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THANET EXTENSION OFFSHORE WIND FARM:

HR WALLINGFORD BRIDGE SIMULATION REPORT

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MARINE AND RISK CONSULTANTS LTD

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HR WALLINGFORD BRIDGE SIMULATION REPORT

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EXECUTIVE SUMMARY

This 2019 Pilot Transfer Bridge Simulation (PTBS) study was commissioned to consider whether there is sufficient sea room in the vicinity of the proposed Thanet Extension Offshore Wind Farm (TEOW), to enable marine navigation and pilotage to continue safely.

The 2019 study has been undertaken utilising the navigation simulator at HR Wallingford which is recognised as one of the leading shipping simulation facilities in Europe. A total of 159 pilot transfers were simulated over 7 days, across a wide range of metocean conditions that are characteristic of the receiving environment when pilot transfer operations are possible.

To address concerns that over-familiarity may have influenced the results of the preceding 2017 PTBS, the pilot transfers were undertaken using independent pilots and coxswains with limited familiarity with the region. In addition, to ensure that both current and potential future traffic is accounted for, the 2019 study incorporated a range of vessel types, including the largest vessels visiting the Port of London Gateway, albeit these vessels do not currently make use of the North East Spit 'nearshore route' region.

The conclusion of the 2019 PTBS is that there is sufficient sea room to undertake pilot transfers safely in all relevant metocean conditions.

This conclusion is based on a combination of qualitative participant feedback and quantitative analysis against objective criteria. The qualitative feedback confirmed that the simulation was a realistic representation of the prevailing metocean conditions, and that that there were no concerns regarding sea room or the ability to respond to a vessel emergency. The quantitative analysis concludes that of the 159 pilot transfers, 100% were carried out safely.

Given the conclusions of the 2019 study it is considered that the findings of the 2017 PTBS and the Navigation Risk Assessment Addendum as submitted during examination remain valid. Conclusions are presented at **Sections 8 and 9**, but in brief this report concludes that there is enough sea-room at the NE Spit for vessels up to 333m to safely conduct pilot transfers with the wind farm extension in place at all pilot stations investigated, and that there is enough sea room at NE Spit for vessels up to 400m to safely conduct transfers with the existing or proposed wind farm extension in place.

1 INTRODUCTION

1.1 Background

This Pilot Transfer Bridge Simulation (PTBS) study has been commissioned to consider further whether there is sufficient sea room in the vicinity of the proposed Thanet Extension Offshore Wind Farm (TEOW) to enable marine navigation and pilotage to continue safely. This simulation assessed pilot transfer operations in the vicinity of the NE Spit pilot boarding area (hereafter referred to as NE Spit) and this report sets out the scope, set-up, implementation and results of the PTBS. It provides conclusions that reflect the aims and objectives, recorded outcomes and feedback from independent mariners who operated the simulator.

Two Pilot Transfer Bridge Simulation studies have now been undertaken for the TEOW application. The first study is referred as the '2017 PTBS' in this document. The 2017 PTBS formed a component of the Navigation Risk Assessment (NRA) (PINS REF APP-089), which accompanied the TEOW (the Project) development consent application. The first simulation, which was undertaken with PLA pilots and coxswains from Estuary Services Limited (ESL), also considered the feasibility of pilotage transfers at the NE Spit with the TEOW (pre-application boundary) in place. It informed the NRA which concluded that the risks to safety of navigation were As Low As Reasonably Practicable (ALARP) and thus acceptable.

During the examination process certain Interested Parties (IPs), including the PLA and ESL, raised concerns in respect of the 2017 PTBS and requested an additional simulation specifically in order to explore a wider range of scenarios and to understand the feasibility of larger vessel transits and pilot transfers. The Examining Authority (ExA) did not request a further simulation study but did ask the Applicant[1] to comment on what the precise brief for such an exercise might be, to which a specification was submitted by the Applicant[2]. The ExA further noted (*ibid*) that "*The conduct of any such work must be a voluntary matter for the Applicant and for any Interested Parties, Other Persons or stakeholders more broadly who might participate in it*".

[1] **Action point 20 of the Issue Specific Hearing (ISH) 8 Action Point document [EV-046]**

[2] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010084/EN010084-001980-Vattenfall%20Wind%20Power%20Limited%20%20D6_Appendix38_TEOW_NavigationSimSpec_RevA.pdf **Subsequently the ExA specifically noted that a procedural decision would not be taken (PINS REF PD-022) due to the need to "operate strictly within the remit and powers provided for it under the Planning Act 2008, related statutory instruments, guidance and advice".**

Notwithstanding the fact that the Applicant's position throughout the examination was that a further navigation simulation exercise was unnecessary because the 2017 PTBS was fit for purpose, the Applicant recognised that a second PTBS, with the simulation taking full account of modifications to the proposed array layout made prior to application and during examination, including the changed Red Line Boundary (RLB) and the introduction of a Structures Exclusion Zone (SEZ) (REP4-018), may be of interest and assistance to the Secretary of State. Accordingly, following the examination, the Applicant undertook a second PTBS and invited relevant IPs to contribute to the set-up of the simulation and to attend as both observers and participants. The second PTBS, hereafter referred to as the '2019 PTBS', took place over 9 days in August and September 2019.

1.1.1 Thanet Extension Offshore Wind Farm (TEOW)

TEOW is a proposed extension to the existing Thanet Offshore Wind Farm as shown in **Figure 1-1**. This figure depicts the RLB and the SEZ. The SEZ was introduced during the TEOW examination (REP4-018) to limit the area in which above sea structures could be placed, increasing the available sea room to the west of the proposed wind farm in the area of the NE Spit. Therefore, when considering the distance between 'the project' and 'a vessel' the 2019 PTBS adopts the SEZ 'boundary' at the east, depicted in Figure 1-1 by the red dotted line, to reflect the increased available sea area, rather than the western RLB. All subsequent reference to the SEZ within this report should be taken to mean the eastern boundary of the SEZ.

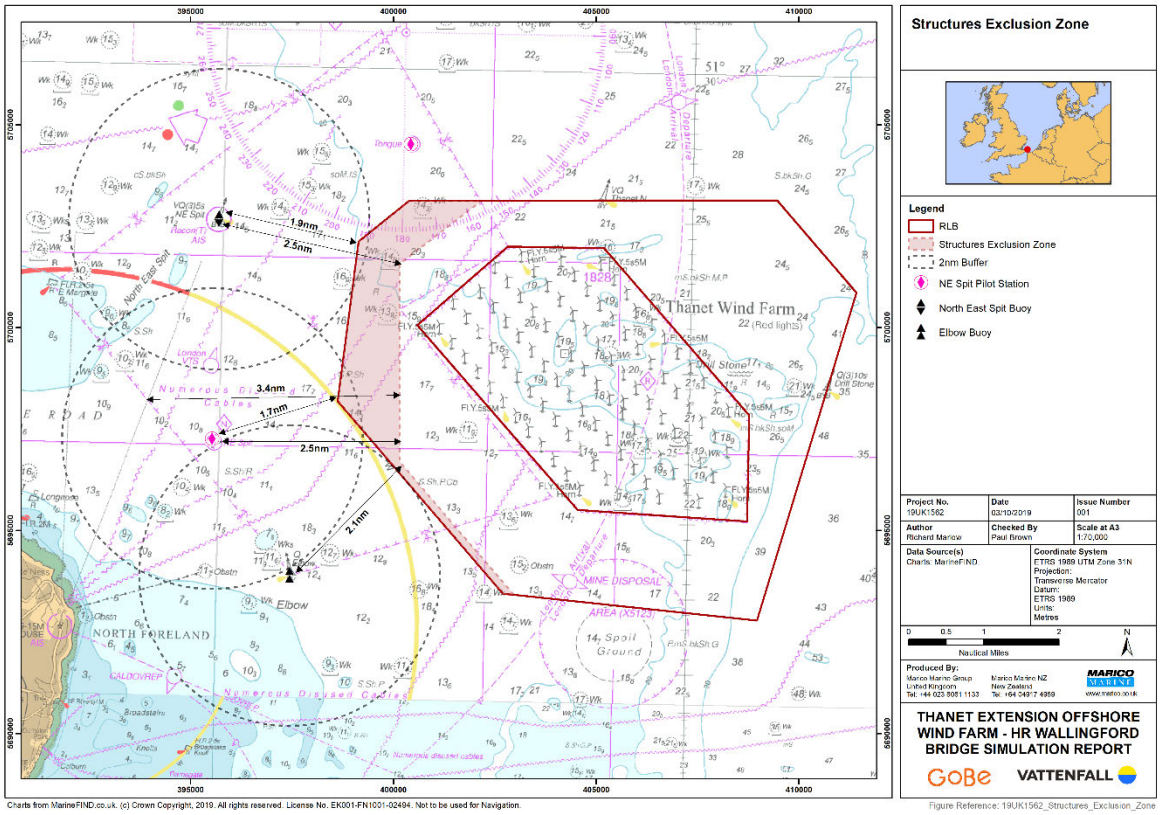

Figure 1-1: TEOW and the Structures Exclusion Zone (SEZ)

1.1.2 NE Spit Pilot Boarding Area

The NE Spit pilot station provides a useful boarding location for vessels proceeding from the south to Thames destinations, that are not constrained by their draught. These vessels can proceed inbound via the Princes Channel and Fisherman's Gat. Deep Draught[3] vessels are directed to board at the Tongue or Sunk. A general image of the area, showing the location of both the NE Spit and the Tongue boarding areas is shown at **Figure 1-2**.

[3] **Deep Draught is generally but not explicitly considered to be vessels with a draught of 10m or above**

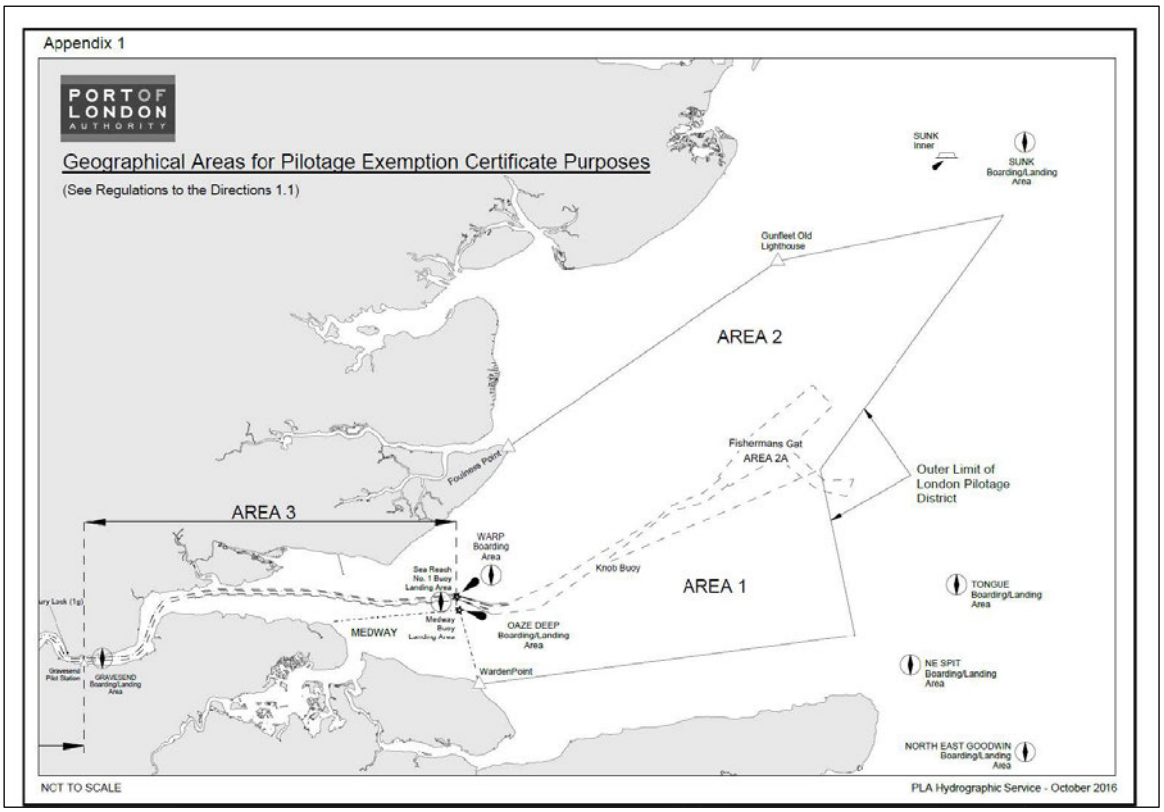

Figure 1-2 : Locations for Pilot Boarding in the Outer Thames (Source PLA PD-2017)

PLA Pilotage Directions, quoted below[4], make it clear that:-

1. Vessels subject to compulsory pilotage to the E of Sea Reach No 1 Lt buoy may board a Pilot at NE Spit or Sunk Pilot Stations.
2. Vessels boarding a Pilot at the NE Spit Pilot Station may take passage through the Princes Channel or Fisherman's Gat. Alternatively, deeper draught vessels embarking a Pilot at NE Spit may take passage to the Black Deep via the Long Sand Head inshore route or via the Sunk Precautionary Area. Unless otherwise notified or instructed, it will be assumed that vessels taking passage through the Princes Channel/Fisherman's Gat will use the inner boarding area and vessels taking passage through the Black Deep via Long Sand Head/Sunk Precautionary Area will use the DW boarding area [the Tongue].

[4] **Taken from Port of London Authority Pilotage Directions 2017, As Amended**

1.1.3 2017 PTBS - Findings Summary

The following section provides a brief summary of the background to the current study, drawing on the conclusions made in the 2017 PBTS and relevant issues raised by IPs during the TEOW examination.

The 2017 PTBS was conducted on the 20th and 21st September 2017, at the Port of London Authority (PLA) simulator in Gravesend, London and was validated and run by PLA pilots and Estuary Services Limited (ESL) coxswains. At the conclusion of the 2017 PTBS, the key outcomes were:

- The simulations were considered, by virtue of using an established navigation simulator used for training London pilots, to be realistic enough to enable meaningful conclusions to be drawn with regards to the continued viability of the North-East Spit station.
- The simulations demonstrated that Pilot transfer operations continue to be feasible at North East Spit Station across the full range of operational conditions even with the reduced navigable sea room caused by the proposed (pre-application) wind farm layout;
- 14 simulation runs were conducted. 13 of the 14 runs were successful and 1 (run 4) was judged to be marginal by virtue of a very narrow breach (by less than 200 yards) of the proximity criteria (1000 yards) to an anchored ship.
- No close quarters situations occurred, and no vessels came in dangerous proximity to the wind farm or shoal water.

The results and specification of the 2017 PTBS were the subject of significant discussion and debate during the examination and formed the basis of specific queries during the ExA's first written questions (ExQ1). Duplication of the full narrative regarding IP and Applicant positions and responses to ExQ1 is not provided here. However, **Annex A** summarises the key concerns raised by IPs at ExQ1 and how the 2019 PTBS has sought to address them.

2 AIMS AND OBJECTIVES

2.1 Aims

The key aim of the 2019 PTBS was to consider further whether there would be sufficient sea room to safely undertake pilot transfers in the NE Spit area and associated pilot stations at the Tongue and Elbow, based on the finalised project boundary having regard to the SEZ and utilising the advanced simulator at HR Wallingford.

A further aim was to address identified limitations and IP concerns of the 2017 PTBS, inclusive of a wider range of metocean conditions, such that a robust and effective assessment of TEOW is undertaken.

2.2 Objectives

The objectives were therefore to:

- Accurately model TEOW, to ensure robust simulation;
- Accurately model vessels expected to transit the area, to ensure a robust simulation;
- Accurately model traffic, existing and realistically predicted, to ensure a robust simulation;
- Use a simulation standard that represents the present “state-of-the-art” technology;
- Test a range of scenarios across all areas of the NE Spit pilotage area which considered metocean conditions, traffic levels and concurrent transfers;
- Receive feedback from experienced independent mariners and pilots unfamiliar with the area to inform the running of and results from the simulation;
- Conclude from the outcomes of the PTBS whether any issues arise that may require an update to the Navigation Risk Assessment Addendum (REP5-039) as submitted in examination.

3 CONSULTATION AND IP ATTENDANCE

3.1 IP Consultation

On 15 July 2019 the Applicant contacted IPs to notify them of the intention to undertake a second PTBS, along with a proposed timetable and an invitation to attend.

This was followed by a specification for the PTBS sent on 16 July 2019, which was revised from the last version submitted into the examination (REP6-058) to take into account comments from IPs received at Deadline 7. The Applicant requested comments on the specification by 30 July 2019; these comments and the Applicant's response to them are provided at **Annex A.**

In addition to technical responses on the specification, IPs responded to the proposed timetable and, as a result of correspondence from the PLA on behalf of the PLA and ESL, the Applicant re-arranged the navigation simulation to be conducted in September 2019 rather than August 2019.

The Applicant engaged with relevant consultees that had been involved in the pre-application and examination phases of TEOW, specifically:

- MCA;
- Trinity House;
- Port of London Authority;
- Estuary Services Limited;
- London Pilots Council;
- Port of Tilbury / DP World London Gateway;
- Chamber of Shipping.

A summary of the key correspondence in chronological order is at **Section 3.2. Annex B** provides a further level of detail of correspondence and consultation held post-examination, during the organisation of the simulation and prior to its commencement.

Following to completion of the navigation simulation, the draft report was circulated to IPs, with a further round of consultation taking place. The record of this consultation is attached at **Annex I**.

3.2 Timetable of Key Correspondence

Table 3-1: Timetable of Key Correspondence/Action

Date	Correspondence / Action
15 July 2019	Applicant informed IPs of the decision to undertake the PTBS in the week of 12 August 2019
16 July 2019	PTBS specification sent to IPs for comment by 30 July 2019
19 July 2019	Request received on behalf of PLA and ESL to consider alternative dates for the PTBS
26 July 2019	Following discussion with PLA on the availability of both PLA and ESL, the date of the PTBS was moved to 2 September. PLA confirmed the Harbour Master (Lower) was available and would be able to provide a pilot.
30 July 2019	Comments on the PTBS specification received from PLA/ESL, DP World London Gateway / Port of Tilbury.
9 August 2019	The Applicant sent IPs an updated PTBS specification and responses to IP comments **(Annex C).**
14 – 15 August 2019	Set up days held at HR Wallingford.
23 August 2019	The Applicant sent results of the set-up days to IPs.
2 – 10 September 2019	Navigation Simulation undertaken at HR Wallingford.
5 September 2019	Email sent to all IPs identifying that the reserve days (9th and 10th September) would be used for further navigation simulation 'runs' and all IPs were invited to attend.
19 September 2019	Draft PTBS report sent to IPs for comment.
4 October 2019	Responses to draft report received from IPs **(Annex I).**
7 October 2019	Submission of final report to Secretary of State.

3.3 IP Attendance at the PTBS

As described above (**Section 3.1),** consultation was held with all IPs in advance of the simulation and requests were made for suitably qualified marine personnel to represent the IPs in observing and participating in the 2019 PTSB.

The MCA and Trinity House attended as observers at relevant points through the 2019 PTSB. Representatives from both organisations were able to observe the detailed workings and the decision-making processes. They were also offered opportunities to comment on the conduct and approach of the 2019 PTBS to ensure it was fit for purpose.

A representative of DP World London Gateway and the Port of Tilbury also attended on two days as an observer and was similarly able to observe the complete working of the simulation and was given the opportunity to comment on the accuracy and conduct of the simulation.

In order to address concerns previously raised by IPs, the simulation was conducted by independent mariners with limited experience of the area. Notwithstanding this, the PLA and ESL were invited to provide a pilot and a coxswain who had local knowledge of the area to participate in the simulation, especially given their involvement in the 2017 PTBS. To facilitate their attendance, at PLA's request, the start date of the simulation was changed from 12 August to 2 September. The Applicant also confirmed to both parties that it would meet their costs for participating in the simulation, in line with the arrangements for the independent mariners. Initially the PLA confirmed that they and a PLA pilot would attend (**Annex B**), however subsequently, the PLA and ESL confirmed that they would not be attending.

Table 3-2 : Correspondence with PLA / ESL

Date	Correspondence / Action
15 July 2019	Applicant informed IPs of the decision to undertake the PTBS in the week of 12 August 2019.
19 July 2019	Request received on behalf of PLA and ESL to consider alternative dates for the PTBS.
26 July 2019	Following discussion with PLA on the availability of both PLA and ESL, the date of the PTBS was moved to 2 September. PLA confirmed the Harbour Master (lower) was available and would be able to provide a pilot.

Date	Correspondence / Action
2 August 2019	ESL confirmed they could not attend the PTBS due to lack of availability as a result of the summer leave roster and changes in ESL management.
22 August 2019	London Pilots Councils (LPC) confirmed that they and PLA pilots would not attend, due to the cost of providing pilots, notwithstanding that the Applicant had previously offered to meet the cost of PLA pilot attendance.
28 August 2019	PLA withdrew their attendance from the simulation.
2 September 2019	PTBS commenced with independent mariners.
2 – 10 September 2019	Navigation Simulation undertaken at HR Wallingford.
5 September 2019	Email sent to all IPs identifying that the reserve days (9th and 10th September) would be used for further navigation simulation 'runs' and all IPs were invited to attend.
19 September 2019	Draft PTBS report sent to IPs for comment.
3 October 2019	PLA ESL response to draft report received by Applicant. A summary is contained at **Annex I.**

The Chamber of Shipping confirmed that they did not have availability to attend (although they did offer to assist in sourcing mariners for the exercise) and confirmed that they were satisfied with the PTBS specification.

4 ROLES AND RESPONSIBILITIES

The following section explains the roles and responsibilities of the various parties involved in the 2019 PTBS navigation simulation. Reference is made to organisations where appropriate and to the IPs collectively.

4.1 The Role of HR Wallingford in the Simulation

- HR Wallingford (HRW) was commissioned as an independent simulation provider and to ensure that the simulation was set-up, administered and conducted fairly, according to industry accepted norms and in keeping with open, accountable scientific principles.
- In practice, this meant that HRW provided a suitably experienced simulator manager with two simulator operators who used the simulator specification and run plans to deliver the day to day running of the simulation, independent of the Applicant.
- The running of the simulation was overseen by the Ships and Dredging Group Manager at HRW.
- HRW also provided the modelling definitions of the metocean conditions for the NE Spit which was subsequently confirmed as accurate by the ex PLA pilot who attended on the set up day.
- HRW were also tasked with the production of objective factual reports for the set-up day and the main simulation, as measured against the specific success criteria as set out in the simulation specification.

4.2 The Role of Marico in the Simulation

- Marico prepared the 2019 PTBS specification document including run plans, and updated them in response to feedback from IPs before and during the simulation;
- Marico were also responsible for sourcing independent mariners to act as Ship Masters, and Coxswains for the simulation;
- Marico were charged with providing validation on the accuracy of the simulations;
- Marico provided oversight of the delivery, operation and conduct of the set-up day and the main simulation ensuring that the program was delivered effectively and that agreed amendments were incorporated as appropriate;
- Marico was responsible for drafting the 2019 PTBS report.

4.3 The Role of Pilots in the Simulation

- A total of 9 pilots from 2 differing UK districts were invited to attend the simulations over the 9-day period. All 9 were authorised, unrestricted[5] pilots in their districts, with recent experience of handling the size and complexity of the vessels simulated. All bar the pilots used for set-up had no prior experience of NE Spit operations;
- Dependent on the phase of simulation pilots acted as either master of vessel (prior to pilot transfer (embarkation)), pilot (prior to pilot transfer (disembarkation)), and pilot/master (post pilot transfer) to ensure the vessel is on a suitable onward route;
- At the briefing stage of each run, each pilot was asked to validate the realism of the simulation and note any observations in relation to 'available sea room' for a vessel to undergo pilot transfer, for each scenario;
- At the debrief, each pilot provided and recorded a full and comprehensive commentary on their actions, thoughts and any concerns. Specifically, each pilot was asked to comment on the accuracy of each simulator run, the handling characteristics of the models and other relevant details, as well as grading the run against the success criteria.

4.3.1 Pilotage Independence

- Each pilot was asked to declare and sign a document attesting to his independence from the project, the Applicant and any of the IPs;
- A maximum of 2 pilots attended the simulation on any one day. Their attendance was deliberately staggered to ensure that there was always one 'new' arrival, who provided a mariner "unfamiliar" with the simulation and to the NE Spit. Accordingly, as a new pilot joined the simulation, they were always tasked with acting as the master of an arriving vessel rather than as the embarked pilot of a departing ship. Thus, their unfamiliarity with both the area and simulator accurately reflected the experience of an unfamiliar master coming into the area;
- It was stressed continually (at each briefing) that the pilot's first responsibility was to behave as they would do in real life and not to accept any simulator artificiality.

4.4 The Role of Coxswains in the Simulation

- 5 coxswains from 2 separate UK pilotage districts attended for the 9 days of simulation. Each coxswain was asked to declare and sign a document attesting to his independence from the project, the Applicant and any of the IPs;
- All 5 coxswains held existing roles at other UK Port Authorities, each with at least 15 years' experience meaning they were able to plan and conduct sequential pilot transfers and comment with sufficient authority on the accuracy of the simulations;

[5] **Unrestricted means a pilot qualified and authorised to pilot any vessel type and the largest vessels using the port.**

- A crew of 2 independent coxswains per day, without prior NE Spit experience, were presented with the issues of boarding and landing pilots at the NE Spit in simulations.

4.5 The Role of IPs in the Simulation

- Every IP was offered the opportunity to attend the 2019 PTBS;
- The MCA, Trinity House and the Ports of London Gateway and Tilbury all sent representatives to the 2019 PTBS. There was consistent attendance from either the MCA or Trinity House throughout the first 5 days and the representative of London Gateway and Tilbury was able to attend the initial day and the 5th day, the latter being focused on the largest vessels that supply London Gateway;
- At the beginning of each day a brief was given to all attendees including a clarification to all on roles and responsibilities;
- The attending IPs were able to observe operations and to ensure that the approach and conduct of the simulation was appropriate, realistic and representative;
- IPs were actively encouraged to provide feedback and to record any comment that they felt able to provide.

5 CONDUCT OF THE SIMULATION

The following section describes the approach taken to simulation. The simulation facility is described, then the approach taken on the 'set-up days' conducted on 14-15th August 2019 (during which the simulator was tested and set-up), followed by the approach taken to the primary simulation conducted on 2-6th and 9-10th September. IPs were invited to attend both the set-up and primary simulation exercise.

The original specification allowed for one set-up day and then 5 days of simulations. However, a second set-up day was programmed to allow sufficient time to validate the set-up. Two main simulation contingency days were made available and subsequently used. The first contingency day was used to undertake 400m simulator runs and the second day to repeat the 6 runs with marginal proximity breaches.

5.1 HR Wallingford - UK Ship Simulator Centre

This simulation was conducted at the HR Wallingford Ship Simulation Centre, Howbery Park, Wallingford, Oxfordshire, OX10 8BA. The simulator was identified by one of the IPs during the TEOW examination as providing excellence for vessel movement simulation and was agreed as suitable through consultation on the specification. In terms of installed technology and software, it is recognised as one of the leading simulators of the UK and Europe.

There are four real time simulators operating at the HR Wallingford UK Ship Simulation Centre; nominally configured as two big ship and two smaller tug / pilot vessel simulators. All provide full bridge, real time manoeuvring facilities and are regularly used by ports and harbour authorities for pilot continuation training and assessments. The simulators have been used successfully in over 300 studies world-wide and have proved to be a reliable, flexible and cost-effective tool for testing ship handling scenarios and training pilots in a safe environment.

5.2 Specification for the 2019 PTSB

Prior to the 2019 PTBS, a detailed specification providing the scope and parameters to be used for the simulations was drafted and circulated to IPs for consultation. IPs comments were taken into account in finalising the specification. The specification for the 2019 PTBS was also developed to address limitations of the 2017 PTBS identified by the IPs, as highlighted at **Annex A**. The

specification was updated as a result of feedback from the experienced pilots and coxswains attending set-up.

Metocean Conditions: The metocean conditions for the 2019 PTBS in the NE Spit area were derived through consultation and reference to empirical data, the latter being agreed with MMO, CEFAS and HR Wallingford as being an accurate and appropriate reflection of the baseline receiving environment. The data for the wind and wave roses, presented within the Physical Environment Environmental Statement chapter (Volume 2, Chapter 2 of the Environmental Statement) (APP-043 – page 2-29), are based on a 40 year hindcast dataset. These identified likely peak wind conditions of 29-38 knots occurring infrequently at the NE Spit. IPs contend that, very occasionally, pilotage operations continue above these conditions (40+ knots) under certain circumstances. The 'limit state' was a phrase used during examination to identify conditions that were approaching or at the safe limit for pilot transfers. In general terms the submissions from PLA and ESL (REP1-139) consider that the upper end of conditions with regards to those in which pilotage operations take place is considered to be around 40-45 knots, depending on wind direction.

Simulator Suitability: The UK Ship Simulator facility at HR Wallingford is one of the world's leading marine simulation facilities capable of accurately simulating a wide range of weather scenarios alongside a range of established vessel models. All IPs who attended the simulation agreed that it was fit for purpose for the 2019 PTBS.

Background traffic: Vessel traffic was taken from daily averages that were then condensed into a single run (approximately an hour period) thereby providing a far more congested area than occurs in reality and which more than accounts for any future growth. In practice this meant taking a range of background traffic values (for example 10 vessels of >90 LOA per day) and compressing these to a single hour, the simulated outcome of which is a scenario which reflects a future baseline of greatly increased vessel numbers operating within a constrained time window, which may represent a tightly constrained tidal access window.

Vessel sizes: Vessel sizes were based on a combination of representative current baseline use of the area as defined according to the multiple submissions made during examination, and future baseline use of the area but larger (>366m) vessels as requested by the Port of London Gateway and Port of Tilbury in particular.

Incident scenarios: The ESL incident record submitted to the examination as part of the NRAA (REP5-039) was summarised in the simulation specification, which showed the frequency of incident type, including aborted transfers due to pilot ladder rigging. The simulation manager

(HRW) delivered incidents in a similar ratio to recorded events, albeit at a higher frequency of occurrence per movement for the purposes of simulation.

1nm proximity criteria: For PTBS 2019, it was decided to retain the 1 nautical mile buffer distance that was used as one of the run success criteria in the 2017 PTBS, allowing a direct 'like for like' comparison between the two simulations and representing a genuine attempt to recognise the concerns raised by IPs during examination and consultation. When considering this distance, particularly in respect to run success, it is important to note three separate considerations:

1. It should be remembered that operational UK wind farms have no formal or advisory approach minima and the 1nm boundary was introduced for the 2017 PTBS and the 2019 PTBS as an objective but entirely arbitrary and artificial measurement which must not be taken as a measure of absolute safety.
2. It should also be noted that the 1 nautical mile proximity distance is double the 0.5 nautical mile 'prudent mariner buffer' that was discussed and widely agreed by the attending mariners during the examination. This was also supported by the independent mariners attending the 2019 PTBS.
3. The 1nm proximity buffer is measured from the SEZ boundary, and all the proposed turbines will be placed at least 300 – 400 yards (0.2nm) inside the SEZ allowing a further margin of safety.

5.3 Set Up Day 14th August 2019

The 14th August was identified as the set-up day for 2019 PTBS and all IPs were strongly encouraged to attend. A draft of the specification report including the scope and programme of the set-up day was circulated well in advance to allow IPs to comment, change and influence every aspect of the day.

On the set-up day, one independent unrestricted practising pilot, from a UK pilotage district with conditions similar to the NE Spit, was engaged to validate the simulation set-up. This pilot also had previous PLA pilotage experience and was authorised in that District to handle the largest vessels entering the Thames system (unrestricted). In addition, HR Wallingford provided their own independent Class 1, 400m vessel qualified pilot to satisfy themselves that the simulation was being set-up and would be run fairly and without bias. In addition, an independent practising coxswain from a UK pilotage district similar to the NE Spit, with over 20 years' experience was engaged to validate the set-up with particular reference to the pilot cutter performance. These personnel were not then used for the main simulation, which retained independence and unfamiliarity for the actual simulation.

Six test runs were conducted on the set-up day and with the exception of run 1, were conducted with the proposed wind farm layout for TEOW in place. Each run was set-up in accordance with the published programme outlined in the specification report and then discussed and amended by the independent participants at the pre-briefing. Where necessary, the set-up was amended to ensure relevance and realism.

Each run was debriefed, where each independent representative was asked to provide detailed feedback on the accuracy of the simulation including representation of metocean conditions and ship handling to ensure that the simulation was fit for purpose. They were also asked to comment on the conduct of the run and then finally to measure the run against the objective success criteria.

5.4 Set Up Day – Findings

A detailed report of the set-up day is at **Annex C**. The primary conclusion of the set-up day was that "*The simulator at HR Wallingford is of suitable accuracy to be used in the simulation to demonstrate feasibility of pilotage, scheduled for 2-6th September 2019, including the contingency days to be held on 9-10th September if required*."

Figure 5-1 Simulator Photograph Showing Pilot Boat Alongside

The set-up day report also made 11 recommendations and comments intended to inform the conduct of the 2019 PTBS. These were circulated to IPs for comment in advance of the simulation. The recommendations arising from the set-up day are summarised below:

- **SIMULATOR SHIP MODELS –** Recommendation: No change other than minor amendments to handling characteristics.
- **SECOND MANNED SHIP -** Recommendation: Run a second bridge simulator to maximise the number of piloted transfers.
- **HR WALLINGFORD INDEPENDENT PILOT -** Recommendation: Request HR Wallingford to provide their own independent senior pilot. NB; HR Wallingford were subsequently unable to provide their own pilot, as such additional senior independent pilots were identified to run the second bridge simulator.
- **PILOT TRANSFER TIMES -** Recommendation: 1 minute for Pilot embarkation; three minutes for disembarkation. NB; This was subsequently increased on the first day of simulations from feedback from another grouping of pilots; **see Sections 5.6 and 7.2**.
- **BACKGROUND SHIPPING -** Recommendation: Background traffic was realistic. Allow background traffic to build incrementally over main simulation timeframe.
- **METOCEAN CONDITIONS -** Recommendation: No change – metocean conditions sufficiently accurate.
- **EMERGENCIES -** Recommendation: 1 or 2 vessels per day should simulate emergencies during runs, with type or presence of an emergency unannounced prior.
- **400M TRIPLE E AND 366M PANAMAX SHIPS -** Recommendation: Boarding for ultra large vessels will only take place during the simulation in the waters to the NE of the Tongue. NB; This recommendation was subsequently changed in order to accommodate IP feedback and is further discussed at **Section 7.4.**
- **EXISTING WIND FARM SIMULATIONS -** Recommendation: Conduct up to 5 runs with the existing wind farm in place to establish a baseline.
- **333M SHIPS -** Recommendation: Undertake transfers for 333m ships during the simulation, but only in conditions with less than 25kts of wind and no more than 1 hour either side of high water.

- **PROXIMITY CRITERIA -** Recommendation: The success criteria for proximity should apply to Pilot transfer operations only.

5.5 Test Runs Conducted after Successful Set Up

Six further test validation runs were undertaken on 15th August 2019, the day following the set-up day. These rapidly increased in complexity with each run, which included both traffic extremes and metocean conditions as laid out in the specification document. The test validation runs confirmed that all the specified criteria for simulation were in place and that it was appropriate for the simulation to be undertaken in September 2019.

5.6 Amendments to Set Up – 2nd September

Part of the first morning of the 2019 PTBS was spent discussing the results of the set-up day with the attending coxswains, pilots and IPs; none of whom had been present at the set-up days held on 14-15th August 2019.

- All of the recommendations made on the set-up day (as listed above) were accepted, with the exception of the pilot transfer times. Participants considered that a 90 second period alongside for the pilot cutter rather than 60 seconds would be more representative of the average time it would take a pilot to ascend a ladder. This was accepted and incorporated in the main simulation.
- It was suggested by the independent mariners on the set-up day that the simulation of pilot transfers to 366m and 400m vessels at the NE Spit could be ruled out. Nevertheless, following constructive discussion with attending IPs and independent mariners on the 2nd September, it was agreed that most of the day's runs on 6th September would be dedicated to examining the feasibility of conducting transfers with these vessels at the NE Spit, firstly with the existing wind farm in place and then secondly with TEOW in place to assess any effect which TEOW might have on the feasibility of conducting such transfers. However, in the absence of any evidence that such transfers may ever take place in the future, it is considered that the success of the simulation in both cases must be viewed with strong caution, particularly with regards to the suggested control measures which would be required irrespective of TEOW. Please see **Section 7.4** for further discussion.
- The lack of passage planning was also discussed. This activity would usually be carried out prior to arriving at the NE Spit and would provide the vessel master with a clear route to follow based on the vessel characteristics (draught, squat, etc.) and the timing of arrival (considering metocean conditions, height of tide, etc.). Whilst acknowledging that this would have reflected reality, it was considered that this could also be construed as leading the independent mariners and therefore devaluing the conclusions reached. As such it was left to each vessel master to make their own decisions based on the prevailing conditions,

whilst noting that for the larger vessels in particular, passage planning may have resulted in avoidance of the NE Spit in any event (irrespective of TEOW).

5.7 Simulator Methodology

The simulation was conducted using the methodology contained in the specification that was circulated to the IPs in advance of the set up day. On the first day of the simulation, the methodology was reviewed with all participants including the attending IPs. As with the 2017 PTBS, each simulation run in the 2019 PTBS was preceded with a comprehensive briefing of the scenario, followed by confirmation from the participants that all vessels involved in the scenario, including background traffic were located at appropriate and realistic starting positions.

During each simulation run, pilots were given the option of a helmsman to assist them where appropriate and coxswains were also assisted by an appropriate 'bow-man' to replicate real life conditions.

HR Wallingford provided operational support, acting as masters of simulated vessels and providing timing of pilot transfers to ensure appropriate and accurate transfer durations were maintained.

Following each scenario, a comprehensive debriefing was undertaken during which each participant was given a formal feedback form to record the runs performance against the success criteria (presented at **Section 5.8**) and to note any relevant observations. The data derived from the feedback forms is presented at **Annex D**.

5.8 Criteria for Successful Run Classification

The criteria for successful run classification was set out in the 2019 simulation specification and with one exception, was drafted to contain the same criteria used in the 2017 PTBS. Success was measured against six key criteria, summarised in **Table 5-1**. The full success criteria table is at **Annex G**.

The one exception was to measure clearance distance to the wind farm during pilot transfer operations and not when the vessel was on passage before or after transfer. This was agreed by all participants on the basis that a vessel on passage might safely pass quite close to the wind farm, depending on the circumstances and conditions on a given day. It was agreed that each event would be considered individually. During run debriefs each of the six success criteria were specifically discussed and the result agreed.

Table 5-1 : Description of Success Criteria (Summary)

Success Criteria		Description
1	Control of vessel	Were mariners in full control of their vessel at all times when considering the metocean conditions and proximity to the wind farm and other vessels.
2	Clearance to the wind farm	Did vessels come within 1nm of the wind farm during pilot transfer.[6]
3	Under keel clearance	Given the characteristics of the vessel (draught, squat, pitch and roll etc), the metocean conditions and the activity being undertaken, did the vessel maintain sufficient under keel clearance to avoid risk of grounding.
4	Clearance from other vessels	In the mariners' opinion, did the vessel maintain appropriate and safe distance from other vessels.
5	Time available to remain safely on course to conduct pilot transfer	Were vessels able to safely remain on course for the time that the pilot cutter was alongside (90 seconds).
6	Capacity and space to respond to emergencies.	In the mariners' opinion, did they maintain sufficient space between other vessels and the wind farm to respond to emergencies.

[6] **1nm is an arbitrary distance chosen from submissions made by IPs during the examination that this could considered an appropriate 'buffer' from the wind farm. It is not considered a threshold or barrier to safe operations and has no basis in marine law or regulation. These distances were measured from the wind farm boundary, however the turbines, which provides the practical boundary as seen by the mariners, were located approximately 200 – 300m inside this. As such the measurements taken were highly precautionary.**

6 RESULTS OF THE SIMULATION

6.1 Overview

During the main simulation, 41 runs were conducted during which 159 pilot transfer operations were simulated. Details of each run as recorded by HR Wallingford in their Simulation Report are presented at **Annex E**, which contains the run matrix, and **Annex F**, which contains the track plots.

All of the 41 simulation runs were graded by the independent participants to be an overall success, with no concerns raised. Based on the success criteria, 153 of the pilot transfers were scored as being conducted successfully, and 6 considered to be marginal. The marginal runs were recorded due to minor proximity breaches of the 1nm distance to the wind farm boundary; these are discussed in detail in **Section 7.2** and at **Annex F:**

The main simulations can be broadly summarised as:

- 2nd Sep: Runs 1-6 to NE Spit, simple runs;
- 3rd Sep: Runs 6a – 12 to NE Spit, increasing complexity;
- 4th Sep: Runs 13 –15 to the Tongue, runs 16-18 to the Elbow;
- 5th Sep: Runs NEC 1 –6 to NE Spit, challenging conditions;
- 6th Sep: Runs L1-4 to NE Spit with large ships;
- 9th Sep: Runs NEA 1-6 to NE Spit in unusual wind directions;
- 10th Sep: Run repeats 14R, 16R, NEC3R, NEC5R, NEC6R, NEA R1.

The independent simulation run report by HR Wallingford (**Annex E)**, records that a full and representative selection of metocean conditions, including tide height and current; wind speed and direction; visibility and daylight; and density of background shipping, were tested during the 41 simulator runs in accordance with the specification.

6.2 Simulation Results by Day

Day 1 and 2: NE Spit Runs 1 –12: The aim of the 2019 PTSB was to determine whether enough sea room exists for the continuation of safe transit and pilot boarding. The majority of the runs over the 7 days were conducted using the NE Spit as the focal point for operations but the resulting geographical and temporal spread of transfers meant that a multi-ship earmarked 'as a NE Spit run' could often have transfers occurring at the Elbow, NE Spit or the Tongue. As

anticipated, and as is standard practice, the geometry of the transfers varied according to the wind speed and direction, the tidal stream and the type of vessel.

As a benchmark, Day 1 of the simulations started with two runs with the existing wind farm layout with a single ship transfer in benign conditions and then a double ship transfer in more demanding conditions. This was then repeated with TEOW in place. After that and into day 2, the runs incrementally increased in complexity and difficulty culminating in the point where 6 ships were presented for transfer in 30 knots of wind with a high level of background traffic in run 12. The results of all these runs are that the transfers were safely and efficiently achieved with participants confirming there to be adequate sea room available and that they were comfortable with the proximity of the vessel to TEOW during simulation.

Analysis of the heat maps at **Section 6-3** (**Figures 6-5** and **6-6**) as well as the run animations compared to the real world AIS generated animations of traffic at the NE spit, prepared during the TEOW examination (REP6-061, REP6-062, REP6-060; REP8-008), shows that transfers to the NE Spit during simulations tended to take place exactly where they do at present. This reflects that whilst there is slightly reduced sea room than currently exists, there would still be sufficient sea room at the NE Spit for pilot transfer operations to continue once TEOW is in place. This was reinforced by the comments made by the independent mariners in the run feedback forms. In day one comments were; "routine pilot transfer" and on 3 occasions "straight forward pilot transfer" and on day 2 there were comments of "sufficient sea room," "ample sea room," "textbook," and "very straight forward" twice, and "routine pilot transfer" on five separate occasions.

Across the 120+ transfers that were conducted in the vicinity of the NE Spit pilot diamond it clearly emerged that there is sufficient sea-room at the NE Spit for vessels up to 333m[7] (the largest vessel to have transited this area to date) to safely conduct pilot transfers with TEOW in place, with all simulated transfers graded successful against the criteria. This finding remains valid in all traffic and metocean conditions applied at the simulation, specifically in winds up to 45 knots from the North West to the South and in winds up to 30 knots South through East to North West.

Day 3: Tongue Runs 13, 14 & 15: which translates to 11 individual transfers targeted at this pilot diamond, were conducted specifically using the existing Tongue Deep Water pilot station with multiple large vessels (up to 400m) being serviced in testing conditions. Other vessels were also serviced at the NE Spit during the same run. These runs were successfully undertaken by

[7] **Subject to underkeel clearance being in accordance with PLA requirements**

independent mariners who are qualified to handle this size of ship and were safely completed in the vicinity of the pilot diamond. Their comments in the feedback forms reflect this; "No complications," "no problem boarding," and "comfortable run." This demonstrates that the presence of TEOW would not require relocation of the Tongue pilot diamond, and that there is enough sea room for transfers to take place at the Tongue Deep Water pilot station for vessels of up to 400m with the existing wind farm and TEOW in place;

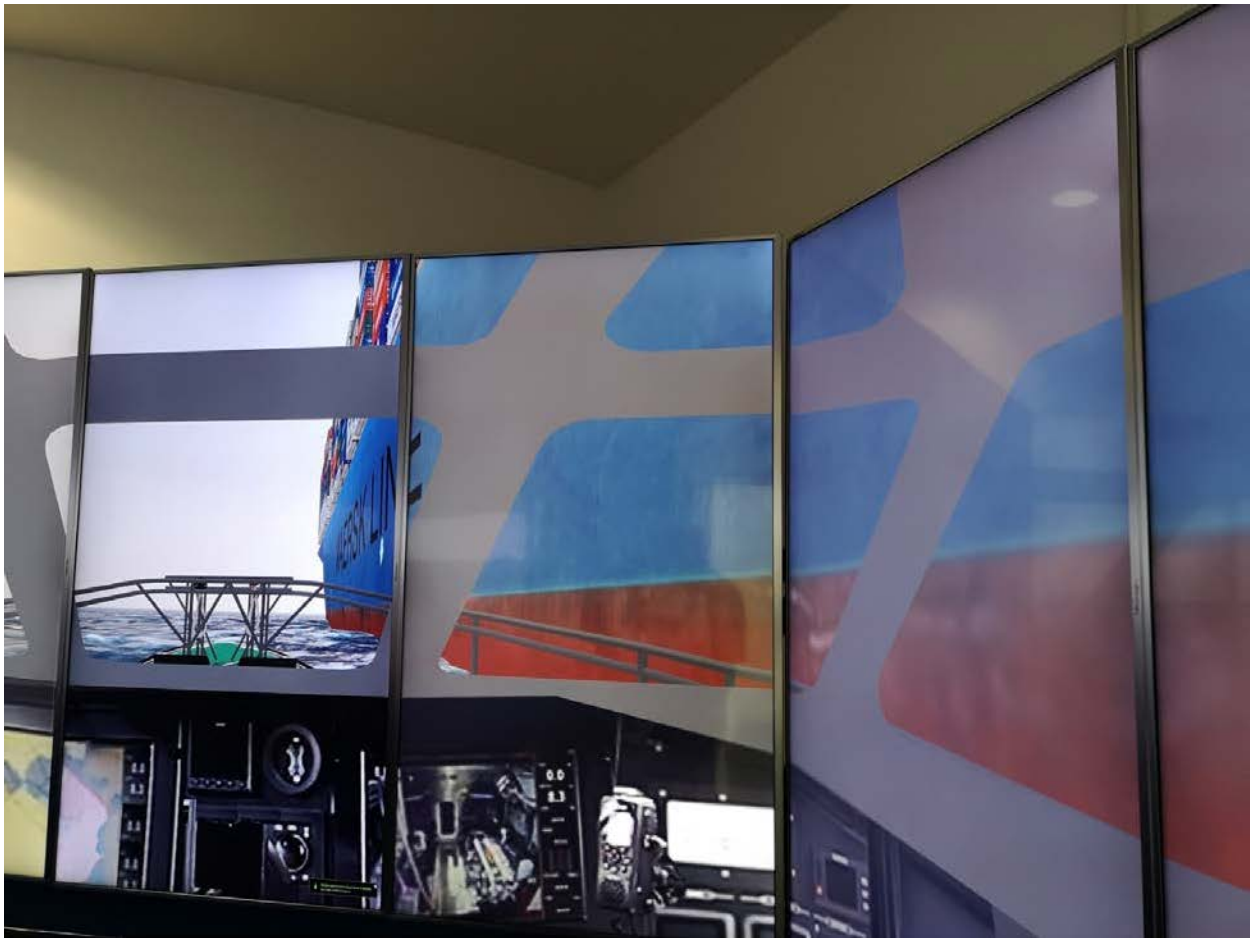

Figure 6-1 : Pilot Alongside a 400m Container Ship During Simulated Transfer at the Tongue

Day 3: Elbow Runs 16, 17 & 18: which translates to 14 individual transfers targeting this pilot diamond, were conducted in the vicinity of the Elbow buoy to specifically examine whether, in demanding weather conditions, this area remains suitable for pilot transfers for those ships able to venture this far inshore. These runs, with up to 5 ships involved, were also successfully and safely undertaken in difficult conditions and demonstrated that there is sufficient sea room for transfers to take place at the Elbow inshore boarding station for vessels up to 300m, with both the existing wind farm and TEOW in place. The independent mariners who conducted these runs reflected that the runs were a "simple manoeuvre with ample space," feeling like "normal

operations" and with "no problem boarding." It should also be noted that during other runs, transfers took place south of the NE Spit pilot diamond in the vicinity of Elbow buoy, particularly during poor weather conditions, which reflects what would occur in reality and further demonstrates that this area can continue to be safely used when required.

Day 4: Challenging Runs NEC 1-6: The intention behind these runs was to explore the upper limit wind speeds as requested by ESL during consultation. Accordingly, the first two runs were completed with winds up to 40 knots and the last 4 with winds at 45 knots, largely considered to be the realistic maximum wind speed at which transfers at the NE Spit could be undertaken (as evidenced in the 1979-2016 hindcast data presented in the Thanet Extension ES (APP-43; Physical Environment chapter, page 2-29). These runs were completed with a variation of ships in size and design and using the premise that in heavy weather there would be a reduced level of background shipping but that traffic to the NE Spit would continue for as long as is safe. The mariners involved during the runs reported that the conditions were deliberately challenging and that they had to consider the set-up of their transfer courses with more care than in benevolent conditions, but that they were able to complete the runs successfully and maintain complete control of their vessels. Their quotes from the feedback forms were "straightforward run," "plenty of sea room to manoeuvre," "no problems," and a "standard bad weather disembarkation." Runs NEC 3, 5 and 6 all recorded proximity breaches of one ship in these multiple ship runs although all were with the subject vessel either completing the pilot transfer facing away or parallel to TEOW; in other words, steaming into safe water. Each one of these runs, applying the same metocean parameters, but with the participants specifically instructed to stay 1 nm (2000 yards) clear of the wind farm was subsequently successfully repeated on Day 7 without a proximity breach and a detailed analysis of each of these runs is contained at **Annex F.**

Day 5 Large Ships Runs L1E, L2E, L3P & L4P: Four runs were, at the request of London Gateway, conducted specifically to examine the feasibility of bringing big ships (366M and above) to the NE Spit for transfer and the weather conditions that may lead to this pilot transfer option being undertaken. The first two runs were conducted with the existing wind farm in place and the second two with TEOW in place. The intention was to examine any effect that TEOW might have, in the event that the first two runs were successful.

It should be noted that these runs were conducted against the advice of the expert mariners present (all of whom routinely handle ships of this size) and against the advice received from deep

sea Channel pilots[8] who might conceivably be asked to deliver a large vessel of this type to the NE Spit for transfer. The primary justification for this was available depth of water[9] at the NE Spit for very large vessels and PLA Pilotage Directions referencing both the routes assumed for vessels boarding at the NE Spit (Princes Channel and Fisherman's Gat, both with depth limitations) and the provision of a deep water route boarding at the Tongue and proceeding in via the Sunk.

Pilots attending the simulations, including a pilot with local experience who attended the set-up days, therefore provided advice at variance to IP feedback. This advice was focused not on whether it could feasibly be done (it can, but in limiting conditions of tidal height and metocean limits), but on whether a vessel master would choose to come into the NE Spit, irrespective of the presence of TEOW, given there are more practical and safer options elsewhere; the Sunk, the Tongue, the NE Goodwin and Dover; this is discussed at **Annex H**. Nonetheless, the simulation proceeded in conditions where very large vessels had a suitable draught (light cargo condition). As such, and in order to provide a realistic scenario for the runs, the following was agreed with those present for the transfers:

a. The Sunk, NE Goodwin, Dover and Tongue Pilot stations would be off station and there was a driving imperative for a pilot to be boarded;
b. No transits – no large vessel would voluntarily come 6 miles further inshore on passage when a safer route exists;
c. The Owners / Insurers / P&I Club would have given specific permission for this transfer to have taken place; as it would likely breach most of the safety minima set by the parent company's safety management system;
d. The transfer would have been fully risk assessed for the vessel and the conditions by the London Pilots Council / PLA, and dynamically so by the conducting pilot prior to the vessel coming inshore and again prior to boarding;
e. Sufficient under keel clearance would be maintained – with a pilot this can be significantly reduced but for an arriving ship this will not be less than 2m and is likely to be more. Thus, the ship would likely to be arriving at the NE Spit (governing depth 11.6m) no earlier or later than 1 hour either side of high water;

[8] **Many large vessels, especially those on Liner Services or carrying hazardous cargoes, transiting the busy Strait of Dover engage commercially available Channel Pilots to provide advice and communication with Coastal Authorities. Channel Pilots can board off Dover or at Brixham in-bound, to assist their transits through the Strait and to the pilot boarding locations. Channel Pilots are not mandatory and hand over to Pilots Authorised by Port Authorities with Pilotage Jurisdictions. (Such Port Authorities are termed Competent Harbour Authorities in the UK Pilotage Act).**

[9] **11.6m at Chart Datum**

f. Transit inwards after transfer would only be by via the Sunk / Long Sand Head Channel – the PLA specifically instructed that passage for a vessel of this size through the Princes Channel would not be permitted;
g. The transfer could take place at wind speeds up to 45 knots;
h. The wind direction must be SSW through W to WNW in order to ensure a reasonable lee for boarding.

All four large ship runs were successful, 2 with the existing wind farm and 2 with TEOW in place, and with ships in every run comfortably maneuvered within the sea room available, demonstrating conclusively that TEOW would not be the governing factor in deciding the feasibility of this proposal. The records made by the independent mariners on the feedback forms were “enough sea room to swing,” “all boardings completed safely,” “all OK,” and “was happy with the situation throughout the manoeuvre.” Notwithstanding these comments and the success of the runs, all of the simulation participants remained skeptical of the wisdom of considering transfers of such large ships at the NE Spit for the reasons identified above. This is further discussed at **Annex H.**

Figure 6-2 : Pilot vessel approaching a 366m container ship during the simulation

Day 6: Unusual Wind Directions Runs NEA 1-6: These runs were designed to explore northerly and southerly winds with the specific intention of generating pilot transfer courses on an easterly or westerly heading and to attempt to stress the pilot transfer process by pointing ships directly at TEOW or at the shoal water to the west in the narrowest part of the sea room available. These runs were incrementally increased in complexity with up to 5 ships of up to and including 330m in length, with increasing levels of background shipping, and with winds up to 30 knots. The mariners involved once again reported that they were able to complete the runs safely and the track plots show them manoeuvering successfully within the sea room available. Their comments in the feedback forms reflect this; “Plenty of room,” three times, “oodles of room,” “no issues with the sea room or other vessels,” and a “normal day at the office.” Run NEA5 was deliberately chosen to replicate the surge of high-speed wind farm service traffic that emerges from Ramsgate every morning at 0700 with the specific intention of seeing if it would complicate any transfers taking place at the NE Spit with the proposed wind farm extension. The track plot at **Annex F** shows that while the sea area becomes very busy at this time it had no effect on the pilot transfer operations.

Day 7: Run Repeats 14R, 16R, NEC 3R, 5R, 6R and NEA R1: 6 of the 41 runs resulted in a single ship breaching the 'not less than 1nm from the wind farm' advisory criteria necessary for a successful run. As stated in the set up report, each run recording a marginal run was required to be considered for a repeat and it was decided to use the last day of simulation to re-examine these runs. For this last day, each one of the masters was issued with an instruction to stay 1 nautical mile or 2000 yards from the wind farm, thereby artificially limiting the sea room available for transfer. It is notable that every one of these runs (including 3 in marginal conditions) was completed safely, comfortably and with a success grading in every criterion. Demonstrating, once again that sufficient sea room exists for transfers at the NE Spit with the proposed wind farm in place. A detailed analysis of these runs is at **Annex F**.

When considering marginal runs, it should be remembered that operational UK wind farms have no formal or advisory approach minima and the 1nm boundary was introduced for the 2017 PTSB and the 2019 PTSB as an objective but entirely arbitrary and artificial measurement which must not be taken as a measure of absolute safety. Any experienced mariner will recognise that proximity to danger is never a factor of empirical distance but a combination of a set of factors including, wind, current, tidal stream and the handling characteristics of the vessel involved; accordingly a ship might be perfectly safe 200 yards from a hazard or in danger 3 miles from it depending on the prevailing circumstances and conditions.

6.3 Summary of Simulation Results

Table 6-1 presents the results of the 7 day simulation period. It demonstrates that a total of 159 (+1 familiarisation) pilot transfers were completed across the 7 days. All 3 primary pilot stations within the wider NE Spit area were utilised during the simulation, Tongue DW to the north of NE Spit, NE Spit, and the Elbow to the south of NE Spit. It should be noted that whilst **Table 6-1** presents each individual pilot station, in reality a range of pilot transfers took place utilising the broad geographical area with some 'NE Spit' transfers being undertaken closer to other stations and during multi-ship runs, in particular in proximity to the Elbow during periods of poor weather.

Table 6-1 : Simulation Results Summary

Pilot Station	Number of Transfers	Successful (across all criteria)	Marginal criteria	Fail criteria	Notes
NE Spit	134	128	6*	0	*6 runs had one marginal criterion out of 6 (proximity). Feedback notes no safety concerns – see **Annex F**
Tongue DW	3 runs specifically targeting Tongue DW – 11 transfers	11	0	0	No marginal runs
Elbow	3 runs specifically targeting Elbow – 14 transfers	14	0	0	No marginal runs

The heat maps at **Figures 6-3** and **6-4**, below, record the location of the pilot transfer operations, taken from 4 separate months of Sea Planner data in 2017 (presented during the examination (REP4-030)) and from the 2019 PTBS.

Two methods have been used to create these maps due to the different data sources. The 2017 heat map is based upon analysis of AIS data, whilst the 2019 PTBS heat map is using the records of transfers made in the simulation. The relative density and primary location of pilot transfers are clearly shown in both and make a useful comparison. Both show the proposed development

Comparison of the heat maps shows that the location of the pilot transfer operations has not significantly moved following the introduction of the Thanet Extension Offshore Wind Farm. The bulk of the transfers continue to take place in the sea room in proximity to the NE Spit pilot transfer diamond (predominantly to the north) there is no evidence that the use of the area is being constrained by the introduction of the project.

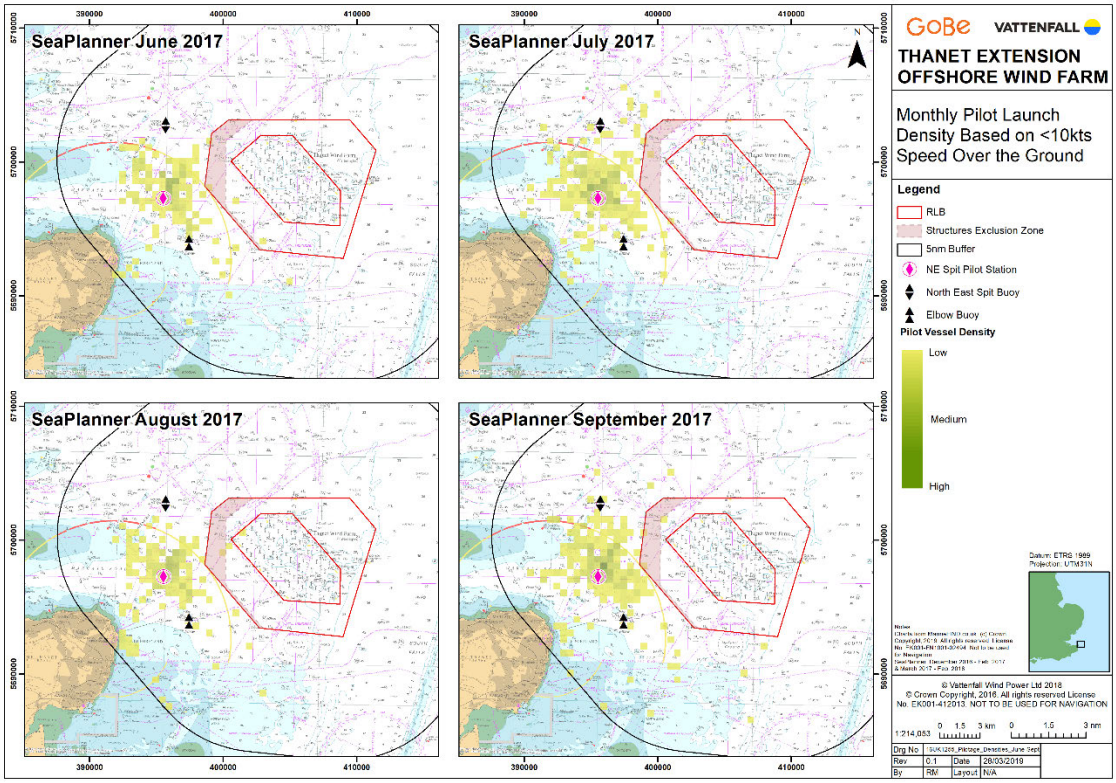

Figure 6-3 : 2017 Sea Planner Heat Maps

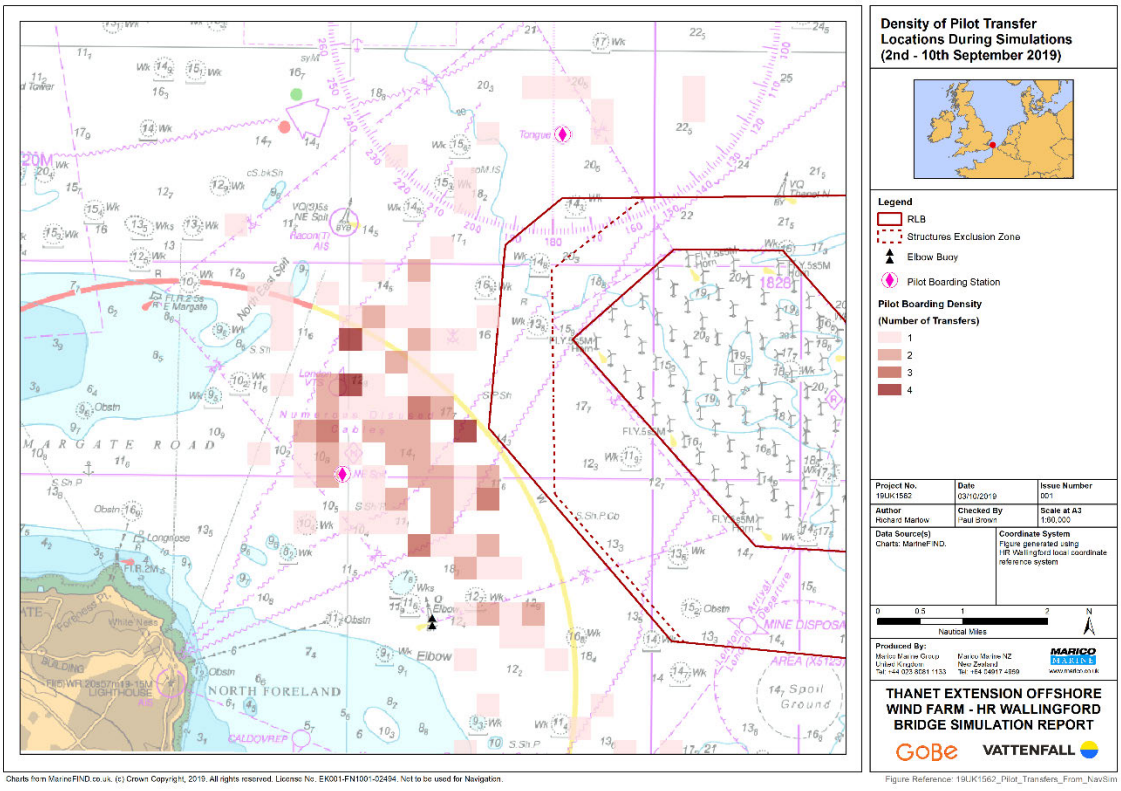

Figure 6-4 : 2019 PTBS Heat Map

After each run participants were debriefed and completed a feedback from. **Figures 6-5 and 6-6** illustrate the results of two key feedback questions related to sea room, with the data from all feedback forms, a summary of which is presented in **Annex D:**

a. Do you think the scenario was representative of potential conditions (metocean/ traffic/ number of transfers etc) under which the operation could be undertaken in reality; and
b. Were you comfortable with sea room and the proximity of your vessel to the wind farm during simulation?

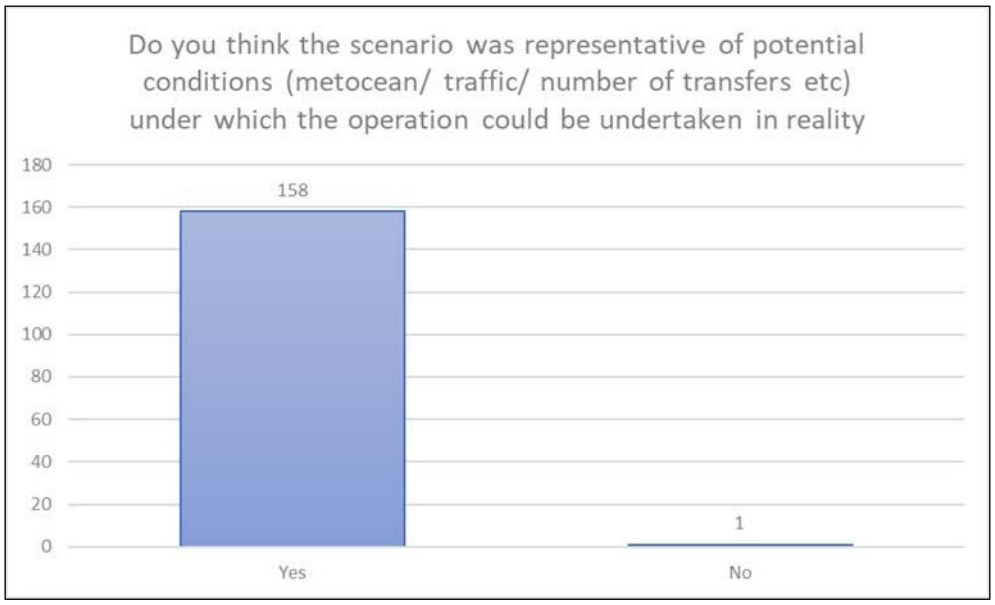

Figure 6-5 : Pilot Feedback from Question One

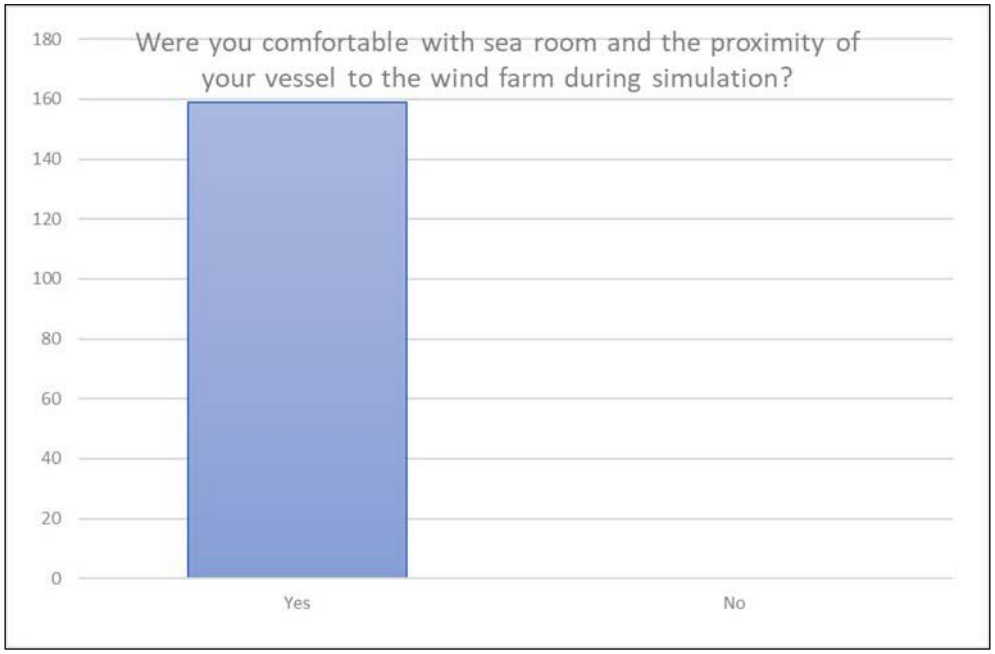

Figure 6-6 : Pilot Feedback from Question Two

As illustrated in **Figure 6-5,** 158 of the pilot transfers were considered to be representative of potential conditions and the number of transfers and volumes of traffic. The exception was a single transfer during which the participant provided feedback that the lack of inter vessel VHF communication was not representative of a realistic scenario (**Annex D**). The impact of this with

regards the overall study is that it effectively introduced an emergency scenario simulating failed or poor communications for a period of time.

Figure 6-6, above, highlights that participants of all 159 pilot transfers were comfortable with the available sea room. This included proximity of the vessel to TEOW during the simulation, notwithstanding the limited number of marginal runs which breached the 1nm distance between the SEZ boundary (not the wind turbines) and the vessel. In this respect, it should be noted that none of the transfers or vessel manoeuvres breached the 0.5nm 'prudent mariner buffer' referred to during the TEOW examination.

With regards the individual success/marginal/fail criteria **Figure 6-7** and **Figure 6-8** illustrate the outputs of the simulation for two indicative, and important criteria:

1. Simulation Criteria 2 (clearance to wind farm (contact risk)); and
2. Simulation Criteria 6 (capacity to respond to emergency).

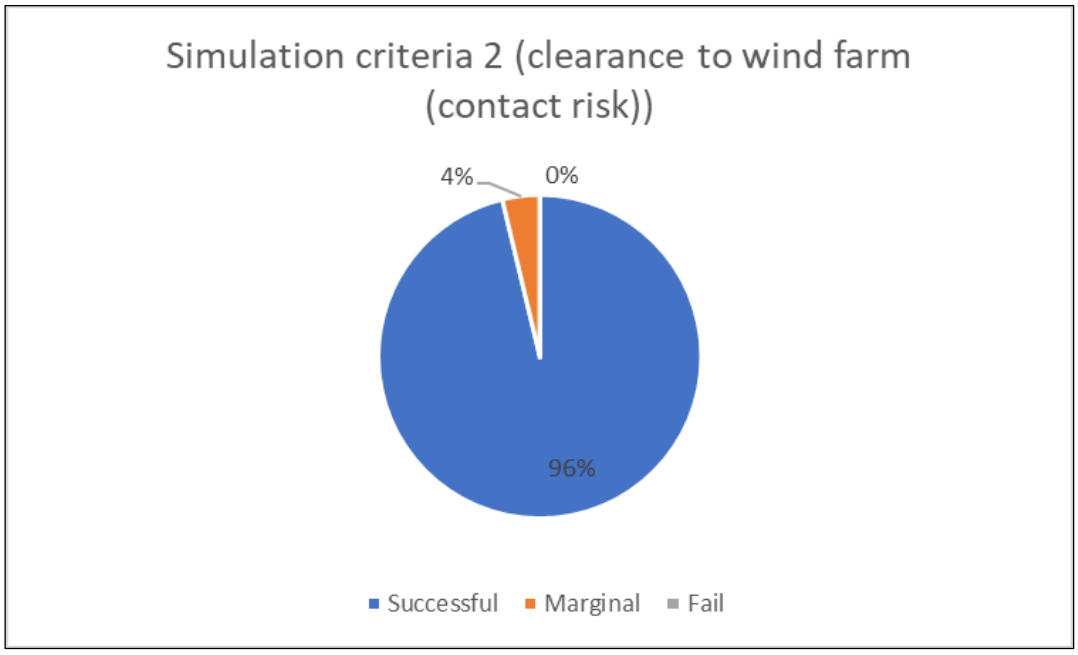

Figure 6-7 : Clearance to Wind Farm (Contact Risk) – Criteria 2

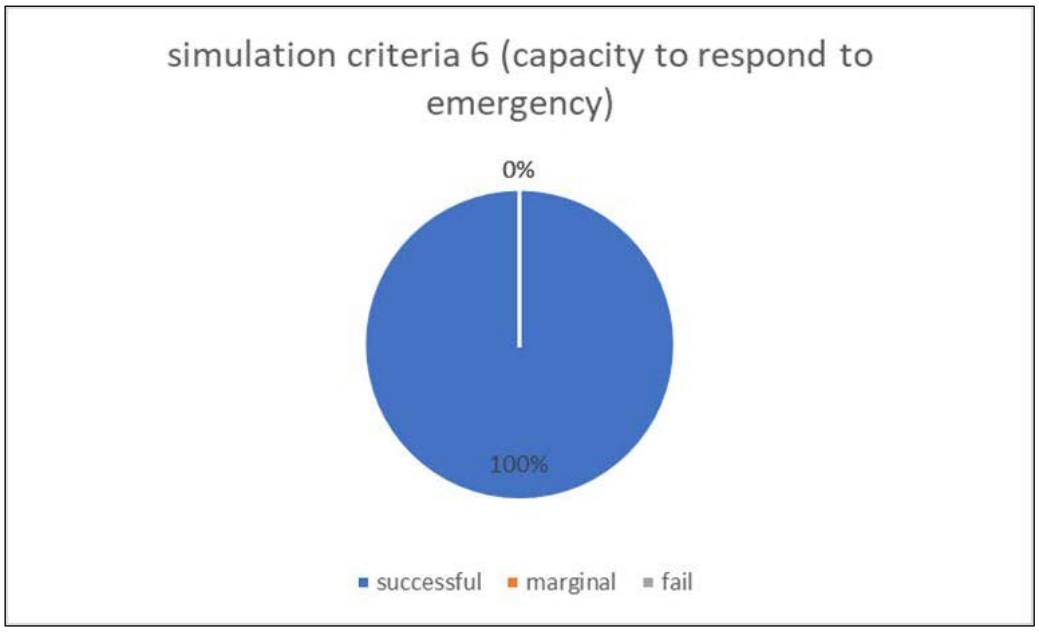

Figure 6-8 : Capacity to Respond Emergency – Criteria 2

As can be seen from **Figure 6-7,** 96% of the simulations were conducted successfully, with 4% providing a marginal result. As noted above, the marginal runs were still completed within sea room sufficient to undertake the pilot transfer operation comfortably, despite having breached the precautionary 1nm buffer as measured between the SEZ boundary and the vessel.

With regards the capacity to respond to an emergency a number of simulations were undertaken with challenges/emergencies introduced by HR Wallingford. 100% of pilot transfers were undertaken with no impediment to respond to emergency scenarios, **Figure 6-8**.

With regards wind direction and wind speed all parts of the compass rose were considered and a range of wind speeds were used, as agreed with IPs or suggested by IPs during the TEOW examination. **Figure 6-9** and **Figure 6-10** illustrate that at least 99% of pilot transfers were completed successfully in all wind directions, which reflects the marginal pilot transfers referred to above. Similarly, 99% of pilot transfers were completed successfully at all wind speeds. Again, this reflects the pilot transfers classified as marginal due to breaches of the 1nm buffer referred to above.

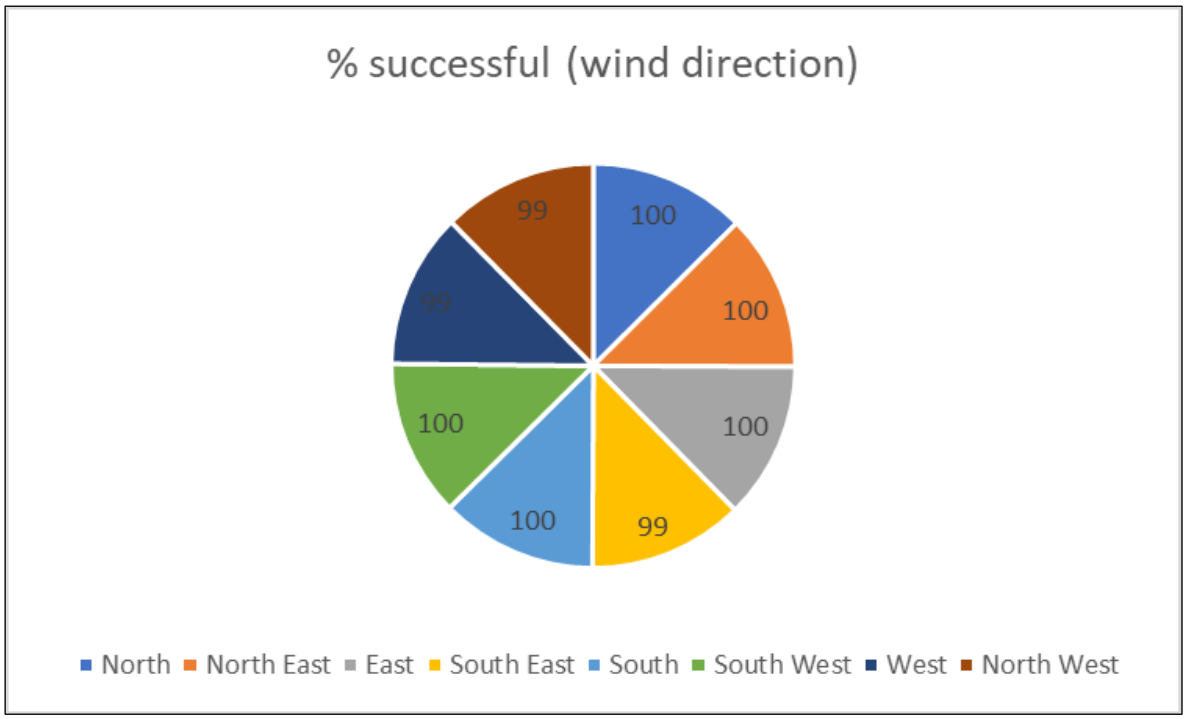

Figure 6-9 : Percentage of Successful Transfers with Respect to Wind Direction

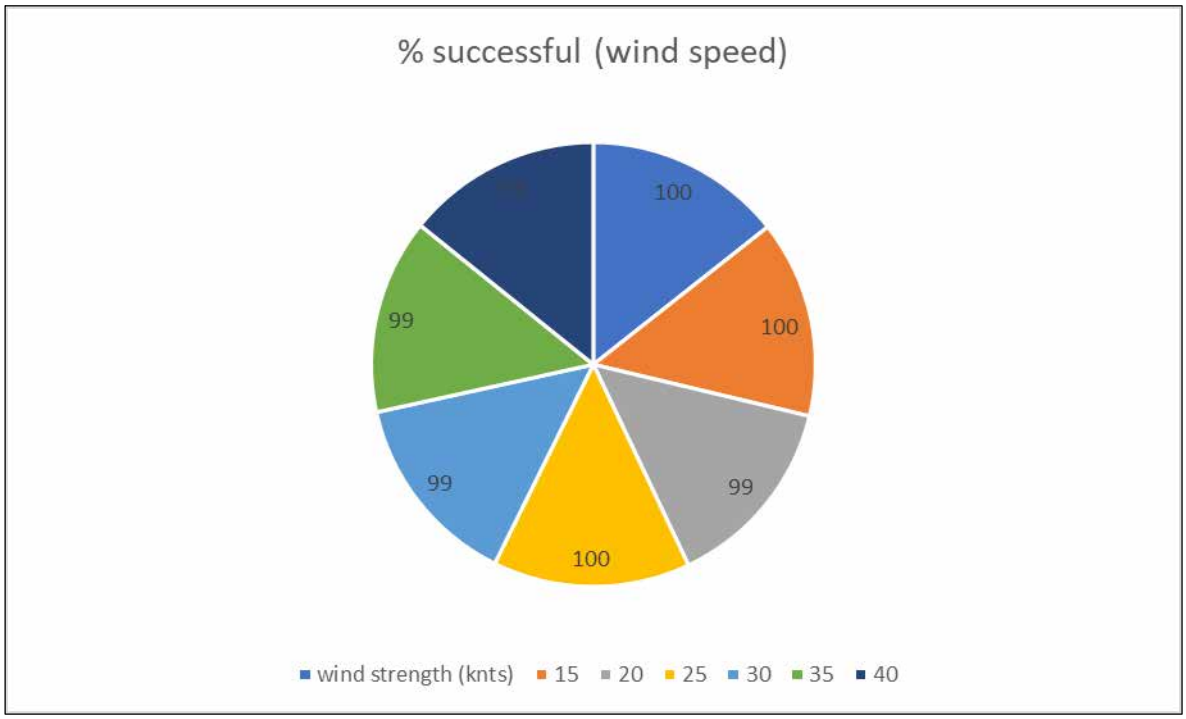

Figure 6-10 : Percentage of Successful Transfers with Respect to Wind Speed

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In summary therefore 159 pilot transfers were undertaken, 99% of which were undertaken successfully against the 'proximity to the proposed offshore wind farm' criteria, with 100% conducted successfully against all 5 other criteria inclusive of the ability to respond to emergency scenarios. This was notwithstanding that a wide range of challenging metocean conditions were simulated. Simulated pilot transfers were conducted safely in all wind directions and speeds, with all directions and strengths seeing at least 99% of transfers being completed successfully.

The 2019 PTBS thus confirms that there is sufficient sea room to undertake pilot transfers safely in all relevant metocean conditions.

7 OBSERVATIONS FROM THE 2019 SIMULATION

The following section describes the overarching observations of the 2019 PTBS. Initially observations are provided regarding the number of runs and individual pilot transfers simulated during the exercise, before presenting observations specifically relevant to pilot operations as simulated within the NE Spit region and the present observations of relevance to the independence of the study. The observations are made with the aim of helping the reader understand the underlying rationale of the study and a contextual analysis of the objective data already presented within this report.

7.1 Number of Runs

A common concern raised by IPs was the numerical adequacy of the number of simulation runs. Clearly different regions, locations, port jurisdictions and applications will take different approaches in defining the number of simulation runs appropriate. In setting up the 2019 PTBS in consultation with HR Wallingford, they indicated that the benchmark number of runs for a project of this size and complexity would normally require "between 15 and 40 runs which would be sufficient to draw relevant and meaningful conclusions on the study objectives." Accordingly, 40 simulated scenarios were set as the goal that would enable a detailed examination of each of the basic parameters including metocean conditions and pilotage operations in order to address the concerns raised by IPs during examination. As noted within the simulation specification report this was not proposed to be a critical limit to the number of pilot transfers explored, but a suitable number to allow investigation of the range of permutations discussed with IPs. The practical management of the simulation exercise was such that it allowed iterative investigation and in adopting this approach focus could be placed on the areas of investigation of most interest to IPs and the Examining Authority as highlighted during the examination; namely testing future baseline scenarios and the more challenging metocean conditions that may be experienced whilst also allowing further simulations to be undertaken dependent on the outputs of each simulation.

Ultimately 41 simulator runs involving 9 pilots and 5 coxswains, with 159 pilot transfer operations were completed and this is considered to not only represent a robust approach with regards to quantitative sample numbers, but importantly represents the end point of a study that was allowed to iteratively and independently analyse each of the most important parameters to their natural conclusion. HR Wallingford supported this in saying "In the case of the work carried out

for TEOW, the 41 runs and 159 pilot transfers over seven days of simulation, was considered adequate to meet the study objectives."

7.2 Pilot Transfer Operations and Simulation at the NE Spit

Pilot Transfer Timing: The length of time taken for each pilot transfer in the 2019 PTBS, as in real life, varied considerably according to the met ocean conditions and the type of vessel. The minimum time that the pilot cutter would spend alongside the target vessel in simulation was discussed at all stages during consultation and was eventually agreed at 90 seconds for embarkation and up to 3 minutes for disembarkations. It should be noted that whilst this was the minimum time planned to be alongside, in simulation it frequently exceeded this as the coxswains stabilised the cutter alongside – exactly as is done in real life. It is also important to note that this time **only** represented the time to disembark the pilot and did not include the additional 5 minutes included in the simulation to represent the time taken for the pilot to transit from the top of the ladder to the bridge or the time that the pilot cutter maneuvered for position before transfer. Lastly it should also be noted that the timings alongside for the 2017 PTBS as mandated by PLA pilots and ESL coxswains was considerably less than for the 2019 PTBS, and this was not raised as one of the issues to be addressed during examination submissions on the simulation scope from IPs (see **Annex A** and PLA/ESL response to ExQ3 REP7-043).

Positive Control: Notwithstanding that the simulation confirmed that there was adequate sea room for the independent pilots and coxswains to manoeuvre with TEOW in place, successful completion required positive management of ships' masters to manoeuvre their vessels as the local conditions demanded, as was also seen in the 2017 PTBS. This level of positive control is considered to be in line with best practice for pilotage operations universally.

Coxswain Situational Awareness: As was recorded in the 2017 PTBS, every run during the 2019 PTBS was completed safely and without any dangerous breach of the success criteria. As currently occurs in practice at the NE Spit, and as simulated for the 2019 PTBS and the 2017 PTBS, the way in which each run / transfer is executed relies on the skill of the coxswain to assess the position of the various vessels and from there to decide on an order for transfer. This is then communicated to the different ships by radio with enough time for them to manoeuvre safely. Provided that the coxswain has sufficient situational awareness of the position of ships, the coxswain is able to take early and firm charge of the arriving ships in order to run an efficient pilot station. Whilst the mechanisms of acquiring situational awareness may vary between pilotage

authority the need for the coxswain to take an informed charge of the ships is in line with current best practice.

Order of Embarkation: Common practice for pilot stations is to place embarking pilots on inbound vessels before disembarking the pilots from outbound ships; the result being that ships have a pilot embarked for longer on the assumption that a ship with a pilot conning (i.e. in control) will be safer than one with a Master who does not know the area or might not be used to handling his ship near others. This real-life practice was repeated throughout each simulation.

Roundabout: Finally, it can be observed from the track plots **(Annex F)** that often in complex multi ship situations with vessels arriving from a variety of directions, the most efficient way of safely organising ships presenting themselves for transfer is for them all to turn the same way and this quickly became known as the 'roundabout' in the 2019 PTBS. A similar solution emerged during the 2017 PTBS which indicates that pilots and coxswains familiar with the area and those not familiar with the area undertake operations applying a similar strategy suited to this region.

7.3 The Benefits of Independence

The Applicant's original intent for the 2019 PTBS simulation was to have had the local practitioners (PLA and ESL) conducting the simulation runs alongside independent mariners in order to demonstrate transparency, rigour and to attempt to achieve a degree of constructive collaboration in the process.

The PLA and ESL were unable to provide any input to the simulation, which meant that the Applicant was obliged to use independent participants throughout; 9 independent pilots and 5 coxswains were used, each who had only distant or limited familiarity with the area. This meant that rather than being able to call upon the available PLA and ESL expertise to inform the execution of the day to day operations of the NE Spit boarding area, the independent participants were obliged to rapidly develop their own techniques for managing and sequentially boarding multiple vessels in a complex selection of circumstances.

This unfamiliarity presented the participants with a much more demanding task than for persons who routinely do this as their professional employment. The fact that all of the independent pilots and coxswains (who both changed daily) were able to use their expertise to deliver safe and effective pilot transfer operations at the NE Spit with TEOW in place can only add to the authority and gravitas of the conclusions reached in the simulation.

It was notable that the independent mariners with experience from other UK ports felt that the NE Spit could be said to offer greater flexibility and safety than some other UK pilot stations because the NE Spit covers a greater geographical area in which to find a suitable boarding point.

Most importantly it must be noted that both the 2017 PTBS, which was conducted with full PLA pilot and ESL coxswain participation, and the 2019 PTBS conducted with independent mariners, reached exactly the same conclusions.

8 CONCLUSIONS FROM THE 2019 SIMULATION

1. The 2019 PTBS was conducted by independent and suitably qualified mariners, with 9 pilots and 5 coxswains involved. All pilots were qualified and experienced with boarding and handling of the largest vessels of the type using PLA waters;
2. Two pilots, one HR Wallingford pilot and one with prior unrestricted PLA experience were used for simulation set-up and test runs. Participants at the main simulation had no prior or recent experience of the NE Spit;
3. The simulator at HR Wallingford was independently verified to be accurate and realistic enough to produce results from which to draw meaningful conclusions;
4. The simulation used advanced technology and independent participants. Much was learned, but ultimately the same outcome was delivered as the simulation involving PLA and ESL during the 2017 PTBS;
5. All the marine professionals at the 2019 PTBS reported that the pilot boarding operations they conducted were safe, faithfully simulated and conducted independently;
6. The 2019 PTBS completed 41 simulator runs and 159 pilot transfer operations. This number is across a range of variable criteria, with a ratio of successful runs to marginal runs that allows statistical analysis and meaningful conclusions to be drawn;
7. All the independent marine professionals at the 2019 PTBS reported sufficient sea room was present with TEOW in place for pilot transfer operations to safely take place at the NE Spit, the Tongue and the Elbow;
8. There is enough sea-room at the NE Spit for vessels up to 333m to safely conduct pilot transfers with TEOW in place. This finding was the case in all traffic and metocean conditions applied at the simulation, specifically;
    a) Winds up to 45 knots North West through West to South.
    b) Winds up to 30 knots South through East to North West
9. There is enough sea room at NE Spit for vessels up to 400m to safely conduct transfers with the existing wind farm and TEOW in place, with the following risk control measures, recommended by pilots participating in the simulation:
    a) The transfers would have been fully risk assessed for the vessel and the conditions by the relevant authority and dynamically so by the conducting pilot prior to the vessel coming inshore and again prior to boarding;
    b) The transfer could take place at wind speeds up to 45 knots;
    c) The wind direction must be South South-West through West to West North-West;
    d) Under-keel clearance in accordance with PLA requirements and not less than 2m;

10. There is enough sea room for transfers to take place at the Tongue Deep Water pilot station for vessels up to 400m, with the existing wind farm and TEOW in place;
11. There is enough sea room for transfers to take place at the Elbow inshore boarding station for vessels up to 300m with the existing wind farm and TEOW in place;
12. The fact that IPs with local pilotage expertise did not attend resulted in a precautionary assessment, undertaken by fully independent mariners.

9 CONCLUSIONS ON TEOW IMPACT ON SHIPPING AND NAVIGATION

The 2017 PTBS was criticised by IPs during the TEOW examination, the argument being that as this simulation could not be relied upon, the Navigation Risk Assessment (NRA) and subsequent NRA Addendum (NRAA) were flawed.

The results of the 2019 PTBS demonstrates that the broad conclusions drawn in 2017, of there being sufficient sea room for ongoing pilotage in the area of the NE Spit, was correct and goes further by testing the full range of weather conditions as defined by IPs, locations and vessel sizes likely to be found in this area, now or into the future. As such both the NRA and NRAA can continue to be relied upon as robust assessments of navigational safety which conclude that the risks are As Low As Reasonably Practical (ALARP) and are therefore acceptable.

In conclusion, the 2019 PTBS is the most detailed and thorough navigation simulation undertaken for an offshore wind farm to date and has been openly and transparently carried out using a wholly independent provider and using independent mariners. The results of the 2019 PTBS are not only conclusive and robust in their own right, but also serve to corroborate and add weight to the conclusions reached through the NRAA and to the Applicant's case as a whole; that the project will not lead to unacceptable impacts on safety of navigation.

Annex A IP Comments and Applicant Response to the Simulator Specification

Table 9-1 : 2017 PTBS Reported Limitations and 2019 PTBS Two Solutions

Concern raised about the 2017 PTBS	How the 2019 PTBS addressed the concern
The 2017 PTBS was not adequately capable of realistically replicating metocean (wave height, visibility, and wind strength) conditions;	The HR Wallingford simulator is recognised as one of the most advanced facilities in Europe and appropriately replicates real world metocean conditions inclusive of wave height, visibility, and wind strength. After each simulation the independent participants were asked a series of questions confirming that the various parameters, including metocean conditions and vessel handling characteristics accurately reflected real world experiences. The anonymised participant outputs are provided in **Annex D.**
The 2017 PTBS did not adequately consider a sufficient range of wind directions and 'limit state' wind speeds;	The specification of the 2019 PTBS, as defined within the specification submitted for IP consultation in July 2019 and updated in August 2019, has closely aligned with the observations made in responses to the ExQ1 (ExQ1.12.3), in particular making reference to the extensive response provided by ESL/PLA with regards to wind direction and where evidenced wind strength as relevant to each of the pilot boarding stations.
The 2017 PTBS utilised pilots and coxswains with extensive local and site-specific knowledge;	The 2019 PTBS was conducted using independent pilots and coxswains from 3 separate pilotage districts, all of whom were suitably experienced and qualified to operate the full range of vessels in the simulation, including the largest container vessels; none had recent knowledge of the NE Spit.
The 2017 PTBS did not adequately account for a sufficiently wide range of emergency scenarios;	The 2019 PTBS has made full reference to the ESL incident record with regards potential emergency scenarios and frequency of occurrence in order to introduce appropriate incidents during simulation. Emergencies were introduced by HR Wallingford, the independent simulator operator, without prior notice and are recorded in the results, **Section 6** of this report.
All traffic in the 2017 PTBS, not under pilotage, behaved in full compliance with the rules of the road and this did not accurately represent the real-world experience;	HR Wallingford, as the independent simulator provider, introduced a series of non-compliant vessels during the 7 days of simulation in the 2019 PTBS.
The 2017 PTBS did not include the full suite of IALA buoys and other Navigation aids which are in place at the NE Spit to ensure safe navigation within the sea area.	Prior to the 2019 PTBS, Trinity House gave an up to date navigation aid plan for the wind farm and the NE Spit area for inclusion within the simulation.

Concern raised about the 2017 PTBS	How the 2019 PTBS addressed the concern
The 2017 PTBS was not capable of visually representing the wind farm and had to use moored barges to denote the extent of the turbines.	The HR Wallingford simulator provided full turbine animations and their locations were accurately modelled based on detailed plans provided by the Applicant.
In the 2017 PTBS, a tug boat was used as a proxy for the pilot cutter.	Full details of the pilot cutters used by ESL at the NE Spit were obtained from the vessel's manufacturer, then modelled by HR Wallingford and were used during the 2019 PTBS. The handling characteristics were then verified as being accurate by independent coxswains from 2 separate UK pilotage districts.
Non-AIS vessels not represented in the 2017 PTBS.	Non-AIS vessels were selected and represented by HR Wallingford in the 2019 PTBS.

Annex B Summary of Communications with IPs

Table 9-2 : Summary of Communications with IPs

IP	Date	Nature and Summary of Communication
MCA, Trinity House, PLA and ESL, Chamber of Shipping, London Pilot's Council, Ports of London Gateway and Tilbury	15th July 2019	Email identifying that the Applicant proposed to undertake a navigation simulation in order to provide greater confidence on the potential impacts that may arise following the change in red line boundary and introduction of the Structures Exclusion Zone, both of which were made post the original navigation simulation. Email provided a commitment to circulate the proposed navigation simulation, identified the preferred supplier and venue (HR Wallingford), and a proposed programme inclusive of requested consultation responses, simulation set-up day, and the navigation simulation itself.
	16th July 2019	Email providing the navigation simulation specification and inviting IP to take part as observers, advise on a preferred pilot and coxswain to participate in the simulation, and provide feedback on the specification report.
Trinity House	19th July 2019	Call (followed by emails during the same day) to discuss upcoming simulation, acknowledging that August was a challenge for IP attendance but should be possible. Offer made by Trinity House to provide a marked plan for aids to navigation to be incorporated within the navigation simulation.
	25th July 2019	Provision of indicative layout for the navigation simulation and lighting/marking plan.
	26th July 2019	Email correspondence between both parties regarding a change of schedule to move the proposed simulation to September to facilitate attendance by PLA and ESL.
	29th July 2019	Email correspondence confirming Trinity House attendance of the navigation simulation revised schedule (w/c 2nd September)
	30th July 2019	Receipt from Trinity House of operational phase marking requirements in relation to the indicative simulation layout.
	14th August 2019	Trinity House confirmed attendance via email for 2nd September with possible further attendance later in the week.
MCA	25th July 2019	Email correspondence between both parties following confirmation received from MCA that there were no

IP	Date	Nature and Summary of Communication
		concerns to raise regarding the content of the specification on this occasion. Confirmation also received regarding attendance of MCA at the simulation in an observer capacity.
	26th July 2019	Email correspondence between both parties regarding a change of schedule to move the proposed simulation to September to facilitate attendance by PLA and ESL. Confirmation received that MCA able to attend.
	21st August 2019	MCA confirmed via email, attendance on 2nd–4th September
PLA/ESL	19th July 2019	Email request made by PLA on behalf of PLA and ESL to consider moving the simulation outside of the main holiday period to allow IPs to be suitably represented. Applicant responded noting the challenges associated with August and asked if it may be possible to arrange pilots/coxswains on a shift pattern to alleviate some of the pressure whilst also broadening the range and therefore experience of participating pilots/coxswains.
	23rd July 2019	Email requesting confirmation of receipt of the specification and requesting confirmation of ability to attend.
	26th July 2019	Telephone correspondence with Cathryn Spain regarding limited ability for Richard Jackson (ESL) or Cathryn Spain (PLA) to attend during August, and a request made by the Applicant to confirm if September (w/c 2nd September 2019) would be more feasible. Confirmation received that September was better for PLA and general pilot/coxswain availability. Email correspondence between both parties confirming with PLA that Cathryn Spain (HM Lower) would be able to attend, and PLA would be able to provide a pilot.
	31st July 2019	Receipt of detailed feedback on the navigation simulation specification, and a request to revise the primary contact for ESL.
ESL	2nd August 2019	Email from ESL stating that due to staff leave roster and changes in ESL management, no staff could attend until October Telephone correspondence with ESL to discuss whether a member of ESL could attend for any part of the nav sim.
	5th August 2019	Telephone correspondence with ESL offering to pay for a coxswain's time to attend (as with the independent

IP	Date	Nature and Summary of Communication
		mariners), should that enable ESL to provide a participant. It was confirmed that this would not alter the situation.
	9th August 2019	Email to ESL asking whether attendance for only one or two days would be feasible. No response received.
PLA	9th August 2019	Call to Cathryn Spain (PLA) to confirm that the Applicant would cover the costs of their pilot to attend (in line with the offer to ESL and to independent mariners).
	22nd August 2019	Call to Cathryn Spain (PLA) requesting confirmation of which days PLA planned to attend and the name of their pilot. It was discussed that 2nd- 4th Sept has been kept free but did not confirm attendance. PLA would get back to the Applicant regarding the PLA pilot attendance.
	22nd August 2019	Email received from LPC (copying PLA) confirming that there would be no attendance from PLA pilots. The Applicant responded on 23rd August reconfirming the offer made to PLA on 9th August that the costs for a pilot to attend would be met; no response was received.
	28th August 2019	Call to Cathryn Spain (PLA) requesting confirmation of PLA's attendance. Subsequent email confirmed non-attendance.
London Pilot Council	18th July 2019	Email correspondence regarding the challenge for LPC to attend due to summer leave pressure on pilotage operations, and regarding provision of commentary on the draft navigation simulation specification report. LPC providing confirmation that feedback would be provided but requesting flexibility around provision of comments and requesting the nav sim be moved out of the August holiday period. Applicant acknowledged challenges and asked if any participants may be available, acknowledged that if any commentary could be provided in advance of the set-up day every effort would be made to accommodate it.
	19th July and 23rd July 2019	Further email offering to meet directly in person or via telephone to help facilitate feedback.
	26th July 2019	Email correspondence notifying LPC of potentially moving the navigation simulation to September to ease roster constraints for PLA, ESL and LPC.
	31st July 2019	Email correspondence between both parties providing confirmation that LPC are unable to attend in August but would be able to attend in September, and that

IP	Date	Nature and Summary of Communication
		feedback on the navigation simulation would be provided by the 6th August.
	22nd August 2019	Email received from LPC confirming that they (and PLA pilots in general) would not be attending the navigation simulation, citing the cost of providing a pilot. The Applicant responded on 23rd August reconfirming the offer made to PLA on 9th August that the costs for a pilot to attend would be met; no response was received.
Ports of London Gateway and Tilbury	23rd July 2019	Email correspondence between both parties regarding confirmation of receipt of the specification and confirmation of ability to attend August simulation.
	26th July 2019	Email correspondence between both parties regarding a change of schedule to move the proposed simulation to September to facilitate attendance by PLA and ESL.
	29th July 2019	Confirmation received regarding attendance at the rescheduled navigation simulation.
	30th July 2019	Joint (ports) response to the navigation simulation specification report. Separate email providing provisional confirmation regarding attendance of the navigation simulation by port harbour masters, subject to diary constraints.
	15th August 2019	Email correspondence raising concerns regarding the Applicant's proposed traffic levels and clarifying the role of HRW during the examination. Traffic levels used for simulation and the logic of these are discussed in **Section 5.2**.
Chamber of Shipping	29th July 2019	Email correspondence between both parties confirming satisfaction with the navigation simulation specification, approval of the choice of 360-degree full mission simulator and offering to assist in sourcing master mariners but confirming that attendance in August would be challenging. Applicant responded with revised dates (w/c 2nd September) and declined offer of master mariner, confirming that PLA had provided confirmation that a pilot would be provided on behalf of IPs.
	30th August 2019	Email correspondence confirming CoS would not be able to attend the simulation but that they were content with the simulation specification.

Annex C Set Up Day Report

Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

PILOT TRANSFER BRIDGE SIMULATION - SET-UP REPORT

Submitted by Vattenfall Wind Power Ltd

Date: August 2019

Revision A

Drafted By:	Vattenfall Wind Power Ltd
Approved By:	Daniel Bates
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Revision:	A

Revision A	Original document submitted to the Examining Authority

MARICO MARINE

GOBE CONSULTANTS LTD

THANET EXTENSION OFFSHORE WIND FARM: PILOT TRANSFER BRIDGE SIMULATION - SET-UP REPORT

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MARINE AND RISK CONSULTANTS LTD

GOBE CONSULTANTS LTD

THANET EXTENSION OFFSHORE WIND FARM: PILOT TRANSFER BRIDGE SIMULATION - REPORT

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1 INTRODUCTION

GoBe Consultants Ltd on behalf of Vattenfall Wind Power Ltd (Vattenfall) commissioned Marine and Risk Consultants Ltd (Marico Marine) to manage a second bridge simulation following concerns in respect of the first bridge simulation, raised by interested parties (IPs) during the examination into the Thanet Extension Offshore Wind Farm (TEOW) development consent order (DCO) application.

In order to maximise simulation run time being held in September 2019, an advance set-up day was arranged for 14th August 2019. Following the set-up day, additional test runs were undertaken on 15th August to validate the proposed set-up. Whilst the test runs do not form part of the formal simulation, the considerations for the set-up that emerged from these runs are summarised in this report.

The purpose of this document is to record the findings, in relation to the configuration of the set-up, of the set-up day on 14th August 2019 and subsequent test runs that were conducted on the 15th August at HR Wallingford. The findings recorded in this report will inform the simulation scheduled to take place from 2nd-6th and 9th-10th September, 2019. This report should be read in conjunction with Revision C of the TEOW Navigation Simulation Specification and the Response to IP Feedback.

The recommendations made in this report will be discussed with IPs who attend the simulation on Monday 2nd September, and will be continually refined during the simulation based on feedback and comments received from participants.

1.1 OBJECTIVES

The objectives of the set-up day and test runs held on 14-15th August were:

- In the light of concerns raised on the PLA simulator in Gravesend (used for the first simulation), to assess the suitability and accuracy of the simulator at HR Wallingford for the simulation scheduled for 2-6th and 9-10th September.
- To conduct test runs for the NE Spit Pilot station, in terms of the metocean conditions and background shipping levels discussed during the examination phase of the application, to inform proposed set-up and simulation runs.
- To conduct test runs at the Tongue pilot station and at the Elbow buoy, as for the NE Spit (described above).

2 MANAGEMENT ARRANGEMENTS

The simulation was specified, and the set-up was managed by Marico Marine. For independence, Marico provided marine experienced personnel to direct and manage the project who had not been party to the earlier issue specific hearings, with one exception. Commander Paul Brown, also a serving pilot, had limited involvement in the hearings, but provided continuity and a necessary maritime pilotage link to specify and attend the simulations.

2.1 PERSONNEL ATTENDING SIMULATION SETUP

Personnel	Details	Role/Responsibility	Location
Mr A Cocuccio	Marico Marine	Project Director	Observer
Cdr P Brown	Marico Marine (serving Pilot)	Project Manager / Pilot 2	Ship Bridge 2
Independent Pilot 1	400M Vessel serving pilot	Ship Master / Pilot 1	Ship Bridge 1
Independent Pilot 2	Proposed by HR Wallingford	Sim Control / Pilot	Control Room
Independent Coxswain	Independent Coxswain	Pilot Launch Coxswain 1	Bridge 3
Mr J Woodhams	HR Wallingford	Simulator Manager	Control Room

3 SET-UP RUNS SUMMARY

3.1 SET-UP DAY

The primary objective of the set-up day, held on 14th August 2019, was to establish that the HR Wallingford simulator provided accuracy, suitability and appropriate vessel models for the simulation. The depiction and location of turbines and presentation of the existing Thanet Wind Farm and proposed TEOW when developed, also required verification.

A number of minor adjustments were made to the set-up to ensure that the operation and representation of the simulator was as accurate as possible. Six test runs were carried out during the set-up day. After the pilots and the coxswain confirmed that all vessel types and the pilot boat to be used for the boarding operation were behaving as expected a first run was undertaken. This

was a single-ship run which enabled all participants to observe the operation of the simulator completing a pilot boat to vessel pilot transfer. Feedback from pilots and the coxswain was also taken about boarding and disembarking and time alongside.

The remaining five test runs involved multiple ships with both main bridges manned by experienced, appropriately qualified and current pilots. Each test run was comprehensively debriefed and all test runs undertaken were reported by participating pilots to have been successful when measured against the criteria. Participants agreed that the simulator was suitable to conduct the simulation scheduled for 2-6th September, 2019 and if necessary, for further contingency days, to be held on 9-10th September 2019.

3.2 TEST RUNS FOLLOWING SET-UP

The simulator was available for a day following the set-up, on 15th August 2019. This time was utilised by undertaking six set up validation runs. These rapidly increased in complexity with each test run, which validated that all the specified criteria for simulation were in place and appropriate for the simulation to be undertaken in September 2019.

4 CONDUCT OF THE SIMULATION

The draft specification document covered the entire simulation process, including the set-up period. The set-up period was designed to help finalise the specification document, taking into account the feedback from IPs and the experience gained in simulation set-up.

Independent current pilots, with large vessel authorisation from other UK pilotage districts were engaged to validate the simulation set-up. In addition, HR Wallingford provided their own independent Class 1 400m vessel qualified pilot to ratify this. There were three independent participants with active roles in tuning and confirming the simulator ensured real-world accuracy. All test-runs, with the exception of run 1, were conducted with the proposed indicative wind farm layout for TEOW in place.

Each run was conducted in accordance with the set-up day programme outlined in the specification report. The set-up of each run was discussed by participants in advance and where necessary amended to ensure relevance to pilotage operations and the area. At debriefs, each independent representative was asked to provide detailed feedback and comment. Commander Paul Brown, Marico project manager, took responsibility for set-up programme management, ensured each run met the set-up objectives and facilitated briefs and debriefs.

Commander Brown provided no input to conclusions drawn on simulator validity, which was provided by the independent participants only.

5 RECOMMENDATIONS FOR 2ND-6TH SEPTEMBER AND 9-10TH SEPTEMBER

A summary of the recommendations arising out of the set-up day and subsequent test runs, is presented in this section.

5.1 SIMULATOR SHIP MODELS

Both independent pilots validated, and where necessary, made minor amendments to the handling characteristics of the ship models used by the HR Wallingford simulator. It was considered that the models selected were reproduced with sufficient accuracy to ensure pilot transfer simulations are representative and therefore meaningful conclusions can be drawn from the simulation.

Recommendation: No change.

5.2 SECOND MANNED SHIP

The ability to add a second manned ship during the simulations doubled the number of transfers and interactions capable of being achieved during each simulator run. In addition to the 23 transfers completed during the set-up (12 runs; 11 double manned) this will enable up to 60 transfers during the period 2nd-6th September and a further 12 transfers during the period 9-10th September. Therefore, in total, double manning the simulator could allow the completion of 95 pilot transfers during the simulations.

Recommendation: Run a second bridge during 2-6th September and also if contingency days are used, on 9-10th September.

5.3 HR WALLINGFORD INDEPENDENT PILOT

HR Wallingford provided their own Class 1, 400m vessel qualified pilot to support the test runs. This role, as the HR Wallingford representative together with the other independent pilots, ensured real-world accuracy and impartiality during the test runs.

Recommendation: Request HR Wallingford to provide their own independent senior pilot during the simulations where possible to support the other independent pilots.

5.4 PILOT TRANSFER TIMES

It quickly became apparent that the recommended 2-3 minute time allowed for the pilot to climb a ladder was over cautious. After feedback from both serving pilots and the coxswain, it was recommended that for pilot embarkation, a 1 minute period for pilot cutter alongside would be allowed but for disembarkation a 2-3 minute period would be retained; this reflects the greater difficulty in disembarkation and increased caution experienced by all pilots as they climb down a rope ladder to a pilot vessel. It should be noted that this time is in addition to the time already allowed for a pilot to proceed from the top of the embarkation ladder to the bridge or vice-versa. It was also noted that the PLA embark 2 pilots for vessels over 300m and so in these cases a minute alongside per pilot would need to be allowed.

Recommendation: 1 minute for Pilot embarkation; three minutes for disembarkation.

5.5 BACKGROUND SHIPPING

During test runs, background traffic was incrementally increased such that for the test runs on 15th August background traffic was represented under the heavy+ scenario (as defined in the specification) or 14 ships an hour. The additional ship timings were controlled and directed by the HR Wallingford staff to mimic real life traffic flows as accurately as possible. Both independent pilots had some previous experience of the study area and reported that heavy+ traffic flows were at an unrealistically high level, but noted this was to simulate increases in traffic from potential future growth, it would build incrementally over time. These traffic levels, representing traffic-volume growth, were to be retained for the simulation.

Recommendation: Allow background traffic to build incrementally over main simulation timeframe.

5.6 METOCEAN CONDITIONS

Both independent pilots and the coxswain agreed that the HR Wallingford simulator reproduces metocean conditions with sufficient accuracy to ensure pilot transfer simulations are representative and therefore that meaningful conclusions can be drawn from the simulation.

Recommendation: No change.

5.7 EMERGENCIES

One emergency situation was tested during test run 4. This simulated an engine failure, after the pilot transfer had occurred and while the vessel was 1nm from TEOW, with the wind and current setting the ship towards the wind farm rotors. The engine failed, the ship was steered until it lost way and stopped, then the anchor was dropped.

Whilst no further emergencies were simulated during the test runs, the participants considered that including emergencies in 10% of all runs was unrepresentative and unnecessary to test the full range of emergency scenarios.

Recommendation: 1 or 2 vessels per day should simulate emergencies during runs.

5.8 400M TRIPLE E AND 366M PANAMAX SHIPS

Both independent pilots and HR Wallingford Staff agreed that it is not feasible to bring 400m or 366m ships into the NE Spit, either on transit or for transfer irrespective of the presence of TEOW. This was due to the limiting depth at the NE Spit being 11.6m (@Chart Datum – i.e. no tide) and the likely draught of vessels of this size typically being in the region of 12-15m (at the time of writing the Madison Maersk (400m) was discharging at Felixstowe, showing a draught of 12.2m). There was no evidence that a vessel of this size has come to the NE Spit or transited through the area and, in any event, this involved a significant detour for a ship on its way to London Gateway.

Given the shallow water depth relative to the draught of the vessel, participants commented that the area would be tagged as a no-go zone in a large vessel's ECDIS (electronic charting system). Participants reported a firm conclusion that it was not credible to undertake a simulation run that would not be allowed to occur either by design or by vessel's bridge teams and would not be recommended by an attending pilot.

During simulation, pilot transfers of 366m ships were conducted to the NE of the Tongue pilot station. Participants were strongly of the view that this part of the simulation was geographically so far removed from TEOW, that it had little relevance to the placing of TEOW.

Recommendation: Boarding for ultra large vessels will only take place during the simulation in the waters to the NE of the Tongue.

5.9 EXISTING WIND FARM SIMULATIONS

The original proposal was to conduct 10 simulations with the existing Thanet Offshore Wind Farm layout, in order to understand existing movements of ships of up to 400m being brought into the NE Spit, either for transit or for transfer by the Ports of Tilbury and London Gateway. However, in view of the feedback from participants as set out above, and subject to the views of LPC, it is proposed that this simulation will only occur to the NE of the Tongue pilot station. However, in order to establish a baseline, up to five simulator runs will be conducted with the existing Thanet Offshore Wind Farm in place, 2 runs on day 1 and 3 on day 5.

Recommendation: Conduct up to 5 runs with the existing wind farm in place to establish a baseline.

5.10 333M SHIPS

Ships 333m in length were brought through for pilot transfer operations at the NE Spit, although it should be noted that both independent pilots considered that conditions allowing this in the shallow waters of the NE Spit were very limited. It was recommended that runs should only be simulated with conditions of less than 25kts of wind and with no more than 1 hour either side of High Water.

There is evidence of only one 333m vessel transiting the inshore route, with only two 333m vessels being served at the Tongue. Participants felt that this reflects a reticence of pilots to undertake transfers at the NE Spit diamond for vessels of this size and draught. Thus, irrespective of the placing of TEOW, frequent future transfers were considered to be unlikely by the independent participants.

Recommendation: Undertake transfers for 333m ships during the simulation, but only in conditions with less than 25kts of wind and no more than 1 hour either side of HW.

5.11 PROXIMITY CRITERIA

Both independent pilots reported that the approach distance to the wind farm limit (criteria) were cautious for transiting vessels – albeit allowing a significant safety-margin. Participants considered that a vessel leaving or arriving in the area is unlikely to remain outside of 1nm from the wind farm, and noted that this is supported by AIS data evidence which suggests a preference for vessels to cut-corners as they proceed on transit. The transiting distance of vessels was discussed and 0.5nm was set as the minimum distance vessels would generally allow when transiting, although AIS records did evidence some vessels passing closer than this to the existing Thanet Offshore Wind Farm.

Notwithstanding this, it was accepted that the specified proximity criteria should be applied during transfer operations.

Recommendation: The success criteria for proximity are altered to refer to Pilot transfer operations only.

6 CONCLUSIONS

- The simulator at HR Wallingford is of suitable accuracy to be used in the simulation to demonstrate feasibility of pilotage, scheduled for 2-6thSeptember 2019, including the contingency days to be held on 9-10th September if required.
- 12 test runs were conducted in which 23 pilot transfers were completed in metocean conditions with background shipping levels that incrementally increased in complexity. These runs informed and validated the recommendations made in section 5 and these recommendations will be adopted for the simulations undertaken on 2-6th September (and 9-10th September if required), subject to IP comments.
- These recommendations and the general set-up will be discussed with IPs who attend the simulation on Monday 2nd September, and continually refined during the simulation based on feedback and comments received from participants.

Annex D Independent Mariner Feedback Sheet

Date	Day	Do you think the scenario was representative of potential conditions (metocean/ traffic/ number of transfers etc) under which the operation could be undertaken in reality	Do you think simulation accurately represented the operation?	were you comfortable with sea room and the proximity of your vessel to the wind farm during simulation?	Were you comfortable in managing safe navigation of the vessel at all times during the simulation?	Please provide any additional comments you would like to make on the simulation run.	Simulation Criteria 1 (control of vessel)	Simulation Criteria 2 (clearance to wind farm (contact risk))	Simulation Criteria 3 (under keel clearance)	Simulation Criteria 4 (collision risk)	Simulation Criteria 5 (time available for 1 person pilot transfer)	Simulation Criteria 6 (capacity to respond to emergency)	Transcription Notes
5/09/2019	4	yes	yes	yes	yes	As close as you are going to get in simulation.	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	vessel was having problems maintaining speed and steering way. Lost steering and [anchored] by NESpit buoy	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	straightforward manoeuvre heading S, then swinging hard round to starboard tohead N to embark a pilot. Minor traffic.	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	I decided to followout the container ship and follow a similar swing t starboard ti make a N heading for a lee. I kept 1/2 mile off min from wind farm	successful	marginal	successful	successful	successful	successful	assumed from narrative description
5/09/2019	4	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	planned to swing the ship into the wind away from the wind farm, conscious of the 11.1m patch to the west	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	bad weather from NW, although rough all ships serviced safely	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	very heavy weather from the NW, ships were boarded below or close to the Elbow Buoy. Operations were conducted safely	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	I proceeded south towards N.Foreland in to fairly shallow water so as to give max room and time to swing to port and disembark pilot. The UKC was a bit less than desirable in these conditions so in hindsight would keep in deeper water	successful	successful	marginal	successful	successful	successful	based on narrative it could be a marginal, but may have been a success (but shallow)
5/09/2019	4	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	straightforward run	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	vessel difficult to steer sometimes and did not react quickly to full ahead bursts	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	very heavy weather pilot launch remained within a couple of miles of the elbow which would be the case in the weather conditions prevailing	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	I maintained a considered safe distance to the wind farm bearing in mind i had a large container ship and a large gas carrier outward seabound west of me, knowing I had to swing to starboard to board my pilot	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	This run was nearer to the limit. The simulation does not represent the roll of the ship very well when beam onto the sea, I think in a real situation this boarding and landing may not have been possible	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	heavy weather conducted operations between the Elbow and NE Spit boarding area	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
5/09/2019	4	yes	yes	yes	yes	vessel seemed underpowered for this type of vessel. Developed larger rate of turns than I would have expected. Apart from that plenty of searoom to manoeuvre to embark pilot on NW heading challenging conditions, brought the container ship down to NE Spit pilot boarding area then turned him North pointing him in the direction he wished to go. Car boat no problem standard bad weather disembarkation.	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	routine pilot transfer	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	particularly chaotic traffic management (where was VTS!) but definitely a good exercise in view of the chaotic traffic. Good simulation	successful	marginal	successful	successful	successful	successful	marginal due to slight impingement on OWF distance
2/09/2019	1	yes	yes	yes	yes	I'd still like full chart info on ECDIS display to make a proper and professional assessment of available water and potential hazards (cables etc) in emergency scenario	successful	successful	successful	successful	successful	successful	emergency anchor scenario
2/09/2019	1	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	straight forward pilot transfer	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	straight forward pilot transfer	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	as we settled into the exercise we had a port swing so found myself closer to elbow buoy than I'd originally planned	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	straight forward pilot transfer	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	Grande class vessel too slow in prevailing conditions	successful	successful	successful	successful	successful	successful	Grande model reverted at this stage from 'manouevering mode' to 'sea mode'
2/09/2019	1	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	In reality the chart would have had a passage plan	successful	successful	successful	successful	successful	successful	common initial theme regarding a passage plan having been drafted prior to any navigation

2/09/2019	1	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
2/09/2019	1	yes	yes	yes	yes	A focal point on the ship for the pilot launch [to target] is needed	successful	successful	successful	successful	successful	successful	This was added to all models after this request
2/09/2019	1	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
3/09/2019	2	no	yes	yes	yes	lack of intership communications, pilot boat had to alter ships to safe heading	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	sufficient sea room for vessel concerned	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	The shipping control is sadly lacking, leaving the burden on the pilot coxn's shoulders!	successful	successful	successful	successful	successful	successful	common theme regarding VTS/shipping control role that is present in other pilotage districts but not at NE Spit
3/09/2019	2	yes	yes	yes	yes	routine pilot transfer, considering the poor manouevering characteristics of the vessel. No undue issues	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	routine pilot transfer - no issues	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	a large container vessel such as this in ballast with similar wind condition may be more challenging	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	routine pilot transfer - no issues	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	routine pilot transfer - no issues	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	comfortable large alteration to make lee with ample sea room	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	the sea conditions were not accurate for the wind speed - too calm	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	routine pilot transfer - no issues	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	lee for disembarkment not as good, could be dangerous	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	very straightforward approach. Initial vessel position may be questionable otherwise no isse	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	we slowed down the outbound ships to get pilots on the inbound ships to enable pilot to pilot contact before disembarking pilots. The operation was completed as per textbook multi pilot landing/disembarking.	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	important to have two coxswains on pilot boat to cope with planning of ship boarding and landing in a reduced area	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	the whole situation felt very straightforward	successful	successful	successful	successful	successful	successful	
3/09/2019	2	yes	yes	yes	yes	Grande vessel: asked to reduce speed to minimum on approaching NE Spit pilot station. Swing to starboard to give the required NEly heading - due to fishing vessel on port quarter, and swinging away from wind farm into wind and tide, this minimising set towards the wind farm.	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	The lee was changed several times during the exercise as was the boarding station. Didn't effect the afety of the situation however and I could have created a lee in whichever boarding we had already agreed.	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	no	yes	yes	Because the pilot boat failed to operate as instructed during the pre-exercise briefing	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	group of various of various ships in a smaller area but no problem boarding using the natural lee of the land.	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	no	yes	yes	simulated sea conditions not accurate, appeared to be south east wind and swell.	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	required to close to less than one mile from wind farm due to outward bound traffic	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	no	yes	yes	NE 25 knots would slow the progress of the pilot boat. Pilot boat still able to make way at full speed. Serving two ships at tongue boarding area in these conditions would take longer than simulated due to bad weather.	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	comfortable simple run into the pilot station in the given circumstance	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	no	coming down from the north east, passage plan had me passing over 2 swpt wrecks of less than my draft.	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	Long run to the north to board but otherwise normal.	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	as a captain I would be happy boarding 1.5 mile east of the diamond in more sea room. Half a mile north of wind farm and heading away.	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	simple manouevre with ample room	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	normal operation	successful	successful	successful	successful	successful	successful	
4/09/2019	3	yes	yes	yes	yes	normal boardings and landings including deep draught vessel in rough conditions	successful	successful	successful	successful	successful	successful	

		yes	yes	yes	yes	pilot transfers undertaken further north than normal, 'Grande' ship had to turn away from and further to sea, causing a delay for pilot boat	successful	successful	successful	successful	successful	successful
4/09/2019	3											
4/09/2019	3	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
4/09/2019	3	yes	yes	yes	yes	I would not have seen as comfortable if vessel was anchored in the deepwater anchorage	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	Boarded all pilots before disembarking 2 from outbound ships	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	closed to within 0.7nm once pilot on board	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	misinterpretation of AIS data - wrong vector length	successful	successful	successful	successful	successful	successful
		yes	yes	yes	yes	enough sea room evident and swing to port without having to wait for [beatric] to clear. Felt more open than home port conditions.						
6/09/2019	5						successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	rough weather but all boardings completed successfully.	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
		yes	yes	yes	yes	Brough triple E down from North and swung him to starboard on to a heading of 330 to make a lee. Previously boarded two vessels from the south and established the headings required to board pilots.						
6/09/2019	5						successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	good conditions all ok	successful	successful	successful	successful	successful	successful
		yes	yes	yes	yes	roro lost steering and aborted run, pilot remained aboard and ran to anchor. The others proceeded south to pilot area and embarked/disembarked as planned						
6/09/2019	5						successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
		yes	yes	yes	yes	330o course - room ahead [hence?] turn commenced further [SD?]						
6/09/2019	5						successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
6/09/2019	5	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	oodles of room	successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	5 ships managed safely	successful	successful	successful	successful	successful	successful
		yes	yes	yes	yes	Difficult with easterly winds and a melley of ships which we sorted as they approached the area we were working						
9/09/2019	6						successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
		yes	yes	yes	yes	One tug in, then pilots to be disembarked from four ships including a large ship coming from the North to drop his pilot. All went well and all ships were served safely.						
9/09/2019	6						successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	Kept east in knowledge that I had to swing through west to NW for lee. Plenty of room	successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	Large container ship on my port beam matched speed and swung once container ship swinging. Plenty of sea room	successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
		yes	no	yes	yes	232m 8m draft - 35 knot beam wind would have been very unlikely to steer in realitty and probably would have needed more engine speed to maintain course. No issues with searoom or other vessels						
9/09/2019	6						successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	90m gas carrier handled as expected, no traffic issues	successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	no	yes	yes	sim [stalled?] at one point. Launch couldn't pull clear	successful	successful	successful	successful	successful	successful
		yes	yes	yes	yes	A large car carrier was introduced which provided a different line of thought landing a pilot owing to the large amount of leeway. All operations carried out successfully.						
9/09/2019	6						successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	Vessel handled as expected	successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	Ships organised into a starboard turn line and with some adjustments to boarding order all went off ok	successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	anti-clockwise roundabout, realistic sea conditions for launch	successful	successful	successful	successful	successful	successful
		yes	yes	yes	yes	lethargic LNG ship, steam powered. Felt v.strong wind - big leeway - v realistic. Given 12m draft and safety contour was mindful of limited searoom in wind conditions. Mindful of vessel limitations versus vessel handling.						
9/09/2019	6						successful	successful	successful	successful	successful	successful
		yes	yes	yes	yes	Container had a ladder problem so aborted boarding to allow rthem time to sort themselves out, normal stuff. Normal day at the office						
9/09/2019	6						successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	A starboard turning roundabout (vertual) was set up. Ships in a line astern which worked well.	successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	Lost steering when 1.5 miles west of wind farm. Vessel swung head to wind, repaired steering and continued on passage.	successful	successful	successful	successful	successful	successful
		yes	yes	yes	yes	was told to observe 1' exclusion zone, squeezed this slightly to 9.5cables due to commercial pressure. Wind farm at 1' felt comfortable.						
9/09/2019	6						successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	The clockwise roundabout worked well.	successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	passed 1 mile to west on southerly heading with 2 nothbound ships to east of me. Felt like there was plentiful searoom.	successful	successful	successful	successful	successful	successful
9/09/2019	6	yes	yes	yes	yes	Simulator didn't feel like NW wind at 25 knots.	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	One usual 'pattern of life' medium/small ships - oodles of room.	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful

10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	Headwind seemed to hinder forward speed more than would be expected in reality?	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	borderline for launch	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	ideal when turning into wind rather than away from it	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	The sea conditions were such that the pilot launch proved to be a bit of a handful!	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	Sea state marginal	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	wind and sea graphics very realistic	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	[simulation accurate] but not a situation (risk v searoom) which I would be comfortable as a 'routine'. [comfortable with searoom] yes, given the rate of turn achieved - abort option would have been to head out to SE if rate of turn insufficient. Just comfortable in the circumstances.	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful
10/09/2019	7	yes	yes	yes	yes	no comments	successful	successful	successful	successful	successful	successful

Annex E HRW Run Report Grid

Thanet Extension Wind Farm

Simulation Days

2nd to 6th, 9th to 10th September 2019, HR Wallingford Ship Simulation Centre, Oxfordshire.

Attendees

Marico Marine

Paul Brown

Andre Cocuccio

Graham Bishop

Vattenfall

Dan Bates

Chris Leamon

Darryl Hall

GOBE Consultants

Sean Leake

HR Wallingford

Jonathan Woodhams

Daniel Bruce

Henry Cruickshank

Pilots

Pilot 1 (P1)

Pilot 2 (P2)

Pilot 3 (P3)

Pilot 4 (P4)

Pilot 5 (P5)

Pilot 6(P6)

Pilot 7 (P7)

Pilot 8 (P8)

Pilot 9 (P9)

Coxswains

Coxswain 1 (C1)

Coxswain 2 (C2)

Coxswain 3 (C3)

Coxswain 4 (C4)

Coxswain 5 (C5)

Observers

Rakesh Pandit (MCA)

Trevor Harris (Trinity House)

Trevor Hutchinson (Consultant for Port of London Gateway and Tilbury)

Table 1: Simulator run summary

Run ID (Coxswain)	Layout	Tide	Visibility	Wind (from)	Waves (Hs, Tp, dir N)	Traffic	Vessels (Pilots)	Manoeuvre	Requested and actual heading (°N)	Run grading criterion					
										1: Control	2: Clearance to wind farm	3: UKC	4: Clearance to traffic	5: Transfer time available	6: Emergency margin
01 (C3)	Existing	HW	Day Good 25nm	SW 15 Knots	0.6m 6.0s 225°N	Light	148m Container ship (P3)	Inbound	Requested: 315°N Actual: 310°N	Good	2.4nm	12.6m	Good	Good	Good
02 (C2)	Existing	HW + 5hr	Day Moderate 3.5nm	NE 30 knots	2.0m 6.0s 045°N	Medium	236m ConRo “Grande” (P4)	Inbound	Requested: 300°N Actual: 300°N	Good	2.5nm	3.0m	Good	Good	Good
							93m Tanker (P3)	Outbound	Requested: 111°N Actual: 110°N		3.3nm	10.0m			
03 (C3)	Proposed	HW	Day Good 25nm	SW 15 knots	0.3m 6.0s 225°N	Light	148m Container ship (P3)	Inbound	Requested: 310°N Actual: 310°N	Good	1.8nm	12.6m	Good	Good	Good
04 (C2)	Proposed	HW + 1hr	Day Good 25nm	NE 15 knots	0.3m 4.0s 045°N	Medium	156m Cruise Ship “Silver Cloud” (P4)	Inbound	Requested: 350°N Actual: 346°N	Good	1.9nm	13.0m	Good	Good	Good
							148m Container ship (P3)	Outbound	Requested: 140°N Actual: 142°N		2.5nm	12.0m			
05 (C3)	Proposed	HW -2hr	Day Moderate 3.5nm	NE 25 knots	2.0m 6.0s 045°N	Medium	156m Cruise Ship “Silver Cloud” (P3)	Inbound	First requested: 250°N Final requested: 330°N Actual: 330°N	Good	1.3nm	15.0m	Good	Good	Good
							148m Container ship (CR)	Inbound	Requested: 340°N Actual: 340°N		1.0nm	12.0m			
							148m Container ship (P4)	Outbound	Requested: 120°N Actual: 120°N		2.5nm	10.0m			
06 (C2)	Proposed	HW +2hr	Day Good 25nm	NW 25 knots	1.5m 6.0s 315°N	Medium	148m Container ship (P4)	Inbound	Requested: 180°N Actual: 170°	Good	1.0nm	16.0m	Good	Good	Good
							120m Heavy Lift ship (P3)	Outbound	Requested: 145°N Actual: 145°N		2.4nm	9.1m			
							162m RoRo (CR)	Outbound	Requested: 150°N Actual: 150°N		2.6nm	7.5m			
							93m Tanker (CR)	Inbound	Requested: 170°N Actual: 170°N		1.2nm	15.1m			
06a (C3)	Proposed	HW +2hr	Day	NW 25 knots	1.5m 6.0s	Medium	148m Container ship (P5)	Inbound	Requested: 270°N Actual: 270°N	Good	2.0nm	12.0m	Good	Good	Good

Repeat of Run 06 due to marginal			Good 25nm		315°N		93m Tanker (CR)	Inbound	Requested: 180°N Actual: 195°N		1.4nm	15.5m			
							120m Heavy Lift ship (CR)	Outbound	Requested: 090°N Actual: 090°N		2.8nm	6.0m			
							236m ConRo (P3)	Outbound	Requested: 045°N Actual: 045°N		2.4nm	7.0m			
07 (C4)	Proposed	HW -5hr	Dusk Low 1.5nm	SE 25 knots	2.0m 6.0s 135°N	High	148m Container ship (P5)	Inbound	Requested: 325°N Actual: 336°N	Good	1.3nm	8.4m	Good	Good	Good
							156m Cruise Ship "Silver Cloud" (CR)	Inbound	Requested: 350°N Actual: 340°N		1.2nm	11.2m			
							93m Tanker (P3)	Outbound	Requested: 180°N Actual: 190°N		2.7nm	9.8m			
							148m Container ship (CR)	Outbound	Requested: 170°N Actual: 170°N		2.7nm	8.3m			
08 (C3)	Proposed	HW -2hr	Dusk Moderate 3.0nm	SW 35 knots	2.0m 6.0s 225°N	High	177,000m^3 LNGC (P5) T=11.7m	Inbound	Requested: 180°N Actual: 240°N	Good	1.5nm	9.5m	Good	Good	Good
							236m ConRo (P3)	Inbound	Requested: 000°N Actual: 330°N		1.3nm	12.5m			
							93m Tanker (CR)	Outbound	Requested: 135°N Actual: 135°N		2.5nm	18.0m			
							148m Container ship (CR)	Outbound	Requested: 135°N Actual: 135°N		2.7nm	15.0m			
09 (C4)	Proposed	HW +2hr	Day Low 1.0nm	SE 15 knots	1.0m 6.0s 135°N	High	93m Tanker (P5)	Inbound	Requested: 000°N Actual: 000°N	Good	1.8nm	14.5m	Good	Good	Good
							148m Container ship (P3)	Inbound	Requested: 330°N Actual: 330°N		1.5nm	12.0m			
							162m RoRo (CR)	Inbound	Requested: 350°N Actual: 350°N		0.9nm	12.5m			
							236m ConRo (CR)	Outbound	Requested: 000°N Actual: 010°N		3.5nm	7.0m			
10 (C3)	Proposed	HW	Day Low 1.5nm	NW 30 knots	2.0m 6.0s 315°N	High+	70m AHT (CR)	Inbound	Requested: 000°N Actual: 000°N	Good	1.9nm	14.0m	Good	Good	Good
							330m Container ship (P5) T=13.0m	Outbound	Requested: 045°N Actual: 045°N		1.4nm	11.3m			
							148m Container ship (CR)	Outbound	Requested: 050°N Actual: 050°N		2.6nm	12.0m			
							177,000m^3 LNGC (P3)	Outbound	Requested: 060°N Actual: 060°N		2.1nm	14.0m			

							236m ConRo (CR)	Outbound	Requested: 045°N Actual: 030°N		1.1nm	14.0m			
11 (C4)	Proposed	HW	Dusk Moderate 3.0nm	SE 30 knots	2.0m 6.0s 135°N	High+	177,000m^3 LNGC (P3) T=11.7m	Inbound	Requested: 010°N Actual: 010°N	Good	1.5nm	10.0m	Good	Good	Good
							225m Container ship (CR)	Inbound	Requested: 280°N Actual: 280°N		3.0nm	9.5m			
							156m Cruise Ship “Silver Cloud” (P5)	Outbound	Requested: 045°N Actual: 045°N		2.1nm	14.2m			
							236m ConRo (CR)	Outbound	Requested: 045°N Actual: 045°N		3.1nm	7.5m			
							148m Container ship (CR)	Inbound	Requested: 045°N Actual: 045°N		3.5nm	9.0m			
12	Proposed	HW -1hr	Day Moderate 5.0nm	NW 30 knots	2.0m 6.0s 315°N	High	177,000m^3 LNGC (P6) T = 11.7m	Inbound From northeast	Requested: 180°N Actual: 195°N	Good	1.4nm	8.0m	Good	Good	Good
							225m Container ship (P8)	Inbound From northeast	Requested: 180°N Actual: 200°N		1.6nm	12.0m			
							148m Container ship (CR)	Inbound From northeast	Requested: 200°N Actual: 200°N		1.5nm	14.0m			
							93m Tanker (CR)	Inbound From northeast	Anchored after engine failure No pilot transfer		N/A	N/A			
							236m ConRo (CR)	Outbound From Princes channel	Requested: 090°N Actual: 085°N		2.0nm	9.5m			
							156m Cruise Ship “Silver Cloud” (CR)	Outbound From Princes channel	Requested: 090°N Actual: 090°N		2.7nm	11.0m			
13 (C3)	Proposed	HW –2hr	Day Good 25nm	SW 30 knots	2.0m 6.0s 225°N	Medium	120m Heavy Lift ship (P5)	Outbound	Requested: 135°N Actual: 135°N	Good	2.0nm	12.0m	Good	Good	Good
							366m Container ship (P6) T=12.8m	Inbound	Requested: 315°N Actual: 315°N		1.6nm	10.0m			
							236m ConRo (CR)	Outbound	Requested: 315°N Actual: 315°N		1.6nm	15.0m			

14 (C4)	Proposed	HW –2hr	Day Good 25nm	SE 30 knots	2.0m 6.0s 135°N	High	366m Container ship (P5) T=12.8m	Inbound	Requested: 045°N Actual: 045°N	Good	1.0nm	10.8m	Good	Good	Good
							399m Container ship (P6) T=14.0m	Inbound	Requested: 045°N Actual: 030°N		0.8nm [1] (Heading away from OWF)	12.7m			
							148m Container ship (CR)	Inbound	Requested: 045°N Actual: 045°N		1.9nm	12.2m			
							93m Tanker (CR)	Inbound	Requested: 045°N Actual: 045°N		2.0nm	15.0m			
15 (C3)	Proposed	HW	Dusk Low 1.0nm	NE 25 knots	2.0m 6.0s 045°N	High+	366m Container ship (P5) T=12.8m	Inbound	Requested: 315°N Actual: 315°N	Good	1.0nm	12.0m	Good	Good	Good
							399m Container ship (P6) T=13.0m	Inbound	Requested: 315°N Actual: 310°N		1.1nm	13.5m			
							148m Container ship (CR)	Inbound	Requested: 315°N Actual: 315°N		1.4nm	15.0m			
							93m Tanker (CR)	Inbound	Requested: 315°N Actual: 315°N		1.3nm	16.0m			
16 (C4)	Proposed	HW	Day Low 1.5nm	SW 35 knots	2.0m 6.0s 135°N	High	93m Tanker (CR)	Inbound	Requested: 330°N Actual: 330°N	Good	1.0nm	15.5m	Good	Good	Good
							162m RoRo (P6)	Inbound	Requested: 330°N Actual: 330°N		1.0nm	13.0m			
							148m Container ship (CR)	Inbound	Requested: 330°N Actual: 330°N		0.9nm [2] (Parallel with OWF)	13.0m			
							236m ConRo (P5)	Outbound	Requested: 135°N Actual: 135°N		1.8nm	10.0m			
17 (C3)	Proposed	HW +2hr	Day Low 2.0nm	NW 30 knots	2.0m 6.0s 315°N	High+	70m 150t AHT (CR)	Inbound	Requested: 045°N Actual: 045°N	Good	1.6nm	15.0m	Good	Good	Good
							236m ConRo (P5)	Outbound	Requested: 180°N Actual: 185°N		2.2nm	6.5m			
							156m Cruise Ship (P6)	Outbound	Requested: 160°N Actual: 160°N		2.2nm	9.0m			
							93m Tanker (CR)	Outbound	Requested: 140°N Actual: 140°N		2.2nm	11.0m			
							148m Container ship (CR)	Outbound	Requested: 140°N Actual: 140°N		1.5nm	11.0m			
18 (C4)	Proposed	HW	Day Moderate 5.0nm	W 35 knots	1.5m 6.0s 270°N	High+	148m Container ship (CR)	Inbound	Requested: 330°N Actual: 330°N	Good	1.5nm	14.0m	Good	Good	Good
							177,000m^3 LNGC (P6)	Inbound	Requested: 300°N Actual: 300°N		1.3nm	12.0m			

							T = 11.7m								
							236m ConRo (CR)	Outbound	Requested: 140°N Actual: 140°N		1.7nm	9.0m			
							148m Container ship (P5)	Outbound	Requested: 315°N Actual: 310°N		2.1nm	13.0m			
							156m Cruise ship (CR)	Outbound	Requested: 135°N Actual: 135°N		3.0nm	11.0m			
NEC1 (C3)	Proposed	HW +2hr	Day Good 25nm	W 40 knots	2.0m 6.0s 270°N	Medium	236m ConRo (P6)	Outbound	Requested: 135°N Actual: 135°N	Good	2.5nm [3]	7.5m	Good	Good	Good
							148m Container ship (P7)	Inbound	Requested: 000°N Actual: 000°N		2.3nm	11.0m			
NEC2 (C5)	Proposed	HW -5hr	Day Low 2.0nm	SW 40 knots	1.5m 6.0s 225°N	Medium	148m Container ship (CR)	Inbound	Requested: 315°N Actual: 315°N	Good	1.2nm	8.0m	Good	Good	Good
							120m Heavy lift ship (P7)	Outbound	Requested: 090°N Actual: 090°N		2.9nm	8.5m			
							148m Container ship (P6)	Outbound	Requested: 315°N Actual: 315°N		1.5nm	9.5m			
NEC 3 (C3)	Proposed	HW -2hr	Day Moderate 5.0nm	SW 45 knots	2.0m 6.0s 225°N	Medium	148m Container ship (P6)	Inbound	Requested: 335°N Actual: 315°N	Good	0.7nm [1]	12.5m	Good	Good	Good
							225m Container ship (CR)	Outbound	Requested: 090°N Actual: 100°N		1.9nm	10.5m			
							177,000m^3 LNGC (P7) T=9.8m	Outbound	Requested: 090°N Actual: 090°N		1.8nm	10.5m			
NEC 4 (C5)	Proposed	HW	Day Moderate 5.0nm	NW 45 knots	2.0m 6.0s 315°N	Medium	148m Container ship (P6)	Inbound	Requested: 000°N Actual: 000°N	Good	1.7nm	13.5m	Good	Good	Good
							120m Heavy lift ship (CR)	Inbound	Requested: 335°N Actual: 350°N		1.3nm	15.5m			
							236m ConRo (P7)	Outbound	Requested: 090°N Actual: 085°N		2.9m	2.5m			
NEC 5 (C3)	Proposed	HW +1hr	Day Moderate 5.0nm	W 45 knots	2.0m 6.0s 270°N	Medium	148m Container ship (CR)	Inbound	Requested: 000°N Actual: 000°N	Good	1.2nm	12.5m	Good	Good	Good
							330m Container ship (P6) T=13.0m	Outbound	Requested: 000°N Actual: 350°N		0.9nm [2]	7.0m			
							177,000m^3 LNGC (P7)	Outbound	Requested: 000°N Actual: 000°N		0.7nm [2]	12.5m			
							236m ConRo (CR)	Outbound	Requested: 000°N Actual: 000°N		1.6nm	11.0m			

NEC 6 (C5)	Proposed	HW	Day Moderate 5.0nm	S 45 knots	2.0m 6.0s 180°N	Medium	225m Container ship (P7)	Inbound	Requested: 250°N Actual: 245°N	Good	0.6nm [1]	11.5m	Good	Good	Good
							120m Heavy lift ship (CR)	Inbound	Requested: 315°N Actual: 315°N		1.0nm	16.5m			
							236m ConRo (P6)	Outbound Steering failure before pilot disembarkation	Anchored after steering failure No pilot transfer		N/A	11.5m			
							148m Container ship (CR)	Outbound	No pilot transfer		N/A	14.5m			
L1E (C5)	Existing	HW – 1hr	Day Good 25nm	SW 20 knots	1.2m 6.0s 225°N	Medium	366m Container ship (P8) T=12.8m	Inbound From south	Requested: 310°N Actual: 320°N	Good	1.5nm	6.0m	Good	Good	Good
							120m Heavy lift ship (CR)	Outbound From Princes channel	Requested: 315°N Actual: 315°N		2.4m	15.0m			
							236m ConRo (CR)	Outbound From Princes channel	Requested: 315°N Actual: 330°N		2.8nm	9.0m			
L2E (C3)	Existing	HW – 1hr	Day Moderate 5nm	SW 30 knots	1.8m 6.0s 225°N	High	148m Container ship (P6)	Inbound From south	Requested: 350°N Actual: 330°N	Good	1.9nm	12.0m	Good	Good	Good
							120m Heavy lift ship (CR)	Inbound From south	Requested: 350°N Actual: 330°N		2.2nm	14.0m			
							399m Container ship (P8) T=13.0m	Inbound From Northeast	Requested: 315°N Actual: 320°N		1.5nm	4.5m			
L3P (C5)	Proposed	HW – 1hr	Day Good 25nm	SW 20 knots	1.2m 6.0s 225°N	Medium	366m Container ship (P6) T=12.8m	Inbound From south	Requested: 330°N Actual: 340°N	Good	1.1nm	5.4m	Good	Good	Good
							236m ConRo (P8)	Outbound From Princes channel	Requested: 330°N Actual: 340°N		1.8nm	10.0m			
							120m Heavy lift ship (CR)	Outbound From Princes channel	Requested: 315°N Actual: 330°N		2.2nm	13.5m			

L4P (C3)	Proposed	HW – 1hr	Day Moderate 5nm	SW 30 knots	1.8m 6.0s 225°N	High	148m Container ship (P6)	Inbound From south	Requested: 315°N Actual: 315°N	Good	1.1nm	13.0m	Good	Good	Good
							120m Heavy lift ship (CR)	Inbound From south	Requested: 315°N Actual: 315°N		1.0nm	14.0m			
							399m Container ship (P8) T=13.0m	Inbound From Northeast	Requested: 180°N Actual: 180°N		1.0nm	6.0m			
NEA1 (C3)	Proposed	HW + 2hr	Dusk Good 25nm	N 25 knots	1.0m 6.0s 0°N	Medium	148m Container ship (P9)	Inbound From Northeast	Requested: 270°N Actual: 270°N	Good	1.2nm	13.5m	Good	Good	Good
							236m ConRo (P6)	Outbound From Princes channel	Requested: 270°N Actual: 270°N		1.0nm	11.0m			
							3,000m3 LPG carrier (CR)	Inbound From Northeast	Requested: 270°N Actual: 270°N		0.8nm [1]	14.5m			
							120m Heavy Lift (CR)	Outbound From Princes channel	Requested: 270°N Actual: 270°N		1.0nm	15.0m			
NEA2 (C2)	Proposed	HW – 5hr	Dusk Moderate 2.0nm	S 25 knots	1.5m 6.0s 180°N	High	148m Container ship (P9)	Inbound From south Pilot ladder rigged on wrong side (port side)	Requested: 090°N Actual: 080°N	Good	1.1nm	10.0m	Good	Good	Good
							156m Cruise ship (CR)	Inbound From south	Requested: 045°N Actual: 045°N		2.0nm	9.0m			
							3,000m3 LPG carrier (P6)	Outbound From Princes channel Steering failure	Requested: 090°N Actual: 080°N		2.0nm	11.0m			
							148m Container ship (CR)	Outbound From Princes channel	Requested: 045°N Actual: 045°N		2.0nm	8.5m			

NEA3 (C3)	Proposed	HW – 2hr	Dusk Moderate 5.0nm	N 35 knots	1.5m 6.0s 0°N	High	148m Container (P6)	Outbound From Princes channel	Requested: 270°N Actual: 270°N	Good	1.8nm	11.0m	Good	Good	Good
							177,000m^3 LNGC (P9) T=9.8m	Inbound From Northeast	Requested: 270°N Actual: 250°N		1.5nm	9.0m			
							3,000m3 LPG carrier (CR)	Outbound From Princes channel	Requested: 270°N Actual: 250°N		1.5nm	13.5m			
							236m ConRo (CR)	Inbound From Northeast	Requested: 270°N Actual: 270°N		1.7nm	10.0m			
NEA4 (C2)	Proposed	HW + 2hr	Dusk Moderate 5.0nm	S 35 knots	1.5m 6.0s 180°N	High	3,000m3 LPG carrier (P6)	Inbound From south	Requested: 270°N Actual: 270°N	Good	1.5nm	19.5m	Good	Good	Good
							232m Car Carrier (P9)	Inbound From south	Requested: 270°N Actual: 280°N		1.1nm	11.5m			
							162m RoRo (CR)	Inbound From south	Requested: 270°N Actual: 270°N		1.7nm	13.0m			
							236m ConRo (CR)	Outbound From Princes channel	Requested: 090°N Actual: 100°N		3.0nm	8.0m			
NEA5 (C3)	Proposed	HW	Early morning Good 25nm	SW 20 knots	1.2m 6.0s 225°N	High+	70m 150t AHT (CR)	Inbound From south	Requested: 000°N Actual: 000°N	Good	2.2nm	14.0m	Good	Good	Good
							330m Container ship (P6) T=13.0m	Inbound From Northeast	Requested: 270°N Actual: 275°N		1.5nm	10.0m			
							177,000m^3 LNGC (P9) T=9.8m	Outbound From Thames Estuary	Requested: 000°N Actual: 000°N		2.2nm	10.0m			
							236m ConRo (CR)	Outbound From Thames Estuary	Requested: 035°N Actual: 035°N		2.6nm	9.0m			
							148m Container ship (CR)	Outbound	Requested: 045°N Actual: 045°N		3.0nm	10.0m			

								From Thames Estuary							
NEA6 (C2)	Proposed	HW	Dusk Moderate 5.0nm	E 25 knots	1.5m 6.0s 090°N	High+	156m Cruise ship (P9)	Outbound From Thames Estuary	Requested: 000°N Actual: 000°N	Good	2.4nm	13.0m	Good	Good	Good
							148m Container ship (CR)	Inbound From south Pilot ladder rigged on wrong side (stbd side)	Requested: 135°N Actual: 135°N		1.5nm	15.0m			
							177,000m^3 LNGC (P6) T = 11.7m	Inbound From Northeast	Requested: 315°N Actual: 315°N		2.3nm	8.0m			
							225m Container ship (CR)	Inbound From Northeast	Requested: 225°N Actual: 225°N		2.2nm	10.5m			
							236m ConRo (CR)	Outbound From Thames Estuary	Requested: 045°N Actual: 045°N		2.4nm	9.5m			
14R (C2)	Proposed	HW –2hr	Day Good 25nm	SE 30 knots	2.0m 6.0s 135°N	High	366m Container ship (P3) T=12.8m	Inbound From northeast	Requested: 270°N Actual: 270°N	Good	1.7nm	11.0m	Good	Good	Good
							399m Container ship (P9) T=14.0m	Inbound From northeast	Requested: 270°N Actual: 275°N		1.5nm	10.0m			
							148m Container ship (CR)	Inbound FD	Requested: 270°N Actual: 270°N		4.0nm	7.0m			
							3,000m^3 LPG Carrier (CR)	Inbound	Requested: 270°N Actual: 265°N		2.4nm	12.0m			
16R (C3)	Proposed	HW	Day Low 1.5nm	SW 35 knots	2.0m 6.0s 135°N	High	3,000m^3 LPG Carrier (P9)	Inbound	Requested: 315°N Actual: 280°N	Good	1.6nm	13.0m	Good	Good	Good
							148m Container ship (CR)	Inbound	Requested: 290°N Actual: 290°N		1.6nm	11.0m			
							162m RoRo (CR)	Inbound	Requested: 290°N Actual: 290°N		1.5nm	11.5m			

							236m ConRo (P3)	Outbound	Requested: 135°N Actual: 120°N		2.0nm	10.0m			
NEC3R (C2)	Proposed	HW -2hr	Day Moderate 5.0nm	SW 45 knots	2.0m 6.0s 225°N	Medium	225m Container ship (P3)	Outbound	Requested: 000°N Actual: 000°N	Good	2.5nm	7.5m	Good	Good	Good
							177,000m^3 LNGC (P9) T=9.8m	Outbound	Requested: 350°N Actual: 350°N		1.6nm	6.5m			
							148m Container ship (CR)	Inbound	Requested: 350°N Actual: 350°N		2.4nm	10.5m			
NEC5R (C3)	Proposed	HW +1hr	Day Moderate 5.0nm	W 45 knots	2.0m 6.0s 270°N	Medium	148m Container ship (CR) 1	Inbound From south	Requested: 310°N Actual: 310°N	Good	1.2nm	11.0m	Good	Good	Good
							177,000m^3 LNGC (P9) T=9.8m 2	Outbound From west Steering failure after pilot transfer	Requested: 340°N Actual: 340°N		1.5nm	10.0m			
							236m ConRo (CR) 3	Outbound From Princes Channel	Requested: 340°N Actual: 310°N		1.5nm	10.0m			
							330m Container ship (P3) T=13.0m [4] [5] 4	Outbound From north	Requested: 340°N Actual: 340°N		1.5nm	7.5m			
NEC6R (C2)	Proposed	HW	Day Moderate 5.0nm	S 45 knots	2.0m 6.0s 180°N	Medium	225m Container ship (P3) 1	Inbound	Requested: 270°N Actual: 270°N	Good	1.6nm	7.0m	Good	Good	Good
							236m ConRo (P9) 2	Outbound	Requested: 270°N Actual: 250°N		1.6nm	11.0m			
							120m Heavy lift ship (CR)	Inbound	Requested: °N Actual: °N		2.3nm	14.5m			
							148m Container ship (CR) 3	Outbound	Requested: 270°N Actual: 270°N		2.0nm	13.0m			
NEAR1 (C3)	Proposed	HW + 2hr	Dusk Good 25nm	N 25 knots	1.5m 6.0s 0°N	Medium	148m Container ship (P9) 2	Inbound From Northeast	Requested: 090°N Actual: 110°N	Good	2.5nm	12.0m	Good	Good	Good
							236m ConRo (P3) 1	Outbound From Princes channel	Requested: 090°N Actual: 080°N		2.6nm	8.0m			

							3,000m3 LPG carrier (CR) 4	Inbound From Northeast	Requested: °N Actual: °N		1.8nm	15.0m		
							120m Heavy Lift (CR) 3	Outbound From Princes channel	Requested: 090°N Actual: 090°N		2.4nm	13.0m		

Notes: 14m Pilot cutter based on an ORC 136 Fast Patrol Craft was used for each run.

Ships piloted by "Control" were based on Autopilot or helm and engine commands by the simulator operator advised by one of the independent pilots when necessary

Tide was taken from NE spit buoy.

Clearance distances to wind farm are measured to wind farm boundary. Minimum distance from wind farm boundary to nearest turbine is 250m

[1]: Ship headed away from OWF, came within 1.0nm of OWF during transfer. No navigation issues with this manoeuvre

[2]: Ship headed parallel with OWF boundary, came within 1.0nm of OWF during transfer. No navigation issues with this manoeuvre

Annex F Marginal Runs and HRW Track Plots

Marginal Runs and HRW Track Plots

The track plots for all 41 runs are contained in **Section 2** of this Annex. **Section 1** of this Annex specifically examines the 6 runs that were graded as having one marginal component and the subsequent repeat runs that were conducted on day 7.

Section One - Marginal Runs and Repeats

All runs that triggered a marginal criterion did so for proximity to the wind farm boundary during pilot transfer. Operational UK wind farms have no formal or advisory approach minima and the 1nm distance was introduced for the 2017 and 2019 PTSBs as an objective but entirely artificial and arbitrary measurement which must not be taken as a measure of absolute safety. For the 2019 PTBS this distance was measured from the SEZ boundary rather than the turbines, which are sited 200 – 300m inside the boundary providing a degree of precaution to these measurements. Any experienced mariner will recognise that proximity to danger is never a factor of empirical distance but a combination of a set of factors including, wind, current, tidal stream and the handling characteristics of the vessel involved; accordingly a ship might be perfectly safe 200 yards from a hazard or in danger 3 miles from it depending on the prevailing circumstances and conditions.

The results of each of the 'original' runs are testament to the participants acting as they would in real life without being unduly influenced by the success criteria. For the re-runs each one of the masters was issued an instruction to stay 1 nautical mile or 2000 yards from the wind farm, thereby artificially limiting the sea room available for transfer. It is notable that every one of these runs (including 3 in marginal conditions) was completed safely, comfortably and with a success grading in every criterion.

Run 14 – Tongue Transfer: This run involved 4 ships inbound for transfer, 2 x large ships (1 x 366m & 1 x 400m) coming to the Tongue pilot station from the north and 2 smaller ships approaching the NE Spit station from the south. The wind was south easterly at 30 knots. Both of the masters of the large ships chose to close the wind farm northern boundary to within 1600 yards (0.8nm) to allow sufficient sea room for them to conduct pilot transfers on a westerly heading and still allow them room to swing to starboard for an exit course to the north. The 1nm proximity criteria was breached but only when both ships were on a parallel course to the wind farm, with the wind setting them strongly away from the turbines and not in any danger whatsoever (as confirmed by the participants). The run was judged to have been an overall success but owing to the marginal proximity breach was repeated on day 7.

Run 14 R – Tongue Transfer: Exactly the same run was conducted, in exactly the same circumstances but with different ship masters; both who were instructed not to come closer to the wind farm than 1nm (2000 yds) if feasible and safe to do so. This they did by staying further to the north than in the first run, both transfers were safely and efficiently conducted, and the run was judged to have been a success.

Run 16 – Elbow Transfer: This run involved 4 ships, 3 inbound and one outbound, all for transfer at the NE Spit station. The wind was south westerly at 35 knots. The 3 inbound ships were approaching the pilot station from the south, roughly separated by a mile. All pilot transfers were conducted safely on a north easterly heading as they came towards the narrower part of the boarding area in the vicinity of the Elbow Buoy. The last vessel of the three breached the 1nm (2000 yard) boundary by 200 yards during pilot transfer (leaving an 1800 yard margin) but was steering a parallel course to the wind farm and was not at any point in any danger (confirmed by the mariner piloting the vessel). The run was judged to have been an overall success but owing to the marginal proximity breach was repeated on day 7.

Run 16R – Elbow Transfer: Exactly the same run was conducted, in exactly the same circumstances but with different ship masters who were instructed not to come closer to the wind farm than 1nm (2000 yds) if feasible and safe to do so. This they did by staying further to the west during transfers; all were safely and efficiently conducted, and the run was judged to have been a success.

Run NEC 3 – NE Spit Challenging Conditions: This run involved 3 ships, 1 inbound and 2 larger vessels outbound, all for transfer at the NE Spit station in very strong south westerly winds at 45 knots. As is normal, the pilot cutter coxswain elected to board a pilot to the arriving ship first while asking the two departing ships (with pilots embarked) to slow and wait in safe water. The inbound ship was asked to come south towards the pilot diamond (and in more sheltered waters) and it safely transited towards the pilot cutter 0.8 of a mile from the wind farm boundary. The original intention was to conduct the pilot transfer with the vessel having turned to starboard to the north east, but the as the pilot cutter closed the ship, the decision was changed to conduct the transfer on a south south-easterly heading as the safe water was opening up to the south (the vessel having reached the 'point'

of the wind farm at turbine 5). The pilot transfer was conducted safely but the vessel breached the 1nm (2000 yard) boundary by 600 yards but again was steering a parallel course to the wind farm and was not at any point in any danger (confirmed by the mariner piloting the vessel). The run was judged to have been an overall success but owing to the marginal proximity breach was repeated on day 7.

Run NEC 3R – NE Spit Challenging Conditions: Exactly the same run was conducted, in exactly the same circumstances but with different ship masters and a different Coxswain who came up with a completely different solution. After having been instructed not to come closer to the wind farm than 1nm (2000 yds), if feasible and safe to do so, the transfers were all conducted directly to the north of the NE Spit pilot diamond in the centre of the boarding area with all ships completing their transfers safely and efficiently and the run was judged to have been a success.

Run NEC 5 – NE Spit Challenging Conditions: This run involved 4 ships, 1 inbound and 3 larger vessels including a 330m ship outbound, all for transfer in the sheltered waters of the NE Spit station in very strong westerly winds at 45 knots. The priority for transfer was allocated to the two large outbound ships (330m & 299m LNG) both of which were asked to come south towards the pilot diamond (and in more sheltered waters) and the plan was to turn the ships to north facing into safe water before then disembarking the pilots. Both ships were deliberately transited 0.8 of a mile from the SEZ boundary by their pilots to make sea room to the west before turning away from the wind farm through west to a northerly heading for transfer. The pilot transfers for both ships were conducted safely but the vessels breached the 1nm (2000 yard) boundary by 200 and 600 yards respectively. Both ships were deliberately placed in this position by their pilots and their vessels were steering a parallel course during transfer and were not at any point in any danger (confirmed by the mariner piloting the vessel). The run was judged to have been an overall success but owing to the marginal proximity breach was repeated on day 7.

Run NEC 5R – NE Spit Challenging Conditions: Exactly the same run was conducted, in exactly the same circumstances but with different Masters and a different Coxswain who came up with similar transfer solutions for the large ships; ie the pilot remained on board until the vessel has turned to the north and is facing into safe water. Having been instructed not to come closer to the wind farm than 1nm (2000 yds), if feasible and safe to do so, all the transfers in this run were conducted safely and efficiently in the centre of the boarding area and the run was judged to have been a success.

Run NEC 6 – NE Spit Challenging Conditions: This run involved 4 ships, 2 inbound from the north 'dipping down' and 2 outbound, all for transfer at the NE Spit station in very strong southerly wind at 45 knots. As is normal, priority for transfer was allocated to the two inbound ships both of which were asked to come south towards the pilot diamond and both safely transited 0.8 of a mile from the SEZ boundary before turning away from the wind farm to a westerly heading for transfer. The pilot transfers for both ships were conducted safely but the lead vessel breached the 1nm (2000 yard) boundary by 800 yards by briefly turning slightly towards the wind farm before starting the 'swing' to starboard and conducting the transfer in the turn away from the wind farm. At no point were any of the ships in any danger (confirmed by the mariner piloting the vessel). The run was judged to have been an overall success but owing to the marginal proximity breach was repeated on day 7.

Run NEC 6R – NE Spit Challenging Conditions: Exactly the same run was conducted, in exactly the same circumstances but with different Masters and a different Coxswain who came up with similar transfer solution geometry but having been instructed not to come closer to the wind farm than 1nm (2000 yds) all the transfers in this run were conducted safely and efficiently in the centre of the boarding area and the run was judged to have been a success.

Run NEA1 – NE Spit Unusual Wind Directions: This run involved 4 ships, 2 inbound from the north 'dipping down' and 2 outbound, all for transfer at the NE Spit station in northerly wind at 25 knots. As is normal, priority for transfer was allocated to the two inbound ships, both of which were asked to come south towards the pilot diamond. Both safely transited 0.6 of a mile from the SEZ boundary before turning away from the wind farm to a westerly heading for transfer. The pilot transfers for both ships were conducted safely but the lead vessel (LNG ship) breached the 1nm (2000 yard) boundary by 200 yards as the transfer was conducted immediately after the turn (with the cutter waiting astern during the turn) before the ship had opened a mile away from the wind farm. At no point were any of the ships in any danger. The run was judged to have been an overall success but owing to the marginal proximity breach was repeated on day 7.

Run NEA R1 – NE Spit Unusual Wind Directions: Exactly the same run was conducted in exactly the same circumstances but with different ship masters and a different Coxswain who came up with different transfer solutions. Having been instructed not to come closer to the wind farm than 1nm (2000 yds), if feasible and safe to do so, all the transfers in this run were conducted safely and efficiently in the centre of the boarding area and the run was judged to have been a success.

Section Two - HRW Track Plots

Explanation: The track plots below were produced independently by HRW and should be viewed in conjunction with the run report grid at **Annex E** (also produced independently by HRW). It was felt that it would be helpful to offer some explanation of the track plots to allow the reader to draw his or her own conclusions.

Run Numbering: It was necessary to change the nomenclature of the run numbers as the week progressed to distinguish each day separately. Thus, large ship runs became 'L' runs with an 'E' to denote existing wind farm runs and a 'P' to denote proposed wind farm runs; similarly NE Spit runs became NE runs with an 'A' to denote additional runs, a 'C' to denote challenging runs and an 'R' to denote repeat runs.

Scale: the scale is on the left-hand side of the track plot. 1 nautical mile = 2000 yards.

Wind, Waves and Swell: are shown on the right-hand margin of each run; these correlate with the run report grid at A**nnex E.**

Tidal stream: is shown by the blue arrows showing the direction across the entire sea part of the plot.

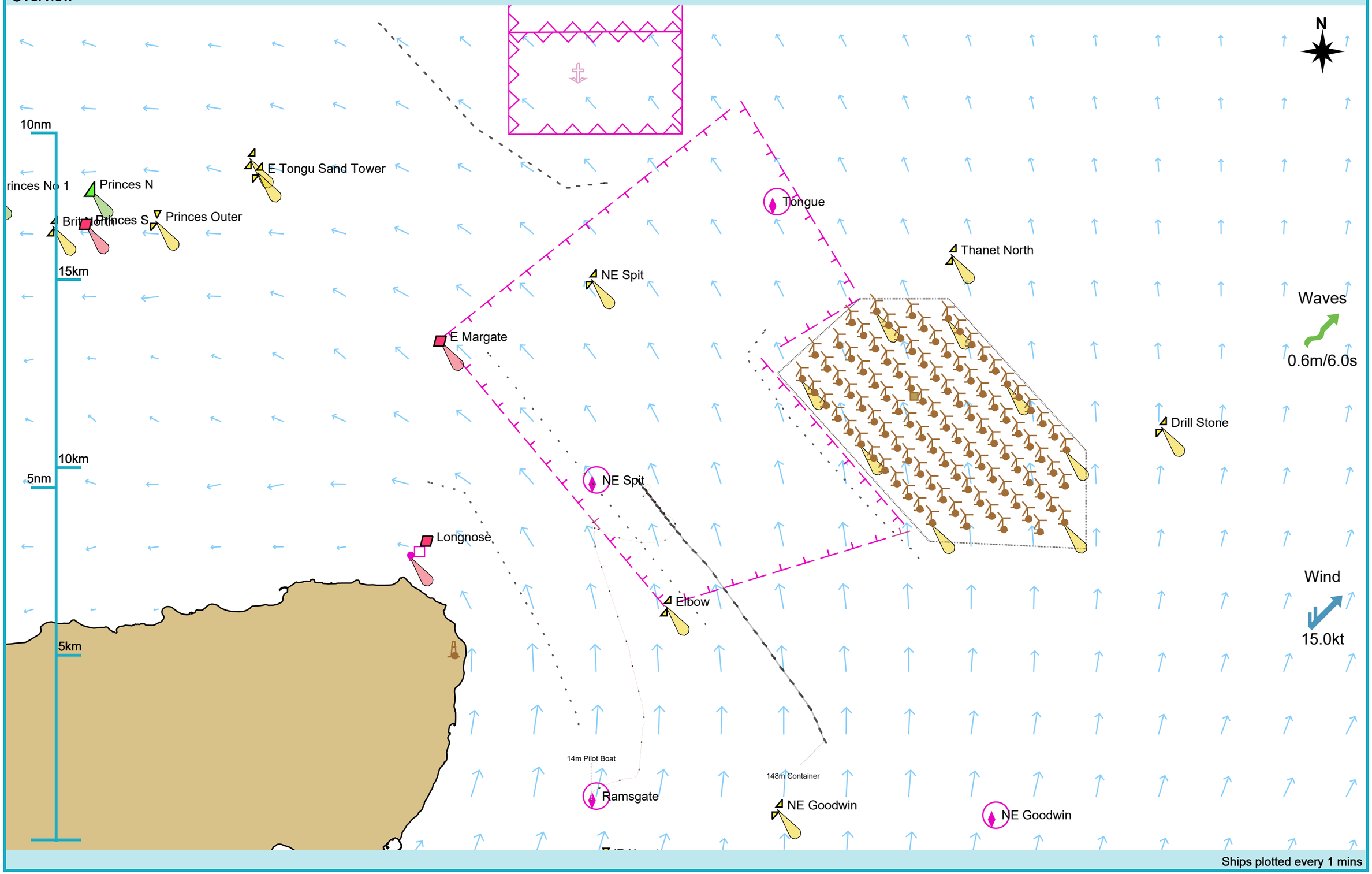
Simulated Vessels: are shown as bold tracks with their name at the beginning of each track. The details of each vessel are contained at **Annex E.**

Background Shipping: are shown as the fainter dotted tracks and are not named.

The track plots for all 41 runs are below:

Summary

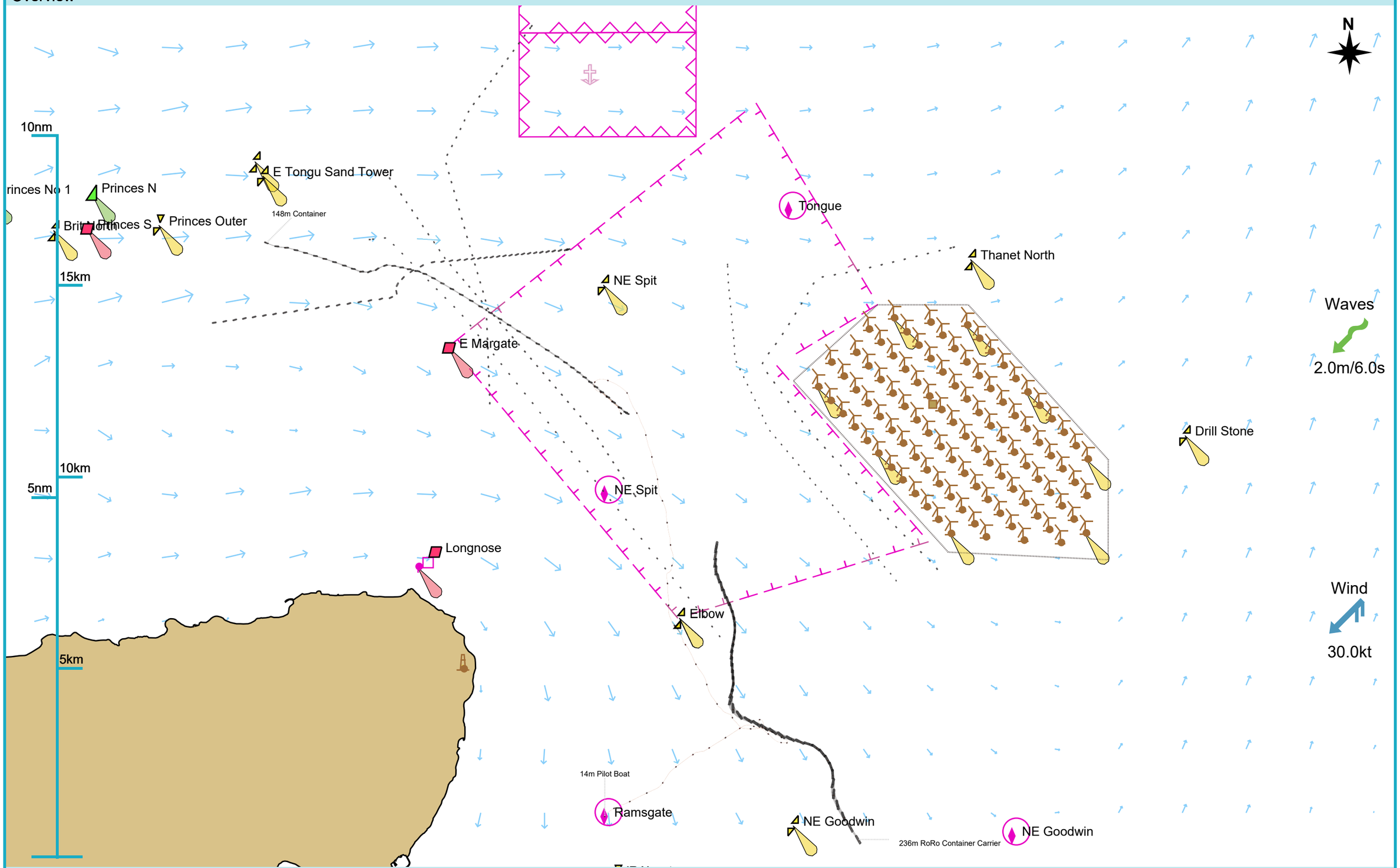
Overview



Ships plotted every 1 mins

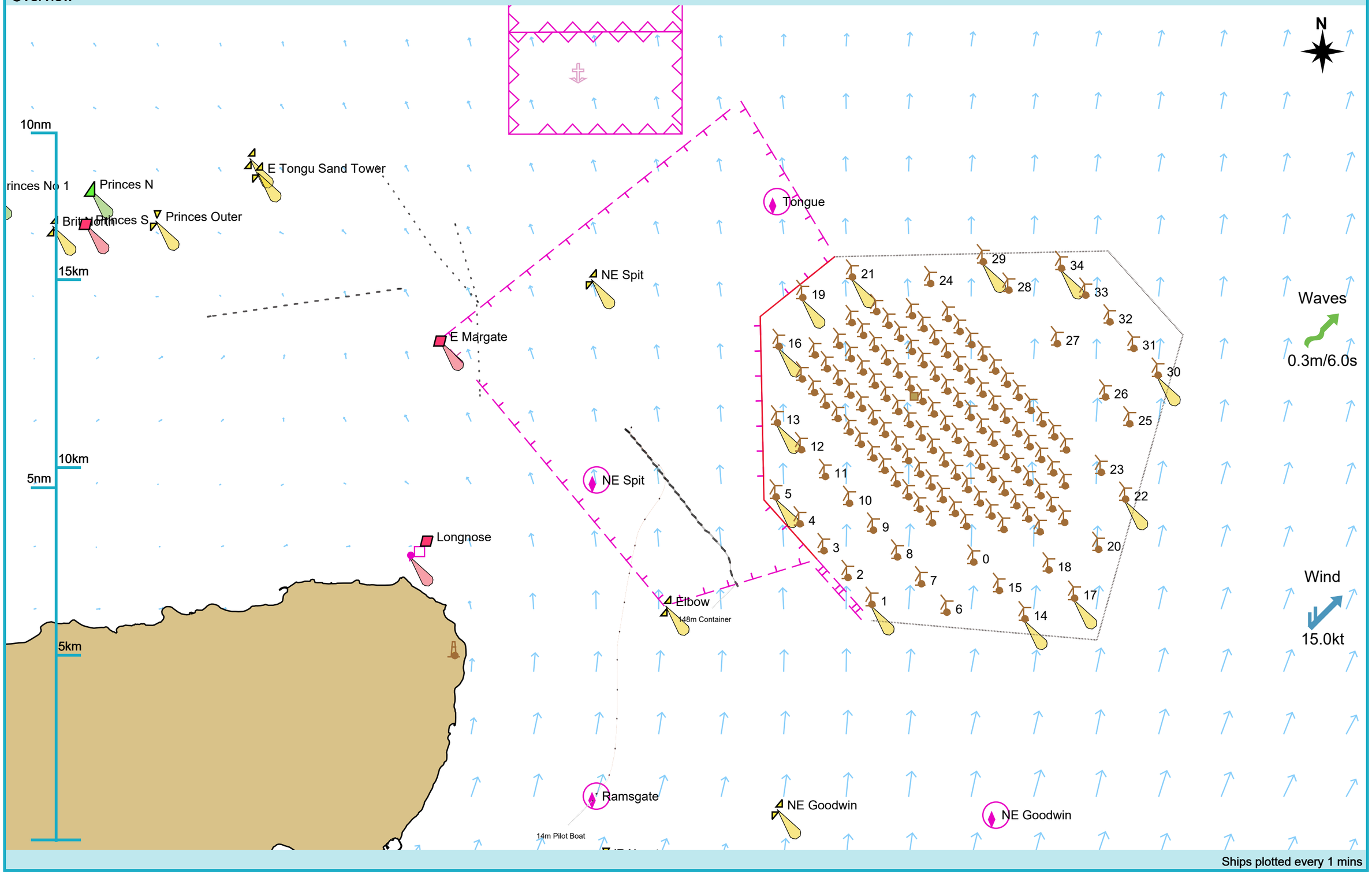
Summary

Overview



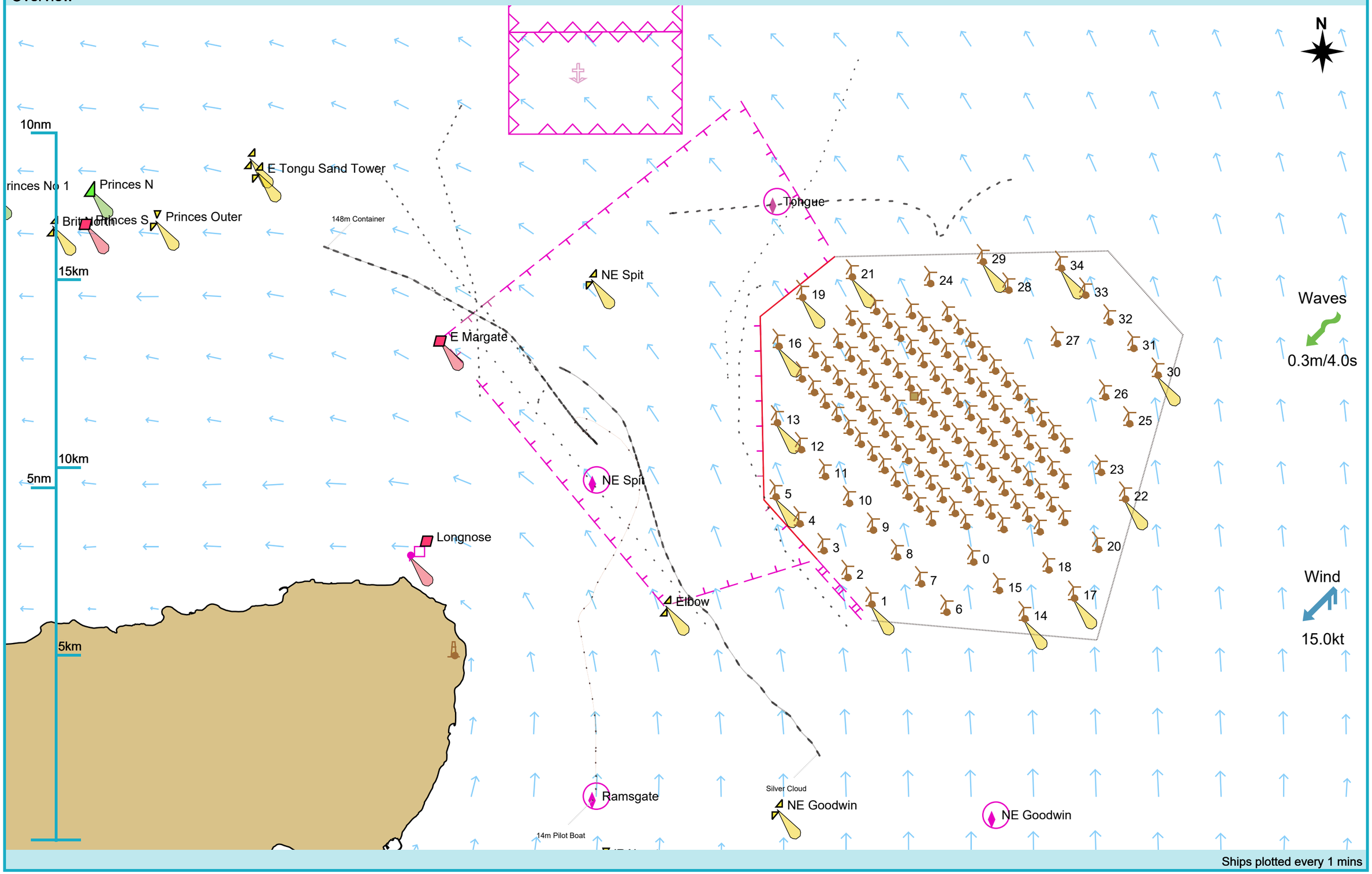
Summary

Overview



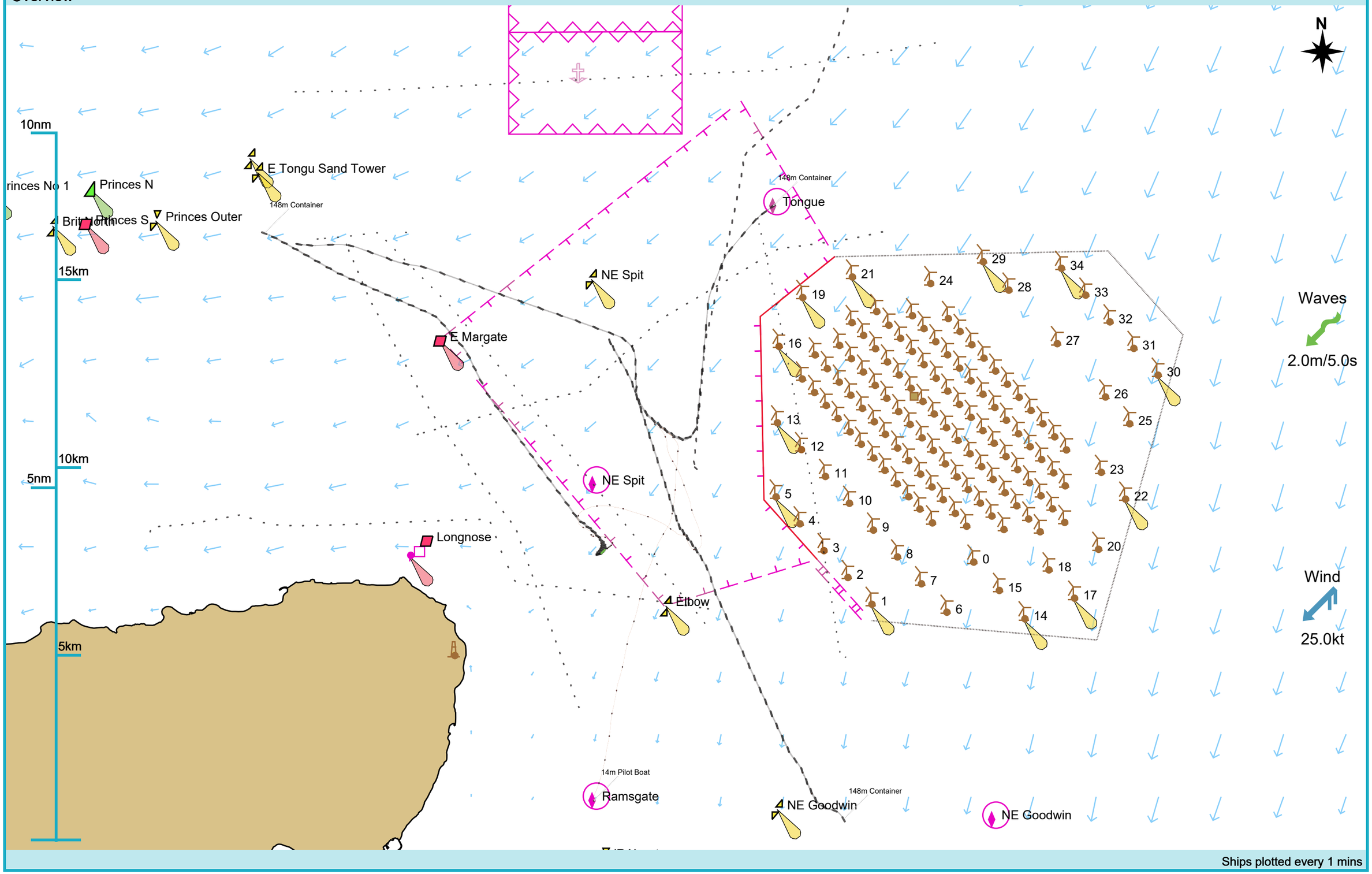
Summary

Overview



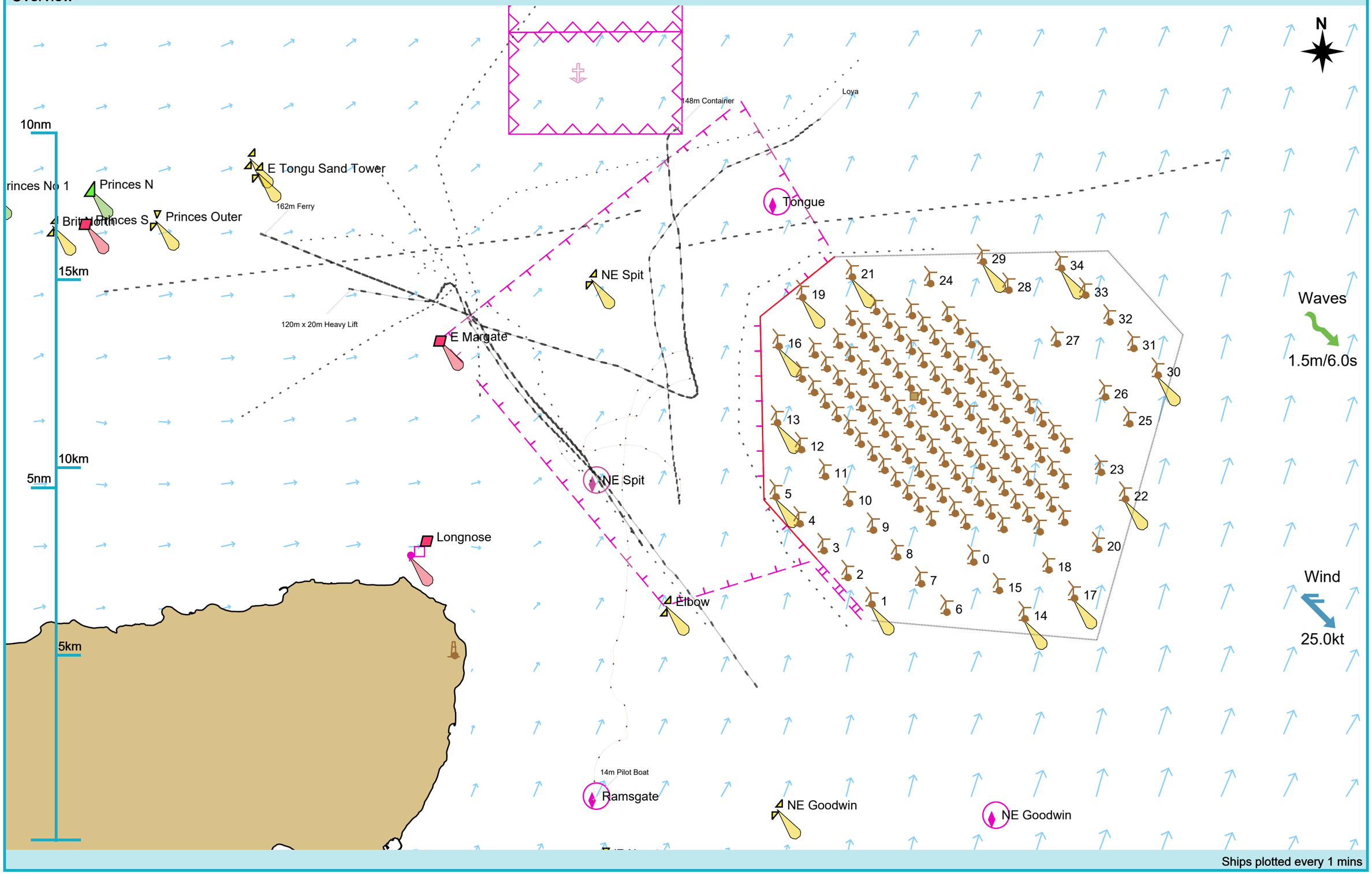
Summary

Overview



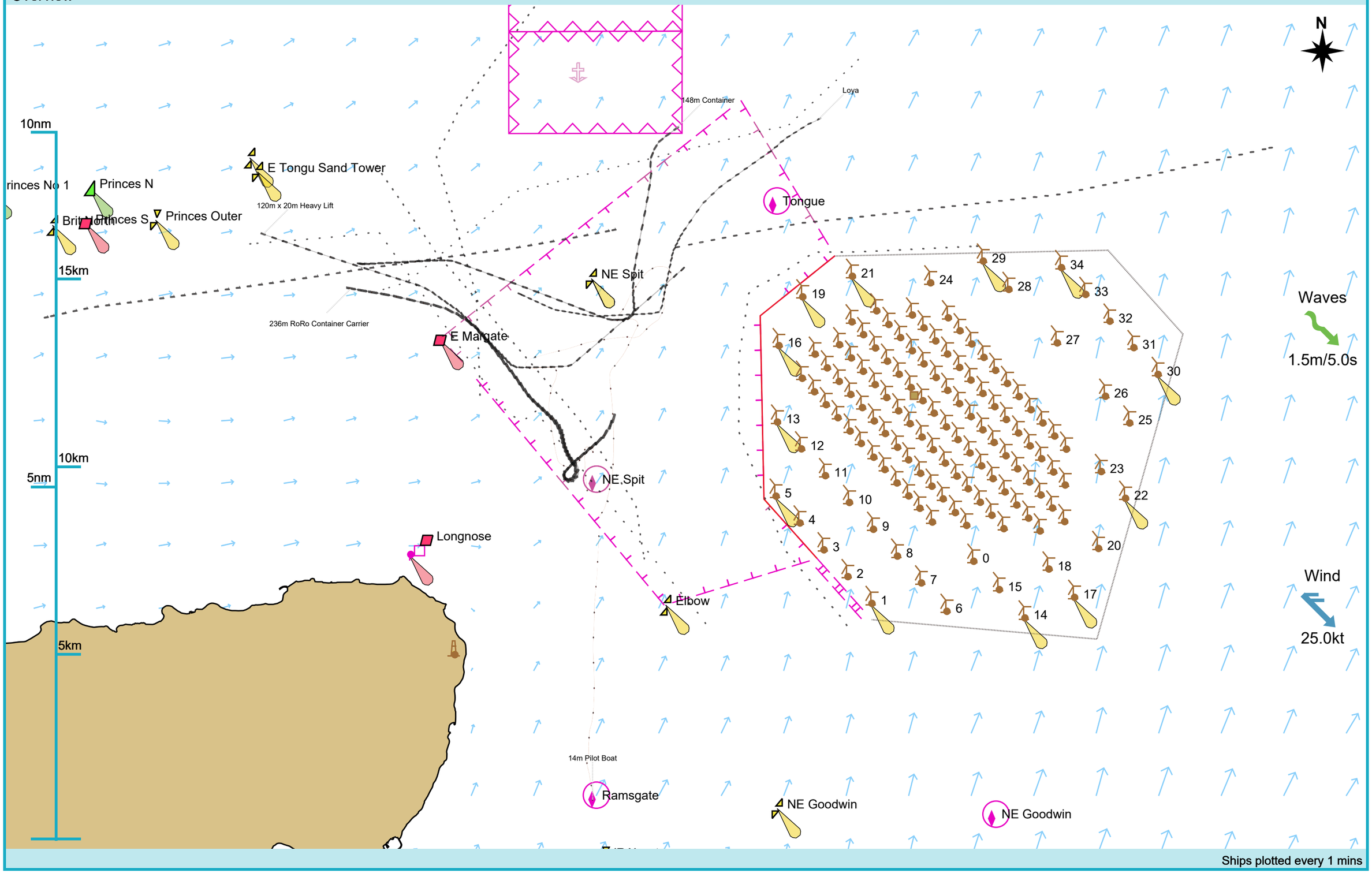
Summary

Overview



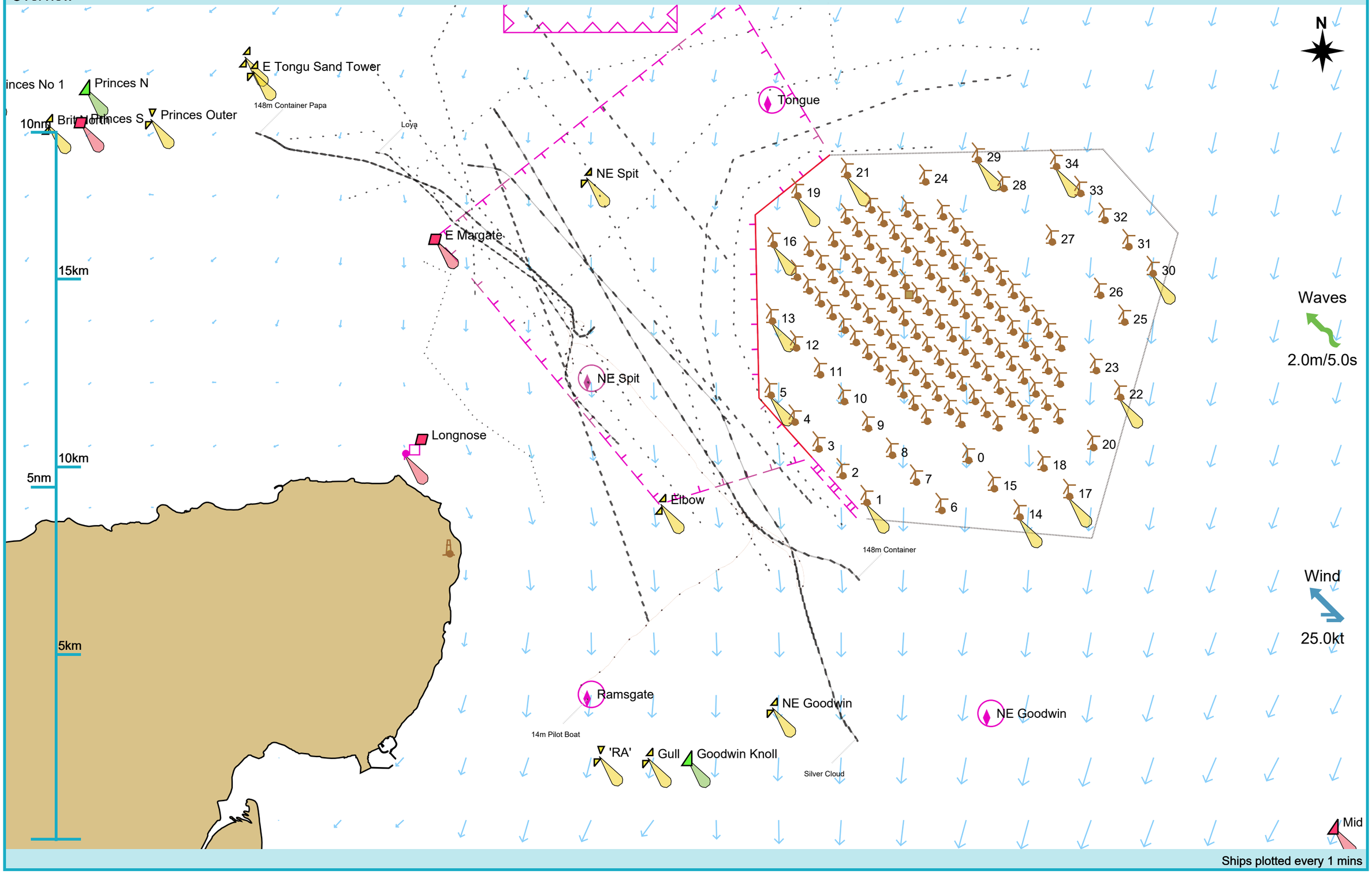
Summary

Overview



Summary

Overview



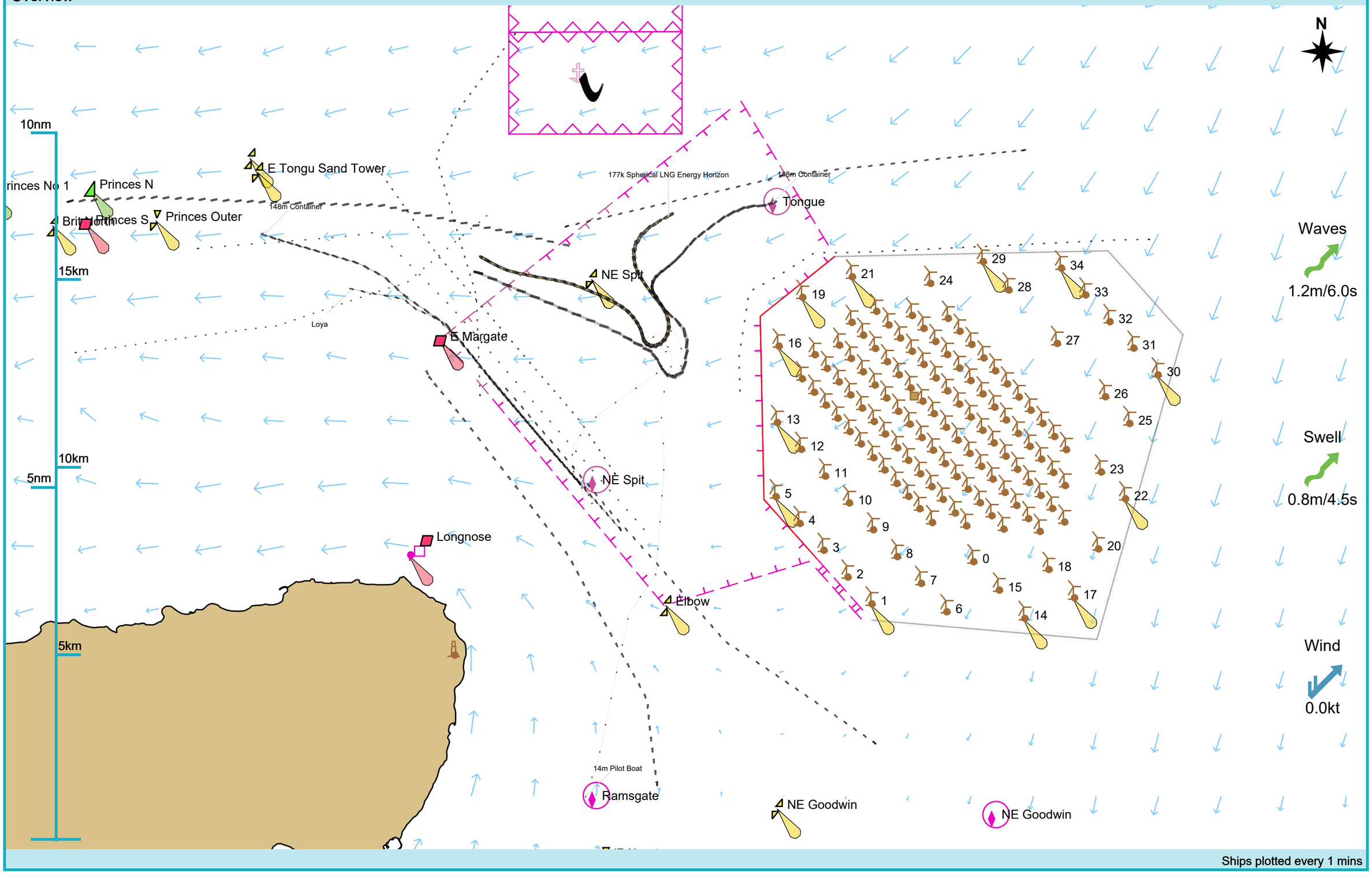
Ships plotted every 1 mins

Pilot: C4/P5/P3/CR/CR
Manoeuvre: Other

Ship: 14m Pilot Boat

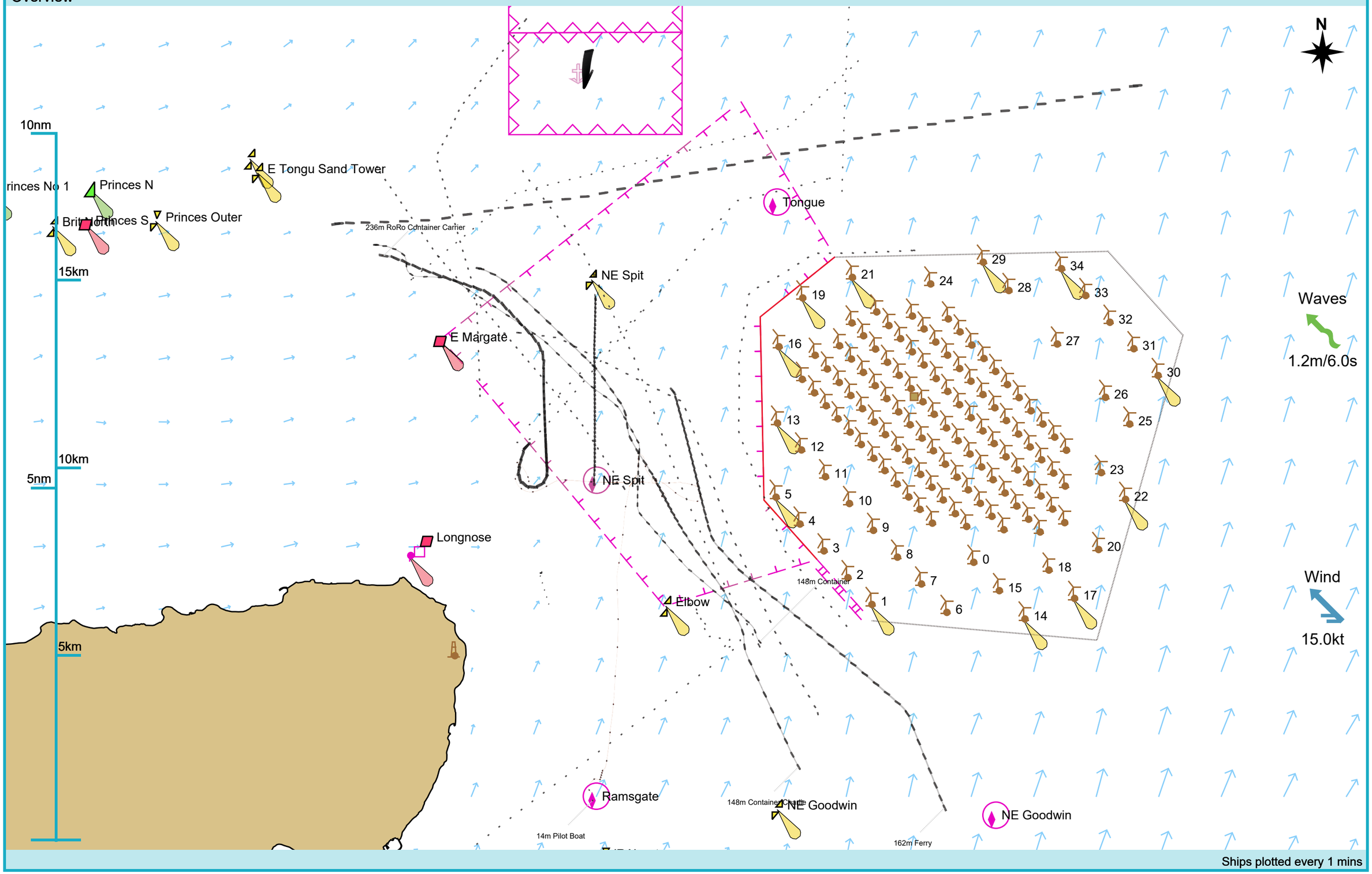
Summary

Overview



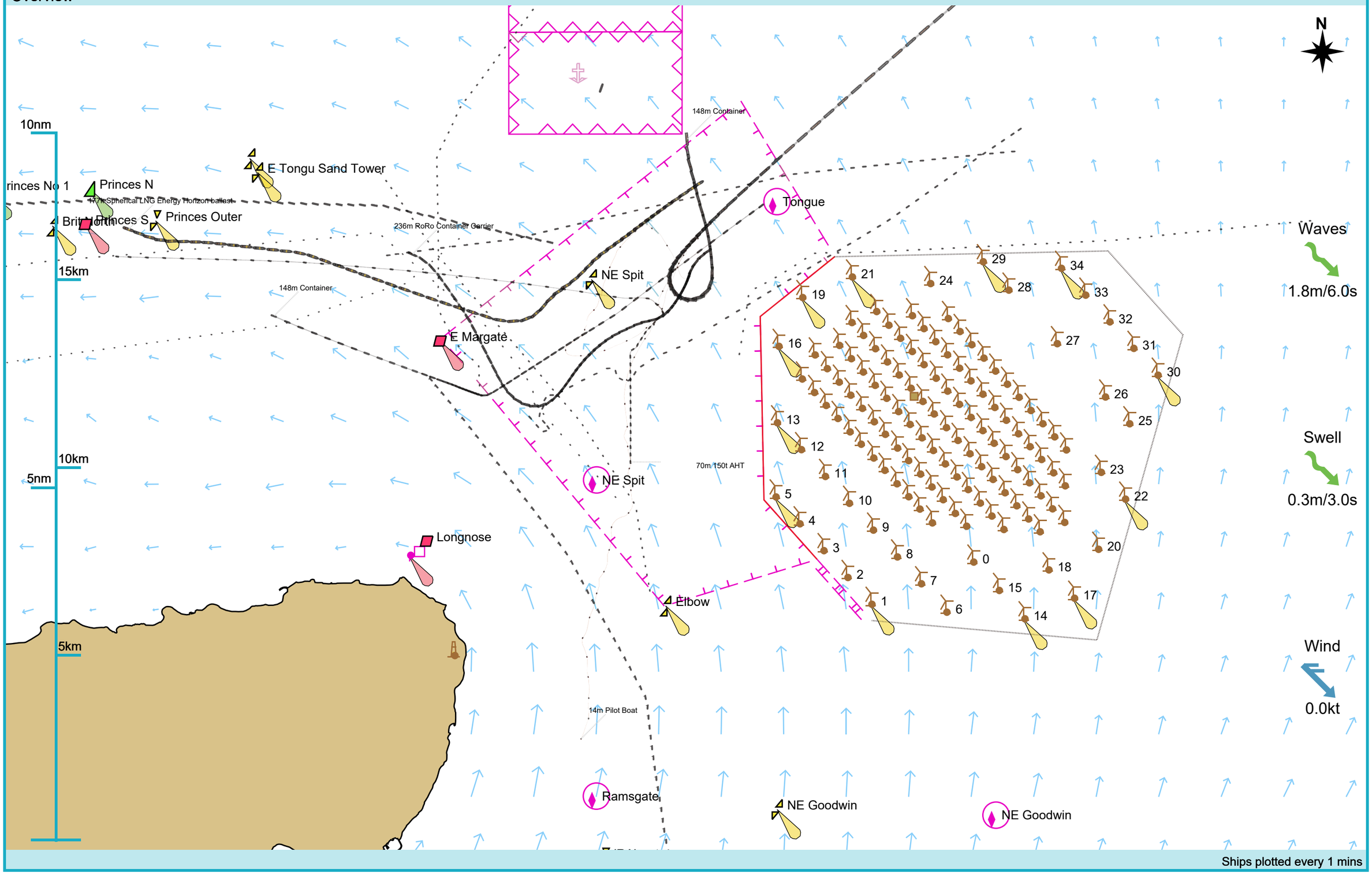
Summary

Overview



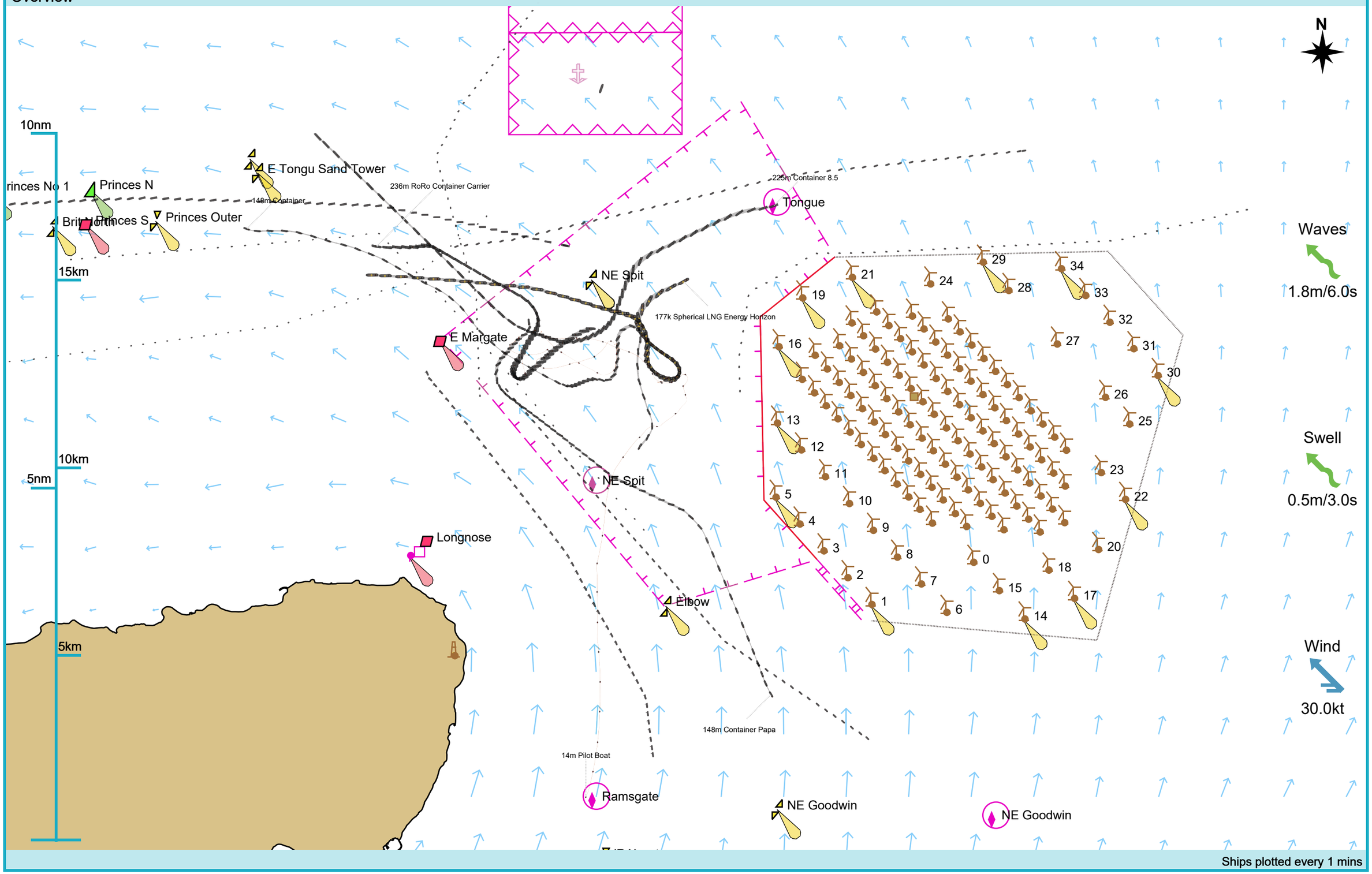
Summary

Overview



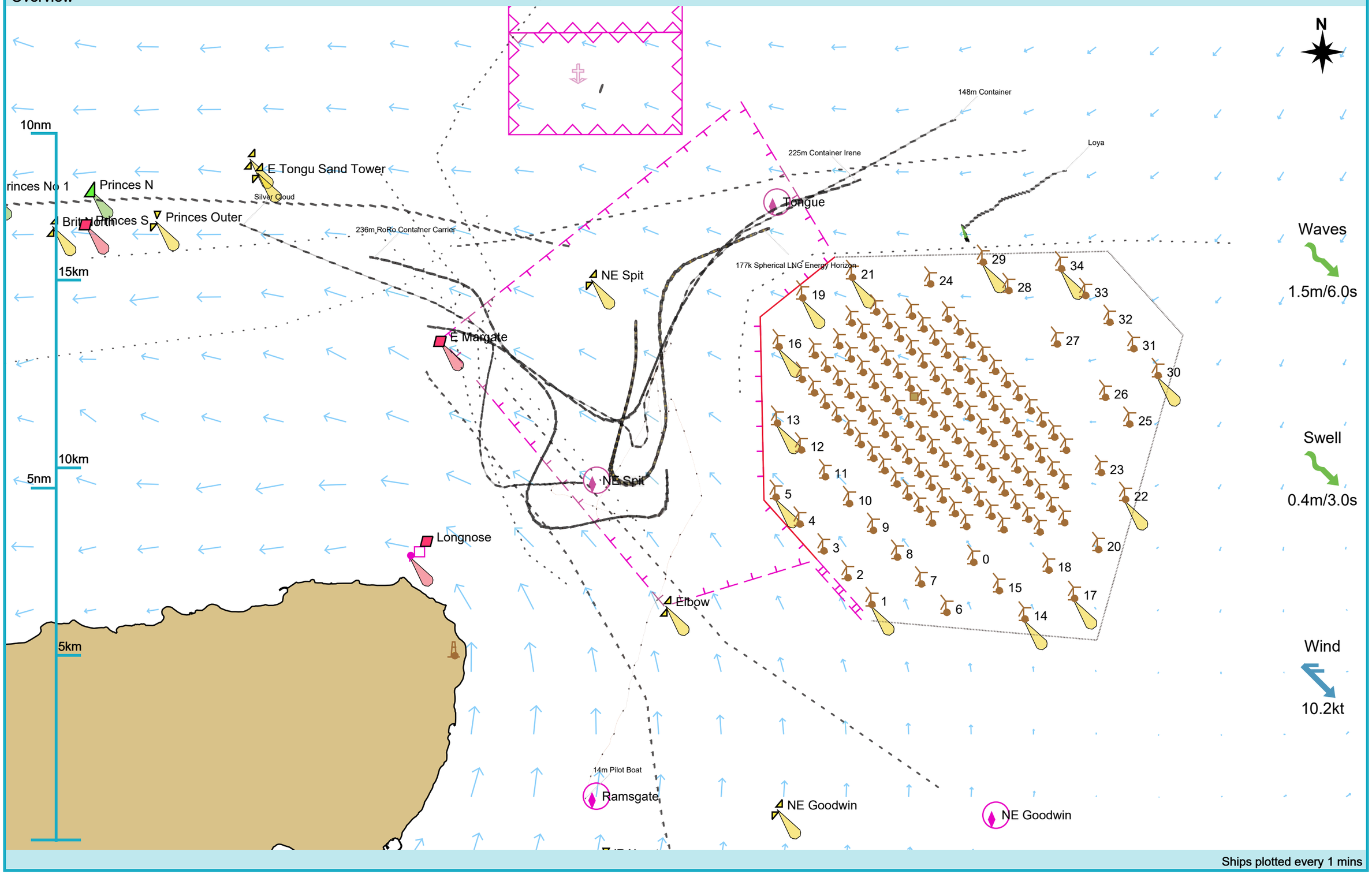
Summary

Overview



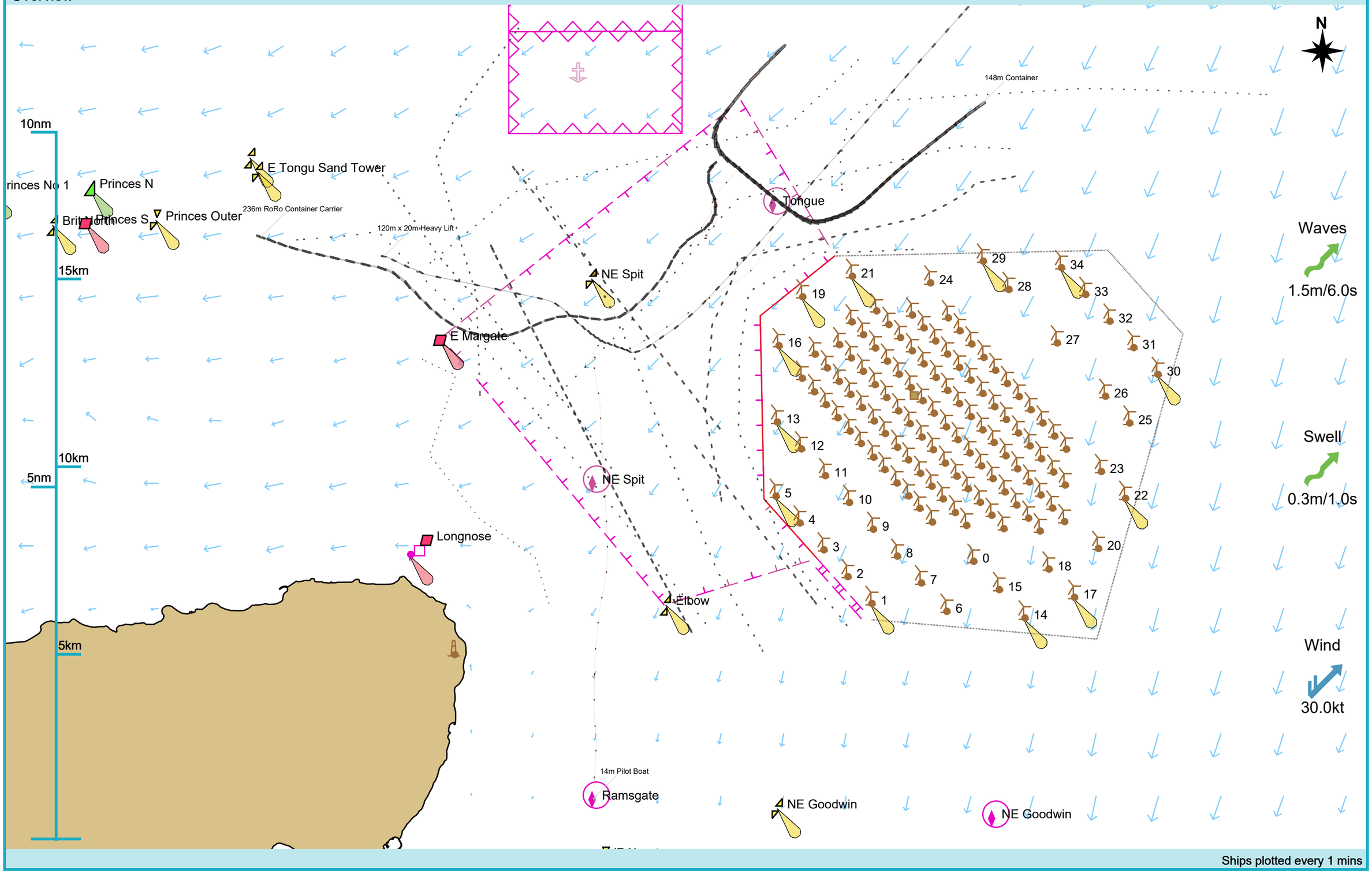
Summary

Overview



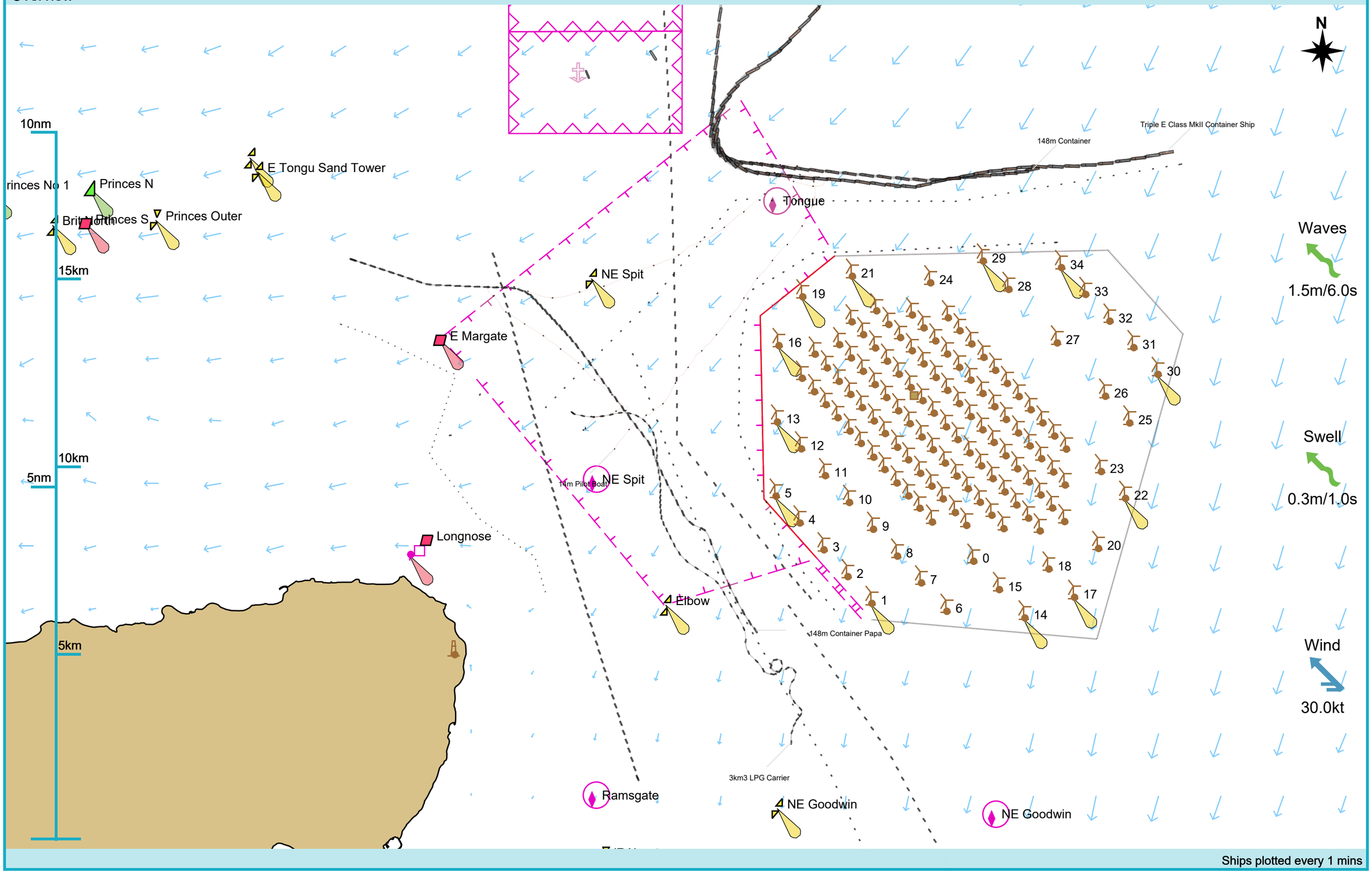
Summary

Overview



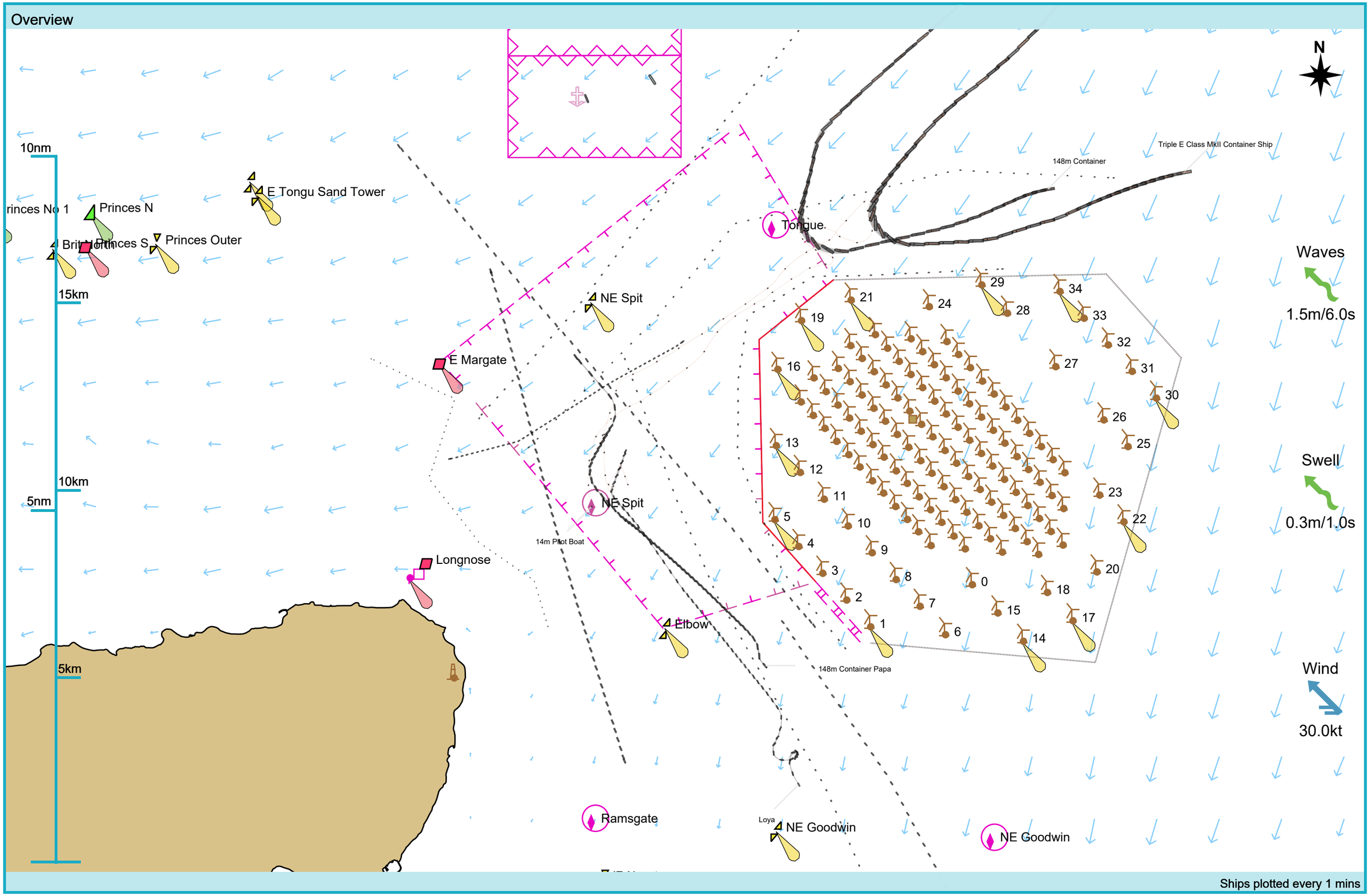
Summary

Overview



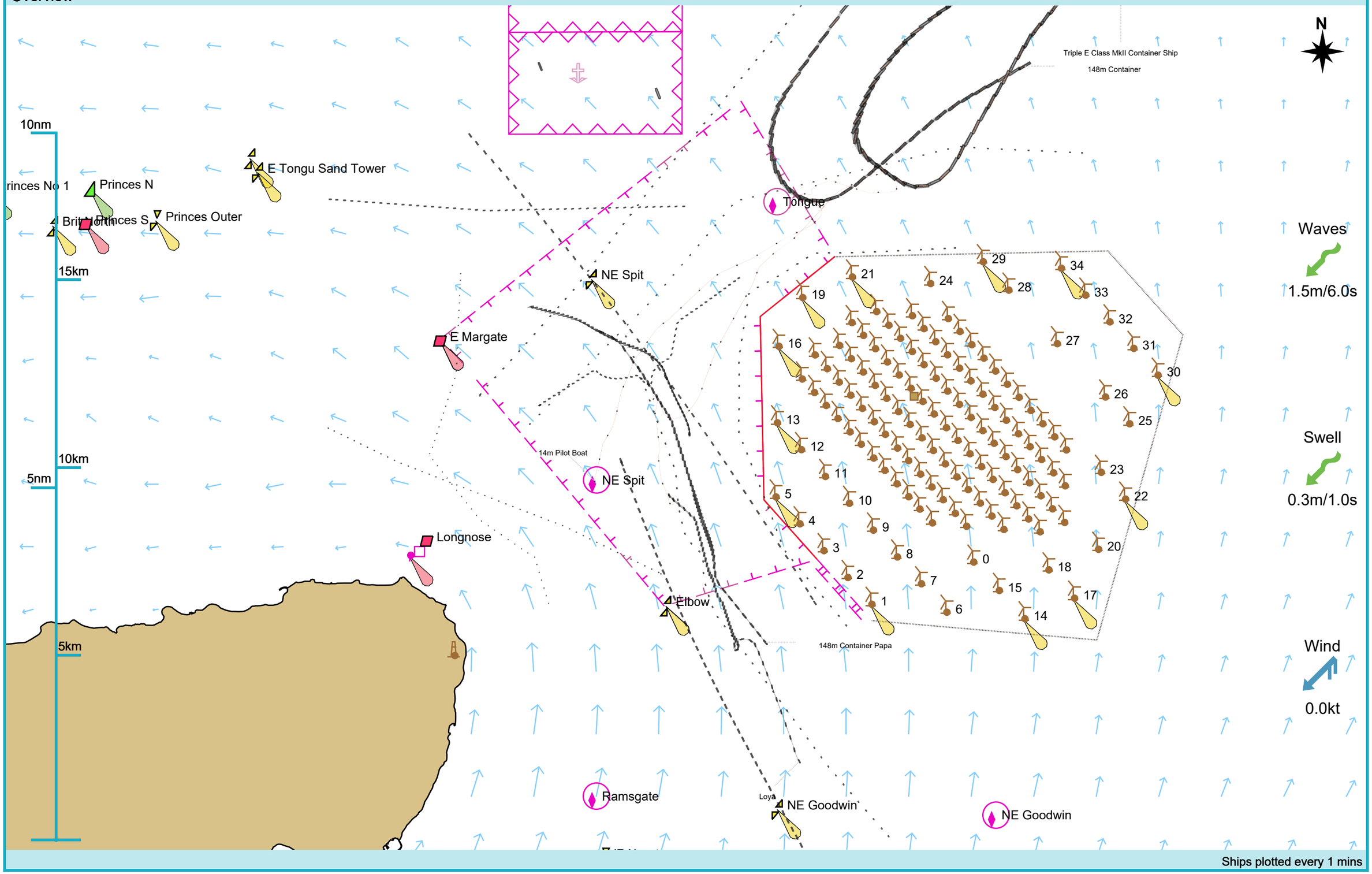
Summary

Overview



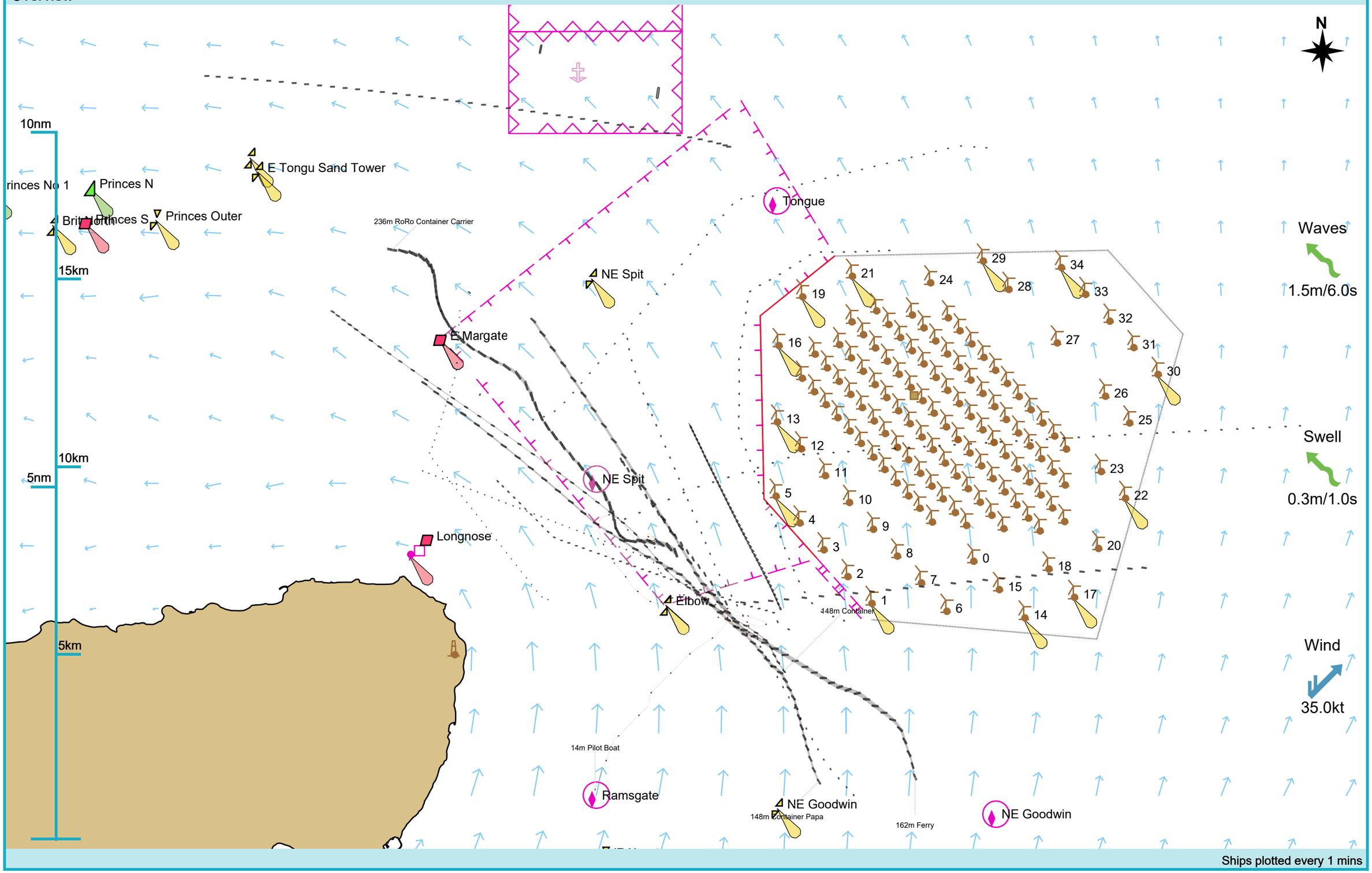
Summary

Overview



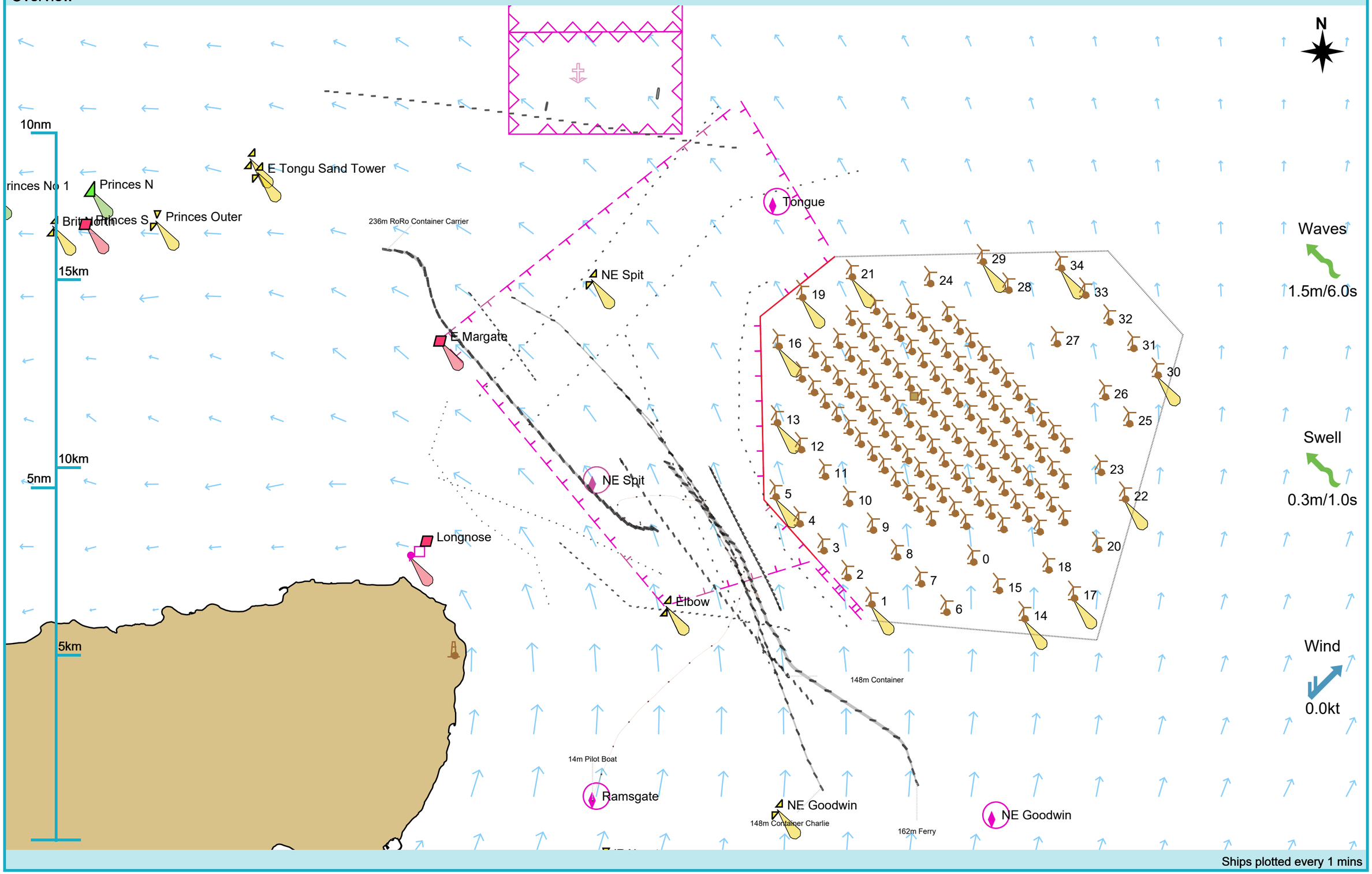
Summary

Overview



Summary

Overview



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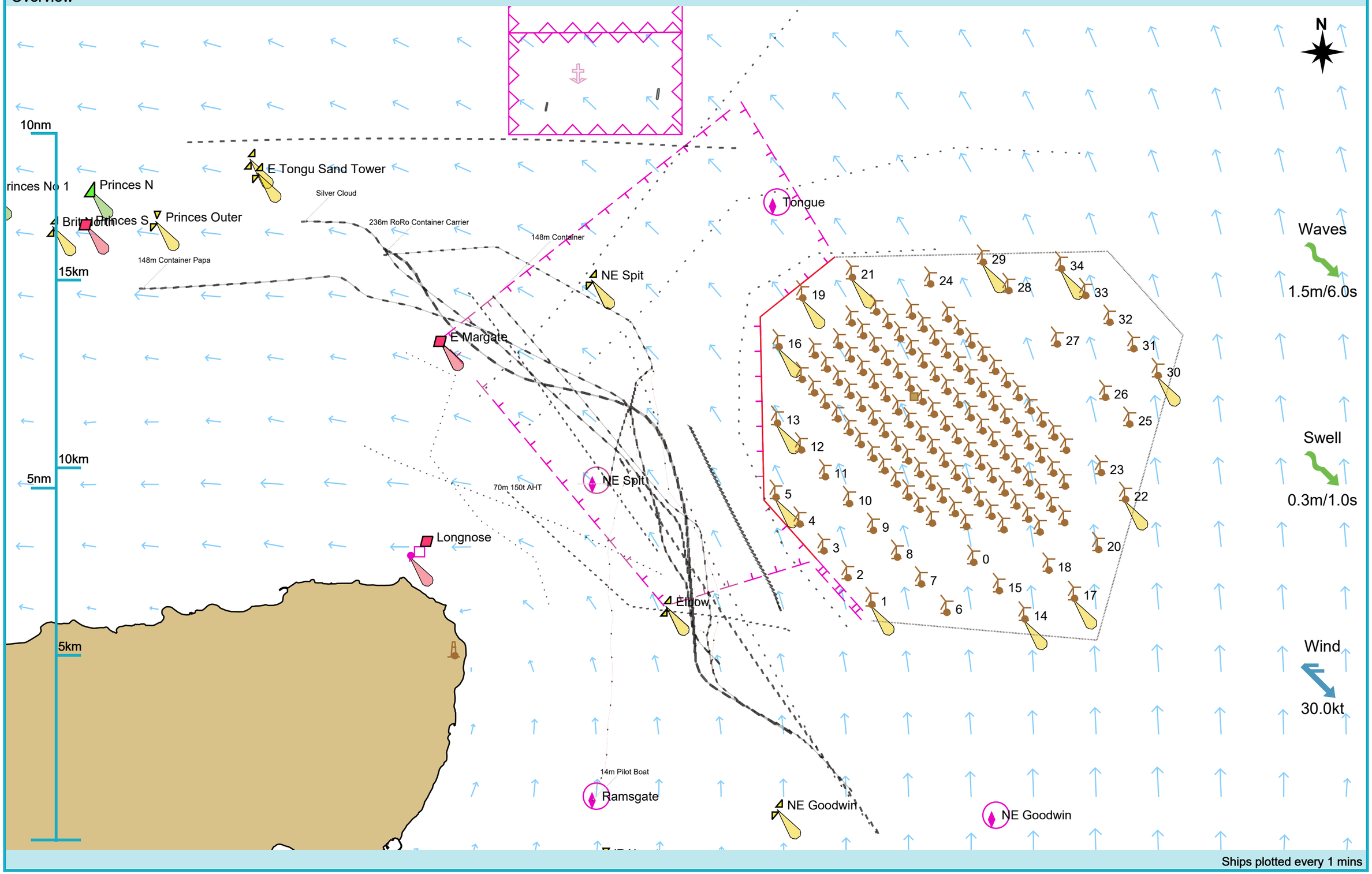

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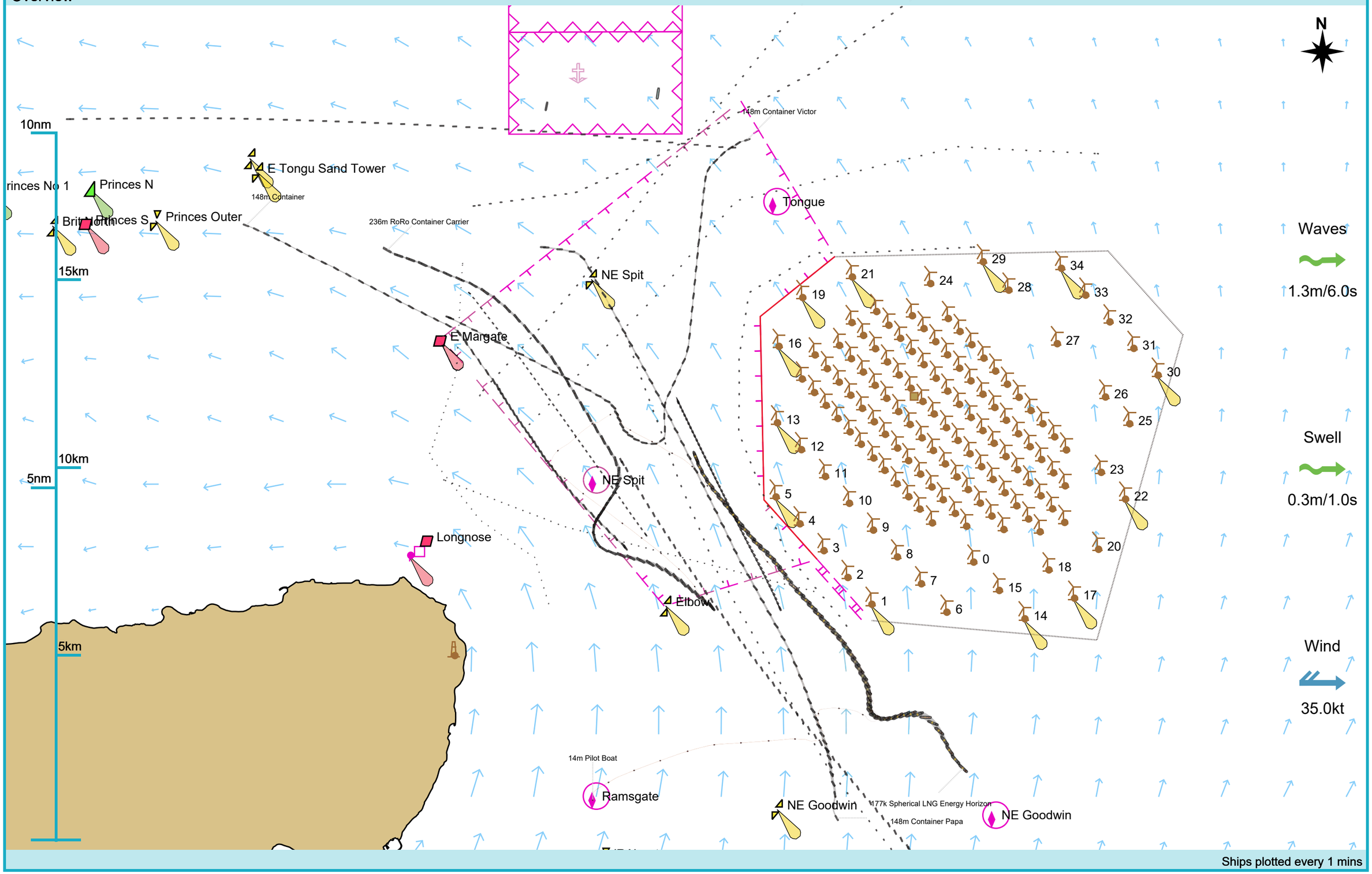
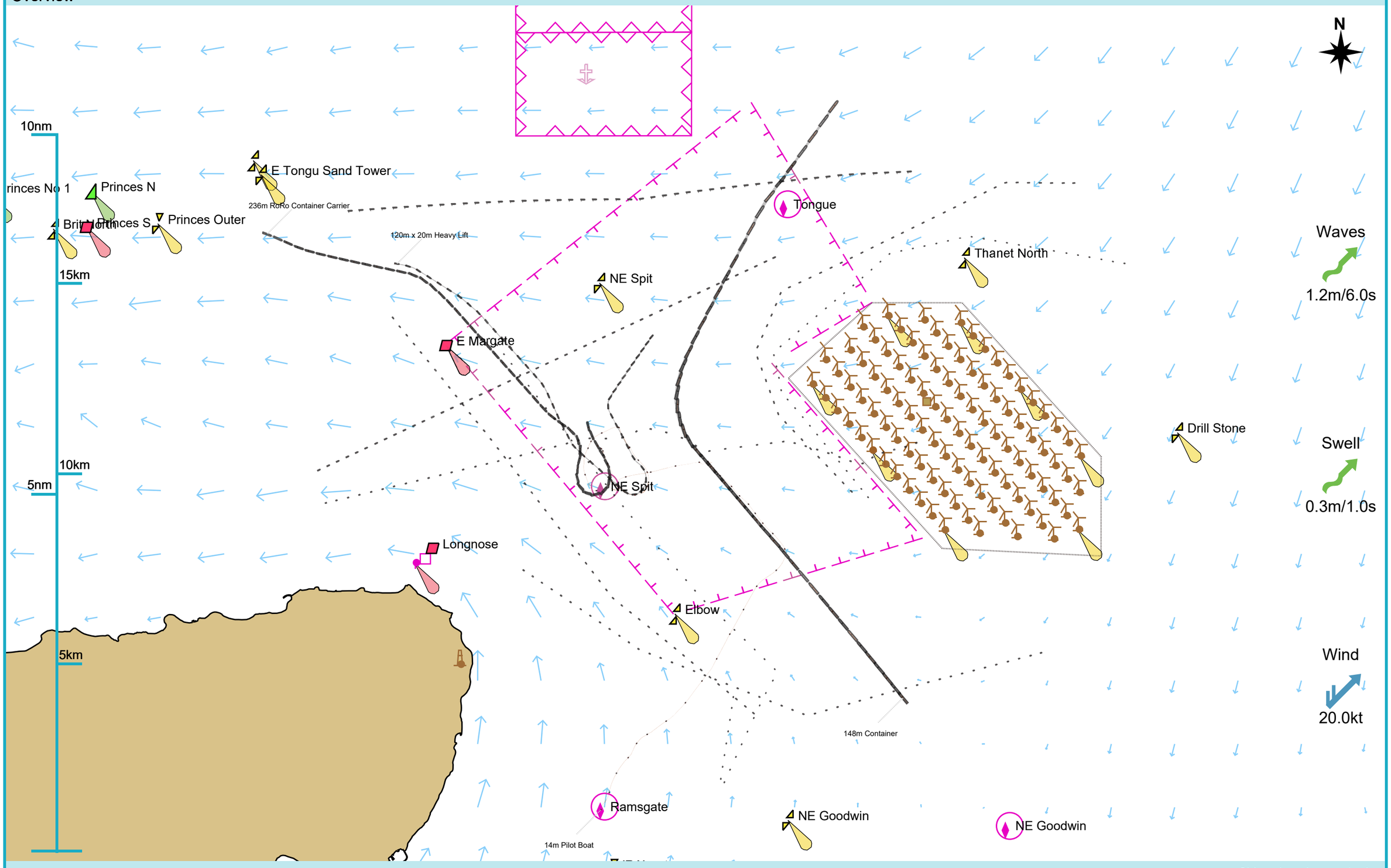


Pilot: C4/P6/P5/CR/CR/CR
Manoeuvre: Other

Ship: 14m Pilot Boat

Summary

Overview



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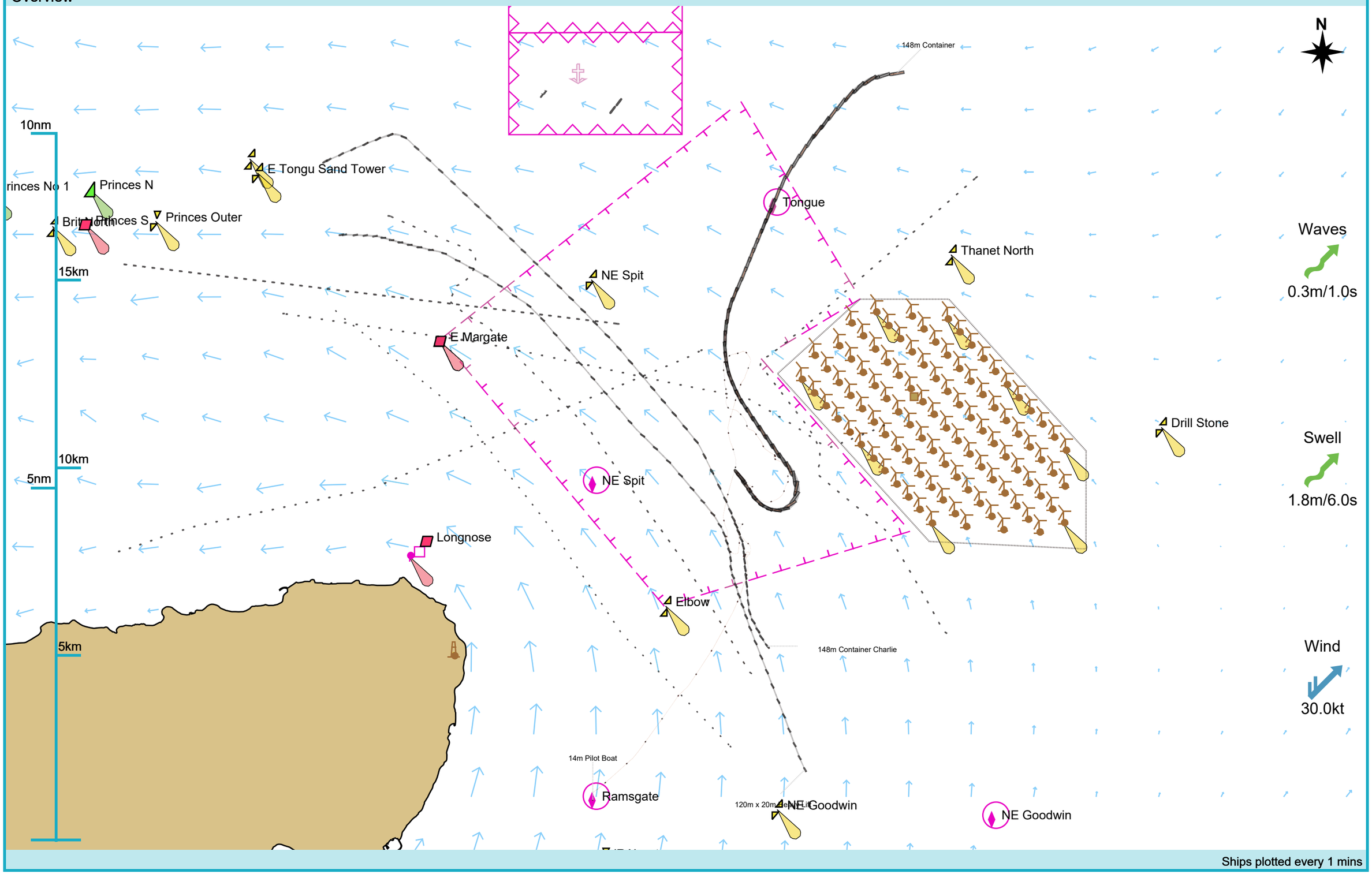

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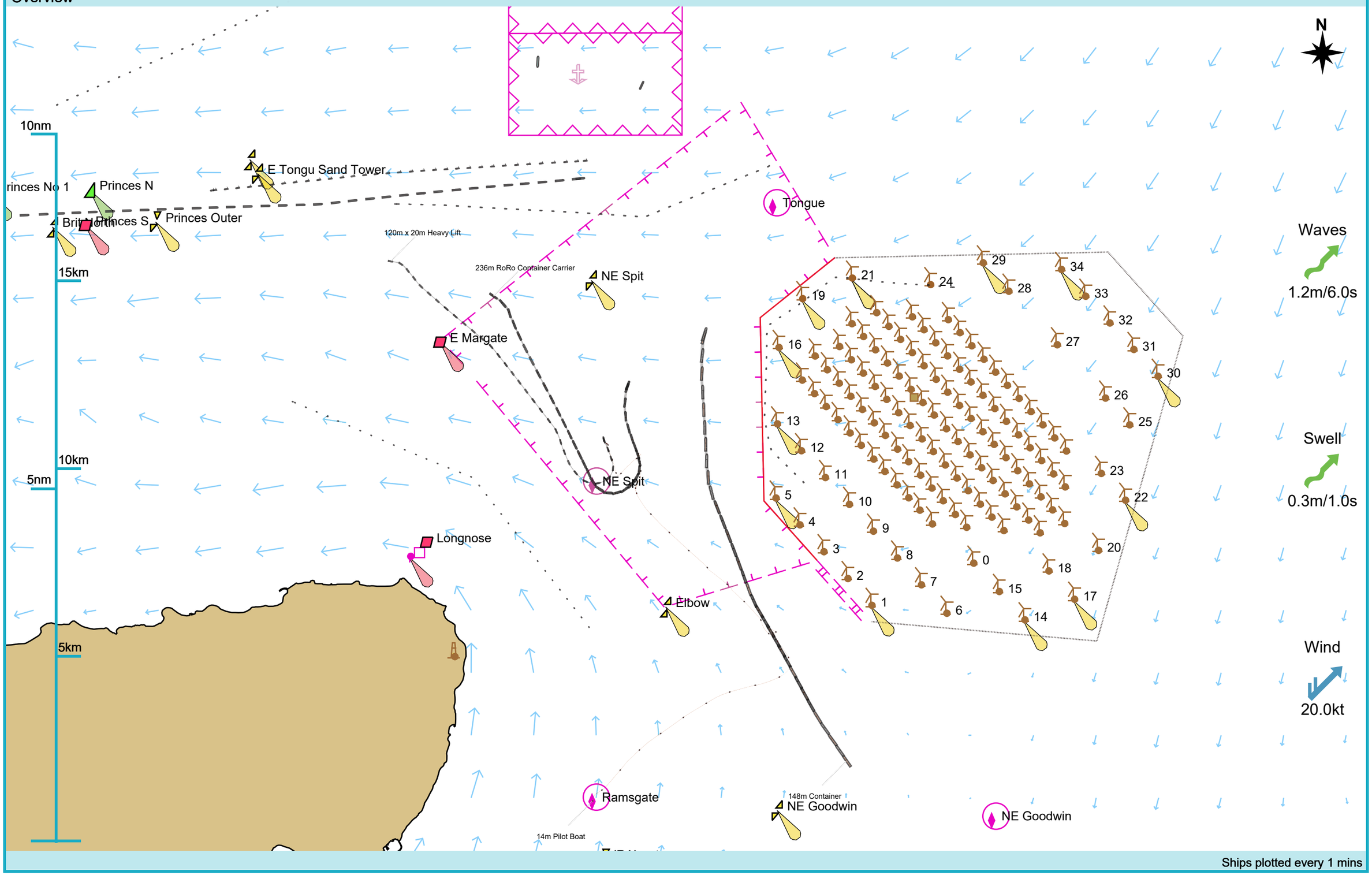

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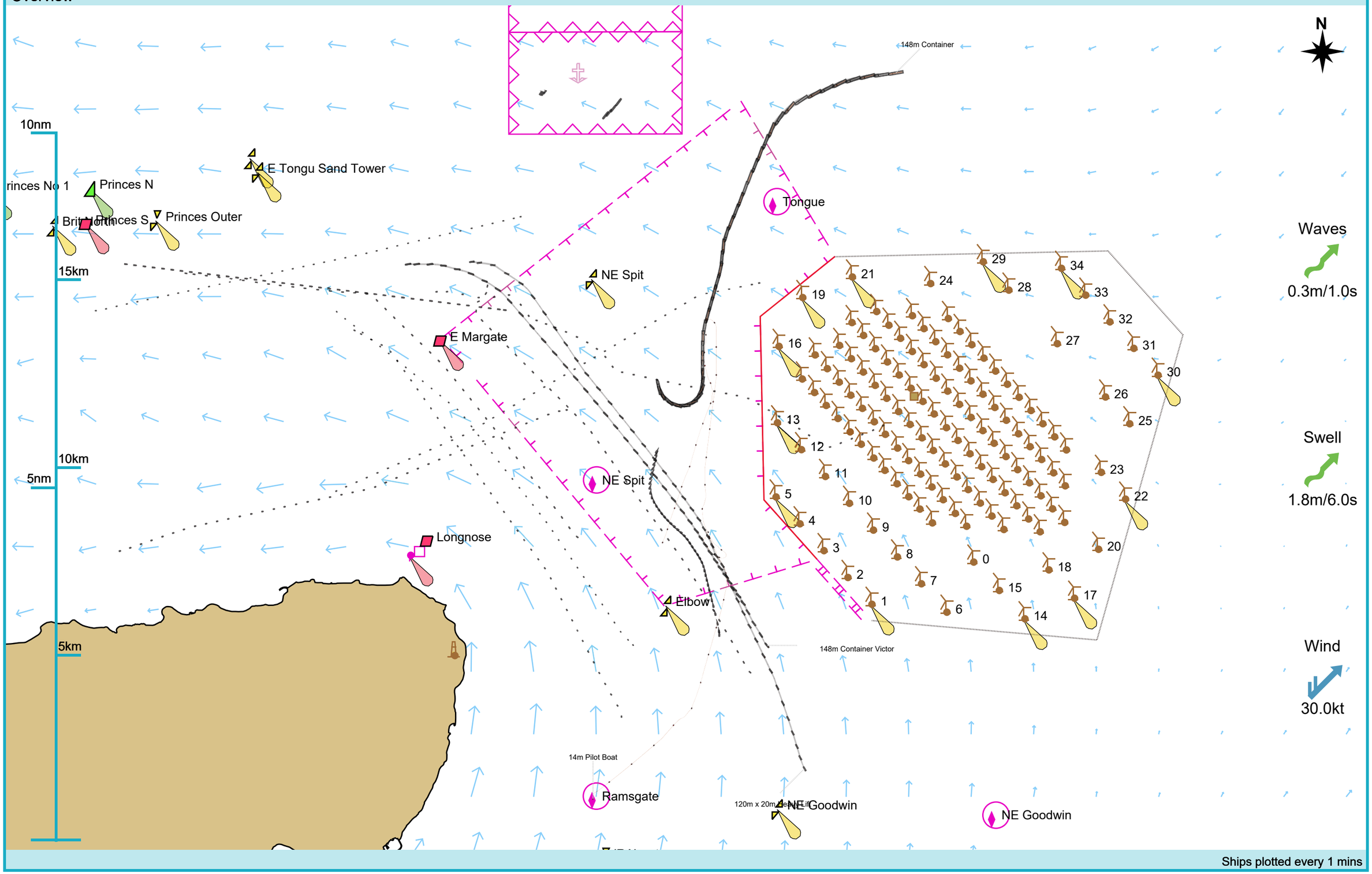

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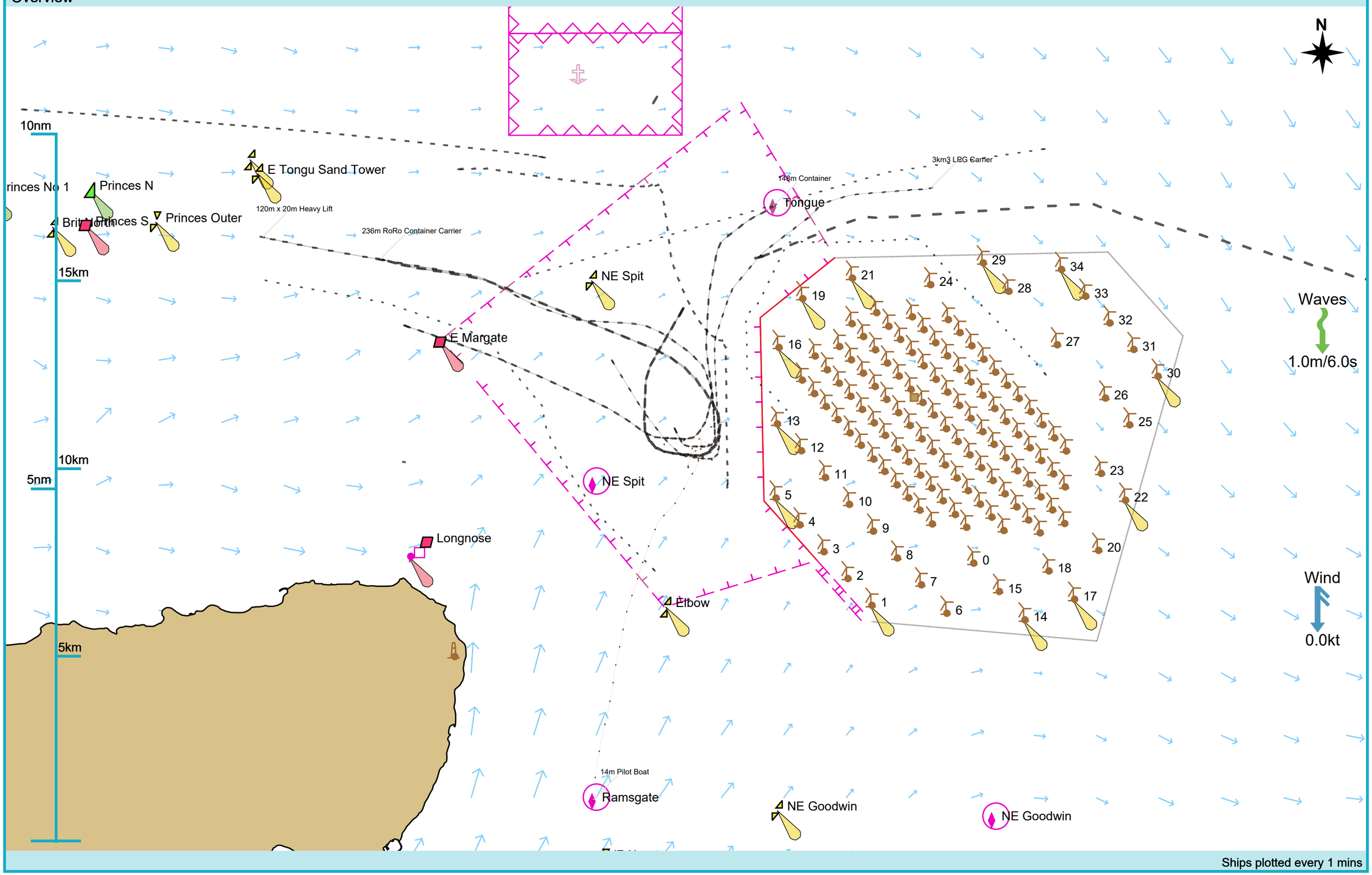

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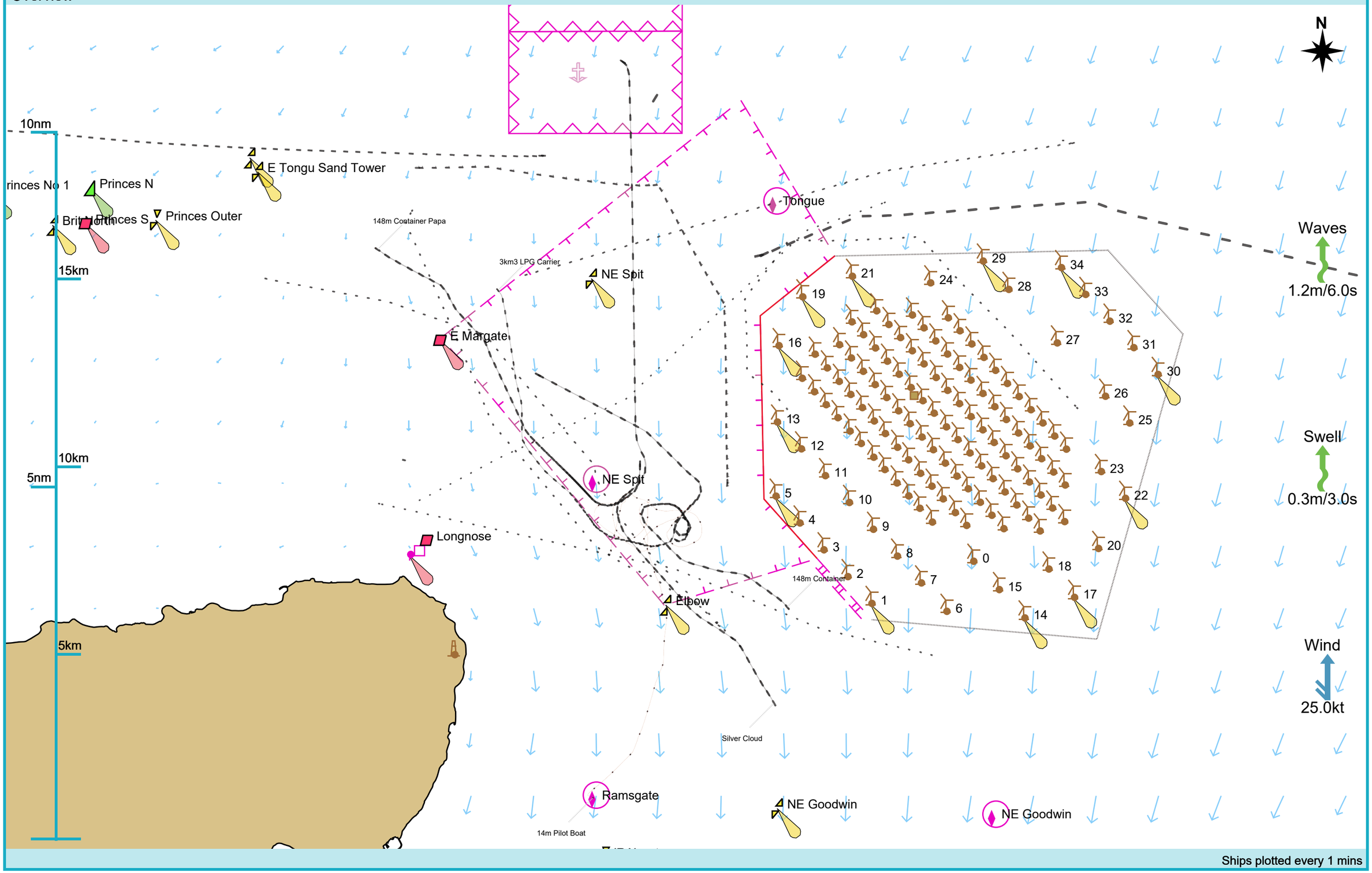

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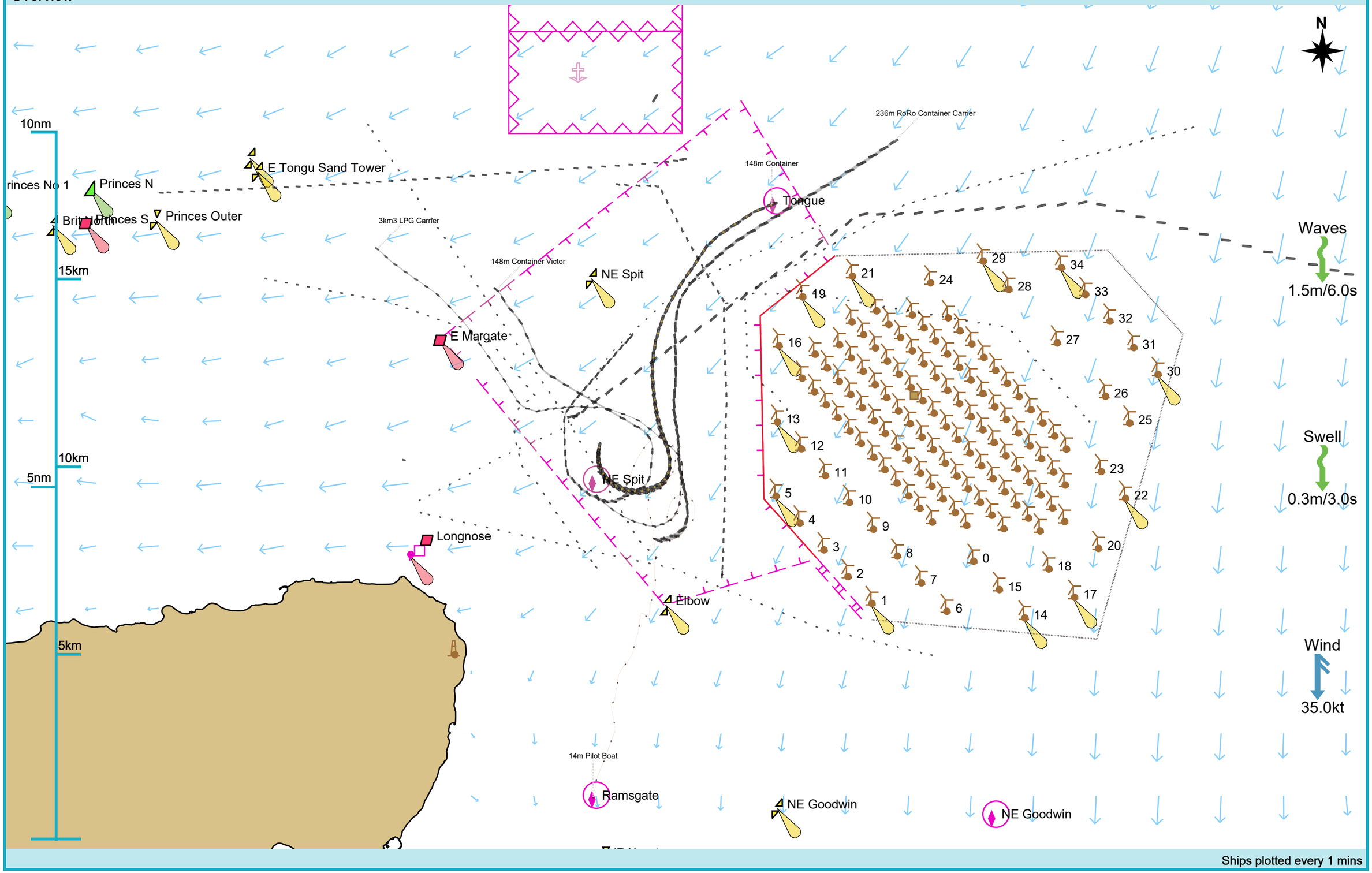

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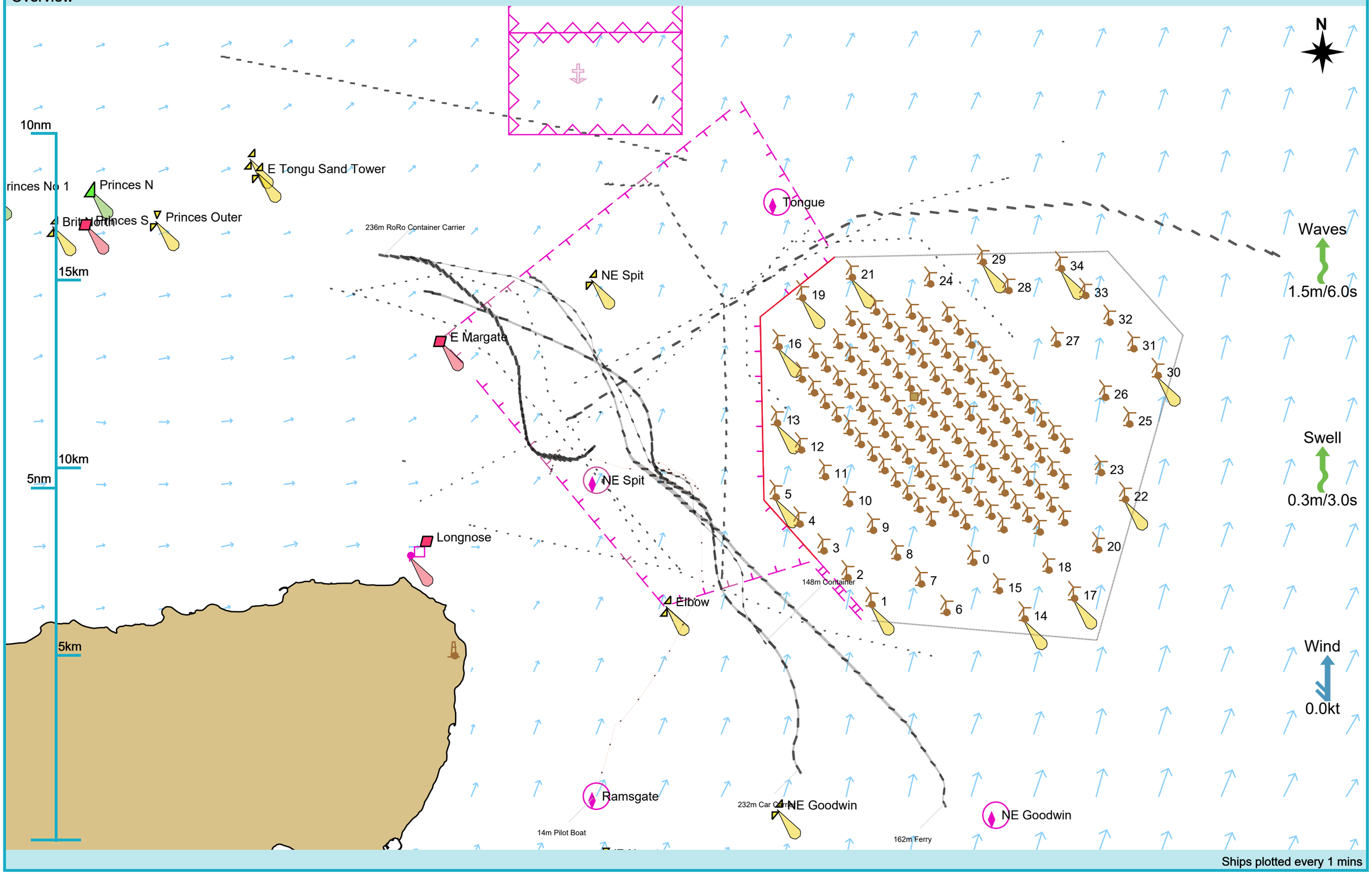

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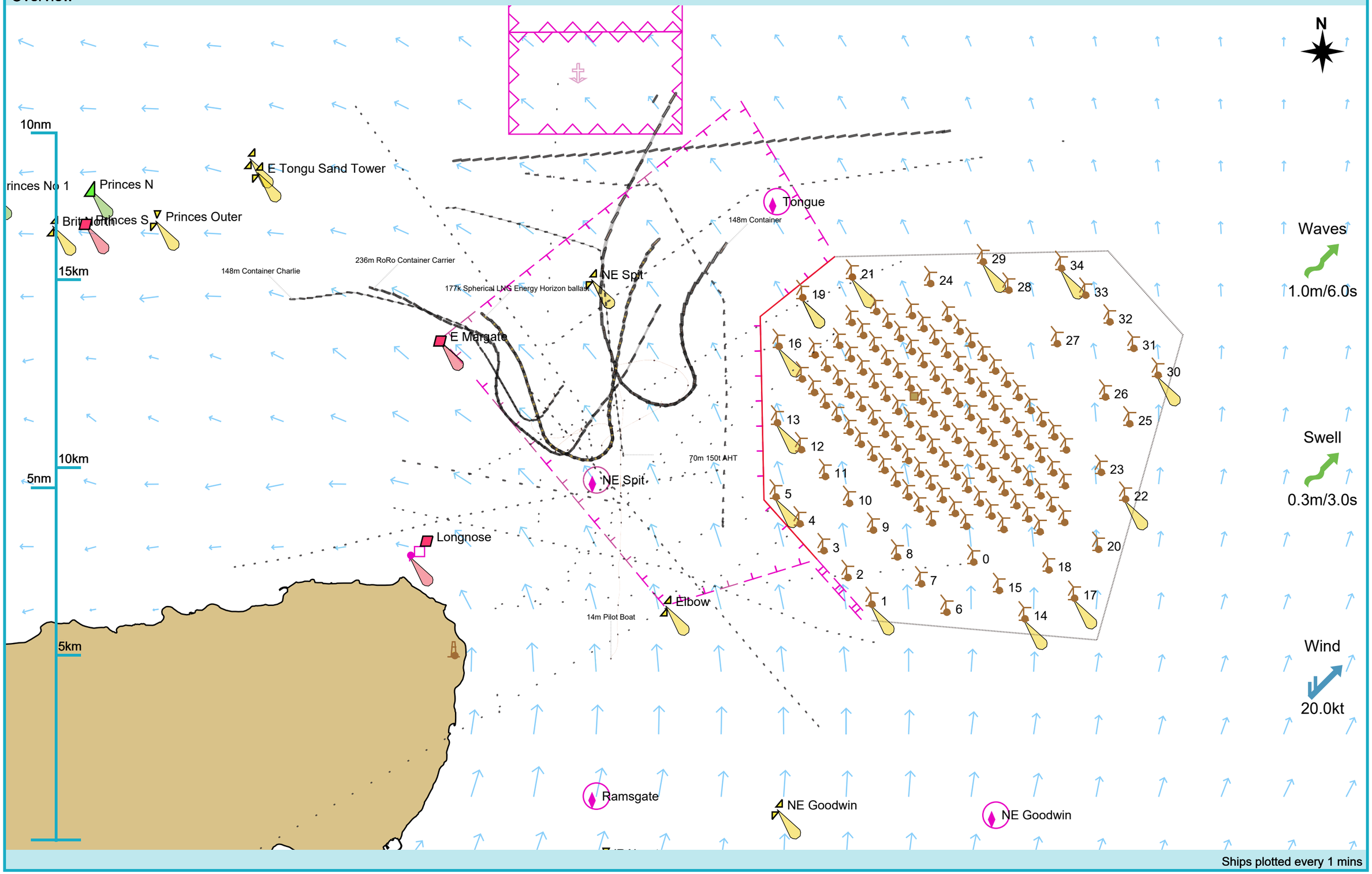
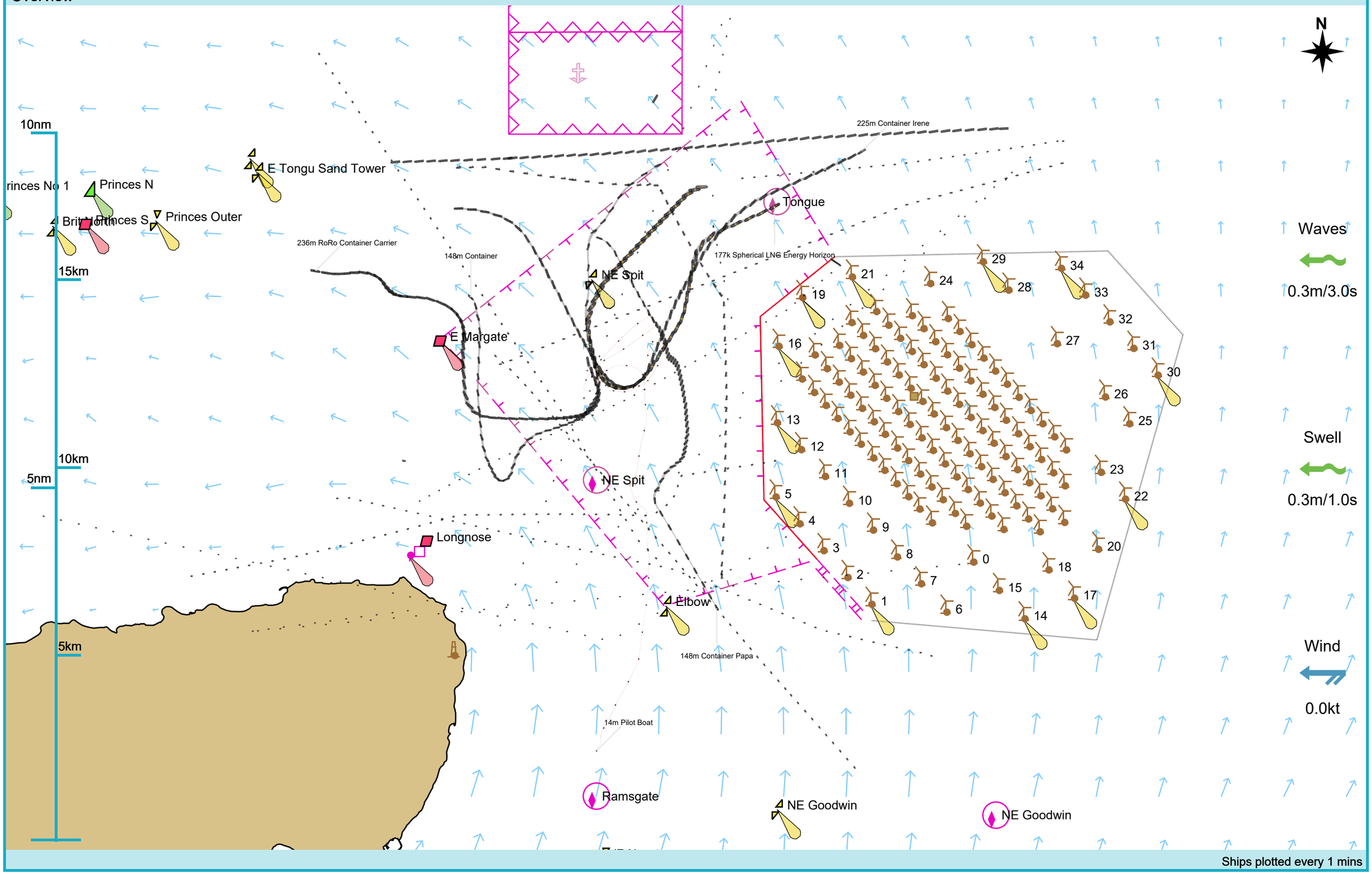


Pilot: C3/P6/P9/CR/CR/CR
Manoeuvre: Other

Ship: 14m Pilot Boat

Summary

Overview



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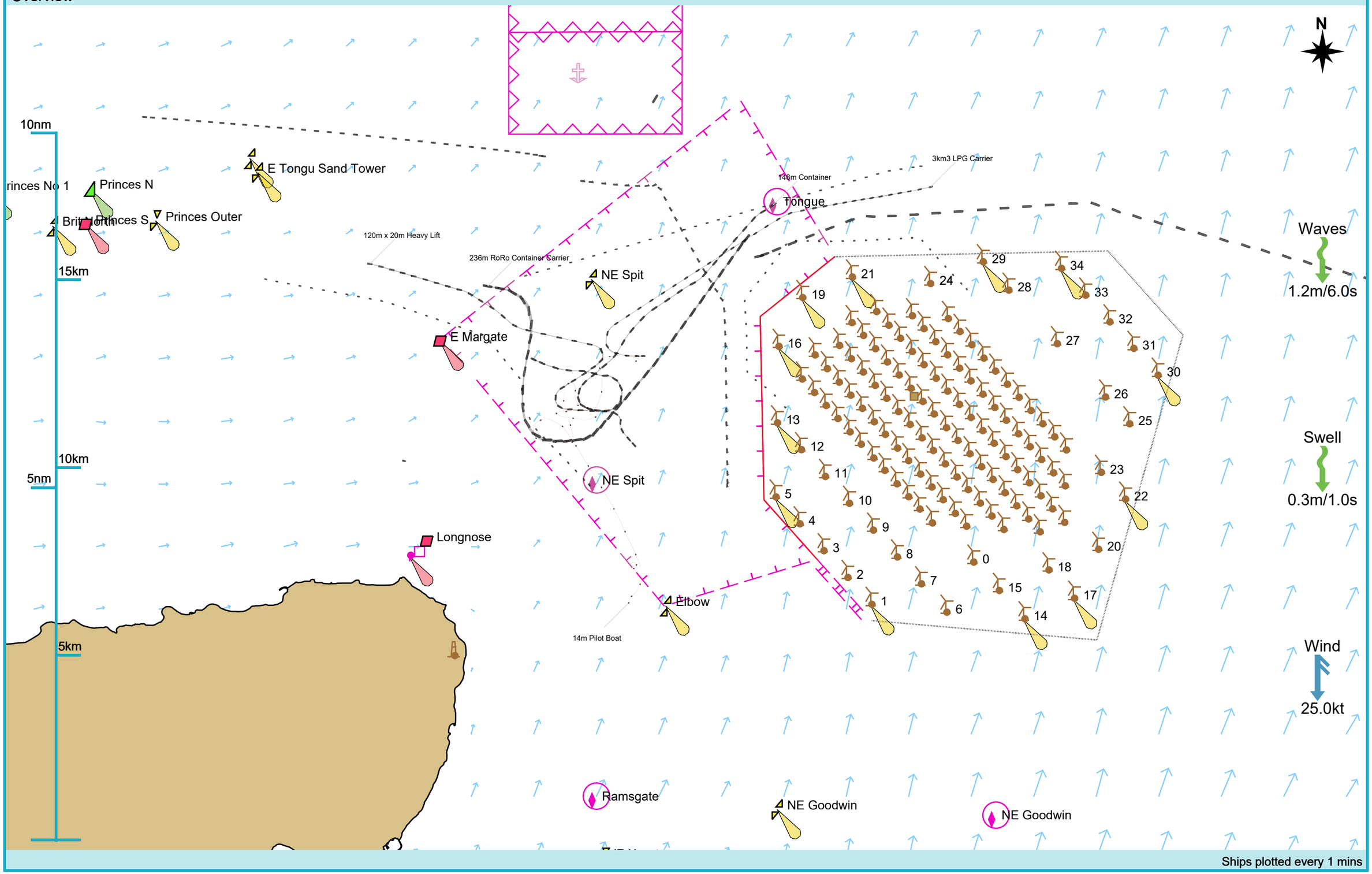

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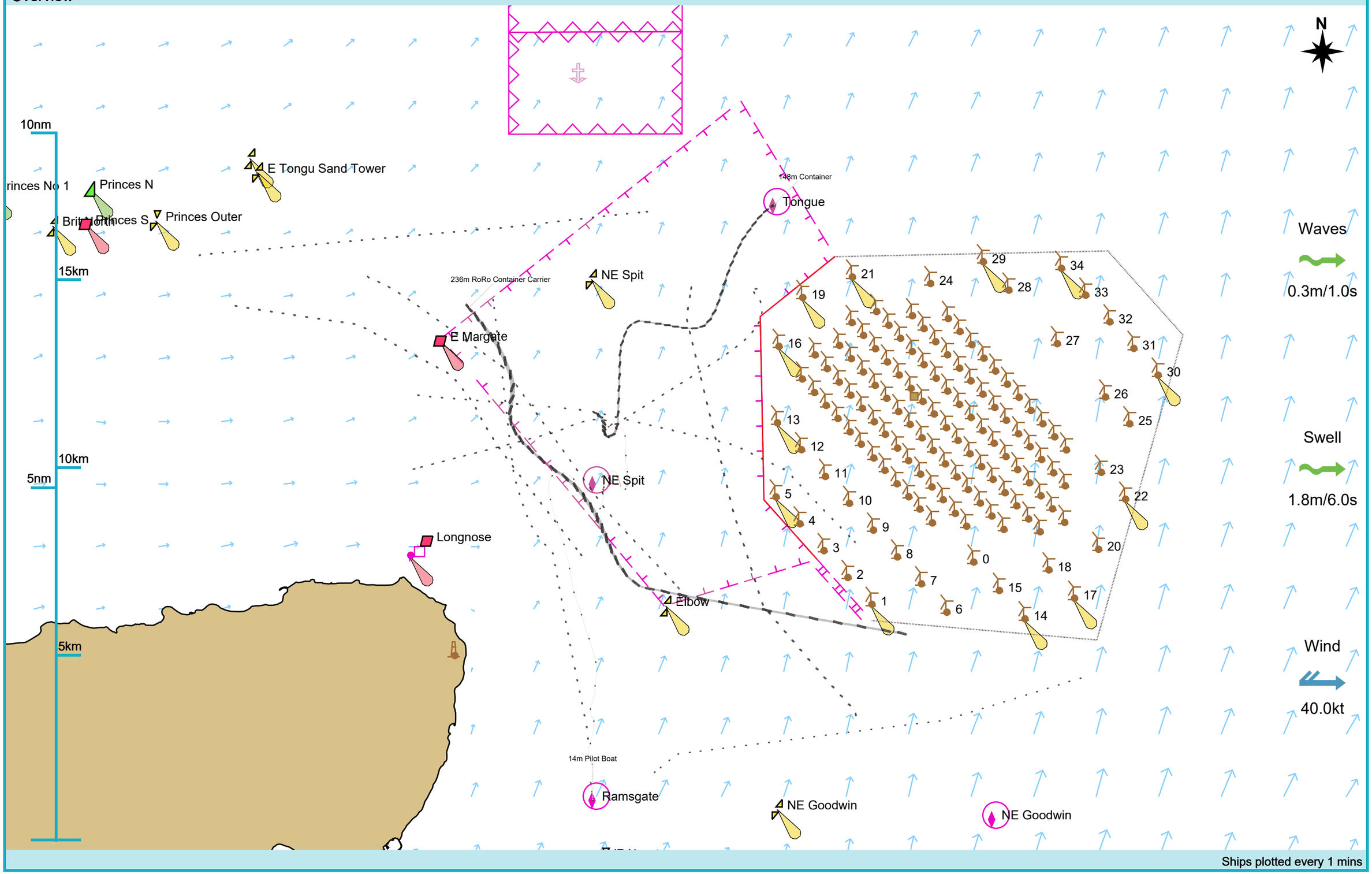

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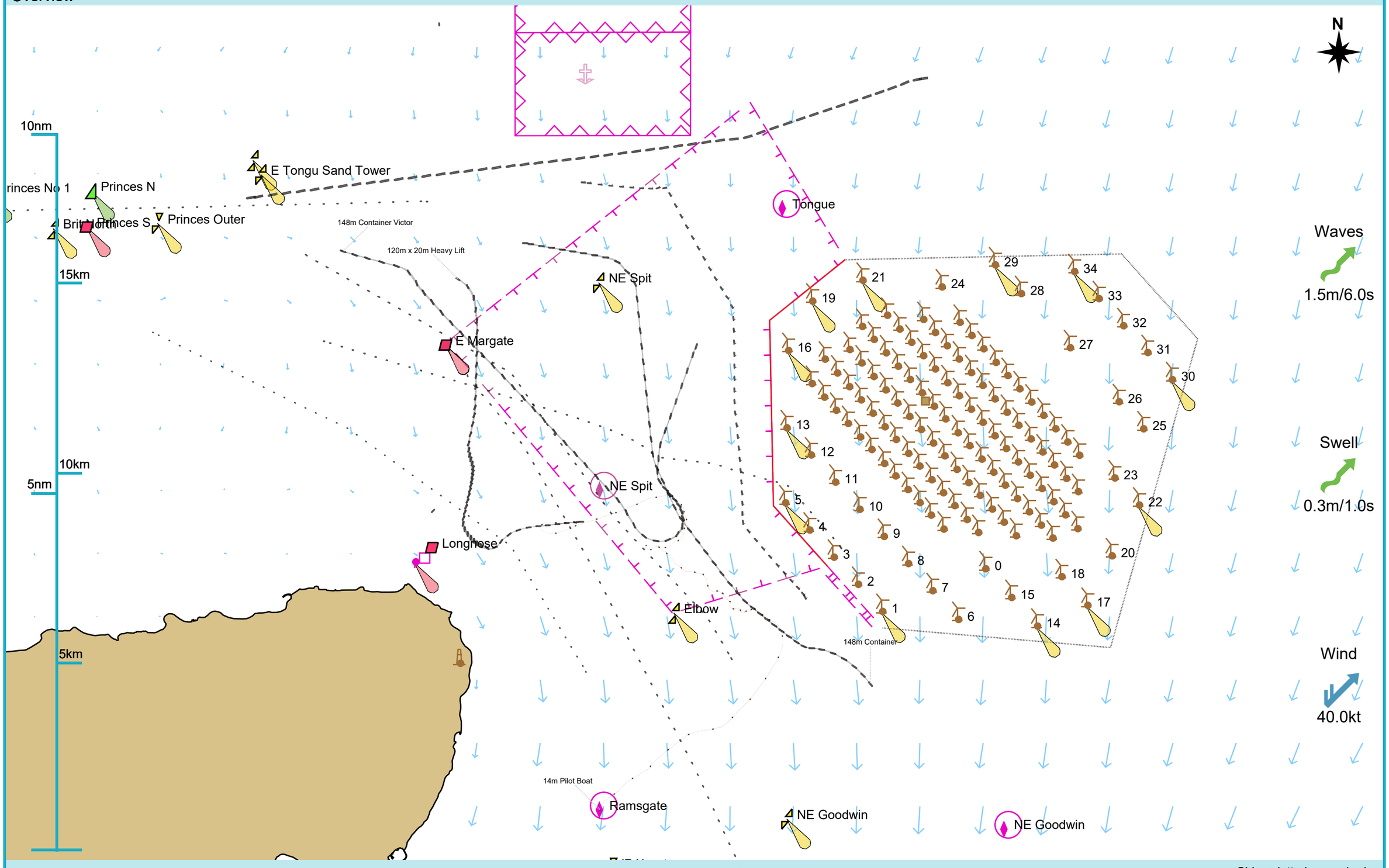

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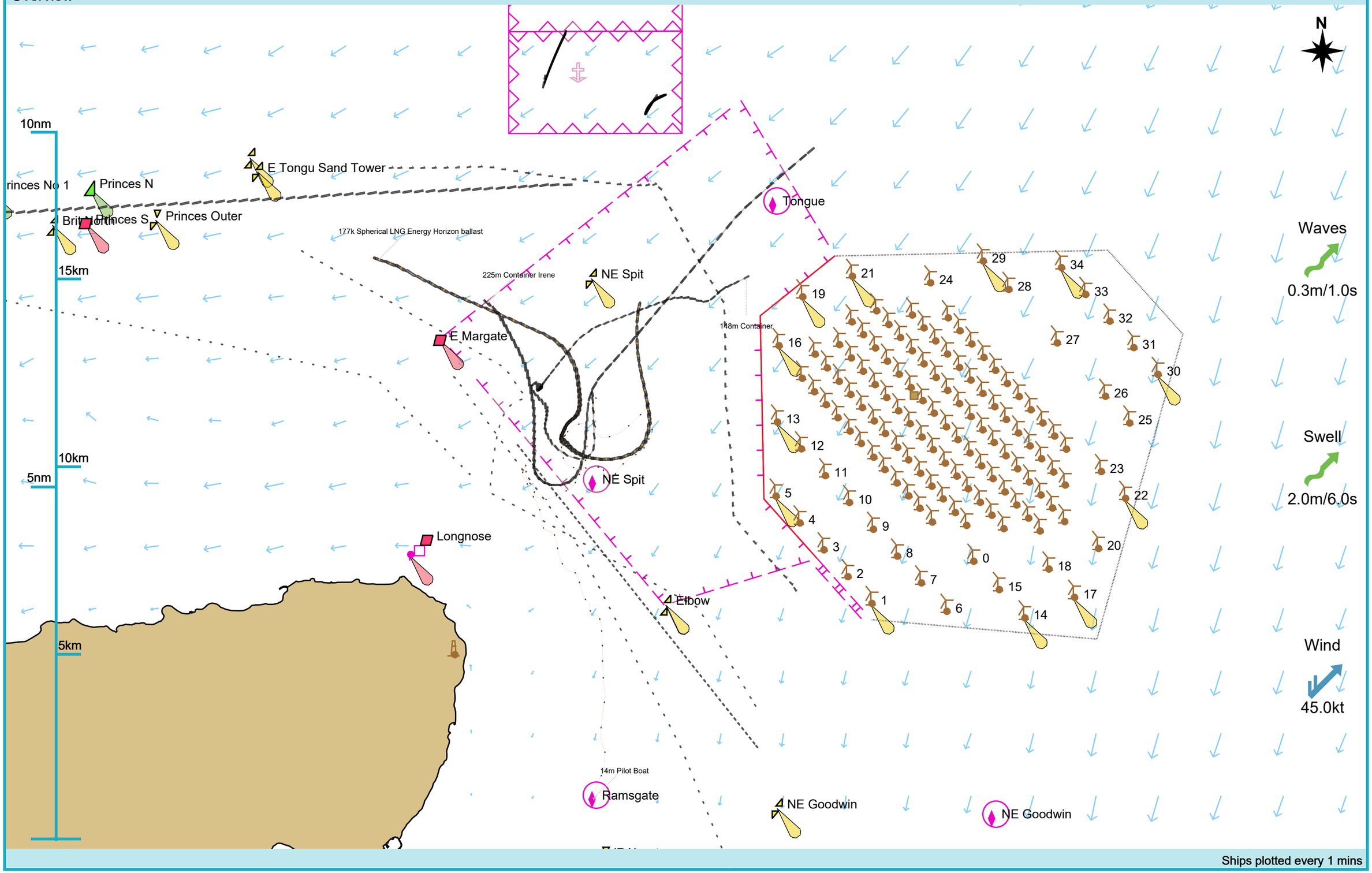

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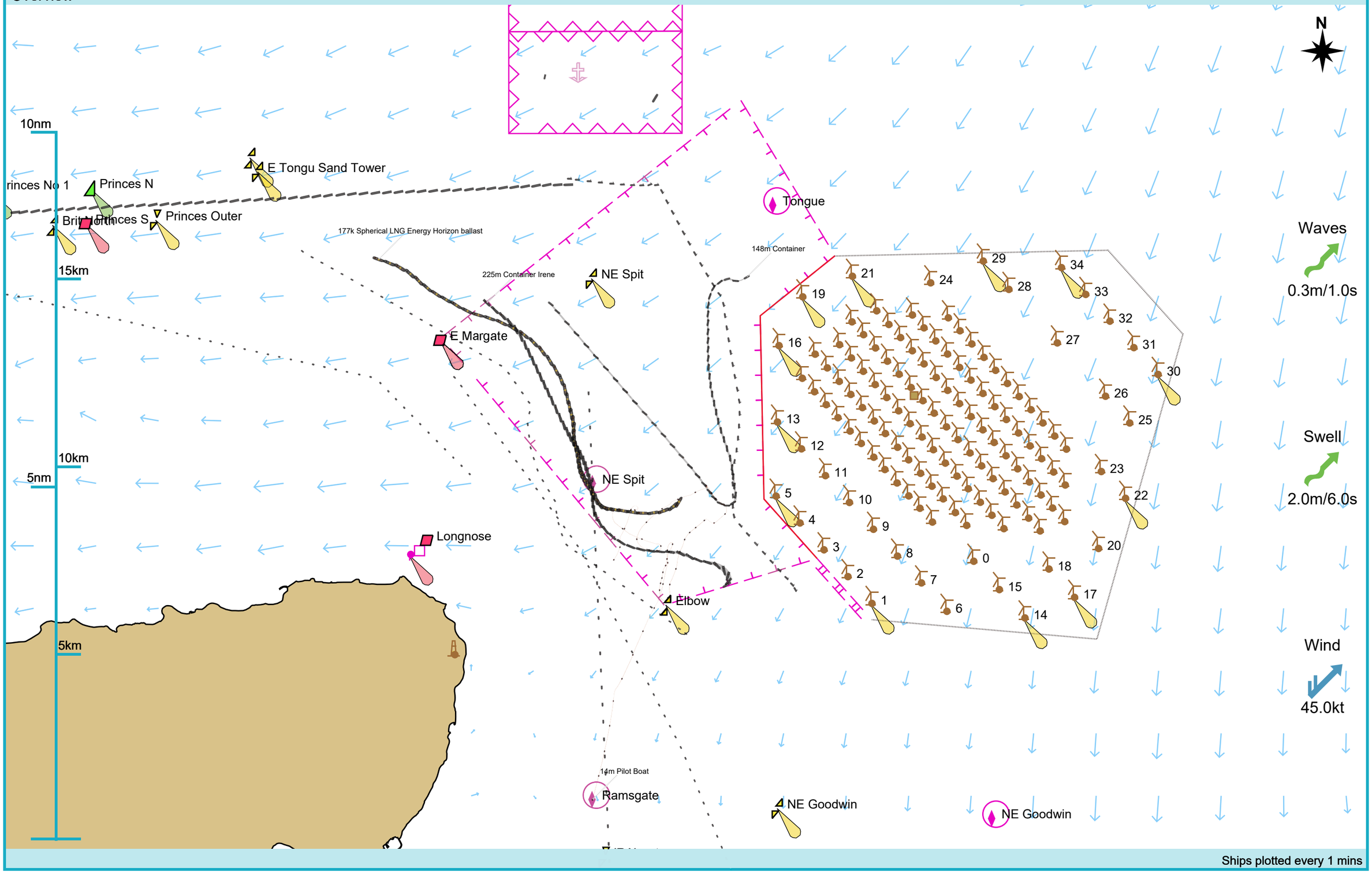

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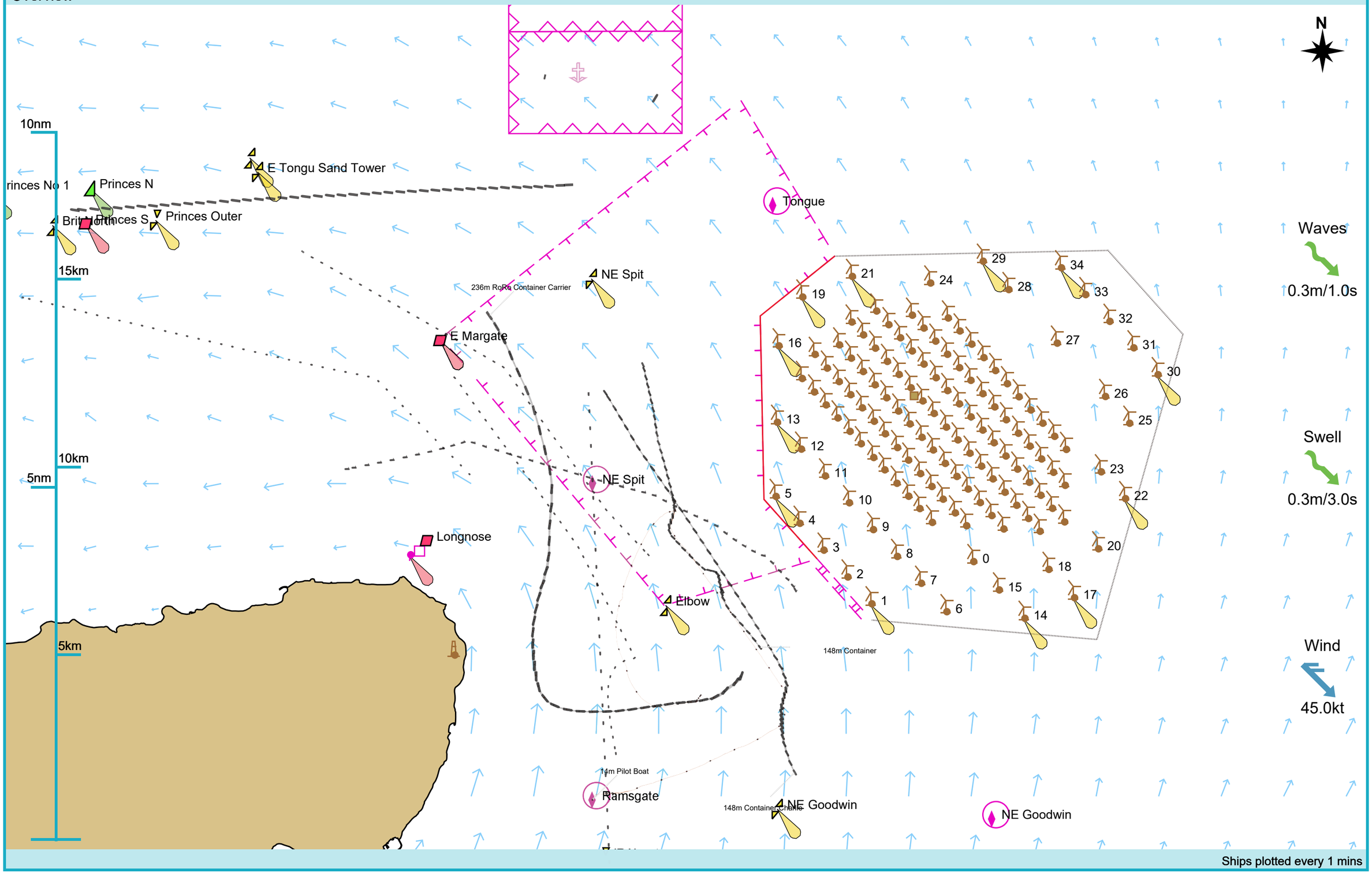

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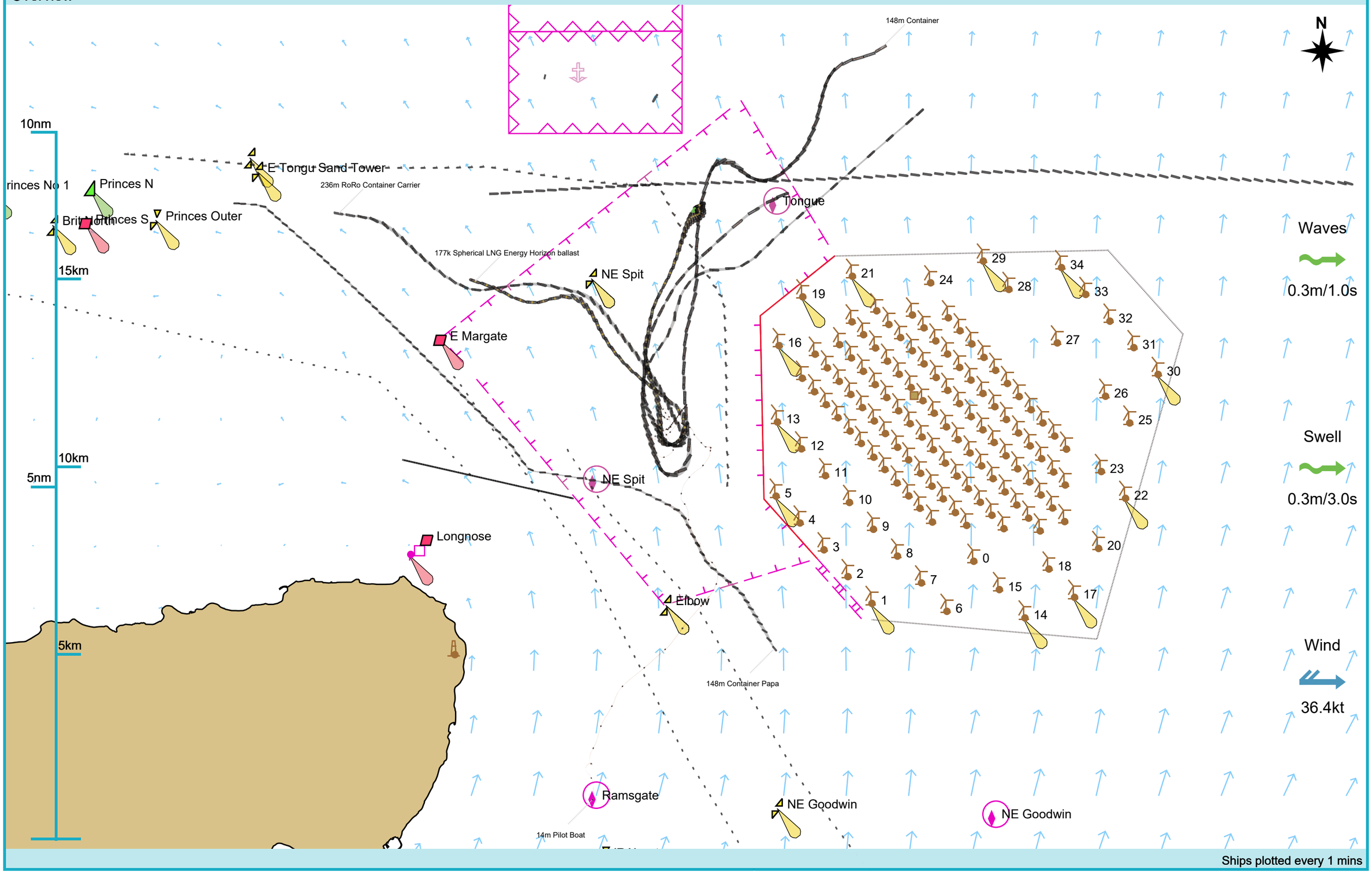

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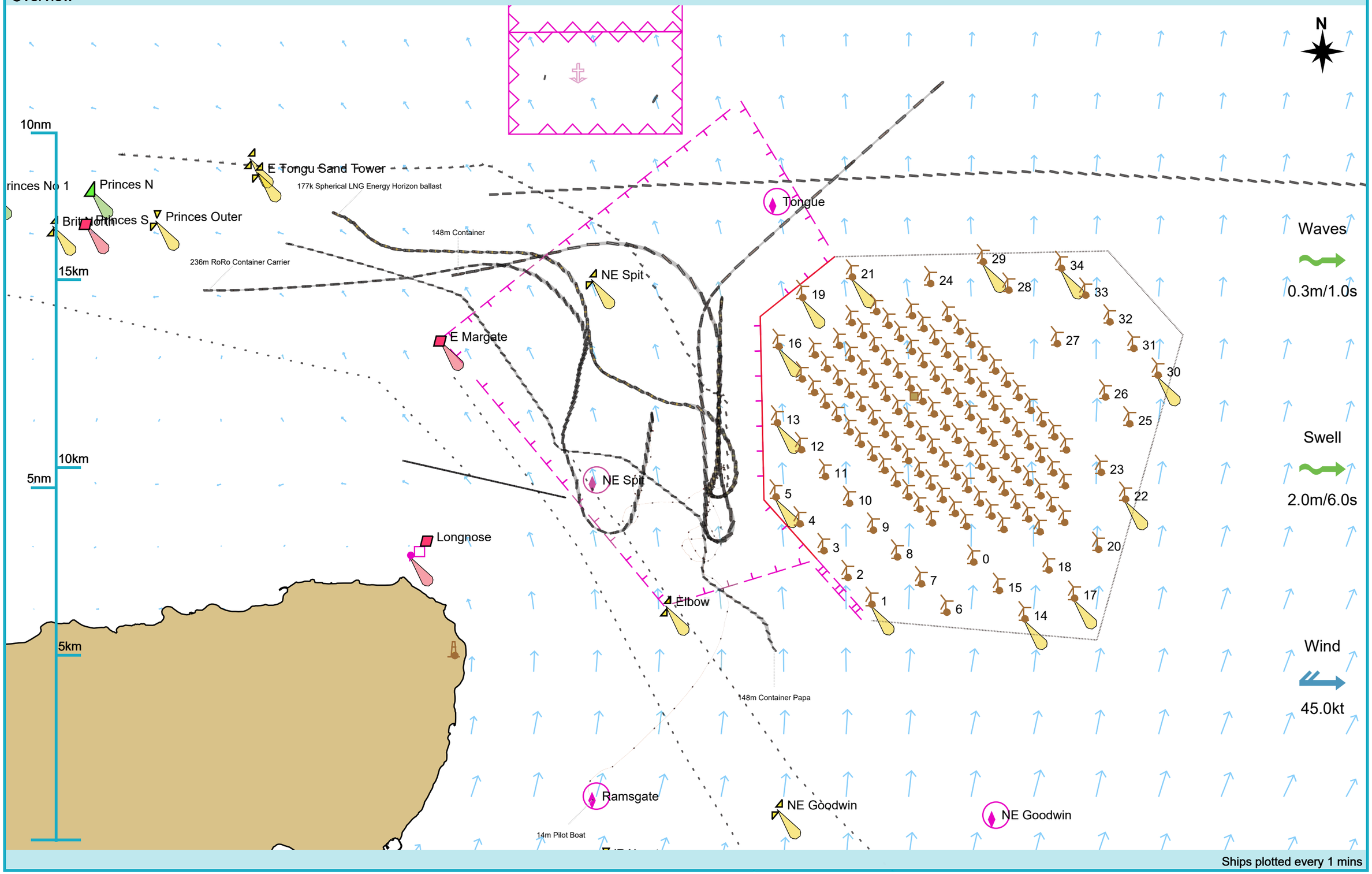

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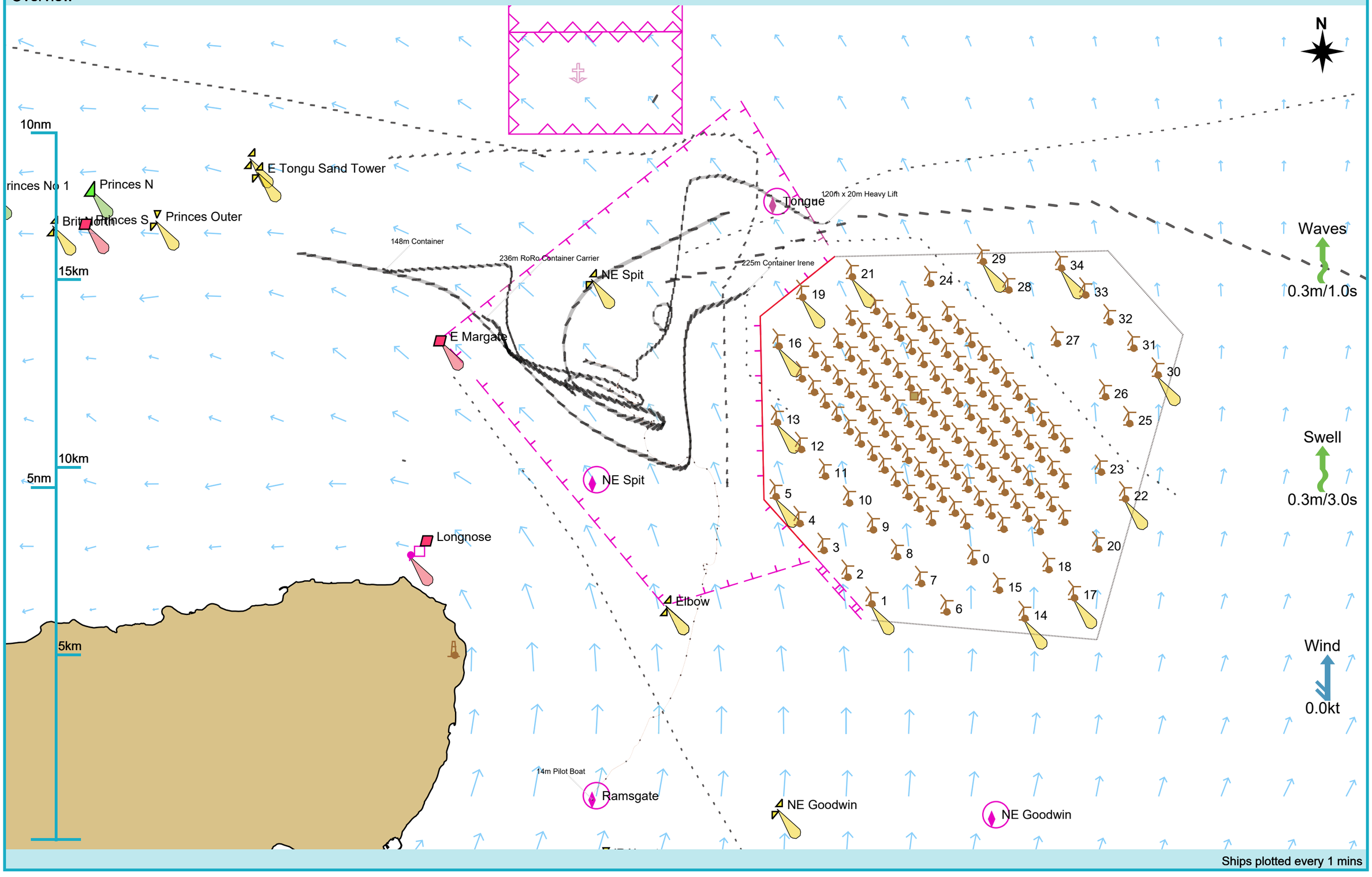

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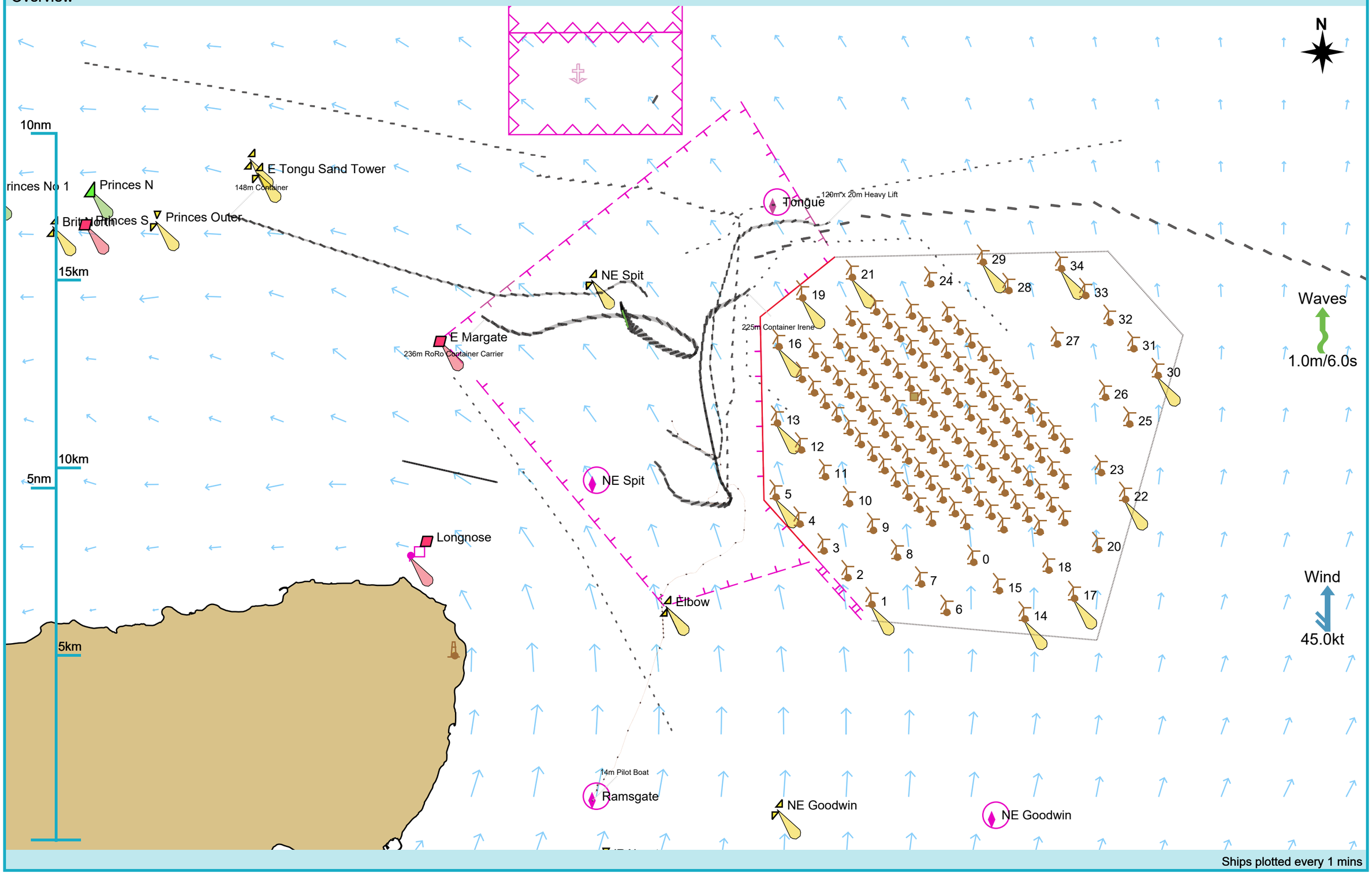

Annex G Simulation Run Success Criteria

Table 9-3 : Simulator Run Success Criteria

Grade	Criteria No.	Criteria Description
Successful	1	Ship remained under full control to the satisfaction of the Pilot and Master and was able to continue to manoeuver safely at all times.
	2	Ship retained acceptable clearances to the Wind Farm as relates to Contact Risk – remained more than 1 nm clear from the wind farm.
	3	Ship retained an acceptable Under Keel Clearance (UKC) as relates to Grounding Risk – not less than 2 metres.
	4	Ship retained acceptable clearance to other vessels as relates to Collision Risk. This item must specifically be noted and agreed in each run debrief.
	5	Time available for 1-person Pilot transfer (constant heading and speed) is >5 min.
	6	The Capacity for ship to respond to emergency is not compromised (e.g. anchor able to be dropped and vessel momentum arrested before breaching wind farm boundary).
Marginal (see notes)	1	Ship was at limit of full control at assessment of the Pilot and Master and was not able to continue to manoeuver safely at all times.
	2	Ship remained outside for 0.5 nm clear of Wind Farm but came within 1nm clear of the wind farm structures.
	3	Ship Under Keel Clearance (UKC) became unacceptably low as relates to Grounding Risk – not less than 1m.
	4	Ship does not retain acceptable clearance to other vessels as relates to Collision Risk. This item must specifically be noted and agreed in each run debrief.
	5	Time available for 1-person pilot transfer (constant heading and speed) is between 3 and 5 min.
	6	Capacity for ship to respond to emergency is compromised, but successfully resolved (e.g. (anchor initially unable to be dropped but vessel momentum arrested before breaching wind farm boundary).

Grade	Criteria No.	Criteria Description
Fail (see notes)	1	Ship lost control and unable to maneuver safely.
	2	Ship breached the Wind Farm boundary as relates to Contact Risk and came within less than 5 cables (0.5nm / 1000 yds) or struck the wind farm structures.
	3	Ship grounded.
	4	Ship collided with another vessel.
	5	Time available for 1-person Pilot transfer (constant heading and speed) is < 3 min.
	6	Ship does not have capacity to respond to emergency (anchor unable to be dropped and vessel momentum arrested before breaching wind farm boundary).

Annex H The Transit of Large Vessels into the Thames System

The Transit of Large Vessels into the Thames System

During the TEOW examination and in the run up to the 2019 PTBS, the question of large vessels (those of 366m length and above) using the NE Spit for pilot transfer in the future was raised by some IPs. As a result, the simulation was programmed to allow this to be explored further.

Participants recognised that vessels wishing to use the NE Spit are bound by the practicalities of draught restriction, and that PLA Pilotage Directions provide advice for routeing of vessels wishing to use the NE Spit (**Section 1.1.2**).

The feedback provided by independent Pilots at the simulation were understandably firm in their opinion that the use of the NE Spit in this way requires specific criteria, irrespective of whether TEOW is in place. While large vessels could come to the NE Spit, the independent mariners participating in the simulation considered this unlikely, even though traffic records do record one such event. They commented that very large vessels are already a reality in the container trades and London Gateway was designed to handle these vessels, but they are generally deeper draught on both arrival and departure (at any UK south-coast port).

A retired pilot[12], ex PLA, who advised Marico, but did not attend the simulation reported that PLA retain arrangements to board draught constrained vessels at the Sunk, using the Harwich Haven pilot launch service. There is an option to pay a premium for the priority boarding of vessels inbound to the Thames. Boarding at the Sunk is a longer journey from the South (the Sunk boarding location is opposite Harwich and administered by Harwich Haven Pilotage Authority), but allows deep draught vessels to route always in deep waters and not go to the shallower waters of the NE Spit. However, Sunk boarding for PLA bound vessels can cause delays, as priority boarding can often be compromised by the arrival of a Felixstowe bound vessel, which is invariably met first (because they board further inshore) meaning the PLA pilot might board second in the sequence, with a delay. That would result in the London pilot needing to make a higher transit speed in order to meet Thames berthing windows, rather than miss a tide and risk cancelling of shore labour resulting in delays into a liner service schedule[13].

Water limitations for the NE Spit and the advice of Pilotage Directions mean the decision to use this boarding location for very large vessels routinely would need to take account of metocean limitations, involve a light draught condition (which for containerships would be limited cargo) and a limited tidal window. If the assumption is that Pilotage Directions are followed, even if draught allowed boarding at the NE Spit, a large vessel may still be advised

by its pilot to enter the channel for London Gateway via the Long Sand Head route, a journey of some 30 miles.

All of the attending independent pilots considered that sea room is not the constraining issue at the NE Spit for most vessels. It will always be the available depth that is the governing factor, and that is vessel size and cargo payload related. Accordingly, in pilot participants' opinions, boarding of very large ships at the NE Spit would only occur with prior planning, which might be at an owner's request, due to schedule. In this event, the pilot's advice would always be a primary factor. Given the already completed risk assessment, there are risk control routing options that provide alternatives for boarding at the NE Spit, which are presented below.

Transit Alternatives to the NE Spit:

There are understandable operational reasons for very large Thames bound vessels to avoid boarding at the Sunk. Considering the risk assessment and available risk control options, there are two alternative options to the NE Spit:

1. Boarding at the Tongue Deep Water Pilot Station; the on-going feasibility of which has been demonstrated with TEOW proposed wind farm in place during 2019 PTBS. This is as assumed in PLA Pilotage Directions;

2. Boarding at the NE Goodwin Pilot Station: This would route very large vessels through a deep water route in accordance with PLA Pilotage Directions and thus away from the wind farm area. Although it is outside the scope of a report of this Simulation, it is a risk control option. There is enough water depth for very large vessels to use this route and benefit from the lee created by the Goodwin Sands. This lies 7.5 miles east of Ramsgate harbour and sits on a 20m depth contour line. A very large vessel arriving from the south can cross the traffic separation scheme between the MPC buoy and the Sandettie light float; both of these are marked with Racon and have AIS transmission. The deep draught vessel would then travel up the inshore route to the North East Goodwin boarding position. Then a large deep draught vessel can pass east of the wind farm heading north to the Sunk Traffic Separation Scheme.

Annex I Consultation Responses to Draft PTBS Report 2019

Table 9-4 : Consultation Responses to this PTBS Report (in Draft)

Consultee	Consultation Responses Received	Applicant Response
Trinity House	At this time the only comments Trinity House will make are: • I [Trevor Harris, Trinity House] can confirm Trinity House provided an operational aid to navigation marking plan for the indicative layout provided and this was used in the relevant scenarios. • I did attend the simulation on behalf of Trinity House on 2nd, 5th & 6th of September in an observatory capacity. • As an IP I was not hindered in any way and could make comments throughout. • In the report on the "1nm proximity criteria", **Section 5.2**, page 17, I do not feel this adequately explains that mariners were navigating using Radar/ECDIS and measuring their own distance direct from the physical turbines as they are unaware of the SEZ boundary. As we discussed at the hearing at least one of the mariners had set up his electronic navigation aids, in some scenarios, to stay a set distance from the turbines which is shown by a reduction in the distances you measured.	The Applicant welcomes Trinity House's attendance, constructive contribution to discussions, and request for clarification within the report. The Applicant can confirm that **Section 5.2** of the report has been updated to reflect the observation.
MCA	I [Helen Croxson] can confirm that the Maritime and Coastguard Agency attended three days (2, 3 and 4th September) of the planned simulation to observe the pilot transfer exercises. We have no comments to make on the content of the report on this occasion.	The Applicant welcomes MCA's attendance, and constructive contribution to discussions held during the simulation exercise.

Consultee	Consultation Responses Received	Applicant Response
Port of Tilbury and Port of London Gateway	At this stage we do not have further comments to add regarding the report however we would highlight our previous comments made in respect of the correct parameters for the simulation (as well as those of other IPs). Whilst LGPL/POTL did send a representative to observe the simulation, that representative was not from a shipping or pilotage background and was therefore not in a position to comment on the accuracy of the simulation itself. We note that several of the important shipping IPs were unable to attend the simulation due to the short notice and availability of their representatives. We reserve the right to make further submissions to the Secretary of State should he choose to accept the report for consideration and seek IPs' views on it.	The Applicant welcomes LGPL/POTL's attendance, and constructive contribution to discussions held during LGPL/POTL's attendance. The Applicant can confirm that parameters raised by LGPL/POTL with regards particular areas of concern, including consideration of future baseline scenarios and future and current large vessels have been simulated to address the concerns raised. The Applicant can also confirm that the queries raised by LGPL/POTL with regards the number of simulated runs has been addressed and agreed as appropriate by HRW, the independent simulator operator.

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and Estuary Services Limited	**Availability to Attend** – The intension to undertake a second simulator study was announced on the 12th of August 2019. The Port of London Authority (PLA) and Estuary Services Ltd (ESL) were unable to offer the appropriate level of attendance for this or the revised date of the 2nd of September. ESL did not refuse to participate in the study. ESL is a small company with a limited number of staff qualified to assist with the applicant's request. In order for ESL to be fully represented throughout the simulator study they would have had to send two of their eight senior coxswains. The two coxswains would have been required to be present at HR Wallingford, in Oxfordshire, for a total of 8 working days (effectively removed from the active roster for a minimum of 12 days). ESL considered this level of attendance to be essential in order to form a full response to any conclusions drawn from the study. It is noted that Vattenfall offered to pay for the cost of the coxswains; however, the issue was the loss of manpower, rather than the consequential costs, which would have resulted in ESL not being able to provide the required level of service to their customers. Although the PLA initially welcomed the change of date and had hoped to be able to provide pilots, it subsequently became apparent that this would cause unacceptable strain on the pilotage roster and may have resulted in delays to vessels as a result. Once again, this was not an issue of the cost of providing pilots, but the resulting impact to shipping as a result of taking pilots out of the roster at such a busy time. ESL and PLA had hoped that working rosters and availability of pilots and coxswains could have been given greater consideration and would have welcomed the opportunity to participate at a later date in the year. The PLA and ESL have fully engaged with the examination process for the last 6 months and with the applicant since 2017. We therefore do not believe the timetabled IP correspondence summary in paragraphs 3.1/3.2 is a fair representation of why the PLA and ESL were not in attendance.	The Applicant is grateful for the involvement of both PLA and ESL throughout the examination and on the specification for the 2019 PTBS. The Applicant further appreciates an acknowledgement of simulation commencement date being delayed to accommodate the initial requests of PLA and ESL. Nonetheless, the presentation of the communication with PLA and ESL with respect to attendance at the 2019 PTBS is considered accurate and reflects email records received from both parties, summarised at **Annex B**; The Applicant can confirm that following informal discussions and requests for confirmation regarding dates, the formal invitation to the September 2019 navigation simulation was issued to all IPs on 2nd August, 2019. This followed the previous formal invitation which was issued to all IPs on the 15th July, 2019. ESL's attendance was confirmed in the report as being due to lack of personnel availability. PLA's attendance was however not communicated to the Applicant in these terms, being based on the cost of providing a PLA Pilot. On 26th July, PLA had advised positively of their attendance, at least in part, and pilot availability. The Applicant has provided a full summary of all correspondence with regards the revised navigation simulation, at **Annex B** of the simulation report.

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and Estuary Services Limited	**Response to Inception Report:** • The PLA and ESL note a number of concerns raised in response to the inception report, submitted to the applicant on the 31st of July as requested. However, a significant number of these were either rejected or do not appear to have been addressed in the study. • *The number of runs should be greatly increased from 25*. The study references 36 runs with the extension in place, 6 of which were repeated marginal runs. For context, ESL conducts approximately 3000 runs per year. • *The* Tongue *and Elbow areas should be given greater consideration*. Six runs were carried out in these areas, three at each. This is nowhere near enough to draw the conclusion that these areas will be unaffected by the extension. • Greater *review of runs at night and in reduced visibility*. The report registers 'dusk' on the run summary which we assume is used to represent 'night'. Concerns were raised over realistic representation of night conditions after the 2017 simulator. We also note that 1nm is the lowest visibility recorded in the run summary and would have hoped to see a more realistic <0.5nm range used for reduced visibility.	**Number of Runs:** • The Applicant consulted HR Wallingford (HRW), as the leading simulator provider in the UK, and their opinion was that "15 – 40 runs would be sufficient from which to draw meaningful conclusions;" • Similarly, HRW concluded that "in the case of the work carried out for TEOW, the 41 runs and 159 pilot transfers over seven days of simulation, was considered adequate to meet the study objectives;" • The comparison of the number of simulator runs versus ESL runs per year is not relevant as every simulation study will seek to answer a question through analysis of a representative sample, not a numerical 'like for like' comparison. Insistence on exact duplication of run numbers would render any simulation unfeasible; • **Tongue:** As explained in the report, available sea room for pilot transfer is significantly abundant in this location. Runs at the Tongue were found to be so straightforward and uncontroversial and the results so conclusive that the independent mariners, the simulator provider and the attending IPs concluded it was unnecessary to expend valuable simulator time on further runs; • **Elbow:** As explained in the report and as shown in the heat map (Figure 6.5), the boundary between NE Spit and Elbow as discrete transfer areas is not firm and in truth, many runs classed as 'NE Spit runs' also included transfers at the Elbow. The independent mariners, the simulator provider and the attending IPs all considered that the transfers at or in the vicinity of the Elbow were adequately explored during the 2019 PTBS; • **Night Runs:** The 2019 PTBS used arguably the best simulation facility in the UK. The independent mariners, the simulator provider and the attending IPs considered that real world conditions were simulated as closely as possible; • **Reduced Visibility:** 6 of the 41 runs simulated conditions of poor visibility (using the Met-office definition). The independent mariners responded appropriately to low visibility conditions (by slowing down, use of bridge navigation aids and sound signals, etc.). Ultimately, conditions of reduced visibility did not affect the ability of the mariners to safely undertake the runs, and there is no reason why further reductions in visibility would alter this finding;

Consultee	Consultation Responses Received	Applicant Response
	• *The study should include emergency situations*. These have been considered, which is an improvement on the 2017 study. However, given the summary in the report it is unclear how they impacted on the overall operational runs, as there is little feedback. Where runs were aborted before the boarding or landing they are not measured. • *Operational difficulties to be taken into account*. These are of a more day to day nature and not necessarily considered 'emergencies'. These would include VHF communication issues, rule violations, difficulties with surrounding non- pilotage traffic, ladder non-compliance. Whilst these may have been considered during some runs it is unclear how these issues impacted on the study apart from a broader 'carried out safely and efficiently' summary.	• **Emergency Runs:** The independent mariners, the simulator provider and the attending IPs agreed that the emergency scenarios represented a realistic set of circumstances. A detailed study of the run plots will show that the emergency scenarios delayed, slowed down or cancelled the pilot transfers but ultimately did not have any effect on the outcome of the simulations or the safe conduct of transfer operations at the NE Spit with TEOW in place. This conclusion is supported by the lack of any comments by the independent mariners or the attending IPs; • **Operational Difficulties**: Some unplanned operational difficulties occurred in simulation just as in real life. Similarly, as is noted in the run report and as the independent mariners, the simulator provider and the attending IPs witnessed, every day occurrences such as; VHF communication issues, rule violations, various propulsion/steering control failures, difficulties with surrounding non- pilotage traffic, and ladder non-compliance, were all simulated. As would be expected from professional seafarers, these incidences were accommodated during simulations. As is evidenced from the lack of commentary by the participants they did not affect the successful conclusion of any of the runs;

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and Estuary Services Limited	Met Ocean Conditions – The wave height appears to be capped at 2 metres. In practice, significantly larger wave heights are experienced from the North West, via North East to South East wind directions. West/South West/Southerly winds do not tend to generate the same size swells as North West via North East to South East. Wave height and direction are **highly significant** and a primary consideration for ESL when deciding how each run should be conducted. The number of runs using a south westerly wind direction is disproportionate. This is important to note because the number of runs with south westerly wind used in the study is significantly higher than all other directions. ESL has previously stated that this wind direction has the least operational impact due to its relation to the boarding positions' geographical locations. ESL and PLA are concerned about how feasible it is for a simulated environment to accurately replicate met ocean conditions at an open water boarding position.	Met Ocean Conditions: • During examination and consultation on the navigation simulation specification, it was accepted by all IPs including PLA and ESL, that the simulator at HRW was considered appropriate for this study; • During the simulation, all the independent professional mariners and the attending IPs agreed that the simulation represented a realistic simulation of the metocean conditions. Whilst it was recognised by participants that wave height and direction did have a very important bearing on boarding operations at the NE Spit, they planned and successfully delivered their own solutions to pilot transfers (in each location); • As stated in the specification report, the spread of wind directions and wind strengths was derived from real world data from the NE Spit and all compass directions were simulated with wind speeds at the upper end of conditions for pilot transfer. Importantly, they were simulated in the relative predominance of each direction, reflecting the real case; • A detailed run plan describing the proposed wind speed / direction and swell heights for each run was specifically sent to the PLA and ESL for discussion and comment 6 weeks before simulation. Specific requests were made for assessment of north easterly and westerly winds which was duly included; • In the PLA and ESL's requests for a further simulation (e.g. R17Q 4.12.1, REP7-043), no concerns were raised in respect of the ability to replicate metocean conditions. Neither has any concern been raised through the feedback of the 15 independent mariners.

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and Estuary Services Limited	Vessel Lees: The executive summary of the new simulator study report states that of the 159 vessels 'simulated' 100% were carried out safely. In Table 1/Simulator run summary 150 vessels are recorded, 2 vessels have no lee entered for boarding/landing and 3 vessel did not engage with the pilot launch. After reviewing the lees of the remaining 145 vessels recorded, the PLA and ESL would strongly disagree with 94 of the lee courses by 20 degrees or more. (In ESL's practical experience, particularly in more challenging weather conditions, a 20 degree margin of error for a lee would be too great; however due to the limitations of a simulator in presenting a realistic working environment, deviations from the correct lee of up to 20 degrees would be accepted.)	Vessel Lees: • The Applicant intentionally employed experienced practising independent Class 1 unrestricted pilots and fully qualified coxswains from 3 UK pilotage districts to conduct the simulations. Experience included vessels up to and including 400m length. Simulator set-up involved an ex PLA authorised pilot, also Class 1 unrestricted, who also conducted test runs involving transfer. The pool of experience was thus significant. All attendees agreed these professionals were competent to decide on the creation of safe, efficient lees for a pilot transfer; • Similarly, it was agreed that the NE Spit did not offer conditions that were significantly more or less challenging than any other comparable pilot stations and in particular did not present circumstances that would require lees or transfer courses different from those required at other pilot stations around the country; • The intention of the 2019 PTBS was not to replicate ESLs operations but to establish if independent professional mariners could safely conduct transfer operations at the NE Spit with TEOW in place; • The lees that were created in the simulation were strictly in accordance with accepted global practice; • As is the case in real life, pilots/coxns were responsible for their own decision-making with respect to the angle of lee requested; • On analysing the track plots in sufficient detail, it is clear that there is sufficient sea room for any appropriate variation in lees created, including those proposed by ESL / PLA, such that this does not have any bearing on the safety of transfers and the ultimate successful outcome of the 2019 PTBS. • The ability of the simulator to present a realistic working environment was confirmed by all attending mariners.

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and Estuary Services Limited	Ladder Assignment – There are numerous examples of ladder assignments that ESL would not request in reality, either due to the lees required or vessel schedule efficiency. For example an outward bound vessel in NW wind being assigned a port ladder would be impractical, over complicated and potentially increase the navigational risk.	Ladder Assignment • The Applicant intentionally employed practising independent Class 1 unrestricted pilots and fully qualified coxswains from 3 UK pilotage districts, to conduct the simulations. It was concluded by all attending that these professionals were suitably qualified, experienced and competent to decide on the safe and efficient assignment of pilot boarding ladders; • The intention was not to replicate ESLs operations but to establish if independent mariners could safely conduct transfer operations at the NE Spit with TEOW in place; • All those attending, including independent professional mariners, the simulator provider and IPs present agreed that the ladder assignment was appropriate, safe and realistic for each run; • None of the ladder assignments, whether 'correct, efficient or over complicated' had any bearing on the safe conduct of transfer operations at the NE Spit with TEOW in place, or the successful outcome of the 2019 PTBS.

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and Estuary Services Limited	Run Times – There are references throughout the report that operations were conducted efficiently. The PLA and ESL do not agree that this can be concluded from this study, as a significant amount of the overall, current pilotage operation is not represented. The PLA and ESL maintain that, as stated in the response to the simulator specification report, one to two minutes should be treated as a minimum boarding time duration in optimum conditions, rather than sixty or ninety seconds. This time should have been increased in proportion to the deteriorating weather conditions. Also, five minutes for the pilot to reach the bridge and complete a satisfactory handover with the Master is more appropriate than the two to three minutes used in the study. It appears that some of the boarding/landing times were increased for some vessels; however, it is not clear from the report when this occurred, the reasons why and what the overall run impacts were.	Run Times: • The length of time taken for each pilot transfer in the 2019 PTBS, as in real life, varied considerably according to the met ocean conditions and the type of vessel. The minimum time that the pilot cutter would spend alongside the target vessel in simulation was discussed at all stages during consultation and was eventually agreed at 90 seconds for embarkation and up to 3 minutes for disembarkations. • It should be noted that this was the minimum time specified to be alongside. In simulation this was frequently exceeded, as coxswains stabilised the cutter alongside – exactly as occurs in real life. It is also important to note that this timescale **only** represented the time needed to conduct the pilot transfer; it did not include an additional 5 minutes added in simulation, representative of the time taken for a pilot to transit from the top of the ladder to the bridge. Further, it did not include the time necessary for the pilot cutter to maneuver into position for transfer. • Lastly it should also be noted that the timings alongside for the 2017 PTBS, as mandated by PLA pilots and ESL coxswains, were considerably less than those used for the 2019 PTBS. This was not raised as one of the issues to be addressed in the PLA / ESL's final examination submission on the simulation scope (**see Annex B** and REP7-043).

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and scenario Estuary Services Limited	Emergencies/Operational Difficulties – In paragraph 6.3 (Figure 6.2) a participant references the lack of VHF communication, but it is unclear between whom and what impact this had on the run. This is then regarded, in retrospect, as an emergency scenario. The details of this are unclear and it appears to be in isolation (communication emergency). In Run 12 a 93m tanker approaches from the north east and suffers engine failure and then appears to drift south west toward the windfarm. It is unclear how close this vessel is to the windfarm when it anchors, as those runs that were aborted before the pilot transfer takes place did not have their closet point of approach recorded and were not graded as /successful/marginal/fail. However, a 93m vessel broken down and anchored in 22m of water close to a windfarm with poor met ocean conditions, potentially setting it toward the windfarm, would be of significant concern and would prompt an emergency response. Whilst it is understood that ladder deficiencies i.e. ladders being improperly rigged and non-compliant were reviewed in the study, it is not fully documented how this impacted on the runs. There is not enough information in the report to confidently agree that emergency and operational difficulties were fully reviewed.	Emergencies/Operational Difficulties: • **Emergency Runs:** The independent mariners, the simulator provider and the attending IPs agreed that the emergency scenarios were a realistic representation. A detailed study of the run plots will show that the emergency scenarios delayed, slowed down or cancelled the pilot transfers but ultimately did not have any effect on the outcome of the simulations or the safe conduct of transfer operations at the NE Spit with TEOW in place. No concerns in relation to this were raised by the independent mariners or the attending IPs; • **Operational Difficulties**: As the IPs attending witnessed, some unplanned operational difficulties occurred in simulation as in real life. Similarly, as is noted in the run report and by the independent mariners, the simulator provider and the attending IPs, everyday occurrences such as "VHF communication issues, rule violations, difficulties with surrounding non-pilotage traffic, and ladder non-compliance were all simulated. As would be expected from professional seafarers, these incidences were successfully accommodated during simulations and as is evidenced from the lack of commentary by the participants they did not affect the successful conclusion of any of the runs. • In summary, the limited commentary of Emergency / Operational difficulties in the report should not be interpreted as inference that consideration of this was insufficient. In fact, because emergencies and operational difficulties were dealt with, without exception, it was not necessary for the report to raise these, because dealing with emergencies had no bearing on the successful outcome of the 2019 PTBS or the safe conduct of transfer operations at the NE Spit with TEOW in place. This conclusion was reached by the attending IPs, the independent mariners and the simulator provider. The simulation report can only reflect their findings.

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and Estuary Services Limited	Launch Operation – Although ESL and PLA's concerns over an appropriate vessel to simulate a pilot launch, which were raised in 2017, have been partially addressed, the report does not demonstrate 'accurate' launch representation. In Annex D – Independent mariner feedback we note the comment 'NE 25 knots would slow the progress of the pilot launch. Pilot boat still able to make way at full speed'. For context, in NE winds of 25 knots ESL would expect the 13m Orc to be reduced to a speed of 14- 15 knots, but it is unclear if this was addressed in the study and if it was, how this impacted on run times. The use of a 25 knots service speed is erring toward the optimum launch service. Whilst we appreciate that there needs to be a benchmark service speed the relationship between this speed, the met ocean conditions and the consequential impact on each run needs to be reviewed fully. We see no evidence of this. No consideration has been given to the implications to the pilotage service in terms of scheduling efficiency, shipping delays or service stress limits.	Launch Operation: • During examination and consultation, it was agreed by IPs, that the simulator at HRW is an appropriately advanced facility and, as stated in the report, is considered to be one of the best facilities in Europe; • During the simulation, all the independent mariners agreed that the simulation represented a realistic simulation of launch performance in the met ocean conditions; • The isolated comment referred to demonstrates that the mariner feedback was open and transparent. Written and verbal comments were encouraged and there was no restriction on subject matter. Commentary was provided about handling of vessels and where necessary, adjustments we made throughout the simulation. As a percentage, 99% of participant comments on accuracy of the simulation advised it was appropriate; • Whilst not an objective of the 2019 PTBS, given the results of the simulation and the fact that transfers took place over a similar area to current operations (Figure 6.3 and 6.4), there is no reason to suggest that there would be particular effects on scheduling or shipping delays.

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and Estuary Services Limited	Repeated Runs - The PLA and ESL do not agree that marginal runs should have been repeated, as previously expressed in feedback to the simulator inception report. The study states that the repeated run participants were told to actively avoid the 1 mile 'marginal' boundary and this, in turn, resulted in a 100% success rate. In addition, it would appear that at least one of the marginal runs included an emergency scenario, but when the run was repeated there were no emergencies introduced, despite the report stating that exactly the same run was conducted in exactly the same circumstances. Giving specific instructions to vessels could be considered as additional mitigation, in the form of traffic management.	Repeated Runs: • Repeating runs that recorded anything other than a full success is a standard, accepted scientific best practice for all simulations and failure to have done so in the 2019 PTBS would have been rightly and robustly challenged by the attending IPs, independent mariners and the simulator provider alike; • The additional instruction in the repeated runs "to actively avoid the 1 mile 'marginal' boundary" represented a significant additional manoeuvring reduction of 1nm of the sea room that was available to the participating mariners. The fact that all of these runs were 100% successful indicates that there is enough sea room even with this additional restriction in place. Without the restriction there is, of course, even more sea room available. This further demonstrates the conclusion of the 2019 PTBS that there is enough sea room with the TEOW in place to safely undertake pilot transfers; • The instructions given were to investigate whether breaches of the 1nm criteria were simply due to mariners acting as per their own experience or if it was because there was insufficient sea room. In all cases it was demonstrated to be the former, with runs both within and outwith the 1nm criteria being conducted safely; • In the run in question (NEC6), the emergency scenario was a steering gear failure to one of four vessels in the simulation, but as explained in some detail in **Annex F,** this was not the vessel that breached the proximity criteria. The steering gear failure resulted in the vessel coming to a stop and safely going to anchor and was not connected to the proximity breach. Accordingly, it was not necessary to repeat this part of the exercise.

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and Estuary Services Limited	Margate Roads Anchorage – In the 2017 study the recorded marginal run was as a result of a vessel coming in close proximity to an anchored vessel in the Margate Roads anchorage. It would appear that this anchorage has been largely disregarded in the 2019 study. There is possibly a single vessel represented at anchor on a small number of runs, but the report is unclear on this.	Margate Roads Anchorage: • The 2017 study recorded a marginal run of a vessel passing 0.5nm from an anchored vessel. 0.5nm was agreed by IPs to represent a prudent mariner's distance and so should not be considered to be in 'close proximity;' • The independent mariners conducted their transfers as dictated by the prevailing metocean circumstances and conditions. Margate Roads located 3 nm to the west of the NE Spit pilot diamond and 5 nm to the west of TEOW was not ignored during the 2019 PTBS, it just did not play a significant part as it was geographically too far away. Analysis of the heat maps (figure 6-4) will show that the majority of the pilot transfers at the NE Spit took place to the north of the diamond and over 2.5 nm away from Margate Roads; • During 2019 PTBS vessels proceeded to and from the Margate Roads anchorage during the simulation as the track plots will reveal; • None of these vessels had any effect on the safe conduct of transfer operations at the NE Spit with TEOW in place.

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and Estuary Services Limited	Tongue - Of the three dedicated runs to the Tongue boarding position two were to test 400m vessel capability. Whilst considered successful, after a marginal result was re-simulated, the caveats put in place were numerous and currently impractical. However, these successful runs aided the overall conclusion that the Tongue boarding position will be unaffected and will not require relocation.	Tongue: • As explained in the report, the runs at the Tongue were considered sufficiently straightforward such that they were allowed to be conducted with 400m ships which rarely, if ever, use the Tongue station. The results were considered so uncontroversial and undemanding by the independent mariners, given the relatively open sea to the north that it was considered more valuable to focus further runs on other locations; • There were no caveats placed on pilot transfer operations simulated at the Tongue; • There were caveats put in place for the proposal to conduct transfers of 400m ships at the NE Spit, which as the report clearly explains was the subject of a separate day's simulation, has never yet happened in reality and is not considered practical without careful mitigations; • The re-running marginal results is best practice for any simulation; • We welcome the conclusion by the PLA and ESL that "these successful runs aided the overall conclusion that the Tongue boarding position will be unaffected and will not require relocation."

Consultee	Consultation Responses Received	Applicant Response
Port of London Authority and Estuary Services Limited	Conclusion – During the examination process the PLA and ESL raised concerns regarding the 2017 simulator study. These were predominantly focused on its broad approach to detail, interpretation of the outcomes and the weight attributed to its conclusions within the NRA. The 2017 study was not sufficient to support the NRA and subsequent NRAA conclusions, which were not agreed by the PLA and ESL or the MCA at the end of the hearing process. The level and volume of data detail that any additional study would have to provide would need to be significantly improved and the overall study would need to take full consideration of current pilotage operations. It was also recommended by the MCA at deadline 6a that for any further simulation '*The participation, configuration and other details would need to be agreed by PLA, ESL and other local IPs to ensure it is representative of a real marine environment.'* The 2019 simulator study, whilst an improvement on the 2017 study falls far short of this, therefore the PLA and ESL cannot agree with the applicant that the 2019 simulator study supports the NRA/NRAA conclusion that the risks are ALARP.	Conclusion: • Trinity House and the MCA attended the 2019 PTBS and have not raised any concerns as to the conduct, accuracy or realism of the 2019 PTBS; • The significant efforts made by the Applicant to consult with and facilitate the attendance of PLA and ESL are set out in the report; • The simulations were robustly and thoroughly undertaken with suitably qualified independent mariners at a simulator that had been recommended by IPs during examination; • Whilst PLA and ESL did not attend, the confirmation of the representativeness of the simulation is demonstrated clearly through the comments of the 15 independent mariners who attended; • The configuration and undertaking of the simulation has been confirmed by the simulator provider as being appropriate; • The 2019 PTBS demonstrated that there is enough sea room to safely conduct pilot transfer operations at the NE Spit with TEOW in place; • The 2019 PTBS study supports the NRA/NRAA conclusion that the risks are ALARP.