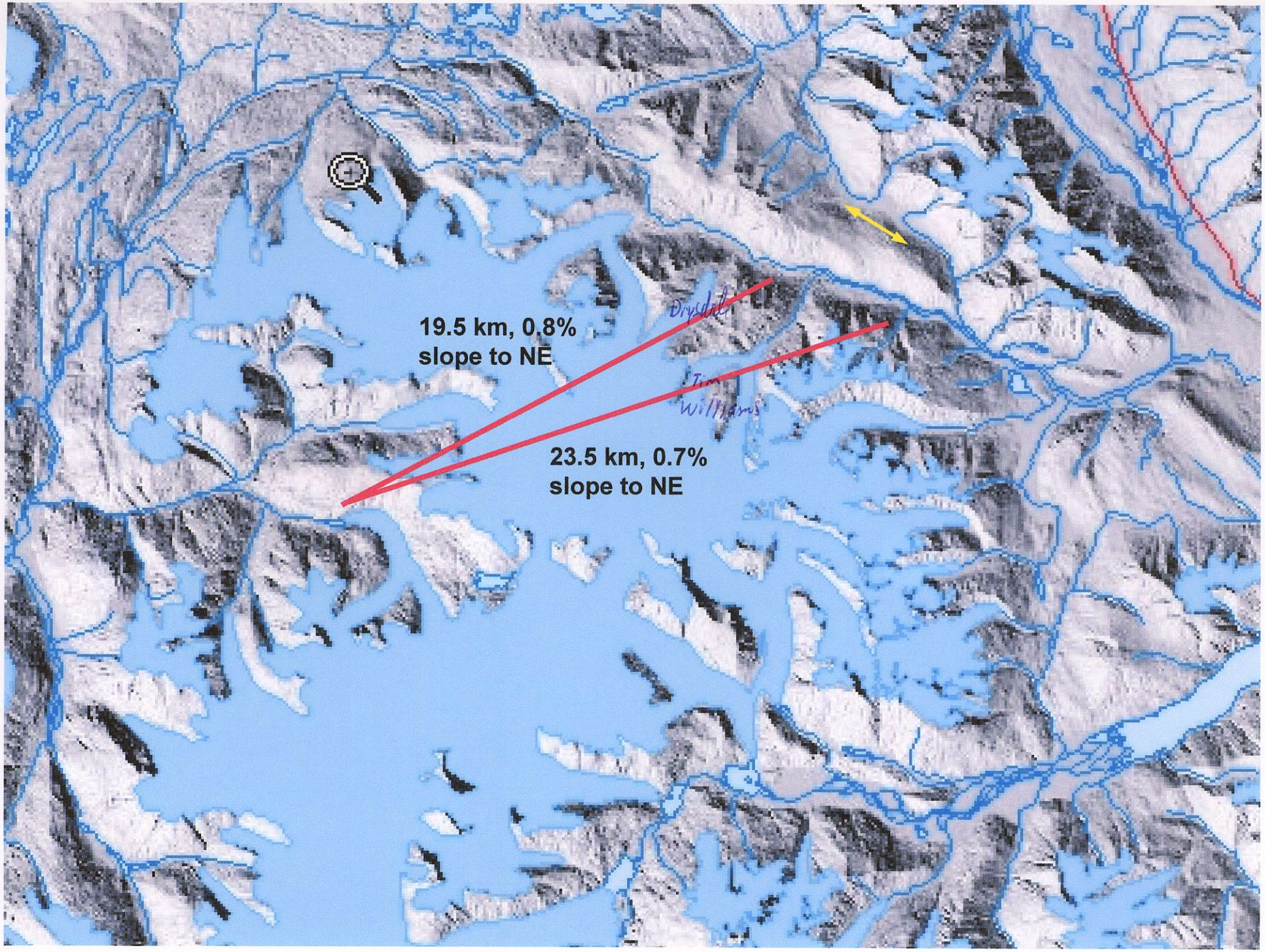
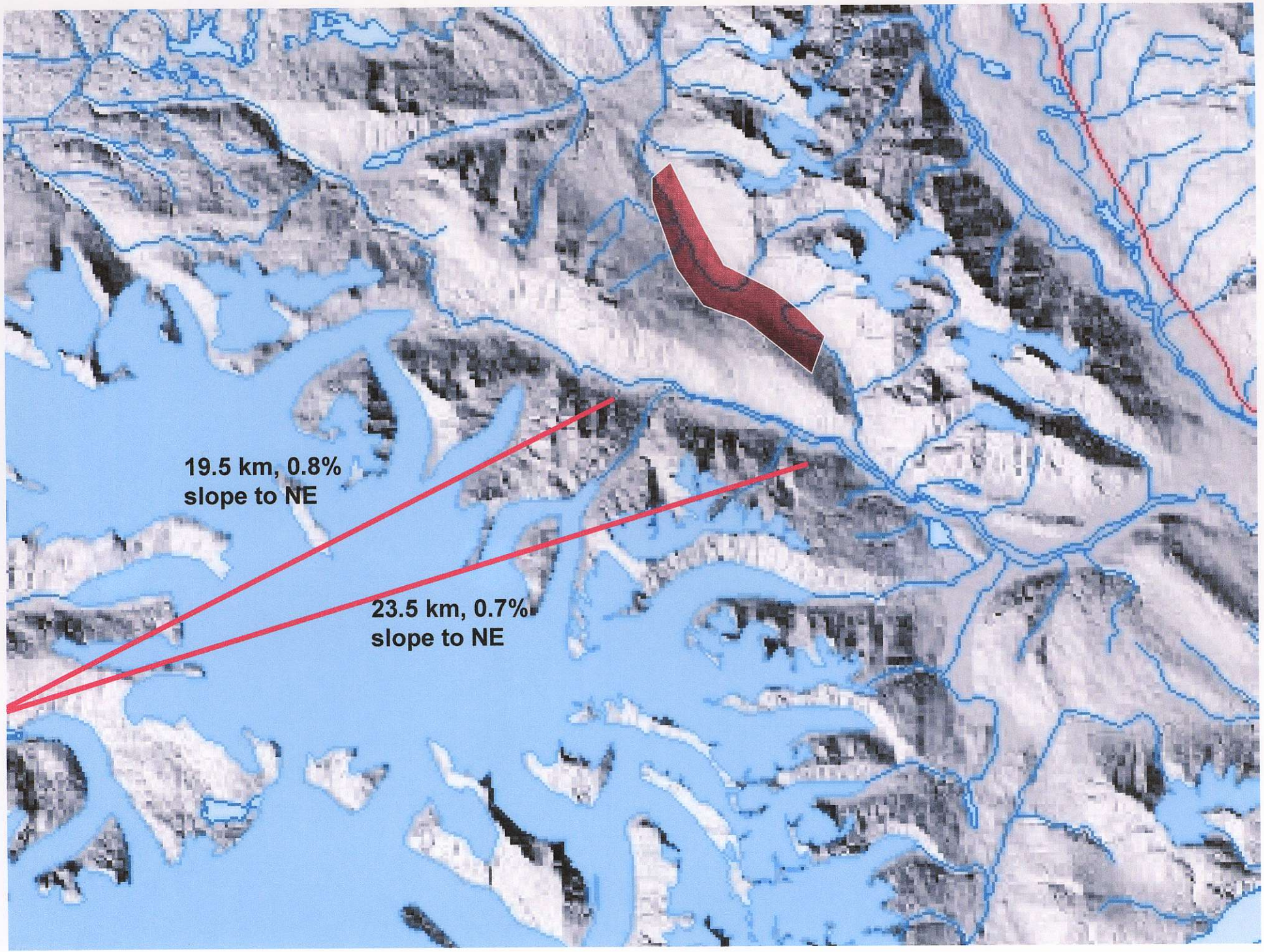
Alternative H – Tailings

Tailings impoundment to northwest of Bowser Lake, tunnel from KS site to NE

The concept.....

- 19-23 km, 6-m dia. tunnel northeast from KS area to Treaty Creek valley, provides year round access (still need a summer road for large equipment)
- Plantsite in Treaty Creek valley, easy access to Highway 37 via approx. 15 km road
- Crush ore at KS and convey via tunnel to plantsite
- Pump tailings approx. 3 km to impoundment (max. elevation difference about ?? m), that straddles a watershed divide, in a tributary valley north of Treaty Creek. From cyclone station, tailings flow via gravity.
- Impoundment formed by two 90-m high dams
- Cyclone station + flotation circuit near impoundment, on south abutment of the southern dam, to create NAG cycloned sand for dam raising (e.g. Kemess)
- PAG tailings to center of impoundment, NAG tailings used for downstream shell construction and upstream beach construction
- Open channel diversions along most of tailings impoundment perimeter, and one diversion dam/conduit


19.5 km, 0,8%
slope to NE
23.5 km, 0.7%
slope to NE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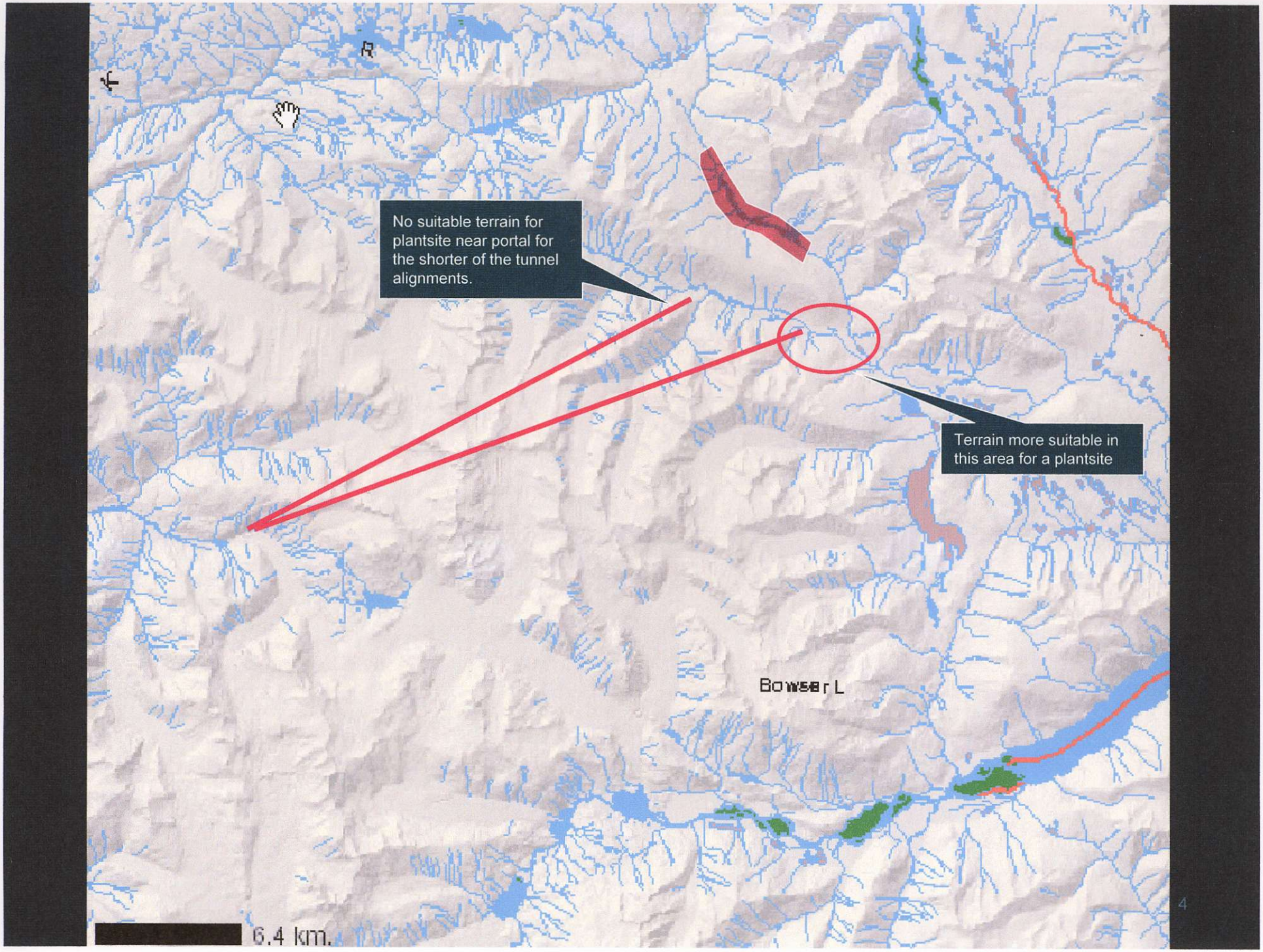
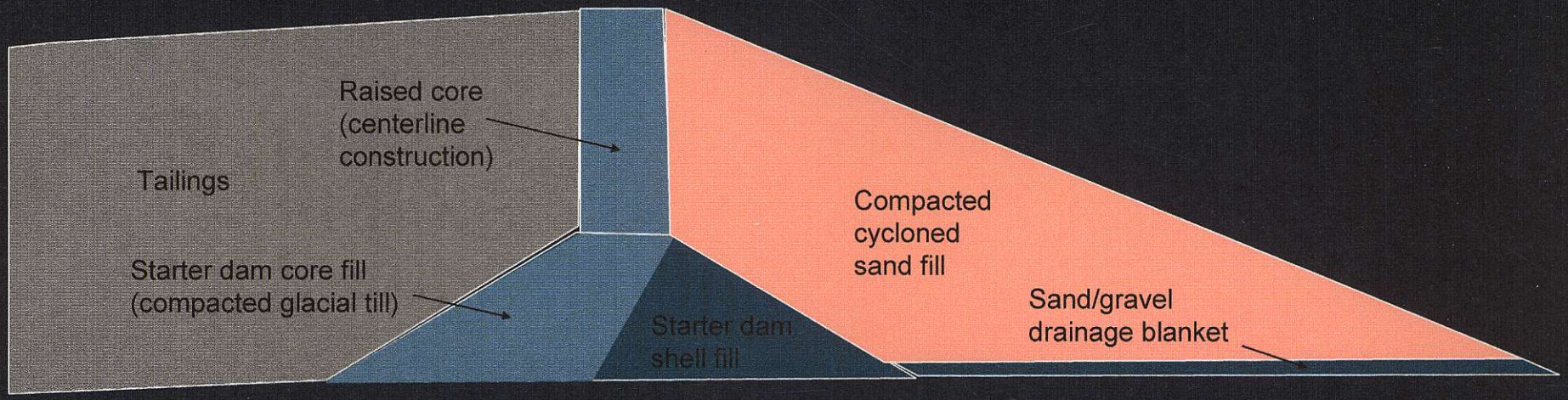

No suitable terrain for plantsite near portal for the shorter of the tunnel alignments.
Terrain more suitable in this area for a plantsite
Bowser L
6.4 km.

Conceptual dam design section

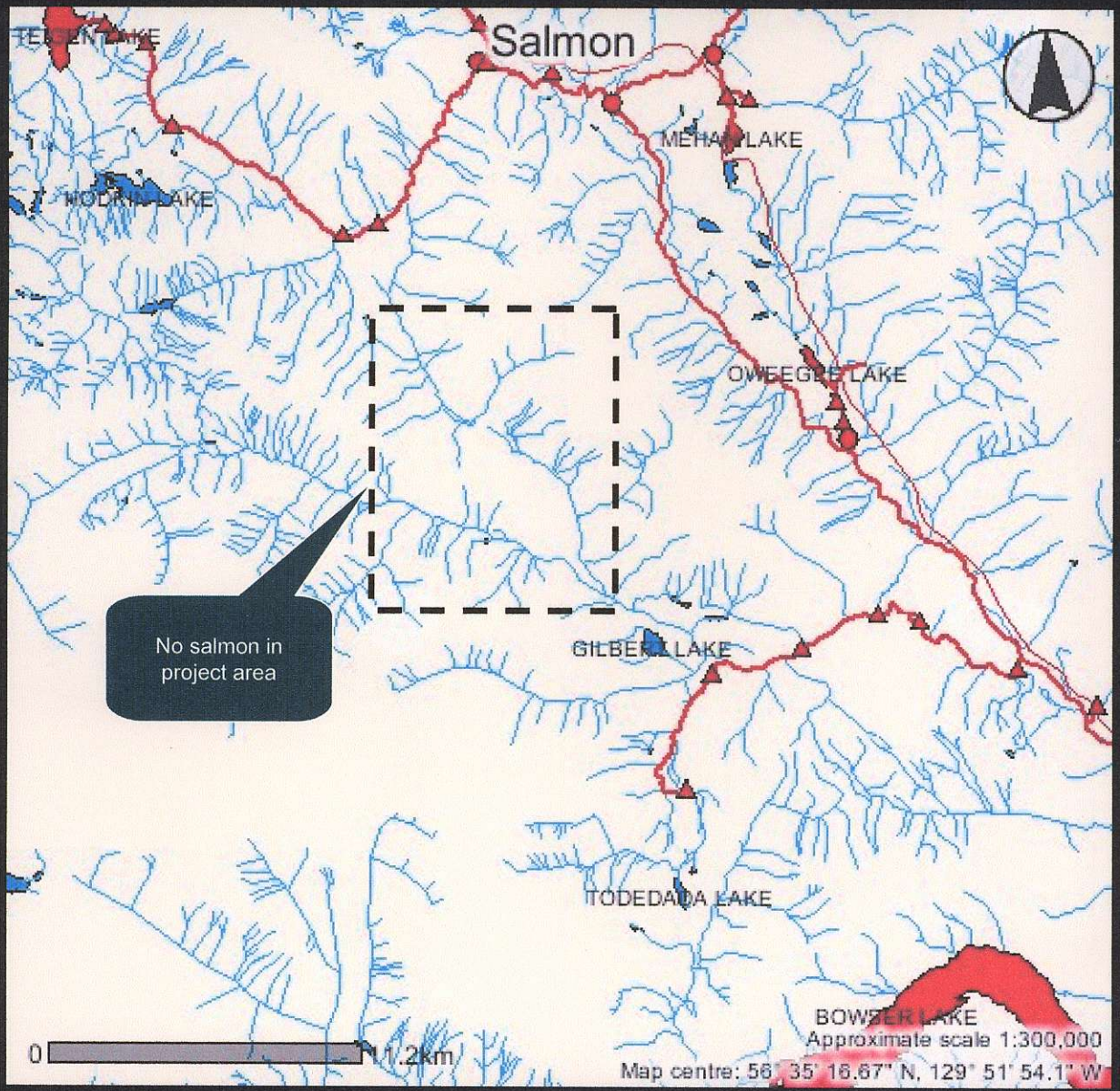


- Via flotation (sulphides removal) and cycloning, produce clean cycloned sand for dam construction
- At Kemess, plant operating cost + sand placement cost about $2.50/m^3
- Cycloned sand to upstream allows centerline raising, which reduces raising fill volumes (above starter dams) by about 50%.
- Starter dam shell fill possibly comprised of spoil (assuming it is NAG) from the tunnel construction (approx. 800,000 m^3, accounting for bulking factor)
- Upstream beach comprised of NAG tailings, so can maintain above water beaches during operations and at closure – simplifies dam design and construction, lowers costs, and enhances long term dam safety
- Sulphidic tailings discharged to central portion of impoundment for permanent submergence

Cycloned sand construction – feasible for this project?

- Same concept (cyclone plant) in place at Kemess, where cycloned sand construction takes place almost 12 months per year, except that at Kemess the flotation for sulphides removal occurs in cyclone plant – at KS:
  - Flotation for sulphides removal could take place in cyclone plant (in which case only one tailings stream is pumped uphill) or
  - Flotation takes place in the plantsite (in which case two separate streams, one NAG and one PAG) are pumped
- Assume 20% of total dam volumes required for starter dams construction, = 0.2 x 20 Mm^3 = 4 Mm^3
- With centerline raising, then remaining 16 Mm^3 fill volume is reduced by about 50%, giving 8 Mm^3 (based on assumed 3H:1V dam slopes, which should suffice unless there are very weak soils (e.g. glaciolacustrine clays) in the valley fill
- Over 12 years of dam raising, this requires production of say 1 Mm^3/year (actually 0.67 Mm^3 averaged over mine life, but dam raising is more rapid in the earlier years)
- Assuming:
  - Sulphides split = 10% of total tailings = 8,000 tpd
  - Double cycloning of 72,000 tpd of NAG tailings
  - 25% sand recovery after double cycloning (= 18,000 tpd)
  - In place compacted sand density = 1.65 t/m^3
  - 85% plant operating factor
- Then require 107 days (say 4 months) of downstream cycloning to place
  - This is easily achievable based on the Kemess experience
  - Leaves additional margin in case flatter dam slopes required based on foundation conditions
  - Also allows for extended periods of cycloning to the upstream to develop and maintain above-water (NAG) beaches

Treaty Creek Salmon Distribution



Alternative H – Tailings

Tailings impoundment to northwest of Bowser Lake, tunnel from KS site to NE

The reality…..

- Appears to be technically viable – unknowns w.r.t. tunnel (geology along alignment, degree of support required, groundwater conditions, etc.)
- Access points for ventilation shafts a problem because most of alignment underlies glacier-covered terrain
- Portal, plantsite and tailings impoundments in areas upstream of limit of reported salmon presence in Treaty Creek
- Tailings impoundment site appears favourable (foundation conditions unknown)
- Fewer permitting issues with this alternative vis a vis alternatives involving use of Bowser Lake
- This alternative is worthy of further consideration

Tailings Alternatives

Where do we stand?

amec

	Alternative	Technically Feasible?	Worthy of Further Consideration?
A	Co-disposal with waste rock in flooded impoundment in Sulphurets Valley	NO	NO
B	Float sulphides to create NAG/PAG streams, separate co-disposal with waste rock in Sulphurets Valley	NO	NO
C	Tailings initially to flooded impoundment in Sulphurets Valley, then to 1st mined-out pit	NO	NO
D1	Crush ore at mine, convey via tunnel to plantsite at Knipple Lake, pipe tailings to subaqueous deposition in Bowser Lake	YES	**YES**
D2	Crush ore at mine, convey via tunnel to plantsite at Knipple Lake, pipe tailings to subaqueous deposition in portion of Bowser Lake segmented via rockfill causeways	YES	YES
D3	Crush ore at mine, convey via tunnel to plantsite at Knipple Lake, pipe tailings to subaqueous deposition in Knipple Lake	NO	NO
E1	Float sulphides, filter NAG tailings and dry stack, co-dispose sulphidic tailings and waste rock in Sulphurets Valley impound.	NO	NO
E2	Float sulphides, filter NAG tailings and dry stack in Bowser drainage, sulphidic tailings to subaqueous deposition in Bowser Lake.	YES	NO
F	Ocean disposal via Unuk River into Alaskan Fjord	YES	NO
G	Tailings impoundment further down Sulphurets Creek, 5 dams, separate impoundment to flood waste rock	YES	NO
H	Tailings to impoundment NW of Bowser Lake, convey crushed ore to plantsite to northeast of KS site.	YES	YES