DISCUSSION DRAFT

High Ground for U.S. 101

A Bypass and Drainage Concept for Seaside, Oregon

A watershedmaps.com case study

November 2026

Prepared in response to ODOT's U.S. 101 Flood Mitigation Study (mileposts 22.5-25).
This draft has not been submitted to ODOT.

Executive Summary

Purpose. U.S. 101 keeps flooding on low ground near Seaside, closing the coast's main through route. The Oregon Department of Transportation (ODOT) is conducting a $250,000 study of the problem between mileposts (MP) 22.5 and 25, with online comments open through Nov. 29, 2026 [1, 2]. This case study uses public data to examine a longer-term alternative: moving the U.S. 101 through route out of town onto higher ground, while improving drainage on the local streets that remain on the valley floor.

Key findings

- **The existing alignment sits on low, wet ground.** Within 330 ft of U.S. 101 at MP 22.5-25, 67% of the land is in the Federal Emergency Management Agency (FEMA) 1% annual-chance flood zone, often called the 100-year floodplain, and 33% is mapped wetland [3-5].
- **Closures recur.** From 2002 to 2009, the road closed about 3.3 times a year for an average of 44 hours, forcing a detour of about 70 mi [6]. It closed again in December 2023 and December 2025 [7-9].
- **The in-town route is almost entirely in the tsunami zone.** Of the 4.3 mi of U.S. 101 from the U.S. 26 junction to Lewis and Clark Road, 99% lies within the largest Cascadia tsunami scenario (XXL1) mapped by the Oregon Department of Geology and Mineral Industries (DOGAMI) [10].
- **A hillside bypass would avoid most flood and tsunami exposure but not landslide risk.** A 7.1-mi planning sketch lies 89% outside the XXL1 zone, but 73% of it crosses ground DOGAMI rates "Very High" for landslide susceptibility [11].
- **Cost alone does not settle the question.** Over 50 years, the bypass would break even only if keeping U.S. 101 in town cost $4.9-37.7 million a year[E], depending on the discount rate and final cost. Traveler delay from closures is estimated at about $2-6 million a year[E], and ODOT does not publish maintenance costs for this segment.

The three-part concept

1. **Near term: keep U.S. 101 dry** at MP 22.5-25 using ODOT's raised-roadway or trestle option, designed for projected 2100 sea levels.
2. **Long term: a hillside bypass** that carries U.S. 101 through traffic east of town, with ramps into Seaside. The existing in-town route would become a local main street, transferred by agreement under Oregon law.
3. **Cross-street drainage:** longer bridges, large fish-passable culverts and raised sections on seven east-west roads that cross the valley floor, including evacuation routes to high ground.

Planning-level capital costs[E]

Element	Range (2024 $)
Part 1: raise or trestle at MP 22.5-25	$7.7-14 million
Part 2: hillside bypass, 7.1 mi (excludes land, ramps, contingency)	$246-521 million
Part 3: local cross streets (priced elements only)	$31.2-52.2 million
Part 3: U.S. 26 crossings (priced elements only)	$13-71 million

Requested actions. The draft comment (Section 9) asks ODOT to identify a hillside bypass corridor as a long-term option and fund a corridor study; size the near-term fix for 2100 sea levels; partner on cross-street drainage; publish segment maintenance and closure costs; compare 50-year life-cycle costs; report whether federal rules list the segment as repeatedly needing emergency repair (23 CFR Part 667); and begin early consultation with the Clatsop-Nehalem Confederated Tribes, landowners and resource agencies.

Assessment. The bypass is a long-range concept with high cost and significant geotechnical risk, and it is offered here for discussion. The near-term fix and the cross-street improvements are worthwhile whether or not a bypass is pursued.

Conventions. [E] marks a planning-level estimate derived from published benchmarks; none is an engineering estimate or bid. [U] marks a value or assumption not verified for this study. Distances are in miles (mi) and feet (ft); elevations are in feet; costs are in U.S. dollars, rounded. Bracketed numbers refer to the References.

1. Background

U.S. 101 serves as both Seaside's main street and the state's coastal through route. South of town, between MP 22.5 and 25, it crosses the floodplain of the Necanicum River and its tributaries. An average of 14,464 vehicles a day crossed the U.S. 101 bridge over the Necanicum River in 2022 [12].

In 2013, ODOT removed berms on Circle Creek at a contract cost of about $728,000, from a $1.1 million allocation [13, 14]. The project reduced flooding during a September 2013 test [6, 15], but the road closed again in December 2023 and December 2025 [7-9].

ODOT's current study, expected to be completed in March 2027, lays out four options: berms, a floodwall, raising about 5,000 ft of road with culverts, and a trestle. All four keep the through highway on its present alignment [1, 16]. ODOT has not published cost estimates for these options. Statewide, ODOT maintains about 7,300 mi of highway and reports a need for about $205 million a year in additional maintenance and operations funding [17].

About 400 acres of low ground lie between U.S. 101 and the road OpenStreetMap labels Wahanna Road, which appears to be the back road to Providence Seaside Hospital[U] [18]. Of that area, 53% is mapped wetland and 63% is in the FEMA 1% flood zone [3-5, 18]. Most of it lies just north of the ODOT study limits and drains through the same Neawanna Creek and Necanicum River system.

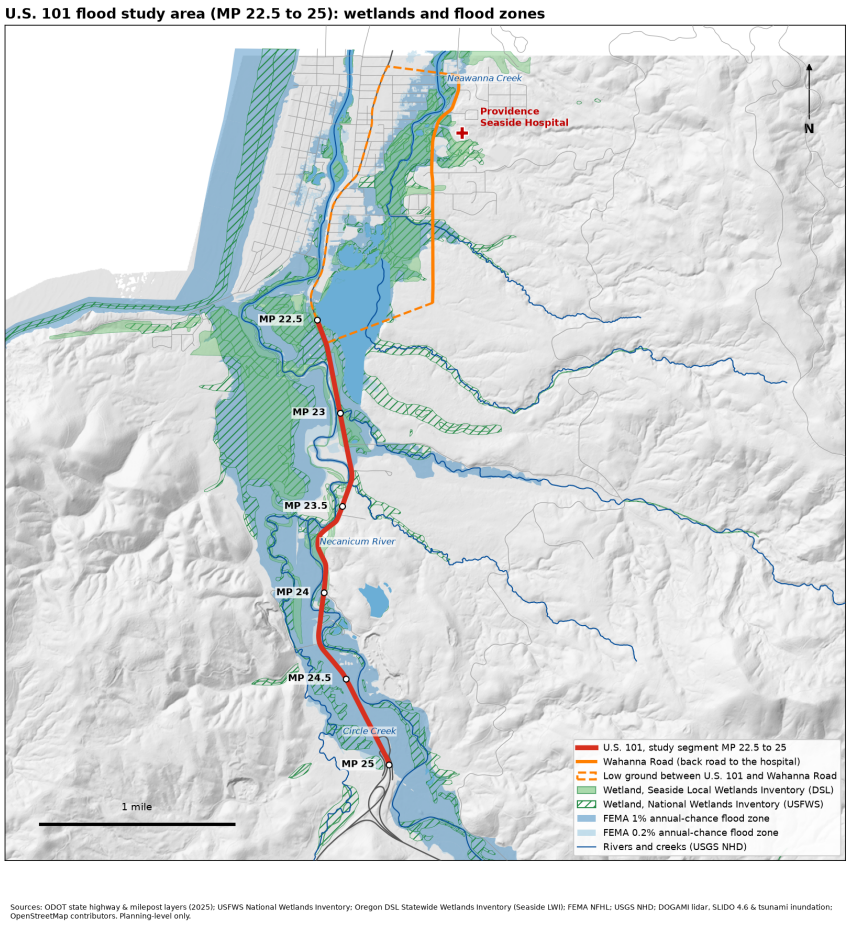


Figure 1. ODOT study segment (MP 22.5-25), mapped wetlands and FEMA flood zones. Sources: [3-5, 18-21].

2. Existing Conditions

2.1 Flood and wetland exposure

At MP 22.5-25, 67% of the land within 330 ft of the highway is in the FEMA 1% annual-chance flood zone and 33% is mapped wetland [3-5]. On the longer in-town route from MP 25 north to Lewis and Clark Road (4.3 mi), 21% of the alignment is in the 1% flood zone and 17% is in mapped wetland [3-5, 18]. The two sets of figures measure different things: the first is the share of all land within 330 ft on either side of the highway, while the second is the share of the road's own length, and measured along the road line itself MP 22.5-25 is 35% in the 1% flood zone and 27% in mapped wetland [4, 5, 21].

2.2 Tsunami exposure

Of the 4.3-mi in-town route, 99% lies within DOGAMI's XXL1 scenario, the largest modeled Cascadia event [10]. Providence Seaside Hospital sits at a ground elevation of about 38 ft, inside the inundation zones of DOGAMI's large (L1) and largest (XXL1) tsunami scenarios [10]. DOGAMI's evacuation analysis found that the failure of any bridge across the Necanicum River or Neawanna Creek would substantially enlarge the area that cannot be evacuated in time, and it lists additional earthquake-resistant bridges as a mitigation option [22].

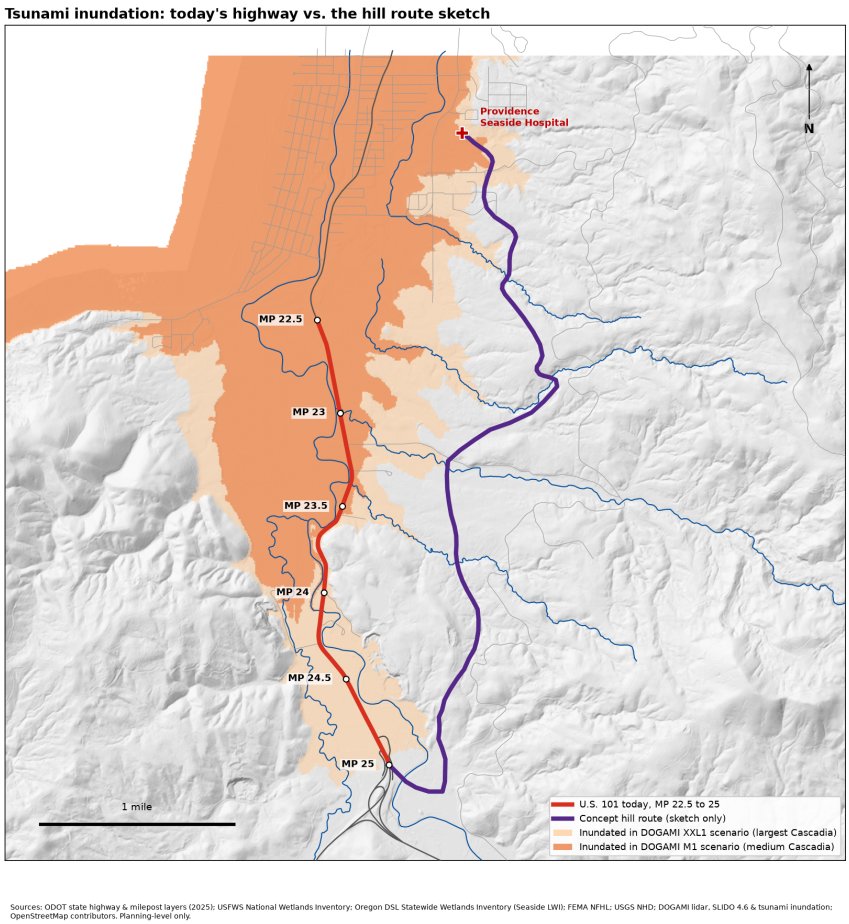


Figure 2. DOGAMI tsunami inundation (XXL1 and M1 scenarios) along U.S. 101 and the southern section of the bypass sketch, which runs from MP 25 to the hospital ramp. Sources: [10, 20, 21].

2.3 Sea-level rise

Relative sea level at Astoria is projected to rise 2.26 ft by 2100 under the intermediate scenario and 5.48 ft under the high scenario [23]. Flooding on the valley floor is therefore expected to increase over the life of any project.

3. The Concept

The concept leaves the town in place. It changes which road serves as the state through route and improves drainage on the local street network, in three parts:

1. **Near term (Part 1):** keep U.S. 101 open at MP 22.5-25, designed for 2100 sea levels.
2. **Long term (Part 2):** relocate the U.S. 101 through route to the forested hillside east of town, with ramps into Seaside. The existing route becomes a local main street.
3. **Concurrent (Part 3):** improve drainage on the east-west roads that cross the valley floor.

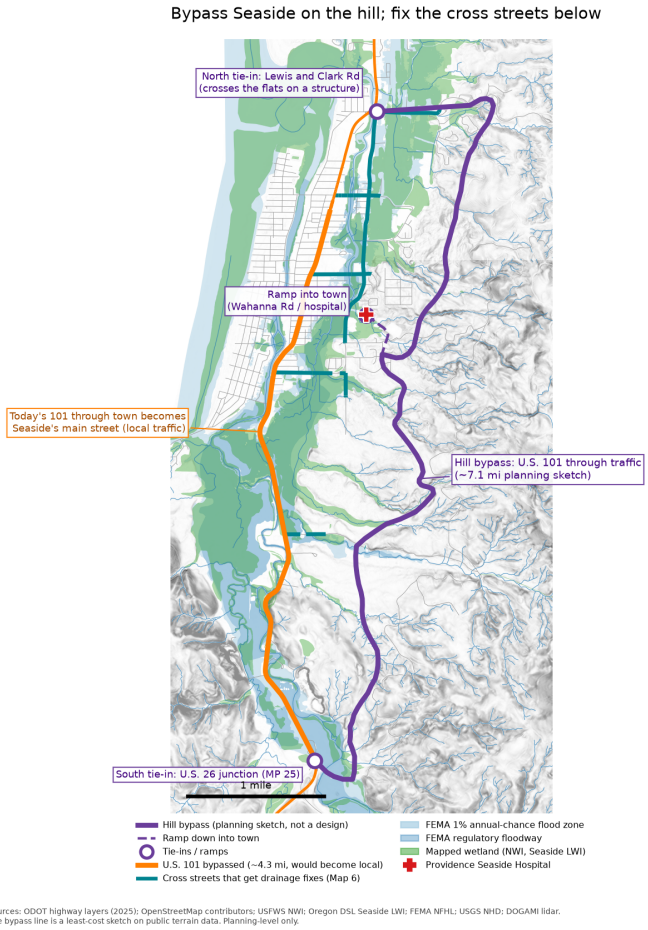


Figure 3. Concept overview: hillside bypass sketch, the in-town section of U.S. 101 that would become local, and the cross streets proposed for drainage improvements. The bypass line is a planning sketch, not a design. Sources: [3-5, 18-21].

4. Part 1: Near-Term Flood Fix at MP 22.5-25

Hospital access, emergency services and through traffic require a dependable road long before a bypass could be built. This case study recommends:

- Supporting ODOT's Option 3 (raise the roadway with culverts) or Option 4 (trestle), whichever the study shows avoids the most closures per dollar [16].
- Designing for at least +2.26 ft of sea-level rise at Astoria and testing the design against +5.48 ft [23].

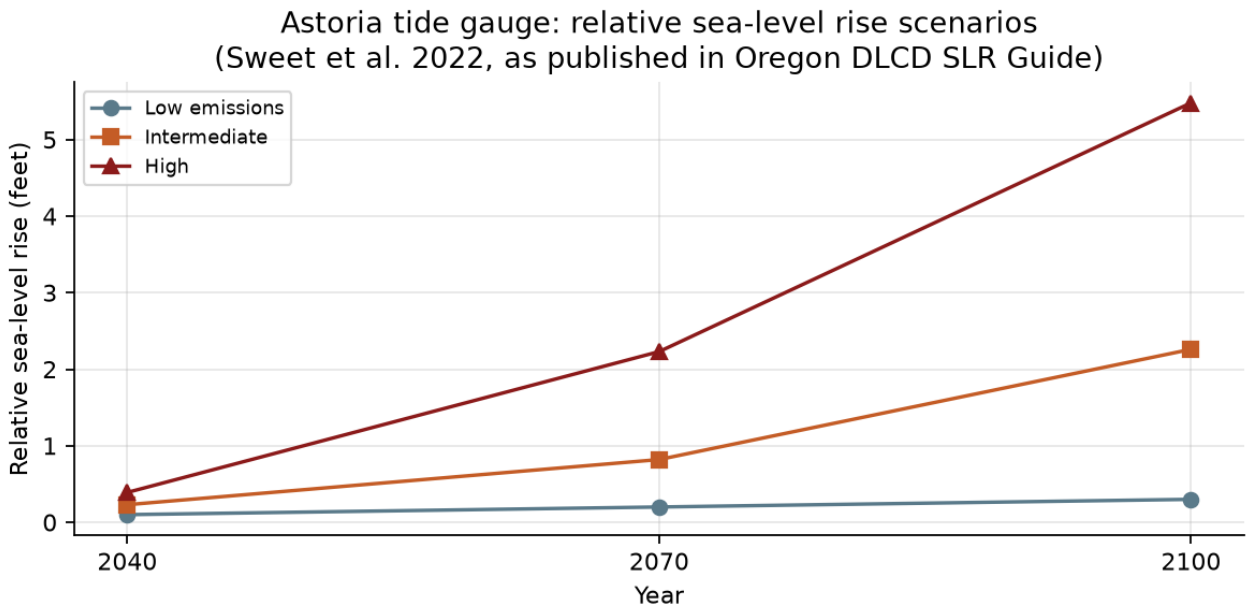


Figure 4. Projected relative sea-level rise at the Astoria tide gauge, 2040-2100. Source: [23].

Planning-level cost[E]. 2011 estimates of about $5.5 million to raise the road with bridges [6] and about $10 million for a trestle [24], adjusted to 2024 dollars with a consumer price index (CPI) factor of about 1.4 [25], give roughly $7.7-14 million. Prices of the goods and services used in highway and street construction rose about 50% from 2015 to 2024, compared with about 32% for consumer prices [25, 26], so these figures are likely low. If a bypass is later built, this raised section would become part of the local road network.

5. Part 2: Hillside Bypass

5.1 Alignment sketch

The bypass sketch is a computer-drawn route that follows the easiest terrain in DOGAMI lidar elevation data (a least-cost path) [20]; it is not an engineering alignment. It runs about 7.1 mi:

- **South tie-in** at the U.S. 26 junction (MP 25).
- **Hillside section**, mostly 100-250 ft above sea level, east of the hospital and downtown.
- **Ramp into town** near Wahanna Road and the hospital (about 0.4 mi).
- **North tie-in** at the Lewis and Clark Road junction. Reaching it requires crossing about 0.7 mi of low ground on the Neawanna flats. Because any northern connection to U.S. 101 must cross this area, this section would be built on an elevated structure rather than fill.

Table 1. Hazard exposure: existing in-town route and bypass sketch.

Measure	U.S. 101, MP 25 to Lewis and Clark Road	Bypass sketch
Length	4.3 mi	7.1 mi
In FEMA 1% flood zone	21%	11% (mostly the north flats crossing)
In mapped wetland	17%	6%
In DOGAMI XXL1 tsunami scenario	99%	11% (about 0.8 mi, nearly all on the north flats)
Median ground elevation	about 22 ft	about 129 ft
Stream crossing sites	6	21
DOGAMI "Very High" landslide susceptibility	0%	73%
On mapped landslide deposits (SLIDO)	0%	24%

Measured for this case study from public layers [3-5, 10, 11, 18-21, 27].

5.2 Expected benefits

- **Moves the state through route off the flood-prone in-town segment.** Through traffic would no longer depend on the low ground that floods and closes today.
- **Reduces through traffic downtown.** Trips that do not stop in Seaside, including freight, would use the bypass. The share of through trips is not public[U]; an origin-destination study would establish it.
- **Provides a through route largely above flood and tsunami hazard.** About 89% of the sketch lies outside the XXL1 zone, compared with about 1% of the existing route [10].
- **Allows the existing route to be redesigned as a main street** for walking, parking and local business. A Seaside bypass has been discussed publicly since at least 2003 [28-31].

5.3 Jurisdiction and maintenance of the existing route

If the bypass became U.S. 101, the in-town route would no longer be needed as a state highway. Oregon law allows ODOT to transfer a highway segment to a city (ORS 374.329) or a county (ORS 366.290) by agreement, and allows ODOT to contribute annual funding toward its maintenance [32, 33]. The process involves a transfer agreement, recorded conveyance documents and an Oregon Highway Plan amendment approved by the Oregon Transportation Commission [34, 35]. Local governments may ask ODOT's Jurisdictional Transfer Advisory Committee to recommend funding to the Legislature [34].

Effect on maintenance is unproven. ODOT would no longer carry 4.3 mi of flood- and tsunami-exposed road, but it would take on about 7.1 mi of new road, mostly on landslide-prone ground that requires slope maintenance. Flooding on the old route would not disappear; it would pass to the city or county unless the transfer agreement addresses it. Whether ODOT's annual costs would fall cannot be determined from public data, because ODOT does not publish maintenance costs for this segment. Any transfer should follow completion of Part 1 and include a funding agreement.

6. Part 3: Cross-Street Drainage Improvements

Between U.S. 101 and the hills, several east-west roads cross the low ground around Neawanna Creek, connected north-south by Wahanna Road. These roads appear to provide access to the hospital[U] and the east side of town and serve as tsunami evacuation routes [22].

Each road was overlaid on FEMA flood zones and floodways, federal and Seaside wetland inventories, U.S. Geological Survey stream maps and DOGAMI lidar [3-5, 18-20]. Only the portion of each road on the valley floor was counted (see Section 10).

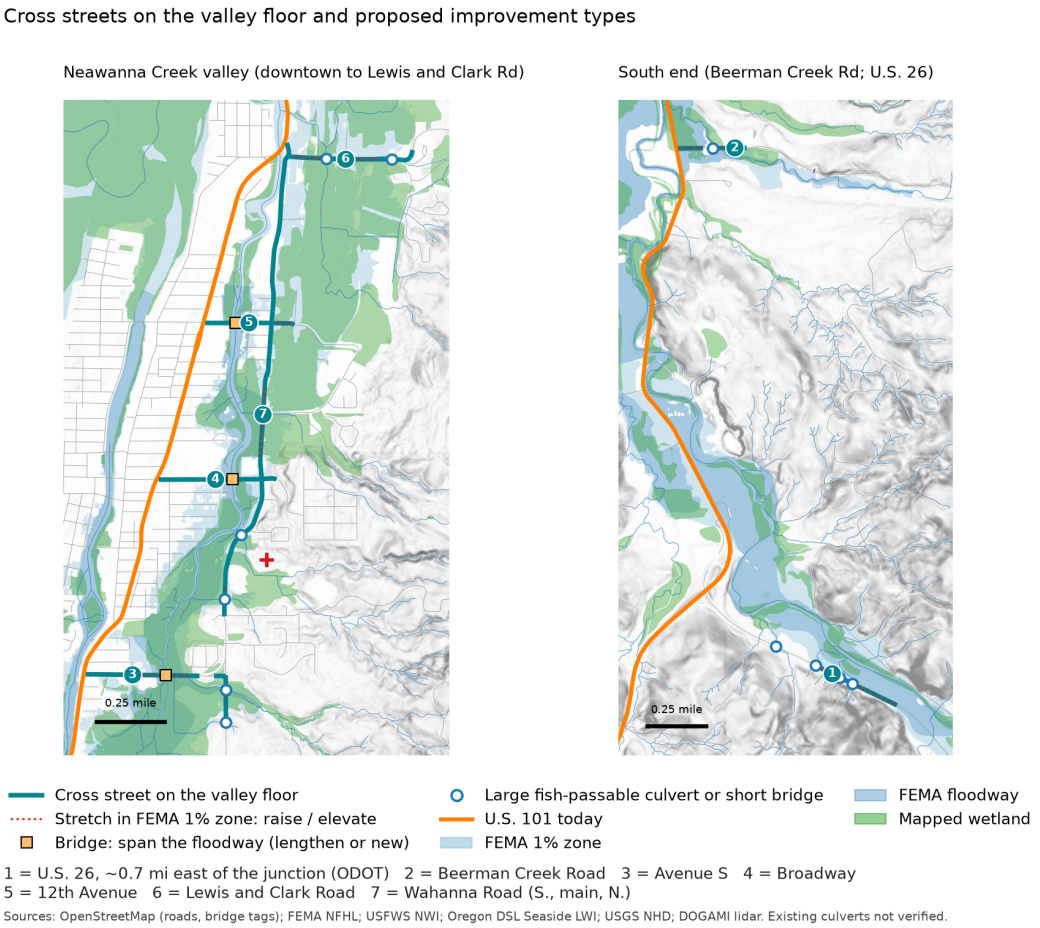


Figure 5. Cross streets on the valley floor and proposed improvement types. Numbers correspond to Table 2. Sources: [3-5, 18-20].

Table 2. Cross-street exposure and proposed improvements (valley-floor portion only).

#	Road	In 1% zone (ft)	In floodway (ft)	In wetland (ft)	Streams crossed	1% flood over road[a]	Proposed improvement	Priced cost[E]
1	U.S. 26, from ~0.7 mi east of junction (ODOT)	2,020	410	0	5 (Meyer Cr. + 4 unnamed)	≈0 ft (road at or just above)	Structure across floodway; 5 fish-passable culverts; raise ~1,610 ft	$13-71M
2	Beerman Creek Road	1,330	570	480	1 (Beerman Cr.)	~1.1 ft	Structure across floodway (includes the Beerman Cr. crossing)[U]; raise ~760 ft	$6.2-9.2M
3	Avenue S (U.S. 101 to Wahanna Rd)	980	600	20	1 (Neawanna Cr., bridge today)	~2.6 ft	Lengthen bridge to span floodway; raise ~380 ft	$6.4-9.7M
4	Broadway (U.S. 101 to Wahanna Rd)	390	180	0	1 (Neawanna Cr., bridge today)	No FEMA elevation	Lengthen bridge to span floodway; raise ~220 ft	$1.9-2.9M
5	12th Avenue (U.S. 101 to N. Wahanna Rd)	560	200	140	1 (Neawanna Cr., bridge today)	~2.9 ft	Lengthen bridge to span floodway; raise ~370 ft	$2.1-3.2M
6	Lewis and Clark Road (north tie-in)	1,650	0	440	2 (Thompson Cr. + 1 unnamed)	~1.7 ft	2 culverts or short bridges; raise ~1,650 ft with bypass flats crossing	$0.8-3.0M
7	Wahanna Road, S. to N.	1,630	1,130	30	6 (Neawanna Cr. + 5 unnamed)	~1.2 ft	Elevated structure across floodway; 4 culverts; raise ~500 ft	$13.8-24.2M

[a] Median of FEMA base flood elevation minus lidar ground where both exist. Bare-earth lidar excludes bridge decks, so readings at bridges reflect the channel bed. The lidar vertical datum is assumed to match FEMA's (NAVD88)[U]. "Bridge today" means OpenStreetMap tags a bridge; other existing structures were not verified[U]. Ownership of roads 2-7 (city or county) was not verified[U]. Row 7 combines the three segments OpenStreetMap names South Wahanna Road, Wahanna Road and North Wahanna Road; its role as the hospital's back road was not verified[U]. On Avenue S the bridge sits where an unnamed NHD channel meets Neawanna Creek. Cr. = Creek; ~ = about; ≈ = approximately. "Culverts" are large fish-passable culverts. [b] Two adjustments, both unverified[U] until a field visit, are built into the costs and counts here. A Beerman Creek Road crossing and a Wahanna Road crossing sit 1-3 m outside the floodway and had been priced as separate culverts next to the floodway bridge; those two are now treated as part of the bridge, which lowers the local-roads total from $32.0-55.2 million to $31.2-52.2 million. At the north tie-in, a bypass crossing of Thompson Creek and a Lewis and Clark Road crossing of an unnamed channel lie 28 m apart and are treated as one site when crossings are counted; both rows remain in the inventory. Sources: [5, 18-20, 36-38].

6.1 Selection of improvement types

- **Bridges across floodways.** Federal floodplain rules prohibit floodway encroachments that raise flood levels [39], so where a road crosses a floodway the improvement is a bridge or elevated structure rather than fill. On Avenue S, Broadway and 12th Avenue, this means a longer bridge when the existing bridge is replaced, built to current seismic standards because these are evacuation routes [22].
- **Large fish-passable culverts or short bridges** where a road crosses a mapped stream outside a floodway. Oregon law requires fish passage when a culvert on a fish-bearing stream is installed or replaced, under ODFW design criteria [40]. Unnamed channels and roadside or agricultural ditches are included as habitat: juvenile coho rear through winter in floodplain wetlands and off-channel water [41], and juvenile salmon have been found in agricultural ditches year-round, most abundantly in winter and spring [42]. Each crossing needs a field check before its fish-passage design is set.
- **Raised road sections** where a road lies in the 1% zone outside the floodway, raised above the projected 2100 flood level, with cross culverts so water is not trapped behind the road.

- **Secondary benefit.** Larger openings would improve flow through existing wetlands. The improvements follow existing roads, but whether any buildings would be displaced was not checked[U].

6.2 Cost method[E]

- **Bridges and structures:** floodway length × assumed deck width (32 ft local; 40 ft on U.S. 26) × Federal Highway Administration (FHWA) Oregon bridge replacement unit cost: $430 per sq ft for bridges not on the National Highway System (NHS) (annual values $335-503) and $513 per sq ft for NHS bridges such as U.S. 26 (annual values $359-667) [36]. Example, Broadway: 178 ft × 32 ft × $430 ≈ $2.4 million (range $1.9-2.9 million).
- **Fish-passable culverts, local roads:** $0.41-1.5 million each. The low value is a 2013 Columbia County crossing budgeted at $306,000 [37], adjusted by 1.35 to 2024 dollars [25]; the high value is the low end of ODOT's state-highway range.
- **Culverts on U.S. 26:** ODOT reports fish-passage culvert replacements on state highways at $1.5 million to more than $12 million each [38], which drives the wide U.S. 26 range.
- **Not priced:** raised sections on fill (about 3,870 ft on local roads and 1,610 ft on U.S. 26), for which no public per-foot benchmark was found; land, design, permitting and utilities.
- **Total, local roads 2-7, priced elements only:** about $31.2-52.2 million.

7. Life-Cycle Cost Comparison

Table 3. Planning-level comparison of the two long-term paths[E].

	Keep U.S. 101 in town	Hillside bypass
Capital cost	Part 1 raise or trestle: $7.7-14 million	Bypass alone: about $246-521 million; with Part 1 built first, about $254-535 million in total
Cross streets	Local roads: $31.2-52.2 million (priced elements only); warranted under either path	Same
Annual costs	Flood repairs, closures and traveler delay, increasing with sea-level rise	New-road maintenance on landslide-prone ground (not priced); old route transferred by agreement
After a Cascadia earthquake	Through route in the tsunami zone	Through route largely above it

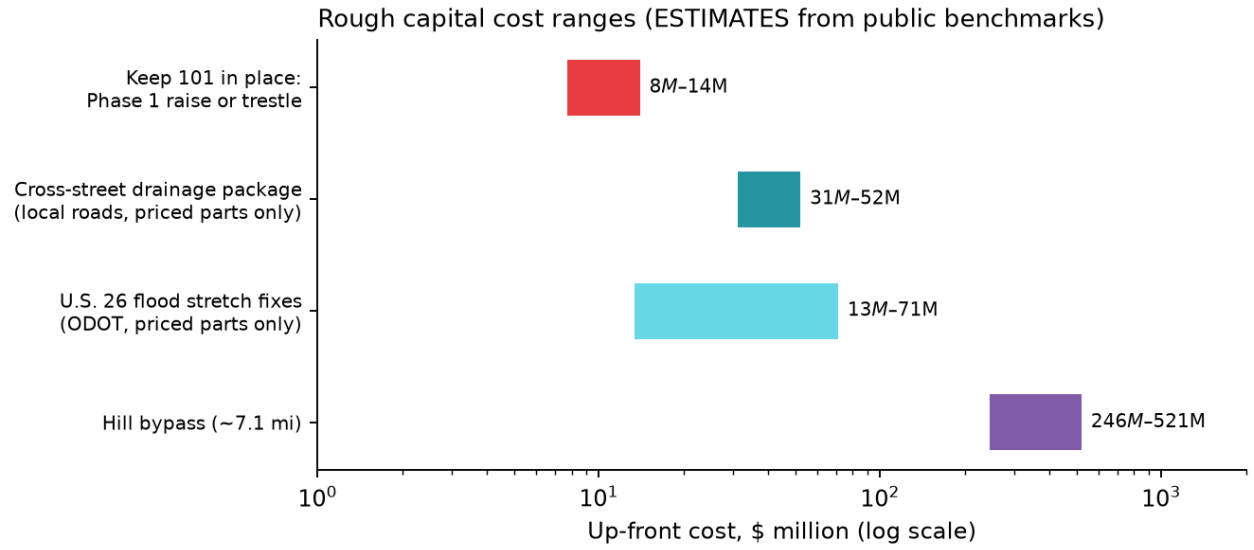


Figure 6. Planning-level capital cost ranges[E] (log scale; the figure rounds the Part 1 low value to $8 million). Sources: [6, 24, 25, 36-38, 43, 44].

Bypass cost[E]. The low value applies ODOT's figure of $34.5 million per mile for new inland highway (2024 dollars) to the 7.13-mi sketch, about $246 million [43]. The high value applies the U.S. 20 Pioneer Mountain-Eddyville project, about 5 mi built for about $365 million (roughly $73 million per mile) after landslide problems, giving about $521 million [44]. The two values are not independent: ODOT's per-mile figure is itself based on the Pioneer Mountain-Eddyville project [43], so both benchmarks trace to one landslide-affected highway. Neither includes land, ramps or contingency. Adding the Part 1 fix ($7.7-14 million) gives about $254-535 million for both. With 73% of the sketch on "Very High" landslide ground, the high value is plausible.

Annual cost of the existing alignment[E]. Traveler delay from closures is about $4.5 million a year, based on 2002-2009 closure frequency, 10,500 daily trips and U.S. Department of Transportation (USDOT) travel-time and vehicle operating values; using the 2022 count of 14,464 daily trips gives about $6.2 million [6, 12, 45]. A planning range of $2-6 million a year is used here. ODOT's own repair spending is not public.

Table 4. Break-even point: what keeping U.S. 101 in town would have to cost each year for the bypass to pay off over 50 years[E].

Discount rate	Bypass at $246 million	Bypass at $521 million
None	$4.9 million/yr	$10.4 million/yr
3.1% (earlier federal guidance)	$9.7 million/yr	$20.6 million/yr
7% (current USDOT grant guidance [45])	$17.8 million/yr	$37.7 million/yr

Capital cost divided by the 50-year annuity factor at each rate (50.00, 25.25 and 13.80).

Interpretation.

- **Cost alone does not justify the bypass.** Estimated delay of $2-6 million a year reaches break-even only without discounting and with a bypass cost near the low estimate.

- **The maintenance argument depends on ODOT data.** If ODOT's flood repair, closure and emergency costs on this segment are substantial, the case strengthens. These figures are not public, and obtaining them is the most useful next step.
- **Several benefits are not monetized here:** reduced through traffic downtown, a through route that remains usable after a Cascadia earthquake, no need to raise the road again as sea level rises, and tourism losses during closures.
- **Near-term steps are inexpensive relative to construction.** Studying and protecting a corridor while it remains timberland would likely cost far less than building it, though that cost was not estimated here[U], and the cross-street improvements are warranted under either path.

8. Risks and Mitigation

Table 5. Principal risks and proposed responses.

Risk	Proposed response
Landslides. 73% of the sketch is on DOGAMI "Very High" susceptibility ground, and 24% crosses mapped landslide deposits [11, 27]. The northern half is more exposed than the southern half.	Refine the alignment to avoid mapped landslides; complete geotechnical investigation before selecting an alignment; use structures or engineered benches where unavoidable. The Eddyville project illustrates the cost of inadequate early investigation [44].
Cost. Bypass alone: $246-521 million or more[E].	Phase the work: study and protect the corridor first; build Part 1 and the cross-street improvements now.
Jurisdiction of the existing route.	Transfer only by agreement under ORS 374.329 or 366.290, after Part 1 is complete, with ODOT funding toward maintenance as the law allows [32-34].
Fish and streams. 21 stream crossing sites on the sketch and 17 stream crossings on the cross streets [19], of which one pair 28 m apart at the north tie-in is treated as a single site[U]. Coho salmon migrate up Neawanna Creek to spawn in Thompson Creek, which Lewis and Clark Road crosses [46]. Unnamed channels and ditches on the valley floor are counted as habitat, since juvenile coho and other salmonids use such areas for winter rearing [41, 42].	Reduce crossings during alignment refinement; span larger streams; field-check each crossing, then build fish-passable structures to ODFW criteria [40].
Tribal interests. The Necanicum estuary is Clatsop and Nehalem homeland [47].	Begin government-to-government consultation before an alignment is drawn. Tribal views on a route are not public and are not assumed here[U].
Timberland. In a 200-ft strip along the southern half of the sketch, county tax lots show about 67 acres in large private timber holdings (two owner groups) [48]. Ownership along the northern half was not checked[U]. Large tracts in the area have changed hands [49].	Secure a corridor option or easement early, at fair value and on willing-seller terms where possible. The appropriate legal tool should be confirmed with ODOT and Clatsop County[U].
Downtown businesses. Some depend on passing traffic.	Signed exits at each end and near the hospital; a main street designed for walking and parking.
Hospital access. The hospital sits at about 38 ft, inside the L1 and XXL1 tsunami zones [10].	The bypass is not presented as a hospital solution. Part 1 and the Wahanna Road improvements (Table 2, row 7) would provide drier access during storms. Tsunami safety for the hospital is a separate matter [22].

9. Requested Actions (Draft Comment)

Draft for the ODOT online open house, which accepts comments through Nov. 29, 2026 [2]. It has not been submitted.

1. **Identify a hillside bypass corridor** in the study's recommendations as a long-term option, and fund a corridor study that includes geotechnical investigation and an origin-destination traffic study to establish the share of through trips.
2. **Design the near-term fix for 2100 sea levels,** using at least +2.26 ft at Astoria and testing against +5.48 ft, and select the option that avoids the most closures per dollar.
3. **Partner with Seaside and Clatsop County on cross-street drainage,** beginning with the three existing Neawanna Creek bridges on Avenue S, Broadway and 12th Avenue, built longer and to current seismic standards, and Wahanna Road. Address ODOT's own crossings on U.S. 26.
4. **Publish current costs for the segment:** maintenance and emergency repair spending on U.S. 101 through Seaside, closure dates and durations, and cost estimates for Options 1-4.
5. **Compare 50-year life-cycle costs** for the existing alignment, the near-term fix alone, and a bypass with jurisdictional transfer of the existing route, stating the discount rate used.
6. **Report whether the segment is identified** under 23 CFR Part 667 as a facility repeatedly requiring repair after emergency events [50].
7. **Begin early consultation** with the Clatsop-Nehalem Confederated Tribes, timber landowners, the City of Seaside, Clatsop County and state and federal fish and wetland agencies on corridor protection and transfer terms.

10. Methods

Data. All inputs are public: ODOT highway centerline and milepost layers [21]; FEMA National Flood Hazard Layer zones, floodways and base flood elevations [5]; USFWS National Wetlands Inventory [3]; Oregon DSL Seaside Local Wetlands Inventory [4]; USGS NHD high-resolution flowlines [19]; OpenStreetMap roads, bridge tags and hospital location [18]; DOGAMI lidar terrain [20], tsunami inundation [10] and SLIDO landslide susceptibility and inventory [11, 27]; and Clatsop County tax lots [48]. Tax-lot owners were grouped; individuals are not named.

Corridor measurements. Shares of flood zone, wetland, tsunami and landslide exposure were computed by overlaying each alignment on the layers above. Stream crossing sites group NHD crossings within about 500 ft (150 m) of one another.

Bypass sketch. The southern section reuses an earlier least-cost path from MP 25 to a high point (about 95 ft) above the hospital. The northern section is a least-cost path on a 33-ft (10-m) grid, constrained to a 60-300 ft hillside band, with penalties for wetlands, FEMA 1% zones, the XXL1 tsunami zone and mapped landslides. It ends at a hillside point next to Lewis and Clark Road and crosses the flats in a straight line. Without the band constraint, the least-cost path either followed the valley floor beside U.S. 101 or detoured far to the east.

Valley floor. Land east of the OpenStreetMap U.S. 101 line, within 1.5 km (about 0.9 mi) of it, and either below 30 ft elevation (DOGAMI lidar) or within the FEMA 1% zone.

Costs. All costs are planning-level estimates built from published unit costs and project benchmarks, adjusted to 2024 dollars with CPI-U [25]. Break-even values divide capital cost by the 50-year annuity factor at each discount rate.

11. Limitations

- **The bypass is a planning sketch, not a design.** Grades, curves, structures and interchange ramps have not been developed. The northern section required manual steering of the least-cost path.
- **All costs are estimates** from published figures; none is an ODOT estimate or bid. Raised sections on fill, land, ramps and landslide stabilization are not priced.
- **The case for the bypass is uncertain.** Cost alone does not justify it, much of the alignment is on landslide-prone ground, and the effect on ODOT's maintenance burden cannot be shown without ODOT data.
- **Cross-street analysis covers only valley-floor segments.** Stream crossings are from NHD. Unnamed channels and ditches are kept as habitat: small channels and roadside or agricultural ditches are often important winter-rearing habitat for juvenile coho and other salmonids [41, 42]. Whether each unnamed line is a ditch or a natural channel was not verified[U], and each crossing needs a field check before its fish-passage design is set. Existing culverts were not inspected[U], and road ownership was not verified[U].
- **Data vintages vary.** The Seaside wetland inventory dates from 1998-2000; FEMA panels became effective in 2010 and 2018; the landslide susceptibility map is regional; and the tsunami maps date from 2013 [4, 5, 10, 11].
- **Not verified:** the lidar vertical datum[U]; the share of through traffic[U]; whether the segment is listed under 23 CFR Part 667[U]; and USDOT benefit-cost values, which were checked against published excerpts because the guidance PDF could not be downloaded directly[U] [45].
- **Delay estimates assume 2002-2009 closure frequency.** The 2013 berm removal likely reduced closures, so the estimate may be high [6, 15].

Conclusion

U.S. 101 through Seaside runs on low ground that floods today, lies almost entirely in the tsunami zone and faces rising seas. Fixing the road at MP 22.5-25 and rebuilding the cross streets as longer, higher crossings would help residents, hospital traffic and travelers whether or not a bypass is ever built, which is why this case study puts them first. A hillside bypass could give the coast a through route largely above flood and tsunami hazard, but it would be expensive, would cross landslide-prone ground and would pay off only if keeping the highway in town costs more than current public figures show. The most useful next step is for ODOT to publish what this segment already costs in repairs and closures, so residents and decision-makers can judge whether a hillside corridor is worth studying and protecting while it is still timberland.

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