

Topanga Surf Quality Impact Assessment

Ashley Ellenson, PhD
David Revell, PhD
Dave Anning, PhD
Kara Scheu, PhD

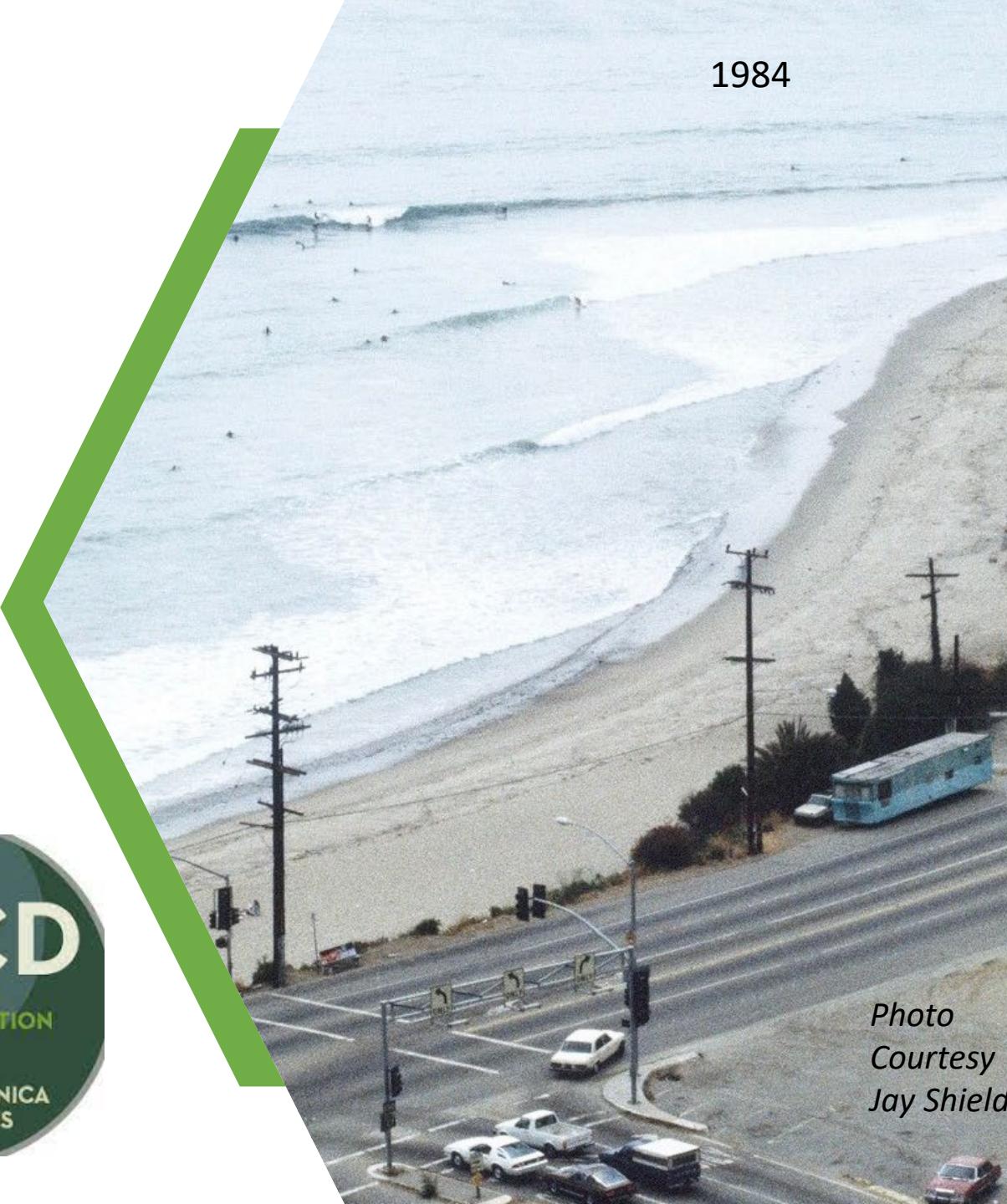


Photo
Courtesy
Jay Shield



Surf Impact Analysis

- › Surfer focus group
 - › Which will have the biggest impact on surf at Topanga Point?
 - › How long after project construction would impacts be felt?

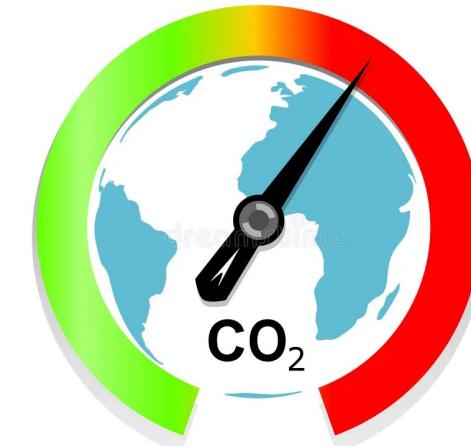
Project



Weather



Sea Level Rise



Presentation Outline

- › Surfability Metrics
- › Method to simulate and quantify metrics
- › Test Cases
- › Results



Assessing Surf Quality



Surfability Metrics

- › Breaking wave height (H_b) – height of the wave at the location of breaking
- › Wave peel angle (α)
- › Ride length



Surfability Metrics

- › Breaking wave height (H_b) – height of the wave at the location of breaking
- › **Wave peel angle (α)**
- › Ride Length





Surf Quality: Measured by Peel Angle





Surf Quality: Measured by Peel Angle



- › **Wave path:** direction wave is travelling



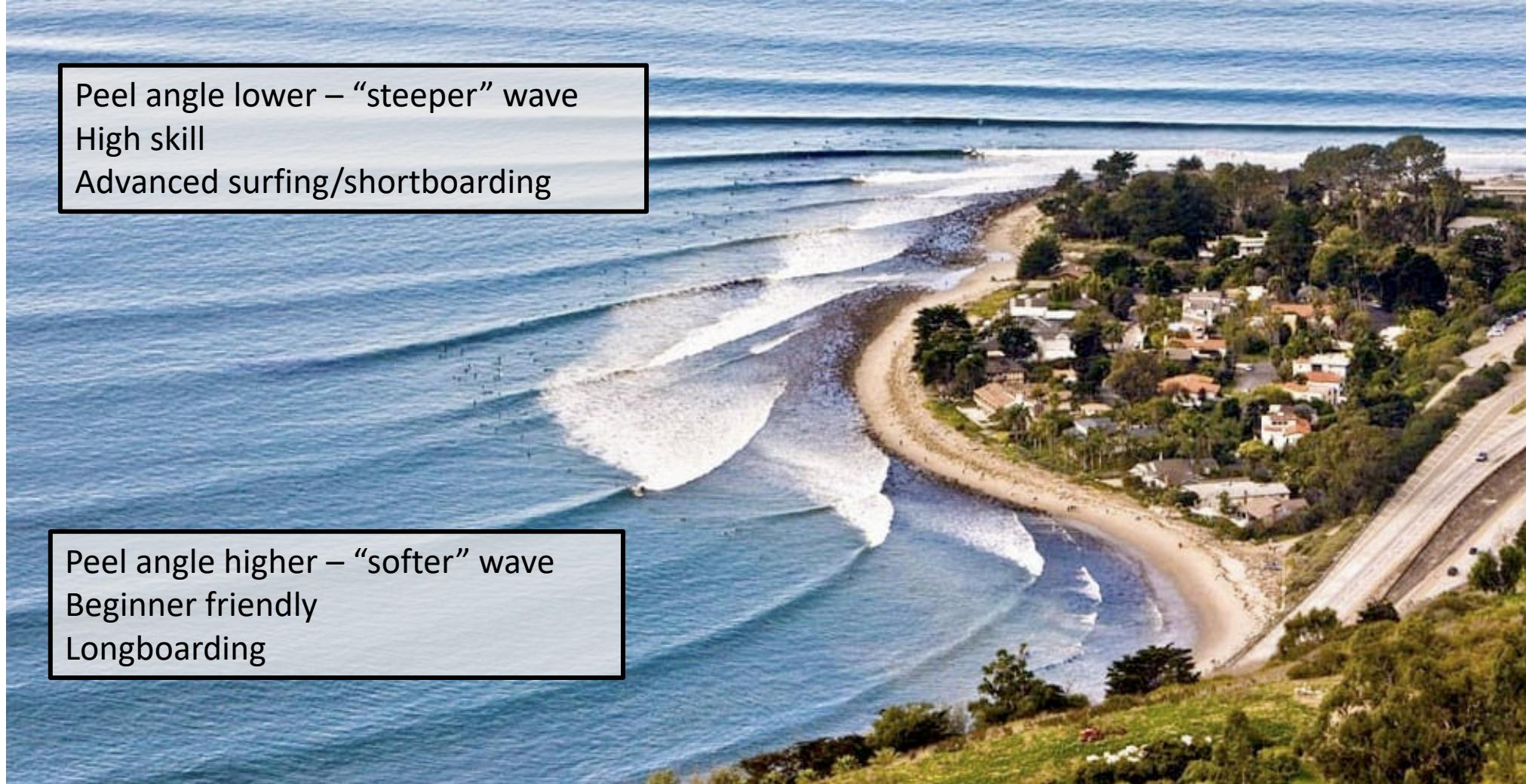
Surf Quality: Measured by Peel Angle



- › **Wave path:** direction wave is travelling
- › **Wave front:** the face of the wave



Surf Quality: Measured by Peel Angle



Simulating Waves



Surfer identified takeoff spot heatmap

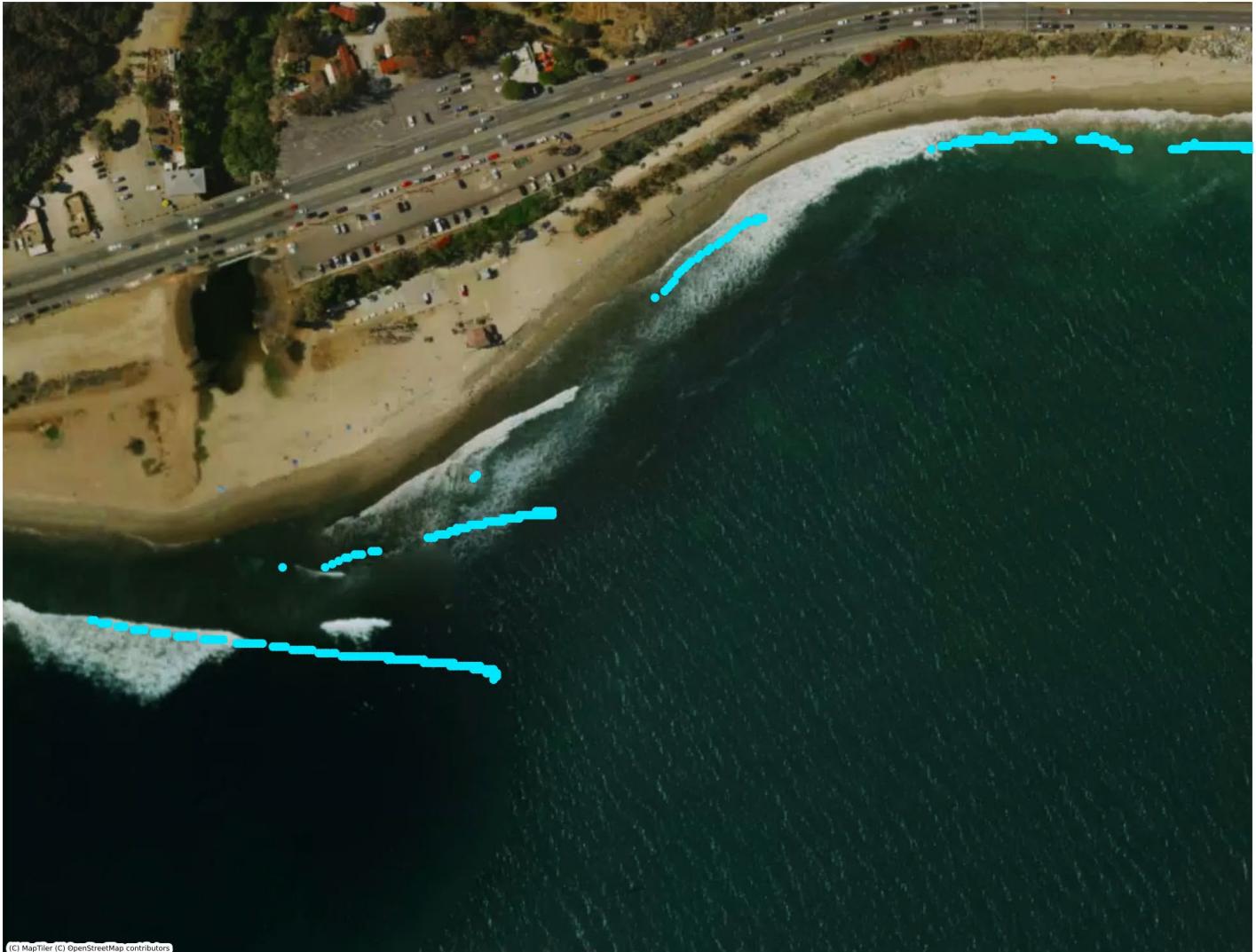


Overview map



Simulating Breaking Waves in XBeach

- Non-hydrostatic waves: simulate wave by wave
- Each wave comes in at a slightly different orientation
- 30 minute run time for each wave case
- Mid tide level



(C) MapTiler (C) OpenStreetMap contributors

Breaking

=



+



+



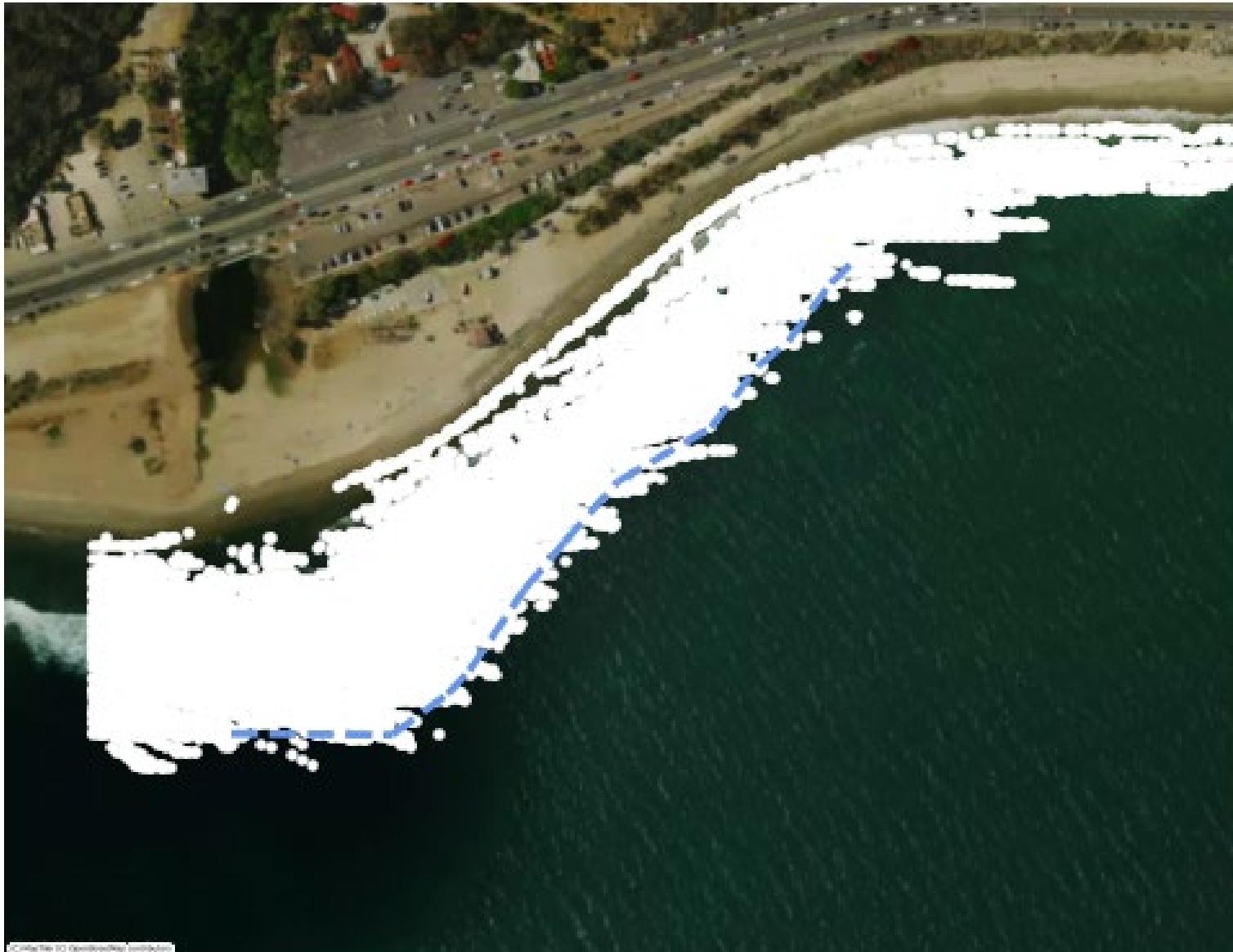
+ ... +



=



Wave Path



Determining Peel Angle

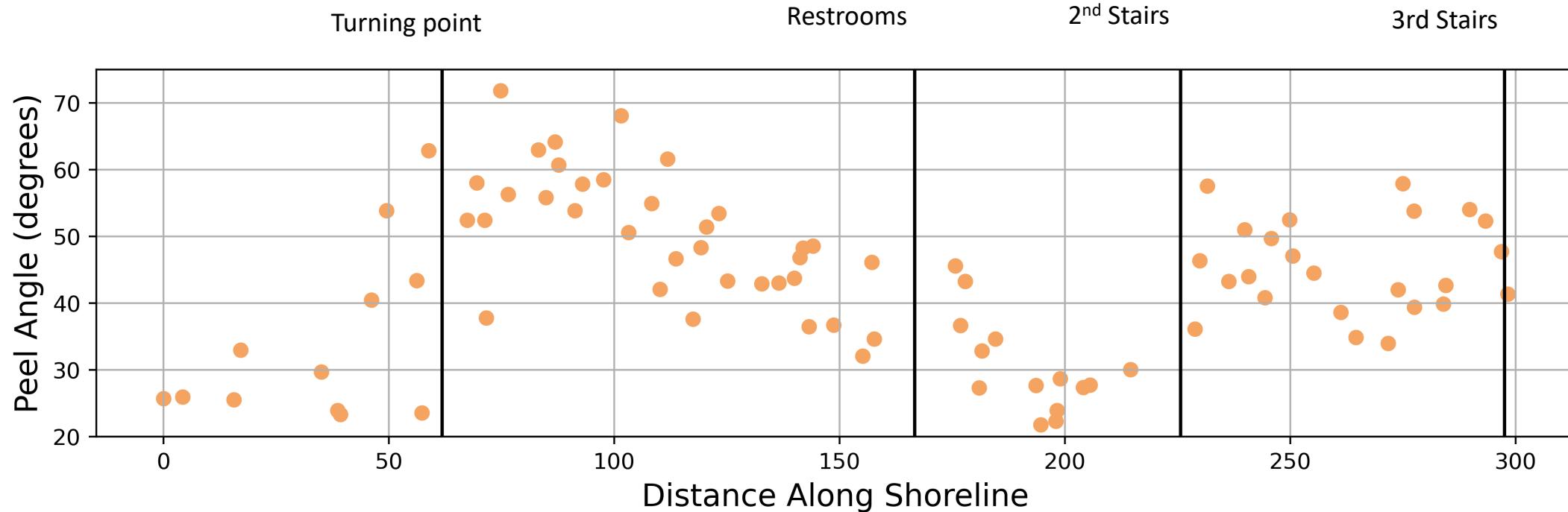
Peel Angle: 70°

- See where waves intersect with wave path
- Caveats:
 - No ride length
 - No breaking height



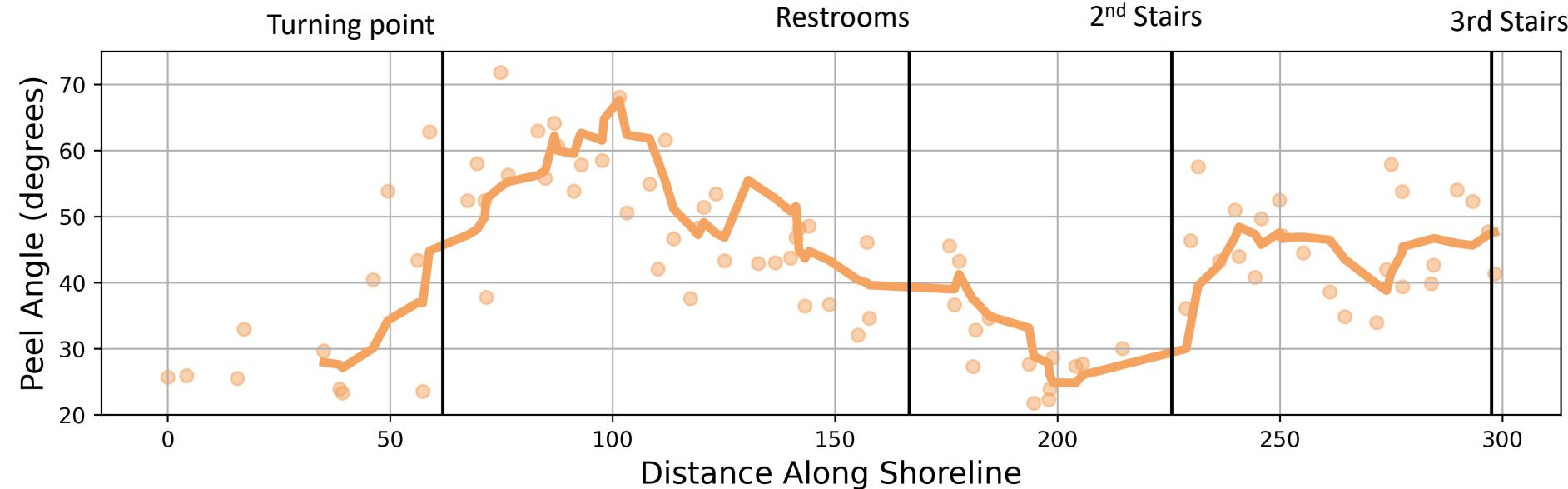


Baseline Conditions



- › Each observation (pink angle) recorded as distance along shoreline

Baseline Conditions



- › Five-point window moving average applied to determine trend

West is best but south too

*200 to 240, 215 is
ideal*

185 to 215 and 260

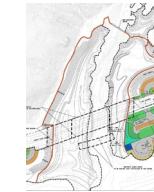
Test Cases

West is best, also NW and Big S/SW





Surf Impact Analysis



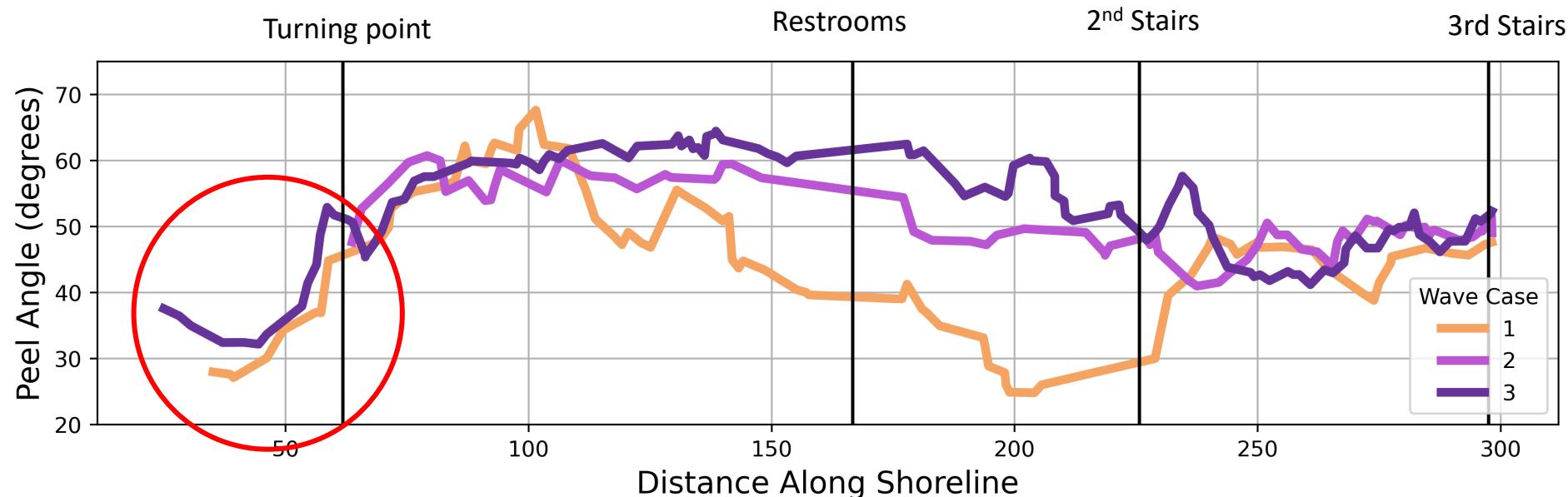
- › Model wave conditions and extract surf metrics
 - › For different weather conditions (wet, dry years)
 - › For different surf conditions (long/short period, south/west)
 - › For different climate conditions (0ft, 1.6ft, 6.6ft)
 - › For different time horizons (post 1 year, post 5 year)
 - › Compare results

= 26 model runs

How do the waves peel today?



Baseline Conditions



- › Peel angle starts steep (fast waves) for all wave conditions

Long Period South

2ft @ 15s @ 230

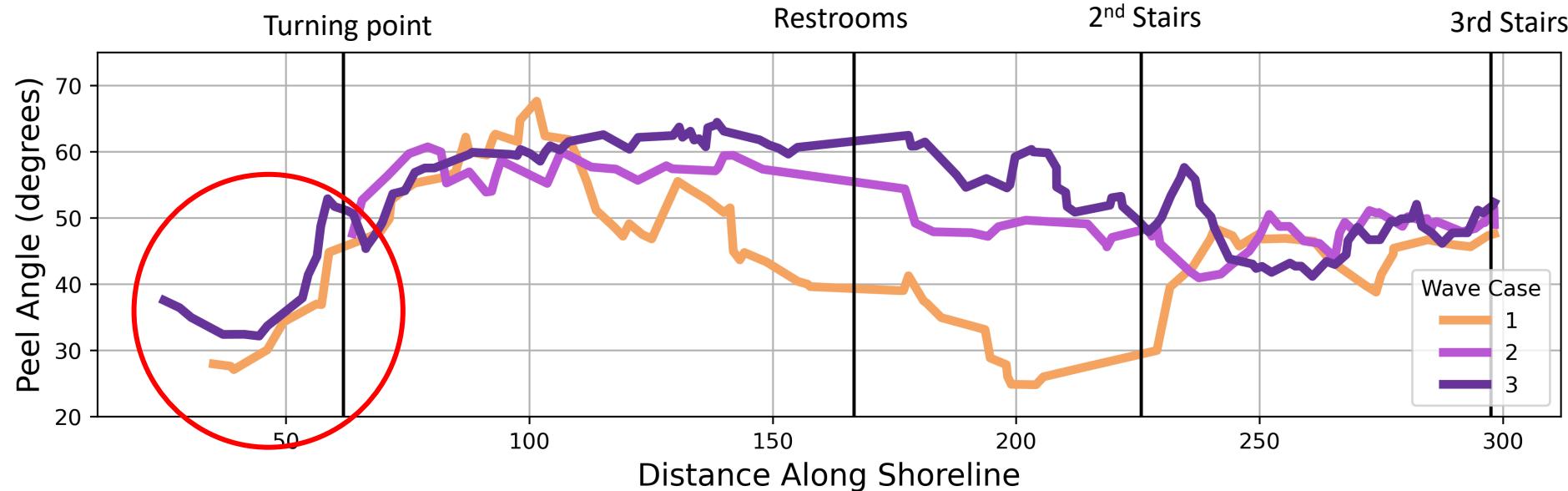
Mid-Period West

4ft @ 11s @ 255

Large Wave Height

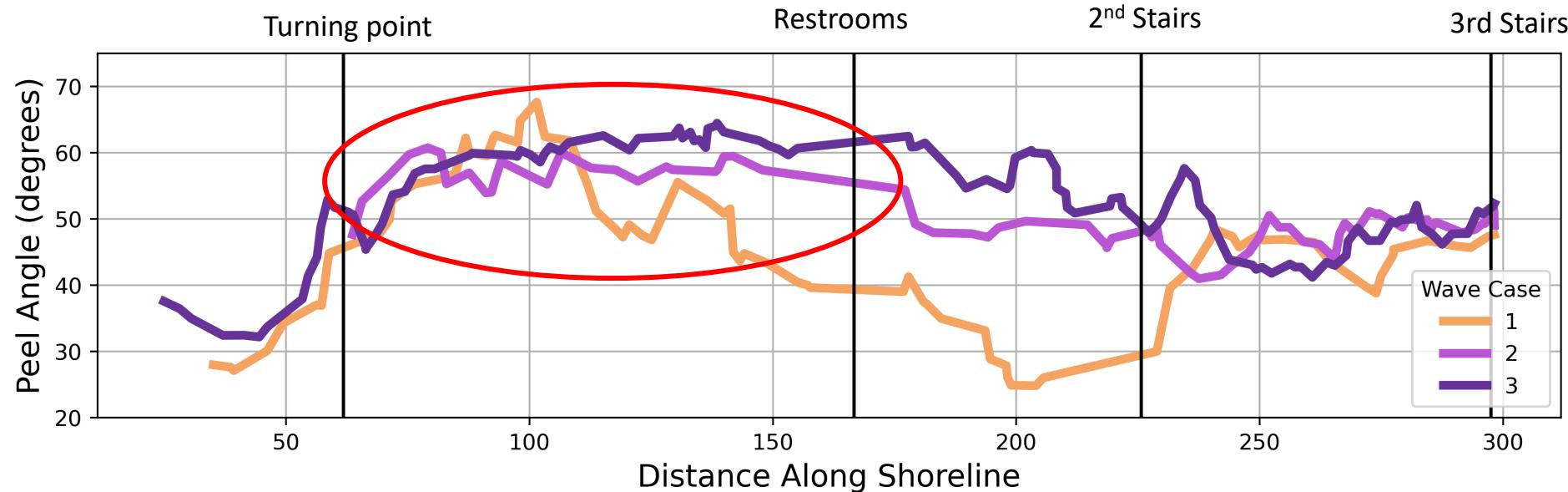
7ft @ 10s @ 260

Baseline Conditions



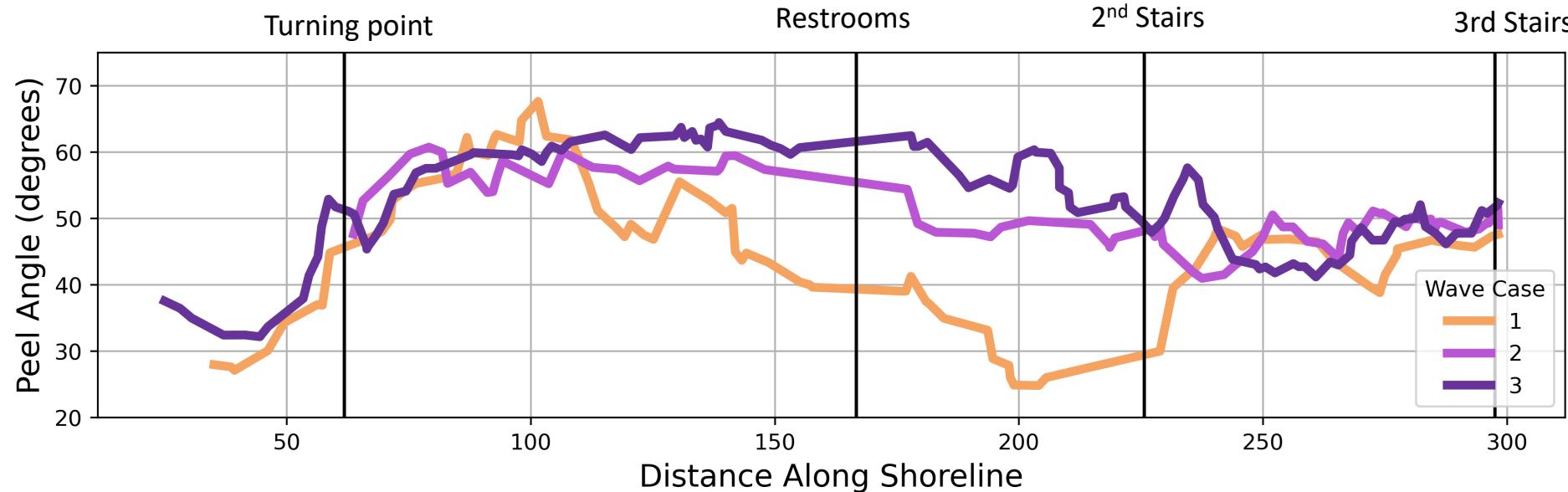
- › Peel angle starts steep (fast waves) for all wave conditions

Baseline Conditions



- › Peel angle starts steep (fast waves) for all wave conditions
- › Increases before restrooms, and then drops between 2nd and 3rd stairs

Baseline Conditions

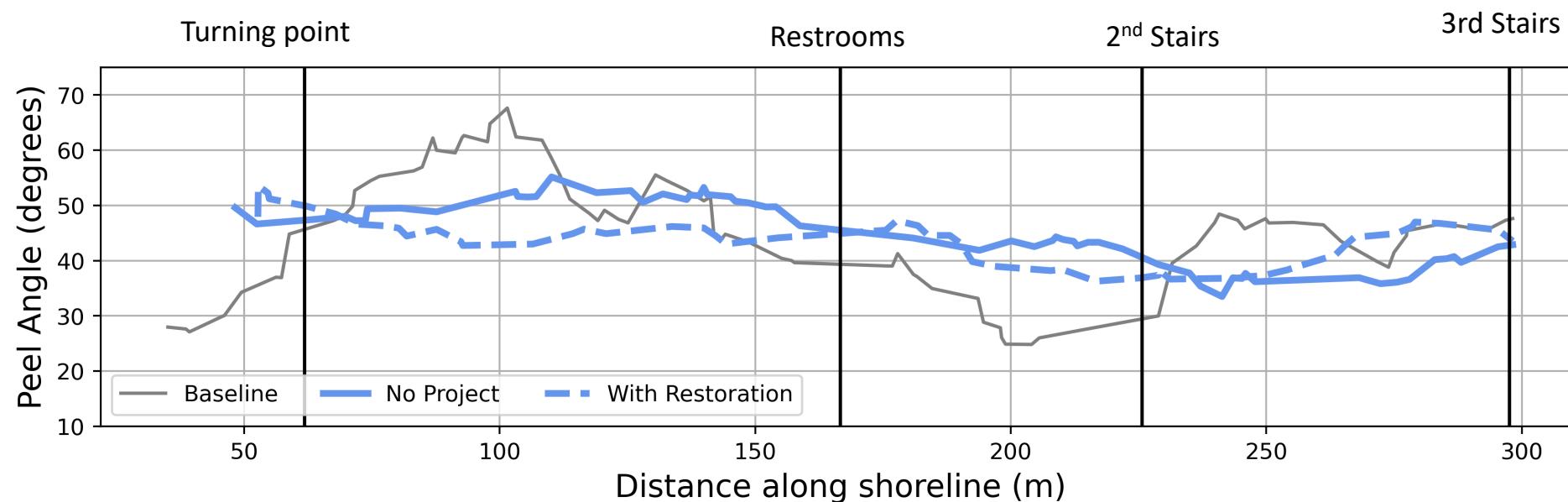


- › South long period swell (orange line) has lowest peel angle (steepest wave)
- › Large mid-period west swell has a similar peel angle to mid mid-period west swell

How is the wave impacted during high creek flow conditions?



Project alternative: Long period, small South Swell, 100 year creek flow, after 1 year



- › Peel angle lower for restoration (steeper wave)

Key Takeaways for Wet Year

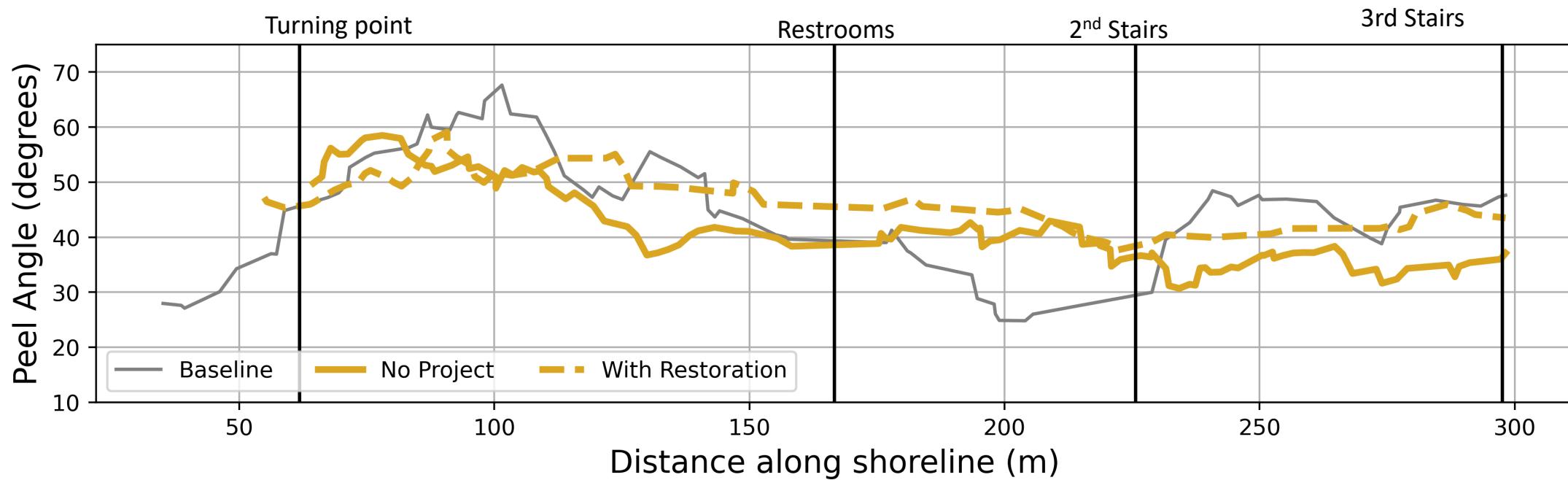
- › Highest impact felt for south period, long swell
 - Overall, project causes waves to have a lower peel angle (steeper wave)
- › Impacts no longer observed after 5 years
- › No impact to peel angle for large west swell



How is the wave impacted during drought conditions?



Project alternative: Long period, small South Swell, drought conditions, after 1 year



- Peel angle higher for project conditions

Key Takeaways for Dry Year

- › Mostly consistent with wet year
- › Project makes wave have a higher peel angle (softer wave)



All tides but poor quality at extremes

from 0. to 5.5 ft

How is the wave impacted by sea level rise?

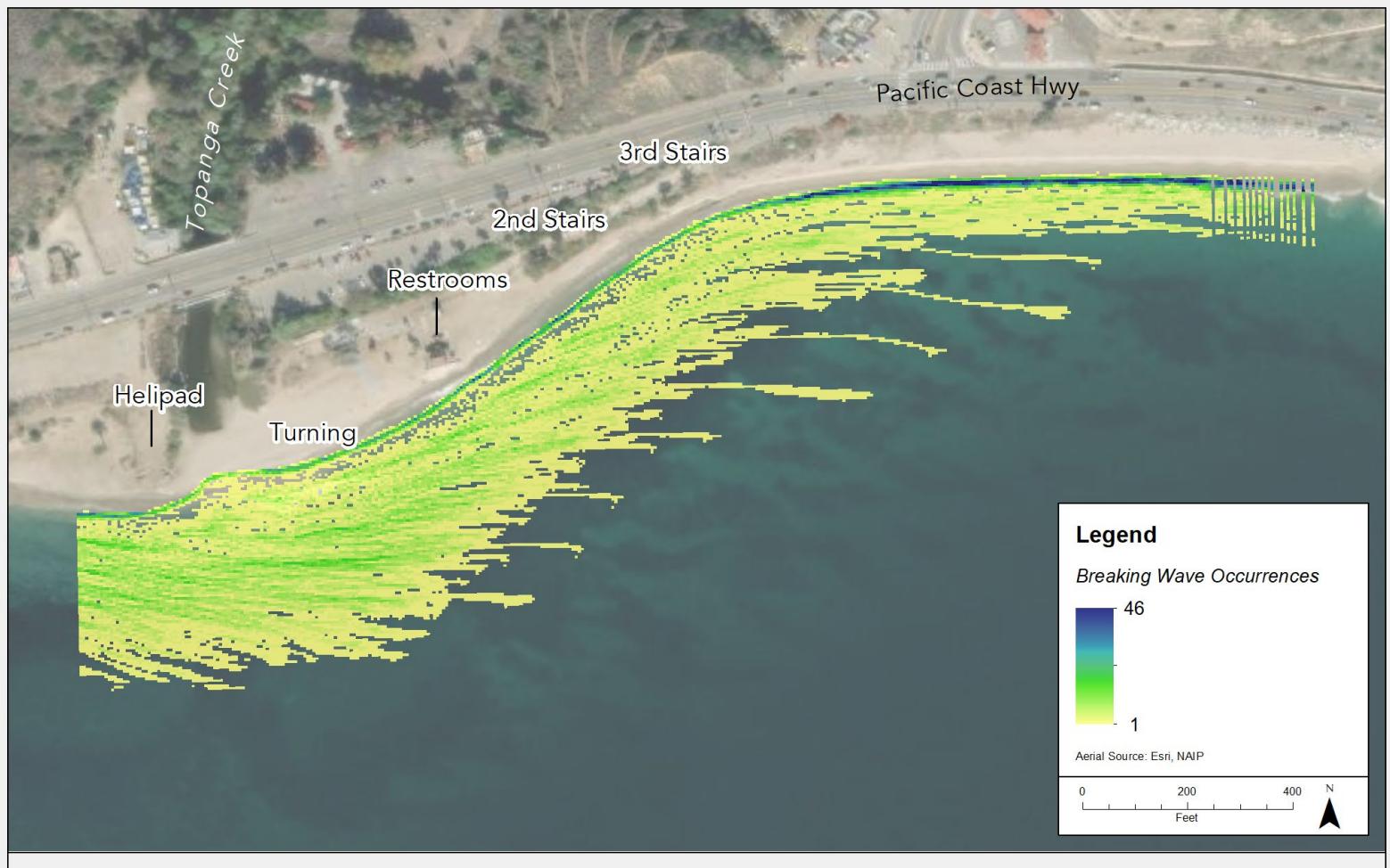
2-5 feet depending on swell

Any tide height, but best between 2-6'



Sea Level Rise 1.6 ft ~ 2045

- South long period swell
- SLR of 1.6 ft not much change; equivalent to waves breaking on high tide
- SLR of 6.6ft sees waves breaking in the mouth and over the shoreline



SLR 6.6 ft: ~2100



- For higher wave heights, SLR of 6.6ft sees waves breaking in the mouth and over the existing beach

Conclusions

- Sea level rise has the largest impact on surf quality
- Highest impact on south period swell after 1 year, project impacts no longer felt after 5 years
 - After a wet year, project causes wave to be slightly steeper
 - After a dry year, project causes wave to be slightly softer
- Differences between project alternatives occur primarily between takeoff location and restroom



integral

Ashley Ellenson, PhD.

(831) 576-2866

aellenson@integral-corp.com



Key Takeaways for Wet Year

- › Highest impact felt for south period, long swell
 - Overall, project causes waves to have a lower peel angle (steeper wave)
- › Impacts no longer observed after 5 years
- › No impact to peel angle for large west swell



Wave Scenarios

Wave Conditions

Long Period South

2ft @ 15s @ 230

Mid-Period West

4ft @ 11s @ 255

Large Wave Height

7ft @ 10s @ 260

Tide Conditions

Tide Constant

3' (mid-tide)

For different weather, climate conditions and time horizons

Weather Conditions

Wet

100 Year Storm

Dry

Drought



Time

1 Year

5 Year

Climate: Sea Level Rise

0 ft

1.6 ft

6.6 ft

Wave Scenarios

Wave Conditions

Long Period South

2ft @ 15s @ 230

Mid-Period West

4ft @ 11s @ 255

Large Wave Height

7ft @ 10s @ 260

Tide Conditions

Tide Constant

3' (mid-tide)



For different weather, climate conditions and time horizons

Weather Conditions

Wet
100 Year Storm

Dry
Drought



Time

1 Year
5 Year

Climate: Sea Level Rise

0 ft
1.6 ft
6.6 ft



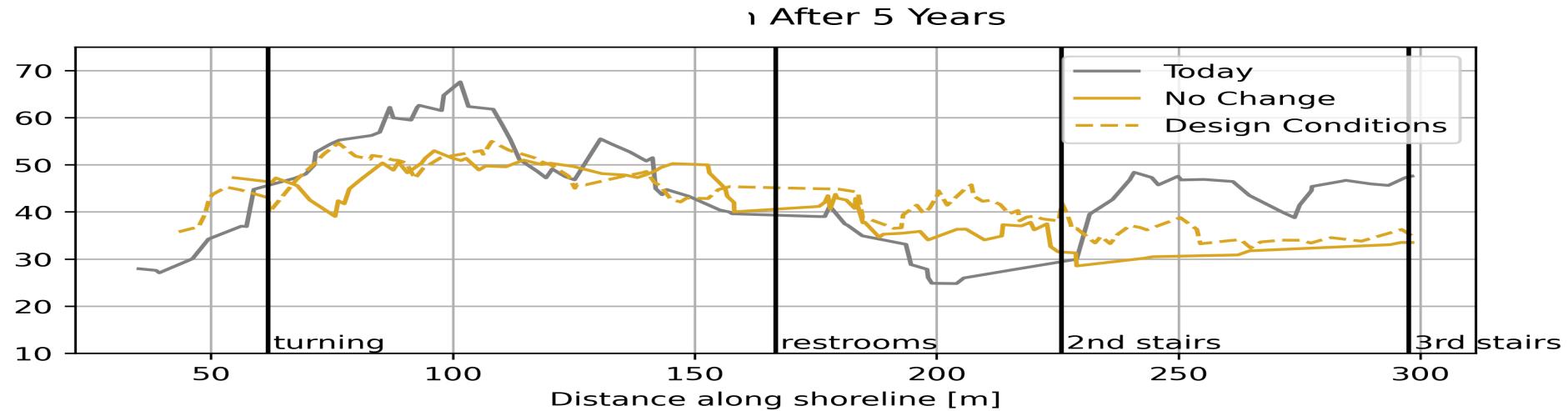
Final Scenarios

- › Choose the most impactful restoration alternative
- › Use bathymetry changes provided by Moffat and Nichol
- › Project restoration alternative 2
 - Dry Year – 1 year, 5 year - three wave cases
 - Wet Year – 1 year, 5 year – three wave cases
 - SLR 1.6, 6.6 ft – one wave case (South long period)

= 26 model runs

Long period, small South Swell, Drought

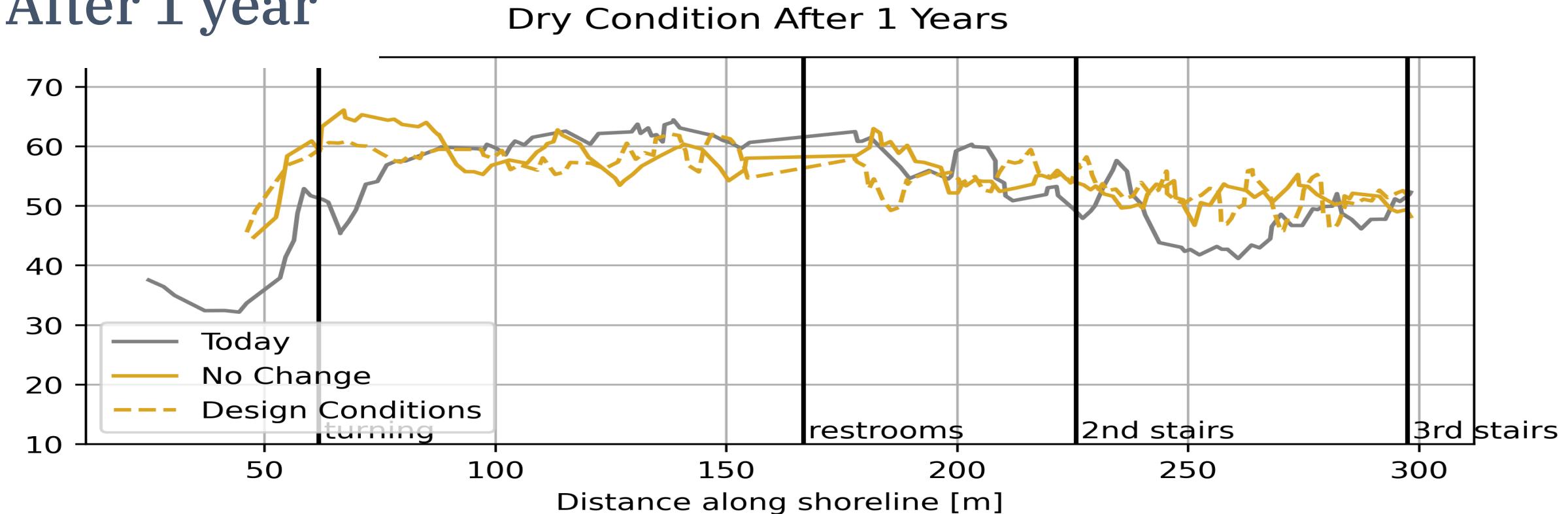
After 5 years



- Project impact is no longer felt between turning point and restrooms
- Angle remains slightly higher between restrooms and 3rd stairs

Big West Swell, Drought

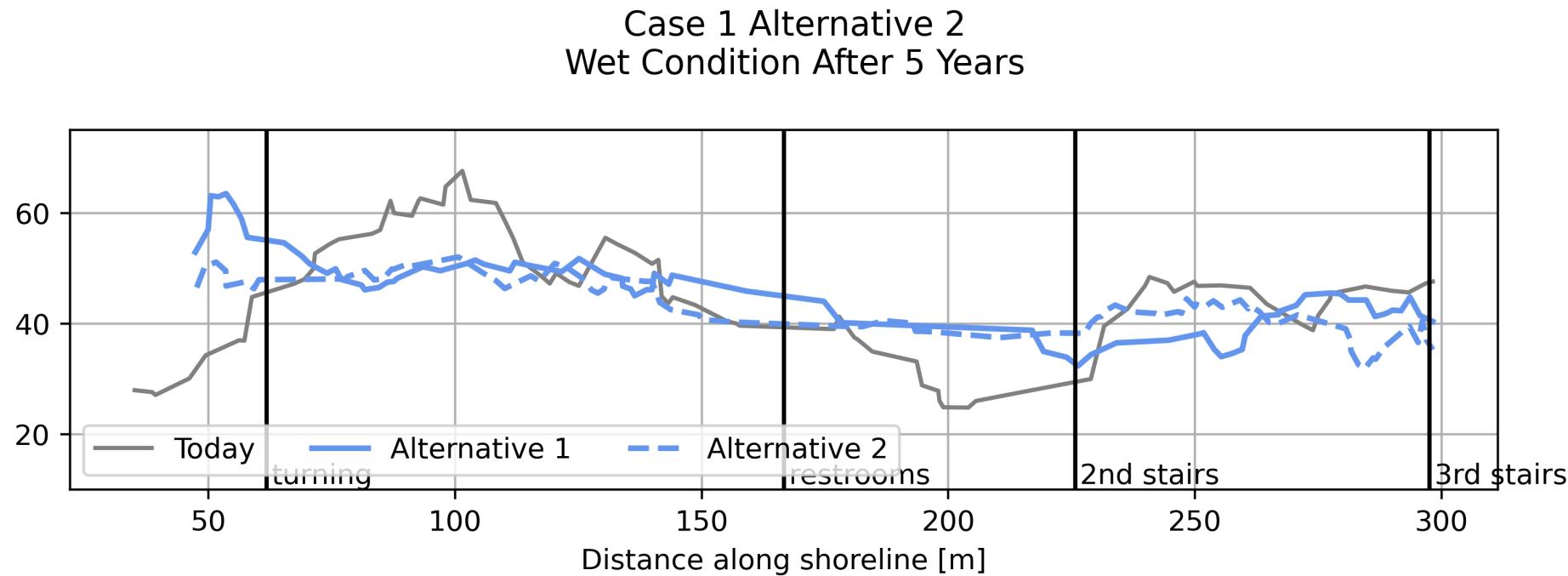
After 1 year



- Larger wave case does not see as much difference

Long period, small South Swell, 100 year creek flow

After 5 years

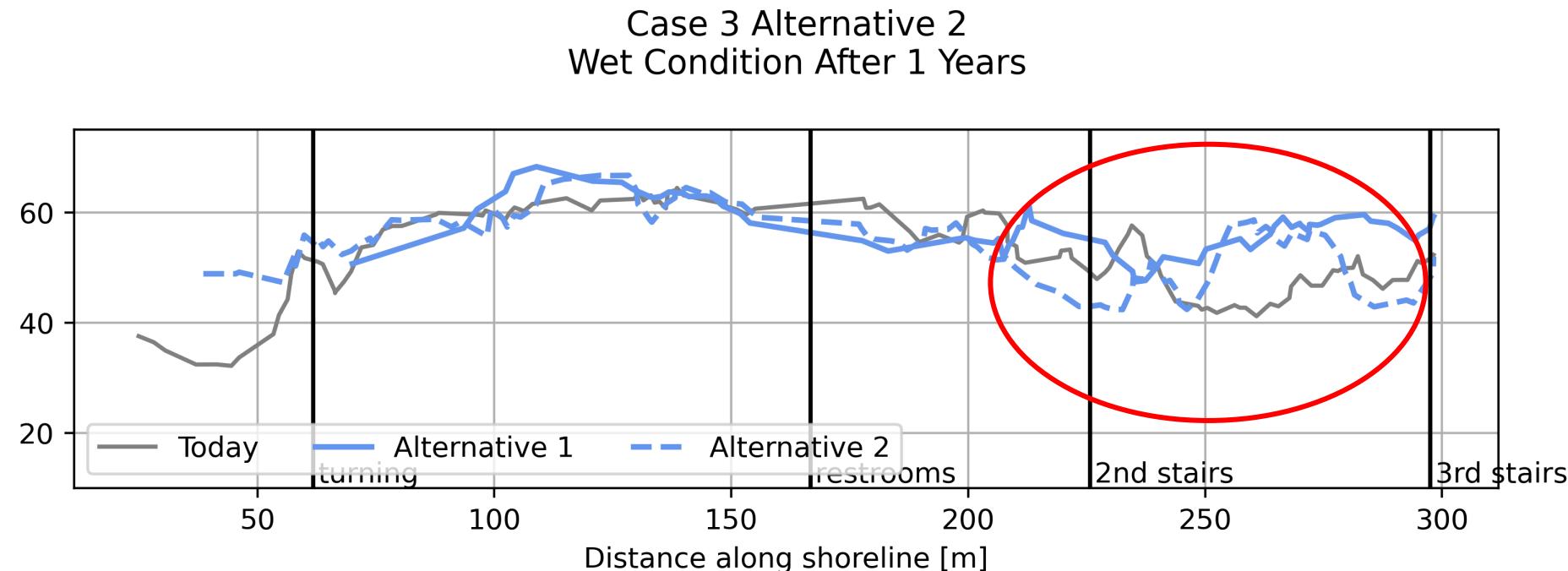


- › After 5 years, the wave is no longer impacted by the project



Big West Swell, 100 year creek flow

After 1 year



- Larger wave case does not see as much impact, except towards the end of the wave where peel angle is higher
- Didn't need to look at 5 since no change