Chapter 3: Applying Observations to the Field Decisions

3.1 Trip Planning and Hazard Forecasting for Avalanche Terrain

Learning Outcomes

- Explain the relationship between Avalanche Danger, Hazard and Likelihood of Triggering.
- Use the Trip Plan as a hazard forecast checklist for travel in avalanche terrain.
- Lead a group discussion aided by the Communication Checklist.
- Explain how small groups can manage risk better than individuals.

Forecasting Danger vs. Hazard vs. Likelihood of Triggering

In some contexts, the terms danger and hazard are used synonymously, in other contexts a distinction is drawn. From a practical perspective, the words represent essentially the same concept – the potential for avalanches to cause damage.

Historically, the distinction between Danger and Hazard was intended to highlight a recreational context versus an operational context. The definitions below come from the 2010 edition.

Avalanche Danger – (SWAG p.132) Danger ratings are descriptors on a five-tiered scale used by regional and local avalanche forecast centers to represent to the public the probability of avalanche activity, the general parameters of degree and terrain distribution of avalanches, and to recommend backcountry travel precautions.

Avalanche Hazard – The potential for avalanches to cause damage to something of value. It is a combination of the likelihood of triggering and the destructive size of the avalanche(s). It implies the potential to affect people, facilities or things of value, but does not incorporate vulnerability of exposure to avalanches. Avalanche danger and hazard are synonymous and are commonly expressed using relative terms such as high, moderate and low. (SWAG p.129, 133). In practice, hazard generally refers to an operational estimation of the threat avalanches pose to people or structures in a specific location and operation. In North America, the Avalanche Hazard Scale is used by transportation and highway operations to describe, given the snowpack conditions, the possibility avalanches will reach the highway, and the amount of snow that will affect the highway. The OGRS (2007 edition) suggests "different operations tailor their hazard ratings (scale) to their operational needs." The terms used by both the Colorado Department of Transportation and the Ministry of Transportation in British Columbia are similar and not to be confused with the Avalanche Danger Scale.

Snow Stability – Snow stability "refers to the chance that avalanches will not initiate, and does not predict the size or potential consequences of expected avalanches" (SWAG p.131). Stability relates instability (or unstable snow) to a given "triggering level or load" (SWAG).

Likelihood of Triggering – Practically speaking, snow instability is discussed in terms of the *Likelihood of Triggering*. Likelihood of triggering considers the slope sensitivity (to a natural or artificially trigger) given the defined location of the weak layer across the terrain (see figure at the beginning of section 1.3 avalanche release). Descriptive parameters include: Almost Certain, Very Likely, Likely, Possible, Unlikely.

Theoretical Example
Conditions: On a north aspect above tree line, 30cm of storm snow has been recently deposited on a surface hoar layer. There has been a 30kph SW wind at ridge top for the past three hours. Two local guides decide to investigate and if possible ski the slope high above a highway.

- The avalanche danger to backcountry skiers is rated by the public bulletin as *CONSIDERABLE* danger over a range of aspects and elevations. Natural and human triggered avalanches are *LIKELY* on the north aspect below ridge top. Human triggered avalanches with a destructive potential of 2.5 have been reported and travel is *not recommended* on north and northeast aspects in wind-loaded alpine terrain.
- The local guides who are backcountry skiers do several profiles and tests on nearby safer slopes and observe the weak layer. Both ski tests on small slopes and large column tests, along with a week's worth of field observations, indicate that the likelihood of triggering *VERY LIKELY*; they decide that avalanches on the north aspect above the highway may be triggered by light (single skier weight) loads. They radio this information to another group skiing nearby.

- The department of transportation and highways rates the hazard to the highway as *LOW.* While areas of unstable snow exist and the likelihood of triggering is *POSSIBLE*, the highway travels through the end of the run-out zones and though natural avalanches are estimated to run to the "upper track" of the avalanche path as a maximum extent, they are not expected to reach the highway. Normal highway operations continue until additional snowfall or continued wind makes conditions worse.

Using the Trip Plan in the AIARE Field Book

Complete the Trip Plan in the AIARE Field Book prior to each trip. It provides a pre-trip checklist of critical avalanche danger factors and a place to summarize available information generated by the local avalanche bulletin. Backcountry users are advised to seek out additional information generated by the community of snow experts including professional guides, forecasters and veteran travelers prior to departure. This information is to be referenced to field observations noted on the facing page of your field book during the decision making process.

Fill out the form as a group and include each person's opinion. Small groups make better evaluations than individuals.

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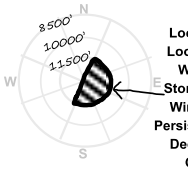
TRIP PLAN

DATE: 20130419	TIME: 0730	FIELD LOCATION: Up Gold Glade, down Green Glade or Blue Bowl

AVALANCHE DANGER: AVALANCHE ACTIVITY? • BULLETIN DANGER RATINGS?

"Where are avalanches likely to occur?" "Describe the problem?" "Specifically, which slopes will we avoid?"



Loose Dry ☑ Steep & sheltered
Loose Wet ☐
Wet Slab ☐
Storm Slab ☐ Above Treeline on NE to S.
Wind Slab ☑
Persist. Slab ☐
Deep Slab ☐
Cornice ☐

- Danger rating: MODERATE near and above treeline, LOW below treeline.
- Expecting touchy wind slabs.
- Yesterday, size 2 wind slab, E aspect, @ 12,000' on Red Ridge.
- Will avoid any wind slabs in upper Blue Bowl (N) by decsending to Green Glade (NW).

SNOWPACK DISCUSSION: NEW / STORM SNOW? • WARMING? • WEAKLAYER(S) TYPE / DEPTH / PERSISTENCE?

"Where is the best snow?" "What field observations needed?" "Do we have experience w/ these conditions?"

25cm storm snow fell two days ago on a stable spring snowpack. Storm began w/ SW wind, ending w/ NW wind. No significant warming trend since storm. Wind slabs expected on E'ly slopes and below ridgelines. Sheltered slopes still hold nice powder.

Obs to take: plan route to view avalanche activity; track storm snow depth w/ probing & hand tests; check wind slab depth/stiffness; ski tests on small safe slopes.

WEATHER FORECAST: SKY / VISIBILITY • PRECIPITATION • WINDS / BLOWING SNOW • TEMPERATURES • TRENDS

"How will forecast affect snow conditions?" "...affect our observations? communication? decision-making?"

Forecast @ 10,500': Clear sky, NO precipitation, L NW winds, High −2.5°C. Expecting great visibility / gentle weather -easy visual observations and no weather stress. Watch temps today, but expecting dry snow during intended descent. Snow surfaces may get wet at the valley floors by PM and on steep southerly aspects.

TRAVEL PLAN: OBJECTIVE • OPTIONS • ANTICIPATED HAZARDS • OBSERVATION PTS • DECISION PTS • GROUP MGMT

"Is plan appropriate for our goals, experience, abilities?" "Everyone included in discussion, w/ consensus?"

Up Gold Glade (SW), w/ small detour to knob @ 11,300' to scan area for avalanche activity.

Decision pt. @ 12,200'. Need to see no wind slab / scoured snow surface at Blue Bowl entrance (N) for that option to go. Otherwise, drop (NW) into Green Glade.

Either way, traverse W ≈ 9,400'on road grade back to lower Gold Glade.

EMERGENCY RESPONSE: LEADERSHIP • GEAR ASSIGNMENTS • COMM. PLAN • EVAC ROUTE • EMERGENCY #'S

"Are we prepared & practiced?" "Outside help realistic?" "All concerns voiced re: dangers, risk, response?"

Radios Ch. 11.11; 911 w/ cell; Joe bivy sac/pad/sled; Keys under Jack's rear bumper; Jen knows tour plan, call her @ 970.349.0000 upon return.
Evacuation route back down Gold Glade skin track.''

The date provides a record of your pre-trip and field trip observations. Re-read yesterday's info prior to writing today's obs.

Write the danger rating from the public bulletin. Form an opinion on whether the rating provided by the bulletin matches or disagrees with your assessment of slope scale hazard and risk.

Trend's are the most important addendum to point observations.

Be vigilant when reported layers of concern include "persistent grain types" like surface hoar, depth hoar or facets. Avalanches may be triggered on these layers when few or no avalanches are occurring naturally.

Summarize the terrain to avoid (for example, slopes on NE aspects, steeper than 30 degree, wind-loaded slopes) by shading the terrain in the "rose" (noting range of aspect and elevation). Also write in the elevations on each representative line (example 6000, 9000, 12000). You can also write notes adjacent to the rose as a reminder of observed recent avalanches or recently observed wind-loading.

Plan which observation you will take using the Avalanche and Observations Reference (next page).

Always leave a copy of your travel plan including options with a friend or neighbor.

The AIARE Avalanche and Observation Reference

AVALANCHES & OBSERVATIONS REFERENCE © 2012

"The Problem"	Critical / Red Flag Observations	Field Tests & Relevant Observations	Important Considerations
Loose Dry Snow	•Fan-shaped avalanches: debris fine. •Loose surface snow ≥12" (30 cm) deep.	•Boot / ski penetration ≥12" (30 cm). •Slope tests / cuts result in sluffs. •Loose snow surface texture (as opposed to wind-affected, refrozen, or other stiff snow textures).	•Can be triggered by falling snow, cornice fall, rock fall, a brief period of sun, wind, or rider. •Sluffs can run fast and far. •Small slides dangerous with terrain traps / cliffs. •Sluffs can trigger slabs in certain conditions.
Loose Wet Snow	•Rain and / or rapid warming. •Air temp > 0ºC for longer than 24 hours (cloud cover may prevent nighttime cooling). •Pinwheels or roller balls. •Fan shaped avalanches: debris lumpy and chunky.	•Observed and forecast temp trend. •Temps (Air, Surface, T20) / freezing level indicate near surface snow temps at 0ºC. •Note slopes receiving / will receive intense radiation. •Wet snow surface: water visible between the grains with a loupe, may be able to squeeze water out with hands.	•Timing is critical. Danger can increase quickly (minutes to hours). •No freeze for multiple nights worsens condition. However, nighttime freeze can stabilize. •Gullies and cirques receive more radiation and retain more heat than open slopes. •Shallow snow areas become unstable first - may slide to ground in terrain with shallower, less dense snowpack.
Wet Slab	•Rain on snow, especially dry snow. •Current or recent wet slab avalanches: debris has channels / ridges, high water content, may entrain rocks and vegetation. •Prolonged warming trend, especially the first melt on dry snow.	•Consider Loose Wet Snow observations. •Observed melting snow surface (rain or strong radiation) of a slab over weak layer. •Tests show change in strength of weak layer due to water and / or water lubrication above crust or ground layer. •Identify the depth at which the snow is 0ºC. •Monitor liquid water content and deteriorating snow strength using hardness and penetration tests. •Nearby glide cracks may be widening during rapid warming.	•May initiate from rocks or vegetation. •Can occur on all aspects on cloudy days / nights. •Conditions may also include cornice fall, rockfall or increased icefall hazards. •Snow temp of slab at or near 0ºC. •Loose wet snow slides can occur just prior to wet slab activity. •Possible lag between melt event and wet slab activity.
Storm Slab	•Natural avalanches in steep terrain with little or no wind. •≥12" (30cm) snowfall in last 24 hours or less with warmer heavier snow. •Poor bond to old snow: slab cracks or avalanches under a rider's weight.	•Observe storm snow depth, accumulation rate and water equivalent. •Observe settlement trend: settlement cones, boot / ski pen, measured change in storm snow (>25% in 24 hours is rapid). •Tests show poor bond w/ underlying layer (Tilt and ski tests). ID weak layer character. •Denser storm snow over less dense snow (boot / ski penetration, hand hardness).	•Rapid settlement may strengthen the snowpack, or form a slab over weak snow. •When storm slabs exist in sheltered areas, wind slabs may be also present in exposed terrain. •May strengthen and stabilize in hours or days depending on weak layer character. •Potential for slab fracturing across terrain can be underestimated.
Wind Slab	•Recent slab avalanches below ridge top and / or on cross-loaded features. •Blowing snow at ridgetop combined with significant snow available for transport. •Blowing snow combined with snowfall: deposition zones may accumulate 3-5x more than sheltered areas.	•Evidence of wind-transported snow (drifts, plumes, cornice growth, variable snow surface penetration with cracking). •Evidence of recent wind (dense surface snow or crust, snow blown off trees). •≥ Moderate wind speeds observed for significant duration (reports, weather stations and field observations).	•Often hard to determine where the slab lies and how unstable and dangerous the situation remains. •Slope-specific observations, including watching wind slabs form, are often the best tool. •Strong winds may result in deposition lower on slopes. •Commonly trigged from thin areas (edges) of slab. •Wind transport and subsequent avalanching can occur days after the last snowfall.
Persistent Slab	•Bulletins / experts warn of persistent weak layer (surface hoar, facet/crust, depth hoar). •Cracking, whumping.	•Profiles reveal a slab over a persistent weak layer. •Use multiple tests that will verify the location of this condition in terrain. •Small column tests (CT, DT) indicate sudden (Q1) results; large column tests (ECT, PST, RB) show tendency for propagating cracks.	•Instability may be localized to specific slopes (often more common on cooler N / NE aspect) and hard to forecast. •Despite no natural occurrences, slopes may trigger with small loads - more likely when the weak layer is 8-36" deep (20-85cm). •Human triggered avalanches are still possible long after the slab was formed.
Deep Slab	•Remotely triggered slabs. •Recent and possibly large isolated avalanches observed with deep, clean crown face.	•Profiles indicate a well preserved but deep (≥1m), persistent weak layer. •Column tests may not indicate propagating cracks; DT and PST can provide more consistent results. •Heavy loads (cornice drop or explosives test) may be needed to release the slope - large and destructive avalanches result.	•May be aspect / elevation specific - very important to track weak layer over terrain. •Slight changes, including mod. snowfall, and warming can re-activate deeper layers. •May be dangerous after nearby activity has ceased. •Tests with no results are not conclusive. •May be remotely triggered from shallower, weaker areas. •Difficult to forecast and to manage terrain choices.
Cornices	•Recent cornice growth. •Recent cornice fall. •Warming (solar, rain at ridge tops).	•Note rate, extent, location and pattern of cornice growth and erosion. •Photos tracking change over time.	•Cornices often break further back onto ridge top than expected. •Can underestimate sun's effect on the back of cornice when traveling on cool, shaded aspects.

Using the Field Observations Page

This form allows for one day's field observations. Record significant field weather, snowpack, and avalanche observations that contribute to your field decisions and hazard analysis. Use the Avalanche and Observations Reference to target relevant observations for the conditions.

This form allows for 4 separate observations over the course a tour in the vertical columns.

FIELD OBSERVATIONS

NAMES:	Joe J., Jane J., Jack J.			
Location •Time •Elevation •Aspect	0800, Trail-head, 9,000' valley floor	0930, Gold Glade knob, 11,300' S	1015, Gold Glade ridge / Blue Bowl entrance, 12,200'	1130, Blue Bowl exit, 9,400', N
Sky •Cloud cover •Precipitation	◯ , NO	◯ , NO	◯ , NO	◯ , NO
Temperature •Air •Surface & 20cm↓	T_{Air} -6.0° T_{Surf} & T_{20} N/O	-3.5° N/O	-3.0° N/O	-2.0° N/O
Wind •Speed / direction •Blowing snow	Calm None	Calm None	Light N winds, None	Calm None
Snow •Surf form / size •New snow •Snow height •Pen boot / ski	est HST 20cm Stellars & D/F's Boot Pen ↓ crust	>10cm HST on ridge (normally windswept)	HST ≈30-40cm just below ridge Boot Pen 45cm	HST ≈25cm Boot Pen 35

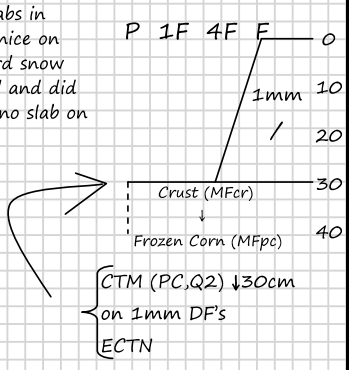
TERRAIN USE • SIGNS OF UNSTABLE SNOW • PATTERNS

Red Flags • Avalanches • Snowpack Tests • Other Observations • Comments

0800 – no fresh avalanches observed on the drive to trailhead. Recent cornice growth above treeline on SE-E aspects.

0930 – seen from Gold Glade knob: 3 wind slabs >12,000' on E and SE aspects below ridge crest (R1-D2) on Red Ridge, Purple Pk. and Maroon Mt. In general, less wind effect on south end of the range closer to town. Soft conditions with no cracks, whumpfs or fresh wind slabs seen so far on S-SW aspects.

1015 – Blue Bowl decision pt: No wind slabs in upper bowl. Dropped block of old hard cornice on N'ly slope @ 12,200' w/ no result. Fist hard snow still on ridge crest. Jane entered Blue Bowl and did two sets of tests, (see profile →) confirmed no slab on frozen old snow.



1200 – sunny slopes getting moist below treeline; crusts tomorrow.

REVIEW THE DAY: *"Were our choices in line w/ our forecast / plan?" "When were we most at risk?" "Where could we have triggered a slide?" "What would we do differently next time?"*

Record names and date across the top row.

Refer to this example each time to assist you in deciding upon which observations are significant.

Use the lower open space to record a variety of observations that may include quick hand tests, ski tests, partial profiles, surface and avalanche observations.

Remember to describe the terrain where the observations were taken.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3.2 Risk Management for Small Groups

Learning Outcomes

- Describe teamwork and small group decision making as an antidote to human factors that can adversely affect pre-trip and field decisions.
- Plan to implement practical communication tools that encourage effective group decision-making.
- Communicate considerations for risk management for small groups in the backcountry in pre-trip meetings, in the field, and after the trip is completed.

Life is full of risks. There are personal, financial and physical risks that we encounter and manage every day. When it comes to travel in avalanche terrain, decisions we make can potentially have life and death consequences. Even the best forecasters and guides can't know *exactly* whether the snow is stable, nor whether the slope will avalanche. Therefore, the best forecasters and guides also have to the ability to extrapolate and be able to draw margins in the terrain and understand how to keep themselves and their party on the safer side of the margin.

Good leaders, by using a strategy to carefully execute a well-informed decision, minimize the chance of an accident. Simply put, this strategy includes gathering and determining the quality and quantity of the information, and applying the information to creating and implementing options. And, most importantly, the strategy includes a process of managing any human factors that can obscure one's ability to interpret information, form accurate opinions and options, or execute decisions.

The most common of these human factors include:

- Individual Bias: The tendency to hold onto a perspective at the expense of equally valid alternatives. For example, a one-sided viewpoint or prejudice.
- Poor situational awareness: Lack of awareness of what's happening in one's vicinity. In particular, being unaware of how one's own actions impact goals and objectives—immediately and in future.
- Poor group interaction: Examples include weighing "my opinion over yours"; or "the majority rules the few". Better interaction includes a shared vision and unanimous decision.
- Poor communication: The inability to communicate important information such as local knowledge, key field observations, or other relevant data that allows the group to make an informed decision.

The antidotes to the aforementioned human factors are simple to state, yet surprisingly complex to deliver; these are—*teamwork and effective communication*, *relevant experience*, and the use of specifically designed *checklists*.

Teamwork and Effective Communication

Small groups *tend* to make more informed decisions than individuals. However, this only occurs in a group with a shared vision and with an experienced facilitator. The leader elicits information from the group, listens to opinions of others and makes decisions from consensus. This process can illustrate and mitigate individual bias. However a few preconditions must occur:

- Know the group and ensure there is a shared vision.
- Complete a trip plan prior to any control route or backcountry trip. Ensure all group members share knowledge of the hazard, the forecast risk, and the plan to mitigate or control the risk prior to departure. Never "assume", always ensure, that communicated knowledge has been heard and understood. Most avalanche professionals write down the plan in a notebook and take it into the field.
- Ensure the group's individual expertise is complementary (local knowledge, good snowpack and terrain skills, a thoughtful decision maker in the group, a stronger person who can facilitate a rescue response or keep the group moving in challenging conditions).
- Ensure complimentary fitness and skills within the group. Or, a group willingness to match the objective to the least skilled and least able.
- Ensure tasks and responsibilities are shared. Group inequalities do not result in unanimous decisions. A healthy group dynamic encourages participation and rewards motivation.
- *Agree to travel together. Agree to decide together. Agree to respect everyone's voice and anyone's veto*. These wise words are from the AIARE Communication Checklist—a tool to help

maintain situational awareness in the field. Prior to departure on either a control route or backcountry adventure the group requires "rules of engagement" to encourage effective group communication and to mitigate individual or group bias. This means agreeing, prior to departure, to regrouping in the terrain and reassessing as a group. Even self-appointed "followers" need to participate in terrain choices, interpret information, and provide an opinion. Acting on decisions is a practiced skill and those who aren't experienced at implementing options should be rewarded with the opportunity to create options. Consider that the inexperienced may have an "outside eye" to a circumstance, and bias maybe distorting the perspective of the most experienced. The antidote is to have a protocol that requires that all decisions to be unanimous, and everyone must have an opinion regardless of their experience or expertise, and that all opinions are respected—regardless of the outcome upon the objective.

- Communicate clearly between any groups in the field. Accidents involving more than one party, or, accidents resulting from groups not relaying key information, are becoming more common. When practical, plan *when* to talk and *what* you will say. For example communicate prior to exercising your option; let your groups know which is the group's preferred choice given what you *now* observe in the field? Talk around radios or cells are popular and frequently carried. Plan to use them!

Relevant Experience

The issues of overconfidence, lack of confidence, uncertainty and unfamiliarity plague the good decision. Many avalanche accidents occur when the group is making ill informed decisions that are out of the depth of their collective relevant experience. This includes:

- The ability to travel through and safely manage the group in the terrain.
- The skills to collect and interpret information and to accurately assess snow instability and avalanche hazard. This includes having a practiced and consistent process for both gathering and evaluating information and making decisions.
- Local familiarity with the terrain. This includes a familiarity with relating avalanche events, to conditions, to specific terrain features – essentially reliable pattern recognition requires familiarity with comparable events.
- Skilled, practiced search and rescue techniques.

Pre-trip planning helps to anticipate whether or not the group is prepared to take on the objective as discussed. "Have we been there before?" "Have we been in similar terrain before?" "Are we familiar with the conditions?" "Is this a typical or atypical season or event?" "Will weather allow us to preview the terrain and get a 'feel' for conditions prior to becoming too committed?" These are questions groups often ask to assess their confidence and familiarity prior to departure.

Pre-event rehearsal and a shake-down tour prepare the group for bigger, more complex terrain. Avalanche operations and guiding operations plan for staff training where control routes are rehearsed, teams work together to see how they get along, emergency response exercises are rehearsed to train decision-making under duress and the methodology of a response. Backcountry skiers can do their own versions of the above and become better prepared to make important decisions as a group and respond as a team should their best decision go awry.

The daily debrief is important to assess whether the risk management applications were appropriate. The day end review often serves to evaluate perspective and performance. These questions are listed on the AIARE 2 Evening Hazard and Risk Assessment worksheet: "Were our choices in line w/ our forecast / plan?"; "When were we most at risk?"; "Where could we have triggered a slide?"; "What would we do differently next time?".

Checklists

Checklists are the most important tools employed by decision makers to maintain the group dynamic, maintain situational awareness, and to simply not forget information critical to the day's decisions. It is important to note the difference between a conceptual model, like the AIARE Decision Making Framework (that provides a 'global' view of the decision making process) and a practical checklist that offers a step by step procedural approach to decisions made in avalanche terrain:

Pre-trip risk assessment checklist:
The AIARE Trip Plan is a checklist designed to facilitate a pre-trip group safety meeting. It can be filled out by anyone and employs prompts to facilitate the discussion. It requires the group to research expert opinion and to

form an opinion with regards to weather, snow and avalanche hazard factors. It also requires the group to assess gaps in knowledge, relate factors to current and prior events, and to assess their avalanche risk. It documents the daily decision making process in a water resistant fieldbook that enables the group to carry both the public bulletin information and group discussion into the field to apply to field decisions (as opposed to relying on memory). The checklist also prompts equipment and rescue response preparedness.

Situational awareness checklist:
The AIARE Communication Checklist is designed to maintain situational awareness in the field and to be employed at key stops during the day: at the trailhead, at key junctures in the terrain, at key decision making points. The prompts are in the voice of the "devil's advocate" ensuring the important process of reflection on intuitive decisions made. "What's changed?", and "What's the consequence if we have a problem?" are examples of reflective questions that encourage each participant's inner voice.

Emergency response checklist:
At the back of the AIARE Fieldbook the rescue checklist provides a "go-to" list of actions required in the unlikely case of an avalanche accident. It is well known that during the elevated stress of an emergency response even the best trained defer to a set of protocols to ensure nothing is forgotten and the response follows a strategic plan. It is hard to think straight when your partner is buried under one meter of dense avalanche debris.

Debrief checklist:
The questions under the subtitle "Review The Day" in the AIARE Fieldbook and the second page of the AIARE 2 PM Avalanche Hazard and Risk Assessment form are a critical post event risk management checklist. In order to improve on daily decisions it is key to debrief the accuracy of the morning risk management plan in light of the decisions made in the field. Along with the other questions, "What would we do differently next time?" identifies what have we learned from our errors and our successes.

Conclusion

The great New York Yankees catcher and coach Yogi Berra has a saying, "It's tough to make predictions, especially about the future." Such is the case when it comes to predicting where avalanches will occur and whether or not we can safely travel in avalanche terrain. Faced with uncertainty, patrollers, forecasters and backcountry travelers must have a process to manage uncertainty and the risk of avalanches.

Consider that case histories reveal contradiction after contradiction when it comes to human behavior and risk management. Anecdotally, "accidents occur because not enough information is available"; "we have trouble recognizing how much information is enough and how much is too much"; "we display risk-aversion when we are offered a choice in one setting and then turn into risk-seekers when we are offered the same choice in a different setting."

We are all vulnerable to prediction errors. This is an important fact. When faced with uncertainty in making life-and-death decisions, manage that risk; err on the side of safety and live for another day.

3.3 Using a Checklist to Evaluate Snowpack Instability – PM Avalanche Hazard and Risk Assessment

Learning Outcomes

- Apply the PM Avalanche Hazard and Risk Assessment checklist.
- Explain why forecasters use checklists to "cover all the bases" when analyzing complex data. This process reduces the likelihood of error when analyzing snowpack stability.

One method the avalanche forecaster employs to manage and prioritize critical information is a checklist. AIARE has developed the PM Avalanche Hazard and Risk Assessment to use when assessing current snowpack instability.

The checklist helps observers identify and process important information. It prevents the observer from missing something major and assists in putting the information in an orderly format and encourages the process of crosschecking factors. This clarifies the step-by-step method by which forecasters analyze snowpack instability. *Note: the checklist does not consider the all-important terrain factors or human factors—only weather, snowpack and avalanche observations.*

The columns and rows of data do not "sum up" factors. There is no magic formula to suggest whether the snow is unstable or not. Experience is still required to relate relevant snowpack information to the terrain. The checklist merely allows one to organize the information, and allows the observer to indicate and track trends and weak layers.

When to use the PM Avalanche Hazard and Risk Assessment – On the AIARE 2, the form is intended to be used at the end of a day of travel in avalanche terrain. This checklist guides a group or an individual through the process of a) transferring information recorded in the field into an "operational" record, b) reviewing critical factors to form a summary opinion about the avalanche danger observed and c) debriefing the day's decisions and risk management strategies. In contrast, the Trip Plan is the checklist used in the morning to process pre-trip information from the avalanche bulletin, the weather forecast, morning weather, and snowpack observations, and to *forecast* terrain use and avalanche hazard.

How to use the PM Avalanche Hazard and Risk Assessment – During a post-trip debrief, a facilitator follows the prompts to lead a group discussion. Everyone can follow along on the form.

Page 1 of the form is used to record data observed, note trends and form a summary opinion on the avalanche danger level observed in the field by the end of the day.

In the Weather section, use data collected from field weather observations. Consider supplementing or comparing the data to nearby weather station data to improve the quality of the data set. If data comes from any source other than the field observations, make sure to note the source, for example: "high temp of 4°C @ Blue Moon wx station, 9,400'." Snowpack information should highlight critical observations from the day and paint a picture of how snow varied over the terrain observed. Note the objective of field tests and their location to provide context for any raw data, for example: "Investigated recent avalanche in Red Gully. A profile on 20° slope, 30m North of and adjacent to Red Gully's startzone on NE aspect, 10,200', revealed a 2cm SH layer, ↓60cm, slab 4F stiff with good propagation potential – CTM (SC), ECTP21." Detail any avalanches observed and summarize your assessment of the day's avalanche problem in the Avalanche section. Note, the danger rating itself is less important than the process of summarizing and highlighting the most significant instability and hazard factors, and observing trends across the terrain and through time.

Page 2 provides a checklist for a day-end debrief, much like the "Review the Day" questions introduced on the AIARE 1 course. Use these questions to elicit discussion on the choices the group made and why. The process of gaining applied experience at managing risk in avalanche terrain can happen much more quickly and reliably when decisions are reviewed and constructively critiqued.

PM AVALANCHE HAZARD and RISK ASSESSMENT – AIARE 2

DATE:	TIME:	LOCATION:	OBSERVER:

WEATHER

From today's field weather observations, describe the changing weather in the area observed *(Field Book symbols pg. 60)*

SKY: *cloud cover, trend, timing*	
TEMP: *high / low @ elevation, trend*	
FREEZING LEVEL: *observed or est.*	
PRECIPITATION: *type / rate*	
WIND SPEED / DIRECTION: *@ ridgetop*	
BAROMETRIC PRESSURE: *trend (mb)*	

SNOWPACK

From <u>near surface</u> snow observations describe how, during the past 24 hrs, the weather is changing the snowpack

SURFACE: form / size (mm)	
TEMP GRADIENT: *Tsurface to T-20cm (°C)*	
NEW SNOW: *est. past 24 hours*	
SETTLEMENT: *from □ in height or foot pen.*	
BLOWING SNOW: *ext. / dir. note location elev.*	

Describe notable observations and field tests that contribute to your knowledge of snowpack layering and instability
Importantly, address uncertainty by noting gaps in evidence and data

OBS: *whumps, shooting cracks, melting, scouring* **FIELD TESTS**: *location, type, objective & relevance, verification*

AVALANCHES

Summarize <u>recent observed and / or reported avalanche activity</u> that indicates instability trend *(Field Book p. 63)*
*Note **size, type and distribution** of avalanches (Example: Numerous size 1 to 1.5 Loose Dry, steep N aspects, past 24 hrs)*

<u>Assess today's avalanche problem</u> and prioritize in order of concern
State the depth of important layers; and the date, if known, when the layers were buried (Field Book p. 4-5)

TYPE & CHARACTERISTICS **LOOSE**: *Dry, Wet* **SLAB**: *Storm, Wind, Persistent, Deep* **CORNICE FALL**	**WEAK LAYER, DATE**	**LIKELIHOOD OF TRIGGERING, EXPECTED SIZE, % PATH** *Almost Certain, Likely, Possible, Unlikely, Very Unlikely*	**LOCATION** *Elevation, Aspect, Terrain shape*
1)			
2)			
3)			

DANGER

Rate the avalanche danger for the area observed

ZONE or ELEVATION RANGE	DANGER RATING	TREND / TIMING: *Improved, Little change, Deteriorated*
ALPINE:		
TREELINE:		
BELOW TREELINE:		

MANAGING RISK

Review the day, and debrief today's risk management

Review the morning plan, our risk evaluation and our confidence. *"Were our choices in line with our forecast and plan?"*

Assess uncertainty and target our understanding of instability, hazard, and terrain: *"When were we most at risk?"*

Lessons learned: "*Where could we have triggered a slide?"*

Lessons learned: "*What would we do different next time?"*

3.4 AIARE 2 Post-Course Self-Evaluation and Course Critique

The AIARE 2 Course Leader facilitates the post course student self-evaluation as part of the course closing exercise. Each question can be discussed in a group discussion—to the degree to which the students feel comfortable.

Learning Outcomes

- Self-evaluate your competence with the skills and knowledge you gained on this course.
- Describe the challenges and dangers that exist when applying new knowledge in the backcountry without the oversight of a skilled mentor or expert.
- Discuss whether the course met or exceeded the student expectations; and what was the knowledge or skills each student gained during this course?

1. Did this course meet your expectations?

2. Did this course allow you to improve your skills? List the new knowledge and skills gained this week:

3. What were the three *most* interesting topics? Which were the topics you *least* enjoyed?

4. Describe your instructor's performance.
In the classroom. In the field.

How could they improve?

Did they provide good demonstrations of skills taught this week?

5. It is a fact that many recent avalanche victims are "avalanche aware" (meaning they have completed an avalanche course). How do you plan to apply the skills learned this week and still ensure that your terrain and snowpack decisions reflect your *current* experience?

6. Where do you plan you go *after this course* to continue the educational process?

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PM AVALANCHE HAZARD and RISK ASSESSMENT – AIARE 2

DATE:	TIME:	LOCATION:	OBSERVER:

WEATHER

From today's field weather observations, describe the changing weather in the area observed *(Field Book symbols pg. 60)*

SKY: *cloud cover, trend, timing*	
TEMP: *high / low @ elevation, trend*	
FREEZING LEVEL: *observed or est.*	
PRECIPITATION: *type / rate*	
WIND SPEED / DIRECTION: *@ ridgetop*	
BAROMETRIC PRESSURE: *trend (mb)*	

SNOWPACK

From near surface snow observations describe how, during the past 24 hrs, the weather is changing the snowpack

SURFACE: form / size (mm)	
TEMP GRADIENT: *Tsurface to T-20cm (°C)*	
NEW SNOW: *est. past 24 hours*	
SETTLEMENT: *from □ in height or foot pen.*	
BLOWING SNOW: *ext. / dir. note location elev.*	

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1)			
2)			
3)			

DANGER

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ZONE or ELEVATION RANGE	DANGER RATING	**TREND / TIMING**: *Improved, Little change, Deteriorated*
ALPINE:		
TREELINE:		
BELOW TREELINE:		

MANAGING RISK

Review the day, and debrief today's risk management

Review the morning plan, our risk evaluation and our confidence. *"Were our choices in line with our forecast and plan?"*

Assess uncertainty and target our understanding of instability, hazard, and terrain: *"When were we most at risk?"*

Lessons learned: "*Where could we have triggered a slide?"*

Lessons learned: "*What would we do different next time?"*

Snow Profile

Reference: _____

Date: _____ Time: _____ Observers: _____

Location: _____

Elev: _____ Aspect: _____ Slope Angle: _____ Precip: _____ Sky: _____ Wind Dir: _____ Speed: _____

Blowing Snow Ext. ____Dir. ____ Surface Penetrability (PF)____ cm HS _____cm Profile Type: [ ]

Snow Layer Temperature (°C)

-18° -16° -14° -12° -10° -8° -6° -4° -2°C

Depth H	Moist θ	Form F	Size E (mm)	Density ρ (kg/m^3)	Test Results and Comments

I K P 1F 4F F

Form supplied by the American Avalanche Association, (SWAG)

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