CALIFORNIA COASTAL COMMISSION
NORTH COAST DISTRICT OFFICE
1385 EIGHTH STREET, SUITE 130
ARCATA, CA 95521
VOICE (707) 826-8950
FAX (707) 826-8960

W10a

CALTRANS INFORMATIONAL BRIEFING

(Last Chance Grade Permanent Restoration Project)

September 6, 2023

EXHIBITS

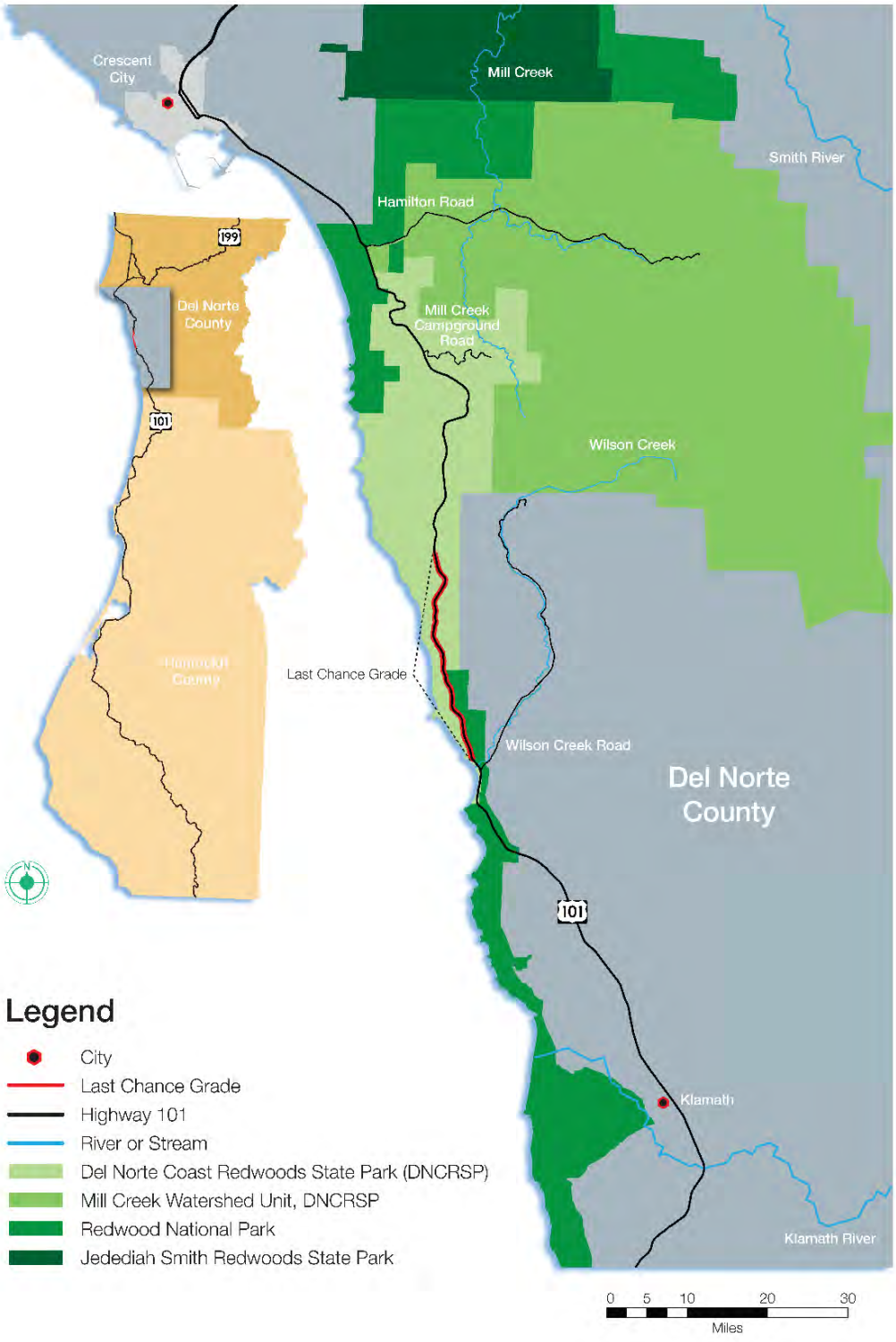


FIGURE 1 – Location Map

Last Chance Grade Permanent Restoration Project

Alternatives Analysis Report

Submittal SUB#031
November 2021

EA# 01-0F280
Project EFIS# 0115000099
Del Norte County, U.S. 101,
PM 12.0/15.5

Caltrans

LAST CHANCE GRADE

Table of Contents

TABLES

FIGURES

ATTACHMENTS

1 Introduction

"Last Chance Grade", the section of United States Highway 101 (US 101) that extends from Wilson Creek to nine miles south of Crescent City in Del Norte County (post miles [PM] 12.0 to 15.5) (Figure 1), has been progressively sliding towards the Pacific Ocean since the roadway was first constructed. Due to the continual movement, ongoing construction and maintenance activities are necessary to keep the highway open to the traveling public. In order to find a long-term sustainable solution, the California Department of Transportation (Caltrans) has studied multiple alternative alignments and design options for the Last Chance Grade (LCG) Permanent Restoration Project.

The purpose of this report is to provide a summary of how the alternative alignments were developed, including screening, stakeholder outreach and participation, performance measure applications, analysis results, and the identification of the alternatives that will be carried forward for environmental review in the Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) to be prepared in compliance with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA).

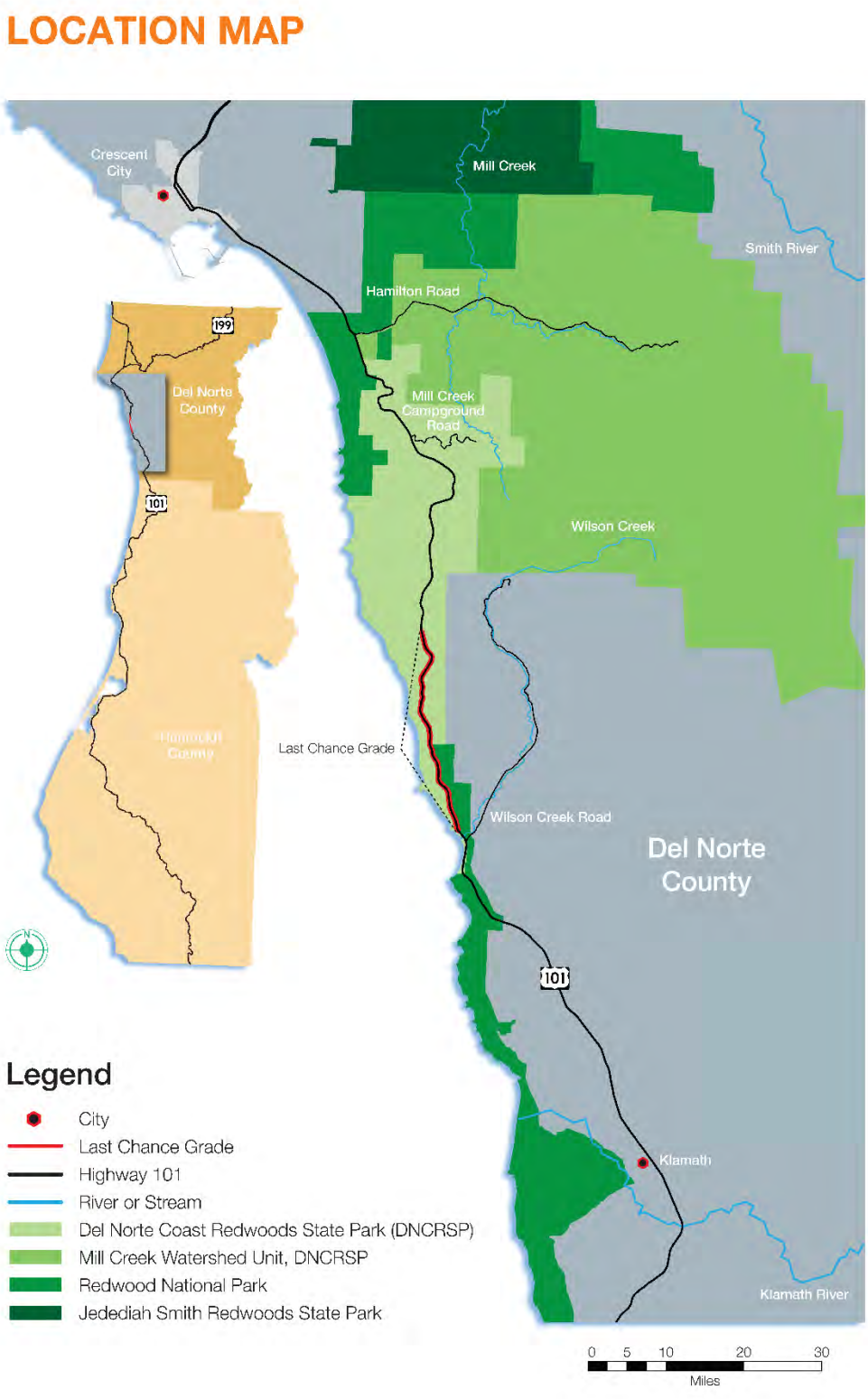
2 Project Purpose and Need

The purpose of the project is to develop a permanent solution to the instability and potential roadway failure at LCG. The project would consider alternatives that provide a more reliable connection and reduce maintenance costs while protecting the economy, natural resources, and cultural landscapes.

Landslides and road failures at LCG have been an ongoing problem for decades. A geologic study in 2000 conducted for Caltrans by the California Geological Survey mapped over 200 historical and active landslides (both deep-seated and shallow) within the corridor between Wilson Creek and Crescent City. Over the years, Caltrans has conducted a considerable number of construction projects and maintenance activities in the LCG area in order to keep the roadway open. Since 1981, landslide mitigation projects, including retaining walls, drainage improvements, and roadway repairs have cost over $54 million ($33 million Emergency Response Projects, $21 million Non-Emergency Response Projects). A long-term sustainable solution at LCG is needed for many reasons, including the following:

- Economic ramifications of a long-term failure and closure;
- Risk of delay/detour to traveling public;
- Increasing maintenance and emergency project costs; and
- Increase in frequency and severity of large storm events caused by climate change.

Figure 1. Project Location



3 Project Stakeholders and Working Group Workshops

Close coordination and collaboration with local, regional, and state partners is imperative for this project, as US 101 is a critical route, and there are various sensitive resources within the project area. This close coordination began in March 2014 when Caltrans established the LCG Partnership to create an active, working relationship with the agencies and groups that have management responsibilities for lands and resources that could be directly impacted by any realignment of the highway. In coordination with the LCG Partnership, four stakeholder Working Groups were created that include federal, state, and local governments, federally and non-federally recognized tribes, private sector industry groups, NGOs, and other concerned citizen groups. A list of participant organizations from each Working Group is provided in the LCG Fact Sheet (Attachment A).

- *Congressman Huffman's Stakeholder Working Group*: Representatives from local governments, Tribal groups, businesses, agencies, and environmental groups.
- *LCG Partners Working Group*: Stakeholders with land ownership and land management responsibilities.
- *Cultural Resources Working Group*: Stakeholders with responsibility for and expertise in cultural resource management and preservation.
- *Biological Resources Working Group*: Stakeholders with responsibilities for and expertise in natural resource management and permitting.

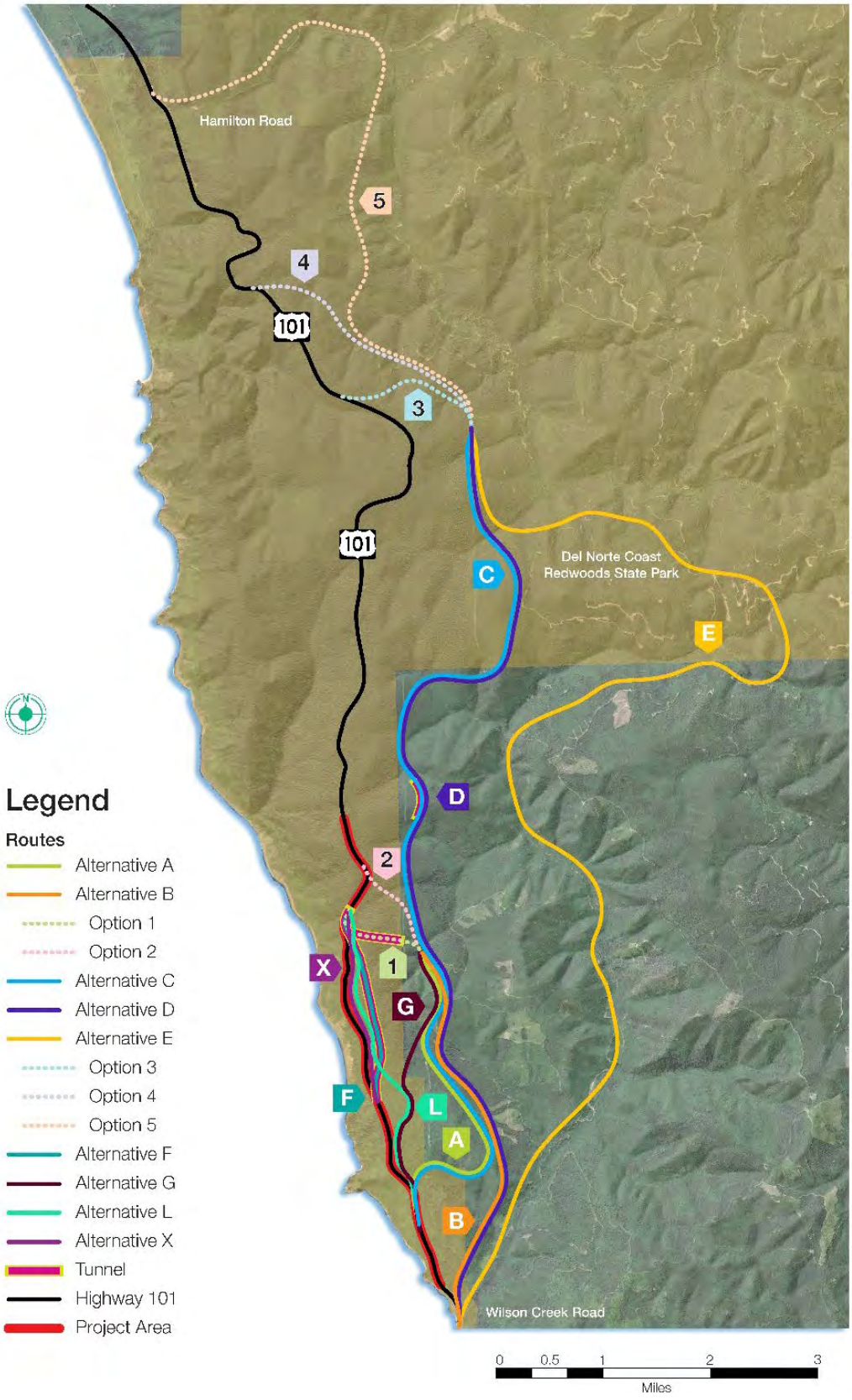
4 Alternatives Development and Evaluation (2015 – 2019)

Caltrans, in coordination with LCG Partnership stakeholders, completed preliminary engineering, economic, geotechnical, and environmental studies to identify potential long-term solutions for the project. The early planning and design efforts listed below[1] examined a broad range of design options and rejected options (Figure 2, Table 4) that would not meet the project purpose and need.

- 2015 Engineered Feasibility Study considered fourteen alternatives and rejected eight
- 2016 Project Study Report considered six alternatives
- 2018 Expert-based Risk Assessment added two alternatives
- 2018 Value Analysis Study Report rejected three alternatives
- 2019 Project Study Report Addendum added two alternatives

[1] The LCG project reports referenced herein are available on the LCG Project website's document library: www.lastchancegrade.com.

Figure 2. Alternatives Evaluated During 2015-2019 Planning Efforts



The 2015 Engineered Feasibility Study considered 14 alternatives to minimize or avoid the risk of roadway failure and reduce ongoing maintenance costs, while considering environmental and cultural factors. The study developed the alternatives using design criteria based on constructability, adherence to design standards, and impacts to the environment and sensitive resources. Based on the results of this study, eight alternatives were eliminated, and the remaining six recommended for further study:

2015 Engineered Feasibility Study	
Alternatives Considered	**Recommended for Study**
A1: Rudisill Road to LCG Tunnel	A1: Rudisill Road to LCG Tunnel
A2: Rudisill Road to Damnation Trailhead	A2: Rudisill Road to Damnation Trailhead
B1: Wilson Creek Bridge to LCG Tunnel	
B2: Wilson Creek Bridge to Damnation Trailhead	
C3: Rudisill Road to South of Mill Creek Access	C3: Rudisill Road to South of Mill Creek Access
C4: Rudisill Road to North of Mill Creek Access	C4: Rudisill Road to North of Mill Creek Access
C5: Rudisill Road to Hamilton Road	C5: Rudisill Road to Hamilton Road
D3: Wilson Creek Bridge to South of Mill Creek Access	
D4: Wilson Creek Bridge to North of Mill Creek Access	
D5: Wilson Creek Bridge to Hamilton Road	
E3: Wilson Creek Road to South of Mill Creek Access	
E4: Wilson Creek Road to North of Mill Creek Access	
E5: Wilson Creek Road to Hamilton Road	
F: Tunnel Bypass	F: Tunnel Bypass

The 2016 Project Study Report (PSR) performed a more detailed analysis and refinement of the six alternatives recommended by the Engineered Feasibility Study.

In 2018, the Geotechnical Expert-based Risk Assessment estimated the risks of the alignments with respect to cost, mobility, and closure for up to a 50-year project life. The analysis included two additional alternatives: Alternative X, an alignment approximately along the existing highway to determine whether a lower cost alternative with less right of way needs may be feasible, and Alternative L as a possible improvement to Alternative X from a geotechnical perspective.

2018 Geotechnical Expert-based Risk Assessment	
Alternatives Considered	**Recommended for Study**
A1: Rudisill Road to LCG Tunnel	A1: Rudisill Road to LCG Tunnel
A2: Rudisill Road to Damnation Trailhead	A2: Rudisill Road to Damnation Trailhead
C3: Rudisill Road to South of Mill Creek Access	C3: Rudisill Road to South of Mill Creek Access
C4: Rudisill Road to North of Mill Creek Access	C4: Rudisill Road to North of Mill Creek Access
C5: Rudisill Road to Hamilton Road	C5: Rudisill Road to Hamilton Road
F: Tunnel Bypass	F: Tunnel Bypass
	L: Upslope Realignment from Rudisill Road to South of Damnation Trailhead
	X: End-to-End Re-engineering On Alignment

The 2018 Value Analysis Study analyzed the eight alternatives from the 2015 Engineered Feasibility Study and 2018 Expert-based Risk Assessment and provided possible cost,

schedule, and/or performance improvement recommendations. The 2018 Value Analysis Study recommended removing three alternatives (C3, C4, and C5) from further consideration due to environmental effects.

2018 Value Analysis Study	
Alternatives Considered	**Recommended for Study**
A1: Rudisill Road to LCG Tunnel	A1: Rudisill Road to LCG Tunnel
A2: Rudisill Road to Damnation Trailhead	A2: Rudisill Road to Damnation Trailhead
C3: Rudisill Road to South of Mill Creek Access	
C4: Rudisill Road to North of Mill Creek Access	
C5: Rudisill Road to Hamilton Road	
F: Tunnel Bypass	F: Tunnel Bypass
L: Upslope Realignment from Rudisill Road to South of Damnation Trailhead	L: Upslope Realignment from Rudisill Road to South of Damnation Trailhead
X: End-to-End Re-engineering On Alignment	X: End-to-End Re-engineering On Alignment

In 2019, Caltrans issued an addendum to the 2016 PSR to describe the changes to the project's scope, alignments, and design concepts. In the addendum, two new eastern alignment alternatives were added to reduce the longer, "S-curve" portions of the A alignments.

2019 PSR Addendum	
Alternatives Considered	**Recommended for Study**
A1: Rudisill Road to LCG Tunnel	A1: Rudisill Road to LCG Tunnel
A2: Rudisill Road to Damnation Trailhead	A2: Rudisill Road to Damnation Trailhead
F: Tunnel Bypass	F: Tunnel Bypass
	G1: Retreat from Rudisill Road to LCG Tunnel
	G2: Retreat from Rudisill Road to Damnation Trailhead
L: Upslope Realignment from Rudisill Road to South of Damnation Trailhead	L: Upslope Realignment from Rudisill Road to South of Damnation Trailhead
X: End-to-End Re-engineering On Alignment	X: End-to-End Re-engineering On Alignment

5 Alternatives Considered During Screening Process (2020 – 2021)

Based on the results of the alternatives development and evaluation process described above, the seven Build Alternatives from the 2019 PSR Addendum were identified for further analysis and refinement. Figure 3 shows the location of the alternatives, and Table 1 contains a summary of each alternative. Additional information is provided in the January 2020 LCG Fact Sheet (Attachment A).

Figure 3. Alternatives Considered During 2020/2021 Screening Process

Table 1. Alternatives Considered during 2020/2021 Screening Process

Alternative	Description	Construction Length (miles)	Estimated Footprint Size (acres)	Estimated Capital Cost ($ Millions)[a]
A1	Departs US 101 at PM 13.47, heading inland, and reconnects with US 101 at PM 15.56. A1 includes a 2,425-foot-long tunnel that begins inland and ends near PM 15.56.	3.4 miles	359.9 acres	$1,078M
A2	Follows Alternative A1 for the initial 2.3 miles where it then continues northward, reconnecting to US 101 at PM 15.92. A2 does not include a tunnel.	3.5 miles	371.6 acres	$690M
F	Constructs a 5,600-foot-long tunnel. Departs US 101 at PM 14.06 and reconnects with US 101 at PM 15.56.	1.5 miles	15.4 acres	$930M
G1	Departs US 101 at PM 13.47, and reconnects with US 101 at PM 15.56. Shares the same southern alignment as Alternative L (below) and the same northern alignment as Alternative A1. Includes the same 2,425-foot-long tunnel alignment as A1.	3.0 miles	348.7 acres	$880M
G2	Follows Alternative G1 for the initial 2.4 miles and reconnects to US 101 at PM 15.92. Shares the same northern alignment as Alternative A2. Alternative G2 does not include a tunnel.	3.1 miles	359.5 acres	$520M
L	Departs the existing alignment at PM 13.47, remains upslope of the existing alignment, and reconnects to US 101 at PM 15.56.	2.2 miles	167.5 acres	$360M
X	Maintains the existing US 101 alignment with segments of realignment and a dewatering component to improve the stability of the slide.	1.1 miles	35.7 acres	$220M

[a] These estimated capital costs are taken from the Alternatives Analysis process in February 2021.

6 Alternatives Screening Process

Caltrans held workshops with the Working Groups in December 2020, March 2021, and April 2021 to present the alternatives screening methodology, receive input on the process used to assess the alternatives, and provide a transparent and defensible process for eliminating alternatives. Working Group members provided constructive input on the alternatives, evaluation methodologies, and performance measures.

Working Group meeting presentations and summaries are provided in Attachment B. The Alternative Screening Process and summary of the results are described below.

Screening alternatives is a process of comparing and evaluating alternatives to determine which options are technically feasible, responsive to the region's unique geotechnical conditions, and cost-effective, while respecting important natural and cultural resources. Screening adds value to the preliminary engineering and environmental phase because it:

- Assesses the range of possible alternatives,
- Identifies the technically and economically feasible alternatives for further detailed study in the environmental document,
- Saves time and resources by narrowing the footprint area for detailed studies,
- Reduces the area and extent of ground-disturbing studies for selection of the final alternative, and
- Provides higher level of certainty and a lowered risk of schedule delay in the environmental phase.

Step 1. Identify Performance Measures and Screening Methodology

The first step in the screening process was to identify performance measures to use to evaluate alternatives. These measures were developed based on the project purpose and the consensus-based list of values and benefits contained in the December 2015 *Huffman Stakeholder Group Consensus White Paper*[1]. The performance measures focus on measurable criteria, such as probability of long-term closure, using available data. The initial sixteen performance measures are listed in the Workshop #1 presentation materials (Attachment B1).

During Workshop #1 in December 2020, the identified performance measures were presented to each Working Group; group members then suggested additions and refinements. For example, the Biological Resources Working Group encouraged the use of tree counts over reporting acreage by forest/habitat type alone. The Working Groups also considered how to weight the performance measures, identified risks to project success, and discussed the relative importance of performance measures. See the Workshop #1 summary in Attachment B1 for more information.

After Workshop #1, Caltrans revised the list of performance measures and their measurable criteria, established a weighting method for the performance measures, and recognized "core factors" — performance measures that were consistently acknowledged as most important by all Working Groups. Core factors include cost to build, cost to mitigate, and tree impacts.

Step 2. Apply Weighted Performance Measures to Alternatives

During the next step in the screening process, Caltrans collected and analyzed data and applied the weighted performance measures to each Build Alternative. Preliminary results of the alternatives analysis were presented to the Working Groups in March 2021, at Workshop #2 (Attachment B2).

Data Sources - Sources of information used to evaluate the alternatives included qualitative assessments, engineering assessments, geographic information system (GIS) analyses, and field inspections of the potential project locations.

Qualitative Assessment - Qualitative performance measures were developed to describe the alternative alignments, including constructability, traffic mobility, geotechnical risks, cost to maintain, and cost to mitigate for environmental effects. Metrics for qualitative assessments included general scales (e.g., high, medium, low) and percentages/probabilities.

Engineering Assessment - Engineering assessments were provided for a number of measures that could be readily quantified at this stage of project development, such as project length, travel time, construction duration, capital costs, cut/fill material balance, and key features of the alignment.

GIS Analysis - The bulk of the analysis was performed using GIS data to assess impacts to sensitive habitats, aquatic resources (i.e., streams), wildlife connectivity, edge effects, and recreational facilities (e.g., trails and campgrounds). A memo describing the environmental constraints mapping and associated data sources is provided in Attachment C. Attachment C also displays sample maps used in the analysis.

Field Inspections - Experienced engineers, biologists, and environmental analysts conducted field reviews of the potential alternatives to identify conditions not visible in aerial photos or on maps. Most notably, sample plots within mapped vegetation communities in the project area were used to identify tree sizes and densities. These plots were extrapolated using aerial photo interpretation to estimate the number and size of trees to be potentially affected by each alternative. Refer to Workshop #2 presentation materials in Attachment B2 for estimated tree removal results.

Core Factors and Performance Measure Weighting - To normalize the metrics across performance measures, Caltrans applied a normalizing scale, which allowed for the comparison of data with different units. In other words, performance measures ranked high, medium, and low could be compared to measures reported in acres. The measures were normalized to a scale of 1 to 5, with 1 representing the lowest level of impact, least amount of time, lowest cost, etc., and 5 representing the highest level of impact, most amount of time, highest cost.

Weighting of core factors was developed based on input from the Working Groups and the Caltrans team. A weighting factor of 1 to 5 was applied to each performance measure, with 5 being given to the measures deemed most important. The performance measures and their associated weight are shown in Table 2.

To determine the effects of weighting on the ranking of alternatives, a sensitivity analysis was conducted to compare various scenarios of normalizing and weighting performance measures. For example, the weight of core factors was doubled or tripled, weighting was eliminated, weighting was adjusted for operational factors, or just the natural or core factors were used. The analysis concluded that the weighting did not produce substantially different results in alternative ranking.

Once the performance measures were normalized and weighted, the numbers were multiplied to receive a final score, and determine the ranking of alternatives. For example, the normalized score for trees for each alternative was multiplied by the factor weight of 5 for a final score for each alternative. Normalized scores, weighted scores, and results are displayed in Attachment D.

Table 2. Performance Measures and Weighting Factors

Performance Measure	Factor Weight
CORE FACTORS	
Trees	5
Cost to construct	5
Cost of mitigation	5
OPERATIONAL FACTORS	
Road closure potential	4
Cost to maintain (relative to existing)	1
Traffic mobility	3
CONSTRUCTION FACTORS	
Footprint size	4
Time to construct	3
Cut/fill deposited within project area	4
Cut/fill to be deposited offsite	4
Trail relocation potential	2

Performance Measure	Factor Weight
NATURAL FACTORS - VEGETATION	
Red Alder	3
Coastal Scrub/Grassland	3
New edges in National and State Parks	3
New edges in Green Diamond land	1
Logged and other young conifer/redwood lands	2
NATURAL FACTORS - WILDLIFE	
Marbled murrelet occupied habitat	4
Marbled murrelet designated critical habitat	2
Marten core habitat	3
Northern spotted owl suitable habitat	4
Potential to disrupt wildlife connectivity	3
NATURAL FACTORS – AQUATIC	
New tributary crossings	3
Wilson Creek watershed disturbance	1

Preliminary Analysis Results

The preliminary results of the alternatives analysis were presented at Workshop #2 (Attachment B2 and Table 3): alternatives F (Tunnel Bypass) and X (Re-Engineered Existing Alignment) scored and ranked best overall.

- Alternative F consistently scored in the top two for all categories of performance measures (i.e., core factors, operational factors, construction factors, and natural factors).
- Alternative X scored in the top two for all categories except in operational factors, where it ranked in the bottom two.
- Alternative G1 and G2 consistently scored worse than the other alternatives except in operational factors, where the G alternatives outperformed Alternatives X and L.
- Alternative A1 and A2 ranked fourth and third overall; the A alternatives performed well in operational factors.
- Alternative L ranked fifth overall, performing worst in operational factors.

The sensitivity analysis showed that rankings remained essentially stable until/unless weightings were significantly increased beyond the 1 to 5 scale.

Table 3. Alternatives Analysis Results Summary

Performance Measure Category	Weighted Scores by Alternative							Possible Score Range (Lowest = Best)
	X	L	F	A1	A2	G1	G2	
Core Factors (Trees, Construction and Mitigation Costs)	35	55	45	55	55	65	55	15 - 75
Operational Factors	40	40	8	8	8	24	24	8 - 40
Construction Factors (Time to Construct, Cut/Fill Volumes, etc.)	35	55	31	59	55	59	59	17 - 85
Natural Resource Factors (Animals, Vegetation, Aquatic)	42	86	38	94	94	110	110	32 - 160
All Factors	152	236	122	216	212	258	248	72 - 360
Alternatives Ranking (1-7) for All Factors	2	5	1	4	3	7	6	n/a

Step 3. Request Stakeholder Concurrence of Alternatives Ranking

In April 2021, all Working Groups met in one session for Workshop #3. Results of the analyses recommended eliminating Alternatives A1, A2, G1, G2, and L from further study and carrying forward Alternatives X and F for further refinement.

- Alternatives F and X performed best during the alternatives analysis. By moving forward with these alternatives, there would be fewer environmental impacts (including less tree removal), study cost would be reduced, and the area required for assessment would be reduced, shortening the project schedule by one year.

- Alternatives G1 and G2 ranked worst overall and were eliminated because they have a longer construction duration and larger project footprint, resulting in substantially higher environmental impacts than Alternatives X or F.

- Alternatives A1 and A2 ranked fourth and third overall, but were also eliminated for their substantially higher environmental impacts than Alternatives X or F.

- Alternative L, ranked fifth overall, was also eliminated based on core and natural resource factors, combined with geotechnical risks.

Workshop #3 gave stakeholders an opportunity to provide feedback on the process and on the final determination on what alternatives to move forward into the draft environmental document. Polling results from the meeting (Attachment B3) indicated there was general support for the

recommendation to proceed with further study of Alternatives F and X, and to remove Alternatives L, A1, A2, G1 and G2 from further study at this time. There was concern voiced related to narrowing the field to only two build alternatives, based on perceptions that Alternatives F and X are not feasible, are too expensive, and/or lack popular support. However, the majority of stakeholders expressed trust in the process and satisfaction with progress made.

7 Results: Alternatives Carried Forward and Eliminated from Further Evaluation

Alternatives F (Tunnel Bypass) and X (Re-Engineered Existing Alignment) will be carried forward as the Build Alternatives for further study in the draft environmental document.

2021 Alternatives Analysis	
Alternatives Considered	**Recommended for Study**
A1: Rudisill Road to LCG Tunnel	
A2: Rudisill Road to Damnation Trailhead	
F: Tunnel Bypass	F: Tunnel Bypass
G1: Retreat from Rudisill Road to LCG Tunnel	
G2: Retreat from Rudisill Road to Damnation Trailhead	
L: Upslope Realignment from Rudisill Road to South of Damnation Trailhead	
X: End-to-End Re-engineering On Alignment	X: End-to-End Re-engineering On Alignment

Other alternatives considered during the project development and alternatives screening process have been eliminated. See Table 4 for a summary of the alternatives eliminated from further analysis, including the rationale for elimination, and refer to Attachment D for detailed results of the Alternative Analysis performance measure analysis.

Table 4. Alternatives Considered but Rejected from Further Study

Alternative	Description	Justification for Eliminating this Alternative	Source Document[1]
A1	Rudisill Road to LCG Tunnel	Alternatives A1 and A2 had a longer construction duration and larger project footprint than Alternatives X or F, resulting in substantially higher environmental impacts. For these reasons, these alternatives were rejected.	Alternatives Analysis 2021
A2	Rudisill Road to Damnation Trailhead		
B1	Wilson Creek Bridge to LCG Tunnel	Alternatives B1 and B2 had greater habitat and cultural landscape impacts, larger construction footprint, and more earthmoving than Alternatives A1 and A2, without added value. For these reasons, these alternatives were rejected.	Engineered Feasibility Study 2015
B2	Wilson Creek Bridge to Damnation Trailhead		
C3	Rudisill Road to South of Mill Creek Access	Alternatives C3, C4, and C5 had the greatest project footprints and substantial old growth redwood and wildlife impacts. For these reasons, these alternatives were rejected.	Value Analysis Study 2018
C4	Rudisill Road to North of Mill Creek Access		
C5	Rudisill Road to Hamilton Road		
D3	Wilson Creek Bridge to South of Mill Creek Access	Alternatives D3, D4, and D5 had greater potential impacts on habitat and cultural landscapes than the C alternatives, without added value. For these reasons, these alternatives were rejected.	Engineered Feasibility Study 2015
D4	Wilson Creek Bridge to North of Mill Creek Access		
D5	Wilson Creek Bridge to Hamilton Road		
E3	Wilson Creek Road to South of Mill Creek Access	The E alternatives had larger habitat impacts than the C and D alternatives, with no advantage over those other alternatives. The E alternatives also added additional travel time and had greatest potential barrier to wildlife connectivity and watershed integrity. For these reasons, these alternatives were rejected.	Engineered Feasibility Study 2015
E4	Wilson Creek Road to North of Mill Creek Access		
E5	Wilson Creek Road to Hamilton Road		
G1	Retreat from Rudisill Road to LCG Tunnel	Alternatives G1 and G2 had a longer construction duration and larger project footprint than Alternatives X or F, resulting in substantially higher environmental impacts. Alternatives G1 and G2 also had a "medium" geotechnical risk. For these reasons, these alternatives were rejected.	Alternatives Analysis 2021
G2	Retreat from Rudisill Road to Damnation Trailhead		
L	Upslope Realignment from Rudisill Road to South of Damnation Trailhead	Alternative L had a "medium" geotechnical risk and a larger project footprint than Alternatives F or X, resulting in higher environmental impacts and impacts to parklands. For these reasons, this alternative was rejected.	Alternatives Analysis 2021

[1] The LCG project reports referenced are available for review on the LCG Project website's document library: www.lastchancegrade.com.

8 Value Analysis 2021

Based on the results of the 2020-2021 screening process, Caltrans conducted a Value Analysis (VA) that focused on evaluating improvements to Alternatives F and X for potential further refinement. The VA was conducted on July 7-9 and July 13-15, 2021, and included design, tunnel, and dewatering experts, as well as representatives from State Parks and the National Park Service. The VA developed five (5) recommendations for Alternative X, three (3) recommendations for Alternative F, and one (1) recommendation that would merge Alternatives X and F (Table 5). These recommendations included concepts for dewatering the landslides, scheduled daily road closures during construction, construction phase procurement strategies, and providing for an on-site construction staging area to facilitate construction of the north portal, in addition to other recommendations. Review and consideration of the VA alternatives by Caltrans Executive staff resulted in the decision to carry forward some of these refined design options. Table 5 summarizes these refined alternatives and rationale for rejecting or carrying them forward.

Table 5. Summary of Value Analysis Results

VA Alternative	Description	Determination
X-1: Construct a drainage gallery in stable ground below the slip surfaces	Construct several horizontal drain collection tunnels about 9 feet in diameter. This alternative also includes drainage wells that radially fan upward and convey water from the slope. It eliminates the tributary tunnels and vertical drainage wells in the baseline design.	**Retained for Further Study.** The drainage gallery alternative will be developed as part of the process of refining Alternative X.
X-2: Implement one 4-hour and one 2-hour full closure daily	This VA alternative proposes to implement two full closures daily (one 4-hour and one 2-hour closure) to reduce the project construction duration by approximately three months. The main benefit of this VA alternative would be to provide unobstructed use of the project site.	**Rejected.** Although the temporary closures could reduce the construction schedule by approximately 3 months, the temporary impacts to local economy and quality of life override schedule benefits.
X-3: Use separate contract for retaining wall construction and for global dewatering	Two separate contractors would be used: one for the retaining wall work and a second for subsurface drainage work. This alternative results in a reduction in contractor overhead, which is estimated at 1% of the total project cost.	**Retained for Further Study.** The concept of separate contracts should be considered as this approach could result in cost savings. This option should be studied in refining both Alternative X and Alternative F.
X-4: Construct subdrains with multiple lines above proposed retaining walls	This idea would supplement the construction of subdrains with multiple connecting lines in the slopes above the retaining walls. These lines would intercept water before it can cause localized slides and/or recharge of the groundwater. The main benefit of this VA alternative is to reduce the water pressure on the retaining walls in order to improve slope stability.	**Retained for Further Study.** The subdrain features are expected to reduce geotechnical risk.
X-5: Narrow the retaining wall terrace width from 60feet to 20 feet	This idea suggests reducing the terrace width to 20 feet in order to keep a stable slope. This will narrow the project's footprint. The 60-foot width proposed in the original project plans may be too wide. This idea requires geotechnical analysis.	**Retained for Further Study.** This option could narrow the project's footprint, reducing environmental impacts, saving costs, and shortening construction duration.

F-1: Construct a smaller single-bore tunnel with one egress corridor	This VA alternative proposes to construct a smaller single-bore tunnel and include one egress corridor in lieu of two egress corridors. It would reduce the external diameter to 60 feet and the crown to 32 feet above the roadway. The main benefit of this VA alternative is to save excavation costs, as it would eliminate one egress tunnel and its related costs.	**Retained for Further Study.** The single-bore option would be studied as a cost-saving tunnel design. However, the twin-bore tunnel would remain the default option for Alternative F.
F-2: Extend and realign south portal tunnels to span poor geological soil conditions	Realign the south portal tunnels further east by approximately 75 feet and extend their length by 500 feet to avoid unstable geologic conditions that the baseline design involves.	**Retained for Further Study.** This optional tunnel design will be developed within the current footprint of environmental studies as part of the process of refining Alternative F.
F-3: Provide an additional one-acre staging area by the north portal	The baseline design does not show the details of the north portal staging area. This VA alternative proposes to reconfigure the north portal area to provide an additional construction staging area, which would help facilitate construction and provide significant time savings. At the time of the VA study there were too many unknowns to accurately quantify cost impacts for this idea.	**Rejected.** The staging area would create excessive impacts to State Parks so was rejected; however, the team would investigate using the existing passing lane north of the portal location as an additional staging area.
C-1: Construct 9,800-foot single-bore tunnel for NB traffic and rehabilitate existing US-101 for SB traffic	This VA alternative proposes to combine elements of Alt. X and Alt. F to construct a single-bore tunnel for NB US-101 traffic and rehabilitate the existing US-101 alignment for SB traffic. This rehabilitation of US-101 would also include accommodations for cyclists and pedestrians.	**Rejected.** Although this approach would meet the purpose and need, it would result in environmental impacts from both Alternative X and F. The environmental impacts outweigh the cost and schedule benefits of this hybrid alternative.