Mapping of seafloor litter at coastal sites

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Summary
This report presents the results of a pilot project carried out by SALT and Green-Bay, commissioned by the Norwegian Environment Agency, to build knowledge and test non-invasive methods for mapping seafloor litter. The project had two main components: first, identifying suitable survey areas based on their potential for litter accumulation; and second, conducting field surveys using a towed video camera system. The report describes the methods applied in both phases and presents the main findings, including visual maps of litter distribution, litter composition, and an evaluation of the field survey and data collection approach.

Appendix 4 includes a set of suggested areas for monitoring of coastal seabed litter in Norway, which builds on findings and methodology in the main report.

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Summary

This report presents the results of a pilot project commissioned by the Norwegian Environment Agency to establish practical, non-invasive methods for mapping seafloor litter in Norwegian coastal waters. The work was carried out jointly by SALT and Green-Bay during August–September 2024 and represents the first systematic attempt to test a standardized, video-based approach for monitoring seafloor litter in shallow coastal environments. The project's overarching aim was twofold: to identify areas suitable for long-term monitoring of seafloor litter and to evaluate the feasibility, precision, and operational efficiency of a towed underwater video system as a primary data-collection tool.

Three survey areas —Kristiansand, Galtesund, and Tromlingene—were selected through a structured process combining geospatial screening, local knowledge, and predefined criteria related to topography, substrate, and proximity to expected litter sources. The resulting set of sites provided a representative gradient from urbanized harbor systems to more exposed coastal environments dominated by small-scale fisheries. Within each area, clusters of 10 transects were laid out using a hexagonal grid design to ensure spatial coherence and comparability while allowing for local operational adjustments related to weather, currents, and navigational constraints.

Fieldwork was conducted from RV *Tyra* using a flying towed video sled equipped with three cameras and adjustable lighting. This system allowed the sled to be kept close to the seafloor while maintaining a wide field of view (~5 m), making it possible to detect and classify individual litter items with high confidence. Across all three areas, a total of 52 clusters and 520 transects were surveyed, covering 260,000 m² of seabed. In total, 1,086 litter observations were recorded and subsequently classified following the ICES Manual for Seafloor Litter Data Collection, adapted where necessary for video-based surveys, equal to approx. 2.1 litter observations per 100-m transect. 46% of all transects (237 transects) had no (0) litter observations recorded.

Overall litter density across all sites was 0.0042 observations/m², corresponding to approximately 4,200 items/km² (upscaled representativity not assessed). Densities varied substantially between areas, highlighting clear differences in environmental exposure and proximity to land-based sources. The highest densities were found in Kristiansand (0.0067 observations/m², 599 observations) and Galtesund (0.0055 observations/m², 436 observations), both located near river outlets, urban infrastructure, and areas influenced by active maritime traffic. In contrast, Tromlingene—an open, exposed area—showed markedly lower densities (0.0006 observations/m², 51 observations), though the items found there were typically larger and often consisted of lost fishing traps and other heavy gear. The three highest numbers of litter observations per100-m transect were 37, 35 and 33, all in different hexagon clusters in Kristiansand and Galtesund.

Litter composition was dominated by Glass and ceramics (36%), Plastic (34%), and Metal (26%), with glass bottles comprising one-third of all observations. Synthetic rope represented the most frequent plastic item, while metal items were often unidentifiable and classified as "other." Spatial analyses revealed high small-scale heterogeneity in litter distribution. Both the coefficients of variation within clusters and between clusters were high (>80% in most cases), demonstrating that seafloor litter accumulates in a highly patchy manner, even at scales of tens of meters. This finding has important implications for the design of monitoring programs, indicating that sufficient replication at both the transect and cluster level is required to capture underlying variability.

The project also included a qualitative assessment of biofouling and substrate type beneath each item. Most litter showed no visible biofouling, suggesting relatively recent deposition in many cases. Among fouled items, brown algae (Ochrophyta) dominated, particularly on ropes and nets,

while bryozoans were commonly attached to glass bottles. Silt and clay was the most common substrate type across all sites and also supported the largest number of litter observations, reflecting both sediment deposition processes and the likelihood that soft substrates accumulate and partially conceal items.

The field protocol and three-person crew configuration proved highly effective for real-time annotation and sled operation. However, the analysis demonstrated that several variables—biofouling, size classification, attached organisms, and substrate—were too time-consuming to classify reliably in real time and required post-survey video review. The project therefore developed a refined operational approach in which annotators marked litter events with time stamps during fieldwork, enabling targeted, efficient review post-survey. This approach allowed full classification of 36 clusters within the project period while enabling basic litter counts for all 52 clusters.

The analysis also identified several item types that were frequent but not well represented by existing ICES categories, notably fishing traps, anchors, and large industrial metal cables. The report therefore recommends adding specific subcategories to accommodate these items in future Norwegian monitoring efforts, improving consistency and data utility.

Based on the experience gained, the project concludes that towed video methods are suitable for coastal seafloor litter mapping and provide a practical alternative to trawl-based surveys and advantages over ROVs in terms of more stable control in the water. The method delivers spatially detailed data, minimizes environmental impact, and aligns well with international monitoring standards. Future improvements—including the use of laser scale markers, inclusion of size-based analyses, and further assessment of sampling replication through power analyses—would strengthen the method's precision and comparability. The results from this pilot therefore form a robust foundation for establishing a long-term national monitoring program for seafloor litter in Norwegian coastal waters.

Appendix 4 includes a set of suggested areas for monitoring of coastal seabed litter in Norway, which builds on findings and methodology in the main report.

UTVIDET SAMMENDRAG (SUMMARY IN NORWEGIAN)

Denne rapporten presenterer resultatene fra et pilotprosjekt bestilt av Miljødirektoratet for å etablere praktiske, ikke-invasive metoder for kartlegging av marint søppel på havbunnen i norske kystområder. Arbeidet ble gjennomført i samarbeid mellom SALT og Green-Bay i perioden august–september 2024, og representerer det første systematiske forsøket på å teste en standardisert, videobasert tilnærming for overvåking av bunnsøppel i grunne kystmiljøer. Prosjektets overordnede mål var todelt: å identifisere områder egnet for langtids overvåking av bunnsøppel, og å vurdere gjennomførbarhet, presisjon og operasjonell effektivitet ved bruk av et slepet undervannsvideosystem som primært datainnsamlingsverktøy.

Tre undersøkelsesområder — Kristiansand, Galtesund og Tromlingene — ble valgt gjennom en strukturert prosess som kombinerte geospatiale analyser, lokal kunnskap og forhåndsdefinerte kriterier relatert til topografi, substrat og nærhet til forventede søppelkilder. De utvalgte områdene representerte en gradient fra urbaniserte havnesystemer til mer eksponerte kystmiljøer dominert av småskala fiske. Innen hvert område ble klynger av 10 transekter lagt ut i et heksagonalt rutenett for å sikre romlig sammenheng og sammenlignbarhet, samtidig som oppsettet tillot lokale tilpasninger knyttet til vær, strømforhold og navigasjonsbegrensninger. Oppsettet sikret høy nok romling oppløsning samtidig som at det på effektiv måte dekket et representativt område.

Feltarbeidet ble gjennomført fra RV *Tyra* ved hjelp av en flyvende, slept videoslede utstyrt med tre kameraer og justerbar belysning. Systemet gjorde det mulig å holde sleden nær havbunnen samtidig som et bredt synsfelt (~5 m) ble opprettholdt, noe som gjorde det mulig å oppdage og klassifisere enkeltobjekter med høy grad av sikkerhet. På tvers av de tre områdene ble totalt 52 klynger og 520 transekter undersøkt, tilsvarende 260 000 m² havbunn. Til sammen ble 1 086 observasjoner av bunnsøppel registrert og klassifisert i henhold til ICES Manual for Seafloor Litter Data Collection, med nødvendige tilpasninger for videobasert metode, tilsvarende ca 2,1 observasjoner per 100 m transekt.

Den samlede tettheten av søppel var 0,0042 observasjoner/m², tilsvarende omtrent 4 200 objekter/km² (oppskalert representativitet ikke vurdert). Tettheten varierte betydelig mellom områdene og reflekterte tydelige forskjeller i miljøeksponering og nærhet til landbaserte kilder. De høyeste tetthetene ble registrert i Kristiansand (0,0067 observasjoner/m², 599 observasjoner) og Galtesund (0,0055 observasjoner/m², 436 observasjoner), begge nært elveutløp, urbane strukturer og områder påvirket av aktiv skipstrafikk. Tromlingene — et åpent og eksponert område — hadde betydelig lavere tetthet (0,0006 observasjoner/m², 51 observasjoner), men objektene som ble funnet der var ofte større og besto gjerne av tapte fiskefeller og annet tungt utstyr. De tre høyeste antallet søppelenheter per 100 m transekt var 37, 35 og 33, i tre ulike hexagoner i Kristiansand og Galtesund. I 46 % av alle transekt (237 transekt) ble det observert null (0) søppelenheter.

Sammensetningen av søppel domineres av glass og keramikk (36 %), plast (34 %) og metall (26 %), med glassflasker som utgjorde en tredjedel av alle observasjoner. Syntetisk tau var den hyppigste plasttypen, mens metallgjenstander ofte var uidentifiserbare og klassifisert som «annet». Romlige analyser viste høy heterogenitet i fordelingen av bunnsøppel på små skalaer. Både variasjonskoeffisientene innen klynger og mellom klynger var høye (>80 % i de fleste tilfeller), noe som viser at bunnsøppel akkumuleres svært ujevnt, selv på skalaer ned mot titalls meter. Dette har

viktige implikasjoner for utforming av overvåkingsprogrammer og understreker behovet for tilstrekkelig replikasjon både på transekt- og klyngenivå.

Prosjektet inkluderte også en kvalitativ vurdering av begroing og substrattype under hvert objekt. De fleste gjenstandene hadde ingen synlig begroing, noe som tyder på relativt nylig avsetning. Blant gjenstander med begroing dominerte brunalger (Ochrophyta), særlig på tau og fiskeredskap, mens mosdyr (Bryozoa) oftest ble funnet på glassflasker. Silt og leire var den mest utbredte substrattypen på tvers av områdene og hadde også flest observasjoner av søppel, noe som reflekterer både sedimentasjonsprosesser og at myke substrater lettere akkumulerer og delvis dekker gjenstander.

Feltprotokollen og bemanningen på tre personer viste seg å være svært effektiv for sanntidsannotering og drift av videosleden. Analysen viste imidlertid at flere variabler — begroing, størrelsesklassifisering, påvekstorganismer og substrat — var for tidkrevende å klassifisere pålitelig i sanntid og krevde gjennomgang av videomateriale i etterkant. Prosjektet utviklet derfor en forbedret operasjonell metode der annotatører registrerte tidsstempler for funn under feltarbeidet, slik at målrettet og effektiv etteranalyse ble mulig. Denne tilnærmingen gjorde det mulig å fullstendig klassifisere 36 klynger innen prosjektperioden, samtidig som grunnleggende telling av søppel ble gjennomført for alle 52 klynger.

Analysen identifiserte også flere gjenstandstyper som ble hyppig registrert, men ikke passet godt inn i eksisterende ICES-kategorier, spesielt fiskefeller, ankere og store industrielle metallkabler. Rapporten anbefaler derfor å innføre egne underkategorier for disse gjenstandene i fremtidig norsk overvåking for å forbedre konsistens og anvendbarhet.

Basert på erfaringene konkluderer prosjektet med at slept videorigg er godt egnet for kartlegging av bunnsøppel i kystsonen og representerer et praktisk alternativ til tråL-baserte metoder og oppviste fordeler mot ROV-baserte undersøkelser ved stabilere kontroll og drift i vann. Metoden gir detaljerte romlige data, reduserer miljøpåvirkning og samsvarer godt med internasjonale overvåkingsstandarder. Fremtidige forbedringer — inkludert bruk av laserskala-markører, størrelsesbaserte analyser og videre vurdering av nødvendig replikasjon gjennom styrkeanalyser — vil kunne øke metodens presisjon og sammenlignbarhet. Resultatene fra dette pilotprosjektet utgjør dermed et solid grunnlag for etablering av et langsiktig nasjonalt overvåkingsprogram for bunnsøppel i norske kystfarvann.

Vedlegg 4 inneholder et sett med foreslåtte områder for overvåking av kystnært havbunnsforsøpling i Norge, som bygger på funn og metodikk i hovedrapporten.

1. BACKGROUND AND PURPOSE

Marine litter is a major global environmental issue, and current knowledge about its quantities, sources, and long-term trends remains limited. In particular, there is considerable uncertainty regarding the amount of litter that accumulates on the seafloor. To fill this knowledge gap, the Norwegian Environment Agency (Miljødirektoratet) initiated a pilot project to map seafloor litter at three coastal locations in Norway.

Previous work by the Institute of Marine Research, SALT, and Runde Environmental Centre (Buhl-Mortensen et al., 2025) has provided recommendations for long-term monitoring programmes of seafloor litter. That work outlined three alternative approaches: a full-scale programme, an intermediate option, and a minimum solution. The present project closely follows the minimum solution proposed in those recommendations.

The main objective of the project was to build knowledge and develop methods for collecting data on seafloor litter. Specifically, the Norwegian Environment Agency requested that the project:

- Propose three suitable coastal areas for pilot mapping of seafloor litter
- Ensure that these areas could later be used for regular monitoring, and
- Carry out the mapping without the use of trawl gear

The project was therefore structured into two main parts. The first involved identifying suitable areas for mapping, based on their expected potential for litter accumulation. The second consisted of carrying out field surveys within these areas using a towed camera system.

2. MATERIALS AND METHODS

2.1 Selection of survey areas

Survey areas were selected along the coast of Southern Norway, within a maximum four-hour radius (at 8 knots) from the home ports in Lillesand and Arendal. Areas were chosen based on the following predefined criteria:

- Topography: We prioritized areas shallower than 100 meters to enable efficient mapping. Steeply sloping seabeds were avoided, as litter is less likely to accumulate in such terrain. Areas with kelp forests were also excluded, as vegetation makes it difficult to detect litter using video methods.
- Substrate: The three areas were selected to represent different substrate characteristics while keeping each area as homogenous as possible in terms of substrate.
- Proximity to expected litter sources: We focused on areas close to river mouths, harbors, populated coastal zones, and known fishing grounds, where litter was expected to be more common.
- Reported lost fishing gear: Data on reported lost fishing gear were obtained from the Norwegian Directorate of Fisheries to identify potential hotspots for fishing-related litter.
- Local knowledge: Both Green-Bay and SALT have previous experience with seabed mapping in the region and contributed insight into where litter is likely to accumulate. Additional insights were obtained from local fishers and local diving clubs.

Based on these criteria, three survey areas were selected: Kristiansand, Galtesund, and Tromlingene. Kristiansand and Galtesund are in close proximity to river outlets, urban areas and harbors. Tromlingene represents a more open and exposed area, dominated by recreational fishing, where less litter was expected.

2.2 Survey design

Within each survey area, clusters of transects were used as the sampling unit. Each cluster consisted of 10 transects, each measuring 100 meters long and 5 meters wide. A 25-meter gap was maintained between transects to avoid overlap caused by GPS inaccuracy or camera drift.

Clusters were positioned in a hexagonal grid (hexagon side length = 275 m). Clusters could be rotated within their respective hexagons according to prevailing weather and current conditions at the time of sampling.

To ensure spatial independence, clusters were placed with at least one empty hexagon between them. Clusters were positioned as close together as practical, avoiding land, unsuitable depths, or restricted areas. This ensured that sampling was both representative and logistically feasible.

Based on an estimated sampling rate of 40-60 transects per day, approximately 4-6 clusters could be completed daily, corresponding to 12-18 clusters per survey area.

2.3 Development of site selection tool

To support site selection and field planning, an interactive web-based mapping tool was developed. The tool facilitated informed selection of survey locations based on predefined criteria such as depth, seafloor slope, and proximity to potential litter sources. The map included the following data layers:

- Hex_PO_275_ID: Hexagonal grid with unique cell IDs used for planning cluster placement.
- River outlets: Displayed as point features.
- Litter recorded at MAREANO stations: None located within the 100 m depth range.
- Litter recorded during the Directorate of Fisheries' cleanup surveys.
- Seafloor slope: Areas with slope <5 m per 100 m, calculated from a 50 m resolution bathymetric map, with buffers of 1, 3, and 5 km from river outlets.
- Mapped habitat types: Displayed as polygons, including areas with kelp forest.
- Depth constraint layer: Highlighting areas shallower than 100 m.

This tool guided selection of hexagons to be sampled in this project and can be used for selecting suitable sampling locations in future surveys.

2.4 Development of protocol

A protocol was designed specifically for this project, based on the ICES Manual for Seafloor Litter Data Collection and Reporting from Demersal Trawl Samples (De Witte et al., 2022). We followed the instructions given in the ICES manual for counting, categorizing, and sizing litter items to the degree that it was possible when sampling with video rather than trawl surveys.

2.4.1 Counting litter items

We did not count items natural to the seafloor or items of active infrastructure (e.g., cables) as these are not defined as litter. Transects with no litter were recorded as zero observations. When multiple pieces clearly originated from the same item (e.g., a continuous rope visible in several frames), they were counted as one. Uncertain cases were counted as separate items.

2.4.2 Categorising litter items

Items were classified according to Table 1 (corresponding to Table 1.2 in the ICES manual). If an item was composed of multiple materials, the visually dominant material determined its category. For example, a fishing trap attached to a rope and buoys was classified as 1 item of *A Plastic, A16 Other fishing related plastic* if the trap was the dominant material.

Table 1: Seafloor litter categories (A-F) and respective subcategories. Modified from Table 1.2 in the ICES manual (De Witte et al., 2022) to include Concrete as a category.

Category	Subcategory	Description
A Plastic	A1 Bottle	Container with a narrow neck.
	A2 Sheet	Soft plastic foil, including wrapping material.
	A3 Bag	All types of bags made of plastic, including mesh bags.
	A4 Caps and lids	All types of caps/lids (e.g. bottle caps, sports caps, and pen lids).
	A5 Monofilament	One single strain of plastic, not necessarily fishing related.
	A6 Monofilament (entangled)	Multiple single strains of plastic, entangled together.
	A7 Synthetic rope	Twined filaments made of synthetic fibres.
	A8 Fishing net	Made from synthetic fibres woven into a grid-like structure.
	A9 Cable ties	A thin strip of plastic with ridges on one edge to allow for a tightening and locking mechanism. Also known as zip ties or hose ties.
	A10 Strapping band	Synthetic woven strip used to secure packaging.
	A11 Crates and containers	From small plastic storage boxes, containers, crates, trays, and other storage products or packaging for food and other consumer goods, to larger products such as stack/nest boxes, small parts bins, and storage tanks, including industrial crates (e.g. fish boxes). Also plastic cups.
	A12 Diapers	A type of single use underwear, most commonly used for infants, but can come in adult sizes. Also known as nappies.
	A13 Sanitary towels and tampons	Includes tampon applicators, panty liners, and their plastic strips.
	A14 Other	Unrecognisable items and items not fitting in other categories, including hard plastic pieces.
	A15 Medical masks	Single use medical masks, FFP2, FFP3, and face shields.
	A16 Other fishing related plastic	Plastic items related to fishing and aquaculture activities (e.g. pots and traps). This category does not include fishing nets which are covered in category A8.
B Metal	B1 Cans (food)	Metal cans, independent of shape, used for food storage.
	B2 Cans (beverage)	Metal cans, independent of shape, used for beverages. For liquids not meant for human consumption, use category B4.
	B3 Fishing related	Metal items related to fishing activities, such as line fishing and/or trawling (e.g. hooks, shackles, ticklers, and sinkers).
	B4 Drums	Cylindrical or oblong containers and pots (e.g. for oil or paint).
	B5 Appliances	Electric or mechanical devices.
	B6 Car parts	All car related items which mainly consist of metal.
	B7 Cables	Metal cables and electrical wires.
	B8 Other	Unrecognisable items or items that do not fit in other categories, including metal pieces and screws.
C Rubber	C1 Boots	A boot made of rubber.
	C2 Balloons	Thin rubber inflatable object (e.g. used as a toy or decoration).
	C3 Bobbins (fishing)	Part of the fishing net (a round or tube-shaped object connected by thread, wire, or net to roll over the seafloor). Also known as rockhoppers.

	C4 Tyre	Thick rubber ring that is fitted around the outer edge of a vehicle wheel.
	C5 Glove	Piece of clothing that is worn on the hands and wrists made from artificial or natural rubber (e.g. gloves used in fisheries and nitrile rubber laboratory gloves).
	C6 Other	Unrecognisable items and items that do not fit in any other rubber categories above.
D Glass and ceramics	D1 Jar	A wide-mouthed container made of glass or pottery.
	D2 Bottle	A glass container with a narrow neck.
	D3 Piece	Fragment of a larger item made of glass or ceramics.
	D4 Other	Unrecognisable items and items that do not fit in other categories (e.g. drinking glasses, cups, ceramic tiles, or bricks).
E Natural products	E1 Wood (processed)	Processed objects made of wood (e.g. broomstick, planks, or rigging).
	E2 Rope	Ropes made from natural fibres, such as cotton, sisal, hemp, or coir. For ropes made from synthetic fibres see category A7.
	E3 Paper and cardboard	For example, newspapers or heavy-duty paper-based products.
	E4 Pallets	Flat wooden transport structure.
	E5 Other	Unrecognisable, man-made, processed items and items that do not fit in other categories, such as slate roof tiles, cobbles, concrete, cinder stone, or coal. When the source material is a natural product that has been intentionally heated to produce a man-made material, it belongs to category D (e.g. bricks or things made of glass).
F Miscellaneous	F1 Clothing and rags	All types of clothing, textile and woven products, except for rubber gloves which belong to subcategory C5.
	F2 Shoes	All types of footwear, except for rubber boots which belong to subcategory C1.
	F3 Other	Unrecognisable items and items that do not fit in other categories.
G Concrete	G1 Concrete item	Any item made of concrete

2.2.3 Sizing litter items

Size categories followed those in Table 2. The two largest dimensions used to assign size. For instance, a rope 100 cm long and 5 cm wide was categorised as D ≤ 50 × 50 (100 cm x 5 cm = 500 cm^2) rather than E ≤ 100 × 100 cm.

Table 2: Size categories for marine litter monitoring taken from ICES Manual for Seafloor Litter Data Collection and Reporting from Demersal Trawl Samples (De Witte et al., 2022).

Size category	Dimensions	Area
A	≤ 5 × 5 cm	< 25 cm^2
B	≤ 10 × 10 cm	25 – 100 cm^2
C	≤ 20 × 20 cm	100 – 400 cm^2
D	≤ 50 × 50 cm	400 – 2500 cm^2
E	≤ 100 × 100 cm	2500 – 10000 = 0.25 cm^2 – 1 m^2
F	> 100 × 100 cm	> 10000 cm cm^2 = > 1 m^2

2.4.4 Recording attached organisms

Biofouling was recorded per item as No, Partly covered, or Largely/fully covered, and organisms were identified to the phylum level.

2.4.5 Substrate

The substrate beneath each litter item was classified into five categories: Bedrock and large boulders (> 630 mm), very course sediment (63 – 630 mm), coarse sediment (sand & gravel; 0.063 – 63 mm), silt & clay (< 0.063 mm) and coralline sand (shell sand composed of fragmented calcareous algae). The first four categories follow the European standard for visual mapping of the seafloor (EN 16260:2012), while coralline sand follows recommendations from Husa & Kutti (2022).

2.5 Fieldwork and data collection

A total of 52 clusters and corresponding 520 transects (10 transects in each cluster) were sampled: 18 clusters in Tromlingene (August 13-15), 16 in Galtesund (August 18, 20-21) and 18 in Kristiansand (September 1-3).

Fieldwork was conducted from RV Tyra using a flying towed video sled equipped with three cameras (side-forward-side) and three lights. The three-camera set-up enabled recording with a wide field of view while keeping the sled close enough to the seabed to detect and identify litter (Picture 1 and 2). This configuration provided a field of view of approximately ± 5 meters, adjustable based on visibility and seafloor topography. Under poor visibility, the sled was lowered closer to the seafloor to maintain image clarity whereas under good conditions it was raised to maintain a wider field of view.

Picture 1 (left) showing the flying towed video sled used for mapping seafloor litter and picture 2 (right) showing the video setup onboard showing the footage from the 3 cameras side-by-side.

The sled was operated with a joystick, allowing the operator to control cable release and retrieval, pushing down to lower the sled and pulling up to raise it, which made it possible to avoid obstacles

and adjust the sled to local topography. The sled was mounted on a winch with 325 meters of available cable and the camera rig was rated to a maximum depth of 500 meters.

Three people were onboard for field operations: one responsible for navigation and steering the vessel, one for operating the sled, and one for annotating litter, starting and stopping video recordings, and marking waypoints at the start and end of each transect. Video was recorded continuously for each transect. The sled operator was positioned next to the video annotator and assisted by announcing visible litter items, ensuring that observations were not missed when the annotator was entering data or making waypoints.

Based on prior experience, video footage was reviewed and annotated in real time onboard, allowing immediate adjustment of camera angle, height, and lighting to maintain image quality.

2.6 Data analysis

For each transect, cluster, and survey area, litter density (number of observations/m^2) was calculated. Interactive heatmaps were created to visualize litter distribution allowing users to toggle between hexagon (cluster) and transect layers and to view detailed litter counts by clicking individual features.

To assess the spatial variability of litter within clusters (i.e. among transects) and between clusters (i.e. among clusters in the same area), the coefficient of variation (CV) was calculated. Low CV values indicate homogenous litter distribution while high CV values indicate patchy or heterogenous distribution.

Litter composition (by category and subcategory) was visualized using interactive sunburst charts for both individual areas and all areas combined.

3. RESULTS AND DISCUSSION

3.1 Assessment of field survey and data collection

3.1.1 Evaluation of protocol

Video footage was reviewed in real time during fieldwork, and data were entered directly into the field protcol. However, it was quickly evident that it was not feasible to classify all variables of interest including *Seafloor litter category*, *Subcategory*, *Size category*, *Biofouling*, *Attached organisms* and *Substrate* in real time. In transects with little litter, most variables could be assessed in the field, except for *Bioufouling* and *Attached organisms*. Full classification required post-survey analysis.

To save time in video analysis by not having to go through all video material, the annotator recorded the approximate time and camera view of each litter observation directly in the *Additional comments from field* column (e.g. Synthetic rope, 4:00, right camera). This approach made the review process more efficient and enabled full analysis of videos from 36 clusters (12 from each area) within the project scope. Consequently, data on litter categories and subcategories were compiled for all 52 clusters, while more detailed information on substrate, size category, biofouling, and attached organisms was compiled for 36 clusters. The results presented in section *3.2 Observations of seafloor litter* are based on all 52 clusters.

For future monitoring in Norwegian coastal waters, we propose three new subcategories that were not included in the ICES manual but were frequently observed during our surveys: 1) fishing traps, 2) anchors, and 3) large metal cables/wires. A total of 42 fishing traps were recorded, accounting for 65% of the items classified as *A16 Other fishing related plastic*. Because this item dominated the subcategory, we recommend establishing a separate subcategory for fishing traps, similar to the existing one for fishing nets. We also recorded seven anchors, which were classified under *B Metal – B8 Other*. As a large proportion (59%) of metal items were placed in this same subcategory, either because they were unidentifiable or did not fit any existing category, we suggest introducing a distinct subcategory for anchors. Finally, in the more industrial areas of Kristiansand and Arendal, we observed numerous large metal cables or wires partly buried in sediment (Figure 1). These were classified as *B Metal – B7 Cables*, following the ICES definition of this subcategory (metal cables and electrical wires; Table 1). However, because the observed cables differ substantially from typical electrical wires (which were also recorded, but rarely), we recommend adding a new subcategory: *B Metal – Large cables*.

Figure 1: Examples of large metal cables/wires frequently found in industrial parts of Arendal and Kristiansand.

3.1.2 Evaluation of equipment and staffing

We evaluate the data collection as most effective with a crew of three people for fieldwork. Although technically possible with two, one operating the boat and the other operating the sled, recording videos and marking waypoints, we perceive this as too demanding for the sled operator. Using only two operators could impact the quality of the data collected and would likely not save time, as all video material would then need to be reviewed afterward.

The flying towed video sled proved effective for systematic and representative mapping of seafloor litter. An ROV could not have maintained such stable transect courses, especially under strong currents, without an experienced pilot and a large, stable unit. However, an ROV would be more suitable for targeted litter removal, as it can be maneuvered and fitted with a gripper arm.

Density estimates were based on an assumed 5 m camera field of view. Most transects had good visibility and therefore full range of view, however visibility was poorer in exposed areas in Tromlingene and near river outlets (e.g., Otra in Kristiansand and Nidelva in Arendal). This introduces uncertainty in density estimates, as the actual field of view varied. Future surveys could reduce this uncertainty by adding laser scale markers to the sled, allowing calculation of the visible area and more accurate litter-size classification (Renn et al., 2024; Sheehan et al., 2016).

3.1.3 Evaluation of survey design

The use of 10 transects per cluster provided adequate spatial resolution while maintaining efficient coverage of representative areas. Transect placement and direction were adjusted based on local conditions such as wind, waves, or obstacles (e.g., fishing buoys, moorings, marine traffic and land). In some hexagons, particularly near urban areas like hexagon 1855376 close to the harbour in Arendal, space constraints limited the placement of transects, and 10 transects was the absolute maximum that could have been sampled within this hexagon. Often, several transects were run consecutively in a continuous line (e.g., a 300 m stretch comprising three transects) for operational efficiency and to fit all transects within the hexagon (see Figures 4-6).

The magnitude of changes over different time scales that is likely to be detectable with the given survey design will need to be assessed through power analyses, and potential adjustments to the replication level (e.g., number of transects and clusters within areas) to achieve the desired power evaluated; a task which was beyond the scope of this project. It should be noted, however, that this survey design for shallow, coastal areas is a fundamentally different approach from the offshore surveys carried out through MAREANO, and the power analyses carried out for these surveys (Buhl-Mortensen et al., 2025) are not transferable to the current design as power analyses only apply to the statistical test and data variance structure for which is was carried out.

Firstly, the litter density in these shallow coastal areas is considerably higher than the offshore areas surveyed in MAREANO, resulting in a different variance structure in the data. The total number of litter items observed during this project slightly exceeded that observed through MAREANO in almost seven times as many transects over the span of 18 years. This considerably

higher encounter rate of litter and reduced zero-inflation of the data will result in increased statistical power for trend detection relative to the results of the power analysis for offshore MAREANO surveys (all other things being equal).

Secondly, for continued monitoring and trend analyses, in the suggested survey design, the unit of temporal replication is the area and clusters, not individual transects as perfectly replicating the tow path is considered too inaccurate. This means that the statistical approach to detecting changes over time will be different than in the repeated measures design suggested for MAREANO surveyes where litter encounter rates were so low that attempting to return to the highest density transects was deemed the only feasible approach. Consequently, the recommendation of repeated monitoring of transects with a minimum of 3 observed litter items does not apply.

3.1.3 Evaluation of sampling areas

The Kristiansand and Galtesund areas, both near urban centres, contained considerably more litter than Tromlingene. In low-litter areas such as Tromlingene, future monitoring would require greater sampling effort to obtain sufficient data for robust statistics than in higher-litter areas such as Kristiansand or Galtesund. For example, one day we mapped 50 transects (25,000 m^2) and only found 4 observations of litter. Although Tromlingene had fewer litter items, those found were typically large in size, mainly lost fishing traps, which contribute more mass than the many glass bottles observed near urban areas. It would be useful to use the data collected in this project to estimate how many transects are necessary to obtain a representative picture of litter load for future monitoring.

In Kristiansand, one sampled hexagon (ID 1458521) was located at Hannevika, an area where capping has been performed at the Falconbridge nickel plant quay facilities (Multiconsult, 2007). The cluster had fewer observations of litter (17) than other clusters in Kristiansand, which could be attributed to the fact that older litter (pre-2004) is now buried and not possible to detect with camera. This attribution is however not possible to confirm, and the time-period between 2004 and the time of sampling (2025) is regarded as an extensive time-period that natural sedimentation or other factors may well play the determining role. Further monitoring of the hexagon at Hannevika is hence not deemed as of special interest.

3.2 Observations of seafloor litter

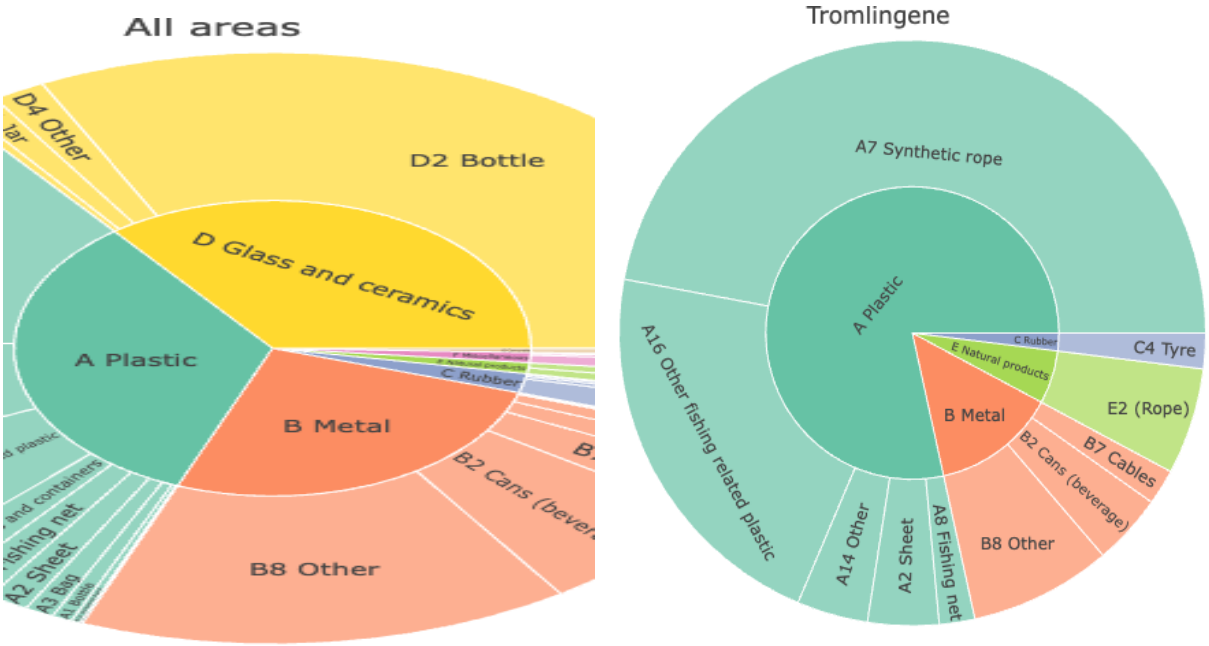
Across all areas, a total of 1,086 seafloor litter observations were recorded, corresponding to 0.0042 observations/m^2. If extrapolated per square kilometer, this corresponds to 4,200 items/km^2, although the statistical representativeness of this estimate has not been assessed. The most common category was *Glass and ceramics* (36% of composition), followed by *Plastic* (34%), and *Metal* (26%) (Figure 2; top left). Within *Glass and ceramics*, glass bottles dominated (91% of this category; 33% of total litter). Within *Plastic*, synthetic rope was most frequent (42%), followed by fishing-related

plastics (22%; A16 Other fishing related plastic + A8 Fishing net), and other (21%) (Figure 2; top left). Within *Metal*, most items were unidentifiable and classified as other (59%), though beverage cans were also common (24%). Because this analysis is based on item counts, glass bottles dominate numerically. A mass-based analysis would likely show a higher contribution from synthetic rope and fishing gear. Photo examples of all litter categories are shown in Appendix 1.

Interactive maps and visualizations of results are available on the hyperlinks.

3.2.1 Litter by area

Of the three areas, Kristiansand had the highest litter density (0.0067 observations /m², 599 observations), followed by Galtesund (0.0055 observations/m², 436 observations), and then Tromlingene (0.0006 observations/m², 51 observations). In Kristiansand and Galtesund, litter composition was similar, dominated by *Glass and ceramics* (41% and 33%, respectively), *Plastic* (31% and 33%, respectively) and *Metal* (25% and 30%, respectively). In contrast, Tromlingene was dominated by *Plastic* (78%), primarily synthetic rope (60%) and fishing-related plastics (30%; A16 Other fishing related plastic + A8 Fishing net).



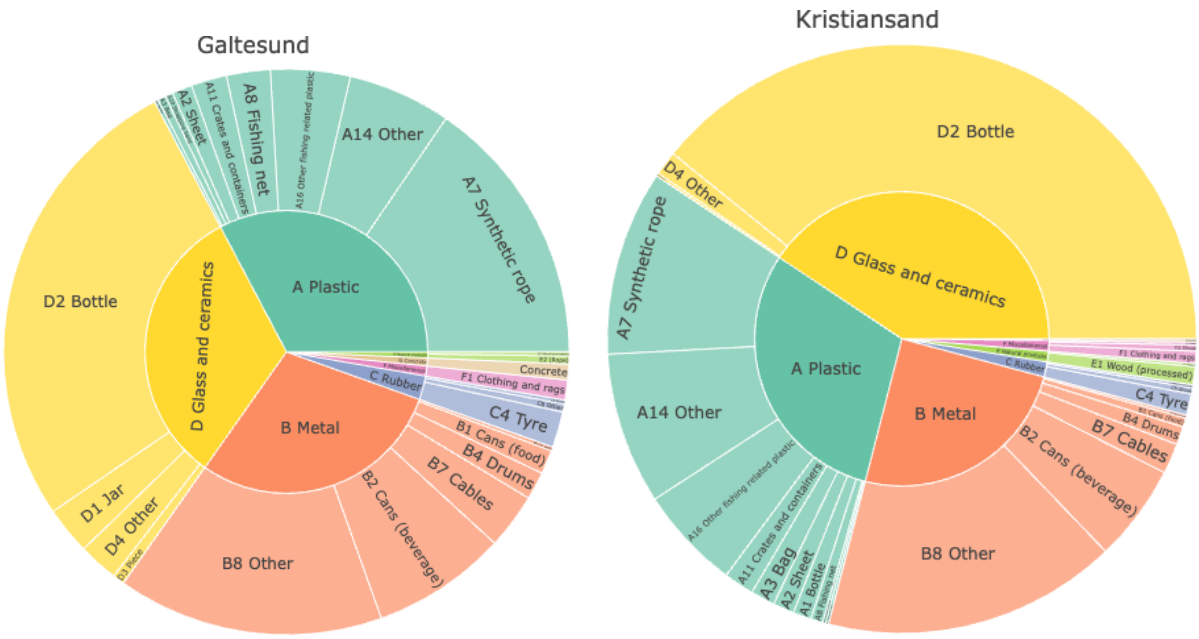


Figure 2: Composition of seafloor litter for all mapped areas combined (top left) and for each individual area. The inner ring represents litter categories (plastic, metal, rubber, glass and ceramics, natural products, and miscellaneous), while the outer ring shows subcategories. Colors correspond to the litter category. Interactive versions of the figures can be found here.

Table 3: Overview of sampling effort and seafloor litter observations in each area. Sampling effort is expressed as the number of clusters, transects, and total surveyed area (m^2). Litter observations are given as total counts per category, with corresponding densities (count/m^2) presented in a separate row below each total.

Area	Clusters (n)	Transects (n)	Sampled area (m^2)	Plastic	Metal	Rubber	Glass and ceramics	Natural products	Misc.	Total	Density (count/m2)
Tromlingene	18	180	90 000	40	7	1	0	3	0	**51**	**0,0006**
Galtesund	16	160	80 000	144	129	12	143	3	5	**436**	**0,0055**
Kristiansand	18	180	90 000	183	148	10	244	7	7	**599**	**0,0067**
Total	**52**	**520**	**260 000**	**367**	**284**	**23**	**387**	**13**	**12**	**1 086**	
Density (count/m^2)				*0.0014*	*0.0010*	*0.0001*	*0.0015*	*0.00005*	*0.00005*	*0.0042*	

3.2.2 Litter by cluster

The cluster with the highest litter count was near the guest harbor in Kristiansand (122 observations; Figure 2; left), dominated by *Glass and ceramics* (45%; Table 2), mainly bottles (44% of total litter). The cluster with the second highest litter count located in Galtesund (114 observations; Figure 2; right), had a similar composition (51% *Glass and ceramics*; 39% bottles). Litter observations per cluster are detailed in Appendix 2.

In Galtesund, litter density decreased with distance from urbans areas. This trend was less pronounced in Kristiansand, where litter was more evenly distributed among clusters.

When all three areas were compared at the same scale (Figure 3), Tromlingene had markedly lower litter densities, making between-cluster variation less visible. We have therefore additionally created maps where each area is visualized on their own scale (Figure 4) to provide clearer visualization of intra-area variation. The Coefficient of variation (CV) in litter density between clusters was 126% in Galtesund, 82% in Kristiansand and 106% in Tromlingene, indicating high variability in the distribution of litter between clusters in Galtesund and Tromlinene, and moderate variability in Kristiansand.

Coefficient of variation

The coefficient of variation (CV) measures how variable the data are relative to the mean.

$$CV = \frac{SD}{Mean} \times 100$$

It provides a measure of how homogeneous or patchy the data are across sampling units:

- Low CV values (<50%) indicate that litter densities are relatively uniform.
- High CV values (>100%) indicate that litter is unevenly distributed or patchy.

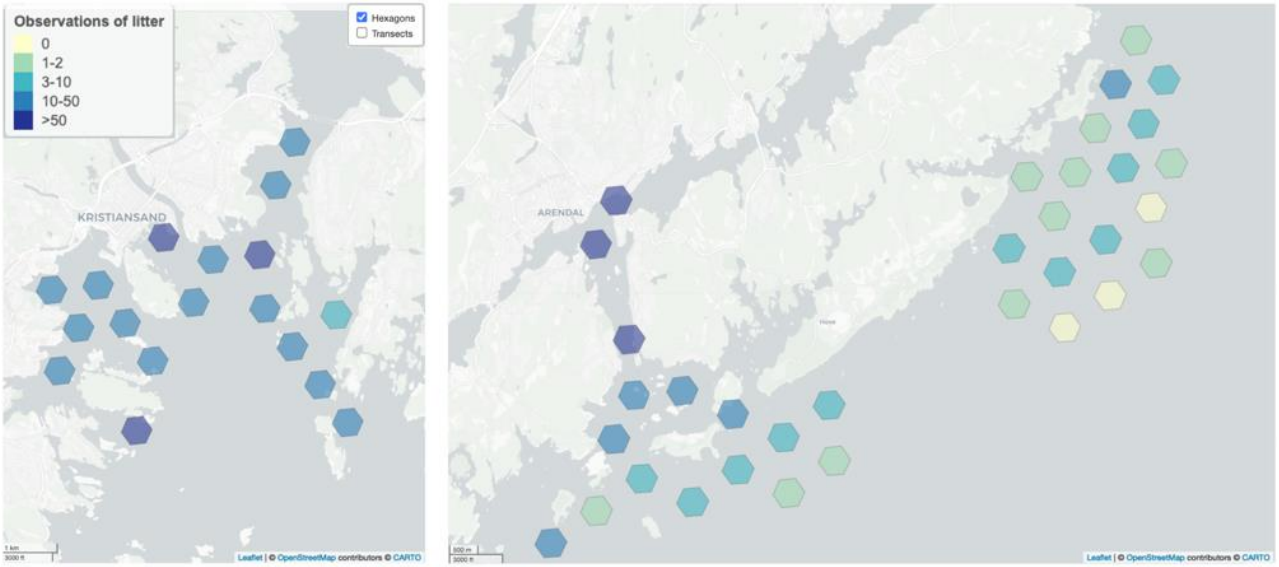


Figure 3: The number of litter observations found in each cluster sampled in Kristiansand (left), Galtesund (left side of right picture), and Tromlingene (right). Interactive versions of the maps can be found here.

3.2.3 Litter by transect

Variation was also high at the 100-m transect scale (Figures 4-6). Coefficients of variation for litter density among transects within clusters ranged from 54 to 211% in Galtesund (mean ± SD = 141 ± 53%), 54 to 164% in Kristiansand (mean ± SD = 100 ± 33%), and 90 to 316% in Tromlingene (mean ± SD = 223 ± 77%). These values confirm a high degree of small-scale heterogeneity in seafloor litter distribution.

The highest number of registered observations per transect were 37 observations in hexagon 1474655 (transect 4) in Kristiansand, 35 observations in hexagon 1852150 (transect 4) in Galtesund and 33 observations in hexagon 1468208 (transect 4) in Kristiansand.

The average amount of litter observations per transect was approx. 2.1. 46% of all transects (237 transects) had no litter observations recorded.

Litter observations per transect are detailed in Appendix 1.

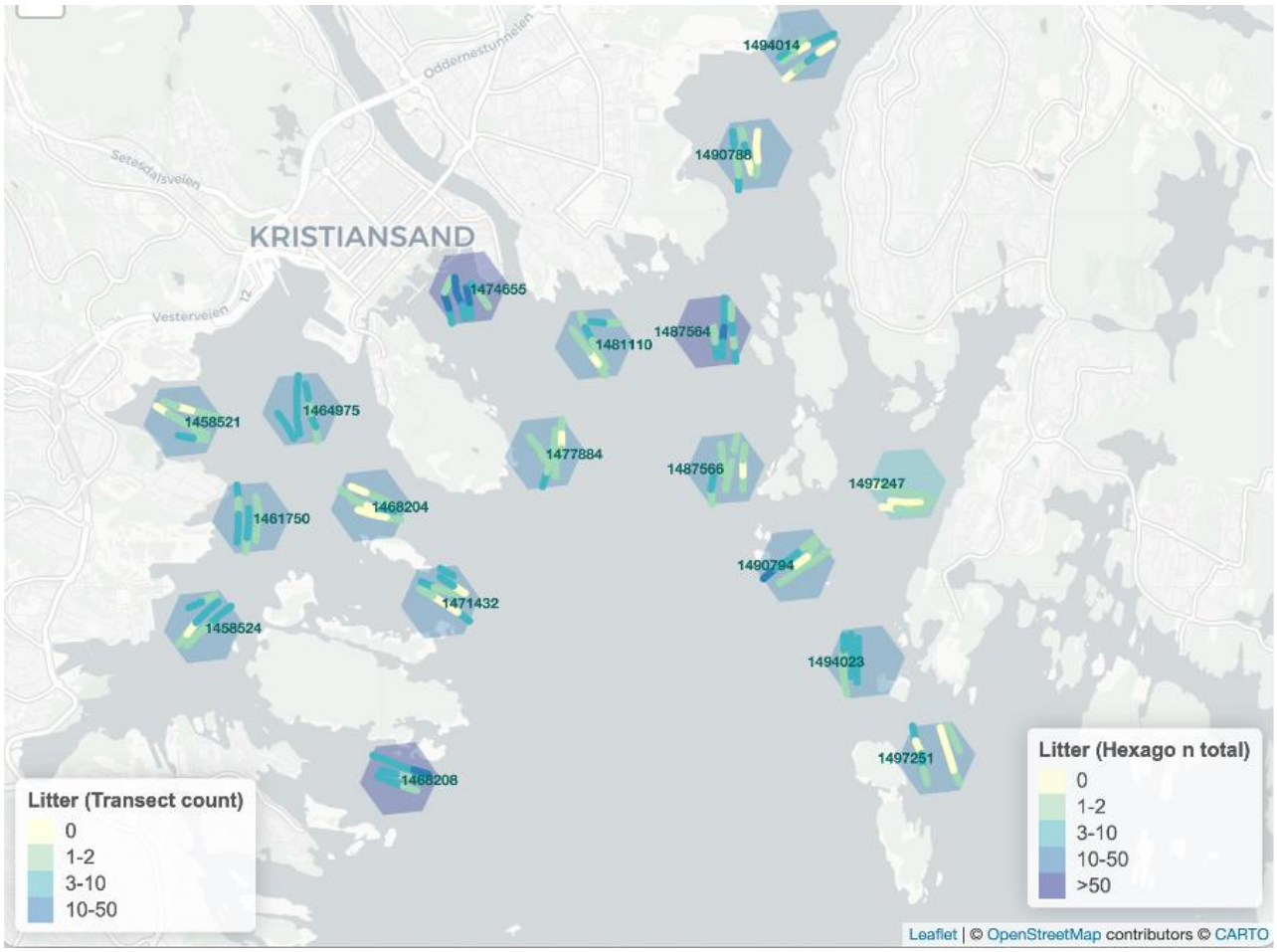


Figure 4: The number of litter observations found in each transect (lines) and cluster (hexagons) sampled in Kristiansand. Observations of litter in all areas are given on their own individual scale. Interactive versions of the maps can be found here.

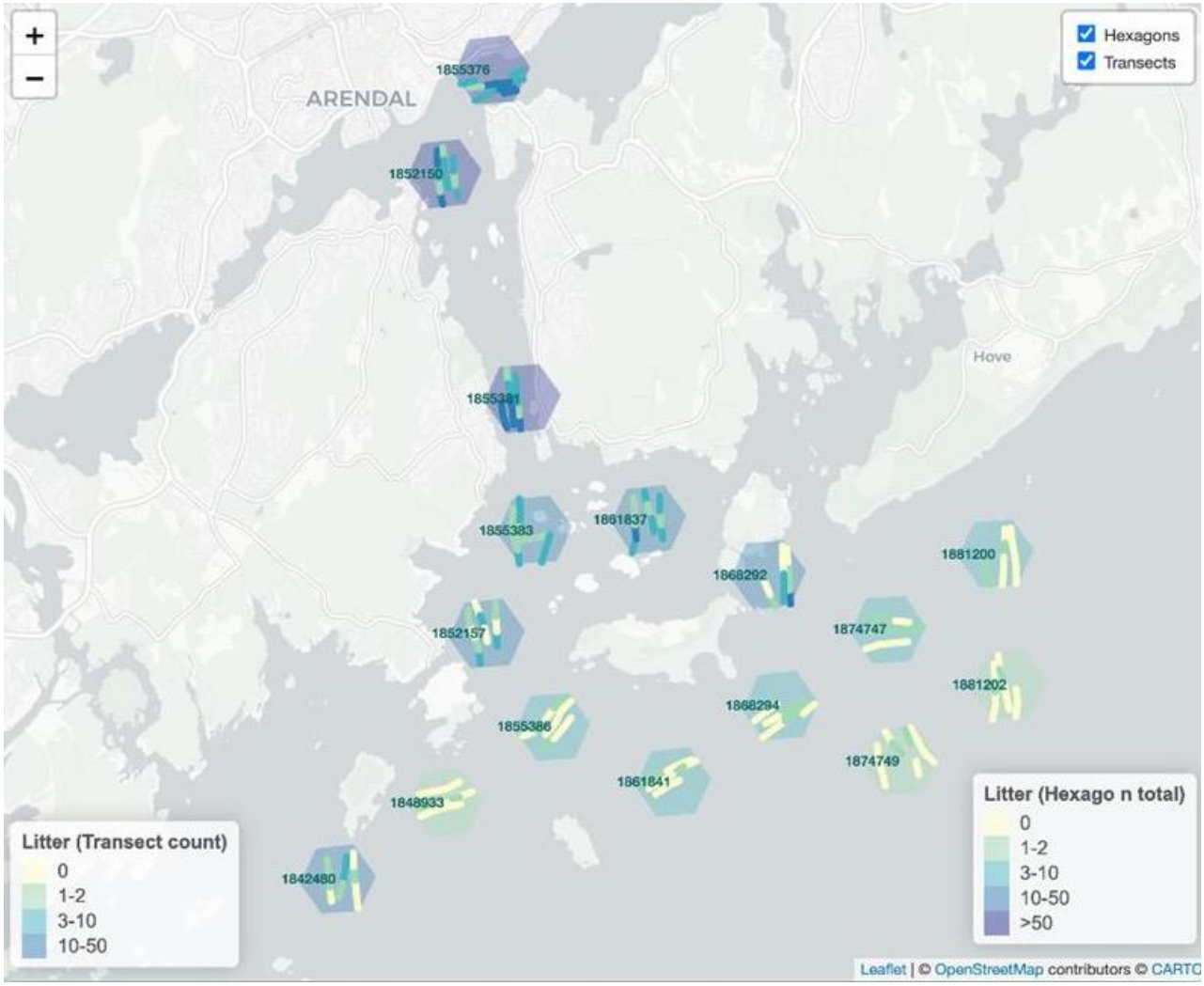


Figure 5: Number of litter observations found in each transect (lines) and cluster (hexagons) sampled in Galtesund. Values are shown on an individual legend scale (specific to each area). Interactive versions of the maps can be found here.

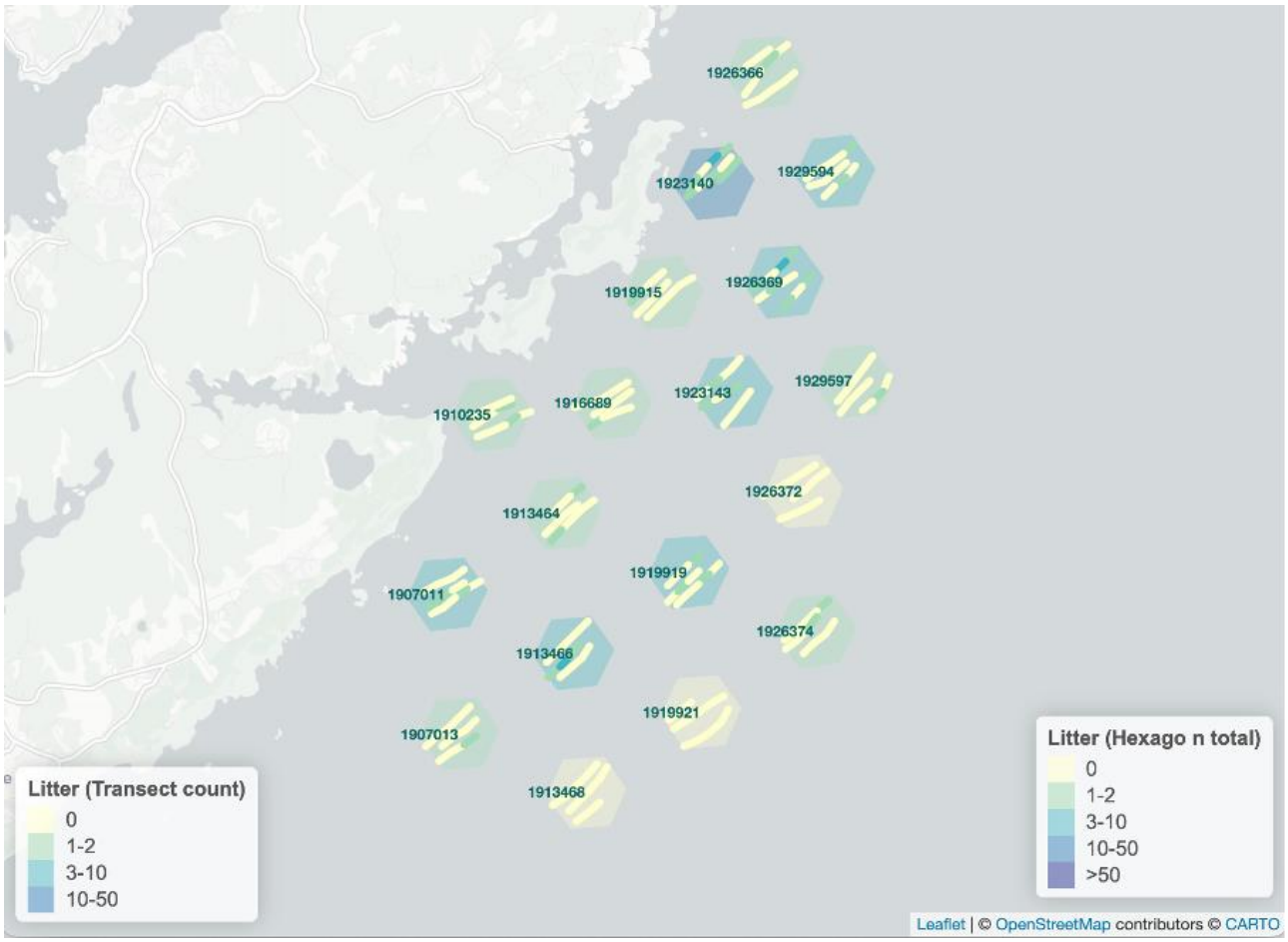


Figure 6: Number of litter observations found in each transect (lines) and cluster (hexagons) sampled in Tromlingene. Values are shown on an individual legend scale (specific to each area). Interactive versions of the maps can be found here.

3.3 Qualitative assessment of attached organisms

Overall, 80% of the recorded litter items had no biofouling, while 12% were partly covered by attached organisms and 8% were largely or fully covered. Among the fouled items, Ochrophyta (brown algae) was the most frequently observed phylum (65%), followed by Bryozoa (17%) and Cnidaria (11%, specifically *Alcyonium digitatum*). Ochrophyta was most commonly attached to ropes and fishing gear, Bryozoa was typically found on glass bottles, and Cnidaria was mainly recorded on metal items or on ropes and fishing gear (Figure 7).

Figure 7: Examples of biofouling: Ochrophyta and Cnidaria on a fishing net (left), and Bryozoa attached to a glass bottle (right).

3.4 Qualitative assessment of bottom substrate

The most common substrate type observed was *Silt & clay,* followed by *Coarse sediment (sand & gravel)*, and then *Bedrock and large boulders*. *Very course sediment* was rarely observed, and *Coralline sand* was never observed. Correspondingly, most litter was observed on *Silt & clay* (519 observations), followed by *Coarse sediment (sand & gravel)* (267 observations), and then *Bedrock and large boulders* (67 observations). Litter such as bottles and fishing gear often accumulated at the base of steep bedrock slopes where substrates meet.

Bedrock areas were the most technically challenging to survey due to abrupt depth changes requiring vertical sled adjustments. However, detection uncertainty is likely greatest on silt and clay, where fine sediments can cover litter items. Visibility was also reduced in such areas, particularly under strong currents.

4. CONCLUSIONS

This pilot project demonstrated a practical and non-invasive method for mapping seafloor litter in coastal waters of Norway using towed video surveys. The approach was efficient and generated spatially detailed data on litter density, composition and distribution across three survey areas: Kristiansand, Galtesund and Tromlingene.

A total of 1,086 litter items were recorded across 520 transects. Litter densities were highest near urban areas in Kristiansand and Galtesund, and lowest in the more exposed Tromlingene area, where litter was sparse but often consisted of larger items such as lost fishing gear. The most common litter types were glass bottles, synthetic rope, and metal debris.

Results showed high spatial variation in litter distribution, both between and within clusters, highlighting the patchy nature of seafloor litter accumulation even at small spatial scales. The findings demonstrate that non-invasive video surveys can produce data compatible with the international monitoring standards given by ICES. Future surveys could be improved by incorporating laser scale markers to accurately measure the camera's field of view and improve size estimates, and by including size-based information in the analyses to better reflect the impact of larger items such as fishing gear.

Lastly, it is recommended that power analyses be carried out to estimate the necessary replication to have a satisfactory probability (power) to detect desired effect sizes (magnitude of change) over a given time period. This applies to replication and trend detection both within areas and among them for trend monitoring at different spatial scales.

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APPENDIX 1 – TRANSECT OVERVIEW

Overview of seafloor litter observations for each transect sampled. The table shows the number of litter items observed in each category (plastic, metal, rubber, glass and ceramics, nautral products, miscellaneous), along with the total number of items per cluster.

Area	Cluster ID	Transect	Latitude start transect	Longitude start transect	Latitude end transect	Longitude end transect	Number of litter observations						
							Plastic	Metal	Rubber	Glass & ceramic	Natural	Misc.	Total
Kristiansand	1458521	1	7,978989618	58,13485258	7,977373045	58,13512286	1	0	0	0	0	0	1
		2	7,977373045	58,13512286	7,975697865	58,13527626	1	1	0	0	0	0	2
		3	7,975697865	58,13527626	7,974081227	58,13556084	0	0	0	0	0	0	0
		4	7,974081227	58,13556084	7,972457079	58,1358157	0	1	0	0	0	1	2
		5	7,971552882	58,13553532	7,973022464	58,13508736	0	0	0	0	0	0	0
		6	7,973022464	58,13508736	7,974525598	58,13467086	1	1	0	0	0	0	2
		7	7,974525598	58,13467086	7,975934555	58,13416583	1	0	0	0	0	0	1
		8	7,975934555	58,13416583	7,97751874	58,13384118	1	1	0	0	0	0	2
		9	7,977529691	58,13346316	7,975848373	58,13358761	1	0	0	1	0	0	2
		10	7,975848373	58,13358761	7,974163986	58,1337682	1	3	0	0	0	1	5
	1458524	1	7,98032053	58,12314634	7,979008321	58,12256927	1	2	1	0	0	0	4
		2	7,979008321	58,12256927	7,977730822	58,12197082	1	1	0	1	0	0	3
		3	7,977730822	58,12197082	7,976434959	58,1213808	0	1	0	0	0	0	1
		4	7,976434959	58,1213808	7,9752506	58,12073001	0	0	0	1	0	0	1
		5	7,974150432	58,12076749	7,975266483	58,12144168	0	0	0	2	0	0	2
		6	7,975266483	58,12144168	7,976272123	58,1221615	0	0	0	0	0	0	0
		7	7,976272123	58,1221615	7,977489264	58,12279565	1	3	0	1	0	0	5
		8	7,977489264	58,12279565	7,978736404	58,1234117	0	1	0	5	0	0	6
		9	7,978450816	58,12385281	7,976937462	58,12344634	0	1	0	1	0	0	2

	10	7,976937462	58,12344634	7,975380673	58,12307683	2	2	0	4	0	0	8
1461750	1	7,981084449	58,13065213	7,981192036	58,12976369	1	0	0	7	0	0	8
	2	7,981192036	58,12976369	7,981260861	58,12886721	1	0	0	1	0	0	2
	3	7,981260861	58,12886721	7,981192133	58,12798311	1	1	0	3	0	0	5
	4	7,981192133	58,12798311	7,981104779	58,12708663	3	2	0	1	0	0	6
	5	7,982068339	58,12650363	7,982221661	58,12740139	1	1	0	0	0	0	2
	6	7,982221661	58,12740139	7,982366562	58,12829462	3	0	0	1	0	0	4
	7	7,982366562	58,12829462	7,982418473	58,12919904	2	1	0	1	0	0	4
	8	7,98329414	58,12990241	7,983584402	58,12902139	0	0	0	2	0	0	2
	9	7,983584402	58,12902139	7,983491373	58,12812347	0	1	0	0	0	0	1
	10	7,983491373	58,12812347	7,983357958	58,12722897	1	1	0	0	0	0	2
1464975	1	7,990576145	58,1334129	7,990250726	58,13429462	0	1	0	0	0	0	1
	2	7,990250726	58,13429462	7,989670335	58,13513697	2	1	0	0	0	0	3
	3	7,989670335	58,13513697	7,989391431	58,13601682	0	1	0	0	0	0	1
	4	7,989391431	58,13601682	7,989092037	58,13689764	0	1	0	2	0	0	3
	5	7,988201375	58,13742622	7,988103095	58,13653558	3	0	0	0	0	1	4
	6	7,988103095	58,13653558	7,988144413	58,13565484	2	5	0	0	0	0	7
	7	7,988144413	58,13565484	7,988096856	58,13476335	1	1	0	1	0	0	3
	8	7,988096856	58,13476335	7,988410967	58,13388119	1	2	0	1	1	0	5
	9	7,987686233	58,13357802	7,986870612	58,13437032	0	2	0	1	0	0	3
	10	7,986870612	58,13437032	7,985842212	58,13509194	3	5	0	0	0	0	8
1468204	1	7,999201484	58,12944909	7,997625088	58,12981828	1	0	0	0	0	0	1
	2	7,997625088	58,12981828	7,996075172	58,13021563	1	0	0	0	0	0	1
	3	7,996075172	58,13021563	7,994501732	58,13057038	0	0	0	0	0	0	0
	4	7,993240388	58,13043217	7,994531805	58,12985682	1	0	0	0	0	0	1
	5	7,994696295	58,1297833	7,996257262	58,12943363	1	0	0	0	0	0	1
	6	7,996257262	58,12943363	7,997880992	58,12916313	0	0	0	0	0	0	0
	7	7,997880992	58,12916313	7,999504456	58,12890908	0	1	0	5	0	0	6

	8	8,000259376	58,12852041	7,998574918	58,12868641	0	0	0	1	0	0	1
	9	7,998574918	58,12868641	7,996891087	58,12885187	0	0	0	0	0	0	0
	10	7,996891087	58,12885187	7,995239222	58,1290918	0	0	0	0	0	0	0
1468208	1	7,996997824	58,11390883	7,99859935	58,11359245	3	1	0	0	0	0	4
	2	7,99859935	58,11359245	8,0001674	58,11324494	3	2	0	3	0	0	8
	3	8,0001674	58,11324494	8,001805441	58,11300938	1	1	0	3	1	1	7
	4	8,001805441	58,11300938	8,003492344	58,11275425	7	1	0	25	0	0	33
	5	8,003042707	58,11237146	8,001349617	58,11253518	2	1	0	0	0	0	3
	6	8,001349617	58,11253518	7,999690092	58,11273859	0	0	0	2	0	0	2
	7	7,999690092	58,11273859	7,99804624	58,1129725	0	0	0	3	0	0	3
	8	7,997458878	58,112632	7,999015795	58,11227791	0	0	0	5	0	0	5
	9	7,999015795	58,11227791	8,00063473	58,112013	1	2	0	0	0	0	3
	10	8,00063473	58,112013	8,002221198	58,11168707	0	1	0	0	0	0	1
1471432	1	8,008309298	58,12225652	8,006926381	58,12277763	0	0	0	4	0	0	4
	2	8,006926381	58,12277763	8,005492731	58,12327854	0	0	0	0	0	0	0
	3	8,005492731	58,12327854	8,004074169	58,12377878	0	0	0	0	0	0	0
	4	8,004074169	58,12377878	8,002587071	58,1242301	1	0	0	0	0	0	1
	5	8,002648107	58,12463776	8,004229311	58,12432465	0	0	0	6	0	0	6
	6	8,004229311	58,12432465	8,005827001	58,12402575	0	0	0	1	0	0	1
	7	8,005827001	58,12402575	8,007444344	58,12375418	1	0	0	0	0	0	1
	8	8,007894601	58,12395841	8,006461878	58,12445101	0	0	0	0	0	0	0
	9	8,006461878	58,12445101	8,004998447	58,12492434	0	2	0	1	0	0	3
	10	8,004998388	58,12553796	8,006410178	58,12502198	1	1	0	1	0	0	3
1474655	1	8,006235384	58,14074053	8,005998818	58,1416386	4	0	0	5	0	0	9
	2	8,005998818	58,1416386	8,005412343	58,14248703	5	4	1	13	0	0	23
	3	8,005507258	58,14260179	8,006127189	58,14344584	1	0	0	0	0	0	1
	4	8,00661285	58,14354386	8,006877902	58,1426622	5	5	1	26	0	0	37
	5	8,006877902	58,1426622	8,007428353	58,14181246	4	4	0	3	0	1	12

	6	8,007428353	58,14181246	8,007885449	58,14095207	3	1	0	4	0	1	9
	7	8,008496008	58,14109974	8,008308638	58,14199232	0	7	0	1	0	0	8
	8	8,008308638	58,14199232	8,008072006	58,14289923	4	10	0	1	0	0	15
	9	8,008487936	58,14316647	8,009614594	58,14249999	1	3	0	1	1	0	6
	10	8,009614594	58,14249999	8,010534018	58,14174208	1	0	0	1	0	0	2
1477884	1	8,016983953	58,13060897	8,017469843	58,13148038	1	2	0	4	0	0	7
	2	8,017469843	58,13148038	8,017878947	58,13235984	1	0	0	0	0	0	1
	3	8,017878947	58,13235984	8,018241088	58,13323967	0	0	0	0	1	0	1
	4	8,018241088	58,13323967	8,018529038	58,13413046	1	0	0	0	1	0	2
	5	8,019076993	58,13469945	8,019124897	58,1338014	1	0	0	0	0	0	1
	6	8,019124897	58,1338014	8,019094137	58,13290712	0	0	0	0	0	0	0
	7	8,019094137	58,13290712	8,018407709	58,13208064	1	0	0	0	0	0	1
	8	8,018407709	58,13208064	8,018411738	58,13119032	0	0	0	1	0	0	1
	9	8,017253833	58,13218115	8,016493628	58,13298853	0	1	0	0	1	0	2
	10	8,016493628	58,13298853	8,015364704	58,13367584	0	1	0	0	0	0	1
1481110	1	8,025932328	58,14071845	8,024216967	58,14072412	1	1	0	0	0	0	2
	2	8,024216967	58,14072412	8,022522011	58,14080266	5	1	0	0	0	0	6
	3	8,021474002	58,1412718	8,021988503	58,14042311	2	0	0	0	0	0	2
	4	8,021988503	58,14042311	8,022749469	58,13962023	2	2	1	1	0	1	7
	5	8,022749469	58,13962023	8,023505037	58,13881473	1	0	0	0	0	0	1
	6	8,023505037	58,13881473	8,024334347	58,13804043	1	1	0	0	0	0	2
	7	8,024252946	58,13743543	8,023376607	58,13820829	2	0	0	0	0	0	2
	8	8,023376607	58,13820829	8,022347461	58,13892196	0	0	0	0	0	0	0
	9	8,022347461	58,13892196	8,021350354	58,13965435	0	0	1	1	0	0	2
	10	8,021350354	58,13965435	8,020286185	58,14035634	0	0	0	0	1	0	1
1487564	1	8,039551848	58,13833142	8,039334827	58,13923247	1	0	0	2	0	0	3
	2	8,039334827	58,13923247	8,039167767	58,14012592	1	0	0	0	0	0	1
	3	8,039167767	58,14012592	8,039068846	58,14102058	2	3	0	1	0	0	6
	4	8,039068846	58,14102058	8,039076139	58,14193144	1	0	0	0	0	0	1

	5	8,038259836	58,14226468	8,038299904	58,14136385	3	0	0	6	0	0	9
	6	8,038299904	58,14136385	8,038139507	58,14047691	0	0	0	5	0	0	5
	7	8,038139507	58,14047691	8,038030895	58,13957966	3	3	0	11	0	0	17
	8	8,038030895	58,13957966	8,038040727	58,13868282	2	1	0	3	0	0	6
	9	8,037306406	58,13865924	8,037125606	58,13955587	2	0	0	3	0	0	5
	10	8,037125606	58,13955587	8,036960215	58,14046089	0	0	0	2	0	0	2
1487566	1	8,040493149	58,13035915	8,040437847	58,13126963	1	0	0	0	0	0	1
	2	8,040437847	58,13126963	8,040450566	58,13217706	0	0	0	0	0	0	0
	3	8,040450566	58,13217706	8,040563	58,13307452	1	0	0	1	0	0	2
	4	8,039691488	58,13376542	8,039469578	58,13287476	1	0	0	1	0	0	2
	5	8,039025561	58,13211343	8,038715656	58,13123196	1	0	0	1	0	0	2
	6	8,038715656	58,13123196	8,038413725	58,13034938	0	1	0	0	0	0	1
	7	8,036780031	58,1294757	8,036744974	58,13038505	1	0	0	0	0	0	1
	8	8,036744974	58,13038505	8,036975828	58,13127596	4	0	0	0	0	0	4
	9	8,038115659	58,13138333	8,038079908	58,13228055	2	0	0	0	0	0	2
	10	8,038079908	58,13228055	8,037953641	58,13318346	1	0	0	0	0	0	1
1490788	1	8,03997055	58,14897345	8,039849549	58,14986317	0	5	0	0	0	0	5
	2	8,039849549	58,14986317	8,039701524	58,15075303	0	1	0	0	0	0	1
	3	8,039701524	58,15075303	8,039489851	58,15165081	0	1	0	0	0	0	1
	4	8,039489851	58,15165081	8,039316893	58,15254912	0	4	0	0	0	0	4
	5	8,040216794	58,15267234	8,040668214	58,15180107	1	1	0	0	0	0	2
	6	8,040668214	58,15180107	8,041039817	58,15092811	0	4	0	0	0	0	4
	7	8,041039817	58,15092811	8,041401892	58,15004806	0	0	0	0	0	0	0
	8	8,04206386	58,14986393	8,042086802	58,15076052	0	0	2	0	0	0	2
	9	8,042086802	58,15076052	8,042067066	58,15165513	0	0	0	0	0	0	0
	10	8,042067066	58,15165513	8,042126418	58,15255499	0	0	0	0	0	0	0
1490794	1	8,050385899	58,12655197	8,048979319	58,12605131	1	0	0	0	0	0	1
	2	8,048979319	58,12605131	8,04753101	58,12557679	1	0	0	0	0	0	1

	3	8,04753101	58,12557679	8,046105621	58,12508973	0	0	0	2	0	0	2
	4	8,046105621	58,12508973	8,044672411	58,12460962	0	0	0	1	0	0	1
	5	8,042849771	58,12488102	8,044154984	58,12545885	3	2	1	14	0	0	20
	6	8,044154984	58,12545885	8,045582281	58,12595602	2	1	0	4	0	0	7
	7	8,045582281	58,12595602	8,046928355	58,12651875	2	0	0	1	0	0	3
	8	8,047457788	58,12675731	8,048877705	58,12728149	1	0	0	0	0	0	1
	9	8,048951745	58,126995	8,048000347	58,12624945	1	0	0	0	0	0	1
	10	8,048000347	58,12624945	8,046619529	58,12570957	0	0	0	0	0	0	0
1494014	1	8,045356923	58,15587061	8,046706313	58,15641865	0	0	0	0	0	0	0
	2	8,046706313	58,15641865	8,048060568	58,15696103	0	1	0	0	0	0	1
	3	8,048060568	58,15696103	8,049401885	58,15751661	0	3	0	0	0	0	3
	4	8,049401885	58,15751661	8,050845851	58,15798865	0	0	0	0	0	0	0
	5	8,051105115	58,15869703	8,049557139	58,15831838	3	0	0	0	0	0	3
	6	8,049557139	58,15831838	8,048014833	58,15794246	2	0	0	1	0	0	3
	7	8,048014833	58,15794246	8,046527471	58,15749644	0	0	0	0	0	0	0
	8	8,046527471	58,15749644	8,045165936	58,15695125	0	2	0	0	0	0	2
	9	8,044707174	58,15723957	8,046150762	58,15772111	4	5	1	0	0	0	10
	10	8,046150762	58,15772111	8,047457718	58,1583027	2	0	0	0	0	0	2
1494023	1	8,052597844	58,11773896	8,052237096	58,11861767	1	1	0	0	0	0	2
	2	8,052237096	58,11861767	8,052109295	58,11952093	0	1	0	1	0	0	2
	3	8,052109295	58,11952093	8,052313263	58,12040631	0	0	0	1	0	0	1
	4	8,052313263	58,12040631	8,052350983	58,12131185	1	0	0	6	0	0	7
	5	8,053095572	58,1214408	8,053158463	58,12054437	1	0	0	2	0	0	3
	6	8,053158463	58,12054437	8,053317717	58,11965251	2	0	0	1	0	0	3
	7	8,053317717	58,11965251	8,053229823	58,1187517	0	2	0	1	0	0	3
	8	8,053779647	58,11840584	8,053897613	58,11931193	2	2	0	2	0	0	6
	9	8,053897613	58,11931193	8,054010903	58,12021279	0	1	0	5	0	0	6
	10	8,054010903	58,12021279	8,053958816	58,12111943	3	0	0	1	0	0	4

	1497247	1	8,055265663	58,1306235	8,056970663	58,13056956	0	0	0	0	0	0	0
		2	8,056970663	58,13056956	8,058583384	58,13029813	1	0	0	0	0	0	1
		3	8,058583384	58,13029813	8,060265762	58,13015262	1	0	0	0	0	0	1
		4	8,060265762	58,13015262	8,061973128	58,13006433	1	0	0	0	0	0	1
		5	8,062835579	58,12963383	8,06114727	58,12961435	1	0	0	0	0	0	1
		6	8,06114727	58,12961435	8,059442753	58,12961332	0	0	0	0	0	0	0
		7	8,059442753	58,12961332	8,057714344	58,12966436	0	0	0	0	0	0	0
		8	8,056704935	58,12931039	8,058389704	58,12919058	0	0	0	0	0	0	0
		9	8,058389704	58,12919058	8,060086089	58,12915601	1	0	0	0	0	0	1
		10	8,060086089	58,12915601	8,061806648	58,12916996	1	0	0	0	0	0	1
	1497251	1	8,060367345	58,11567679	8,06078196	58,1148024	2	3	0	2	0	0	7
		2	8,06078196	58,1148024	8,061335946	58,11395667	0	0	0	0	0	0	0
		3	8,061335946	58,11395667	8,061513191	58,1130604	5	0	0	1	0	0	6
		4	8,061513191	58,1130604	8,062067927	58,11219475	1	0	0	1	0	0	2
		5	8,065791919	58,1121718	8,065097978	58,11300193	0	1	0	0	0	0	1
		6	8,065097978	58,11300193	8,064603929	58,11387021	0	0	0	0	0	0	0
		7	8,064603929	58,11387021	8,064074343	58,11472572	0	0	0	0	0	0	0
		8	8,064074343	58,11472572	8,063563557	58,11558441	0	0	0	0	0	0	0
		9	8,064452013	58,11577971	8,065206468	58,11497734	0	0	1	1	0	0	2
		10	8,065206468	58,11497734	8,065842375	58,11413705	0	0	0	1	0	0	1
Galtesund	1842480	1	8,764805624	58,40765672	8,764601943	58,40855051	0	0	0	0	0	0	0
		2	8,764601943	58,40855051	8,764448854	58,40944467	0	0	0	0	0	0	0
		3	8,764448854	58,40944467	8,764359308	58,41034552	0	0	0	1	0	0	1
		4	8,764359308	58,41034552	8,764306208	58,41124964	0	0	0	0	0	0	0
		5	8,763481514	58,41101629	8,763240888	58,41012541	3	0	0	6	0	0	9
		6	8,763240888	58,41012541	8,762894187	58,40925475	5	0	0	0	0	0	5
		7	8,762894187	58,40925475	8,762470417	58,40838281	0	0	0	1	0	0	1
		8	8,761581457	58,40810644	8,761434782	58,40900272	0	0	0	0	0	0	0

	9	8,761434782	58,40900272	8,761335361	58,40990022	1	0	0	0	0	0	1
	10	8,761335361	58,40990022	8,761088429	58,41078954	0	0	0	2	0	0	2
1848933	1	8,77249214	58,41499849	8,774175193	58,41516438	0	0	0	0	0	0	0
	2	8,774175193	58,41516438	8,775802282	58,41540987	0	0	0	0	0	0	0
	3	8,775802282	58,41540987	8,777315089	58,415845	0	0	0	0	0	0	0
	4	8,77899383	58,4152225	8,777463671	58,41481482	0	0	0	0	0	0	0
	5	8,777463671	58,41481482	8,775889018	58,41446541	1	0	0	0	0	0	1
	6	8,775889018	58,41446541	8,774191948	58,414314	0	0	0	0	0	0	0
	7	8,774191948	58,414314	8,772472922	58,41419602	0	1	0	0	0	0	1
	8	8,772615863	58,4135975	8,774187422	58,41395661	0	0	0	0	0	0	0
	9	8,774187422	58,41395661	8,775847382	58,41418658	0	0	0	0	0	0	0
	10	8,775847382	58,41418658	8,777516965	58,41439489	0	0	0	0	0	0	0
1852150	1	8,775317147	58,45318763	8,774925896	58,45406111	4	4	0	3	0	0	11
	2	8,774925896	58,45406111	8,774796423	58,454959	1	1	0	0	0	0	2
	3	8,774796423	58,454959	8,774677928	58,45584893	2	4	1	0	0	0	7
	4	8,774677928	58,45584893	8,774644291	58,45675434	2	7	0	26	0	0	35
	5	8,775408306	58,45693532	8,775577474	58,45605101	1	0	0	0	0	0	1
	6	8,775577474	58,45605101	8,77552841	58,45515034	0	4	0	0	0	0	4
	7	8,77552841	58,45515034	8,775947303	58,45428692	1	3	0	0	0	0	4
	8	8,777301177	58,45361961	8,776847344	58,45448693	2	2	0	0	0	0	4
	9	8,776847344	58,45448693	8,776700632	58,45537893	0	2	0	0	0	0	2
	10	8,776700632	58,45537893	8,776750682	58,45628016	1	2	0	0	0	0	3
1852157	1	8,779898606	58,42344507	8,779710929	58,42432839	3	0	1	0	0	0	4
	2	8,779710929	58,42432839	8,77921087	58,42517795	1	0	0	1	0	0	2
	3	8,77921087	58,42517795	8,778671158	58,42604251	0	0	0	0	0	0	0
	4	8,778671158	58,42604251	8,7783733	58,42694052	1	0	0	0	0	0	1
	5	8,779356688	58,42745345	8,780003453	58,42662975	0	0	0	0	0	0	0
	6	8,780003453	58,42662975	8,780506528	58,42578293	1	1	0	0	1	0	3

	7	8,780506528	58,42578293	8,780882347	58,42490919	0	0	0	0	0	0	0
	8	8,782044306	58,42466869	8,782020003	58,42557619	1	0	2	0	0	0	3
	9	8,782020003	58,42557619	8,781861264	58,42648795	0	0	0	0	0	0	0
	10	8,781861264	58,42648795	8,781848866	58,42739925	1	0	0	1	0	0	2
1855376	1	8,779236762	58,45993496	8,780816186	58,46027901	3	3	1	0	0	0	7
	2	8,780816186	58,46027901	8,782371343	58,46067224	4	2	0	3	0	0	9
	3	8,782371343	58,46067224	8,784088071	58,46080207	0	6	0	5	0	0	11
	4	8,785299024	58,46128745	8,783621014	58,46111381	1	4	0	0	0	0	5
	5	8,783621014	58,46111381	8,781911866	58,46099214	0	13	0	3	0	1	17
	6	8,781911866	58,46099214	8,780205146	58,46088973	3	8	0	0	0	0	11
	7	8,780205146	58,46088973	8,77851364	58,4607325	2	0	0	0	0	0	2
	8	8,777633128	58,46101489	8,779285203	58,46124669	2	0	1	2	0	0	5
	9	8,78383626	58,46152719	8,785359659	58,46196009	0	1	2	0	0	0	3
	10	8,784499292	58,46058683	8,782833098	58,46037059	3	5	1	4	0	0	13
1855381	1	8,784928666	58,43861589	8,784809953	58,43951395	4	0	0	12	0	0	16
	2	8,784809953	58,43951395	8,784554064	58,44040424	1	0	0	1	0	0	2
	3	8,784554064	58,44040424	8,784451339	58,44130422	2	3	0	2	0	1	8
	4	8,784451339	58,44130422	8,784208444	58,44219483	3	1	1	1	1	0	7
	5	8,783239275	58,4425171	8,783440711	58,44162364	1	0	0	1	0	0	2
	6	8,783440711	58,44162364	8,783698921	58,44073245	3	1	0	0	0	0	4
	7	8,783698921	58,44073245	8,783919574	58,43983829	7	4	0	14	0	1	26
	8	8,783919574	58,43983829	8,784156959	58,43895647	2	2	0	15	0	0	19
	9	8,7832393	58,43876297	8,782637998	58,43960365	5	3	0	8	0	0	16
	10	8,782637998	58,43960365	8,782515197	58,44049913	4	6	0	4	0	0	14
1855383	1	8,784777188	58,42995306	8,784561556	58,43085485	2	2	0	2	0	0	6
	2	8,784561556	58,43085485	8,784048367	58,43172431	0	1	0	0	0	0	1
	3	8,784048367	58,43172431	8,783929612	58,43261828	1	0	0	1	0	0	2
	4	8,783929612	58,43261828	8,783898564	58,43352392	1	0	0	0	0	0	1

	5	8,784793127	58,43412967	8,784962961	58,43322543	1	2	0	1	0	0	4
	6	8,784962961	58,43322543	8,784838417	58,43233152	4	1	0	2	0	0	7
	7	8,784838417	58,43233152	8,785133414	58,43145647	2	0	0	0	0	0	2
	8	8,785133414	58,43145647	8,788542688	58,43179301	1	0	0	0	0	0	1
	9	8,787515314	58,43006563	8,787976718	58,43093633	4	2	0	0	0	0	6
	10	8,787976718	58,43093633	8,788542688	58,43179301	3	0	0	0	0	0	3
1855386	1	8,785356673	58,4188058	8,786951477	58,41915414	0	0	0	0	0	0	0
	2	8,786951477	58,41915414	8,788026756	58,41986001	1	0	0	0	0	0	1
	3	8,788026756	58,41986001	8,789095044	58,42057142	0	0	0	0	0	0	0
	4	8,789095044	58,42057142	8,790327632	58,42121996	1	1	0	0	0	0	2
	5	8,79107984	58,42103503	8,789902678	58,42038611	0	0	0	0	0	0	0
	6	8,789902678	58,42038611	8,789232613	58,41956542	0	0	0	0	0	0	0
	7	8,789232613	58,41956542	8,788039567	58,41890727	0	0	0	0	0	0	0
	8	8,78763907	58,41802499	8,788992543	58,41859188	1	0	0	0	0	0	1
	9	8,788992543	58,41859188	8,790066352	58,41928703	0	0	0	0	0	0	0
	10	8,790066352	58,41928703	8,791134021	58,41999707	0	0	0	0	0	0	0
1861837	1	8,798699776	58,43070272	8,799175042	58,43157082	4	3	0	1	0	0	8
	2	8,799175042	58,43157082	8,799059204	58,43247401	2	6	0	4	0	1	13
	3	8,799059204	58,43247401	8,798972015	58,43337341	1	0	0	0	0	0	1
	4	8,798972015	58,43337341	8,798802614	58,43427362	0	0	0	1	0	0	1
	5	8,800163335	58,43465176	8,800587758	58,43378398	2	0	0	1	0	1	4
	6	8,800587758	58,43378398	8,801105378	58,43294251	1	0	1	0	0	0	2
	7	8,801105378	58,43294251	8,801429455	58,43205397	0	3	0	0	0	0	3
	8	8,802459701	58,43156893	8,802290605	58,43247191	3	2	0	0	0	0	5
	9	8,802290605	58,43247191	8,802182729	58,43340124	0	1	0	0	0	0	1
	10	8,802182729	58,43340124	8,802075814	58,43430483	2	1	0	0	0	0	3
1861841	1	8,799741954	58,41588478	8,801359617	58,41619071	1	0	0	0	0	0	1
	2	8,801359617	58,41619071	8,802910802	58,41659298	1	0	1	0	0	0	2

	3	8,802910802	58,41659298	8,804653	58,41702913	0	0	0	0	0	0	0
	4	8,804653	58,41702913	8,806084423	58,4172967	0	0	0	0	0	0	0
	5	8,806640894	58,41713449	8,805051656	58,41678248	0	0	0	0	0	0	0
	6	8,805051656	58,41678248	8,80360791	58,41629545	1	0	0	0	0	0	1
	7	8,80360791	58,41629545	8,80216	58,41581	0	0	0	0	0	0	0
	8	8,80216	58,41581	8,800674339	58,41536659	0	0	0	0	0	0	0
	9	8,801553817	58,4150326	8,80309	58,41553	0	0	0	0	0	0	0
	10	8,80309	58,41553	8,804534737	58,41594124	0	0	0	0	0	0	0
1868292	1	8,818227694	58,42730944	8,818012316	58,42820479	5	2	0	10	0	0	17
	2	8,818012316	58,42820479	8,817992781	58,42910371	0	2	0	0	0	0	2
	3	8,817992781	58,42910371	8,817909043	58,43000367	1	0	0	0	0	0	1
	4	8,817909043	58,43000367	8,817751308	58,43090022	0	0	0	0	0	0	0
	5	8,817167899	58,4311266	8,817240563	58,43022985	0	0	0	0	0	0	0
	6	8,817240563	58,43022985	8,817388555	58,42932852	0	0	0	0	0	0	0
	7	8,817388555	58,42932852	8,817381575	58,42843435	1	1	0	1	0	0	3
	8	8,817381575	58,42843435	8,817386235	58,42753412	2	1	0	0	0	0	3
	9	8,816289478	58,42718482	8,815589455	58,42800618	0	1	0	0	0	0	1
	10	8,815589455	58,42800618	8,814969551	58,42885067	0	0	0	0	0	0	0
1868294	1	8,813862142	58,41979536	8,81522159	58,42035074	0	0	0	0	0	0	0
	2	8,81522159	58,42035074	8,816581631	58,42089244	0	0	0	0	0	0	0
	3	8,819509946	58,42099533	8,818113435	58,42048181	1	0	0	0	0	0	1
	4	8,818113435	58,42048181	8,816679205	58,42001054	1	0	0	0	0	0	1
	5	8,816679205	58,42001054	8,815183489	58,41957181	0	0	0	0	0	0	0
	6	8,814763733	58,41875157	8,816197603	58,41925441	0	0	0	0	0	0	0
	7	8,816197603	58,41925441	8,817523253	58,41982389	0	0	0	0	0	0	0
	8	8,817523253	58,41982389	8,818891097	58,42036588	2	0	0	0	0	0	2
	9	8,818891097	58,42036588	8,820280824	58,42091187	1	0	0	0	0	0	1
	10	8,821078529	58,42088123	8,819865378	58,42024383	0	0	0	0	0	0	0

	1874747	1	8,827550828	58,42446333	8,829232923	58,42469383	0	0	0	0	0	0	0
		2	8,829232923	58,42469383	8,830922142	58,42484663	0	0	0	0	0	0	0
		3	8,830922142	58,42484663	8,832627366	58,42493816	0	0	0	0	0	0	0
		4	8,834498855	58,42593287	8,833164703	58,4256754	1	0	0	0	0	0	1
		5	8,833164703	58,4256754	8,831426306	58,42561374	1	1	0	0	0	0	2
		6	8,831426306	58,42561374	8,829712922	58,4255927	1	0	0	1	0	0	2
		7	8,829712922	58,4255927	8,827997493	58,42564732	0	1	0	0	0	0	1
		8	8,827759835	58,42651236	8,82945617	58,42638569	0	1	0	1	0	0	2
		9	8,82945617	58,42638569	8,831153205	58,4262318	0	1	0	0	0	0	1
		10	8,831153205	58,4262318	8,832868586	58,42616696	0	0	0	0	0	0	0
	1874749	1	8,829966813	58,41551856	8,829586061	58,41637851	0	0	0	0	0	0	0
		2	8,829586061	58,41637851	8,829127825	58,41724729	0	0	0	0	0	0	0
		3	8,829127825	58,41724729	8,828819783	58,41813943	0	0	0	0	0	0	0
		4	8,82999883	58,41910185	8,830790992	58,41830363	0	0	0	0	0	0	0
		5	8,830790992	58,41830363	8,831971359	58,41764965	1	0	0	0	0	0	1
		6	8,833734762	58,41715651	8,83396185	58,41626696	0	0	0	0	0	0	0
		7	8,835940321	58,41711235	8,834753163	58,41775943	0	0	0	0	0	0	0
		8	8,834753163	58,41775943	8,83383788	58,41852634	0	0	0	0	0	0	0
		9	8,83383788	58,41852634	8,832977543	58,41931493	0	0	0	0	0	0	0
		10	8,832267578	58,41920223	8,832942613	58,41836944	1	0	0	0	0	0	1
	1881200	1	8,846102516	58,42870164	8,846077334	58,42960264	0	0	0	0	0	0	0
		2	8,846077334	58,42960264	8,845812115	58,43049057	0	0	0	0	0	0	0
		3	8,845812115	58,43049057	8,845574729	58,43138584	0	0	0	0	0	0	0
		4	8,845574729	58,43138584	8,845393048	58,43229032	0	0	0	0	0	0	0
		5	8,844762904	58,43217863	8,844678332	58,43127878	0	0	0	0	0	0	0
		6	8,844678332	58,43127878	8,844557041	58,43038134	1	0	0	0	0	0	1
		7	8,844557041	58,43038134	8,844485168	58,42948511	0	0	0	0	0	0	0
		8	8,844485168	58,42948511	8,844292018	58,42858875	0	0	0	0	0	0	0

		9	8,842956898	58,42857557	8,842413015	58,42942809	0	0	0	0	1	0	1
		10	8,842413015	58,42942809	8,841878218	58,43028377	0	0	0	1	0	0	1
	1881202	1	8,843178078	58,41989311	8,843394476	58,4207919	0	0	0	0	0	0	0
		2	8,843394476	58,4207919	8,843403502	58,42168194	0	0	0	0	0	0	0
		3	8,843403502	58,42168194	8,843430201	58,42257878	1	0	0	0	0	0	1
		4	8,843430201	58,42257878	8,843312518	58,42347689	0	0	0	0	0	0	0
		5	8,843765898	58,42398427	8,84405113	58,42310876	0	0	0	0	0	0	0
		6	8,84405113	58,42310876	8,844425444	58,42222823	1	0	0	0	0	0	1
		7	8,844425444	58,42222823	8,84480772	58,42135095	0	0	0	0	0	0	0
		8	8,84480772	58,42135095	8,845185946	58,42047157	0	0	0	0	0	0	0
		9	8,845972809	58,42002726	8,846216308	58,42092239	0	0	0	0	0	0	0
		10	8,846216308	58,42092239	8,84607943	58,4218195	0	0	0	0	0	0	0
Tromlingene	1907011	1	8,899906496	58,45536396	8,898378553	58,45495423	0	0	0	0	0	0	0
		2	8,898378553	58,45495423	8,896997654	58,45440847	0	1	0	0	0	0	1
		3	8,896997654	58,45440847	8,895748514	58,45378811	0	0	0	0	0	0	0
		4	8,895748514	58,45378811	8,894242698	58,45334684	0	0	0	0	0	0	0
		5	8,893908397	58,45371618	8,895178496	58,45432367	0	1	0	0	0	0	1
		6	8,895178496	58,45432367	8,89661533	58,45481647	1	0	0	0	0	0	1
		7	8,89661533	58,45481647	8,89813671	58,4552703	0	0	0	0	0	0	0
		8	8,898023653	58,4560442	8,89661338	58,45552786	0	0	0	0	0	0	0
		9	8,89661338	58,45552786	8,895041102	58,45514717	0	0	0	0	0	0	0
		10	8,895041102	58,45514717	8,893483399	58,45477472	0	0	0	0	0	0	0
	1907013	1	8,893620265	58,44533362	8,894970808	58,44589726	0	0	0	0	0	0	0
		2	8,894970808	58,44589726	8,896286493	58,44646851	0	0	0	0	0	0	0
		3	8,896286493	58,44646851	8,897526537	58,44709079	0	0	0	0	0	0	0
		4	8,897526537	58,44709079	8,898776924	58,44772389	0	0	0	0	0	0	0
		5	8,899459147	58,44694295	8,898212403	58,44631695	0	0	0	0	0	0	0
		6	8,898212403	58,44631695	8,896778859	58,44583543	0	0	0	0	0	0	0

	7	8,896778859	58,44583543	8,89543635	58,44530896	0	0	0	0	0	0	0
	8	8,895107494	58,44444833	8,896579477	58,44491564	0	0	0	0	0	0	0
	9	8,896579477	58,44491564	8,89801884	58,44540878	0	0	0	0	0	0	0
	10	8,89801884	58,44540878	8,89946068	58,44593095	0	1	0	0	0	0	1
1910235	1	8,905816209	58,46570714	8,904167095	58,46544834	0	0	0	0	0	0	0
	2	8,904167095	58,46544834	8,902824683	58,46489306	1	0	0	0	0	0	1
	3	8,902824683	58,46489306	8,901288957	58,46450152	0	0	0	0	0	0	0
	4	8,901288957	58,46450152	8,899654462	58,46416662	0	0	0	0	0	0	0
	5	8,899089467	58,46479538	8,900568209	58,46530135	0	0	0	0	0	0	0
	6	8,900568209	58,46530135	8,901991514	58,46582926	0	0	0	0	0	0	0
	7	8,901991514	58,46582926	8,903582111	58,46617533	1	0	0	0	0	0	1
	8	8,903511935	58,46649451	8,901931296	58,46616256	0	0	0	0	0	0	0
	9	8,901931296	58,46616256	8,900419794	58,46575335	0	0	0	0	0	0	0
	10	8,900419794	58,46575335	8,898902399	58,46534351	0	0	0	0	0	0	0
1913464	1	8,913133931	58,46032512	8,911847861	58,45972593	0	0	0	0	0	0	0
	2	8,911847861	58,45972593	8,910601988	58,45911344	0	0	0	0	0	0	0
	3	8,910601988	58,45911344	8,909332396	58,45850469	0	0	0	0	0	0	0
	4	8,909332396	58,45850469	8,908148722	58,45782991	1	0	0	0	0	0	1
	5	8,907478177	58,45821006	8,9087208	58,45882643	0	0	0	0	0	0	0
	6	8,9087208	58,45882643	8,909938319	58,45945876	0	0	0	0	0	0	0
	7	8,909938319	58,45945876	8,91125839	58,46004856	0	0	0	0	0	0	0
	8	8,911820195	58,46108384	8,910452093	58,46053927	1	0	0	0	0	0	1
	9	8,910452093	58,46053927	8,909195699	58,45992411	0	0	0	0	0	0	0
	10	8,909195699	58,45992411	8,908140431	58,45940632	0	0	0	0	0	0	0
1913466	1	8,912453475	58,45297789	8,911251434	58,45234623	0	0	0	0	0	0	0
	2	8,911251434	58,45234623	8,910050631	58,45169614	0	0	0	0	0	0	0
	3	8,910050631	58,45169614	8,908857138	58,45103898	0	0	0	0	0	0	0
	4	8,908857138	58,45103898	8,907633949	58,45040677	0	0	0	0	0	0	0

	5	8,907924187	58,4495557	8,909270498	58,45011793	1	0	0	0	0	0	1
	6	8,909270498	58,45011793	8,910406331	58,45078816	3	0	0	0	0	0	3
	7	8,910406331	58,45078816	8,911470092	58,45149159	0	0	0	0	1	0	1
	8	8,91273663	58,4514198	8,911751569	58,45067761	0	0	0	0	0	0	0
	9	8,911751569	58,45067761	8,910459977	58,450073	0	0	0	0	0	0	0
	10	8,910459977	58,450073	8,909181163	58,44948671	0	0	0	0	0	0	0
1913468	1	8,908396903	58,4417514	8,909836283	58,44225238	0	0	0	0	0	0	0
	2	8,909836283	58,44225238	8,911087028	58,44287214	0	0	0	0	0	0	0
	3	8,911087028	58,44287214	8,912298328	58,44351375	0	0	0	0	0	0	0
	4	8,912298328	58,44351375	8,913442662	58,44419552	0	0	0	0	0	0	0
	5	8,914789638	58,44403762	8,913882413	58,44328667	0	0	0	0	0	0	0
	6	8,913882413	58,44328667	8,912705982	58,44263227	0	0	0	0	0	0	0
	7	8,912705982	58,44263227	8,911519182	58,44199078	0	0	0	0	0	0	0
	8	8,911519182	58,44199078	8,910296504	58,44134286	0	0	0	0	0	0	0
	9	8,911048925	58,44076309	8,912445689	58,44129684	0	0	0	0	0	0	0
	10	8,912445689	58,44129684	8,913794782	58,44188998	0	0	0	0	0	0	0
1916689	1	8,910952792	58,465957	8,912635066	58,46619309	0	0	0	0	0	0	0
	2	8,912635066	58,46619309	8,914229566	58,46654178	0	0	0	0	0	0	0
	3	8,914229566	58,46654178	8,915685655	58,46700762	0	0	0	0	0	0	0
	4	8,915685655	58,46700762	8,917139847	58,46748768	0	0	0	0	0	0	0
	5	8,917494955	58,46695439	8,916113043	58,4664332	0	0	0	0	0	0	0
	6	8,916113043	58,4664332	8,914777322	58,46587416	0	0	0	0	0	0	0
	7	8,914777322	58,46587416	8,913216045	58,4655136	0	0	0	0	0	0	0
	8	8,912883926	58,46478464	8,91426435	58,46532889	1	0	0	0	0	0	1
	9	8,91426435	58,46532889	8,915859429	58,46565462	0	0	0	0	0	0	0
	10	8,915859429	58,46565462	8,917459984	58,46599005	0	0	0	0	0	0	0
1919915	1	8,924691759	58,47383942	8,923144958	58,47340915	0	0	0	0	0	0	0
	2	8,923144958	58,47340915	8,921943124	58,47275477	0	0	0	0	0	0	0

		3	8,921943124	58,47275477	8,920710441	58,47212363	0	0	0	0	0	0	0
		4	8,920710441	58,47212363	8,919402472	58,47146984	0	0	0	0	0	0	0
		5	8,918135109	58,4715923	8,919328659	58,47225212	0	0	0	0	0	0	0
		6	8,919328659	58,47225212	8,920513677	58,47290649	0	0	0	0	0	0	0
		7	8,920513677	58,47290649	8,921675974	58,47358243	0	0	0	0	0	0	0
		8	8,921170577	58,47418881	8,919870129	58,47359812	0	0	0	0	0	0	0
		9	8,919870129	58,47359812	8,918618336	58,47298933	0	0	0	0	0	0	0
		10	8,918618336	58,47298933	8,917417526	58,47233521	1	0	0	0	0	0	1
	1919919	1	8,927846074	58,45642989	8,926620804	58,45582761	0	0	0	0	0	0	0
		2	8,926620804	58,45582761	8,925342099	58,45521556	1	0	0	0	0	0	1
		3	8,925342099	58,45521556	8,924070363	58,45459464	0	0	0	0	0	0	0
		4	8,924070363	58,45459464	8,922860671	58,4539637	0	0	0	0	0	0	0
		5	8,921725944	58,45408587	8,922965707	58,45470205	0	0	0	0	0	0	0
		6	8,922965707	58,45470205	8,924107065	58,45538311	1	0	0	0	0	0	1
		7	8,924107065	58,45538311	8,92540008	58,45598776	0	0	0	0	0	0	0
		8	8,925583339	58,45687006	8,924204883	58,45631262	1	0	0	0	1	0	2
		9	8,924204883	58,45631262	8,92295258	58,45569793	0	0	0	0	0	0	0
		10	8,92295258	58,45569793	8,921678535	58,45512462	0	0	0	0	0	0	0
	1919921	1	8,923611672	58,44527729	8,925134185	58,44569176	0	0	0	0	0	0	0
		2	8,925134185	58,44569176	8,926621609	58,44615828	0	0	0	0	0	0	0
		3	8,926621609	58,44615828	8,927880863	58,44678292	0	0	0	0	0	0	0
		4	8,927880863	58,44678292	8,928850455	58,44754542	0	0	0	0	0	0	0
		5	8,928253897	58,44836173	8,926733399	58,44789398	0	0	0	0	0	0	0
		6	8,926733399	58,44789398	8,925339751	58,44736234	0	0	0	0	0	0	0
		7	8,925339751	58,44736234	8,92389553	58,4468656	0	0	0	0	0	0	0
		8	8,92389553	58,4468656	8,922483097	58,44636811	0	0	0	0	0	0	0
		9	8,921849364	58,44691005	8,923223778	58,44745427	0	0	0	0	0	0	0
		10	8,923223778	58,44745427	8,924583263	58,4480133	0	0	0	0	0	0	0

	1923140	1	8,928908196	58,48186169	8,927562093	58,48130619	1	0	0	0	0	0	1
		2	8,927562093	58,48130619	8,92632624	58,48068708	3	0	0	0	0	0	3
		3	8,92632624	58,48068708	8,925250865	58,47998053	0	0	0	0	0	0	0
		4	8,925250865	58,47998053	8,924310195	58,47924869	1	0	0	0	0	0	1
		5	8,924006471	58,47876718	8,925297339	58,47934038	2	0	0	0	0	0	2
		6	8,925297339	58,47934038	8,926597126	58,47990032	0	0	0	0	0	0	0
		7	8,926597126	58,47990032	8,92786809	58,48053683	1	1	0	0	0	0	2
		8	8,92786809	58,48053683	8,929068114	58,48119492	0	0	0	0	0	0	0
		9	8,930070441	58,48104987	8,928904168	58,48039162	1	0	0	0	0	0	1
		10	8,928904168	58,48039162	8,927726088	58,47974248	1	0	0	0	0	0	1
	1923143	1	8,930145724	58,46894977	8,929054606	58,46825861	0	0	0	0	0	0	0
		2	8,929054606	58,46825861	8,927796022	58,46764967	0	0	0	0	0	0	0
		3	8,927796022	58,46764967	8,926437645	58,46707579	1	0	0	0	0	0	1
		4	8,926437645	58,46707579	8,925137791	58,46649739	0	0	0	0	0	0	0
		5	8,925708747	58,46598802	8,927182659	58,46645182	2	0	0	0	0	0	2
		6	8,927182659	58,46645182	8,928666003	58,46689065	0	0	0	0	0	0	0
		7	8,928666003	58,46689065	8,930199043	58,46732081	0	0	0	0	1	0	1
		8	8,931399948	58,46696612	8,930417114	58,46622218	0	0	0	0	0	0	0
		9	8,930417114	58,46622218	8,92929911	58,4655406	0	0	0	0	0	0	0
		10	8,92929911	58,4655406	8,928207239	58,46484135	0	0	0	0	0	0	0
	1926366	1	8,930827024	58,48666398	8,932167062	58,48724184	0	0	0	0	0	0	0
		2	8,932167062	58,48724184	8,933618561	58,48776576	0	0	0	0	0	0	0
		3	8,935681973	58,48803181	8,934348852	58,48745922	0	0	0	0	0	0	0
		4	8,934348852	58,48745922	8,932627234	58,48649011	1	0	0	0	0	0	1
		5	8,932627234	58,48649011	8,931663533	58,4857386	0	0	0	0	0	0	0
		6	8,931663533	58,4857386	8,930651675	58,48500745	0	0	0	0	0	0	0
		7	8,930872222	58,48435598	8,932445312	58,48474768	0	0	0	0	0	0	0
		8	8,932445312	58,48474768	8,933851413	58,4852563	0	0	0	0	0	0	0

	9	8,933851413	58,4852563	8,935263711	58,48575536	0	0	0	0	0	0	0
	10	8,935263711	58,48575536	8,936520648	58,48637604	0	0	0	0	0	0	0
1926369	1	8,936597574	58,47552048	8,935521516	58,47482307	1	0	0	0	0	0	1
	2	8,935521516	58,47482307	8,934246645	58,47422134	2	1	0	0	0	0	3
	3	8,934246645	58,47422134	8,932935509	58,47363553	0	0	0	0	0	0	0
	4	8,932935509	58,47363553	8,931603522	58,47308258	1	0	0	0	0	0	1
	5	8,932208416	58,47253917	8,933657685	58,47301574	0	0	0	0	0	0	0
	6	8,933657685	58,47301574	8,935055517	58,47354278	2	0	0	0	0	0	2
	7	8,935055517	58,47354278	8,93646596	58,47404923	0	0	0	0	0	0	0
	8	8,938349187	58,47402902	8,937303585	58,47331471	1	0	0	0	0	0	1
	9	8,937303585	58,47331471	8,936185915	58,47263885	0	0	0	0	0	0	0
	10	8,936185915	58,47263885	8,93498617	58,4719991	0	1	0	0	0	0	1
1926372	1	8,932982209	58,46053791	8,93441865	58,46102646	0	0	0	0	0	0	0
	2	8,93441865	58,46102646	8,935925649	58,46148151	0	0	0	0	0	0	0
	3	8,935925649	58,46148151	8,937396568	58,46195004	0	0	0	0	0	0	0
	4	8,937396568	58,46195004	8,93885192	58,46244357	0	0	0	0	0	0	0
	5	8,940261348	58,46213663	8,938971903	58,46152928	0	0	0	0	0	0	0
	6	8,938971903	58,46152928	8,937641173	58,46096508	0	0	0	0	0	0	0
	7	8,937641173	58,46096508	8,936285582	58,46042986	0	0	0	0	0	0	0
	8	8,934879506	58,4591364	8,936483755	58,45945972	0	0	0	0	0	0	0
	9	8,936483755	58,45945972	8,937994941	58,45987896	0	0	0	0	0	0	0
	10	8,937994941	58,45987896	8,939489161	58,46031884	0	0	0	0	0	0	0
1926374	1	8,940405994	58,45415818	8,939089953	58,4535806	0	0	1	0	0	0	1
	2	8,939089953	58,4535806	8,937872732	58,45294749	0	0	0	0	0	0	0
	3	8,937872732	58,45294749	8,936639436	58,452312	0	0	0	0	0	0	0
	4	8,936639436	58,452312	8,93528778	58,45173624	0	0	0	0	0	0	0
	5	8,935557608	58,45123107	8,936926731	58,4517655	0	0	0	0	0	0	0
	6	8,936926731	58,4517655	8,938005629	58,45247058	0	0	0	0	0	0	0

		7	8,938005629	58,45247058	8,939107453	58,45317084	1	0	0	0	0	0	1
		8	8,941084173	58,45289945	8,940083903	58,45216119	0	0	0	0	0	0	0
		9	8,940083903	58,45216119	8,938774335	58,45156301	0	0	0	0	0	0	0
		10	8,938774335	58,45156301	8,937499763	58,45096527	0	0	0	0	0	0	0
	1929594	1	8,943452536	58,48198211	8,942179636	58,48138074	1	0	0	0	0	0	1
		2	8,942179636	58,48138074	8,94076155	58,48087175	0	0	0	0	0	0	0
		3	8,94076155	58,48087175	8,939256909	58,48043135	0	0	0	0	0	0	0
		4	8,939256909	58,48043135	8,937867669	58,47991722	0	0	0	0	0	0	0
		5	8,938242618	58,47946139	8,939869288	58,47972731	0	0	0	0	0	0	0
		6	8,939869288	58,47972731	8,941238913	58,48026273	0	0	0	0	0	0	0
		7	8,941238913	58,48026273	8,94247192	58,48088584	0	0	0	0	0	0	0
		8	8,94359391	58,48064521	8,942503348	58,4799435	0	0	0	0	0	0	0
		9	8,942503348	58,4799435	8,941177242	58,47938439	2	0	0	0	0	0	2
		10	8,941177242	58,47938439	8,939894116	58,47878453	0	0	0	0	0	0	0
	1929597	1	8,945550482	58,4691301	8,944638988	58,46837976	0	0	0	0	0	0	0
		2	8,944638988	58,46837976	8,943617599	58,46768523	0	0	0	0	0	0	0
		3	8,943617599	58,46768523	8,942512737	58,46698985	0	0	0	0	0	0	0
		4	8,942512737	58,46698985	8,941417928	58,46629531	0	0	0	0	0	0	0
		5	8,941776748	58,4656199	8,942938771	58,46629352	0	0	0	0	0	0	0
		6	8,942938771	58,46629352	8,944048105	58,46699209	0	0	0	0	0	0	0
		7	8,944048105	58,46699209	8,945316446	58,46758713	0	0	0	0	0	0	0
		8	8,947427912	58,46780616	8,946743136	58,46698216	0	0	0	0	0	0	0
		9	8,946743136	58,46698216	8,945566436	58,46633841	0	1	0	0	1	0	2
		10	8,945566436	58,46633841	8,944362499	58,46574381	0	0	0	0	0	0	0

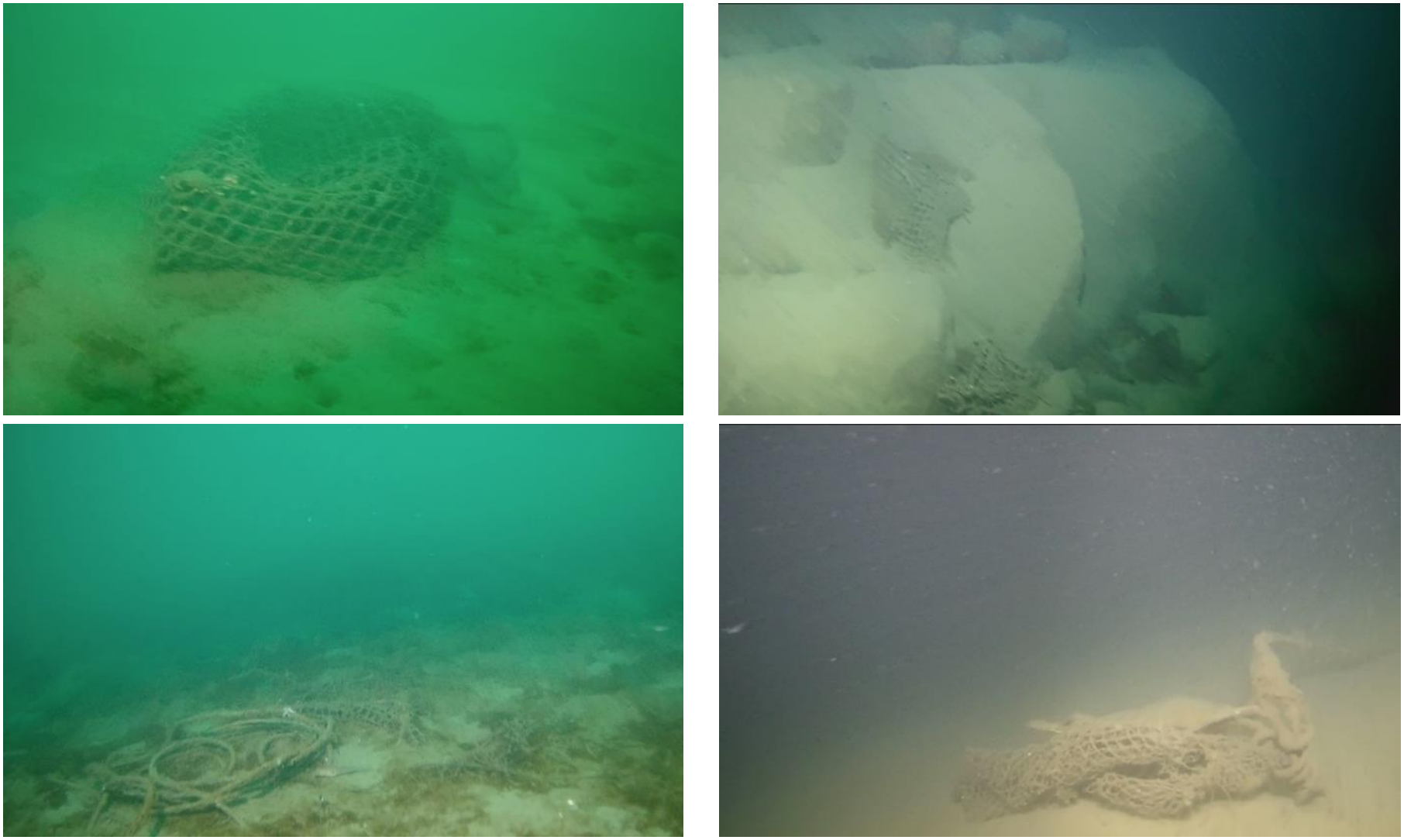
APPENDIX 2 – SEAFLOOR LITTER PER CLUSTER

Overview of seafloor litter observations for each cluster sampled. The table shows the number of litter items observed in each category (plastic, metal, rubber, glass and ceramics, natural products, miscellaneous), along with the total number of items per cluster. Densities (count/m^2) are given in parentheses.

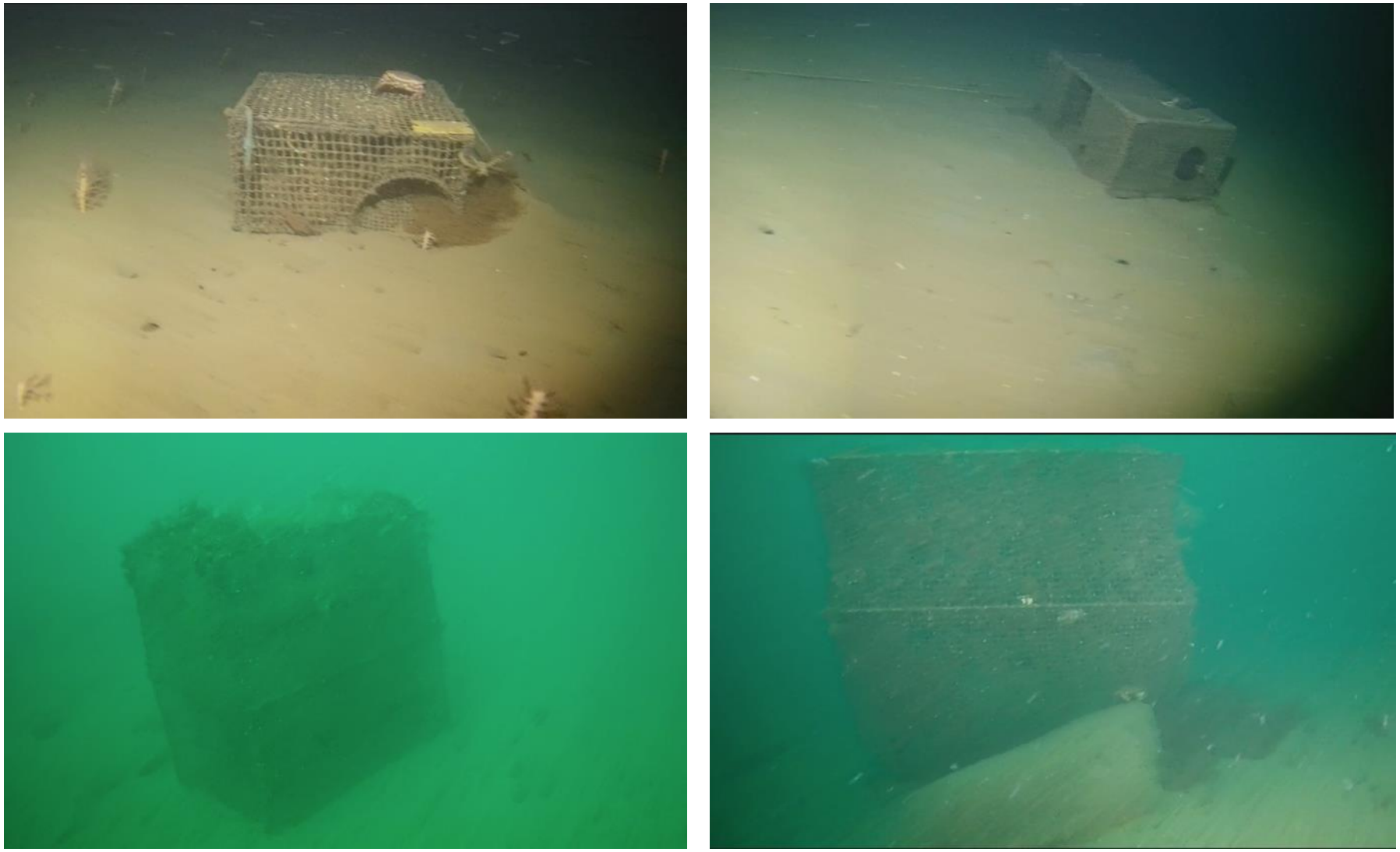
Area	Cluster ID	Plastic	Metal	Rubber	Glass and ceramics	Natural products	Miscellaneous	Total
Galtesund	1842480	9 (0.0018)	0 (0)	0 (0)	10 (0.0020)	0 (0)	0 (0)	**19 (0.0038)**
	1848933	1 (0.0002)	1 (0.0002)	0 (0)	0 (0)	0 (0)	0 (0)	**2 (0.0004)**
	1852150	14 (0.0028)	29 (0.0058)	1 (0.0002)	29 (0.0058)	0 (0)	0 (0)	**73 (0.0146)**
	1852157	8 (0.0016)	1 (0.0002)	3 (0.0006)	2 (0.0004)	1 (0.0002)	0 (0)	**15 (0.0030)**
	1855376	18 (0.0036)	42 (0.0084)	5 (0.0010)	17 (0.0034)	0 (0)	1 (0.0002)	**83 (0.0166)**
	1855381	32 (0.0064)	20 (0.0040)	1 (0.0002)	58 (0.0116)	1 (0.0002)	2 (0.0004)	**114 (0.0228)**
	1855383	19 (0.0038)	8 (0.0016)	0 (0)	6 (0.0012)	0 (0)	0 (0)	**33 (0.0066)**
	1855386	3 (0.0006)	1 (0.0002)	0 (0)	0 (0)	0 (0)	0 (0)	**4 (0.0008)**
	1861837	15 (0.0030)	16 (0.0032)	1 (0.0002)	7 (0.0014)	0 (0)	2 (0.0004)	**41 (0.0082)**
	1861841	3 (0.0006)	0 (0)	1 (0.0002)	0 (0)	0 (0)	0 (0)	**4 (0.0008)**
	1868292	9 (0.0018)	7 (0.0014)	0 (0)	11 (0.0022)	0 (0)	0 (0)	**27 (0.0054)**
	1868294	5 (0.0010)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**5 (0.0010)**
	1874747	3 (0.0006)	4 (0.0008)	0 (0)	2 (0.0004)	0 (0)	0 (0)	**9 (0.0018)**
	1874749	2 (0.0004)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**2 (0.0004)**
	1881200	1 (0.0002)	0 (0)	0 (0)	1 (0.0002)	1 (0.0002)	0 (0)	**3 (0.0006)**
	1881202	2 (0.0004)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**2 (0.0004)**
Kristiansand	1458521	7 (0.0014)	7 (0.0014)	0 (0)	1 (0.0002)	0 (0)	2 (0.0004)	**17 (0.0034)**
	1458524	5 (0.0010)	11 (0.0022)	1 (0.0002)	15 (0.0030)	0 (0)	0 (0)	**32 (0.0064)**
	1461750	13 (0.0026)	7 (0.0014)	0 (0)	16 (0.0032)	0 (0)	0 (0)	**36 (0.0072)**
	1464975	12 (0.0024)	19 (0.0038)	0 (0)	5 (0.0010)	1 (0.0002)	1 (0.0002)	**38 (0.0076)**
	1468204	4 (0.0008)	1 (0.0002)	0 (0)	6 (0.0012)	0 (0)	0 (0)	**11 (0.0022)**
	1468208	17 (0.0034)	9 (0.0018)	0 (0)	41 (0.0082)	1 (0.0002)	1 (0.0002)	**69 (0.0138)**

	1471432	3 (0.0006)	3 (0.0006)	0 (0)	13 (0.0026)	0 (0)	0 (0)	**19** **(0.0038)**
	1474655	29 (0.0058)	33 (0.0066)	2 (0.0004)	55 (0.0110)	1 (0.0002)	2 (0.0004)	**122** **(0.0244)**
	1477884	5 (0.0010)	4 (0.0008)	0 (0)	5 (0.0010)	3 (0.0006)	0 (0)	**17** **(0.0034)**
	1481110	14 (0.0028)	5 (0.0010)	2 (0.0004)	2 (0.0004)	1 (0.0002)	1 (0.0002)	**25** **(0.0050)**
	1487564	15 (0.0030)	7 (0.0014)	0 (0)	33 (0.0066)	0 (0)	0 (0)	**55** **(0.0110)**
	1487566	12 (0.0024)	1 (0.0002)	0 (0)	3 (0.0006)	0 (0)	0 (0)	**16** **(0.0032)**
	1490788	1 (0.0002)	16 (0.0032)	2 (0.0004)	0 (0)	0 (0)	0 (0)	**19** **(0.0038)**
	1490794	11 (0.0022)	3 (0.0006)	1 (0.0002)	22 (0.0044)	0 (0)	0 (0)	**37** **(0.0074)**
	1494014	11 (0.0022)	11 (0.0022)	1 (0.0002)	1 (0.0002)	0 (0)	0 (0)	**24** **(0.0048)**
	1494023	10 (0.0020)	7 (0.0014)	0 (0)	20 (0.0040)	0 (0)	0 (0)	**37** **(0.0074)**
	1497247	6 (0.0012)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**6** **(0.0012)**
	1497251	8 (0.0016)	4 (0.0008)	1 (0.0002)	6 (0.0012)	0 (0)	0 (0)	**19** **(0.0038)**
Tromlingene	1907011	1 (0.0002)	2 (0.0004)	0 (0)	0 (0)	0 (0)	0 (0)	**3** **(0.0006)**
	1907013	0 (0)	1 (0.0002)	0 (0)	0 (0)	0 (0)	0 (0)	**1** **(0.0002)**
	1910235	2 (0.0004)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**2** **(0.0004)**
	1913464	2 (0.0004)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**2** **(0.0004)**
	1913466	4 (0.0008)	0 (0)	0 (0)	0 (0)	1 (0.0002)	0 (0)	**5** **(0.0010)**
	1913468	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**0** **(0)**
	1916689	1 (0.0002)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**1** **(0.0002)**
	1919915	1 (0.0002)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**1** **(0.0002)**
	1919919	4 (0.0008)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**4** **(0.0008)**
	1919921	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**0** **(0)**
	1923140	10 (0.0020)	1 (0.0002)	0 (0)	0 (0)	0 (0)	0 (0)	**11** **(0.0022)**
	1923143	3 (0.0006)	0 (0)	0 (0)	0 (0)	1 (0.0002)	0 (0)	**4** **(0.0008)**
	1926366	1 (0.0002)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**1** **(0.0002)**
	1926369	7 (0.0014)	2 (0.0004)	0 (0)	0 (0)	0 (0)	0 (0)	**9** **(0.0018)**
	1926372	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**0** **(0)**
	1926374	1 (0.0002)	0 (0)	1 (0.0002)	0 (0)	0 (0)	0 (0)	**2** **(0.0004)**
	1929594	3 (0.0006)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	**3** **(0.0006)**
	1929597	0 (0)	1 (0.0002)	0 (0)	0 (0)	1 (0.0002)	0 (0)	**2** **(0.0004)**

APPENDIX 3 – PHOTO EXAMPLES OF LITTER



Examples of category A Plastic, subcategory A8 Fishing net.



Examples of category A Plastic, subcategory A16 Other fishing related plastic.

Examples of category A Plastic, subcategory A7 Synthetic rope.

Examples of category B Metal including a pot (B4 Drums; top left), a chimney cap (B8 Other; top right), an anchor (B8 Other; bottom left) and a large metal block (B8 Other; bottom right).

Examples of category C Rubber including tires (C4 Tyre; top), a bobbin (C3 Bobbins; bottom left), and a bicycle inner tube (C6 Other).

Examples of category D Glass and ceramics including glass bottles (D2 Bottle; top left and bottom right), brick (C4 Other; top right), plate (C4 Other; bottom left) and a roof tile (C4 Other; bottom right).

Examples of category E Natural products, subcategory E1 Wood (processed) (top left) and F Miscellaneous including a car battery (F3 Other; top right), a shoe insole (F3 Other; bottom left) and a shoe (F2 Shoes; bottom right).

APPENDIX 4 – SUGGESTED AREAS FOR MONITORING OF COASTAL SEABED LITTER IN NORWAY

SALT REPORT 1101

Appendix 4 - Suggested areas for monitoring of coastal seabed litter in Norway

Report title
Appendix 4 - Suggested areas for monitoring of coastal seabed litter in Norway

Report nr.
1101

Date
16.12.2025

Client
The Norwegian Environment Agency (N. EPA)

Client's reference
Inger Lise Nerland Bråte

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Sammendrag
On assignment by the Norwegian Environment Protection Agency (EPA), this report suggests potential areas for monitoring seabed litter in coastal zones along the Norwegian coastline. A web-based GIS tool has been developed to support the manual selection process. The report suggests areas for monitoring, one area in each of the 12 Norwegian OSPAR zones. Supplementary alternative areas are suggested in 7 of the zones. The report methodology builds on findings in a pilot study carried out earlier in 2025, also on assignment by the EPA.

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CONTENT

SUMMARY

As a follow-up to the completed pilot project for mapping seabed litter in coastal locations (SALT Report 1097, 2025), this supplementary report 1101 proposes a nationwide selection of areas for monitoring coastal seabed litter. The report has been prepared on assignment by Norwegian Environment Agency.

The method is based on the guidelines established in the pilot project, with an expansion to cover the entire Norwegian coastline.

A division of Norway's coast into 12 OSPAR strata zones forms the basis for the distribution of the proposed monitoring areas. At least one area is proposed per Norwegian OSPAR strata zone, with one additional alternative monitoring area suggested in 7 of the 12 zones.

SAMMENDRAG (IN NORWEGIAN)

Som en oppfølging av det gjennomførte pilotprosjektet for kartlegging av marin forsøpling på havbunnen i kystnære områder (SALT-rapport 1097, 2025), foreslår dette tilleggsoppdraget et landsdekkende utvalg av områder for overvåking av marin forsøpling på kystnær havbunn. Forslaget er utarbeidet på oppdrag fra Miljødirektoratet.

Metoden er basert på retningslinjene som ble etablert i pilotprosjektet, med en utvidelse til å omfatte hele norskekysten.

En inndeling av Norges kyst i 12 OSPAR-soner danner grunnlaget for fordelingen av de foreslåtte overvåkingsområdene. Det foreslås minst ett område per norsk OSPAR-sone, med ett ekstra alternativt overvåkingsområde foreslått i 7 av de 12 sonene.

BACKGROUND

This report is a deliverable in a supplementary assignment related to the pilot project on mapping seafloor litter in coastal areas, carried out by SALT and Green-Bay in 2025 on behalf of the Norwegian Environment Agency (SALT Report 1097, 2025). The deliverable consists of an updated web-based map tool and this report document.

The main project tested a standardized video-based method and established three pilot areas (Galtesundet outside Arendal, the coastal area outside Kristiansand, and the marine area off Tromlingene in Agder), selected through a combination of structured GIS screening and professional judgement. This supplementary assignment includes further development of the ArcGIS map solution and a proposal for a nationwide expansion of monitoring areas along the entire Norwegian coast. The proposed areas are divided according to the OSPAR stratification of the Norwegian coastline into 12 zones (each reaching approximately 2000 kilometers along the outer coastline) (Figure 1), with additional alternatives suggested where appropriate.

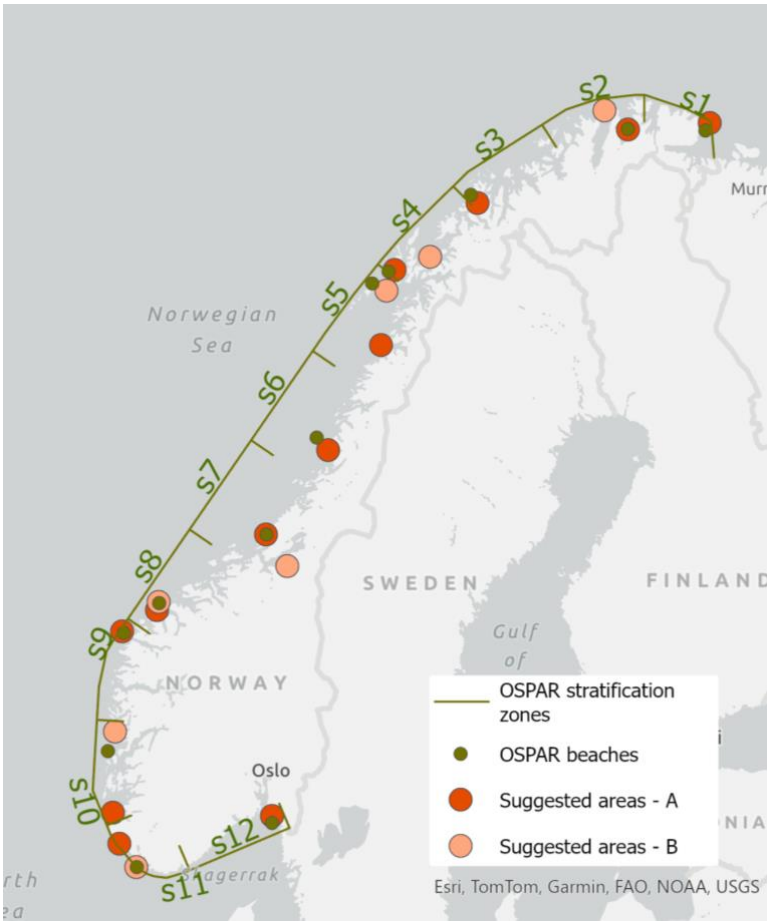


Figure 1: Map showing the suggested areas for mapping of seafloor litter, OSPAR stratification zones, 1-12 and OSPAR beaches.

The guideline of the assignment was to identify at least one suitable area for monitoring seabed litter in a coastal locality in each of the 12 OSPAR strata zones, potentially in proximity to the OSPAR beaches currently under monitoring for beach litter by the Norwegian EPA. Where needed and feasible, multiple areas may be proposed within a single zone. In addition, further development of the GIS solution is desired, including assessment of the integration of datasets such as ocean currents to better identify accumulation areas for seafloor litter. The supplementary assignment thus includes GIS-based area selection and map expansions, without new field surveys or statistical analyses.

The sampling methodology for each selected area is explained in the main report for this project (SALT Report 1097, 2025). In short, the method involves dividing the Norwegian coast into a grid of hexagons with 275-meter-long edges. Within each monitoring area, sampling is conducted in 12–18 hexagons, where 10 transects of 100 meters are run with a towed camera along the seabed to identify and manually annotate seafloor litter using a standardized form based on the ICES Manual for Seafloor Litter Data Collection. The hexagons selected for sampling in an area are chosen based on expert judgement to cover an assumed accumulation zone for seafloor litter. The selected hexagons are placed with at least one hexagon spacing between them, and as close together as otherwise possible, forming a cluster. Together, the cluster constitute areas for monitoring seafloor litter. This report suggests additional locations of such monitoring areas along the Norwegian coastline.

DATA AND METHODS

For this supplementary assignment, the interactive web-based mapping solution established in the main project (SALT Report 1097, 2025) is further developed. The mapping tool is used to identify new areas that are expected to accumulate seafloor litter, based on the same combination of predefined criteria and professional judgement as in the pilot study.

The updated mapping solution is available at the following link[1]:
https://saltlofoten.maps.arcgis.com/apps/instant/sidebar/index.html?appid=7853b2bce34547aa915699c8e087ec3a

The following tables summarize map layers used for selecting monitoring areas, areas mapped in the pilot project and suggested areas from this project. Table 1 shows the administrative map layers, where we suggested 1-2 areas from each OSPAR strata zone. Where suitable, we placed one area near

[1] Webpage temporarily hosted by SALT until February 2026.

to an OSPAR beach. The purpose of the hexagon grid was to choose 12 locations for transects within each area, with minimum one empty hexagon between, and preferably as close to each other as possible to reduce transportation whilst ensuring a geographical spread of samples in the monitored area.

Table 1: Administrative map layers included in the web-based mapping solution.

Map layer	Description	Data owner	Data access
lexagon Norge	Nationwide hexagon network, sea/coast selection, with unique ID for selection purposes.	SALT	
)SPAR Stratification Zone	Division of Norway's coast into 12 OSPAR areas.	N. EPA	N. EPA
)SPAR Beaches	Norwegian OSPAR beaches.	OSPAR	OSPAR
uggested areas for mapping f seafloor litter	Areas suggested for mapping of seafloor litter, divided in A and B areas.	SALT	
reas mapped in main project	Objects includes information of number of mapped seafloor litter in each hexagon.	SALT	

From a 50m depth raster, we derived map layers showing depth of 100 meters and shallower, and areas with slope no more than 5 degrees within the 100 meters depth map (Table 2). These are the limits selected for operational purposes of the equipment used to map the seafloor in the main project. As the origin raster has a resolution of 50m, the slope layer should only be seen as a guidance. Results from the pilot project showed that they were able to take planned transects within hexagons that only had a part of it showing slope >5 degrees. We therefor included hexagons based on this information. The equipment is also sensitive to strong currents, and we included a map showing bottom currents for 3 regions of Norway. We did not have information on the equipment's' limitation to currents but tried two avoid the parts showing the strongest currents as a precaution, when the current map overlapped with our chosen areas.

Table 2: Map layers in the web-based mapping solution used to delineate areas suitable for data collection regarding technical limitations of the monitoring equipment.

Map layer	Description	Data owner	Data access
epth ≤100m	Areas up to 100 m depth, derived from the Norwegian mapping authority's (Kartverket) bathymetry 50m grid layer "Dybdedata – terrengmodeller 50 meters grid landsdekkende". The dataset is available from Geonorge.	SALT	
epth ≤100m and slope ≤5 egrees	Areas up to 100 m depth and 5 degree slope, derived from the Norwegian mapping authority's bathymetry 50m grid layer "Dybdedata – terrengmodeller 50 meters grid landsdekkende" from the Norwegian Mapping Authority.	SALT	
MS IMR – Bottom current	Modelled bottom current from marine basemaps, not covering the whole coast.	Norwegian Institute of Marine Research (IMR)	Geonorge/IMR

Other areas to be avoided were kelp forests, and we included a layer showing predicted kelps forests (Table 3). Kelp forests are avoided because of poor visibility in videos filmed from above.

Table 3: Map layers in the web-based mapping solution that show habitat types that should be avoided when selecting areas for monitoring.

Map layer	Description	Data owner	Data access
Major kelp forests	Shows larger kelp forest occurrences. Object type Greater kelp forest deposits from the dataset Marine Habitat Types/DN handbook19.	N. EPA	Geonorge

Table 4 shows map layers used to identify areas of interest regarding land-based sources of litter, and registered seafloor litter. Areas of interest were areas close to cities and towns, harbours and rivers. Of the registered seafloor litter data, the one showing lost fishing gear was assessed the most useful, as is it covers all the coast and have relatively new registrations. The layer showing registered litter from dive clubs is patchy along the coast and limited to the shallower parts close to land. The MAREANO data is focused outside of the marine baseline and on deeper waters but have coastal data in a few areas. The map layer showing harbours, seemed to be incomplete, but we assessed the layer showing urban development to provide enough information. Rivers are of interest as they can be a source of litter from a large inland population and area and disperse the litter to a larger area due to the flow of the river. We used buffers of 1, 3 and 5 kilometres as proxies to litter from rivers.

Table 4: Map layers used to assess potential sources of litter.

Map layer	Description	Data owner	Data access
MAREANO Seafloor Litter	Shows litter registered at MAREANO stations.	MAREANO	Geonorge
Søppel FDIR	Shows lost fishing gear found by diving clubs 2017-2021. Not covering the whole coast.	N. Directorate of Fisheries (NDF)	N. Directorate of Fisheries
Lost Fishing Gear	Lost fishing gear, reported to N. Directorate of Fisheries	N. Directorate of Fisheries	Barentswatch
KaiBrygge	Shows quays and piers. Object type KaiBrygge from the map layer N500_BygningerOgAnlegg_senterlinje in the dataset N500. Incomplete coverage. Probably not complete.	Norwegian mapping authority	Geonorge
Tettbebyggelse	Marking of area classified as urban development. Object type “TettBebyggelse» from the map layer N500_Arealdekke_omrade in the dataset N500.	Norwegian mapping authority	Geonorge
River outlets	Outlet point for rivers derived from The Norwegian Water Resources and Energy Directorate’s (NVE') layer “Main River” (ELVIS Hovedelv).	SALT	
River outlets - buffer	Buffer added to “Elveutløp” for 1, 3 and 5 km	SALT	

SELECTED AREAS FOR MONITORING

SALT has based its work on OSPAR’s stratification of the Norwegian coast into 12 zones, not including Svalbard. Based on experience and considerations described in the project’s main report (SALT Report 1097, 2025), areas have been selected to meet the technical requirements of the monitoring equipment in order to effectively identify seabed litter. In practice, this has involved identifying assumed accumulation areas for litter with depths of less than 100 m, relatively flat seabed over a transect length of 100 m, and proximity to major ports, large cities, or significant

river outlets which could be potential litter sources. Areas with strong currents and kelp forests were excluded. Areas with potential to accumulate lost fishing gear were also assessed based on datasets of lost gear.

At least one area is proposed in each of the 12 OSPAR strata zones. In cases where only one area is proposed within a zone, the proposed area is either considered well suited—meaning there is no need to look for alternatives—or suitable alternatives could not be found within the same OSPAR zone. In cases where two alternatives (A and B) are proposed, this is because more than one option appears well suited but exhibits different characteristics (e.g., one area near a city and another near an OSPAR beach), or because neither alternative is fully ideal and further evaluation is needed before making a final selection.

The following describes the proposed monitoring areas, organized by OSPAR zone from north to south (1–12). In cases where two areas are proposed, they are labeled as A and B alternatives.

Table 5: Proposed monitoring areas divided by OSPAR zone including justifications for the selection of each area. Alternative areas are marked A and B for each zone.

Norwegian OSPAR Zone	Suggested monitoring area	Justification of area selection
1	Vardø	Close to a populated area with a small airport and fishing activity. Relatively close to the OSPAR beach in the zone. Suitable seabed conditions.
2	Alt. A Mannskarvika OSPAR beach	Suitable seabed conditions around the OSPAR beach. Located relatively far from potential litter sources and deep in the Laksefjord, which is why an alternative B is suggested.
2	Alt B Honningsvåg	Closest populated area from the OSPAR beach.
3	Tromsø	Large, populated city with a river outlet and harbor, industry, and active marine-related businesses and traffic. Suitable seabed conditions.
4	Alt. A Stokmarknes	Relatively close to the OSPAR beach on Hadseløya with suitable seabed conditions, populated area with industry activity and marine traffic. The OSPAR beach lies inside a belt of kelp forest, whilst it is too deep outside, hence not suitable for monitoring in its direct vicinity.
4	Alt. B Harstad	Good seabed conditions. Alternative to Stokmarknes, as that area is more protected from the exposed outer coast. Populated area with significant industry activity and marine traffic.
5	Alt. A Bodø	Chosen as the A-alternative because it is the largest populated area in the zone, with significant transport and maritime traffic, and because many other areas in the zone have extensive kelp forests.
5	Alt. B Lofoten Vestfjord	Fishing area and populated area. Closer to the OSPAR beach in the zone, although on the other (southern) side of Lofoten.
6	Brønnøysund	Few areas within the OSPAR zone are suitable with regards to depth, and areas outside Søla are exposed and harder to access.
7	Alt. A Kleivvika OSPAR beach	Not close to populated areas and with few river outlets in proximity, but located along the coastline, in contrast to the B alternative which is situated in the Trondheim fjord.
7	Alt. B Stjørdal	The area is well populated, close to the city of Trondheim and with a river outlet with significant industry activity and the Værnes Airport in its proximity. Suitable seabed conditions.
8	Alt. A Ålesund	Suitable seabed conditions around the city of Ålesund. A marine base map with data on sea current exists in the area and hexagons are placed with respect to current patterns.
8	Alt. B Lausundsanden OSPAR beach	The area around the OSPAR beach Lausundsanden is suitable due to its proximity to a populated area and suitable seabed conditions. Attention to possible kelp forest needs to be taken in field.
9	Nordfjord outlet – Rekevika OSPAR beach	Located relatively close to the Rekevika OSPAR beach but further towards exposed sea. Long stretches of flat seabed and sandy bottom.

10	Alt. A Stavanger	Suitable seabed conditions outside the city. An alternative B is available in the same zone, also with suitable characteristics but closer to the OSPAR beach.
10	Alt B Nesttun	The sea outside Kvernavika OSPAR beach becomes too deep just offshore, hence not suitable, and the B alternative is therefore suggested outside Nesttun. The area is highly populated and is in the proximity of the city of Bergen. The marine areas outside the main harbour of Bergen city were too deep and did not accommodate for the placement of 12 hexagons, hence the marine area outside Nesttun were chosen instead.
11	Alt. A Eigersund	Kristiansand is already an area selected within the zone as part of the pilot project. The area outside Eigersund is hence proposed as an alternative, relatively near the OSPAR beach Steinsvika in the zone.
11	Alt. B Steinsvika OSPAR beach	Exposed area but not in close proximity to major populated areas. Hexagons selected outside kelp forest areas, but attention must be taken to possible kelp forests in field.
12	Fredrikstad	The area is situated near several major rivers and the city of Fredrikstad. It is also relatively close to the OSPAR beach Ytre Hvaler in the OSPAR zone.

In the following sections, the suggested monitoring areas are visualized on individual maps. Each area map shows a set of 12 highlighted hexagons that were deemed suitable for monitoring by the authors. The selection of hexagons was based on the interest of covering a diverse representation of the area of interest with a suitable geographical spread with regards to monitoring logistics, whilst targeting potential locations of special interest, e.g. close to harbors, and whilst avoiding areas seemingly to steep, deep or with registered kelp forest habitats. Changes to the selection of hexagons can be made if deemed needed, e.g. if field staff experience physical obstacles such as marine traffic, or in-situ conditions do not allow for sampling. All maps below are exported from the web-based mapping tool (see link above). Figure 2 shows the legend.

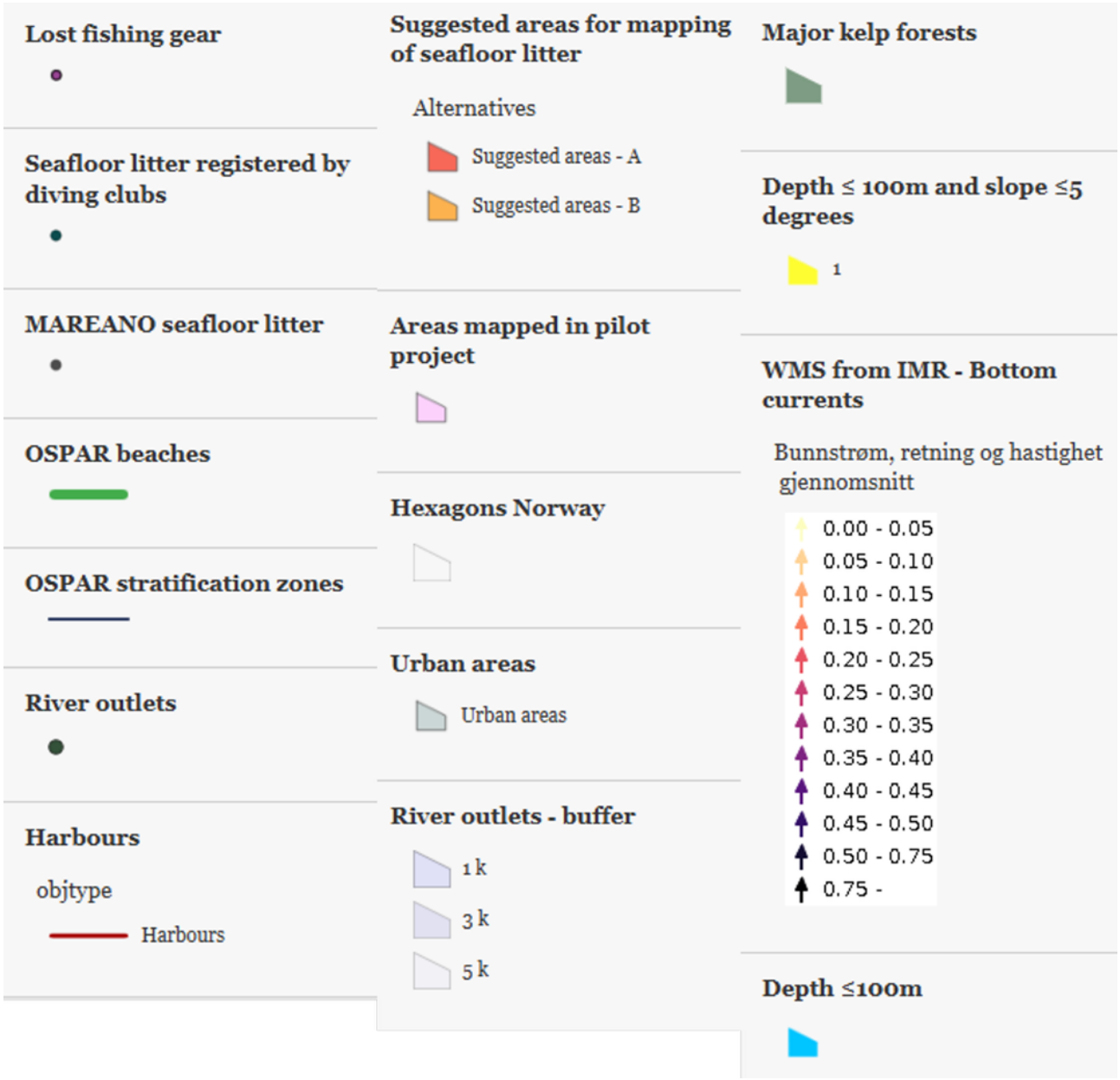
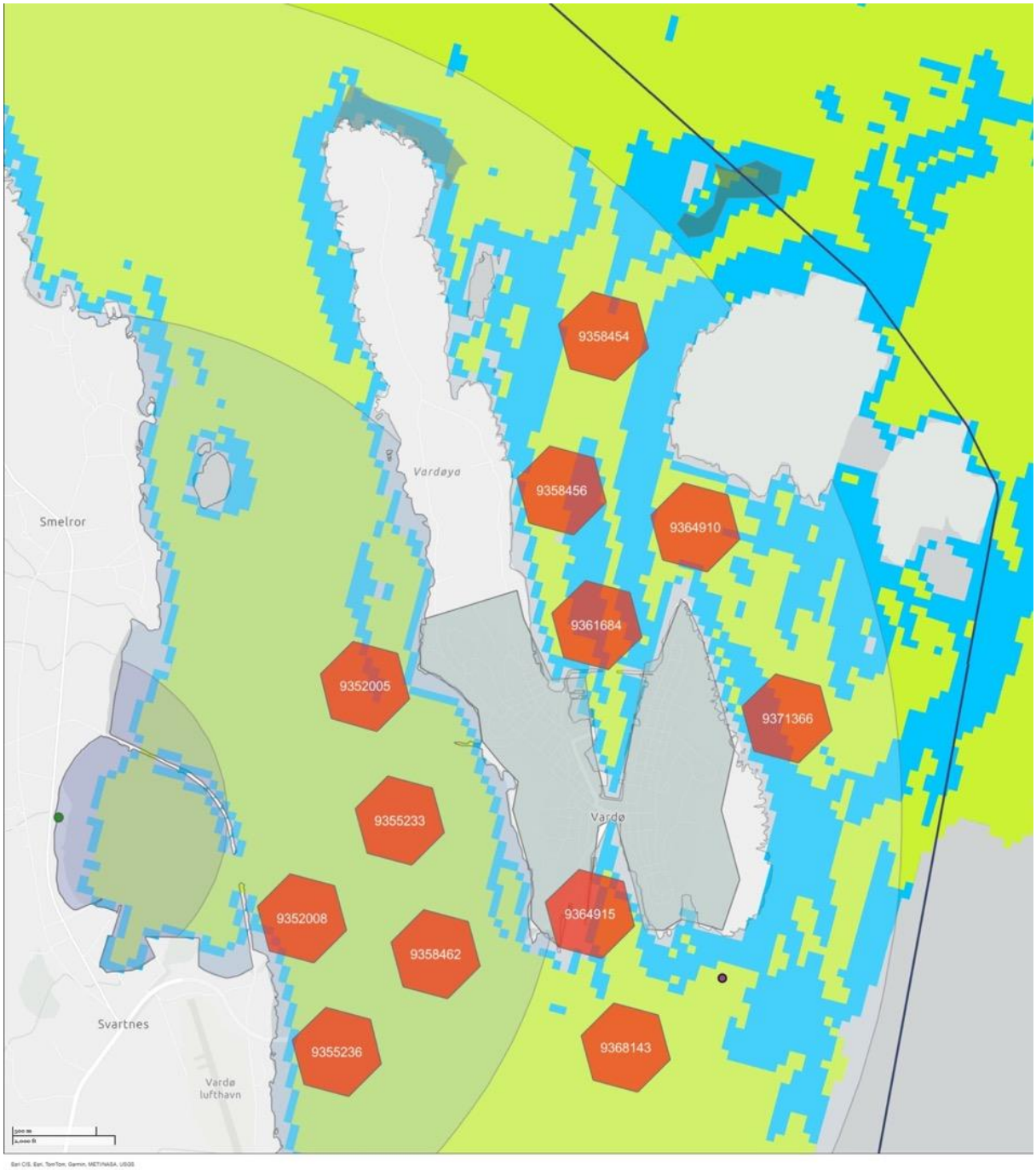


Figure 2: Legend from the mapping tool.

OSPAR Zone 1

Vardø

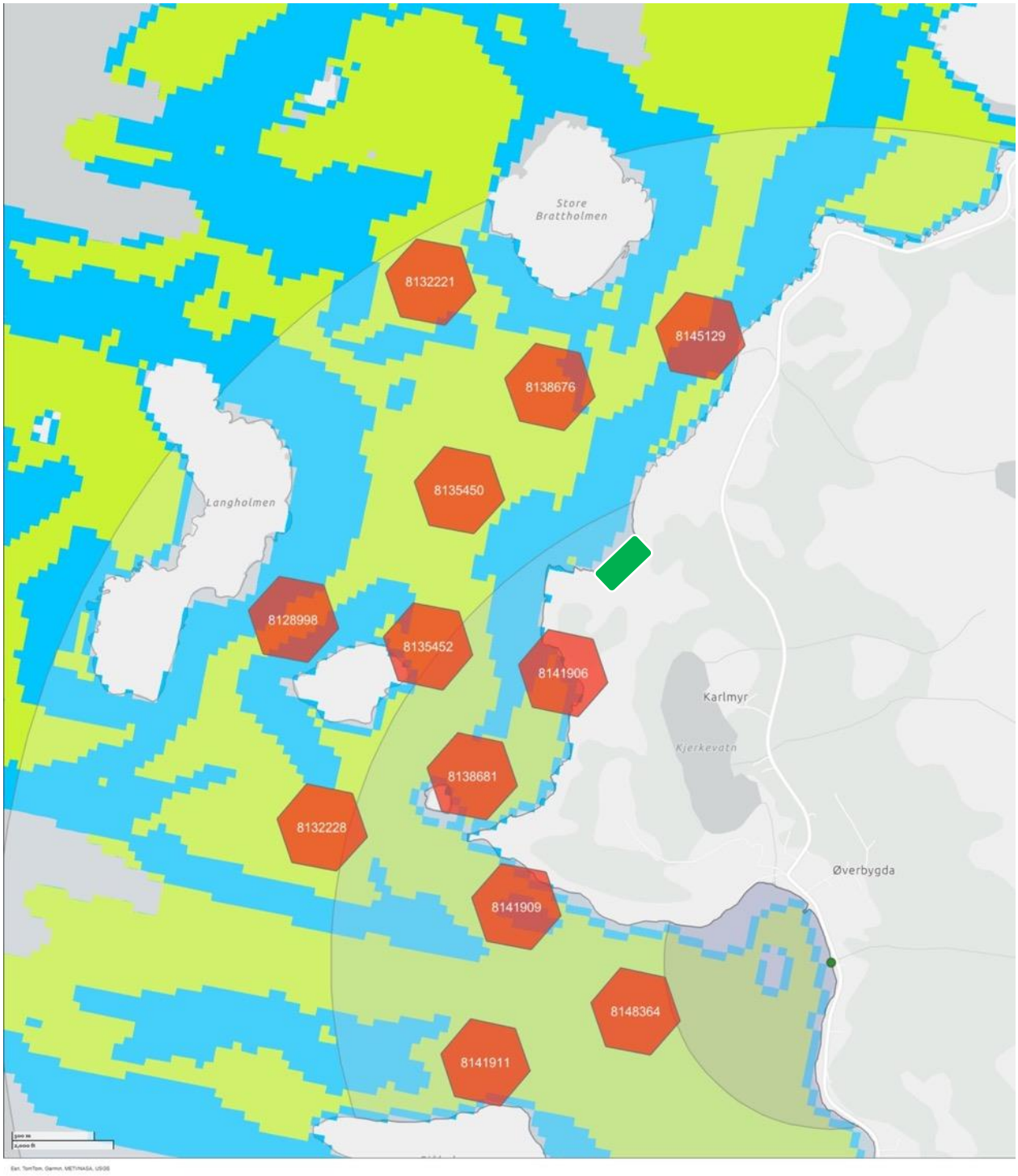
The suggested area is situated close to a populated area (Vardø) with a small airport and fishing activity. Relatively close to the OSPAR beach Svartnesbukta in the OSPAR zone. Suitable seabed conditions.



OSPAR Zone 2

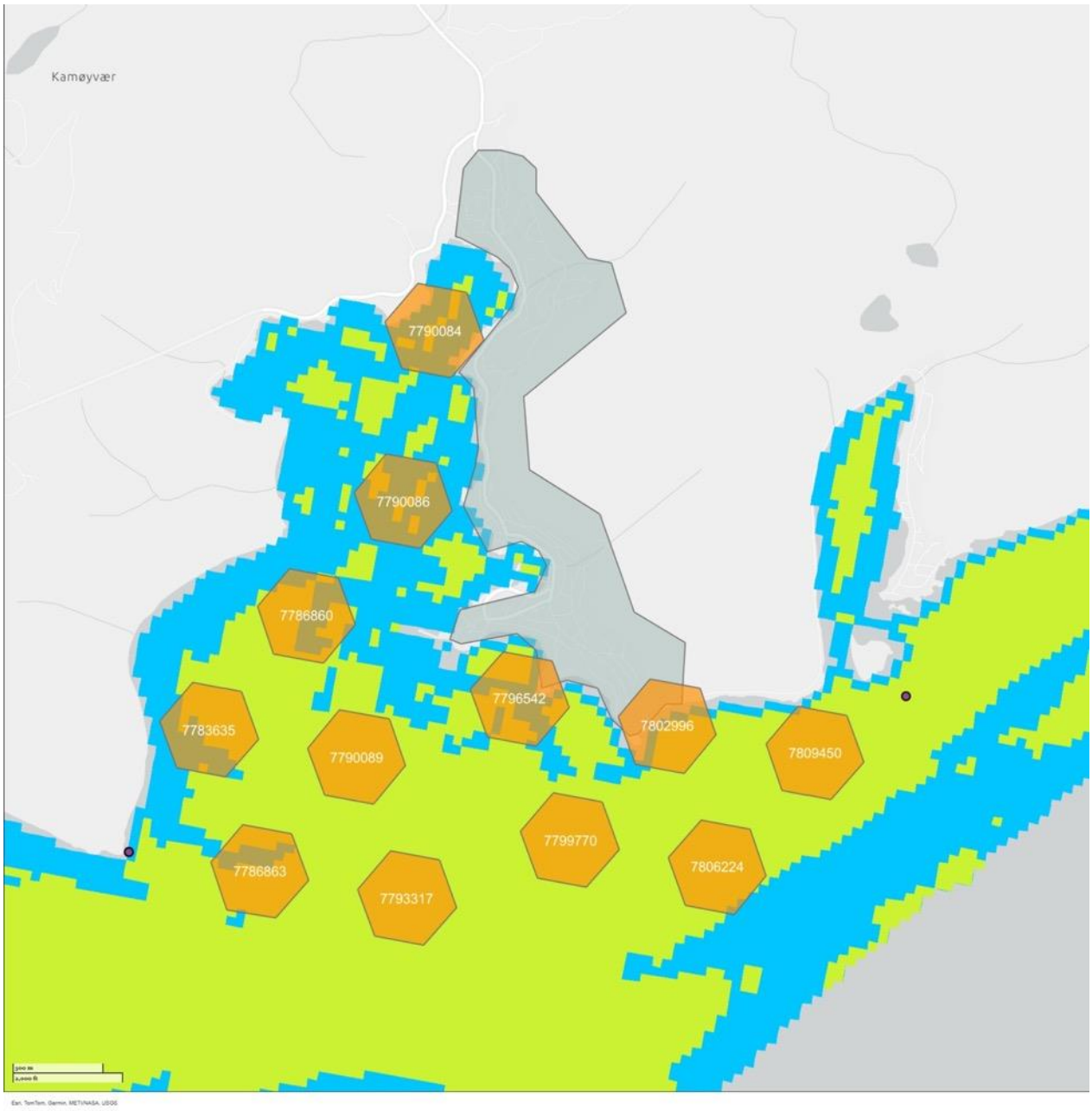
Alt. A Mannskarvika OSPAR beach

Suitable seabed conditions around the OSPAR beach Mannskarvika allow for monitoring in its close proximity. The area is however located relatively far from potential litter sources and deep in the Laksefjord, which is why an alternative B is suggested.



Alt. B Honningsvåg

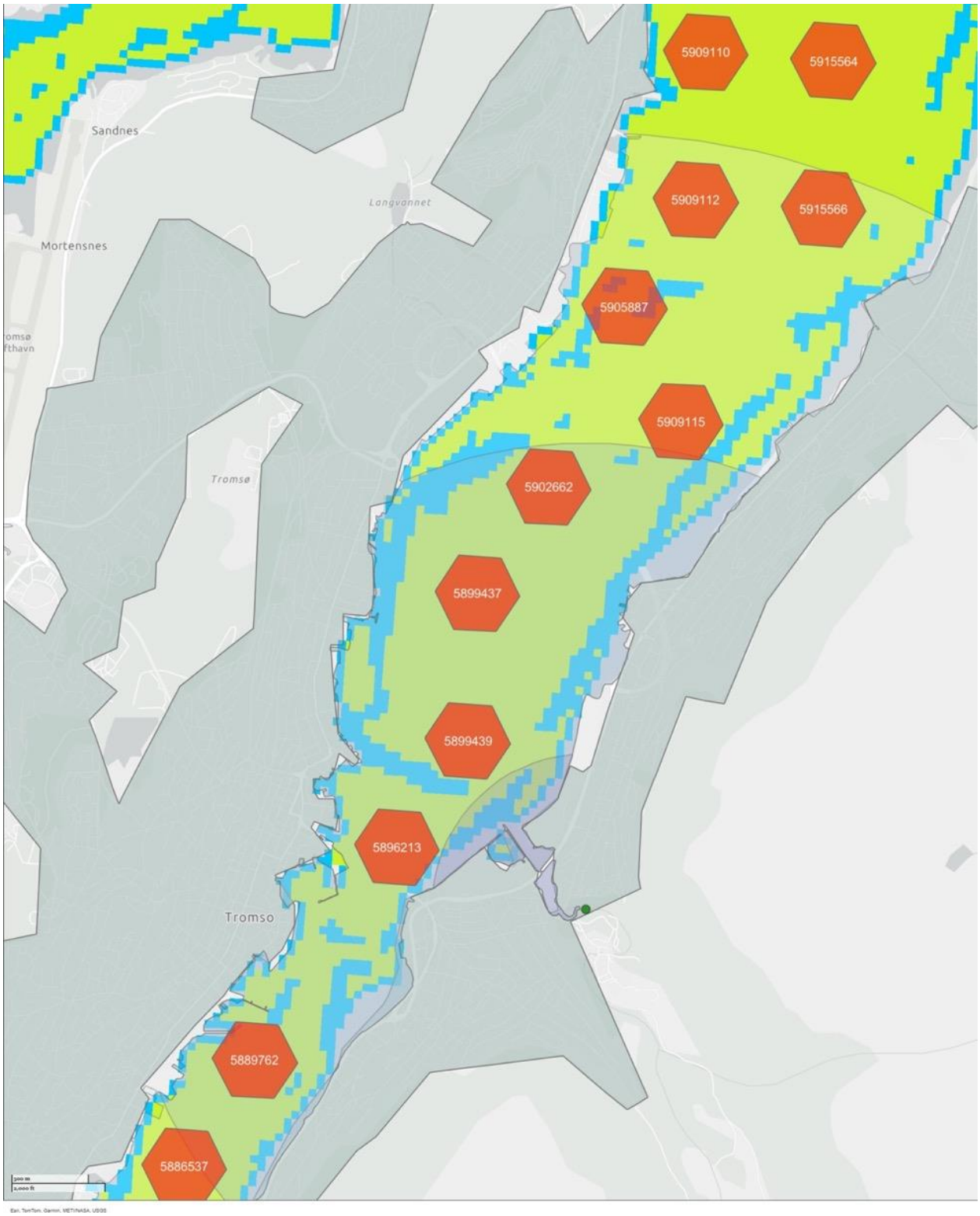
Honningsvåg is the closest populated area from the OSPAR beach Mannskarvika, which might be of higher interest to monitor for litter, hence suggested as an alternative B.



OSPAR Zone 3

Tromsø

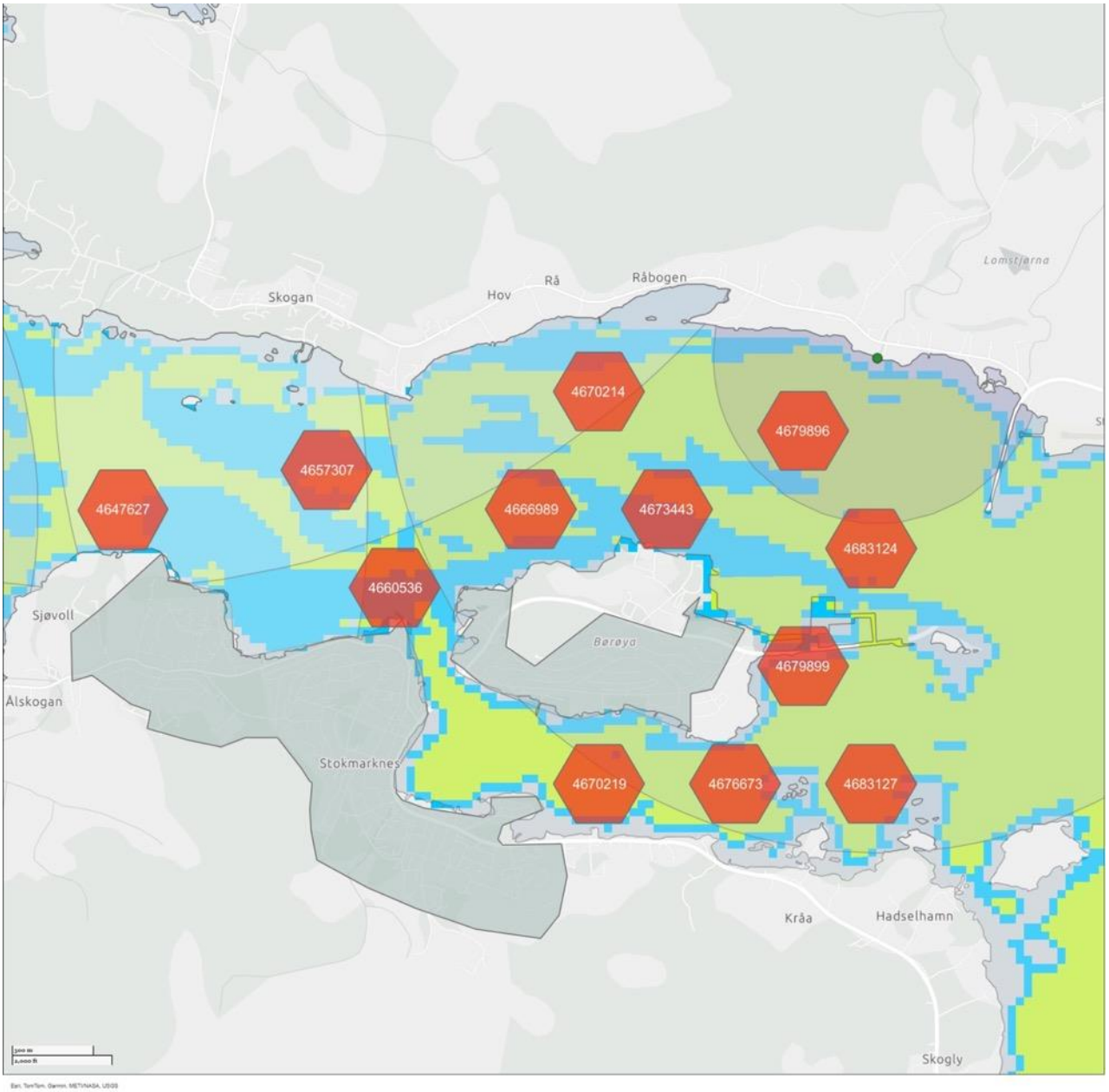
Tromsø is a relatively large, populated city with a river outlet and harbor, industry, and active marine-related businesses and traffic. Seabed conditions around the city are suitable for monitoring.



OSPAR Zone 4

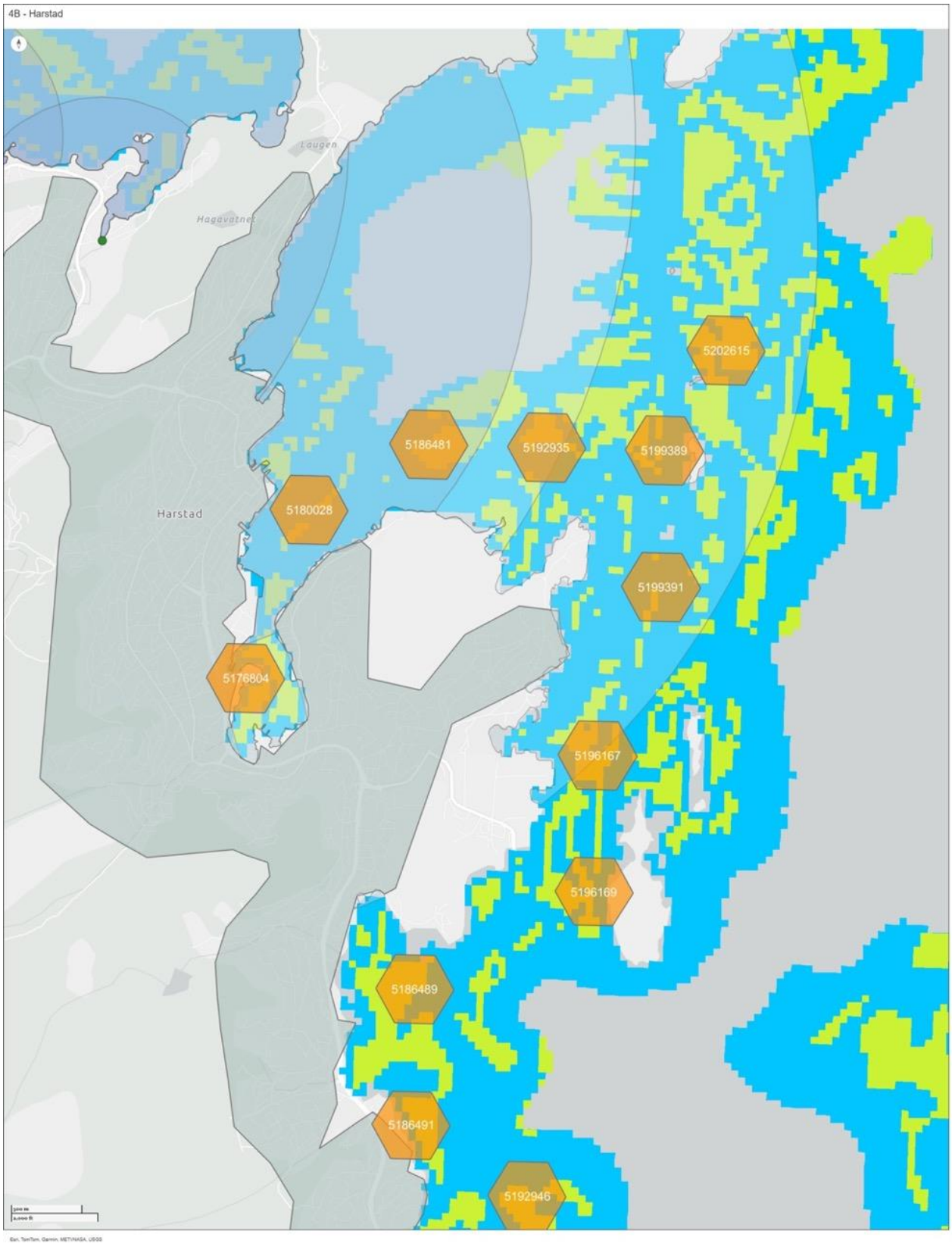
Alt. A Stokmarknes

The area is relatively close to the OSPAR beach on Hadseløya with suitable seabed conditions available outside the city of Stokmarknes. The area is populated with industry activity and marine traffic. The OSPAR beach lies inside a belt of kelp forest, whilst it is too deep outside the belt for monitoring, hence not suitable for monitoring in the direct vicinity of the beach.



Alt. B Harstad

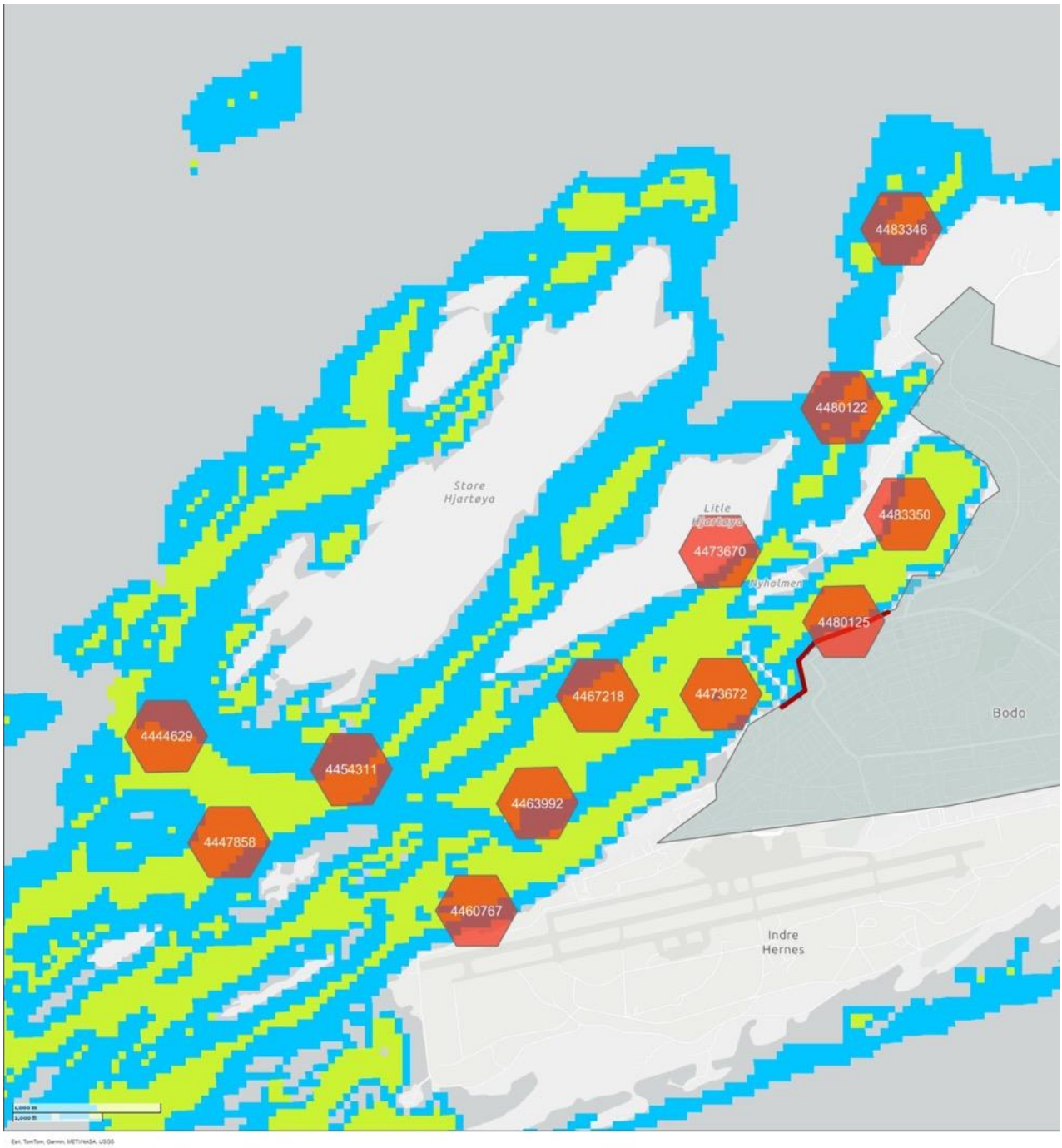
The area is suggested as an alternative to Stokmarknes, as it is more protected from the exposed outer coast. Suitable seabed conditions are available just outside the city of Harstad, with significant industry activity and marine traffic.



OSPAR Zone 5

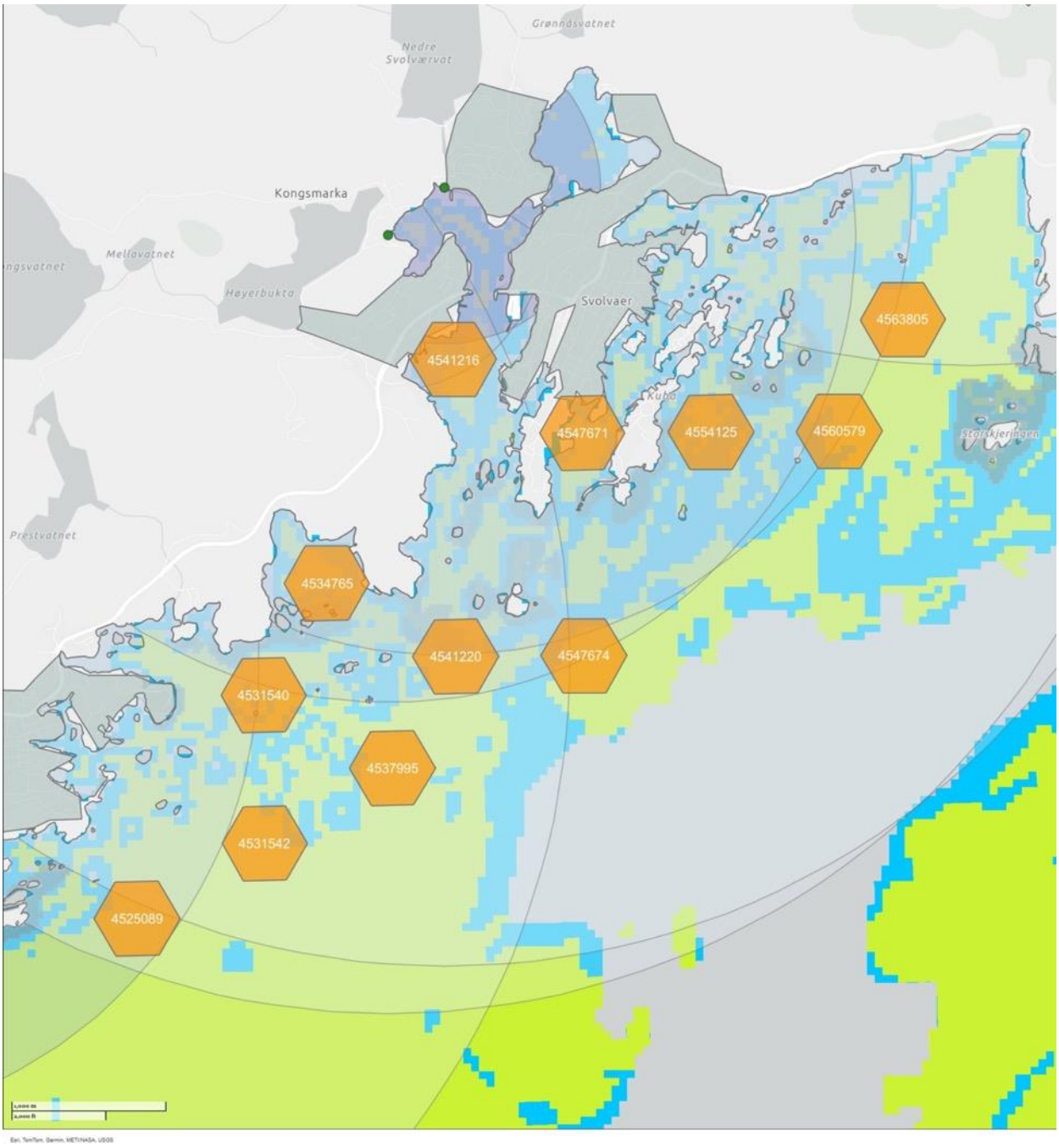
Alt. A Bodø

Chosen as the A-alternative because it is the largest populated area in the zone, with significant transport and maritime traffic, and because many other areas in the zone have extensive kelp forests.



Alt. B Lofoten Vestfjord

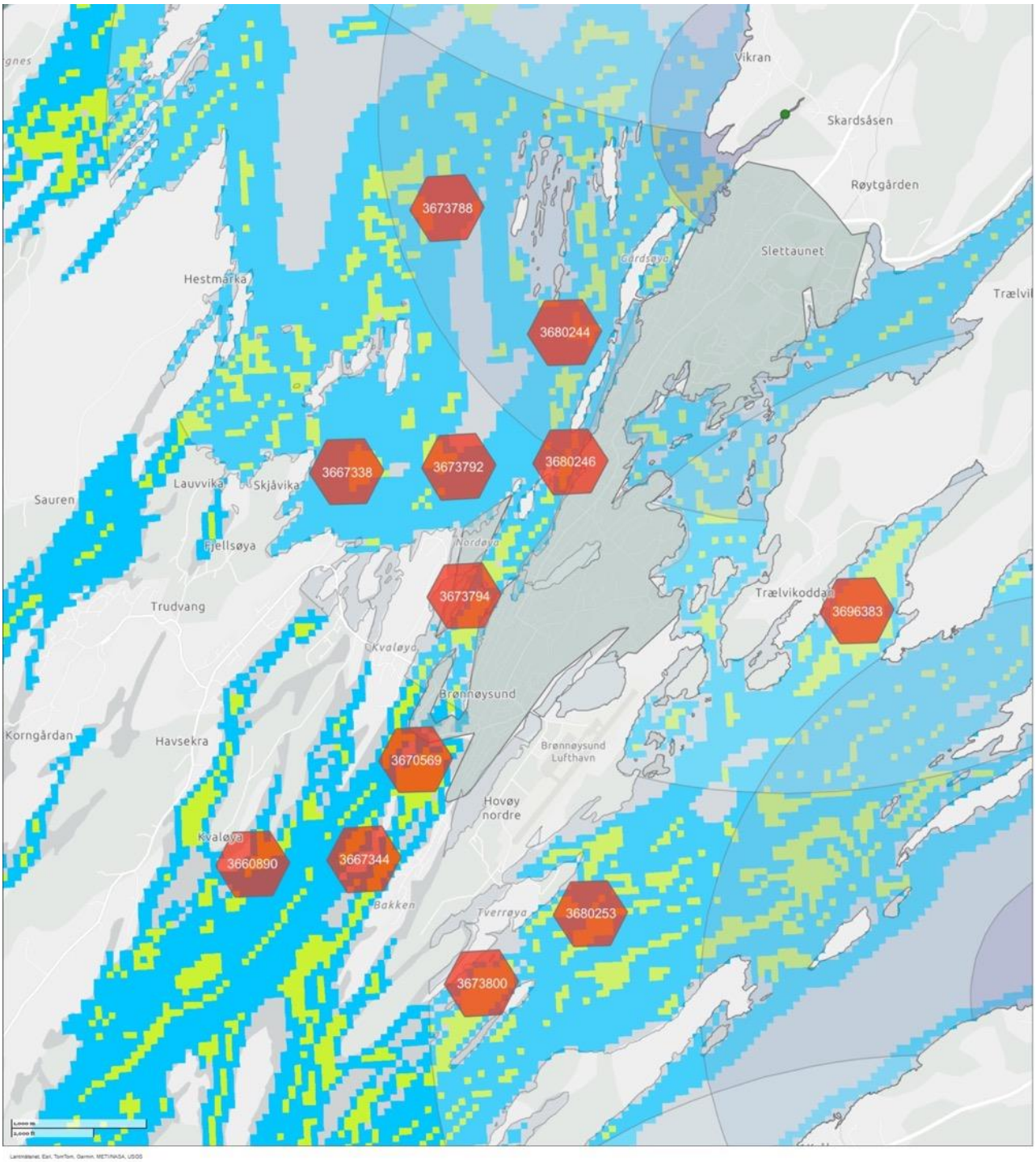
Svolvær is a known fishing harbour, with populated areas along the coastline. The area is closer to the OSPAR beach in the zone than Bodø is, although still on the other (southern) side of Lofoten.



OSPAR Zone 6

Brønnøysund

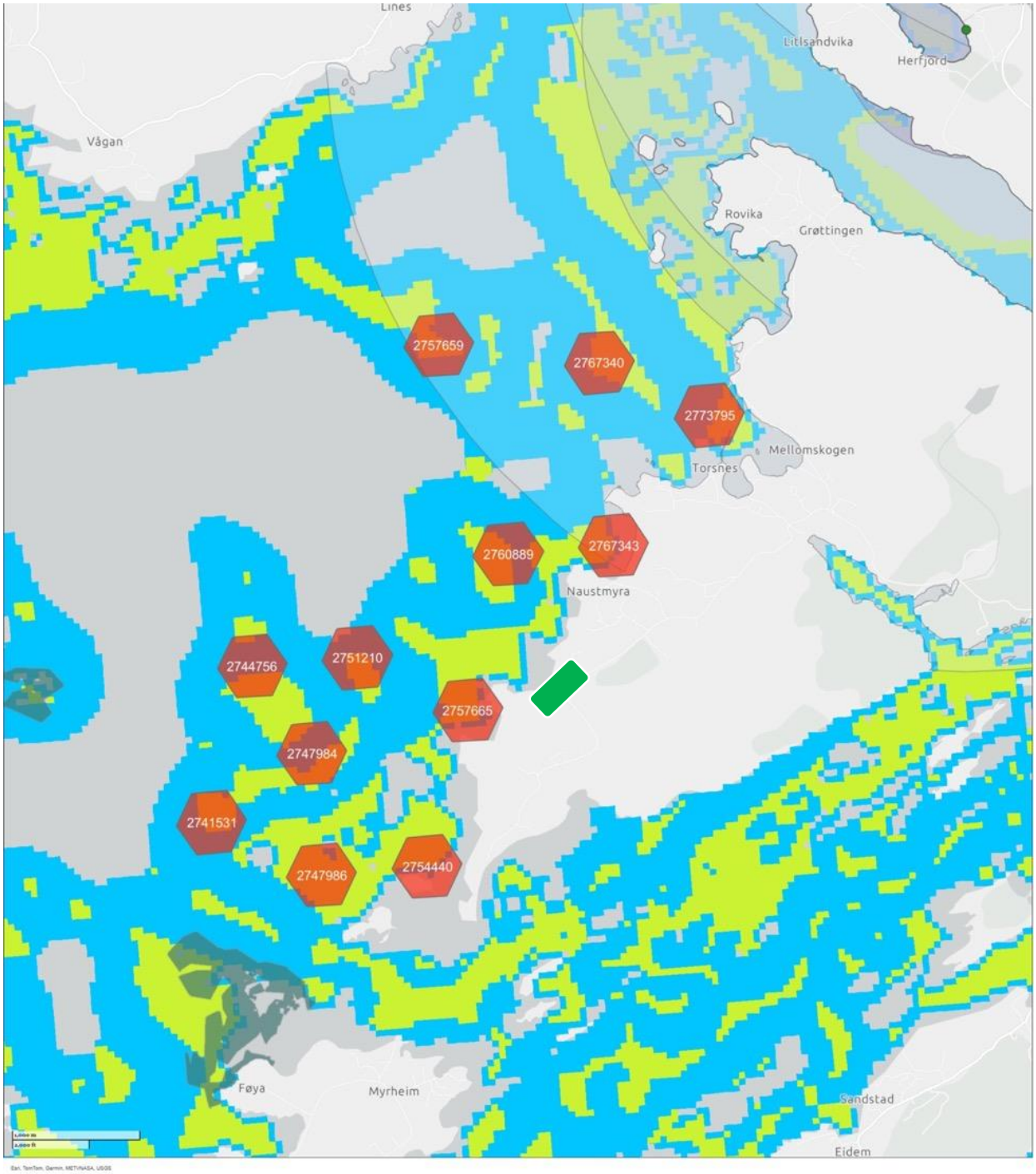
There are few areas within the OSPAR zone suitable with regards to depth, and areas outside Søla are exposed and harder to access. Hence, the area outside of Brønnøysund is suggested.



OSPAR Zone 7

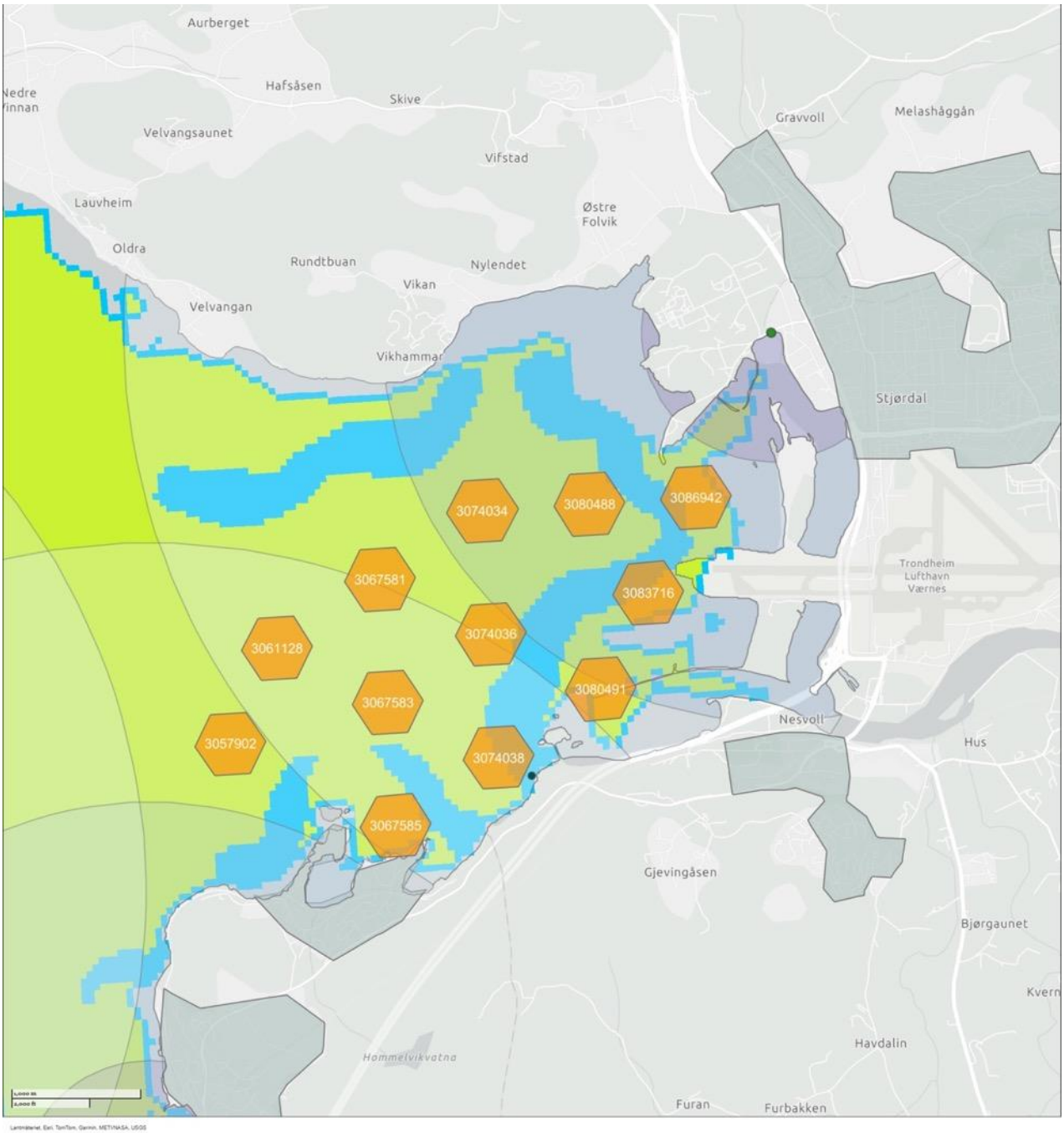
Alt A. Kleivvika OSPAR beach

The OSPAR beach is not located close to populated areas and with few river outlets in its proximity. It is however located along the coastline, in contrast to the B alternative which is situated in the Trondheim fjord.



Alt. B Stjørdal

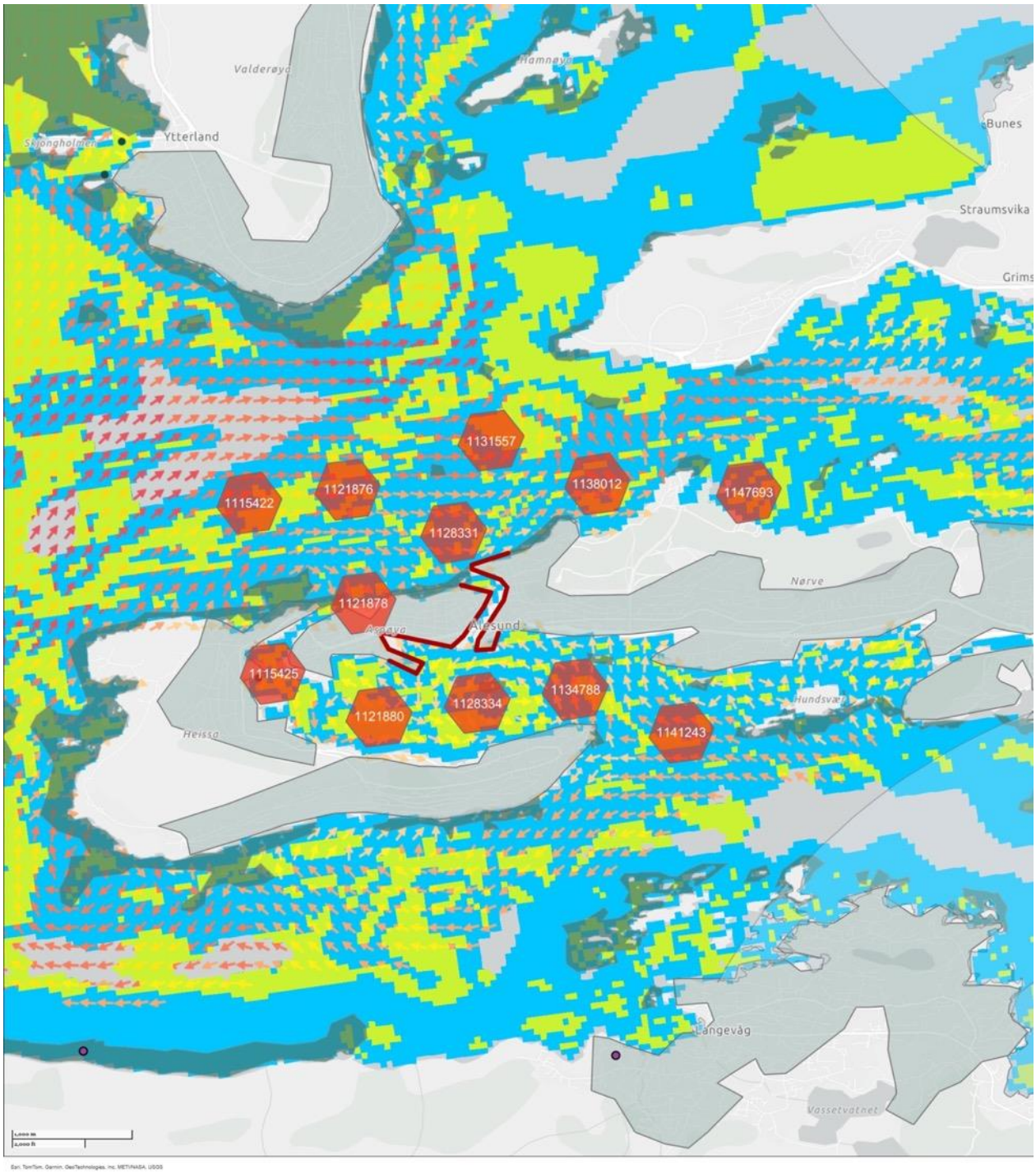
The area is well populated, close to the city of Trondheim and with a river outlet with significant industry activity and the Værnes Airport in its proximity. Suitable seabed conditions.



OSPAR Zone 8

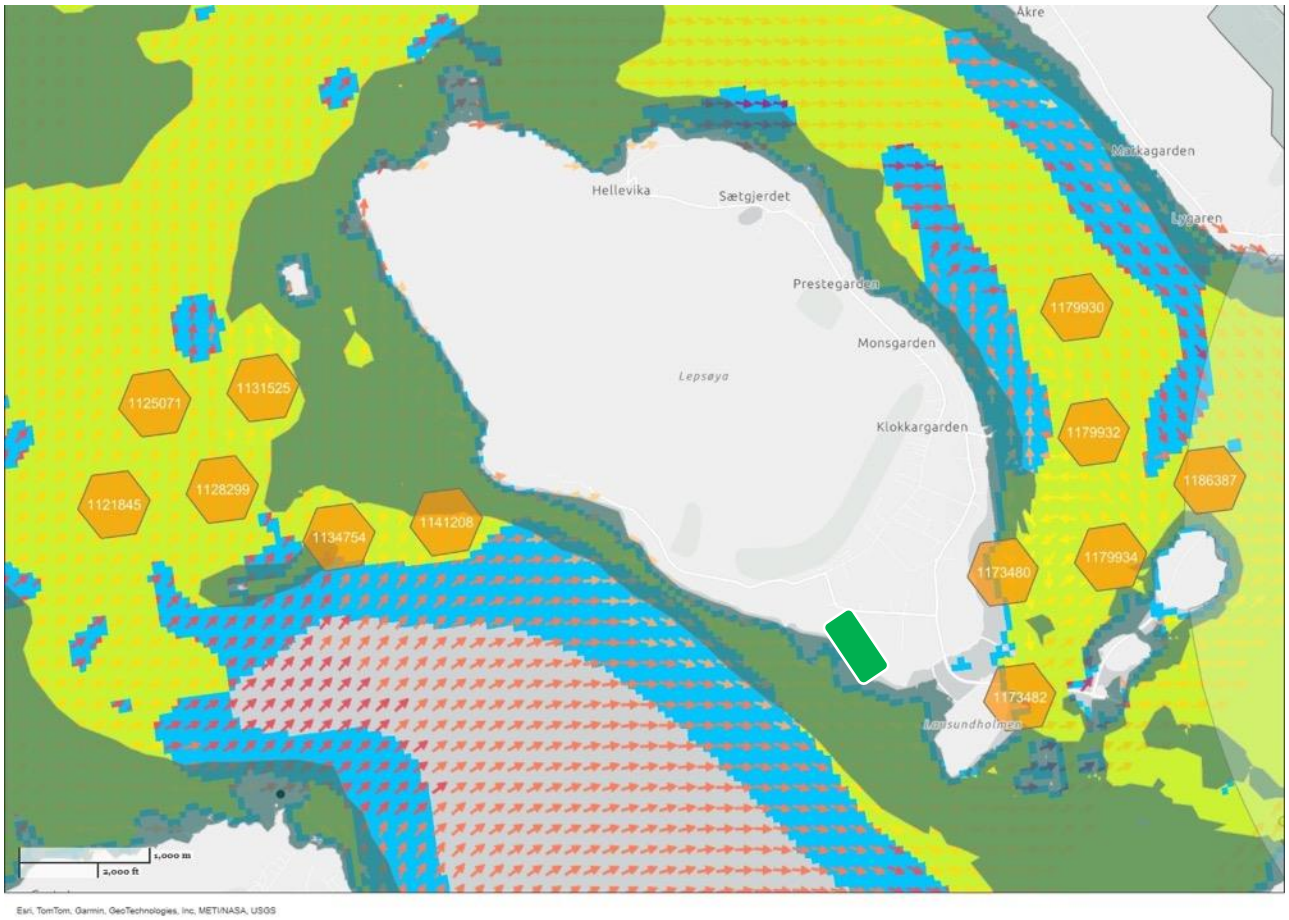
Alt. A Ålesund

Suitable seabed conditions around the city of Ålesund. A marine base map with data on sea current exists in the area and hexagons are placed with respect to current patterns.



Alt. B Lausundsanden OSPAR beach

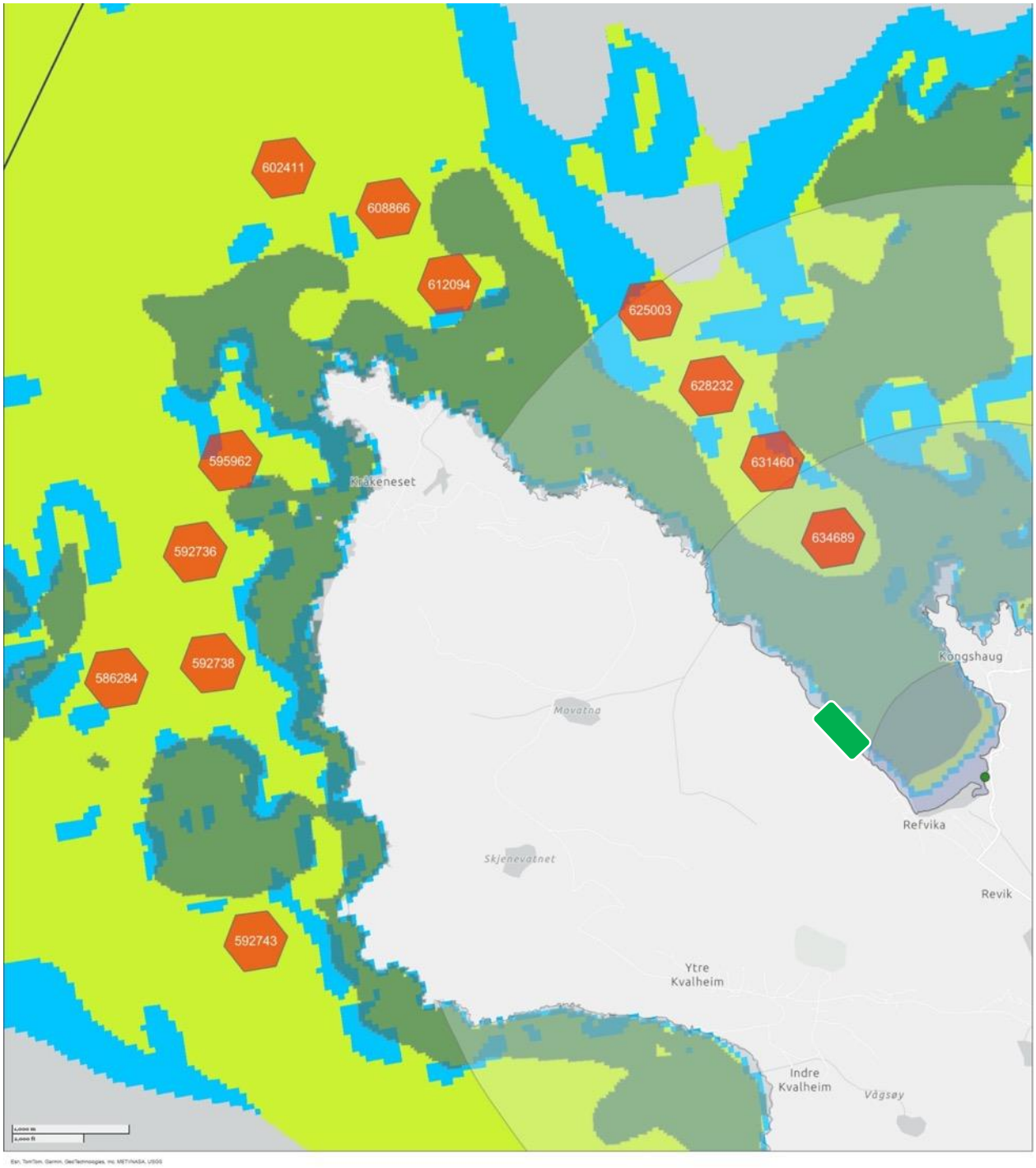
The area around the OSPAR beach Lausundsanden is suitable due to its proximity to a populated area and suitable seabed conditions. Attention to possible kelp forest needs to be taken in field.



OSPAR Zone 9

Nordfjord outlet – Rekevika OSPAR beach

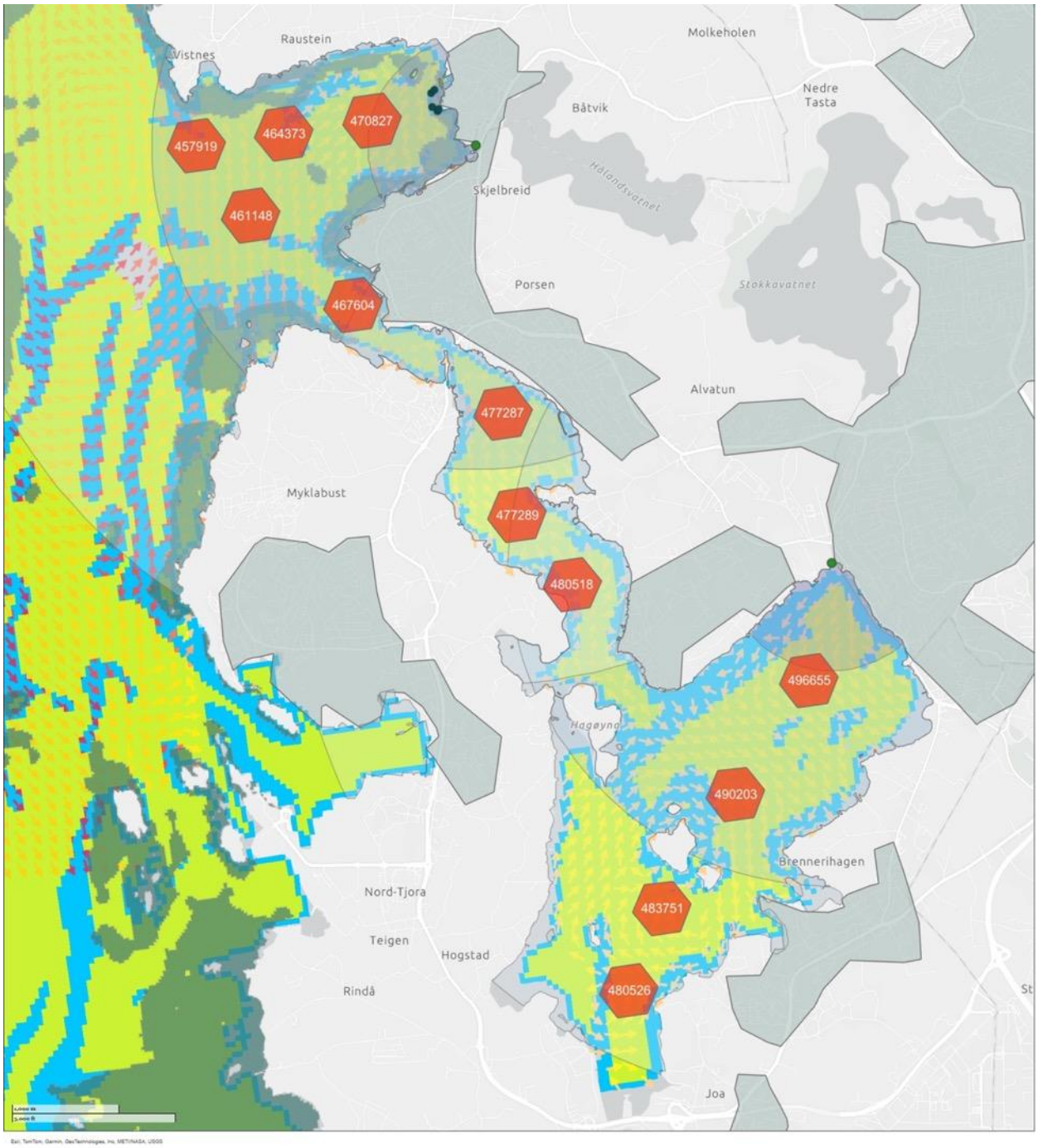
The area is located relatively close to the Rekevika OSPAR beach but further towards exposed sea. Attention to possible kelp forest in the area must be taken in field. Few other suitable areas of interest in the OSPAR zone.



OSPAR Zone 10

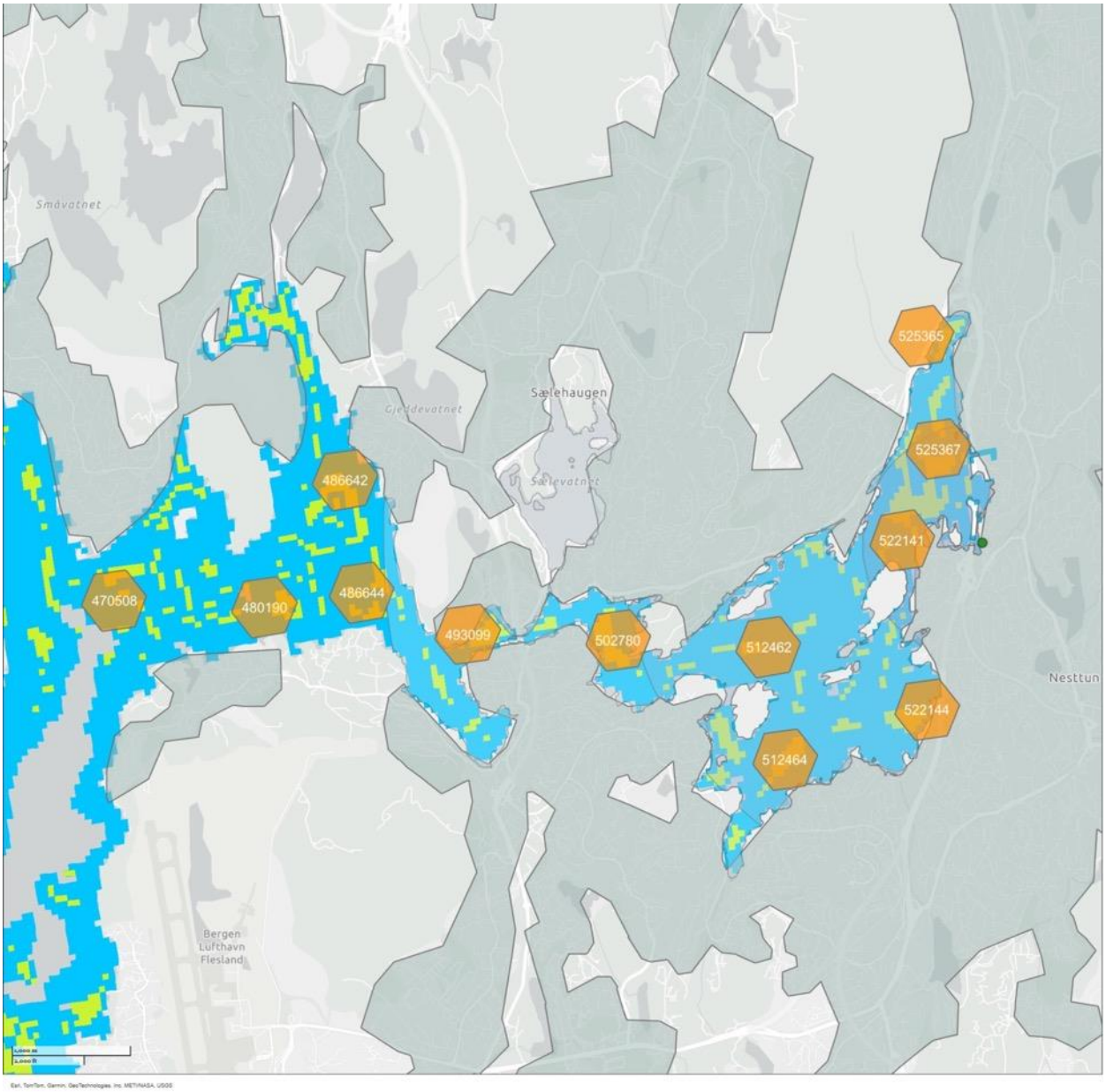
Alt. A Stavanger

Suitable seabed conditions outside the city of Stavanger make for an interesting monitoring area.



Alt. B Nesttun

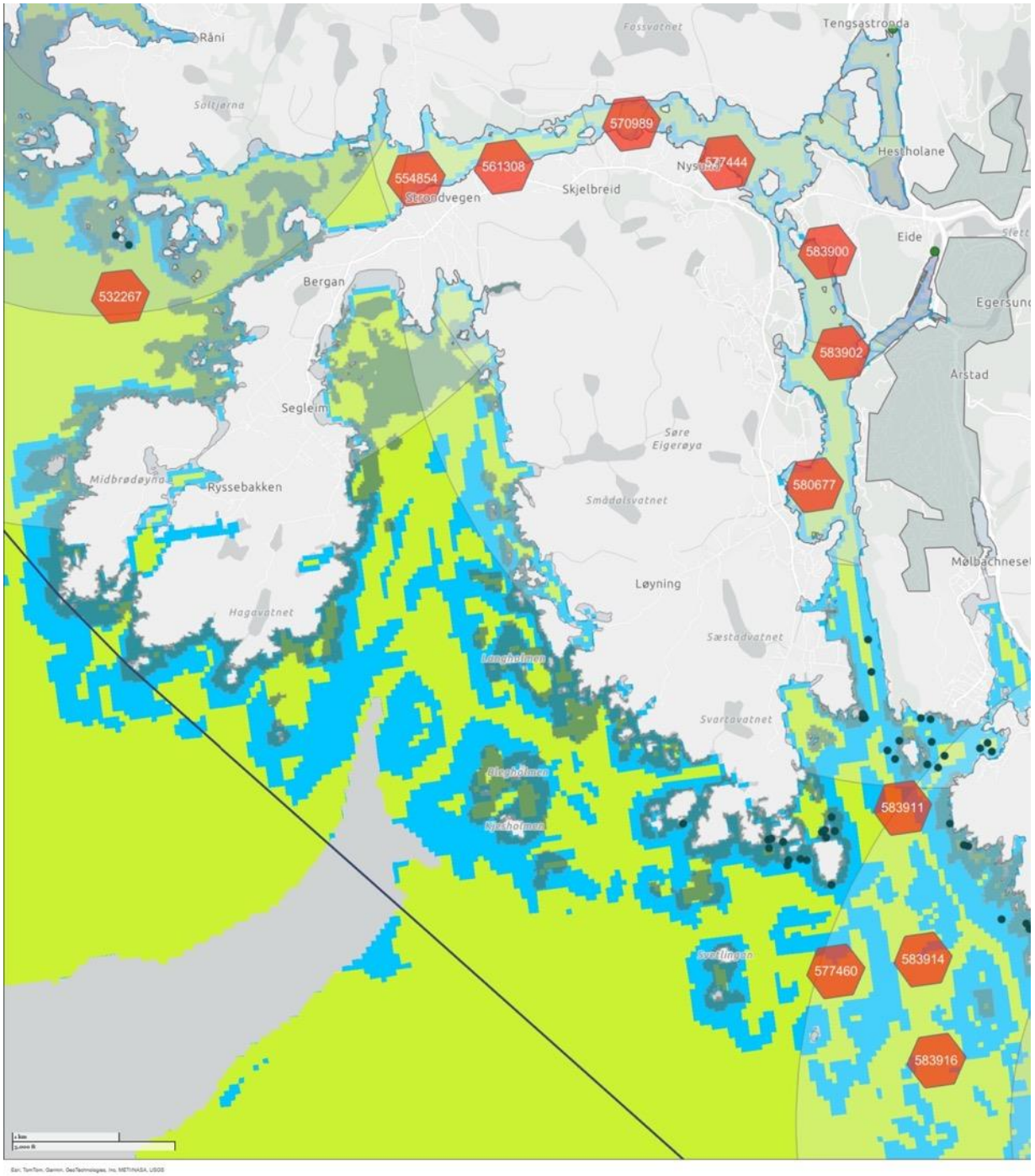
The sea outside Kvernavika OSPAR beach becomes too deep just offshore, hence not suitable, and the B alternative is therefore suggested outside Nesttun. The area is highly populated and is in the proximity of the city of Bergen. The marine areas outside the main harbour of Bergen city were too deep and did not accommodate for the placement of 12 hexagons, hence the marine area outside Nesttun were chosen instead.



OSPAR Zone 11

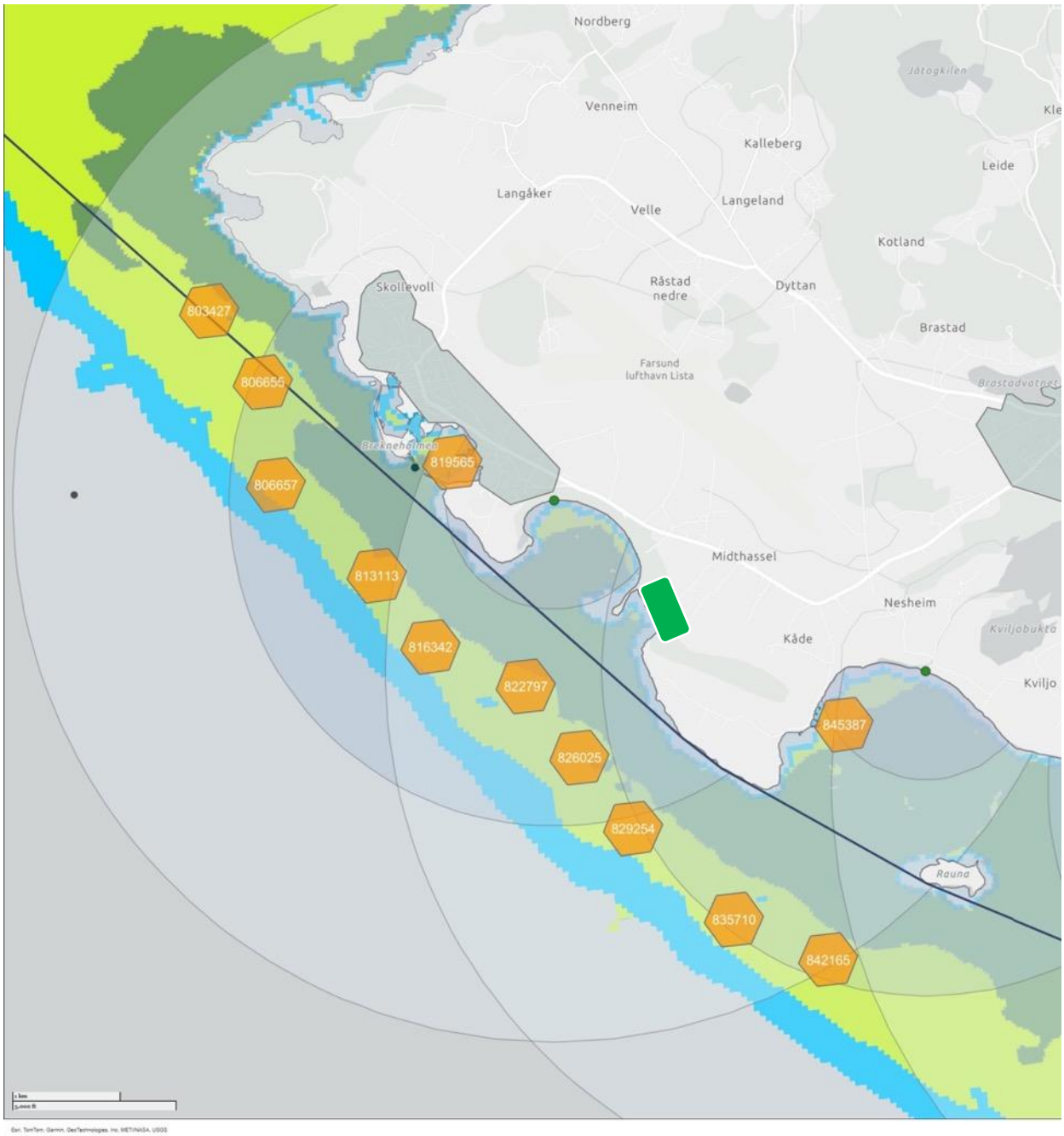
Alt. A Eigersund

Kristiansand is already an area selected within the zone as part of the pilot project. The area outside Eigersund is hence proposed as an alternative, relatively near the OSPAR beach Steinsvika in the zone.



Alt. B Steinsvika OSPAR beach

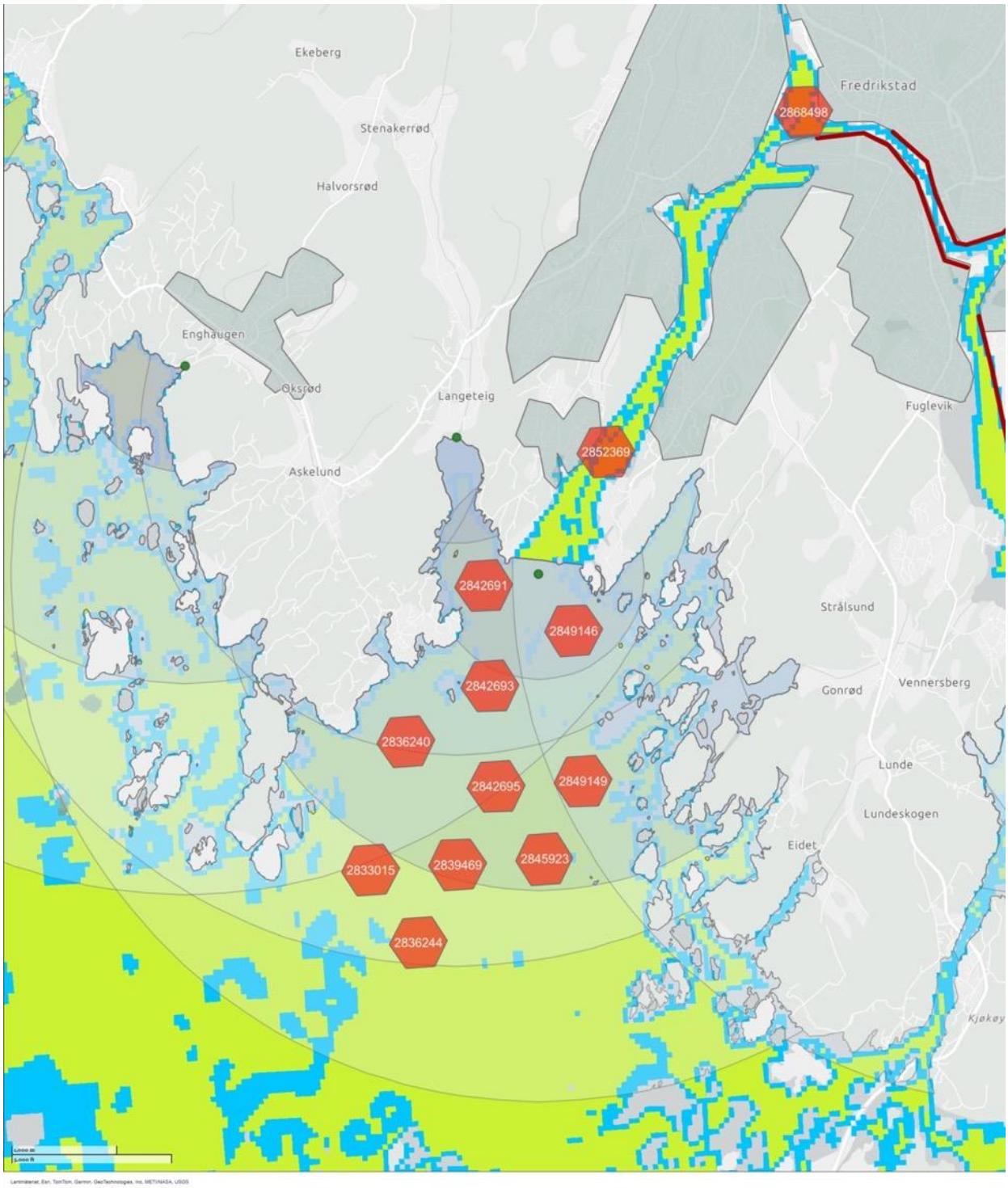
Exposed area but not in close proximity to major populated areas. Hexagons selected outside kelp forest areas, but attention must be taken to possible kelp forests in field.



OSPAR Zone 12

Fredrikstad

The area is situated near several major rivers and the city of Fredrikstad. It is also relatively close to the OSPAR beach Ytre Hvaler in the OSPAR zone.



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Sustainable coastal development