From: Ke Mell <kemell@alaskan.com>
Sent: Sunday, April 16, 2023 1:34 PM
To: PC_Comments
Subject: Comment on Severe Avalanche and Severe Landslide Area Maps and Draft Ordinance
Attachments: Hazard vs. Risk - Wirehouse Employer Services.pdf; 22 10-03 Predicting Landslides - NPR Short Wave.pdf; David A. Kent - January 19, 1972 Mr. Juneau Avalanche.pdf

Friends and neighbors,

I've attended the past two Planning Commission Committee of the Whole work sessions on the Avalanche & Landslide Hazard Maps Draft Ordinance. I've watched with considerable frustration as the Commission appeared unaware of or struggled to address fundamental issues. Those include:

Avalanches and landslides are different. Snow melts. In Juneau there is **NO** avalanche hazard in July. For six months of the year there is no avalanche hazard. That means for six months of the year avalanche hazard areas can be used for anything—including seasonal housing, tourist business, and recreation. Juneau—and downtown in particular—suffer from a severe shortage of seasonal (summer) housing for visitors and seasonal workers, among others.

Hazards covered by the proposed ordinance come in two flavors: upslope and downslope. Upslope (the ground comes down on you from above) and downslope (the ground falls out from underneath you) are fundamentally different and are addressed in different ways. In Juneau there is no construction in the on mountaintop cornices, so avalanches always come down from above (upslope), never out from under one's feet. Landslide hazard can be either, but CBJ's current ordinance does not differentiate. It appears to be concerned only with upslope hazard. Downslope hazard is addressable through CBJ's current Hillside Endorsement for development on slopes exceeding 18%. ***This ordinance should clearly state whether it is concerned with downslope risk or with upslope only.*** Tetra Tech distinguishes between upslope and downslope landslide hazard on its maps (+/-), but on the resulting areas that are subject to both it is unclear whether the hazard color would change if, for example, only upslope hazard were considered.

Hazard is not risk. According to Wirehouse Employer Services, https://wirehouse-es.com/health-and-safety/whats-the-difference-between-hazard-and-risk-a-complete-guide/, which has a very concise definition:

- Hazard: something that could potentially cause harm.
- Risk: the degree of likelihood that harm will be caused.

Let's not confuse the two. Tetra Tech provided hazard maps. As City Manager Rorie Watt noted of Tetra Tech's study in his November 3, 2022 memo to the Assembly, "disclaimers in the study that indicate that the maps are not to be used for site specific decisions". Tetra Tech's maps provide a 10,000 foot view of the terrain. Iin their report, Sec. 1.5.2 Limitations, Tetra Tech states, "Geologic conditions are known to be variable, and the amount of information available from mapping using remote sensing data plus limited

field-checking means that there are bound to be some areas with conditions different than those anticipated from the air photo interpretation and mapping work done to date."

Tetra Tech's maps establish hazard: something that could potentially cause harm. They do not establish risk, the determination of which will require additional information, both with regard to site particulars, and with regard to site uses. TetraTech themselves consider their work to date a first step. From page 8 of their report: "The hazard designations assigned do not account for current or future positioning of infrastructure or people, as this is considered ***risk mapping,*** which ***is beyond the scope of this study****.* Similarly, ***analysis of magnitude/frequency, runout, and risk assessment are not part of this study***." (emphasis added)

In his November 3 memo, Rorie continues, "At a high cost, the consultant has indicated that additional site specific analysis could cost between $250K and $1M per hazard path." This further analysis is essential to the development of reasonable regulations. (for comparison with regard to flood hazard and risk CBJ's website: https://fema.maps.arcgis.com/apps/StorytellingSwipe/index.html?appid=48beaefc7ca447f895978686b8e6bd1d# , at the bottom of the upper portion of the left sidebar, just above the Legend, states *"Please note, data is for informational purposes only.* Effective regulatory flood hazard data is available through the FEMA Map Service Center website." *Emphasis added*.)

Tetra Tech's study has provided the City and Borough of Juneau and its residents with significantly more information that was available previously, but not with adequate information to establish risk, much less to establish the degree of harm that might potentially be caused. As such ***Tetra Tech's study is not ready for adoption as the basis for regulation of development***. ***The study is ready for adoption—and should be immediately adopted—on an informational basis.***

Adopted on an informational basis, the study would support language in the proposed ordinance stating that "Owners shall provide written notice to potential buyers or renters that the property is located in a severe avalanche (or landslide) **hazard** area prior to sale or rental of the property." This is essential. Everyone should know what their getting into, and then be allowed to judge for themselves the risks they are willing to take on. The ordinance must explain or refer to an explanation of the difference between hazard and risk, as this may not be common knowledge.

The regulation of development should be addressed separately; this is—as Rorie noted—considerably more complicated. ***Regulation of development should be underpinned by a community-wide consensus as to risk, what sorts of risk, assumed by which parties, and to what levels of risk.*** Tetra Tech has explicitly declined to address risk, except in future work at considerable cost.

The draft ordinance Sec. 2. (a), (2), states, "Development in mapped … areas shall minimize the risk of loss of life or property ...." (Complete quote: "Development in mapped moderate and severe avalanche and severe landslide areas shall minimize the risk of loss of life or property due to landslides and avalanches.") Life and property are different. Life is generally more important than property. Life can move out of harm's way; property generally can't.

Risk to life can be minimized through attention to weather conditions and site particulars. CBJ invests resources in avalanche prediction, issuing Urban Avalanche Advisory daily during the avalanche season. In the wake of the 2015 Kramer Avenue landslide, Sitka established a community-based early warning system for landslides—somewhat analogous to Juneau's Urban Avalanche Advisories. On October 3, 2022 National Public Radio's Short Wave published the attached story of Sitka's experience. Despite differences in soil types between Juneau and Sitka, Juneau could benefit from discussions with

Sitka's community and municipal government. I draw several lessons from Sitka: 1) landslides are predictable; 2) risk can be estimated; 3) public notice can be provided; 4) what Sitka is doing with landslides is similar to what CBJ does with avalanches.

Risk to private property can be addressed through personal choice as to where to live, through insurance, and through site specific mitigation. Sec. 2 (b), (2) of the proposed ordinance requires "site specific engineering for the following: peak drainage, special foundation or high back wall engineering, and debris flow diversion mechanisms." Such engineering requires quantification of risk in a particular location. ***Assertion of hazard is not a substitute for quantification of risk, and the proposed ordinance provides no mechanism for quantification of risk.***

Sec. 2 (b), (4) allows for relocation of mapped hazard area boundaries. ***Relocation of hazard area boundaries depends on quantification of risk, and the ordinance provides no mechanism for quantification of risk.***

Sec. 2 (b), (5) and Sec. (c), (4) mention "mitigating measures certified as effective by a civil engineer licensed in the State of Alaska". "Such measures may include dissipating structures or dams, special structural engineering, or other techniques designed for the site." Certifying as effective"—to what standard? Design professionals regularly certify construction as in compliance with locally adopted codes; to what national model codes or well-developed State or local codes would they be certifying? "Certified as effective" is unreasonable as there are no codes or standards to which to certify, and the ensuing professional liability is more than any licensed professional, firm, or professional liability insurer is willing to assume. "***In the absence of quantification of risk, allowing mitigation is meaningless.***

Site specific analysis is required to quantify risk. Such analysis is only available for a very few properties, and most such analyses were done by Bill Baxandall, P.E. (now deceased) decades ago. In September 2021 I contacted Tetra Tech to ask if they could provide a site-specific assessment for my property, as having done the initial mapping and being acquainted with the area, they were obviously most suited. They declined, citing their work with CBJ. I inquired elsewhere; despite considerable research, I was unable to find engineers or firms willing to provide such analysis. Reasons cited include: In the course of working with Tetra Tech CBJ consulted most, if not all, of the individuals and firms with local civil and geotechnical expertise. They were asked to review Tetra Tech's work and provide comments to CBJ. I have talked to several (there are not many in Juneau). They were unwilling to speak on the record or be identified, but they felt that ***having reviewed and commented on Tetra Tech's work for CBJ, they could not openly criticize it, or work for someone who took issue with the work.***

With considerable difficulty I found an expert outside Juneau, an Alaska licensed civil engineer with decades of experience in civil engineering, who owns a civil and geotechnical engineering firm with dozens of employees and offices in several western states as well as Alaska. He stated that, despite having no professional or other connections to CBJ or Tetra Tech, given that Tetra Tech mapped hazard only, and that the maps were vague and arbitrary, ***the professional liability***--on account of the lack of quantification of risk or professional standards to guide work--***was so great that he and his firm could not become involved.*** Local engineers with whom I spoke had the same concerns, in addition to their direct involvement with CBJ.

As Rorie noted in his November 3, 2022 memo, "private engineers and geologists who have expertise in hazard zones have little to gain by participating in individual site selections on reduced budgets. The liability is simply too great and the applicant's ability to pay for a detailed analysis is very limited. Private engineers with economic resources to protect are going to be naturally conservative." … "The new landslide mapping is not linked to event probabilities. Some discussion of probability was included in the draft report and

deleted by the consultant in the final report; the consultant was unwilling to tie their work to event probability estimates." *(emphasis added)*

Who is to "prepare site specific studies" if no one will so?

I live at 850 Basin Road; I care about my neighborhood, and the risks to myself and my neighbors. I also care about property values—mine and theirs—and my ability—and theirs—to maintain and prudently develop our properties. My neighborhood is upper Basin Road, a flat section before the road turns abruptly north into Last Chance Basin. I have lived here since 2002, having bought the property from my JDHS guidance counselors, who had lived there since 1969.

Near my neighborhood are a couple of extremely risky areas, with active landslide chutes that discharge rocks and debris annually if not more often. Tetra Tech lumps those areas in with my neighbor at 883 Basin Road, whose house is on a knob of rock at very little to no risk, as there are no cliffs above to shed rocks and any debris flow would be deflected by topography before reaching the house. My neighborhood of perhaps ten houses has seven or eight distinct topographic conditions that would directly affect landslide risk; Tetra Tech's work colors the entire neighborhood the same. This is not helpful. Of those seven or eight areas, the potential risk at two of those areas results from past CBJ work in the neighborhood. Aside from the known chutes with annual rock and debris flow, there has been no landslide activity (with one exception, below) in the neighborhood at least since the early 60s, when they moved in, according to my neighbor at 883 Basin Road.

As TetraTech says on page 6 of their report, C. Criteria for Slope Stability Interpretations, under Slope Morphology, "Slopes with irregular or benched topography controlled by bedrock are relatively stable;" In my neighborhood (upper Basin Road) that describes the ground largely upslope of the road, and the near-surface bedrock downslope of the road throughout the neighborhood. There are a series of bedrock terraces parallel to the road, which do not shed rocks or debris, and tend to retain loose material. By contrast, on both sides of our neighborhood, where Basin Road wraps to the east and north, those terraces become active chutes. Tetra Tech's maps are too coarse-grained to capture this critical distinction.

The exception noted above was a landslide, approximately 4' deep and 30' wide, which collapsed an unoccupied portion of my parking area in November 2005 during very heavy rains. I took no action and the area has since revegetated. On January 19, 1972 a large avalanche came down Mt. Juneau, dammed Gold Creek, and buried the adjacent stretch of Basin Road, see attached webpage by David A. Kent. The following spring CBJ Streets Dept. approached Richard and Anne Meeker, then property owners of 850 Basin Road, asked, and obtained permission to dump "many truckloads"—in Richard's words—of debris from the landslide onto the slope at 850 Basin Road. For 53 years this debris expanded the parking area at 850 from two cars parallel to the road to four (compact) cars perpendicular to the road. This area collapsed in 2005, restoring the parking area and hillside to the pre-1972 profile. There had been minor sloughing before, and given its history I knew the slope to be unstable. No vehicles were parked there when it collapsed. This collapse was the direct and inevitable outcome of actions by CBJ personnel decades before and did not represent a naturally occurring slope condition. Since 2005, the slope has been quite stable. In later correspondence with Tetra Tech with regard to their mapping through CBJ Planner Teri Camry, Tetra Tech noted the area of collapse as a "slide path", but did not appear aware of the source. I offer this example to illustrate the variability within neighborhoods, the necessity for site specific analysis, and the risk of relying on hazard maps, which are **NOT** risk assessments.

To summarize:

1) Snow melts
2) Upslope vs. downslope
3) Hazard vs. risk
4) Sitka forecasts
5) Site specific analysis
6) An example: my neighborhood

I'd like to thank the Planning Commission for their work—to date and future--on the Avalanche & Landslide Hazard Maps Draft Ordinance. Gunalch鼸span>esh (Without you, it would not be possible.)

Ke Mell
850 Basin Road

What's the Difference Between Hazard and Risk? A Complete Guide

July 08, 2019 | By: Victoria Owings

The statistics are shocking. The Health and Safety Executive reports that 1.4 million people in the UK are currently suffering from a work-related illness or injury. 555,000 injuries occur every single year at work. A staggering 144 people were killed at work in the year 2017/18. It is critical for employers to actively assess and implement strategies to avoid harm to their employees. As the numbers show, numerous employers still don't take this responsibility seriously. When asked: "what's the difference between hazard and risk ?", many people are unable to give you an answer.

This guide will help you to understand fully what's the difference between hazard and risk, and how you use the two together to ensure your workplace is the safest place it could be.

Let's begin with a definition.

When it comes to amateur health and safety efforts, the words 'hazard' and 'risk' are often used interchangeably. However, these terms have both totally different meanings and totally different functions. Let's take a look at definitions for both words:

- Hazard: something that could potentially cause harm.
- Risk: the degree of likelihood that harm will be caused.

In short, a hazard can cause harm. A risk is how likely it is to do so. The two terms work together to enable employers fully assess their working environment for potential dangers and prioritise them effectively. Let's look more in-depth at hazards and how they can be identified and categorised.

What Exactly Is A Hazard?

Many accidents are entirely avoidable, and the key to doing so is in minimising all possible hazards. Some items are naturally hazardous; while others harbour potential dangers if used incorrectly or inappropriately.

Hazards can be broken down into two basic categories:

- 1. Acute Hazard – these are hazards that pose obvious issues and would impact instantly. An example of this would be a liquid spillage, causing an immediate danger of somebody slipping over and hurting themselves.
- 2. Chronic Hazard – these hazards are not immediately apparent, and can have more of a hidden issue, sometimes only arising after long periods. An example of this would be the build-up of workplace stress or the gradual decline of a piece of machinery.

All hazards, whether acute or chronic fall into six core categories.

- 1. Physical – It refers to the stereotypical workplace hazard most of us would think of, for example, lighting issues, objects obstructing walkways, unsafe machinery, spillages on floors.
- 2. Chemical – This includes any form of liquid, vapour, dust, fumes or gases that could be spilt, leaked or misused.
- 3. Ergonomic – Usually stems from ill-thought-out design or spatial awareness. This can include workstations that aren't fit for healthy usage. However, this category can also include hazards associated with lack of training (e.g. manual handling) or unsafe working conditions leading to injury (e.g. repetitive movement).
- 4. Radiation – This may be more prevalent in a clinical setting and covers x-rays, gamma rays, UV and microwaves.
- 5. Psychological – This applies heavily across all industries in many forms. Examples of psychological risk include stress, working shifts, problems dealing with the public, internal harassment and lack of empowerment.
- 6. Biological – Not to be confused with chemical, biological risks involve viruses, bacteria and fungi. This can happen through bites, cuts, or contamination through contact with an infected person.

How To Identify A Hazard

Before the start of a shift or new procedure, equipment should be checked, and surroundings should be reviewed for potential hazards, especially around high-risk areas. When designing the workflow, consider the potential hazards involved, e.g. installing a new office kitchen consists of a myriad of dangers. If you are installing new machinery, consider its features and its impact on the immediate environment.

During Work

While tasks are being completed, ensure staff are aware of any changes. If something abnormal happens, whether that is a new smell, an unusual sound or simply an intuitive feeling, it should be clear to whom and how they should report it.

After Accidents

All accidents or injuries should be reported to Management and recorded in the accident book, including details of the full circumstances so that risks from hazards can be identified and minimised or removed.

Health and Safety Inspections

Informal and formal inspections should take place regularly, with full focus on hazard identification. A Health and Safety Supervisor or, in bigger companies, a Health and Safety Committee should take charge, planning and reviewing the results of inspections.

To make sure that no hazards are missed:

- Remember all stages of the working day, not just the main tasks. Include non-routine activities such as maintenance and repairs or cleaning.
- Look at all components of each process; all equipment and materials involved, as they may not be stored together during inspection.
- Make sure you speak to individual workers. They may have vital information that is not obvious from simple observation alone.
- Read records from previous accidents and injuries – what happened and has it all been fixed?
- There will also be risks to visitors or the public, take these into account.

To be completely thorough, it is important to imagine yourself in various scenarios. Ask yourself the following questions:

- 1. Which materials could I come into contact with?
- 2. What materials or equipment is being used?
- 3. What could I hit myself on or get myself stuck in?

- 4. What could I fall from or off?
- 5. What could I slip on or trip over?
- 6. How could I overexert myself?

Try to be imaginative and think about all of the possible things that could happen, even if the chances are minimal. Think about what would happen if violence happened in your workplace, and staff members behaved in a more erratic way than usual? What would happen if unauthorised visitors entered the building? What if a staff member was working alone and there was a fire?

How Do I Determine Risk Level?

We know from the earlier definition that a risk is a 'degree of likelihood'. But how do we work this out?

Firstly, look at the people involved. If you are working in a school and there are hundreds of children running around, there is a higher chance of them not noticing a hazard. Older, frail people may have problems with mobility or eyesight and may also miss a hazard. Young, inexperienced workers may not yet have adequate health and safety knowledge. Think also of other vulnerable groups: pregnant women, foreign workers with experience of different regulations and disabled staff or visitors.

Secondly, look at the time. How long has the risk been there and how long will it stay there? Is this a busy time of day, or is there a particularly significant event coming up?

Finally, keeping the above people and time in mind, look at the place. How many people will come near the hazard, and how often? What other hazards may be nearby?

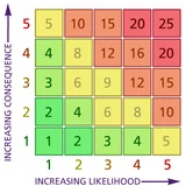
Introducing Risk Assessments

You have now been introduced to the concepts of hazard and risk, and should now understand what's the difference between hazard and risk. However, the chances are, you will find that your workplace is riddled with hazards, all posing different levels of risk. So how do you put everything into an effective prioritised list? The answer is with a Risk Assessment.

To identify and prioritise potential risks, they must be assessed and acted on accordingly. The best way to do this is to ask yourself the following two questions:

- 1. How severe will the consequences (or harm) be?
- 2. How likely is it to happen?

There are different methods you can use to carry out a Risk Assessment. This blog looks at the 5 x 5 matrix method. To use this method, the person carrying out the Risk Assessment would issue a numerical value between 1 and 5 for likelihood of the hazard causing harm and also give the consequence a numerical value rating between 1 and 5. Then multiple the two numerical values together to work out the risk rating (Likelihood x Consequence = Risk Rating).



Download Our Risk Assessment Template

Our 5x5 Risk Assessment template helps you quickly identify any risks via our risk rating calculator

What's the Difference Between Hazard and Risk : Real Life Scenarios

Here are two scenarios that could happen in real life, featuring different forms of hazard and risk, then we have provided an example of the Risk Assessment for each.

- Example 1: An Office Spillage

Jane cleans the office of a busy law firm every evening between 10 pm and midnight. Part of this job is mopping the lobby floor. One night, while doing so, Jane kicks the mop bucket and knocks the water and cleaning agent mix onto the floor. Jane needs more water to finish the job, so takes the empty mop and bucket upstairs to refill before she can finish the job and clean up the spillage. She displays a caution wet floor sign to warn others of the spill.
Where is the hazard? In this case, this is the liquid spillage on the floor.
Who can be harmed? Cleaner, lawyers working late, security guards.
What is the likelihood of harm? The lobby is at its busiest during the day and has minimal footfall at night. There are occasionally lawyers working late, and security work in the buildings 24 hours a day. Therefore, there is a risk, but it would be lower than a comparative time of 10am-12pm. Within 15 minutes, Jane will have cleaned the spillage. The likelihood would, therefore, be a 2 (unlikely).
What is the potential consequence of harm? A member of staff could slip and injure themselves. Most of the law firm employees are young and physically able. A fall is likely to result in bruising or possibly a sprain. The severity would, therefore, be at a 3 (moderate risk).
Risk Assessment score: 2 x 3 = 6 (adequate).

- Example 2: Care Home Carpet

A carpet tile has come loose in the middle of a corridor in a busy care home, with a corner sticking up an inch in the central walkway. The walkway provides access to the resident rooms, living area and the staff kitchen.
Where is the hazard? The hazard is the defective, loose carpet tile.
Who can be harmed? Elderly residents, employees and anyone visiting the care home.
What is the potential consequence of harm?
A fall for an older person can cause severe injuries, including broken bones and the need for extended hospital time. A fall for a busy care home staff member could result in moderate injuries and potential loss of earnings. This is severe, so 4 (major).
What is the likelihood of harm? Being a care home, there is an unusually high level of people with restricted mobility and of fragile health. Further, care home staff are often very overworked and may be rushing to complete their work, increasing the risk even more. Older people with poor eyesight or spatial awareness have less of a chance of seeing the problem and avoiding it. An accident is very likely, so 5 (very likely).
Risk Assessment score: 4 x 5 = 20 (unacceptable)
As you can see, a risk rating of 20 is unacceptable in terms of risk. Control measures such as fixing the carpet needs to be implemented to reduce the risk.

What Are The Next Steps?

So, now we know what's the difference between hazard and risk, and how we use the two together to assess potential danger. But how do we ensure we are utilising this information properly to stay within the law?
The Management of Health & Safety at Work Regulations 1999 stipulates that employers must carry out Risk Assessments to be legally compliant. The five steps to a Risk Assessment are:

- 1. Identify potential hazards associated with work activities
- 2. Identify those at risk from those hazards
- 3. Implement control measures (how are you managing the risks now, what more could you do)
- 4. Record the findings of the Risk Assessment
- 5. Review the Risk Assessment regularly

Incorporating these five steps into your routine will ensure you stay on a clear path to excellent health and safety. So now, you can answer the question: "what's the difference between hazard and risk ?" and answer confidently. Follow the lessons learnt in this guide, and you will be one big step closer to keeping your workplace and those within it happy, healthy and safe.

SHORT WAVE

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October 3, 2022 · 12:10 AM ET

14-Minute Listen

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Transcript

EMILY KWONG, HOST:

You're listening to SHORT WAVE from NPR.

OK, Aaron, I want to tell you a little bit about Sitka. So this is the town in Alaska where I used to live and report. And there was one day that honestly changed people's relationship to the weather.

AARON SCOTT, BYLINE: Emily, I love your Sitka stories, so I'm all ears.

KWONG: Yeah. Sitka's on an island on the edge of the Pacific Ocean in the Tongass National Forest. It's beautiful there, and it rains a lot - over 100 inches a year.

LISA BUSCH: We have beautiful rivers with salmon, and the salmon need rain. Our ecosystems need a lot of rain.

KWONG: This is Lisa Busch, executive director of the Sitka Sound Science Center.

BUSCH: You know, all of this is like, this is - we are rain people. We are people of the rain.

KWONG: And Lisa never feared the rain before. But the morning of August 18, 2015, was different.

BUSCH: I remember my pants getting wet, like, all the way up to my knees, just walking from my car to the airport. So I remember thinking, this is a lot of rain, a lot of rain.

KWONG: Rivers in town began to rise, and the land started to slide. Forty landslides were documented on Baranof and Chichagof Islands that day. A slope above a subdivision of new homes under construction gave way.

This landslide, the Kramer Avenue landslide, demolished a building and took the lives of three Sitkans - brothers Elmer and Ulises Diaz and Sitka's building inspector, William Stortz. I heard the news at the radio station. Lisa heard it on the plane.

BUSCH: I mean, I knew all the people who died. I knew all the people who were affected. I knew lots of people who were searching for these people. It's hard to get your head around.

KWONG: And the feeling in town that day was just one of precarity. The sky was so gray. There were these thick clouds that were almost pressing down. And the mountains - you don't think about mountains moving, right? But looking around, the geology suddenly didn't feel so static. For days, Sitkans were shoveling debris, cooking casseroles, keeping vigil with the families of those lost and coordinating shelters for those evacuated.

UNIDENTIFIED PERSON #1: I can stay with a friend, so my whole house is open.

UNIDENTIFIED PERSON #2: Chartereis (ph) has room.

KWONG: These are locals reading Facebook posts written at the time.

UNIDENTIFIED PERSON #3: My home is very small. But I can offer food, blankets.

UNIDENTIFIED PERSON #4: (Speaking Spanish).

KWONG: Keith Perkins of Sitka wrote this the day the last missing person was recovered.

KEITH PERKINS: (Reading) The sun set tonight in Sitka. Seven days from a horrific moment, a day of warm sun, the day Sitkans helped bring out our third friend home to his family, the day that marks closure, the day that begins a healing process for the community.

SCOTT: Emily, no matter how much you read or hear about natural disasters in other communities, nothing prepares you for when it happens to your own community.

KWONG: Absolutely. And I wanted to take you back to this moment so you could understand everything that happened after because the thing for Lisa, the Sitka Sound Science Center to do was to get answers. Why did this happen? Why did this rain tip the scale the way it did? Why Kramer Avenue? And how do you stop a tragedy like this from ever happening again?

SCOTT: Yeah. I mean, those are huge questions. Who do you call for something like that?

KWONG: You call scientists.

SCOTT: Of course you do.

KWONG: You know, my boss at the time, news director Rob Woolsey, said the answer is literally a puzzle, and everyone's holding a different piece. And Lisa dialed everyone - NASA, the National Forest Service, the National Park Service, the U.S. Geological Survey.

BUSCH: They responded so quickly. Yes, how can we help? All these scientists said, yes, we can help you with our expertise.

KWONG: With the goal of creating something Sitka and, really, the United States had never seen before - a community-based early warning system for landslides. This is the story of how scientists and locals found common ground to protect a community from disaster.

I'm Emily Kwong.

SCOTT: I'm Aaron Scott. And you're listening to SHORT WAVE, the daily science podcast from NPR.

(SOUNDBITE OF MUSIC)

SCOTT: So, Emily, introduce us to Sitka's landslide early warning system.

KWONG: I am going to do you one better, Aaron. It just launched last month, so can I show it to you?

SCOTT: Yes, please. Website? App? What should I look at?

KWONG: It's a website. It's like a digital dashboard. So take out your phone or your laptop. Type in sitkalandslide.org. Tell me what you see.

SCOTT: OK. So I'm looking at a clean page. There's a green checkmark that says the current risk of landslide is low, and the 24-hour forecast is also low. So this is great. This is reassuring.

KWONG: Mmm hmm. It kind of works like a traffic light system.

SCOTT: Right, right, right.

KWONG: And you saw for yourself it's really simple to look at. But developing a system that's both science-backed and user-friendly took seven years, a $2.1 million grant from the National Science Foundation and the involvement of an entire town.

SCOTT: Yeah, and a town that had just gone through a massive tragedy.

KWONG: Yeah. I mean, parents, a year after the landslide, were still calling the school district when it rained, asking, is it safe to send my kid to school?

SCOTT: Wow.

KWONG: And the superintendent - she was used to determining a snow day based on road conditions, but she had no frame of reference for when to call a rain day.

SCOTT: So if you're surrounded by these hillsides, how do you know which ones are at risk of sliding?

KWONG: Yeah, this is the where piece of the puzzle. Where do landslides happen?

I'm going to let Jacyn Schmidt, a local geologist, show us that.

JACYN SCHMIDT: Hey, Emily. Here in the field.

KWONG: Jacyn is the geoscience coordinator at the Sitka Sound Science Center, heavily involved in this project. I asked her to hike us to the origin point of an old landslide.

SCHMIDT: A debris flow happened here couple of years ago. And I'm at the head scarp, so it's the place where it all started.

KWONG: A debris flow - that's the type of landslide we're talking about here.

SCOTT: OK.

KWONG: It happens when you get a lot of water in the system, water that travels down through gravity and transforms layers of earth into a slurry of mud, water and other debris, taking on the consistency of wet cement. It can move up to 25 miles per hour, giving you very little time to get out of the way. It almost looks like the mountain has liquefied and has turned into a river coming towards you.

SCOTT: And so this is what happened on Kramer Avenue in 2015?

KWONG: It is. And Jacyn says a part of what makes Sikta landslide-prone is that the land is young. It hasn't had a lot of time to pack together and consolidate.

SCHMIDT: And you can see the layers that are making up the geology of slopes here.

KWONG: If you read the layers, you learn the story of how Sitka came to be. So the top layer is the Tongass Forest, the pretty stuff.

SCHMIDT: Where there's grasses and mosses and berries. Blueberries are ripe.

KWONG: Underneath that is the volcanic ash, which is called tephra.

SCHMIDT: It's a little bit orange in color. And when I rub it between my fingers, it's superfine material.

KWONG: And this tephra settled out of the air from blankets of ash spewed up by Mount Edgecumbe, the local volcano, about 10,000 years ago.

SCHMIDT: Then underneath the tephra, there's some glacial till. It's this gray, unconsolidated. When you run your hand over the rock, it just falls off.

KWONG: And it's only below all that that you finally reach the bedrock. So the layers of land - they're just not packed together super tight. It's more like a loose lasagna.

SCOTT: Emily, the fact that she can rub the tephra between her fingers and that the glacial till, like, breaks off when she just brushes against it with her hand...

KWONG: Yeah, I know.

SCOTT: ...Like, it's scary how unstable that sounds.

KWONG: It is typically very stable, by the way. It's just when it rains.

SCOTT: OK.

KWONG: But the soil - it does contain a clue. There are scars of old landslides all around Sitka. And geology tells us that new landslides are likely to form in the footprint of these old landslides, which is telling. So when Sitka's geo task force started discussing that, the Forest Service, Lisa says, was like, hold on.

BUSCH: Well, we have a landslide inventory that we've been keeping track of for the last 50 years in the area. Would that be helpful? And we were all like, what?

KWONG: Historical data? Yes.

BUSCH: Hello? We didn't even know that they were doing that.

SCOTT: I love it when discovering a database is like discovering hidden treasure.

KWONG: Yes. And that trove of data wound up in the hands of Annette Patton, a post-doc at the University of Oregon and now lead geologist on this project. So with a sense of how slopes have failed before, the ridge above Kramer Avenue being one of them, Annette, along with Josh Roering at the University of Oregon, wanted to know what amount of rain tips the balance.

SCOTT: So, like, do certain amount of rainfall predictably lead to landslide risk?

KWONG: Something like that, yeah.

ANNETTE PATTON: Like, if it rains really hard for a day, is that what triggers a landslide? If it rains really hard for an hour? So we didn't know for sure exactly what timescale of heavy rainfall would trigger a landslide. So that's where we wanted to start.

KWONG: So Annette combined this landslide inventory that the Forest Service happened to have with Sitka's rain record - 20 years of data gathered at the airport. And after a lot of number crunching and statistics, she started to see a pattern. Five of the most catastrophic landslides in the last decade, ones that blocked roads, destroyed human life and property - they all saw a certain amount of rain in a three-hour interval.

SCOTT: Ooh, this is like a rain mystery. So how much? How much rain?

KWONG: It's not an absolute because the model is more designed to calculate probability. So a high-risk probability warning is triggered around 1.3 inches of rain in a three-hour interval. Before the Kramer Avenue landslide, 1.7 inches fell between 6 and 9 a.m., so it was like a whole day's worth of rain happened in that three-hour time period.

SCOTT: That's a hard rain. So what's great about this, though, is that it's taking this unpredictable thing - rainfall and landslides - and then putting some order on it. And we can then start to decode what might lead to these disasters, right?

KWONG: That's the question. And the pieces started coming together. We had where. We had why. Annette built an algorithm that pulled all of that information into one place. And that's the basis of Sitka's early warning system. The Science Center - they also installed soil sensors in the three slopes most at risk - Gavan Harbor and Verstovia - and 10 of these tipping buckets in people's backyards. These are just designed to measure local rainfall totals.

SCOTT: And so they're building up infrastructure on the ground to gather even more data in the years to come and kind of move into the future of this.

KWONG: Yeah, it's very Alaskan. You know, if you give people the chance to get involved, they will get involved. So the Science Center - they consulted the community as much as possible. Sitka Tribe of Alaska got involved. They contributed traditional knowledge about landslides and human movement. That's on the dashboard. And to make sure the warning system actually reaches everyone in town, the Science Center

decided to map the social networks. Robert Lempert led this part. He's a senior scientist at the RAND Corporation and did all these co-design workshops.

ROBERT LEMPERT: We ran a game, an exercise where we asked everybody in the room - and there's about 20 people or so - to fill out a little form and say, whom in the room would they take shopping for clothes to get good advice on, you know, what to buy?

SCOTT: I love this, Emily. So the people we trust most are the people we know will give us honest feedback on what we're wearing.

KWONG: (Laughter). Yeah. And certain names kept coming up again and again. Social network mapping identified 50 super connectors in Sitka, 50 people who should know about the landslide early warning system.

LEMPERT: And this idea that you've got individuals who have worked through the process who now, you know, trust this body of information, trust each other.

KWONG: Basically, any innovation in geo hazard science is meaningless if there aren't innovations in human preparedness and scientists taking the time to do this work thoughtfully and people willing to show up for that. This kind of collaboration - it's only becoming more important, right? I mean, these landslides - they're connected to climate change. Southeast Alaska is going to see more extreme rainfall.

SCOTT: Yeah. I mean, a lot of places are going to see more rainfall, which raises the question, are other communities taking note of this project?

KWONG: Yes. Yes, communities who also worry about landslides and other things. Which is why the Science Center hopes to bring this predictive modeling to six other rural and tribal communities in southeast Alaska.

SCOTT: Oh, great.

KWONG: The NSF-funded project, which is called Kuti, which is the Tlingit word for weather, helps to create a regional system for warning people about flooding, avalanches and landslides. These natural hazards can't be stopped, at least not yet. But Lisa Busch says people can learn to live with them.

BUSCH: To me, it's heartening to see a community adapt and move on. Yes, we have to live among landslides. We have to live in a changed world, and that's not easy. But it's heartening when people do it.

KWONG: Especially, Aaron, I think, at the local level to keep people safe. I can't think of a better use for science.

SCOTT: Emily, thank you for bringing us this story from Sitka.

KWONG: My pleasure, Aaron.

SCOTT: This episode was produced by Chloee Weiner and edited and fact-checked by Gabriel Spitzer. The audio engineer was Ko Takasugi-Czernowin.

KWONG: Special thanks to KCAW Sitka, especially Robert Woolsey and Katherine Rose. And to the following Sitkans - Megan Pasternak, Brooke Schafer, Paul Norwood,

Keith Perkins and Jason Schmidt (ph). Beth Donovan is our senior director, and Anya Grundmann is our senior vice president of programming. I'm Emily Kwong.

SCOTT: I'm Aaron Scott. Thanks, as always, for listening to SHORT WAVE from NPR.

(SOUNDBITE OF MUSIC)

SCIENCE
Tweeting directly from your brain (and what's next)

Wednesday, January 19, 1972, 32 years ago, A Clear, Eventful, EXTREMELY WINDY, Very Cold day with Taku Winds.

Mt. Juneau, 3,576 feet, Juneau, Alaska. The avalanche originated at the top of the streak of white running down the mountain right of center. Mt. Maria is the foothill to the right. Picture taken February 4, 2005 by O. Richard Kent.

11:07 A.M. PST (Juneau was on Pacific Time then):

KINY Radio's tower (reported to be 500' tall) on the A.J. Rock Dump blew over, putting 1 of the only 2 radio stations in town at the time off the air. Gusts were to some 100 m.p.h.; chill factor -60 degrees below zero.

2:15 PM PST (Approximately):

A HUGE Snowslide on Mt. Juneau at the main waterfall-drainage visible from downtown Juneau on the Last Chance Basin side of the mountain.

Speed of the air blast is estimated at 180 m.p.h.

Downtown Juneau including the Federal Building is engulfed in the tremendous billowing cloud of snow, snow reaches Douglas Island and our house. To this date (January 19, 2004) there has not been an avalanche since in any way equivalent to the 1972 avalanche.

RESULTING IN:

Gold Creek is dammed by the slide and Basin Road along the NW side of Mt. Maria is buried under the snow.

The Municipal Water System of Juneau is put out of commission for 2 days because of the destruction of the Spring Line where it crosses Gold Creek and the electric power lines in Last Chance Basin that supplied power to the well pumps were damaged. A check valve at the 8th Street Reservoir then malfunctioned because of a block of wood, allowing the water to drain out of the reservoir. Because of the 40" - 45" of snow in the front yard of 3270 Nowell Avenue (then numbered 240) there was plenty of snow to melt for water..the bathtub was filled with snow so it could melt and be an in-house reservoir.

One of the pictures of the slide as it happened, taken by Juneau resident Jonathan "Skip" Gray from the A.J. Rock Dump was featured in the September 1982 issue of "National Geographic" on pages 292-293 in the article "Avalanche! Battling the Juggernaut" pages 290-305.

MEANWHILE ON DOUGLAS ISLAND:

Mrs. Marie Kent in the morning was holding a "Sarah Circle" women's church group meeting at the house and wondering if the large windows in the Living Room were going to blow out from the wind. When the avalanche occurred and the snow reached 240, Mrs. Kent did not know immediately what was happening.

David the author, was in Gastineau Elementary School on 3rd Street in

Douglas in the 4th grade classroom of Mrs. Kreuzenstein listening to the Taku winds whistling through the gaps in the aluminum window frames. He was totally unaware of what else was going on in town; school was let out when the water system failed.

AND DOWNTOWN:

Mr. O. Richard (Dick) Kent Contracting Officer for the U.S.D.A. Forest Service in Room 527 on the 5th floor (SE side of building...the side opposite Mt. Juneau) of the Federal Building came home at +/- 4:00 P.M. after the Juneau water system failed and the 8th Street reservoir had run dry (no water at 240 Nowell by 3:45 P.M.). Earlier in the afternoon Mr. Kent had come home to tie down the tarps over our 22' Sabre Craft cabin cruiser boat stored in the front yard, which were being torn off by the winds.
