump Sum	\$ 100,000.00	\$ 100,000
Channel Excavation and Material Disposal	5,000	yd3	\$ 50.00	\$ 250,000
Culvert Bedding Material (crushed stone)	3,299	yd3	\$ 40.00	\$ 131,973
Compacted Fill	11,963	yd3	\$ 30.00	\$ 358,889
Geotextile (8 oz, non-woven)	59,388	ft2	\$ 0.20	\$ 11,878
Subdrainage Piping (plastic pipe)	8,500	Feet	\$ 20.00	\$ 170,000
Culvert Access/Cleanout Structure (Cast in Place)	1	Each	\$ 20,000.00	\$ 20,000
Hydraulic Structures (sluice gate, 72"x72")	1	Each	\$ 60,000.00	\$ 60,000
Box Culvert (6' x 6' precast), Installed	8,500	Feet	\$ 700.00	\$ 5,950,000
Restoration (reseeding)	5.8	Acre	\$ 2,000.00	\$ 11,686
Fencing/Gates	1	Each	\$ 6,000.00	\$ 6,000
			Subtotal	\$ 7,070,426
Additional Construction Items				
Contractor Mobilization	% of Materials Subtotal		5.0%	\$ 353,521
Temporary Construction Easements	0	Each	\$ 25,000.00	\$ -
Environmental Permits and Compliance Monitoring	% of Materials Subtotal		0.5%	\$ 35,352
Minor Utility Relocations	% of Materials Subtotal		2.0%	\$ 141,409
Construction Contingency	% of Materials Subtotal		15.0%	\$ 1,060,564
			Additional Construction Items Subtotal	\$ 1,590,846
			Construction Subtotal	\$ 8,661,272
Engineering				
Survey/Geotechnical Investigations/Seismic Design	% of Construction Total		1.5%	\$ 129,919
Final Engineering Design & Plan Production	% of Construction Total		5.0%	\$ 433,064
Bid Documents and Contractor Procurement	% of Construction Total		0.5%	\$ 43,306
Construction Management (CM)	% of Construction Total		1.0%	\$ 86,613
			Engineering Subtotal	\$ 692,902
			Grand Total	\$ 9,354,173
			Range (0% to +10%, Rounded)	\$ 9,400,000
Operations				
Estimate Annual Operation and Maintenance			\$	30,000
P/A Discounting Factor, 4.125%/year, n=50 years			x	21.03
Net Present Value 50-yr Box Culvert O&M Cost--Conceptual Estimate			\$	630,900

Table C2-2. Estimated Lost Hydropower Revenues

HDR Engineering

Prepared by: Ben Jacob
10/19/2010

Reviewed by: Rudy Vigila

Revised by: Terry Warner
1/27/2011

Power Generation Estimate for 60 CFS to a Hydropower Turbine	
60	Maximum Average Flow Diverted Away from Power Generation (CFS) (Calculation of Energy Charge)
70	Peak Flow Diverted Away from Power Generation (CFS) (Calculation of Demand Charge)
0	Assumed Flow Remaining for Power Generation
6	Months of Diversion (April 15 to October 15)
4931	Elevation (MSL) Point of Diversion for Logan Hydro 2 Power Plant
22	Total Hydraulic Losses
	12 Friction and Losses (ft) @ 0.12 ft/100ft x 10,000 ft Penstock + Pipeline
	10 Allowance for All Minor Losses (ft)
4691	Turbine/Generation Elevation (MSL)
218	Total Head Available for Power Generation (ft)
80%	Water to Wire Efficiency for Generation
\$ 0.0320	Energy Rate (\$/kWh), Logan Schedule 7
\$ 15.51	Demand Rate (\$/kW/month), Logan Schedule 7
	Example Power Generation Calculation
885	kW @ 60 CFS Formula Adapted From Cameron Hydraulic Data
1032	kW @ 70 CFS
3,822,116	kWh @ 60 CFS
\$ 96,057.21	Estimated Annual Demand Charge for Offset
\$ 122,307.71	Estimated Energy Charge for Offset
\$ 218,364.91	Total Estimated Offset Charge
\$ 0.051	\$/kW
21,421	Total Annual Diversion (AF)
\$ 10.19	Per AF Diverted
21.03	P/A Discounting Factor, 4.125%/year, n=50 years
\$ 4,592,214.16	NPV
From Logan City Power Data (Nielson, 12/2/10)	
15	Assumed CFS for 1kW
60	CFS
900	kW
6	months
3,888,000	kWh total 3888 MW
\$ 56.00	MW (would be inclusive of per kW rate plus power demand charge)
\$ 0.0560	kw/hr
\$ 217,728	Total Estimated Offset Charge
	<i>check</i>

Table C2-3. Pump Station Capital Cost Estimates

HDR Engineering

Prepared by: Ben Jacob
9/27/2010Reviewed by: Rudy Vigilia
10/1/2010

Item	Quantity	Units	Unit Price	Total Cost (rounded)
Force Main (48" HDPE)	3000	LF	\$ 543	\$ 1,630,000
Site Work	1	LS	\$ 75,000	\$ 75,000
Clear Well Excavation/ Dewater/ Sheeting	1	LS	\$ 173,000	\$ 173,000
Clear Well Concrete	770	CY	\$ 250	\$ 193,000
Mechanical Piping/Valving	1	LS	\$ 220,000	\$ 220,000
Pumping Equipment (Five 600-hp motors)	5	Each	\$ 175,000	\$ 875,000
Electrical Equipment (variable frequency drives, controls)	1	LS	\$ 503,000	\$ 503,000
Substation	1	LS	\$ 395,000	\$ 395,000
			Subtotal "A"	\$ 4,064,000
			Labor at 15% of Subtotal "A"	\$ 610,000
			Subtotal "B"	\$ 4,674,000
			Contractor OH&P at 20% of Subtotal "B"	\$ 935,000
			Subtotal "C"	\$ 5,609,000
			Contingency at 30% of "C"	\$ 1,683,000
			Subtotal "D"	\$ 7,292,000
			Sales Tax at 6.3% of Subtotal "D"	\$ 460,000
			Total Cost	\$ 7,752,000
			Range (0% to +10%, Rounded)	\$ 7,800,000 \$ 8,600,000

Table C2-4. Pump Option, Annual Operation and Maintenance Costs

HDR Engineering

Prepared by: Ben Jacob

10/1/2010

Revised 10/4/2010, B. Jacob

Reviewed by: Rudy Vigilia

10/1/2010

Results	Calculation	
	70 Flow CFS (Max, Design)	
	31430 GPM	
	200 TDH (ft)	
	1.0 SG	
	3960 Constant for Units Conversion	
	0.75 Pump Hyd Effic.	
2116 Brake HP, (assume submersible turbine)		
	2116 Brake HP	
	0.92 Motor Effic.	
2301 Electrical Input HP		
1717 Electrical Input kW		
	\$ 0.032 Cost \$ per kWh	
	6 Operating Period (months)	
	4320 Operating Period (hours)	
	60 Average Flow (cfs)	
	6,357,147 Total Annual kWh usage	
\$ 203,429	Estimated Annual Cost Energy Charge	
	\$ 15.51 Power Capacity Charge (per kW/Month)	
\$ 159,767	Estimated Annual Cost Power Charge	
	Other annual operations and maintenance (ex-electrical service)	
	1.5% Conceptual O&M rate for Station and Equipment	
	\$ 8,000,000 Estimated Capital Cost	
\$ 120,000	Annual O&M (Conceptual level cost estimate)	
\$ 483,196	Sum of All Annual O&M Costs--Conceptual Estimate	
	21.03 P/A Discounting Factor, 4.125%/year, n=50 years	
\$ 10,161,616	Net Present Value 50-yr Pump Station O&M Cost--Conceptual Estimate	

Notes:
 Variable Cells
 Calculation Cells

Table C2-5. Estimated Existing Pumping Costs

HDR Engineering

Prepared by: Terry Warner
11/19/2010

Reviewed by:

Estimated Pumping Costs, Pumped from LN Canal		
1000	HP	pump power between 1500 N and 3100 N, estimate by Meikle 11/4/10 work group meeting
745.7	kW @	1.34 HP/kW
6	months	pumping
8	hours	per day pumping
1440	total hours	pumping
1,073,826	kWh	
\$	0.0453	rate/kWh
\$	48,644	Annual Cost, total
	21.03	P/A Discounting Factor, 4.125%/year, n=50 years
\$	1,022,990	Net Present Value



Table C2-6. Green (US89) Alternative Cost Estimate

HDR Engineering
Prepared by: Terry Warner
2/2/2011

Reviewed by: Karen Nichols
2/15/2011

Item	Quantity	Units	Unit Price	Total Cost
Irrigation Conveyance, Logan Canyon Segment (8,500 feet)				
Reconfigure LHPS point of diversion	1	Lump Sum	\$ 100,000.00	\$ 100,000
Channel Excavation and Material Disposal	5,000	yd ³	\$ 50.00	\$ 250,000
Culvert Bedding Material (crushed stone)	3,299	yd ³	\$ 40.00	\$ 131,973
Compacted Fill	11,963	yd ³	\$ 30.00	\$ 358,889
Geotextile (8 oz, non-woven)	59,388	ft ²	\$ 0.20	\$ 11,878
Subdrainage Piping (plastic pipe)	8,500	Feet	\$ 20.00	\$ 170,000
Culvert Access/Cleanout Structure (Cast in Place)	1	Each	\$ 20,000.00	\$ 20,000
Hydraulic Structures (sluice gate, 72"x72")	1	Each	\$ 60,000.00	\$ 60,000
Box Culvert (6' x 6' precast), Installed	8,500	Feet	\$ 700.00	\$ 5,950,000
Restoration (reseeding)	5.8	Acre	\$ 2,000.00	\$ 11,686
Fencing/Gates	1	Each	\$ 6,000.00	\$ 6,000
			Subtotal	\$ 7,070,426
Irrigation Conveyance, Golf Course Segment (530 feet)				
Channel Excavation and Material Disposal	589	yd ³	\$ 37.50	\$ 22,083
Culvert Bedding Material (crushed stone)	471	yd ³	\$ 30.00	\$ 14,133
Excavation, Compacted Backfill, and Regrading	250	yd ³	\$ 10.00	\$ 2,500
Geotextile (8 oz, non-woven)	6,360	ft ²	\$ 0.20	\$ 1,272
Subdrainage piping (plastic pipe)	500	Feet	\$ 20.00	\$ 10,000
Inlet Structure	1	lump	\$ 75,000.00	\$ 75,000
Flow Meter	1	lump	\$ 20,000.00	\$ 20,000
Box Culvert (12' x 5' precast), Installed	530	Feet	\$ 800.00	\$ 424,000
Trench, Backfill, sod replacement/landscaping	530	Feet	\$ 150.00	\$ 79,500
Replace Gates/Modify Stormdrain Pipes	10	Each	\$ 2,000.00	\$ 20,000
10" Diameter HDPE Pipe (from LNC POD to Laub)	3,168	Feet	\$ 20.00	\$ 63,360
Restoration (reseeding)	0.3	Acre	\$ 2,000.00	\$ 500
Fencing/Gates	2	Each	\$ 6,000.00	\$ 12,000
			Subtotal	\$ 744,349
Pressure Pipe Segment (9,500 feet)				
42" Diameter HDPE Pipe and Fittings	9,500	Feet	\$ 80.00	\$ 760,000
Excavation and Compacted Backfill	17,000	yd ³	\$ 10.00	\$ 170,000
Thrust Blocking	12	each	\$ 5,000.00	\$ 60,000
Surge Protection	1	lump	\$ 300,000.00	\$ 300,000
Trench Backfill, Replace Asphalt	9,500	Feet	\$ 150.00	\$ 1,425,000
Energy Dissipating Structure/Valve	1	lump	\$ 100,000	\$ 100,000
Tunnel Crossings (Jack and Bore)	3	each	\$ 50,000.00	\$ 150,000
Misc Excavation, Debris Removal, and Material Disposal	1,000	yd ³	\$ 20.00	\$ 20,000
Pressure Reducing Valves 2" (service for future individual users)	5	each	\$ 300.00	\$ 1,500
Air Vents	9	each	\$ 2,500.00	\$ 22,500
			Subtotal	\$ 3,009,000



Table C2-6. Green (US89) Alternative Cost Estimate

HDR Engineering
Prepared by: Terry Warner
2/2/2011

Reviewed by: Karen Nichols
40589

Summary of Materials and Installation Cost (Page 1)

Irrigation Conveyance, Logan Canyon Golf Course Segments
Pressure Pipe Segment (9,500 feet)

Subtotal \$ 7,814,774

Subtotal \$ 3,009,000

Materials & Installation Subtotal \$ 10,823,774

Item	Quantity	Units	Unit Price	Total Cost
Property Purchases & Easements				
Property Acquisition	14	Each	\$ 157,000.00	\$ 2,198,000
Structure Demolition	14	Each	\$ 10,000.00	\$ 140,000
Relocation Assistance	14	Each	\$ 10,000.00	\$ 140,000
Temporary Construction Easements	10	Each	\$ 25,000.00	\$ 250,000
			Property Subtotal	\$ 2,728,000
			Materials & Installation Subtotal	\$ 10,823,774
			Material, Installation, & Property Purchases, Subtotal A	\$ 13,551,774
Additional Construction Items				
Contractor Mobilization		% of Subtotal A	5.0%	\$ 677,589
Environmental Permits and Compliance Monitoring		% of Subtotal A	0.5%	\$ 67,759
Minor Utility Relocations		% of Subtotal A	7.0%	\$ 948,624
Construction Contingency		% of Subtotal A	15.0%	\$ 2,032,766
			Additional Construction Items, Subtotal B	\$ 3,726,738
Engineering				
Survey/Geotechnical Investigations/Seismic Design		% of Subtotal A	1.5%	\$ 203,277
Final Engineering Design & Plan Production		% of Subtotal A	5.0%	\$ 677,589
Bid Documents and Contractor Procurement		% of Subtotal A	0.5%	\$ 67,759
Construction Management (CM)		% of Subtotal A	1.0%	\$ 135,518
			Engineering, Subtotal C	\$ 1,084,142
			Material, Installation, & Property Purchases, Subtotal A	\$ 13,551,774
			Additional Construction Items, Subtotal B	\$ 3,726,738
			Engineering, Subtotal C	\$ 1,084,142
			Grand Total (2010\$)	\$ 18,362,654
			Range (0% to +10%, Rounded)	\$ 18,400,000 \$ 20,200,000



Table C2-7. Yellow (Canyon Road Alternative) Cost Estimate

HDR Engineering
Prepared by: Terry Warner
2/5/2011

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2/15/2011

Item	Quantity	Units	Unit Price	Total Cost
Irrigation Conveyance				
Reconstruct LN point of diversion	1	Lump Sum	\$ 100,000.00	\$ 100,000
Roadway Excavation and Material Disposal	35,241	yd ³	\$ 37.50	\$ 1,321,528
Pressure Pipe (72" Steel)	8,650	Feet	\$ 700.00	\$ 6,055,000
Pipe Bedding Material (crushed stone)	9,931	yd ³	\$ 30.00	\$ 297,944
Compacted Backfill and regrading	1,333	yd ³	\$ 10.00	\$ 13,333
Compacted Backfill, subgrade for paving	9,611	yd ³	\$ 20.00	\$ 192,222
10" Diameter HDPE Pipe (from LNC POD to Laub)	3,168	Feet	\$ 30.00	\$ 95,040
Pressure Pipe Inlet Structure	1	Lump Sum	\$ 10,000.00	\$ 10,000
Inlet and Outlet Fencing & Gates	2	Lump Sum	\$ 6,000.00	\$ 12,000
Outlet Structure	1	Lump Sum	\$ 10,000.00	\$ 10,000
Clean outs and Airvents (every 1,000 LF)	8.65	ea	\$ 2,500.00	\$ 21,625
Asphalt Removal/Disposal and Replacement (Half of the roadway, 20')	8,650	LF	\$ 150.00	\$ 1,297,500
			Subtotal	\$ 9,426,193
Major Utility Relocations				
Replace Sanitary Sewer Pipeline (8")	4,325	ft	\$ 200.00	\$ 865,000
Excavation and Compacted Backfill for Utilities	15,000	yd ³	\$ 10.00	\$ 150,000
Reconnect Sewer Laterals	6	each	\$ 15,000.00	\$ 90,000
Replace Individual Sewer Connections	40	each	\$ 5,000.00	\$ 200,000
Water Line Replacement (24" Dugway Rd)	800	ft	\$ 400.00	\$ 320,000
Water Line Replacement (16" Canyon Road, Crocket Well line)	1,600	ft	\$ 350.00	\$ 560,000
Asphalt Removal/Replacement (repave half of the roadway 20')	4,325	ft	\$ 150.00	\$ 648,750
			Subtotal	\$ 2,833,750
Property Purchases & Easements				
Temporary Relocations	1,000	Family-Days	\$ 200.00	\$ 200,000
Property Acquisition	14	Each	\$ 157,000.00	\$ 2,198,000
Structure Demolition	14	Each	\$ 10,000.00	\$ 140,000
Relocation Assistance	14	Each	\$ 10,000.00	\$ 140,000
Temporary Construction Easements	10	Each	\$ 25,000.00	\$ 250,000
			Subtotal	\$ 2,928,000

Summary of Materials and Installation Cost (Page 1)

Irrigation Conveyance	Subtotal	\$ 9,426,193
Major Utility Relocations	Subtotal	\$ 2,833,750
Property Purchases & Easements	Subtotal	\$ 2,928,000
	Material, Installation, & Property Purchases, Subtotal A	\$ 15,187,943

Item	Units	Unit Price	Total Cost
Additional Construction Items			
Contractor Mobilization	% of Subtotal A	5.0%	\$ 759,397
Environmental Permits and Compliance Monitoring	% of Subtotal A	0.5%	\$ 75,940
Minor Utility Relocations	% of Subtotal A	5.0%	\$ 759,397
Construction Dewatering (Canyon Road Excavation)	7 per month	\$ 50,000.00	\$ 350,000
Construction Contingency	% of Subtotal A	15.0%	\$ 2,278,191
	Additional Construction Items, Subtotal B		\$ 4,222,925
Engineering			
Survey/Geotechnical Investigations/Seismic Design	% of Subtotal A	2.0%	\$ 303,759
Final Engineering Design & Plan Production	% of Subtotal A	5.0%	\$ 759,397
Bid Documents and Contractor Procurement	% of Subtotal A	0.5%	\$ 75,940
Construction Management (CM)	% of Subtotal A	1.0%	\$ 151,879
	Engineering, Subtotal C		\$ 1,290,975
	Material, Installation, & Property Purchases, Subtotal A		\$ 15,187,943
	Additional Construction Items, Subtotal B		\$ 4,222,925
	Engineering, Subtotal C		\$ 1,290,975
	Grand Total (2010\$)		\$ 20,701,843
	Range (0% to +10%, Rounded)	\$ 20,800,000	\$ 22,800,000