Part 1

On June 3, 2015, a rock slide closed the Stillwater River Road 0.15 miles west of Midnight Canyon Road, which is about 12 miles west of Absarokee. Since that time the rock slide has not been cleared off the road. There are road block signs to the east and west of the rock slide. This slide has the road blocked off completely, therefore many of the people that live on the southwest side of the slide now have to add a minimum of 50 miles to their commute because this slide is in a remote and rural area, being there is no way around it without crossing private land. Therefore, travelers have to nearly double their travel distance to get around the slide.

Part 2

During the investigation, we put a survey out for the public to answer, which produced good results. The people surveyed could leave a comment on how they thought the rock slide should be cleaned up and suggest possible solutions. We also searched the internet, which provide us with numerous news articles produced by both the *Stillwater County News* and the *Billings Gazette*. We also sent out emails to our County Commissioners.

First, Ben, found an article from the Stillwater County News, titled "Rock Slide Shuts Down Stillwater River Road 1,2 Weeks," This article was written by Marlo Pronovost, dated June 3, 2015.

Next, Bo found an article titled, "Unstable Rock Slide to Keep Stillwater River Road Closed," written by Marlo Pronovost, dated June 11, 2015 by Stillwater County News.

The next article was found by Benw, written by Marlo Pronovost, dated June 17, 2015, titled, "Stillwater River Rd. To Remain Closed."

Bo found one titled, "Stillwater Road Resident To Commissioners: "Get Things Done!," This article was written by Marlo Pronovost, dated June 25, 2015, published by Stillwater County News.

Then Ben found an article titled, "Estimate For Stillwater River Rd. Rockslide Fix Escalates," written by Richard Hanners, dated August 20, 2015, published to Stillwater County News.

The last article that Bo found was from the Stillwater County News, titled, "Possible Slide Solutions," it was written by Richard Hanners, dated December 31, 2015.

Bo later found an article from the Billings Gazette, titled, "Stillwater River Road Proposals," written by Kristi Angel, dated July 28, 2015 . This article contained links to two proposals, one from GeoStabilization International (GSI), and the other from SK Geotechnical, which are intended to propose solutions to the problem.

Part 3

"Rock Slide Shuts Down Stillwater River Road 1,2 Weeks," dated June 3, 2015. Written by Marlo Pronovost. This article states that there would be an informational meeting on June 4th

at 1:30 p.m. at the Fishtail Community Center. The first citizen report was called in at 7:39 a.m. on June 3rd, the morning of the slide. "We're not going to put anyone under it if it's not safe."said Road and Bridge Superintendent Mark Schriner. Phone service was knocked in the Midnight Canyon area temporarily. A homeowner asked a Fish, Wildlife & Parks representative if another slide could potentially block off the river completely, which the representative felt would probably not happen.

"Unstable Rock Slide to Keep Stillwater River Road Closed," dated June, 11, 2015, written by Marlo Pronovost. This article states that there were 3 recommended evacuations. There were reports of people with small children climbing on the rubble of the slide. Bob Schreiner cautioned that at this point, it is a wait and see game. There will be no detailed plans made until the area is stable enough for a closer look.

"Stillwater River Rd. To Remain Closed." dated June 17, 2015. Written by Marlo Pronovost. This article stated that there was a high potential for future issues and that the road is to remain closed until the engineers give the green light. Until then, safety will be the primary concern.

"Stillwater Road Resident To Commissioners: "Get Things Done!," dated June 25, 2015. Written by Marlo Pronovost. One resident wants the slide cleaned up, saying it has caused "great burden" on his business. In the letter, dated June 13, the resident explains what used to take him 17 minutes to drive to work, now takes him upwards of an hour and a half, plus an additional 64 miles. Also, stated is "that if it was going to go it would have went by now, put up signs that say 'Slide Area travel at your own risk" In a letter from the commissioners, it was stated "it is the property owner's responsibility to determine what course of action to take in order that they may protect themselves, their visitors, and their property."

"Estimate For Stillwater River Rd. Rockslide Fix Escalates," dated August 20, 2015. Written by Richard Hanners. Geostabilization International (GSI) sent a representative to meet with the Stillwater County commissioners on August 11, 2015. GSI sent a new estimate to the county on August 13, 2015. The original estimate came out to $1.5 million. The actual figure for the new estimate is blacked out for proprietary reasons. Commissioner Gerald Dell said that the new estimate cost is "significantly higher" There is a wedge shape of dangerous rock that is still in the rock face. Removing this wedge by blasting is considered not feasible because vibrations from the blast could cause the whole wedge to come down. The actual word could take 3-4 months, preferably next spring the letter stated.

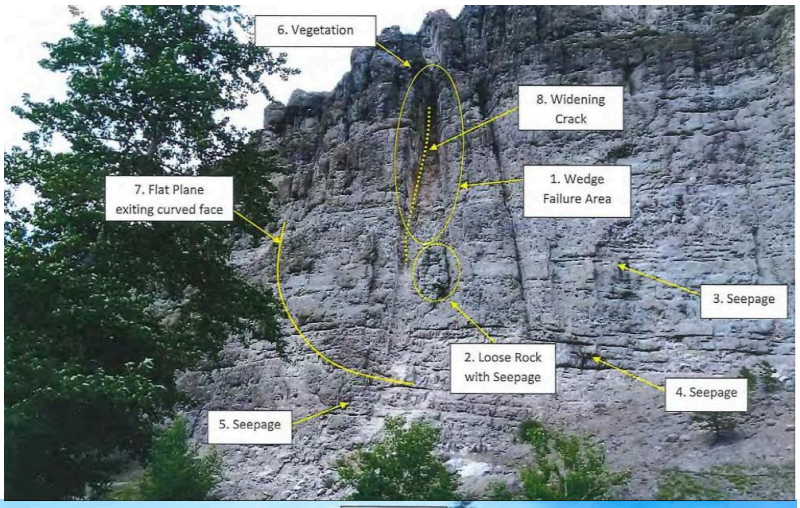
"Possible Slide Solutions," dated December 31, 2015. Written by Richard Hanners. This article states that an 18 page draft report by the engineering company hired arrived on at the Commissioner's office on Dec. 23. The failure zone measures about 5-10 feet wide, 5 feet deep, and 50 feet long.

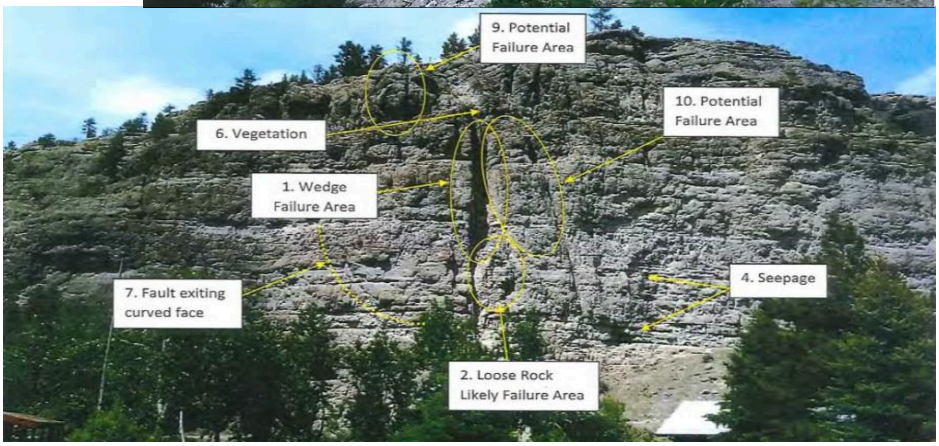
- Option 1 calls for slope scaling, with workers removing rocks from the face that had been loosened by the freeze-thaw cycles.
- Option 2 calls for erection of a 250-300 foot long rockfall fence between the road and the river capable of stopping rocks up to 5 feet in diameter from entering the river.
- Option 3 calls for erecting a 200-250 foot long rockfall fence about 30 feet above the road on the cliff face.

- Option 4 calls for erecting a 200-250 foot loin rockfall detection fence that could automatically close a gate on the road or signal the county road department. How soon additional evaluation work can be conducted could depend on winter conditions and access.

The article titled "Stillwater River Road Proposals," dated July 28, 2015 written by Kristi Angel was the two written proposals from GeoStabilization International(GSI) out of Bend, Oregon and SK Geotechnical out of Billings, Montana. In GSI's report it states "that the most critical portion of the slope is approximately ¼ mile long… A flexible rockfall barrier, installed at the base of the lower angle slopes on either side of the scaled portion is recommended." This rockfall barrier will arrest larger rockfall events to prevent deposition on the road surface or within the Stillwater River. The estimate for scaling, rock bolting/dowels, and the flexible rockfall barrier is approximately $1.497 million.

SK Geotechnical states, " the rock slide was a wedge-shaped failure approximately 50 feet long, 5 to 10 feet wide and about 5 feet deep, this failure was about 30-40 feet above the roadway. The Stillwater River is about 15 feet below the surface of the road." Several areas around the slide was reported to be seeping water from the face. These seeps were located about 10-15 feet away from the failure point. This group also say, "the proximity of this rock face to Stillwater County Road and residences represents a significant hazard to people and property… The only way to eliminate these risks is to close or relocate the roadway. Closing the roadway would force residents west of the failure area to take an alternate route, while relocating the road would require building two bridges and a new section of county road." They recommend "rockfall" signage be placed along the road to warn the public of the risk. A percentage of gasoline tax collected by cities and towns to be used for construction maintenance and repair on rural roads as per Montana State law.





Part 4

At this point in time the options from GSI include slope scaling, with workers removing rocks from the face that had been loosened by the freeze-thaw cycles. We think the possibility of this happening is not good because we can not see our county spending almost 1.5 million on a rural gravel road. Now if it were a paved highway then the slide would have been cleaned up months ago, but we personally think that the commissioners do not realize the effect that the slide has on the residents in that area.

Our options also include the erections of numerous rockfall fences capable of stopping rocks up to 5 feet in diameter. These fences of variable geometry are fabricated from a complex system of steel cables, connections of steel cables to structural elements, energy absorbing devices and anchorages, capable of high deformation capacities which are designed to be easily transported and assembled in extreme conditions.

The pictures posted in part 3 analyzes the rock face and helps to predict the possibility of future slides, and where they might occur. Label #2 is a portion of rock hanging just below the wedge failure. It was observed to be damp and possibly seeping, but not dripping. In the vicinity of label #2, several suit-case sized rocks were observed which appeared to be relatively loose. Areas #9 and #10 have discontinuities that intersect to create a wedge. A large rock mass is defined by the discontinuity shown with lines labeled #7 and #8. In and around the existing wedge failure, portions of the rock face have similar joint conditions and are at risk of failing. The rock face has always had a risk of failure and subsequent hazardous conditions. The risk of failure increases seasonally with the highest risk coming in the spring with heavy snow melt and spring rains. SK Geotechnical says, "Assuming some risk is acceptable, then it is our opinion the road can be cleared and opened when the visible seeps are no longer apparent.

Part 5

Through our research and findings, we can conclude that this is going to be an issue to get the slide cleaned up, partly because the commissioners are worried about safety concerns and the risks of future slides. Based on our findings, we recommend that the slide be cleared sooner than later. Commissioners say that it is still too risky to put workers in the area in case of future slides. However, you could go in and make the face safe, by rock bolting and scaling, before clearing the road. Then again, the commissioners say that money is a problem, that it is too expensive to get the proper work done to make it safe, so that the road can be cleared.

We think that one way or another this slide needs to be cleaned up, we believe it will be beneficial to the landowners and the surrounding community. It is going to cost some money to get the road cleared but you have to expect that because nothing in this world is free. Reevaluating the face would be too expensive to have done again.

The slide area has already been evaluated and both of the companies that evaluated it stated that the face was unstable and likely to fail again. At this point in the investigation, we recommend that the slide area be cleared, but because of the information provided by SK Geotechnical and GSI, county commissioners do not want workers under the face. The slide area should remain closed off because of the risk of another slide injuring or possibly killing road workers in the process of cleaning the road.