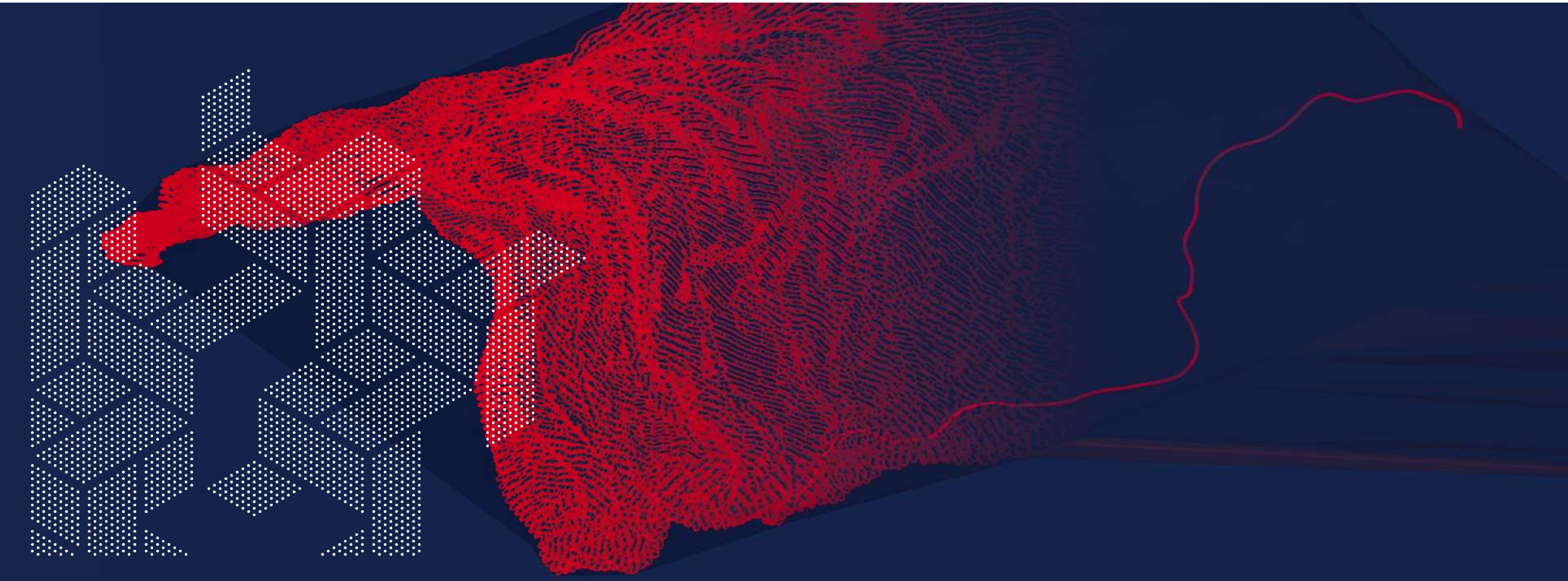
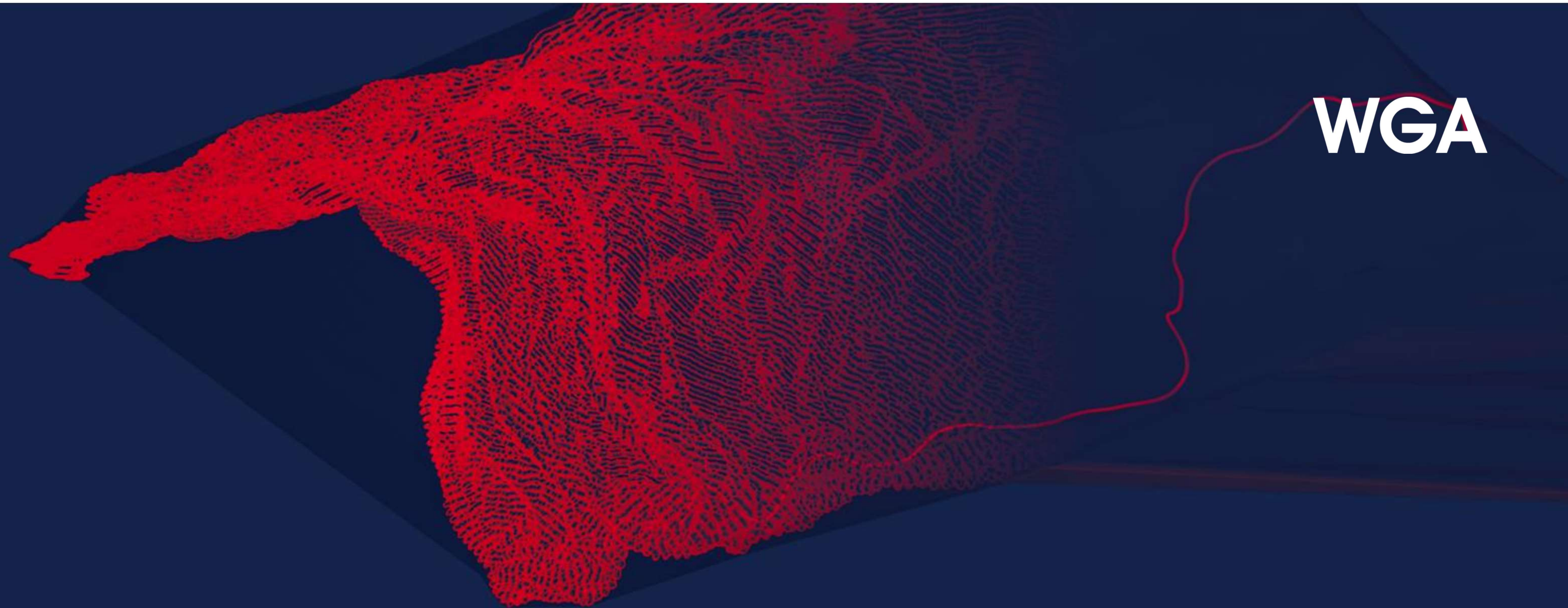


WGA

3D SNAPBACK VISUALISATION MODELS FOR IMPROVED PORT SAFETY – JORDAN BUTLER & LINDSAY ADCOCK

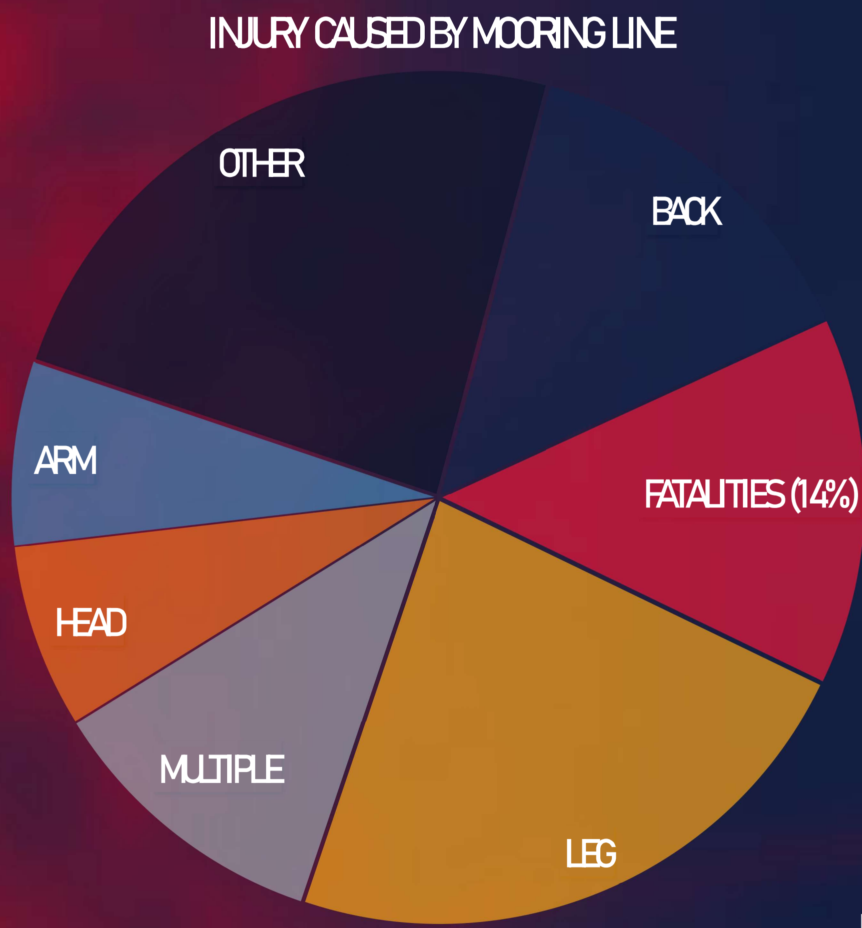
28/08/2024



WGA

"1 IN 7 SNAPBACK INCIDENTS THAT INJURES A PERSON RESULTS IN A FATALITY."

UK P&I CLUB, 2009

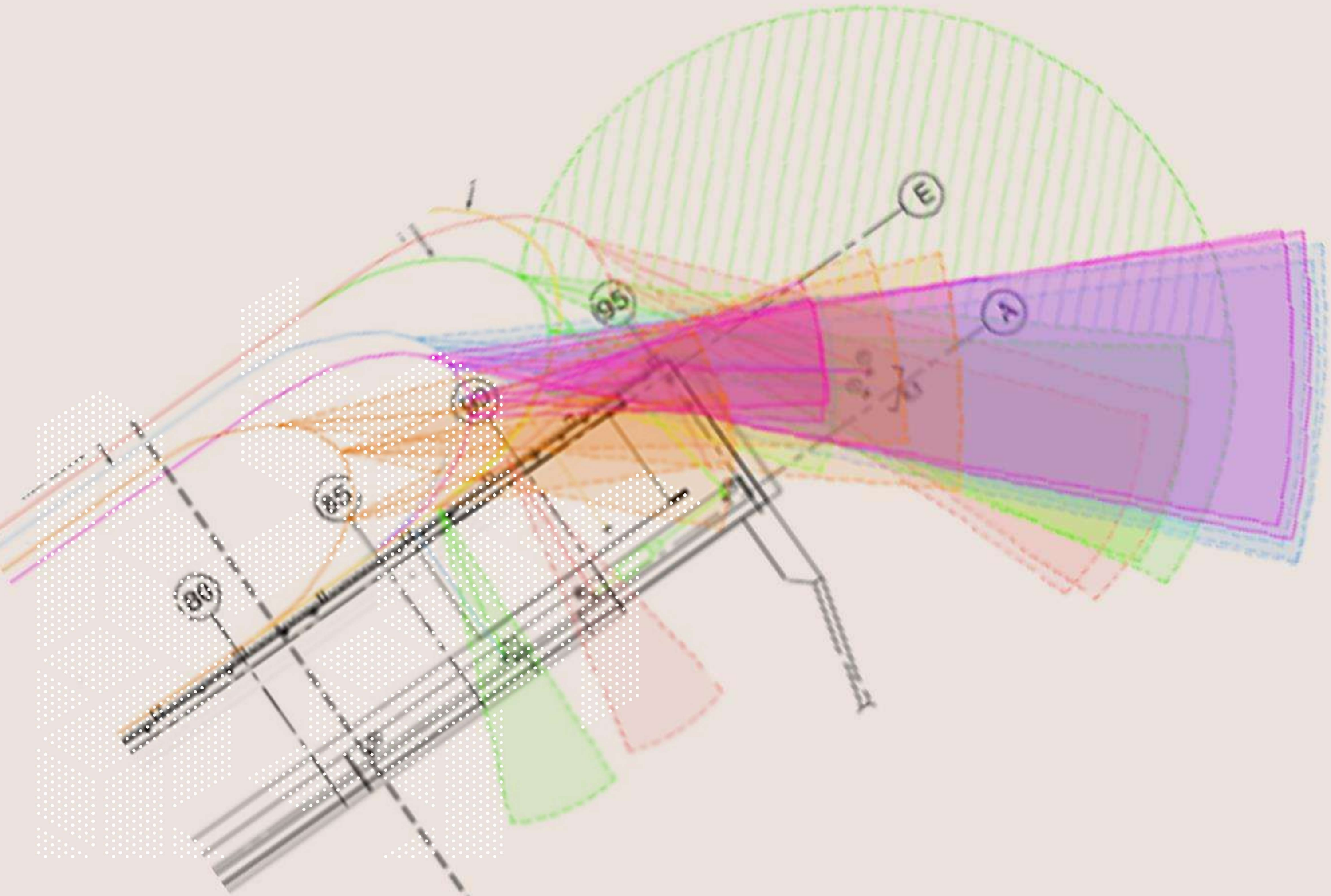


UK P&I CLUB, 2009

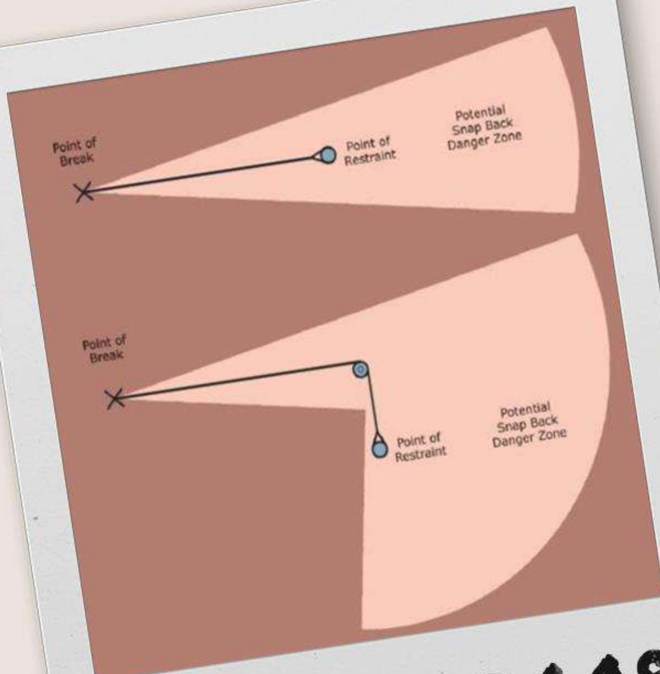
WGA


WGA
28/08/2024
IMAGE GENERATED USING AI

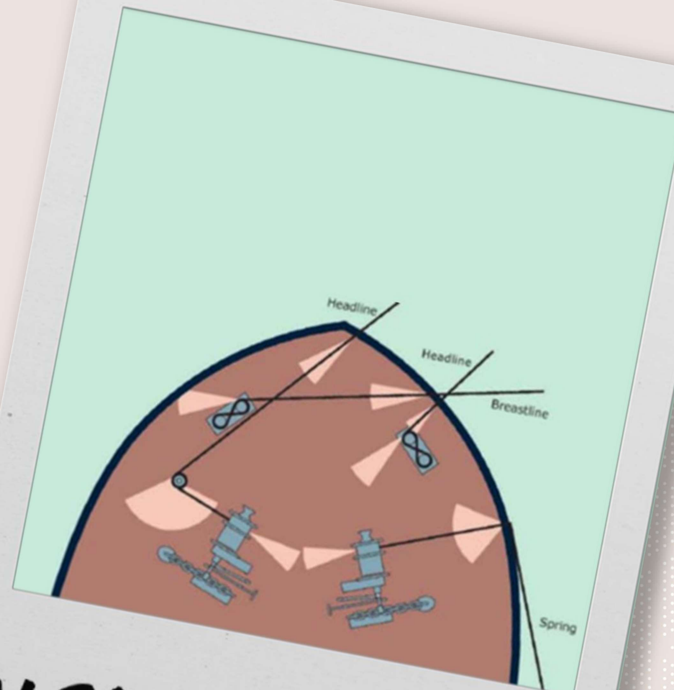
WGA



IN 2019, THIS IS WHAT A SNAPBACK ZONE LOOKED LIKE



MEG3 - 2008



ALSO MEG3 - 2008

MEG 3 WAS INTENDED FOR VESSELS,
NOT THE BERTHS THEY VISIT.

PORTS ARE DYNAMIC.

DRAWINGS ARE NOT.

WGA

You may remember us from such papers as:

- PIANC APAC 2022, “Breaking Point – Understanding the Dynamics of Parted Mooring Lines and Protection Barriers” – Butler, WGA
- PIANC APAC 2022, “Mooring Line Barriers – Better Understanding the Risks We’re Mitigating” – Deussen, WGA
- Australasian Coasts and Ports 2023, “Loose Ends: Computational Modelling of Snapback Paths” – Butler, WGA
- 35th PIANC World Congress 2024, “Snapback to The Future: New Methods for Parted Mooring Line Analysis” – Butler, WGA

AND PIANC WG 251

WGA

PIANC
The World Association for
Waterborne Transport Infrastructure

Maritime Navigation Commission

MarCom

WG 251

GUIDANCE ON THE DESIGN OF PARTED MOORING LINE ARRESTING SYSTEMS

PROPOSED TECHNICAL WORKING GROUP

TERMS OF REFERENCE

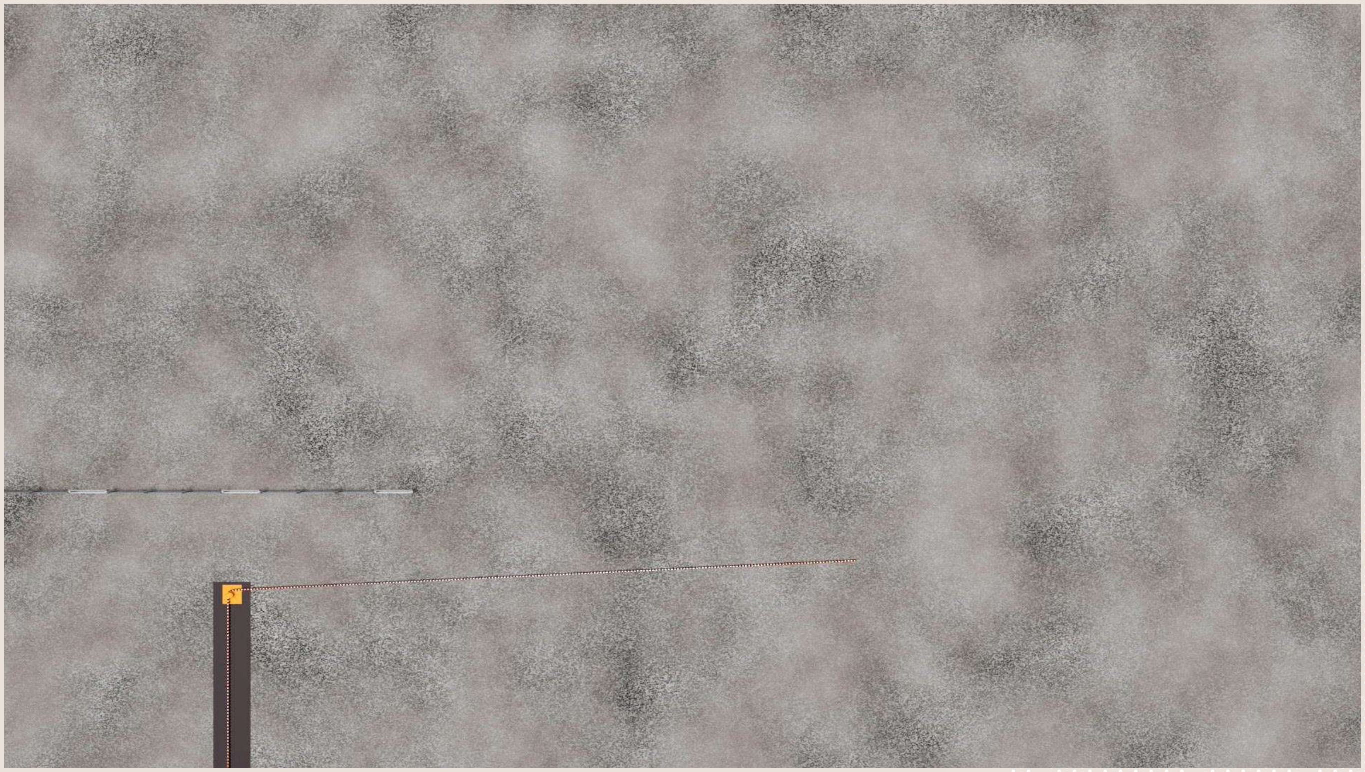
1. Historical Background Definition of the problem

Parted mooring lines are a frequent occurrence at ports around the world and present a significant risk to personnel at these ports. It is estimated that 1 in 7 interactions between personnel and parted mooring lines results in a fatality. Further, it is estimated that Australian ports see a fatality due to parted mooring lines approximately once every 5 years.

WGA

HOW DO WE UNLOCK THE VALUE OF IMPROVED SNAPBACK MODELLING?

SNAPBACK PATH ANALYSIS IS A POWERFUL TOOL



...BUT THE AMOUNT OF DATA IT CONTAINS IS MASSIVE:

Imagine a Bulk Export Facility:

- 4 Berths
- 4 Sizes of Bulk Carrier
- 3 Tides and Vessel Ballast Conditions
- 9 Possible Mooring Arrangements
- 2 Failure Points (Winch, Fairlead)
- 16 Mooring Lines

IF WE PRINTED ALL OF THE SNAPBACK PATH ANALYSIS DATA AT SIZE 12 FONT ON A4 SHEETS OF PAPER, HOW TALL WOULD THE STACK OF PAGES BE?

WGA

IF WE PRINTED ALL OF THE SNAPBACK PATH ANALYSIS IS DATA AT SIZE 12 FONT ON A4 SHEETS OF PAPER, HOW TALL WOULD THE STACK OF PAGES BE?

A:	AS TALL AS A LABRADOR	0.6 m
B:	AS TALL AS THE AVERAGE ADULT MALE	1.75 m
C:	AS TALL AS THE STATUE OF LIBERTY	92 m
D:	AS TALL AS MOUNT EVEREST	8,849 m

THE CORRECT ANSWER IS…

NONE OF THE ABOVE

WGA

IT WOULD REACH THE INTERNATIONAL SPACE STATION.

WGA

WE WERE FACED WITH QUITE THE CHALLENGE:

Problem Statement:

CLIENTS NEED A WAY TO VISUALISE SNAPBACK RISK, BUT DRAWINGS DO NOT CAPTURE THE CHANGES IN CONDITIONS THAT OCCUR IN REAL LIFE, AND SNAPBACK PATH MODELS CONTAIN TOO MUCH DATA TO BE EASILY UNDERSTOOD.

WE WERE FACED WITH QUITE THE CHALLENGE:

WHAT IS THE MINIMUM AMOUNT OF INFORMATION NEEDED TO ACCURATELY CONVEY SNAPBACK RISK?

METHODOLOGY:

1. CALCULATE THE SNAPBACK PATH MODELS
   (125,000 MODELS FOR PREVIOUS EXAMPLE)

2. SORT THE DATA INTO GROUPS OF SIMILAR TYPES
   (I.E. ALL FAIRLEAD FAILURES FOR A GIVEN BREAST LINE)

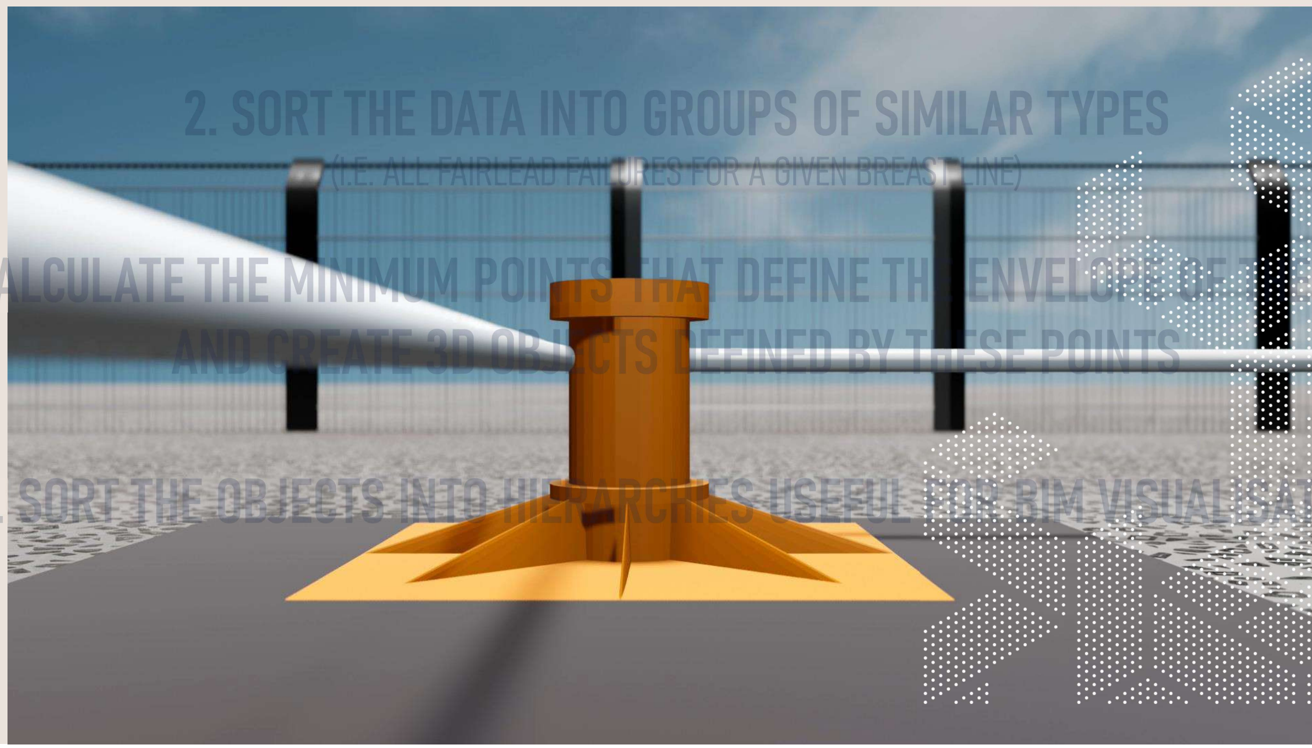
3. CALCULATE THE MINIMUM POINTS THAT DEFINE THE ENVELOPE OF THE PATH, AND CREATE 3D OBJECTS DEFINED BY THESE POINTS

4. SORT THE OBJECTS INTO HIERARCHIES USEFUL FOR BIM VISUALISATION

METHODOLOGY:

1. CALCULATE THE SNAPBACK PATH MODELS

(125,000 MODELS FOR PREVIOUS EXAMPLE)



2. SORT THE DATA INTO GROUPS OF SIMILAR TYPES

(I.E. ALL FAIRLEAD FAILURES FOR A GIVEN BREAST LINE)

3. CALCULATE THE MINIMUM POINTS THAT DEFINE THE ENVELOPE OF THE PATH, AND CREATE 3D OBJECTS DEFINED BY THESE POINTS

4. SORT THE OBJECTS INTO HIERARCHIES USEFUL FOR BIM VISUALISATION

WGA

METHODOLOGY:

2. SORT THE DATA INTO GROUPS OF SIMILAR TYPES

(I.E. ALL FAIRLEAD FAILURES FOR A GIVEN BREAST LINE)

VESSEL CLASS_BERTH_TIDE_FAILURE LOCATION_MOORING CONFIGURATION_LINE

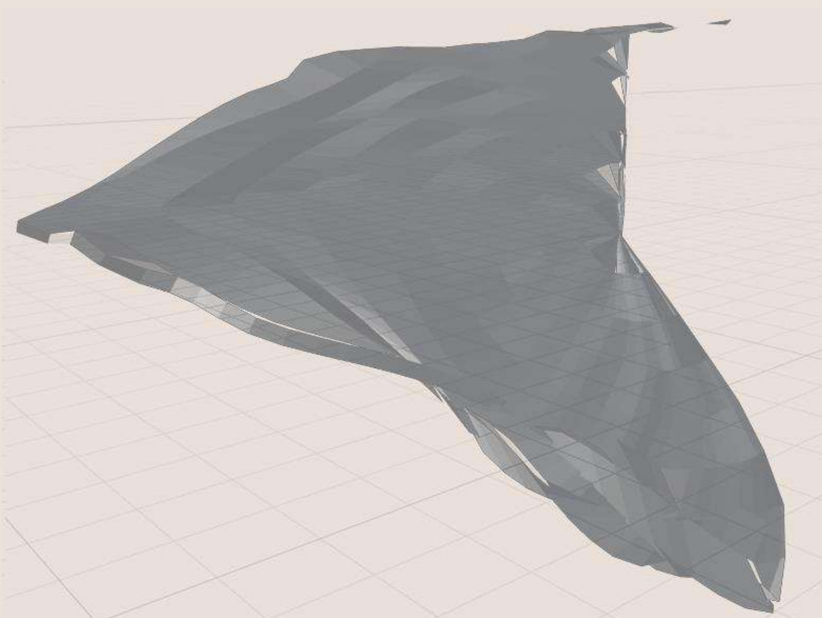
METHODOLOGY:

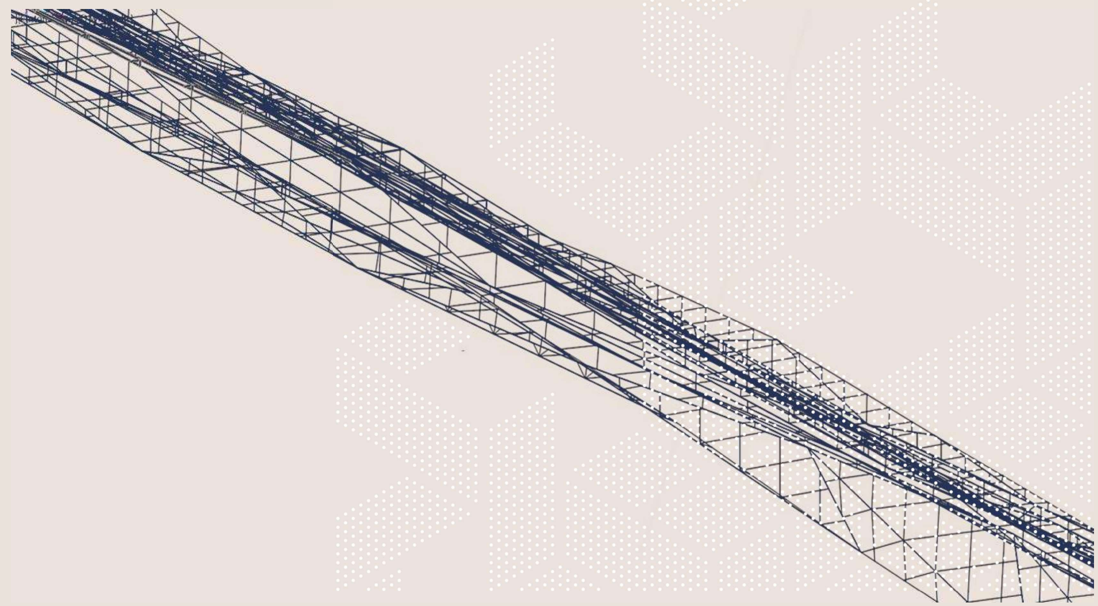
3. CALCULATE THE MINIMUM POINTS THAT DEFINE THE ENVELOPE OF THE PATH, AND CREATE 3D OBJECTS DEFINED BY THESE POINTS

METHODOLOGY:

3. CALCULATE THE MINIMUM POINTS THAT DEFINE THE ENVELOPE OF THE PATH, AND CREATE 3D OBJECTS DEFINED BY THESE POINTS

ATTEMPT 1: NODE-TO-NODE ALGORITHMS

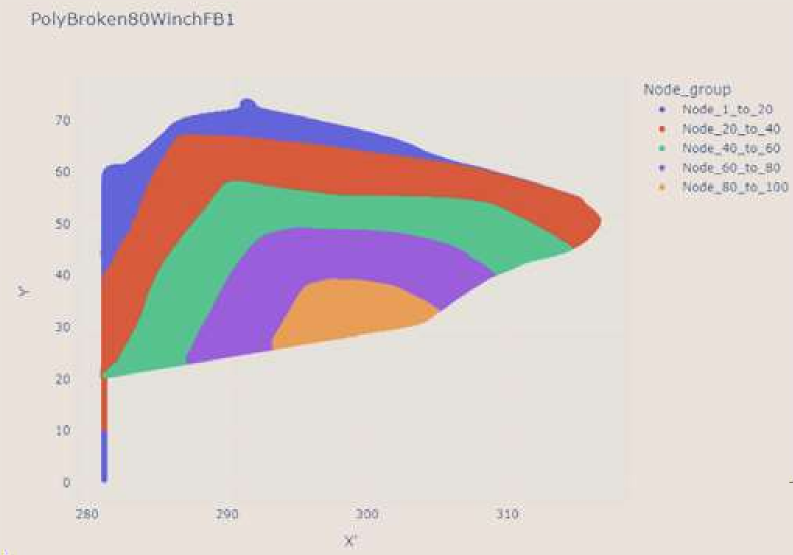


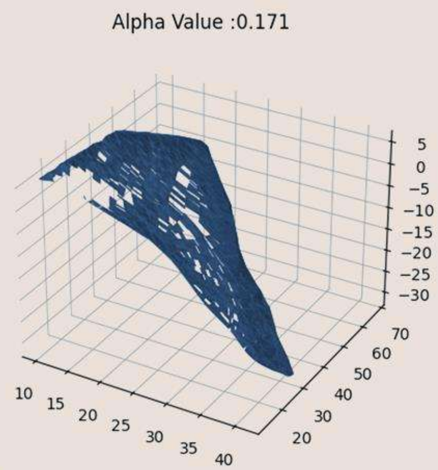


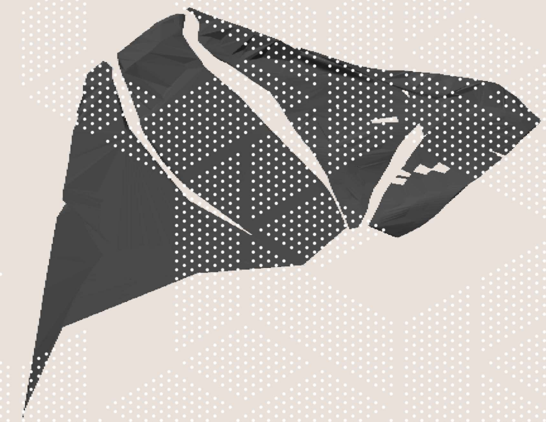
METHODOLOGY:

3. CALCULATE THE MINIMUM POINTS THAT DEFINE THE ENVELOPE OF THE PATH, AND CREATE 3D OBJECTS DEFINED BY THESE POINTS

ATTEMPT 2: ALPHA HULLS





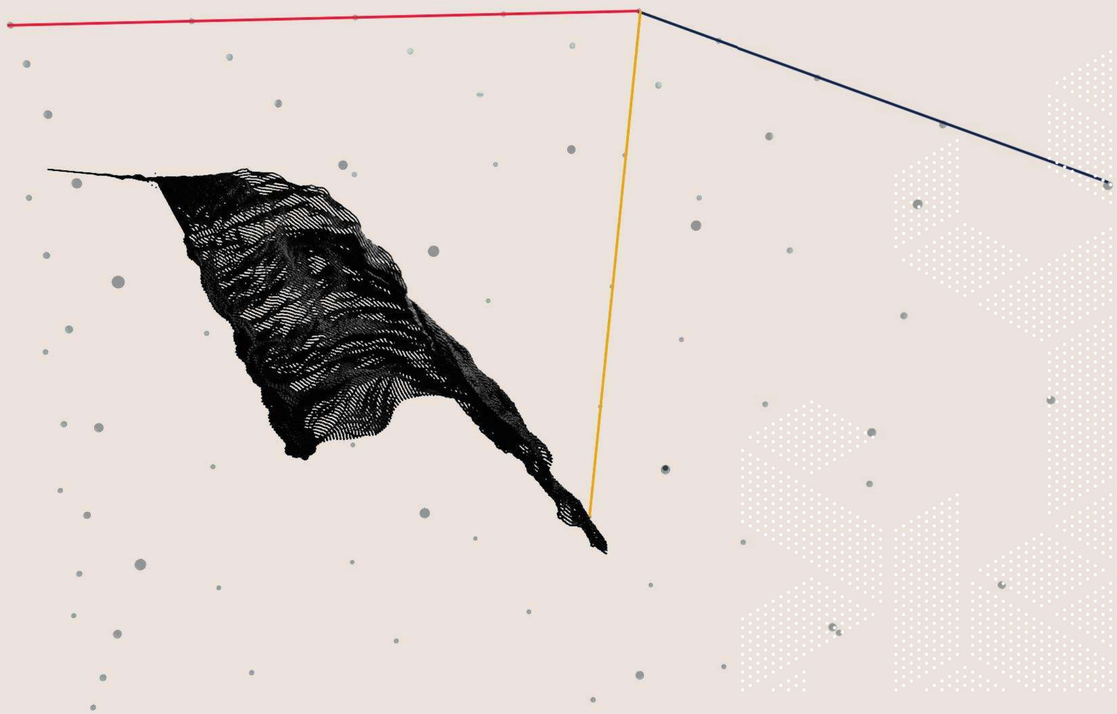


METHODOLOGY:

...BUT THEN, WE HAD A SIMPLER IDEA...

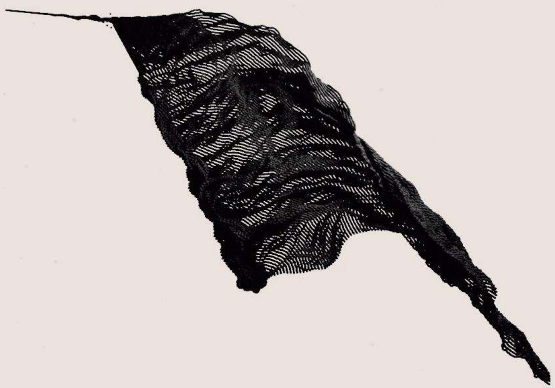
METHODOLOGY:

3. CALCULATE THE MINIMUM POINTS THAT DEFINE THE ENVELOPE OF THE PATH, AND CREATE 3D OBJECTS DEFINED BY THESE POINTS



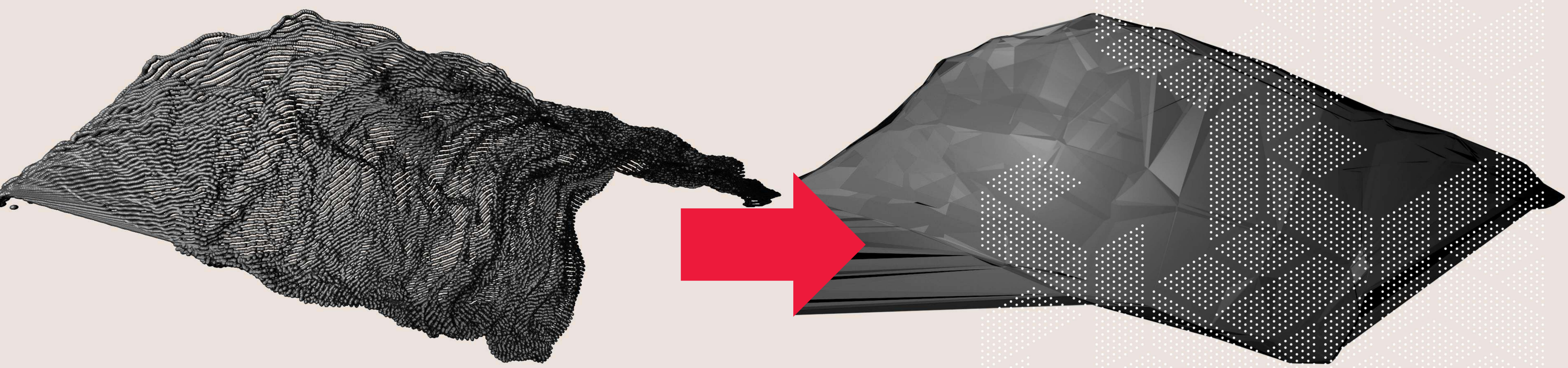
METHODOLOGY:

3. CALCULATE THE MINIMUM POINTS THAT DEFINE THE ENVELOPE OF THE PATH, AND CREATE 3D OBJECTS DEFINED BY THESE POINTS



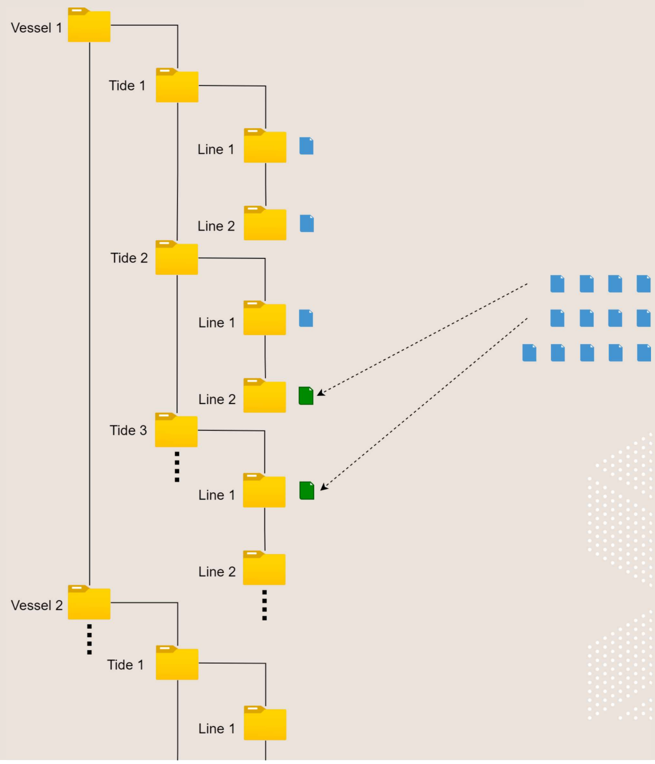
METHODOLOGY:

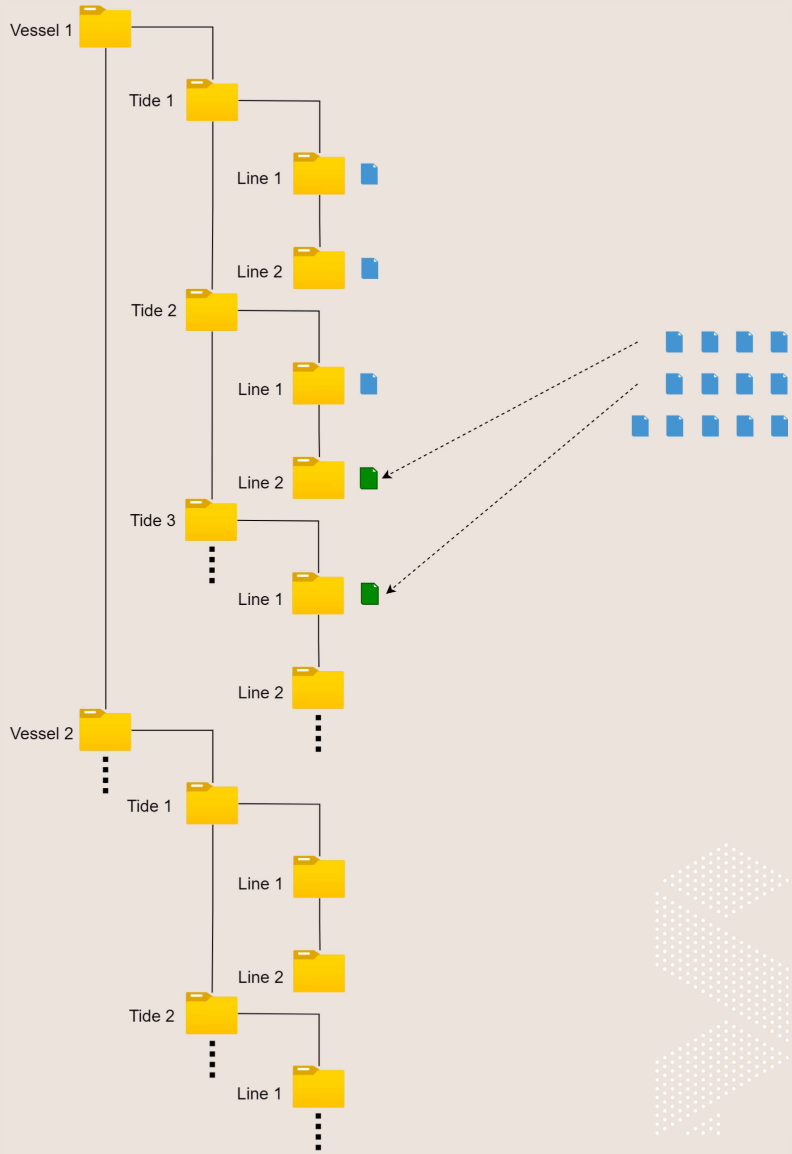
3. CALCULATE THE MINIMUM POINTS THAT DEFINE THE ENVELOPE OF THE PATH, AND CREATE 3D OBJECTS DEFINED BY THESE POINTS

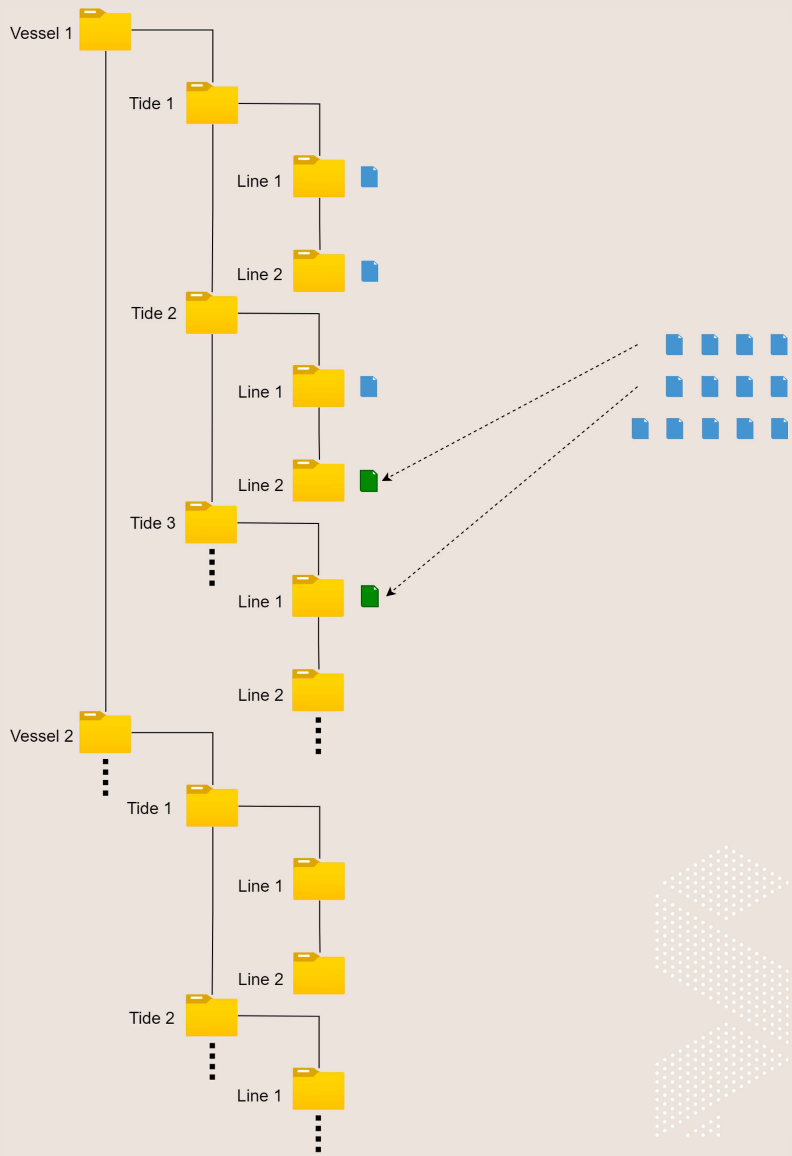


METHODOLOGY:

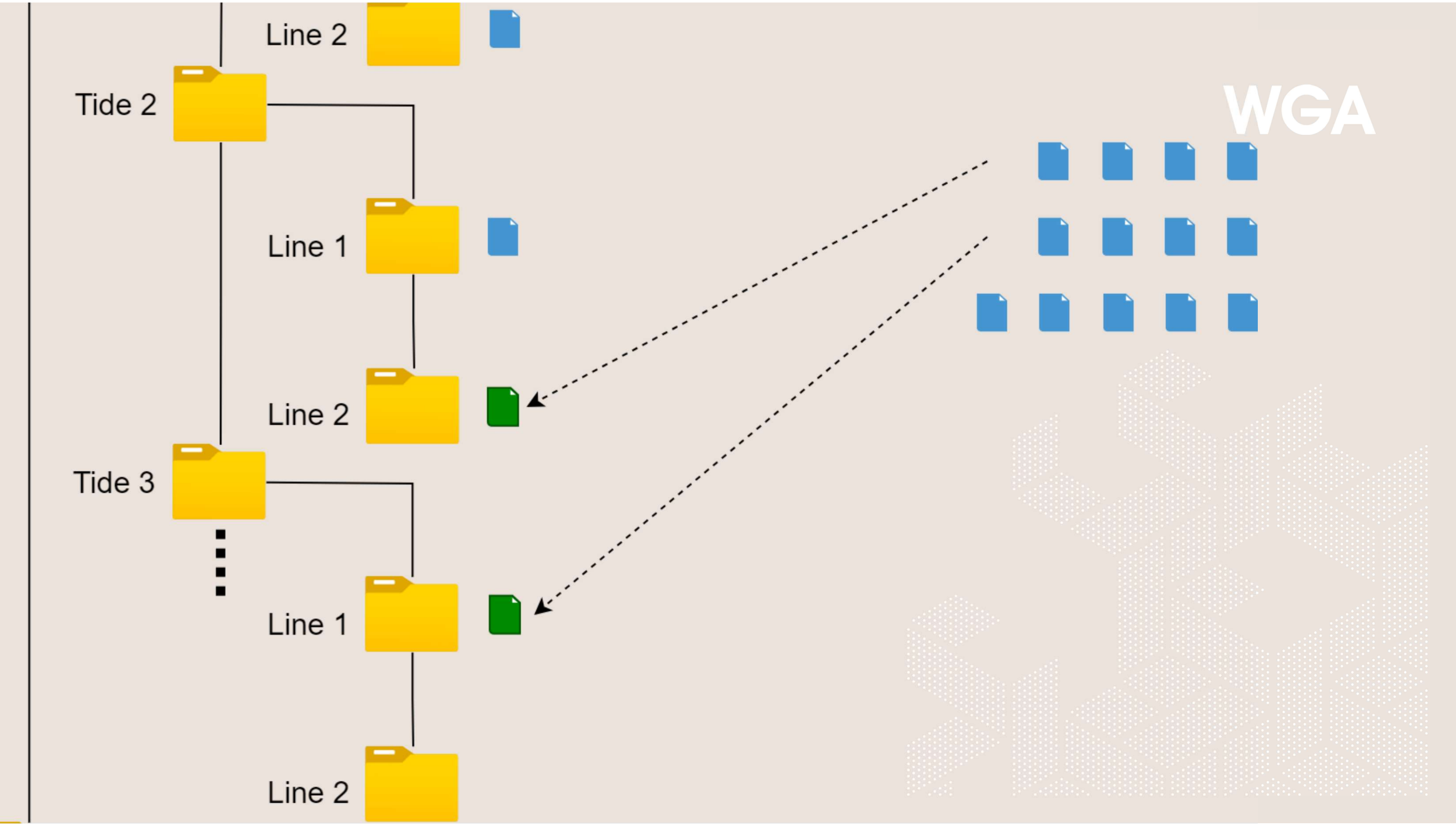
4. SORT THE OBJECTS INTO HERARCHIES USEFUL FOR BIM VISUALISATION




Vessel 1
Tide 1
Line 1
Line 2
Tide 2
Line 1
Line 2
Tide 3
Line 1
Line 2
Vessel 2
Tide 1
Line 1
Line 2
Tide 2
Line 1


Vessel 1
Tide 1
Line 1
Line 2
Tide 2
Line 1
Line 2
Tide 3
Line 1
Line 2
Vessel 2
Tide 1
Line 1
Line 2
Tide 2
Line 1

WGA



Line 2
Tide 2
WGA
Line 1
Line 2
Tide 3
Line 1
Line 2

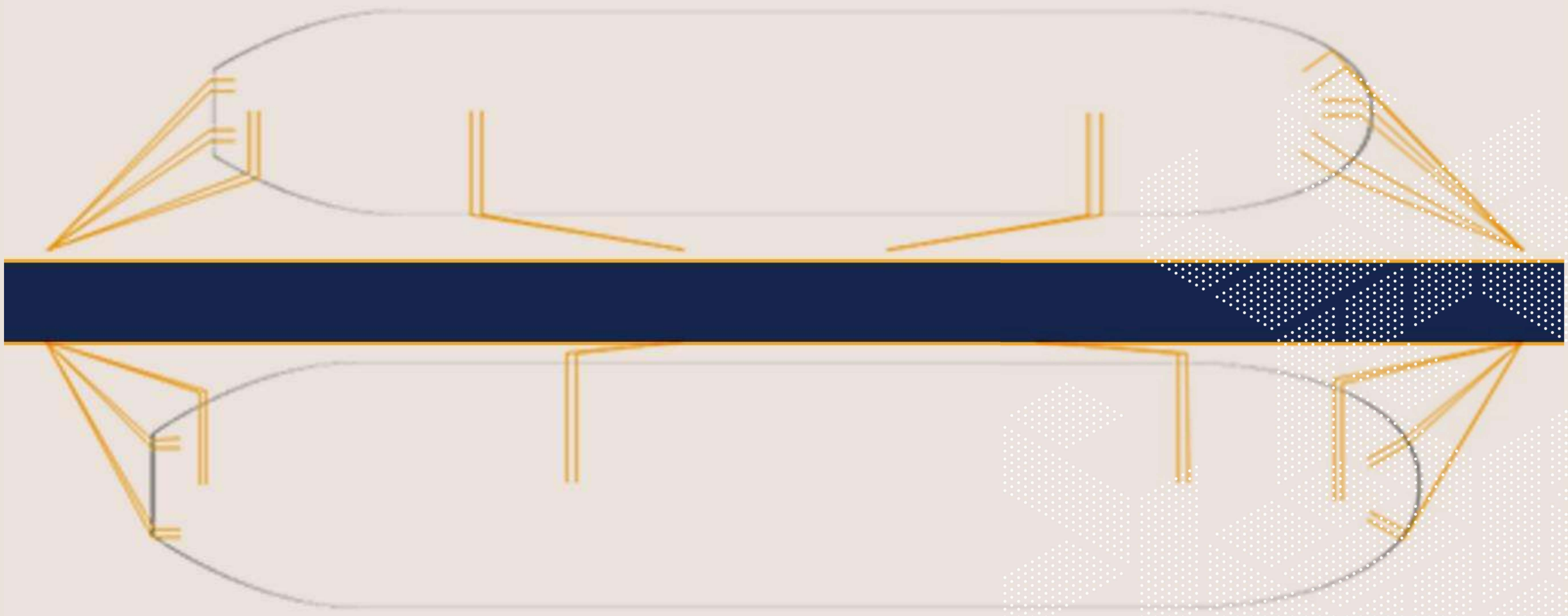
WGA

THE RESULTS

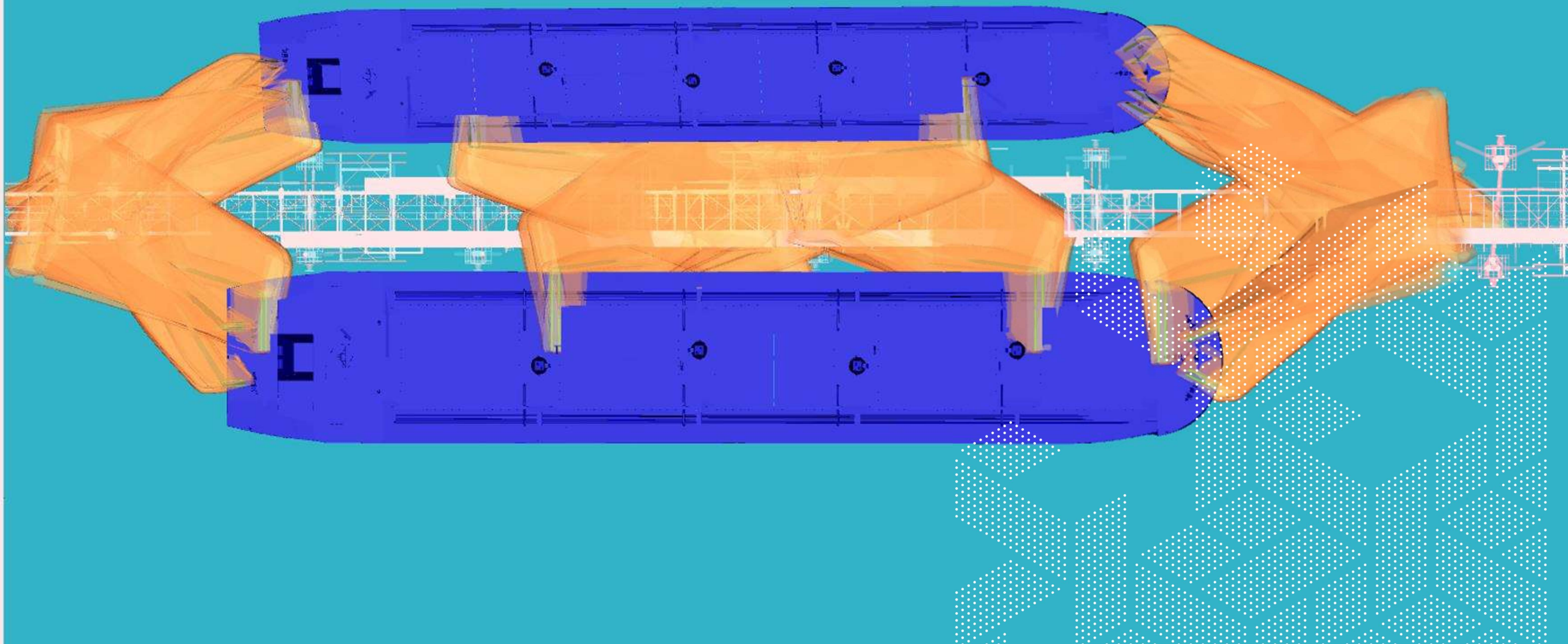
REAL TIME RENDERED 3D SNAPBACK ZONES.

EXAMPLE 1:

A 180k DWT and 250k DWT vessel call port with different spring and head line arrangements.



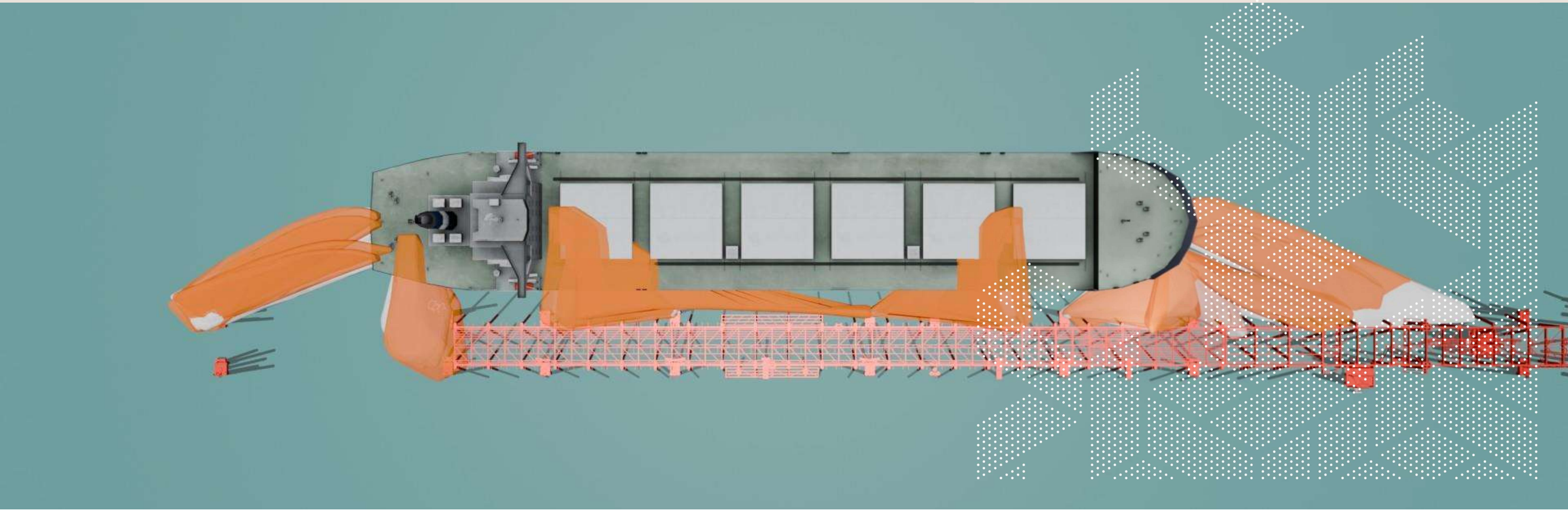
WGA



THIS FACILITY, STRUCTURAL ARRANGEMENT, AND MOORING CONFIGURATION IS ARTIFICIAL AND GENERATED FOR ILLUSTRATIVE PURPOSES.

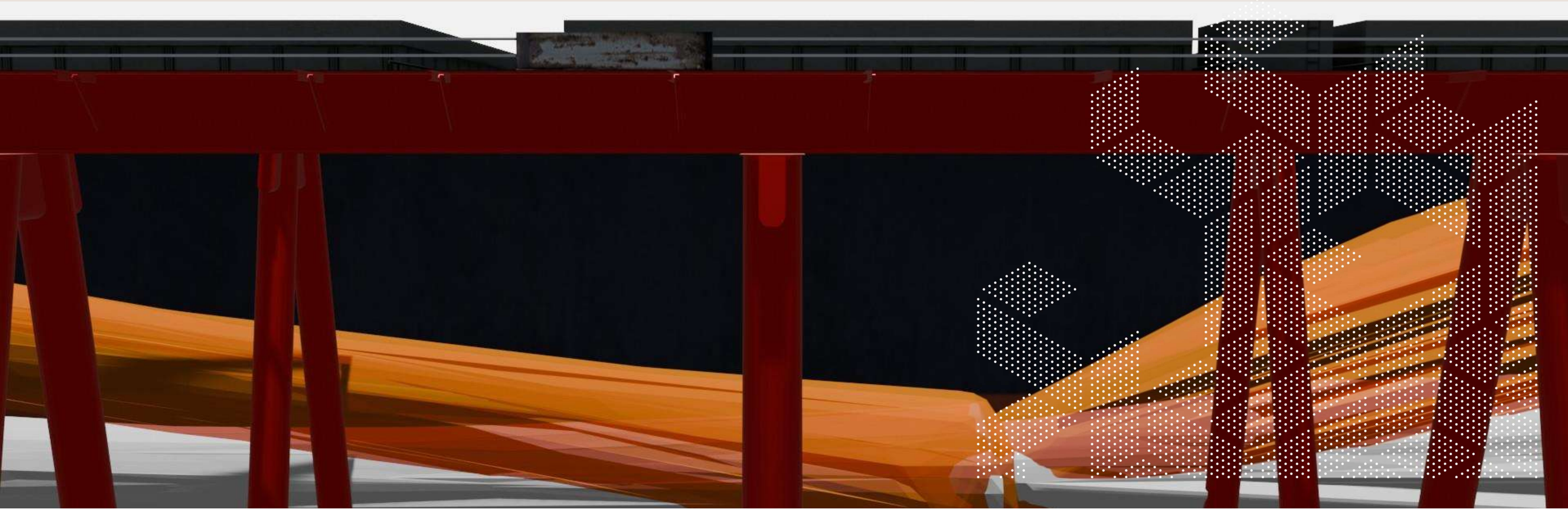
EXAMPLE 2:

A user wishes to understand their overall snapback risk for a given mooring arrangement and sets up a hierarchy to suit.



EXAMPLE 2:

Later, they intend to do remediation works on piles – instead of a hierarchy for mooring arrangement, now they need to understand tides.



WGA

EXAMPLE 2:

As part of the pile remediation works, they identify damage to a dolphin, and now wish to change their model hierarchy to prioritise the battery limits spatially around the dolphin.

EACH BIM MODEL CAN BE GENERATED AUTOMATICALLY.

THE RESULTS

1. DATASETS REDUCED BY 300 – 8000 TIMES

(OUR LATEST SNAPBACK PATH BIM MODEL IS A SMALLER FILE THAN THESE SLIDES)

THE RESULTS

2. BIM HIERARCHIES ARE AUTOMATED BASED ON EXCEL INPUT

(CLIENTS CAN DEFINE WHAT DATA THEY WANT TO SEE, HOW GRANULAR, AND IN WHAT ORDER THEY WANT TO SEE IT)

WGA

THE RESULTS

3. SNAPBACK ZONES CAN BE UPDATED DYNAMICALLY

(MODEL CAN BE CHANGED INSTANTLY FOR NEW VESSELS, NEW MOORING ARRANGEMENTS, DIFFERENT TIDES, ETC.)

WHICH MEANS SAFER PORTS FOR ALL

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE


WGA

WGA

WGA

JORDAN BUTLER

Senior Maritime Structural Engineer

jbutler@wga.com.au

+614 55 401 223

Scan the QR code for LinkedIn

AUS | NZ