

# Hubman Landing Residents Follow-Up Meeting: Undermining

Coast Canmore Hotel and Conference Centre  
August 18, 2016

## Attendees

Rimma Goodfellow  
Trevor Goodfellow  
Hans Wolf  
Steve Baylin  
Murry Hunter  
Dave Eaket  
Curtis Scherer  
Sally Scherer  
Paul Ysselmuiden  
Glen Werner  
Greg Heath  
Wendy Gregory  
Kevin Gregory  
Jane McClennan  
Paul Lessard- CAG Representative

## Support

Lori Van Roojen- Facilitator  
Chris Ollenberger- Owners Representative for TSMV  
Darren Kennard- Golder Associates  
Peter Thomson- Golder Associates  
Richard Beddoes- Golder Associates  
Tracy Woitenko- Town of Canmore  
Jessica Karpat- QPD  
Phil Wareham- QPD  
Jenn Giesbrecht- QPD

## Welcome and Introduction

- The Facilitator welcomed everyone and thanked Hubman Residents for attending the meeting.
- The Facilitator noted that undermining is a very complex topic and asked the group to hold all of their questions until the end of the presentation to ensure that all of the information is presented. The Project Team will make sure that all questions are addressed before we adjourn the meeting.
- Notes from the last meeting (the wildlife follow-up meeting) will be prepared as soon as possible, hopefully by next week.
- Chris added that he intends to begin the presentation at a high level to make sure that everyone is on the same page prior to getting into technical detail.

## Undermining in TSMV: History- Chris Ollenberger

- There are two ASPs going forward for the Three Sisters area: the Smith Creek ASP and the Resort Centre ASP Amendments
  - The Smith Creek ASP Plan Area is located at the eastern edge within the Town of Canmore, adjacent to Stewart Creek Golf Course and includes areas identified as Sites 7,8 and 9 in the Town of Canmore Land Use Bylaw DC 1-98, the lands occupied by Thunderstone Quarries (currently an active mine) and two Provincial parcels along the Trans-Canada Highway.

- The Resort Centre Plan Area is located on the east side of the Town of Canmore on the westerly portion of Three Sisters Mountain Village.
- The area around Canmore was mined from the early 1900s until 1979. There were seven different coal mines and at least ten different seams. A seam of coal can refer to the different elevations of coal or when a fault breaks a seam into a new one. There are sites that have coal but were not mined for reasons related to economic feasibility.
- Mining operations in Canmore involved surface strip mines and underground mines, with all surface features associated with mining like portals, exploratory roads, railroads, air shafts, etc.
- Most of Three Sisters and other areas of Canmore have seen mining activity or is undermined in some way or another.
  - Smith Creek does not have a lot of undermined land. Most of the mines within this ASP Plan Area are located in the wildlife corridor area to the south of the development and south of the corridor.
  - Stewart Creek Phase 3 does not have undermining, however, the Stewart Creek Golf Course does. Our Lady of the Snows Catholic Academy has undermining present as does the Stewart Creek clubhouse.
  - Cairns on the Bow, Homesteads and the eastern portion of Peaks of Grassi are undermined. Ravenrock and Armstrong Place are both located on lands with more complex undermining similar to most of the area beneath the unfinished golf course in the Resort Centre.
  - Hubman Landing does not have undermining directly below but there are mines on the north and south that had an influence on the design of the site. Miskow Close also generally does not have undermining beneath it.
- What is interesting about the undermining in Canmore is that the coal is generally softer and the geology can be more complex than other mines in Alberta.
- In the 1990s there were a few different methodologies to deal with undermined lands. Gerry Stephenson, a long time Canmore resident worked in the mines and later worked with Norwest on mine remediation. In Three Sisters, Gerry worked on older areas like Peaks of Grassi and the assessment of Stewart Creek Golf course.
  - Gerry was a pioneer for his work on undermining in Canmore and his data still informs some of the work that is done today. However, in the last 16 years since Gerry was actively working to remediate mines there have been a number of tools developed that were not available in the 1990s when he last actively worked on Canmore undermining.
- With regard to mitigation, there are a few isolated areas in Three Sisters where there are near-vertical mines (a near vertical mine is one that slopes quite steeply into the ground; one is fenced off behind Worldmark Hotel for example) that are typically avoided for development. While these sites can be mitigated safely, the cost to mitigate far exceeds what a development could sell for, and therefore avoidance and preventing human access or injury is the goal for the vertical workings.

## Undermining Mitigation

### Undermining Mitigation: The Development Process

*The undermining map from the 2004 Resort Centre ASP was displayed.*

- This map identifies the undermined areas within the boundaries of the ASP as they were identified in 2004. Areas shown in green are areas with no constraints, while areas showing red stripes are vertical workings. Areas shown in yellow, purple and brown identify different extents of undermining and identifies levels of different mitigations that might be required.
  - Vertical workings are mitigated using avoidance. Most of the vertical workings in town are located in the wildlife corridor and are fenced to prevent access to people.
  - Purple, brown and yellow zones have been built on in other areas of Three Sisters; only indicate different types and costs for mitigating.
- The development of an undermining report is ongoing throughout the development process:
  - At an ASP level, the identification of undermining is very broad (as shown in the displayed 2004 map) because an ASP does not identify where specific buildings, roads, utilities etc. will be built. The analogy that was provided in the meeting is that an ASP is comparable to an airplane flying at a high altitude- you can see broadly how land is partitioned but it is difficult to define exactly where the road networks are, where the houses are and so on.
    - The process of creating an ASP and identifying areas to build upon is very iterative because determining the areas where development can occur in relation to undermining is based on cost and many other planning considerations.
  - At the land use stage of development, the types of development that can occur on specific areas of land is more defined. The decision on where certain land uses should be located within an ASP area is determined by the undermining conditions. For example, it can be more cost effective to mitigate for a single family dwelling due to the relatively small size of building than it is to mitigate for larger building footprint, higher density developments. Consequently, lower density residential developments are generally located on areas with more complex undermining (with the exception of vertical mines which are avoided for development all together due to the high cost of mitigation).
  - At the development permit stage the specific mitigations to address undermining are determined by undermining engineers (who are generally specialized geotechnical engineers). However, the siting of a home and the design of the development permit can still change to respond to undermining. Avoidance is the most cost effective mitigation however, other mitigations can be viable as well.
    - At this stage, undermining engineers work to determine the specific mitigation while structural engineers and architects are also involved to determine the specific level of design for structural mitigations.
  - At the development permit stage the undermining report is not complete because when the development is built there must be an investigation, an assessment and an “as built” record to be registered on title.

- The “as built” record is important because if a house were to burn down, when it is rebuilt, it must be designed per the parameters that it was originally built on. If the owner wants to change the housing design or move the home the owner must hire a qualified geotechnical engineer to create a new undermining report. Should the homeowner fail to implement these measures, they would not be covered by the Province as a third party should there be any damages related to undermining.
  - At the subdivision phase, prior to someone taking ownership of their home, the lawyer is obligated to tell the new owner about all of the caveats on title including the undermining report. This is also the case should a new owner take over an existing property.
    - Early developments in Three Sisters by United (2000-2002) would register a caveat stating that the house is impacted by undermining and provide a reference to the report. However, since 2004 the entire report has generally been registered on title for all homes located in an undermined zone.
- It was noted that the Resort Golf course was sited due to wildlife considerations, not due to undermining.

**Attendee Question: Can you describe the undermining conditions shown on the map for the area near Hubman I and Hubman II? How far south of us is the orange hatched and the purple?**

- The green zone means that there is no ground mitigation or very minor structural mitigation required for all forms of development.
- The yellow zone means that ground mitigation is considered to be economically feasible for all forms of development.
- The orange zone shows that structures may be built with structural mitigation. Land shown in the orange zone indicates that the land is suitable for roads, utilities and green spaces without ground mitigation while ground mitigation for buildings may be economically feasible.
- The purple zone means that the land is developable but it is possible that there are bigger ground strains, and so mitigation can be expensive.
- The red hatched area is not near Hubman but refers to a zone where the surface areas are affected by vertical working or backfilled open pits. Development is avoided in these zones.
- Overall, the map indicates that land within the yellow, orange, and purple zones mitigation is possible, feasible and safe to do. Hatched areas mean that more investigation is required prior to development to better define the actual mitigations required.

**Attendee Question: Have you amended this undermining map seen in the ASP since 2007?**

- Yes, the map has been amended three times and we are working to amend it again.

**Attendee Question: Was it TSMV drilling boreholes on the golf course in 2012 or 2013?**

- No this was not TSMV. It was the Town of Canmore doing work related to creek hazards following the flood in 2013.

**Attendee Question: Does the Town have any say on what gets developed or what doesn't based on undermining risk? Does the Town need to resolve the issue of Provincial coverage before ASP approval?**

- The Town's role in determining what gets developed and what doesn't is ongoing and the conversations about this is happening currently, however undermining considerations is not used by the Town due to Provincial Regulations.
- Not having Provincial coverage applicable to Town infrastructure is not typically a "show-stopper" for an ASP or for Land Use approvals because the undermining considerations within an ASP and the Land Use Bylaw are very broad. However, not having Provincial coverage for Town infrastructure could be a potential problem at the subdivision stage, however there are several solutions there too.
- At the ASP stage, should the land not have Provincial coverage for Town infrastructure, the Town will want to be involved in the process of developing public infrastructure to ensure that the level of risk is acceptable for the Town.

**Attendee Question: Given that the Province is self-insured for a portion of this land, when can the Province cut development to manage risks?**

- These types of conversations do not happen because the Province is thinking about long term gain more than short term risk. Taxes on development are implemented for perpetuity.
- For example, there is an area in Calgary called East Village. Prior to redevelopment the area was derelict and was not bringing in any taxes. To fund upgrades to infrastructure in this area when it was redeveloped the Province borrowed against the profit from taxes that the area would generate after redevelopment. This is the type of long-term thinking that is employed by the Province when considering undermining risk versus redevelopment benefit. Notably, there have been no undermining related concerns with respect to buildings or structures as they are assigned a different level of risk and safety versus landscaping or parks etc.

**Undermining Mitigation: Regulatory Process and Safeguards**

- Most engineering companies undertake a rigorous set of internal reviews by multiple experienced engineers on all reports and projects. This is a commonly accepted process for all engineering-related initiatives in Alberta. The Town's engineers also review all engineering drawings and reports to make sure they make sense and meet Town standards (with the exception of undermining reports). Undermining reports specifically also go through a completely independent third-party review on behalf of the Province by an experienced undermining engineer.
- When Gerry Stephenson started working on mine remediation in Canmore, the safeguards were different then they are now.
  - Until 1998 the Town of Canmore was previously involved in the review process for undermining.
  - There was an undermining committee of local experts. Two committee members were municipal councillors, one member was from Town administration and several members who were familiar with undermining at different levels of understanding.

- Gerry would meet with the committee and explain the processes that he took to remediate the development area, and also take feedback from the local group about any concerns they had.
- In 1998 the jurisdiction for dealing with undermining was transferred to the Province through the Canmore Undermining Regulation. There were weaknesses in the previous system due to the transient nature of the committee members, and the level of experience of the local committee members. It was difficult to maintain a consistent standard. With this transfer, the Province refused to indemnify and accept liability for all of the mitigations completed under the jurisdiction of the Town committee because the Province perceived too much risk. Currently, the Province does not accept liability for issues related to undermining on lands generally located west of the Worldmark Hotel.
- Since 1998 the Province approves an individual to act as a third party reviewer for undermining reports. This independent third party reviewer is an individual who is vetted by the Province and is very experienced with undermining. Typically this person is very senior and holds a lot of knowledge related to undermining. When this person retires, the replacement must be extensively briefed and vetting again.
- The independent third party review is paid for by the developer, however the third party reviewer is not involved in the preparation of the project report or drilling investigation; he is independently assessing the work and engineering.
- The third party reviewer is tasked with reviewing undermining reports to ensure that the undermining process has been adhered to and that everything technically checks out. While the third party reviewer does not write the report, the process of reviewing the report can be iterative as the reviewer may ask the project's undermining engineers to make revisions to the report. Overall, the third party reviewer can either accept or reject the report.
- Once the report is complete, the first page is sealed by the project engineer. The second page is sealed by the third party reviewer and the third page is signed by the Province (this is a process check).
- If all of these steps are adhered to, the undermining report has all three pages above, and the development is built per the mitigations recommended in the report, the Province will cover any undermining related damage for anyone on title except the Town of Canmore.

### **Undermining Mitigation: Failures in TSMV**

- There have been two failures on Three Sisters lands since the 1990s. Both failures occurred on infrastructure not buildings, as infrastructure is treated at different levels of risk versus occupied buildings (standard engineering practice).
- The first failure was on the Three Sisters Parkway about 8-10 years ago.
  - The Parkway was placed on top of a capped airshaft that went down about 70 feet.
  - In the winter a pipe burst and erosion of the materials supporting the cap occurred, which caused the cap to be damaged. Since the road was frozen, the asphalt initially bridged the gap created by the erosion.
  - Chris and Phil were involved with development in Three Sisters at the time of the failure and spent \$750,000 repairing it by constructing what is essentially a buried thick bridge of heavily-reinforced concrete that was designed by structural engineers.

- There have been changes in risk criteria since the early days in Three Sisters (1990s). The largest change was after the Parkway failure.
- The second failure was the sinkhole near Dyrgas Gate.
  - Dyrgas Gate was an airshaft that was known and documented during the time Gerry Stephenson was working on mine remediation. When the airshaft was buried it was deeper than anyone thought and Gerry was not able to find it during his site assessment. For mitigation he decided to lay down a buried mesh of geofabric to ensure that no one falls into it should it open up in the future, and it would be addressed later should something occur. Public safety was addressed.
  - The site was included as a “site of interest” and was inspected on an annual basis.
  - When United owned Three Sisters they wanted to build housing in the area around this airshaft. Golder re-dug up the ground to find the airshaft but were still not able to find it. Consequently, homes were setback enough that no person’s property could be structurally impacted. The idea was that if any settling were to occur, they would come back and make the necessary repairs and mitigations.
  - The mitigations for Dyrgas worked as designed- no buildings were impacted and no one was injured. There are five different solutions to fix the Dyrgas sinkhole however, this is a Town initiative, and so TSMV is not in a position to discuss them.
  - The issue with repairing the Dyrgas sinkhole is that the Town of Canmore is not protected by the Province.
    - Per the Canadian Constitution, municipal governments are considered to be legal “creatures of the Province” which essentially means that they are not recognized as independent legal entities and cannot exist without the Province (similar to corporate subsidiaries).
    - When the Province took over the third party coverage for undermining issues, they indicated that a municipality cannot be considered a third party and it would not be liable for issues related to undermining for subsidiaries. Consequently, Town owned public property in Canmore (such as the pathway in Dyrgas Gate) is not protected by the Province.
    - However, there is some debate pertaining to the role of the Town of Canmore and the Province in assuming responsibility for Dyrgas because the *Municipal Government Act* (MGA) regulations state that municipalities are not responsible for addressing undermining related damages. The Town and Three Sisters are working with the Province to rectify the issue.
    - Unfortunately the sinkhole formed while the land was in receivership. Chris indicated that he would have just fixed it, just like the Parkway, as a fix that would meet all public safety requirements is not overly complex, however, this is being looked after by the Town and they are looking for funding.

### **Undermining Mitigation: Developing on Undermined Land**

- This first step to developing on undermined lands is for experienced geotechnical engineers to go into the field and mitigate any surface features that may pose a risk to public safety within 500m of the development.

- For instances sinkholes, ditches and old portals can occur (referred to as “settlements”). Settlements are mitigated to the extent that either people can walk on them safely or they are blocked off using a fence.
  - Within 500m of development all surface features have been made safe enough to walk on or are blocked off.
- Exploratory boreholes are drilled to compare current mine conditions with the historical and existing data.
  - There are data on the undermined conditions in Resort Centre from the mine closure or onward. It was noted that the historic maps have been very accurate as Gerry Stephenson did a good job ensuring that the mine documentation was well done. However, there are some areas where there are differences between new data and the original data.
  - Overall, exploratory boreholes are drilled to establish whether or not there are mining features (i.e. tunnels or portals) where the historical data shows that they are.
- In 2004 the Resort Centre ASP map was produced along with data for other areas in Three Sisters.
- In 2007 there was a permit put forward to build the Resort Centre golf course. Prior to this application a lot of the golf course had not been extensively drilled for investigation. In 2007 the land was drilled in detail because the land was cleared enough to allow equipment access.
- After the golf course land was drilled, the detailed design of the golf course was finalized based on the undermining conditions. Overall, the idea was to locate high traffic areas and areas of the course that would be more expensive to mitigate (i.e. greens, ponds, tee boxes and buildings) on areas with less extensive undermining and areas with more expensive undermining on fairways. Not only does this provide for public safety, it is also more cost effective.
  - The level of care taken for developing a golf course on undermined land is very different from the level of care taken for developing a home. The level of risk tolerance for a building, a piece of infrastructure or a public facility is much lower than a pathway, a roadway or a grass space.
  - The difference between a home and a path or park is that sometimes a pathway or park is located specifically because the mitigations on the site are generally not economically viable to build a home on, but are suitable for park use.

### **Undermining Mitigation: Types of Failures and Mitigation**

- As previously mentioned, there has been an evolving process on how undermining is assessed. This started with Gerry Stephenson’s work with Norwest starting 1989. Since then, additional steps have been put in place and the body of knowledge has been expanded.
- Original mining plans are still used to inform investigation. Overall, the investigation involves whether the existing mine plans are accurate. The goal of investigation is to understand the mine plans.
  - Coal seams can be as thick as the meeting room and typically dip (slope into the ground) towards the mountains.
  - To mine the coal seams, tunnels are drilled along the dip and strike (the direction of the line that is formed by the intersection of the dip of the coal seam with a hypothetical



horizontal surface). This helps miners to define where the coal is. The area between the tunnels is referred to as a pillar. This pillar is what prevents the mine from caving in. If the pillar is removed the mine will likely eventually collapse and stabilize, but the time this takes depends on the geology and physical conditions of the mined workings.

- In mine plans for lands in Three Sisters there are some pillars that were mined out and others that were left. Drilling is necessary to determine if the mine plan is accurate and whether areas where pillars were removed collapsed and stabilized or if there are areas that have not collapsed and could.
- The process of collapse and stabilization can happen relatively quickly or over 20-30 years or more.
- Sinkholes are a type of failure that can occur when there is a mining void close to the surface.
  - Rocks collapsing jumble on top of each other (referred to as “bulking”) and work their way towards the surface. The sinkhole is a depression in the ground that could form relatively quickly once the migrating failure (or bulking) makes its way towards the surface.
  - Sinkholes are mitigated by filling voids to stop the bulking process from migrating towards the surface.
  - During the investigation of undermined land, if there is an open tunnel (that has not collapsed and stabilized yet), and less than 15 meters of suitable rock above it, this could potentially form a sinkhole. The assumption is that the tunnel will collapse and therefore the void is filled with paste.
    - Paste is a void filling material that is made of natural soils native to the area as well as water and cement. While paste is not as strong as concrete, it is as strong as the soil on the surface and serves to prevent anything from falling into an opening or void. For instance, if a rock were to crack in a void that had been filled with paste, the rock would not have anywhere to fall thus preventing any bulking.
  - Near surface voids are filled with paste if there is going to be any development on them.
  - After a void is identified, paste is poured down a borehole. Cameras are used in the borehole to ensure that the void is filled with paste to the point that the air gap is reduced enough that should the roof of the void cave it, there is nowhere for the rocks to go and they will not work their way up to the surface.
  - Pasting was used as a mitigation technique for the Allen Ridge Project, on Armstrong Place as well as in Ravenrock. In addition, pasting was used to mitigate an airshaft in the SW corner of Hubman.

**Attendee Question: Is the paste a non-shrinking paste?**

- No, the paste does shrink however the shrinking is negligible.

**Attendee Question: Are these mines flooded?**

- Yes, many of the mines are flooded.

**Attendee Question: Are there any environmental risks associated with pasting?**

- The potential leachate that could be released from the pasting material would be minimal as the paste primarily consists of local soil and water. There is not a lot of cement in the mixture. It has similar environmental risks as concrete sidewalks, and is generally considered inert and negligible.

**Attendee Question: Was there water testing in the mines?**

- There was water testing at the time of the NRCB decision in 1992. Testing revealed that the water was suitable for irrigation but was not suitable for human use.
- Additionally, a condition of the NRCB decision is that water cannot be removed because the groundwater serves to assist in stabilize the mines.

**Attendee Question: Are you concerned that redirecting water from the mine may have negative consequences elsewhere? How do you study the flow of water through the mine and the impacts that mitigations may have on that water flow?**

- The overall hydrogeological system in the mine is very complicated given that there are multiple coal seams with fractures in each. It is hard to know exactly where the water is following.
- Its also noted that the mines appear to be well connected hydraulically through tunnels, shafts, air vents, rock fractures, faults as the water levels in the various mines are quite similar and change in similar ways seasonally.
- However, pasting is done in area with voids at shallow depths and therefore there is not a lot of groundwater in these areas.
- Additionally, pasting is impermeable but rarely goes all the way to the top of the void so there is still room for water flow. Pasting is not to be confused with grouting.
- It was also noted that Stewart Creek used to follow into the landfill (which was previously a surface mine) and then through a dry pit and come out by the cattle guard near the Three Sisters interchange. The process of redirecting Stewart Creek was more of a problem than pasting ever caused due to the high levels of flow from the creek flowing through the mines and causing erosion of pavement surface near the interchange.

**Attendee Question: What mitigation was used on Ravenrock?**

- Both structural mitigation and pasting was used at the RavenRock project.

**Undermining Mitigation: Examination of TSMV Data**

The final portion of the meeting involved Chris Ollenberger and geotechnical engineers from Golder Associates showing meeting attendees examples of data that was collected on Three Sisters Land and addressing attendee questions specifically related to the displayed data.

- *A cross section of an area near Hubman was displayed.*
  - A cross section refers to a “slice in the ground.” The displayed cross section faces west and shows that Hubman is located between two mines.

- The cross section showed that most of the area was de-pillared and that there are cracks in the ground from where the voids collapsed as well as the boreholes that were drilled to determine where the mines end.
- It was noted that pasting was used on this area for the maintenance compound (which wasn't built) and because it is an area of interest, the site is subject to regular inspection.
- *An example of a borehole log was also shown to provide attendees with an understanding of the types of data that are collected when boreholes are drilled.*
- *A three dimensional model was shown.*
  - This three dimensional rendition of geology in the mine not only showed the coal seam in relation to the mine, it also showed where boreholes were drilled. Some boreholes were drilled straight down, others were drilled on an angle.

**Attendee Question: How wide are the mines from east to west?**

- The mines were continuous within the seams mined generally, and can be quite wide in lateral extent with all the tunnels and workings. At the back edge (when facing Hubman), there was a lot of investigation to figure out if the mine ended when the mine plans say it did.

**Attendee Question: Why do you use boreholes for investigation? Could you not use a seismic approach?**

- While seismic can be an efficient way to broadly understand the ground without digging boreholes, the boreholes provide more confidence and far more details that geotechnical engineers can assess properly.

**Attendee Question: What are you looking for in the borehole?**

- There are a number of things that can be identified through a borehole. Specifically, geotechnical engineers are looking at how fast the drilling goes and what the rock is like as well as if there is an overburden of surface soil and if sedimentary rocks are intact. They are looking to determine how thick the coal is, to identify voids or whether tunnels have stabilized, as well as for fractured rock (which can indicate that some collapse has happened by has not finished yet). In addition, they are investigating if a mine is deep enough that there can be structural mitigation.

**Attendee Question: How deep do boreholes go?**

- The borehole shown in the borehole log shown at the meeting went 80m. The decision to drill a borehole and the depth at which a borehole should be drilled is based on where we think a mine or a coal seam is.

**Conclusion**

- Prior to concluding the meeting the facilitator asked if any of the attendees had any questions that had not been addressed. No additional questions were brought forward.

- The facilitator thanked everyone for attending the meeting and let everyone know that draft notes would be distributed to meeting attendees as soon as possible. As with other notes, attendees will have the opportunity to make revisions and amendments to the notes. After the notes are finalized that they will be shared on the Smith Creek and Resort Centre project websites.