Rehab/Rebuild Options – Middle and Lower Dams

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May 2013

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SUMMARY OF PRESENTATION

- Study background
- Brief review of Classification system for dam
- Overview of concepts considered for rehabilitation or reconstruction of Colliery Park dams
- Description of candidate rehab/repair concepts
- Unit costs considered
- Cost estimates for each option

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Dam Classification

- The Classification of a dam is based on the consequences of failure
- Consequences of failure are considered from the perspectives of:
  - Life Safety
  - Economic Impacts
  - Cultural Losses
- Flood inundation assessment combined with engineering judgment and experience used to assess Classification

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Dam Classification – Extreme vs Very High

- Classification is based on Canadian Dam Association Dam Safety Guidelines and BC Water Act Dam Safety Regulation
- Classification is used to assign design flood events and design seismic event

Classification	Loss of Life	Design Flood Event	Design Seismic Event
Very High	10 to 100	2/3 between 1:1000 event and PMF (161 m^3/sec)	1:5,000 year event
Extreme	In excess of 100	PMF (205m^3/sec	1:10,000 year event

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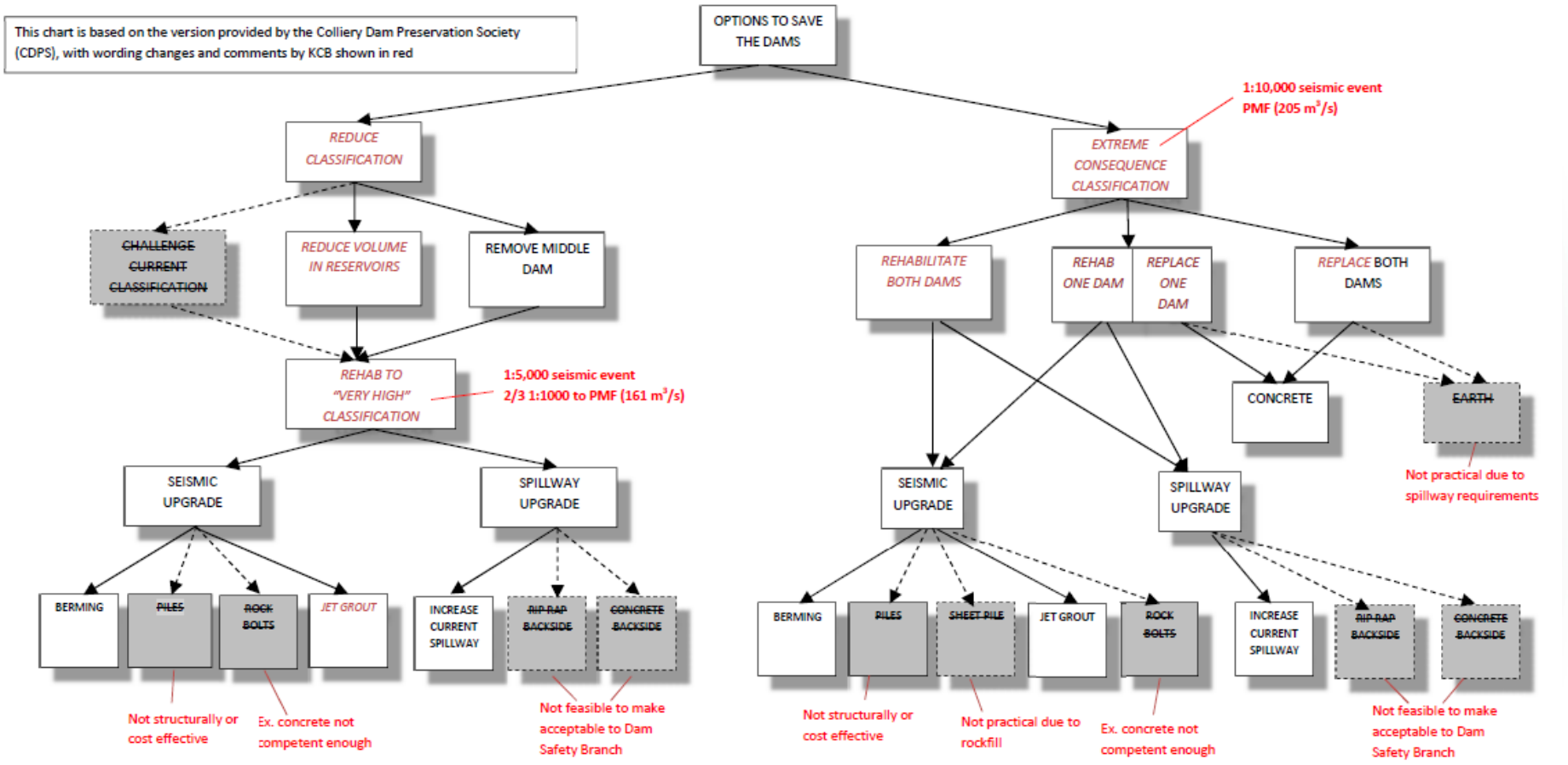
CONCEPTUAL OPTIONS



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OPTIONS SELECTED FOR COSTING

VH1 – Lower Both Lakes by 3m, Rehabilitate Both

VH2 – Remove Middle Dam, Rehabilitate Lower Dam

VH4 – Remove Middle Dam, Replace Lower Dam

EXT1 – Rehabilitate Both Dams Without Drawdown

EXT2 – Replace Middle Dam, Rehabilitate Lower Dam

EXT3 – Replace Lower Dam, Rehabilitate Middle Dam

EXT4 – Replace Both Dams, Without Drawdown

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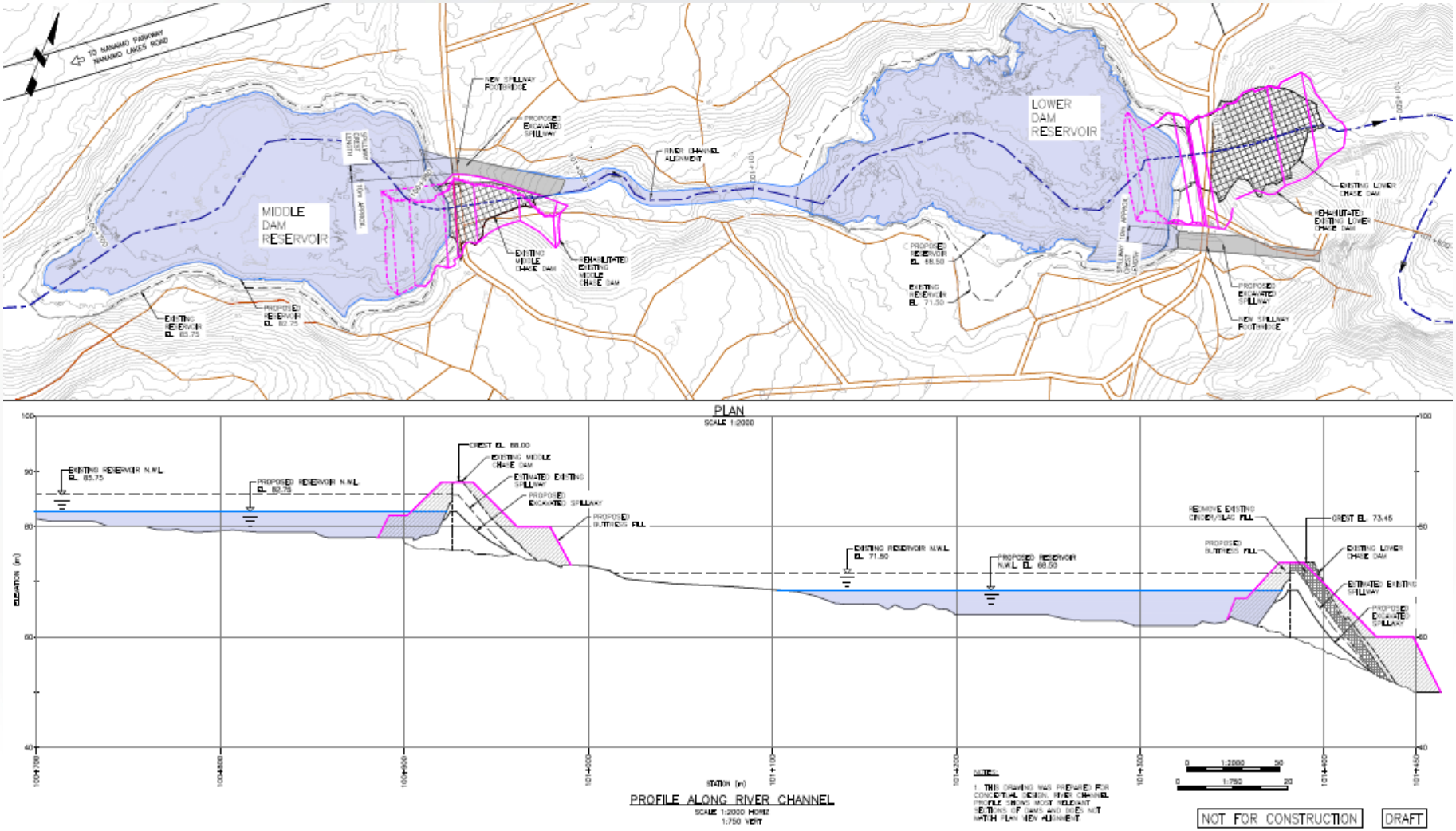
VH1 – Lower Both Lakes by 3m, Rehabilitate Both



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VH1 – Middle Lake and Spillway Lowered 3m

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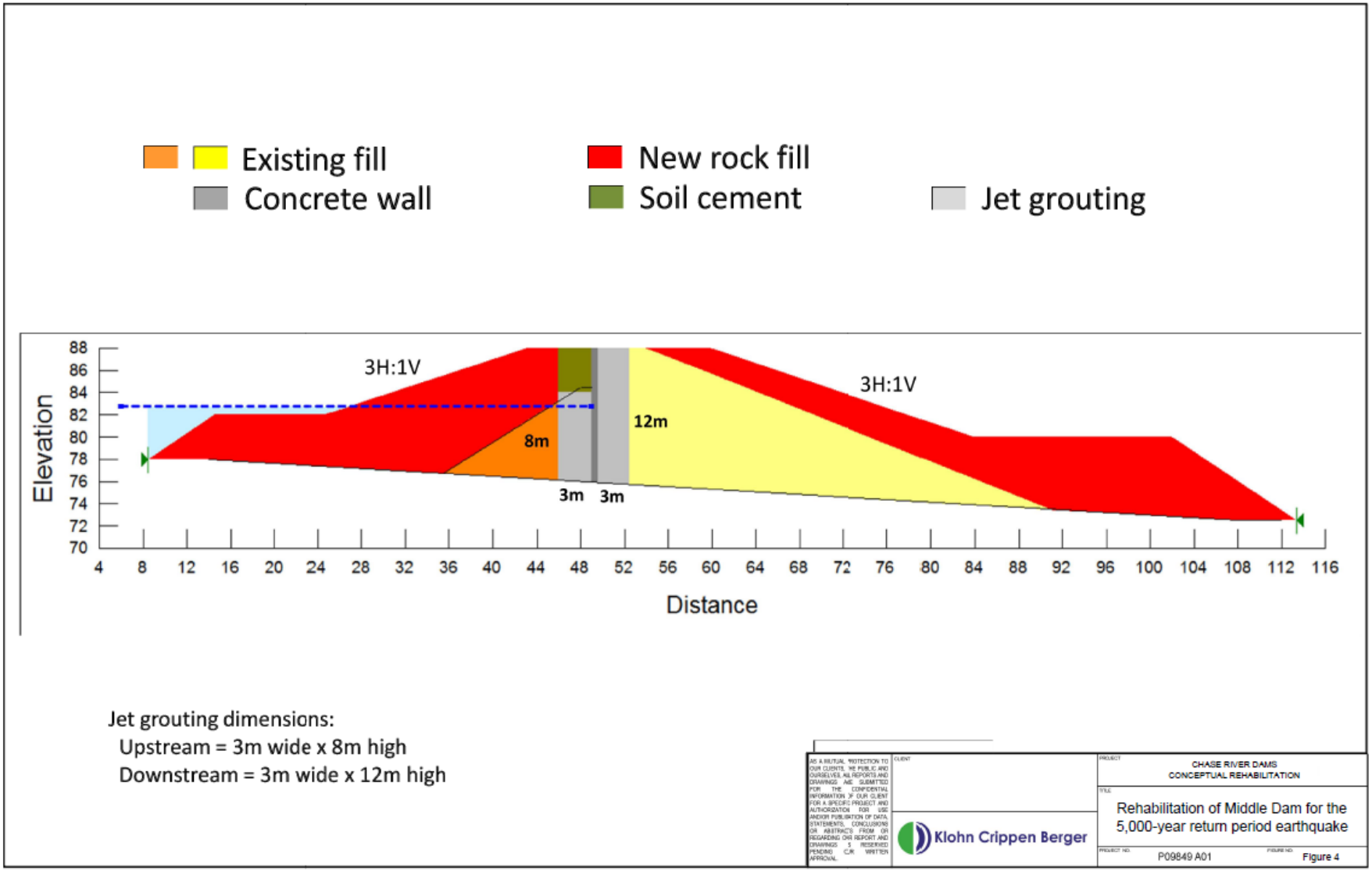
VH1 – Rehabilitate Middle Dam



Jet grouting dimensions:
Upstream = 3m wide x 8m high
Downstream = 3m wide x 12m high

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CHASE RIVER DAMS
CONCEPTUAL REHABILITATION

Rehabilitation of Middle Dam for the 5,000-year return period earthquake

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Figure 4

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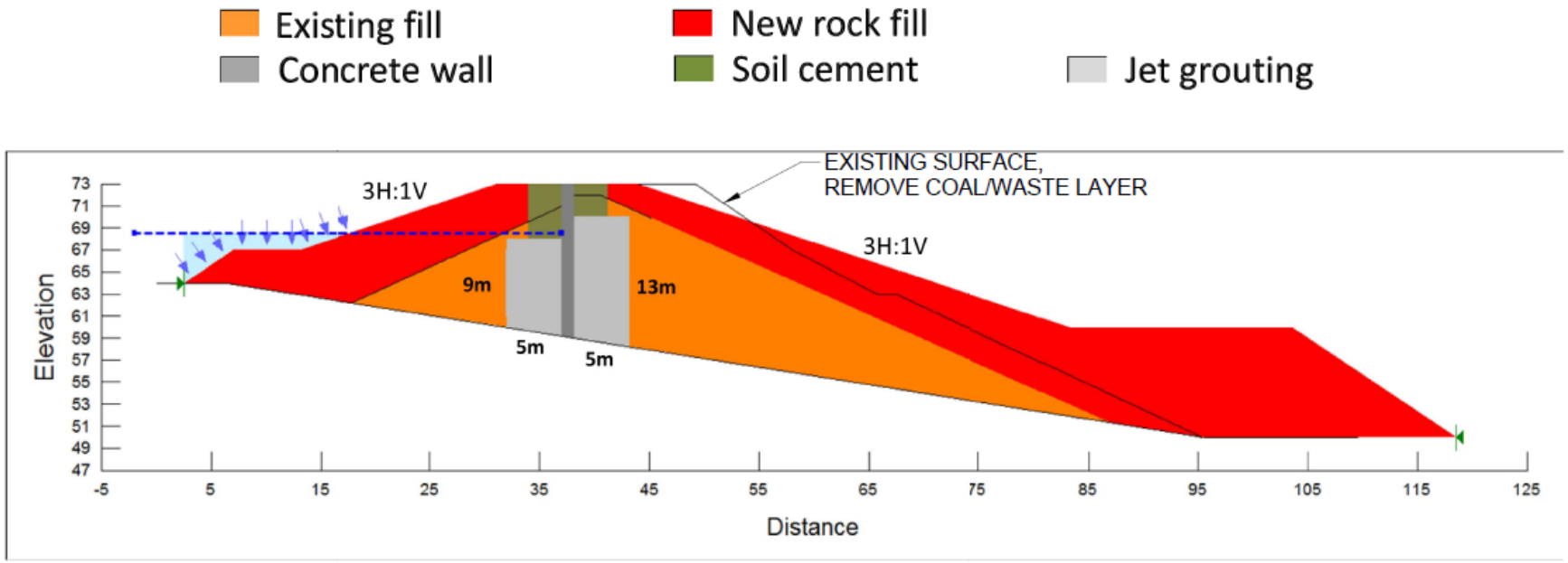
VH1 – Rehabilitate Lower Dam



Jet grouting dimensions:
Upstream = 5m wide x 9m high
Downstream = 5m wide x 13m high

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Figure 6

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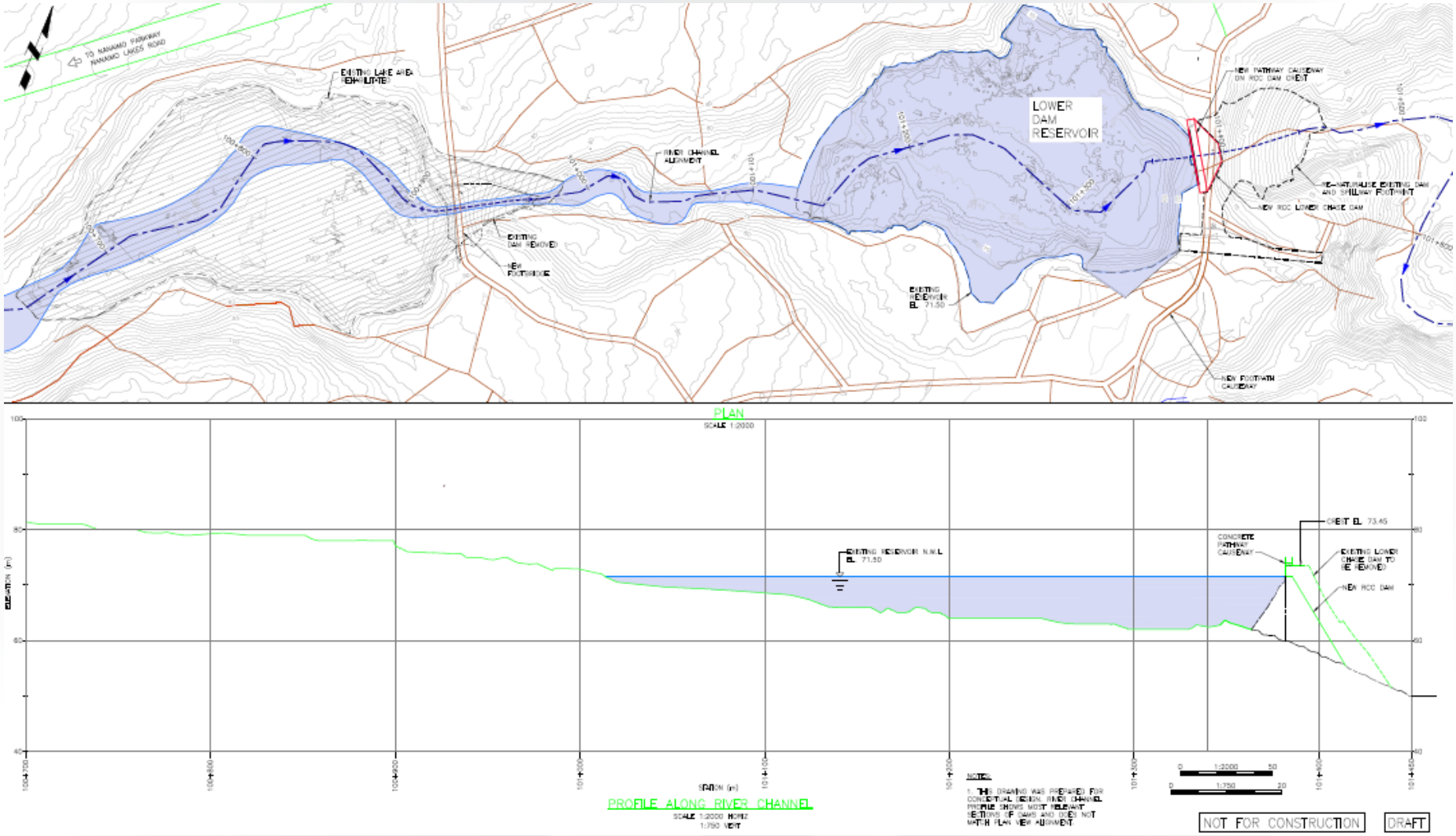
VH4 – Remove Middle Dam, Replace Lower



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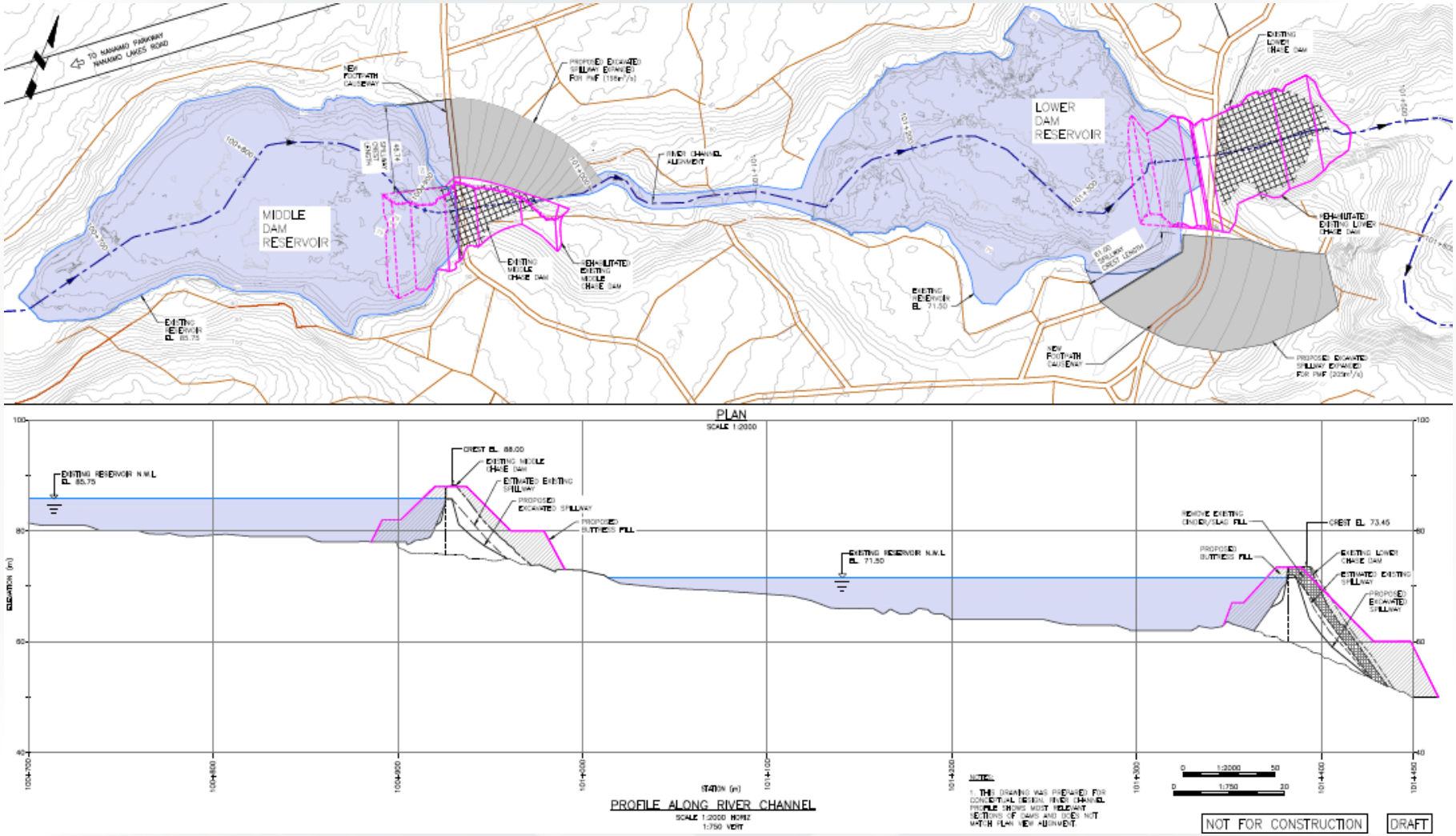
EXT1 – Rehabilitate Both Dams



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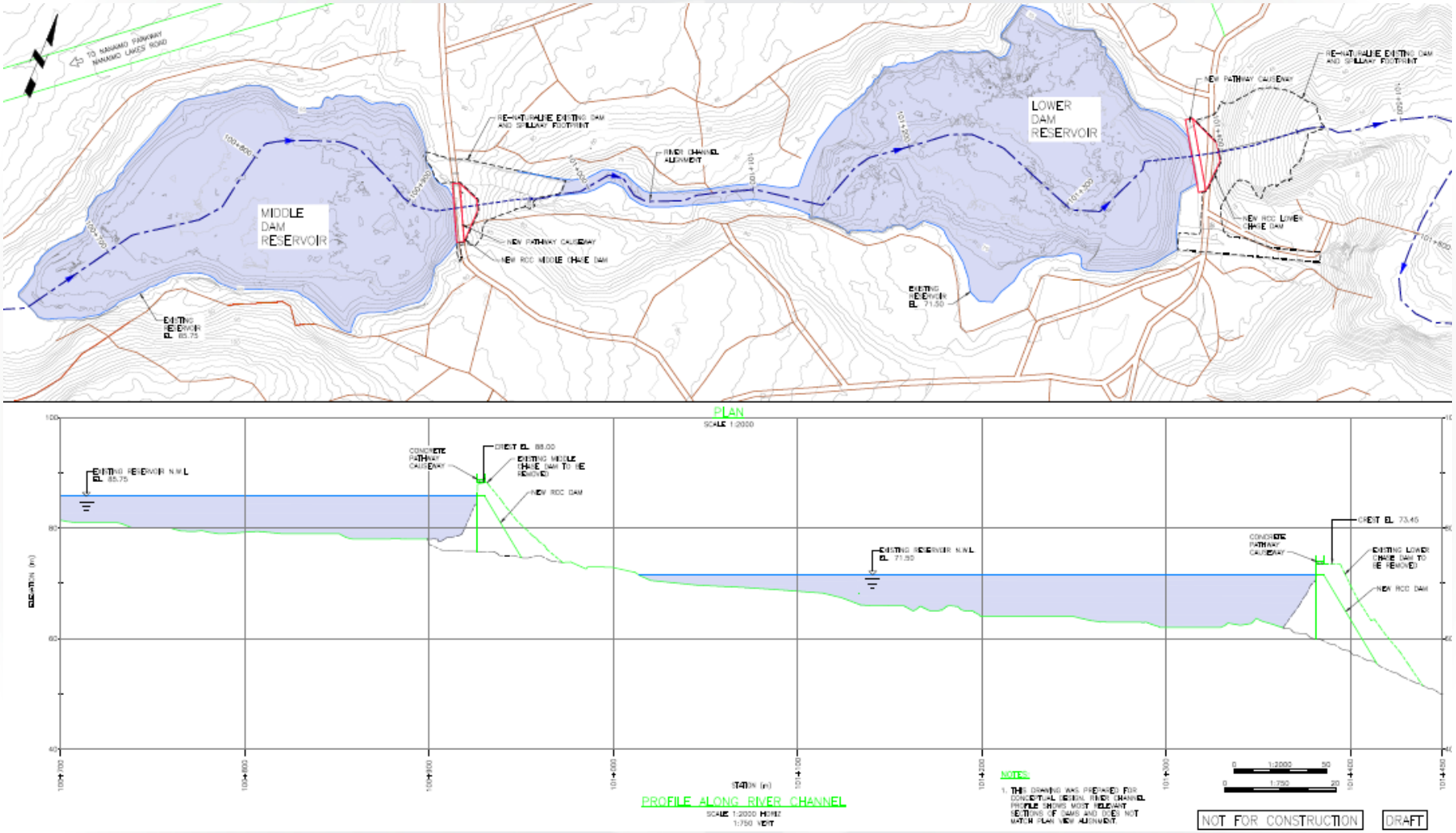
EXT4 – Replace Both Dams



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Modular Cost Estimating

Cost Code	Cost Component	Remarks	Risk Contingency allowance added to base estimate	VH1	VH2	VH4	EXT1	EXT2	EXT3	EXT4		REMOVAL
				Reduce Level of Both Reservoirs	Remove Middle, Rehab Lower	Remove Middle, Replace Lower	Rehab Both Dams	Replace Middle, Rehab Lower	Rehab Middle, Replace Lower	Replace Both Dams		Remove both Dams, Renaturalize both Lakes
				Lower both lakes	Remove Middle Lake, keep Lower Lake		Retain Both Lakes at existing water Level					Remove Both Dams
	MIDDLE DAM											
RH1-M	Rehab (Extreme)	Rehab Middle Dam to "Extreme" Classification	30%				$ 3,694,600		$ 3,694,600			
RH2-M	Rehab(Very High)	Rehab Middle Dam to "Very High" Classification	30%	$ 2,550,600								
SW1-M	Expand Spillway at Ex WL (205 m3/s)	Widen Spillway for 205 m^3/s at existing level	20%				$ 4,128,000		$ 4,128,000			
SW2-M	Expand Spillway at Ex WL (161 m3/s)	Widen Spillway for 161 m^3/s at existing level	20%									
SW3-M	Expand Spillway -3m (161 m^3/s)	Reduce Spillway Level (-3m) and widen for 161 m^3/s	20%	$ 1,530,000								
RM1-M + RM2-M	Remove Middle Dam	clean material to lakebed, concrete offsite	10%		$ 426,800	$ 426,800						$ 426,800
RM1-M	Remove Middle Dam (lake disposal)	dispose "clean material" in lake	10%					$ 390,500		$ 390,500		
RN1-M	Renaturalise Lakebed and dam areas	Establish river channel and landscape	10%		$ 911,900	$ 911,900						$ 911,900
RN2-M	Topsoil and seed lake perimeter	exposed by 3m drop	10%	$ 123,750								
RN4-M	Compensation Works for HADD	additional footprint and construction disturbance	10%	$ 440,000			$ 440,000	$ 440,000	$ 440,000	$ 440,000		
RN5-M	Clean and Armour Channel	for over-winter after dam removal	10%					$ 110,000		$ 110,000		
NS1-M	New Concrete Dam Middle	RCC dam with crest spillway and pathway bridge	30%					$ 1,168,700		$ 1,168,700		
NS2-M	New Footbridge (Middle)	incl. abutments	20%		$ 217,200	$ 217,200						$ 217,200
	LOWER DAM											
RH1-L	Rehab Lower (Extreme)	Rehab Lower Dam to "Extreme" Classification	30%				$ 6,099,600	$ 6,099,600				
RH2-L	Rehab Lower (Very High)	Rehab Lower Dam to "Very High" Classification	30%	$ 5,969,600	$ 5,969,600							
SW1-L	Expand Spillway at Ex WL (205 m3/s)	Widen Spillway for 205 m^3/s at existing level	20%				$ 3,168,000	$ 3,168,000				
SW2-L	Expand Spillway at Ex WL (161 m3/s)	Widen Spillway for 161 m^3/s at existing level	20%		$ 2,635,200							
SW3-L	Expand Spillway -3m (161 m^3/s)	Reduce Spillway Level (-3m) and widen for 161 m^3/s	20%	$ 1,897,200								
RM1-L + RM2-L	Remove Lower Dam	clean material to lakebed, concrete offsite	10%									$ 1,025,200
RM1-L	Remove Lower Dam (lake disposal)	dispose "clean material" into lake	10%			$ 936,100			$ 936,100	$ 936,100		
RN1-L	Renaturalise Lower Lake and dam area	establish river channel and landscape	10%									$ 957,000
RN2-L	Topsoil and seed lake perimeter	exposed by 3m drop	10%	$ 123,750								
RN4-L	Compensation Works for HADD	additional footprint and construction disturbance	10%	$ 660,000	$ 660,000	$ 660,000	$ 660,000	$ 660,000	$ 660,000	$ 660,000		
RN5-L	Clean and Armour Channel	for over-winter after dam removal, for replacement	10%			$ 165,000			$ 165,000	$ 165,000		
NS1-L	New Concrete Dam Lower	RCC dam with crest spillway and pathway bridge	30%			$ 1,973,400			$ 1,973,400	$ 1,973,400		
NS2-L	New Footbridge (Lower)	incl. abutments	20%									$ 213,600
	COMMON											
	Drain Lakes			$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000		$ 50,000
OH1	River Flow Diversion		20%	$ 249,600	$ 249,600	$ 208,000	$ 208,000	$ 208,000	$ 208,000	$ 208,000		$ 208,000
	Mob/demob/General Conditions	10% of above total		$ 1,359,450	$ 1,112,030	$ 554,840	$ 1,844,820	$ 1,229,480	$ 1,225,510	$ 610,170		$ 400,970
RN3	Restore and Landscape Laydown Areas		20%	$ 180,000	$ 180,000	$ 180,000	$ 180,000	$ 180,000	$ 180,000	$ 180,000		$ 45,000
OH2	Engineering	Design and Construction Phases	20%	$ 984,000	$ 789,600	$ 808,800	$ 984,000	$ 1,003,200	$ 1,003,200	$ 894,400		$ 538,400
OH3	Engineering	Dam Breach Analysis update	10%	$ 92,400	$ 92,400	$ 92,400						
OH4	City Admin Costs	10% of above total		$ 1,611,795	$ 1,320,193	$ 709,204	$ 2,145,702	$ 1,470,748	$ 1,466,381	$ 778,627		$ 499,407
				$ 17,822,145	$ 14,614,523	$ 7,893,644	$ 23,602,722	$16,178,228	$16,130,191	$ 8,564,897		$ 5,493,477

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Summary of Cost Estimates for Each Option

Option	Cost Estimate	Cost Estimate with Budget Contingency
VH1 – Lower Both Lakes and Rehabilitate Both Dams	$17,822,145	$23,168,789
VH2 – Remove Middle Dam, Rehabilitate Lower Dam	$14,614,523	$17,537,428
VH4 – Remove Middle Dam, Replace Lower Dam	$7,893,644	$9,472,373
EXT1 – Rehabilitate Both Dams Without Drawdown	$23,602,722	$30,683,539
EXT2 – Replace Middle Dam, Rehabilitate Lower Dam	$16,178,228	$21,031,696
EXT3 - Rehabilitate Middle Dam, Replace Lower Dam	$16,130,191	$20,969,248
EXT4 – Replace Both Dams	$8,564,897	$11,134,366

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Comments on Cost Estimates

- Costs viewed to be accurate to within 30%
- Engineering estimates of costs provide guidance, but submitted contractor tenders ultimately determine the final cost
- Costs for replacement and rehabilitation do not include the following considerations:
  - Construction impacts
  - Life cycle costs for monitoring, maintenance, upgrading
  - Maintained public safety impacts
  - Loss of opportunity to restore Chase River to original state

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Rehab/Rebuild Options – Middle and Lower Dams

QUESTIONS?

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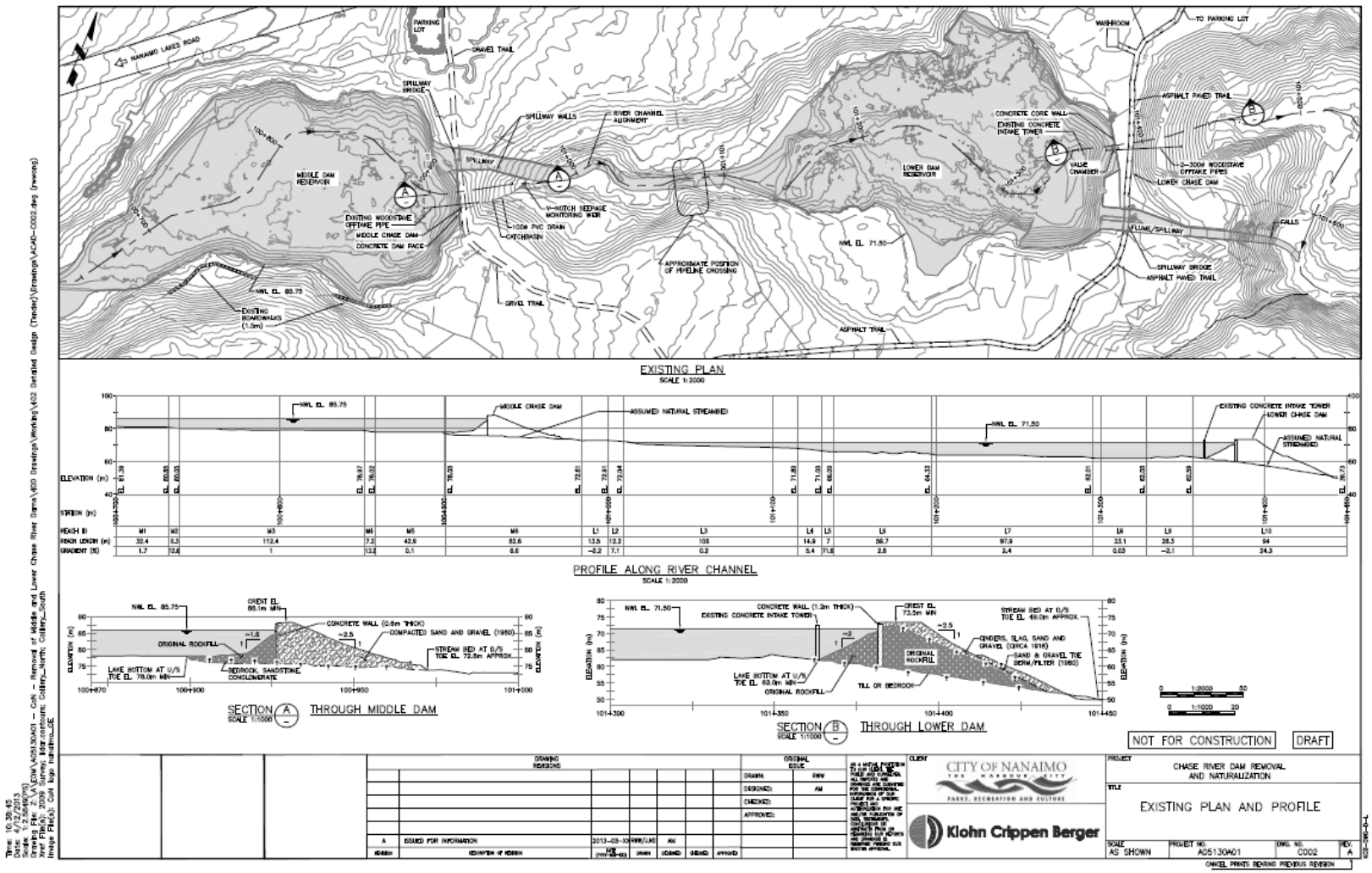
PROFILE OF CHASE RIVER THROUGH PARK



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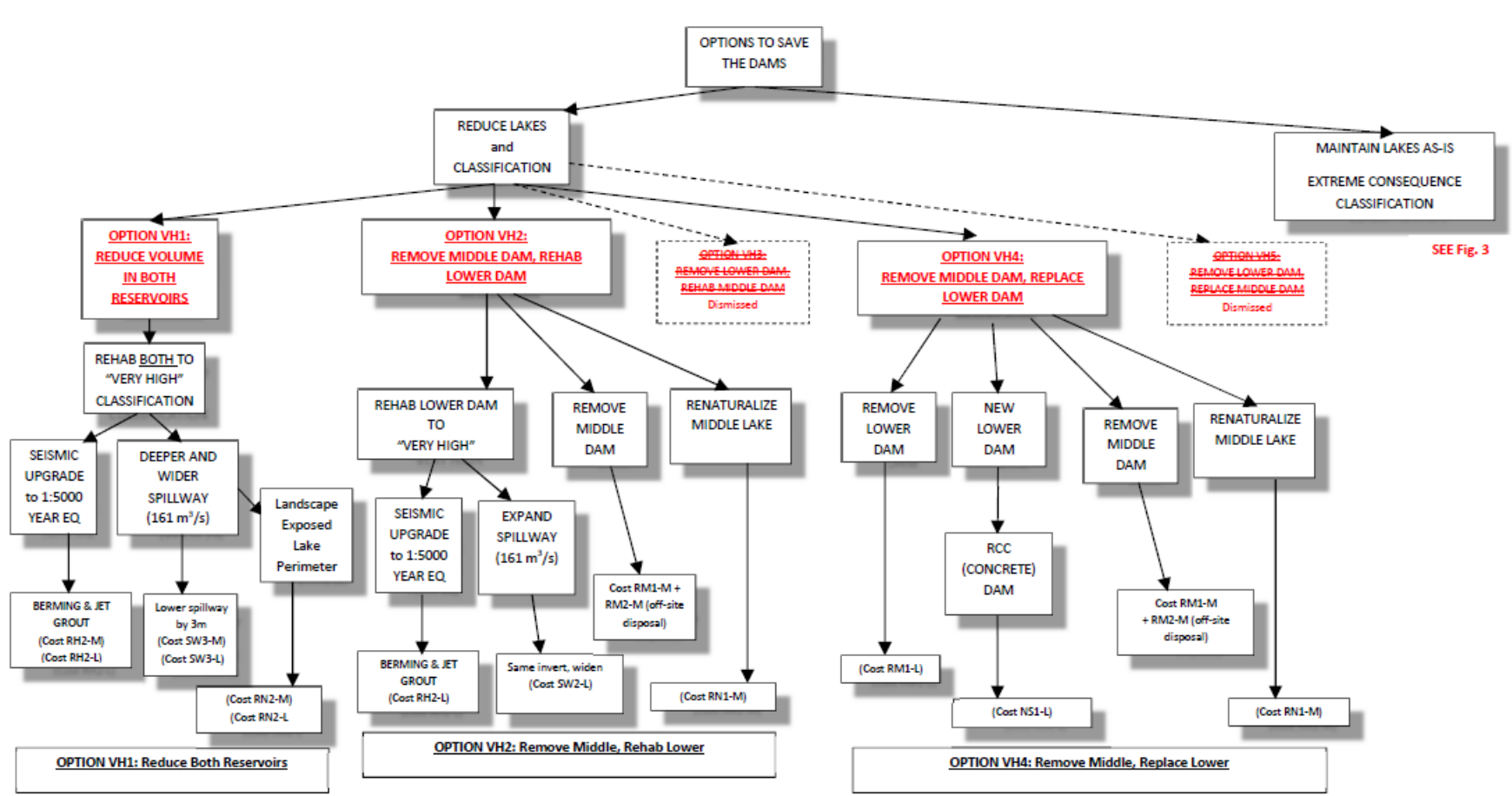
CONCEPTUAL "VH" OPTIONS - COMPONENTS



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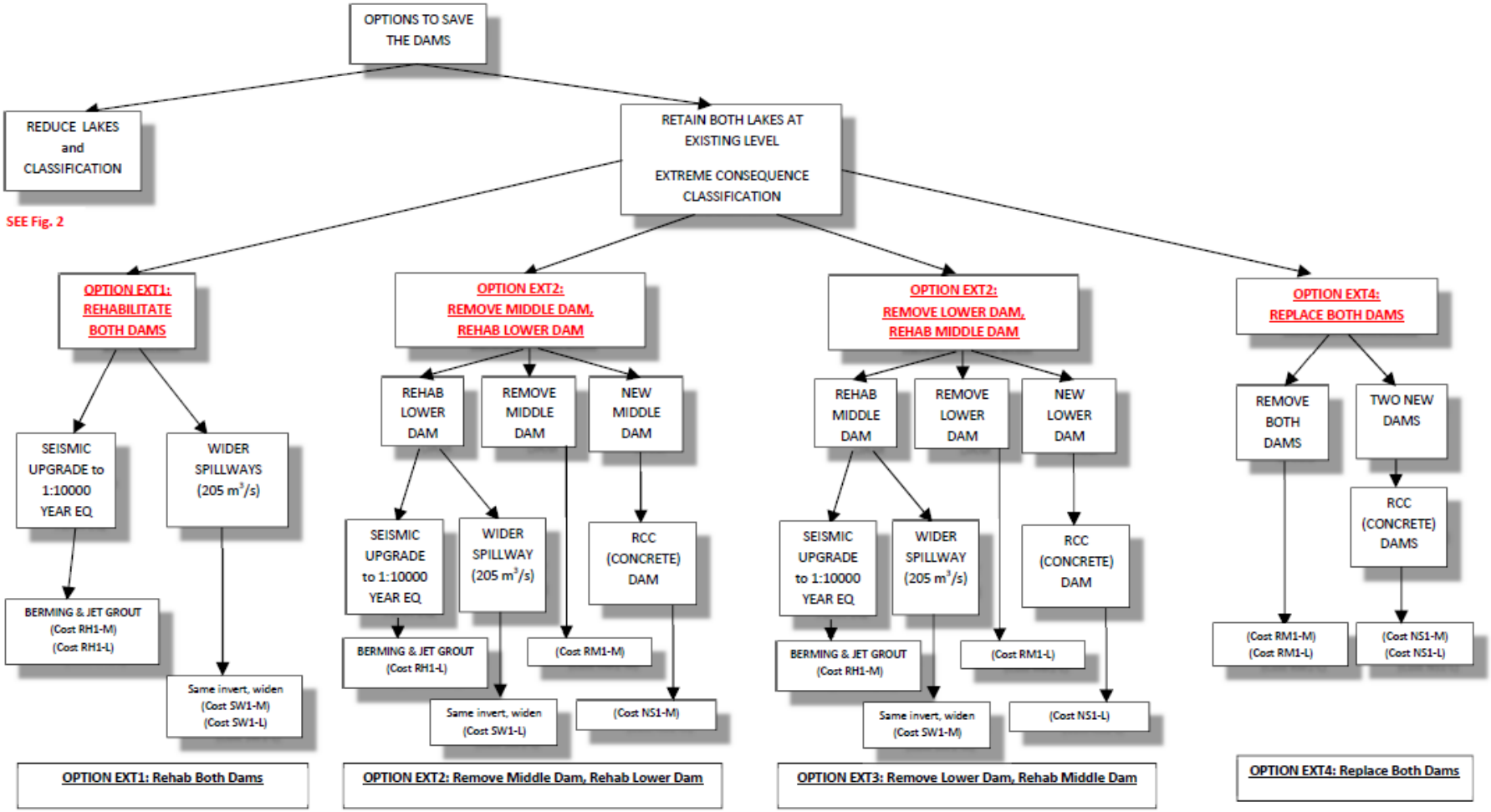
CONCEPTUAL "EXT" OPTIONS - COMPONENTS



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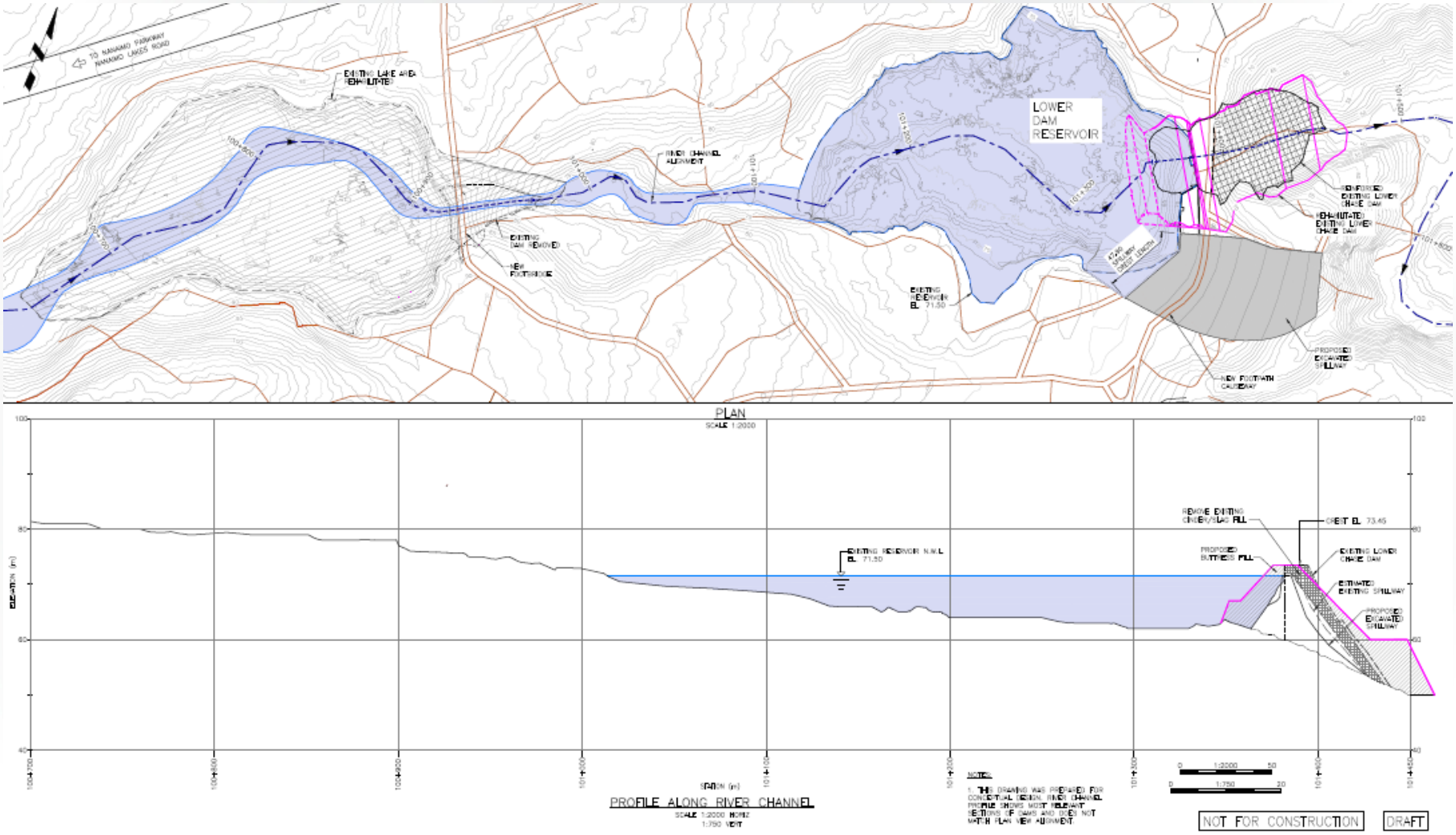
VH2 – Remove Middle Dam, Rehabilitate Lower



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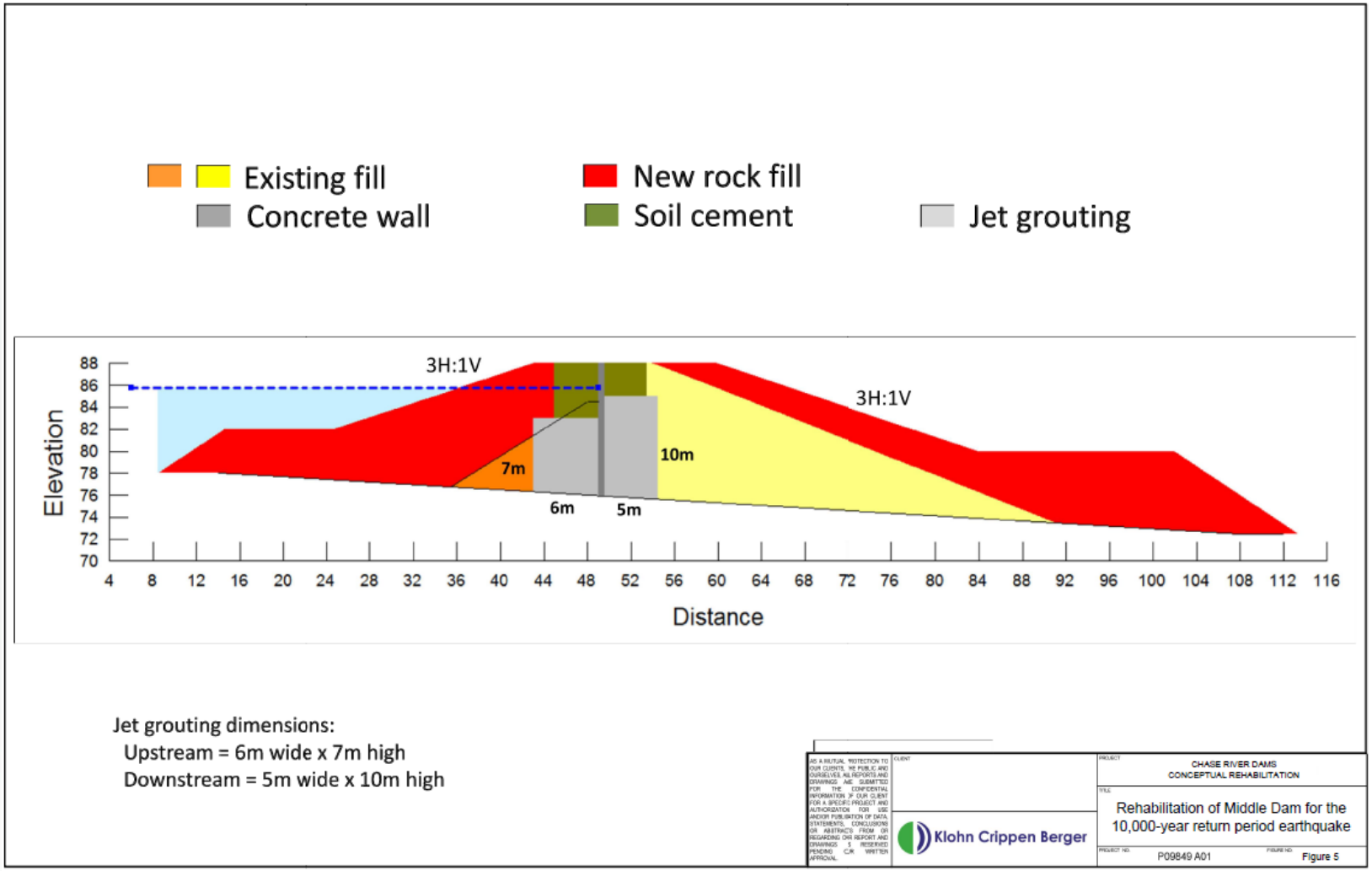
EXT1 – Rehabilitate Both Dams (Middle)



Jet grouting dimensions:
Upstream = 6m wide x 7m high
Downstream = 5m wide x 10m high

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CONCEPTUAL REHABILITATION

Rehabilitation of Middle Dam for the 10,000-year return period earthquake

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Figure 5

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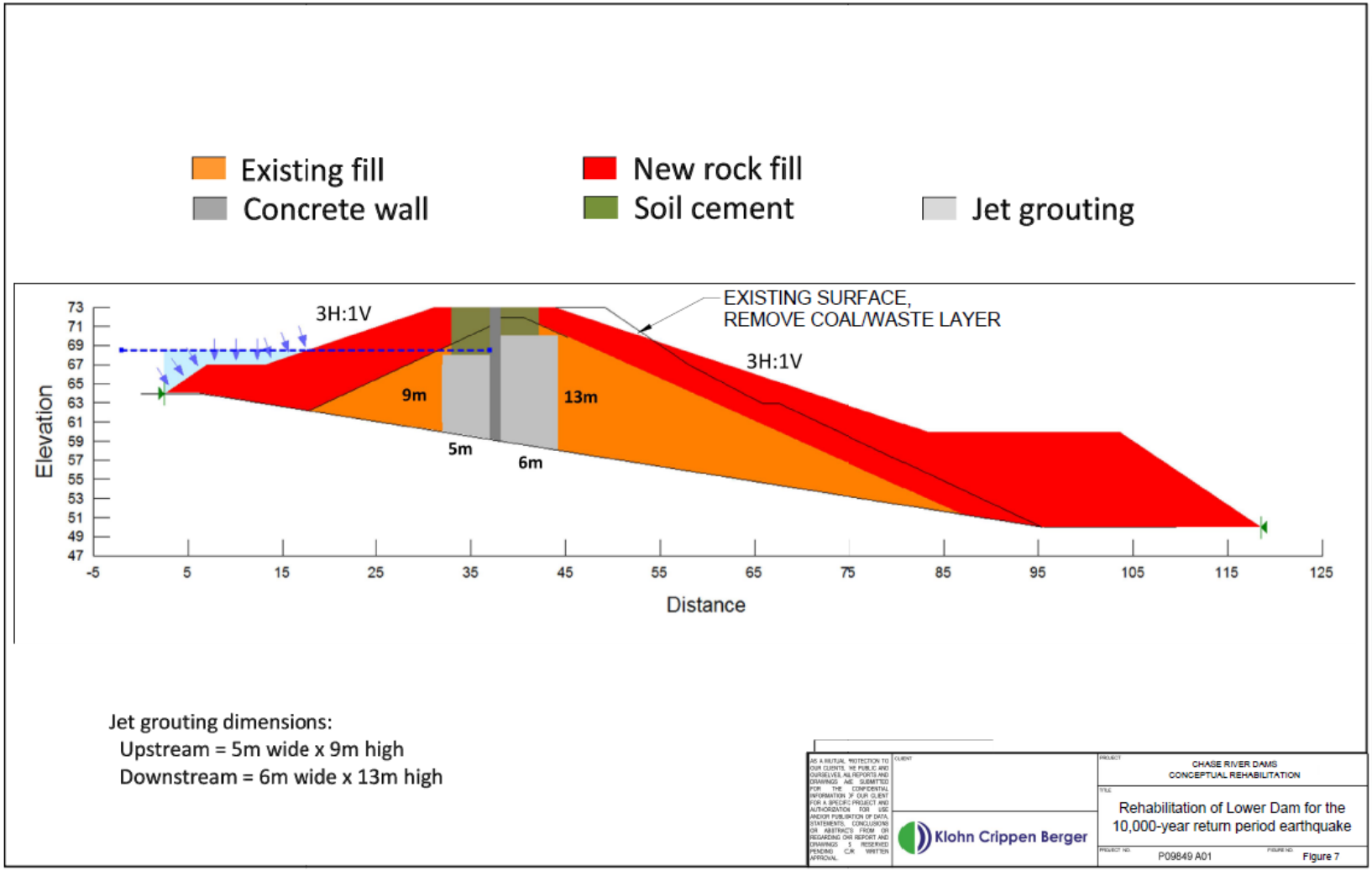
EXT1 – Rehabilitate Both Dams (Lower)



Jet grouting dimensions:
Upstream = 5m wide x 9m high
Downstream = 6m wide x 13m high

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CONCEPTUAL REHABILITATION

Rehabilitation of Lower Dam for the 10,000-year return period earthquake

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Figure 7

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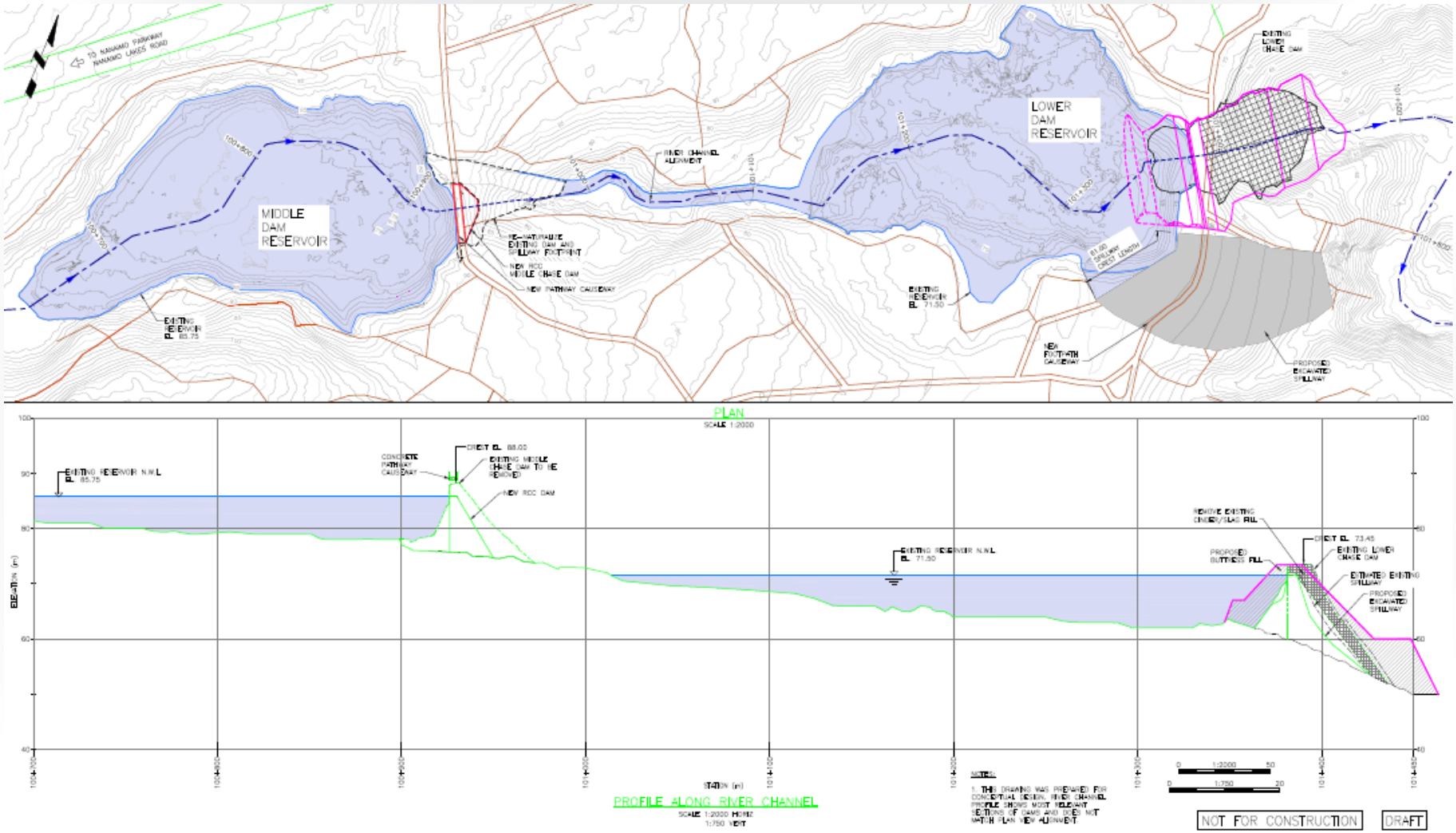
EXT2 – Replace Middle Dam, Rehabilitate Lower



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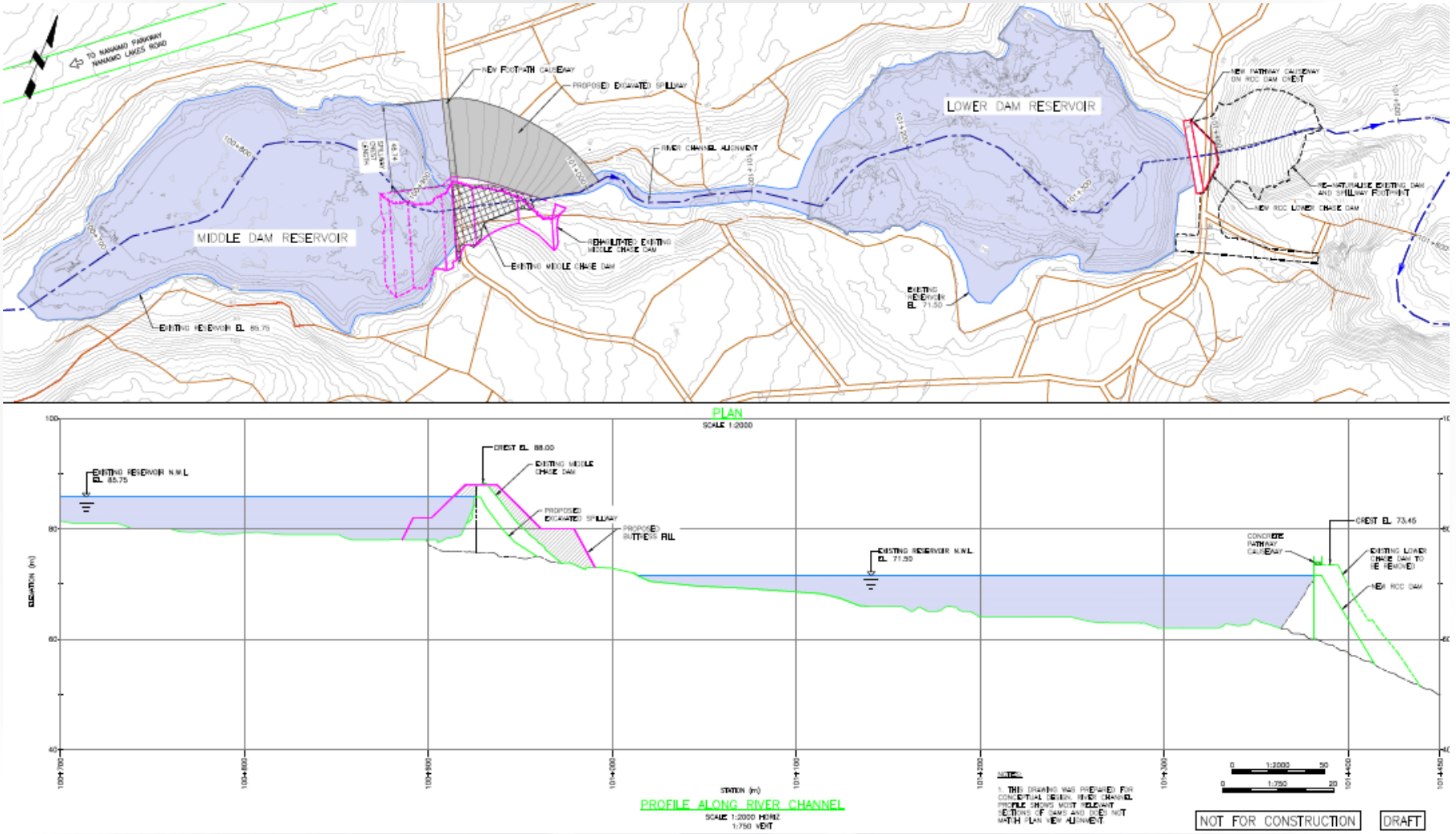
EXT3 – Replace Lower, Rehabilitate Middle



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