RECENT CHANGES IN THE DUTCH BASELINE: THE INSEPARABLE CONNECTION OF HUMAN ACTIVITIES AND NATURAL PROCESSES

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Abstract

Over the past few years, the baseline of the Netherlands in the North Sea has undergone several large-scale changes. We present two of these changes: the construction of the Maasvlakte 2 extension to the Port of Rotterdam and the construction of the Zandmotor sand nourishment project. Both projects are man-made at a scale that influences natural processes along a substantial, overlapping part of the coast. The 17 km^2 Maasvlakte 2 project was first charted by the Netherlands Hydrographic Service in 2009. The project started with the construction of an artificial island, which grew into a shore-connected port extension. The 2 km^2 Zandmotor project is part of the Building with Nature initiative, in which natural processes are used to efficiently manage the coast. It is expected that tidal streams distribute the sand, placed at a single location connected to the shore, along the coast over the next two decades. The Zandmotor was charted in 2012. The natural development is characterized by the existence of temporary alternating sand bars and tidal outlets, before the main bulge of sand disappears. In the framework of UNCLOS, the impact of these two projects on the baseline is, in the first place, determined by Article 5 ("Normal baseline"), whereas Article 11 ("Ports") is not relevant. The role of Article 121 ("Régime of islands") will also be considered.

1. Introduction: changes along the Dutch coast

Over the past few years, the coastline of the Netherlands along the North Sea has undergone two large-scale man-made changes. They are the construction of the Maasvlakte 2 ("Meuse Plain 2") extension to the Port of Rotterdam and the construction of the Zandmotor ("Sand Engine") sand nourishment project. The North Sea is a shallow sea with relatively large tides, which results in tidal streams reaching more than 2 knots along the Dutch coast. The residual streams[1] have a Northeastern direction, resulting in a net sand transport from the Belgian towards the German coast.

[1] Also known as residual tidal currents, defined by the IHO as "the mean current without periodic components" (IHO online dictionary, available at hd.iho.int/en)

Figure 1 shows the geographic locations of both the projects, as well as the residual streams (red arrows) in relation to the lines of equal high and low water (white lines) and the amphidromic points without tides (yellow circles). The Zandmotor was designed to continuously nourish the beaches to its Northeast up to the harbour works of Scheveningen, and, to a lesser extent, to its Southwest up to the Maasvlakte and Maasvlakte 2 extensions of the Port of Rotterdam[2]. The Zandmotor will slowly change shape until it will have disappeared in about two decades. The project is part of the Building with Nature programme of the EcoShape consortium[3], a public-private partnership. This programme attempts to use natural processes to efficiently manage the coast.

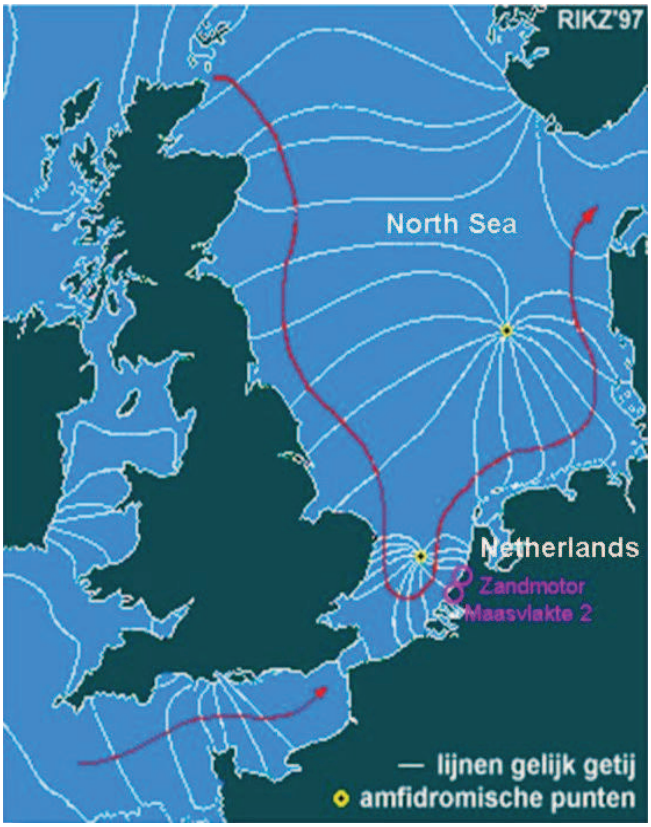

Figure 1: Geographic position of Maasvlakte 2 and the Zandmotor in relation to the tidal streams in the North Sea[4]

Maasvlakte 2 was designed as a permanent structure connected to the present Maasvlakte, the westernmost part of the Port of Rotterdam. Although its main purpose is to allow for further growth of the Port of Rotterdam, the extension also has functions for recreation[5], and coastal protection[6]. The construction will be finished by 2015.

[2] L. M. Bochev-Van der Burgh, "Decadal-scale morphologic variability of foredunes subject to human interventions" Dissertation defended on 6 September 2012. University of Twente, Enschede, the Netherlands.
[3] www.ecoshape.nl
[4] Adapted version of a figure of Rijkswaterstaat
[5] http://www.maasvlakte2.com/en/index/show/id/662/Recreation: "All possible forms of recreation will soon be possible again, from swimming to sunbathing and from nudism to surfing, kite-surfing and other sporting activities."
[6] http://www.maasvlakte2.com/en/index/show/id/522/Seawall: "In the southwest, beaches and dunes will offer protection from the sea. On the northern edge of Maasvlakte 2, there is not enough room for this soft seawall. Here, the contractor will therefore build a hard seawall."

The design of Maasvlakte 2 aims to minimise the increase in cross-shore tidal streams around the entrance channel to the Port, to prevent adverse effects on ship handling. Flow changes cannot be neglected though, resulting in changes of the sand and silt transport induced by these streams, which in turn may have a long term effect on the coastal configuration[7].

Figure 2 shows that the 17 km^2 Maasvlakte 2 project started with the construction of several artificial islands, which were extended until they connected to the shore. The 2 km^2 Zandmotor project site is visible behind the Maasvlakte 2.

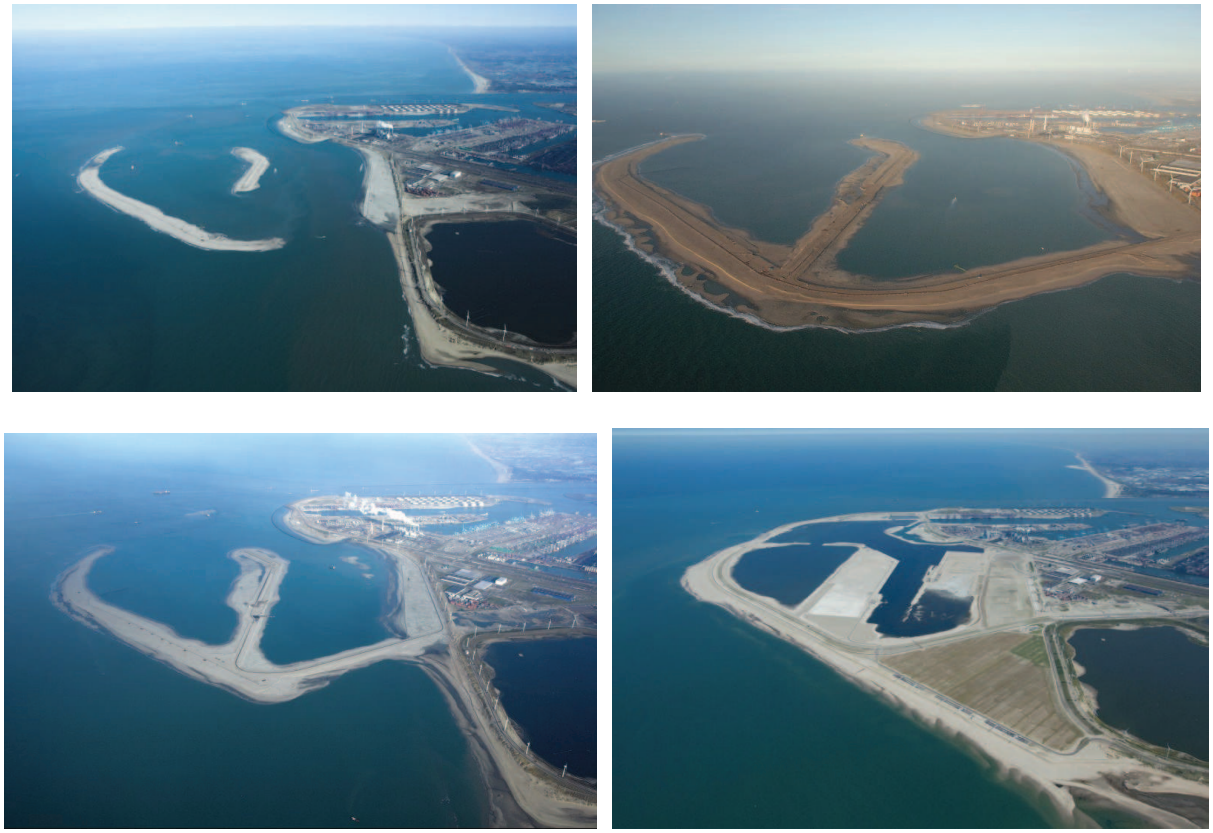

Figure 2: construction of Maasvlakte 2: situation of October 2009 (top left); November 2009 (top right); January 2010 (bottom left) and July 2012 (bottom right). Notice the presence of the Zandmotor in back of the right-hand photo.[8]

Figure 3 shows the development of the Zandmotor: in a few months time, natural processes have created several tidal outlets through the original construction, which was fully connected to the shore. It is unclear whether the outlets are deeper than Chart Datum, which would classify the sand bars in between as islands, or even as low-tide elevations. Chart Datum is defined as Lowest Astronomical Tides (LAT) for Dutch nautical charts.[9]

[7] http://www.maasvlakte2.com/nl/index/show/id/654/Morphology: "Maasvlakte 2's construction affects morphological processes. The land reclamation forms a physical barrier to waves and to the tidal currents along the coast. This affects the transport of sand and silt in the sea. The position of the seabed can thus change in the longer term."

[8] Source: Port of Rotterdam; Aerial photographs of all stages of the project available at http://www.maasvlakte2.com/nl/index/show/id/316/Volg+de+voortgang+vanuit+de+lucht.

[9] "The effects of changing baselines on the limits of the Netherlands in the North Sea", Leendert Dorst and Ina Elema. Paper presented at ABLOS2008

Figure 3: morphological development of the Zandmotor:
situation of January 2012 (left) and May 2012 (right)[10]

2. Corresponding changes of the Dutch baseline and maritime zones

The Maasvlakte 2 project was first charted by the Netherlands Hydrographic Service on 22 December 2009[11], extending the Netherlands territory with 54 km^2 (area between the old and the new outer limit of the territorial sea). Publication of this edition was done after the connections to the shore were established (Figure 2, upper right-hand photo). One month later, another island stage had begun (Figure 2, lower left-hand photo). The Zandmotor was first charted on 29 March 2012[12], extending the Netherlands territory with 4 km^2. Figure 4 gives an impression of the charting work.

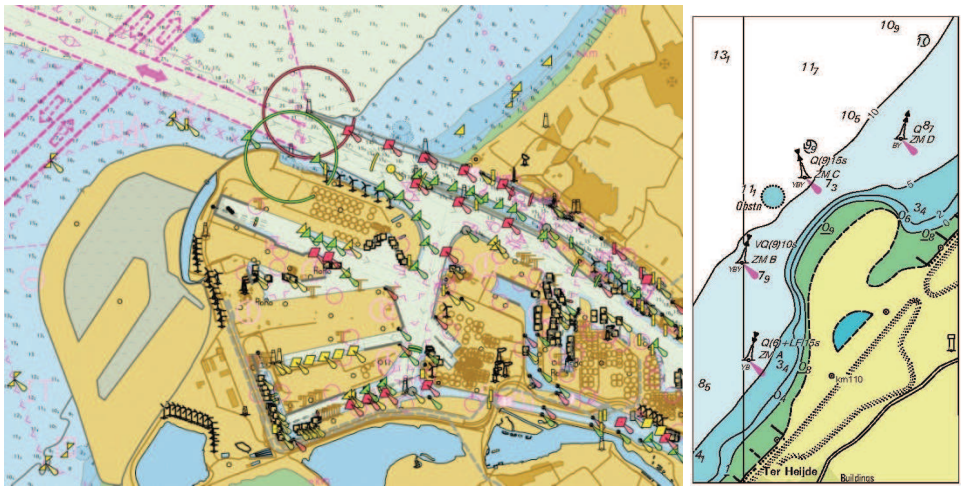

Figure 4: new edition of ENC NL50132A, December 2009 (left, showing Maasvlakte 2);
and block correction of NtM 162/12, March 2012 (right, showing the Zandmotor)[13]

Figure 2 (lower right-hand photo) shows the proximity of the two projects. The Zandmotor directly and deliberately changes the sediment transport along the coast, while the Maasvlakte 2 project indirectly changes the sediment transport, through the change in tidal streams, in spite of the design efforts to minimise such changes. The two projects result in one combined set of changes to the coastal zone. The changes are partly natural (sediment transport by tidal streams is a natural phenomenon) and partly induced by human activities (the two projects).

[10] Source: Rijkswaterstaat
[11] New edition of ENC NL50132A: "Rotterdam, Europoort and Maasvlakte"
[12] Dutch Notice to Mariners 162-2/12 an 162-3/12 for paper charts 122 and 1630 respectively, and corresponding updates to ENC NL400122 and NL301630
[13] Source: Hydrographic Service of the Royal Netherlands Navy

As defined by the Territorial sea (Demarcation) Act of 9 January 1985, the normal baseline of the Netherlands changed in both cases at the date of the publication of the changes by the Netherlands Hydrographic Service[14]. Dutch baseline changes are published by NtM[15], with a reference to detailed illustrations and the data on the website of the Hydrographic Service[16].

Both changes to the baseline influence all maritime zones related to this line: the 1M zone of the European Water Framework Directive[17]; the 3M and 6M zones of the European Common Fisheries Policy[18]; the 12M territorial sea[19]; the 24M contiguous zone[20] (its outer limit only marginally in case of the Zandmotor); and the 12M inner limit of the EEZ[21]. The outer limits of the EEZ and Continental Shelf are not affected: they have been determined by treaties[22], which use fixed lines. The changes are illustrated in Figure 5. The Maasvlakte 2 baseline change was accompanied by a press release of the Royal Netherlands Navy[23], while the Zandmotor baseline change was not, due to its smaller geographical impact.

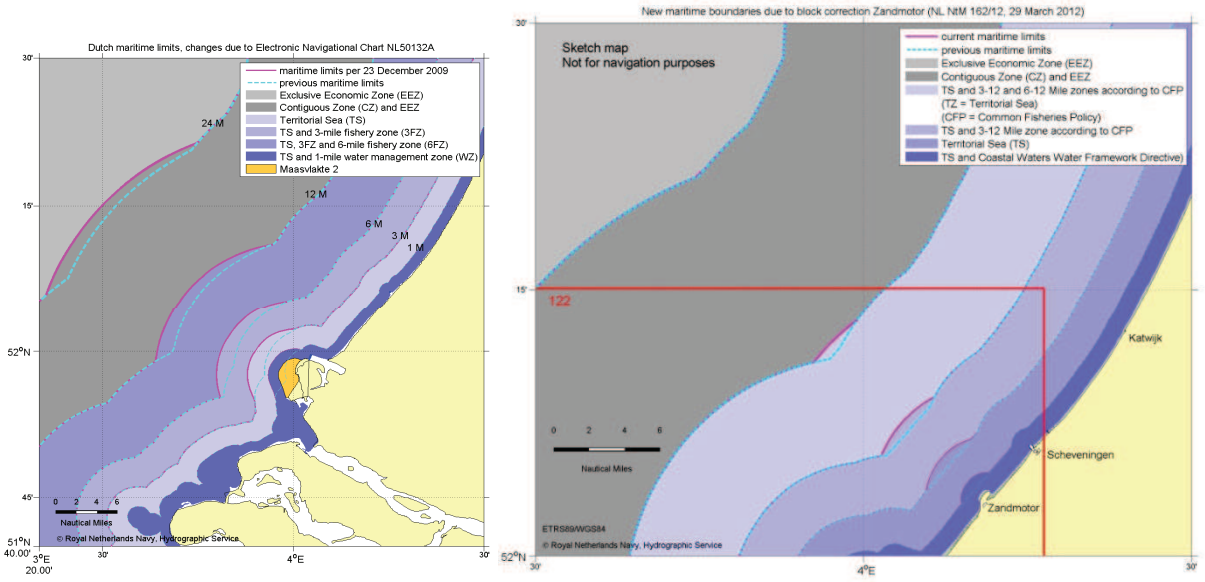

Figure 5: changes in the Dutch limits in the North Sea due to the publications of Figure 4.

[14] Section 1 of the Territorial sea (Demarcation) Act of 9 January 1985 states "1. The territorial sea of the Netherlands shall extend to a line, each point on which lies twelve international nautical miles, […], seawards of the nearest point on the low-water line along the coast, with the proviso that, where a naturally formed elevation of the seabed which is covered at high tide but dry at low tide lies within this distance from the low-water line, the territorial sea shall be measured from the closest point on the low-water line of such an elevation. 2. The low-water line shall be defined as the line indicating the depth of 0 metres on the large-scale Dutch sea charts issued upon the instructions of the Minister of Defence."

[15] In this case Dutch Notices to Mariners 596/09 and 162-1/12, respectively

[16] http://www.defensie.nl/english/navy/hydrographic_service/geodesy_and_tides/maritime_limits/download

[17] Implemented in Dutch legislation by the Water Act of 2009

[18] Defined by the Regulation on the conservation and sustainable regulation of fisheries resources under the common fisheries policy of 2002

[19] Defined by the Territorial Sea (Demarcation) Act of 9 January 1985

[20] Defined by the Contiguous Zone (Demarcation) Decree of 2006

[21] Defined by the Exclusive Economic Zone of the Netherlands (Outer Limits) Decree of 2000

[22] Treaty between the Kingdom of the Netherlands and the Federal Republic of Germany concerning the lateral delimitation of the continental shelf in the vicinity of the coast of 1 December 1964; Agreement between the Government of the Kingdom of the Netherlands and the Government of the United Kingdom of Great Britain and Northern Ireland relating to the delimitation of the continental shelf under the North Sea between the two countries of 6 October 1965; Treaty between the Kingdom of the Netherlands and the Federal Republic of Germany concerning the delimitation of the continental shelf under the North Sea of 28 January 1971; Treaty between the Kingdom of the Netherlands and the Kingdom of Belgium on the Delimitation of the Continental Shelf of 18 December 1996.

[23] "Maritime zones North Sea changed by construction Maasvlakte 2", press release of the Royal Netherlands Navy of 22 December 2009.

3. Baseline changes according to UNCLOS

3.1. Identification of relevant UNCLOS Articles

The relevant UNCLOS Articles for these changes are Article 5 ("Normal baseline"), and possibly Article 11 ("Ports") and 121 ("Régime of islands"). Article 5 provides the general rule, and reads "Except where otherwise provided in this Convention, the normal baseline for measuring the breadth of the territorial sea is the low-water line along the coast as marked on large-scale charts officially recognized by the coastal State."

A recent review of the drafting history of Article 5 of UNCLOS, State practice and international decisions indicates that there are different views possible on the interpretation of this provision.[24] Apart from the view that the normal baseline is the low-water line as charted, the view that the actual low-water line should be determinative for defining the normal baselines has been advanced.

Article 11 defines the "coast" of Article 5 in case of harbour works: "For the purpose of delimiting the territorial sea, the outermost permanent harbour works which form an integral part of the harbour system are regarded as forming part of the coast." Article 11 does not apply to harbour works that are not "permanent", for which no further guidance is provided . There are also two exceptions: "Off-shore installations and artificial islands shall not be considered as permanent harbour works."

Article 121 provides that "1. An island is a naturally formed area of land, surrounded by water, which is above high water at high tide. 2. [T]he territorial sea, the contiguous zone, [and] the exclusive economic zone […] of an island are determined in accordance with the provisions of this Convention applicable to other land territory." In case of artificial islands, Article 60(8) stipulates: "Artificial islands […] do not possess the status of islands. They have no territorial sea of their own, and their presence does not affect the delimitation of the territorial sea, the exclusive economic zone or the continental shelf". The consequence is that, as the UNCLOS baseline provisions are applicable to natural islands but not to artificial islands, the natural or artificial origin of each island has to be established. UNCLOS does not explicitly address the status of islands that originated partly from human activities and partly from natural processes.

The requirement of being naturally formed is also present for low-tide elevations. Article 13(1) states: "A low-tide elevation is a naturally formed area of land which is surrounded by and above water at low tide but submerged at high tide. Where a low-tide elevation is situated wholly or partly at a distance not exceeding the breadth of the territorial sea from the mainland or an island, the low-water line on that elevation may be used as the baseline for measuring the breadth of the territorial sea." In the remainder of this paper we only discuss the case of islands. The case of low-tide elevations is similar.

It should be noted that the requirement of being naturally formed does not apply in the case of land reclamation projects (either attached to a mainland coast or attached to an island in the sense of article 121 of UNCLOS). The coast of the Netherlands is a case in point. The first Maasvlakte project led to a change in the normal baseline as well, an approach that has been generally accepted.

[24] See ILA Committee Baselines under the International Law of the Sea: *Conference Report Sofia 2012,* forthcoming.

3.2. The application of UNCLOS to the Zandmotor

Article 5 applies to the Zandmotor project, in any case to the attached part. The "large-scale chart officially recognized by the coastal State" is the Netherlands paper chart 122, including the NtM. It shows a clear low-water line (Figure 4), i.e. the zero-metre depth line with respect to LAT. If the detached parts are detached at the tidal level of the moment of the photograph, but attached with respect to LAT, the situation in the large-scale chart corresponds to reality.

If the detached parts are also detached at LAT, natural processes have created a difference with the large-scale chart. The question is raised whether these would then be natural islands. Two views seem to be possible. First, it could be argued that these features are naturally formed, and are part of the baseline. Although the Zandmotor is an artificial extension of the coast, the islands have become detached from the coast through natural processes of currents and actions of the waves. Alternatively, it could be argued that the features in essence are man-made, and they need to be excluded from the baseline. In that view, the fact that these features have become detached from the coast by natural processes does not change their man-made origin.

Under the Dutch Territorial sea (Demarcation) Act, it is irrelevant to track the detailed development of the Zandmotor, as the chart is the source of the baseline. It is not necessary to determine whether the sand bars in the second photo of Figure 3 are detached at low water, because these sand bars are not present in the relevant nautical chart. It is expected that the Zandmotor will gradually disappear. When the next edition of nautical chart 122 will be published, the detached features may no longer be present.

By using nautical charts, the baseline is frozen until the next edition of the chart is published, usually after a few years. The intermediate stability of the baselines and outer limits has an advantage for mariners, like fishermen and their inspectors. They do not have to ascertain continuously whether the limits have changed, but have to handle changes in the extent of zones due to a specific coastal project only once every few years. A permanent, gradual change of the extent of zones would have been a lot harder to implement into procedures for up-to-date geographic information at sea.

3.3. The application of UNCLOS to the permanent stage of Maasvlakte 2

"Harbour works" are defined by IHO as "permanent manmade structures built along the coast which form an integral part of the harbour system such as [...] sea walls, etc." Although a "harbour system" is not defined by IHO, a "harbour" is: "A natural or artificially improved body of water providing protection for vessels, and generally anchorage and docking facilities."[25] In the case of the Maasvlakte and the permanent stage of Maasvlakte 2, the "harbour" is the internal water inside the port extension, rather than the territorial sea outside the shoreline. The "harbour system" includes all the facilities that are built around the harbour, and the "harbour works" extend this further to "[...] structures [...] which form an integral part of the harbour system." Although "sea walls" are mentioned as a potential part of "harbour works", it is not evident that this includes sea walls located at the other side of the port extension, especially if it has other functions than "providing protection for vessels [...] anchorage and docking facilities": in this case recreation and coastal protection in general.

Moreover, the IHO definition of "port" sheds more light on the status of the seaward side of Maasvlakte 2: "a place provided with terminal and transfer facilities for loading and discharging cargo or passengers, usually located in a harbour". This tells us that a port has a specific function

[25] hd.iho.int/en

for maritime transport, and is usually located in a harbour. It is not an area surrounding harbour works, with significant recreational and coastal protection functionality.

Carleton has qualified the permanent stage of the original Maasvlakte as reclaimed land, rather than "permanent harbour works"[26]. We agree with Carleton, and classify the Maasvlakte and Maasvlakte 2 port extensions as reclaimed land. Therefore, the permanent stage falls directly under Article 5, not Article 11.

As concluded above, the Dutch Territorial sea (Demarcation) Act provides for usage of the charted low-water line to determine the normal baseline. However, Figure 4 shows that the "large-scale chart officially recognized by the coastal State" does not contain such a line for Maasvlakte 2. This is explained by the cartographic generalization process. It is common practice that "[i]n that case the coastline as shown on the chart may be taken as the normal baseline".[27] The same advantage of this Act for the mariner applies as identified in Section 3.2.

3.4. The application of UNCLOS to the nonpermanent stages of Maasvlakte 2

If Maasvlakte 2 would fall under Article 11, we already concluded that nonpermanent stages are excluded (Section 3.1). The first nonpermanent stage is a stage of detached features. This clearly concerns artificial islands that are not entitled to maritime zones or a baseline of their own (Article 121), and their presence does not affect the outer limit of the territorial sea (Article 60(8)). The second nonpermanent stage is a stage of attached features, for which Article 5 applies.

During the attached, second nonpermanent stage, Maasvlakte 2 was included in the nautical chart, showing a stage that was not achieved until two and a half years later (Figure 2, lower right-hand photo). in the intermediate period, we identify another detached stage (Figure 2, lower left-hand photo). The detached stages are not relevant, as artificial islands were not charted, and, consequently, not included in the baseline. Nevertheless, the question could be raised when it is admissible to use a chart that shows a construction in a future stage.

4. Discussion

4.1. One consistent approach to baseline changes

The Territorial sea (Demarcation) Act of 9 January 1985 of the Netherlands (Section 2 of this paper provides the relevant text) would correspond to the application of UNCLOS, if the two projects would not have detached stages. UNCLOS Article 5 would, in that case, allow for the construction of the baseline from the charted low-water line on Dutch nautical charts. As UNCLOS formulates an exception for detached stages of projects (Sections 3.2 and 3.4), differences with the Act occur.

[26] "Problems relating to man-made Basepoints under UNCLOS", Chris Carleton. Paper presented at ABLOS2010.
[27] "A manual on the technical aspects of the United Nations Convention on the Law of the sea -- 1982", prepared by the IHO, IAG, IOC Advisory Board on the Law of the Sea (ABLOS). IHO Special Publication S51, 4th edition, March 2006, Section 4.2.

The application of the single chart-based approach of the Act to the two projects corresponds to our sense of logic. The two projects are part of a single morphological system of mixed human and natural origin (Section 1). Therefore, they should also be treated with one approach to the definition of the baseline (Section 2). The responsibility of staging the development of such a mixed morphological system into different phases should be with hydrographic offices. This allows for a coordinated change of a State's maritime zones from the old to the new situation, serving the interests of the mariner.

4.2. Difficulties in applying Article 5

The Dutch approach to the application of Article 5 becomes problematic for nautical charts that clearly deviate from reality. Examples are given by, *e.g.*, Boyes *et al.* and McGregor *et al.*[28]. We believe that the frequency of new editions of Dutch nautical charts is sufficiently high to keep the differences between the charts and reality limited and temporal. The question of the maximum allowable difference for the application of Article 5 is, in our view, unanswered and relevant.

Article 5 itself does not provide an answer. A number of considerations seem to be relevant. (1) It is not feasible that a coastal State permanently surveys its coasts and updates its nautical charts. (2) Mariners, dependent on the location of the limits of maritime zones, benefit from the stability of maritime zones. The alternative would be that they have to continuously determine the location of the actual low-water line themselves. (3) On the other hand, there may be situations in which the low-water line as charted will not be determinative. Outdated charts that significantly differ from the actual situation have been challenged in cases of bilateral boundary delimitations. There is no indication that in such a situation a neighboring State is obliged to accept the charted low-water line, because of Article 5.

4.3. Difficulties in applying Article 121

The case of the Zandmotor indicates that it may be difficult to draw a clear line between naturally formed islands and artificial islands. In the case of the Zandmotor, the implications of classifying potential islands in one way or the other is small (See the right-hand photo of Figure 3 in relation to Figure 5), but in other cases the effect may be significant. The question of the classification of islands as either artificial or natural may also arise in different situations. One can think of harbour works that change the tidal streams sufficiently to create an island further along the coast, or an artificial construction near a low-tide elevation that leads to the accumulation of materials that change the feature into an island. As illustrated above, Article 121 does not offer a clear answer to these situations.

5. Conclusion

The construction of a baseline according to the Territorial Sea (Demarcation) Act of the Netherlands corresponds to UNCLOS, possibly with the exception of the intermediate detached stages of the two projects. The differences are either a question of the timing of the publication of the chart (Maasvlakte 2), or hardly have an impact (Zandmotor). A chart-based baseline provides a simple and clear solution for a coast that is dynamic due to an inseparable combination of human activities and natural processes. The Maasvlakte 2 and Zandmotor projects raise questions about the maximum allowable differences between the low-water line as depicted in nautical charts, and the actual low-water line. We leave the determination of the limits of such a difference open for further debate.

[28] "Australia's Approach to Using Remotely Sensed Data to Determine Territorial Sea Baselines", Grant Boyes et al. and "Building a Solid Foundation – A Case for Adopting Fixed Maritime Zones", Matthew McGregor et al. Papers presented at ABLOS2010.

We believe that in highly dynamic circumstances, whether natural or man-made, reliance on charted low-water line as the normal baseline is justified, perhaps with certain exceptions. We suggested some considerations to assess whether an island of mixed natural and human origin should fall under Article 121. In view of the expected increase of sea-based projects, this question is likely to become even more relevant in the future.

Biographies

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Thijs Ligteringen is a Geodetic Engineer from the Delft University of Technology. In 2005, he joined the Ministry of Defence as a navigation consultant at the Defence Materiel Organisation. Since 2009, he has been employed at the Netherlands Hydrographic Service at the Geodesy & Tides Department. His main interests are navigation systems, surveying and positioning techniques and the Law of the Sea.