

# A Legacy Lecture

## Outstanding Contributions to British Columbia By Eight Geotechnical Engineers

Bryan D. Watts

Canadian Geotechnical Conference, 2006



I am going to talk briefly about the contributions of eight well-known engineers from British Columbia. How do you choose these individuals when you know that many equally deserving individuals cannot be mentioned? Our criteria was relatively simple; they should be nominally retired and have contributed to geotechnical engineering in business, mentoring or in more formal education. I decided to exclude professors if only because their contributions are better known and accessible.

# Leggett Award Winners



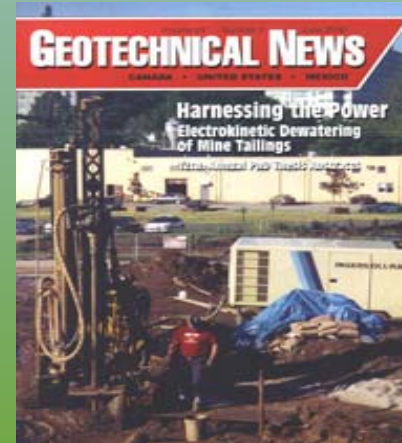
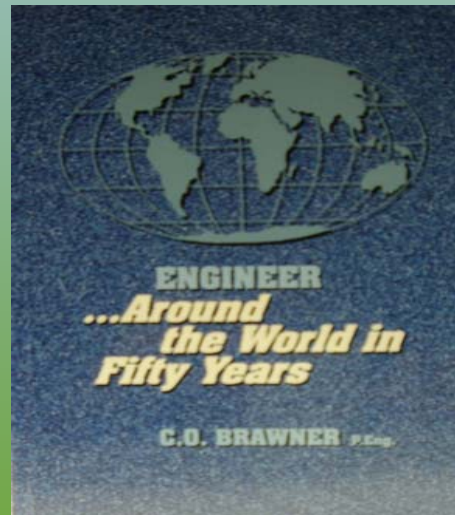
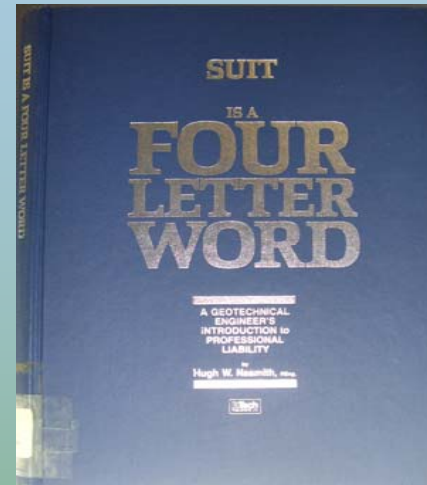
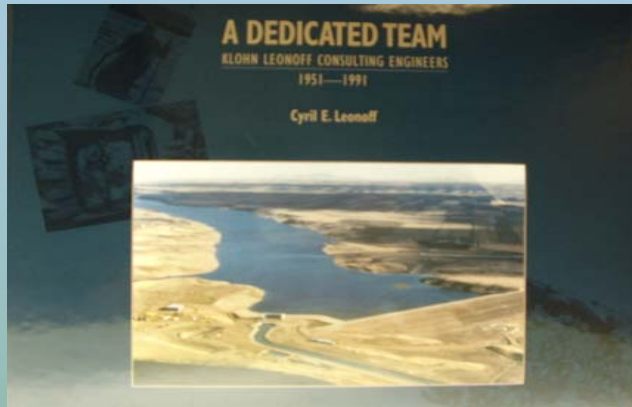
- 1970 Robert Peterson (deceased)
- 1971 Robert M. Hardy (deceased)
- 1972 Norman W. McLeod (deceased)
- 1973 Victor Milligan
- 1974 G. Geoffrey Meyerhof (deceased)
- 1975 Carl B. Crawford
- 1976 Anthony G. Stermac (deceased)
- 1977 Pierre Larochelle
- 1978 Donald H. MacDonald
- 1979 Norbert R. Morgenstern
- 1980 Roger Brown (deceased)
- 1981 Branko Ladanyi
- 1982 Donald J. Bazett (deceased)
- 1983 Jack I. Clark
- 1984 Laval Samson
- 1985 John I. Adams
- 1986 M.A.J. (Fred) Matich
- 1987 C.F. (Charlie) Ripley
- 1988 William A. (Bill) Trow
- 1989 Kwan Yee Lo
- 1990 Earl J. Klohn
- 1991 Robert M. Quigley (deceased)
- 1992 Jack D. Mollard
- 1993 Raymond N. Yong
- 1994 Michael Bozozuk
- 1995 François A. Tavenas (deceased)
- 1996 John L. Seychuk
- 1997 Gordon C. McRostie
- 1998 Delwyn G. Fredlund
- 1999 C.O. (Chuck) Brawner
- 2000 Donald H. Shields
- 2001 James (Jim) Graham
- 2002 Raymond P. (Ray) Benson
- 2003 R. Kerry Rowe
- 2004 Guy Lefebvre
- 2005 John Krahn

So the first place we looked was the CGS Leggett Award List. That gave us Charlie Ripley, Earl Klohn, Chuck Brawner, and Ray Benson. To this list we added Norm McCammon from Golder, Al Imrie from BC Hydro, John Gadsby from everywhere, and Frank Patton of rock mechanics fame and Westbay Instruments. Time limits me to these few individuals. No less deserving individuals are Cyril Leonoff, Graham Morgan, Nigel Skermer, Graham MacLeod. I can't hope to do justice to the stellar careers of these outstanding gentlemen. I can only give quick snapshots of their careers.

# We Added

- Al Imrie (dams)
- Norm McCammon (foundation engineering)
- John Gadsby (mining and education)
- Frank Patton (rock mechanics and landslides)

# Publications of Senior Members



Even in retirement, our senior members continue good work. Cyril Leonoff wrote a dedicated team on the 40th anniversary of Klohn Leonoff which was about the exploits of Charlie Ripley, Earle Klohn, and Ray Benson, and Cyril himself. Suit is a Four Letter Word is all about legal pitfalls in geotechnical engineering with contributions from John Gadsby, and Chuck Brawners autobiography, well worth reading. And of course, BiTechs "Geotechnical News" which is published right here is Greater Vancouver.

# Natural Hazards - Lower Mainland

**GEOSCAPE VANCOUVER**  
LIVING WITH OUR GEOLOGICAL LANDSCAPE

**LIVING IN THE SHADOW OF VOLCANOES**  
Mt. Garibaldi: Unstable Slopes  
Mt. Meager: STILL COOKIN'!  
Mt. Baker: The Sleeping Giant

**SEA TO SKY**  
Britannia Mine: Economic Boom, Environmental Problem  
Treacherous Slopes  
Metals on the Move  
Protecting People and Property

**EARTHQUAKE !! ON SHARKY GROUND**  
Plates & Quakes  
Where Earthquakes Happen  
Quake Damage  
Earthquakes Felt in Vancouver

**THE FRASER RIVER DELTA NATURE'S NEW GROUND**  
Where River Meets Sea  
The Unstable Front  
What Happens When It BREAKS?  
Can't stop CROWDING - or can it?

**WHAT'S UNDER OUR FEET?**  
What's just left digging?  
What's under the City?  
What Infrastructure?

**MOUNTAIN CORRIDORS OUR ECONOMIC LIFELINES**  
Rockfalls in the Fraser Canyon  
Avalanches Along the Coquihale Highway  
When a Mountain Falls  
Hope Slide  
Coquihale Highway

**WATER UNDERGROUND VITAL BUT VULNERABLE**  
Groundwater  
Water Under the Ground

**WHEN THE FRASER FLOODS**  
Floods, Dikes, and Floodplains  
BIG FLOODS  
SO WHAT CAN BE DONE?

**GEOVERSITY: All Rocks Are Not The Same**  
Different Rocks, Different Resources  
There's copper and gold in them thar hills  
Sand and gravel: a big business  
Granite, pumice and clay: the industrials

**The Population Boom**  
Greater Vancouver Regional District  
1951, 1961, 1971, 1981, 1991, 2001, 2011

**NEED MORE INFO?**  
Additional Reading  
Web and Internet Info

We have challenging ground conditions and all types of Natural Hazards in Greater Vancouver alone, soft clays, peats amongst landslide hazards, flooding, earthquakes, and every once in a millenium a volcano. There is more variety in soil conditions in Greater Vancouver than in some entire provinces in Canada. In our province we have steep terrain, high rainfall, and large earthquakes.

# Kenney Dam

400 feet high in the 1950s



At the time that it was built in the early 1950s, Kenney Dam was the highest earthfill in the world. Karl Terzaghi was the designer.

# Bennett Dam

600 feet high in the 1960s



In the early 1960s Bennett Dam or the Portage Mountain Dam was constructed at 600 ft high was the highest earthfill in the world for a short period.

# Mica Dam

800 feet high in the 1970s



And when Mica was finished in the early 70s it was the highest earthfill dam in the world at the time.  
So British Columbia has seen big challenges and, fortunately, we had talented people to deal with these challenges



# Charlie Ripley



My first featured engineer is Charlie Ripley who started Ripley and Associates in 1951. His brother, Herbert Ripley was one of the founders of Associated Engineering, a large civil engineering company in Canada. He came from Alberta after completed graduate studies at Harvard under Karl Terzaghi.

Charlie was President of Ripley, Klohn and Leonoff until his retirement in the early 1970s. His firm worked on primarily large industrial foundations and dams throughout the 1950s and 1960s. In the technical literature, Charlie is perhaps best known for his work on filter design for dams. His work is quoted in the recent update to Terzaghi and Peck.

# Aluminum Company of Canada



Charlie Ripley testing the dredged fill for the preload at the Alcan aluminum smelter in Kitimat April 1952.

# Cheakamus Dam



This is Charlie at the Cheakamus Dam site which we all pass on our way to skiing at Whistler. It was built directly on the Rubble Creek landslide fill. Terzaghi was the designer.  
From left: Mark Olsen, Charlie Ripley, Alan Fletcher, Victor Dolmage

# Crown Zellerbach



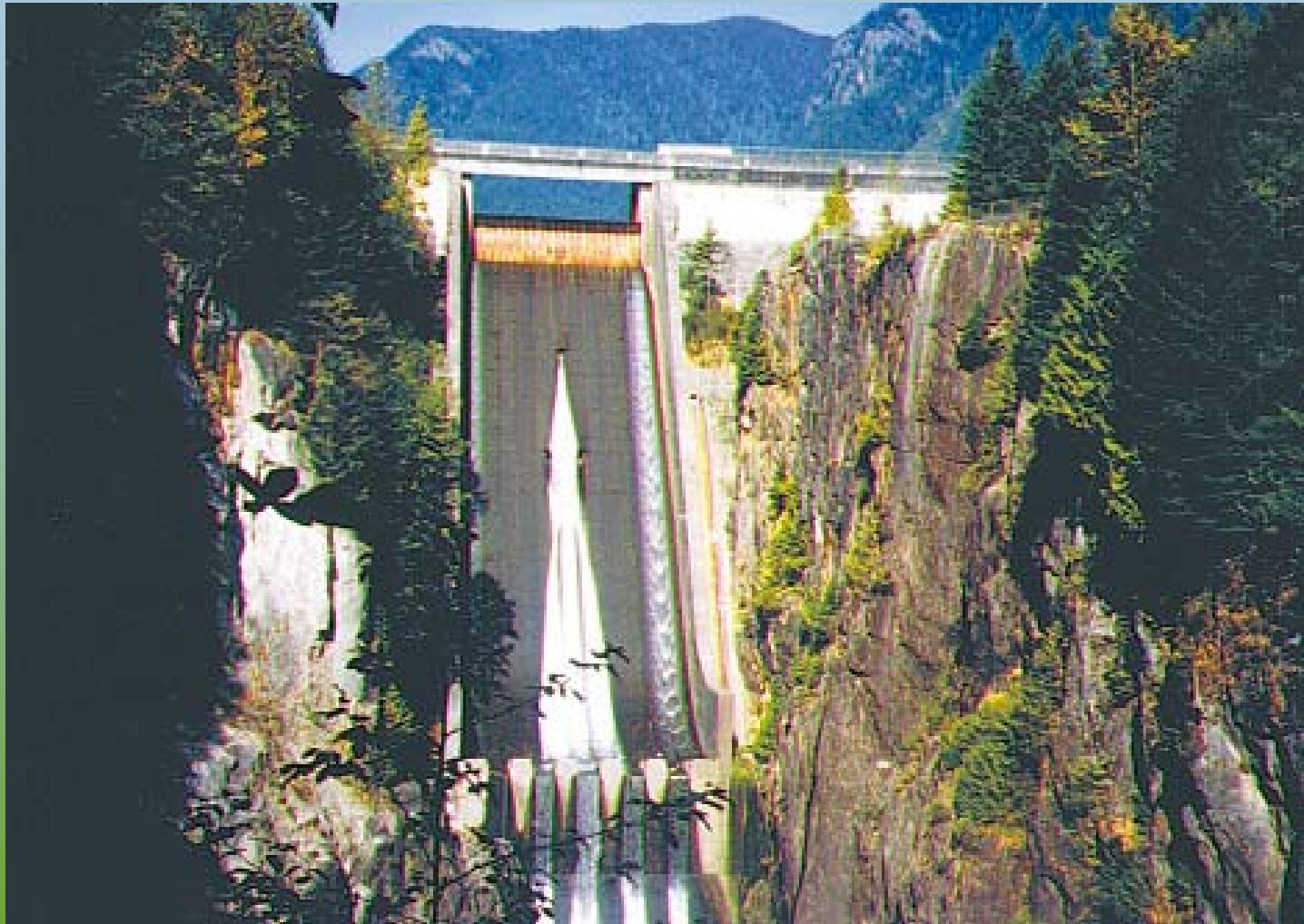
This box plant was the first structure to use engineered preload in the Fraser River Delta in the 1950s. Terzaghi was heavily involved (Photo: 1956)

# Iona Island Sewage Treatment



This plant opened April 19, 1963. Preload fill in place December 3, 1960. Thereafter, many preloads were constructed.

# Cleveland Dam



This is the concrete section of the Cleveland Dam, a water supply dam just to the north of us on the Cleveland River. For years, Charlie worked on the seepage and potential internal erosion of the through the buried channel on the left abutment. He took six months off to work on this problem.

# Karl Terzaghi



After Terzaghi's passing, Charlie and his wife would regularly take vacations with Ruth Terzaghi, a geologist, to see dam sites. Photo: Karl Terzaghi at Salmon Glacier near Stewart, BC, taken on a trip with his son, Eric, along with Juul Hvorslev, Charles Ripley and Herbert Ripley, summer 1956.

# Chuck Brawner



Chuck Brawner is a native British Columbian born in Summerland. He started his career in the 1950s with the BC Dept of Highways. He got his Masters degree under Meyerhoff in Nova Scotia. In 1963, he joined Golder Associates which formed Golder Brawner here in British Columbia. In 1978, he left Golder for teaching at the University of British Columbia where he stayed to inspire students until 1995 when he went back to full time consulting. He is best known for the rock mechanics aspects of open pit design and the stabilization of landslides through vacuum drainage. Following slides show the extensive list of projects on which he has worked.





# Chuck Brawner's Experience

## Tunnels

- BC Dept. of Highways, Sailor Bar Tunnel
- BC Dept. of Highways, Saddle Rock Tunnel
- BC Dept. of Highways, China Bar Tunnel
- CP Rail, Mt. Macdonald Tunnel Alignment, BC
- CP Rail Mile 9 Tunnels, Revelstoke, BC
- CP Rail, Mink Tunnel, Ontario
- CP Rail, Red Sucker Tunnel, Ontario
- CP Rail, Beaver Tunnel, BC
- CP Rail, Spiral Tunnels drainage control, BC
- CP Rail, Jackfish Tunnel, Ontario
- CP Rail, Ruby Creek Tunnel, BC
- BC Rail Wolverine Tunnel, BC
- BC Rail Table Tunnel, BC
- BC Rail Seton Lake Tunnel, BC
- Melbourne City Center Subway Tunnel, Australia
- Greenvale Railway Tunnel, Queensland, Australia
- Snettisham Penstock Tunnel, AK
- Russian River Fish Ladder Tunnel, AK
- Alaska Railway Whittier Tunnels, AK
- Mile 17 Tunnel, White Pass and Yukon A.A., AK
- Arch Cap Highway Tunnel, OR
- Blue Mountain Tunnel, Union Pacific Railway, OR
- Mossier Tunnels Rehabilitation, OR
- Elk Creek Tunnel, OR
- Sagamoso Penstock Tunnels and Powerhouse, Columbia
- Tazamina Power Project, AK

## Landslides - Rockslides

- Black Canyon Rockslide, BC
- Jefferson County Landslide, OR
- Dryrock Slide, Spences Bridge, BC
- Park Bridge Slide, Golden, BC
- Lakelse Lake Slides, Terrace, BC
- King Kamehameha Highway Slide, Oahu
- Malibu Landslide Stabilization, Malibu, CA
- CP Rail Mile 52, Thompson Subdivision, BC
- Osweg Creek Landslide litigation, OR
- Queensland Railway slides, Australia
- C.N.R. Mile 12 Slide, Fraser Canyon, BC
- Cassiar Clinton Creek Waste Pile Slide, YT
- Keystone Canyon Rock Slide, AK
- Fort Smith Landslide, NT
- Peace River Valley Slides, BC Rail, BC
- Bonnyville Dam Lock Stability, OR
- Rocky Point Stability, OR
- Ketchikan Jail Rock Slopes, AK
- Squamish Highway Rockslides, BC
- Hungry Horse Canyon, MT
- Skagway Harbor Submarine Slide, AK
- Quintette Coal Waste Dump Slides, BC
- Fording Coal Waste Dump Slides, BC
- Downie Slide, CP Rail, BC
- BC Dept. of Highways, Peace River Valley Slides, BC
- South Okanagan Valley silt slides, BC
- Aberdeen Hills Subdivision Slide, BC
- Showbread Slide, Idaho Dept. of Highways, ID
- Dutchman Creek Rockslide, Mica Dam, BC
- Arrow Lake Landslides, BC Hydro, BC
- Mile 47.9 Slide, CP Rail, Ashcroft, BC
- Makapuu Rock Fall Control - HI
- Waimea Rock Fall Control - Oahu, HI



# Chuck Brawner's Experience

## Industrial and Building Foundation Projects

- Lafarge Cement Plant, Kamloops, BC
- Annacis Island Cement Plant, Vancouver, BC
- Development of Beaufort Sea Dredged Islands, Humble Oil Co. Horseshoe Bay Ferry Terminal, Vancouver, BC
- Skagway Deepsea Port, AK
- Pioneer Grain Elevator, Vancouver, BC
- Bulkley Valley Sawmill, Houston, BC
- Fording Coal Plant Facilities, BC
- Simon Fraser University, Vancouver, BC
- Westcoast Transmission Building, Vancouver, BC
- Bank of Nova Scotia Building, Vancouver, BC
- Pacific Coliseum, Vancouver, BC
- Canadian Pacific Marshalling Yard, Coquitlam, BC
- Deuba Beach Resort, Fiji
- Delta Municipal Hall, BC
- Kelowna Court House, BC
- Revelstoke Hospital, BC
- Johns Manville World Headquarters, CO

## Transportation Projects

- Burnaby-Freeway, Trans Canada Highway, BC
- Fraser Canyon Highway, Trans Canada Highway, BC
- Rogers Pass Highway, Trans Canada Highway, BC
- Anchorage-Seward Highway, (5 projects), AK
- Canadian Pacific Railway, BC, AB, ON, NB and ME
- Burlington Northern Railway, WA
- Greenvale Railway, Queensland, Australia
- Tahsis Company Logging Road Stability (2006), BC
- Mt. St. Helens National Park Highway, WA
- White Pass and Yukon Railway, AK
- Detroit Lakes Rock Slope Stabilization, OR
- BC Railway, Seton Lake Rockslide, BC
- Rocky Point Rock Stabilization, OR
- Keystone Canyon Rockslides, AK
- Stevens Pass Slope Stabilization, WA
- White Pass Railway Snow Avalanches, AK
- Lytton North Siding Extension, C.N.R., BC
- Banks - Loman Rock Stability, MT
- Haines - Canadian Border, AK
- Iceland Dept. of Highways - Rock Seminar, Iceland Ketchikan Bypass, AK
- Arizona D.O.T., Rock Bolting Seminar, AZ
- Thompson Pass Reconstruction, ID
- Montpelier East Reconstruction, ID
- Ahba Descent Highway Stability Review, Saudi Arabia
- Alaska Dept. of Highways, Thane Road, Juneau, AK
- Public Works Canada, Fort Nelson West Rock Stability, BC
- Hawaii Dept. of Highways - Rock Slope Inspections, HI
- Hungry Horse Canyon, Montana Dept. of Highways, MT
- Kicking Horse Canyon, Trans Canada Highway, BC
- Coast Highway Rock Slope Stabilization, OR
- Dept. of Transportation, Mile 4.1 Historic Highway, OR
- Denver and Hudson Railway, NY
- Goff Bridge - Riggins, ID



# Chuck Brawner's Experience

## Bridge Foundation Projects

- Alexander Bridge, Fraser Canyon, BC
- Fraser River Bridge, Prince George, BC
- Fraser River Bridge, Port Mann, BC
- Qualicum River Bridge, BC
- Fraser River Bridge, Quesnel, BC
- Nechako River Bridge, BC
- Okanagan River Bridges, Penticton, BC
- Sicamous Bridge, BC
- Columbia River Bridge, Trail, BC
- Columbia River Bridge, Castlegar, BC
- Elk River Bridge, Fernie, BC
- Columbia River Bridge, Golden, BC
- Clanwilliam Overpass, Eagle Pass, BC
- Dechutes River Bridge, OR
- Thompson River Bridge, Spences Bridge, BC
- Columbia River Bridge, Revelstoke, BC
- Fraser River Bridge, Williams Lake West, BC
- Skeena River Bridge, Terrace, BC
- Thompson River Bridge, Kamloops, BC
- Sikanni River Bridge, Fort Nelson, BC
- Kootenay River Bridge, Creston, BC
- Pine River Bridge, Chetwynd, BC
- Buckley River Bridge, Smithers, BC
- Buckley River Bridge, Houston, BC
- Number 5 Road Overpass, Richmond, BC
- Serpentine River Bridge, Surrey, BC
- Kicking Horse River Bridges (3), Golden, BC
- Crooked River Bridge, Bend, OR

## Litigation

- Foreman vs State of Oregon, OR
- Govt. of Canada vs Kean Construction, AB
- Just vs Govt. of BC, BC
- Syncrude Canada vs Commonwealth Constr., AB
- CP Rail vs Selkirk Contractors, AB
- Wolverine Contractors vs BC Rail, BC
- Molosso vs State of Alaska, AK
- Theiss Constr. vs Freeport Nickel, Australia
- CP Rail vs Govt of Ontario, ON
- Cominco vs Cementation, NT
- State of Alaska vs Harding Lawson Ltd., AK
- Craft vs Norfolk Southern A.A., VI
- CIGNA Insurance Group vs IMC Potash, SK
- OK Tedi Mining vs Insurance Consortium, PNG
- Miller Construction vs Dept. of Transportation, Canada
- Gobin vs The Queen, BC
- Dillingham Construction vs BC Hydro, BC
- Chinook Aggregates vs Matsqui, BC
- Walton vs The Queen, BC
- Holt vs The Queen, BC
- Mochinski vs The Queen, BC
- Sloan vs North Coast Construction, BC
- BC Rail vs CPCS, BC
- Watson vs BC Highways, BC
- Tercon vs Noranda, BC
- Edgeworth Construction vs BC Highways, BC Morrison vs SRK Robinson, BC
- Williams Storage vs SKR Robinson, BC
- Class Action vs Cyprus Mines, CA
- Wig mar Cosntruction vs AGRA, BC
- Ducette vs BC Highways, BC
- TCI Construction vs Bureau of Reclamation, CA
- Gerling Insurance vs Golder Assoc., MT
- State of Alaska vs PND Engineering, AK
- Onishi vs County of Honolulu, HI



# Chuck Brawner's Experience

## Review Consultancy

- Chairman, Syncrude Geotechnical Review Bd., AB
- Chairman, Pine Point Seepage Review, NT
- Annual Reviews, Yukon Water Board, YT
- State Electric Commission, Morwell Coal Project, Australia
- State Electric Commission, Yallorn Coal Project, Australia
- Tumbler Ridge Review Board, BC Rail, BC
- CODELCO Stability Review, Chuquicamata Mine, Chile
- Atlas Consolidated Mine Stability Review, Philippines
- Rio Tinto Huelva Open Pit Stability Review, Spain
- Yaamba Oil Shale Project, Queensland, Australia
- Suncor Tar Sand Geotechnical Review, AB
- Teck Corp San Nicolas Project, Mexico
- Burlington Northern Railway Rock Stability Review, WA
- Canadian Pacific Railway Rock Stability Reviews, Canada
- Tosco (The Oil Shale Corp) Mine Review, CO
- OK Tedi Tailings Site Failure Review, Papua New Guinea
- Electricity Generation Authority, Lam Pang, Thailand
- Titania Mine Slope Stability Review, Norway
- Sante Fe Gold Corp Stability Review (6 projects), USA
- Baja Descent Highway Rock Stability Review, Saudi Arabia
- Lihir Gold Project Review, Papua New Guinea
- American Barrick Goldstrike Pit Stability Review, NV
- Hammersley Iron Mine Stability Review, Australia
- Westar Elkview Waste Pile Stability Review, BC
- Princeton Mining Huckleberry Project Review, BC
- El Pachon Pit Slope and Tailings Dam Stability, Argentina
- La Granja Pit Slope and Tailings Dam Stability, Peru
- OMAI Gold Mine Tailings Outflow Review Board, Guyana
- Marcopper Tailings Outflow, Independent Review Expert, Philippines
- Kemess Mine Review Board, BC
- Carlota Project Pit Slope and Leach Dump Review, AZ
- Cambior Gros Rosbel Tailings Dam Review, Surinam
- Tech Corp Petraquippa Project Pit Slope Review, Panama
- Sagamosa Hydro Project Rock Stability, Columbia
- Placer Dome Las Cristinas Tailings Dam Review, Venezuela
- Cambior Metallica Mine Rock Slope Review, Mexico
- Newmont Mining, Yanacocha Pit Slope Review, Peru
- Placer Dome Seminar and Stability Review, ON
- Placer Dome Cortez Stability Review, NV
- Placer Dome Western Deeps Water Control, South Africa
- Wabush Iron Mine Dewatering Review, NL
- Highland Valley Copper Overburden Review, BC
- Crystallex San Gregorio Mine, Uruguay
- Empire Iron Mine Slope Stability, MI
- Batu Hijau Pit Slopes, Newmont, Indonesia



# Chuck Brawner's Experience

## Stability for Surface Coal Mining

- Quintette Coal Mine, BC
- Teck Bullmoose Coal Mine, BC
- Utah Blackwater and Goonyella Projects, Australia
- Lochiel Coal Project, South Australia
- Hail Creek Coal Project, Queensland, Australia
- Rotowara Coal Mine Stability, New Zealand
- Line Creek Coal Mine, BC
- Byron Creek Coal Mine, BC
- Fording Coal Pit Slopes, Tailings Dams and Waste Piles, BC
- Saskatchewan Power Open Pit Stability, SK
- Highvale and Wabamun Pit Stability, AB
- Cardinal River Coal, AB
- Luscar Coal Mine, AB
- Consolidation Coal pit stability, IL
- Rocky Mountain Energy Coal Project, CO
- Kaiser Resources pit and waste pile stability, BC
- Greenhills Coal Mine pit and waste pile stability, BC
- Morrison Knudsen Elk Valley Project, BC
- Sukunka Coal Project, BC
- Manalta Coal Mine Stability, AB
- Westar Waste Dump Stability, BC

## Tailings Dams

- Bethlehem Copper Corp., Highland Valley, BC
- Lornex Highland Valley Mine, BC
- Syncrude Tar Sand Mine, AB
- Suncor Tar Sand Mine, AB
- Craigmont Mines Ltd., BC
- Dalton Mines Ltd., BC

- Giant Mascot Mine, Hope, BC
- Treminco, Silvana Mine, Sandon, BC
- Lepanto Mining Corp., Philippines
- Marcopper Copper Mine, Philippines
- Mines du Rif, Morocco
- Pinchi Lake Mercury Mine, BC
- Bouchard Hebert Mine, QC
- Coeur d'Alene Mines, New Zealand
- Fording Coal Wash Plant tailings, BC
- Westmin Premier Mine, BC
- Ranger Uranium Mine, Australia
- Barahona and Colihues Dams, El Teniente, Chile
- Endako Mine, BC
- Bell Mine, Granisle, BC
- OMAI NO.2 Tailings Dam, Guyana
- Cypress Anvil Mine, YK
- Mina Matilda Mine, Bolivia
- Avoca Mines Ltd., Ireland
- Pine Point Mines Ltd., NT
- Centromin Casapalen Mine, Peru
- Eskay Creek Mine Tailings Dam Review, BC
- Princeton Huckleberry Mine, BC
- Golden Bear Tailings Dam Review, BC
- Hecla Grouse Creek Mine, ID
- Westmin Myra Creek Mine, BC
- El Pachon Mine, Argentina
- Imperial Metals, Mt. Polly Mine, BC
- Kemess Project - Northgate, BC
- La Doyon Mine, Barrick Cambior, QC
- Niobec Mine, QC
- Comsur Mine, Bolivia
- La Granja project, Peru
- Mascot Gold Mine - Hedley, BC



# Chuck Brawner's Experience

## **Stability for Surface Mining (non-coal)**

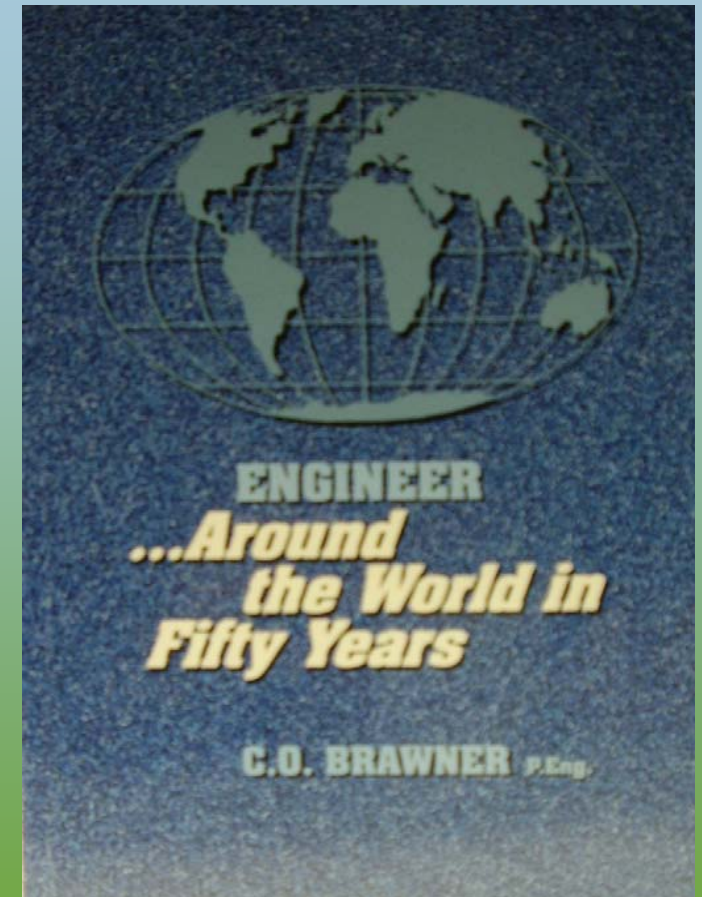
- Amok Cluff Lake Uranium Mine, SK
- BC Molybdenum Project, BC
- Kennco Stikine Galore Creek Project, BC
- Cassiar Asbestos, BC
- Bethlehem Copper, Highland Valley, BC
- P.T. Pacific Nickel Project, Indonesia
- Kaiser Cement and Gypsum, CA
- EXXON Highland Uranium Mine, WY
- Cyprus Anvil Mine, YT
- Roan Consolidated Chambishi & Kalalushi Mines, Zambia
- Nichanga Consolidated Copper Mine, Zambia
- Falconbridge Westrob Mine, BC
- Canadian Johns Manville, QC
- Flintkote Asbestos Mine, QC
- Lake Asbestos Mine, QC
- Rio Tinto Zinc Project, Wales
- Utah International Molybdenum, Port Hardy, BC
- Placer Endako Mine, BC
- Placer Gibraltar Mine, BC
- Viceroy Castle Mountain Project, NV
- Cleveland Cliffs Iron Co., MI
- Iron Ore Co. of Canada - Schefferville, QC
- Iron Ore Co. of Canada - Labrador City, NL
- Quebec Cartier Mining, Gagnon, QC
- Marcopper Mining Corporation, Philippines
- Lornex Highland Valley Mine, BC
- Highmont Highland Valley Mine, BC
- Valley Copper Highland Valley Mine, BC
- Afton Mine, BC
- Gortdrum Mine, Tipperary, Ireland
- Tara Mine, Ireland
- Hammersley Iron Mine, Australia
- Hanna Mining Company, MI
- First Miss Getchel Mine, NV
- Oslo Tar Sand Project, AB
- Molycorp, Questa, New Mexico
- Dye Mine, Whan, P.R. of China
- Bell Mine, Granisle, BC
- Colomac Gold Mine, NT
- Steep Rock and Caland Mine Closure, ON
- Anamax Twin Buttes Mine, AZ
- Marindique Mining, Philippines
- Princeton Similkameen Mine, BC
- Pegasus Beal Mt. Gold Mine, MT
- Cambior Omai Gold Mine, Guyana
- Goldenbell Mariposa Gold Project, CA
- Valdez Creek Gold Mine, AK
- Mascot Gold Mine, Hedley, BC
- INCO Thompson Mine, MB
- New Imperial Mt. Polly Project, BC
- Porgera Mine, Papua New Guinea
- Missima Mine, Papua New Guinea
- La Granja Project - Cambior, Peru
- El Pachon Project - Cambior, Argentina
- Empire Iron Mine, MI
- Crystellex Victoria Mine, Venezuela
- North Kemess Project, BC



# Chuck Brawner's Experience

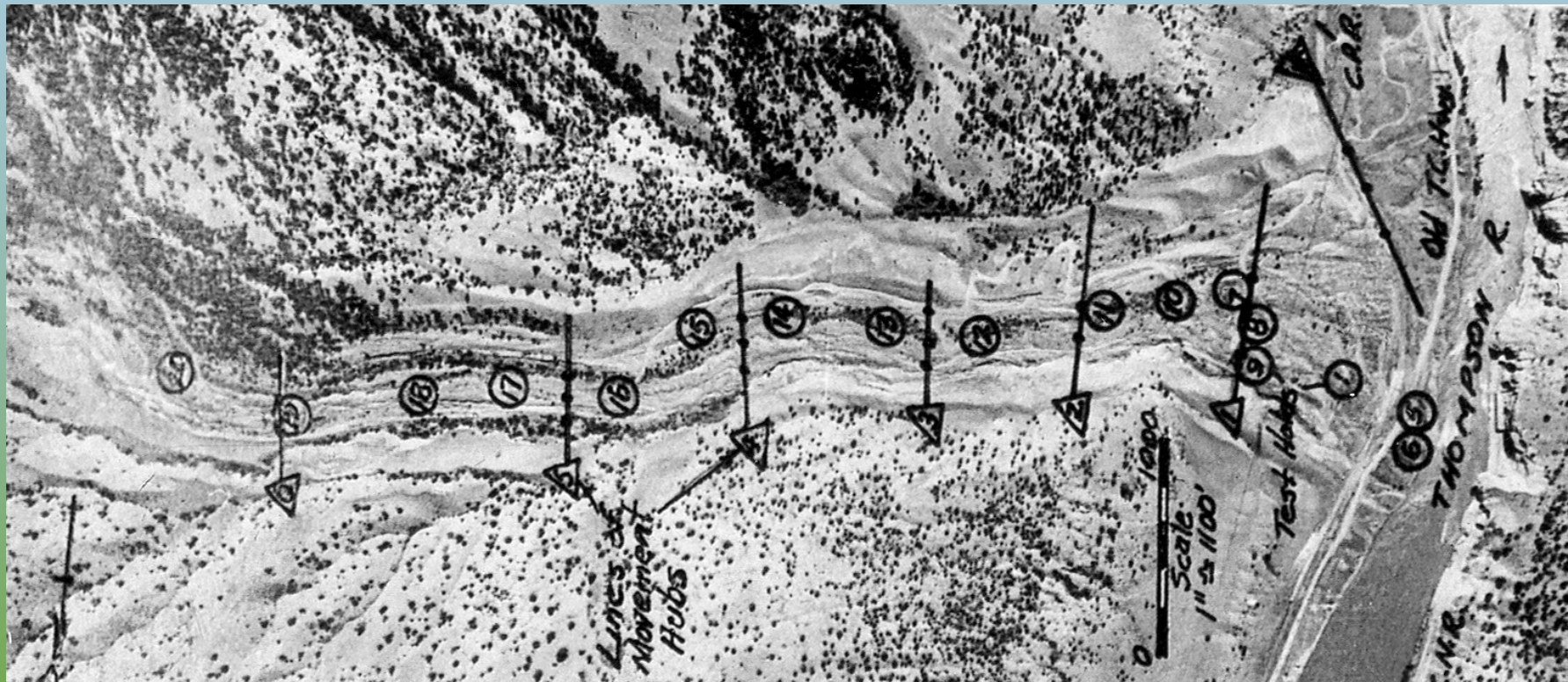
Where did he find the time?

Read all about it in his book!





# Drynoch Slide



Drynoch Slide near Spences Bridge, BC. The total movement is 2.2 miles long with annual movement averaging about 3 feet. When Chuck Brawner was a young engineer with the Dept of Highways he determined that the movement was due to high groundwater and designed a drainage program which stabilized the landslide in 1959.





# Highway 1 – Burnaby



Preloaded peat area with final grade construction underway in Burnaby, BC: first to use lightweight sawdust fill equal to settlement estimate This highway has given 40 years of excellent service. Preloading peat is now used internationally.

# Lakelse Lake



Major slide in weak lacustrine clay which liquefied due to excess fill loading during highway construction. Lakelse Lake area near Terrace, BC. No geotechnical investigation had been performed. The clay was displaced and a new fill constructed.

# CP Rail Rockfall



Rockfall on the Canadian Pacific Railway (CPR) caused an empty coal train to derail near Spences Bridge, BC in 1974. This accident led to a Canadian Transport Board hearing and subsequently to development of a priority stabilization program on CPR all across Canada by the author.

# Arrow Lakes



Roller compacted soil cement slope stabilization at the Nakusp, BC waterfront to control slope stability and erosion. The Arrow Lakes were raised about 90 feet by construction of the Keenleyside Dam near Castlegar, BC. The first such slope in Canada (1968).

# Arrow Lakes



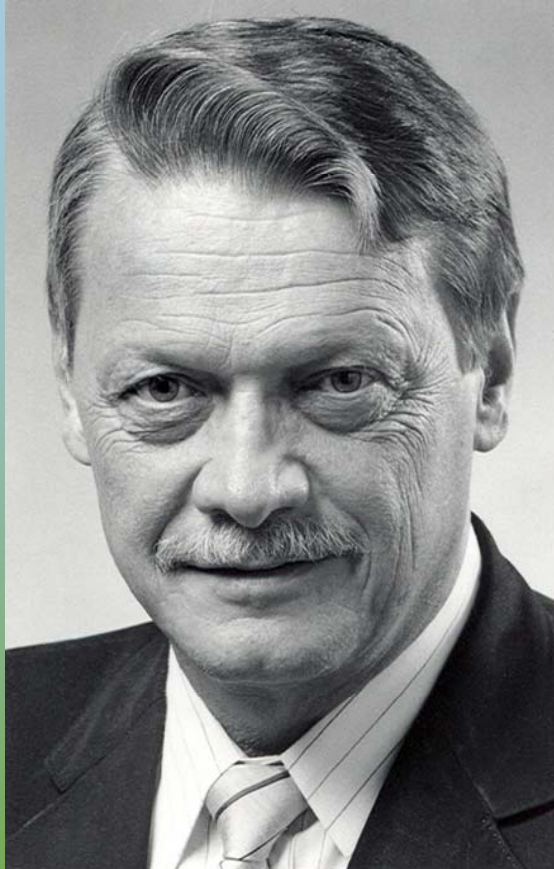
Stabilized slope 35 years after construction. The alternative protection of rip rap was considered to be unacceptable. The area is now a park with easy access to the lakeshore.

# Syncrude Canada Mine



Mr. Brawner was a member of the Syncrude Review Board which oversees all geotechnical work at Syncrude. Here is a picture of one of the draglines. One of the main tasks of the Board was to review the stability of the pit wall. They installed thousands of inclinometers and never lost a single dragline although mine economics assumed one loss every 10 years.

# Earle Klohn



Mr. Earle Klohn came to British Columbia from Alberta in the early 1950s and was one of the first employees of Ripley Associates which he was to lead until 1999 when he moved into retirement. He got a Master's degree from the University of Alberta. Mr. Klohn has many accomplishments but the one that sticks with me is that he introduced engineering principles into the design of tailings dams for mine sites in the 1960s. His use of modern seismic principle in the 1970s meant that all of the tailings dams from that era meet all of the modern seismic codes. Together with John Gadsby, they were the first lecturers in the case histories course at UBC.



# Brenda Dam





# Squaw Rapids Hydroelectric



The client was G.E. Crippen and Associates. This was the first major hydroelectric project built in Saskatchewan. The project involved an earthfill dam, a long power canal, and a powerhouse. The author's involvement included all geotechnical aspects of the dam, the spillway, and the power canal through both the design and construction phases. This project was one of those published in the early years of the Canadian Geotechnical Journal.



# Macmillan Bloedel Expansion



The client was H.A. Simons. This project involved the driving of approximately 30,000 piles - most of them timber and in lengths varying from 30 to 125 feet. Redriving heaved piles to ensure their firm contact with the bearing stratum was a major consideration. The author's paper describing this project won the Alfred A Raymond Award for the best original manuscript on *Design and Construction of Foundations of Structures*. This project was the author's first large industrial foundation engineering project and his first opportunity to work under the guidance of Dr. Terzaghi, a relationship that continued on future projects. For both these two reasons this project stands out as a milestone in his career.

# Site C



In the late 1980s Mr. Klohn was a key part of the resurrection of the Site C hydroelectric project on the Peace River. Construction is hoped for downstream of the Peace Canyon Dam which, in turn, is downstream of the mighty Bennett Dam.

# Norm McCammon



Mr. Norm Mc Cammon graduated with Masters Degree from Purdue in 1962. Thereafter he has spent his career at Golder Associates working on a great variety of projects most notably bridges and waterfront structures. He also lists experience at Keenleyside Dam and Bennett Dam showing that those projects involved everyone of note in BC. Mr. McCammon has worked on over 100 bridges, many of them in Vancouver.

# Alex Fraser Bridge



Alex Fraser Cable-Stayed Highway Bridge, Vancouver, BC. Foundation pile driving in progress at the location of the north tower of this major bridge across the Fraser River some 6km downstream from New Westminster. The piles are 914 mm diameter steel pipe piles driven open-ended and are approximately 85 m in length. Photo 1984. Client: Ministry of Transportation, BC

# Alex Fraser Bridge



Head frame of a high capacity static compression pile test underway at the Alex Fraser Bridge site in Vancouver, BC. The test pile is a 914 mm diameter steel pipe pile 90 m long which was loaded to a maximum of 13,340 kN (1500 tons). Date of photo is 1983. Client: Ministry of Transportation, BC

# Alex Fraser Bridge



Aerial view of the Alex Fraser Highway Bridge over the Fraser River in Vancouver, BC, approximately 6 km downstream from New Westminister. At the time of its construction in 1985, the main span of this major cable-stayed six-lane bridge at 465 m was the longest in the world for this type of bridge. Photograph 1987. Client: Ministry of Transportation, BC

# Duke Point Ferry Terminal



Mr. McCammon has worked on innumerable marine terminals in BC including virtually all of the facilities in Burrard Inlet. Aerial view of the Duke Point Ferry Terminal (BC Ferries) near Nanaimo on Vancouver Island, BC. The site is located on strong sandstone rock. Photograph May 1997. Client: Reid Crowther and Partners (now Earthtec)

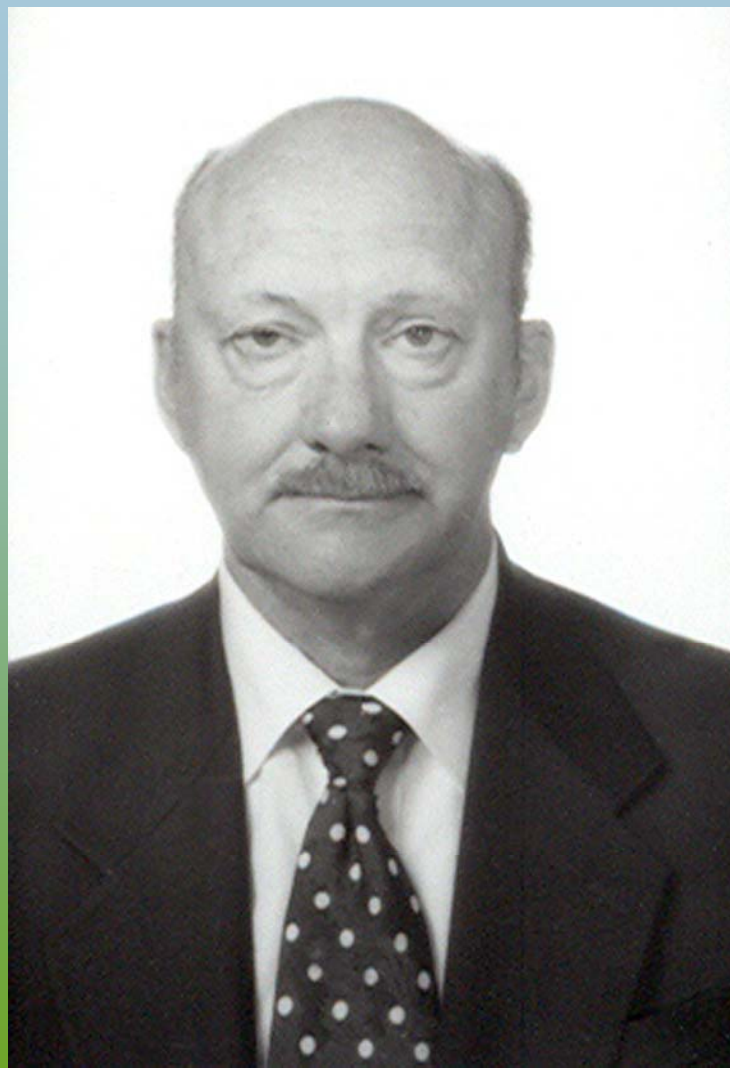


# Fairview Deepsea Terminal



Prince Rupert, BC: Construction underway at the third berth and associated backup land. The wharf structure consists of six precast concrete caissons floated in and sunk on a prepared base. Photograph 1989. Client: CWMM Ltd.

# Dr. Ray Benson



# BC Rail Tumbler Ridge



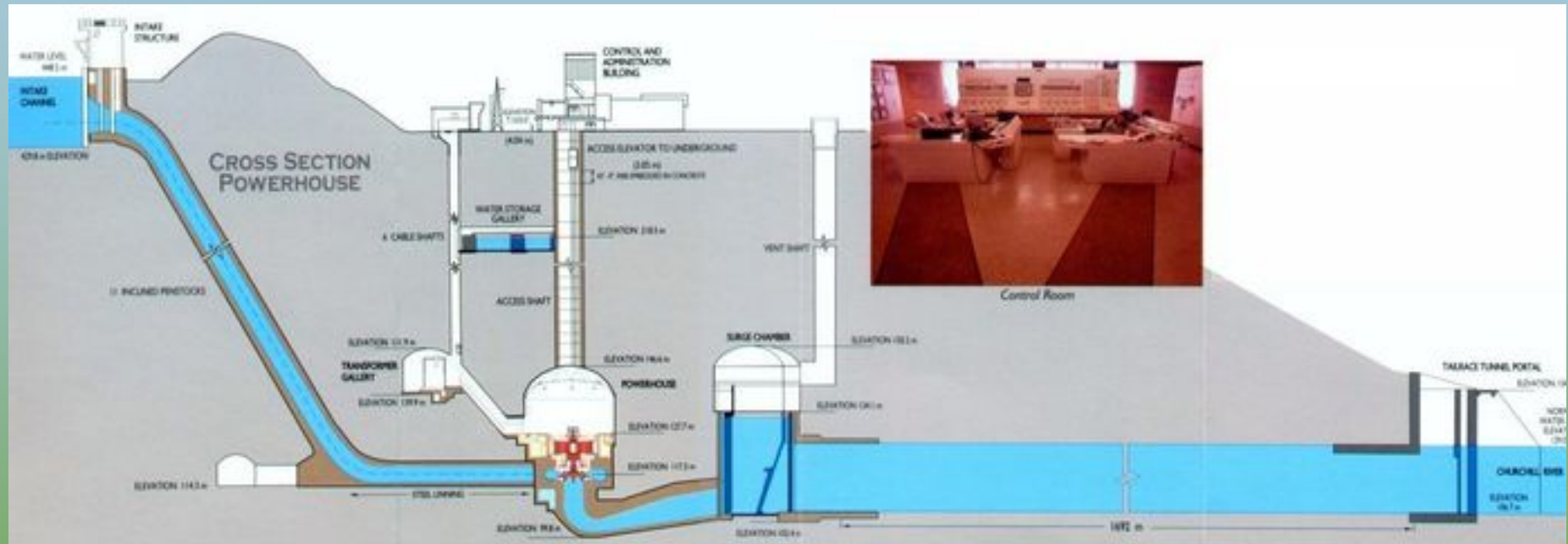
Tumbler Ridge Tunnels: Designed and constructed in the early 1980s; almost 16km long. Opens up a whole new area of BC for development

# Churchill Falls





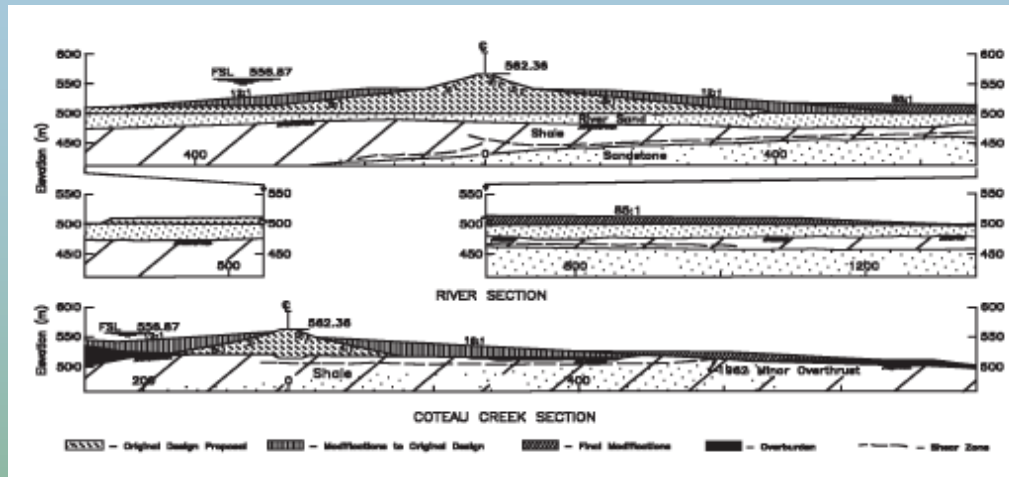
# CF Underground Hydro Project



Ray Benson completed his PhD thesis on this project in the late 1960s, during his involvement in design and construction. He is now Chairman of the current consulting board (the Dyke Board), which has been in place since about 1967 and is second only perhaps to the Syncrude Board



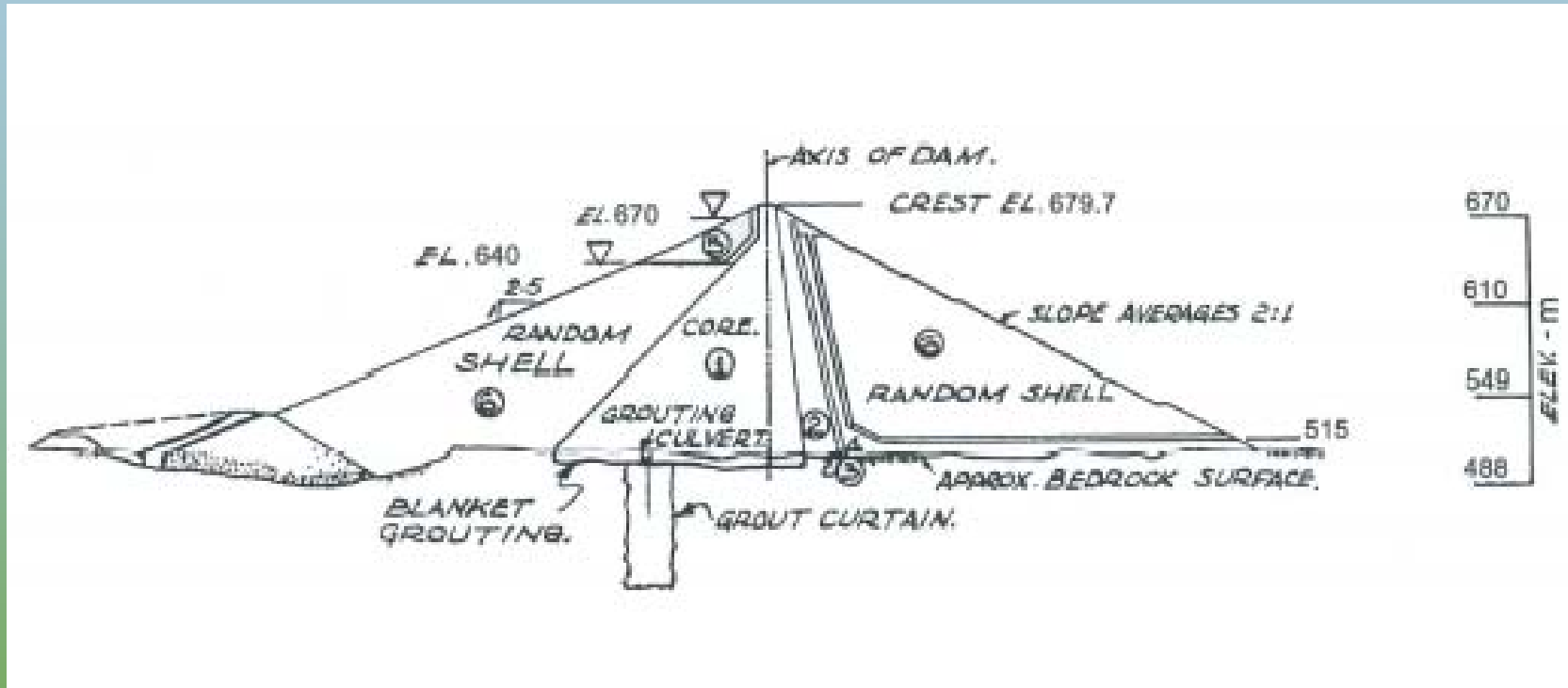
# Gardiner Dam



In Ray Benson's day this was known as the South Saskatchewan River Dam. Benson was involved as a bright-eyed new engineer in design and construction in the early 1960s, working for Bob Peterson



# Bennett Dam



In Ray Benson's day, this was known as the Peace River Dam.

Benson was involved in design and construction in the early 1960s with IPEC and BC Hydro

"The subsequent things, with which you are so familiar, did not diminish the grandness of the project in any way."

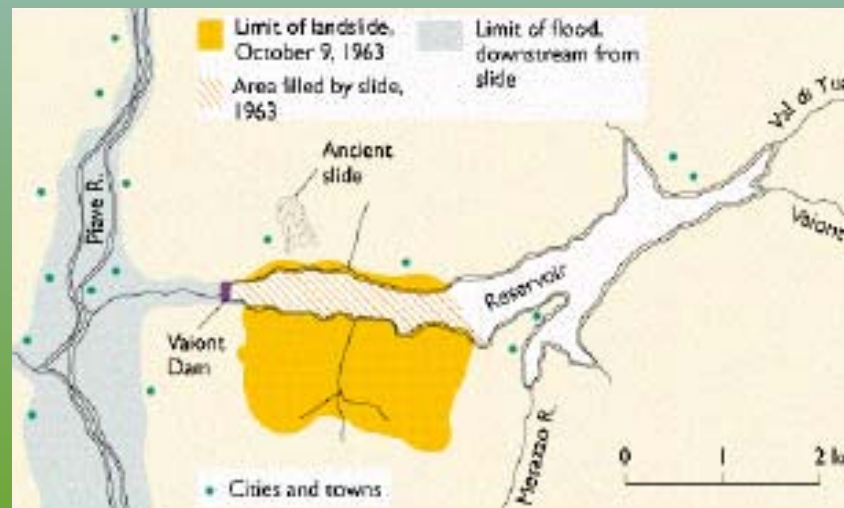
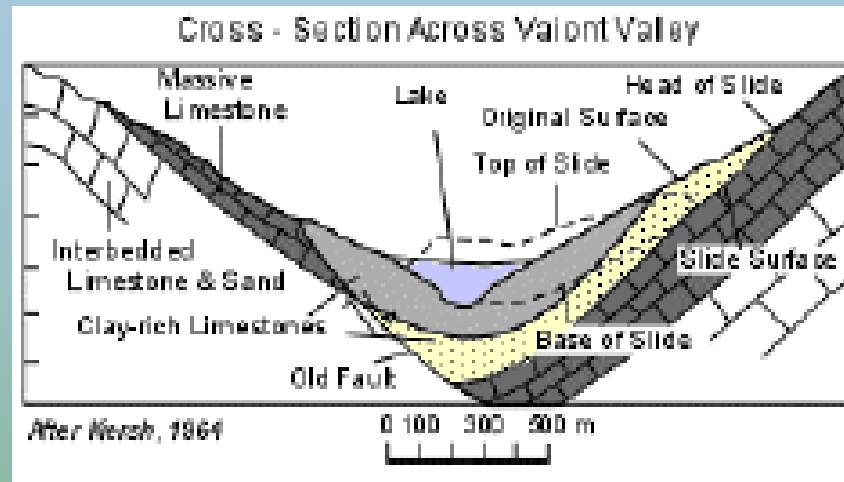
# Dr. Frank Patton



Dr. Frank Patton got his Bachelors degree from the University of Alberta and went on to do his Ph.D. at the University of Illinois in the famed graduate school of Dr. Ralph Peck who attended the Canadian Geotechnical Conference in Vancouver in 2006. Dr. Patton was a Professor at Illinois and Wisconsin before starting Westbay Instruments in 1973. He was an adjunct Professor at UBC from 1974 to 1988 in 1974 and taught a fascinating course which used case histories to teach problem solving. He is best known for his work on landslides.



# Vaiont Slide



Two slides from the Vaiont slide in Italy which failed in 1963 and overtopped the concrete dam without failing the dam but causing much destruction downstream. Drs. Patton and Hendron published a definitive review of the landslide.

# Downie Slide

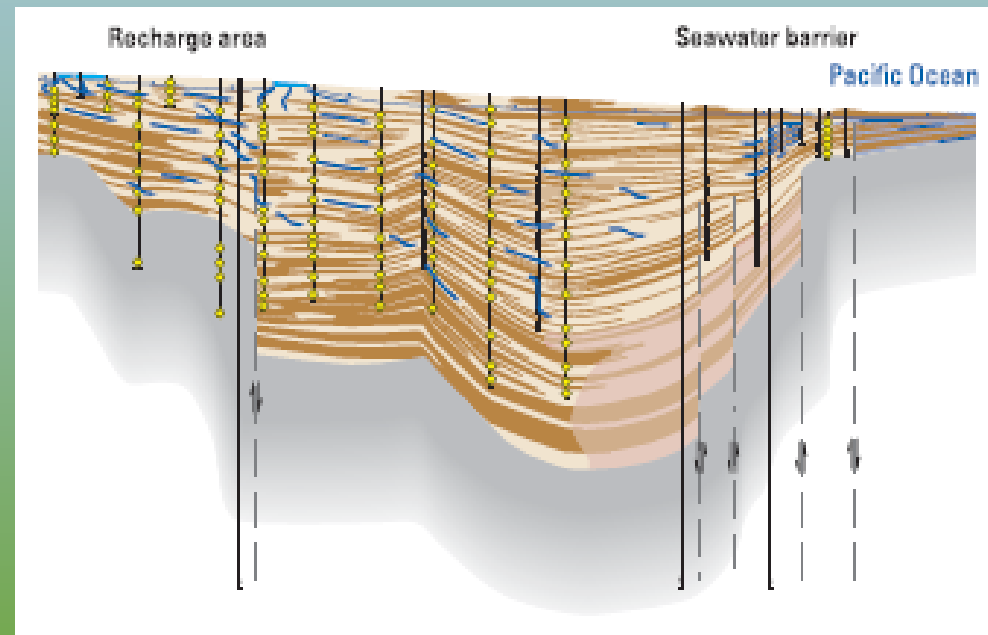
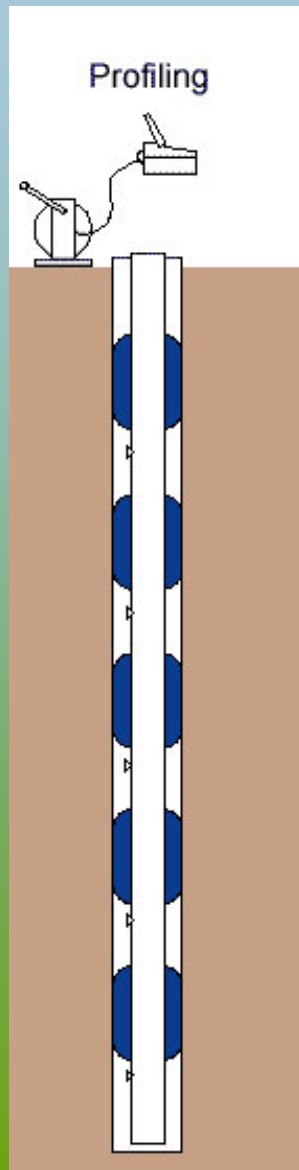


# Downie Slide



Dr. Patton's paper on "The Role of the **Downie Slide** in the Development of 3D Groundwater Instrumentation" was presented at the 2006 Canadian Geotechnical Conference in Vancouver – see CGS website, Documents.

# The Multipoint Piezometer



# Al Imrie



Mr. Imrie is another graduate of the U of A where he got his Bachelor and Masters degrees in the 1960s. He has spent most of his career at BC Hydro from which he retired in 2004. He has had a distinguished career in design of hydroelectric dams, tunnels, and slope stabilization. He was with BC Hydro through the golden years when they constructed many of their large dams. He progressed from design engineer to Chief Technical Officer during his 40 years at BC Hydro.

# Revelstoke Dam



This is the 2700 MW Revelstoke Dam on the Columbia downstream of Mica and upstream of Hugh Keenlyside. Mr. Imrie was responsible for the 15 m diversion tunnel and all rock mechanics, foundation aspects of Revelstoke

# REV Advisory Board



# Downie Slide Basal Zone



Al Imrie was also heavily involved in the Downie Slide evaluation as we see him looking at the Downie basal slide zone.



# John Hart Seismic Upgrade



This a photo of the seismic upgrade to the John Hart Dam on Vancouver Island, which is in the seismic zone.

# Mica Dam



# Peace Canyon Dam



# Technical Review Group Bennett



Mr. Imrie led the Technical Review Group or TRG which reviewed all of the work of the engineers dealing with the Bennett Dam sinkhole remediation. In the photo from left are Dr. Peter Byrne, Mr. Alan Imrie, Mr. Earle Klohn, Dr. Ray Benson.

# Wanjiashai Dam, Yellow River



People's Republic of China

# John Gadsby



John Gadsby is on the bike, not in the truck. Consulting engineer for various companies in the UK from 1949-1960. Obtained his M.S. at the University of Illinois in 1961 - Ralph Peck

# John Gadsby



This is how John maintains his youthful look. He is responsible for introducing mountain biking into BC.

# John Gadsby

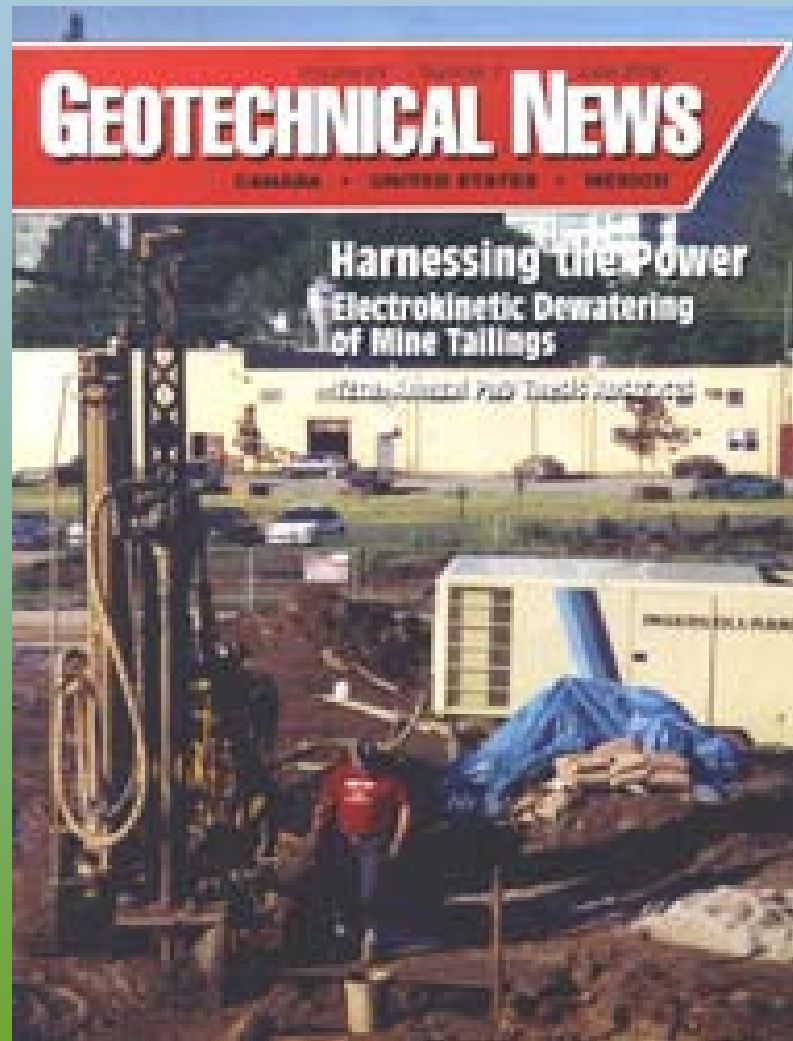


- Wrote the Ontario mine closure guidelines
- Coined the phrase: *Designing for closure*
- John and Earle Klohn were the first two instructors for the Civil Case Histories course at UBC in the 1960s.
- John started an executive course, *Managing Environmental and Social Concerns for Mining*, at Royal Roads

The UBC course continues to this day (2006). The Royal Roads course was ahead of its time and so didn't survive, but the time will come for its resurrection.

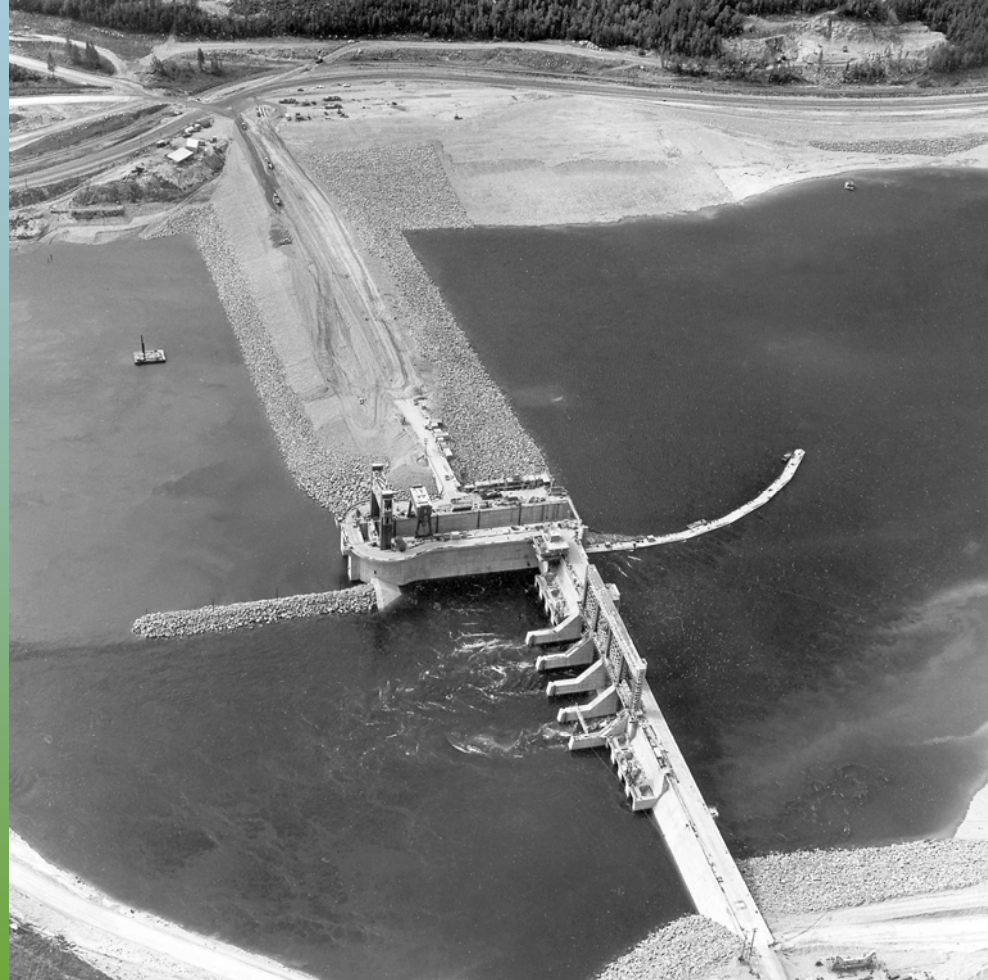


# John Gadsby



John Gadsby started BiTech Publishing. He is instrumental in spreading current news about geotechnique around North America and the world.

# Keenleyside



Arthur Casagrande said to John Gadsby: "In your lifetime you will see the public being involved in project planning and decision making – this will be your challenge."

# Burrard Inlet Crossing



John Gadsby worked on the third crossing of Burrard Inlet for CBA but this project was never built. Although these slides have shown civil engineering projects, since 1980 Mr. Gadsby has worked primarily on mining projects. He led the extensive risk assessment for the Cinola gold project on the Queen Charlotte Islands which was never built. He was project manager for the Antamina CFRD tailings dam which was built and will be 250 metres high when complete. He is an accomplished project manager which allows him to move freely among engineering and environmental projects.

# The Legacy

This group of engineers learned whatever was required to solve the most difficult of problems. They show all of us that anything is possible.

