Central Colorado Project (CCP)

Colorado's innovative State Water Plan

(See Governor Hickenlooper's Executive Order D-005, May 14, 2013)

U.S. Patented Regional Water and Energy Productivity Multiplier Solution

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(12) **United States Patent**
Miller

(10) **Patent No.: US 7,866,919 B2**
(45) **Date of Patent: Jan. 11, 2011**

(54) **SYSTEM AND METHOD FOR CONTROLLING WATER FLOW BETWEEN MULTIPLE RESERVOIRS OF A RENEWABLE WATER AND ENERGY SYSTEM**

(75) Inventor: **Allen David Miller**, Palmer Lake, CO (US)

(73) Assignee: **Natural Energy Resources Company**, Palmer Lake, CO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 295 days.

(21) Appl. No.: **12/102,651**

(22) Filed: **Apr. 14, 2008**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 60/911,451, filed on Apr. 12, 2007.

(51) **Int. Cl.**
E02B 9/02 (2006.01)
E02B 13/00 (2006.01)

(52) **U.S. Cl.** **405/80**; 405/51; 405/53; 405/75

(58) **Field of Classification Search** 405/36, 405/51–53, 55, 75, 80; 210/747, 170.01
See application file for complete search history.

(56) **References Cited**

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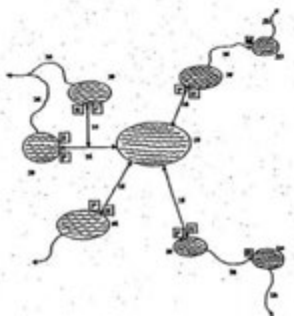
Primary Examiner—Tara Mayo-Pinnock
(74) *Attorney, Agent, or Firm*—Sheridan Ross P.C.

(57) **ABSTRACT**

A high altitude pumped-storage system for selectively integrating, storing, and distributing water and energy to increase the regional productivity of existing and future water and energy resources throughout multiple river basins is disclosed. This system addresses in part the increased requirement of supplying energy demands from a renewable energy source, such as wind, solar, or water generated power. The system includes at least one primary reservoir connected to multiple secondary reservoirs by conduits. The system allows for selectively distributing water and energy between secondary reservoirs and at least one primary reservoir. The system may comprise one or more hydroelectric power generation facilities. A method for increasing the regional efficiency of existing and future systems for producing, storing, and delivering energy from sources such as hydroelectric, wind and solar power from the water collected by the system described herein is also disclosed.

16 Claims, 4 Drawing Sheets



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Inventor's Profile—Allen David (Dave) Miller

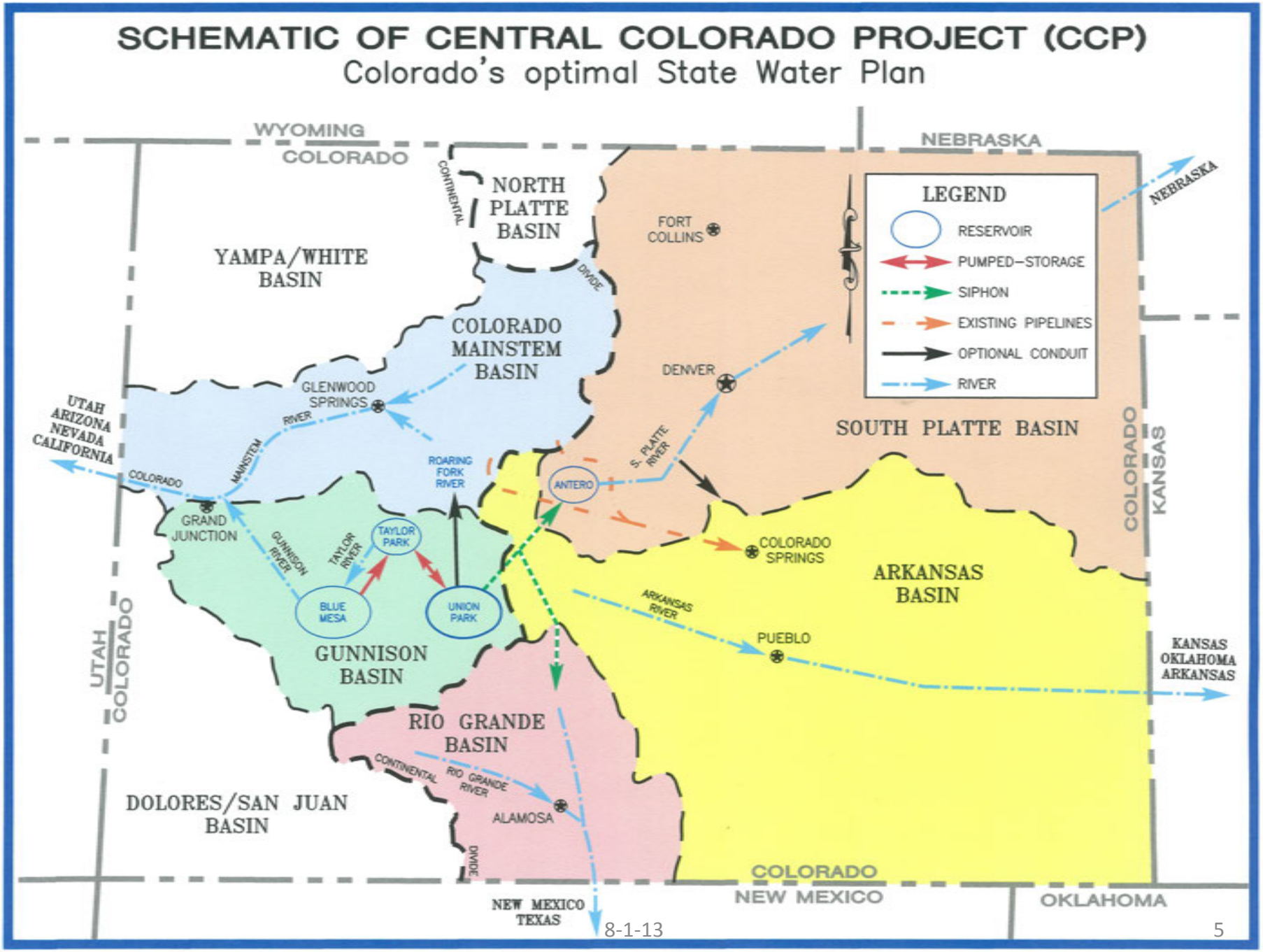
- **Education**
  - BS Business Management, Univ. of Colorado, 1954
  - MS Transportation Management, Univ. of Tennessee, 1963
  - Air Force Command & Staff College, Distinguished Graduate, 1967

- **Military Innovations & Record 1954 - 1974**
  - Helped conceive universal materials handling system for military airlift operations
  - Conceived Speedload System for resupply of troops in combat
  - Helped conceive universal express shipment tracking system
  - Served on International Intermodal Containerization Committee
  - Promoted ahead of most contemporaries through Colonel
  - Retired with 20 years of service and Legion of Merit

- **Civilian Record 1974 - 2013**
  - Colorado Farm & Ranch Realtor, Owner & Developer
  - President, Natural Energy Resources Company, 1986 to present
  - Inventor of Central Colorado Project, 2007 to present

Presentation Overview

- CCP's Water & Energy Productivity Multiplier Concept
- Advantages for Colorado & Southwestern Region
- Aspinall Reservoirs & Aspinall Water Rights
- Union Park Dam & Reservoir
- Union Park Dam & Colorado Roadless Rules
- Multi-purpose enlargement - Taylor Park Reservoir
- CCP's Water and Energy Costs, Revenues & Profits
- CCP – Operational Control
- CCP – Ownership Options
- CCP Conclusions
- Required State Water Planning Actions


SCHEMATIC OF CENTRAL COLORADO PROJECT (CCP)
Colorado's optimal State Water Plan
WYOMING
COLORADO
NEBRASKA
NORTH PLATTE BASIN
YAMPA/WHITE BASIN
COLORADO MAINSTEM BASIN
SOUTH PLATTE BASIN
ARKANSAS BASIN
GUNNISON BASIN
RIO GRANDE BASIN
DOLORES/SAN JUAN BASIN
FORT COLLINS
DENVER
COLORADO SPRINGS
PUEBLO
ALAMOSA
GLENWOOD SPRINGS
GRAND JUNCTION
TAYLOR PARK
BLUE MESA
UNION PARK
ANTERO
ROARING FORK RIVER
S. PLATTE RIVER
ARKANSAS RIVER
RIO GRANDE RIVER
GUNNISON RIVER
TAYLOR RIVER
MAINSTEM
COLORADO
CONTINENTAL
DIVIDE
LEGEND
RESERVOIR
PUMPED–STORAGE
SIPHON
EXISTING PIPELINES
OPTIONAL CONDUIT
RIVER
UTAH
ARIZONA
NEVADA
CALIFORNIA
KANSAS
OKLAHOMA
ARKANSAS
NEW MEXICO
TEXAS

CCP State & Regional Advantages

- Integrates, selectively augments, and multiplies reliability and productivity of existing water rights, storage, and delivery systems throughout Colorado's South Platte, Arkansas, Rio Grande, Gunnison, & Colorado River Basins
- Develops 300,000 acre-feet of Colorado's substantial unused Colorado River rights for state's peak water & energy needs (CO uses 2.2 maf out of entitled 3.87maf)
- Converts sporadic wind & solar energy into reliable energy for high value regional blackout protection needs
- Reduces current & future water & energy costs for state & regional consumers

CCP Advantages (cont.)

- Provides flexible state & regional water solutions for unpredictable droughts and climate change
- Provides low cost solutions for state & regional growth
- Enhances State & Region's water quality
- Enhances farming and environments throughout Colorado and down river states on both sides of Divide.
- Recharges aquifers (i.e. Ogallala, Denver & San Luis) during wet cycles
- Enhances Gunnison Basin of Origin's agriculture, environments & tourist economies

CCP Advantages (cont.)

- Enhances Colorado's fisheries and recreation
- Protects endangered species and rivers on both sides of Continental Divide
- Prevents failures of Bureau's Taylor Park, Blue Mesa, and Pueblo Reservoir Dams from river flows above 55% of today's Probable Maximum Flood (PMF) criteria
- Reduces state and regional evaporation losses
- Creates potential profits for Colorado's roads, schools, parks, storm water drainage, fire protection, etc.
- CCP's expected life-hundreds of years - no siltation

Aspinall Reservoirs & Water Rights

- Authorized by Congress in 1956 as Compromise to USBR's proposed Gunnison- Arkansas Project (450,000 acre-feet)
- Primary Purpose – to help Colorado develop 300,000 acre-feet of it's unused Colorado River rights for statewide needs
- Aspinall Marketable Pool Rights still undeveloped since 1956
- Original purpose of Aspinall Pool Rights reconfirmed November 20, 2000 by Colorado Supreme Court, Case 98SA327
- Colorado's future threatened by current state proposal to use Aspinall rights & storage as bank against future Colorado River calls by California, Arizona, and Nevada


Taylor Park Reservoir
Proposed Union Park Dam
Blue Mesa Reservoir

Union Park Dam Site Investigations

1986 - Initial Report – EBASCO Services

- Earth-core rock fill dam- 370 ft high
- 600,000 ac-ft reservoir

1989 - Reconnaissance level geotechnical investigation - WRC

- RCC dam – 460 ft high
- 900,000 ac-ft reservoir

2003-2004 – Feasibility Level Geological and Geotechnical Investigation - Ueblacker

- RCC dam – 570 Ft high
- 1.2 million acre-feet reservoir

OBITUARY

Engineer cleared way on Eisenhower Tunnel

The Austria native chose to stay in Colorado and worked on many jobs.

By Virginia Culver *The Denver Post*

Horst Ueblacker, who came to Colorado to help build the Eisenhower Tunnel, died of cardiac arrest March 3. He was 71.

Private services were held.

Ueblacker, an engineer who earned his degree in Austria, worked for an engineering company there. In 1962, workers at the Eisenhower Tunnel were having trouble with the first bore, said his wife, Susan Ueblacker.

They contacted the Austrian company, which sent Ueblacker to Colorado. He worked on the tunnel during the day and took graduate classes at Colorado School of Mines at night.

"He was a geo-technical engineer, or rock mechanic, as they call them," his wife said.

It was the rock mechanic's job to find out where and how to drill.

"He was a very brilliant man," said Dick Prosence, who worked for the Colorado Department of Transportation at the time. "He was so smart that sometimes he talked over people's heads."

After a while, Ueblacker opened his own business.

Several Colorado tunnels are now built with curving walls because of Ueblacker, Prosence said.

"He'd been involved in European tunnels. Those with curved walls hold more weight and are more aesthetically pleasing," Prosence said.

Prosence said CDOT hired Ueblacker for other jobs.

In addition to the Eisenhower Tunnel, the work Ueblacker was most proud of was on the Glenwood Canyon project, his wife said.

Engineer Horst Ueblacker was most proud of his work on the Eisenhower Tunnel and the Glenwood Canyon project, his wife said. *Special to The Post*

Horst Ueblacker was born in the Czech Republic on May 19, 1939. He, his mother and his brother fled when Adolf Hitler's forces moved in. The family went to Austria, where they had relatives.

He and his first wife, Sigrid Ueblacker, had four children.

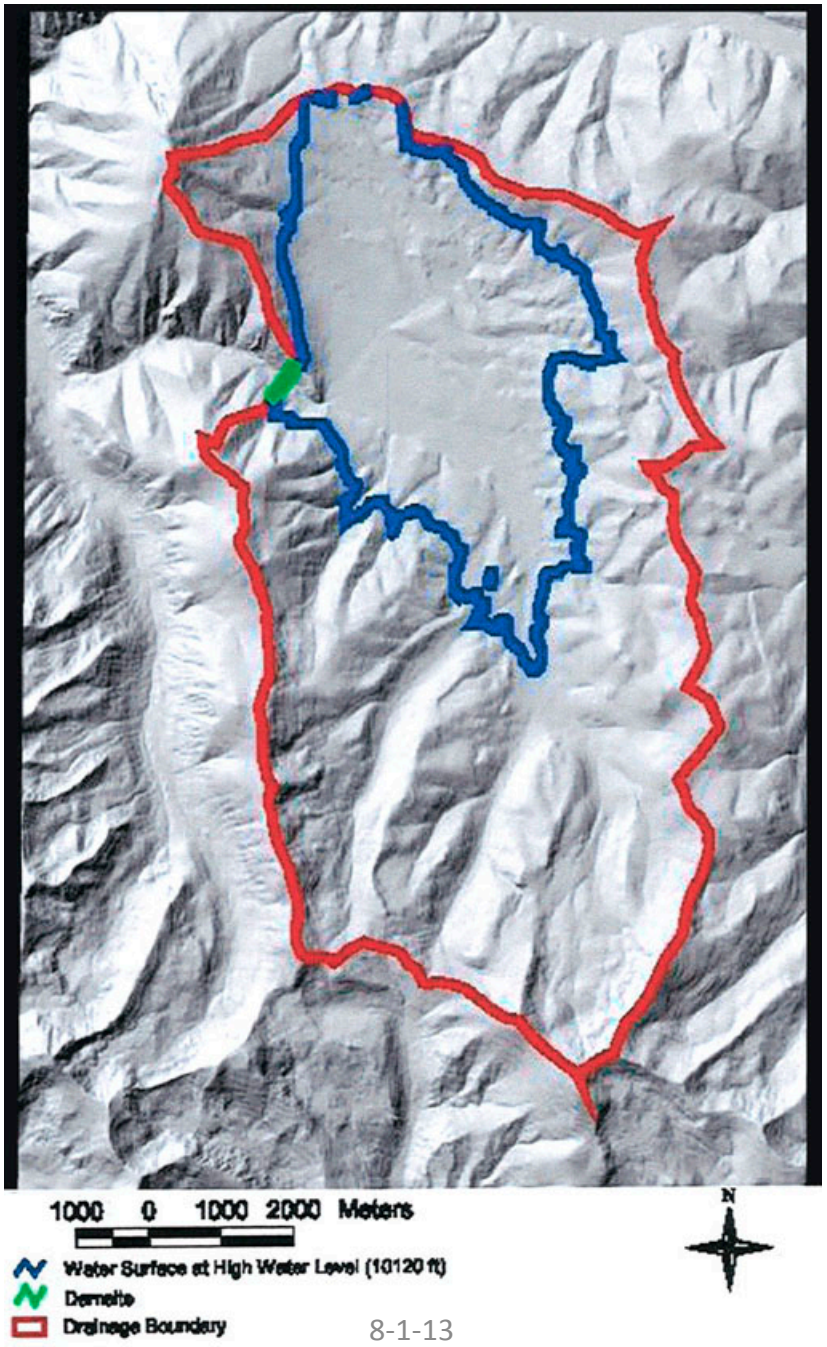
He married Susan Jones on Jan. 21, 1993.

In addition to her, he is survived by two sons, Gernot Ueblacker of California and Walter Ueblacker of Denver; two daughters, Elke Edwards of Norman, Okla., and Sabina Ueblacker of Denver; and his brother, Peter Ueblacker, who lives in Austria.

Virginia Culver: 303-954-1223 or vculver@denverpost.com

Added Note by Dave Miller: Although Horst Ueblacker was well known in Colorado's engineering circles, he was also highly respected internationally as a dam design, construction, and safety expert. He was a strong supporter of Central Colorado Project's breakthrough, high altitude, pumped-storage concept and solutions for multiple Southwestern river basins and the western power grid.

Union Park Dam, Reservoir and Drainage Area

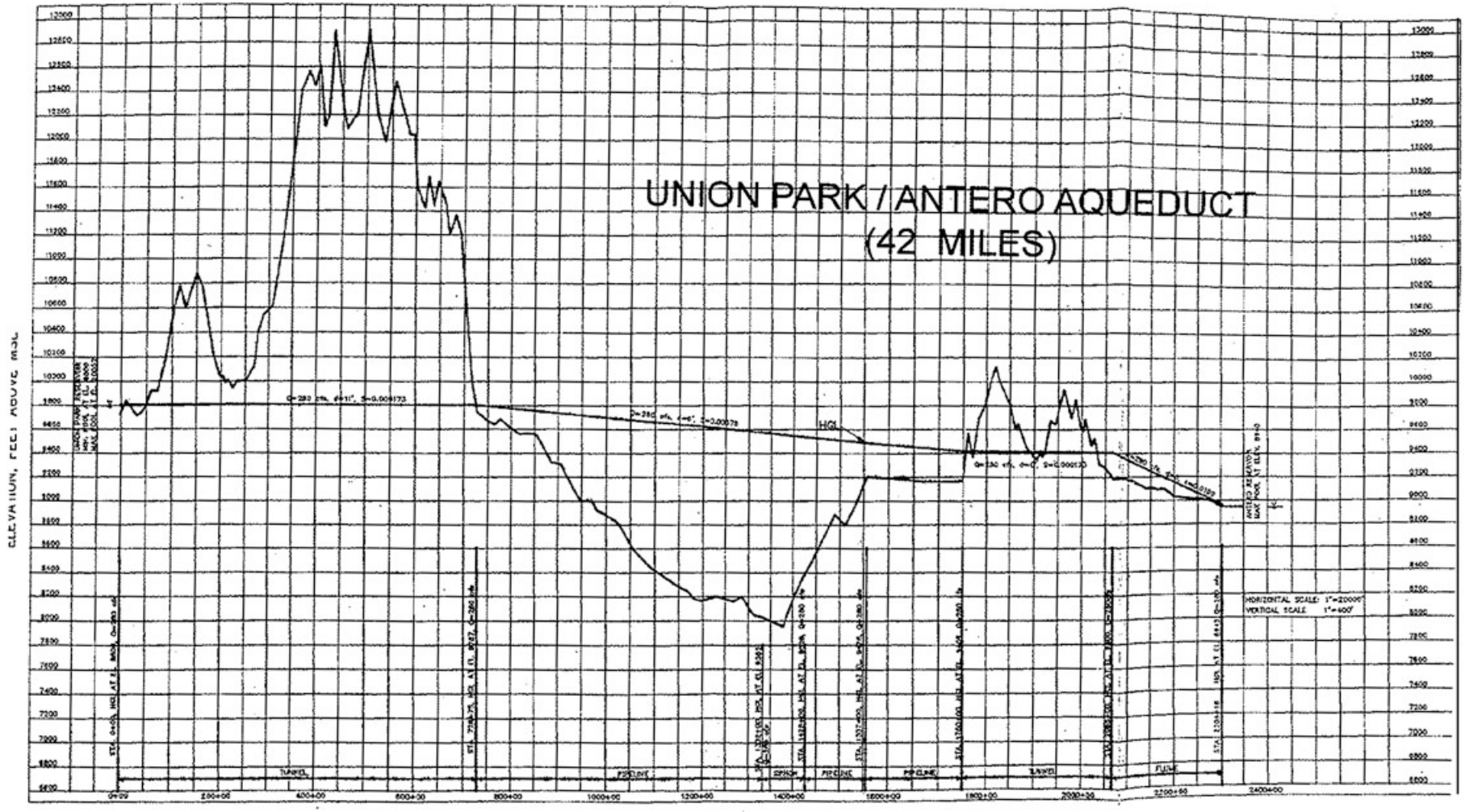


Reservoir surface area 7.2 square miles

Drainage area 26 square miles

Emergency spillway not required

Union Park to Antero Reservoir Aqueduct (42 Miles)

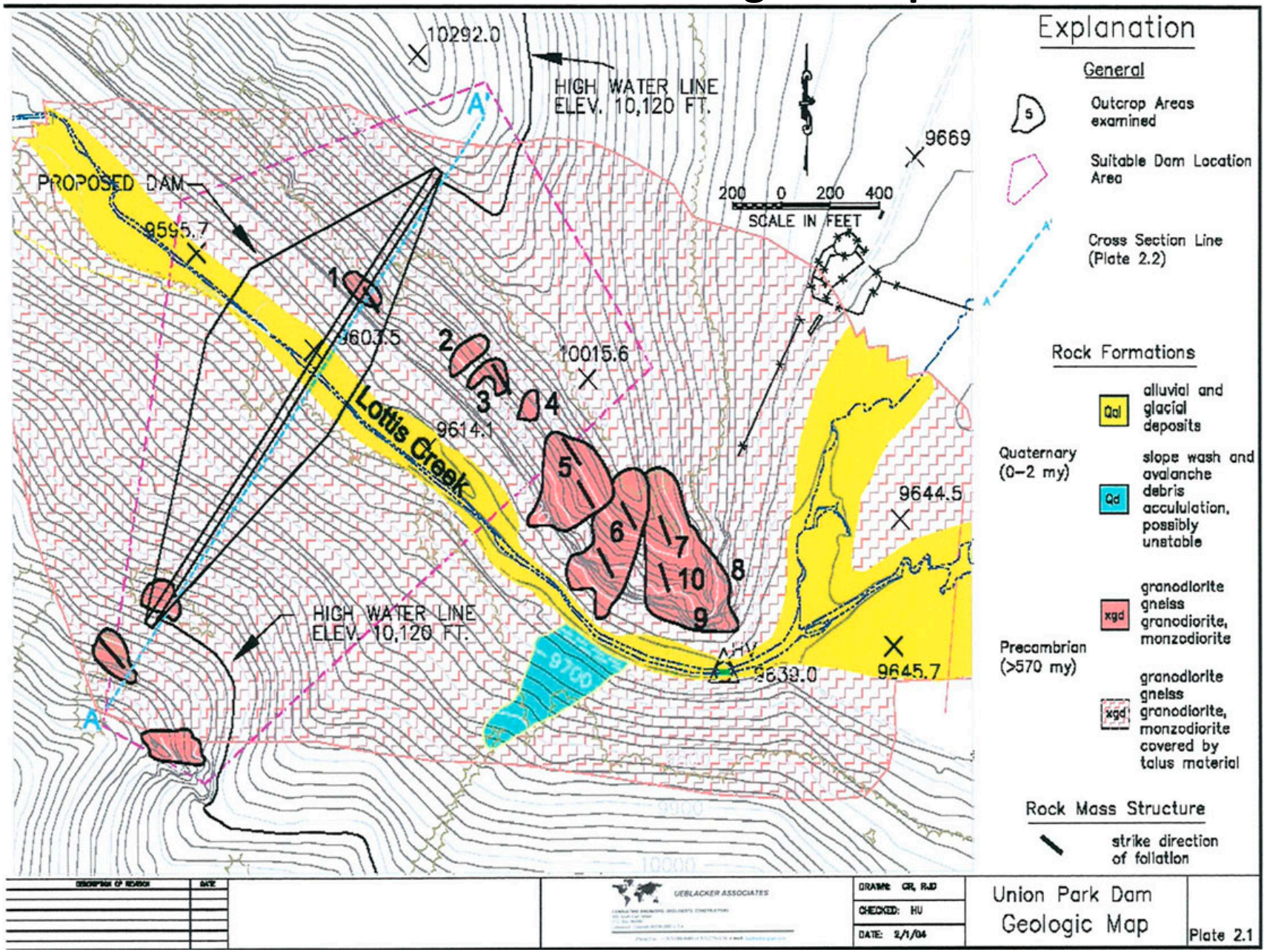



Union Park Dam Site looking east toward Reservoir


Union Park Reservoir and ridge above Taylor Park Reservoir


Union Park Reservoir looking Southeast from Dam Site

Union Park Dam Geological Map



Union Park Dam Site Geological Cross Section

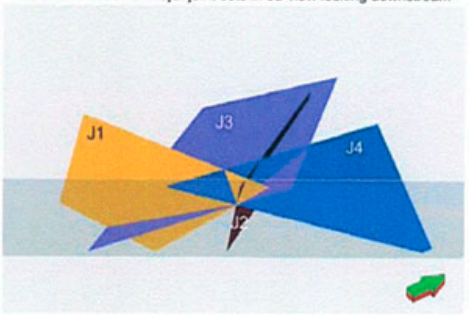
Explanation

Rock Formations

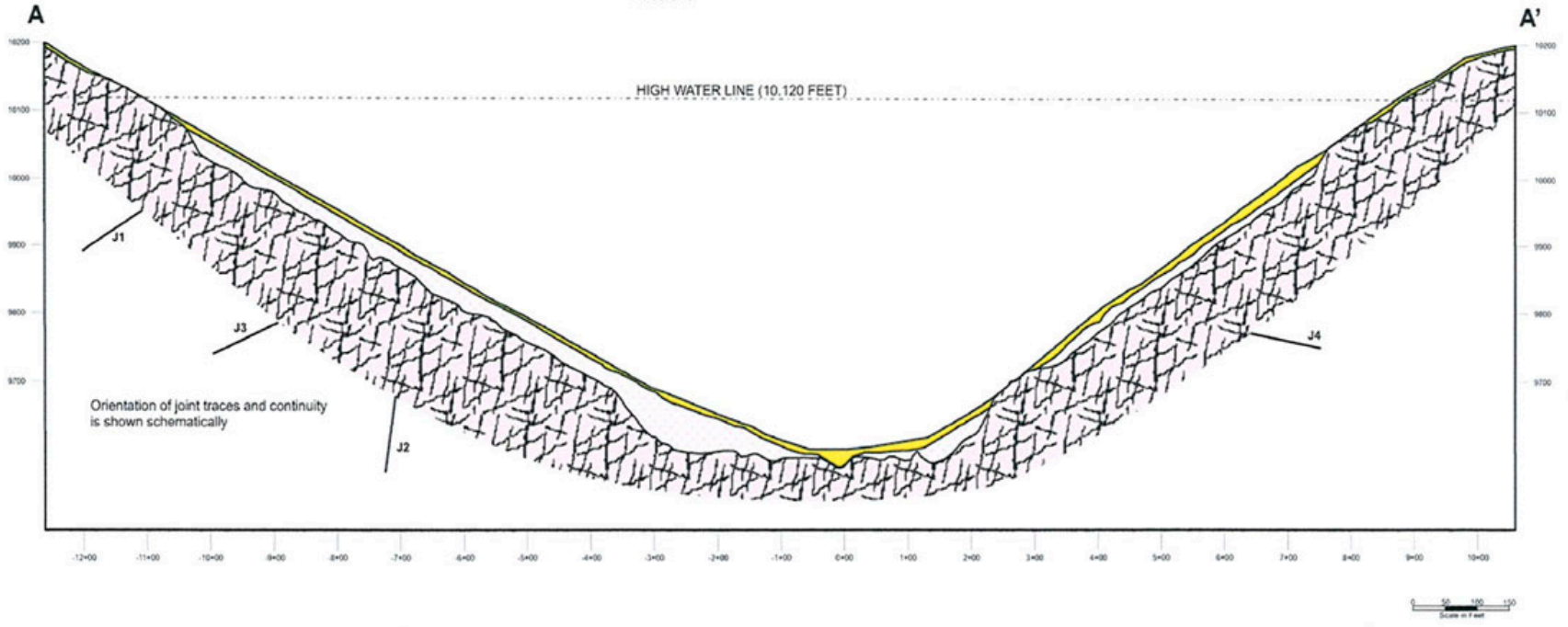
- Quartenary overburden talus, alluvial / glacial deposits
- Highly weathered to decomposed bedrock of underlaying Precambrian rocks
- Precambrian granodiorite gneiss granodiorite, monzodiorite

(Boundaries are based on results of refraction seismic survey)

Mean orientation of major joint-sets in 3d-view looking downstream



VIEW LOOKING DOWNSTREAM
PROPOSED AXIS OF DAM
N 35.5 E



UEBLACKER ASSOCIATES

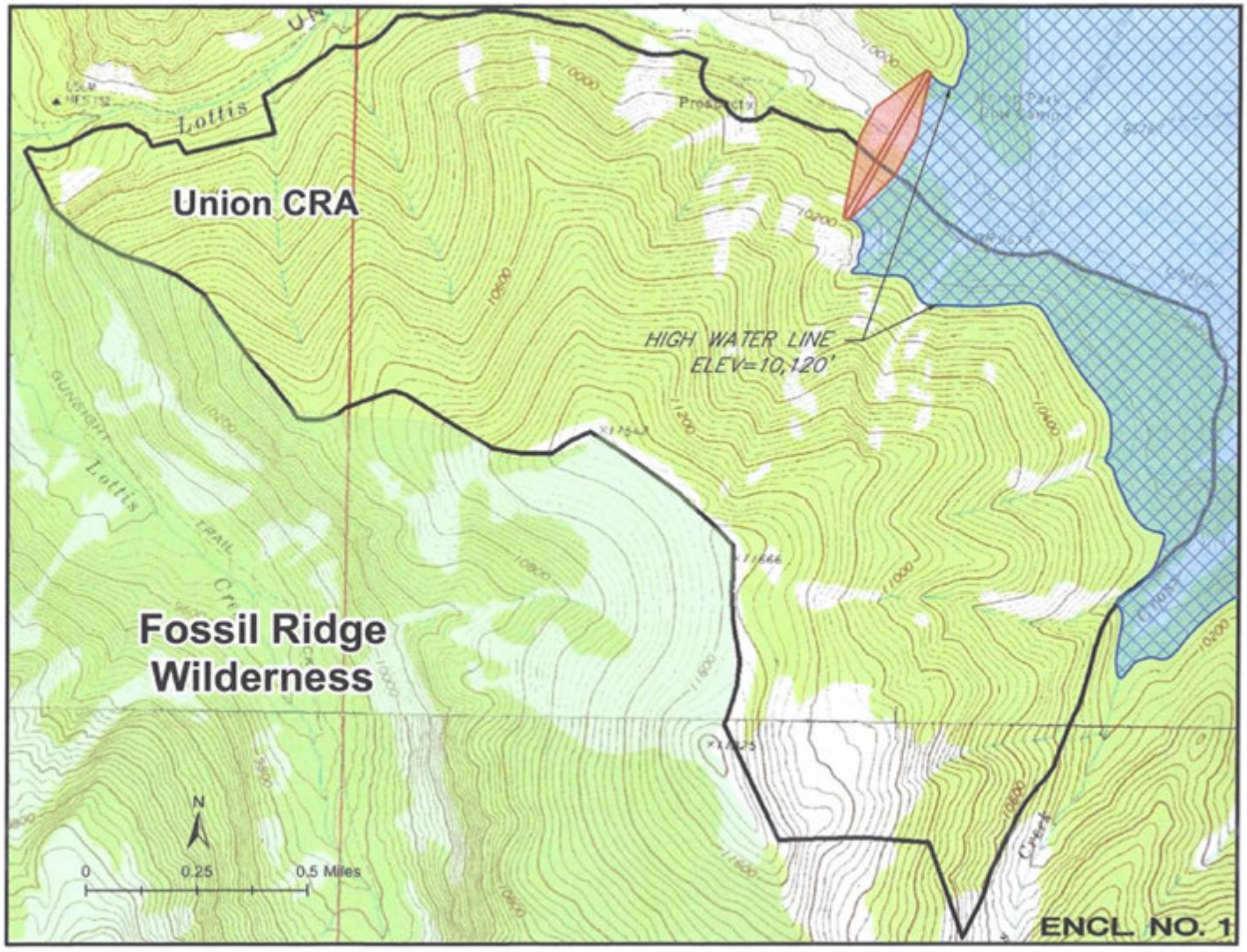
Plate 2.2
Geological Cross Section A-A'


Union Park Dam Site looking Northwest
down stream with Granodiorite outcropping

Union Park Dam Specifics

- Pool Elevation 10,120 feet
- Approximate cost $394,563,309
  - Based on 2002 cost estimate
- 18 month construction time, RCC
- Main Dam – 575 ft. high
- 2 saddle dams
- 1.2 million acre-ft. water storage
- Cost only $329/acre-ft. of storage

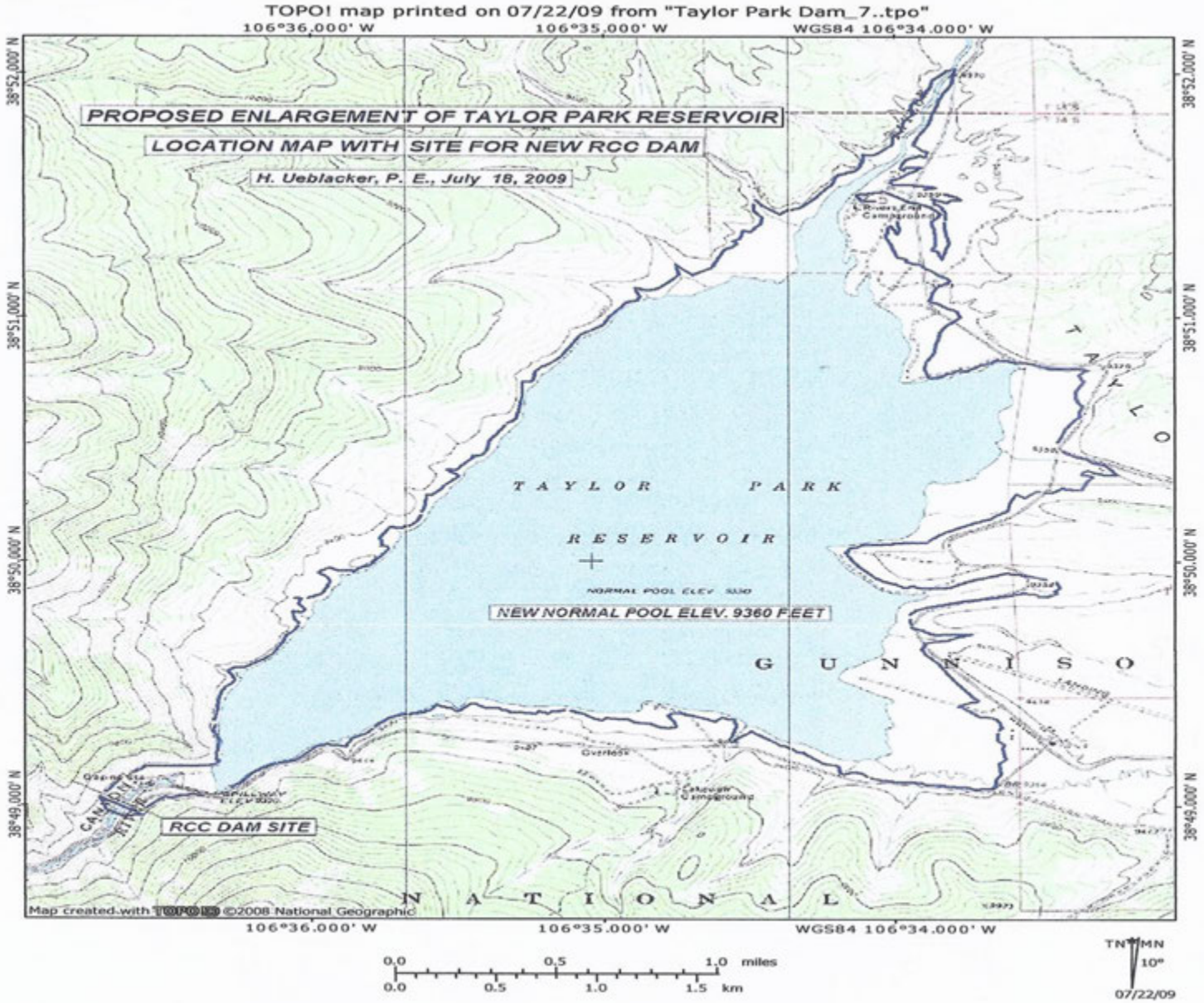
Union Colorado Roadless Area & Union Park Reservoir



CCP's proposed Union Park Reservoir is exempt from USFS's Colorado Roadless Area rules because it develops USBR's Aspinall Water Rights

CCP's Taylor Park Reservoir Enlargement

For 3,000 Megawatt Union-Taylor Pumped Hydro-Energy Storage Operation



CCP's Estimated Water Supply Costs

PRELIMINARY ESTIMATE OF COSTS FOR CONSTRUCTING AND OPERATING THE CENTRAL COLORADO PROJECT (CCP) MULTI-BASIN WATER SUPPLY AND STORAGE SYSTEM - ALL FEATURES INCLUDED, prepared by Horst Ueblacker, P. E., June 6, 2009

Description of Additional Multi-Basin Water Supply Features: Pump Lift from Blue Mesa Reservoir to Taylor Park Reservoir for up to 300,000 acre-feet annually, with gravity delivery conduits from Union Park Reservoir (1.2 million acre-feet) for selective diversons to South Platte, Arkansas, Rio Grande, and Gunnison River Basins, when and where needed for growth, droughts, climate change, recreation and environments. (Note: Regional modeling will determine expected values and revenues from CCP's integrated multi-basin water suppply augmentation capabilities.)

Power and Energy Requirements Pump Lift Operation Blue Mesa - Taylor Park Reservoir: 126.0 MW (Power); 919,800 MWh (Energy)

Item	Features/Capacity/Size			Jan 09 Costs
1	*Blue Mesa Pumping Plant Intake Structure: Q=500cfs*			$ 7,382,250.00
2	*Blue Mesa Pumping Plants: 3 EA. @ Q=500 cfs*			$ 195,034,625.50
3	*Blue Mesa Pipeline: Q=500 cfs, L=187,000', d=9'*			$ 426,990,900.00
4	*Enlargement of Taylor Park Reservoir: 167,500 acre-feet (HWL El. 9,360 feet)*			$ 36,462,592.00
5	*Union Park Dam, Reservoir, Waterways, and Access Roads: (see 3,000 MW Union Park PHES Operation)*			$ -
6	*Union Park Tunnel: Q=500 cfs, d=11', L=75,400'*			$ 434,275,200.00
7	*South Cottonwood Creek Pipeline: Q=500 cfs, d=9', L=15,500'*			$ 18,669,750.00
8	*Arkansas Valley Siphon: Q=500 cfs, d=9', L=64,300'*			$ 498,470,280.00
9	*Sevenmile Creek Pipeline: Q=500 cfs, d=9', L=4,300'*			$ 4,708,500.00
10	*Trout Creek Pass Tunnel: Q=500 cfs, d=11', L=29,900'*			$ 136,463,760.00
11	*Salt Creek Drop Structure/Creek Stabilization: Q=500 cfs, L=23,000'*			$ 7,617,600.00
12	*Transmission Line: 69KV (900 Amps), L=150,000'*			$ 10,113,636.36
13	*Rio Grande Basin Conduit: Q=200 cfs, d=6.5', L=184,694'*			$ 222,095,016.00
14	*Roaring Fork Valley Conduit: Q=200 cfs', d=6.5', L=85,061' (Pipeline); Q=400 cfs, d=10', L= 47,045' (Tunnel)*			$ 277,292,268.00
	Subtotal			**$ 2,275,576,377.86**
	Unlisted Items (20%)			$ 455,115,275.57
	Subtotal			**$ 2,730,691,653.43**
	Engineering, Administrative and Legal Services (25%)			$ 682,672,913.36
	Total Construction Cost			**$ 3,413,364,566.79**
	Interest During Construction @ 4.196%, n = 5 years			$ 778,886,552.32
	Total Investment			**$ 4,192,251,119.11**
	Annual Cost			
	Amortized Investment 50 yrs. @ 5%			$ 229,637,830.64
	OM (Excluding power and energy costs/revenues) @ 4.98%			$ 11,435,963.97
	Replacement Storage @ Blue Mesa ($50/acre-ft.)			$ 15,000,000.00
	Annual Power and Energy Costs: $1,686,750.09/MW; $45.77/MWh			$ 254,629,757.34
	Total Annual Cost			**$ 510,703,551.95**
	Annual Cost per acre-ft ($/acre-ft.)			**$ 1,702.35**

CCP's Energy Supply Revenues & Costs

PRELIMINARY ESTIMATE OF PROBABLE REVENUES AND CONSTRUCTION COSTS FOR UNION PARK/TAYLOR PARK PUMPED HYDRO ENERGY STORAGE OPERATION, Horst Ueblacker, P. E., June 3, 2009 **PAGE 1 OF 2**

Power and Capacity			
Head	240.58	Meters	
Limiting Forebay Volume	41,939,000.00	M^3	
	40,000.00	acre feet	
Res.Surface Area @ El.10,120 ft.	10,040.00	Acres	
Flow Rate Min	1,164.97	M^3/S	
Flow Rate Max	1,456.22	M^3/S	
Storage Time Min	8.00	hours	
Storage Time Max	10.00	hours	
Power Min	2,474.48	MW	
Power Max	3,093.11	MW	
Energy	24,744.85	MWh/day	** Assumes 15% of forebay volume is unused
Revenue			
Cycle Value	$1,104,130		
Annual Revenue	$401,903,194		
Avoided NG Cost	$253,325,388		
Avoided CO_2 Emissions	9,713,020.54	tons[metric] of CO2 avoided/year	
CO_2 value	$48,565,102.72	value per annual CO2 reduction	
Avoided SO_2 Emissions	2,165.35	tons[metric] of SO2 avoided/year	
SO_2 value	$1,299,209.44	Annual Traded Value	
Total	$705,092,894.68	Total Annual Value	
Total	$450,468,296.92	Counted Annual Revenue	
Cost Breakdown by %			%
Environmental Impact Statements and Federal Permits			2% $82,398,318
Power Station Structures and Improvements			9% $351,058,033
Reservoirs, Dams, Waterways, and Access Roads			22% $890,519,820
Reversible Pump Turbines and Valve Governors			9% $370,792,430
Generator Motors and Static Starting Equipment			6% $257,494,743
Accessory Electrical Power and Plant Substation Equipment			10% $408,970,317
Engineering, Administrative, and Legal Services			14% $569,399,842
Subsurface Exploration, Design, and Construction			27% $1,090,404,406
OTHER:			$0
Cost Estimate Based on Needed Facilities and other Costs			TOTAL $4,021,037,909

CCP's Projected Annual Energy Revenues, Payback Time & Net Present Value

PRELIMINARY ESTIMATE OF PROBABLE REVENUES AND CONSTRUCTION COSTS FOR UNION PARK/ TAYLOR PARK PUMPED HYDRO ENERGY STORAGE OPERATION, Horst Ueblacker, P. E., June 3, 2009 cont'd **PAGE 2 OF 2**

Payback Period and Life Cycle					
overnight cost	$4,021,037,910	Cost based on Max Cost of shortest storage duration & itemized cost entries.			
Does CO2 Have Market Value?	yes	yes or no	CO2 valued at	$48,565,102.72	at $5/ton
Annual Rev	$655,228,583	Revenue based on Min storage time and buying vs.selling data			
Payback Time	13	years			
Life Time Net Present Value	$93,102,943,163	100 year plant lifetime			
Interest Rate	6.50%				
O & M	$20,105,190	per year			
Construction Time	5	years			
Annual % increase in Cost	1.00%				

CCP's Economic Projection

•Total Annual Energy Supply Revenues	$655,228,583
•Total Annual Water Supply Costs/ 5 Basins	510,703,551
•Total Annual Profits Before Water Sales	$144,525,032

•The above Economic Projection does not include CCP's innovative economic and environmental productivity multiplier values to be realized from optimized flows throughout five major Southwestern river systems. These unprecedented major values should be determined by an emergency state-federal modeling program, as required by NEPA scoping rules for all reasonable water and energy alternatives.

CCP – Operational Control

- Programmed Central Control by Stakeholders
- Determines when to pump-store water and energy resources, using real time data
- Determines when and where gravity releases are needed to optimize water and energy resources throughout five basins and western power grid
- Control program – Benefits all Stakeholders
- Program adjusted as needed for changing climate, growth and environmental conditions

CCP – Ownership Options

- All Federal ownership, i.e. USBR
- All Colorado ownership
  - Potential major revenue generator for public schools, roads, services, etc.
- All local, state, regional, and Federal stakeholders
- Proprietary rights – Values shared equitably by all participating stakeholders

CCP Conclusions

•Modeling simulations can quickly confirm CCP's regional benefit-cost expectations of at least 10 to 1, as compared to 2 to 1 for traditional water projects.

•CCP's economic, environmental and public safety advantages are substantially superior to all current and proposed state and regional alternatives

•NEPA rules require preliminary scoping comparisons of all reasonable alternatives

•CCP is Colorado's primary and optimal State Water Plan for current and future generations.

Required State Water Planning Actions

•Eliminate institutional barriers stifling Colorado's professional State Water Planning efforts since 1937

•Recognize Colorado's costly experiment with volunteer Basin Roundtable Planning has not identified any consensus State Water Plan solutions since its 2005 implementation

•Recognize Colorado's continuing support for excessive Front Range Transmountain and Transmountain Reuse Projects will permanently harm Colorado's farms & river environments on both sides of Divide

•Eliminate state water planning barriers to evaluating CCP since its April 2007 public disclosure (see U.S. Patent Application and CCP White Paper @ www.centralcoloradoproject.us)

Required State Water Planning Actions (cont.)

•Confirm CCP's capabilities to correct serious public safety threats involving USBR's Pueblo & Taylor Park Reservoirs

•Conduct State Water Planning with federal permitting agencies

•Initiate emergency state-federal modeling to confirm CCP's breakthrough economic, environmental and public safety advantages for Colorado & Southwestern Region

•Recognize CCP's annual revenues from CCP's regional peaking power and blackout protection can exceed CCP's integrated annual water supply and productivity multiplier costs for five major river basins

•Timely accept CCP as Colorado's optimal and primary State Water Plan for current and future generations, per Governor's May 14, 2013 Executive Order