May 20, 2014

Middle and Lower Chase River Dams Progress Update
18 m wide at spillway entrance tapering to ~10 m wide.

- Total labyrinth height 3 m – 3 of the walls comprised of 12 pre-cast concrete panels and 1 wall comprised of 5 pre-cast concrete stop logs.

- Stop logs enable controlled draw down of reservoir following seismic event. (or for repairs, etc)

- Low level outlet for dry season releases
- Total Wall height 5 m at spillway entrance tapering to ~3 m high.
- Uncertainty of foundation materials – particularly beneath the weir
  - Excavation assumed to be half in rock and half in soil
- Grout or concrete seal required at spillway entrance and drainage along channel base.
- Heavy reinforced concrete walls and foundation
Construction Sequence
- Construct lab first
- Sectional removal and construction of spillway – starting from downstream

Footprint
- Loss of ~2050m² of habitat permanently (includes existing spillway footprint)
- Disturbing of habitat during construction – footprint ~2850m² (including existing spillway).
Lower Dam: WL drawn down 5 m using 2 ea 450 mm siphons.
Middle Dam: WL drawn down 5 m using 2 ea 450 mm siphons
Cofferdam required at the Lower Dam only.
The ideal construction period is Jul-Aug-Sept and 2 siphons supply capacity that’s more than 600% of anticipated base flow.
Flood in excess of diversion capacity to be routed through construction works
  Cannot pass water over concrete less than 72 hrs - to be addressed in EMP.
Construction Laydown, Access Roads Layout and Silt Control

- Access to site and site offices
- Existing walkway may have to be widened
- Silt control along all access roads
Lower Dam – Overtopping Grading Plan

- Non-level crest to concentrate flow on center of dam.
- Requires a new bridge
- Grading to minimize convergence and provide uniformity to flow.
- Existing spillway modifications required to confine design storm flows (berms not shown in plan).
The downstream face is re-graded to bowl shape by cut and fill.

Berms up to 1.5 m high made of soil/cement mix are constructed along portions of the north and south sides of the existing spillway.

Requires a new bridge.
‘Hardening’ done by excavating and soil/cement mixing in strips from surface down to about 1-3 m depth.
Construction Laydown, Access Roads Layout and Silt Control

- Access road to lower slope
- Access to site and site offices
- Existing walkway may have to be widened
- Silt control along all access roads
Lower Dam: Labyrinth Spillway (12 m)

- Similar in design and construction sequence to the 18 m wide spillway.
- 12 m wide at spillway entrance tapering to ~8 m wide.
- Loss of ~1730m² of habitat permanently (includes existing spillway footprint).
- Disturbing of habitat during construction – footprint ~2380m² (including existing spillway).
- Cost: $5,214,769.41
Design Options – Construction Schedule
Labyrinth (12 or 18 m)

- 3 - 4 month construction period
  - Start July 1, end Oct 26
  - Work in channel complete mid Oct
- 3 month construction period
- Avoid fill placement during wet periods – best done during summer months
Risks and Opportunities

Labyrinth Option - Risks

- Design
  - Unexpected fdn materials
- Construction
  - Flooding risk
  - Fish salvage?

Labyrinth Option - Opportunities

- Channel Walls – alternative designs
- Porta Dam – reduce or eliminate?

Overtop Option - Risks

- Design
  - Cannot re-use on site materials (testing program cannot achieve design parameters)
- Construction
  - Encounter unexpected materials
  - Productivity (poor access, more diff to estimate)

Overtop Option - Opportunities
## Budget Costs

<table>
<thead>
<tr>
<th>Labyrinth Option</th>
<th>Overtop Option</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base Cost</strong></td>
<td><strong>Base Cost</strong></td>
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<tr>
<td>$5.4</td>
<td>$3.2</td>
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<tr>
<td><strong>Other items</strong></td>
<td><strong>Other items</strong></td>
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<tr>
<td>$0.3</td>
<td>$0.7</td>
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<tr>
<td><strong>Contingency (10%)</strong></td>
<td><strong>Contingency (30%)</strong></td>
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<tr>
<td>$0.6</td>
<td>$1.2</td>
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<tr>
<td><strong>Design, RE</strong></td>
<td><strong>Design, RE</strong></td>
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<tr>
<td>$0.6</td>
<td>$0.8</td>
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<tr>
<td><strong>CM</strong></td>
<td><strong>CM</strong></td>
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<tr>
<td>$0.6</td>
<td>$0.8</td>
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<tr>
<td><strong>Owners Costs</strong></td>
<td><strong>Owners Costs</strong></td>
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<tr>
<td>$0.6</td>
<td>$0.6</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>TOTAL</strong></td>
</tr>
<tr>
<td><strong>$8.1M</strong></td>
<td><strong>$7.3M</strong></td>
</tr>
</tbody>
</table>

- Other items – bridge, landscaping
- Reduced contingency reflects opportunities as well as risks
- Other items – bridge, perm. siphon, drains, landscaping
- Increased design and CM effort for this option
## Lower Dam – Overtopping vs Labyrinth

<table>
<thead>
<tr>
<th></th>
<th>Overtopping (soil cement)</th>
<th>Labyrinth</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Environmental</strong></td>
<td>(-) SI larger construction footprint</td>
<td>(-) Requires reducing the reservoir levels during construction</td>
</tr>
<tr>
<td></td>
<td>(-) Larger area(s) of disturbance for construction, hauling, stockpiling, and staging</td>
<td>(-) Removal of heritage spillway</td>
</tr>
<tr>
<td><strong>Design and</strong></td>
<td>(-) Sampling and testing of soil cement not yet undertaken</td>
<td>(+) Ability to incorporate some drawdown</td>
</tr>
<tr>
<td><strong>Construction</strong></td>
<td>(-) High level of engineering inspection required</td>
<td>(-) Const risk – flooding risk</td>
</tr>
<tr>
<td></td>
<td>(-) Not a typical armoring solution</td>
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<td></td>
<td>(-) Existing spillway lifespan in question</td>
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<tr>
<td></td>
<td>(-) Const risk – materials in dam poorly understood – possible effect on sched and cost;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>risk of inclement weather</td>
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<tr>
<td><strong>Design Reliability</strong></td>
<td>(-) Slightly higher risk of failure (risk assessment)</td>
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<tr>
<td><strong>(life safety risk)</strong></td>
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<tr>
<td><strong>Maintenance</strong></td>
<td>(-) After flood or seismic event, mtce may be required</td>
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<tr>
<td><strong>Construction Cost</strong></td>
<td>(+) Potentially lower cost</td>
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<tr>
<td><strong>Schedule</strong></td>
<td>(-) 2014 probably not possible</td>
<td>(+) 2014 possible</td>
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</tbody>
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