

# Technical Memorandum

January 22, 2022

Project# 230210.040

To: Lisa Cornutt  
Oregon Department of Transportation  
3500 NW Stewart Parkway  
Roseburg, OR 97470

RE: South Coast Site Reconnaissance Report

## INTRODUCTION AND OVERVIEW

The purpose of the site reconnaissance was to observe and record the geologic and landslide conditions present for the thirteen slide complexes included in the South Coast Slide Study as well as conducting a windshield survey of US 101, Carpenterville Road, and other potential detour routes around the thirteen slide complexes. The site reconnaissance took place the week of October 11-15, 2021, from Port Orford to Brookings, Oregon. Prior to and during the site reconnaissance, weather conditions were generally dry, with some precipitation on Tuesday October 12<sup>th</sup>. Representatives from the Oregon Department of Transportation (ODOT) escorted Kittelson & Associates, Inc. (Kittelison) and Shannon & Wilson, Inc. (Shannon & Wilson) staff for a general overview of the sites on October 11<sup>th</sup> and 12<sup>th</sup> before the field teams conducted the more in-depth visits. **Figure 1** shows the locations of the slide complexes and the detour routes explored during the field review.

Information and observations gathered during the reconnaissance will be used for future project planning, landslide evaluations, and roadway mitigations. This memo includes a general summary of the team's key observations, findings gathered from each of the study areas, and a preliminary list of priority slides based on those most likely to result in a roadway closure.

Figure 1: Routes Explored During Site Visit



- Landslides
- Site Visit - Detour/Alternative Routes
- Site Visit - US 101



Figure 1

Routes Explored During Site Visit



## SITE RECONNAISSANCE KEY FINDINGS

### Slides

A reconnaissance of the 13 landslide sites was performed by a Shannon & Wilson engineer and geologist between October 11 and October 15, 2021. During the site reconnaissance, areas of roadway pavement distress indicative of landslide activity such as tension cracking, patching, and guardrail offsets were observed and noted. Select landslide features upslope and downslope of US 101 including pistol butted trees, tension cracking, head scarps and vertical offsets, seeps or springs, and grabens were also observed and mapped. Site plans showing select mapped landslide features will be provided with the Geotechnical Assessment Reports as part of the Technical Appendix for the full report. ODOT provided available information regarding the sites to Shannon & Wilson for review prior to the reconnaissance. Publicly available 2008 LiDAR data from the Statewide Landslide Information Database for Oregon (SLIDO) (DOGAMI, 2017) and aerial imagery was also reviewed. Site-specific 2019 and 2021 LiDAR data for the Hooskanaden and Arizona Inn slides, respectively, was also provided by ODOT. During the site reconnaissance, areas of roadway pavement distress and existing slide mitigations were observed and noted, select landslide features were mapped, and general observations and assessments were made by comparing the previous data and information to current site conditions. Potential site constraints, construction staging issues, and environmental issues were also identified for preliminary evaluation of engineering improvements.

#### **SLIDE #1 RETZ CREEK SOUTH**

The reconnaissance of the Retz Creek South slide was performed between October 12 and October 13, 2021. ODOT indicated that the southbound lanes of US 101 within the slide area require closures and re-paving annually. Measurements were taken in the roadway where large areas of pavement distress and guardrail warping were observed which indicate the active slide is affecting approximately 800 lineal feet of US 101. Previous landslide mapping by ODOT was reviewed and used on site to assess the landslide features in the Old US 101 area, which is located approximately 50 to 100 feet east and upslope of the current US 101 alignment. Multiple additional secondary scarps were mapped upslope from US 101 and vertical offsets in the Old US 101 roadway were observed and measured (Exhibit 1). Recent head scarps were observed as far east as the ODOT stockpile area east and upslope of Old US 101. Downslope from US 101, recent scarping was observed (Exhibit 2) and some larger head scarps were mapped and traced up through US 101 east into the Old US 101 area.



**Exhibit 1: Vertical offset and pavement damage on Old US 101 along the southern margin of the slide.**



**Exhibit 2: Recent scarp movement observed downslope from US 101.**



## SLIDE #2 COAL POINT

The reconnaissance of the Coal Point slide was performed between October 12 and October 13, 2021. ODOT indicated that extensive maintenance measures were required to keep US 101 open through the slide area during the winter of 2005-2006, up to May 2006, and use of a buttress with drilled stone columns was considered as a potential mitigation alternative (similar to the mitigation implemented at Retz Creek North) but the cost would likely have been over \$6 Million. The Coal Point slide extends over a large area stretching from the coastline to approximately 630 feet east and upslope of Old US 101 near the top of the ridge. The slide has a broad head scarp upslope of Old US 101 which hosts a series of secondary scarps with displacements ranging from a few feet, to over 15 to 20 feet, as well as large areas of disturbed ground with hummocky terrain, grabens, and pistol butted trees (Exhibit 3). To the west along the current US 101, large areas of pavement distress and guardrail offsets (Exhibit 4) were observed which indicate the active slide is affecting approximately 600 lineal feet of US 101. Groundwater seepage was observed approximately 280 feet upslope from US 101 which forms the incised drainage that flows southwest and is visible on aerial and LiDAR maps. A large sandstone block forms the southern boundary of the slide. Slide boundaries on the north side were difficult to identify in the field.



**Exhibit 3: Disturbed, hummocky ground and pistol butted trees observed in the upper portion of the Coal Point slide near the head scarp.**



**Exhibit 4: Old guardrail with several feet of vertical offset along US 101 southbound.**

### **SLIDE #3 NORTH BRUSH CREEK HUMP**

The North Brush Creek Hump slide reconnaissance was performed between October 12 and October 13, 2021. The upper portion of the slide extends approximately 250 feet east and upslope of Old US 101 near the top of the ridge. The terrain in the area of the Old US 101 roadway is highly deformed with extensive tension cracking in the pavement and scarps and hummocky ground throughout. The lower portion of the slide, including the toe, is located near the roadway grade of the current US 101 alignment, where a large rock buttress was constructed by ODOT district maintenance (Exhibit 5). The rock buttress was constructed in 2011 and extends for approximately 520 lineal feet along US 101 northbound. According to ODOT, no maintenance or re-paving has been required along US 101 since the construction of the buttress. North-south oriented tension cracking (Exhibit 6) was observed approximately 20 to 30 feet upslope from the top of the buttress, which occurred after construction of the buttress according to ODOT. Below US 101, numerous slump failures were observed along the slope from the highway to the coastline due to wave erosion.





**Exhibit 5: Rock buttress along US 101 northbound constructed by ODOT in 2011.**



**Exhibit 6: Tension cracking located approximately 20 to 30 feet upslope from the top of the rock buttress.**

## SLIDE #4 BRUSH CREEK

The Brush Creek slide reconnaissance was performed on October 13, 2021. The Brush Creek slide area is located in a through cut (i.e., cut slopes on both sides of US 101) with a relatively thin sliver of steep, rocky terrain situated between US 101 and the coastline. Pavement distress, indicative of a head scarp, was observed along US 101 southbound which indicates the active slide is affecting approximately 60 lineal feet of US 101. Landslide features were not readily observed along the cut slopes above US 101. On the back side of the cut, adjacent to US 101 southbound (slope facing the coastline), multiple slope failures and rock falls were mapped. Large scarps were identified (Exhibit 7), mostly oriented north-south near the western cliff edge with one scarp observed oriented southeast towards US 101. Large active scarps were observed causing benches of material to appear suspended off the slope face. Hairline to 3-mm-thick tension cracks (Exhibit 8) were observed in rock outcrops near the cliff facing the coastline.



**Exhibit 7: Active scarp on the cliff facing the coastline (on back side of cut along US 101 southbound).**





**Exhibit 8: Tension cracking in rock outcrops on cliff facing the coastline.**

## **SLIDE #5 ARIZONA NORTH**

The Arizona North slide reconnaissance was performed on October 13, 2021. The Arizona North slide area extends from the coastline below US 101, potentially 800 to 1,000 feet upslope from US 101. This slide area, as well as the Arizona Inn slide area, have been explored extensively and multiple mitigations have been implemented including horizontal drains and a soil nail stabilization below US 101 southbound at the Arizona North slide. ODOT indicated that the horizontal drains were installed in the early 2000's and the soil nail stabilization was constructed in Spring 2020. Many of the existing

mitigation installations observed during the reconnaissance at the Arizona North slide were damaged including horizontal drains and diversion drainpipes which are leaking water throughout the site. ODOT indicated that the horizontal drains were last cleaned in February 2020 and measurements obtained during the cleaning indicate an average 34 percent of the total drain length at the site is still functioning. Damage to the soil nail stabilization from a localized slope failure was also observed and open cavities and voids over 1-foot wide undercut much of the shotcrete facing currently (Exhibit 9). ODOT indicated the roadway above the soil nail stabilization has already been repaved with a geogrid reinforced section after the soil nail stabilization failed. Multiple secondary failures were mapped below US 101 with the southern portion of the slide area below US 101 appearing to show more landslide activity compared to the north portion. Some of these failures cut off former access roads and horizontal drain drill pads and show evidence of recent movement. Water seeps were observed in the slope below US 101 and some of these seeps are from drainage pipes or horizontal drains that were cross-cut or damaged by the recent slope failures (Exhibit 10). Paved over cracking along both directions of US 101 indicative of head scarping was observed (Exhibit 11), which indicate the active slide is affecting approximately 1,135 lineal feet of US 101. The area upslope from US 101 was not accessible since there was no right-of-entry.



**Exhibit 9: Localized failure of the slope below US 101 southbound. The failure caused damage to the existing soil nail stabilization including an approximate 1-foot gap at the bottom of the shotcrete facing.**





**Exhibit 10: Recent secondary slope failure below US 101 that has damaged existing drainage pipes.**



**Exhibit 11: Cracking and sinkhole along US 101 southbound indicative of head scarp.**

## **SLIDE #6 ARIZONA INN**

The Arizona Inn slide reconnaissance was performed on October 14, 2021. The Arizona Inn slide, located south of the Arizona North slide, is a large slide complex which stretches from the coastline to over 1,200 feet upslope of US 101. Pavement distress within both directions of US 101 and tension cracking along the US 101 southbound shoulder (Exhibit 12) was observed which indicate the active slide is affecting approximately 655 lineal feet of US 101. Numerous existing slope inclinometer tubes were observed throughout the slide area. Existing mitigations constructed at the site include horizontal drains upslope of US 101 and a large-diameter drainage shaft with radial horizontal drains extending from the shaft downslope of US 101. ODOT indicated that the horizontal drains upslope of US 101 were last cleaned in February 2020 and measurements obtained during the cleaning indicate an average 34 percent of the total drain length at the site is still functioning. The horizontal drains in the drainage shaft were last cleaned in 2005. Further downslope from the drainage shaft, multiple large scarps and recent failures were observed with one failure cutting the access road that switches back down the western edge of the slope (Exhibit 13). Large portions of the cliff facing the coastline in the central portion of the active slide area have collapsed down to the beach in this area. Upslope and to the east of US 101, slide boundaries were mapped and a general reconnaissance was made of the central portion of the slide and the previous mitigation efforts.





**Exhibit 12: Large tension crack at the southern margin of the active slide area, along US 101 southbound shoulder.**



**Exhibit 13: Slope failure cutting access road in the southwestern portion of the slide downslope of US 101.**

### **SLIDE #7 CHRISTMAS TREE (FRANKPORT NORTH)**

The reconnaissance of the Christmas Tree slide area was performed on October 14, 2021. Pavement distress as well as tension cracking along US 101 southbound was observed which indicates the active slide is affecting approximately 320 lineal feet of US 101. Off the southbound shoulder of US 101, up to 6 feet of asphalt thickness was observed indicating ongoing displacement of the shoulder pavement (Exhibit 14). ODOT indicated that no previous mitigation efforts have been implemented for this slide. Measurements were taken within the roadway and scarps were mapped just west and downslope of US 101. Further west and downslope from US 101, heavy cover of trees and limited right-of-way made field mapping and reconnaissance difficult.





**Exhibit 14: Multiple layers of asphalt pavement on US 101 southbound shoulder indicating ongoing displacements.**

### **SLIDE #8 SISTERS ROCK SINK**

The reconnaissance of the Sisters Rock Sink slide area was performed on October 14, 2021. This slide area has a well-defined head scarp along the north slide flank with vertical offsets ranging from 1 to 5 feet near the Old US 101 alignment which is just west of the current US 101 alignment. Large sections of asphalt with significant tension cracking were observed downslope of the US 101 southbound shoulder which may be the old highway (Exhibit 15). Pavement distress along the US 101 southbound shoulder,

indicative of head scarping, was observed which indicates the active slide is affecting approximately 395 lineal feet of US 101. The southern boundary of the head scarp turns to the west through a gravel turnout with tension cracking observed in the roadway and gravel area. Downslope from US 101, highly disturbed terrain was observed, and secondary scarps were mapped. Within the slide area, two large separate slide blocks were possibly identified. The main toe of the landslide appears to be near the beach according to LiDAR maps. A large drainage pipe was also observed which outfalls in the south-central area of the slide. ODOT indicated that no previous mitigation efforts have been implemented for this slide.



**Exhibit 15: Large sections of asphalt with tension cracking downslope of US 101 southbound, potentially the old highway.**



## SLIDE #9 FRANKPORT SOUTH

The Frankport South slide reconnaissance was performed on October 14, 2021. The landslide in this area is large and complex. Many visible landslide features were observed and mapped downslope from US 101 including large tension cracks, grabens, secondary scarps, and what appeared to be a recent slope failure near the north margin of the slide mass (Exhibit 16). Recent north-south oriented tension cracking was traced throughout the northern and southern portions of the slide area downslope from US 101. The active slide stretches from the point and large rock outcrop to the north, approximately 900 feet south to the area below the gravel parking lot of the Sisters Rock hiking trail. The toe of the slide appears to be split by a block of sandstone near the beach and the northern portion of the toe contains slumped and pistol butted trees and disturbed ground (Exhibit 17). The area upslope from US 101 was not accessible since there was no right-of-entry. However, highly disturbed ground was observed from US 101 and the Old US 101 roadway is completely destroyed in an area, approximately 400 feet wide. A large bowl-shaped upper head scarp area makes up the top of the ridge above the Old US 101 alignment. No pavement cracking or distress was observed within the US 101 roadway; however, a recently paved section of the roadway indicates the active slide is affecting approximately 340 lineal feet of US 101. ODOT indicated that the Christmas Tree, Sisters Rock Sink, and Frankport South slides all have an approximate 1- to 3-year recurrence interval for US 101 repaving within the slide limits and usually all three slides experience movement during the same time period.



**Exhibit 16: Potential recent slope failure along north margin of slide area.**



**Exhibit 17: Toe of the landslide in the central portion of the photo with slumped trees and disturbed ground.**

## **SLIDE #10 WOODROOF CREEK**

Reconnaissance of the Woodroof Creek slide area was performed on October 14, 2021. The slide area extends from US 101, down to Woodroof Creek where the toe of the landslide is being undercut by Woodroof Creek as it flows out of a culvert underneath the US 101 embankment to the ocean. Paved over cracking along both directions of US 101, indicative of a head scarp, was observed (Exhibit 18), which indicates the active slide is affecting approximately 310 lineal feet of US 101. ODOT indicated that slide movement occurred in 2006, 2012, and 2016 and typically results in a head scarp that forms within the US 101 southbound lane and migrates into the northbound lanes. Previous mitigation efforts include horizontal drains that were installed in the roadway embankment in the 1950's. Downslope from the embankment is dense forest with two separate steep incised drainage channels which feed into Woodroof Creek. Disturbed ground, secondary scarps, and small slope failures were observed near the creek (Exhibit 19). The toe of the landslide forms the steep northern edge of the creek with trees slumping and collapsing into the creek channel.





**Exhibit 18: Paved over head scarp within US 101 northbound travel lanes.**



**Exhibit 19: Toe of the landslide up against the steep channel of Woodroof Creek**



## SLIDE #11 EIGHTY ACRES

Reconnaissance of the Eighty Acres slide area was performed on October 14, 2021. Tension cracks within the US 101 southbound shoulder were observed, which indicate the active slide is affecting approximately 250 lineal feet of US 101. ODOT indicated that an approximate 12-foot-deep French drain was constructed along the US 101 northbound shoulder to intercept and lower groundwater levels within the slide mass. Almost yearly closures of US 101 were required within the slide limits prior to the construction of the French drain, but since it's construction ODOT has only had to close the southbound lane of US 101 once. The top of the slide and main head scarp appears to be located within in the southbound lane of US 101. The slide is flanked from the north and south by two creek drainages which merge near the bottom of the slope below US 101. The main toe of the landslide runs in between these drainage channels downslope and appears to be pinned where the channels merge. A smaller landslide toe is in the central portion of the landslide and was indicated in previous mapping by ODOT. The southern flank of the slide has multiple small and relatively recent slope failures along the creek channel and the area along the southern drainage is highly unstable. Hummocky ground and pistol butted/distorted trees were observed throughout the slide mass below US 101 (Exhibit 20).



**Exhibit 20: Slumped trees in the central portion of the slide area**



## SLIDE #12 BURNT HILL

Reconnaissance of the Burnt Hill slide area was performed on October 15, 2021. The Burnt Hill slide extends from the coastline to slightly upslope and east of US 101. The upper head scarp is marked with tension cracks located within the US 101 travel lanes (Exhibit 21), which indicate the active slide is affecting approximately 610 lineal feet of US 101. ODOT indicated that the only documented US 101 closure due to this slide occurred in December 2005. The northern boundary of the active scarp could possibly stretch north beyond the repaired and patched pavement areas. Downslope from US 101, the area is heavily forested and disturbed ground, slumped trees, and scarping was observed throughout the slide area. The southern slide boundary is marked with multiple stair-stepped scarps. Within the central portion of the slide near the coastline, the toe is broken up into multiple sections with the northern portion visible in LiDAR near the coastline. The other portions of the toe have experienced erosion and secondary failures which form steep slopes overlying the beach. Signs of recent development and grading were observed in the lower portion of the slide mass. Upslope of US 101 northbound, a leaning power pole and pistol butted trees were observed (Exhibit 22).



**Exhibit 21: Tension cracks along south flank of slide running through all lanes of US 101**



**Exhibit 22: Leaning power pole and pistol butted trees just upslope of US 101 northbound**

### **SLIDE #13 HOOSKANADEN**

Reconnaissance of the Hooskanaden slide area was performed on October 15, 2021. The Hooskanaden slide extends over a very large area and is complex with multiple secondary failure masses. Major episodes of movement occurred in 1975, 1995, and 2019. During the reconnaissance, previous landslide mitigation efforts were observed and ODOT provided an on-site description of most of these mitigation methods during the initial site visit on October 12, 2021. ODOT indicated that previous mitigation efforts included excavation and maintenance of drainage channels above US 101 (Exhibit 23) to control surface water in the 1950's. In the summer of 2020, construction of an approximate 300-foot-long soil nail stabilization downslope of US 101 southbound near the south margin of the slide mass occurred (which appears to be performing adequately). Additionally, reconstruction of the entire US 101 roadway with a 6-foot-thick geogrid-reinforced "Deep Patch" occurred in the summer 2020.

Landslide features were observed and mapped where visible, and with the time granted, key areas of interest within the slide were assessed. The area immediately downslope and west of US 101 southbound at the gravel turnout area is riddled with former road pavement surfaces and debris that are at least 100 feet downslope of the existing highway (Exhibit 24). Further downslope to the west, the ground surface is highly deformed and multiple secondary scarps and grabens were mapped and appear to have recent movement. Near the coastline, the ground is upheaved and cut where the upper portions of the toe meet the coastline and are being eroded (Exhibit 25).



ODOT indicated that a passive toe of the slide may have been uplifted and observed within the surf zone during the 1975 slide episode, although no photographic documentation exists.

No pavement cracking or distress was observed within the US 101 roadway; however, a recently paved section of the roadway indicates the active slide is affecting approximately 2,160 lineal feet of US 101. The slide extends approximately 2,100 feet upslope and east of US 101. Within this area, numerous landslide features were observed and mapped. The southeastern portion of the slide appeared to have recent slope failures with some access roads displaced and offset, and recent tension cracking in relatively flatter open grass areas (Exhibit 26). Outcrops of resistant sandstone were observed in portions of the slope indicating the presence of a sandstone block underlying the southeastern slide area. The central eastern portion of the slide downslope from the main head scarp had multiple secondary slope failures and scarping. Groundwater seepage was mapped below the central portion of the main head scarp. The northern boundary of the slide appears to cross-cut the access road that leads to the upper head of the slide. Other recent scarping was observed in the northeast portion of the slide.



**Exhibit 23: Drainage channels within the upper head of the slide constructed by ODOT**





**Exhibit 24: Large sections of pavement and road debris below US 101 southbound**



**Exhibit 25: Portion of the toe near the coastline being eroded**



**Exhibit 26: Recent scarping in the southeastern portion of the slide upslope of US 101**



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## US 101 and Alternative Routes Around Slides

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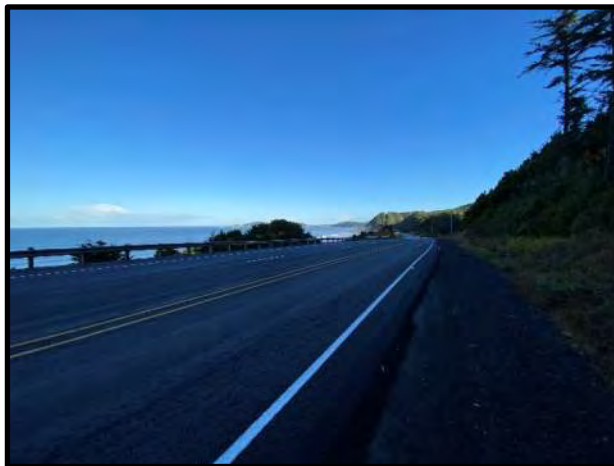
To identify alternative routes around slide areas to explore during the site reconnaissance, US 101 and surrounding roadways were initially assessed based on previous ODOT studies, aerial imagery, and through a meeting with ODOT personnel on September 31, 2021. Videos of US 101 and the alternative routes were provided to ODOT electronically.

### US 101

A windshield survey of US 101 at key slide locations was conducted to identify opportunities for roadway and or operational mitigations. Conditions are depicted in the exhibits below. Limited opportunities to cost effectively improve US 101 exist given the area of slide influence along the highway.

### Retz Creek South Slide (MP 304.72)

**Exhibits 27 and 28 - Looking North\* (Left) & Looking South\* (Right) at Retz Creek South Slide**



\*North and south denote the travel direction on US 101

## Coal Point Slide (MP 305.53)

Exhibits 29 and 30 - Looking North (Left) & Looking South (Right) at Coal Point Slide



## North Brush Creek Hump (MP 306.12)

Exhibits 31 and 32 - Looking North (Left) & Looking South (Right) at North Brush Creek Hump





## Brush Creek Slide (MP 310.24)

Exhibits 33 and 34 - Looking North Close In (Left) & Looking North Further Out (Right) at Brush Creek Slide



## Arizona North Slide (MP 312.00)

Exhibits 35 and 36 – Above Slide Complex Looking South (Left) & Looking South (Right) at Arizona North Slide



## Arizona Inn Slide (MP 312.39)

Exhibits 37 and 38 - Looking North (Left) & Looking South (Right) at Arizona Inn Slide



## Christmas Tree (Frankport North) Slide (314.10)

Exhibits 39 and 40 - Looking North (Left) & Looking South (Right) at Christmas Tree Slide





## Sisters Rock Sink (314.32)

Exhibits 41 and 42 - Looking North (Left) & Looking South (Right) at Sisters Rock Sink



## Frankport South Slide (MP 314.79)

Exhibits 43 and 44 - Looking North (Left) & Looking South (Right) at Frankport South Slide



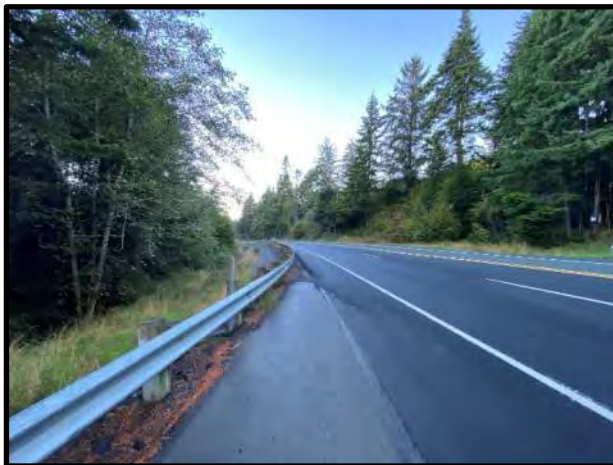
## Woodroof Creek Slide (MP 315.93)

Exhibits 45 and 46- Looking North (Left) & Looking South (Right) at Woodroof Creek Slide



## Eighty Acres Slide (MP 332.55)

Exhibits 47 and 48 - Looking North (Left) & Looking South (Right) at Eighty Acres Slide





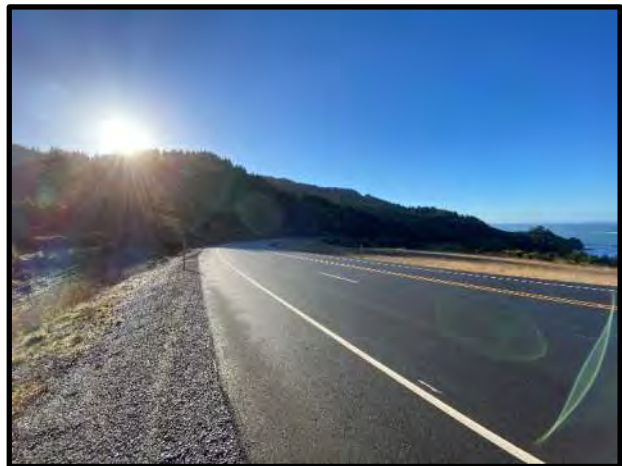
## Burnt Hill Slide (MP 342.55)

Exhibits 49 and 50 - Looking North (Left) & Looking South (Right) at Burnt Hill Slide



## Hooskanaden Slide (MP 343.63)

Exhibits 51 and 52 - Looking North (Left) & Looking South (Right) at Hooskanaden Slide



## POTENTIAL ALTERNATIVE ROUTES

There were several routes explored during the site reconnaissance with varying levels of viability for travel during a potential slide event. And while there are no local routes that bypass all thirteen slide complexes, the routes explored had the potential to bypass at least one of the slide complexes. During the field visit, the identified routes were evaluated as being either suitable for detour routes or restricted access routes. Detour routes are suitable for public and heavy vehicle/freight travel. Restricted access routes are suitable for emergency operations, ODOT operations and maintenance personnel, and local access for some passenger vehicles.

On the subsequent maps, segments that are suitable as detour routes are colored green. Segments that are suitable for restricted access routes are colored yellow and orange. Segments that are not suitable for either detour routes or restricted access routes are colored red.

### Southern Bypass Route: Carpenterville Road

This route starts just south of Pistol River and connects back to US 101 just north of Brookings. The entire route is on a single road, Carpenterville Road, which is an ODOT owned/maintained highway (Highway 255), with a posted speed limit of 55 miles per hour. The route, shown in **Figure 2**, is approximately 19 miles in length and takes approximately 40 minutes to drive. The ODOT unstable slopes inventory identifies 98 hazard areas along Carpenterville Rd (either landslide or rockfall locations). These locations were not reviewed as part of this site reconnaissance.



**Figure 2– Southern Bypass Route**



The images below show the current condition of Carpenterville Road including new curve warning signage that was recently installed (curve warning sign shown in right image).



There are numerous locations along the roadway that would allow for larger freight to use the road with the assistance of pilot cars and allow slower traffic to use pullouts in wider areas along the corridor such as the image below.



Carpenterville Road bypasses the two most southern slide complexes and was used as a modified detour route in the 2019 catastrophic failure at the Hooskanaden slide complex.

***This route has the potential to be a full detour route (with the possible exception of large freight vehicles, e.g., WB-40/WB-67) and should be considered as such with minimal improvements necessary.***

### **Northern Bypass Route: Elk River Road – Forest Service (FS) Road 5502 – Euchre Creek Road**

As shown in **Figure 3**, this route starts north of Port Orford and heads southeast on Elk River Road for approximately 10 miles on a paved County owned/maintained road.



**Figure 3 – Elk River Rd/FS 5502/Euchre Creek Rd (Bypasses 10 slide locations between Woodroof Creek Slide and Retz Creek South Slide)**



The images below (all looking north) show that the county road segment is very comfortable and in excellent condition.



The route then heads along a gravel Forest Service owned/maintained road FS-5325/FS-5502 for approximately 19 miles. It traverses through a large amount of elevation change peaking at an elevation of 2,600, about five miles into this segment. The images

below show the steep topography and narrow corridor along the Forest Service segment.



The final segment to connect back to US 101 at Ophir is also a paved County owned/maintained road, five miles in length. This segment is also in good condition aside from some slide damage near US 101 (see right image below).



The overall route is approximately 34 miles and took approximately 2 hours to drive, with an average travel speed of 15 miles per hour. This route bypasses the 10 northern most slides and likely has no adjacent slide complexes that would be triggered simultaneously with the slide complexes along US 101.

While this northern bypass route has a lot of benefit, there likely would still be required vehicle restrictions due to the road condition and the elevation change along the corridor. **This route will not be considered as a full detour route but will be considered as a restricted access route for local ODOT, access passenger vehicles, small freight, and emergency vehicles.**



## Retz Creek/Coal Point/North Brush Bypass Route: County Road 280

While this route bypasses the Retz Creek, Coal Point, and North Brush slide complexes, the entire route is gravel, narrow, and has extremely steep topography that would not lend itself well to vehicles other than passenger vehicles. The route is shown in **Figure 4**.

**Figure 4 – CR 280/China Mountain Rd (Bypasses Retz Creek Slide/Coal Point Slide/North Brush Creek Hump)**



The images below highlight the steep terrain experienced along this route.



***It is not recommended to use this route as a restricted access route in the event of a closure on US 101. It may be suitable for some passenger vehicles. Using the longer Elk River Rd/FS 5502/Euchre Creek Rd route would be a more suitable restricted access route.***

### **Arizona Bypass Route: Arizona Ranch Road – Old Highway**

This route bypasses both the Arizona North and Arizona Inn slide complexes, but the roadway is not accessible near the tight hairpin turn shown in **Figure 5**.

**Figure 5– Arizona Bypass Route**



Even if the roadway was cleared and maintained, if a significant slide event closed US 101, this roadway would most likely be in a similar condition given its proximity to US 101.

***This is not a viable detour or restricted access route.***



## Woodruff Creek Bypass Route: County Road 509 (Coy Creek Road)

This route would bypass the Woodruff Creek slide complex, but the route is not connected back to US 101. There is a paved roadway from Ophir at the southern limits to the northern most horizontal curve shown in **Figure 6**. At that point the road is gated and connects to a private residence.

**Figure 6 – Woodruff Creek Bypass Route**



See image below showing the gated access point.

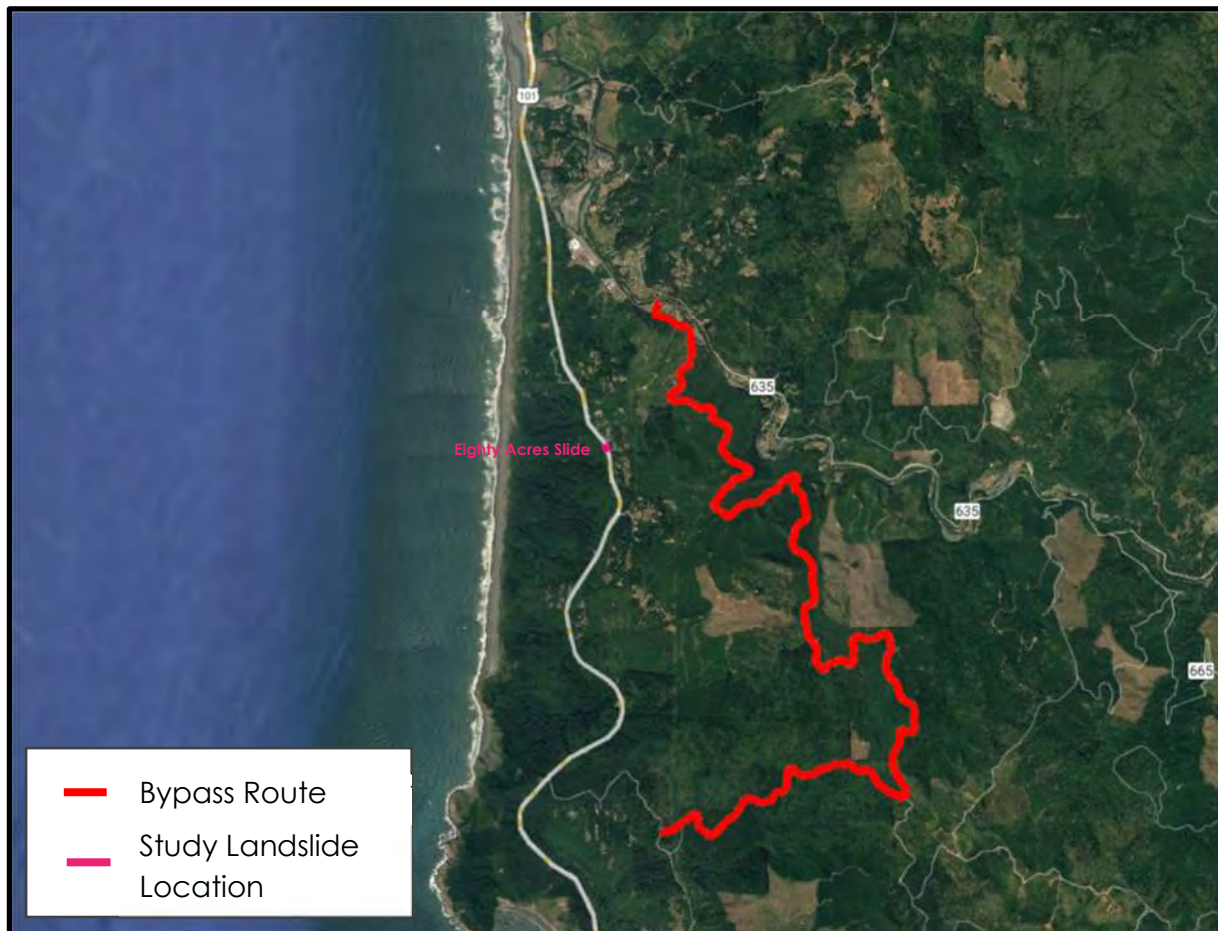


***This is not a viable detour or restricted access route.***

### **Eighty Acres Bypass Route: County Road 635 – Meyers Creek Road**

As shown in **Figure 7**, this route is the only potential route to bypass the Eighty Acres slide complex, however, the route is not currently accessible on either end.

**Figure 7 – Eighty Acres Bypass Route**





The northern access point near Hunter Creek Road is no longer accessible (blocked by vegetation and unable to be located) and the southern access point near Meyers Creek Road was gated off and likely not useable. See image below showing the southern gated access point.



***This is not a viable detour or restricted access route.***

## **PROPOSED DETOUR/RESTRICTED ACCESS ROUTE IMPROVEMENTS**

Through field investigations, there are viable detour and/or restricted routes for all but one of the thirteen slide complexes for certain vehicle types (Eighty Acres Slide being the only one without a viable bypass route). There are no routes that would allow all vehicle types to completely bypass a slide complex without improving the roadways or providing traffic control measures. Roadway, operational, and traffic control improvements for viable routes will be further assessed in the next phase of the project. For slide complexes that do not have a viable detour or restricted access route (Eighty Acres), stockpile locations for emergency material will be evaluated.

### **Southern Bypass Route: Carpenterville Road**

As previously described, Carpenterville Road is in good condition. This route has been used in the past as a detour route with the assistance of pilot cars. Under the last full detour in 2019, there was feedback from freight and transit drivers that the roadway was difficult to drive because of the available width, curvature, and number of private access points.

As a result of this feedback, there was a recent project that installed new curve warning signage along the entire length of the corridor to help alleviate some of those concerns by better aligning driver expectations to the road's conditions. Additional proposed improvements to further help make this route suitable for all vehicles may include:

- ***Destination signage to US 101.*** Currently there is no destination signage installed that makes it clear that drivers using Carpenterville Road as a detour route need

to stay on it for its entirety to reconnect with US 101 to the north and south. Installing destination signage, whether in a permanent fashion (most expensive option) or having the signs fabricated for temporary detours (least expensive option) would also assist with driver expectations for how long users will be on this detour route.

- **Guardrail installation in spot locations.** While there are runs of guardrail in certain locations along the corridor, there are areas that would benefit from barrier protection due to the mountainous terrain and steep drop-offs. The limitation here is that not all locations have sufficient width to install guardrail while providing standard shy distance from the barrier.
- **Creating longer pullouts in existing widened areas.** Similar to any improvements associated with guardrail runs, this improvement would be dictated by available width as a large portion of this highway does not have sufficient room for widening without expensive retaining walls or disturbing slopes that have the potential to increase the risk of slides in the area. However, there are locations along the corridor that could extend existing widened shoulders/pullouts to allow larger freight vehicles or additional vehicles to use these areas to turn around or use in tandem with pilot cars.

### **Northern Bypass Route: Elk River Road – Forest Service (FS) Road 5502 – Euchre Creek Road**

This route can be used to bypass ten slide complexes with minimal added travel time compared to US 101. While not all forms of transportation will be able to use this route even with improvements, passenger vehicles, emergency service vehicles, and smaller freight vehicles would be able to navigate this route. For this reason, this route would benefit from increased investment in improvements. Proposed improvements to help make this route more suitable for most vehicles include:

- **Destination signage to US 101.** There is no destination signage installed to help users get to and from US 101, which is necessary if this is going to be used as an alternative route. There are a lot of County and Forest Service roads that stem off this route and users will need to be clear which roadways to use to get to their destination. Locations of destination signage will need to be very specific as this route does not lend itself to all vehicle types. It is likely signage would just be used in an emergency. No signage is being proposed on US 101.
- **Curve warning signage.** There are some locations along the route that have existing curve warning signage, but there are many locations that could benefit from additional signage to better align driver expectations to the roadway conditions.
- **Paving the northern most five miles of the route.** This is the most expensive potential improvement but would likely create the most benefit. The northern



most five miles of the gravel portion of this route are extremely steep, changing approximately 2,500 feet in elevation over those five miles, with continued winding horizontal geometry. Paving this portion of the roadway would improve traction through the winter months when this would likely need to be used and would also improve comfortability of the drivers using this route.

### **Retz Creek/Coal Point/North Brush Bypass Route: County Road 280**

This route has the potential to be used as a restricted access route by passenger vehicles if the Elk River Rd/FS 5502/Euchre Creek Rd is not passable and US 101 is fully closed by either the Retz Creek, Coal Point, or North Brush Creek Hump slides. Proposed signage improvements would be necessary. There are multiple spur roadways along this route and making it very clear on how to get to and from US 101 would be critical.

### **Eighty Acres Bypass Route: County Road 635 – Meyers Creek Road**

While the route explored is not a viable route to bypass the Eighty Acres slide complex, providing gravel stockpile locations to the north and south of the slide to expedite re-opening US 101 after a slide would be beneficial. The identified potential stockpile locations are shown in **Figure 8**.

#### **Potential Northern Stockpile Location: Intersection of US 101 and Hunter Creek Road (MP 331.07)**



This location provides a widened shoulder that could provide enough room to stockpile a smaller amount of material and is 1.5 miles north of the Eighty Acres slide complex allowing easy access from Gold Beach in a significant event. The wide intersection would also allow for easy truck turning movements.

### **Potential Southern Stockpile Location: US 101 MP 334.25**



This location provides a significant amount of area to stockpile material (it looks like it's currently being used for that in some capacity) and is less than 2 miles away from the center point of the Eighty Acres slide complex. There is enough room for trucks to fully pull off the road and turn around before re-entering.



Figure – 8: Potential Stockpile Locations



Figure 8

# RECONNAISSANCE SUMMARY

Based on the site reconnaissance and information provided on site by ODOT, a preliminary list of priority slides based on those most likely to result in a roadway closure have been developed as shown below. The priority list considers whether the slide is likely to close the entire roadway, frequency of past roadway closures or maintenance efforts, and whether a viable local detour and/or restricted access route exists. The criteria used to assess the slides is included in **Table 1**. The preliminary list of priority slides is included in **Table 2**. This list will continue to be refined as conceptual mitigation measures are evaluated.

**Table 1: Criteria Used to Assess Slides**

	<b>Likelihood of Closing US 101</b>	<b>Frequency of Past Closures/ Maintenance Efforts</b>
<b>Low</b>	No documented full closures <b>AND</b> Slide does not extend across entire roadway based on site reconnaissance	Either no documentation of past closures <b>OR</b> Return interval for the closures was on the order of 10+ years
<b>Moderate</b>	No documented full closures <b>AND</b> Slide extends across entire roadway based on site reconnaissance	Closures/maintenance every few years (1-10 year return interval)
<b>High</b>	Documented full closures <b>OR</b> Slide extends across entire roadway and would almost assuredly close road if it were to mobilize	Closures/maintenance every year



**Table 2: Preliminary List of Priority Slides**

Preliminary Priority	Slide	Likelihood of Closing US 101	Frequency of Past Roadway Closures/ Maintenance Efforts	Presence of Local Detour Route Suitable for Public/ Freight	Presence of Alternative, Restricted Access Route	Notes
1	Retz Creek South	Moderate	High	None	Elk River Rd, CR 280	History of annual closures/repaving. No history of full roadway closures but there is potential for it. ODOT maintenance staff report that the Retz Creek and Arizona slides give them the most issues.
2	Arizona Inn	High	High	None	Elk River Rd	Existing mitigations are reaching the end of their "useful life" and there is a history of full roadway closures.
3	Arizona North	Moderate	Moderate	None	Elk River Rd	Existing mitigations have either failed or are reaching the end of their "useful life." There is no history of full roadway closures but there is potential for it.
4	Brush Creek	High	Low	None	Elk River Rd	No history of road closures but if the slide moves far enough to close the road, it will be very expensive to fix. ODOT refers to it as a "sleeping giant."
5	Frankport South	Moderate	Moderate	None	Elk River Rd	Has a 1-3 year maintenance interval and no history of full roadway closures but there is potential for it.
6	Coal Point	Moderate	Moderate	None	Elk River Rd, CR 280	No history of full roadway closures but there is potential for it.
7	Burnt Hill	High	Low	Carpenterville Rd	--	Only documented closure was 2005 but it did close the entire road.
8	Christmas Tree	Low	Moderate	None	Elk River Rd	Has a 1-3 year maintenance interval with no history of full roadway closures but there is potential for it.

Preliminary Priority	Slide	Likelihood of Closing US 101	Frequency of Past Roadway Closures/ Maintenance Efforts	Presence of Local Detour Route Suitable for Public/ Freight	Presence of Alternative, Restricted Access Route	Notes
9	Sisters Rock Sink	Low	Moderate	None	Elk River Rd	Has 1-3 year maintenance interval with no history of full roadway closures but there is potential for it.
10	Woodroof Creek	Low	Moderate	None	Elk River Rd	Recent large-scale movement every 4-5 years. No history of full roadway closures but there is potential for it.
11	Hooskanaden	High	Low	Carpenterville Rd	--	Full closures about every 20 years and the lack of viable mitigation alternatives keeps this as a lower priority.
12	Eighty Acres	Low	Moderate	None	None	Previous mitigation efforts (French drain) have reduced frequency of southbound (SB) lane closures since 2015. Prior to that, SB closures occurred almost yearly.
13	North Brush Creek Hump	Low	Low	None	Elk River Rd, CR 280	No road closures since the 2011 mitigation (shear key buttress), although the mitigation has not stopped slide movement.