## *Open-Ended Design Problem #1*

Note - This section should be written up as a short consulting report to be handed in separately from the Lab Answer Sheet that is also due for this lab.

In an effort to reduce turbidity in Vancouver's water supply, GVRD is constructing a 1.8 billion L/day water filtration plant in the Seymour Valley. For this, two 3.8m diameter twin tunnels are required for water conveyance, both of which will be excavated using a hard rock tunnel boring machine (TBM). The potential for intersecting water saturated valley fill sediments (flowing ground) to depths of 100 m requires that the tunnels be launched from a large underground chamber at the bottom of a 180 m deep shaft.

The launch chamber has a width of 14 m and has an arched roof (height at shoulder = 4 m, height at mid-span = 6 m). The E-W length of the chamber is 70 m. The geological setting ranges from granodiorites to quartz diorites, with three key local joint sets dipping at 31/256°, 85/346° and 30/121°. A major shear zone has also been identified dipping at 73/159°.

You have been contracted to perform a kinematic analysis and to design a rock bolt pattern to achieve a Factor of Safety of 1.5 against wedge failure in the chamber roof. Make sure to list all assumptions. Consideration should be given to how to implement the design which takes into account applicable codes and safety legislation. This is provided on the next page. The rock bolts available from your supplier, and their properties, are also listed on the next page.

Applicable codes and safety legislation:

WORK SAFE BC
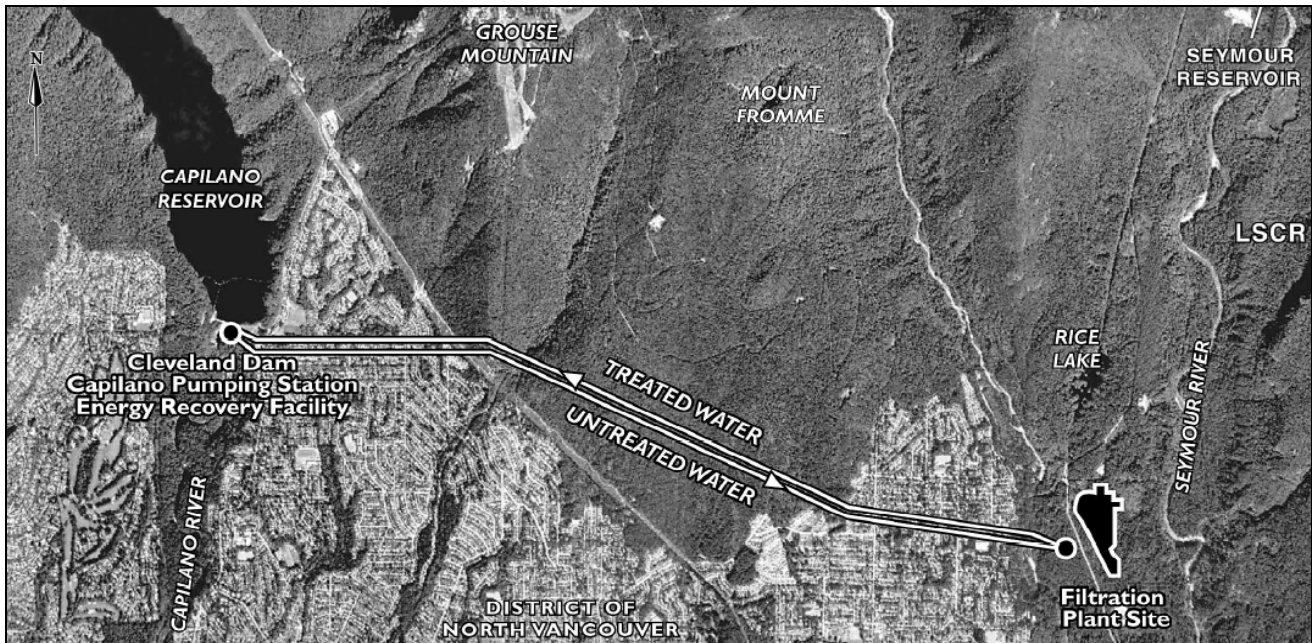
 Ground Control 22.62 to 22.65:   http://www2.worksafebc.com/publications/ohsregulation/part22.asp

DYWIDAG-SYSTEMS INTERNATIONAL

DSI

Rock and Roof Bolts

	Yield Strength		Ultimate Tensile Strength		Calculated Shear Strength	Standard Elongation	Uniform Elongation	Mass per Metre	Bar Core Diameter	Major Bar Diameter	Cross Sectional Area
	MPa	kN	MPa	kN	kN	%	%	kg	mm	mm	mm²
16 mm	500	110	640	130	130	16	8	1671	16	17,4	210[1]
18 mm	500	150	640	210	150	16	8	2140	18	19,8	316[2]
20 mm	500	160	730	230	160	16	8	2583	20	21,8	316[3]

* Plate Capacity = 100 kN