Quarry Pines

Water Courses

Water draining downhill from the Ships Prow on Mount Lawrence Grassi *does not* end up in Quarry Lake

ENVIRONMENTAL, MUNICIPAL AND URBAN RESERVES WERE CREATED (AT LEAST IN PART) IN THE QUARRY PINES TO PROVIDE SPACE FOR THE *OVERLAND DRAINAGE OF WATER!*

15-1-11

Recent History

We understand now that the manner in which the Cougar Creek subdivision was designed did not address *potential* water flows in that area.

Preserving <u>natural spaces</u> will always be the most dependable method of overland drainage. Engineered solutions, as we have seen in Cougar Creek, are sometimes underestimated and lead to catastrophic failures.

- Q: Knowing then what you know now, could council approve *today* the subdivision (Damming) of land and installation of homes along the banks of Cougar Creek?

- The answer of course is that it would all have been done differently if the implications of that *alluvial fan* of river stone had been understood at the time.

Overland Drainage through Quarry Pines has long been recognised.

All of the reports acknowledge the presence of an overland drainage from the Sub-catchment basin below the Ships prow feature of Mount Lawrence Grassi.

NRCB, UMA and BGC reports identify the alluvial fan that spreads across Wilson Way downhill toward LGR.

None of the reports quantifies the volume, or frequency, of water flows.

The principal mitigative measure all reports arrive at is to provide an allowance of space for water to move through.

New homes will act as Dams!

Environmental Impact Assessment done for TSRI

TSRI report completed in 1994 and submitted 1996 *(also references NRCB review)*

UMA Engineering report completed in 1998

BGC Engineering report identifying X,Y,Z “Creeks” summer 2013

BGC Report Highlights

Was BGC aware that plans were being made to develop the lowest part of the Quarry Pines subdivision?

How might that knowledge have impacted their analysis of the overland flows through the area?

BGC has made several recommendations in its 2013 report aimed at determining the risk more precisely, including;

- Lidar mapping of the area

- Cutting trenches to measure the alluvial fan

- Development of hazard maps and specific mitigation measures

- Development of a detailed hazard and risk assessment

"Long-term mitigation measures will strongly depend on future development plans, although BGC understands through discussions with the Town that there are currently no development plans upslope of Wilson Way or further to the east on the fan of X creek."

(Sic)

Prevention

In the absence of a current and comprehensive EIA, or fulsome engineering analysis, along with suitable mitigations implemented, Council should *decline* the current application to rezone for reasons of public safety.

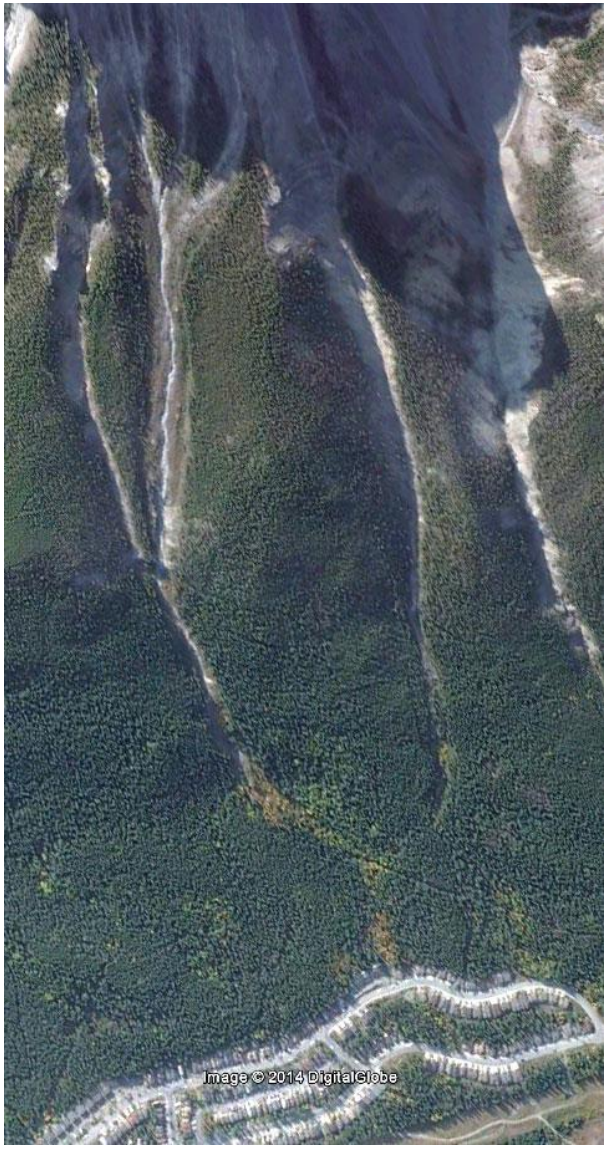
(Amongst the many other reasons)

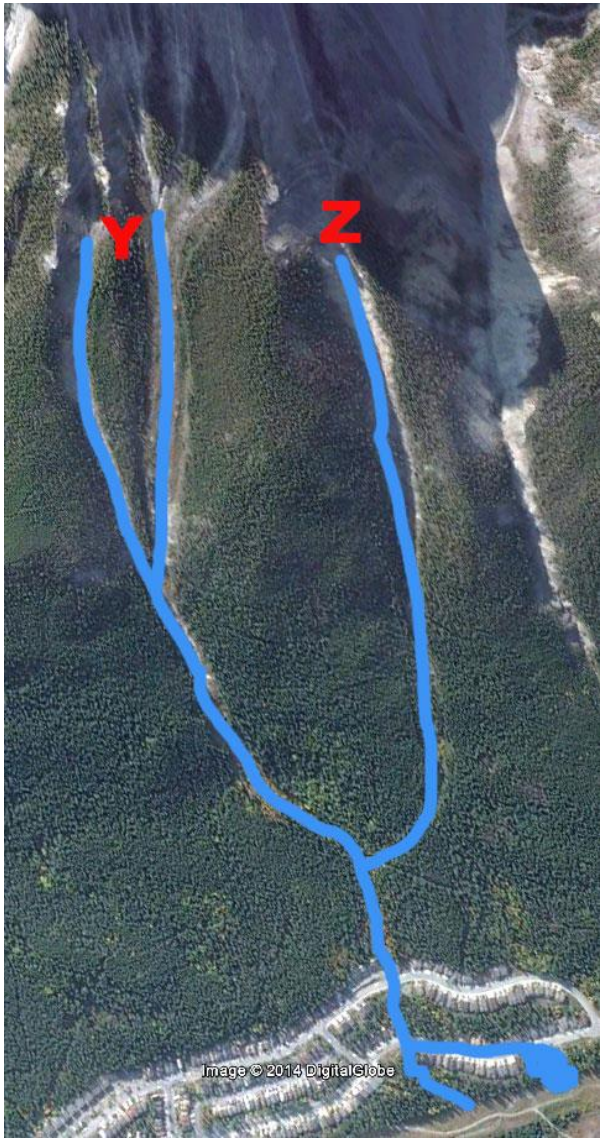
Council also needs to apply a permanent prohibition on development in these UR's for safety reasons, and define those reasons, for reference by future councils, and potential future applicants.

Mount Lawrence Grassi

- Three drainages (X,Y and Z) off the Ship's Prow join 180m above the nearest home in the Quarry Pines then tumble across an alluvial fan to a man-made swale installed about ten years ago on the SW side of the street along Wilson Way.
- Water is intended by design to cascade down that swale to the street, then continue downhill through the "Municipal/Urban Reserve" all the way to Lawrence Grassi Ridge.
- Water then follows the natural lie of that road to the lowest point in the community, and then drain away downhill and continue its journey toward the Bow River further down in the valley.

Drainages – Aerial View





POG and QP

June 2013 rain event caused neighbourhood Swales to wash full of water and carry debris across the roads.

Water coming off Mount Lawrence Grassi literally waterfalls down the slope.

The mud splashed onto these mailboxes, happened when one of the swales in the middle of the community was overwhelmed during rain event in June 2013.

During that rain, a waterfall developed right through the middle of POG. The area pictured to the right was buried in mud and debris, and needed to be shoveled clear by residents after the rain stopped.

The swales and drainage paths functioned as designed, and “infill” developments in these drainages would have been disastrous.

QP Swale above 1021 Wilson Way (Across from MR and ER)

- During the last ten years it has seldom filled with water, but the drainage to its immediate southeast did fill (X Creek), and water, rocks and brush were washed across streets, and down alleyways creating a dramatic flow at the same time the flooding of Cougar Creek was occurring on the other side of the valley.

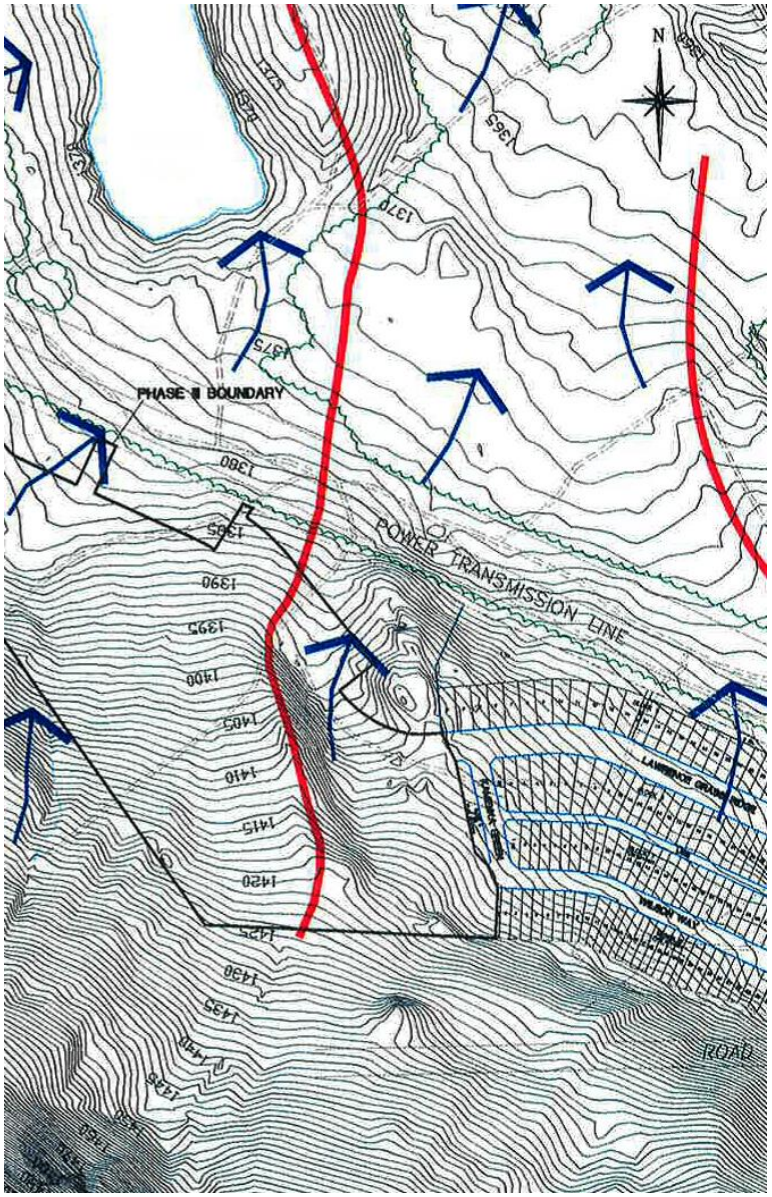
Q: What are the chances that water will rise at some point in that drainage over the next fifty or one hundred years?

- **A: One hundred per cent.**
  - **i.e. certain.**

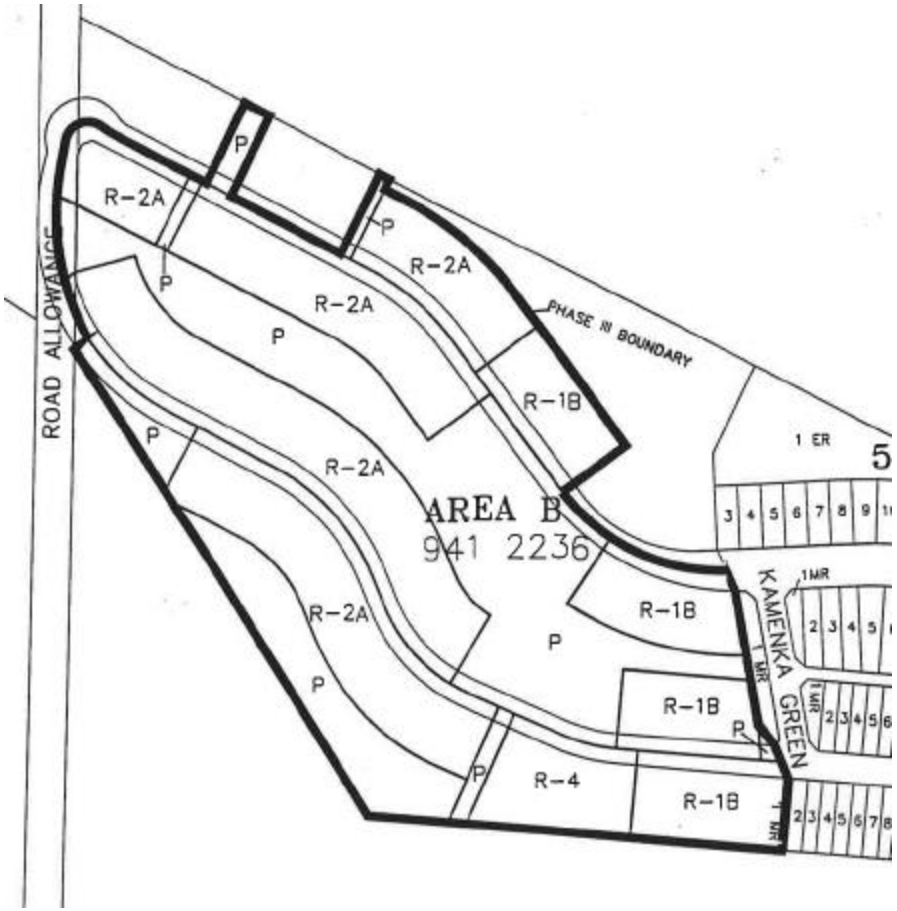
- *Planting homes in the path of that waterfall will be entirely destructive when that happens.*

Existing Topography, vegetation and drainage

- This image was taken from the 1998 UMA report, pre-phase III sub-dividing.
- Blue arrows denote surface drainage.
- Red lines are the sub-catchment limits

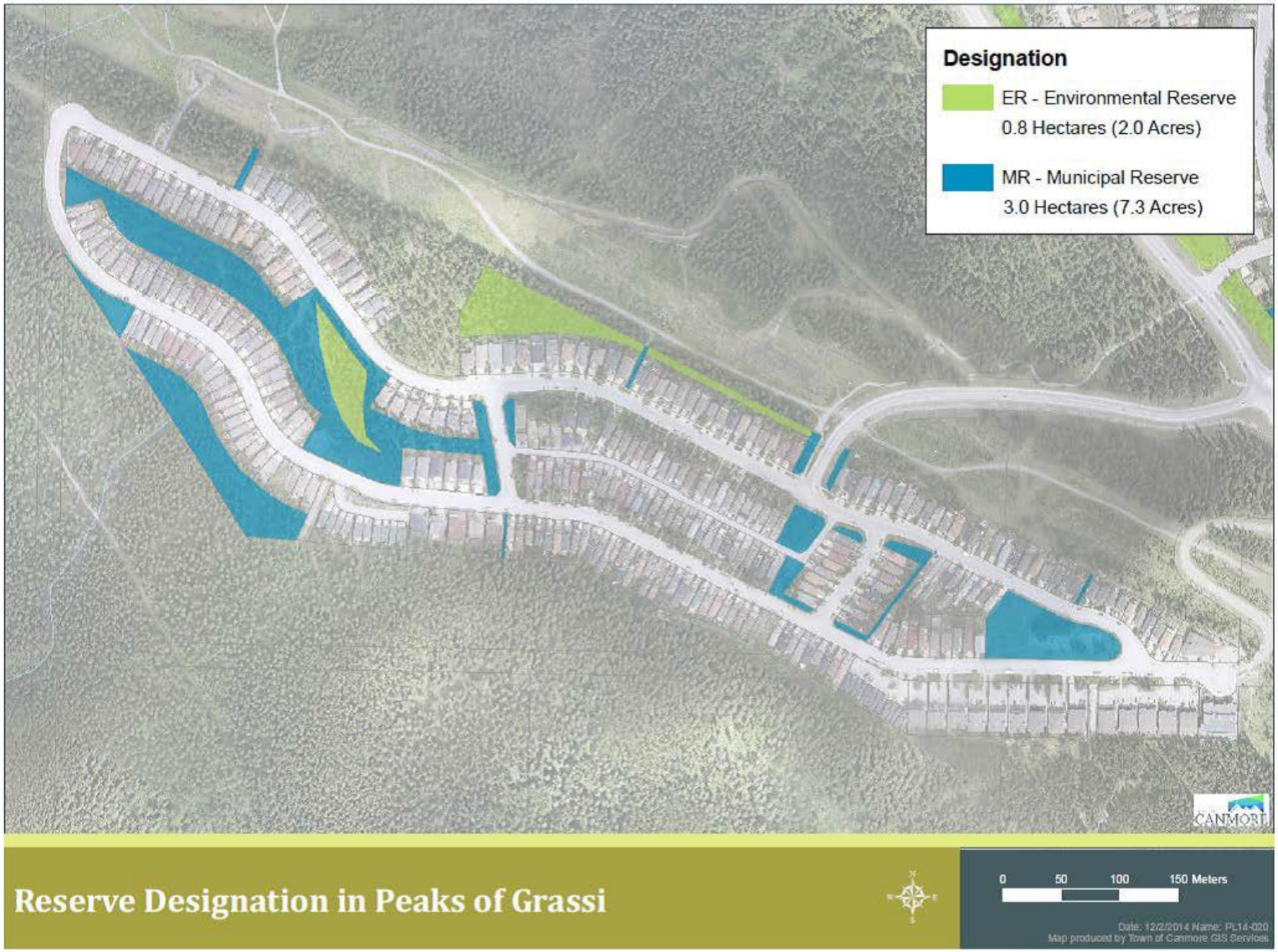


Phase III area plan

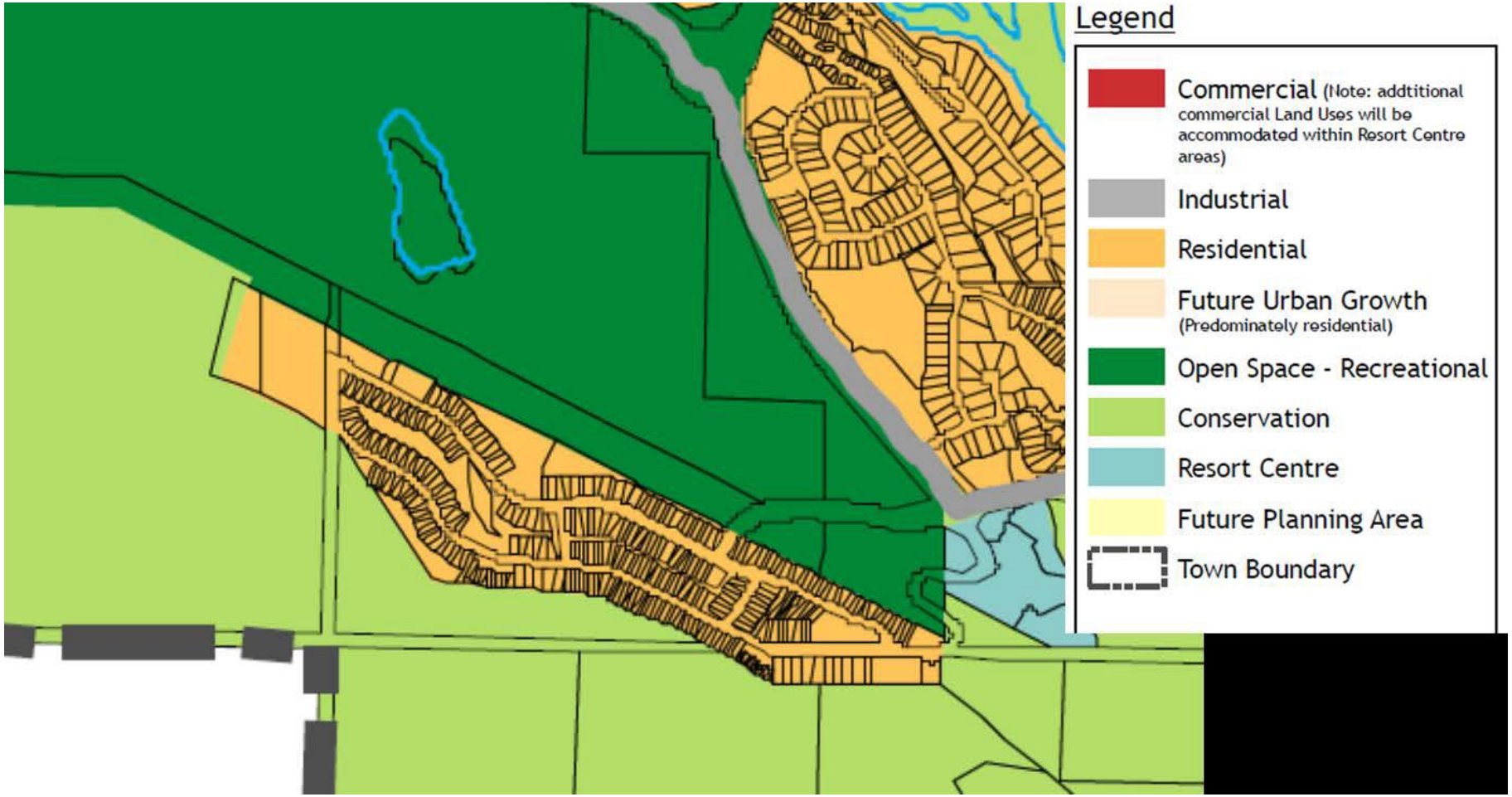


Streams, from UMA engineering report

MR and ER from First Reading presentation for Council



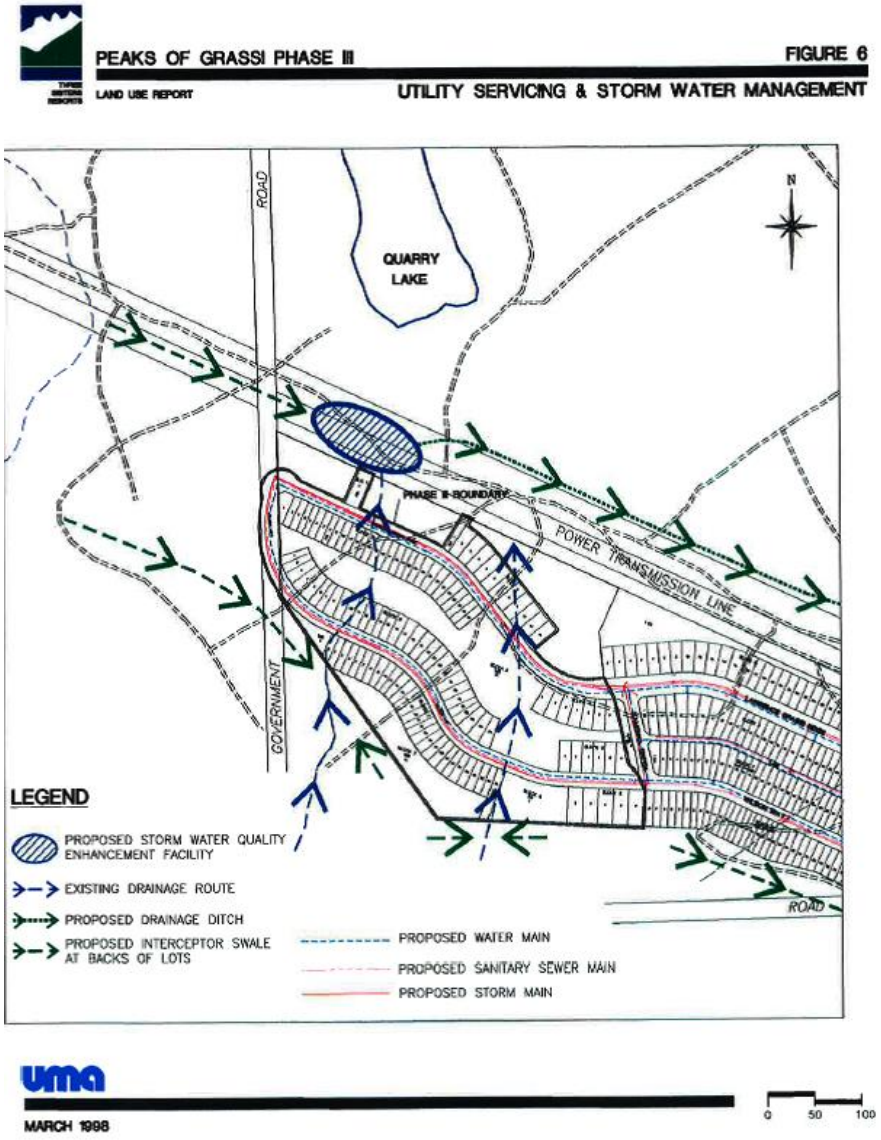
Residential potential, from presentation to council during First Reading



Water is collected, by existing design, at the site of the proposed development!

The easternmost stream will eventually hit LGR, and a portion will overflow and drain away on the west side of the rock outcrop, a portion will enter the storm drain network, and a portion will run down the street, overflow the street at the NW corner of the community and drain overland into swales that have been constructed to slow the movement of the water overland.

In June 2013 that swale (Pictured as a blue pond) adjacent to the powerline trail was full of water.



Storm Water management is specifically addressed in the same UMA report

Groundwater

- "A groundwater study was completed, submitted and accepted for the Peaks of Grassi Phases I and II"
- "Groundwater, if encountered in Phase III (Quarry Pines) will be dealt with similarly"

Storm Water Management

- "The Storm Water Management scheme for Phase III has been designed in accordance with the "Grassi District – Storm water Management Plan"
- **"The report proposes to utilise existing natural water drainage courses and the provision of a detention pond"**
- "The plan will address the need to intercept and channel water flows from the mountain slopes above"

Collected Water from Overland drainage

The image to the right is taken from the Environmental Brief created by Corvidae Environmental Consulting for the Quantum Place subdivision proposal. It is not merely an aquatic habitat, rather a structure designed to slow the movement of water cascading downhill.

There are additional structures that channel water away from this site when these collection areas fill.

This same report (Corivdae) fails to identify the presence of the alluvial fan at the top of Wilson Way, or address the impacts of this geologic feature.

Municipal Government Act

When the quarry Pines was first built-out, allowances were made to preserve the natural movement of water.

Environmental Reserves were created, and these were suitably buffered by Municipal Reserves, and;

Covenants were applied to the titles of affected lots throughout the neighbourhood.

Environmental reserve

664(1) Subject to section 663,

a subdivision authority may require the owner of a parcel of land that is the subject of a proposed subdivision to provide part of that parcel of land as environmental reserve if it consists of

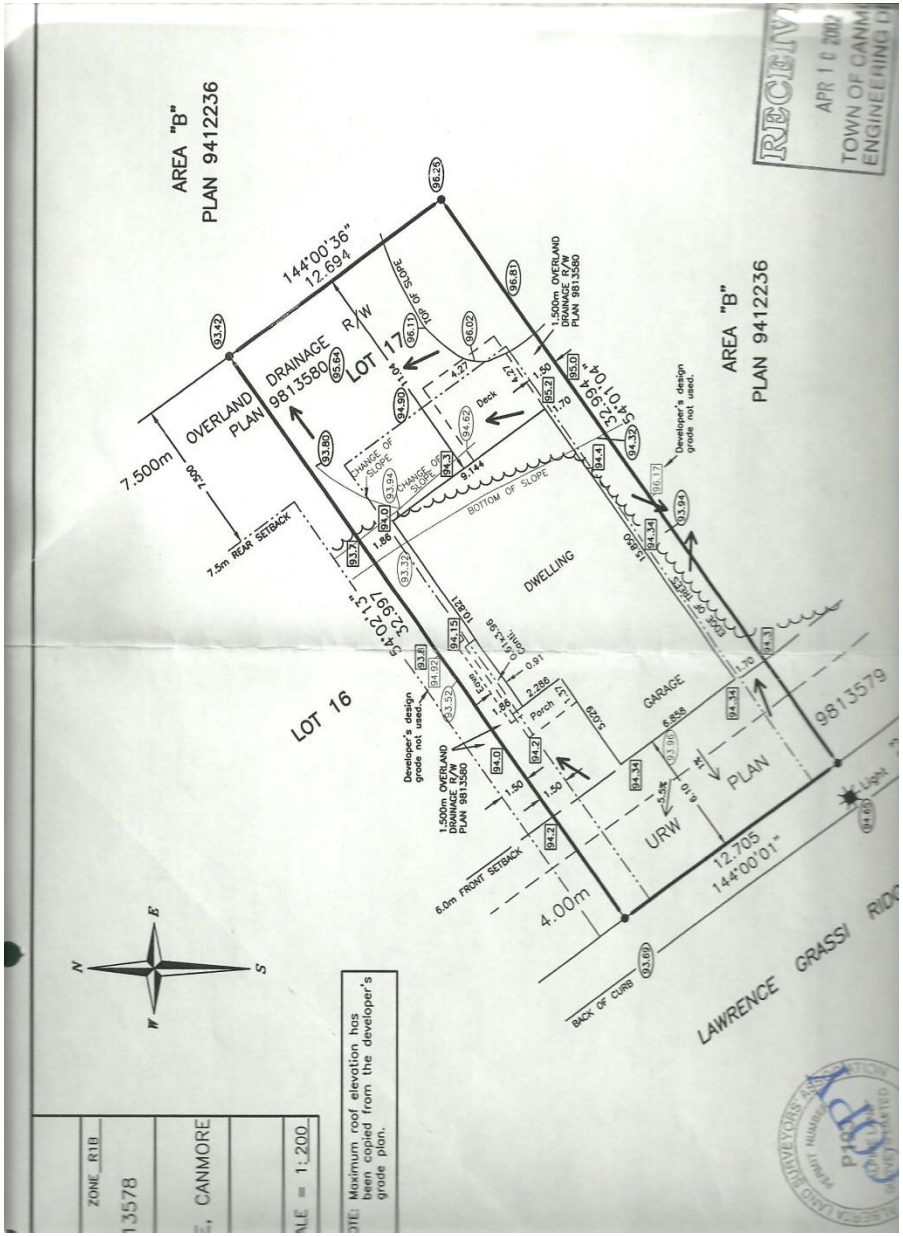
(a) a swamp, gully, ravine, coulee *or natural drainage course*,

(b) land that is subject to flooding or is, in the opinion of thesubdivision authority, unstable

Example Plan

The plan pictured to the right very clearly identifies the type of restrictions on the titles of many homes along LGR and WW.

“Overland Drainage”



TOWN OF CANMORE
MAYOR
DESIGNATED OFFICER

THE TOWN OF CANMORE SUBDIVISION AUTHORITY
APPROVED
AUTHORIZED OFFICER

VALID	EXPIRES	FILE No.
Nov. 13, 1998	Nov. 13, 1999	SB98-005

SUBJECT TO :

REGISTRAR
LAND TITLES

PLAN NO. 9813580
ENTERED AND REGISTERED
ON DEC 17 1998
INSTRUMENT NO.: 9813071 13
A.D. REGISTRAR

9813580

S.W.1/4 Sec.29 - 24 - 10 - 5

CALGARY POWER R/W PLAN RW 553

CALGARY POWER R/W PLAN 114 J.K.

S.W. 1/4 Sec.29 - Twp.24 - Rge.10 - W4M

GOVERNMENT ROAD ALLOWANCE

AREA "A" PLAN 9412236

AREA "B" PLAN 9412236

AREA "B" PLAN 9412236

AREA "B" PLAN 9412236

BLK 12 1 PUL

LAWRENCE GRASSI RIDGE

BLOCK 17

BLOCK 19

BLOCK 9 29 MR

BLK 9 30 ER

BLOCK 9

BLK 8 47MR

BLOCK 9

BLOCK 9

BLOCK 5 PLAN 9711871 1 ER

BLOCK 5 PLAN 9711871

LAWRENCE GRASSI RIDGE

BLOCK 6 PLAN 9711871

BLOCK 7 PLAN 9711867

KAMENKA GREEN

PLAN 9711290

WILSON WAY

WILSON WAY

BLOCK 8 PLAN 9711867

BLOCK 8

BLOCK 8 48MR

BLK 8 74

PUL

S.W.1/4 Sec.29 - 24 - 10 - 5

CANMORE - ALBERTA

PEAKS OF GRASSI - PHASE III

PLAN OF SURVEY

SHOWING

OVERLAND DRAINAGE
RIGHT OF WAYS

AFFECTING
Lots 49 to 72 Inclusive
AND
Lots 74 to 79 Inclusive
Block 8
Lots 2 to 7 Inclusive, Lots 9 to 28 Inclusive
Lots 31 to 73 Inclusive
Block 9
Lots 2 to 17 Inclusive
Block 11

PLAN 981 3579 __
IN
S.W. 1/4 SEC 29 TWP 24 RGE 10 W5M.

SCALE - 1 : 500
METRES 0 5 10 15 20 30 40 50 60 70 80
Not to Scale

By: D.R. Jaques A.L.S. - 1998

LEGEND:
Distances are in metres and decimals thereof.
Lots designated ER are Environmental Reserve Lots.
Lots designated PUL are Public Utility Lots.
Lots designated MR are Municipal Reserve Lots.
Area affected by the registration of this plan is outlined thus .....
(a) Datum N.A.D. 83, (b) Projection 3 T.M., (c) Reference Meridian 114°,
(d) Combined Factor 0.9997516
R/W's overlap at their intersections.

SURVEYOR'S AFFIDAVIT

I, Donald R. Jaques, of the City of Calgary, Alberta Land Surveyor, make Oath and Say:
1. That the Survey represented by this Plan was made under my Personal Supervision,
2. That the Survey was made in accordance with Good Surveying Practices and in accordance with the provisions of THE SURVEYS ACT, and,
3.that the Survey was performed between the dates of July 9th, 1998 and Sept. 10th, 1998, and that this Plan is true and correct and was prepared in accordance with the provisions of THE LAND TITLES ACT.

SWORN before me at the City of Calgary, in the Province of Alberta this 11th day of September, 1998.

P 049
Alberta Land Surveyor

A Commissioner for Oaths in and for the Province of Alberta
(Charmaine Hemming Exp. July 29/1999)

REGISTERED OWNER
THREE SISTERS RESORTS INC.

Seal

UMA Geomatics
A Division of UMA Engineering Ltd.
2540 Kensington Road N.W. Calgary, Alberta

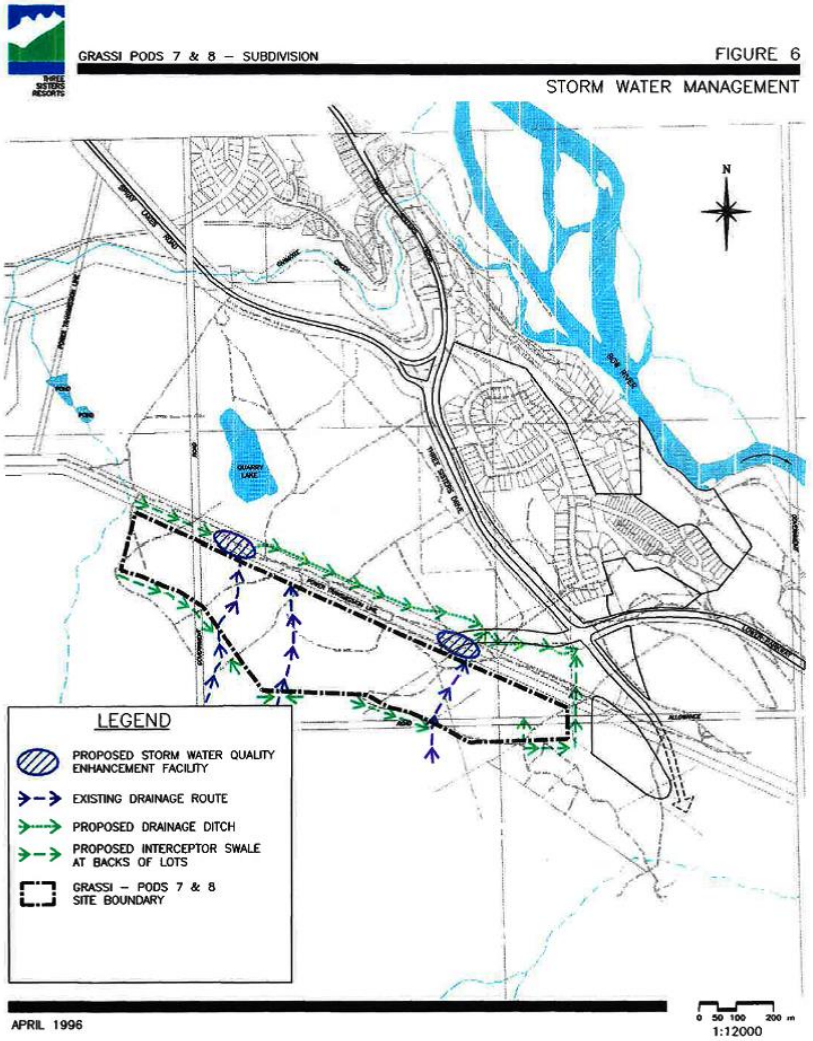
Dwg.: 98080002.DWG
File No. 0350-094-00-36

Subdivision Report

Submitted to the Town of Canmore Environmental Services Dept. from Three Sisters Resorts in April 1996

This report in 1996 used the same images that were used in the 1994 report.

This report also identified the X,Y,Z streams (although they were not named at that time), and recognized the drainage paths (proposed) through the Quarry Pines subdivision.



BGC Report Highlights

The BGC report reviewed how water appeared to move through the PoG subdivision during the spring 2013 rain events.

The report briefly analyzed the geologic history of the area as well ***and identified the presence of an alluvial fan.***

The alluvial fan begins above the subdivision, and at the Quarry Pines area spreads right across Wilson Way and downhill towards Lawrence Grassi Ridge.

Homes have already been built on this fan.

- "The gradients along the mainstem channels of X, Y, Z Creeks are certainly steep enough to convey debris flows and future larger events may reach the development as debris flows." (sic)

BGC Report Highlights

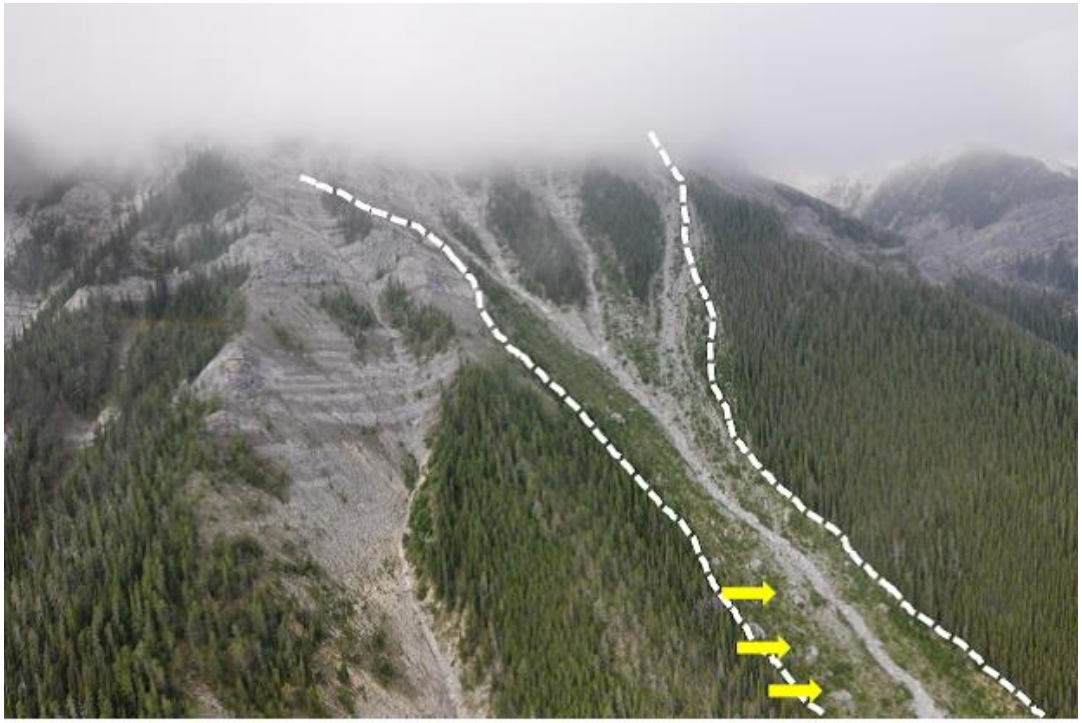
The alluvial fan that exists above the Quarry Pines and extends into the existing development has been accumulated gradually since the last period of glaciation.

The sub-catchment basin above the community is nearly 500m wide, and the fan nearly 700m wide.

"Z" creek might have drained to the west side of the subdivision at one time, but now appears to converge with "Y" 180 m above the nearest homes.

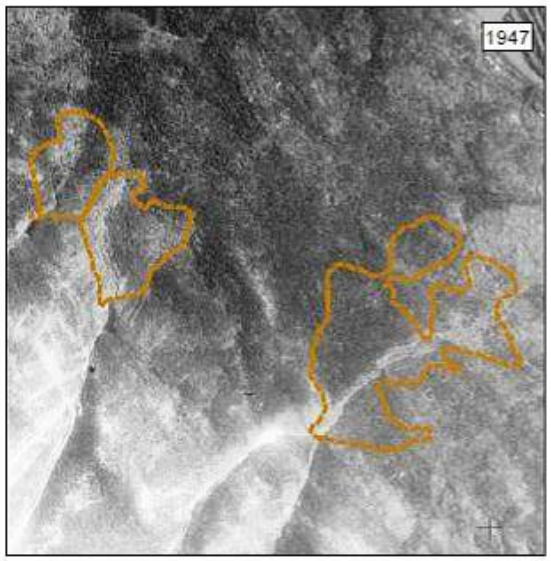
BGC Report Highlights

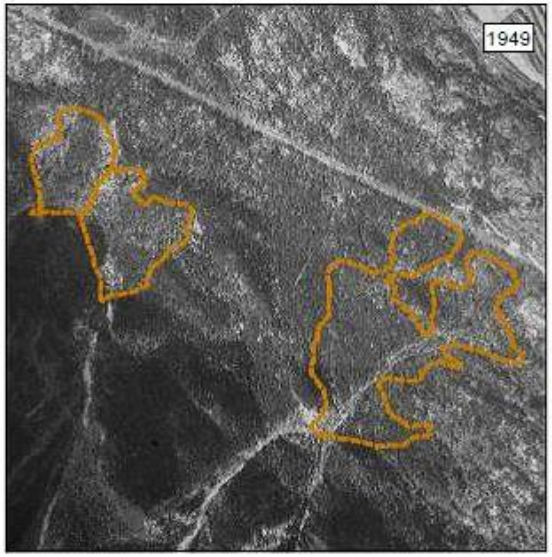
"Aerial view of "Y" creek showing a well pronounced avalanche path (deliniated in white dashed lines) and several very large rock-fall boulders (arrows). ***This channel has significantly more debris storage than "X" creek and could thus produce larger debris flows.***"

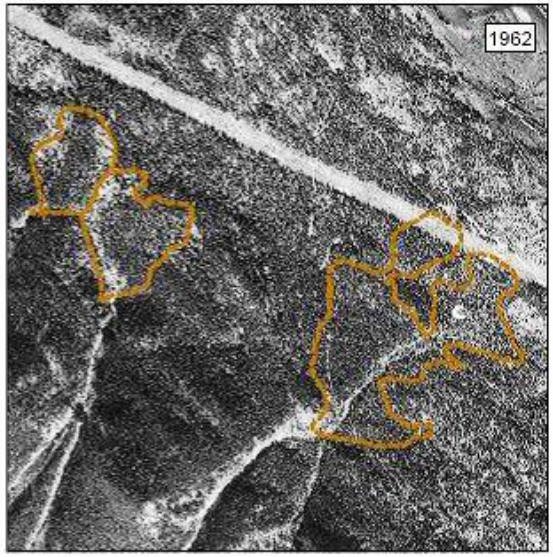


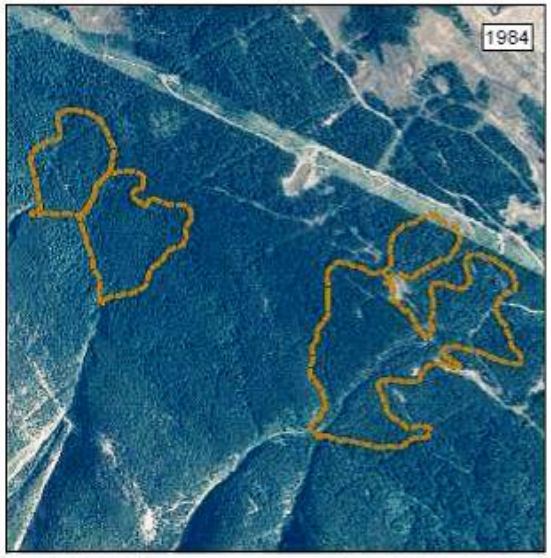
(BGC Photograph of July 23 2013)

Satellite Photos Showing the Progression of Development Below Alluvial Fan.





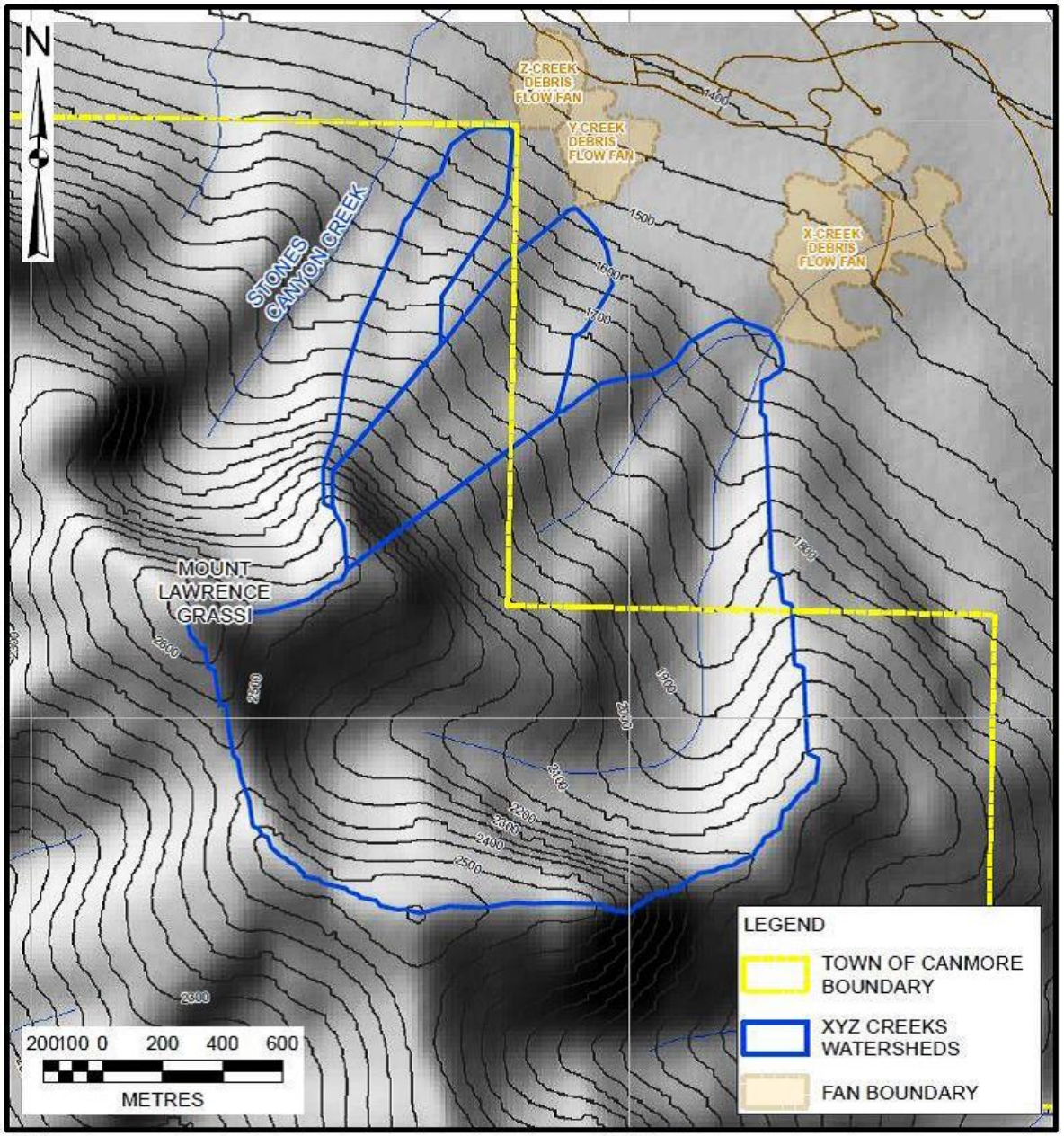




BGC Report on X,Y,Z Drainages and their Alluvial Fans

Y and Z fans either touch against, or protrude into the Quarry Pines community.

Where does the water go from there?



The Lore

Another council, twenty years from now, may be asked to consider a future application for development here.

Context may have changed slightly, and the importance of these UR's for safety may be overlooked, and reports forgotten (again).

The view changes with seasons, and with snow cover in particular, and the problem is far less apparent during the winter.

No additional space exists for an entire new subdivision anywhere in the PoG community.

The potential flow of water through the Quarry Pines has never been fully quantified or mapped. Many of the reserves in this community are drainages!

Council should ***decline*** the current application for reasons of public safety.

Council needs to apply a permanent prohibition on development in these UR's for safety reasons, and define those reasons, for reference by future councils, and potential future applicants.

Thank-You.