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TO: Deputy Mayor Gladziszewski and Assembly Committee of the Whole

FROM: Rorie Watt, City Manager

DATE: November 3, 2022

RE: Hazard Mapping Update/Recommendation

From a municipal policy perspective, hazard mapping is very complicated. While we all acknowledge that the existing mapping and code is weak and antiquated, several attempts to update the code and maps have failed. In order to effect an update to the code, the Assembly should be prepared to spend quality time on the topic. While draft recommendations are included in this memo, no action is requested tonight. I suggest that the Assembly digest the information in this memo, read a lot of the companion information and take the topic up again at the 11/28 Committee of the Whole.

Changes to hazard maps and implementing code will be codified in Title 49 and all changes to this chapter are required by code to go to the Planning Commission for work, public input and recommendation. Any direction the Assembly gives will be a point of departure for staff to begin that work with the Commission.

As this is an enormous topic, I have included quite a few endnotes to help frame the topic.

Many documents (including the new maps) are available on the Community Development Department webpage under special projects, linked here:

<https://juneau.org/community-development/special-projects/landslide-avalanche-assessment>

The existing adopted hazard maps from 1987 are antiquated and the companion Code (49.70.300) does not accommodate the necessary subtlety to allow for best answers for development in or near hazard areas. Existing Mapping and Code generally guides and limits development as follows:

*Purpose - Minimize the risk of loss of life or property due to landslides and avalanches*

*Mapping - Two zones: Moderate and Severe (same categories for both avalanche and landslide)*

*Restrictions*

- every action except a single family home requires a Conditional Use Permit
- developer may change map boundaries with engineering analysis
- Planning Commission may require mitigating measures
- severe areas may not increase density or construct more than a single family home

The new mapping has more hazard categories (and we have not developed companion code):

*Mapping Categories-*

*Landslide - Four zones: Moderate, High, Severe, Severe w/ Bedrock failure*

*Avalanche - Two zones: Moderate, Severe*

- Estimated impact pressure threshold differentiating the zones
- Impact pressure can be used to inform building requirements

Uncomplicated policy implementations are at the ends of the spectrum – either doing nothing, or outright prohibiting development is the least complex. Anything decision in between is significantly more complex. Partially limiting property owners from developing requires very careful rationale to allow justifications to

limit development rights – in situations that are all subtly different. New companion code must accommodate existing building renovation/expansion proposals while also regulating vacant land. This is made more complicated by disclaimers in the study that indicate that the maps are not to be used for site specific decisions. At a high cost, the consultant has indicated that additional site specific analysis could cost between \$250K and \$1M per hazard path.

Because landslide mapping can never be perfect, and if development is to be restricted, I recommend that the code should continue to allow property owners an avenue to change map boundaries. There is a less strong case that we should allow changes to avalanche mapping. The avalanche mapping has been historically consistent, yet allowing an avenue for change/updating does seem reasonable. I have to admit to having mixed feelings about this recommendation.

Landslides are more complicated than avalanches (or flood plains) from a policy perspective, they are less predictable and can take more forms than avalanches. We can (and do) measure and analyze snow packs and make risk predictions throughout the winter and an occupant that is in danger of an avalanche could temporarily vacate a structure. Similarly, a person can also vacate a structure during a high water event when flooding is predicted or when it is occurring.

Landslides can occur in several forms – large mass wasting events (1921, 1936), episodic gully washers and September's large tree event are examples. Unlike avalanches, landslides are not at all easy to predict. Some communities have adopted slope or weather and soil monitoring approaches, but those do not seem like obviously good strategies for Juneau. Monitoring would not have predicted the tree event of 9/26/22 or the episodic gully washing events that occur from time to time in the main drainage channels (organic debris builds up over time, high rainfall events trigger relatively minor and localized slide events, scouring the drainage channels to bedrock). Peak hour rainfall monitoring may be a better landslide risk indicator (but is unlikely to be a flawless metric).

**Code Purpose Draft Recommendation:**

The existing purpose statement in 49.70.300 appears to be appropriate. Minimizing loss of life and property is appropriate. Unfortunately, eliminating loss of life and property is not possible. I recommend that we maintain this same purpose.

**Avalanches:**

The new and existing avalanche maps are similar, and the existing code appears to strike a reasonable balance between information, restriction and prohibition. The maps are clear and believable to the public (avalanche activity has been observed in our lifetimes and in documented memory), and enforce an uncomplicated restriction (nothing greater than a single family home in a severe avalanche hazard area). The draft report also recommends tangible mitigating standards, namely construction that has to resist a certain force.

***Avalanche Mapping & Code Draft Recommendation:***

I recommend that the Assembly request a draft Ordinance that would adopt the new avalanche maps and contain companion legislation that mirror's the current code. The information on the estimated impact pressure should be included as an advisory note in the draft legislation. The Draft would be sent to the Commission for review.

**Landslides:**

Landslides have been reported in recent years in several other Southeast communities, some with fatal results. People should reasonably ask – does Juneau face similar risks? Are our citizens at risk of fatality if development or occupancy proceeds in our hazard zones or in other areas of Juneau? The answers to these questions will be necessarily dissatisfying – we can't perfectly know. We can predict and estimate, but we can't know the real actuarial risk. We can, however, make reasonable decisions based on the available information that we have.

In comparison to the adopted maps, the new mapping is more assertive in where it shows landslide hazard zones. Whether the Assembly buys into this newly shown increased risk is uncertain. Whether the Assembly feels that restricting development is sound public policy is also uncertain. In weighing the consideration of the TGH project or the pre-development loan to the Gastineau Lodges project, both the Planning Commission and the Assembly seem inclined to support development projects and to let private applicants sort out the complicated details of hazard zone development.

***Landslide Mapping & Code Recommendation:***

I recommend that we adopt the maps as the best updated mapping available and develop a draft Ordinance for Commission review that would propose to regulate development as follows:

- No restrictions in Low, Moderate or High Hazard Areas
- Single Family Residency permissible in Severe Hazard Areas
  - Development Density Greater than Single Family Requires a Conditional Use Permit, with the developer proposing special engineering for the following:
    - Peak Drainage
    - Special Foundation and/or High back wall Engineering
    - Debris Flow diversion mechanisms
    - Possible Adjustments to Map Boundaries

Additionally, the developer/owner should be required to notify hazard details to renters  
Consider requiring property sellers to disclose hazard designation to potential buyers

**Endnotes:**

**Skagway:**

In the last year, the White Pass cruise ship dock has been damaged by rock landslides and private consultants have been assessing the situation. The geological composition of that cliff side is different than downtown Juneau. The [exposed slope in Skagway](#) shows fractured and over steepened cliff bands; unconsolidated boulders are poised for descent some 950' down to their cruise ship dock. It is not immediately analogous to our situation and the immediate and severe nature of the risk is evident to a lay person. Skagway is considering some expensive [short term](#) measures than are not at all likely to make the north cruise dock safe for use.

**Haines:**

The tragic Haines slide of 12/2/2020 occurred on a forested slope, gentler in grade than Mount Roberts. It actually looks more similar to other Juneau slopes (including Douglas Island) than it does to our downtown hazard areas. It is a good reminder that any mountainous slope can be unstable. Soil depths to bedrock appear to be much greater than those on Mount Roberts which resulted in the availability of much more soils debris for the landslide.

**Sitka:**

Sitka experienced a fatal landslide on 8/18/2015. Sitka's soil strata is very different than much of southeast, a layer of tephra soils (explosively erupted ash from the Mount Edgecumbe Volcano) underlay surface soils in the region. These soils have different soil mechanics resulting in different slope stability considerations. Soil depths to bedrock appears to be greater than those found on Mount Roberts. With Federal NSF funding, the non-profit Sitka Science Center maintains a [Sitka landslide risk dashboard](#). I do not believe that the City and Borough of Sitka endorses this website's risk analysis. An interesting link to a video about correlation between rainfall and landslide risk is also [available](#) (time stamp at about 18:30 for discussion on correlation of peak rainfall and risk elevation). The problem with this approach is that people interested in understanding risk may get a false sense of security – landslides can and will occur outside of peak rainfall events.

**Juneau/Mount Roberts:**

Juneau had two large slide events on Mount Roberts in the earlier part of the 20<sup>th</sup> century. Both slides appear connected to the AJ Mine's rail road development and its practice of side dumping rock on the steep slopes above town for the construction of a rail road that ran side hill above town. Informing slope stability, the historic mill site ruins appear unchanged since they were constructed some 100 years ago. Several mine penetrations readily offer inspection of Mount Robert's bed rock which appears to be very stable. These mine tunnels provide limited but very valuable geotechnical information.

CBJ has cleaned up several smaller mudslides on Gastineau Avenue in the last 20 years. Several drainage channels have been episodically active and we should expect them to continue to be periodically active. When these channels have scouring events, the underlying bedrock is typically exposed and appears to be stable.

CBJ's significantly reconstructed Gastineau Avenue in 2001. Those project improvements are mitigating factors for slope hazard analyses for properties that are downhill of the road. Substantial geotechnical engineering including soil stabilization, retaining walls (including anchoring) and water management improvements were constructed as part of that project.

Soil depths in the drainage channels on Mount Roberts are observable in many locations and are shallow, resulting the availability of less soil debris for landslide events.

### **Climate Change:**

As measured at the Juneau Airport, Juneau has seen a rough doubling in the last 20 years of days with more than one inch of rain from the historical averages. From 1944 – 1990 we had an average of about 5-8 days per year with greater than one inch of rain and from 2000-2020 about 10-15 days per year. There are many ways to measure climate changes (this one comes with a warning about a smallish sample size) but peak rainfall events appear to be increasing - which is very consistent with many climate change predictions.

### **Private Updating of Hazard Maps:**

Given the nature of our hazard maps (a broad overview, not property specific) it makes sense to allow applicants and property owners a process to update mapping. In theory this sounds reasonable, but in practice it is actually quite challenging for several reasons. First, private applicants don't have large financial resources that will likely result in more detail than CBJ's FEMA funded mapping effort. Second, 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.

In making the decision on whether to allow a path for property owners to update the hazard maps, the Assembly has to balance several issues. First, global hazard mapping is an effort to broadly help the community, while the ability to adjust maps would allow individual owners to represent their financial interests, the interests of specific properties. Second, it is unlikely that private proposals to update will have similar mapping quality than the new maps.

### **Statistics & Probability:**

Any policies about hazard zone regulation are inextricably bound to the likelihood that events occur within a named period of years. The avalanche efforts are tied to a 30 year concept that is derived from climate and event data. Flood mapping is typically tied to 100 or 30 year event probabilities. Like avalanche risk analysis, flood mapping is heavily reliant on measurable rainfall data, topography and records of historical events. Landslide or mass wasting probability is much more difficult to predict. 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.

There are about 30 mapped severe landslide hazard chutes between about 2<sup>nd</sup> Street and the Little Rock Dump. The consultant has generally mapped the severe hazard exposure areas to the waterside of Franklin Street/Thane Road. When discussing probability of new code restrictions, I suggested to the Assembly that we not try to regulate hazards that are not predicted to occur within a 50 year time frame, the Assembly preferred a more conservative approach of not regulating events that are not predicted to occur within a 100 year timeframe.

### **Doing the Math:**

Statistically, a landslide path with a 100 year event probability has a 63% chance of occurring in any given 100 year period (or a 37% chance of NOT occurring). We have 30 mapped landslide paths and more than 100 years of data and two mine railroad related events that caused debris flows to reach South Franklin. The chance of All of these mapped paths having a 100 year event probability and ALL NOT having a non-made made debris slide reach South Franklin in ANY of these paths in a 100 year period is something like one millionth of a percent.

The simple math tells us that these mapped severe areas are not all likely to reach South Franklin Street as shown on the maps. Is it possible? Yes, of course. But it is more likely to be on some multi-100 year likelihood. Maybe we'll be unlucky enough to see a 500 or 1,000 year event in our lifetimes, but most probably not.

### **Downed Trees:**

Geologists consider the September event that damaged homes on Gastineau Avenue to be a landslide event. Another perspective is that the event very well may have been initiated by high winds which blew down a 300+

year old tree and it was this tree and associated woody debris that caused damage to the homes. This distinction is likely significant for homeowners and their insurance companies. While there was rainfall and soil erosion, the causative factor in the home damage was from trees that fell and mobilized at high velocity down the hillside.

To my knowledge, we do not have historical knowledge of events like this one. There are many downed and dead trees on the hillside, yet they have not mobilized in storm events. Notably, AEL&P performs maintenance on the power line corridor that is above the roads. They cut down and trim trees that are potentially hazardous to the aerial power lines. These downed trees are in the power line corridor, slowly decomposing. It seems very strange and unusual to have 300ish year old tree fall and take a 600-700 toboggan ride, root wad first. Speaking for myself, it had not occurred to me that it would be possible, I would have assumed that falling trees would get hung up on other trees.