7 RECEIVING ENVIRONMENT

Block 5/6/7 is located within the southern Benguela Region. This chapter provides a description focusing on the West, South-West and South Coast regions and the physical, biological and socio-economic environment within the Project's area of influence. The extent of the effect of a proposed project activity on a particular physical, biological or social resource will vary and is termed the area of influence. An understanding of the environmental and social context and sensitivity within which the proposed project activities would be located is important for the consideration and assessment of the potential impacts.

7.1 PROJECT'S AREA OF INFLUENCE

The area of influence of the proposed exploration well drilling project defines the spatial extent of the baseline information and can be separated into the area of influence for normal operations and for unplanned events, summarised below:

- **Direct area of influence (normal operations)** (see Figure 7-1) will be confirmed based on the results of the underwater noise modelling and marine ecology / fisheries assessments.
  - Block 5/6/7 and specifically the Area of Interest for proposed exploration drilling within which project activities will take place (includes a 20 km buffer around the area of interest). These include drilling operations, refuelling at sea and maintenance of an operational safety zone during drilling;
  - Cape Town (port / harbour) as the most likely location for the onshore logistics base for the supply of equipment and materials, waste management and accommodation for staff. Saldanha Bay could also be considered as an alternative for the onshore base;
  - Airspace between airport and the drilling unit for helicopter-based crew changes;
  - Marine traffic routes between Cape Town (or possibly Saldanha) and the drilling unit; and
  - Indirect impacts on ecosystem services, such as commercial fishing areas, marine mammals, etc. due to underwater noise and safety exclusion zone which may extend beyond the Area of Interest.
- **Indirect area of influence (unplanned events)** will be confirmed based on the oil spill modelling results:
  - The coastal and nearshore region located landward of Block 5/6/7 and between approximately Port Nolloth on the West Coast and Gqeberha the South-East Coast that could be affected in the unlikely event of a well blow-out.

7.2 GEOPHYSICAL CHARACTERISTICS

7.2.1 Bathymetry

The continental shelf along the West Coast is generally wide and deep, although large variations in both depth and width occur. The shelf maintains a general north-north-west trend, widening north of Cape Columbine (between Saldanha Bay and St Helena Bay) and reaching its widest (180 km) off the Orange River (at the South African border with Namibia) (see Figure 7-2). The nature of the shelf break varies off the West Coast. The immediate inshore area (i.e. the area influenced by wave energy and light, at a depth ranging between 30 m and 50 m) consists mainly of a narrow (about 8 km wide) rugged rocky zone and slopes steeply seawards to a depth of around 80 m. The middle (50 m to 150 m) and outer shelf (150 m to 350 m) normally lacks relief and slopes gently seawards reaching the shelf edge at a depth of between 350 m to 500 m (Sink *et al.* 2019). North of Cape Columbine there is usually a double shelf break, with the distinct inner and outer slopes, separated by a gently sloping ledge.

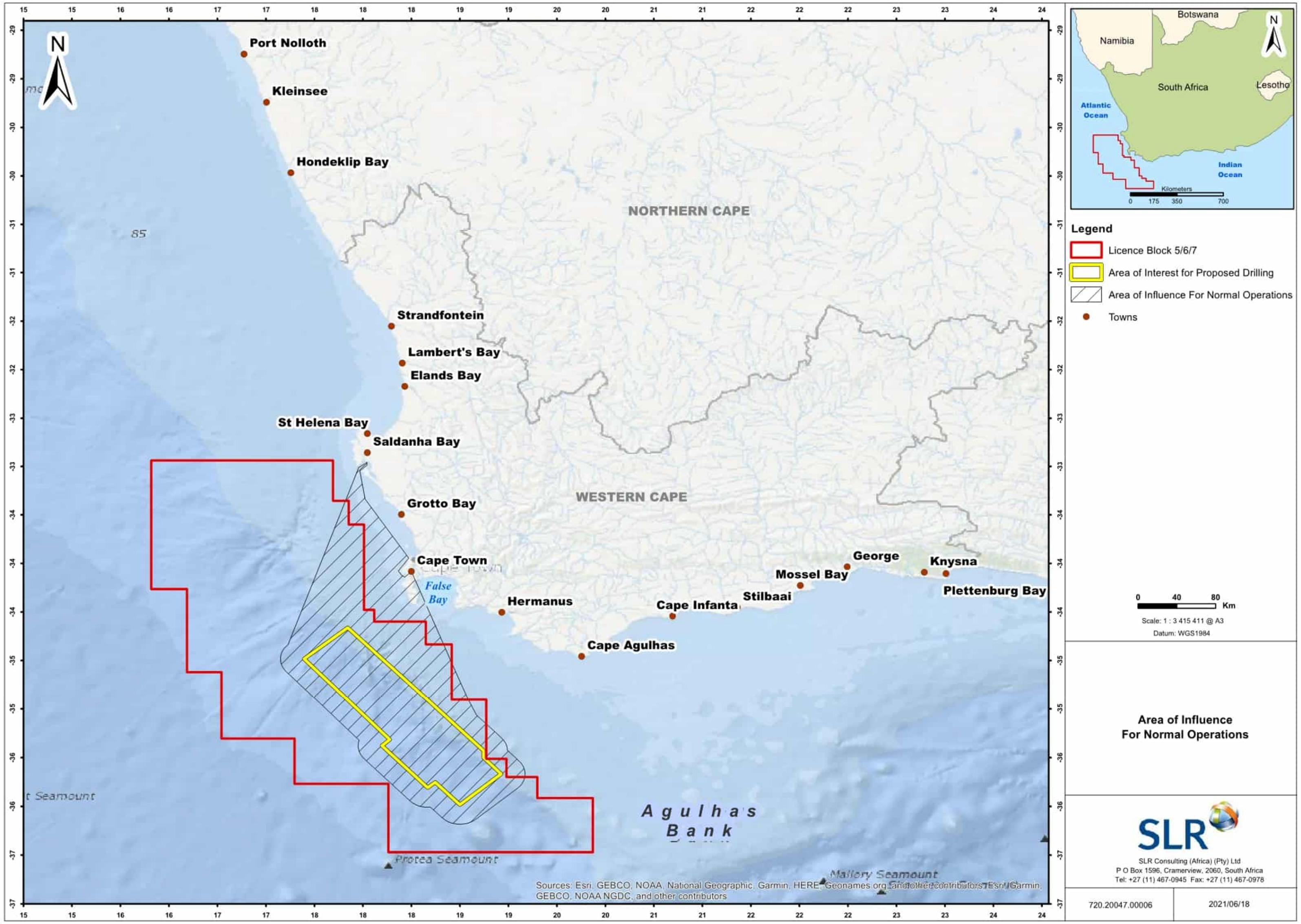

FIGURE 7-1: AREAS OF INFLUENCE DURING NORMAL OPERATIONS

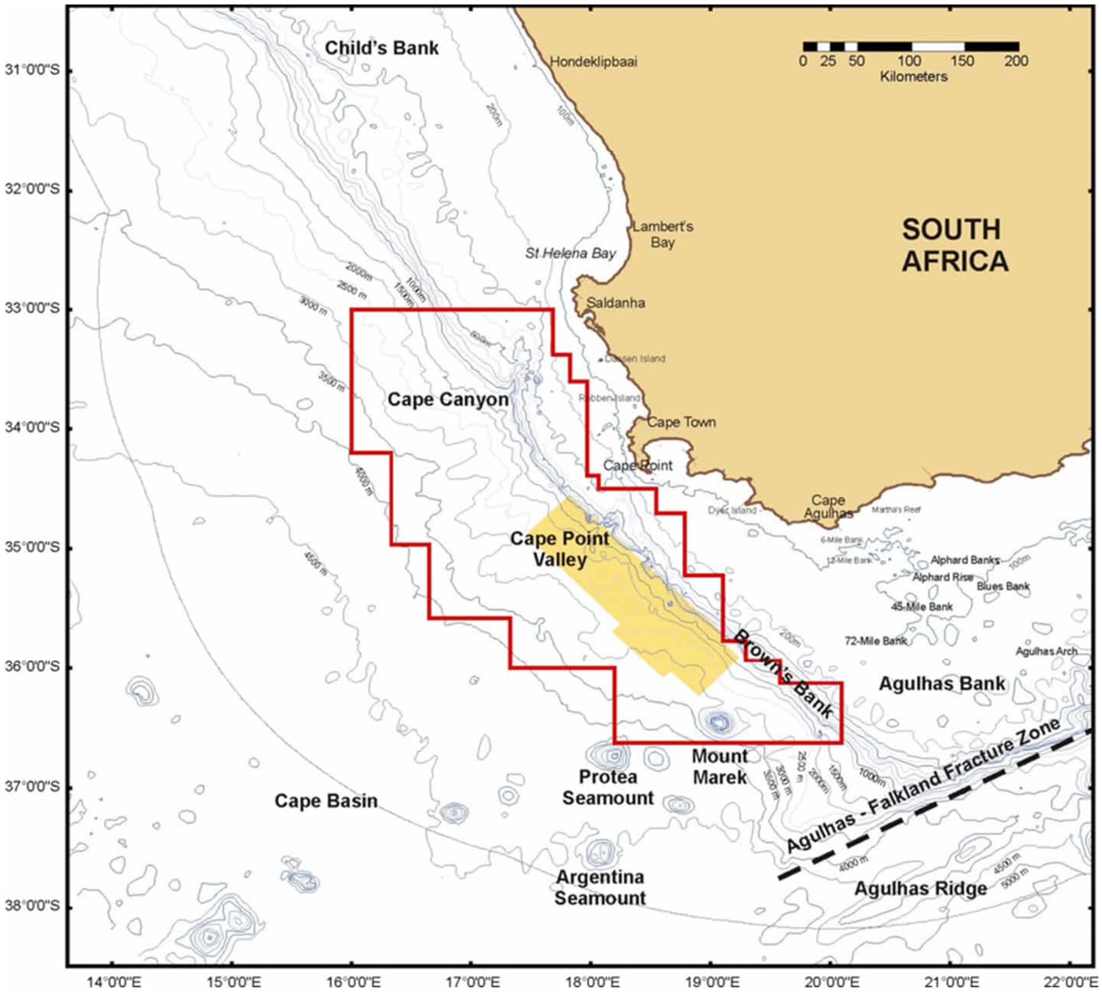

FIGURE 7-2: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO BATHYMETRY AND SEABED FEATURES OF THE SOUTH-WEST COAST

Source: Pisces

Along the South / East Coast, the bathymetry is characterised by a very narrow shelf, which widens in the region of Algoa Bay at Gqeberha (previously Port Elizabeth) to the east of the area of influence. Moving westwards, depth increases more gradually to the shelf break, which is located at a depth of 130 m off Cape St Francis and 300 m south of Cape Agulhas (Birch & Rogers 1973). Between 22° and 23°E, the shelf break indents towards the coast forming the Agulhas 'bight' (Schumann 1998). At the apex of the Agulhas Bank, an approximately 116 000 km^2 triangular-shaped extension of the continental shelf, the shelf widens to 250 km.

Major bathymetric features on the continental shelf from the West to the South Coasts include (see Figure 7-2):

- **Orange River Cone (of Shelf)**, which is a shallow (160 - 190 m) zone where the Benguela continental shelf widens to reach maximal widths (180 km) offshore of the Orange River **(over 400 km north of Block 5/6/7)**. The Orange River Cone (sometimes also referred to as the Orange Shelf or Orange Bank) is a transboundary area spanning the mouth of the Orange River. It represents the Orange River Holocene Delta (Rogers & Rau 2006) and is characterised by a wave-influenced and well-developed sandy, shallow delta front (0 m to 40 m water depth) and a pro-delta (40 m to 120 m water depth) comprising the terrigenous mud belt (Rogers 1977).

- **Child's Bank**, situated approximately 150 km offshore and **approximately 250 km north of Block 5/6/7**, is a major feature on the West Coast margin, rising from a depth of 350 m - 400 m water to less than 200 m at its shallowest point. It is a rounded, flat topped, sandy plateau, which is estimated to cover approximately 1 450 km^2 (Sink *et al.* 2012b). The bank has a gentle northern, eastern and southern margin but a steep, slump-generated outer face (Birch & Rogers 1973; Dingle *et al.* 1983; de Wet 2013). At its south-western edge, the continental slope drops down steeply from 350 m to 1 500 m over a distance of less than 60 km (de Wet 2013) creating precipitous cliffs at least 150 m high (Birch & Rogers 1973).
- The **Cape Canyon, located in the northern part of Block 5/6/7,** forms a well-developed trench on the continental shelf, 100 m deep and 4 km wide (Wigley 2004; Wigley & Compton 2006), characterised by unconsolidated sediments in the form of sands and faecal pellet-rich Holocene mud. South of Cape Columbine, the canyon becomes progressively narrower and deeper. Adjacent to Cape Town at a water depth of 1 500 m, the canyon has a local relief in the order of 500 m – 800 m (Simpson & Forder 1968; Dingle *et al*. 1987). The Cape Canyon has a longitudinal extent of at least 200 km and can be traced to a water depth of at least 3 600 m (Dingle 1970), where the topography of the distal end is rugged and complex (Dingle et al. 1987). The canyon serves as an upwelling feature funnelling cold, nutrient-rich South Atlantic Central Water up the canyon slope providing highly productive surface waters, which in turn power feeding grounds for cetaceans and seabirds (Filander 2018; www.environment.gov.za/ dearesearchteamreturnfromdeepseaexpedition).
- The **Cape Point Valley, which lies about 70 km south of the Cape Peninsula and overlaps with the Area of Interest**, is another large canyon breaching the shelf. This canyon has sustained the highest fishing effort and catches in the South African demersal trawl fishery for almost a century (www.marineprotectedareas.org.za/canyons). Palan (2017) identified numerous **submarine canyon systems** within Block 5/6/7, most of which are less extensive than the Cape Canyon and Cape Point Valley (refer to as the Hope Canyon by Palan 2017) and do not incise the shelf (see Figure 7-3).
- The **Cape Rise** comprises a group of north-east/south-west trending seamounts known as the Southeast Atlantic Seamounts and the recently discovered Mount Marek. The **Southeast Atlantic Seamounts** include the **Argentina and Protea Seamounts, which lie 20 km and 75 km south of the southern boundary of the Licence Block, respectively**. They were formed by volcanic activity and are recognised as biological hotspots, which results from their steep slopes that interact with currents to carry nutrients from the ocean to the sunlit surface waters. **Mount Marek, which lies within the southern boundary of Block 5/6/7** and south of Brown's Bank on the western shelf edge of the Agulhas Bank, is considered a different ecosystem type, namely **Southeast Atlantic Slope Seamount**. These seamounts rise up from 2 500 m depth in the Cape Basin abyss to 700 m deep.
- **Agulhas Bank** includes various banks (Alphard, 6-Mile, 12-Mile, 45-Mile and 72-Mile Banks, and the "Blues" and "Brown's" Banks), situated south of Cape Infanta and off Cape Agulhas (Birch & Rogers 1973). **Brown's Bank**, which forms part of the Brown's Bank Corals MPA (see Section 7.5.1), lies on the western edge of the Agulhas Bank and **in the south-eastern corner of Block 5/6/7**.
- The **Agulhas Ridge** is a positive relief feature rising more than 3 km above the surrounding seafloor and forms part of the Agulhas-Falkland Fracture Zone (Ben-Avraham *et al.* 1997; Uenzelmann-Neben & Gohl 2004). This approximately 2 500 km long linear feature, located between the southern margin of South Africa and the northern edge of the Falkland Plateau separates the Cape Basin and the Agulhas Basin (Ben-Avraham *et al.* 1997; Schut *et al.* 2002; Uenzelmann-Neben & Gohl, 2004). To the west of the Agulhas Ridge lies the Cape Basin and the prominent Southeast Atlantic seamounts discussed above.

The water depths in Block 5/6/7 range from approximately 150 m to 4 000 m, whereas within the Area of Interest for proposed exploration drilling water depths range from 700 m to 3 200 m.

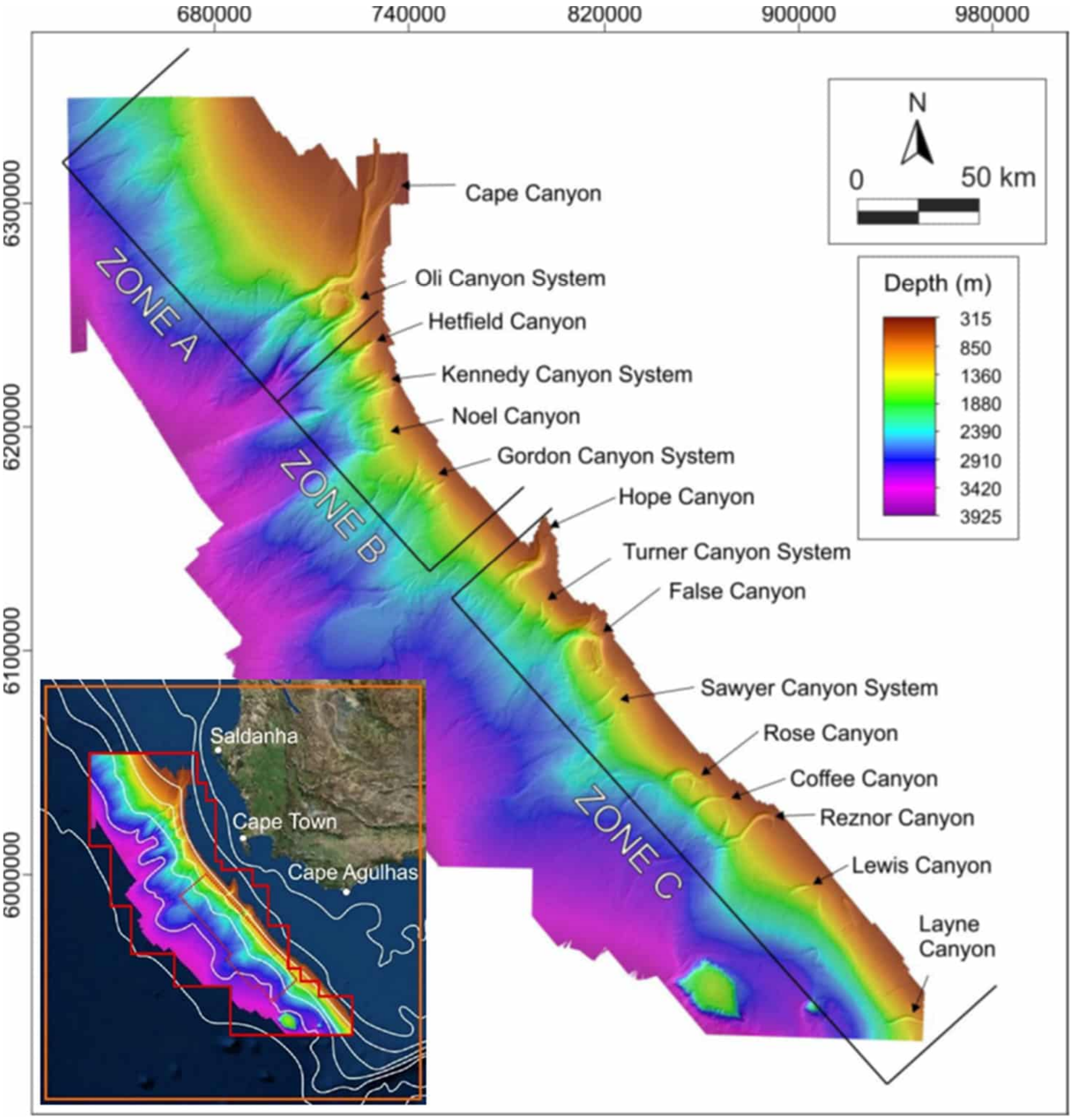

FIGURE 7-3: SUBMARINE CANYON DOMAINS OF THE SOUTHWESTERN CAPE CONTINENTAL MARGIN IDENTIFIED BY PALAN (2017)

Note: Insert shows the locality of the study area within Block 5/6/7
Adapted from Palan 2017

7.2.2 Coastal and Inner-Shelf Geology and Seabed Geomorphology

Figure 7-4 illustrates the distribution of seabed surface sediment types off the South-West Coast. The inner shelf is underlain by Precambrian bedrock (Pre-Mesozoic basement), whilst the middle and outer shelf areas are composed of Cretaceous and Tertiary sediments (Dingle 1973; Dingle *et al.* 1987; Birch *et al.* 1976; Rogers 1977; Rogers & Bremner 1991). As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input. An approximately 500-km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated over the inner shelf between the Orange River and St Helena Bay (Birch *et al.* 1976). Further offshore and **within Block 5/6/7 sediment is dominated by muds and sandy muds**. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

Although sediment distribution studies (Rogers & Bremner 1991) suggest that the outer shelf is characterised by unconsolidated sediments (see Figure 7-4), recent surveys conducted between 180 m and 480 m depth offshore of the Northern Cape coast revealed high proportions of hard ground rather than unconsolidated sediment, although this requires further verification (Karenyi unpublished data). **The occurrence of hard grounds in Block 5/6/7 is, therefore, likely.**

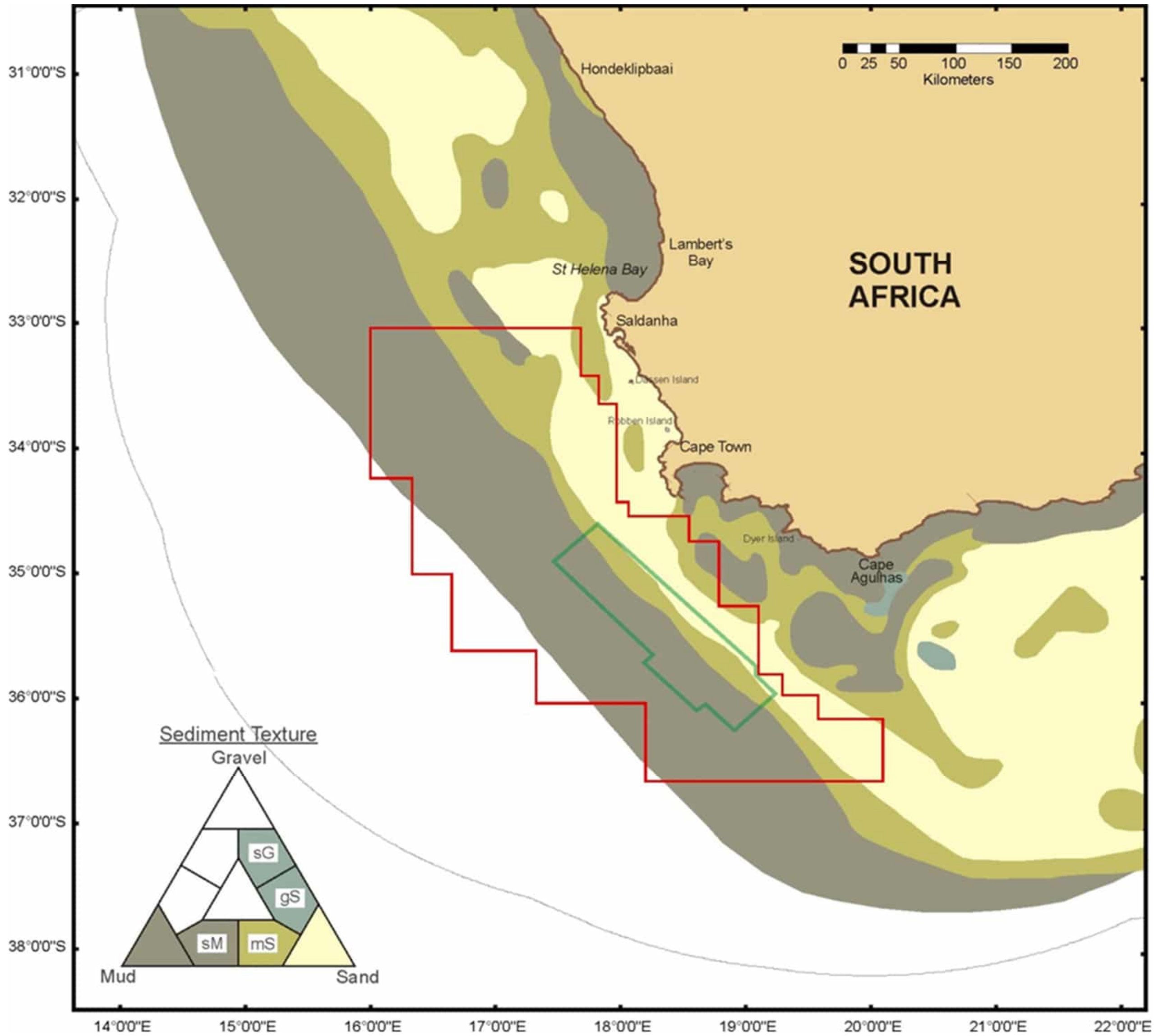

FIGURE 7-4: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO SEDIMENT DISTRIBUTION ON THE CONTINENTAL SHELF OF THE SOUTH-WEST COAST

Adapted from Rogers 1977

Scientific coring undertaken in Block 5/6/7 in 2008 confirmed the geologic profile in area (Hall *et al.* 2017 cited in BSL 2021). Cores were composed of light greenish grey, greenish grey and light olive-grey consolidated nannofossil ooze throughout the profile. No primary sedimentary structures were observed. Bioturbation was the only secondary sedimentary structure and was widespread throughout the cores. Intervals rich in sand-sized quartz and foraminifers within cores evidenced the deposition of sediment is associated with winnowing activity of currents. On average, the sediment grain size of the cores consisted of 70% (±9%) of clay, 19% (±6%) of silt, and 11% (±4%) of sand. The sediments within the cores were assigned to the 'mud' and 'sandy mud' Folk classification system and reflected the expected background sediments within the block. Bulk density profiles showed a linear increasing trend from the seafloor (1.49 g.cm^3) to 135 m core depth (1.83 g.cm^3). From 135 m to 289 m core depth, density values fluctuated around an average of 1.80±0.03 g.cm^3. At 289 m core depth, densities increased suddenly to 2g/cm^3 in the lowermost part of the hole. The average grain density was measured as 2.74±0.02 g/cm^3.

The benthic habitat / substratum types were classified and mapped in detail through the 2011 National Biodiversity Assessment (NBA) (Sink *et al.* 2012a) and refined in the 2018 NBA (Sink *et al.* 2019) (see Figure 7-5). **The Area of Interest for proposed exploration drilling in dominated by Southeast Atlantic Unclassified Slopes, with minor overlap with the Southeast Atlantic Canyons** (Sink *et al.* 2019)**.** Refer to Section 7.4.2.1 for a brief description of the ecosystem types.

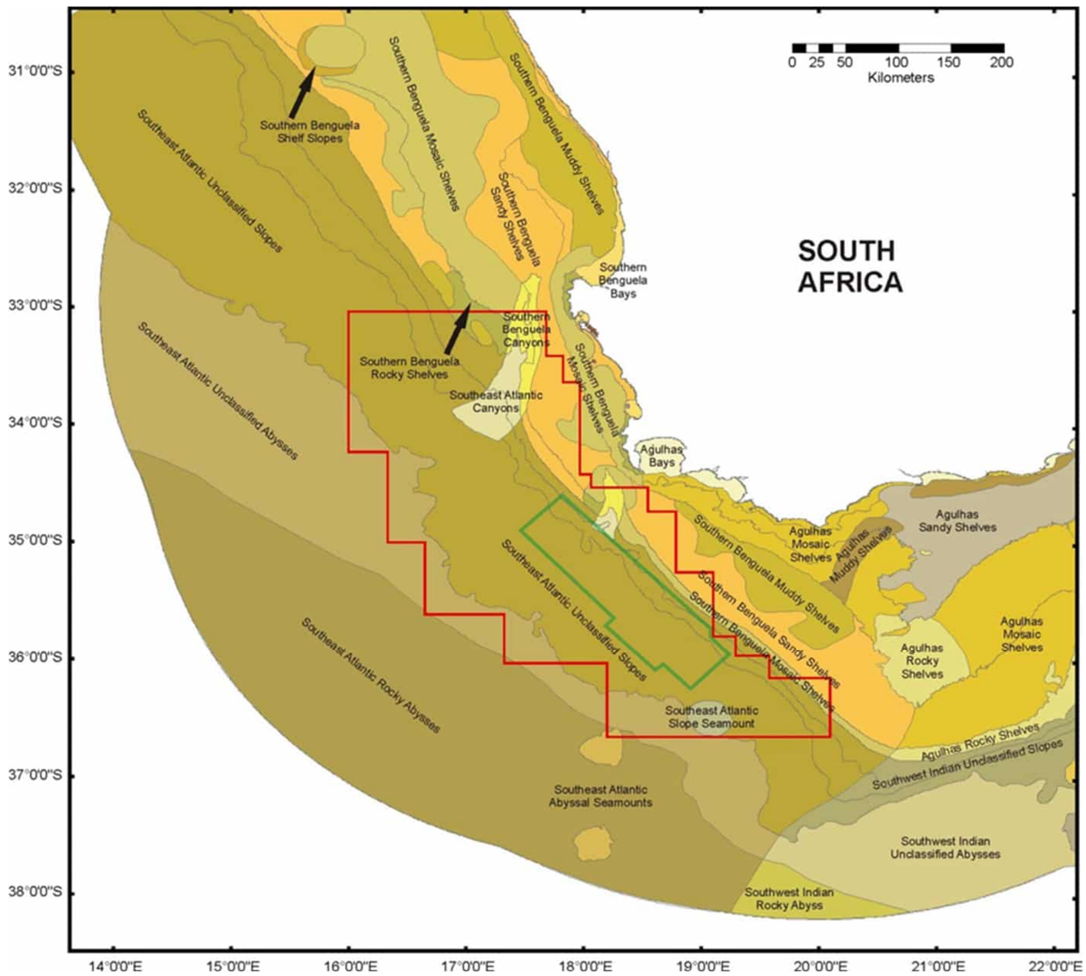

FIGURE 7-5: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE DISTRIBUTION OF SEABED SUBSTRATUM TYPES ALONG THE SOUTH-WEST COAST

Adapted from Sink *et al.* 2019

7.2.3 Sedimentary Phosphates

Phosphorite or phosphate-rich rock (i.e. sedimentary rock typically containing between 5%-20% phosphate) occurs in the marine environment either as a nodular hard ground capping of a few metres thick or as series of unconsolidated sediments (Morant 2013). Several types of sedimentary phosphates occur offshore and onshore in South Africa, the largest of which is the diagenetic replacement resource on the Agulhas Bank. This replacement phosphate resource occurs as near-continuous 'pavements' or cappings of limestones at depths between 200 m and 500 m on the continental shelf between Cape Agulhas and Cape Recife (Gqeberha), covering an approximate area of 21 500 km^2. Further sporadic phosphate mantles over the continental shelf are known to occur from Lamberts Bay, north to the mouth of the Orange River (see Figure 7-6).

The phosphate-rich rocks on the Agulhas Bank are estimated to have an average P_2O_5 content of 16.2%. With an area of 35 000 million m^2, an average thickness of 0.5 m, the Agulhas Bank offshore phosphate deposits are estimated to contain in the order of 5 000 million tonnes of P_2O_5 (Birch 1990). **The inshore portion of the Area of Interest for proposed exploration drilling overlaps marginally with phosphate-rich rocks.**

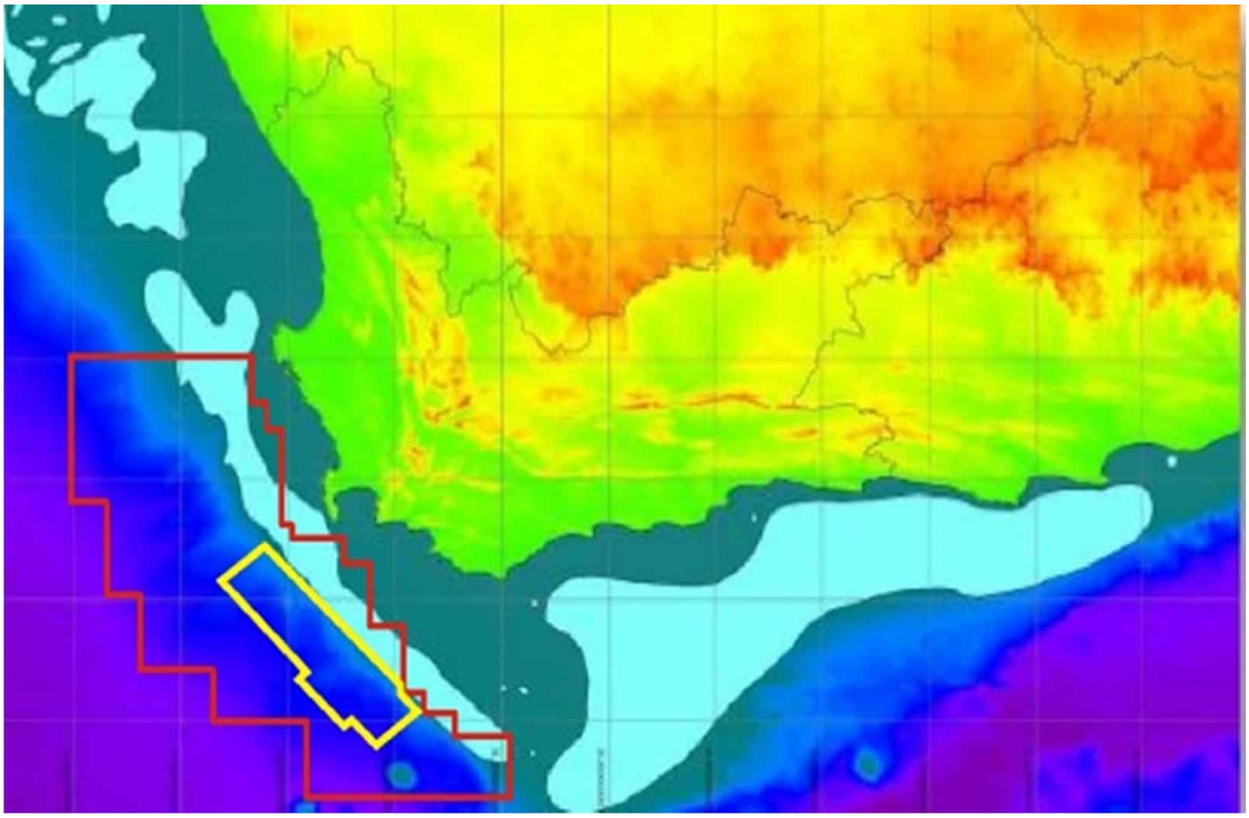

FIGURE 7-6: BLOCK 5/6/7 IN RELATION TO THE DISTRIBUTION OF PHOSPHORITE HARD GROUNDS (CYAN / LIGHT BLUE)

Adapted from Sink *et al.* 2019

7.3 BIOPHYSICAL CHARACTERISTICS

7.3.1 Climate

The climate along the West Coast of South Africa transitions from the Mediterranean winter (May to August) rainfall climate in the Western Cape, which occurs between Cape Town and Saldanha Bay, to arid conditions in Namaqualand to the north. Average minimum and maximum temperatures at Cape Towns are 15 and 26°C, respectively, in summer and approximately 7 to 18°C in winter. At Cape Columbine (between Saldanha Bay and St Helena Bay), average minimum and maximum temperatures are similar at approximately 13°C and 26.5°C in summer and approximately 7°C and 17.5°C in winter (CSAG 2020; BSL 2021).

Variability in precipitation is also influenced by the El Niño Southern Oscillation (ENSO). ENSO events are caused by changes in the temperature of the surface waters of the tropical Pacific Ocean and are characterised by two opposing patterns: El Niño and La Niña. During El Niño, unusual warming of the sea surface temperature occurs due to the weakening of the trade winds, which causes weakening of upwellings and changes in rainfall and temperature. South Africa experiences hotter and drier weather during the El Niño phase, while the La Niña brings cooler and wetter conditions (BSL 2021).

7.3.2 Wind Patterns

Winds are one of the main physical drivers of the nearshore Benguela Region, both on an oceanic scale, generating the heavy and consistent south-westerly swells that impact this coast, and locally, contributing to the northward-flowing longshore currents, and being the prime mover of sediments in the terrestrial environment. Consequently, physical processes are characterised by the average seasonal wind patterns, and substantial episodic changes in these wind patterns have strong effects on the entire Benguela region.

There are substantial differences between the typical summer and winter wind patterns in the region, as the southern hemisphere anti-cyclonic high-pressures system and the associated series of cold fronts, moves northwards in winter, and southwards in summer.

Most winds in summer come from the south to south-south-east (Figure 7-7 and Figure 7-8). These southerlies occur over 40% of the time, averaging 10 - 15 m/s and reaching speeds in excess of 31 m/s, bringing cool, moist air into the coastal region and driving the massive offshore movements of surface water, and the resultant strong upwelling of nutrient-rich bottom waters, which characterise this region in summer. These strong winds towards the equator are interrupted by the passing of coastal lows which are associated with periods of calm or north or north-west wind conditions. The northerlies occur throughout the year but are more frequent in winter.

Winter remains dominated by southerly to south-easterly winds, but the closer proximity of the winter cold-front systems results in a significant south-westerly to north-westerly component. This 'reversal' from summer condition results in cessation of upwelling, movement of warmer mid-Atlantic water shorewards and breakdown of the strong thermoclines that typically develop in summer. There are also more calms in winter, occurring approximately 3% of the time, and wind speeds generally do not reach the maximum speeds of summer. As the westerly winds blow in synchrony with the prevailing south-westerly swell direction, this results in heavier swell conditions in winter.

The winds in the offshore environment of Block 5/6/7 are less extreme than closer to the coast (NCEP 2012). **However, during winter the westerly winds blow in synchrony with the prevailing south-westerly swell direction, resulting in heavier swell conditions.** Modelled maximum winds speeds for Block 5/6/7 (20 years data) exceeded 20 m/s with a 95 percentile of about 16 m/s in the austral winter where wind directions prevailed west-northwest. In the austral summer, winds prevailed from the south-east with a simulated maximum wind speed reported at 20 m/s with a 95th percentile speed of 13 m/s (Figure 7-9; Fugro, 2018).

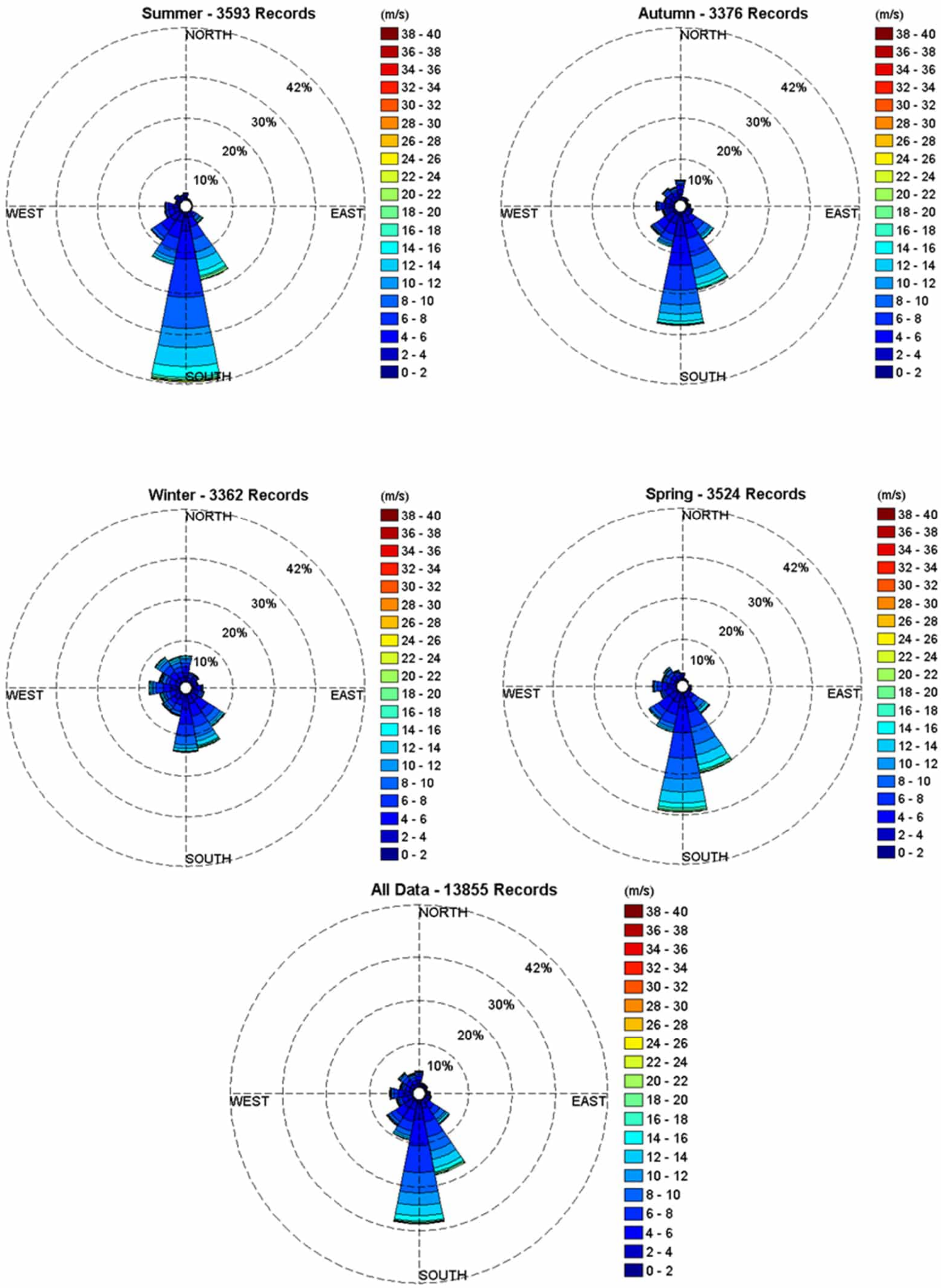

FIGURE 7-7: WIND SPEED VS. WIND DIRECTION DATA FOR THE CAPE COLUMBINE AREA 32.0 TO 32.9 S AND 17.0 TO 17.9 E (1903-11-01 TO 2011-05-24; 13,855 RECORDS)

Source: CSIR

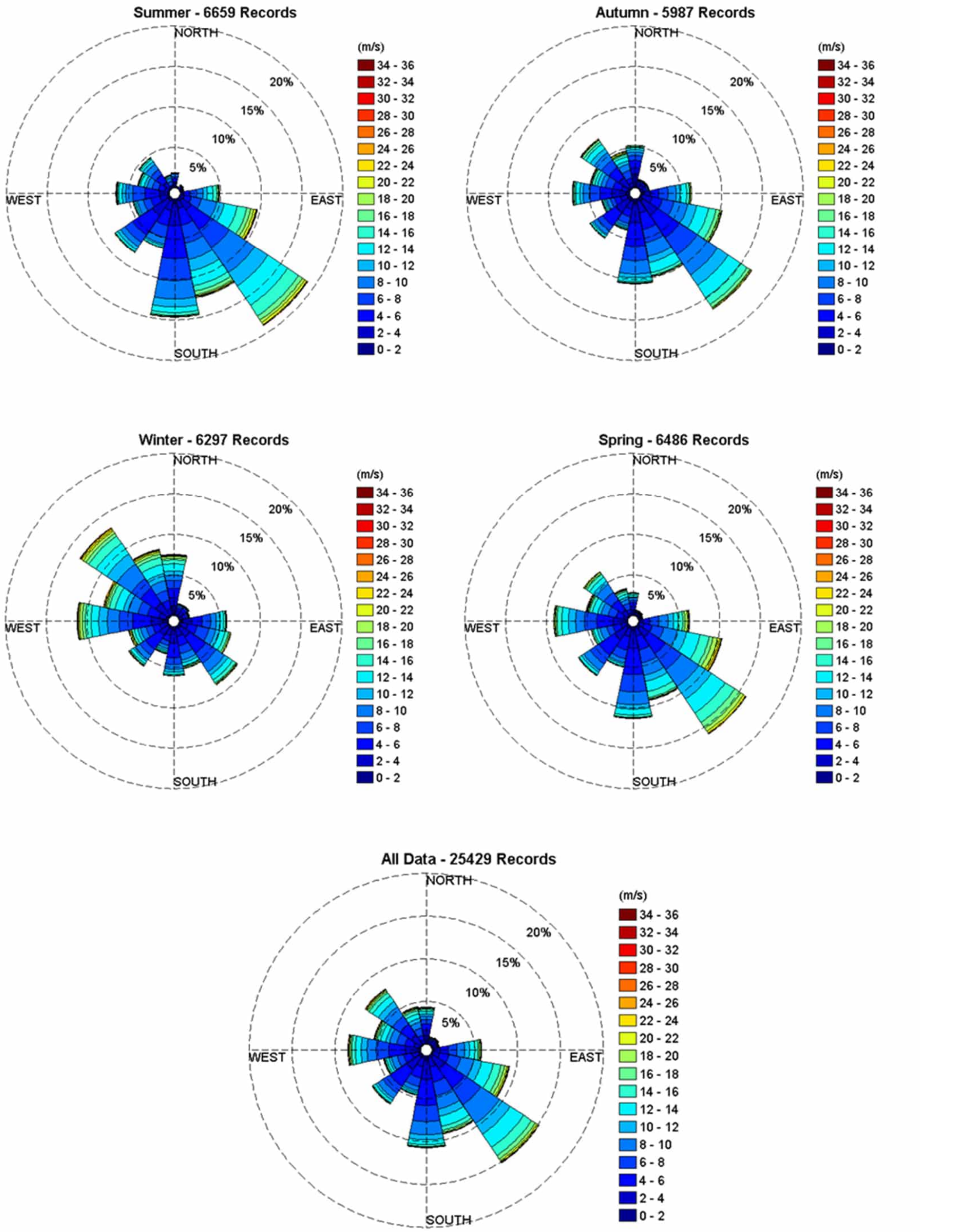

FIGURE 7-8: WIND SPEED VS. WIND DIRECTION DATA FOR THE CAPE POINT AREA 34.0 TO 34.9 S AND 18.0 TO 18.9 E (1900-01-01 TO 2011-05-24; 25,429 RECORDS)

Source: CSIR

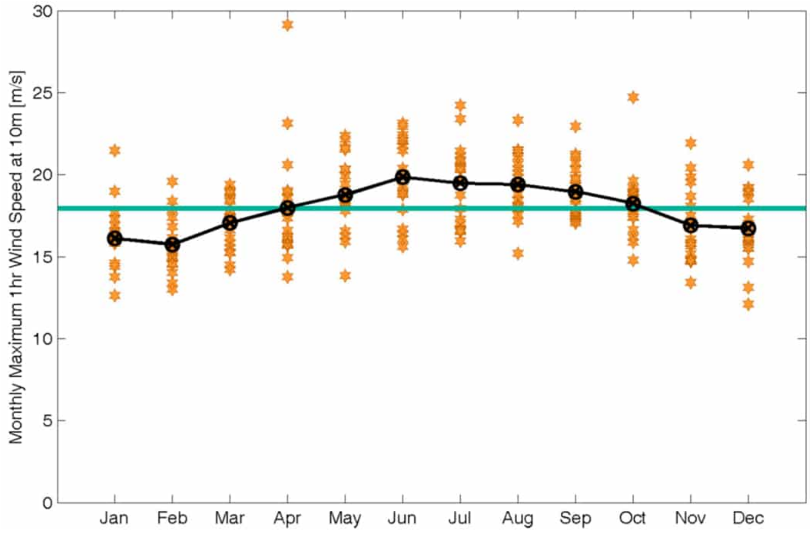

FIGURE 7-9: MONTHLY MAXIMUM WIND SPEED PER YEAR (STARS), ALL YEARS (SOLID CIRCLES) AND ALL-TIME AVERAGE (CYAN LINE)

Source: Fugro 2018

7.3.3 Large-Scale Water Circulation, Coastal Currents and Upwelling

Block 5/6/7 is primarily located within the Southern Benguela system, although the southern portion of the Block falls within the Agulhas Retroflection area (see Figure 7-10)**.**

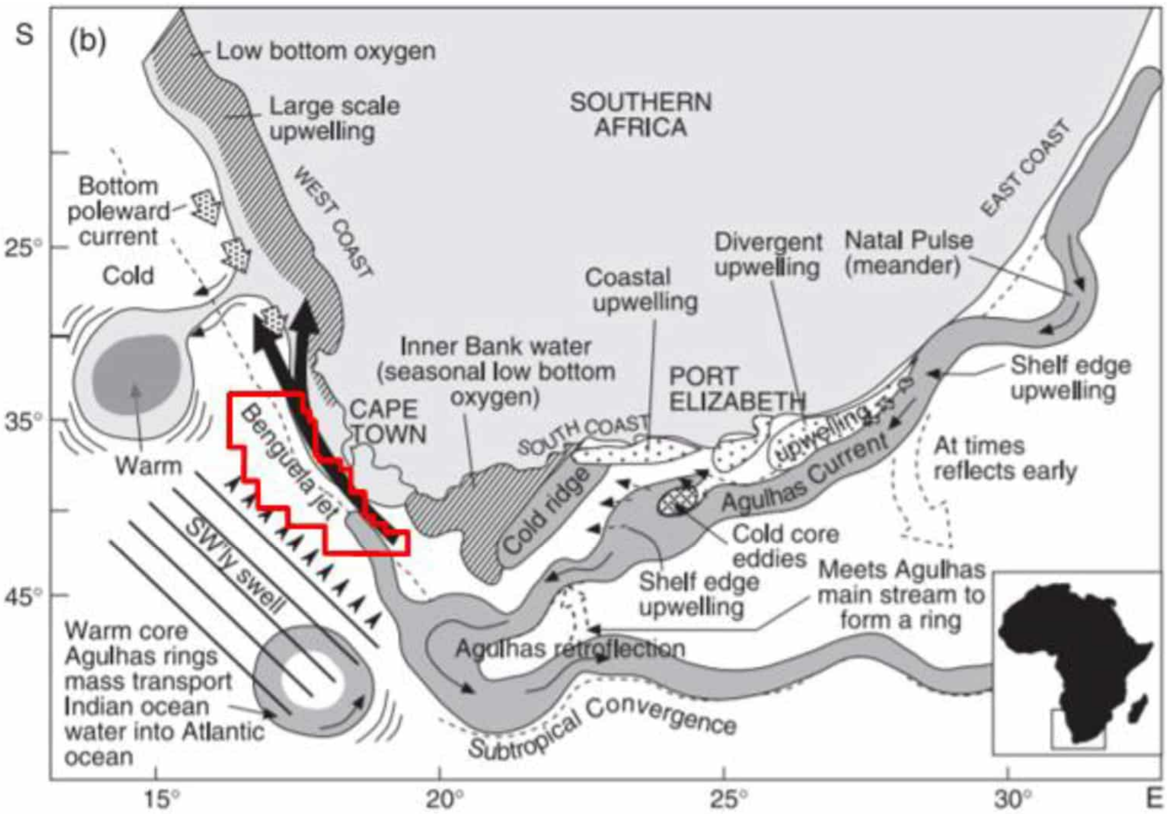

FIGURE 7-10: OCEANOGRAPHIC CURRENTS ON THE SOUTH AFRICAN COAST IN RELATION TO THE APPROXIMATE LOCATION OF LICENCE BLOCK 5/6/7

Source: Adapted from: Roberts, 2005

The southern African West Coast is strongly influenced by the cold Benguela Current (see Figure 7-11**)**. Current velocities in continental shelf areas generally range between 0.1–0.3 m/s (Boyd & Oberholster 1994). On its western side, flow is more transient and characterised by large eddies shed from the retroflection of the Agulhas Current. This results in considerable variation in current speed and direction over the domain. In the south the Benguela Current has a width of 200 km, widening rapidly northwards to 750 km. The surface flows are predominantly wind-forced, barotropic and fluctuate between poleward and equatorward flow (Shillington et al. 1990; Nelson & Hutchings 1983). The most energetic currents are restricted to the upper 750 – 1 000 m of the water column. Current speeds decrease with depth, while directions rotate from predominantly north-westerly at the surface to south-easterly near the seabed. Near bottom shelf flow is mainly poleward with low velocities of typically <0.05 m/s (Nelson 1989; PRDW 2013). The poleward flow becomes more consistent in the southern Benguela and appear to be strongest at depths between 300 m and 1 000 m (Nelson 1989).

The oceanography of the South Coast is almost totally dominated by the warm Agulhas Current. The current forms between 25° and 30° S, flowing southwards along the shelf edge of the southern African East Coast (Schumann 1998) as part of the anticyclonic Indian Ocean gyre (see Figure 7-11). On the eastern half of the South Coast, the Agulhas Current flows along the shelf break at speeds of up to 3 m/sec, diverging inshore of the shelf break south of Still Bay before realigning to the shelf break off Cape Agulhas (Heydorn & Tinley 1980). The Agulhas Current may produce large meanders with cross shelf dimensions of approximately 130 km, which move downstream at approximately 20 km per day (Lutjeharms 2006). It may also shed eddies, which travel at around 0.2 m/s and transfer heat onto the Agulhas Bank (Swart & Largier 1987; Penven *et al.* 2001).

Where the Agulhas Current passes the southern tip of the Agulhas Bank (Agulhas Retroflection area), filaments of warm surface water and huge warm-water rings may occasionally break off from the main current and slowly spin off into the South Atlantic, carrying heat, salt and some pelagic plants and animals characteristic of the Agulhas Current far into the South Atlantic Ocean (Gründlingh 1988; Luschi *et al.* 2003a, 2003b; Lutjeharms 2006). These rings may extend to the seafloor and west of Cape Town may split, disperse or join with other rings. During the process of ring formation, intrusions of cold subantarctic water moves into the South Atlantic. **The contrast in warm (nutrient-poor) and cold (nutrient-rich) water is thought to be reflected in the presence of cetaceans and large migratory pelagic fish species** (Best 2007). This movement of surface waters from the Indian Ocean to the Atlantic is an important component of the global circulation of water, maintaining the input of heat and salt into the Atlantic Ocean (Peeters et al. 2004; Beal *et al.* 2011). After detaching from the shelf edge at 15°E, the Agulhas Current retroflects and flows eastwards as the Agulhas Return Current (Schumann 1998). The Return Current navigates through shallower features such as the Agulhas Plateau, which result in wide meanders along the eastern edge of the Agulhas Bank in the direction of the equator (see Figure 7-11).

A major feature of the Benguela Current is coastal upwelling and the consequent high nutrient supply to surface waters leads to high biological production and large fish stocks. The prevailing longshore winds towards the equator move nearshore surface water northwards and offshore. To balance the displaced water, cold, deeper water wells up inshore. Although the rate and intensity of upwelling fluctuates with seasonal variations in wind patterns, the most intense upwelling tends to occur where the shelf is narrowest and the wind strongest. **There are three upwelling centres in the southern Benguela, namely the Namaqua (30°S), Cape Columbine (33°S) and Cape Point (34°S) upwelling cells** (Taunton-Clark 1985) (see Figure 7-12). Upwelling in these cells is seasonal, with maximum upwelling occurring between September and March. **Block 5/6/7 is located on the**

western edge of the Cape Point and Cape Columbine upwelling events, but the Area of Interest for drilling is located to the south of these upwelling cells.

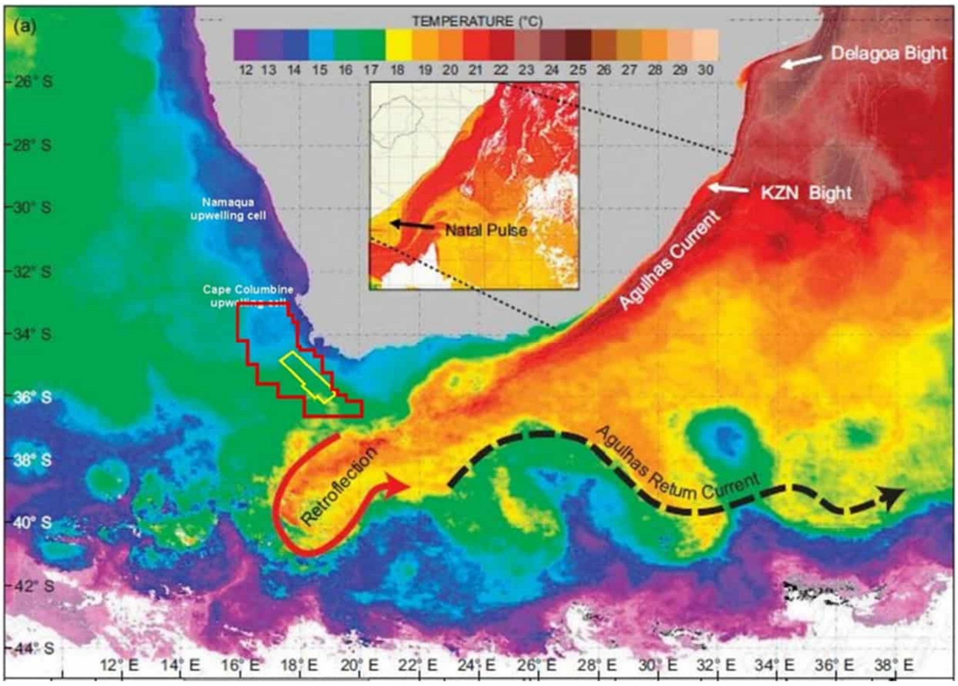

FIGURE 7-11: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO SEA-SURFACE TEMPERATURE

Adapted from Roberts *et al.* 2010

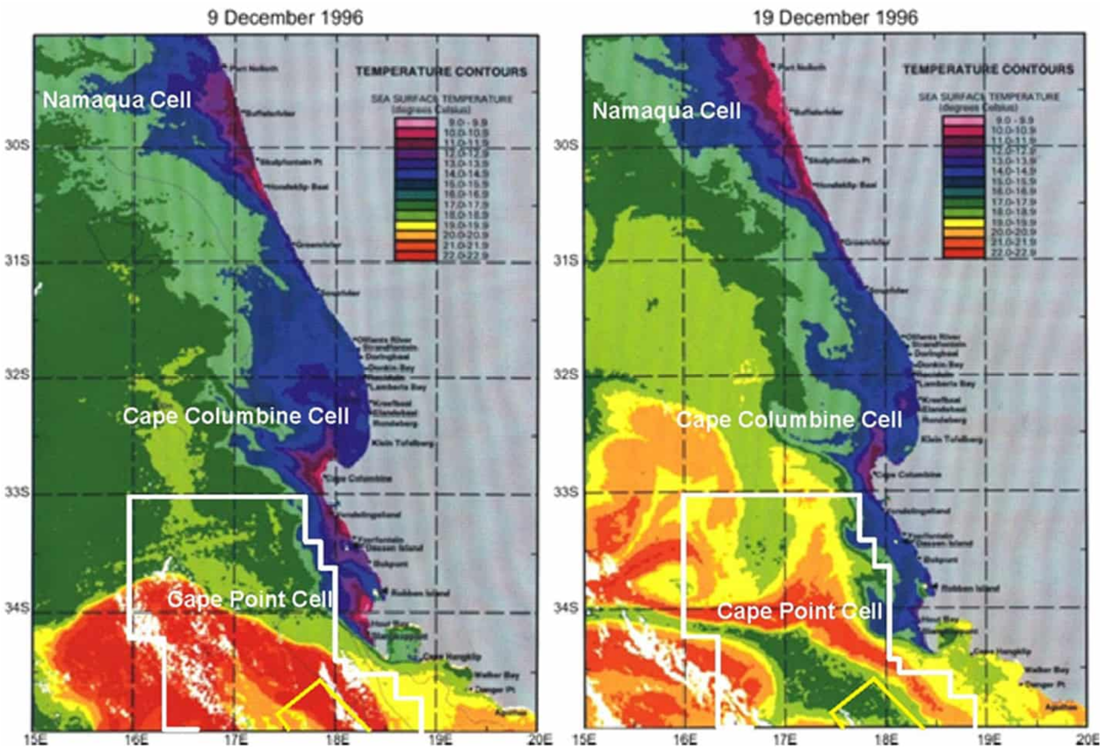

FIGURE 7-12: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO SEA-SURFACE TEMPERATURE SHOWING UPWELLING INTENSITY ALONG THE WEST COAST ON TWO DAYS IN DECEMBER 1996

Adapted from Lane & Carter 1999

7.3.4 Waves and Tides

Most of the South-West Coast is classified as exposed, experiencing strong wave action (McLachlan 1980). Much of the coastline is therefore impacted by heavy south-westerly swells, as well as significant sea waves generated locally by the prevailing moderate to strong southerly winds characteristic of the region.

Typical seasonal swell-height rose-plots are shown in Figure 7-13 and Figure 7-14. The wave regime along the West Coast shows only moderate seasonal variation in direction, with virtually all swells throughout the year coming from the south and south-south-west direction. **Winter swells are strongly dominated by those from the south and south-south-west, which occur almost 80% of the time, and typically exceed 2 m in height, averaging about 3 m, and often attaining over 5 m.**

In comparison, **during the summer there is a slightly more pronounced southerly swell component and swells tend to be smaller on average, typically around 2 m, not reaching the maximum swell heights of winter.** These wind-induced southerly waves are relatively local and, although less powerful, tend to work together with the strong southerly winds of summer to cause the northward-flowing nearshore surface currents, and result in substantial nearshore sediment mobilisation, and northwards transport, by the combined action of currents, wind and waves.

In common with the rest of the southern African coast, **tides are semi-diurnal** (i.e. two equally high and equally low tides during a day), with a total range of some 1.5 m at spring tide, but only 0.6 m during neap tide periods. **Tidal influence in the offshore regions of Block 5/6/7 will be minimal**.

7.3.5 Water Mass Characteristics

South Atlantic Central Water (SACW) comprises the bulk of the seawater in the study area, either in its pure form in the deeper regions, or mixed with previously upwelled water of the same origin on the continental shelf (Nelson & Hutchings 1983). Salinities range between 34.5‰ and 35.5‰ (Shannon 1985).

More recently, Rommerskirchen *et al.* (2011) described the physical structure of the Benguela Upwelling System comprising relatively warm, highly saline, oxygen rich and nutrient-poor North Atlantic Deep Water (NADW) at depths of between 2 500 m and 4 000 m. Below this lies Lower Circumpolar Deep Water (LCDW), whereas Upper Circumpolar Deep Water (UCDW) occurs between about 2 500 m and 1 000 m, with Antarctic Intermediate Water (AAIW) occurring above this to depths of ~500 m. South Atlantic surface waters down to depths of ~400 m are warmer (~15°C to 23°C) and more saline (~35.4 to 36.0 PSU) than the underlying AAIW (temperature: 6°C to 16°C; salinity: 34.5 to 35.5 PSU), leading to the development of a strong permanent thermocline.

Well-developed thermal fronts exist, demarcating the seaward boundary of the upwelled water. Upwelling filaments are characteristic of these offshore thermal fronts, occurring as surface streamers of cold water, typically 50 km wide and extending beyond the normal offshore extent of the upwelling cell. Such fronts typically have a lifespan of a few days to a few weeks, with the filamentous mixing area extending up to 625 km offshore. South and east of Cape Agulhas, the Agulhas retroflection area is a global “hot spot” in terms of temperature variability and water movements (see Figure 7-11).

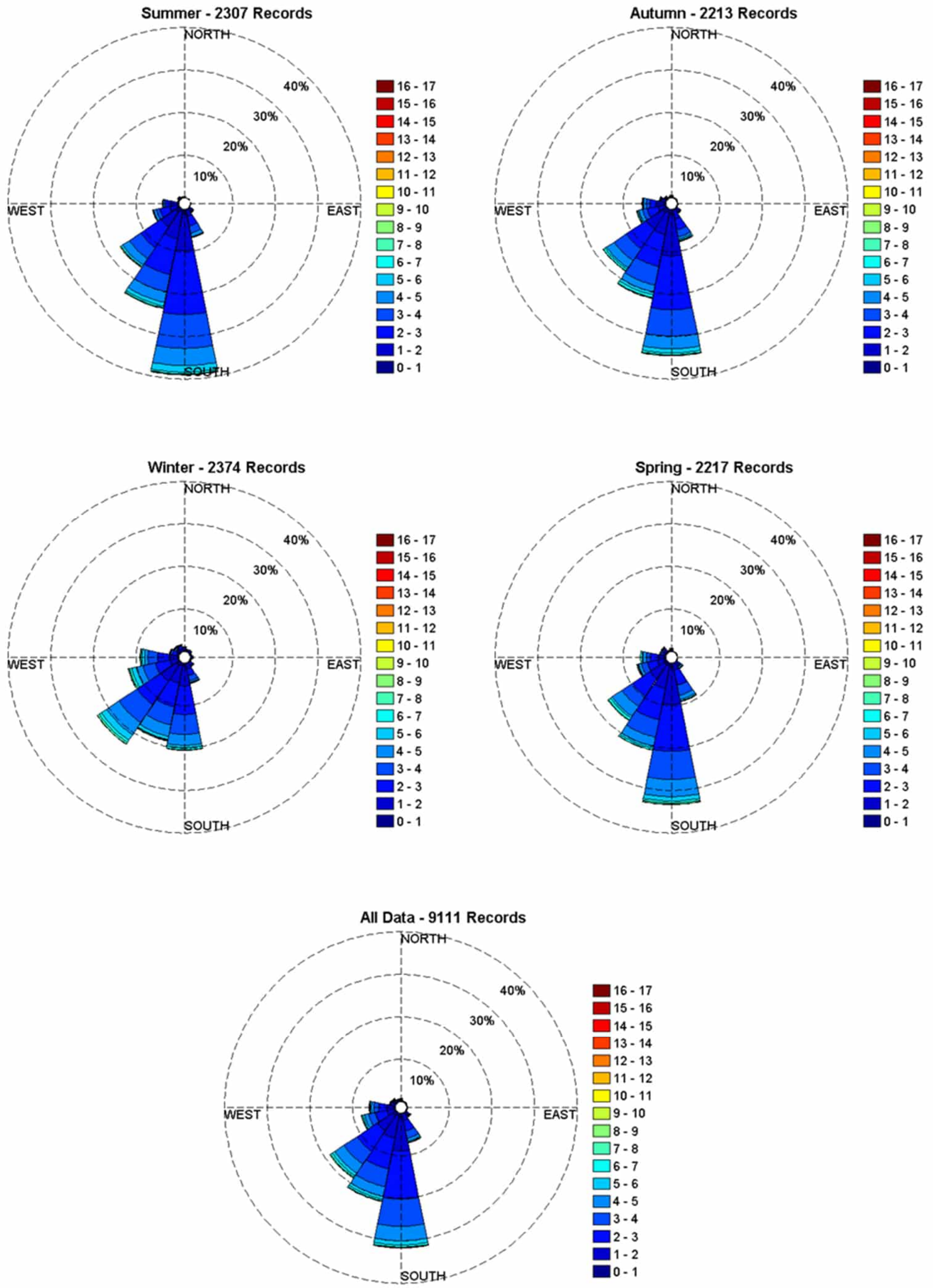

FIGURE 7-13: WAVE HEIGHT (M) VS WAVE DIRECTION DATA FOR THE CAPE COLUMBINE AREA 32.0 TO 32.9 S AND 17.0 TO 17.9 E (1903-11-01 TO 2011-05-24; 9,111 RECORDS)

Source: CSIR

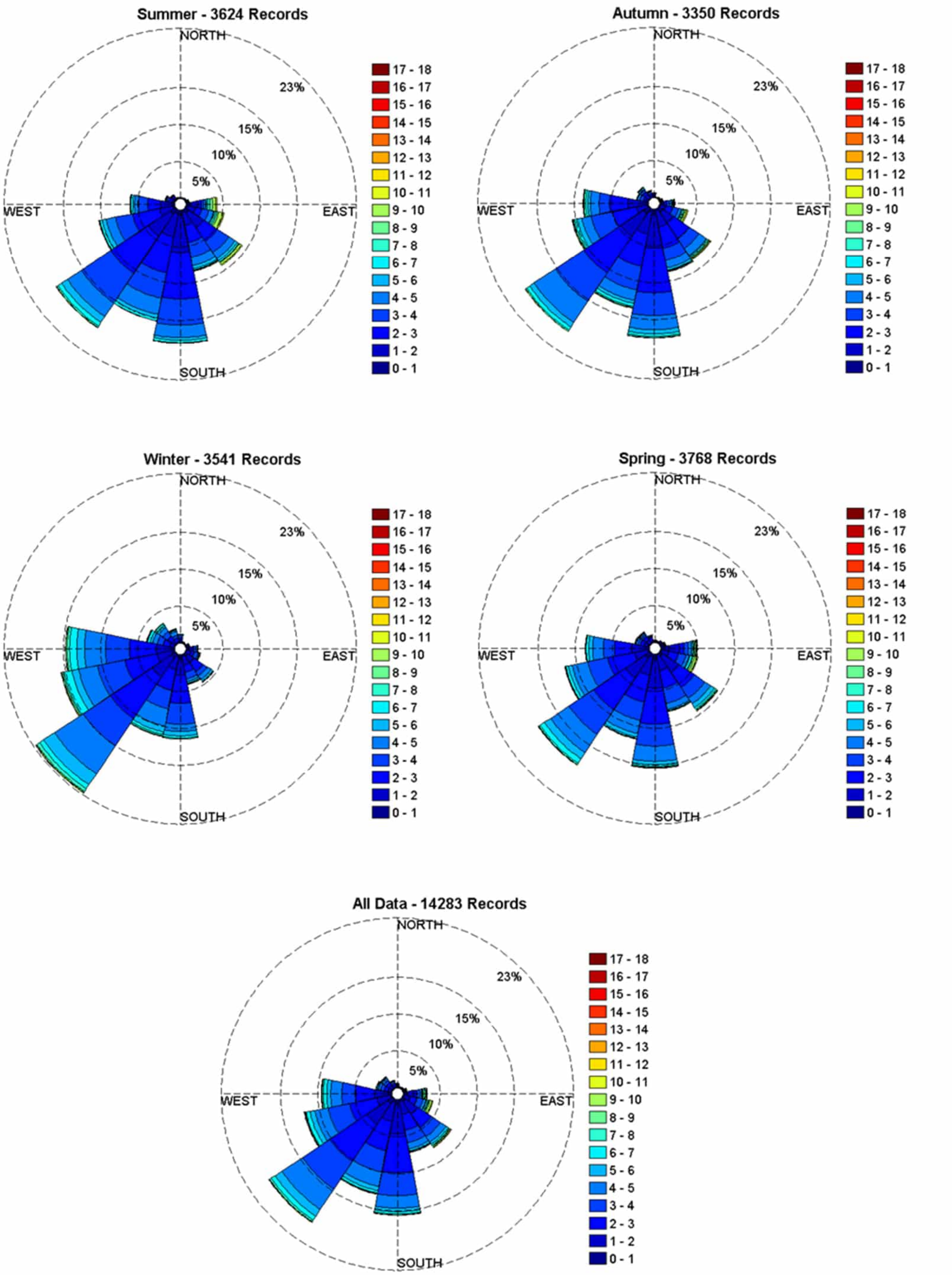

FIGURE 7-14: WAVE HEIGHT (M) VS WAVE DIRECTION DATA FOR THE CAPE POINT AREA 34.0 TO 34.9 S AND 18.0 TO 18.9 E (1900-01-01 TO 2011-05-24; 14,283 RECORDS)

Source: CSIR

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations, especially on the bottom (also see Section 7.3.6 and 7.3.7)**.** SACW itself has depressed oxygen concentrations (~80% saturation value), but lower oxygen concentrations (<40% saturation) frequently occur (Bailey *et al.* 1985; Chapman & Shannon 1985).

Nutrient concentrations of upwelled water of the Benguela system attain 20 µM nitrate-nitrogen, 1.5 µM phosphate and 15-20 µM silicate, indicating nutrient enrichment (Chapman & Shannon 1985). This is mediated by nutrient regeneration from biogenic material in the sediments (Bailey *et al.* 1985). Modification of these peak concentrations depends upon phytoplankton uptake which varies according to phytoplankton biomass and production rate. **The range of nutrient concentrations can thus be large but, in general, concentrations are high.**

7.3.6 Organic Inputs

As noted above, **the Benguela upwelling region is an area of particularly high natural productivity, with extremely high seasonal production of phytoplankton and zooplankton.** These plankton blooms in turn serve as the basis for a rich food chain up through pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (snoek), mammals (primarily seals and dolphins) and seabirds (jackass penguins, cormorants, pelicans, terns and others).

Thirty six percent (36%) of the phytoplankton and 5% of the zooplankton are estimated to be lost to the seabed annually. This natural annual input of millions of tonnes of organic material onto the seabed off the southern African West Coast has a substantial effect on the ecosystems of the Benguela region. It provides most of the food requirements of the particulate and filter-feeding benthic communities that inhabit the sandy-muds of this area, and results in the **high organic content of the muds in the region**. As most of the organic detritus is not directly consumed, it enters the seabed decomposition cycle, resulting in subsequent depletion of oxygen in deeper waters (see Section 7.3.7).

An associated phenomenon ubiquitous to the Benguela system are red tides (dinoflagellate and/or ciliate blooms) (Shannon & Pillar 1985; Pitcher 1998; Pitcher & Calder 2000), also referred to as Harmful Algal Blooms (HABs). These events can cause extensive mortalities of fish and shellfish through direct poisoning, while degradation of organic-rich material derived from both toxic and non-toxic blooms results in oxygen depletion of subsurface water. **HABs, being associated primarily with upwelling cells, may occur in the northern inshore portions of the Area of Interest for proposed exploration drilling.**

7.3.7 Low Oxygen Events

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations with <40% saturation occurring frequently (Visser 1969; Bailey *et al.* 1985). The low oxygen concentrations are attributed to nutrient remineralisation in the bottom waters of the system (Chapman & Shannon 1985). The two main areas of low-oxygen water formation in the southern Benguela region are in the Orange River Bight and St Helena Bay (Chapman & Shannon 1985; Bailey 1991; Shannon & O'Toole 1998; Bailey 1999; Fossing *et al.* 2000). **Coastal upwelling processes can move this low-oxygen water up onto the inner shelf, and into nearshore waters.**

These periodic low oxygen events in the nearshore region can have catastrophic effects on the marine communities leading to large-scale stranding of rock lobsters, and mass mortalities of marine biota and fish (Newman & Pollock 1974; Matthews & Pitcher 1996; Pitcher 1998; Cockcroft *et al.* 2000). The development of anoxic conditions, as a result of the decomposition of huge amounts of organic matter generated by phytoplankton blooms, is the main cause for these mortalities and walkouts. The most recent walkout occurred in early March 2022 at Elands Bay, when some 500 tonnes of rock lobster were reported stranded on the beach. The blooms develop over a period of unusually calm wind conditions when sea surface temperatures where high. Algal blooms usually occur during summer-autumn (February to April) but can also develop in winter during the 'berg' wind periods, when similar warm windless conditions occur for extended periods.

7.3.8 Turbidity

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulate matter. Total Suspended Particulate Matter (TSPM) can be divided into Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM).

The POM usually consists of detritus, bacteria, phytoplankton and zooplankton, and serves as a source of food for filter-feeders. Seasonal microphyte production associated with upwelling events, both inshore and along the shelf edge, will play an important role in determining the concentrations of POM in coastal waters. **Although Block 5/6/7 is located on the western edge of the Cape Columbine and Cape Point upwelling cells, the Area of Interest for proposed exploration drilling is located to the south of the upwelling cells and POM loading is expected to be low.**

PIM, on the other hand, is primarily of geological origin consisting of fine sands, silts and clays. Off Namaqualand, to the north of Block 5/6/7, the PIM loading in nearshore waters is strongly related to natural riverine inputs (mainly the Orange River) or from 'berg' wind events. **Although the Berg River** (outlets at St Helena Bay) **and Olifants River** (outlets at 250 km north of Cape Town) (two of only three permanently open river systems on the West Coast) **enter the South-West Coast, annual sediment yields are low due to thin soils and the resistant nature of Table Mountain Sandstones** (Clark & Ractliffe 2007). **PIM loading in the offshore regions of Block 5/6/7 would, therefore, be negligible.**

Concentrations of suspended particulate matter in shallow coastal waters can vary both spatially and temporally, typically ranging from a few mg/l to several tens of mg/l (Bricelj & Malouf 1984; Berg & Newell 1986; Fegley *et al.* 1992). Field measurements of TSPM and PIM concentrations in the Benguela current system have indicated that outside of major flood events, background concentrations of coastal and continental shelf suspended sediments are generally <12 mg/l, showing significant long-shore variation (Zoutendyk 1995). Considerably higher concentrations of PIM have, however, been reported from southern African West Coast waters under stronger wave conditions associated with high tides and storms, or under flood conditions. Suspended sediment concentrations on the South-West Coast are estimated to be between 5mg/l and 5g/l, with higher values associated with high wave conditions (Zoutendyk 1995).

The major source of turbidity in the swell-influenced nearshore areas off the West and South-West Coast is the redistribution of fine inner shelf sediments by long-period Southern Ocean swells. The Benguela Current is capable of resuspending and transporting considerable quantities of sediment towards the equator. Under relatively calm wind conditions, however, much of the suspended fraction (silt and clay) that remains in suspension for longer periods becomes entrained in the slow poleward undercurrent (Shillington *et al.* 1990; Rogers & Bremner 1991). Superimposed on the suspended fine fraction, is the northward littoral drift of coarser bedload sediments, parallel to the coastline. This northward, nearshore transport is generated by the predominantly south-westerly swell and wind-induced waves. Longshore sediment transport varies considerably in the shore-perpendicular dimension, being substantially higher in the surf-zone than at depth, due to high turbulence and convective flows associated with breaking waves, which suspend and mobilise sediment (Smith & Mocke 2002).

On the inner and middle continental shelf, the ambient currents are insufficient to transport coarse sediments typical of those depths, and re-suspension and shoreward movement of these by wave-induced currents occur primarily under storm conditions (Drake *et al.* 1985; Ward 1985). Most of the sediment shallower than 90 m can be subject to re-suspension and transport by heavy swells (Lane & Carter 1999). Offshore of the continental shelf, the oceanic waters are typically clear as they are beyond the influence of aeolian and riverine inputs. Thus, **the waters in the Area of Interest for drilling are expected to be comparatively clear, although potentially seasonally influenced by upwelling.**

7.3.9 Natural Hydrocarbon Seeps

Petroleum discharges, both from natural seeps at the seabed and discharges occurring during the production and transport of petroleum are a common source of toxic substances in marine ecosystems (NRC, 2003). Satellite imagery analysis covering an area of 156 600 km^2 was used by TEEPSA (in 2020) in an oil slicks detection study of the southern offshore part of South Africa. The large radar dataset covering 15 years included medium and high resolution 178 ENVISAT (2005 - 2011) and 632 SENTINEL (2015 - 2019) radar images, respectively.

The following was concluded from the oil slicks detection study:

- No oil seep anomaly was detected in Block 5/6/7.
- The following were identified / detected in Block 5/6/7:
  - 120 potential oil spills (pollutions) - Note: 2 shipping lines were visible (1 298 boats detected).
  - Two isolated potential oil seeps, but they are not recurrent.
  - Scattered small-sized potential oil seeps (“Leopard spots”), especially along the continental slope where the gas migration (with possible light oil) is more favourable.

7.4 BIOLOGICAL OCEANOGRAPHY

7.4.1 Introduction

Biogeographically, **Block 5/6/7 falls into the Southern Benguela and Southeast Atlantic Deep Ocean Ecoregions** (Sink *et al.* 2019) (see Figure 7-15).

The **Southern Benguela ecoregion** is a cold, temperate shelf ecoregion extending from Namibia to Cape Point and offshore includes the western Agulhas Bank. It is bounded by a deep shelf edge that ranges between depths of 200 m to 600 m, making it one of the deepest in the world (de Wet 2013). The coastal, wind-induced upwelling characterising the Western Cape coastline, is the principle physical process which shapes the marine ecology of the Southern Benguela Ecoregion. The Benguela system is characterised by the presence of cold surface water, high biological productivity, and highly variable physical, chemical and biological conditions.

The **Southeast Atlantic Oceanic Ecoregion** extends from the shelf edge of the Southern Benguela onto the slope and into the abyssal plain of the Cape Basin, which comprises a relatively monotonous plain, interrupted by sporadic seamounts. This deep ocean region extends into Namibia and is bounded in the north by the prominent Walvis Ridge. In the south it is separated from the Southwest Indian Deep Ocean by the Agulhas Ridge, a transverse ridge that forms part of the Agulhas Falklands Fracture Zone and acts as a divide between the Cape Basin and the Agulhas Basin. The biodiversity patterns in the deep ocean ecosystems are not well understood (Sink *et al.* 2019).

Communities within marine habitats are largely ubiquitous throughout the West / South-West Coast region, being particular only to substrate type or depth zone. The biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). Beyond the surf-zone, marine ecosystems comprise a limited range of substrata, namely unconsolidated seabed sediments, deep-water reefs and the water column. The biological communities 'typical' of these habitats are described briefly below, focussing both on dominant, commercially important and conspicuous species, as well as potentially threatened or sensitive species, which may be affected by the proposed exploration activities.

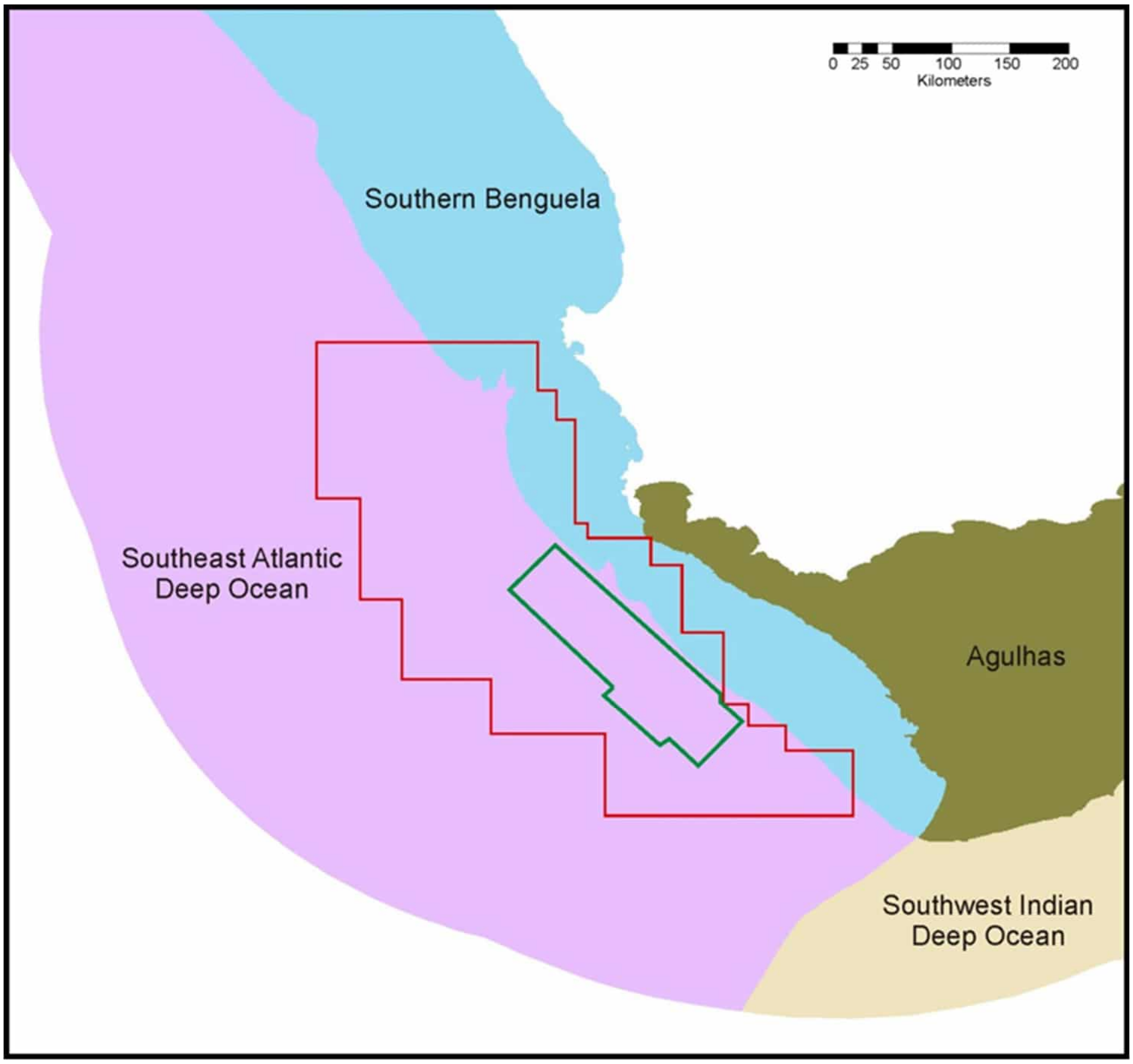

FIGURE 7-15: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO THE INSHORE AND OFFSHORE ECOREGIONS OF THE SOUTH-WEST COAST

Adapted from Sink *et al*. 2019

7.4.2 Demersal Communities (living on or close to the seafloor)

7.4.2.1 Benthic Habitats and Fauna

The seabed communities in Block 5/6/7 lie within the Southwestern Cape Sub-Photic and Continental Slope Biozones, which extend from a 30 m depth to the shelf edge, and beyond to the lower deep-sea slope, respectively. Block 5/6/7 is characterised by a wide variety of ecosystem types covering both the inner, mid- and outer shelves, the Southeast Atlantic continental slope and the Cape Basin Abyss (see Figure 7-16).

The Area of Interest for drilling area, however, coincides with four ecosystem types, namely:

- **Southeast Atlantic Lower Slope** - Unknown seabed type on the lower slope of Southeast Atlantic with a water depth range of 1 800 m to 3 500 m.
- **Southeast Atlantic Mid Slope** - Unknown seabed type on the mid slope in the Southeast Atlantic ecoregion spanning water depths of 1 000 m to 1 800 m.
- **Southeast Atlantic Upper Slope** - Unknown seabed type and associated water column on the upper slope (water depths of 500 m to 1000 m) in the Southeast Atlantic ecoregion.
- **Cape Lower Canyon** - the lower component of the Cape Canyon (500 m water depth) located in the continental slope adjacent to the Southern Benguela ecoregion.

The benthic biota of unconsolidated marine sediments constitute invertebrates that live on (epifauna) or burrow within (infauna) the sediments, and are generally divided into macrofauna (animals >1 mm) and meiofauna (<1 mm). The invertebrate macrofauna are important in the marine benthic environment as they influence major ecological processes (e.g., remineralisation and flux of organic matter deposited on the sea floor, pollutant metabolism, sediment stability) and serve as important food source for commercially valuable fish species and other higher order consumers.

Numerous studies have been conducted on the continental shelf and nearshore benthos off the Northern Cape coast. Since these studies have concentrated on the continental shelf and nearshore regions, and consequently the benthic fauna of the outer shelf and continental slope (beyond approximately 450 m depth) are very poorly known. Due to the lack of information on benthic macrofaunal communities beyond the shelf break, no description can be provided specifically for Block 5/6/7.

Three macro-infauna communities have been identified on the inner (0-30 m depth) and mid-shelf (30-150 m depth) off the Northern Cape coast (Karenyi *et al.* 2016). Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the West Coast. The inner-shelf community, which is affected by wave action, is characterised by various mobile gastropod and polychaete predators and sedentary polychaetes and isopods. The mid-shelf community inhabits the mudbelt and is characterised by mud prawns. A second mid-shelf community occurring in sandy sediments, is characterised by various deposit-feeding polychaetes. The distribution of species within these communities are inherently patchy reflecting the high natural spatial and temporal variability associated with macro-infauna of unconsolidated sediments (Kenny et al. 1998; Kendall & Widdicombe 1999; van Dalfsen *et al.* 2000; Zajac *et al.* 2000; Parry *et al.* 2003), with evidence of mass mortalities and substantial recruitments recorded on the South African West Coast (Steffani & Pulfrich 2004b). Also associated with soft-bottom substrates are epifauna and bottom-dwelling vertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source.

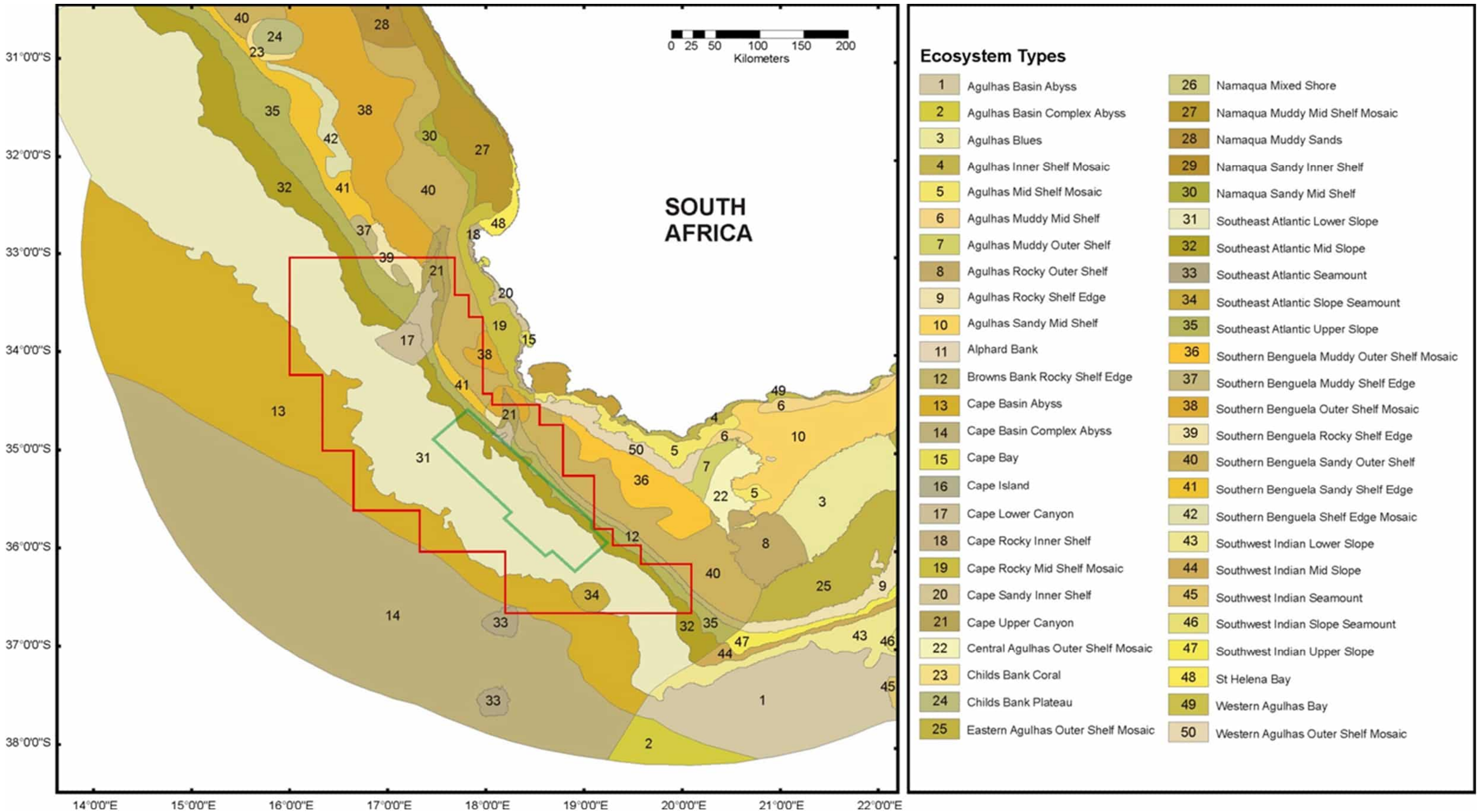

FIGURE 7-16: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO ECOSYSTEM TYPES ALONG THE SOUTH-WEST COAST

Adapted from Sink *et al.* 2019

Karenyi *et al.* (2016) found that off Namaqualand, species richness generally increased from the inner-shelf across the mid-shelf and is influenced by sediment type. The highest total abundance and species diversity was measured in sandy sediments of the mid-shelf. Biomass was highest in the inshore and decreased across the mid-shelf. This is contrary to Christie (1974, 1976) who found that biomass was greatest in the mudbelt at 80 m depth off Lamberts Bay, where the sediment characteristics and the impact of environmental stressors (such as low oxygen events) are likely to differ from those off the northern Namaqualand coast.

Benthic communities are structured by the complex interplay of a large array of environmental factors. Water depth and sediment grain size are considered the two major factors that determine benthic community structure and distribution on the South African West Coast (Christie 1974, 1976; Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b). However, studies have shown that shear bed stress, (a measure of the impact of current velocity on sediment), oxygen concentration (Post *et al.* 2006; Currie *et al.* 2009; Zettler *et al*. 2009, 2013), productivity (Escaravage *et al.* 2009), organic carbon and seafloor temperature (Day *et al.* 1971) may also strongly influence the structure of benthic communities. There are clearly other natural processes operating in the deep water shelf areas of the West Coast that can over-ride the suitability of sediments in determining benthic community structure, and it is likely that periodic intrusion of low oxygen water masses is a major cause of this variability (Monteiro & van der Plas 2006; Pulfrich *et al.* 2006). In areas of frequent oxygen deficiency, benthic communities will be characterised either by species able to survive chronic low oxygen conditions or colonising and fast-growing species able to rapidly recruit into areas that have suffered oxygen depletion. The combination of local, episodic hydrodynamic conditions and patchy settlement of larvae will tend to generate the observed small-scale variability in benthic community structure.

Despite the current lack of knowledge of the community structure and endemicity of South African macro-infauna off the edge of the continental shelf, the South Atlantic Bathyal and Abyssal Unconsolidated Habitat Types that characterise depths beyond 500 m have been rated as being of ‘Least concern’ in the 2018 National Biodiversity Assessment (see Figure 7-17), reflecting the great extent of these habitats in the South African EEZ. Those communities occurring along the shelf edge (-500 m) and Cape Canyon are, however, considered ‘Vulnerable’, with isolated portions being rated as ‘Endangered’ (Cape Upper Canyon and Southern Benguela Muddy Shelf Edge), and ‘Critically Endangered’ (Brown’s Bank Rocky Shelf Edge). **The Area of Interest for proposed exploration drilling is dominated by ecosystems rated as 'Least Concern'[17] by the 2018 National Biodiversity Assessment, with only marginal overlap with the ‘Vulnerable’[18] Cape Canyon habitat.**

Most of the ecosystem types within the Area of Interest for drilling are classified as ‘not protected’ with only the inshore portions along the shelf edge being classified as ‘poorly protected’ (see Figure 7-18)**.** The Browns Bank Rocky Shelf Edge is one of the most threatened ecosystem types which has recently been upgraded from ‘no protection' to ‘moderately well protected’ due to the Browns Bank MPA being established in 2019 (Refer to Section 7.5).

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[17] More than 80% Good and Fair

[18] Less Than 80% Good and Fair

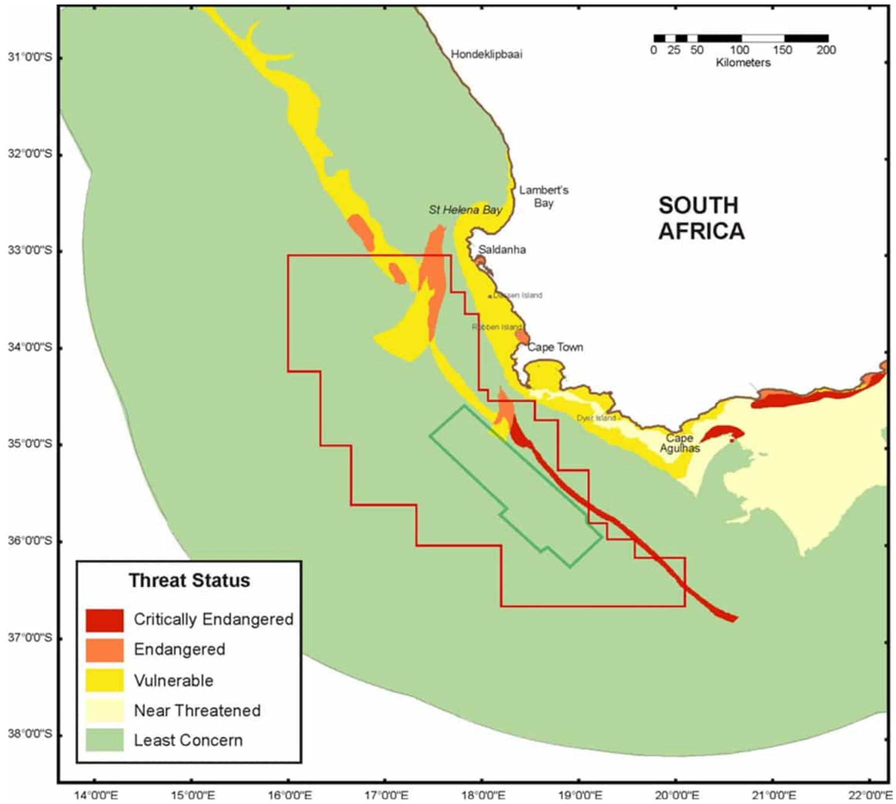

FIGURE 7-17: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO ECOSYSTEM THREAT STATUS FOR COASTAL AND OFFSHORE BENTHIC AND PELAGIC HABITAT TYPES ON THE SOUTH-WEST COAST

Adapted from Sink *et al.* 2019

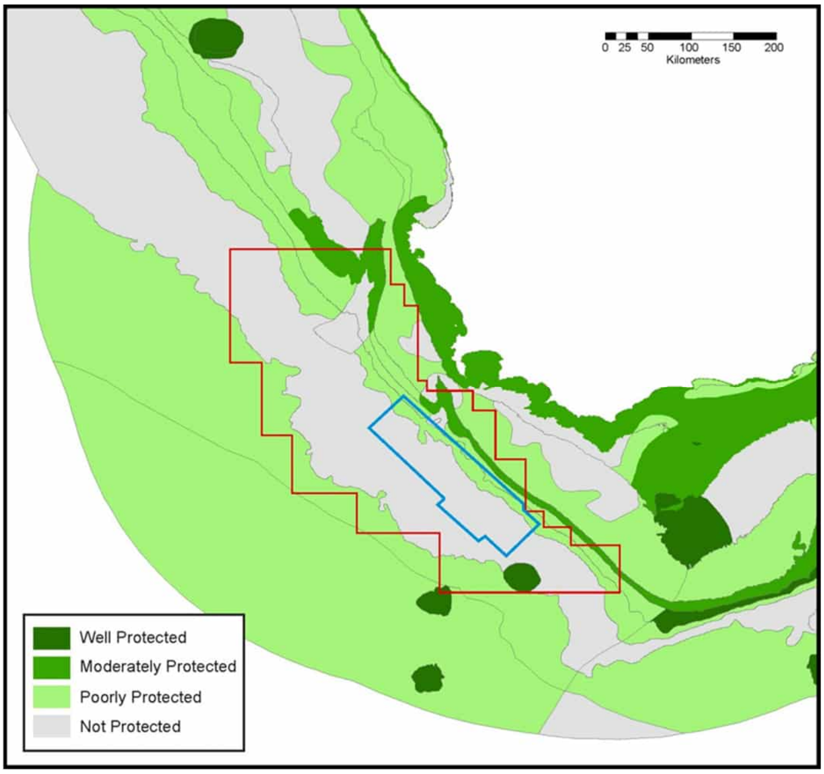

FIGURE 7-18: BLOCK 5/6/7 AND THE AREA OF INTEREST FOR DRILLING IN RELATION TO MARINE ECOSYSTEM PROTECTION LEVELS

Adapted from Sink *et al.* 2019

7.4.2.2 Deep-Water Reef Communities

Deep-water corals are benthic filter-feeders generally occur at depths below 150 m with some species being recorded from as deep as 3 000 m. These communities add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity (Breeze *et al.* 1997; MacIsaac *et al.* 2001) and are sensitive to disturbance and their long generation times. Deep water corals establish below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current over special topographical formations which cause eddies to form. Nutrient seepage from the substratum might also promote a location for settlement (Hovland *et al.* 2002).

Much of the inner shelf between Cape Columbine and Cape Point, and between Cape Hangklip and Cape Agulhas is characterised by highly structured reef areas that host highly diverse benthic and motile biota including sponges, azooxanthellate corals, octocorals, gorgonians, black corals, cerianthids and stylasterine lace corals, bryozoans, ascidians, and basket stars. Fauna occurring in the deeper reef areas and canyons have community assemblages distinctly different to those from shallower reefs (Sink *et al.* 2006).

These habitats have been identified as sensitive, as the fauna typically associated with them are frequently slow-growing, slow to mature and long-lived, making them particularly vulnerable to disturbance. These reefs host a diversity of deep-water corals and sponges, that have established themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current. Reef-building cold water corals have also been documented within the Agulhas Inner and Mid Shelf Mosaic, Agulhas Rocky Shelf Edge and in association with deep reefs and submarine canyons on the Agulhas Inner Shelf and Shelf Edge respectively (Sink & Samaai 2009; Sink *et al.* 2011). **The Area of Interest for drilling could thus potentially be capable of supporting rich, deep-water benthic, filter-feeding communities.** Corals and sponges add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity (Breeze *et al.* 1997; MacIsaac *et al.* 2001). Their frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead frameworks.

Such communities would also be expected with topographic features such as the Argentina, Protea and Mount Marek Seamounts located in and adjacent to the southern boundary of the Licence Block (see Figure 7-2, Section 7.2.1 and Section 7.4.2.3).

7.4.2.3 Seamount and Submarine Canyon Communities

Features such as banks, knolls and seamounts (referred to collectively here as "seamounts"), which protrude into the water column, are subject to, and interact with, the water currents surrounding them. The effects of seamounts on the surrounding water masses can include the upwelling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity (Clark *et al.,* 1999), which can in turn strongly influence the distribution of organisms on and around seamounts. Evidence of enrichment of bottom-associated communities and high abundances of demersal fishes has been regularly reported over such seabed features.

Such complex benthic ecosystems in turn enhance foraging opportunities for many other predators, serving as mid-ocean focal points for a variety of pelagic species with large ranges (turtles, tunas and billfish, pelagic sharks, cetaceans and pelagic seabirds) that may migrate large distances in search of food or may only congregate on seamounts at certain times (Hui, 1985; Haney *et al.*, 1995). Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for a large number of species (SPRFMA, 2007). Consequently, the fauna of seamounts is usually highly unique and may have a limited distribution restricted to a single geographic region, a seamount chain or even a single seamount location (Rogers et al. 2008). As a result of conservative life histories (i.e. very slow growing, slow to mature, high longevity, low fecundity and unpredictable recruitment) and sensitivity to changes in environmental conditions, such biological communities have been identified as Vulnerable Marine Ecosystems (VMEs) (see Box 7-1). They are recognised as being particularly sensitive to anthropogenic disturbance (primarily deep-water trawl fisheries and mining), and once damaged are very slow to recover, or may never recover (FAO 2008).

BOX 7-1: VULNERABLE MARINE ECOSYSTEMS

The concept of a 'Vulnerable Marine Ecosystem' (VME) centres upon the presence of distinct, diverse benthic assemblages that are limited and fragmented in their spatial extent, and dominated (in terms of biomass and/or spatial cover) by rare, endangered or endemic component species that are physically fragile and vulnerable to damage (or structural/biological alteration) by human activities (Parker et al. 2009; Auster et al. 2011; Hansen et al. 2013).

VMEs are known to be associated with higher biodiversity levels and indicator species that add structural complexity, resulting in greater species abundance, richness, biomass and diversity compared to surrounding uniform seabed habitats (Buhl-Mortensen et al. 2010; Hogg et al. 2010; Barrio Froján et al. 2012; Beazley et al. 2013, 2015). Compared to the surrounding deep-sea environment, VMEs typically form biological hotspots with a distinct, abundant and diverse fauna, many species of which remain unidentified. Levels of endemism on VMEs are also relatively high compared to the deep-sea. The coral frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead coral framework thereby creating spatially fragmented areas of high biological diversity (Bett & Rice 1992; Raes & Vanreusel 2005; Beazley et al. 2013; Ashford et al. 2019).

VMEs are also thought to contribute toward the long-term viability of a stock through providing an important source of habitat for commercial species (Pham et al. 2015; Ashford et al. 2019). They can provide a wide range of ecosystem services ranging from provision of aggregation- and spawning sites to providing shelter from predation and adverse hydrological conditions (Husebø & Nøttestad et al. 2002; Krieger & Wing, 2002; Tissot et al. 2006; Baillon et al. 2012; Pham et al. 2015). Indicator taxa for VMEs are also known to provide increased access to food sources, both directly to associated benthic fauna, and indirectly to other pelagic species such as fish and other predators due to the high abundance and biomass of associated fauna (Krieger & Wing, 2002; Husebø & Nøttestad et al. 2002; Buhl-Mortensen et al. 2010; Hogg et al. 2010; Auster et al. 2011).

VME frameworks are typically elevated from the seabed, increasing turbulence and raising supply of suspended particles to suspension feeders (Krieger & Wing 2002; Buhl-Mortensen & Mortensen 2005; Buhl-Mortensen et al. 2010). Poriferans and cold-water corals further shown to provide a strong link between pelagic and benthic food webs (Pile & Young 2006; Cathalot et al. 2015). VMEs are increasingly being recognised as providers of important ecosystem services due to associated increased biodiversity and levels of ecosystem functioning (Ashford et al. 2019).

It is not always the case that seamount habitats are VMEs, as some seamounts may not host communities of fragile animals or be associated with high levels of endemism

Geological features of note within the project's area of influence are Child's Bank and the Southeast Atlantic Seamounts, as well as the Cape Canyon and Cape Point Valley (see Section 7.2.1 for further detail on these features). Sampling of the Cape Canyon (from head to -500 m depth) revealed that a diversity of echinoderms, molluscs and crustaceans dominated the canyon head (see Figure 7-19), while scavengers such as ophuiroidea and decapoda were prevalent within habitats ranging from sandy areas, to patches of inshore and offshore mud belts. At depths of <100 m inshore of the canyon head, boulder beds hosted gorgonian and stylasterine corals.

As sampling beyond 1 000 m depth has not taken place (Atkinson & Sink 2018), **it is not known whether similar communities may be expected in the deeper portions of Block 5/6/7, particularly associated with the Southeast Atlantic Seamounts.** The distribution of known and potential VME habitat based on potential VME features, DFFE and SAEON trawl survey data, and many visual surveys indicating the presence of indicator taxa have been mapped by Harris *et al.* 2022 (see Figure 7-20). Some sites, however, need more research to determine their status. The Area of Interest for drilling is located mostly offshore of these known and potential VMEs, although there is some overlap with the base of the Cape Valley canyon.

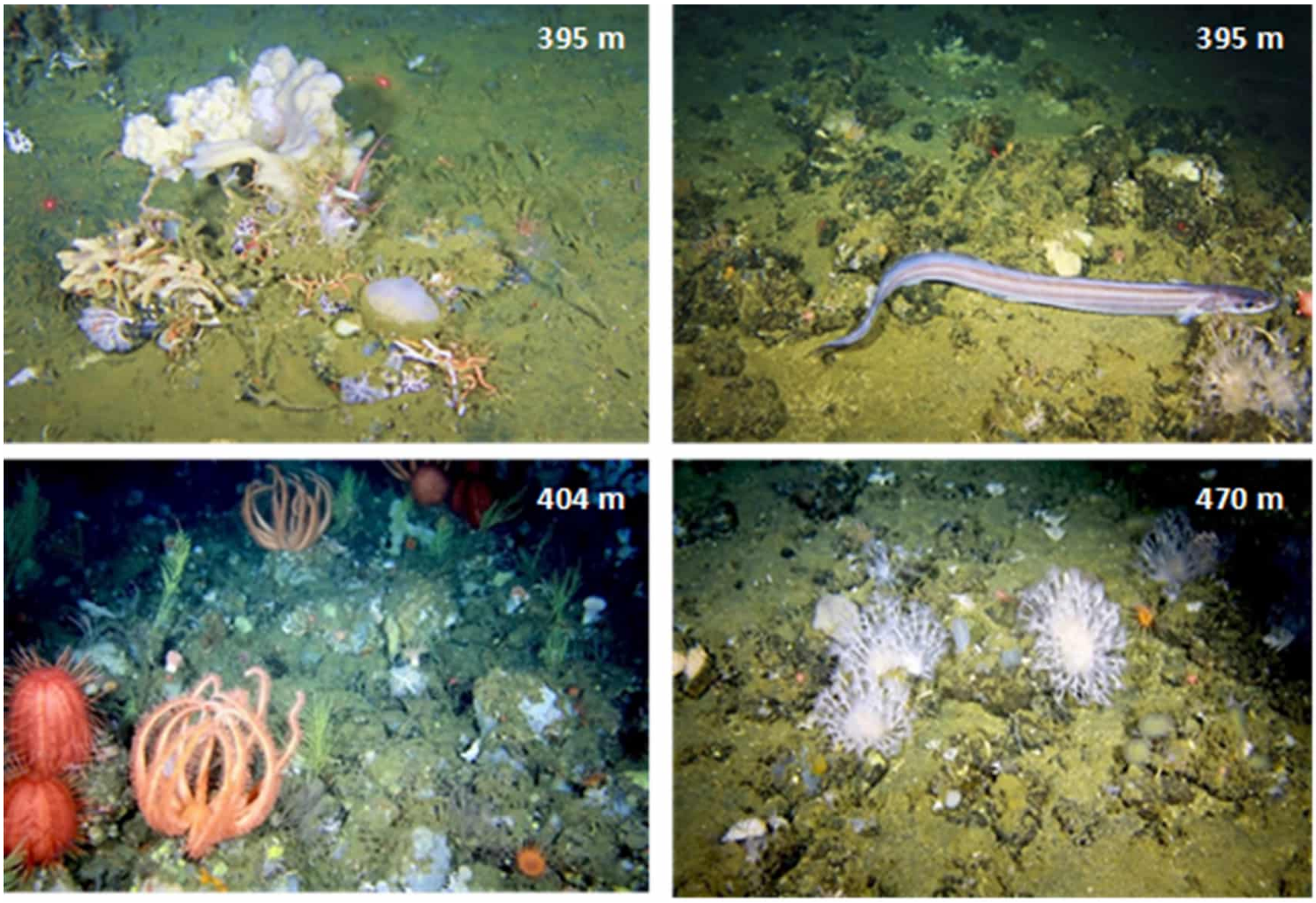

FIGURE 7-19: DEEP WATER BENTHIC MACROFAUNA FROM VARIOUS DEPTHS IN THE CAPE CANYON
Source: www.environmedeepwaternt.gov.za/dearesearchteamreturnfromdeepseaexpedition

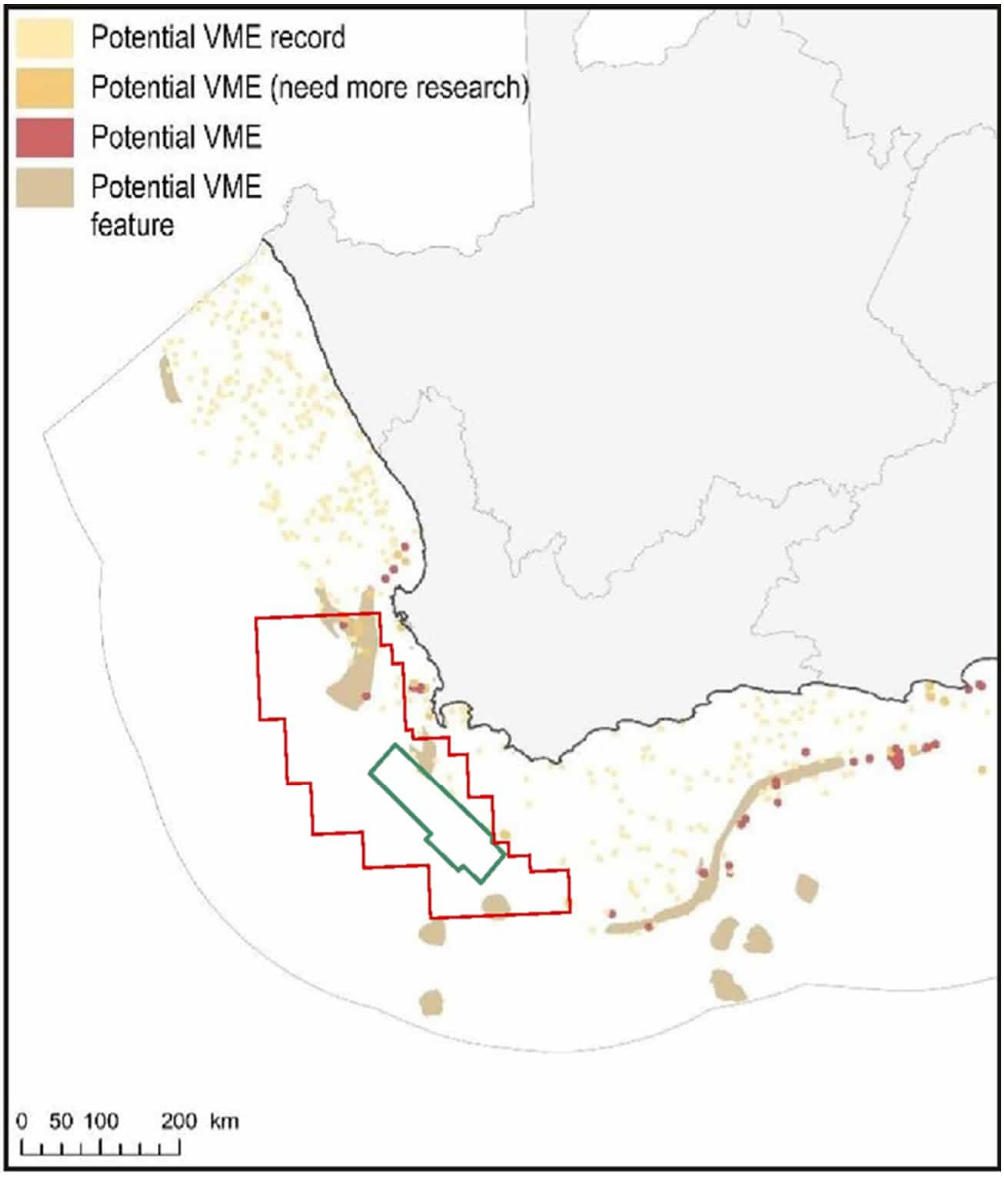

FIGURE 7-20: BLOCK 5/6/7 (RED POLYGON) AND THE AREA OF INTEREST FOR PROPOSED DRILLING (GREEN POLYGON) IN RELATION TO THE DISTRIBUTION OF KNOWN AND POTENTIAL VULNERABLE MARINE ECOSYSTEM HABITAT
Adapted from Harris *et al.* 2022

7.4.2.4 Demersal Fish Species

Demersal fish are those species that live and feed on or near the seabed. As many as 110 species of bony and cartilaginous fish have been identified in the demersal communities on the continental shelf of the West Coast (Roel 1987). Changes in fish communities occur both latitudinally (Shine 2006, 2008; Yemane et al. 2015) and with increasing depth (Roel 1987; Smale *et al.* 1993; Macpherson & Gordoa 1992; Bianchi *et al.* 2001; Yemane *et al.* 2015), with the most substantial change in species composition occurring in the shelf break region between 300 m and 400 m depth (Roel 1987; Atkinson 2009). The shelf community (<380 m) is dominated by the Cape hake (*Merluccius capensis)*, and includes jacopever (*Helicolenus dactylopterus)*, Izak catshark (*Holohalaelurus regain)*, soupfin shark (*Galeorhinus galeus)* and whitespotted houndshark (*Mustelus palumbes)*. The more diverse deeper water community is dominated by the deep-water hake (*Merluccius paradoxus)*, monkfish

(*Lophius vomerinus)*, kingklip (*Genypterus capensis)*, bronze whiptail (*Lucigadus ori)* and hairy conger (*Bassanago albescens)* and various squalid shark species. There is some degree of species overlap between the depth zones.

The species that may occur in the Area of Interest and on the continental shelf inshore thereof, and their approximate depth range, are listed in Table 7-1. The distribution of some of these species is provided in Harris *et al.* (2022) (see Figure 7-21 and Figure 7-22). Table 7-2 details the variety of demersal fish species landed by fishers along the South-West Coast. These species, however, generally occur inshore of Block 5/6/7.

There is limited information about bathyal fish communities in South Africa. South Africa defines its bathyal zone as extending from 500 m to 3 500 m, recognising an upper slope (500-1 000 m, mid slope (1 000-1 800 m) and lower slope (1 800-3 500 m). Typical upper slope fishes (200-2 000 m) include rattails (Macrouridae), greeneyes (*Chlorophthalmus species*), notacanthids, halosaurs, chimaeras, skates, bythitids such as Cataetyx spp. and morids (deepsea cods) (Smith & Heemstra 2003). Rattails, bythitids, liparidids (snail fishes) and notacanthids (Polyacanthonotus species and halosaurs) are characteristic of the lower bathyal (Iwamoto & Anderson 1994; Jones 2014).

TABLE 7-1: DEMERSAL CARTILAGINOUS SPECIES FOUND ON THE CONTINENTAL SHELF ALONG THE WEST COAST, WITH APPROXIMATE DEPTH RANGE AT WHICH THE SPECIES OCCURS

Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Frilled shark	*Chlamydoselachus anguineus*	200-1 000	LC
Six gill cowshark	*Hexanchus griseus*	150-600	NT
Gulper shark	*Centrophorus granulosus*	480	EN
Leafscale gulper shark	*Centrophorus squamosus*	370-800	EN
Bramble shark	*Echinorhinus brucus*	55-285	EN
Black dogfish	*Centroscyllium fabricii*	>700	LC
Portuguese shark	*Centroscymnus coelolepis*	>700	NT
Longnose velvet dogfish	*Centroscymnus crepidater*	400-700	NT
Birdbeak dogfish	*Deania calcea*	400-800	NT
Arrowhead dogfish	*Deania profundorum*	200-500	NT
Longsnout dogfish	*Deania quadrispinosum*	200-650	VU
Sculpted lanternshark	*Etmopterus brachyurus*	450-900	DD
Brown lanternshark	*Etmopterus compagnoi*	450-925	LC
Giant lanternshark	*Etmopterus granulosus*	>700	LC
Smooth lanternshark	*Etmopterus pusillus*	400-500	LC
Spotted spiny dogfish	*Squalus acanthias*	100-400	VU
Shortnose spiny dogfish	*Squalus megalops*	75-460	LC
Shortspine spiny dogfish	*Squalus mitsukurii*	150-600	EN
Sixgill sawshark	*Pliotrema warreni*	60-500	LC
Goblin shark	*Mitsukurina owstoni*	270-960	LC
Smalleye catshark	*Apristurus microps*	700-1 000	LC
Saldanha catshark	*Apristurus saldanha*	450-765	LC
“Grey/black wonder” catsharks	*Apristurus* spp.	670-1 005	LC
Tiger catshark	*Halaelurus natalensis*	50-100	VU
Izak catshark	*Holohalaelurus regani*	100-500	LC
Yellowspotted catshark	*Scyliorhinus capensis*	150-500	NT
Soupfin shark/Vaalhaai	*Galeorhinus galeus*	<10-300	CR (EN)

Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Common smoothhound / Houndshark	*Mustelus mustelus*	<100	EN (DD)
Whitespotted smoothhoundshark	*Mustelus palumbes*	>350	LC
Leseer guitarfish	*Acroteriobatus annulatus*	>100	VU (LC)
Atlantic electric ray	*Torpedo nobiliana*	120-450	LC
African softnose skate	*Bathyraja smithii*	400-1 020	LC
Smoothnose legskate	*Cruriraja durbanensis*	>1 000	DD
Roughnose / triangular legskate	*Crurirajaparcomaculata*	150-620	LC
African dwarf skate	*Neoraja stehmanni*	290-1 025	LC
Thorny skate	*Raja radiata*	50-600	VU
Bigmouth skate	*Raja robertsi*	>1 000	LC
Slime skate	*Raja pullopunctatus*	15-460	LC
Rough-belly skate	*Raja springeri*	85-500	LC
Yellowspot skate	*Raja wallacei*	70-500	VU
Roughskin skate	*Raja spinacidermis*	1 000-1 350	EN
Biscuit skate	*Raja clavata*	25-500	NT
Munchkin skate	*Raja caudaspinosa*	300-520	LC
Bigthorn skate	*Raja confundens*	100-800	LC
Ghost skate	*Raja dissimilis*	420-1 005	LC
Leopard skate	*Raja leopardus*	300-1 000	LC
Smoothback skate	*Raja ravidula*	500-1 000	LC
Spearnose skate	*Raja alba*	75-260	EN
St Joseph	*Callorhinchus capensis*	30-380	LC (LC)
Cape chimaera	*Chimaera* sp.	680-1 000	LC
Brown chimaera	*Hydrolagus* sp.	420-850	LC
Spearnose chimaera	Rhinochimaera atlantica	650-960	LC

LC - Least Concern; VU - Vulnerable; NT - Near Threatened; EN - Endangered; CR - Critically Endangered; DD - Data Deficient
Source: Compagno *et al.* 1991

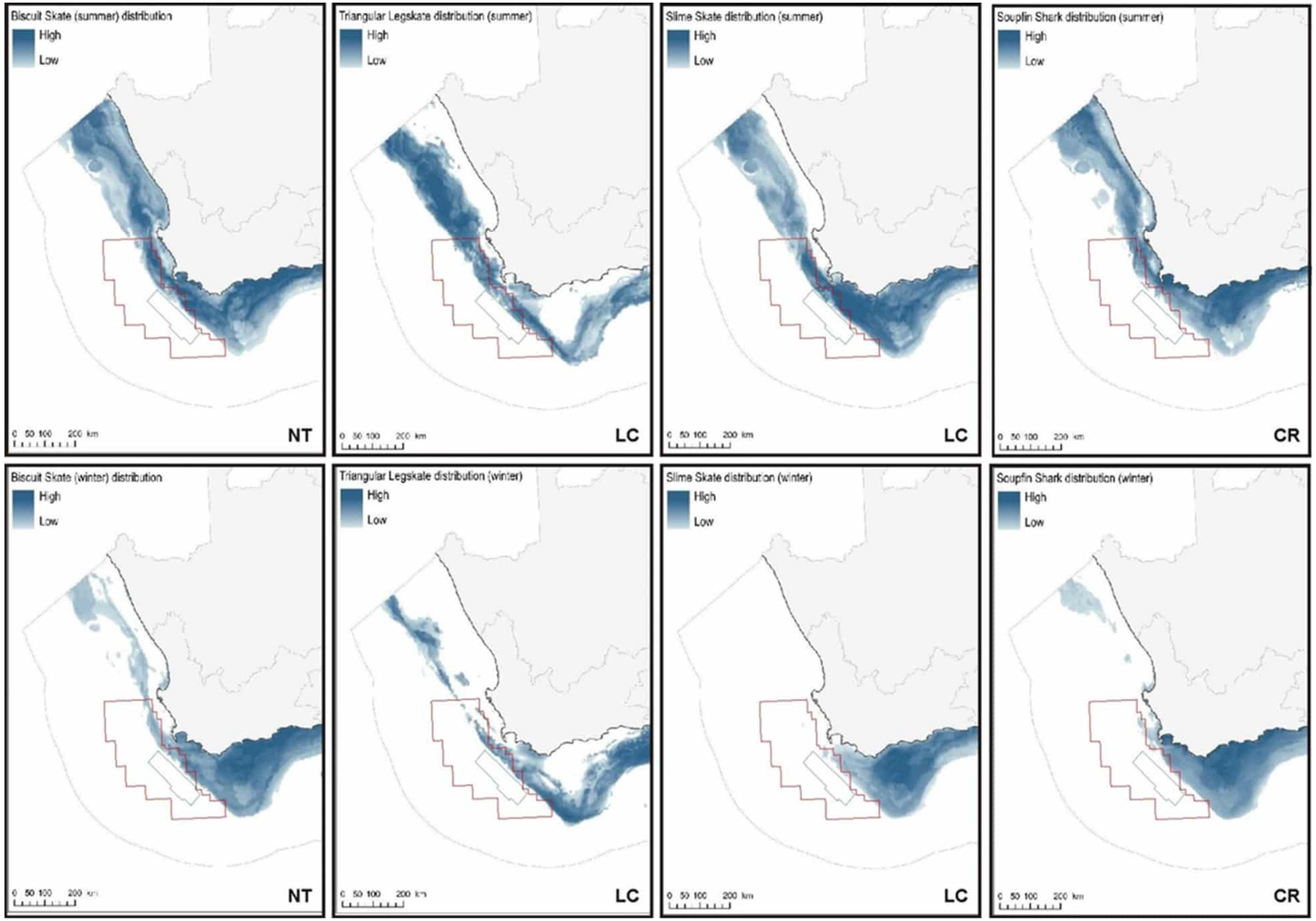

FIGURE 7-21: BLOCK 5/6/7 (RED POLYGON) AND THE AREA OF INTEREST FOR DRILLING (GREEN POLYGON) IN RELATION TO SUMMER (TOP) AND WINTER (BOTTOM) DISTRIBUTION OF BISCUIT SKATE, TRIANGULAR LEGSKATE, SLIME SKATE AND SOUPFIN

Note: IUCN conservation status is also provided

Adapted from Harris *et al.* 2022

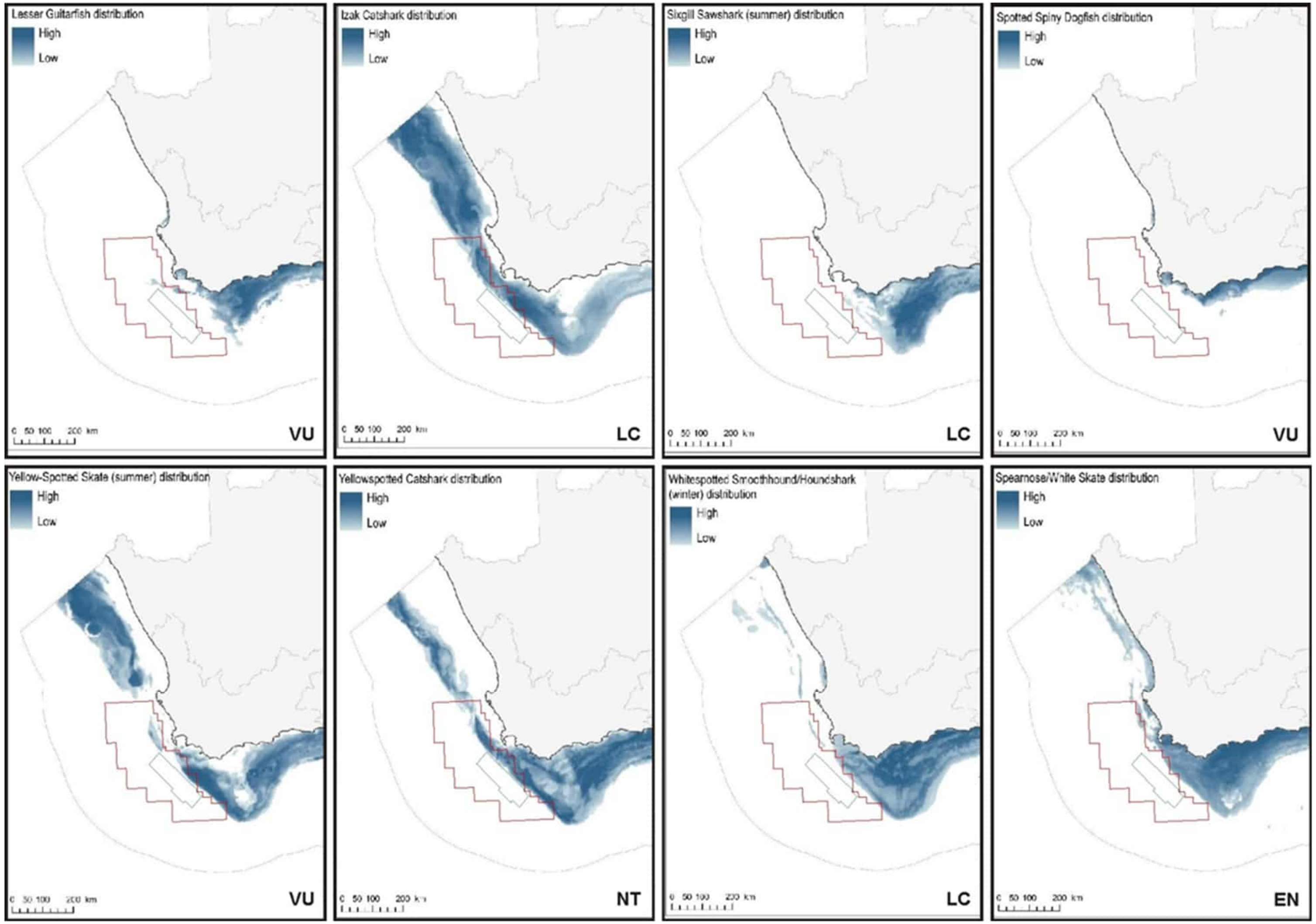

FIGURE 7-22: BLOCK 5/6/7 (RED POLYGON) AND THE AREA OF INTEREST FOR DRILLING (GREEN POLYGON) IN RELATION TO THE DISTRIBUTION OF CARTILAGINOUS SPECIES

Note: IUCN conservation status is also provided

Adapted from Harris *et al.* 2022

TABLE 7-2: DEMERSAL LINE-FISH SPECIES LANDED BY COMMERCIAL AND RECREATIONAL BOAT FISHERS AND SHORE ANGLERS ALONG THE SOUTH-WEST COAST OF SOUTH AFRICA

Species	Common Name	Species	Common Name
Chirodactylus grandis	Bank steenbras	*Petrus rupestris*	Red steenbras
Umbrina canariensis	Belman	*Chrysoblephus gibbiceps*	Red stumpnose
Diplodus sargus	White sunbream	*Acanthopagrus berda*	River bream
Pachymetopon aeneum	Blue hottentot	*Epinephelus spp.*	Grouper
Pachymetopon grande	Bronze bream	*Lithognathusmormyrus*	Sand steenbras
Rhabdosargus holubi	Cape stumpnose	*Cheimerius nufar*	Santer
Argyrozona argyrozona	Carpenter	*Polysteganus praeorbitalis*	Scotsman
Chrysoblephus christiceps	Dageraad	*Polysteganus undulosus*	Seventyfour
Chrysoblephus anglicus	Englishman	*Chrysoblephus puniceus*	Slinger sunbream
Boopsoidea inornata	Fransmadam	*Otolithes ruber*	Tigertooth croaker
Dichistius capensis	Galjoen	*Pomadasys commersonnii*	Spotted grunter
Kyphosus bigibbus	Grey chub	*Argyrosomus thorpei*	Squaretail kob
Argyrosomus hololepidotus	Kob	*Spondyliosoma emarginatum*	Steentjie
Johnius dussumieri	Sin croaker	*Sarpa salpa*	Strepie
Sparodon durbanensis	Musselcracker	*Lithognathus lithognathus*	White steenbras
Rhabdosargus sarba	Goldlined seabream	*Rhabdosargus globiceps*	White stumpnose
Cymatoceps nasutus	Black musselcracker	*Polyprion americanus*	Wreckfish
Trachinotus africanus	Pompano	*Diplodus cervinus*	Zebra
Chrysoblephus laticeps	Red roman		

Source: BSL, 2021

7.4.3 Pelagic Communities (inhabit water column)

7.4.3.1 Plankton

Plankton is particularly abundant in the shelf waters off the West Coast, being associated with the upwelling characteristic of the region. Plankton range from single-celled bacteria to jellyfish of 2 m diameter and include phytoplankton, zooplankton and ichthyoplankton.

7.4.3.1.1 Phytoplankton

Phytoplankton are the principle primary producers with mean productivity ranging from 2.5 - 3.5 gC/m^2/day (monthly average of gross primary production) for the midshelf region and decreasing to 1 gC/m^2/day inshore of 130 m (Shannon & Field 1985; Mitchell-Innes & Walker 1991; Brown *et al.* 1991; Walker & Peterson 1991; Brown 1992). The phytoplankton is dominated by diatoms, which are adapted to the turbulent sea conditions. Diatom blooms occur after upwelling events, whereas dinoflagellates are more common in blooms that occur during quiescent periods. As noted previously, red-tides are ubiquitous features of the Benguela system; however, they are unlikely to occur in the offshore regions of the Area of Interest for drilling.

7.4.3.1.2 Zooplankton

The mesozooplankton (≥200 µm) is dominated by copepods, which are overall the most dominant and diverse group in southern African zooplankton. The macrozooplankton (≥1 600 µm) are dominated by euphausiids of which 18 species occur in the area.

Although biomass shows no appreciable onshore-offshore gradients, standing stock is highest over the shelf, with accumulation of some mobile zooplankton (euphausiids) known to occur at oceanographic fronts. Beyond the continental slope biomass decreases markedly. Localised peaks in biomass may, however, occur in the vicinity of Child's Bank and the Southeast Atlantic Seamounts in response to topographically steered upwelling around such seabed features. Zooplankton biomass also varies with phytoplankton abundance and, accordingly, seasonal minima will exist during non-upwelling periods when primary production is lower (Brown 1984; Brown & Henry 1985), and during winter when predation by recruiting anchovy is high. More intense variation will occur in relation to the upwelling cycle; newly upwelled water supporting low zooplankton biomass due to paucity of food, whilst high biomasses develop in aged upwelled water subsequent to significant development of phytoplankton. Irregular pulsing of the upwelling system, combined with seasonal recruitment of pelagic fish species into West Coast shelf waters during winter, thus results in a highly variable and dynamic balance between plankton replenishment and food availability for pelagic fish species.

7.4.3.1.3 Ichthyoplankton

Although ichthyoplankton (fish eggs and larvae) comprise a minor component of the overall plankton, it remains significant due to the commercial importance of the overall fishery in the region. Various pelagic and demersal fish species are known to spawn in the inshore regions of the southern Benguela, including pilchard, round herring, chub mackerel lanternfish and hakes (Crawford *et al.* 1987; Hutchings *et al.* 2002) (see Figure 7-23), and their eggs and larvae form an important contribution to the ichthyoplankton in the region.

Spawning of key species are presented below.

- Hake, snoek and round herring move to the western Agulhas Bank and southern west coast to spawn in late winter and early spring (key period), when offshore Ekman losses are at a minimum and their eggs and larvae drift northwards and inshore to the west coast nursery grounds. Figure 7-24 highlights the temporal variation in hake eggs and larvae with there being a greater concentration of eggs and larvae between September - October compared to March - April. However, hake are reported to spawn throughout the year (Strømme *et al.* 2015). Snoek spawn along the shelf break (150 400 m) of the western Agulhas Bank and the West Coast between June and October (Griffiths 2002).
- Horse mackerel spawn over the east/central Agulhas Bank during winter months.
- Anchovies spawn on the whole Agulhas Bank(see Figure 7-25, right), with spawning peaking during mid-summer (November–December) and some shifts to the west coast in years when Agulhas Bank water intrudes strongly north of Cape Point.
- Sardines spawn on the whole Agulhas Bank during November, but generally have two spawning peaks, in early spring and autumn, on either side of the peak anchovy spawning period (see Figure 7-25, left). There is also sardine spawning on the east coast and even off KwaZulu-Natal, where sardine eggs are found during July–November.

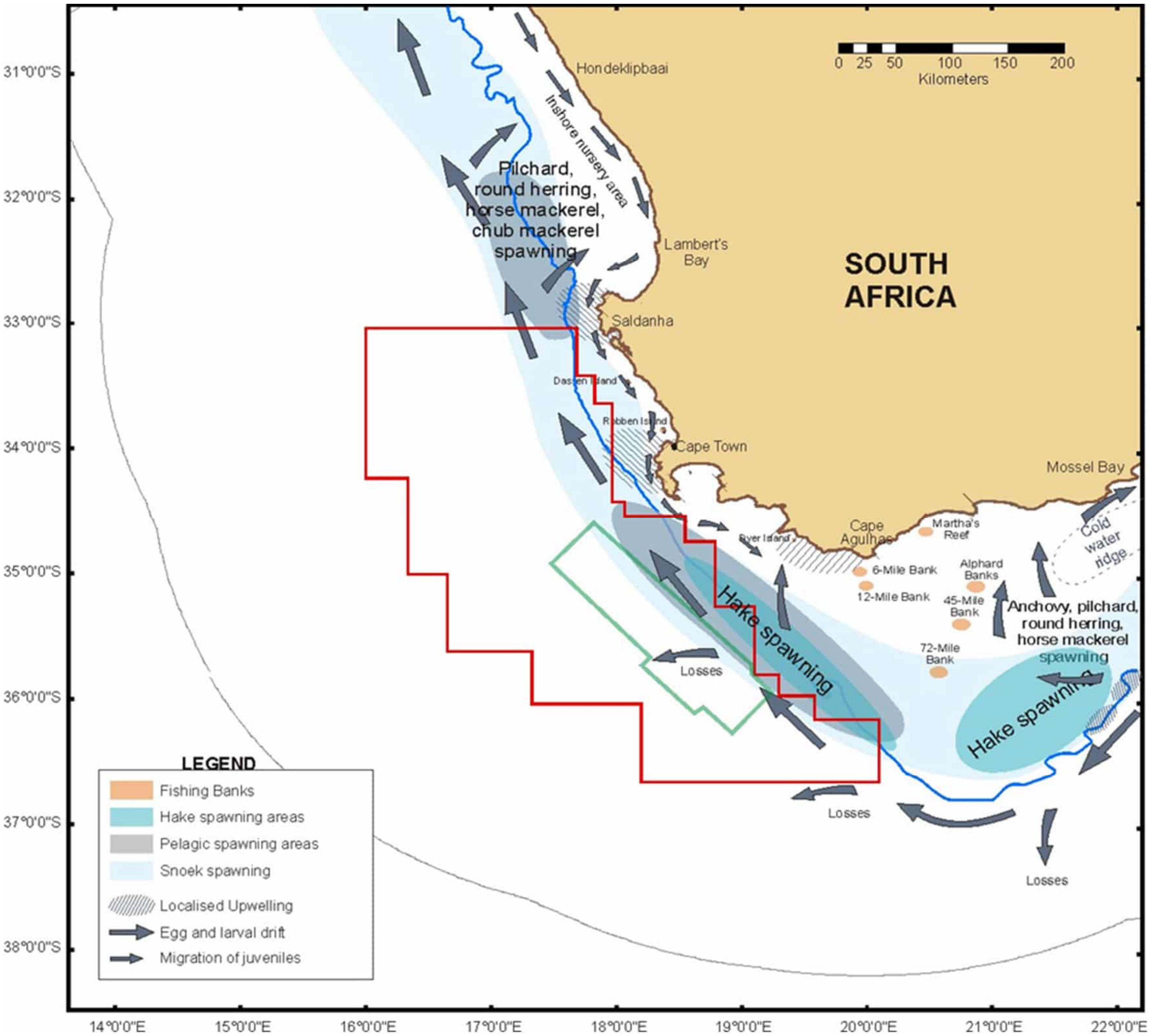

FIGURE 7-23: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO MAJOR SPAWNING AREAS IN THE SOUTHERN BENGUELA REGION

Adapted from Cruikshank 1990

The eggs and larvae are carried around Cape Point and up the coast in northward flowing surface waters. At the start of winter every year, the juveniles recruit in large numbers into coastal waters across broad stretches of the shelf between the Orange River and Cape Columbine to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point. Following spawning, the eggs and larvae of snoek are transported to inshore (<150 m) nursery grounds north of Cape Columbine and east of Danger Point, where the juveniles remain until maturity. There is, therefore, some overlap of Block 5/6/7 with the northward egg and larval drift of commercially important species, and the return migration of recruits (see Figure 7-23). Thus, **ichthyoplankton abundance in the inshore portion of the Area of Interest is likely be seasonally high.**

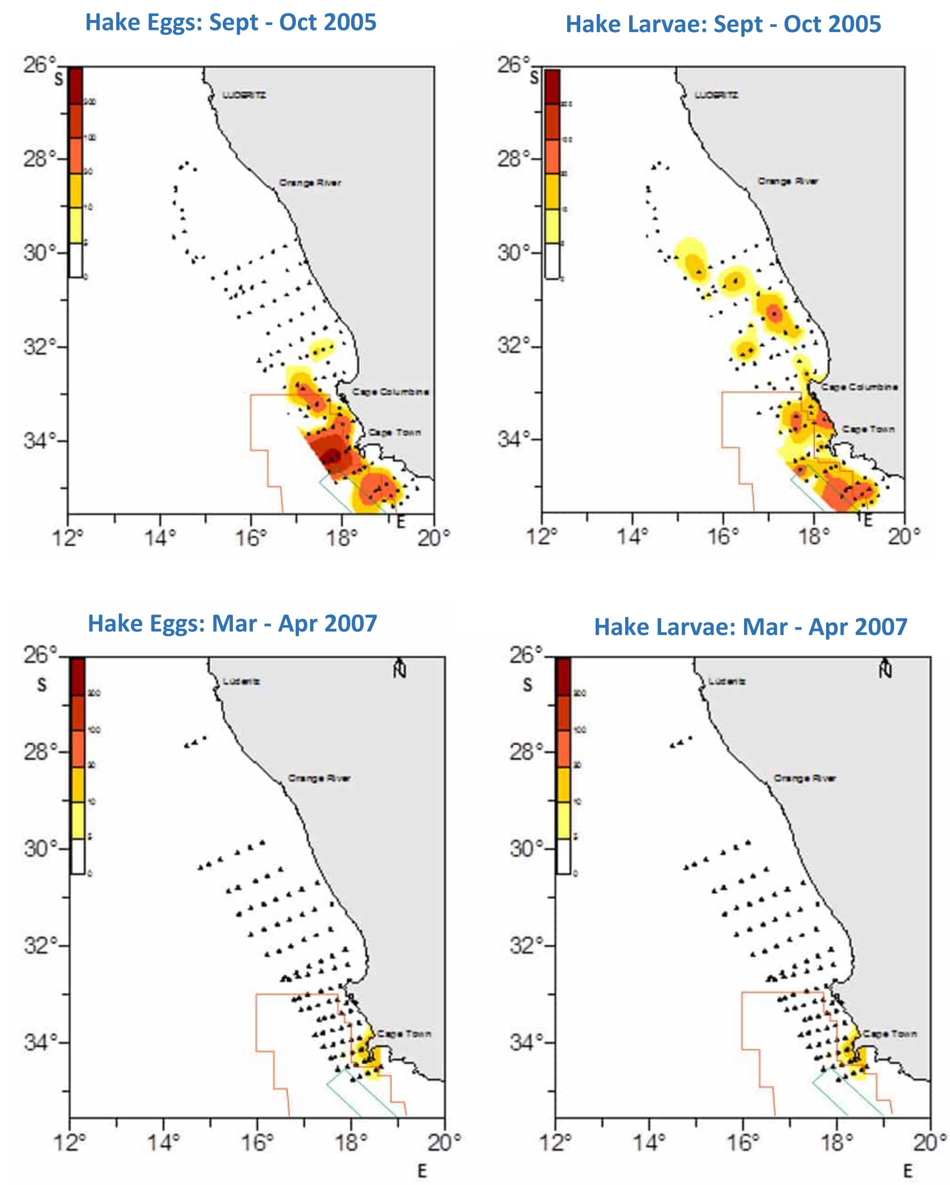

FIGURE 7-24: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO THE DISTRIBUTION OF HAKE EGGS AND LARVAE OFF THE WEST COAST OF SOUTH AFRICA BETWEEN SEPTEMBER - OCTOBER 2005 AND MARCH - APRIL 2007

Adapted from Stenevik *et al.* 2008

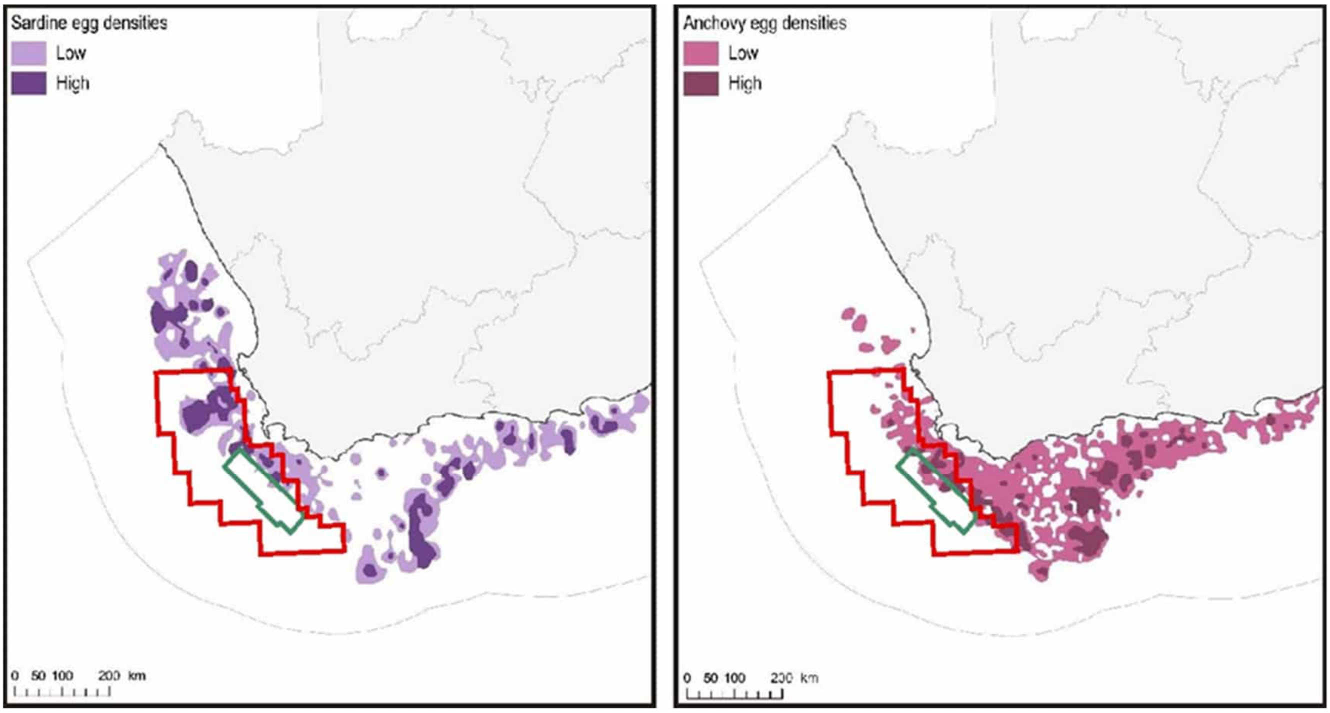

FIGURE 7-25: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO THE DISTRIBUTION OF SARDINE (LEFT) AND ANCHOVY (RIGHT) SPAWNING AREAS, AS MEASURED BY EGG DENSITIES

Adapted from Harris *et al.* 2022

7.4.3.2 Cephalopods

The major cephalopod resource in the southern Benguela is cuttlefish with up to 14 species being recorded (Lipinski 1992; Augustyn *et al.* 1995). Most of the cephalopod resource is distributed on the mid-shelf with *Sepia australis* being most abundant at depths between 60 - 190 m, whereas *S. hieronis* densities were higher at depths between 110 - 250 m. *Rossia enigmatica* occurs more commonly on the edge of the shelf to depths of 500 m. Biomass of these species was generally higher in the summer than in winter. Cuttlefish are largely epi-benthic and occur on mud and fine sediments in association with their major prey item; mantis shrimps (Augustyn *et al.* 1995). They form an important food item for demersal fish.

The giant squid, *Architeuthis sp*. may also be encountered in the project's area of influence. This is a deep dwelling species, usually found near continental and island slopes all around the world's oceans (see Figure 7-26) and **could thus potentially occur in the area of interest, although the likelihood of an encounter is extremely low.** Growing to in excess of 10 m in length, they are the principal prey of the sperm whale, and are also taken by beaked whaled, pilot whales, elephant seals and sleeper sharks. Nothing is known of their vertical distribution, but data from trawled specimens and sperm whale diving behaviour suggest they may span a depth range of 300 to 1 000 m.

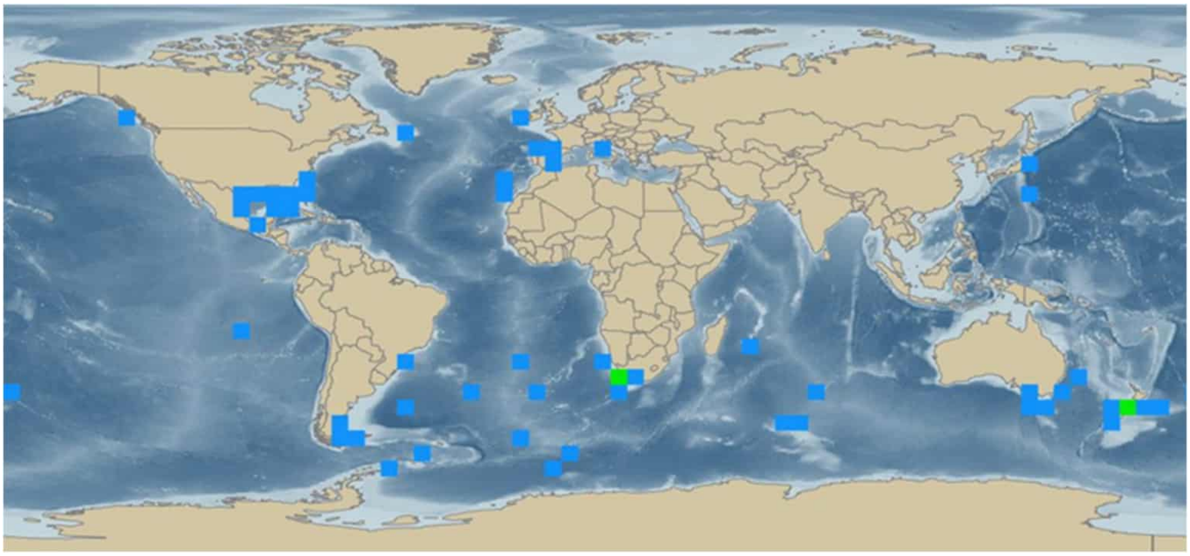

FIGURE 7-26: DISTRIBUTION OF THE GIANT SQUID
Note: Blue <5 observations; Green 6-10 observations
Source: http://iobis.org

7.4.3.3 Pelagic Fish

Small pelagic species include the sardine/pilchard (*Sadinops ocellatus*), **anchovy** (*Engraulis capensis*), **chub mackerel** (*Scomber japonicus*), **horse mackerel** (*Trachurus capensis*) **and round herring** (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes (Crawford *et al.* 1987), and **generally occur within the 200 m depth contour and thus unlikely to be encountered within the Area of Interest for proposed exploration drilling.** Most of the pelagic species exhibit similar life history patterns involving seasonal migrations between the West and South Coasts. The spawning areas of the major pelagic species are distributed on the continental shelf and along the shelf edge extending from south of St Helena Bay on the West Coast to Mossel Bay on the South Coast (Shannon & Pillar 1985) (see Figure 7-23). They spawn downstream of major upwelling centres in spring and summer, and their eggs and larvae are subsequently carried around Cape Point and up the coast in northward flowing surface waters.

At the start of winter every year, juveniles of most small pelagic shoaling species recruit into coastal waters in large numbers between the Orange River and Cape Columbine. They recruit in the pelagic stage, across broad stretches of the shelf, to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point.

Two species that migrate along the West Coast following the shoals of anchovy and pilchards are snoek (*Thyrsites atun)* and chub mackerel (*Scomber japonicas)*. Both these species have been rated as 'Least concern' on the national assessment (Sink *et al.* 2019). While the appearance of chub mackerel along the West and South-West coasts is highly seasonal, adult snoek are found throughout their distribution range and longshore movement are random and without a seasonal basis (Griffiths 2002). Initially postulated to be a single stock that undergoes a seasonal longshore migration from southern Angola through Namibia to the South African West Coast (Crawford & De Villiers 1985; Crawford et al. 1987), Benguela snoek are now recognised as two separate sub-populations separated by the Lüderitz upwelling cell (Griffiths 2003). On the West Coast, snoek move offshore to spawn and there is some southward dispersion as the spawning season progresses, with females on the West

Coast moving inshore to feed between spawning events as spawning progresses. In contrast, those found further south along the western Agulhas Bank remain on the spawning grounds throughout the spawning season (Griffiths 2002) (see Figure 7-27). They are voracious predators occurring throughout the water column, feeding on both demersal and pelagic invertebrates and fish. Chub mackerel similarly migrate along the southern African West Coast reaching South-Western Cape waters between April and August. They move inshore in June and July to spawn before starting the return northwards offshore migration later in the year. Their abundance and seasonal migrations are thought to be related to the availability of their shoaling prey species (Payne & Crawford 1989).

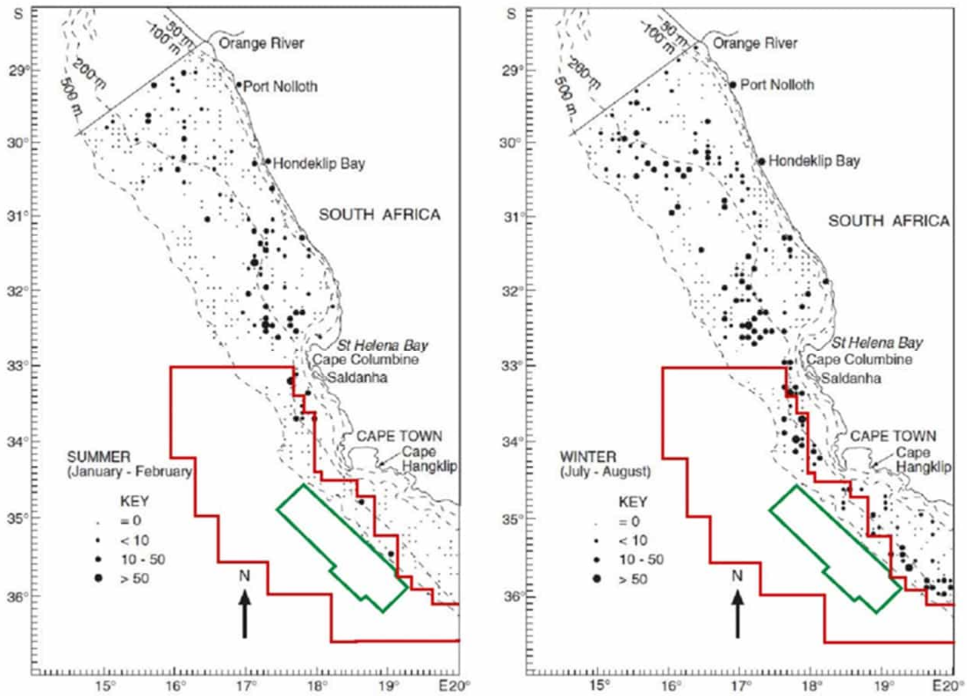

FIGURE 7-27: BLOCK 5/6/7 (RED POLYGON) AND THE AREA OF INTEREST FOR DRILLING (GREEN POLYGON) IN RELATION TO THE MEAN NUMBER OF SNOEK PER DEMERSAL TRAWL PER GRID BLOCK (5 × 5 NM) BY SEASON (JULY 1985–JAN 1991) FOR (A) THE WEST COAST AND (B) THE SOUTH COAST

Adapted from: Griffiths 2002

The fish most likely to be encountered on the shelf, beyond the shelf break and in the offshore waters of the Area of Interest for drilling are the large migratory pelagic species, including various tunas, billfish and sharks, many of which are considered threatened by the International Union for the Conservation of Nature (IUCN), primarily due to overfishing (see Table 7-3). Tuna and swordfish are targeted by high seas fishing fleets and illegal overfishing has severely damaged the stocks of many of these species. Similarly, pelagic sharks, are either caught as bycatch in the pelagic tuna longline fisheries, or are specifically targeted for their fins.

These large pelagic species migrate throughout the southern oceans, between surface and deep waters (>300 m) and have a highly seasonal abundance in the Benguela system. Species occurring off western southern Africa include the albacore/longfin tuna (*Thunnus alalunga)*, yellowfin (*T. albacares)*, bigeye (*T. obesus)*, and skipjack (*Katsuwonus pelamis)* tunas, as well as the Atlantic blue marlin (*Makaira nigricans)*, the white marlin (*Tetrapturus albidus)* and the broadbill swordfish (*Xiphias gladius)* (Payne & Crawford 1989). The distributions of these species are dependent on food availability in the mixed boundary layer between the Benguela and warm central Atlantic waters. Concentrations of large pelagic species are also known to occur associated with underwater feature such as canyons and seamounts, as well as meteorologically induced oceanic fronts (Shannon *et al.* 1989; Penney e*t al.* 1992). Seasonal association with Child's Bank (off Namaqualand) and Tripp Seamount (off southern Namibia) occurs between October and June, with commercial catches often peaking in March and April (www.fao.org/fi/fcp/en/NAM/body.htm). The South Atlantic Seamounts, which lie within and adjacent to the southern boundary of Block 5/6/7 and within the Agulhas Current retroflection zone, also serve as an important aggregation site for migratory species, such as sharks and tuna.

TABLE 7-3: IMPORTANT LARGE MIGRATORY PELAGIC FISH IKELY TO OCCUR IN THE OFFSHORE WATERS OF THE WEST COAST

Common Name	Species	National Assessment	IUCN Conservation Status
Tunas			
Southern Bluefin Tuna	*Thunnus maccoyii*	Not Assessed	Critically Endangered
Bigeye Tuna	*Thunnus obesus*	Vulnerable	Vulnerable
Longfin Tuna/Albacore	*Thunnus alalunga*	Near Threatened	Least concern
Yellowfin Tuna	*Thunnus albacares*	Near Threatened	Least concern
Frigate Tuna	*Auxis thazard*	Not Assessed	Least concern
Eastern Little Tuna	*Euthynnus affinis*	Least concern	Least concern
Skipjack Tuna	*Katsuwonus pelamis*	Least concern	Least concern
Atlantic Bonito	*Sarda sarda*	Not Assessed	Least concern
Billfish			
Black Marlin	*Istiompax indica*	Data deficient	Data deficient
Blue Marlin	*Makaira nigricans*	Vulnerable	Vulnerable
Striped Marlin	*Kajikia audax*	Near Threatened	Near Threatened
Sailfish	*Istiophorus platypterus*	Least concern	Least concern
Swordfish	*Xiphias gladius*	Data deficient	Least concern
Pelagic Sharks			
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Not Assessed	Vulnerable
Dusky Shark	*Carcharhinus obscurus*	Data deficient	Vulnerable
Bronze Whaler Shark	*Carcharhinus brachyuru*	Data deficient	Near Threatened
Great White Shark	*Carcharodon carcharias*	Least concern	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Vulnerable	Endangered
Longfin Mako	*Isurus paucus*	Not Assessed	Vulnerable
Whale Shark	*Rhincodon typus*	Not Assessed	Endangered
Blue Shark	*Prionace glauca*	Least concern	Near Threatened

Note: Species reported from Block 5/6/7 by MMOs are highlighted (CapMarine Environmental 2020)
Source: Sink *et al*. 2019; www.iucnredlist.org

A number of species of pelagic sharks are also known to occur on the West and South-West Coast, including blue (*Prionace glauca)*, short-fin mako (*Isurus oxyrinchus)* and oceanic whitetip (*Carcharhinus longimanus)* sharks. Occurring throughout the world in warm temperate waters, these species are usually found further offshore on the West Coast. Great white (*Carcharodon carcharias)* and whale sharks (*Rhincodon typus)* may also be encountered in coastal and offshore areas, although the latter occurs more frequently along the South and East Coasts. The distributions of some of the pelagic sharks (Great white, Bronze whaler, shortfin mako and whale shark) are provided in Harris *et al.* (2022) (see Figure 7-28).

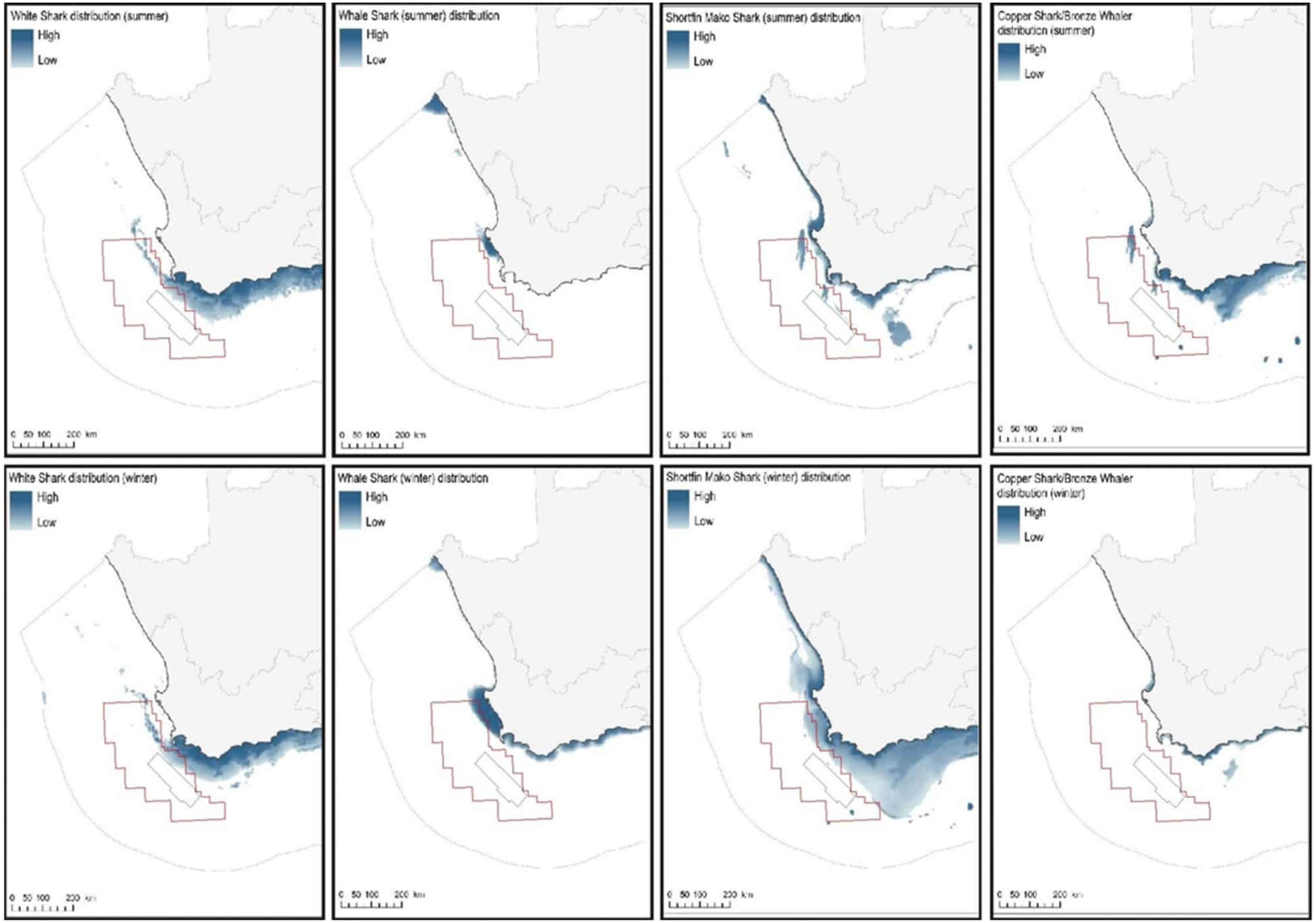

FIGURE 7-28: BLOCK 5/6/7 AND THE AREA OF INTEREST FOR DRILLING IN RELATION TO THE SUMMER (TOP) AND WINTER (BOTTOM) DISTRIBUTION OF WHITE SHARK, WHALE SHARK, SHORTFIN MAKO AND BRONZE WHALER SHARK

Adapted from Harris *et al.* 2022

The whale shark and shortfin mako are listed in Appendix II (species in which trade must be controlled in order to avoid utilisation incompatible with their survival) of CITES (Convention on International Trade in Endangered Species) and Appendix I and/or II of the Bonn Convention for the Conservation of Migratory Species (CMS). The whale shark is also listed as 'Vulnerable' in the List of Marine Threatened or Protected Species (TOPS) as part of the National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEMBA).

Until recently, the Southern Bluefin Tuna was globally assessed as 'Critically Endangered' by the IUCN, and in South Africa the stock is considered collapsed (Sink *et al.* 2019). Although globally the stock remains at a low state, it is not considered overfished as there have been improvements since previous stock assessments. Consequently, the list of species changing IUCN Red List Status for 2020-2021 now list Southern Bluefin Tuna is globally 'Endangered'.

7.4.3.4 Turtles

Three species of turtle occur along the South-West Coast, namely the Leatherback (*Dermochelys coriacea*), the Loggerhead (*Caretta caretta*) (see Figure 7-29), and occasionally the Green (*Chelonia mydas*) turtle. The most recent conservation status is provided in Table 7-4. Leatherback turtles have been assessed as "Critically Endangered" for the southwest Indian region have been listed under CITES Appendix 1.

After completion of the nesting season (October to January) both Leatherbacks and Loggerheads undertake long-distance migrations to foraging areas. Loggerhead turtles (see Figure 7-29) are coastal specialists keeping inshore, hunting around reefs, bays and rocky estuaries along the African South and East Coast. **Although reported in Block 5/6/7** from Marine Mammal Observers sightings (CapMarine Environmental 2020)**, satellite tagging of loggerheads suggests that they seldom occur west of Cape Agulhas** (Harris *et al.* 2018; Robinson *et al.* 2019). **Thus, they can be expected to occur only as occasional visitors along the West Coast.**

TABLE 7-4: GLOBAL AND REGIONAL CONSERVATION STATUS OF THE TURTLES OCCURRING OFF THE SOUTH COAST

Listing	Leatherback Turtle	Loggerhead Turtle	Green Turtle
IUCN Red List:			
Species (date)	V (2013)	V (2017)	E (2004)
Population (RMU)	CR (2013)	NT (2017)	*
Sub-Regional/National			
NEMBA TOPS (2017)	CR	E	E
Sink & Lawrence (2008)	CR	E	E
Hughes & Nel (2014)	E	V	NT

NT – Near Threatened V – Vulnerable E – Endangered CR – Critically Endangered
DD – Data Deficient UR – Under Review * - not yet assessed

FIGURE 7-29: LOGGERHEAD TURTLE OBSERVED IN BLOCK 5/6/7 DURING 2020 3D SEISMIC SURVEY
Source: CapMarine Environmental, 2020

The Leatherback is the turtle most likely to be encountered in the offshore waters of west South Africa. Their abundance in the study area is unknown but expected to be low. The Benguela ecosystem, especially the northern Benguela where jelly fish numbers are high, is increasingly being recognised as a potentially important feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Gabon, Brazil) and south-east Indian Ocean (South Africa) (Lambardi *et al.* 2008, Elwen & Leeney 2011; SASTN 2011[19]). Leatherback turtles from the east South Africa population have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Lambardi *et al.* 2008, Robinson *et al.* 2018) (see Figure 7-30).

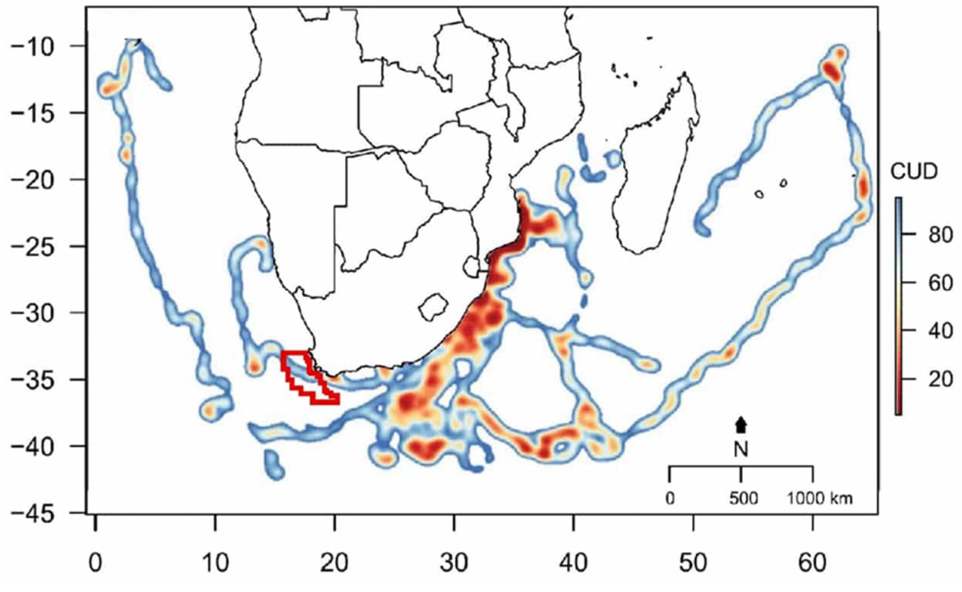

FIGURE 7-30: BLOCK 5/6/7 IN RELATION TO THE MIGRATION CORRIDORS OF LEATHERBACK TURTLES IN THE SOUTH-WESTERN INDIAN OCEAN
Note: Relative use (CUD, Cumulative Utilization Distribution) of corridors is shown through intensity of shading: light, low use; dark, high use.
Adapted from Harris *et al.* 2018

[19] SASTN Meeting – Second meeting of the South Atlantic Sea Turtle Network, Swakopmund, Namibia, 24-30 July 2011.

Green turtles are non-breeding residents often found feeding on inshore reefs on the South and East Coasts and are expected to occur only as occasional visitors along the West Coast, as confirmed by Marine Mammal Observers sightings in Block 5/6/7 (CapMarine Environmental 2020).

7.4.3.5 Seabirds

Large numbers of pelagic seabirds exploit the pelagic fish stocks of the Benguela system. Of the 49 species of seabirds that occur in the Benguela region, 15 are defined as resident, 10 are visitors from the northern hemisphere and 25 are migrants from the Southern Ocean. On the South Coast, 60 seabird species are known, or thought likely to occur. These can be categorised into three categories: 'breeding resident species', 'non-breeding migrant species' and 'rare vagrants' (Shaughnessy 1977; Harrison 1978; Liversidge & Le Gras 1981; Ryan & Rose 1989). The species classified as being common in the southern Benguela, and likely to occur in Block 5/6/7, are listed in Table 7-5.

TABLE 7-5: PELAGIC SEABIRDS COMMON IN THE SOUTHERN BENGUELA REGION AND THEIR CONSERVATION STATUS

Common Name	Species name	Regional Assessment	Global IUCN
Shy Albatross	*Thalassarche cauta*	Near Threatened	Near Threatened
Black Browed Albatross	*Thalassarche melanophrys*	Endangered	Least concern
Yellow-Nosed Albatross	*Thalassarche chlororhynchos*	Endangered	Endangered
Wandering Albatross	*Diomedea exulans*	Vulnerable	Vulnerable
Giant Petrel sp.	*Macronectes halli/giganteus*	Near Threatened	Least concern
Pintado Petrel	*Daption capense*	Least concern	Least concern
Greatwinged Petrel	*Pterodroma macroptera*	Near Threatened	Least concern
Soft-plumaged Petrel	*Pterodroma mollis*	Near Threatened	Least concern
Arctic Prion	*Pachyptila desolata*	Least concern	Least concern
Broad-billed Prion	*Pachyptila vittata*	Least concern	Least concern
White-chinned Petrel	*Procellaria aequinoctialis*	Vulnerable	Vulnerable
Cory's Shearwater	*Calonectris diomedea*	Least concern	Least concern
Great Shearwater	*Puffinus gravis*	Least concern	Least concern
Sooty Shearwater	*Puffinus griseus*	Near Threatened	Near Threatened
European Storm Petrel	*Hydrobates pelagicus*	Least concern	Least concern
Leach's Storm Petrel	*Oceanodroma leucorhoa*	Critically Endangered	Vulnerable
Wilson's Storm Petrel	*Oceanites oceanicus*	Least concern	Least concern
Blackbellied Storm Petrel	*Fregetta tropica*	Near Threatened	Least concern
Pomarine Jaeger	*Stercorarius pomarinus*	Least concern	Least concern
Subantarctic Skua	*Catharacta antarctica*	Endangered	Least concern
Sabine's Gull	*Larus sabini*	Least concern	Least concern

Note: Species reported from Block 5/6/7 by MMOs are highlighted (CapMarine Environmental 2020).
Source: Crawford *et al.* 1991; Sink *et al*. 2019

The area between Cape Point and the Orange River supports 38% and 33% of the overall population of pelagic seabirds in winter and summer, respectively. **Most of the pelagic seabird species in the region reach highest densities offshore of the shelf break (200 – 500 m depth), and are therefore likely to occur in the Area of Interest, with highest population levels during their non-breeding season (winter).** Support vessels and possible helicopter flights may, however, encounter more coastal seabirds when *en route* between the drilling unit and the port or airport.

Fifteen species of seabirds breed in southern Africa, including Cape Gannet, African Penguin, African Black Oystercatcher, four species of Cormorant, White Pelican, three Gull and four Tern species (see Table 7-6). The breeding areas are distributed around the coast with islands being especially important. **The closest breeding islands to the Area of Interest for proposed exploration drilling are Dassen Island, Robben Island and Seal Island approximately 125 km, 95 km and 85 km to the north of the northern section of the area of interest, respectively, and Dyer Island approximately 100 km north-east of the area of interest. There are breeding colonies of African Penguins at Robben Island, Boulders Beach in False Bay and Betty's Bay, all of which lie over 75 km from the Area of Interest for proposed exploration drilling.**

TABLE 7-6: BREEDING RESIDENT SEABIRDS PRESENT ALONG THE SOUTH-WEST COAST AND THEIR CONSERVATION STATUS

Common Name	Species name	National Assessment	Global IUCN
African Penguin*	*Spheniscus demersus*	Endangered	Endangered
African Black Oystercatcher*	*Haematopus moquini*	Least Concern	Near Threatened
White-Breasted Cormorant	*Phalacrocorax carbo*	Least Concern	Least Concern
Cape Cormorant*	*Phalacrocorax capensis*	Endangered	Endangered
Bank Cormorant*	*Phalacrocorax neglectus*	Endangered	Endangered
Crowned Cormorant*	*Phalacrocorax coronatus*	Near Threatened	Near Threatened
White Pelican	*Pelecanus onocrotalus*	Vulnerable	Least Concern
Cape Gannet*	*Morus capensis*	Endangered	Endangered
Kelp Gull	*Larus dominicanus*	Least Concern	Least Concern
Greyheaded Gull	*Larus cirrocephalus*	Least Concern	Least Concern
Hartlaub's Gull*	*Larus hartlaubii*	Least Concern	Least Concern
Caspian Tern	*Hydroprogne caspia*	Vulnerable	Least Concern
Swift Tern	*Sterna bergii*	Least Concern	Least Concern
Roseate Tern	*Sterna dougallii*	Endangered	Least Concern
Damara Tern	*Sterna balaenarum*	Vulnerable	Vulnerable

Note: Species reported from Block 5/6/7 by MMOs are highlighted (CapMarine Environmental 2020).
* denotes endemicity
Source: CCA & CMS 2001; Sink *et al*. 2019

Most of the breeding seabird species forage at sea with most birds being found relatively close inshore (10 - 30 km). Cape Gannets, which breed at only three locations in South Africa (Bird Island Lamberts Bay, Malgas Island and Bird Island Algoa Bay), are known to forage within 200 km offshore (Dundee 2006; Ludynia 2007; Grémillet *et al.* 2008; Crawford *et al.* 2011) and African Penguins have also been recorded as far as 60 km offshore. **The Area of Interest for drilling lies on the western extent of the gannet and penguin foraging areas** (see Figure 7-31), but overlaps with the foraging ranges of various pelagic bird species, particularly Wandering Albatross, Atlantic Yellow-nosed Albatross and Indian Yellow-nosed Albatross (see Figure 7-32). Cape Cormorant core usage areas lie well inshore of Block 5/6/7 (BirdLife South Africa 2021; Harris *et al.* 2022).

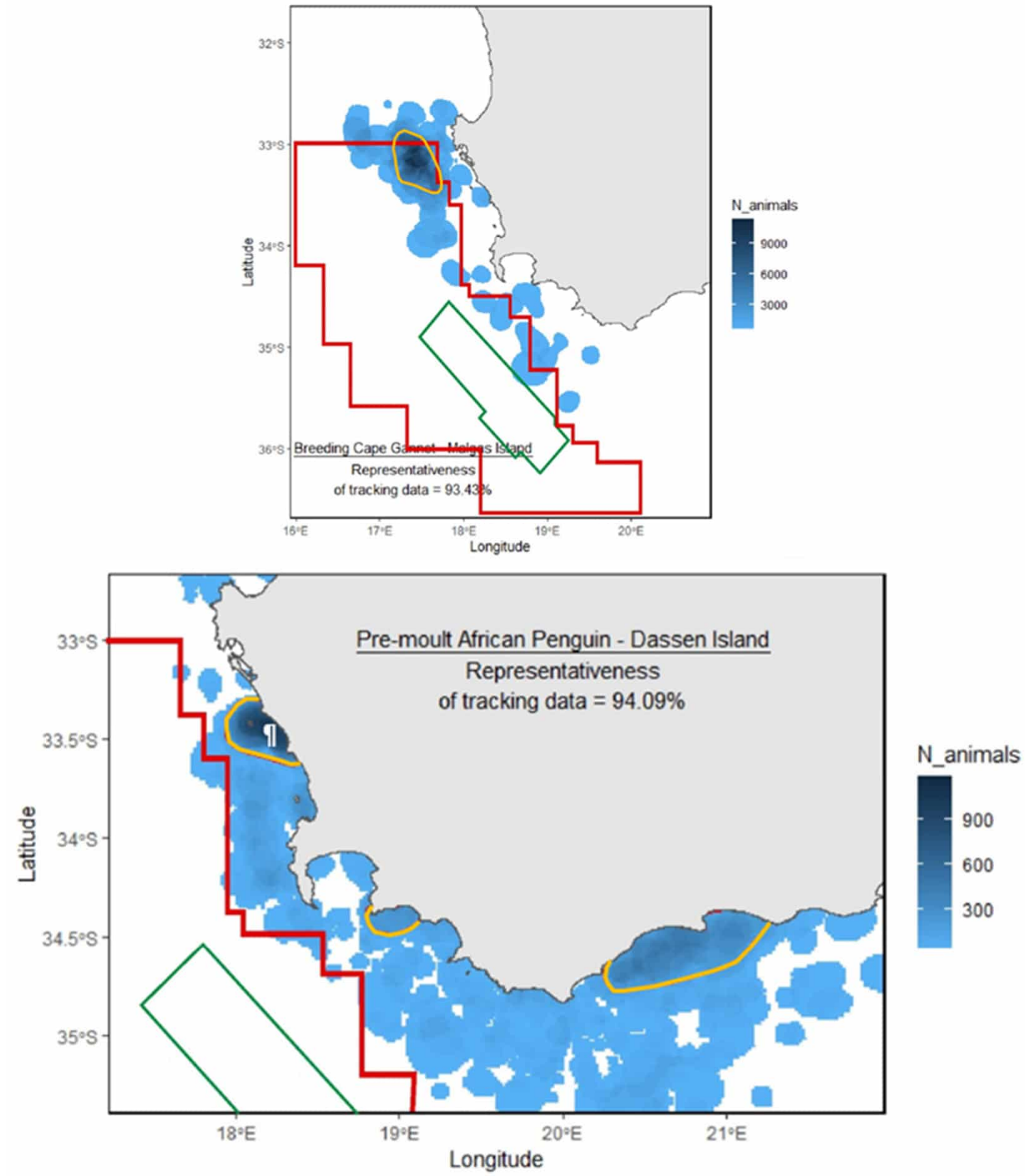

FIGURE 7-31: BLOCK 5/6/7 AND AREA OF INTERTEST IN RELATION TO CORE USAGE AREAS (ORANGE POLYGON) AND GENERAL DISTRIBUTION (BLUE SHADING) FOR BREEDING CAPE GANNETS FROM MALGAS ISLAND (TOP) AND FOR PRE-MOULT AFRICAN PENGUINS FROM DASSEN ISLAND (BOTTOM)

Adapted from BirdLife South Africa 2021

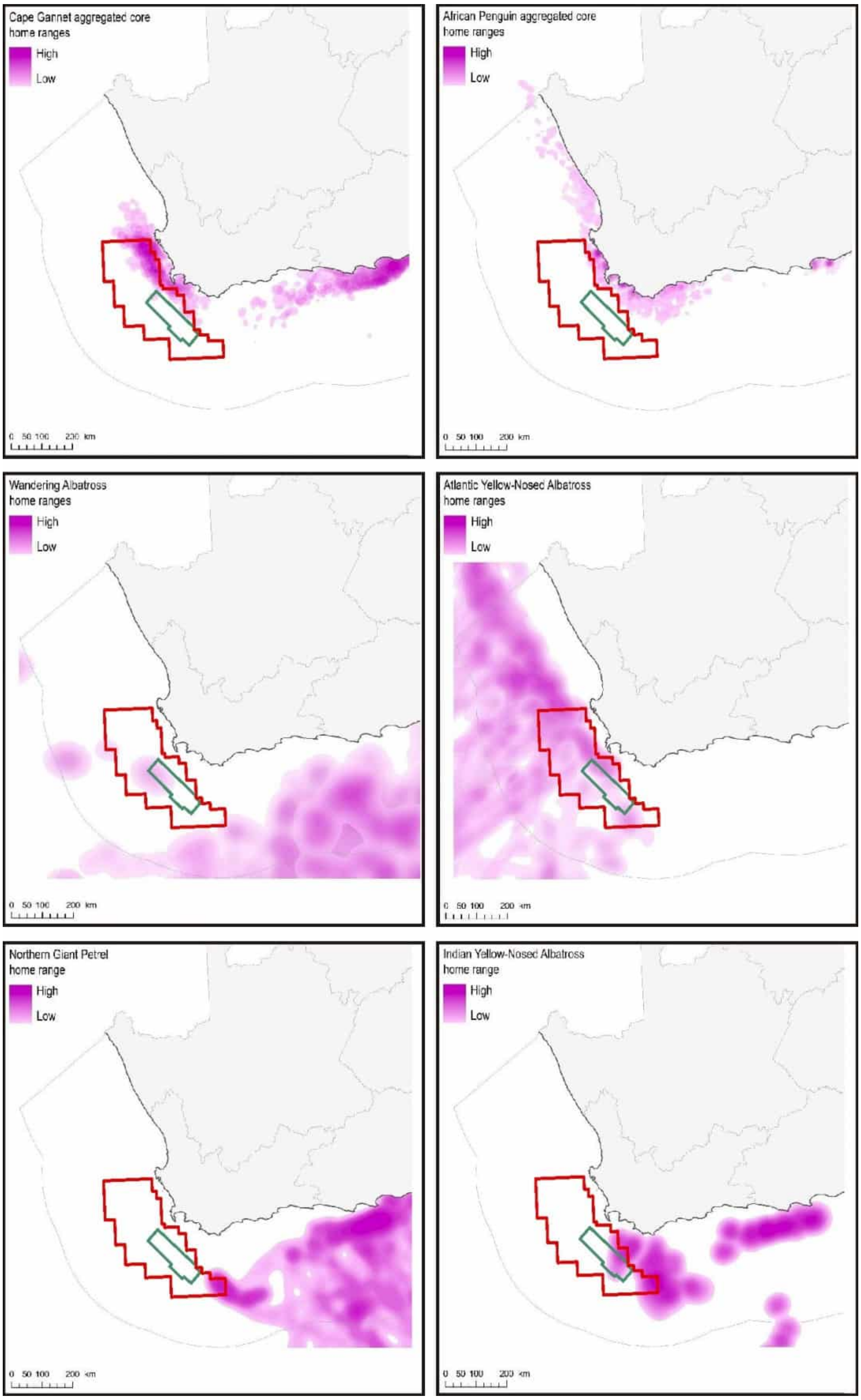

FIGURE 7-32: BLOCK 5/6/7 IN RELATION TO AGGREGATE CORE HOME RANGES OF CAPE GANNET (TOP LEFT), AFRICAN PENGUIN (TOP RIGHT) FOR DIFFERENT COLONIES AND LIFE-HISTORY STAGES, AND FORAGING AREAS OF WANDERING ALBATROSS (MIDDLE LEFT), ATLANTIC YELLOW-NOSED ALBATROSS (MIDDLE RIGHT), NORTHERN GIANT PETREL (BOTTOM LEFT) AND INDIAN YELLOW-NOSED ALBATROSS (BOTTOM RIGHT)

Adapted from Harris ***et al.*** 2022

Interactions with commercial fishing operations, either through incidental bycatch or competition for food resources, is the greatest threat to southern African seabirds, impacting 56% of seabirds of special concern. Crawford *et al.* (2014) reported that four of the seabirds assessed as Endangered compete with South Africa's fisheries for food: African Penguins, Cape Gannets and Cape Cormorants for sardines and anchovies, and Bank Cormorants for rock lobsters (Crawford *et al.* 2015). Populations of seabirds off the West Coast have recently shown significant decreases, with the population numbers of African Penguins currently only 2.5% of what the population was 80 years ago (Sink *et al.* 2019). For Cape Gannets, the global population decreased from about 250 000 pairs in the 1950s and 1960s to approximately 130 000 in 2018, primarily as a result of a >90% decrease in Namibia's population in response to the collapse of Namibia's sardine resource. In South Africa, numbers of Cape Gannets have increased since 1956 and South Africa now holds >90% of the global population. However, numbers have recently decreased in the Western Cape but increased in Algoa Bay mirroring the southward and eastward shift in sardines and anchovies. Algoa Bay currently holds approximately 75% of the South African Gannet population. Cape cormorants and Bank cormorants showed a substantial decline from the late 1970s/early 1980s to the late 2000s/early 2010s, with numbers of Cape cormorants dropping from 106 500 to 65 800 breeding pairs, and Bank cormorants from 1 500 to only 800 breeding pairs over that period (Crawford *et al.* 2015).

Demersal and pelagic longlining are key contributors to the mortality of albatrosses (Browed albatross 7%, Indian and Atlantic Yellow-Nosed Albatross 3%), petrels (white-chinned petrel 66%), shearwaters and Cape Gannets (2%) through accidental capture (bycatch and/or entanglement in fishing gear), with an estimated annual mortality of 450 individuals of 14 species for the period 2006 to 2013 (Rollinson *et al.* 2017). Other threats include predation by mice on petrel and albatross chicks on sub-Antarctic islands, predation of chicks of Cape, Crowned and Bank Cormorants by Great White Pelicans, and predation of eggs and chicks of African Penguins, Bank, Cape and Crowned Cormorants by Kelp gulls. Disease (avian flu), climate change (heat stress and environmental variability) and oil spills are also considered major contributors to seabird declines (Sink *et al.* 2019).

7.4.3.6 Cetaceans

Thirty-five species or sub-species/populations of cetaceans (whales and dolphins) are known (based on historic sightings or strandings records) or likely (based on habitat projections of known species parameters) to occur in the waters of the South-West Coast. Of the 35 species listed, the blue whale is considered 'Critically endangered', the sei whale is 'Endangered' and the fin and sperm whales are considered vulnerable (IUCN Red Data list Categories). Altogether, eight species are listed as 'data deficient' underlining how little is known about cetaceans, their distributions and population trends.

The distribution of cetaceans can largely be split into those associated with the continental shelf and those that occur in deep, oceanic water. Importantly, species from both environments may be found on **the continental slope, from the shelf break (200 m to 2 000 m), making this the most species rich area for cetaceans and also high in density** (De Rock *et al.* 2019; SLR data). Cetacean density on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide ranging across thousands of kilometres. **The most common species within Block 5/6/7 (in terms of likely encounter rate not total population sizes) are likely to be the long-finned pilot whale, common dolphin, sperm whale and humpback**

whale. Southern right whales may also be encountered passing through the Block on their way to their coastal breeding grounds.

Cetaceans are comprised of two basic taxonomic groups: the mysticetes (filter-feeding baleen whales) and the odontocetes (toothed predatory whales and dolphins). The term 'whale' is used to describe species in both these groups and is taxonomically meaningless (e.g., the killer whale and pilot whale are members of the Odontoceti, family Delphinidae and are thus dolphins). Due to large differences in their size, sociality, communication abilities, ranging behaviour and acoustic behaviour, these two groups are considered separately.

Table 7-7 lists the cetaceans likely to be found within Block 5/6/7 based on data sourced from Findlay *et al.* (1992), Best (2007), Weir (2011), Sink *et al.* (2019), and unpublished records held by Sea Search. Figure 7-33 shows distribution of cetaceans along the West and South Coasts between 2001 and 2020 based on MMO records, while Figure 7-34 shows predicted distributions of several odontocete species off the South African Coast.

All whales and dolphins are given protection under the South African Law. The Marine Living Resources Act, 1998 states that no whales or dolphins may be harassed, killed or fished. No vessel or aircraft may, without a permit or exemption, approach closer than 300 m to any whale and a vessel should move to a minimum distance of 300 m from any whales if a whale surfaces closer than 300 m from a vessel or aircraft.

7.4.3.6.1 Mysticete (Baleen) Whales

Mysticete (baleen) whales potentially occurring in the Block 5/6/7 area include the blue, fin, sei, Antarctic minke, dwarf minke, Bryde's, pygmy right, humpback and southern right. The most abundant baleen whales off the coast of South Africa are the southern right and humpback whales. Most of these species occur in pelagic waters, with only occasional visits into shelf waters. All of these species show some degree of migration either to, or through, the licence block when travelling between higher-latitude feeding grounds (Antarctic or Subantarctic) and lower-latitude breeding grounds. Depending on the ultimate location of these feeding and breeding grounds, seasonality off South Africa can be either unimodal (usually in June-August, e.g., minke and blue whales) or bimodal (usually May-July and October-November, e.g., fin whales), reflecting a northward and southward migration through the area. As whales follow geographic or oceanographic features, the northward and southward migrations may take place at difference distances from the coast, thereby influencing the seasonality of occurrence at different locations. Table 7-8 summarises the seasonality of expected baleen whale occurrence in the project area.

TABLE 7-7: CETACEANS OCCURRENCE OFF THE SOUTH-WEST COAST OF SOUTH AFRICA, THEIR SEASONALITY, LIKELY ENCOUNTER FREQUENCY WITH PROPOSED EXPLORATION ACTIVITIES AND SOUTH AFRICAN AND GLOBAL IUCN RED LIST CONSERVATION STATUS

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Delphinids							
Dusky dolphin	*Lagenorhynchus obscurus*	HF	Yes (0- 800 m)	No	Year round	Least Concern	Least Concern
Heaviside's dolphin	*Cephalorhynchus heavisidii*	VHF	Yes (0-200 m)	No	Year round	Least Concern	Near Threatened
Common bottlenose dolphin	*Tursiops truncatus*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Common dolphin	*Delphinus delphis*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Southern right whale dolphin	*Lissodelphis peronii*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Striped dolphin	*Stenella coeruleoalba*	HF	No	Yes	Year round	Least Concern	Least Concern
Pantropical spotted dolphin	*Stenella attenuata*	HF	Edge	Yes	Year round	Least Concern	Least Concern
Long-finned pilot whale	*Globicephala melas*	HF	Edge	Yes	Year round	Least Concern	Least Concern
Short-finned pilot whale	*Globicephala macrorhynchus*	HF	Edge	Yes	Year round	Least Concern	Least Concern
Rough-toothed dolphin	*Steno bredanensis*	HF	No	Yes	Year round	Not Assessed	Least Concern
Killer whale	*Orcinus orca*	HF	Occasional	Yes	Year round	Least Concern	Data deficient
False killer whale	*Pseudorca crassidens*	HF	Occasional	Yes	Year round	Least Concern	Near Threatened
Pygmy killer whale	*Feresa attenuata*	HF	No	Yes	Year round	Least Concern	Least Concern
Risso's dolphin	*Grampus griseus*	HF	Yes (edge)	Yes	Year round	Data Deficient	Least Concern
Sperm whales							
Pygmy sperm whale	*Kogia breviceps*	VHF	Edge	Yes	Year round	Data Deficient	Data Deficient
Dwarf sperm whale	*Kogia sima*	VHF	Edge	Yes	Year round	Data Deficient	Data Deficient
Sperm whale	*Physeter macrocephalus*	HF	Edge	Yes	Year round	Vulnerable	Vulnerable

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Beaked whales							
Cuvier's	*Ziphius cavirostris*	HF	No	Yes	Year round	Data Deficient	Least Concern
Arnoux's	*Beradius arnouxii*	HF	No	Yes	Year round	Data Deficient	Data Deficient
Southern bottlenose	*Hyperoodon planifrons*	HF	No	Yes	Year round	Least Concern	Least Concern
Layard's	*Mesoplodon layardii*	HF	No	Yes	Year round	Data Deficient	Data Deficient
True's	*Mesoplodon mirus*	HF	No	Yes	Year round	Data Deficient	Data Deficient
Gray's	*Mesoplodon grayi*	HF	No	Yes	Year round	Data Deficient	Data Deficient
Blainville's	*Mesoplodon densirostris*	HF	No	Yes	Year round	Data Deficient	Data Deficient
Baleen whales							
Antarctic Minke	*Balaenoptera bonaerensis*	LF	Yes	Yes	>Winter	Least Concern	Near Threatened
Dwarf minke	*B. acutorostrata*	LF	Yes	Yes	Year round	Least Concern	Least Concern
Fin whale	*B. physalus*	LF	Yes	Yes	MJJ & ON	Endangered	Vulnerable
Blue whale (Antarctic)	*B. musculus intermedia*	LF	No	Yes	Winter peak	Critically Endangered	Critically Endangered
Sei whale	*B. borealis*	LF	Yes	Yes	MJ & ASO	Endangered	Endangered
Bryde's (inshore)	*B brydei (subspp)*	LF	Yes	Edge	Year round	Vulnerable	Least Concern
Bryde's (offshore)	*B. brydei*	LF	Edge	Yes	Summer (JFM)	Data Deficient	Least Concern
Pygmy right	*Caperea marginata*	LF	Yes	?	Year round	Least Concern	Least Concern
Humpback sp.	*Megaptera novaeangliae*	LF	Yes	Yes	Year round, SONDJF	Least Concern	Least Concern
Humpback B2 population	*Megaptera novaeangliae*	LF	Yes	Yes	Spring Summer peak ONDJF	Vulnerable	Not Assessed
Southern Right	*Eubalaena australis*	LF	Yes	No	Year round, ONDJFMA	Least Concern	Least Concern

Notes:

- Species recorded by Marine Mammal Observers (MMOs) in Block 5/6/7 during the 2020 3D seismic survey are shaded / highlighted (CapMarine Environmental 2020).
- Marine animals do not hear equally well at all frequencies within their functional hearing range. Based on the hearing range and sensitivities, Southall *et al (*2019) have categorised noise sensitive marine mammal species into six underwater hearing groups: low-frequency (LF), high-frequency (HF) and very high-frequency (VHF) cetaceans, Sirenians (SI), Phocid carnivores in water (PCW) and other marine carnivores in water (OCW).

Adapted from Child *et al.* 2016

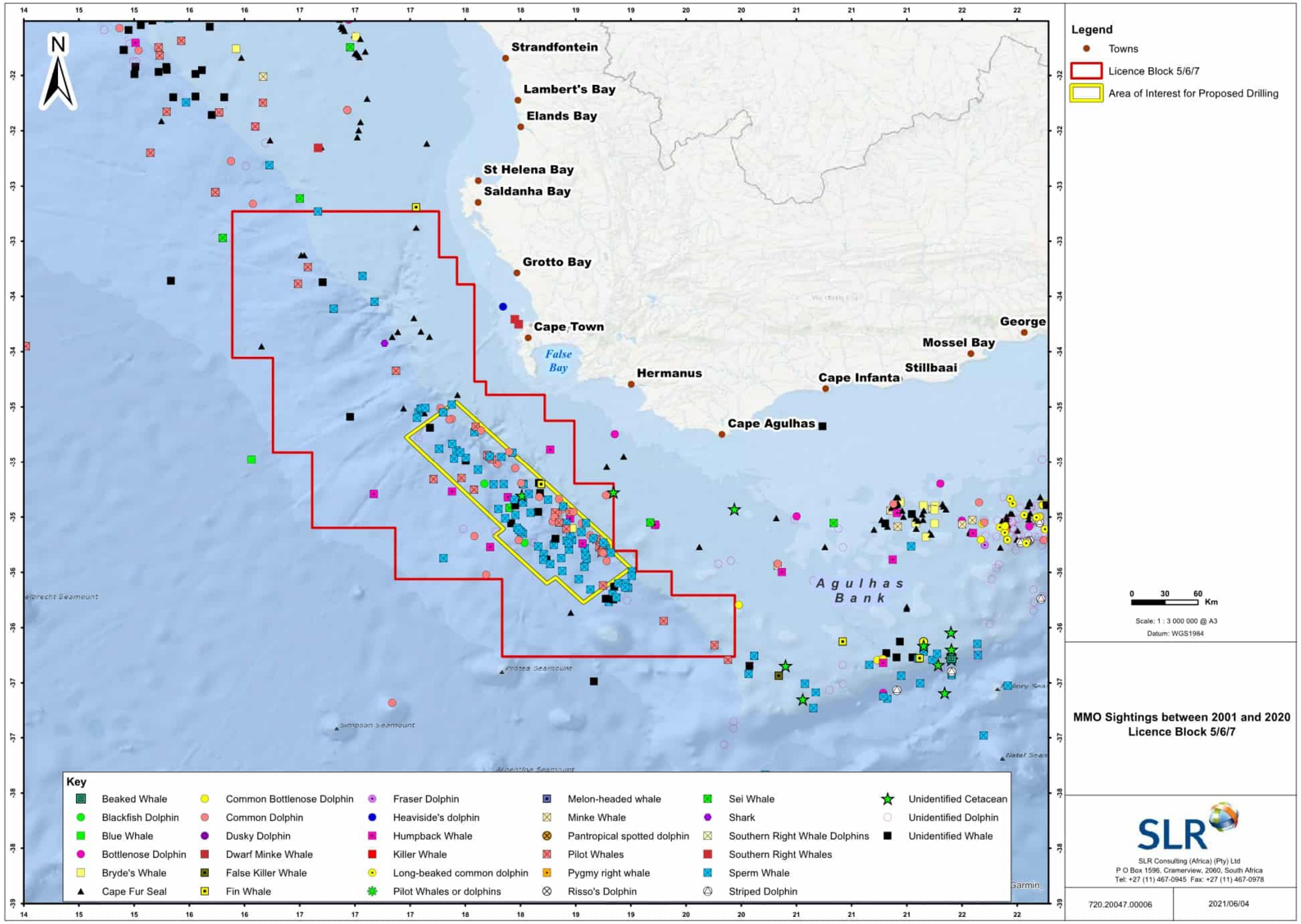

FIGURE 7-33: DISTRIBUTION AND MOVEMENT OF CETACEANS ALONG THE WEST AND SOUTH COASTS OF SOUTH AFRICA COLLATED BETWEEN 2001 AND 2020

Note: Figure depicts separate MMO sightings from seismic surveys undertaken between 2001 and 2020, including the 2020 3D seismic survey within the Area of Interest.

Source: SLR

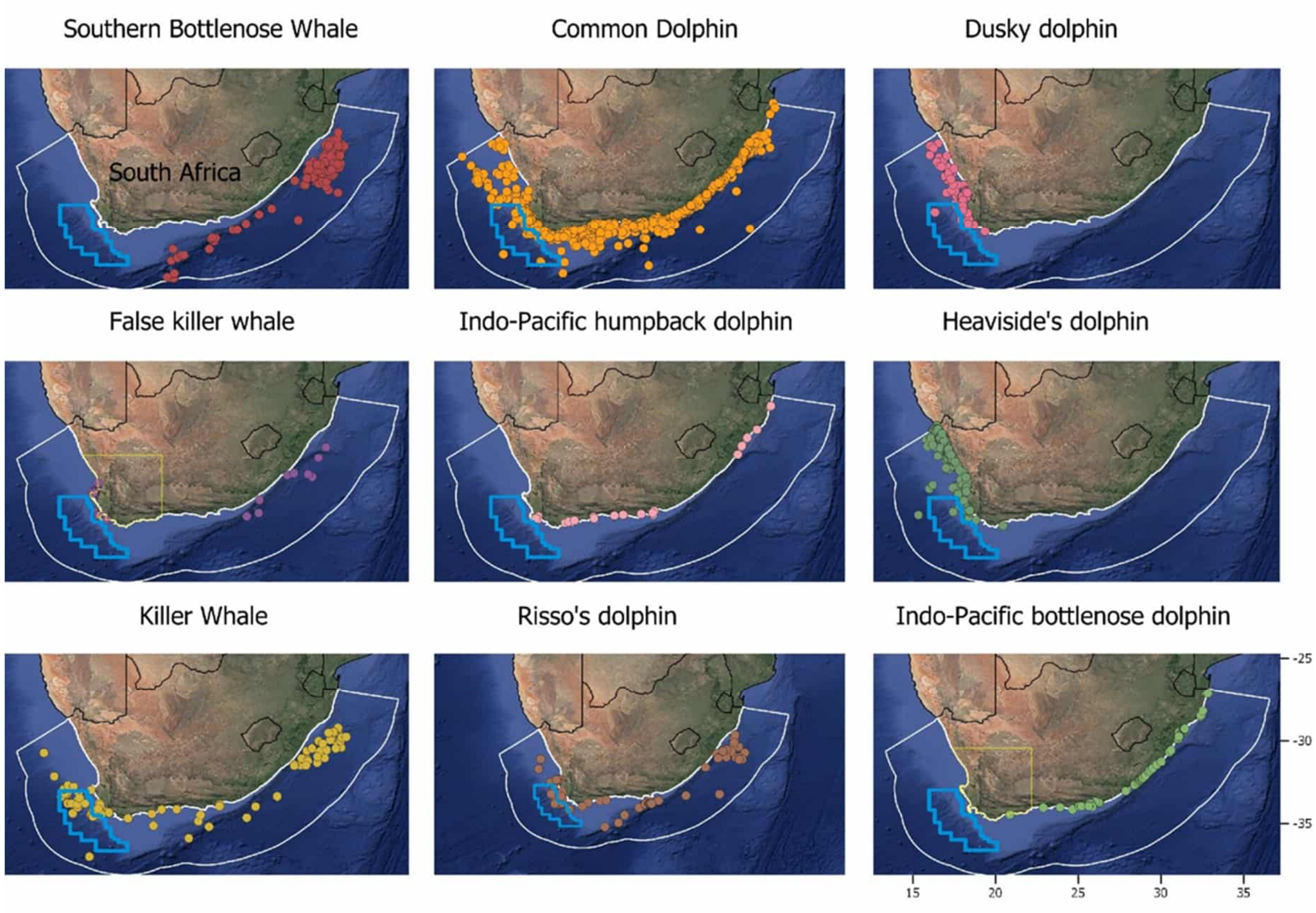

FIGURE 7-34: BLOCK 5/6/7 IN RELATION TO PREDICTED DISTRIBUTIONS FOR NINE ODONTOCETE SPECIES OFF THE COAST OF SOUTH AFRICA
Adapted from: Purdon *et al.* 2020a.

TABLE 7-8: SEASONALITY OF BALEEN WHALES (MYSTICETES) IN THE BROADER PROJECT AREA

Whales	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bryde's Inshore	L	L	M	M	M	M	M	L	L	M	M	L
Sei	M	L	L	L	H	H	M	H	H	H	M	M
Fin	M	M	M	M	H	H	H	L	L	H	H	M
Blue	L	L	L	L	M	M	M	L	L	L	L	L
Minke	M	M	M	H	H	H	M	H	H	H	M	M
Humpback	H	M	L	L	L	M	M	M	H	H	H	H
Southern Right	H	M	L	L	L	M	M	M	H	H	H	H

Note: Based on data from multiple sources, predominantly commercial catches (Best 2007 and other sources) and data from stranding events (NDP unpubl. data).

Note: Values of high (H), Medium (M) and Low (L) are relative within each row (species) and not comparable between species.

Due to the complexities of the migration patterns, each species is discussed in further detail below.

- **Southern right whales** (*Eubalaena australis*) : **The most abundant baleen whales in the Benguela region are southern right and humpback whales** (discussed separately below). Both species have long been known to feed in the Benguela Ecosystem and numbers since 2000 have grown substantially. The feeding peak of timing in the Benguela is spring and early summer (October – February) and follows the 'traditional' South African breeding season (June – November) and its associated migration (Johnson *et al.* 2022).

  The southern African population of **southern right whales** historically extended from southern Mozambique (Maputo Bay) to southern Angola (Baia dos Tigres) and is considered to be a single population within this range (Roux *et al.* 2011). The most recent abundance estimate for this population is available for 2017 which estimated the population at approximately 6 100 individuals including all age and sex classes, and still growing at approximately 6.5% per annum (Brandaõ *et al.* 2017). When the population numbers crashed in 1920, the range contracted down to just the South Coast of South Africa, but as the population recovers, it is repopulating its historic grounds, including Namibia (Roux *et al.* 2001, 2015; de Rock *et al.* 2019) and Mozambique (Banks *et al.* 2011).

  Some individual southern right whales move directly from the South Coast breeding grounds directly to the West Coast feeding ground (Mate *et al*. 2011). When departing from feeding ground all satellite tagged animals in that study took a direct south-westward track, which would take them directly across the northern portion of Block 5/6/7. Mark-recapture data from 2003-2007 estimated roughly one third of the South African right whale population at that time were using St Helena Bay for feeding (Peters *et al.* 2005). While annual surveys have revealed a steady population increase since the protection of the species from commercial whaling, the South African right whale population has undergone substantial changes in breeding cycles and feeding areas (Van Den Berg *et al.* 2020), and numbers of animal using our coast since those studies were done – notably a significant decrease in the numbers of cow-calf-pairs following the all-time record in 2018, a marked decline of unaccompanied adults since 2010 and variable presence of mother-calf pairs since 2015 (Roux *et al.* 2015; Vermeulen *et al.* 2020). The change in demographics are indications of a population undergoing nutritional stress and has been attributed to likely spatial and/or temporal displacement of prey due to climate variability (Vermeulen et al. 2020; see also Derville *et al.*

2019; Kershaw *et al.* 2021; van Weelden *et al.* 2021). Recent sightings (2018-2021) confirm that there is still a clear peak in numbers on the West Coast between February and April. Given this high proportion of the population known to feed in the southern Benguela, and current numbers reported, **it is highly likely that several hundreds of southern right whales can be expected to pass through Block 5/6/7 when migrating southwards from the feeding areas between April and June** (see Figure 7-35)**.** No sightings were, however, reported during the 2020 3D seismic survey in Block 5/6/7 (CapMarine Environmental 2020).

FIGURE 7-35: BLOCK 5/6/7 IN RELATION TO 'WHALE SUPERHIGHWAYS' SHOWING TRACKS OF HUMPBACK WHALES (ORANGE) AND SOUTHERN RIGHT WHALES (GREEN) BETWEEN SOUTHERN AFRICA AND THE SOUTHERN OCEAN FEEDING GROUNDS

Adapted from: Johnson et al. 2022

- **Humpback whales** (*Megaptera novaeangliae*): The majority of **humpback whales** passing through the Benguela region are those migrating to breeding grounds off tropical West Africa between Angola and the Gulf of Guinea (Rosenbaum *et al*. 2009; Barendse *et al*. 2010) (see Figure 7-35). Until recently it was believed that that these breeding grounds were functionally separate from those off east (Mozambique-Kenya-Madagascar), with only rare movements between them (Pomilla & Rosenbaum 2005) and movements to other continental breeding grounds being even more rare. Recent satellite tagging of animals between Plettenberg Bay and Port Alfred during the northward migration, showed them to turn around and end up feeding in the Southern Benguela (Seakamela *et al.* 2015) before heading offshore and southwards using the same route as whales tracked off Gabon and the West Coast of South Africa. Unexpected results such as this highlight the complexities of understanding whale movements and distribution patterns and the fact that descriptions of broad season peaks in no way captures the wide array of behaviours exhibited by these animals. Furthermore, three separate matches have been made between individuals off South Africa and Brazil by citizen scientist photo-identification (www.happywhale.com). This included whales from the Cape Town and Algoa Bay-Transkei areas. Analysis of humpback whale breeding song on Sub-Antarctic feeding grounds also suggests exchange of singing male whales from western and eastern South Atlantic populations (Darling & Sousa-Lima 2005; Schall *et al.* 2021; but see also Darling *et al.* 2019; Tyarks *et al.* 2021).

In southern African coastal waters, the northward migration stream is larger than the southward peak (Best & Allison 2010; Elwen *et al.* 2014), suggesting that animals migrating north strike the coast at varying places north of St Helena Bay, resulting in increasing whale density on shelf waters and into deeper pelagic waters as one moves northwards. On the southward migration, many humpbacks follow the Walvis Ridge offshore then head directly to high latitude feeding grounds, while others follow a more coastal route (including the majority of mother-calf pairs) possibly lingering in the feeding grounds off the West Coast in summer (Elwen *et al.* 2014; Rosenbaum *et al.* 2014). Although migrating through the Benguela, there is no existing evidence of a clear 'corridor' and humpback whales appear to be spread out widely across the shelf and into deeper pelagic waters, especially during the southward migration (Barendse *et al.* 2010; Best & Allison 2010; Elwen *et al.* 2014). The only available abundance estimate put the number of animals in the West African breeding population (Gabon) to be in excess of 9 000 individuals in 2005 (IWC 2012) and it is likely to have increased substantially since this time at about 5% per annum (IWC 2012; see also Wilkinson 2021). The number of humpback whales feeding in the southern Benguela has increased substantially since estimates made in the early 2000s (Barendse *et al.* 2011). Since ~2011, 'supergroups' of up to 200 individual whales have been observed feeding within 10 km from shore (Findlay *et al.* 2017) with many hundred more passing through and whales are now seen in all months of the year around Cape Town. It has been suggested that the formation of these super-groups may be in response to anomalous oceanographic conditions in the Southern Benguela, which result in favourable food availability, thereby leading to these unique humpback whale feeding aggregations (Dey *et al.* 2021; see also Avila *et al.* 2019; Meynecke *et al.* 2020; Cade *et al.* 2021).

Humpback whales are thus likely to be the most frequently encountered baleen whale in the project area, ranging from the coast out beyond the shelf, with year-round presence but numbers peaking in June – February during the northward migration and a smaller peak with the southern breeding migration around September – October but with regular encounters until February associated with subsequent feeding in the Benguela ecosystem. Humpback whale sightings were reported by MMOs during the recent 2020 3D seismic survey in Block 5/6/7 (CapMarine Environmental 2020). In the first half of 2017 (when numbers are expected to be at their lowest) more than 10 humpback whales were reported stranded along the Namibian and west South African coasts. A similar event was recorded in late 2021-early 2022 when numerous strandings of young humpbacks were reported along the Western Cape Coast and in Namibia (Simon Elwen, Sea Search, *pers. comm*.). The cause of these deaths is not known, but a similar event off Brazil in 2010 was linked to possible infectious disease or malnutrition (Siciliano *et al.* 2013). Unusual mortality events of humpback whales between 2016 and 2022 have similarly been reported along the US Atlantic Coast from Maine to Florida (https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2022-humpback-whale-unusual-mortality-event-along-atlantic-coast). The West African population may be undergoing similar stresses in response to changes in their ecosystem (see for example Kershaw *et al.* 2021). It is not yet understood what may be driving these ecosystem changes and what the long-term effects to populations could potentially be.

- **Blue whales** (*Balaenoptera musculus*) - Critically Endangered: Blue whales were historically caught in high numbers during commercial whaling activities, with a single peak in catch rates during June to July in Namibia and Angola suggesting that in the eastern South Atlantic these latitudes are close to the northern migration limit for the species (Best 2007). Although there were only two confirmed sightings of the species in the area between 1973 and 2006 (Branch *et al.* 2007), evidence of blue whale presence off Namibia is increasing. Recent acoustic detections of blue whales in the Antarctic peak between December and January (Tomisch *et* al. 2016) and off western South Africa (Shanbangu *et al.* 2019), as well as in northern Namibia between May and July (Thomisch 2017), support observed timing from whaling records. Several recent (2014-2015) sightings of blue whales during seismic surveys off the southern Namibian coast (water depth >1 000 m) confirm their existence in the area and occurrence in Autumn months (April to June). **The chance of encountering the species in the Block 5/6/7 is considered low.**

- **Fin whales** (*Balaenoptera physalus*) - Vulnerable: Fin whales were historically caught off the West Coast of South Africa. A bimodal peak in the catch data suggests animals were migrating further north to breed (during May-June) before returning to Antarctic feeding grounds (during August-October). However, the location of the breeding ground (if any) is unknown (Best 2007). Some juvenile animals may feed year round in deeper waters off the shelf (Best 2007). The occasional single whale has been reported during humpback whale research in the southern Benguela, and a feeding aggregation of approximately 30 animals was observed in November 2019 approximately 200 km west of St Helena Bay in approximately 2 000 m of water (Sea Search unpubl. Data). Current sightings records support the bimodal peak in presence observed from whaling data (but with some chance of year-round sightings) with animals apparently feeding in the nutrient rich Benguela during their southward migration. There are no recent data on abundance or distribution of fin whales off western South Africa. **The sighting of an unidentified rorqual whale, thought to be a fin whale, was reported by MMOs during a 3D seismic survey in Block 5/6/7** (CapMarine Environmental 2020). **Encounters in the licence area are thus possible.**

- **Sei whales** (*Balaenoptera borealis*) - Endangered: There is very little information on Sei whales in South African waters and most information on the species from the southern African sub-region originates from whaling data from 1958-1963. Sei whales spend time at high latitudes (40-50˚S) during summer months and migrate north through South African waters to unknown breeding grounds further north (Best 2007). Their migration pattern thus shows a bimodal peak with numbers west of Saldanha Bay being highest in May and June, and again in August, September and October. All whales were caught in waters deeper than 200 m with most occurring deeper than 1 000 m (Best & Lockyer 2002). A recent survey to Vema Seamount ~1 000 km west of Cape Town during October to November 2019, encountered a broadly spread feeding aggregation of over 30 sei and fin whales at around 200 m water depth (Elwen et al. in prep**). A single sei whale sighting was reported by MMOs during a 3D seismic survey in Block 5/6/7** (CapMarine Environmental 2020). **Encounters in the licence area are thus possible.**

- **Bryde's whales** (*Balaenoptera edeni*): Two genetically and morphologically distinct populations of Bryde's whales live off the coast of southern Africa (Best 2001; Penry 2010). The "offshore population" lives beyond the shelf (> 200 m depth) off West Africa and migrates between wintering grounds off equatorial West Africa (Gabon) and summering grounds off western South Africa. Its seasonality on the West Coast is thus opposite to the majority of the balaenopterids with abundance likely to be highest in the broader potential impact zone in January - March. The "inshore population" of Bryde's whales is unique amongst baleen whales in the region by being non-migratory. The inshore population has recently been recognised as its own (yet to be named) sub species (*Balaenoptera brydei edeni*, Penry *et al.* 2018) with a total population for this subspecies of likely fewer than 600 individuals. The published range of the population is the continental shelf and Agulhas Bank of South Africa ranging from Durban in the east to at least St Helena Bay off the West Coast with possible movements further north up the West Coast and into Namibia during the winter months (Best 2007). There are no current data on population size and is currently listed as 'Data deficient' (offshore population) and Vulnerable (inshore population) on the South African Red List. The inshore stock is regarded as extremely vulnerable and listed as such on the South African red list as it regularly suffers losses from entanglement in trap fisheries and has been subject to significant changes in its prey base due to losses and shifts in the sardine and small pelagic stocks around South Africa**. Bryde's whale sightings have been reported by Marine Mammal Observers (MMOs) during a 3D seismic survey in Block 5/6/7** (CapMarine Environmental 2020). **Encounters in the licence area are thus likely to occur.**

- **Minke whales** (*Balaenoptera bonaerensis / acutorostrata*): Two forms of minke whale occur in the Southern Hemisphere, the Antarctic minke whale and the dwarf minke whale; both species occur in the Benguela region (Best 2007). Antarctic minke whales range from the pack ice of Antarctica to tropical waters and are usually seen more than approximately 50 km offshore. Although adults of the species migrate from the southern ocean (summer) to tropical/temperate waters (winter) where they are thought to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year round. Recent data available from passive acoustic monitoring over a two-year period off the Walvis Ridge (Namibia) shows acoustic presence in June - August and November - December (Thomisch *et al*. 2016). The dwarf minke whale has a more temperate distribution than the Antarctic minke and they do not range further south than 60-65°S. Dwarf minke whales have a similar migration pattern to Antarctic minkes with at least some animals migrating to the southern ocean in summer months. Around southern Africa, dwarf minke whales occur closer to shore than Antarctic minkes and have been seen <2 km from shore on several occasions around South Africa. **Both species are generally solitary and densities are likely to be low in the area of interest, but encounters may occur.**

- **Pygmy right whale** (*Caperea marginata*): The pygmy right whale is the smallest of the baleen whales reaching only 6 m total length as an adult (Best 2007). The species is typically associated with cool temperate waters between 30°S and 55°S with records from southern and central Namibia being the northern most for the species (Leeney *et al.* 2013). **Its distribution off the West Coast of South Africa is thus likely to be limited to the cooler shelf waters of the main Benguela upwelling areas and encounters within Block 5/6/7 may occur.**

7.4.3.6.2 Odontocetes (Toothed) Whales and Dolphins

The majority of toothed whales and dolphins have more resident distribution patterns, rather than migratory. Those occurring in the study area are listed in Table 7-7 and discussed below.

- **Sperm whales** (*Physeter macrocephalus*) - Vulnerable: Sperm whales are the largest of the toothed whales and have a complex, structured social system with adult males behaving differently to younger males and female groups. They live in deep ocean waters, usually greater than 1 000 m depth, although they occasionally come into waters 500 to 200 m deep on the shelf (Best 2007). They are relatively abundant globally (Whitehead 2002), although no estimates are available for South African waters. Seasonality of historical catches off west South Africa suggests that medium and large sized males are more abundant in winter months, while female groups are more abundant in autumn (March-April), although animals occur year round (Best 2007). Analysis of recent passive acoustic monitoring data from the edge of the South African continental shelf (800 - 1 000 m water depth, roughly 80 km west-south-west of Cape Point) confirms year-round presence. Sperm whales have also been regularly identified by MMOs working in this area (SLR MMO data). Sperm whales feed at great depths during dives in excess of 30 minutes making them difficult to detect visually. However, the regular echolocation clicks made by the species when diving make them relatively easy to detect acoustically using Passive Acoustic Monitoring (PAM). **Sperm whales were the most commonly reported species sighted by MMOs and detected with PAM during the 2020 3D seismic survey undertaken in Block 5/6/7** (CapMarine Environmental 2020).

- **Killer whales** (*Orcinus orca*): Killer whales have a circum-global distribution being found in all oceans from the equator to the ice edge (Best 2007). Killer whales occur year-round in low densities off western South Africa (Best *et al.* 2010), Namibia (Elwen & Leeney 2011) and in the Eastern Tropical Atlantic (Weir *et al.,* 2010). **Off South Africa they are reported most frequently along the continental shelf edge, especially in association with longline fisheries off Cape Point** and along the eastern Agulhas bank. In recent years, their presence in coastal waters (e.g., False Bay) has been strongly linked to the presence and hunting of common dolphins (Best *et al.* 2010; Sea Search unpublished data). Further from shore, there have been regular reports of killer whales associated with long-line fishing vessels on the southern and eastern Agulhas Bank, and the Cape Canyon to the south-west of Cape Point. **Killer whales are found in all depths from the coast to deep open ocean environments and may thus be encountered in the Area of Interest at low levels.**

- **False killer whale** (*Pseudorca crassidens*): This species has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1 000 m, although a few observations have also been made close to shore (Findlay *et al*. 1992). False killer whales usually occur in groups ranging in size from 1 - 100 animals) (Best 2007). The strong bonds and matrilineal social structure of this species makes it vulnerable to mass stranding (8 instances of 4 or more animals stranding together have occurred in the Western Cape, all between St Helena Bay and Cape Agulhas). There is no information on population numbers or conservation status and no evidence of seasonality in the region (Best 2007). **Encounters within the project area may occur.**

- **Long-finned** (*Globicephala melas*) and **short-finned** (*G. macrorhynchus*) **pilot whales**: These whales display a preference for temperate waters and are usually associated with the continental shelf or deep water adjacent to it, but moving inshore to follow prey (primarily squid) (Mate *et al.* 2005; Findlay *et al.* 1992, Weir 2011; Seakamela *et al.* 2022). They are regularly seen associated with the shelf edge by MMOs, fisheries observers and researchers. The distinction between long-finned and short-finned pilot whales is difficult to make at sea. As short-finned pilot whales are regarded as more tropical species confined to the southwest Indian Ocean (Best 2007), it is likely that the vast majority of pilot whales encountered in South African waters are long-finned. **There have been many confirmed sightings of pilot whales along the shelf edge of South Africa and Namibia, including within the Area of Interest since 2010 (de Rock *et al.* 2019; Sea Search unpublished data, SLR MMO data).** Observed group sizes range from 8-100 individuals (Seakamela *et al.* 2022). **Pilot whales were commonly sighted by MMOs and detected by PAM during a 3D seismic survey in Block 5/6/7** (Figure 7-36**;** CapMarine Environmental 2020). A recent tagging study showed long-finned pilot whale movements within latitudes of 33-36°S, along the shelf-edge from offshore of Cape Columbine to the Agulhas Bank, with concentrations in canyon areas, especially around the Cape Point

Valley, and to a lesser degree around the Cape Canyon. It is postulated that the pilot whales target prey species in these productive areas (Seakamela *et al.* 2022).

FIGURE 7-36: PILOT WHALES OBSERVED IN BLOCK 5/6/7 DURING 2020 3D SEISMIC SURVEY
Source: CapMarine Environmental, 2020

- **Dwarf** (*Kogia sima*) and **pygmy** (*K. breviceps*) **sperm whales**: The genus *Kogia* currently contains two recognised species, the dwarf and pygmy sperm whales, both of which occur worldwide in pelagic and shelf edge waters, with few sighting records in their natural habitat (McAlpine 2018). Their abundance and population trends in South African waters are unknown (Seakamela *et al.* 2021). The majority of what is known about the distribution and ecology of Kogiid whales in the southern African subregion is derived mainly from stranding records (e.g., Ross 1979; Findlay *et al.* 1992; Plön 2004; Elwen *et al.* 2013, Moura *et al.* 2016). **Kogia species are most frequently occur in pelagic and shelf edge waters, are thus likely to occur in Block 5/6/7 at low levels (numbers)**. Dwarf sperm whales are associated with warmer tropical and warm-temperate waters, being recorded from both the Benguela and Agulhas ecosystem (Best 2007) in waters deeper than approximately 1 000 m.

  During 2020 the incidence of Kogiid strandings between Strandfontein on the West Coast and Groot Brak River on the South Coast (n=17), was considerably higher than the annual average during the previous 10 years (n=7). The dwarf sperm whale (*K. sima*) accounted for 60% of these strandings, of which most were recorded during autumn and winter. These seasonal stranding patterns are consistent with previously published accounts for the South African coast. In 2020, 40% of the total strandings were recorded in winter and 15% during summer. The occurrence of strandings throughout the year may, however, indicate the presence of a resident population with a seasonal distribution off the South Coast in autumn and winter (Seakamela *et al.* 2020, 2021). The cause of the strandings is unknown.

- **Beaked Whales** (Various Species): These whales were never targeted commercially and their pelagic distribution makes them the most poorly studied group of cetaceans. They are all considered to be true deep-water species usually being seen in waters in excess of 1 000 – 2 000 m deep (see various species accounts in Best 2007). All the beaked whales that may be encountered in the project area are pelagic species that tend to occur in small groups usually less than five, although larger aggregations of some species are known (MacLeod & D'Amico 2006; Best 2007). Beaked whales are particularly vulnerable to certain types of man-made sounds, particularly naval sonar (Cox *et al.* 2006; MacLeod & D'Amico 2006) and a seismic survey also using a multi-beam echo-sounder and sub bottom profiler (Southall *et al.* 2008; Cox *et al.* 2006; DeRuiter *et al.* 2013). They appear to show a fear-response surfacing too quickly and with insufficient time to release nitrogen resulting in a form on decompression sickness. Necropsy of stranded animals has revealed gas embolisms and haemorrhage in the brain, ears and acoustic fat consistent with decompression sickness (Fernandez *et al.* 2005). Beyond decompression sickness, the fear/flee response may be the first stage in a multi-stage process ultimately resulting in stranding (Southall *et al.* 2008; Jepson *et al.* 2013). **Sightings of beaked whales in the project area are expected to be very low.**

- **Dusky dolphin** (*Lagenorhynchus obscurus*): Dusky dolphins are likely to be the most frequently encountered small cetacean in water less than 500 m deep. The dusky dolphin is resident year round throughout the Benguela ecosystem in waters from the coast to at least 500 m deep, but may occur as far as 2 000 m depth (Findlay *et al.* 1992). A recent abundance estimate from southern Namibia calculated roughly 3 500 dolphins in the approximately 400 km long Namibian Islands Marine Protected area (Martin *et al.* 2020), at a density of 0.16 dolphins/km^2 and similar density is expected to occur off the South African coast where they are regularly encountered in near shore waters between Cape Town and Lamberts Bay (Elwen *et al.* 2010; NDP unpubl. data) with group sizes of up to 800 having been reported (Findlay *et al.* 1992). **Encounters in the licence area are thus possible.**

- **Heaviside's dolphin** (*Cephalorhynchus heavisidii*): Heaviside's dolphins are relatively abundant in the Benguela ecosystem with 10 000 animals estimated to live in the 400 km of coast between Cape Town and Lamberts Bay (Elwen *et al.* 2009a) and approximately 1 600 in the Namibian Islands Marine Protected Area (Martin *et al.* 2020). This species occupies waters from the coast to at least 200 m depth, (Elwen et al. 2006; Best 2007; Martin et al. 2020), and may show a diurnal onshore-offshore movement pattern (Elwen *et al.* 2010a, 2010b), as they feed offshore at night. **Heaviside's dolphins are resident year round but will mostly occur inshore of the Area of Interest for proposed exploration drilling.**

- **Common dolphin** (*Delphinus spp*): Two forms of common dolphins occur around southern Africa, a long-beaked and short-beaked form (Findlay *et al.* 1992; Best 2007), although they are currently considered part of a single global species (Cunha *et al.* 2015). The long-beaked common dolphin lives on the continental shelf of South Africa rarely being observed north of St Helena Bay on the West Coast or in waters more 500 m deep (Best 2007), although more recent MMO sightings suggest presence out to 1 000 m or more (SLR data, Sea Search data). Group sizes of common dolphins can be large, averaging 267 (± Standard Deviation 287) for the South Africa region (Findlay *et al*. 1992). Far less is known about the short-beaked form which is challenging to differentiate at sea from the long-beaked form. Group sizes are also typically large. It is likely that common dolphins encountered deeper than 2 000 m are of the short-beaked form. Sightings of common dolphins were reported by MMOs during the 2020 3D seismic survey in Block 5/6/7 (CapMarine Environmental 2020). **Encounters in the licence area are thus likely to occur.**

- **Bottlenose dolphin**: Two species of bottlenose dolphins occur around southern Africa. The smaller Indo-Pacific bottlenose dolphin (*aduncus* form) occurs exclusively to the east of Cape Point in water usually less than 50 m deep and generally within 1 km of the shore (Ross 1984; Ross *et al.* 1987). The larger common bottlenose dolphin (*truncatus* form) is widely distributed in tropical and temperate waters throughout the world, but frequently occur in small (10s to low 100s) isolated coastal populations. An offshore 'form' of common bottlenose dolphins occurs around the coast of southern Africa including Namibia and Angola (Best 2007) with sightings restricted to the continental shelf edge and deeper. Offshore bottlenose dolphins frequently form mixed species groups, often with pilot whales or Risso's dolphins. **Encounters in the offshore waters of Block5/6/7 are likely to be low.**

- **Risso's Dolphin:** A medium sized dolphin with a distinctively high level of scarring and a proportionally large dorsal fin and blunt head. Risso's dolphins are distributed worldwide in tropical and temperate seas and show a general preference for shelf edge waters <1 500 m deep (Best 2007; Purdon *et al.* 2020). Many sightings in southern Africa have occurred around the Cape Peninsula and along the shelf edge of the Agulhas bank. **Presence of Risso's Dolphins within Block 5/6/7 is possible** (see Figure 7-34), as sightings were reported by MMOs in Block 11b/12b in early 2020 (CapMarine Environmental 2020).
- **Other Delphinids**: Several other species of dolphins that might occur in the deeper waters of broader project area at low levels include the pygmy killer whale, southern right whale dolphin, rough toothed dolphin, pantropical spotted dolphin and striped dolphin (Findlay *et al.,* 1992; Best, 2007). **Although nothing is known about the population size or density of these species in the broader project area, it is likely that encounters in the Area of Interest would be rare.**

7.4.3.7 Seals (Pinnipeds)

The Cape fur seal (*Arctocephalus pusillus pusillus*) **is the only species of seal resident along the West Coast and is considered as 'Least Concern'**, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs (see Figure 7-37). The South African seal population, which includes the West Coast colonies, was estimated at 725 000 individuals in 2020. This is about 40% of the total southern African population, which has previously been estimated at up to 2 million (Seakamela *et al.* 2022). Vagrant records from four other species of seal more usually associated with the Subantarctic environment have also been recorded: southern elephant seal (*Mirounga leoninas*), subantarctic fur seal (*Arctocephalus tropicalis*), crabeater (*Lobodon carcinophagus*) and leopard seals (*Hydrurga leptonyx*) (David 1989).

There are a number of Cape fur seal breeding colonies within the broader study area: at Bucchu Twins near Alexander Bay, at Cliff Point (~17 km north of Port Nolloth), at Kleinzee (incorporating Robeiland), Strandfontein Point (south of Hondeklipbaai), Paternoster Rocks and Jacobs Reef at Cape Columbine, Vondeling Island, Robbesteen near Koeberg Nuclear Power Station, Seal Island in False Bay, Geyser Rock at Dyer Island, Quoin Point and Seal Island in Mossel Bay. The colony at Kleinzee has the highest seal population and produces the highest seal pup numbers on the South African Coast (Wickens 1994). **The closest breeding colonies to the Area of Interest for drilling are at Robbesteen, Seal Island and Geyser Rock and Dyer Island located approximately 110 km, 85 km and 100 km inshore of the Area of Interest for drilling, respectively.**

Non-breeding and haul-out colonies occur at Doringbaai south of Cliff Point, Rooiklippies, Swartduin and Noup between Kleinzee and Hondeklipbaai, at Spoeg River and Langklip south of Hondeklip Bay, on Bird Island at Lambert's Bay, at Paternoster Point at Cape Columbine and Duikerklip in Hout Bay. **These colonies all fall well inshore and to the east of Block 5/6/7 and the Area of Interest for drilling. The closest non-breeding colony is at Duikerklip, approximately 80 km inshore of the northern portion of the Area of Interest for proposed exploration drilling.**

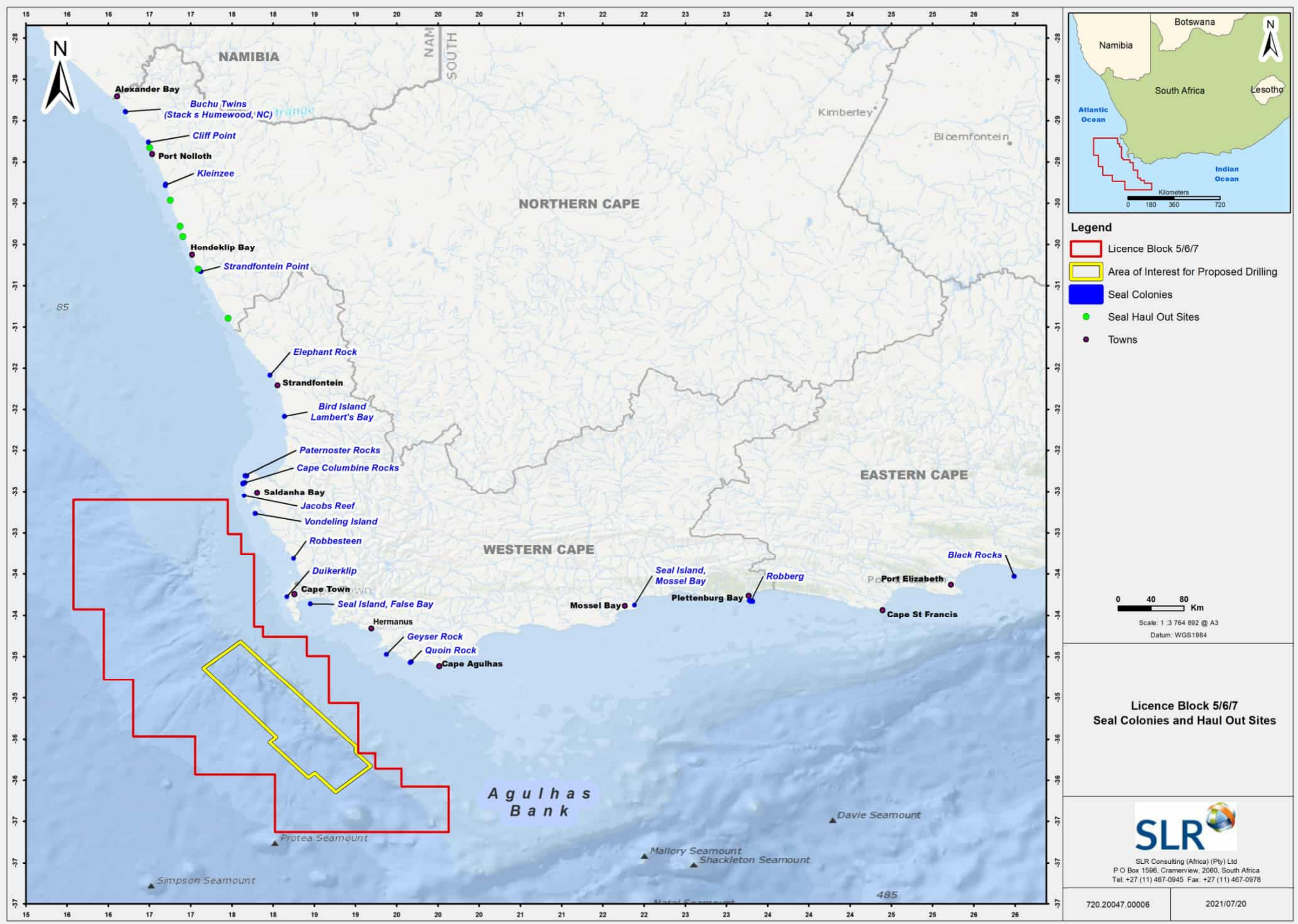

FIGURE 7-37: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO SEAL COLONIES AND HAUL OUT SITES

Source: Shapefiles (seal colonies) obtained from Dr Linda Harris, Coastal and Marine Research Institute, 2022

Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nm (222 km) offshore (Shaughnessy 1979), with bulls ranging further out to sea than females (see Figure 7-38). Their diet varies with season and availability and includes pelagic species such as horse mackerel, pilchard, and hake, as well as squid and cuttlefish. Benthic feeding to depths of nearly 200 m for periods of up to 2 minutes has, however, also been recorded (Kirkman *et al.* 2015).

The overall Cape fur seal population is considered healthy and stable in size, although there has been a westward and northward shift in the distribution of the breeding population (Kirkman *et al.* 2013). An unprecedented mortality event was recorded in South Africa between September and December 2021 at colonies around the West Coast Peninsula and north to Lambert's Bay and Elands Bay. Primarily pups and juveniles were affected. Post-mortem investigations revealed that seals died in a poor condition with reduced blubber reserves, and protein energy malnutrition was detected for aborted foetuses, juveniles and subadults. Although no unusual environmental conditions were identified that may have triggered the die-off, or caused it indirectly (e.g., HABs), 2021 was a year of below average recruitment of anchovy and sardine, the main food source for seals. While a lack of food, as a result of possibly climate change and/or overfishing, has been predicted to be the cause of this mass mortality, the underlying causes of the mortality event remain uncertain (Seakamela *et al.* 2022).

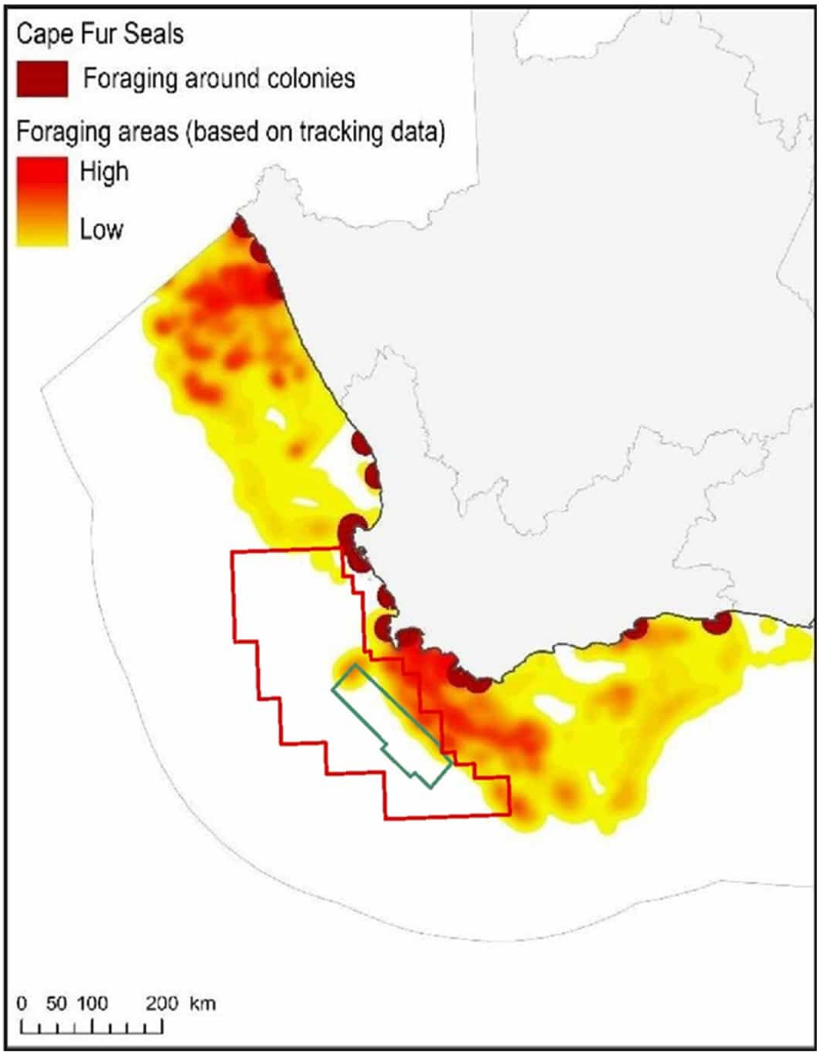

FIGURE 7-38: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO SEAL FORAGING AREAS ON THE WEST AND SOUTH COASTS

Adapted from Harris *et al.* 2022

7.4.4 Coastal Communities

The coastline of the project's area of influence is characterised by a mixture of intertidal sandy beaches and rocky shores, but also estuaries, rocky subtidal habitats and kelp beds. These were categorised into ecosystem types by Sink *et al.* (2019) and assigned a threat status depending on their geographic extent and extent of ecosystem degradation. Table 7-9 summarises the threat status of these ecosystem types in the broader project area.

A general description of intertidal and shallow subtidal habitats on the South-West Coast is provided below.

TABLE 7-9: THREAT STATUS OF THE INTERTIDAL AND SHALLOW SUBTIDAL ECOSYSTEM TYPES IN THE PROJECT'S AREA OF INFLUENCE

Ecosystem Type	2019 Threat Status
Agulhas Boulder Shore	Near threatened
Agulhas Dissipative Intermediate Sandy Shore	Least Concern
Agulhas Dissipative Sandy Shore	Near threatened
Agulhas Exposed Rocky Shore	Vulnerable
Agulhas Exposed Stromatolite Rocky Shore	Vulnerable
Agulhas Intermediate Sandy Shore	Least Concern
Agulhas Island	Vulnerable
Agulhas Kelp Forest	Vulnerable
Agulhas Mixed Shore	Near threatened
Agulhas Reflective Sandy Shore	Vulnerable
Agulhas Sheltered Rocky Shore	Endangered
Agulhas Stromatolite Mixed Shore	Vulnerable
Agulhas Very Exposed Rocky Shore	Vulnerable
Agulhas Very Exposed Stromatolite Rocky Shore	Near threatened
Cape Bay	Endangered
Cape Boulder Shore	Vulnerable
Cape Exposed Rocky Shore	Vulnerable
Cape Island	Endangered
Cape Kelp Forest	Vulnerable
Cape Mixed Shore	Vulnerable
Cape Sheltered Rocky Shore	Endangered
Cape Very Exposed Rocky Shore	Near threatened
Eastern Agulhas Bay	Vulnerable
False and Walker Bay	Vulnerable
Namaqua Exposed Rocky Shore	Vulnerable
Namaqua Kelp Forest	Vulnerable
Namaqua Mixed Shore	Vulnerable
Namaqua Sheltered Rocky Shore	Vulnerable
Namaqua Very Exposed Rocky Shore	Vulnerable
Southern Benguela Dissipative Intermediate Sandy Shore	Least Concern
Southern Benguela Dissipative Sandy Shore	Least Concern
Southern Benguela Intermediate Sandy Shore	Near threatened
Southern Benguela Reflective Sandy Shore	Endangered
St Helena Bay	Vulnerable
Western Agulhas Bay	Endangered

Source: Sink *et al.* 2019

7.4.4.1 Intertidal Sandy Beaches

Sandy beaches are one of the most dynamic coastal environments. With the exception of a few beaches in large bay systems (such as St Helena Bay, Saldanha Bay and Table Bay), the beaches along the West Coast are typically highly exposed. Exposed sandy shores consists of coupled surf-zone, beach and dune systems, which together form the active littoral sand transport zone (Short & Hesp 1985). The composition of their faunal communities is largely dependent on the interaction of wave energy, beach slope and sand particle size, which is termed beach morphodynamics. Three morphodynamic beach types are described: dissipative, reflective and intermediate beaches (McLachlan *et al.* 1993). Generally, **dissipative beaches** are relatively wide and flat with fine sands and low wave energy. Waves start to break far from the shore in a series of spilling breakers that 'dissipate' their energy along a broad surf zone. This generates slow swashes with long periods, resulting in less turbulent conditions on the gently sloping beach face. These beaches usually harbour the richest intertidal faunal communities. **Reflective beaches** in contrast, have high wave energy, and are coarse grained (>500 µm sand) with narrow and steep intertidal beach faces. The relative absence of a surf-zone causes the waves to break directly on the shore causing a high turnover of sand. The result is depauperate faunal communities. **Intermediate beach** conditions exist between these extremes and have a very variable species composition (McLachlan *et al.* 1993; Jaramillo *et al.* 1995; Soares 2003). This variability is mainly attributable to the amount and quality of food available. Beaches with a high input of kelp wrack have a rich and diverse drift-line fauna, which is sparse or absent on beaches lacking a drift-line (Branch & Griffiths 1988). As a result of the combination of typical beach characteristics, and the special adaptations of beach fauna to these, beaches act as filters and energy recyclers in the nearshore environment (Brown & McLachlan 2002).

The macrofaunal communities of sandy beaches are generally ubiquitous throughout the southern African West Coast region, being particular only to substratum type, wave exposure and/or depth zone (see Figure 7-39a). **Due to the exposed nature of the coastline in the study area, most beaches are of the intermediate to reflective type**.

The **upper beach dry zone (supralittoral zone)** is situated above the high-water spring tide level, and receives water input only from large waves at spring high tides or through sea spray. This zone is characterised by a mixture of air breathing terrestrial and semi-terrestrial fauna, often associated with and feeding on kelp deposited near or on the driftline. Terrestrial species include a diverse array of beetles and arachnids and some oligochaetes, while semi-terrestrial fauna include the oniscid isopod *Tylos granulatus*, and amphipods of the genus *Talorchestia*.

The **mid-beach retention zone and low-beach saturation zone (intertidal zone or mid-littoral zone)** has a vertical range of about 2 m. This mid-shore region is characterised by the cirolanid isopods *Pontogeloides latipes*, *Eurydice (longicornis=) kensleyi* and *Excirolana natalensis*, the polychaetes *Scolelepis squamata, Orbinia angrapequensis, Nepthys hombergii* and *Lumbrineris tetraura*, and amphipods of the families *Haustoridae* and *Phoxocephalidae*. In some areas, juvenile and adult sand mussels *Donax serra* may also be present in considerable numbers.

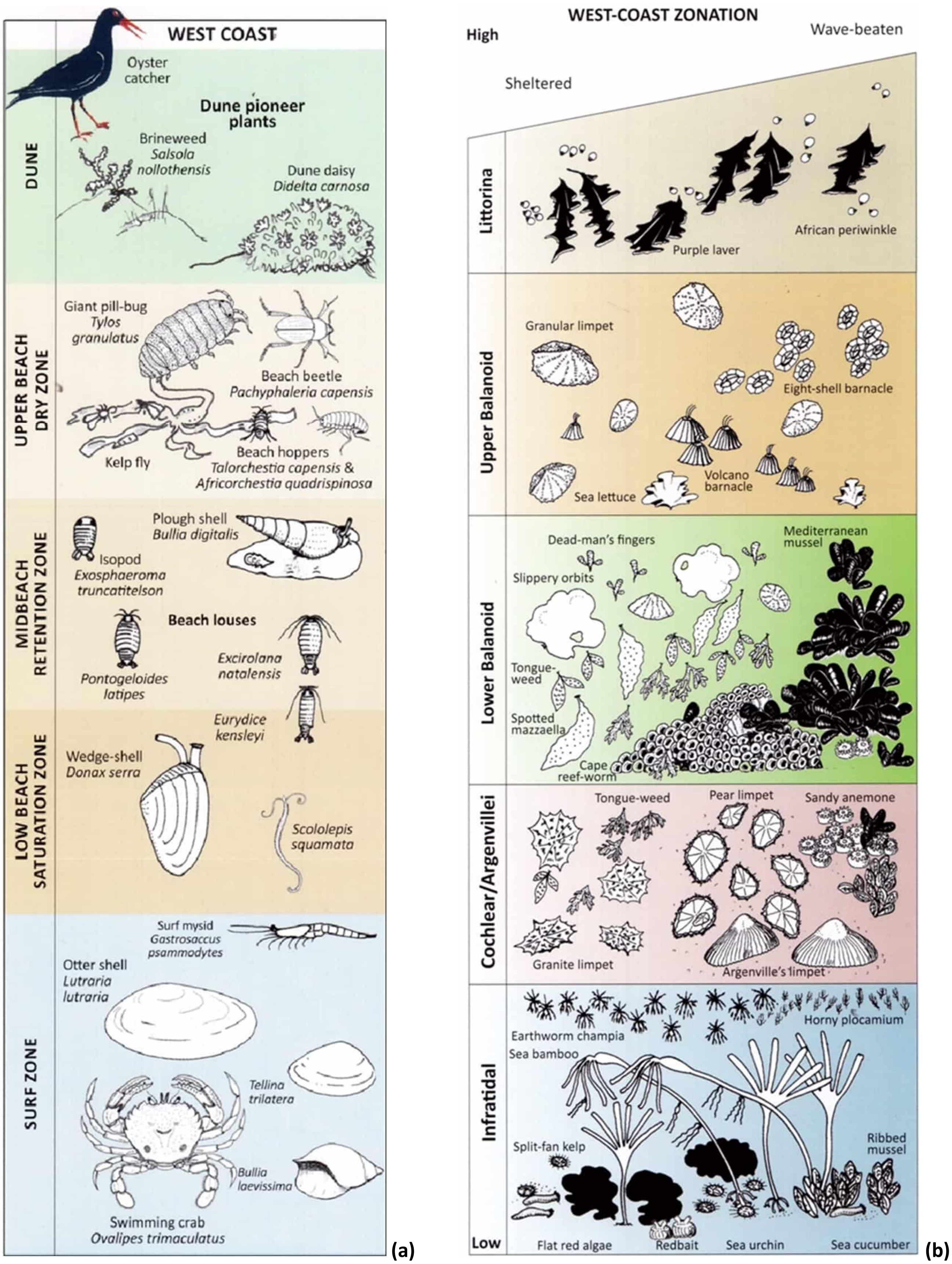

FIGURE 7-39: SCHEMATIC REPRESENTATION OF THE WEST COAST INTERTIDAL (A) BEACH ZONATION AND (B) ROCKY SHORE ZONATION

Adapted from Branch & Branch 2018

The **surf zone (inner turbulent and transition zones)** extends from the low water spring mark to about 2 m depth. The mysid *Gastrosaccus psammodytes* (Mysidacea, Crustacea), the ribbon worm *Cerebratulus fuscus* (Nemertea), the cumacean *Cumopsis robusta* (Cumacea) and a variety of polychaetes including *Scolelepis squamata* and Lu*mbrineris tetraura,* are typical of this zone, although they generally extend partially into the midlittoral above. In areas where a suitable swash climate exists, the gastropod *Bullia digitalis* (Gastropoda, Mollusca) may also be present in considerable numbers, surfing up and down the beach in search of carrion.

The **transition zone** spans approximately 2 - 5 m depth beyond the inner turbulent zone. Extreme turbulence is experienced in this zone, and as a consequence this zone typically harbours the lowest diversity on sandy beaches. Typical fauna includes amphipods such as *Cunicus profundus* and burrowing polychaetes such as *Cirriformia tentaculata* and *Lumbrineris tetraura*.

The **outer turbulent zone** beyond the surf zone and extends below 5 m depth, where turbulence is significantly decreased and species diversity is again much higher. In addition to the polychaetes found in the transition zone, other polychaetes in this zone include *Pectinaria capensis* and *Sabellides ludertizii*. The sea pen *Virgularia schultzi* (Pennatulacea, Cnidaria) is also common as is a host of amphipod species and the three spot swimming crab *Ovalipes punctatus* (Brachyura, Crustacea).

7.4.4.2 Intertidal Rocky Shores

Several studies on the West Coast of southern Africa have documented the important effects of wave action on the intertidal rocky-shore community. Specifically, wave action enhances filter-feeders by increasing the concentration and turnover of particulate food, leading to an elevation of overall biomass despite a low species diversity (McQuaid & Branch 1985, Bustamante & Branch 1995, 1996a, Bustamante et al. 1997). Conversely, sheltered shores are diverse with a relatively low biomass, and only in relatively sheltered embayments does drift kelp accumulate and provide a vital support for very high densities of kelp trapping limpets, such as *Cymbula granatina* that occur exclusively there (Bustamante *et al.* 1995). In the subtidal, these differences diminish as wave exposure is moderated with depth.

West Coast rocky intertidal shores can be divided into five zones on the basis of their characteristic biological communities: The Littorina, Upper Balanoid, Lower Balanoid, Cochlear/Argenvillei and the Infratidal Zones (see Figure 7-39b). These biological zones correspond roughly to zones based on tidal heights. Tolerance to the physical stresses associated with life on the intertidal, as well as biological interactions such as herbivory, competition and predation interact to produce these five zones.

The uppermost part of the shore is the **supralittoral fringe**, which is the part of the shore that is most exposed to air, perhaps having more in common with the terrestrial environment. The supralittoral is characterised by low species diversity, with the tiny periwinkle *Afrolittorina knysnaensis*, and the red alga *Porphyra capensis* constituting the most common macroscopic life.

The **upper mid-littoral** is characterised by the limpet *Scutellastra granularis*, which is present on all shores. The gastropods *Oxystele variegata, Nucella dubia* and *Helcion pectunculus* are variably present, as are low densities of the barnacles *Tetraclita serrata, Octomeris angulosa* and *Chthalamus dentatus*. Flora is best represented by the green algae *Ulva spp*.

Toward the **lower Mid-littoral or Lower Balanoid zone**, biological communities are determined by exposure to wave action. On sheltered and moderately exposed shores, a diversity of algae abounds with a variable representation of: green algae – *Ulva spp, Codium spp*.; brown algae – *Splachnidium rugosum*; and red algae – *Aeodes orbitosa,* Mazzaella (=Iridaea) capensis, *Gigartina polycarpa (=radula*), *Sarcothalia (=Gigartina) stiriata*, and with increasing wave exposure *Plocamium rigidum* and *P. cornutum*, and *Champia lumbricalis*. The gastropods *Cymbula granatina* and *Burnupena spp*. are also common, as is the reef building polychaete *Gunnarea capensis*, and the small cushion starfish *Patiriella exigua*. On more exposed shores, almost all of the primary space can be occupied by the dominant alien invasive mussel *Mytilus galloprovincialis*, which is now the most abundant and widespread invasive marine species spreading along the entire West Coast and parts of the South Coast (Robinson *et al.* 2005). *M. galloprovincialis* has partially displaced the local mussels *Choromytilus meridionalis* and *Aulacomya ater* (Hockey & Van Erkom Schurink 1992) and competes with several indigenous limpet species (Griffiths *et al.* 1992; Steffani & Branch 2003a, b). Recently, another alien invasive has been recorded, the acorn barnacle *Balanus glandula*, which is native to the West Coast of North America where it is the most common intertidal barnacle (Simon-Blecher *et al.* 2008). There is, however, evidence that it has been in South Africa since at least 1992 (Laird & Griffith 2008). At the time of its discovery, the barnacle was recorded from 400 km of coastline from Elands Bay to Misty Cliffs near Cape Point (Laird & Griffith 2008). Thus, it is likely that it occurs inshore of Block 5/6/7 area. When present, the barnacle is typically abundant at the mid zones of semi-exposed shores.

Along the **sublittoral fringe**, the large kelp-trapping limpet *Scutellastra argenvillei* dominates forming dense, almost monospecific stands achieving densities of up to 200/m^2 (Bustamante *et al.* 1995). Similarly, *C. granatina* is the dominant grazer on more sheltered shores, also reaching extremely high densities (Bustamante *et al.* 1995). On more exposed shores *M. galloprovincialis* dominates. There is evidence that the arrival of the alien *M. palloprovincialis* has led to strong competitive interaction with *S. argenvillei* (Steffani & Branch 2003a, 2003b, 2005). The abundance of the mussel changes with wave exposure, and at wave-exposed locations, the mussel can cover almost the entire primary substratum, whereas in semi-exposed situations it is never abundant. As the cover of *M. galloprovincialis* increases, the abundance and size of *S. argenvillei* on rock declines and it becomes confined to patches within a matrix of mussel bed. As a result, exposed sites, once dominated by dense populations of the limpet, are now largely covered by the alien mussel. Semi-exposed shores do, however, offer a refuge preventing global extinction of the limpet. In addition to the mussel and limpets, there is variable representation of the flora and fauna described for the lower mid-littoral above, as well as the anemone *Aulactinia reynaudi*, numerous whelk species and the sea urchin *Parechinus angulosus*. Some of these species extend into the subtidal below.

The invasion of West Coast rocky shores by another mytilid, the small *Semimytilus algosus*, has been noted (de Greef *et al.* 2013). Its current range extends from the Groen River mouth (Northern Cape) in the north to Bloubergstrand (Cape Town) in the south. Where present, it occupies the lower intertidal zone, where they completely dominate primary rock space, while *M. galloprovincialis* dominates higher up the shore. Many shores on the West Coast have thus now been effectively partitioned by the three introduced species, with *B. glandula* colonizing the upper intertidal, *M. galloprovincialis* dominating the mid-shore, and now *S. algosus* smothering the low-shore (de Greef *et al.* 2013).

7.4.4.3 Rocky Subtidal Habitat and Kelp Beds

Biological communities of the rocky sublittoral on the South-West Coast can be broadly grouped into an inshore zone from the sublittoral fringe to a depth of about 10 m dominated by flora, and an offshore zone below 10 m depth dominated by fauna.

From the sublittoral fringe to a depth of between 5 and 10 m, the benthos is largely dominated by algae, in particular two species of kelp. The canopy forming kelp *Ecklonia maxima* extends seawards to a depth of about 10 m. The smaller *Laminaria pallida* forms a sub-canopy to a height of about 2 m underneath *Ecklonia*, but continues its seaward extent to about 30 m depth, although further north up the West Coast increasing turbidity limits growth to shallower waters (10-20 m) (Velimirov *et al.* 1977; Jarman & Carter 1981; Branch 2008). *Ecklonia maxima* is the dominant species in the south forming extensive beds from west of Cape Agulhas to north of Cape Columbine, but decreasing in abundance northwards. *Laminaria* becomes the dominant kelp north of Cape Columbine and thus in the project's area of influence, extending from Danger Point east of Cape Agulhas to Rocky Point in northern Namibia (Stegenga *et al.* 1997; Rand 2006).

Kelp beds absorb and dissipate much of the typically high wave energy reaching the shore, thereby providing important partially-sheltered habitats for a high diversity of marine flora and fauna, resulting in diverse and typical kelp-forest communities being established. Through a combination of shelter and provision of food, kelp beds support recruitment and complex trophic food webs of numerous species, including commercially important rock lobster stocks (Branch 2008).

Growing beneath the kelp canopy, and epiphytically on the kelps themselves, are a diversity of understorey algae, which provide both food and shelter for predators, grazers and filter-feeders associated with the kelp bed ecosystem. Representative under-storey algae include *Botryocarpa prolifera, Neuroglossum binderianum, Botryoglossum platycarpum, Hymenena venosa* and *Rhodymenia (=Epymenia) obtusa*, various coralline algae, as well as subtidal extensions of some algae occurring primarily in the intertidal zones (Bolton 1986). Epiphytic species include *Polysiphonia virgata, Gelidium vittatum (=Suhria vittata)* and *Carpoblepharis flaccida*. In particular, encrusting coralline algae are important in the under-storey flora as they are known as settlement attractors for a diversity of invertebrate species. The presence of coralline crusts is thought to be a key factor in supporting a rich shallow-water community by providing substrate, refuge, and food to a wide variety of infaunal and epifaunal invertebrates (Chenelot *et al.* 2008).

The sublittoral invertebrate fauna is dominated by suspension and filter-feeders, such as the mussels *Aulacomya ater* and *Choromytilus meriodonalis*, and the Cape reef worm *Gunnarea capensis*, and a variety of sponges and sea cucumbers. Grazers are less common, with most herbivory being restricted to grazing of juvenile algae or debris-feeding on detached macrophytes. The dominant herbivore is the sea urchin *Parechinus angulosus*, with lesser grazing pressure from limpets, the isopod *Paridotea reticulata* and the amphipod *Ampithoe humeralis*. The abalone *Haliotis midae* is present in kelp beds south of Cape Columbine, but naturally absent north. Key predators in the sub-littoral include the commercially important West Coast rock lobster *Jasus lalandii* and the octopus *Octopus vulgaris*. The rock lobster acts as a keystone species as it influences community structure via predation on a wide range of benthic organisms (Mayfield *et al.* 2000). Relatively abundant rock lobsters can lead to a reduction in density, or even elimination, of black mussel *Choromytilus meriodonalis*, the preferred prey of the species, and alter the size structure of populations of ribbed mussels *Aulacomya ater*, reducing the proportion of selected size-classes (Griffiths & Seiderer 1980). Their role as predator can thus reshape benthic communities, resulting in large reductions in taxa such as black mussels, urchins, whelks and barnacles, and in the dominance of algae (Barkai & Branch 1988; Mayfield 1998).

Of lesser importance as predators, although numerically significant, are various starfish, feather and brittle stars, and gastropods, including the whelks *Nucella spp*. and *Burnupena spp.* Fish species commonly found in kelp beds off the West Coast include hottentot *Pachymetopon blochii*, two tone finger fin *Chirodactylus brachydactylus*, red fingers *Cheilodactylus fasciatus*, galjoen *Dichistius capensis*, rock suckers *Chorisochismus dentex* and the catshark *Haploblepharus pictus* (Branch et al. 2010).

There is substantial spatial and temporal variability in the density and biomass of kelp beds, as storms can remove large numbers of plants and recruitment appears to be stochastic and unpredictable (Levitt *et al.* 2002; Rothman *et al.* 2006). Some kelp beds are dense, whilst others are less so due to differences in seabed topography, and the presence or absence of sand and grazers.

7.4.4.4 Estuaries

Location of estuaries on the West / South-West and South Coasts and their conservation status are summarised in Figure 7-40 and Figure 7-41, respectively. Estuaries along the West and South Coast generally fall within the Cool Temperate and Warm Temperate bioregions, respectively. **Along the South-West Coast, rainfall is relatively high and this contributes to a higher density of estuarine systems along this portion of the coastline.** Five of the estuarine systems are classed as predominantly open and one (the Knysna estuary) as an estuarine bay. Estuaries in this area range in scale from the moderately large Breede River (Cape Infanta) and Knysna River systems, which receive and discharge mean annual runoffs of 1 034 and 928 million m^3, respectively (Royal Haskoning DHV 2016, 2017), down to micro-estuaries with very little flow at all (van Niekerk *et al.* 2019).

On the West Coast (see Figure 7-40), there are three perennial river mouths that are always open to the sea and have estuarine systems in their lower reaches: the Orange, Olifants and Berg Rivers. The Berg River Estuary has the largest and most diverse associated saline and freshwater wetlands compared to all other permanently open estuaries in South Africa. Langebaan is an estuarine lagoon comprising shallow intertidal sand banks and deeper channels that experience tidally driven input of nutrient rich, upwelled water from the sea and groundwater input in the upper reaches. Together, this creates an ecologically productive system that supports long-standing fisheries. Other estuaries include the Verlorenvlei and Klein estuarine lakes. The numerous smaller estuaries along the West Coast are intermittently, or seasonally, open (Holgat, Buffels, Swartlintjies, Bitter, Spoeg, Groen, Brak, Sout and Jakkals Rivers).

Predominantly open estuaries, estuarine lagoons and estuarine bays are particularly important for recruitment for some inshore linefish species and are the most vulnerable to marine pollution events as they receive tidal inflows almost constantly. Tidal range varies greatly, with tidal range in the Breede estuary extending over 50 km inland (DWAF 2003), making it vulnerability to potential marine pollution.

Estuarine habitats are highly variable environments with salinity, temperature pH and other variables change with the tides, seasons and climatic conditions. Changes in the extent of water coverage and flow may alternately expose estuarine organisms to desiccation and scouring floods. This high variability has led to a high degree of specialisation within estuaries.

The smaller estuaries are generally wave-dominated, with little freshwater inflow to maintain inlet stability and over 75% of South African estuaries close periodically due to wave-driven sandbar formation. If these periods persist for lengthy time periods, warm, hypersaline conditions can form (van Niekerk *et al*. 2019), which are unfavourable to most estuarine fauna. Toxic algal blooms are also common under these conditions and increase the likelihood of fish and invertebrate mortality.

There are 64 estuarine systems along the West Coast between the Orange River and Cape Agulhas, with a further 30 systems between Cape Agulhas and Plettenberg Bay (SANBI 2018). **Approximately 75% of the Cool Temperate bioregion estuarine ecosystem (West Coast) types are 'Critically Endangered' or 'Endangered'**, while 13% are considered 'Vulnerable'. In contrast, of Warm Temperate estuarine ecosystem types (South Coast), only 14% are 'Critically Endangered' or 'Endangered', while 57% are 'Vulnerable'. Of the estuaries on the West and South-West Coasts, the **Orange River wetlands, Verlorenvlei, Langebaan, Bot / Kleinmond, Heuningnes, De Hoop and the Wilderness-Sedgefield Lakes complex are proclaimed as Ramsar Sites**. Although most fall within National Parks or are protected within local or provincial nature reserves (National Protected Areas Register 2020), the Orange, Verlorenvlei and Bot / Kleinmond estuaries do not have formal protection.

Approximately 176 estuarine associated plant species are known within South Africa, with 56 species associated with salt marsh habitat. Salt marsh dominates the vegetation in the cool and warm temperate estuaries along the West and South-West Coasts. The Langebaan and Olifants estuaries on the West Coast support large salt marsh habitat, with the combined area of inter- and supratidal habitat of 1 350 ha and 1 010 ha, respectively. On the South-West Coast, the Knysna estuary has the highest inter- and supratidal saltmarsh habitat 685 ha. There is a high degree of endemism with only 66 estuarine plant species occurring in five or more estuaries nationally (van Niekerk *et al.* 2019).

Many estuarine fauna also have restricted ranges with the endangered Knysna seahorse (*Hippocampus capensis*) restricted to only three estuaries along the South Coast, namely the Knysna, Keurbooms and Swartvlei estuaries. Similarly, the endangered Bot River Klipvis *Clinus spatulatus* is known only from the Bot / Kleinmond and Klein estuaries in the South-Western Cape. The vulnerable freshwater mullet *Pseudomyxus capensis* is one of the few marine fish species that spawns at sea, but makes extensive use of the estuarine environment as a nursery area. Endemic to South Africa it occurs predominantly from Kosi Bay to Table Bay, but has recently been recorded in a few estuaries on the West Coast, as far north as the Orange River indicating that it may be expanding its range. The razor clam *Solen capensis* is endemic to estuaries in the cool temperate and warm temperate bioregions in South Africa, occurring from the Olifants Estuary on the West Coast to St Lucia on the East Coast. Even the common species in the West and South-West Coast estuaries have ranges restricted to southern Africa; sand and mud prawns *Callichirus krausii* and *Upogebia africana* are limited to southern Africa, while the freshwater sand-shrimp (*Paleamon capensis*) is endemic to South Africa (van Niekerk *et al.* 2019). Turpie *et al. (*2012) and Hockey *et al.* (2005) also list 35 bird species that are likely to be dependent on estuaries, many of which occur throughout the West and South-West Coast.

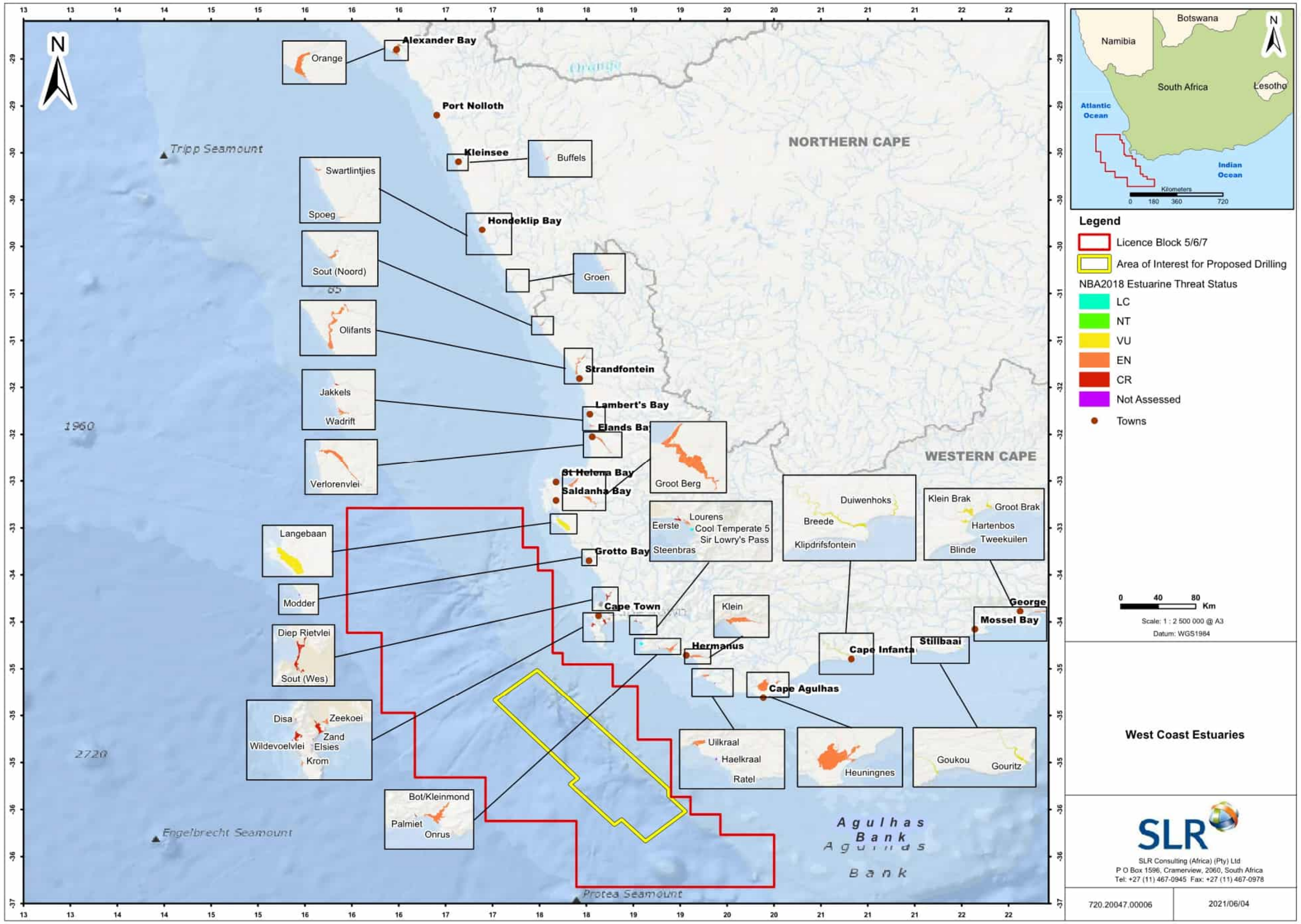

FIGURE 7-40: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF THREATENED ESTUARINE ECOSYSTEMS OF THE WEST / SOUTH-WEST COAST

Adapted from Van Niekerk *et al.* 2019

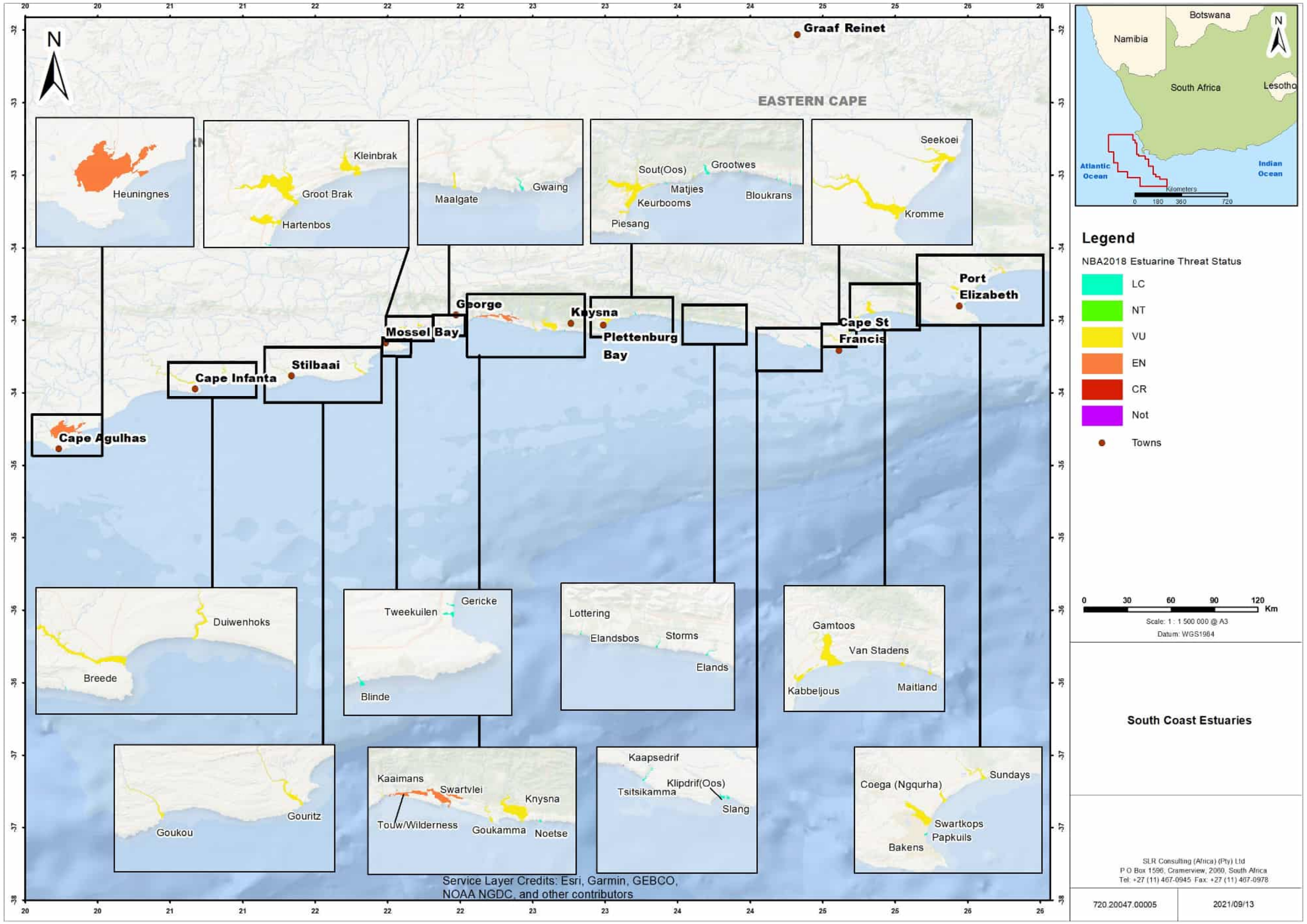

FIGURE 7-41: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF THREATENED ESTUARINE ECOSYSTEMS OF THE SOUTH COAST

Adapted from Van Niekerk *et al.* 2019

Estuaries are highly productive systems and offer rich feeding grounds, warmer temperatures and sheltered habitat for many organisms. The high productivity is exploited by many line-fish and harvested invertebrate species either as a nursery or later in life either directly through habitat availability or indirectly through the contribution to overall coastal productivity (van Niekerk *et al.* 2019). Turpie *et al.* (2017) estimated the contribution of the estuarine nursery function as R960 million in 2018 terms (equivalent to over R1 billion in 2020) to the South African economy, with the highest value attributed to the estuaries of the South Western and Eastern Cape.

7.4.4.5 Coastal Sensitivity

Harris *et al.* (2019) compiled a **habitat map for the entire South African coastline, which identified that 60% of coastal ecosystem types are threatened**, thereby having proportionally three times more threatened ecosystem types than the rest of the country. The spatial distribution of threatened coastal ecosystem types inshore of Block 5/6/7 is illustrated in Figure 7-42.

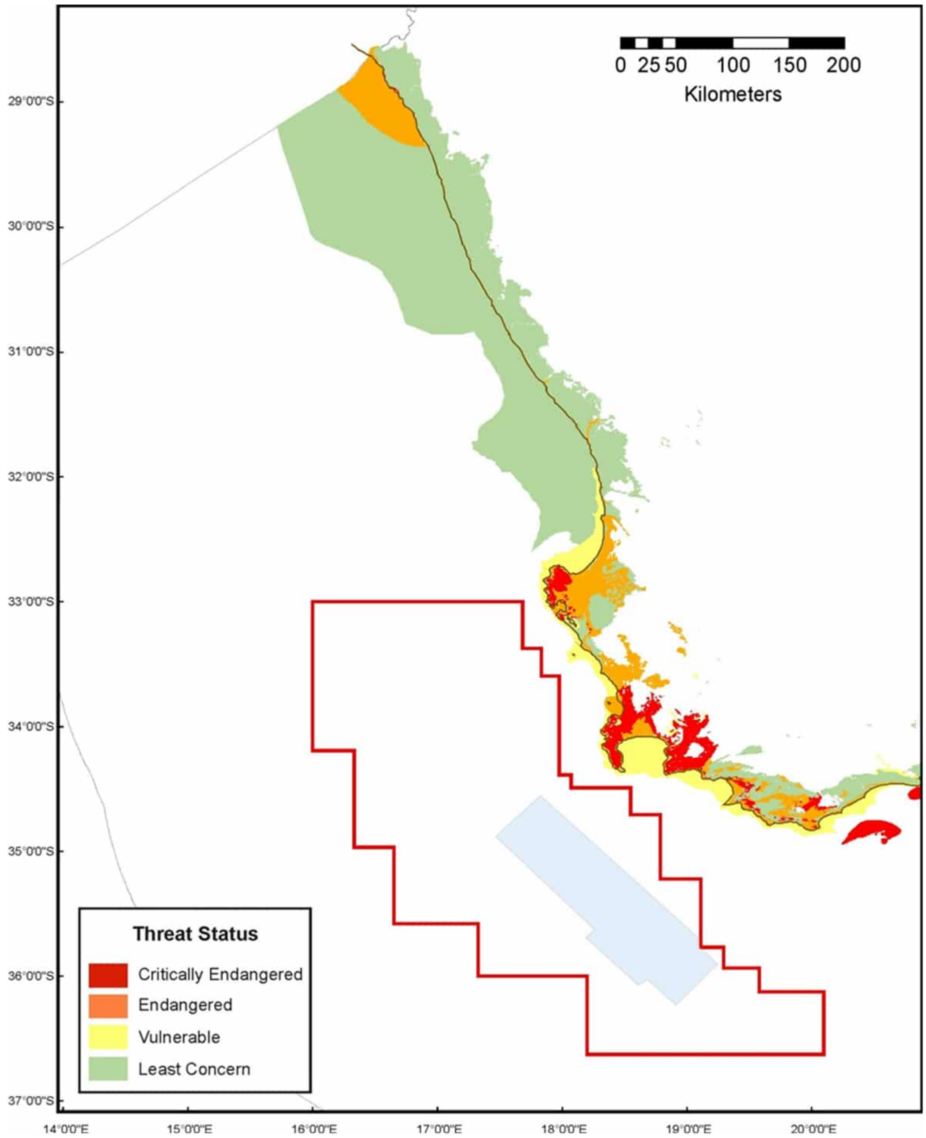

FIGURE 7-42: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF THREATENED COASTAL ECOSYSTEM TYPES ALONG THE SOUTH-WEST COAST

Adapted from Harris *et al.* 2019

7.5 MARINE PROTECTED AND SENSITIVE AREAS

Several Marine Protected Areas and other recently identified sensitive marine areas along the West and South-West Coasts are discussed below.

7.5.1 Marine Protected Areas (MPAs)

The approved MPAs within the broad project area are shown in Figure 7-43. **Although Block 5/6/7 overlaps with two offshore MPAs (namely the Brown's Bank and Southeast Atlantic Seamounts MPAs), the Area of Interest for proposed exploration drilling avoids all MPAs.** These two offshore MPAs are briefly described below.

- The **Southeast Atlantic Seamounts MPA** covers 6 000 km^2 and protects the Protea, Argentina and Mount Marek Seamounts. These seamounts are recognised as biological hotspots due to their high diversity of marine animals, which results from the interaction of their steep slopes with deep oceanic currents. This upwelling of nutrient-rich water fuels enhanced productivity, which in turn provides food for a wide diversity of marine biota ranging from corals to fish and turtles. The MPA, which spans a depth range of 750 m to 4 600 m, protects seamount, slope and abyssal ecosystems. Refer to Section 7.2.1 for a description of these seamounts.

- **Brown's Bank Corals MPA** lies on the western edge of the Agulhas Bank and in the south-eastern corner of Block 5/6/7. It includes benthic habitats such as rocky, sandy and reef substrates and a pelagic habitat type that is characterised by elevated productivity and frequent fronts due to shelf-edge upwelling (Lutjeharms *et al.* 2000; Lagabrielle 2009; Roberson *et al.* 2017; Sink *et al.* 2019). This 300 km^2 MPA consists of three separate areas covering a depth range of 280 m and 550 m and is part of a critical area for retention of spawning products (Hutchings *et al.* 2002). The region supports several types of deep-sea corals and is a proposed marine 'Important Bird Area' (IBA) for two species of seabirds: Cory's Shearwater and Atlantic Yellow-nosed Albatross (BirdLife International 2013). This area and the western Agulhas shelf edge are also thought to serve as a parturition and nursery area for blue sharks, with movement of sharks from there into both adjacent ocean basins (da Silva *et al.* 2010).

There are also a number of other MPAs within the Project's indirect area of influence. These are described briefly below.

Coastal Marine Protected Areas

- The **Namaqua National Park MPA** provides the first protection to habitats in the Namaqua Bioregion, including several 'critically endangered' coastal ecosystem types. The area is a nursery area for Cape hakes, and the coastal areas support kelp forests and deep mussel beds, which serve as important habitats for the West Coast rock lobster. This 500 km^2 MPA was proclaimed to boost tourism to this remote area and to provide an important baseline from which to understand ecological changes (e.g., introduction of invasive alien marine species, climate change) and human impacts (harvesting, mining) along the West Coast. Protecting this stretch of coastline is part of South Africa's climate adaptation strategy.

- The **Rocher Pan MPA** (1.5 km^2) stretches 500 m offshore of the high-water mark of the adjacent Rocher Pan Nature Reserve. The MPA primarily protects a stretch of beach important as a breeding area to numerous waders. It is located in St Helena Bay approximately 90 km north-east of Block 5/6/7.

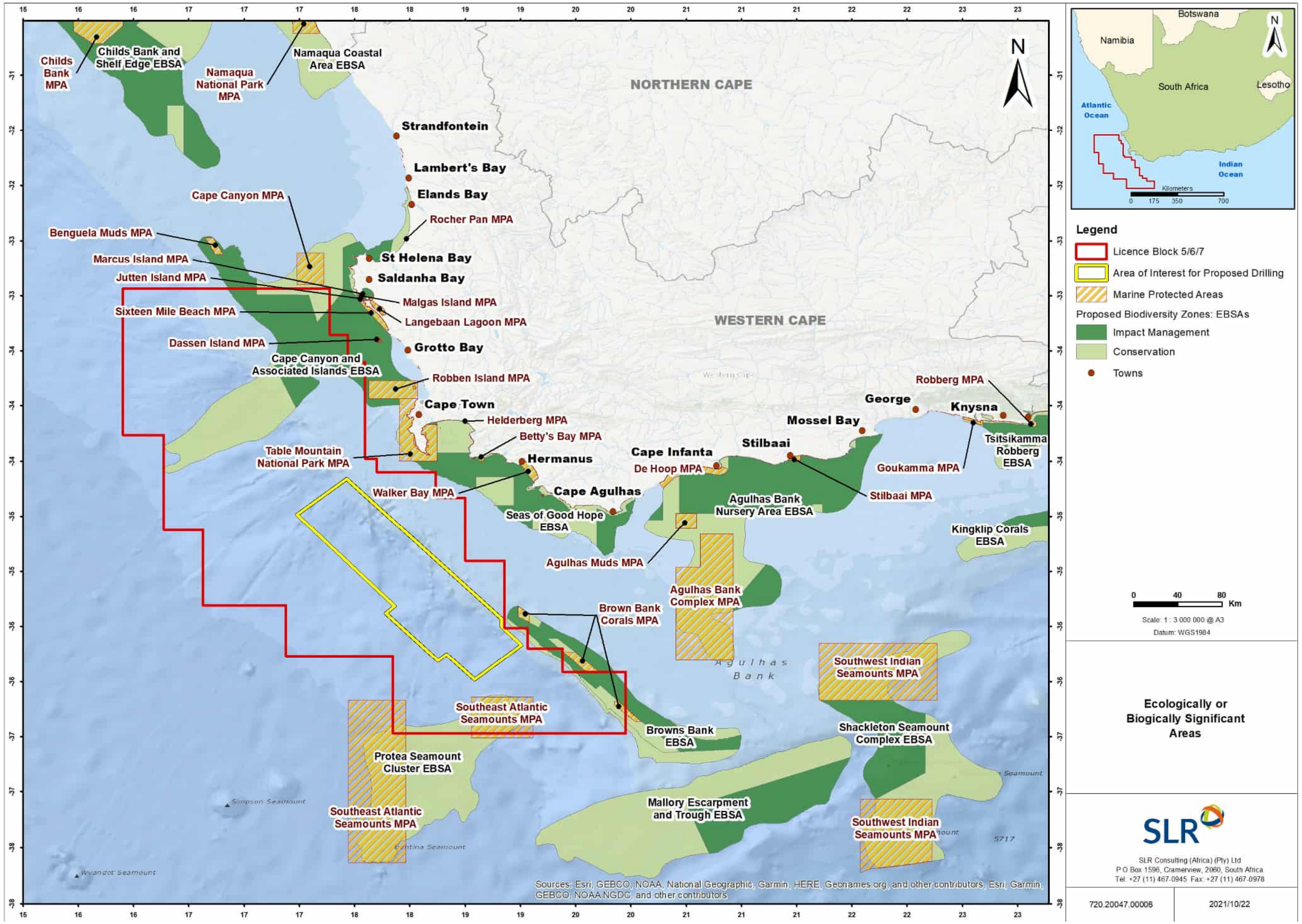

FIGURE 7-43: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO MPAS AND EBSAS ALONG THE SOUTH-WEST COAST
Adapted from MARISMA EBSA Workstream 2020

- The **West Coast National Park MPA network** incorporates the following MPAs: **Langebaan Lagoon (47 km^2), Sixteen Mile Beach (107 km^2)**, **Marcus Island (17 ha), Malgas Island (18 ha) and Jutten Island (43 ha)**. Langebaan Lagoon was designated as a Ramsar site in April 1988 under the Convention on Wetlands of International Importance especially as Waterfowl Habitat. The lagoon is divided into three different utilization zones namely: wilderness, limited recreational and multi-purpose recreational areas. The wilderness zone has restricted access and includes the southern end of the lagoon and the inshore islands, which are the key refuge sites of the waders and breeding seabird populations respectively. The limited recreation zone includes the middle reaches of the lagoon, where activities such as sailing and canoeing are permitted. The mouth region is a multi-purpose recreation zone for power boats, yachts, water-skiers and fishermen. However, no collecting or removal of abalone and rock lobster is allowed. The length of the combined shorelines of Langebaan Lagoon MPA and Sixteen Mile Beach is 66 km. The uniqueness of Langebaan lies in its being a warm oligotrophic lagoon, along the cold, nutrient-rich and wave exposed West Coast.

- The **Table Mountain National Park MPA** includes 996 km^2 of the sea area and 137 km of coastline around the Cape Peninsula from Moullie Point in the North to Muizenberg in the south. Although fishing is allowed in the majority of the MPA (subject to permits, regulations and seasons), the MPA includes six ‘no-take’ zones where no fishing or extractive activities are allowed. These ‘no-take’ zones are important breeding and nursery areas for a wide variety of marine species thereby providing threatened species with a chance to recover form over-exploitation.

- The **Helderberg MPA** is a very small 2.4 km^2 MPA, which protects sandy and rocky shore ecosystems.

- The **Betty’s Bay MPA** is a coastal MPA that forms part of the core zone of the United Nations Educational and Scientific Organisation (UNESCO) designated Kogelberg Biosphere Reserve. The MPA was established to protect declining line fish stocks and to counter the over-exploitation of abalone. The MPA has a variety of habitats including rock headlands, wave-cut platforms, high-energy sandy beaches, kelp forests, estuaries, subtidal reefs, and pelagic habitats. The intertidal diversity is considered particularly rich, while kelp forests provide a rich source of food and shelter for kelp limpets, alikreukel, abalone and West Coast lobster.

- The **Walker Bay MPA** was proclaimed in 2001 and protects an area of 108 km^2. The MPA provides protection for southern right whales and their calves on a seasonal basis between July and November. The MPA also protects rocky and sandy shore habitats and kelp forests.

- The **De Hoop MPA** was declared in 1985, with the adjacent De Hoop Nature Reserve being listed as a World Heritage Site in 2004. The MPA extends along a 46-km stretch of coastline between Stilbaai Point and Skipskop and extends three nautical miles offshore covering an area of approximately 25 300 ha. It is currently the only conservation area that affords protection to the unique intertidal system of large, eroding, soft sandstone and limestone platforms. The intertidal biota represents both warm-water east coast and cold-water west coast species, resulting in highly diverse communities. De Hoop MPA is also critically important for the conservation of the Southern Right whale and together with St. Sebastian Bay contains 70-80% of cow-calf pairs on the South African coast, thus ranking as probably the most important nursery area for Southern Right whales in the world. The MPA also contains an important breeding area for the near-threatened African black oystercatcher.

- The **Goukamma MPA** has a coastline of approximately 14 km from Buffalo Bay to Platbank and stretches 1 mn (1.85 km) out to sea. The specific objectives of the Goukamma MPA are protection of intertidal species with an emphasis on protection of sought after bait species, the protection of important offshore reefs that provide habitat for commercially threatened sparid species, particularly red steenbras and black musselcracker, and the natural functioning of marine and estuarine ecosystems. The MPA contains rocky platforms, sandy beaches, subtidal rocky reefs and subtidal sandy benthos.

- **Robberg MPA** is adjacent to Robberg Nature Reserve (Plettenberg Bay), which forms a peninsula with a single access point. The length of the Robberg MPA shoreline is 9 km and includes rocky platforms, sandy beaches, subtidal rocky reefs and subtidal sandy benthos. A Cape fur seal colony is also present.

Offshore Marine Protected Areas

- The **Orange Shelf Edge MPA** (2 000 km^2) covers depths of between 250 m and 1 500 m. As this area has never been trawled, it provides a glimpse into what a healthy seabed should look like, what animals live there and how the complex relationships between them support important commercial fish species such as hake, thereby contributing fundamentally towards sustainable fisheries development. This MPA also protects the pelagic habitats that are home to predators such as blue sharks, as well as surface waters where thousands of seabirds such as Atlantic yellow-nosed albatrosses feed.

- The **Namaqua Fossil Forest MPA**, which lies approximately 400 km north of Block 5/6/7, provides evidence of age-old temperate yellowwood forests from a hundred million years ago when the sea-level was more than 200 m below what it is today; trunks of fossilized yellowwood trees covered in delicate corals. These unique features stand out against surrounding mud, silt and gravel habitats. The 1 200 km^2 MPA protects the unique fossil forests and the surrounding seabed ecosystems and including a new species of sponge previously unknown to science.

- The **Child's Bank MPA** (1 335 km^2), located some 250 km north of Block 5/6/7, supports seabed habitats inhabited by a diversity of starfish, brittle stars and basket stars, many of which feed in the currents passing the bank's steep walls. Although trawling has damaged coral in the area, some pristine coral gardens remain on the steepest slopes. The MPA provides critical protection to these deep-sea habitats (180 m - 450 m) as they allow for the recovery of important nursery areas for young fish.

- The **Benguela Muds MPA**, is the smallest of the South African offshore MPAs. At only 72 km^2 the muddy habitats located in this area are created by sediment washed down the Orange River and out to sea. These mud habitats are of limited extent and were considered 'critically endangered' on South Africa's deep continental margin of the West Coast (Sink *et al.* 2019). The MPA represents the least trawled stretch of muddy seabed on the West Coast.

- The **Cape Canyon MPA** (580 km^2) protects the upper part of the Cape Canyon where depths range from 180 m to 500 m. The Cape Canyon is a deep and dramatic submarine canyon carved into the continental shelf and extending to a maximum depth of 3 600 m. Underwater footage has revealed a rich diversity of seafans, hermit crabs and mantis shrimps, with hake, monk and john dory resident on the soft canyon floor. Rocky areas in the west of the canyon support fragile rocky habitat, but the area also includes sandy and muddy habitats, which have been trawled in the past. Interaction of nutrient-rich bottom water with a complex seascape results in upwelling, which in turn provides productive surface waters in which seabirds, humpback whales and Cape fur seals feed. The MPA lies on the northern boundary of Block 5/6/7, approximately 175 km north of the Area of Interest.

- The **Robben Island MPA** (612 km^2) protects the surrounding kelp forests - one of the few areas that still supports viable stocks of abalone. The island harbours the 3rd largest penguin colony, with the breeding population peaking in 2004 at 8 524, but declining since. The island also holds the largest numbers of breeding Bank Cormorant in the Western Cape (120 pairs in 2000) and significant populations of Crowned Cormorant, African Black Oystercatcher (35 breeding pairs in 2000), Hartlaub's Gull and Swift Tern. Robben Island is also an important tourism area for wildlife and cultural heritage.

- The **Agulhas Bank Complex MPA** (4 300 km^2) includes Alphard Banks, a volcanic pinnacle that rises up from a depth of 80 m to a shallow 14 m. The unique kelp forest ecosystems that blanket these pinnacles are teeming with shoals of yellowtail, geelbek, stingrays and red stumpnose. Below 40 m, the kelp forests transform into cold water coral gardens that provide important refuges for young fish. The MPA includes parts of the 45 and 72 Mile Banks and protects spawning aggregations of endangered red steenbras, a long-lived seabream that reaches over 1m, making it the largest seabream in the world.

- The **Agulhas Muds MPA** protects 207 km^2 of critically endangered shallow mud habitats between the 80 and 100 m depth range, and is located approximately 135 km south-east of Block 5/6/7. Mud ecosystems in South Africa have suffered from reduced riverine flow and a century of trawling for sole, silver kob and other seafood species. This MPA protects critically endangered good-condition mud habitats and supports recovery of the commercially important Agulhas sole.

- The **South West Indian Seamount MPA** is located approximately 140 km south-east of Block 5/6/7. This MPA is separated into two areas – the North Zone and Natal Seamount Zone. The MPA covers 7 500 km^2 with the majority of the shallower part consisting of un-trawled rocky shelf edge hosting several kinds of habitat forming cold water corals at depths between 200 and 1 200 m. These corals are vulnerable to changes in ocean temperature, oxygen and acidity and may hold clues to the history of the South African climate. The deeper part of the MPA protects slope and abyssal plain habitats in the 3 800 m to 5 200 m depth range making it the deepest MPA in the South African EEZ MPA network. The MPA protects the only Indian Ocean seamount in the network. The MPA protects many threatened species such as mako sharks, which use this area as a nursery. In addition, the MPA also provides protection to the foraging areas used by endangered seabirds such as the Atlantic yellow-nosed albatross, Indian yellow-nosed albatross, and the critically endangered Tristan albatross.

7.5.2 Ecologically or Biologically Significant Areas (EBSAs)

As part of a regional Marine Spatial Management and Governance Programme (MARISMA 2014-2020), the Benguela Current Commission (BCC) and its member states identified a number of EBSAs both spanning the border between Namibia and South Africa and along the South African West, South and East Coasts, with the intention of implementing improved conservation and protection measures within these sites. The principal objective of the EBSAs is identification of features of higher ecological value that may require enhanced conservation and management measures. These EBSAs currently carry no legal status.

The impact management and conservation zones within the EBSAs are under review and currently constitute a subset of the biodiversity priority areas map (see Section 7.5.3) where "EBSA conservation zones" equate to

Critical Biodiversity Areas (CBAs), whereas "EBSA impact management zones" equate to Ecological Support Area (ESAs). The relevant sea-use guidelines accompanying the CBA areas would apply.

South Africa currently has 12 EBSAs identified solely within its jurisdiction with a further three having been proposed[20]. It also shares eight trans-boundary EBSAs with other countries (Namibia (3) and Mozambique (2)) and/or high seas (3). The EBSAs within the Project's area of influence are shown in Figure 7-43. The text and figures below are based on the EBSA status presented in MARISMA EBSA Workstream 2020 (there has been no change to the shapefile since this time).

Although Block 5/6/7 overlaps with five EBSAs (namely the Cape Canyon and Associated Islands, Seas of Good Hope, Protea Seamount Cluster, Brown's Bank and Benguela Upwelling System EBSAs), the Area of Interest for proposed exploration drilling avoids all EBSAs. These five EBSAs are briefly described below.

- The **Cape Canyon and Associated Islands EBSA** overlaps with the northern portion of Block 5/6/7 and is 70 km from the Area of Interest for proposed exploration drilling at its closest point. The EBSA includes the Benguela Muds MPA and the Cape Canyon, which is thought to hosts fragile habitat-forming species. The area is considered important for pelagic fish, foraging marine mammals and several threatened seabird species and serves to protect nine 'Endangered' and 12 'Vulnerable' ecosystem types, and two that are 'Near Threatened'. There are several small coastal MPAs within the EBSA.
- The proposed **Seas of Good Hope EBSA** is located at the coastal tip of Africa, wrapping around Cape Point and Cape Agulhas. This EBSA has minor overlap with the inshore boundary of Block 5/6/7 and at its closest point is ~50 km inshore of the Area of Interest for proposed exploration drilling. It extends from the coast to the inner shelf, and includes key islands (Seal Island, Dyer Island and Geyser Rocks), two major bays (False Bay and Walker Bay) and is of key importance for threatened species and habitats. The threatened habitats include coastal, inshore and inner shelf ecosystem types. The important life-history stages supported by the area are breeding and/or foraging grounds for a myriad of top predators, including sharks, whales, and seabirds, some of which are threatened species. This EBSA is also the place where the Benguela and Agulhas Currents meet.
- The proposed **Protea Seamount Cluster EBSA**, which lies in the far south of Block 5/6/7 and approximately 18 km from the Area of Interest for proposed exploration drilling at its closest point, is important for both its benthic and pelagic features, notably for supporting threatened habitats and species, and vulnerable, fragile and sensitive ecosystems and species. It comprises a seamount cluster that includes the Protea, Argentina and Mount Marek Seamounts that rise from the southeast Atlantic abyss. Refer to Section 7.2.1 for a description of these seamounts. Given this position, and its location relative to the Agulhas basin and Agulhas continental shelf, local productivity is high and consequently, it serves as an important aggregation site for migratory species, such as sharks, seabirds and tuna.
- The **Browns Bank EBSA**, which lies in the far south-east of Block 5/6/7 and approximately 4 km from the Area of Interest for proposed exploration drilling at its closest point, includes unconsolidated sandy

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[20] The delineations are final and currently under review with DFFE: Oceans and Coasts. Once signed off there they will be submitted to the subsidiary body on scientific, technical and technological advice (SBSTTA) of the CBD. The original boundaries have already been internationally adopted (*pers. comm*. Harris & Holness, MARISMA).

habitats, hard ground and deep reef habitats that form part of the western Agulhas Bank spawning ground and is part of a critical area for retention of spawning products. The area ranges from approximately 150 m to 800 m water depth and is the meeting point of the Agulhas and Southern Benguela ecoregions. The biodiversity includes benthic macrofaunal communities characterised by high abundances of brittle stars and many species of polychaetes, cold-water corals, brisingid starfish and 77 morphospecies of macroinvertebrates. The pelagic habitat is characterised by elevated productivity and frequent fronts due to shelf edge upwelling. The area has been proposed as a marine IBA for Cory's Shearwater and Atlantic Yellow-nosed Albatross (see Section 7.5.4).

- The **Benguela Upwelling System EBSA**, which overlaps with the northern inshore portion of Block 5/6/7 and is approximately 30 km inshore of the proposed Area of Interest for drilling, is a transboundary EBSA (not shown in Figure 7-43) and is globally unique as the only cold-water upwelling system to be bounded in the north and south by warm-water current systems, and is characterised by very high primary production. It includes important spawning and nursery areas for fish, as well as foraging areas for threatened vertebrates, such as sea- and shorebirds, turtles, sharks, and marine mammals. Another key characteristic feature is the diatomaceous mud-belt in the northern Benguela, which supports regionally unique low-oxygen benthic communities that depend on sulphide oxidising bacteria.

There are several EBSAs in the indirect area of influence both to the north and east of Block 5/6/7. These are described briefly below.

- The **Orange Seamount and Canyon Complex EBSA**, occurs at the western continental margin of southern Africa, spanning the border between South Africa and Namibia (approximately 500 km north-west of the area of interest). On the Namibian side, it includes Tripp Seamount and a shelf-indenting canyon. The EBSA comprises shelf and shelf-edge habitat with hard and unconsolidated substrates, including at least eleven offshore benthic habitat types of which four habitat types are 'Threatened', one is 'Critically endangered' and one 'Endangered'. The Orange Shelf Edge EBSA is one of few places where these threatened habitat types are in relatively natural/pristine condition. Although focussed primarily on the conservation of benthic biodiversity and threatened benthic habitats, the EBSA also considers the pelagic habitat, which is characterized by medium productivity, cold to moderate Atlantic temperatures and moderate chlorophyll levels related to the eastern limit of the Benguela upwelling on the outer shelf.

- The **Orange Cone EBSA** is a transboundary EBSA, spanning the mouth of the Orange River (approximately 610 km north of the area of interest). The estuary is biodiversity-rich but modified, and the coastal area includes many 'Critically endangered', 'Endangered' and 'Vulnerable' habitat types. The marine environment experiences slow, but variable currents and weaker winds, making it potentially favourable for reproduction of pelagic species. An ecological dependence of river outflow for fish recruitment on the inshore Orange Cone is also likely. The Orange River Mouth is a transboundary Ramsar site and falls within the Tsau//Khaeb (Sperrgebiet) National Park.

- The **Namaqua Fossil Forest EBSA** is a small seabed outcrop composed of fossilised yellowwood trees at 136-140 m depth, approximately 30 km offshore on the West Coast (approximately 545 km north of the area of interest). A portion of the EBSA comprised the Namaqua Fossil Forest MPA. The fossilised tree trunks form outcrops of laterally extensive slabs of rock have been colonised by fragile, habitat-forming scleractinian corals and a newly described habitat-forming sponge species. The EBSA thus encompasses a unique feature with substantial structural complexity that is highly vulnerable to benthic impacts.

- The **Childs Bank and Shelf Edge EBSA** is a unique submarine bank feature rising from a water depth of 400 m to 180 m on the western continental margin on South Africa (approximately 300 km north-west of the area of interest). This area includes five benthic habitat types, including the bank itself, the outer shelf and the shelf edge, supporting hard and unconsolidated habitat types. Childs Bank and associated habitats are known to support structurally complex cold-water corals, hydrocorals, gorgonians and glass sponges; species that are particularly fragile, sensitive and vulnerable to disturbance, and recover slowly. The Child's Bank MPA forms part of this EBSA.

- The **Namaqua Coastal Area EBSA** encompasses the Namaqua Coastal Area MPA and is characterised by high productivity and community biomass along its shores (approximately 345 km north of the area of interest). The area is important for several threatened ecosystem types represented there, including two 'Endangered' and four 'Vulnerable' ecosystem types, and is important for conservation of estuarine areas and coastal fish species.

- **Mallory Escarpment and Trough EBSA** includes the outer margin along the southern tip of the Agulhas Bank in South Africa (approximately 140 km south-east of the area of interest). The area similarly includes important benthic and pelagic features, including the shelf edge, a very steep slope (up to 20° in some places and thought to be globally rare) and a trough as part of the Agulhas-Falkland Fracture zone, shelf-edge driven upwelling, and fragile and sensitive habitat-forming species. Habitat diversity is thus particularly high for a location this far offshore. This dynamic area consequently supports numerous ecological processes, such as spawning and foraging, and comprises a rich diversity of both resident (e.g., benthic gorgonians) and transient (e.g., migrating leatherback turtles) species.

- The Agulhas Bank is a spawning ground and nursery area and is the centre of abundance of numerous warm-temperate species, including several endemic sparids. It is the only warm temperate nursery area for species that spawn on the narrow shelf in the north, and is important for retention, recruitment, and food provision. Dense benthic copepod communities provide a rich food source. The **Agulhas Bank Nursery Area EBSA** (approximately 120 km east of the area of interest) includes 'Critically Endangered' mud habitats and unique high-profile volcanic offshore reefs that support cold-water coral communities. There is a spawning aggregation area for the threatened endemic reef fish, *Petrus rupestris*, within this area. The Agulhas Bank Nursery Area EBSA contains two existing MPAs, namely De Hoop and Still Bay, and extends from the dune base across to the outer shelf south of Cape Infanta to almost -150 m depth.

- **Shackleton Seamount Complex EBSA** includes the outer margin along the southern tip of the Agulhas Bank (approximately 125 km east-south-east of the area of interest). It lies within the Agulhas-Falkland Fracture zone and is a dynamic offshore area with high productivity and high pelagic and benthic habitat heterogeneity. The Agulhas and Southern Benguela ecoregions meet at this point, and sporadic shelf-edge upwelling enhances productivity along the outer margin. The area is recognised as a spawning area for sardine, anchovy, horse mackerel and hake, and this apex area of the Agulhas Bank serves as a critical area for retention of spawning products. Eddies in the area help recirculate water inshore and link important nursery areas with spawning habitat on the shelf edge. This EBSA also contains the Mallory, Shackleton and Natal Seamounts. This area was identified as a priority focus areas for offshore protection due to its relatively high habitat diversity and because it can meet multiple benthic and pelagic habitat conservation targets in a small area.

- **Kingklip Corals EBSA** was established to offer protection to Secret Reef, Kingklip Koppies and Kingklip Ridge, which lie on and extend east of Grue Bank, on the shelf edge and upper bathyal area, about 100 km offshore of Knysna. The feature spans a broad water depth range of 150 m to 800 m. This newly discovered biogenic coral reef structure is most important for its benthic features as it includes threatened benthic habitats, particularly fragile and sensitive coral and bryozoan species. Reef-forming scleratinean corals characterise the crest and edges of the northern end of the ridge, and dense clouds of plankton and hake occur above the ridge. Three of the five ecosystem types represented in the EBSA are threatened, including the Endangered Kingklip Ridge and Vulnerable Kingklip Koppies and Agulhas Coarse Sediment Shelf Edge ecosystem types.

- **Tsitsikamma-Robberg EBSA** is a coastal EBSA, which includes Tsitsikamma MPA, Robberg MPA, Goukamma MPA, and part of the Garden Route Biosphere Reserve. It extends from the shore largely to the back of the middle shelf (100 m isobath), with some extension onto the shallow outer shelf, and includes the extent of five estuaries, including Knysna. The protection afforded to the inshore reefs from these MPAs has contributed to a high diversity and abundance of species, including fragile, vulnerable, sensitive and slow-growing species, that in turn support many top predators.

7.5.3 Biodiversity Priority Areas

The National Coastal and Marine Spatial Biodiversity Plan[21] comprises a map of Critical Biodiversity Areas (CBAs), Ecological Support Area (ESAs) and accompanying sea-use guidelines. The CBA Map presents a spatial plan for the marine environment, designed to inform planning and decision-making in support of sustainable development. The sea-use guidelines enhance the use of the CBA Map in a range of planning and decision-making processes by indicating the compatibility of various activities with the different biodiversity priority areas so that the broad management objective of each can be maintained.

Block 5/6/7 overlaps with areas mapped as Protected Area, Critical Biodiversity Area 1 (CBA 1) Natural, CBA 1 Restore, Critical Biodiversity Area 2 (CBA 2) Natural, CBA 2 Restore and Ecological Support Area (ESA), whereas the Area of Interest for proposed exploration drilling overlaps with CBA 1 Natural & Restore and CBA 2 Natural & Restore mainly in the north, but also marginally in the south. Approximately 5.4 % of Area of Interest is covered by CBA 1 and CBA 2 (see Figure 7-44). CBA 1 indicates irreplaceable or near-irreplaceable sites that are required to meet biodiversity targets with limited, if any, option to meet targets elsewhere, whereas CBA 2 are "best design sites" and there are often alternative areas where feature targets can be met; however, these will be of higher cost to other sectors and / or will be larger areas.

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[21] The National Coastal and Marine Spatial Biodiversity Plan is intended to be used by managers and decision-makers in those national government departments whose activities occur in the coastal and marine space, e.g. environment, fishing, transport (shipping), petroleum, mining, and others. It is also intended for use by relevant managers and decision-makers in the coastal provinces and coastal municipalities, ESIA practitioners, organisations working in the coast and ocean, civil society, and the private sector. The latest version of National Coastal and Marine Spatial Biodiversity Plan (v1.2 was released in April 2022 (Harris *et al.* 2022)

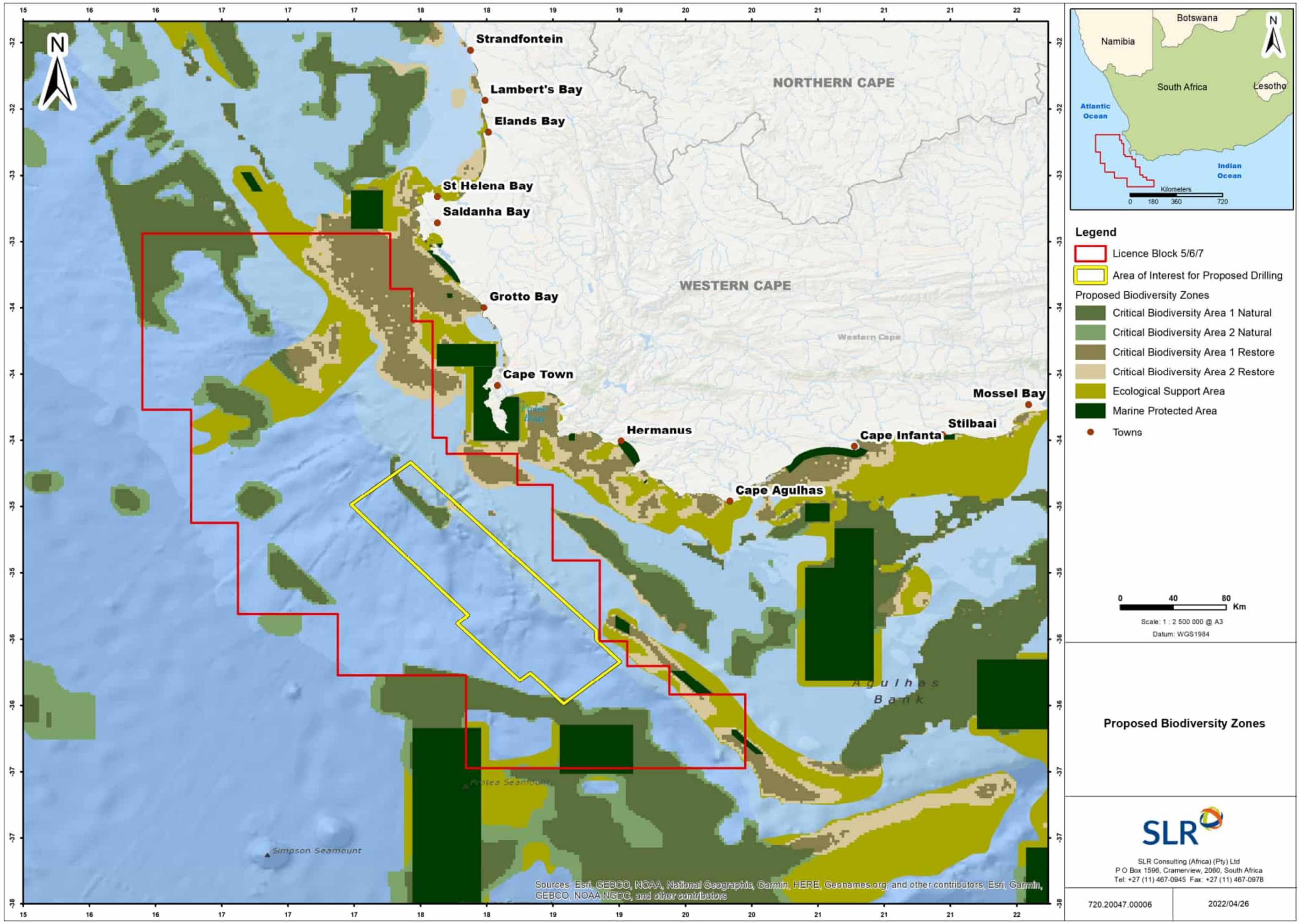

FIGURE 7-44: BLOCK 5/6/7 AND THE AREA OF INTEREST FOR PROPOSED EXPLORATION DRILLING IN RELATION TO MPAS, CRITICAL BIODIVERSITY AREAS (CBAS) AND ECOLOGICAL SUPPORT AREAS (ESAS)

Adapted from Harris *et al.* 2022 (Version 1.2, April 2022)

Regardless of how CBAs are split, CBAs are generally areas of low use and with low levels of human impact on the marine environment, but can also include some moderately to heavily used areas with higher levels of human impact. Given that some CBAs are not in natural or near-natural ecological condition, but still have very high biodiversity importance and are needed to meet biodiversity feature targets, CBA 1 and CBA 2 were split into two types based on their ecological condition. CBA Natural sites have natural / near-natural ecological condition, with the management objective of maintaining the sites in that natural / near-natural state; and CBA Restore sites have moderately modified or poorer ecological condition, with the management objective to improve ecological condition and, in the long-term, restore these sites to a natural/near-natural state, or as close to that state as possible. ESAs include all portions of EBSAs that are not already within MPAs or CBAs, and a 5-km buffer area around all MPAs (where these areas are not already CBAs or ESAs), with the exception of the eastern edge of Robben Island MPA in Table Bay where a 1.5-km buffer area was applied (Harris *et al.* 2022).

Activities within these management zones are classified into those that are "compatible", those that are "not compatible", and those that have "restricted compatibility". **Non-invasive and invasive (e.g., exploration wells) exploration activities are classified as having "restricted compatibility".** Activities with restricted compatibility require a detailed assessment (e.g. as part of the marine ecology impact assessment) to determine whether the recommendation is that they should be permitted (general), permitted subject to additional regulations (consent), or prohibited, depending on a variety of factors**.** Petroleum production is, however, classified as "not compatible" in CBAs, but may be compatible, subject to certain conditions, in ESAs (Harris *et.al.* 2022).

7.5.4 Important Bird Areas (IBAs)

There are numerous coastal IBAs in the general project area (see Table 7-10) (https://maps.birdlife.org/marineIBAs), all of which are located well inshore of Block 5/6/7. Various marine IBAs have also been proposed in South African territorial waters, with a candidate marine IBA suggested off the Orange River mouth and a further candidate marine IBA suggested in international waters west of the Cape Peninsula (see Figure 7-45). **Block 5/6/7 overlaps with the proposed Bird Island / Dassen Island / Heuningnes River and estuary system / Lower Berg river wetlands marine IBA and the Atlantic Southeast 19 IBA. The Area of Interest for proposed exploration drilling only overlaps with the proposed Atlantic Southeast 19 IBA[22].**

TABLE 7-10: LIST OF CONFIRMED COASTAL IMPORTANT BIRD AREAS (IBAS) AND THEIR CRITERIA LISTINGS

Site Name	IBA Criteria	Notes
Olifants River Estuary (ZA078)	A3, A4i	A1. Globally threatened species A2. Restricted-range species A3. Biome-restricted species A4. Congregations i. Applies to 'waterbird' species ii. This includes those seabird species not covered under i. iii. Modelled on criterion 5 of the Ramsar Convention for identifying wetlands of international importance. The use of this
Verlorenvlei Estuary (ZA082)	A4i	
Berg River Estuary (ZA083)	A4i	
West Coast National Park and Saldanha Bay Islands (ZA 084)	A1, A4i, A4ii, A4iii	
Dassen Island (ZA088)	A1, A4i, A4ii, A4iii	
Robben Island (ZA089)	A1, A4i, A4ii, A4iii	
Rietvlei Wetland: Table Bay Nature Reserve (ZA090)	A1, A4i	

[22] There is no indication on the BirdLife International website when this "proposed" IBA will become a "confirmed" IBA.

Site Name	IBA Criteria	Notes
Boulders Beach (ZA096)	A1	criterion is discouraged where quantitative data are good enough to permit the application of A4i and A4ii.
False Bay Nature Reserve (ZA095)	A1, A4i, A4iii	
Boland Mountains (ZA086)	A1, A2, A3	
Cape Whale Coast (ZA097)	A4i, A4iii	
Dyer Island Nature Reserve (ZA099)	A1, A4i, A4ii, A4iii	
Overberg Wheatbelt (ZA094)	A1, A2, A3, A4i	
Agulhas Plain – Heuningnes Estuary	A1, A4i	
De Hoop Nature Reserve (ZA098)	A1, A2, A3, A4i, A4iii	
Wilderness-Sedgefield Lakes Complex (ZA093)	A2, A3, A4i, A4iii	
Tsitsikama – Plettenberg Bay (ZA077)	A1, A2, A3	

Source: www.BirdLife.org.za

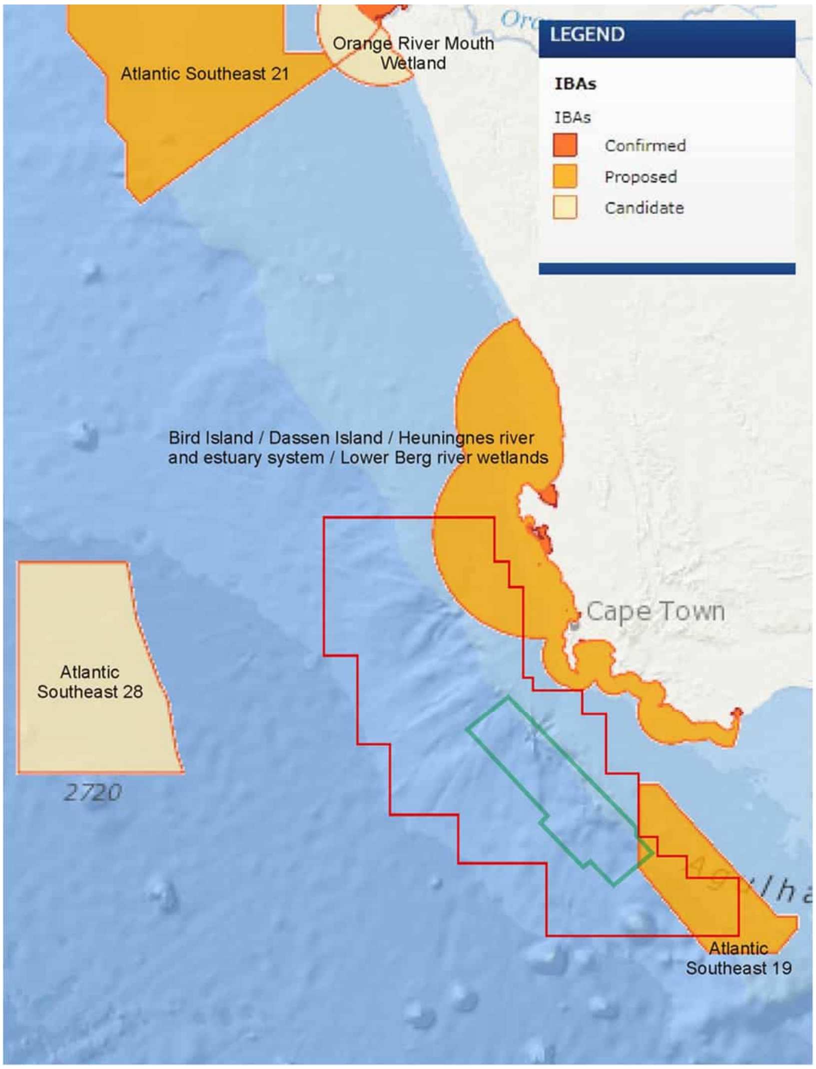

FIGURE 7-45: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO PROPOSED AND CONFIRMED COASTAL AND MARINE IBAS OFF THE SOUTH WEST COAST

Source: https://maps.birdlife.org/marineIBAs

7.5.5 Ramsar Sites

South Africa currently has 27 sites designated as Wetlands of International Importance (Ramsar Sites[23]), with a surface area of 571 089 hectares. **Ten RAMSAR sites occur within the Project's indirect area of influence** (see Table 7-11 and Figure 7-46).

TABLE 7-11: RAMSAR SITES WITHIN THE PROJECT'S AREA OF INFLUENCE

Name	Size (ha)	Province	Description
Orange River Mouth	2 000	Northern Cape	Ramsar site no. 526. Transboundary area of extensive saltmarshes, freshwater lagoons and marshes, sand banks, and reedbeds shared by South Africa and Namibia. Important for resident birds and for staging locally migrant waterbirds. Following the collapse of the saltmarsh component of the estuary, the site was placed on the Montreux Record in 1995.
Langebaan	6 000	Western Cape	Ramsar site no. 398. National Park. A large, shallow marine lagoon, which includes islands, reedbeds, sand flats, saltmarshes and dwarf shrubland. The lagoon is an important nursery area for a number of fish species and supports a diverse and ecologically important algal and shoreline biota. Important for wintering and staging wading birds, and the numerous breeding birds include the largest colony of gulls in South Africa.
Dassen Island Nature Reserve	737	Western Cape	Ramsar site no. 2 383. The Dassen Island Nature Reserve, lying off the Western Cape Province, is the second-largest coastal island on the South African continental shelf. It is within the Benguela upwelling ecosystem, which lifts cold, nutrient-rich water to the surface. Sandy inner shelf, rocky mid-shelf mosaic, island shore and kelp forest are the main habitat types. Dassen Island is covered by Cape seashore vegetation and a number of cetacean species are found in the surrounding seas. The Site is an Important Bird Area providing habitat for significant numbers of seabird and shorebird species, including 10 of the 15 seabirds endemic to southern Africa, and numerous Palearctic and sub-Antarctic migrants. It provides safe breeding refuge for threatened species such as the African penguin and Cape cormorant and other coastal birds.
Verlorenvlei	1 500	Western Cape	Ramsar site no. 525. Verlorenvlei is a long estuary stretching between the villages of Elands Bay and Redelinghuys. Verlorenvlei is one of the most important estuarine systems in the Western Cape and one of the largest natural wetlands along the West Coast of South Africa. It is also one of the few coastal freshwater lakes in the country. The system comprises a coastal lake and reed swamp connected to the sea by a small estuary. The site is an important feeding area for rare pelicans and fish, for moulting and breeding birds, as well as for staging wading birds.
False Bay Nature Reserve	1 542	Western Cape	Ramsar site no. 2 219. The False Bay Nature Reserve is a unique area on the Cape Flats, situated between False Bay and Table Bay, consisting of about 50% permanent wetland and 49% terrestrial vegetation including the critically endangered Cape Flats Sand Fynbos and Cape Flats Dune Strandveld and some sand beaches. The False Bay Nature Reserve contains two lakes, Rondevlei (protected area reserve) and Zeekoevlei. Serving as a reservoir of biodiversity, the False Bay Nature Reserve supports important populations of mammals and is home to over 60% of the bird species in the South-western Cape (228 species). About 256 species of indigenous plants grow on the site.

[23] A Ramsar site is considered wetland designated to be of international importance under the Ramsar Convention, also known as "The Convention on Wetlands", an intergovernmental environmental treaty established by UNESCO in 1971.

Name	Size (ha)	Province	Description
Bot - Kleinmond Estuarine System	1 350	Western Cape	Ramsar site no. 2 291. The Bot-Kleinmond Estuarine System consists of an estuarine lake, flanked by deeply weathered Bokkeveld shale terrain and mountains oriented perpendicular to the coastline. The Site is recognized as one of the ten most significant wetlands for waterbirds in South Africa during the dry summer months; 86 species of waterbird have been recorded there. The Site is also important as a nursery area for fish, with 41 species from 24 families recorded, of which 19 species are dependent on estuaries to complete their lifecycle.
Dyer Island and Geyser Island Provincial Nature Reserves	288	Western Cape	Ramsar site no. 2 384. This site is composed of two islands, namely Dyer Island and Geyser Island. A sandy channel known as Shark Alley separates them. Located within the Benguela upwelling ecosystem, the surrounding seas are characterised by coastal wind-induced upwelling, which lifts cold, nutrient-rich water to the surface. As an IBA, the site hosts around 48 bird species and it is a breeding area for 21 of them, including globally endangered seabirds such as the African penguin and Cape cormorant which number more than 35 000. The surrounding seas are inhabited by at least 11 shark species including great white shark and dusky ground shark. A further 26 fish species have been recorded, as well as whales and dolphins.
De Hoop Vlei	750	Western Cape	Ramsar site no. 34. Provincial Nature Reserve. A coastal lake of seasonally varying levels of water and salinity, formed when dunes blocked the course of the Sout River. Important for numerous species of wintering and staging waterbirds.
De Mond	918	Western Cape	Ramsar site no. 342. Nature Reserve. Estuary, dune system and saltmarsh where shifting dunes are isolating the estuary. Important as wintering, staging and feeding area for several species of breeding birds and locally migrant waterbirds. Provides habitat for various reptiles, notable crustaceans, and the sea horse *Hippocampus*.
Wilderness Lakes	1 300	Western Cape	Ramsar site no. 524. National Park. A series of three permanent, interconnected coastal lakes linked to the Indian Ocean; includes a dune system with associated thickets, woodlands, marshes, and reedbeds. Important numbers of locally-migrant resident birds as well as staging and breeding birds use the site, which supports 285 native plant species, 32 fish species (several of which use the site as a nursery area), and a diverse marine invertebrate fauna.

7.5.6 Sanctuaries

Sanctuaries are considered a type of management area within South Africa's multi-purpose expanded MPA network in which access and/or resource use is prohibited. **Sanctuaries areas in the vicinity of the project area in which restrictions apply are the McDougall's Bay, Stompneusbaai, Saldanha Bay, Table Bay and Hout Bay rock lobster sanctuaries**, which are closed to commercial exploitation of rock lobsters. These sanctuaries were originally proclaimed early in the 20^{th} century as a management tool for the protection of the West Coast rock lobster (Mayfield *et al.* 2005). **These lie well inshore or to the north of Block 5/6/7.**

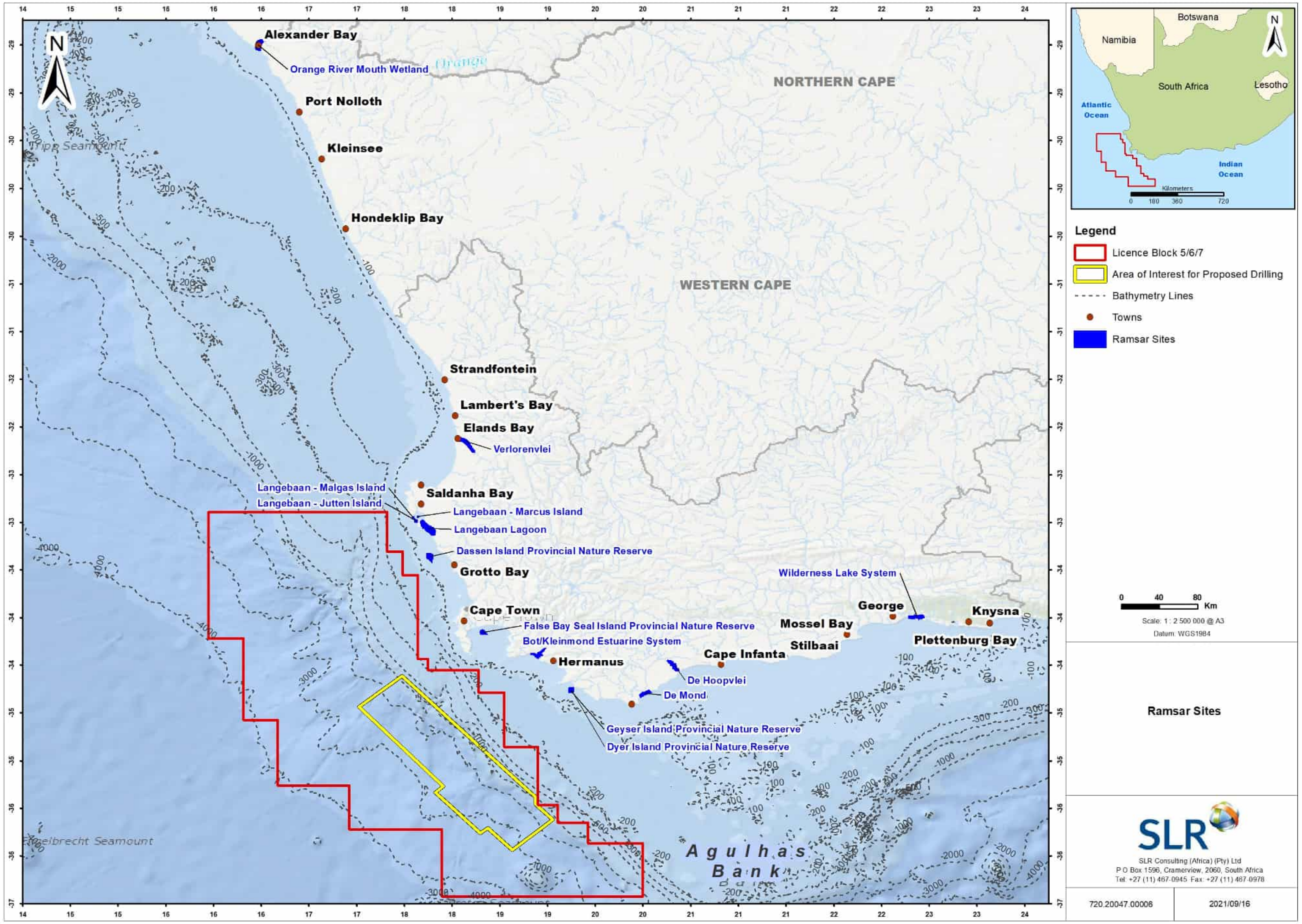

FIGURE 7-46: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO RAMSAR SITES WITHIN THE PROJECT'S AREA OF INFLUENCE
Source: https://soer.environment.gov.za/soer/CMSWebSite/GISdata.aspx (2022)

7.5.7 Important Marine Mammal Areas

Important Marine Mammal Areas (IMMAs) were introduced in 2016 by the IUCN Marine Mammal Protected Areas Task Force to support marine mammal and marine biodiversity conservation. Complementing other marine spatial assessment tools, including the EBSAs and Key Biodiversity Areas, IMMAs are identified on the basis of four main scientific criteria, namely (A) species or population vulnerability, (B) distribution and abundance, (C) key life cycle activities and (D) special attributes (see Table 7-12). IMMAs are not prescriptive but comprise an advisory, expert-based classification of areas that merit monitoring and place-based protection for marine mammals and broader biodiversity.

Although much of the West Coast of South Africa has not yet been assessed with respect to its relevance as an IMMA, the coastline from the Olifants River mouth on the West Coast to the Mozambiquan border overlaps with three declared IMMAs (see Figure 7-47), **none of which overlap with the area of interest for proposed drilling.** The three IMMAs include (www.marinemammalhabitat.org):

- **Southern Coastal and Shelf Waters of South Africa IMMA** (166 700 km^2): This IMMA extends from the Olifants River mouth to the mouth of the Cintsa River on the Transkei Wild Coast. Qualifying species are the Indian Ocean Humpback dolphin (Criterion A, B1), Bryde's whale (Criterion C2), Indo-Pacific bottlenose dolphin (Criterion B1, C3, D1), Common dolphin (Criterion C2) and Cape fur seal (Criterion C2). The IMMA covers the area supporting the important 'sardine run' and the marine predators that follow and feed on the migrating schools (Criterion C2), as well as containing habitat that supports an important diversity of marine mammal species (Criterion D2), including the Indian Ocean humpback dolphin, the inshore form of Bryde's whale, Indo-Pacific bottlenose dolphin, common dolphin, Cape fur seal, Humpback whales, Killer whales and Southern Right whales.
- **Cape Coastal Waters IMMA** (6 359 km^2): This IMMA extends from Cape Point to Woody Cape at Algoa Bay. It serves as one of the world's three most important calving and nursery grounds for southern right whales, which occur in the extreme nearshore waters (within 3 km of the coast) from Cape Agulhas to St. Sebastian Bay between June and November (Criterion B2, C1). Highest densities of cow-calf pairs occur between Cape Agulhas and the Duivenhoks River mouth (Struisbaai, De Hoop, St Sebastian Bay), while unaccompanied adult densities peak in Walker Bay and False Bay. The IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin and Indo-Pacific bottlenose dolphin.
- **South East African Coastal Migration Corridor IMMA** (47 060 km^2): This IMMA extends from Cape Agulhas to the Mozambiquan border and serves as the primary migration route for C1 substock of southern hemisphere Humpback whales (Criterion C3). On their northward migration between June and August, they are driven closer to shore due to the orientation of the coast with the Agulhas Current, whereas during the southward migration from September to November, they remain further offshore (but generally within 15 km of the coast) utilising the southward flowing Agulhas Current as far west as Knysna. This IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin, Common dolphin, Indo-Pacific bottlenose dolphin, Spinner dolphin, Southern Right whale, and Killer whale.

TABLE 7-12: IMMA SELECTION CRITERIA

Criterion	Description
Criterion A	**Species or Population Vulnerability: Areas containing habitat important for the survival and recovery of threatened and declining species**
Criterion B	**Distribution and Abundance**
Sub-criterion B1	Small and Resident Populations: Areas supporting at least one resident population, containing an important proportion of that species or population, that are occupied consistently.
Sub-criterion B2	Aggregations: Areas with underlying qualities that support important concentrations of a species or population.
Criterion C	**Key Life Cycle Activities**
Sub-criterion C1	Reproductive Areas: Areas that are important for a species or population to mate, give birth, and/or care for young until weaning.
Sub-criterion C2	Feeding Areas: Areas and conditions that provide an important nutritional base on which a species or population depends.
Sub-criterion C3	Migration Routes: Areas used for important migration or other movements, often connecting distinct life-cycle areas or the different parts of the year-round range of a non-migratory population.
Criterion D	**Special Attributes**
Sub-criterion D1	Distinctiveness: Areas which sustain populations with important genetic, behavioural or ecologically distinctive characteristics.
Sub-criterion D2	Diversity: Areas containing habitat that supports an important diversity of marine mammal species.

Source: https://www.marinemammalhabitat.org/immas/imma-criteria/

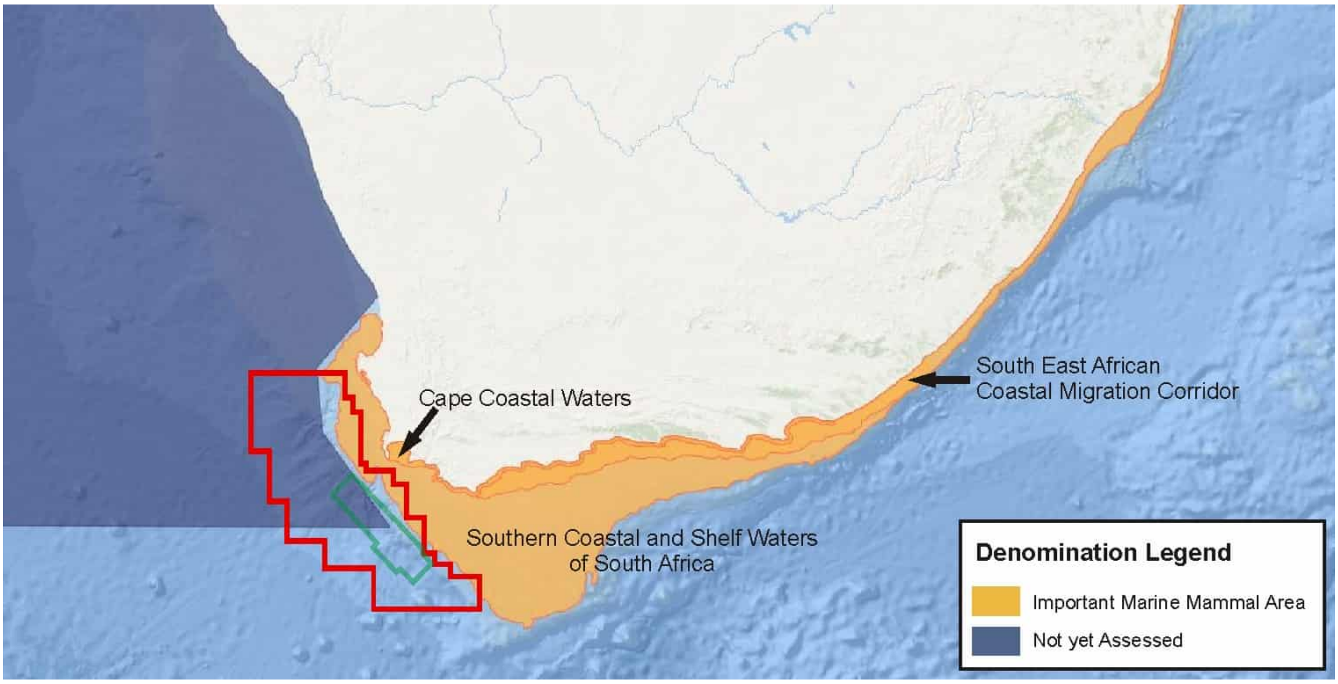

FIGURE 7-47: BLOCK 5/6/7 (RED POLYGON) AND THE AREA OF INTEREST FOR DRILLING (GREEN POLYGON) IN RELATION TO COASTAL AND MARINE IMMAS

Source: www.marinemammalhabitat.org/imma-eatlas (2022)

7.6 ECOLOGICAL NETWORK CONCEPTUAL MODEL

Figure 7-48 provides a simplified conceptual model for the nearshore and offshore receiving environment on the West and South-West Coasts illustrating key variables, processes, linkages, relationships, dependencies and feed-back-loops.

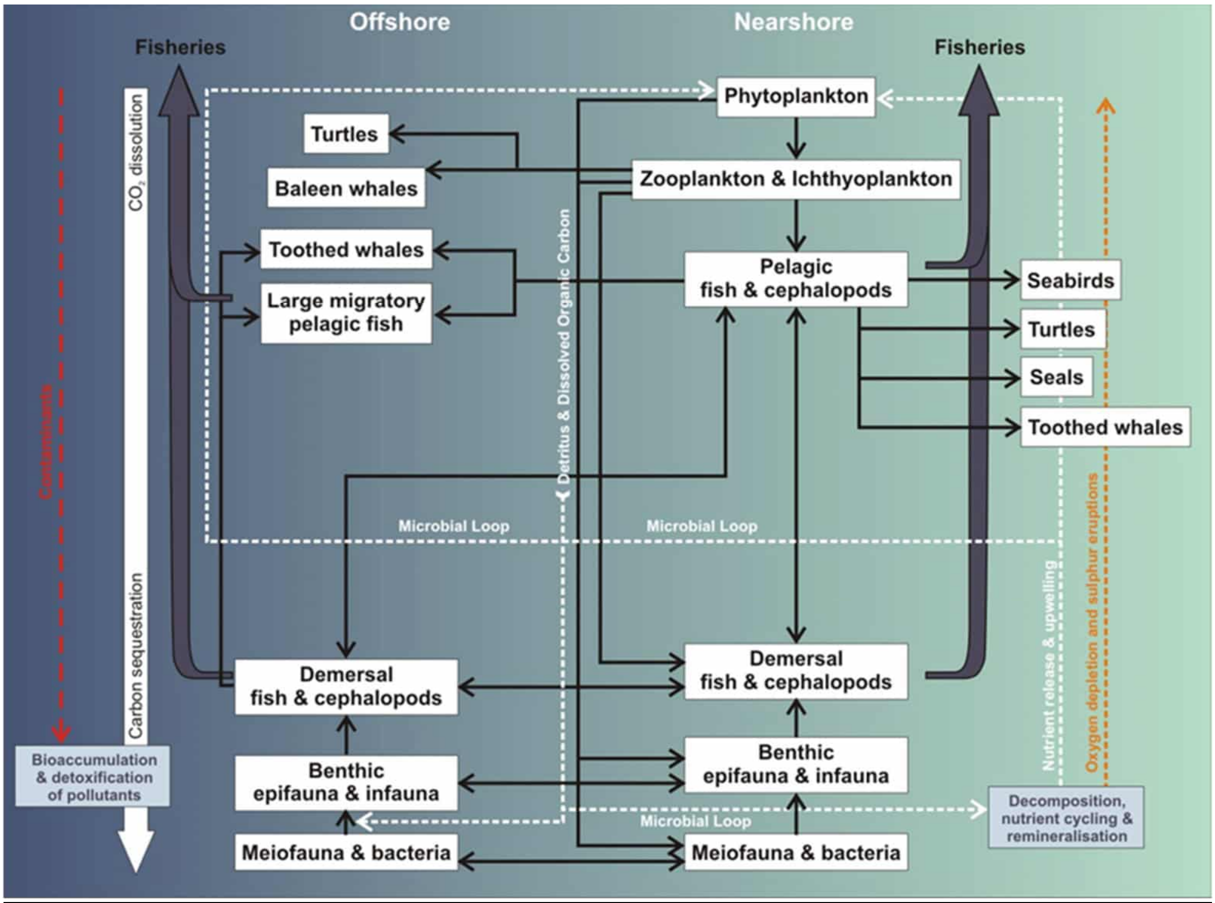

FIGURE 7-48: SIMPLIFIED NETWORK DIAGRAM INDICATING THE INTERACTION BETWEEN THE KEY ECOSYSTEM COMPONENTS OFF THE SOUTH-WEST AND WEST COASTS

Source: Pisces

The upwelling of nutrients in the southern Benguela is the main driver that supports substantial seasonal phytoplankton production, which in turn serves as the basis for a rich food chain up through zooplankton, pelagic fish, cephalopods, and marine mammals, as well as demersal species and benthic fauna. High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters, resulting in a wind-related cycle of plankton production, mortality, sinking of detritus and eventual nutrient enrichment and remineralisation through the microbial loops active in the water column and on the seabed. The natural annual input of millions of tonnes of organic material onto the seabed provides most of the food requirements of the particulate and filter-feeding benthic communities, resulting in the high organic content of the muds in the region. Organic detritus not directly consumed enters the seabed decomposition cycle, potentially resulting in the depletion of oxygen in deeper waters and the formation of hydrogen sulphide by anaerobic bacteria.

In the offshore oceanic environment in the vicinity of a seamount, similar processes of decomposition and remineralisation, upwelling of nutrients and enhanced localised primary and secondary production would apply, thereby serving as focal points for higher order consumers. The cold-water corals typically associated with seamounts and canyons also add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity and the development of detritivore-based food-webs, which in turn lead to the presence of seamount scavengers and predators. Seamounts also provide an important habitat for commercial deepwater fish stocks.

Ecosystem functions of the offshore deepwater environment include the support of highly productive fisheries, the dissolution of CO_2 from the atmosphere and subsequent sequestering of carbon in seabed sediments, as well as waste absorption and detoxification.

The structure and function of these nearshore and offshore marine ecosystems is influenced both by natural environmental variation (e.g. El Niño Southern Oscillation (ENSO)) and multiple human uses, such as hydrocarbon developments and the harvest of marine living resources.

A brief discussion of potential population-level and ecosystem-wide effects of disturbance and the application of the integrated ecosystem assessment framework for evaluating the cumulative impacts of multiple pressures on multiple ecosystem components is provided below.

With growing evidence of the ecosystem-wide effects of seismic noise (Nieukirk *et al.* 2012; Kavanagh *et al.* 2019; Kyhn *et al.* 2019) and the potential consequences of sub-lethal anthropogenic sounds affecting marine animals at multiple levels (e.g., behaviour, physiology, and in extreme cases survival), there is increasing recognition for the need to consider the effects of anthropogenic noise at population and ecosystem level. The sub-lethal effects of sound exposure may seem subtle, but small changes in behaviour can lead to significant changes in feeding behaviour, reductions in growth and reproduction of individuals (Pirotta *et al.* 2018) and can have effects that go beyond a single species, which may cause changes in food web interactions (Francis *et al.* 2009; Hubert *et al.* 2018; Slabbekoorn & Halfwerk 2009).

For example, the intensified upwelling events associated with the Cape Canyon, provide highly productive surface waters, which power feeding grounds for cetaceans and seabirds (www.environment.gov.za/dearesearchteam returnfromdeepseaexpedition). Roman & McCarthy (2010) demonstrated the importance of marine mammal faecal matter in replenishing nutrients in the euphotic zone, thereby locally enhancing primary productivity in areas where whales and/or seals gather to feed (Kanwisher & Ridgeway 1983; Nicol *et al.* 2010). Surface excretion may also extend seasonal plankton productivity after a thermocline has formed, and where diving and surfacing of deep-feeding marine mammals (e.g. pilot whales, seals) transcends stratification, the vertical movement of these air-breathing predators may act as a pump bringing nutrients below the thermocline to the surface thereby potentially increasing the carrying capacity for other marine consumers, including commercial fish species (Roman & McCarthy 2010). Behavioural avoidance of marine mammals from such seasonal feeding areas in response to increasing anthropogenic disturbance may thus alter the nutrient fluxes in these zones, with possible ecosystem repercussions.

Likewise, long-lived, slow-reproducing species play important stabilising roles in the marine ecosystem, especially through predation, as they play a vital role in balancing and structuring food webs, thereby maintaining their functioning and productivity. Should such predators be impacted by hydrocarbon exploration at population level, and this have repercussions across multiple parts of a food web, top-down trophic cascades in the marine ecosystem could result (Ripple *et al.* 2016).

At the other end of the scale, significant impacts on plankton by anthropogenic sources can have significant bottom-up ripple effects on ocean ecosystem structure and health as phytoplankton and their zooplankton grazers underpin marine productivity. Healthy populations of fish, top predators and marine mammals are not possible without viable planktonic productivity. Furthermore, as a significant component of zooplankton communities comprises the egg and larval stages of many commercial fisheries species, large-scale disturbances (both natural and anthropogenic) on plankton communities can therefore have knock-on effects on ecosystem services across multiple levels of the food web.

Due to the difficulties in observing population-level and/or ecosystem impacts, numerical models are needed to provide information on the extent to which sound or other anthropogenic disturbances may affect the structure and functioning of populations and ecosystems. Attempts to model noise-induced changes in population parameters were first undertaken for marine mammals using the population consequences of acoustic disturbance (PCAD) or Population

Consequences of Disturbance (PCoD) approach (NRC 2005). The PCAD/PCoD framework assesses how observed behavioural responses on the health of an individual translates into changes in critical life-history traits (e.g. growth, reproduction, and survival) to estimate population-level effects. Since then, various frameworks have been developed to enhance our understanding of the consequences of behavioural responses of individuals at a population level. This is typically done through development of bio-energetics models that quantify the reduction in bio-energy intake as a function of disturbance and assess this reduction against the bio-energetic need for critical life-history traits (Costa *et al.* 2016; Keen *et al.* 2021). The consequences of changes in life-history traits on the development of a population are then assessed through population modelling. These frameworks are usually complex and under continual development but have been successfully used to assess the population consequences and ecosystem effects of disturbance in real-life conditions both for marine mammals (Villegas-Amtmann 2015, 2017; Costa *et al.* 2016; Ellison *et al.* 2016; McHuron *et al*. 2018; Pirotta *et al*. 2018; Dunlop *et al.* 2021), fish (Slabbekoorn & Halfwerk 2009; Hawkins et al. 2014; Slabbekoorn et al. 2019) and invertebrates (Hubert et al. 2018). The PCAD/PCoD models use and synthesise data from behavioural monitoring programmes, ecological studies on animal movement, bio-energetics, prey availability and mitigation effectiveness to assess the population-level effects of multiple disturbances over time (Bröker 2019).

Ecosystem-based management is a holistic living resource management approach that concurrently addresses multiple human uses and the effect such stressors may have on the ability of marine ecosystems to provide ecosystem services and processes (e.g. recreational opportunities, consumption of seafood, coastal developments) (Holsman *et al.* 2017; Spooner *et al.* 2021). Within complex marine ecosystems, the integrated ecosystem assessment framework, which incorporates ecosystem risk assessments, provides a method for evaluating the cumulative impacts of multiple pressures on multiple ecosystem components (Levin *et al*. 2009, 2014; Holsman *et al.* 2017; Spooner *et al.* 2021). It, therefore, has the potential to address cumulative impacts and balance multiple, often conflicting, objectives across ocean management sectors and explicitly evaluate trade-offs. It has been repeatedly explored in fisheries management (Large *et al.* 2015) and more recently in marine spatial planning (Hammar *et al.* 2020; Carlucci *et al.* 2021; Jonsson *et al.* 2021; Harris *et al.* 2022).

However, due primarily to the multi-dimensional nature of both ecosystem pressures and ecosystem responses, quantifying ecosystem-based reference points or thresholds has proven difficult (Large *et al.* 2015). Ecosystem thresholds occur when a small change in a pressure causes either a large response or an abrupt change in the direction of ecosystem state or function. Complex numerical modelling that concurrently identifies thresholds for a suite of ecological indicator responses to multiple pressures is required to evaluate ecosystem reference points to support ecosystem-based management (Large *et al.* 2015).

The required data inputs into such models are currently limited in southern Africa. Slabbekoorn *et al.* (2019) point out that in such cases expert elicitation would be a useful method to synthesise existing knowledge, potentially extending the reach of explicitly quantitative methods to data-poor situations.

7.7 SOCIO ECONOMIC ENVIRONMENT

This section provides an overview of the national and regional context of the project's area of influence covering Western and Southern Cape coastline. This area encompasses the entire approximate coastline that extends between Saldanha Bay and Cape Agulhas and extends into the Northern Cape, Western Cape and Eastern Cape provinces of South Africa. In addition, greater focus is given to the areas which have been identified as possible onshore supply bases. The fishing sectors are discussed under Section 7.7.

7.7.1 Institutional Arrangements

South Africa is a parliamentary republic with a three branched system of government – comprising of the legislative (Parliament), executive (the president, ministers and their departments), and judiciary. The governemnt is also divided into three spheres, namely the national, provincial and local level.

South Africa is divided into nine provinces (with the indirect area of influence extending over the Eastern Cape, Western Cape and Northern Cape Provinces) and each province has its own executive and legislative branches. Local governments consist of either District Municipalities (which have shared powers with Local Municipalities) and Metropolitan Municipalities.

The functions of the District Municipalities primarily concern key service delivery areas such as water, sanitation, electricity, municipal health services and other district-wide functions, while also providing an overall co-ordination function between local municipalities. They are also ordinarily the competent authority for air quality, including the granting of AELs under the NEM: AQA. Local Municipalities play a key role in terms of integrated planning, town planning and basic service provision (including water, sanitation, public transport, infrastructure, etc.).

7.7.2 Administrative Structure

The various metropolitan, districts and local municipalities within the Project's indirect area of influence is shown in Figure 7-49 and Figure 7-50 and summarised in Table 7-13.

TABLE 7-13: COASTAL MUNICIPALITIES WITHIN THE PROJECT'S INDIRECT AREA OF INFLUENCE

Province	District Municipalities (Coastal only)	Local Municipalities (Coastal only)
Northern Cape	Namakwa	Richtersveld
		Nama Khoi
		Kamiesberg
Western Cape	West Coast	Matzikama
		Cederberg
		Berg River
		Saldanha Bay
		Swartland
	City of Cape Town (Metropolitan)	City of Cape Town
	Overberg	Theewaterskloof
		Overstrand
		Cape Agulhas
		Swellendam
	Garden Route	Kannaland
		Hessequa
		Mossel Bay
		George
		Knysna
		Bitou
Eastern Cape	Sarah Baartman	Kou-Kamma
		Kouga
	Nelson Mandela Bay (Metropolitan)	Nelson Mandela Bay

7.7.3 Settlement Distribution

The significant key populated areas include the City of Cape Town (a major metropolitan area and port), Nelson Mandela Bay Metropolitan Municipalities (a major metropolitan area and port), and Saldanha Bay (a secondary town and port), with the latter located in the West Coast District Municipality. The Namakwa District Municipality is located further from major metropolitan areas or major towns and is sparsely populated with much smaller coastal towns.

The City of Cape Town Metropolitan Municipality is densely populated metropolitan area, while the remainder of the West Coast coastline is characterised by sparse development with sporadic settlements and limited infrastructure. The exception is the West Coast Peninsula, which is located just over 100 km north of Cape Town. This area which includes the active port of Saldanha Bay, and several historic and fishing towns, including Vredenburg, Langebaan, Paternoster and St Helena Bay. Several other small towns are scattered along the coastline between Cape Town (in the south) and Alexandra Bay (in the north), which have small populations (averaging between 300 – 2000 people).

The Nelson Mandela Bay Metropolitan Municipality is densely populated, the number of coastal settlements found between Cape Town and Gqeberha (previously Port Elizabeth) are estimated to be 173; however, it is far more common for such settlements to extend in a linear fashion along the coastline.

7.7.4 Population Demographics

Both Cape Town (City of Cape Town Metropolitan Municipality) and Gqeberha (Nelson Mandela Bay Metropolitan Municipality) are major metropolitan areas in South Africa, which in 2019 support an estimated population of 4 131 722 and 1 207 485, respectively (Statistics South Africa, 2020). Cape Town is the second largest metropolitan area in South Africa (after Johannesburg), while Gqeberha is ranked fifth.

The population size (in 2020) of the respective coastal district municipalities between Cape Town and Gqeberha is estimated at 291 150 and 631 005 persons for the Overberg and Garden Route Municipalities, respectively (Western Cape Government 2017), while the Sarah Baartman District Municipality had 479 923 persons in 2016 (Sarah Baartman Municipality 2020). The population size of the entire West Coast District Municipality is estimated at 455 881 persons (West Coast District Municipality 2020) and the Namakwa District has an approximate population of 132 000 (Namakwa District Municipality 2020). Saldanha Bay Local Municipality has the second highest population in the West Coast District with a population size of 119 132 in 2019 (Saldanha Bay Local Municipality 2020).

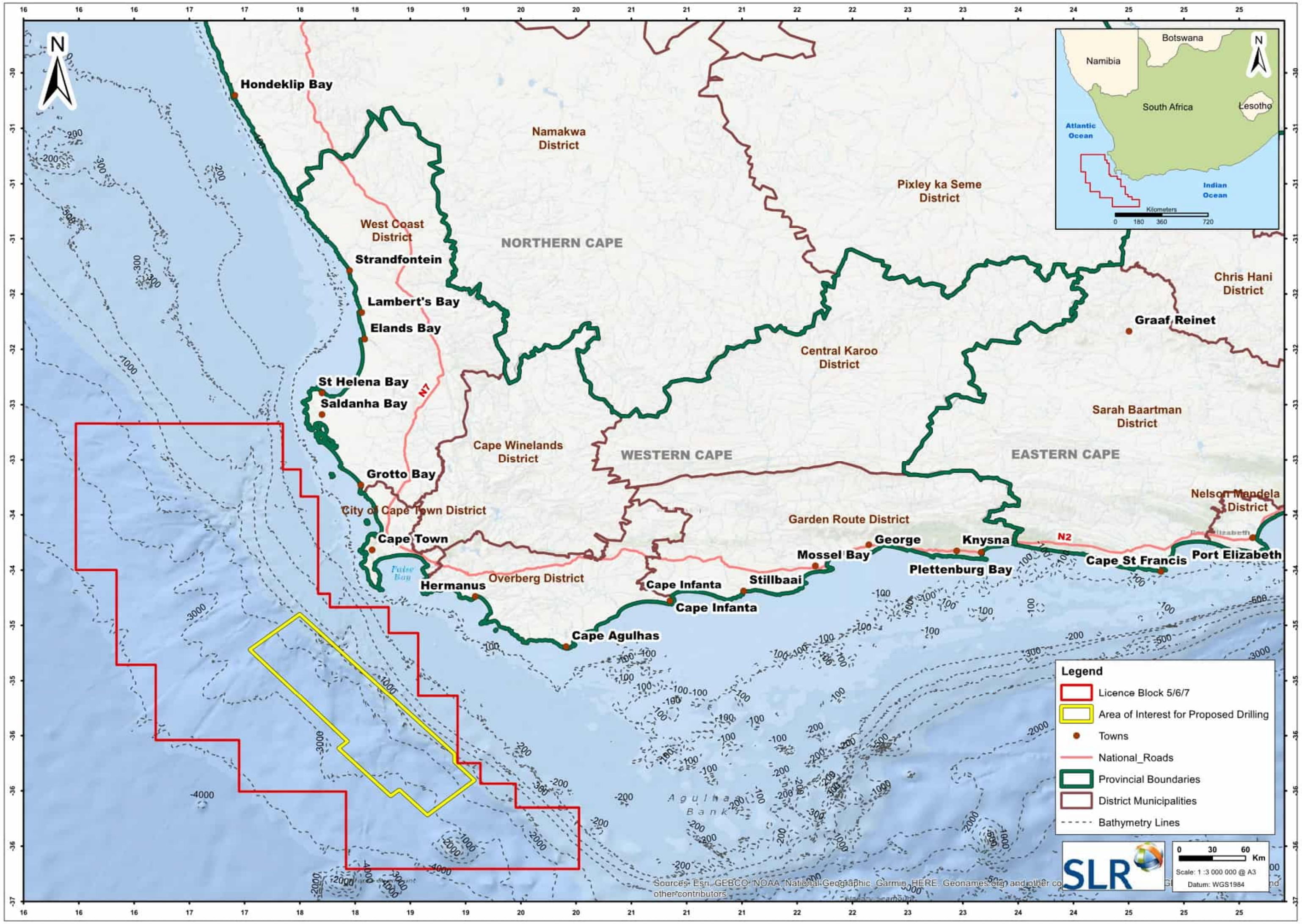

FIGURE 7-49: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO DISTRICTS, KEY CITIES AND TOWNS ALONG THE WEST, SOUTH-WEST AND SOUTH COASTS

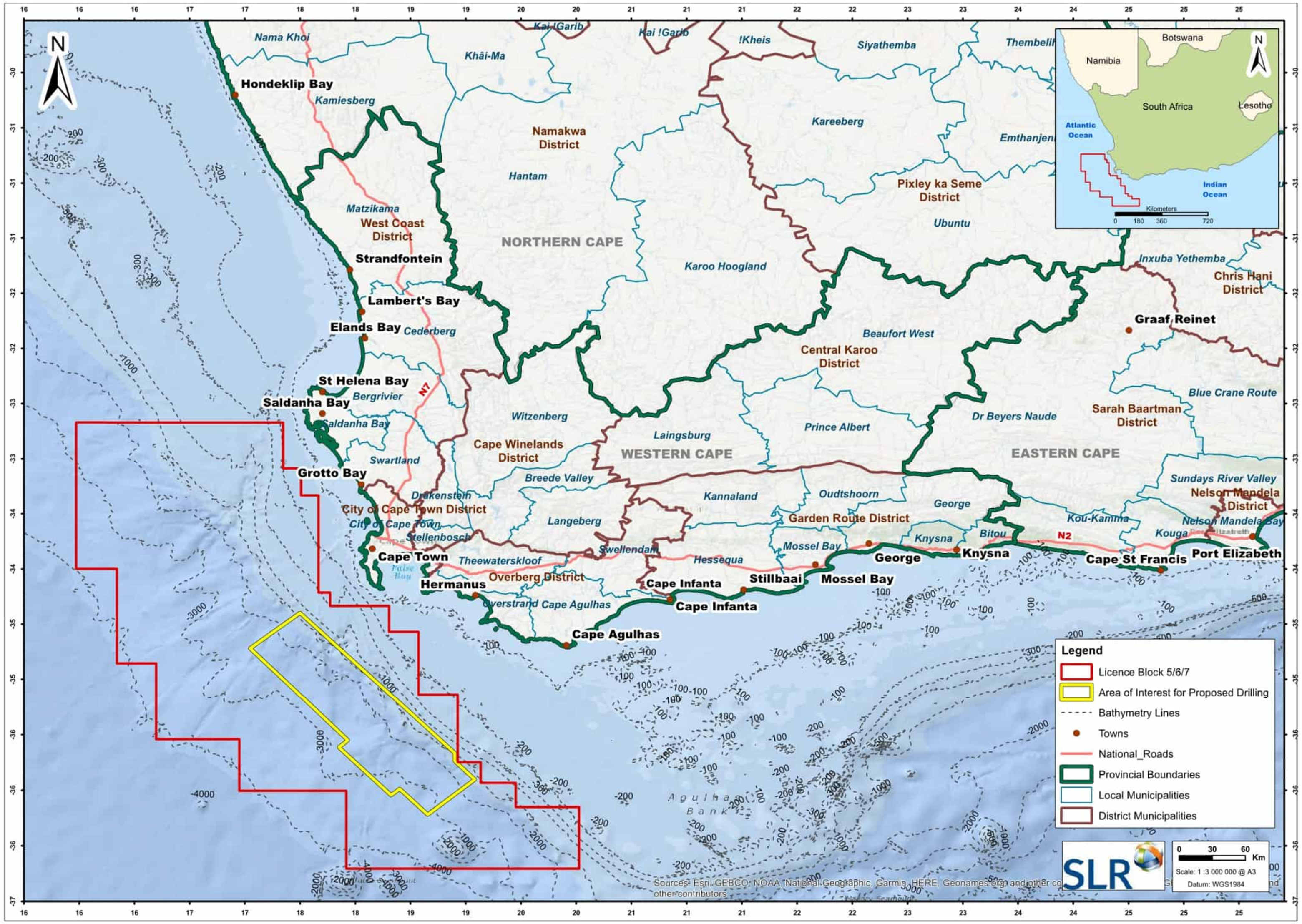

FIGURE 7-50: BLOCK 5/6/7 AND THE AREA OF INTEREST IN RELATION TO LOCAL MUNICIPALITIES, CITIES AND TOWNS ALONG THE WEST, SOUTH-WEST AND SOUTH COASTS

The population density of the City of Cape Town is estimated at 1 530 persons per square kilometre, while the Nelson Mandela Bay Metropolitan Municipality supports 646 people per square kilometre. The largely rural Namakwa District is the lowest at 1.1 persons per square kilometre with the Overberg, Garden Route West Coast and Sarah Baartman District Municipalities with 21, 25, 14.6 and 8 persons per square kilometre, respectively.

7.7.5 Age and Gender

The age cohorts for the study area are as set out in Table 7-14 (as per the 2016 Statistics South Africa Community Survey). The West Coast District, City of Cape Town and Western Cape reflect a similar distribution of the population through the age groups. The population of the Namakwa District and the Eastern Cape areas are home to a somewhat larger cadre of persons that are defined as slightly older than the West Coast District and Cape Town. This could be due to young people leaving the Eastern Cape and Northern Cape to find education and employment in more developed and populated areas such as Cape Town. The population profile within the study area is, on the whole, marginally older when compared to South Africa.

The national gender ratio for South Africa is 51% female and 49% male. Similar figures are noted for the Western Cape Municipalities with the City of Cape Town Metropolitan, West Coast District Municipality, Garden Route and Overberg District Municipality at 50.8% females and 49.2% males, 50.2% females and 49.8% males, 51.1% females and 48.9%, 50.1% females and 49.9% males, respectively.

The Eastern Cape Municipalities displayed similar trends with 52% females and 48% males for the Nelson Mandela Bay Metropolitan Municipality, and 52.1% females and 47.9% males for the Sarah Baartman District Municipality.

The Namakwa District, however, has a slightly higher proportion of males at 50.4% to 49.6% female (Statistics SA 2020). The reason for this may be due to the mining activities in the inland areas of district which would attract a higher proportion of men for employment.

TABLE 7-14: AGE AND GENDER PROFILE

Province	District	Percentage of Total Population			
		Children (0-14yrs)	Youth (15-34 yrs)	Adults (35-64 yrs)	Elderly (+65yrs)
Western Cape	City of Cape Town	26%	33%	34%	6%
	West Coast	26%	35%	33%	6%
	Garden Route	25.4	33.9	32.9	7.8
	Overberg	26.1	32.9	33.3	7.7
Eastern Cape	Nelson Mandela Bay	30.6	32.0	28.0	9.5
	Sarah Baartman	30.1	34.8	25.6	9.5
Northern Cape	Namakwa	22%	33%	31%	14%
South Africa		30%	36%	28%	5%

Source: Statistics SA 2020

7.7.6 Education

In terms of education, the distribution of educational attainment for the study area by those aged above 20 years of age is as set out in Table 7-15 (as recorded by the Statistics South Africa 2016 Community Survey).

The more densely populated urban centres of the Western Cape in the coastal districts of Garden Route and City of Cape Town, and in Nelson Mandela Bay, have a higher proportion of people who have completed secondary schooling or have a tertiary education than the population of the more rural Overberg and particularly the Sarah Baartman Districts. Only 25% of the population of the latter has completed secondary school compared to 35-36% in the more urbanised districts.

TABLE 7-15: EDUCATIONAL ACHIEVEMENT RATES

District	Percentage of Population Above the Age of 20					
	None	Incomplete Primary	Complete Primary	Incomplete Secondary	Complete Secondary	Higher
City of Cape Town	2.1	6.7	4.2	37.1	35.0	14.8
West Coast	12.2	22.7	5.6	31.7	19.6	6.1
Garden Route	3.0	11.2	5.9	36.1	34.7	9.2
Overberg	3.3	12.7	7.0	38.3	28.5	10.1
Nelson Mandela Bay	2.6	6.7	4.0	39.3	36.1	11.4
Sarah Baartman	5.2	15.9	4.7	41.5	24.6	6.0
Namakwa	4.4	12.6	8.1	39.4	24.0	9.1

Source: Statistics SA 2020

7.7.7 Employment

Unemployment and underemployment are chronic issues in South Africa. In the third quarter of 2016, the narrow unemployment rate for South Africa was estimated at 27.1% (Statistics South Africa 2020). However, including discouraged work seekers, this proportion rises to 36.3%. Although current estimates are not yet available, the unemployment rate is expected to rise significantly once the impacts of the COVID-19 lockdown are fully apparent. Current estimates are unreliable given the impact of lockdowns that increased the unemployment rate but were followed by relatively sharp rises in employment growth.

In the Western Cape, the recorded narrow unemployment rate for 2019 was 19.3% (Statistics South Africa 2020). For the City of Cape Town, the rate was estimated at 24.8% in 2019 (City of Cape Town 2020) and for West Coast District Municipality it was 10.7% in 2018 (West Coast District Municipality 2020). Unemployment for the Western Cape has been steadily rising over the last decade. In part this is due to in-migration of work seekers from other areas but is also linked to the poor performance of the national economy.

In the Eastern Cape, the unemployment rate is 28.1%, and the expanded rate is 41.3% (Statistics South Africa, 2020). At 13.2%, this gap between the official and expanded unemployment rates is higher than five other provinces due to the large number of discouraged work seekers in the province. Unemployment is over 50% in the Eastern cape for the age group 15 – 24 years. The overall unemployment rate in 2019 for Nelson Mandela Bay is estimated at 28.9% and for the Sarah Baartman DM it is estimated at 23%.

In the Northern Cape, the unemployment rate for the Namakwa District was 25% in 2018 (Namakwa District Municipality 2020).

7.7.8 Health

The 2016 Community Health survey covered a number of key health indicators. The full immunisation coverage rate[24] for children under the age of one in the City of Cape Town in 2016 was 82.2%, which is higher than the Western Cape rate of 79.9%. The immunisation rate in the Garden Route District declined marginally from 85% in 2014 to 83.7 % in 2016. The immunisation rate in Overberg District has decreased from 86.4% in 2015 to 71.5% in 2016. For Nelson Mandela Bay, the immunisation rate was recorded at 82.9% for the year 2016 and for Sarah Baartman District it was recorded as 79.9%. The full immunisation rate for children within the West Coast District is general low but increased from 54.3% 2017 to 59.1% in 2018 (Western Cape 2019). The rate of immunisation in the City of Cape Town is higher than the West Coast, but decreased slightly between 2017 and 2018 from 72.6 to 71.6 percent (Western Cape 2019).

The City of Cape Town achieved the Province's target of reducing neonatal deaths to 6 per 1 000 live births by 2019. The neonatal mortality rate for the Overberg District increased from 7.7 (per 1 000 live births) in 2014 to 10 in 2015, thereafter decreasing to 6.3 in 2016. Neonatal mortality in the Garden Route District decreased from 7.2 deaths per 1 000 live births in 2014 to 6.9 deaths per 1 000 live births in 2016. For Nelson Mandela Bay, the neonatal mortality rate was recorded at 6.6 per 1 000 for the year 2016 and for Sarah Baartman District it was recorded as 9.9 per 1000. The neonatal mortality rate (per 1 000 live births) improved from 9.2 in 2017 to 6.4 in 2018 within the West Coast District; however, remained high and increased for this period from 9.1 to 9.6 in the City of Cape Town (Western Cape 2019). The low birth weight indicator increased slightly from 13.4% in 2017 to 13.8% in 2018 in the West Coast District, while the City of Cape Town remained constant at 13.9% (Western Cape 2019).

A total of 14% of all babies born in the City of Cape Town and the Western Cape as a whole in 2016 were considered to be underweight. Approximately 12% of all babies born in the Overberg District facilities were born with low birth weight; the lowest for all districts recorded in 2016. The low birth weight indicator for the Garden Route District improved from 16.0% in 2014 to 14.6% in 2016. For Nelson Mandela Bay, the low birth weight indicator rate was recorded at 14.5% for the year 2016 and for Sarah Baartman District it was recorded as 14.8%.

The malnutrition rate for the City of Cape Town was recorded as 1.8% for 2018. In the Garden Route District, the malnutrition rate decreased from 3.8 % in 2014 to 3.5 % in 2016. Overberg's malnutrition rate worsened from 1.5 (per 1,000 children) in 2014 to 2.4 in 2015 and subsequently improved to 1.6 in 2016. The number of malnourished children under the age of five in the West Coast District in 2017 was 1.7 per 100 000 persons, worsening to 2.1 in 2018, whereas malnutrition improved slightly for this period from 1.2 to 1.1 in the City of Cape Town (Western Cape 2019).

HIV/AIDS and Tuberculosis (TB) are considered the two of the most significant health issues affecting adults (and therefore the labour force) within South Africa, and specifically the Western Cape. Access to treatment, such as

[24] This indicator shows the percentage of children younger than one year who are fully immunised. "Full immunisation" refers to children having received all the required doses of vaccines given in the first year of life (Source: http://childrencount. uct.ac.za/indicator.php?domain=5&indicator=28).

antiretroviral treatments (ART), assist with improving quality and length of life for a number of patients living with HIV.

The West Coast District had 43 ART clinics/treatment site and 11 255 registered patients receiving treatment (Western Cape 2019). The total number of patients receiving ARTs increased significantly from 2017 to 2018 by a total of 1053 patients (or 10%); however, the number new patients receiving ARTs decreased by 7% (from 2015 to 2018), potentially indicating a decrease in the number of HIV infections or that less people are being tested (Western Cape, 2019).

TB is closely related to HIV and AIDS and accounted for 7.6% of premature deaths within the Western Cape in 2016 (Western Cape, 2019). In the West Coast District, patients with TB accounted for 8.8% (3,611) of the total patient load within the Western Cape and were treated at 75 TB clinics or treatment centres around the District (Western Cape, 2019).

With respect to health facilities, the West Coast District had 62 primary healthcare clinics in 2018, 7 district hospitals, and one community day centre (Western Cape, 2019). Whereas the City of Cape Town had a total number of 132 primary healthcare facilities – 81 fixed primary healthcare clinics, 42 community day centres as well as 9 community health centres (Western Cape 2017).

7.7.9 Poverty Rates

The deteriorating financial health of households and individuals under the weight of economic pressures, specifically between 2011 and 2015, has resulted in an increase in the poverty levels, according to the Poverty Trends in South Africa in 2017 (Funding Practice Alliance 2017). This has been exacerbated by the 2020/2021 COVID-19 pandemic and its impacts, but the consequences are not yet statistically correlated. The report cites rising unemployment levels, low commodity prices, higher consumer prices, lower investment levels, household dependency on credit, and policy uncertainty as the key contributors to the economic decline in recent times. Poverty levels were generally regarded as not improving in the study area in general.

The upper poverty line is defined by StatsSA as the level of consumption at which individuals are able to purchase both sufficient food and non-food items without sacrificing one for the other. This variable measures the number of individuals living below that particular level of consumption for the given area and is balanced directly to the official upper poverty rate as measured by StatsSA. For 2019, the upper bound poverty line was defined as R1 227 per person per month (Statistics SA 2019).

The Western Cape has the lowest upper poverty line head count of 33.2% compared to the national average for 2016 of 49.2%. In 2016, there were 640 000 people living in poverty in the Nelson Mandela Bay Metropolitan Municipality, with a 15.98% increase in poverty rates since 2006. However, as a percentage of the total population (considering population growth) people living in poverty have decreased from 50.89% to 50.70% between 2006 and 2016.

The National Development Plan has set a target of reducing income inequality in South Africa from a Gini coefficient[25] of 0.7 in 2010 to 0.6 by 2030. In 2016 it was recorded nationally as being 0.628. The Cape Town City Gini coefficient is 0.61 (2016). Available figures indicate that the Overberg District's income inequality has steadily increased from 2011 onward, reaching 0.60 in 2016. Income inequality has increased in the Garden Route District between 2010 and 2016, probably due to the decline in economic performance during that period. Income inequality in the West Coast District has increased between 2012 and 2018, with the Gini coefficient increasing from 0.560 in 2012 to 0.595 in 2018 (Western Cape 2019).

The Gini coefficient for the Garden Route District was estimated to be 0.61 in 2016. In 2016, the Gini coefficient in Nelson Mandela Bay Metropolitan Municipality was at 0.628, which reflects a marginal increase in the number over the ten-year period from 2006 to 2016. The Eastern Cape Province had a Gini coefficient of 0.617. The Gini Coefficient for the Sarah Baartman District was recorded as being 0.609 for 2016.

The Gini coefficient for the Namakwa District was 0.566 in 2018, however this remains largely favourable compared to the larger Northern Cape Province and South Africa in general, as both had a more unequal spread of income amongst their residents (at 0.604 and 0.63 respectively) (Namakwa District Municipality 2020).

7.7.10 Economic and Industrial Profile

The City of Cape Town's economy contributed 71.8 % to the Western Cape's total Gross Domestic Product (GDP) in 2016. The national economy maintained an average annual growth rate of 2.9% since 2005, whereas the Western Cape's growth across this period was 3.0%. The largest contributor to GDP within the Metro in 2015 was the Tygerberg planning district, an area dominated by finance, insurances, real estate, and business services. The fastest growing area within the City of Cape between 2005 and 2015 was the Blaauwberg planning district, growing at a rate of 4.2% which was considerably higher than the Metro's average across the same period. Overall, the primary sector contributed only 1.5% of the GDP for the City of Cape Town in 2015 (with agriculture, forestry and fishing being 1.3%). The secondary sector (mostly manufacturing) contributed 23.6% of the GDP. The tertiary sector contributed 74.9% with finances and insurances, as well as real estate making up 27.8%. This was followed by wholesale, retail, catering and accommodation (16.9%).

The West Coast District contributed 5.2 % (R29.8 billion) to the Western Cape's economy in 2017 (West Coast District 2020). The top three contributors to the District GDP in 2019 were (1) agriculture, forestry and fishing (20.9% of District GDP), (2) manufacturing (21.4% of District GDP), and (3) wholesale, retail trade, catering and accommodation (15.2% of District GDP) (West Coast District Municipality 2020). Combined, these three sectors contributed R17.1 billion (or 57.5%) to the West Coast District's economy, estimated to be worth R29.812 billion in 2017 (West Coast District Municipality 2020). The trend between 2008 and 2017 shows that the agriculture, forestry and fishing sector registered the highest annual average growth rates (4.3%), followed by the construction sector (3.4%) and the and the finance, insurance, real estate and business services sector (3.2%) (West Coast District Municipality 2020). The primary direct economic benefits of coastal resources within the West Coast District include port activities within the Saldanha Bay Port, small scale fisheries, recreational fishing and coastal tourism (West Coast District Municipality 2019).

[25] The Gini coefficient is a measure of statistical dispersion intended to represent the income inequality or wealth inequality within a nation or any other group of people.

The Overberg District is the Western Cape's second smallest economy with a 3.5% contribution to the Provincial GDP in 2015. The top three economic sectors are clustered in the tertiary and secondary economic sectors, and include the finance, insurance, real estate and business services, the wholesale and retail trade, catering and accommodation and the manufacturing sectors. The primary sector contributed 9.9% with the secondary sector 23.8% (mostly manufacturing) and the tertiary sector 66.3%.

In 2015, the Garden Route District contributed just over 10% to the Western Cape GDP, with the size of the economy estimated at about R40 billion. The local economy of the Garden Route District grew by 3.2 % per annum between 2005 and 2015, driven by the tertiary sector, especially the finance and business services sector and construction. Between 2010 and 2015 the finance and business services sector reported a 4.2% average annual growth rate while construction slowed down to 1.3 % on average during the same period. The primary sector contributed 11.1% with the secondary sector 17.7% (mostly manufacturing) and the tertiary sector 71.2%. The tertiary sector is driven by wholesale, retail, catering, and accommodation enterprises.

With a GDP of R 120 billion in 2016 (up from R 52.3 billion in 2006), the Nelson Mandela Bay Metropolitan Municipality contributed 51% to the Eastern Cape Province GDP of R 338 billion. The community service sector (largely government services) contributed 24% of the GDP followed by finance (23%,) manufacturing (with the automotive industry a key component) at 19% and retail and wholesale trade making up 17%.

In the Sarah Baartman District, the 2016 GDP was R 21.6 billion. The largest contributor was community services accounting for R 6.4 billion (29.6%) followed by retail and wholesale trade making up 21.8% and then finances (16.4%).

The Namakwa District Municipality contributed only 11% to the Northern Cape Province GDP with the main economic sectors being agriculture and tourism, with potential for growth in the mining and aquaculture sectors (Namakwa District Municipality 2020).

7.7.11 Tourism and Recreation

The wider project area falls into the broadly termed City of Cape Town, Cape Overberg, and Garden Route (Mossel Bay to Knysna) regional tourism areas in the Western Cape, and the Jeffrey's Bay to Gqeberha region in the Eastern Cape.

Both domestic and international tourism is a central economic activity for the Western Cape Province, the City of Cape Town, and the South Coast. The province supported 1.6 million international tourist arrivals in 2016, and 2.1 million from the domestic tourism market. This resulted in a total generated income of R 18.1 billion in foreign spend and R 2.5 billion in domestic tourism spend (WESGRO N.D.). This has declined dramatically since the COVID-19 pandemic has restricted tourist traffic and foreign tourism in the year March 2020 – March 2021 was virtually nil.

Cape Town has a relatively high share of domestic tourists (67%) compared to international tourists (32%), while the Cape Overberg and the Garden Route show a relatively even split between domestic and international tourists (WESGRO N.D.).

Across all three regions the top tourism and recreational activities include outdoor activities, scenic drives, visits to national parks, culture and heritage, beaches, food and wine. Coastal tourism and recreational activities and services are extensive along the entire South Coast largely in response to both international and domestic tourism demand.

Coastal tourism and recreational activities and services are found primarily in and around Cape Town, while the Langebaan/Saldanha Bay area has the second highest concentration of tourism activities. Small pockets of coastal tourism are found scattered along the entire length of the west coast in small towns dotted along the coastline. The Port of Cape Town contains the Victoria and Albert Waterfront (V&A Waterfront), which is a major international tourism and recreational destination. The Waterfront supports multi-use shopping, marine recreation and tourism activities through an estimated 396 businesses and the employment of 23 000 people (V&A Waterfront 2018). It also plays host to an average of 1.7 million visitors per month, which increases to over 2.5 million during the summer months and peak domestic and international tourist seasons.

Coastal destinations within the West Coast District attract 26.3% to 31.3% of foreign tourists visiting the West Coast area, and 68.7% to 71.7% of domestic tourists (West Coast District Municipality 2019). Key coastal activities include whale watching, water sports at Langebaan Lagoon, and scenic drives and views. The cold Atlantic Ocean waters and often severe weather means that swimming and other water sports (outside of the protected Langebaan Lagoon) are scarce.

With respect to the Cape Overberg and Garden Route regions, the coastline will play a central role in promoting key recorded activities (WESGRO N.D.) including scenic drives (~21-45% of recorded activities), outdoor activities (~21- 36% of recorded activities), whale watching (15% of recorded activities), beaches (~11-16% of recorded activities) cruises (9% of recorded activities) and other activities such as fishing and shark cage diving (~11-22% of recorded activities).

The tourism market in the Eastern Cape Province is less developed when compared to the Western Cape Province. It, however, remains a key economic sector with a total tourism spend of R 12 billion in 2016 and an average annual growth rate of 2.6% over the period, compared to South Africa which has an average annual growth rate of 7.7%.

While the Western Cape's tourism numbers have grown year on year, in both districts of the Eastern Cape, tourism has declined between 2008 and 2016, although the number of international visitors showed a slight increase in the order of 1.75%. Total tourism spend over the ten year period from 2006 to 2016 increased more in the Sarah Baartman District Municipality than in Nelson Mandela Bay with an annual average increase of 4.1% (from R 1.69 billion to R 2.52 billion) versus 1.7% (from R 2.7 billion to R 3.2 billion), respectively, compared to the national increase of 7.7%.

There is extensive tourism and recreational attractions along the entire South Coast. In pure numbers, most activities are concentrated around the City of Cape Town; however, the entire coastline supports both international and domestic tourism and additional facilities will be found at all major towns. A broad distribution map of tourism attractions is provided in Figure 7-51.

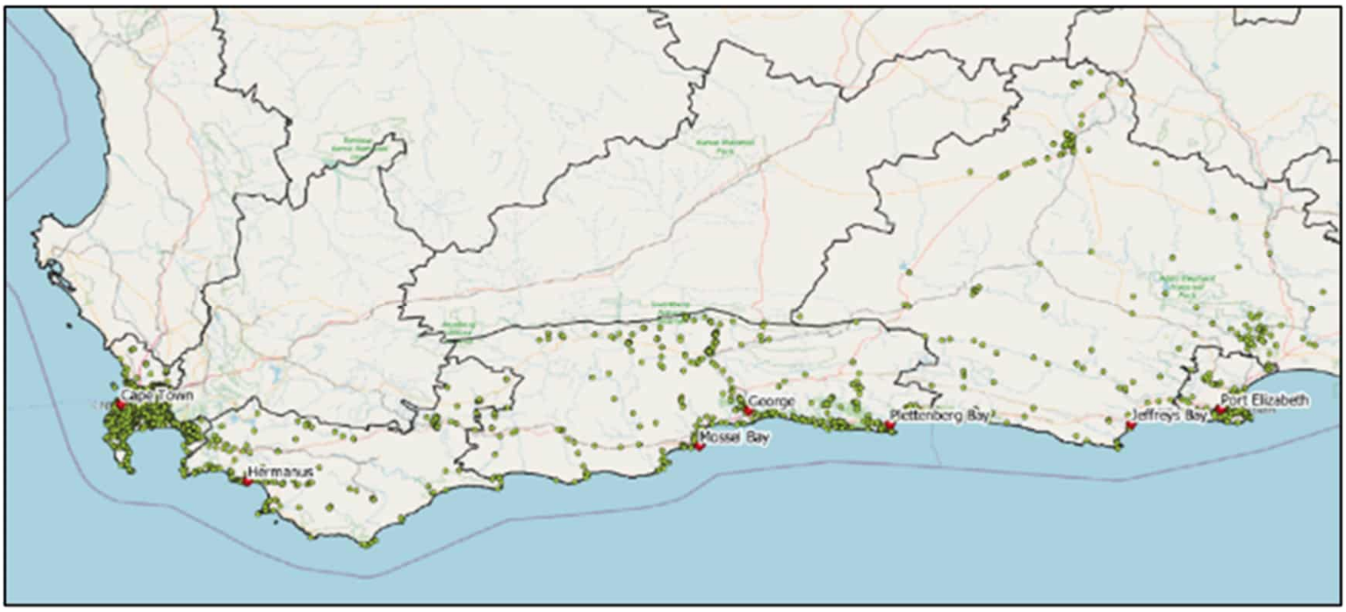

FIGURE 7-51: BROAD DISTRIBUTION OF TOURISM AND RECREATIONAL FACILITIES
Source: OpenStreetMap

The South Coast is also well known for its swimming and recreational beaches that are found along the entire coastline. The most populated beaches are linked to local town centres; however, the entire coastline is accessible and extensively used by local residents and tourists for sunbathing, walking, swimming, diving and onshore fishing.

In addition, boat cruises, whale watching, shark cage diving and offshore recreational fishing, as noted earlier, are important activities along the entire coastline and are undertaken as both personal recreation, as well as commercial operators. There is no definitive list of such commercial operators, however they will be widely distributed along the entire coast. Commercial operators will likely be found at formal clubs (including multiple clubs in Saldanha Bay, Langebaan, Cape Town, Hermanus, Mossel Bay, George, Knysna, and Gqeberha). Private recreational fishers will however be able to access the coastline from multiple registered boat-launch sites along the coast.

The tourism market in the Northern Cape Province is less developed, but is one of the fastest growing contributors to the province's economy with an annual tourism spend of R850 million in 2013 (Northern Cape 2018). The Namakwa District, with its sparse population and small towns attracts the more adventurous tourists. Inland attractions, such as the wildflowers in the spring, geological and historical landmarks, and cultural features are key for tourism in this area, as the cold and windy coastline deters people from coastal recreational activities. Costal tourism is limited to the fishing towns of Hondeklipbaai, Kleinzee and Port Nolloth. Large distances between centres and a lack of infrastructure, tourist attractions and activities hinder active tourism growth in this area.

7.7.12 Private / Public Services, Facilities and Roads

The West and South Coasts outside of major metropolitan or urbanised areas is generally poorly serviced in terms of both public and private services and facilities, including as road networks. The City of Cape Town and the Saldanha Bay are exceptions. As major metropolitan area, the City of Cape Town is well serviced, with a good standard of infrastructure and facilities (see Figure 7-52 and Figure 7-53). Saldanha Bay has roads and public infrastructure around the main centre and immediately neighbouring towns on the West Coast Peninsula. Further north, however, the level of infrastructure declines significantly, with only major arterial roads and unpaved secondary roads servicing the sparsely populated region. The small settlements along the coast have some limited services, such as post offices and police stations, however, these types of services are sporadic.

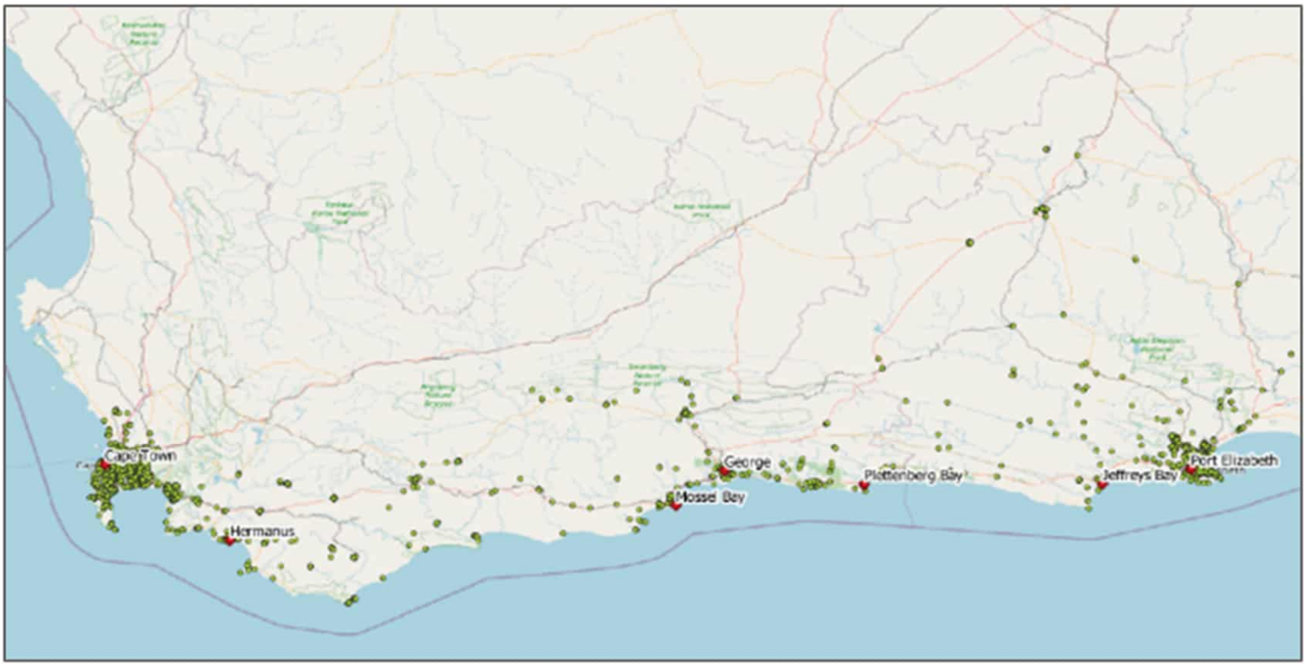

FIGURE 7-52: BROAD DISTRIBUTION OF PRIVATE AND PUBLIC SERVICES
Source: OpenStreetMap

FIGURE 7-53: ROAD NETWORK
Source: OpenStreetMap

7.7.13 Ports

TEEPSA proposes to use either the port of Cape Town or Saldanha Bay for the provision of supplies. The general characteristics of these ports is presented below.

7.7.13.1 Port of Cape Town

The Port of Cape Town is one of eight commercial seaports in South Africa and is operated by TNPA. The Port primarily supports the shipment of containerised and bulk goods with an installed capacity to handle 1.1 million TEUs[26] of containers per annum, as well as an additional 2.1 million tonnes of dry bulk, 1.5 million tonnes of break bulk, and 3.4 million kilolitres of liquid bulk per annum (Transnet, 2019). The handling of bulk goods is supported across 18 berths at the Port.

The Port also plays a key role in supporting local commercial fisheries including several commercial fishing rights holders that include inshore and offshore demersal trawl fisheries. The Port of Cape Town includes berthing for fishing vessels, as well as the Cross Berth Cold Storage that handles the import and storage of fresh and frozen fish and fish products (Ports Regulator 2015/2016).

7.7.13.2 Port of Saldanha Bay

The Port of Saldanha Bay handles two major commodities, namely iron ore (export) and crude oil imports, which makes the port the primary dry bulk and liquid bulk for the Northern and Western Cape Provinces (Transnet 2019). The port handles approximately 70 million tonnes of cargo per annum of which approximately 86 % is the export of iron ore (Transnet 2019).

The Port of Saldanha Bay is a natural deep-water harbour, which consists of a 3 km long, man-made causeway which splits the port into Big Bay on the eastern side and Small Bay on the west (Transnet 2019). The layout includes:

- An iron ore stockyard and the reclamation dam located on the Big Bay coastline and a Mossgas Quay is located on the Small Bay coastline.
- The main jetty structure located at the end of the causeway consists of the dry bulk and liquid bulk terminals.
- The Break Bulk Terminal and the Offshore Supply Base are located directly north of the dry bulk terminal, on the causeway which connects with the shore.
- The Small Craft Harbour is located further westwards and is connected to Marcus Island by means of an artificial breakwater.
- An LPG facility, including a multi-buoy mooring, and a sub-sea and land-based sub-surface pipeline connected to a storage facility outside port limits.

There are a number of initiatives underway to support the ports viability and growth in the market. The strategic objectives for the Port of Saldanha is to leverage the port's competitive advantages based on a Phase 2 iron ore expansion berth, the reconfiguration of the oil jetty, the development of an offshore supply base, the

[26] A TEU (twenty-foot equivalent unit) is a measure of volume in units of twenty-foot long containers.

development of the Mossgas jetty marine manufacturing facility, and the provision of one new berth for ship repair facilities (Transnet 2019).

7.7.14 Human Rights

South Africa has a well-established and globally recognised Constitution and institutions dedicated to the protection of human rights (specifically the Human Rights Commission). Human rights are primarily framed under Chapter 2 – Bills of Right in the Constitution, and it is ingrained in all laws promulgated that they must be consistent with the Constitution. The Human Rights Commission Act of 1994 establishes a legal commission to monitor - pro-actively and by way of complaints brought before it - violations of human rights and redress for such violations.

South Africa's Human Rights Commission has a history of active protection and monitoring of human rights notably with respect to large and high-profile developments such as mining. In addition, with a very active legal industry and strong social and formal media presence, South Africans are sensitive and responsive to potential human rights abuses and the collective knowledge around the package of rights is well understood. South Africa has an extremely empowered civil society that is well acquainted with human right's issues and the means by which redress can be pursued. The media in South Africa operates in a free, albeit proactively self-regulated, manner.

Under the Constitution, which requires the protection of the environment and human health as a fundamental right (Article 24 of the Bill of Rights) any significant pollution event can potentially be construed as a human rights violation. This would depend on the nature of such event and impacts posed to affected persons and the extent to which reparations are managed. While no human rights impacts are expected from day-to-day operations of the project activities, pre-existing resistance to the oil and gas sector in general that ignites mass opposition against the proposed exploration activities may also be construed as a human rights related issue.

7.7.15 Labour Rights

South Africa also has strict labour laws that are enforced by the State, labour unions, and local NGO's. Unfair labour practices are frequently challenged and upheld through the work of the Council for Conciliation, Mediation and Arbitration (CCMA). Under national labour law, basic employment rights (including minimum wage, working hours, unfair labour practice, working conditions, occupational health, and safety) are in place as well as the right to collectively organise. The role of collective bodies and unions have substantive political power in South Africa and have a very strong profile in terms of active protection and monitoring of labour rights notably with respect to large and high-profile developments and private entities.

South Africa's strong labour rights profile is founded on well-established national constitution and labour laws, which in turn are largely aligned with International Labour Organisation (ILO) conventions. ILO conventions to which South Africa is a signatory are listed in Section 2.3.

The risks associated with TEEPSA operations with respect to potential human and labour rights abuses are considered low provided that there is compliance with South African legislation and the ILO conventions. The activities do not require expropriation of any land or assets, or displacement of people or communities from any private or common resources.

7.7.16 Civil Society

Civil society is an umbrella term for a community, groups of people or organisations that represent a wide range of interests and normally operate outside of the government or private spheres. South Africa has a long and continuing history of strong civil society that covers both social and environmental interests and as of 2020 there were an estimated 228 822 Non-Profit Organisations (NPOs) registered in South Africa, of which 23 492 registered in the Western Cape (Parliamentary Monitoring Group[27]).

Civil society groups and non-profit organisations have a powerful social media profile and are able to form and coalesce around particular interests. Such groups do not necessarily function in specific areas, but many will have an international, national and local presence with offices in the major metropolitan areas. This includes organisations such as the World Wildlife Fund (WWF), SANBI, Wildlife and Environment Society South Africa (WESSA), Birdlife Africa, and WildTrust, as well as numerous academic and private institutions. While not locally based, such groups are expected to have substantial interest in the exploration activities as well as general oil and gas sector development in the future.

7.8 FISHERIES ACTIVITIES

South Africa has a coastline that spans two ecosystems over a distance of 3 623 km, extending from the Orange River in the west on the border with Namibia, to Ponta do Ouro in the east on the Mozambique border. The western coastal shelf has highly productive commercial fisheries similar to other upwelling ecosystems around the world, while the East Coast is considerably less productive but has high species diversity, including both endemic and Indo-Pacific species.

Approximately 14 different commercial fisheries sectors currently operate within South African waters and are all active in the indirect area of influence, including:

- Demersal trawl;
- Mid-water trawl;
- Hake demersal longline;
- Shark demersal longline;
- Small pelagic purse-seine;
- Large pelagic longline;
- Tuna pole;
- Traditional line fish;
- West Coast rock lobster;
- South Coast rock lobster;
- Squid jig;
- Small-scale fisheries;
- Beach-seine and gillnet fisheries (netfish); and
- Aquaculture / Mariculture (including abalone, mussels, oysters, seaweed and finfish).

Each of these sectors, as well as fisheries research, recreational and illegal fishing, are described in more detail

[27] https://pmg.org.za/committee-meeting/30312/

below (note: catch and effort data were sourced from DFFE by CapMarine).

Most commercial fish landings must take place at designated fishing harbours. For the larger industrial vessels targeting hake, only the major ports of Saldanha Bay, Cape Town, Mossel Bay and Gqeberha are used. On the West Coast, St. Helena Bay and Saldanha Bay are the main landing sites for the small pelagic fleets. Smaller fishing harbours on the West / South-West Coast include Port Nolloth, Hondeklipbaai, Laaiplek, Hout Bay and Gansbaai harbours. On the East Coast, Durban and Richards Bay are deployment ports for the crustacean trawl and large pelagic longline sectors.

7.8.1 Demersal Trawl

Demersal trawl is South Africa's most valuable fishery accounting for approximately half of the income generated from commercial fisheries. The fishery is separated into an offshore sector targeting deep-water hake (*Merluccius paradoxus)* and an inshore sector targeting shallow-water hake (*M. capensis*) and Agulhas sole (*Austroglossus pectoralis*). Secondary species include a large assemblage of demersal fish of which monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*) are the most commercially important. The wholesale value of catch landed by the inshore and offshore demersal trawl sectors, combined, during 2017 was R3.982 Billion, or 40.5% of the total value of all fisheries combined. The 2021 Total Allowable Catch (TAC) for hake is set at 139 109 tonnes, of which 84% and 6% is allocated to the offshore and inshore trawl sectors, respectively (the remaining 10% is allocated to the hake demersal longline sector).

The fishery is restricted by permit condition to operating within the confines of an area of approximately 57 300 km^2 and 17 000 km^2 for the offshore and inshore fleets, respectively.

The **offshore fishery** is comprised of approximately 45 vessels operating from most major harbours on both the West and South Coasts where the fishing grounds extend in a continuous band along the shelf edge between the 200 m and 1 000 m bathymetric contours. Most effort occurs in water of depth between 300 m and 600 m. Monk-directed trawlers tend to fish shallower waters than hake-directed vessels on mostly muddy substrates. Trawl nets are generally towed along depth contours (thereby maintaining a relatively constant depth) running parallel to the depth contours in a north-westerly or south-easterly direction. Trawlers also target fish aggregations around bathymetric features, in particular seamounts and canyons, where there is an increase in seafloor slope and in these cases the direction of trawls follow the depth contours. The deep-sea trawlers may not fish in waters shallower than 110 m or within five nautical miles of the coastline.

The **inshore fishery** consists of approximately 31 vessels, which operate on the South Coast mainly from the harbours of Mossel Bay and Gqeberha. Inshore grounds are located on the Agulhas Bank and extend towards the Great Kei River in the east. Vessels also target sole close inshore between Struisbaai and Mossel Bay, between the 50 m and 80 m isobaths. Hake is targeted further offshore in traditional grounds between 100 m and 200 m depth in fishing grounds known as the *Blues* located on the Agulhas Bank.

Otter trawling is the main trawling method used in the South African hake fishery. This method of trawling makes use of trawl doors (also known as otter boards) that are dragged along the seafloor ahead of the net, maintaining the horizontal net opening (see Figure 7-54). The configuration of trawling gear is similar for both offshore and inshore vessels; however, inshore vessels are smaller and less powerful than those operating within the offshore sector. The offshore fleet is segregated into wetfish and freezer vessels, which differ in terms of the capacity for the processing of fish at sea and in terms of vessel size and capacity. While freezer vessels may work in an area for up to a month at a time, wetfish vessels may only remain in an area for about a week before returning to port.

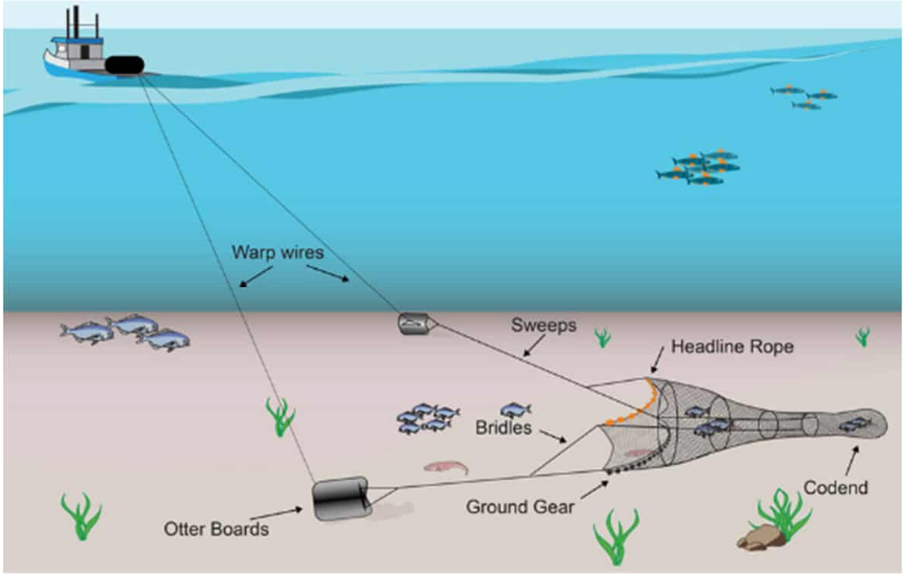

FIGURE 7-54: TRAWL GEAR TYPICALLY USED BY DEMERSAL TRAWLERS TARGETING HAKE
Source: http://www.afma.gov.au/portfolio-item/trawling

Figure 7-55 shows the demersal trawling effort in relation to Block 5/6/7 and Area of Interest for proposed exploration drilling area.

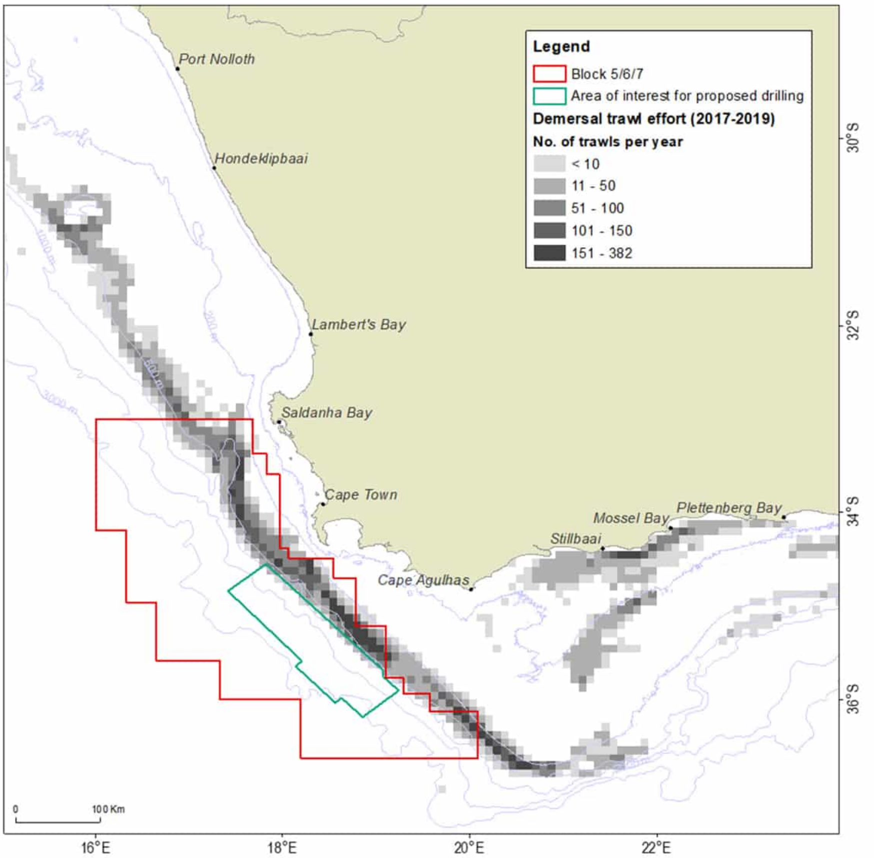

FIGURE 7-55: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF DEMERSAL TRAWL EFFORT (2017-2019)
Note: effort is shown as the number of fishing hours at a gridded resolution of 5x5 minutes (each grid block covers an area of approximately 86 km^2). Source: CapMarine

Block 5/6/7 coincides with demersal trawling grounds extending offshore from Saldanha Bay to Cape Agulhas at a depth range of approximately 200 m to 980 m, which equates to 15 403 km^2 of trawling ground (i.e. 26.88% of the total extent of the offshore demersal trawling footprint within the South African EEZ). **Over the period 2017 to 2019, an average of 14 767 trawls per year were reported within the licence block area yielding 47 238 tonnes of catch. This is equivalent to 38.37% and 39.76% of the overall effort and catch, respectively, reported nationally by the sector.**

The Area of Interest for proposed exploration drilling is situated offshore of the main trawl grounds in the area; however there the area does coincide with the outer depth range of fishing effort. **The Area of Interest for proposed exploration drilling covers 364 km^2 of trawling ground, which amounts to 0.64% of the total extent of the offshore demersal trawling footprint within the South African EEZ. Over the period 2017 to 2019, an average of 60 trawls per year were reported within the proposed drilling area yielding 317 tonnes of hake. This is equivalent to 0.16% and 0.27% of the overall effort and catch, respectively, reported nationally by the sector.** The area coincides with a number of commercial grid blocks which has a maximum reported trawling depth of 773 m (see Figure 7-56). Although the fishery operates continuously throughout the year, effort within the Area of Interest for proposed exploration drilling shows a **seasonal trend of higher effort in December and over the period April to August than during the remaining months** (see Figure 7-57).

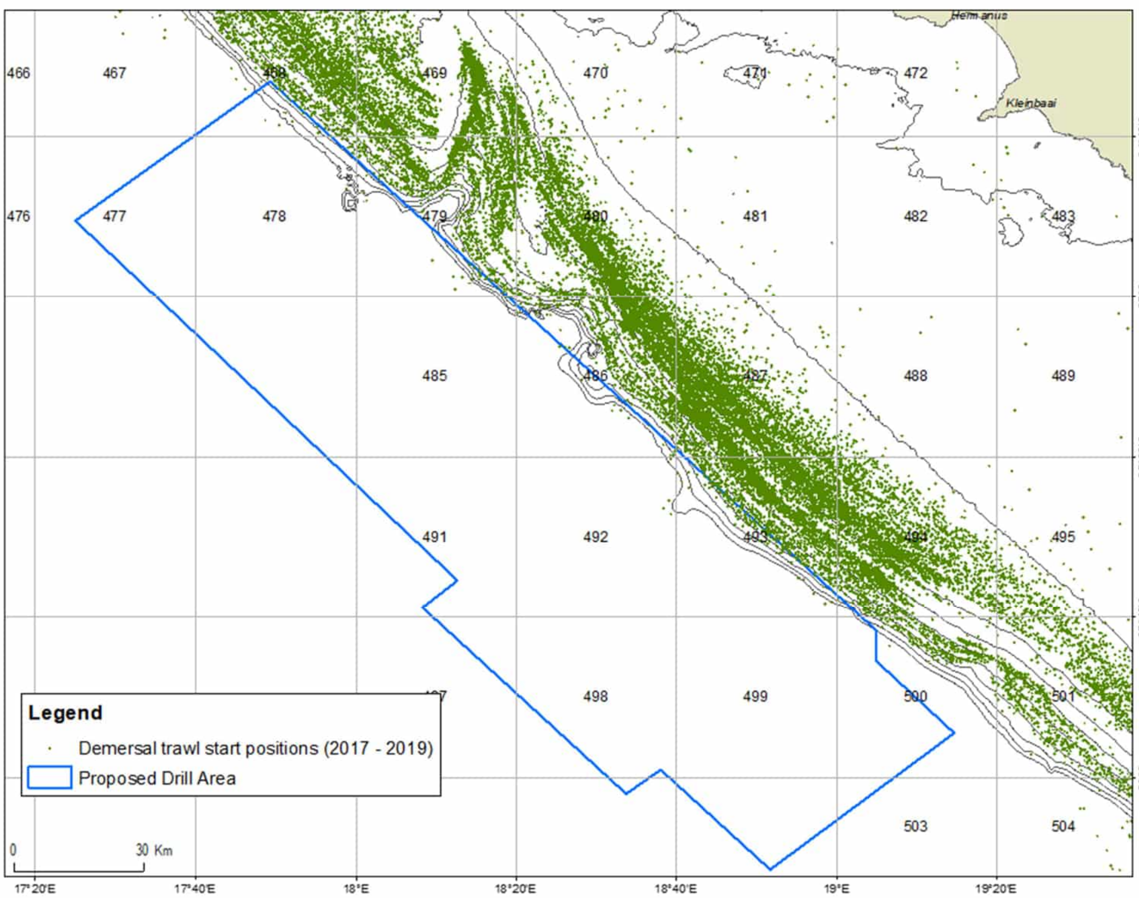

FIGURE 7-56: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF DEMERSAL TRAWL EFFORT (2017-2019)

Note: The location of the start of each trawl over the period 2017 to 2019 is shown in respect to commercial grid blocks (labelled). Depth contours indicated (100 m to 1 000 m).
Source: CapMarine

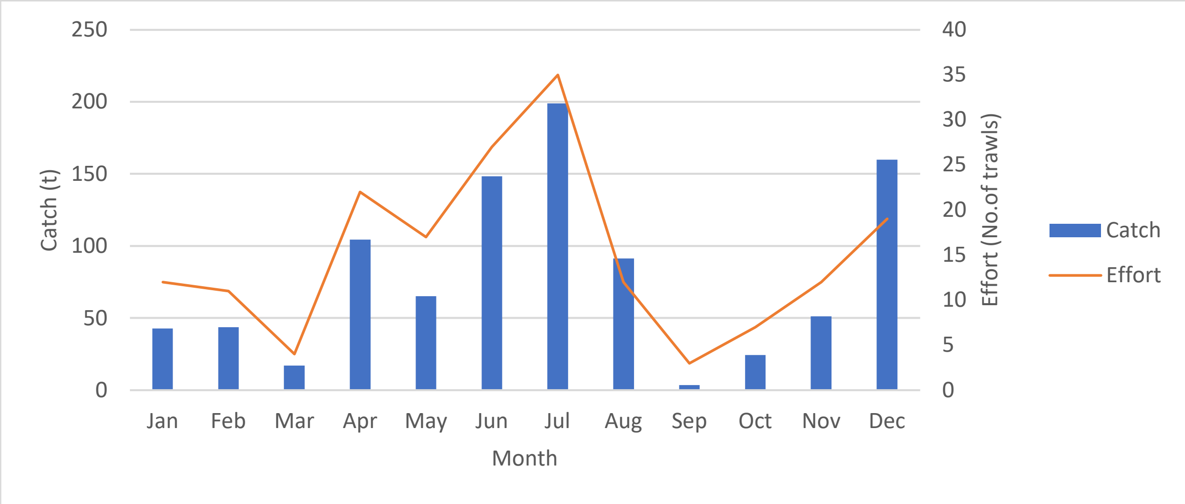

FIGURE 7-57: DEMERSAL TRAWL CATCH AND EFFORT BY MONTH WITHIN THE AREA OF INTEREST FOR DRILLING (2017 TO 2019)

Source: CapMarine

7.8.2 Mid-Water Trawl

The mid-water trawl fishery targets adult Cape horse mackerel (*Trachurus capensis*), which aggregate in highest concentration on the Agulhas Bank (South Coast) compared to the West Coast. Shoals of commercial abundance are found in limited areas and the spatial extent of mid-water trawl activity is relatively limited when compared to that of demersal trawling.

Fishing grounds are located into three main areas on the shelf edge of the South and East coasts:

1. Between 22°E and 23°E at a distance of approximately 70 nm offshore from Mossel Bay;
2. Between 24°E to 27°E at a distance of approximately 30 nm offshore; and
3. South of the Agulhas Bank between 21°E and 22°E.

These grounds range in depth from 100 m to 400 m and isolated trawls are occasionally recorded up to 650 m. Since 2017, DFFE has permitted experimental fishing to take place westward of 20°E.

Figure 7-58 shows the spatial extent of grounds fished by midwater trawlers in relation to Block 5/6/7 and the Area of Interest for proposed exploration drilling area.

Fishing activity takes place within the licence block approximately between the 160 m to 530 m isobath. Over the period 2017 to 2019, an average of 256 trawls per year were reported within the licence block area yielding 1 856 tonnes of catch. This is equivalent to 22.32% and 14.61% of the overall effort and catch, respectively, reported nationally by the sector. The Area of Interest for proposed exploration drilling area is situated approximately 10 km offshore of the closest expected fishing activity and there is no overlap with these fishing grounds.

At present, the midwater trawl fleet comprises a single, large midwater trawler (the FV Desert Diamond, which lands about 70% of horse mackerel trawl catches) and a number of smaller hake trawlers carrying both hake and horse mackerel Rights (the so-called "dual Rights vessels") that allow them to opportunistically target horse mackerel with mid-water gear additional to their normal hake fishing operations using demersal trawl gear.

Mid-water trawling gear configuration is similar to that of demersal trawlers, except that the net is manoeuvred vertically through the water column. The towed gear may extend up to 1 km astern of the vessel and comprises trawl warps, net and codend (see Figure 7-59). Once the gear is deployed, the net is towed for several hours at a speed of 4.8 to 6.8 knots predominantly parallel with the shelf break. Mid-water trawling can occur at any depth between the seabed and the surface of the sea without continuously touching the bottom. However, in practice, mid-water trawl gear does occasionally come into contact with the seafloor.

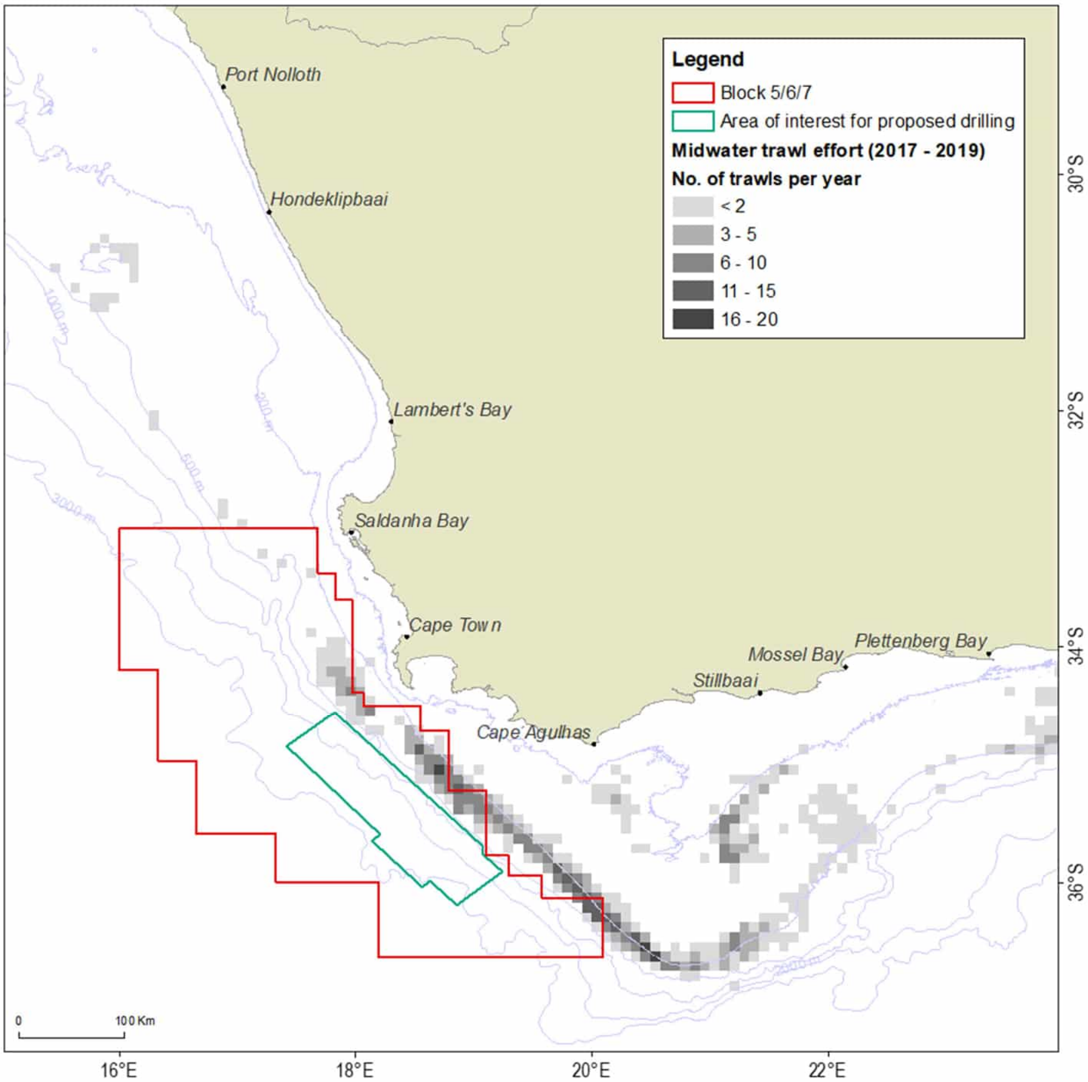

FIGURE 7-58: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF MID-WATER TRAWL EFFORT TARGETING HORSE MACKEREL (2017-2019)

Note: The location of the start of each trawl over the period 2017 to 2019 is shown in respect to commercial grid blocks (labelled). Depth contours indicated (100 m to 1000 m).
Source: CapMarine

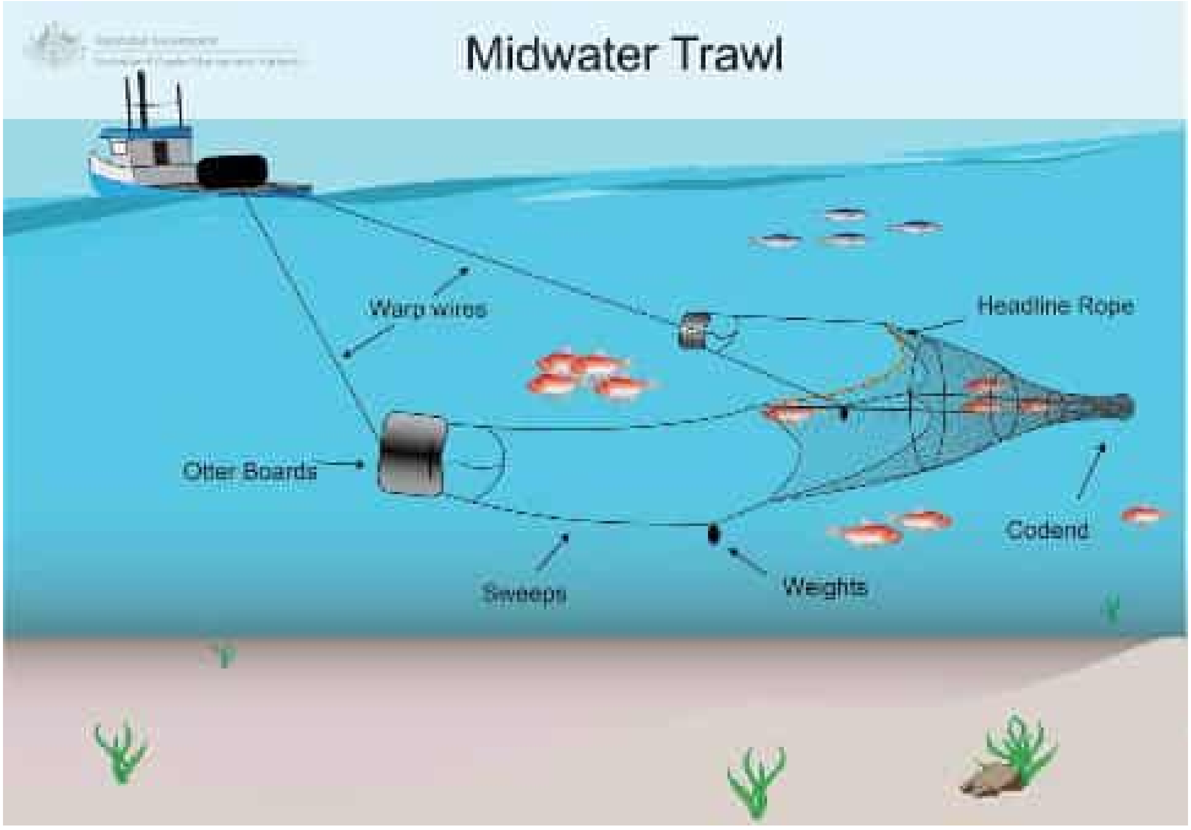

FIGURE 7-59: TYPICAL CONFIGURATION OF MID-WATER TRAWL GEAR
Source: www.afma.gov.au/fisheries-management/methods-and-gear/trawling

7.8.3 Hake Demersal Longline

The demersal longline fishing technique is used to target bottom-dwelling species of fish. Like the demersal trawl fishery the target species are the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. In 2017, 8 113 tonnes of hake was landed with a wholesale value of R319.2 million, or 3.2% of the total value of all fisheries combined. Landings of 8 230 tonnes were reported in 2018. Fishing takes place along the West and South East coasts in areas similar to those targeted by the demersal trawl fleet.

The hake longline footprint extends down the West Coast from approximately 150 km offshore of Port Nolloth. It lies inshore to the south of St Helena Bay moving offshore once again as it skirts the Agulhas Bank. Along the South Coast the footprint moves inshore again towards Mossel Bay. Lines are set parallel to bathymetric contours, along the shelf edge up to the 1 000 m depth contour in places.

Figure 7-60 shows the spatial distribution of hake demersal longline effort in relation to the licence block and proposed drilling area. **Block 5/6/7 coincides with longline fishing grounds situated between the 180 m and 700 m bathymetric contours. Over the period 2018 to 2020, an average of 1 005 lines per year (14 million hooks) were set yielding 2 336 tonnes of hake. This is equivalent to 51.79% of the overall effort and 51.99% of the overall catch reported nationally by the sector.**

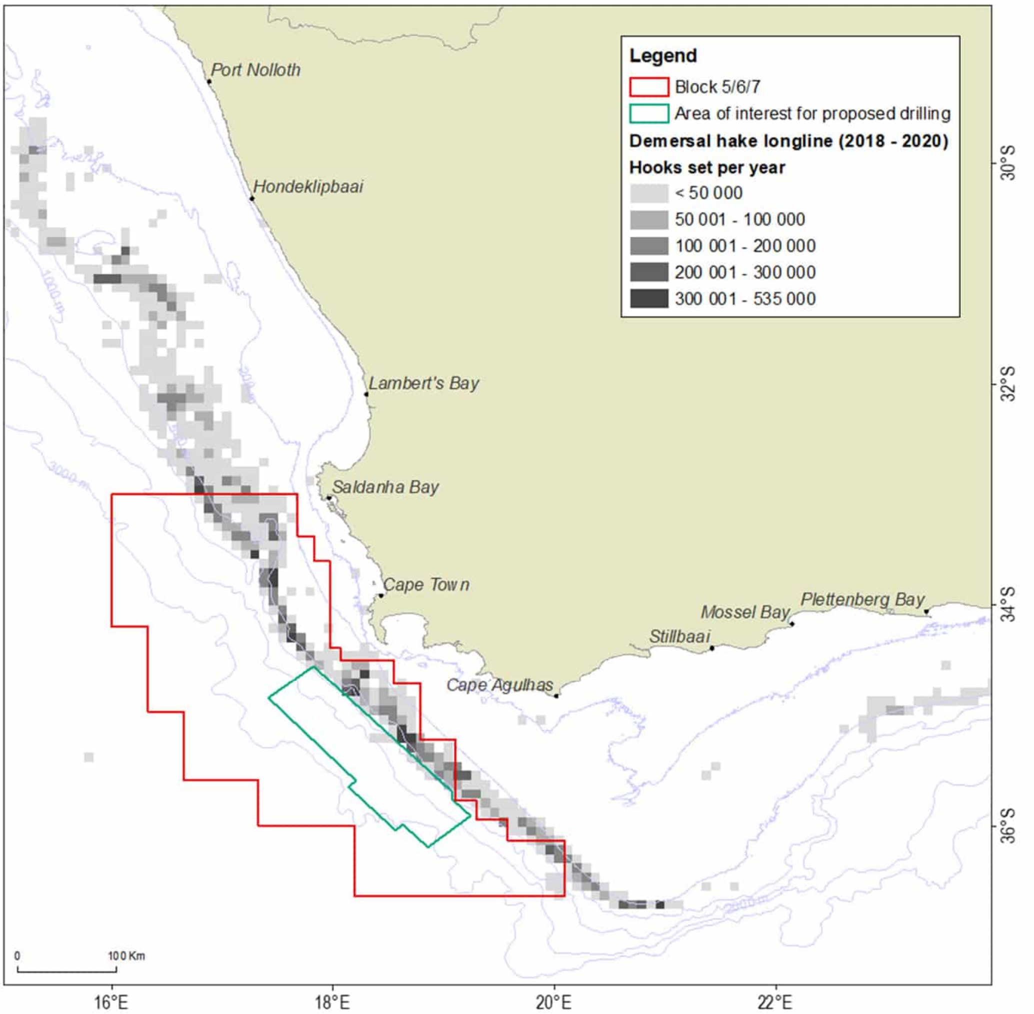

FIGURE 7-60: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF HAKE DEMERSAL LONGLINE EFFORT (2018-2020)

Source: CapMarine

The Area of Interest for proposed exploration drilling area is situated largely offshore of the main fishing grounds in the area; however, there the area does coincide with the outer depth range of fishing effort. Over the period 2018 to 2020, an average of 2 lines per year were set within the proposed drilling area at a depth range of 620 m to 655 m, yielding 5.5 tonnes of hake. This is equivalent to 0.10% and 0.12% of the overall effort and catch, respectively, reported nationally by the sector.

There are approximately 64 vessels licenced within the sector, operating from all major harbours, including Cape Town, Hout Bay, Mossel Bay and Gqeberha. Secondary points of deployment include St Helena Bay, Saldanha Bay, Hermanus, Gansbaai, Plettenberg Bay and Cape St Francis. Vessels based in Cape Town and Hout Bay operate almost exclusively on the West Coast (west of 20° E).

Lines are typically between 10 km and 20 km in length, carrying between 6 900 and 15 600 hooks each. Baited hooks are attached to the bottom line at regular intervals (1 to 1.5 m) (see Figure 7-61). Gear is usually set at night at a speed of between five and nine knots. Once deployed the line is left to soak for up to eight hours before it is retrieved. A line hauler is used to retrieve gear (at a speed of approximately one knot) and can take six to ten hours to complete.

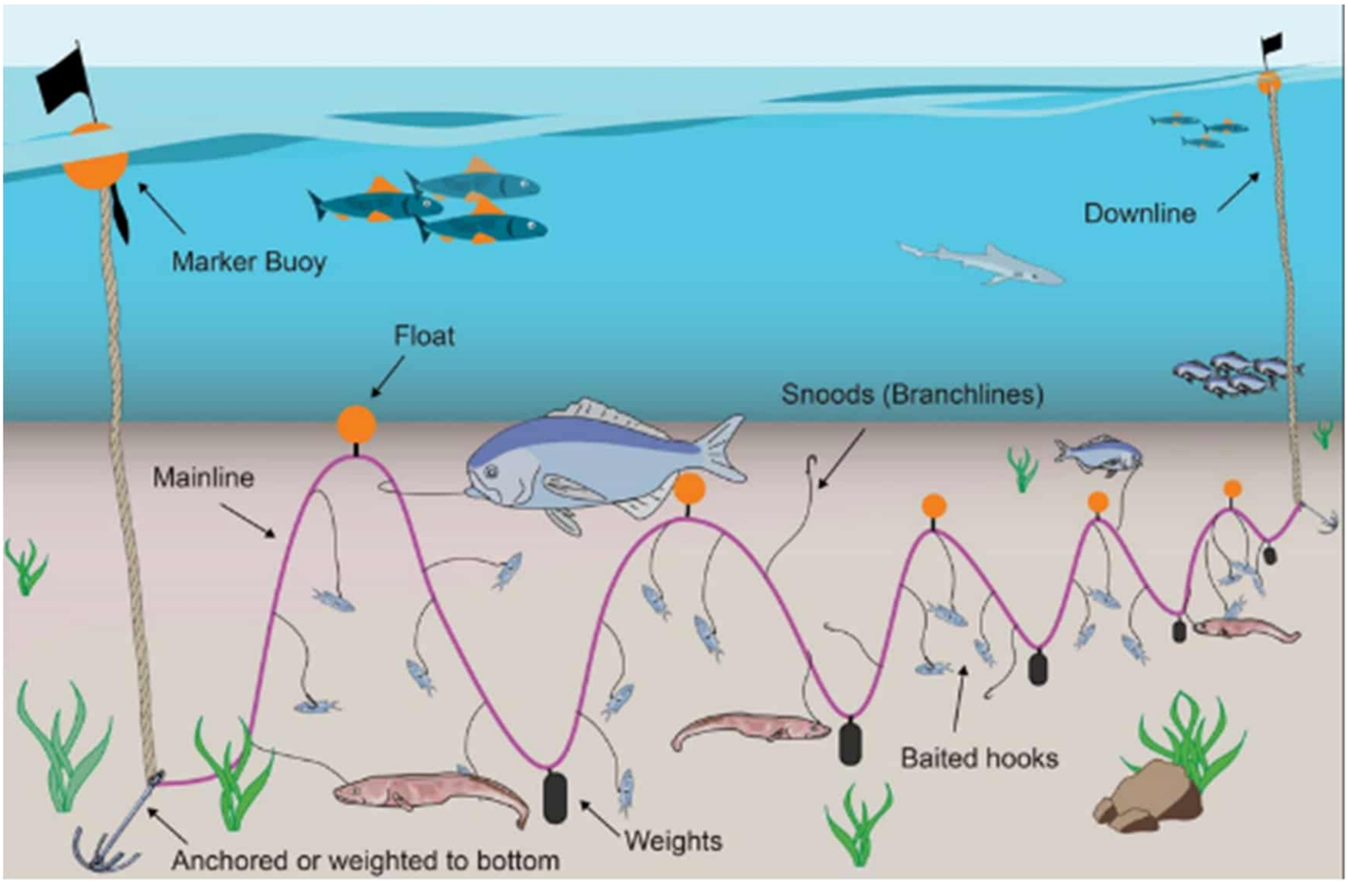

FIGURE 7-61: TYPICAL CONFIGURATION OF DEMERSAL (BOTTOM-SET) HAKE LONGLINE GEAR
Source: http://www.afma.gov.au/portfolio-item/longlining

7.8.4 Shark Demersal Longline

The demersal shark longline fishery is uses bottom-set gear to target predominantly soupfin sharks and smoothhound sharks in coastal waters. The fishery operates in waters generally shallower than 100 m from the Orange River on the West Coast to the Kei River on the East Coast, but fishing rarely takes place north of Table Bay. **Fishing effort is directed inshore of the 100 m depth contour thus inshore of the licence block** (see Figure 7-62).

Vessels are typically <30 m in length and use weighted longlines baited with up to 2 000 hooks. As the majority of Right Holders own additional Rights in other fisheries, the number of active vessels fluctuates over the year but rarely exceeds four vessels operating at the same time. Annual landings have fluctuated widely due to variation in demand and price. Rights are due to be re-allocated during the fishing Rights allocation process in 2021/2022.

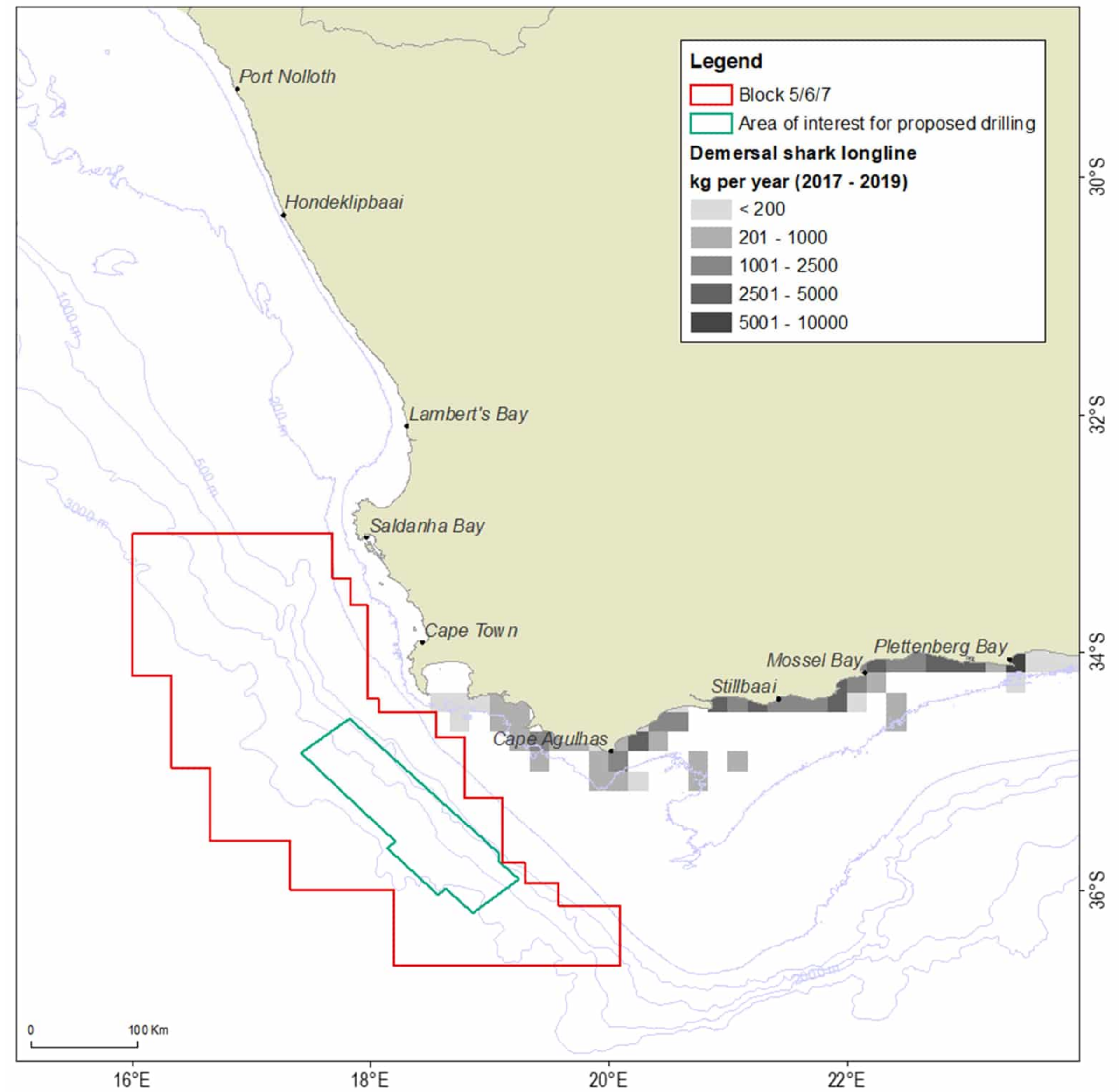

FIGURE 7-62: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF SHARK DEMERSAL LONGLINE CATCH (2017-2019)

Source: CapMarine

7.8.5 Small Pelagic Purse-Seine

The South African small pelagic purse seine fishery is the largest fishery by volume and the second most important in terms of value (after the demersal trawl fishery). The two main targeted species are sardine and anchovy, with some rights holders also targeting round herring (red-eye), with associated by-catch of round chub mackerel and horse mackerel.

Small pelagic fish species abundance and distribution fluctuates considerably in accordance with the upwelling ecosystem in which they exist. The total combined catch of anchovy, sardine and round herring landed by the small pelagic fishery has decreased by 45% from 395 000 t in 2016 to 219 000 t in 2019, due mainly to a substantial decrease in the catch of anchovy from 262 000 t in 2016 to only 166 000 t in 2019. Despite this decline, the average combined catch over the last five years of 322 000 t is only slightly lower than the long-term

(1949–2019 - see Figure 7-63) average annual catch of 334 000 t. The wholesale value of catch landed by the sector during 2017 was R2.164 Billion, or 22% of the total value of all fisheries combined.

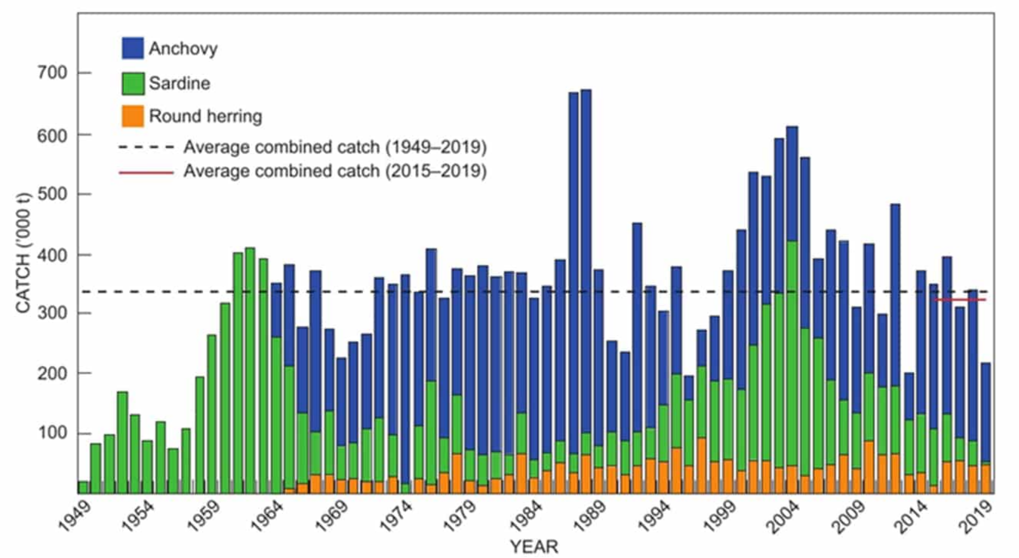

FIGURE 7-63: NATIONAL ANNUAL COMBINED CATCH OF ANCHOVY, SARDINE AND ROUND HERRING (1949-2019)

Notes: The average combined catch since the start of the fishery (1949-2019; black dashed line) and for the past five years (2015-2019; red solid line).
Source: DFFE 2021

The fleet consists of approximately 100 wooden, glass-reinforced plastic and steel-hulled vessels ranging in length from 11 m to 48 m. The majority of the fleet operate on the West / South-West Coasts from St Helena Bay, Laaiplek, Saldanha Bay and Hout Bay, with fewer vessels operating on the South Coast from the harbours of Gansbaai, Mossel Bay and Gqeberha. Ports of deployment correspond to the location of canning factories and fish reduction plants along the coast. The sardine-directed fleet concentrates effort in a broad area extending from Lambert’s Bay, southwards past Saldanha and Cape Town towards Cape Point and then eastwards along the coast to Mossel Bay and Gqeberha. The anchovy-directed fishery takes place predominantly on the South-West Coast from Lambert’s Bay to Kleinbaai (near Gansbaai) and similarly the intensity of this fishery is dependent on fish availability and is most active in the period from March to September. Round herring (non-quota species) is targeted when available and specifically in the early part of the year (January to March) and is distributed from Lambert’s Bay to south of Cape Point. This fishery may extend further offshore than the sardine and anchovy-directed fisheries.

Fish are targeted in inshore waters, primarily along the West and South Coasts of the Western Cape and the Eastern Cape coast, up to a maximum offshore distance of about 100 km. Figure 7-64 shows the spatial extent of fishing grounds in relation to the licence block and Area of Interest for proposed exploration drilling. **Over the period 2000 to 2016, an average of 418 hours per year (219 sets) were fished within Block 5/6/7 yielding 9 668 tonnes of catch. This is equivalent to 2.03% of the overall effort and 2.22% of the overall catch reported nationally by the sector. Favoured catch grounds lie inshore of the Area of Interest for proposed exploration drilling area and fishing activity expended beyond the 200 m depth contour is considered unlikely.**

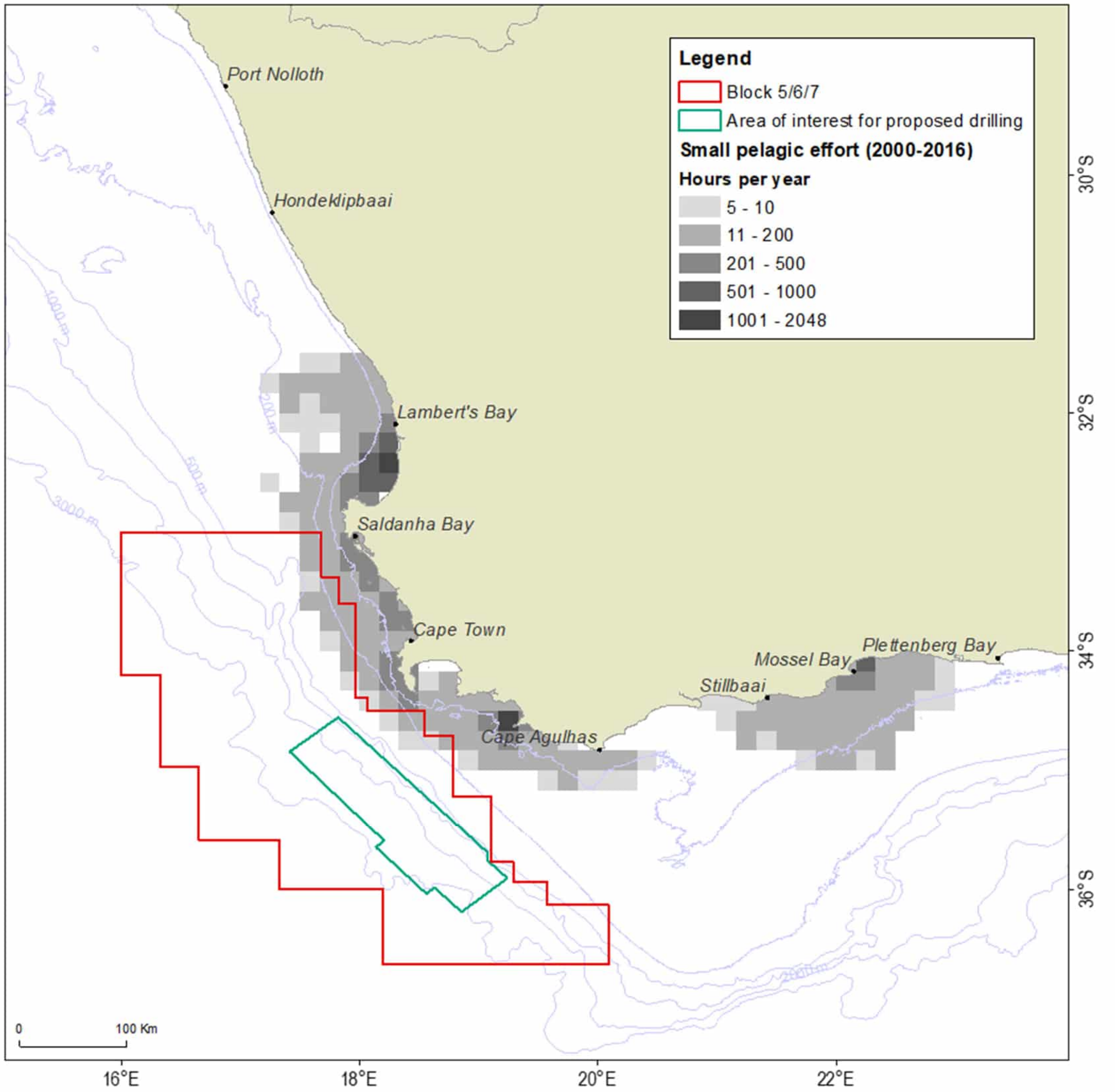

FIGURE 7-64: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF PURSE-SEINE EFFORT TARGETING SMALL PELAGIC SPECIES (2000-2016)

Source: CapMarine

The fishery operates throughout the year with a short seasonal break from mid-December to mid-January. Seasonality of catches is shown in Figure 7-65 with an increase in fishing effort and landings evident during the winter months.

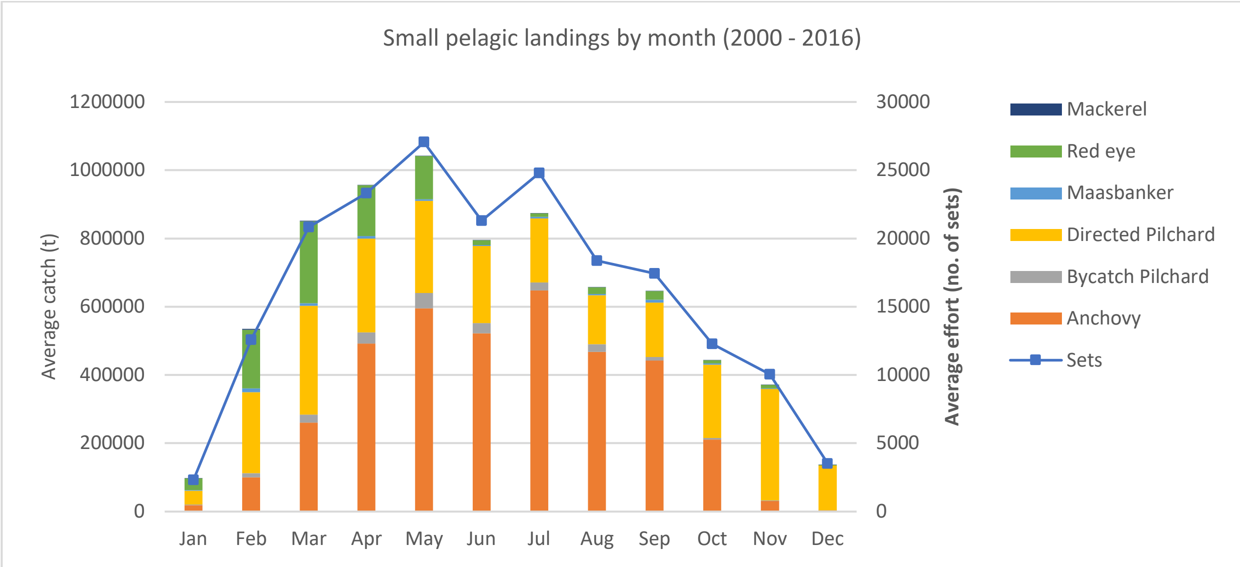

FIGURE 7-65: GRAPH SHOWING MONTHLY CATCH (TONNES) AND EFFORT (NUMBER OF SETS) REPORTED FOR THE SMALL PELAGIC PURSE-SEINE FLEET OVER THE PERIOD 2000 TO 2016 (CUMULATIVE)

Source: CapMarine

The targeted pelagic fish species are surface-shoaling and once a shoal has been located the vessel will steam around it and encircle it with a large net, extending to a depth of 60 m to 90 m (see Figure 7-66). Netting walls surround aggregated fish, preventing them from diving downwards. It is important to note that after the net is deployed the vessel has no ability to manoeuvre until the net has been fully recovered on board and this may take up to 1.5 hours. Vessels usually operate overnight and return to offload their catch the following day.

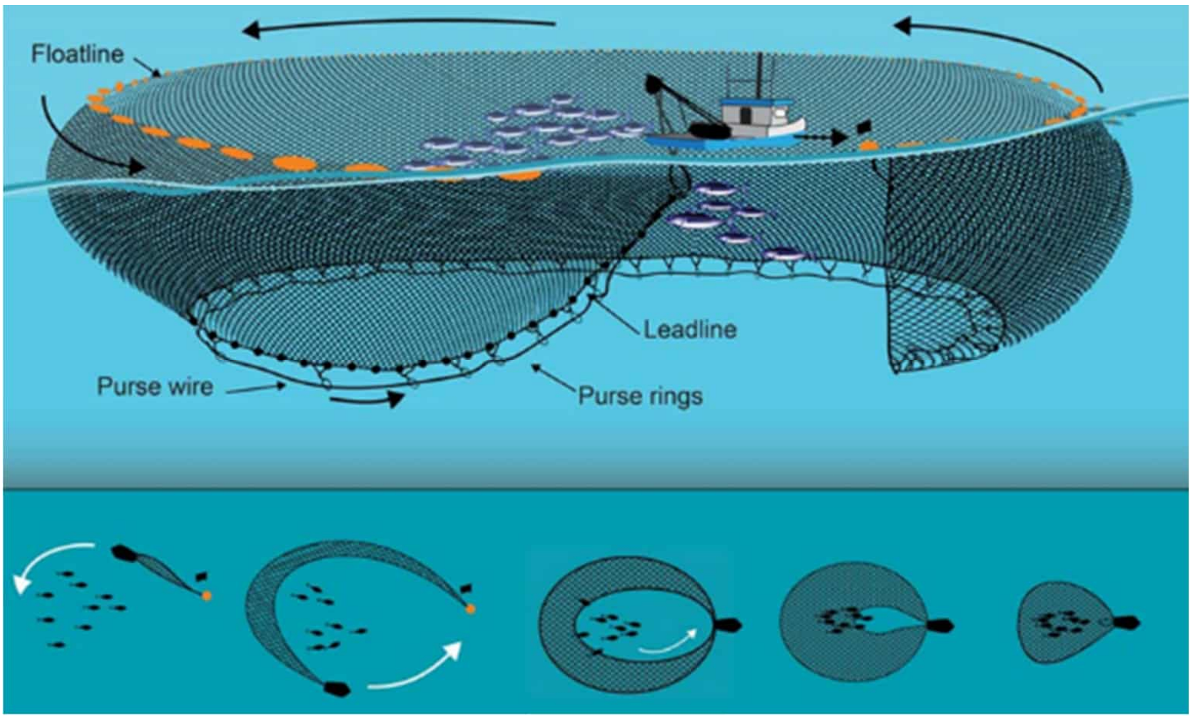

FIGURE 7-66: TYPICAL CONFIGURATION AND DEPLOYMENT OF A SMALL PELAGIC PURSE-SEINE FOR TARGETING ANCHOVY AND SARDINE AS USED IN SOUTH AFRICAN WATERS

Source: http://www.afma.gov.au/portfolio-item/purse-seine

7.8.6 Large Pelagic Longline

The target species within the South African pelagic longline sector are albacore tuna, yellowfin tuna, bigeye tuna, swordfish and shark species. Due to the highly migratory nature of these species, stocks straddle the EEZ of a number of countries and international waters. As such they are managed as a "shared resource" amongst various countries.

The wholesale value of catch landed by the sector in 2017 was R154.2 million, or 1.6% of the total value of all fisheries combined, with landings of 2 541 tonnes (2017) and 2 815 tonnes (2018). Total catch and effort figures reported by the fishery for the years 2000 to 2018 are shown in Figure 7-67.

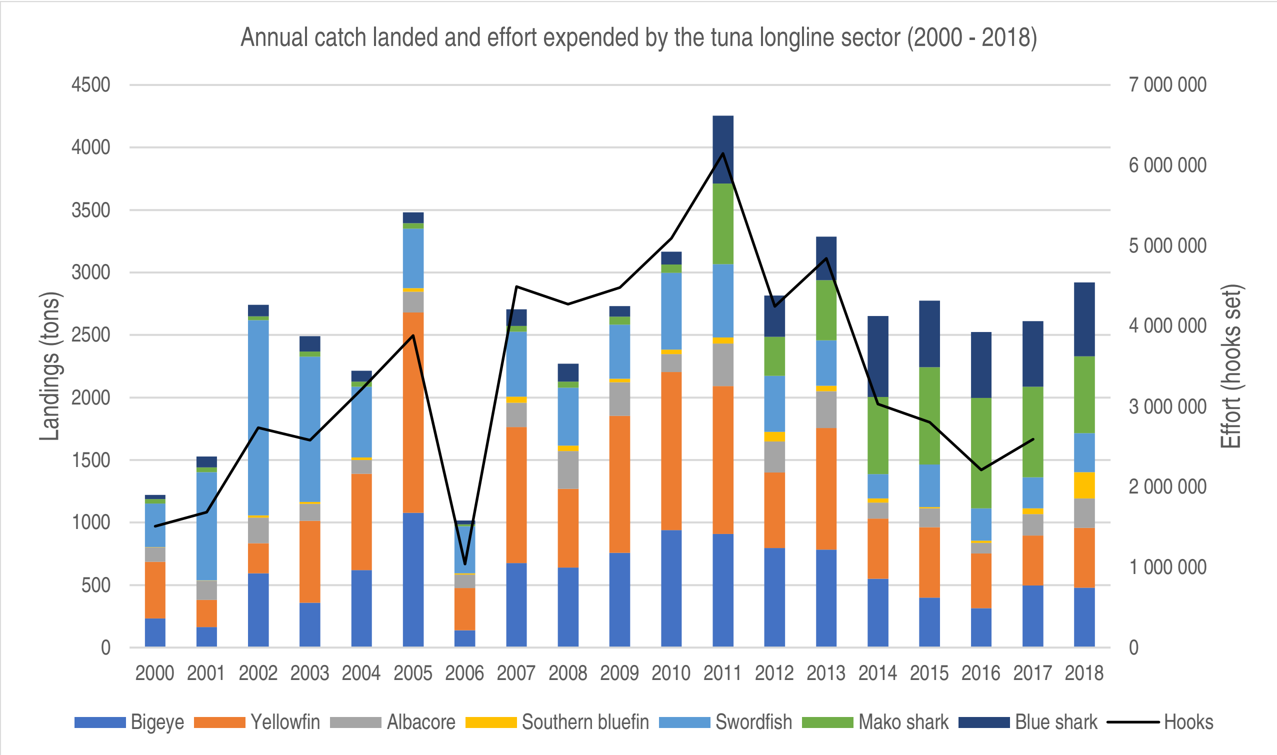

FIGURE 7-67: INTER-ANNUAL VARIATION OF CATCH LANDED AND EFFORT EXPENDED BY THE LARGE PELAGIC LONGLINE SECTOR IN SOUTH AFRICAN WATERS AS REPORTED TO THE TWO REGIONAL MANAGEMENT ORGANISATIONS, ICCAT AND IOTC (2000 - 2018)

Source: DFFE, 2019

The fishery operates year-round with a relative increase in effort during winter and spring shown by foreign-flagged longline vessels (see Figure 7-68b). The numbers of hooks set by foreign vessels peak between May and October each year, whereas local vessels fish throughout the year, with marginally fewer hooks set in January and February than other months (see Figure 7-68b).

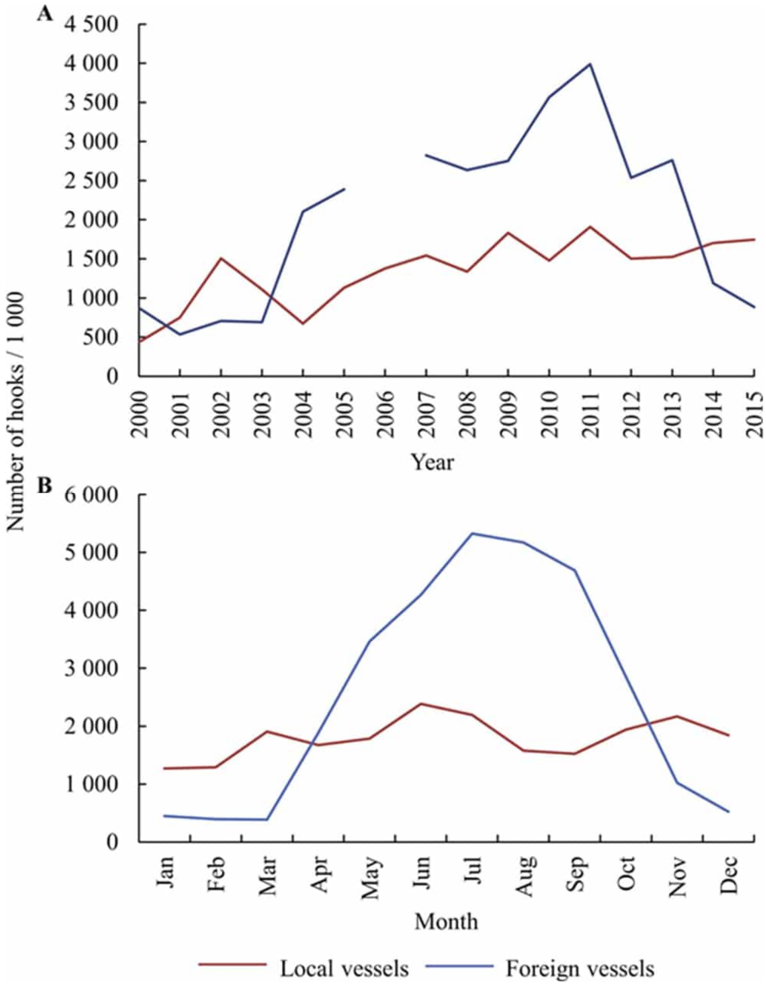

FIGURE 7-68: NUMBERS OF HOOKS SET PER (A) YEAR (2000–2015) AND (B) PER CALENDAR MONTH, AS REPORTED BY LOCAL AND FOREIGN PELAGIC LONGLINE VESSELS

Source: Jordaan *et al.* 2018

The geographical distribution of fishing effort by local and foreign pelagic longline vessels between 2000 and 2015 is shown in Figure 7-69. Local vessels fish in all four areas (West, South-West, South and East), but in the East their range is limited to the northern half of the area, near a landing site at Richards Bay. Foreign vessels fish mainly in the Indian Ocean, with the bulk of all hooks set in the South (58%) and East (33%) areas, and the remaining 9% in the Atlantic (West and South-West areas). Foreign vessels set an average of 2 493 ± 597 (SD) hooks per line, compared to only 1 282 ± 250 hooks per line used by local vessels.

Figure 7-70 shows the spatial extent of pelagic longline fishing grounds in relation to the licence block and Area of Interest for proposed exploration drilling. **Over the period 2017 to 2019 (cumulative local and foreign fleets), an average of 726 lines per year were set within Block 5/6/7 yielding 1 049 tonnes of catch. This is equivalent to 17.66% of the overall effort and 14.67% of the overall catch reported nationally by the sector. Fishing activity takes place over the entire Area of Interest for proposed exploration drilling where, over the period 2017 to 2019, an average of 298 lines per year were set yielding 414 tonnes of catch. This is equivalent to 7.25% and 5.79% of the overall effort and catch, respectively.**

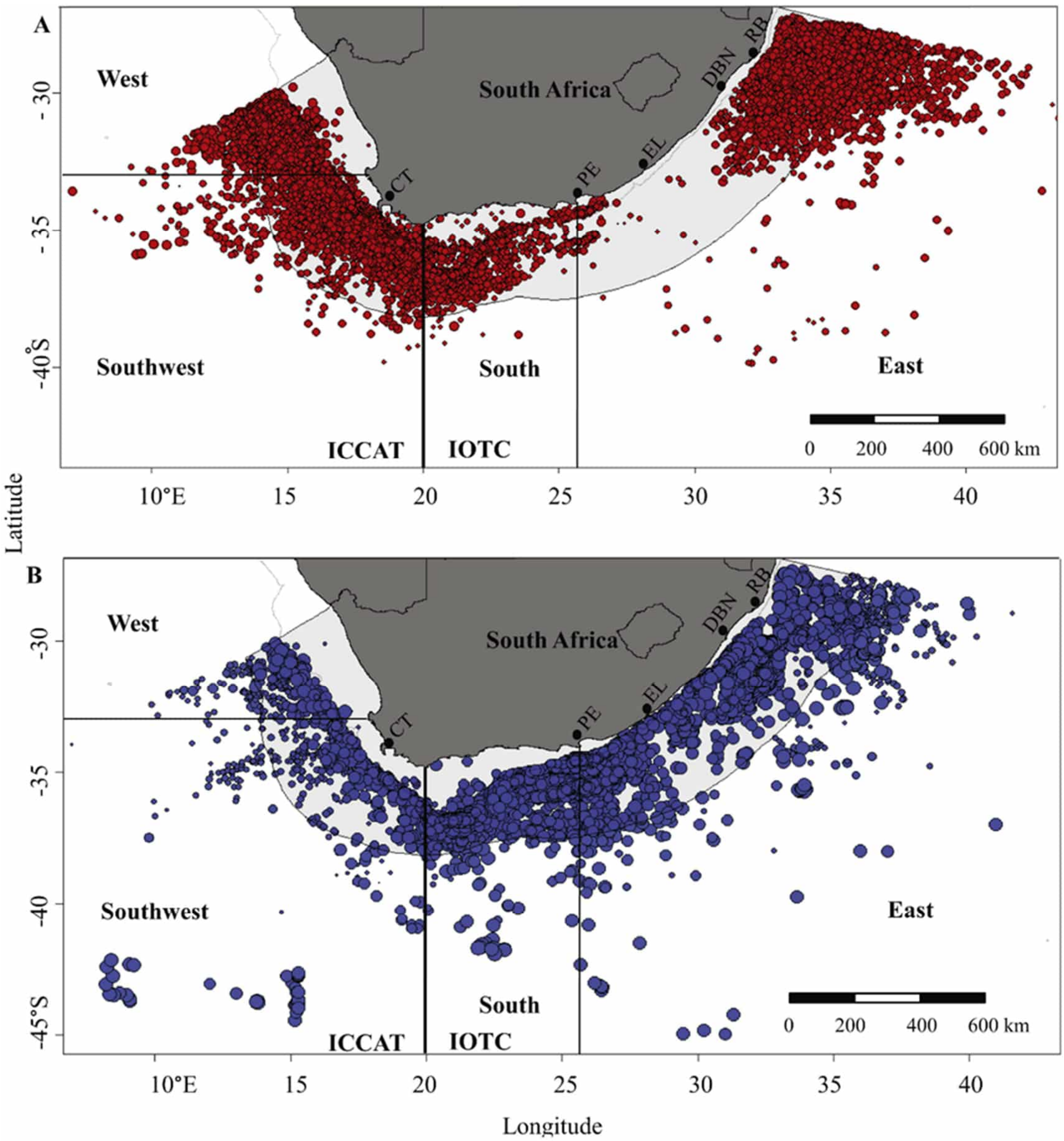

FIGURE 7-69: GEOGRAPHICAL DISTRIBUTION OF FISHING EFFORT BY (A) LOCAL AND (B) FOREIGN PELAGIC LONGLINE VESSELS BETWEEN 2000 AND 2015

Notes: Bubble size is proportional to the numbers of hooks set per line. Data based on logbook data provided by vessel skippers.

Source: Jordaan *et al.* 2018

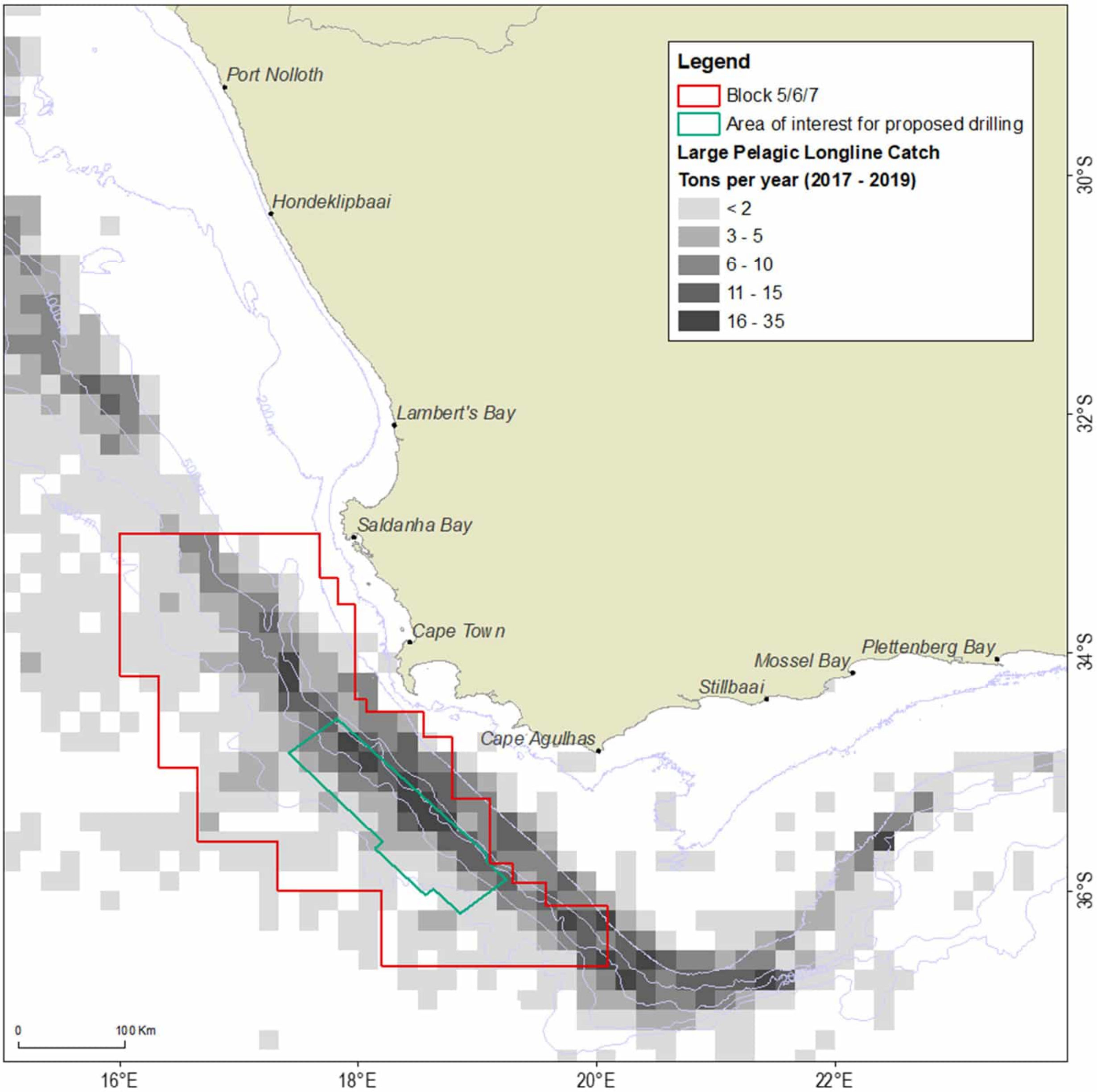

FIGURE 7-70: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF PELAGIC LONGLINE CATCH (2017-2019)

Source: CapMarine

Pelagic longline vessels set a drifting mainline, which are up to 100 km in length. The mainline is kept near the surface or at a certain depth (20 m below) by means of buoys connected via “buoy-lines”, which are spaced approximately 500 m apart along the length of the mainline (see Figure 7-71). Hooks are attached to the mainline via 20 m long trace lines, which are clipped to the mainline at intervals of approximately 50 m. There can be up to 3 500 hooks per line. Various types of buoys are used in combinations to keep the mainline near the surface and locate it should the line be cut or break for any reason. Each end of the line is marked by a Dahn Buoy and Radar reflector, which marks its position for later retrieval by the fishing vessel. A line may be left drifting for up to 18 hours before retrieval by means of a powered hauler at a speed of approximately 1 knot. During hauling a vessel’s manoeuvrability is severely restricted and, in the event of an emergency, the line may be dropped to be hauled in at a later stage.

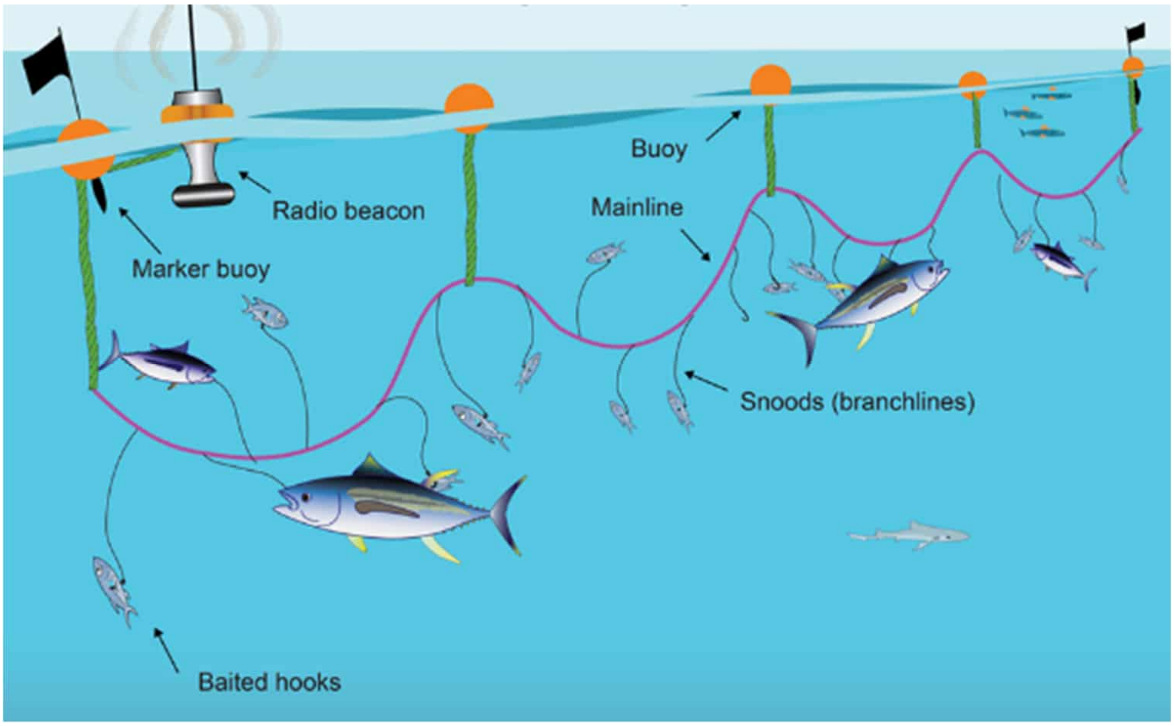

FIGURE 7-71: TYPICAL LARGE PELAGIC LONGLINE GEAR SOURCE
Source: http://www.afma.gov.au/portfolio-item/longlining

7.8.7 Tuna Pole

Poling for tuna is predominantly based on the southern Atlantic longfin tuna stock also referred to as albacore. Other catch species include yellowfin tuna, bigeye tuna and skipjack tuna. The fishery is seasonal with vessels active predominantly between November and May and peak catches recorded from November to January. Due to the seasonality of tuna in South Africa's waters the tuna pole fishery is also allowed access to snoek and yellowtail. Landings of albacore for 2018 amounted to 2471 tonnes, with a wholesale value of R124 million, or 1.2% of the total value of all fisheries combined.

The active fleet consists of approximately 92 pole-and-line vessels, which are based at the ports of Cape Town, Hout Bay and Saldanha Bay. Vessels normally operate within a 100 nm (185 km) radius of these locations with effort concentrated in the Cape Canyon area (South-West of Cape Point) and up the West Coast to the Namibian border with South Africa.

Fishing activity for tuna occurs along the entire West Coast beyond the 200 m bathymetric contour, along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore of Saldanha Bay. Snoek-directed fishing activity is coastal and seasonal in nature – taking place inshore of the 100 m depth contour during the period March to July.

Figure 7-72 shows the location of fishing activity in relation to Block 5/6/7 and Area of Interest for proposed exploration drilling. **Fishing records show tuna-directed fishing within the licence block, particularly over the Cape Canyon. Over the period 2017 to 2019, an average of 1 613 fishing events per year were reported having taken place within Block 5/6/7 yielding 1 955 tonnes of albacore. This is equivalent to 64.39% of the overall effort expended by the pole-line sector and 70.5% of the albacore catch landed by the sector.**

The proposed drilling area is situated adjacent to Cape Canyon and there is evidence of fishing activity extending towards the 2 000 m depth contour. Over the period 2017 to 2019, an average of 322 fishing events per year were reported within the proposed drilling area yielding 391 tonnes of albacore. This is equivalent to 12.54% and 13.74% of the overall effort and catch, respectively. The seasonality of catch from October to December within the Area of Interest for proposed exploration drilling is shown in Figure 7-73.

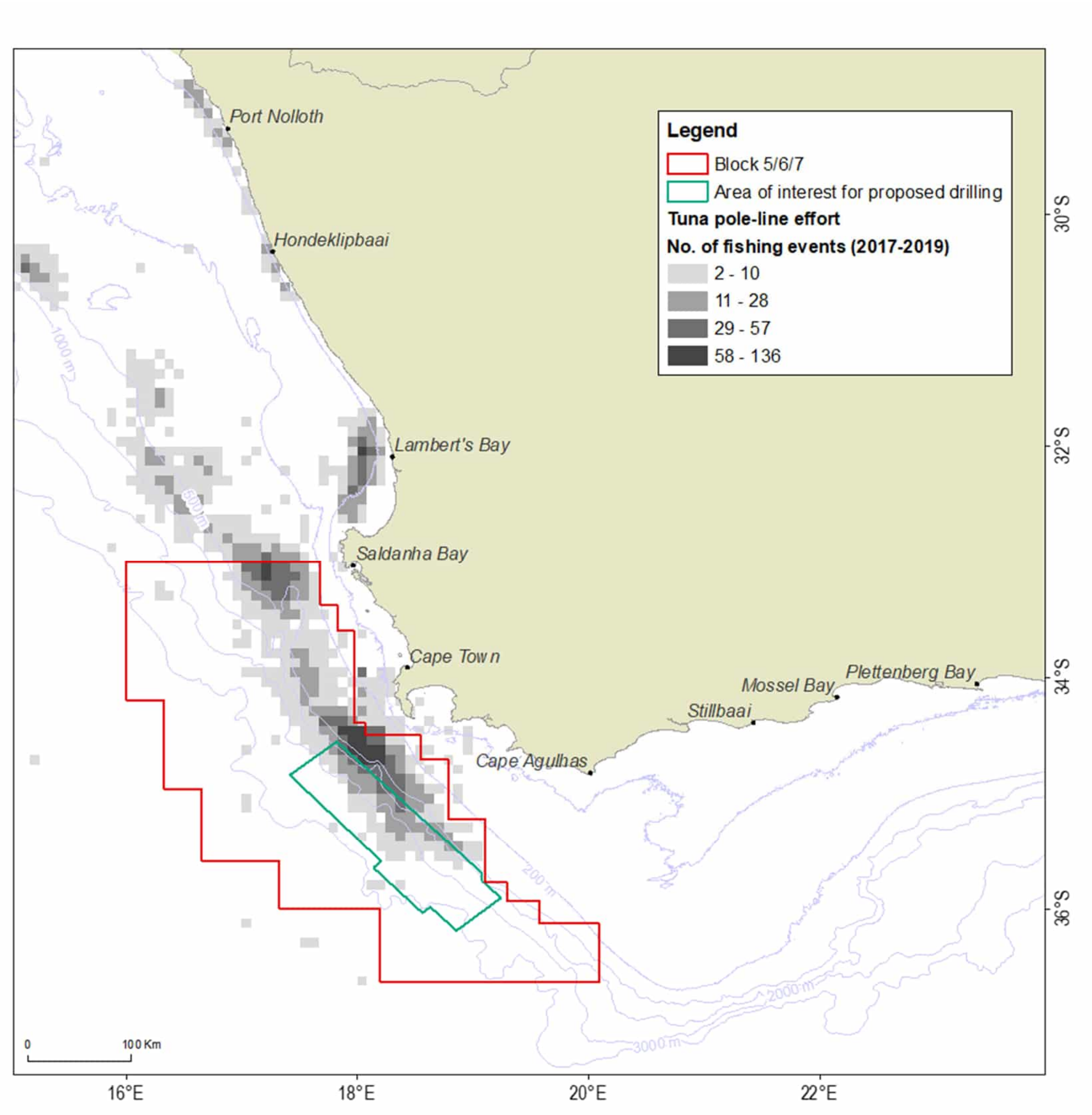

FIGURE 7-72: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF TUNA POLE EFFORT (2017-2019)

Source: CapMarine

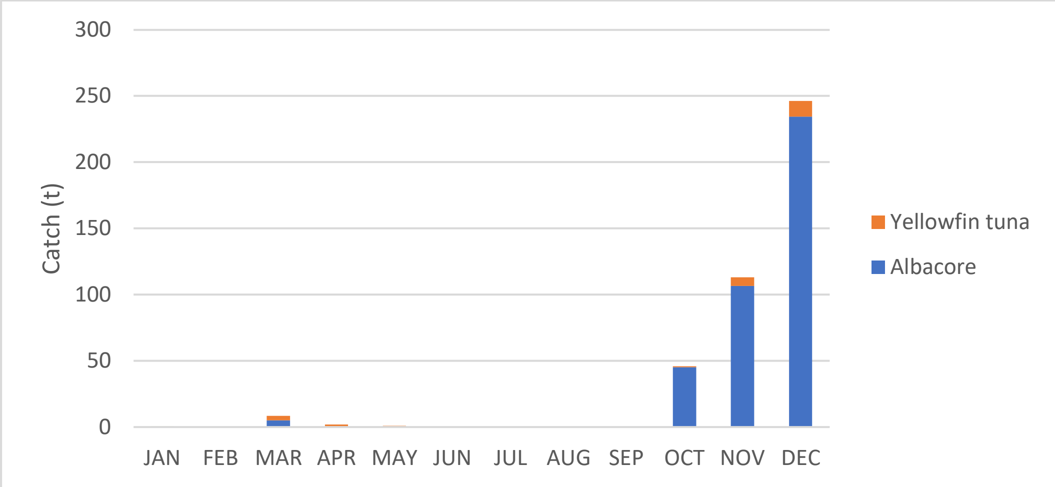

FIGURE 7-73: AVERAGE CATCH PER MONTH TAKEN BY THE TUNA POLE-LINE SECTOR WITHIN THE AREA OF INTEREST (2017 – 2019)

Source: CapMarine

Whilst vessels are at sea, the majority of time is spent searching for fish with actual fishing events taking place over a relatively short period of time. Sonars and echo sounders are used to locate schools of tuna. At the start of fishing, water is sprayed outwards from high-pressure nozzles to simulate small baitfish aggregating near the water surface, thereby attracting tuna to the surface. Live bait is flung out to entice the tuna to the surface (chumming). Tuna swimming near the surface are caught with hand-held fishing poles. The ends of the 2 m to 3 m poles are fitted with a short length of fishing line leading to a hook. Hooked fish are pulled from the water and many tonnes can be landed in a short period of time. In order to land heavier fish, lines may be strung from the ends of the poles to overhead blocks to increase lifting power (see Figure 7-74).

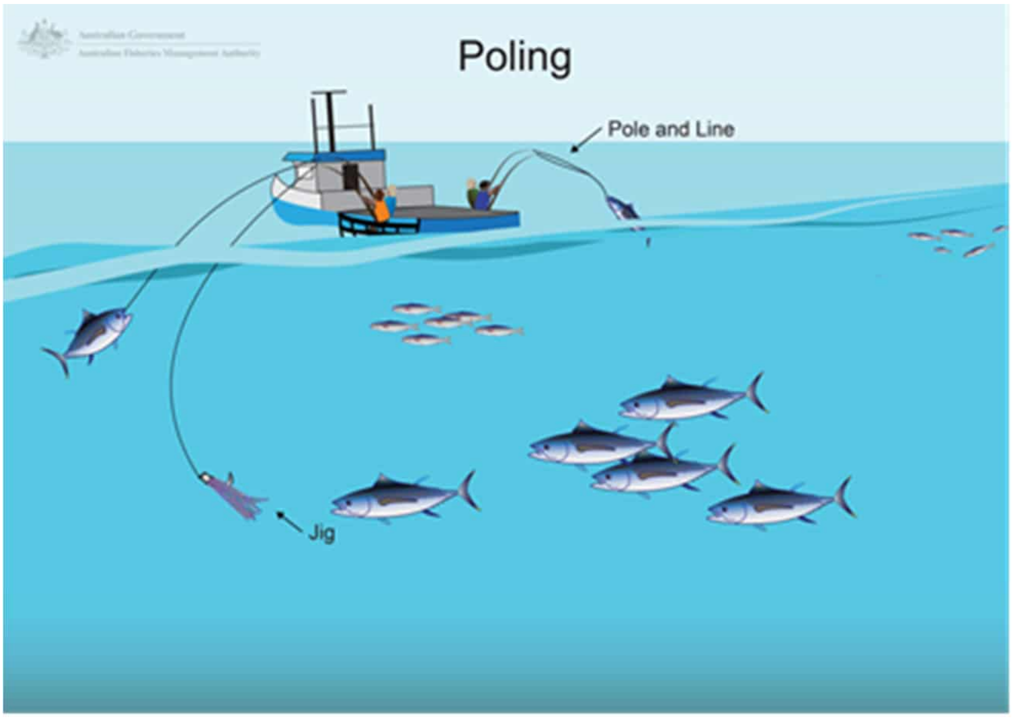

FIGURE 7-74: SCHEMATIC DIAGRAM OF POLE AND LINE OPERATION

Source: http://www.afma.gov.au/portfolio-item/minor-lines

7.8.8 Commercial or Traditional Line Fish

This sector has its origins from the recreational sector. Essentially recreational linefishers commercialised resulting in a systematic decline in the “linefish" stocks. The Minister of Fisheries in the 1980’s reformed the sector. This was done by creating a small commercial linefish sector, as well as introducing a moratorium on exploiting many species that were collapsed or near collapse. The commercial linefish sector now only allows a limited number of key species to be exploited.

The commercial linefish fishery is South Africa’s third most important fishery in terms of total tonnes landed and economic value. This fishery is South Africa’s third most important fishery in terms of total tonnes landed and economic value. It is a long-standing, **nearshore fishery** targeting approximately 200 species of marine fish along the full 3 000 km coastline, of which 50 species may be regarded as economically important. Within the Western Cape, the predominant catch species is snoek while other species such as Cape bream (hottentot), geelbek, kob and yellowtail are also important. Towards the East Coast the number of catch species increases and includes resident reef fish, pelagic migrants and demersal migrants. In 2017, the wholesale value of catch was reported as R122.1 million.

The fishery is widespread along the country’s shoreline from Port Nolloth on the West Coast to Cape Vidal on the East Coast. Effort is managed geographically with the spatial effort of the fishery divided into three zones. Zone A extends from Port Nolloth to Cape Infanta, Zone B extends from Cape Infanta to Port St Johns and Zone C covers the KwaZulu-Natal region. Most of the catch (up to 95%) is landed by the Cape commercial fishery, which operates on the continental shelf from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Fishing takes place throughout the year but there is some seasonality in catches.

Vessels range in length between 4.5 m and 11 m and the offshore operational range is restricted by vessel category to 40 nm (75 km). Fishing effort at this outer limit is sporadic, with most activity within 15 km of a launch site.

There are an estimated 455 commercial vessels consisting of approximately 3 450 crew operating extensively around the coast with 425 rights holders. In addition to the commercial vessels there are many more ski boats that are used in the recreational sector, which may be launched from a number of slipways and harbours.

Figure 7-75 shows the spatial extent of traditional line fish grounds in relation to Block 5/6/7 and Area of Interest for proposed exploration drilling. **Fishing effort is primarily coastal, with vessels operating in waters shallower than 100 m. However, there are records of fishing in the vicinity of Cape Canyon reported at a distance of 55 km offshore of Saldanha Bay and Hope Canyon due South of Cape Point. Over the period 2017 to 2019, an annual average of 21.3 tonnes of albacore tuna and 4.4 tonnes of yellowtail was caught within Block 5/6/7. Catch within the Block amounted to 0.5% of the total catch. Fishing within this area is seasonal – October to May. There is no activity expected within the Area of Interest for proposed exploration drilling, which is situated approximately 18 km from fishing locations.**

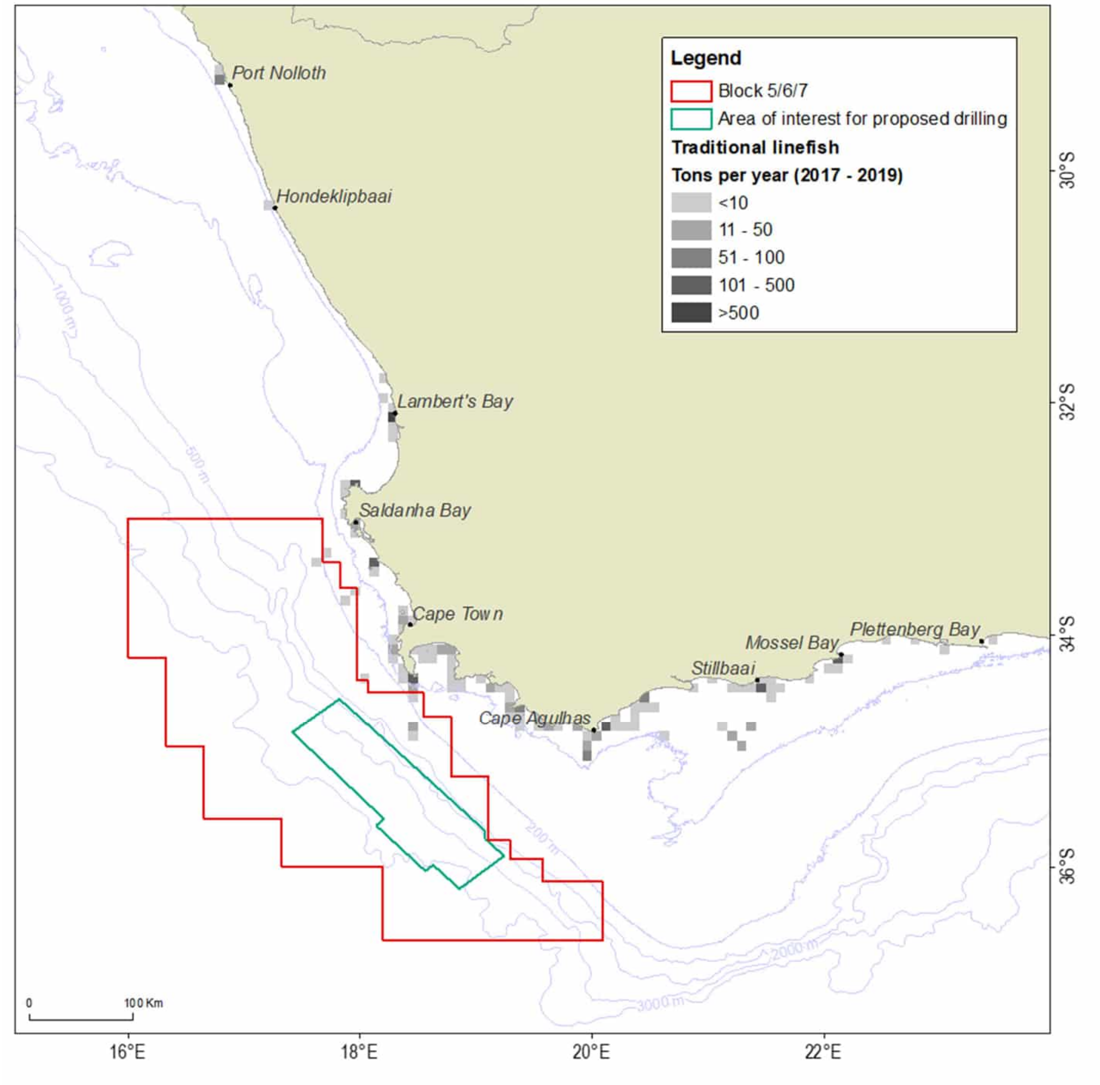

FIGURE 7-75: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF LINE FISH CATCH (2017-2019)

Source: CapMarine

7.8.9 West Coast Rock Lobster

The West Coast rock lobster (*Jasus lalandii*) is a valuable resource along West Coast and consequently an important income source for West Coast fishermen. The resource occurs inside the 200 m depth contour along the West Coast from Namibia to East London on the East Coast of South Africa. Fishing grounds stretch from the Orange River mouth to east of Cape Hangklip in the South-Eastern Cape.

The resource is managed geographically in various management zones, with TACs set annually for the different management zones. The fishery is comprised of four sub-sectors – commercial offshore, commercial nearshore, small-scale and recreational, all of which have to share from the same national TAC, which set at 837 tonnes for 2020/21. The commercial and small-scale fishing sectors are authorised to undertake fishing for four months in each management zone therefore closed seasons are applicable to different management zones. Average monthly landings over the period 2006 to 2020 are shown in Figure 7-76.

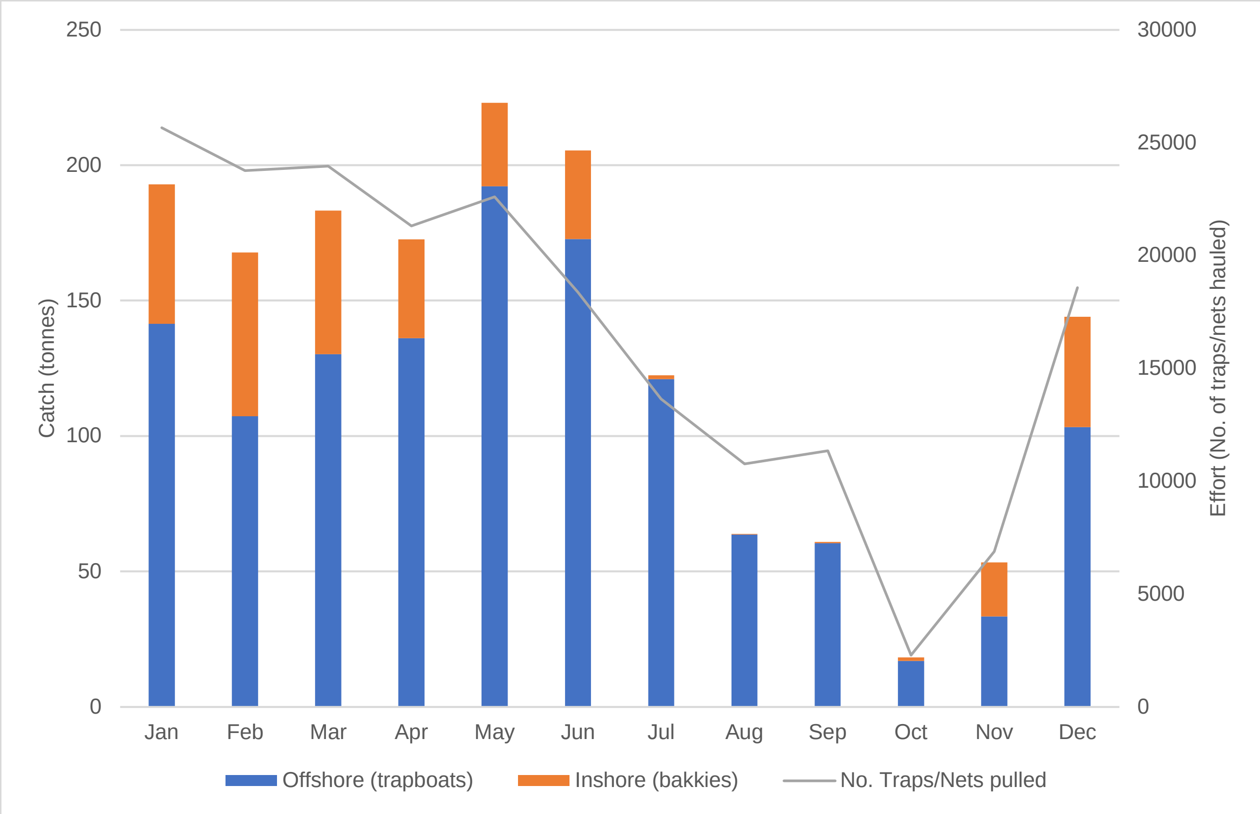

FIGURE 7-76: GRAPH SHOWING THE AVERAGE MONTHLY CATCH AND EFFORT REPORTED BY THE OFFSHORE AND INSHORE ROCK LOBSTER SECTORS (2006-2020)

Source: CapMarine

The commercial offshore sector operates at a depth range of approximately 30 m to 100 m, making use of traps consisting of rectangular metal frames covered by netting. These traps are set at dusk and retrieved during the early morning. Approximately 138 vessels participate in the offshore sector.

The commercial nearshore sector makes use of hoop nets to target lobster at discrete suitable reef areas along the shore at a water depth of up to 15 – 30 m. These are deployed from a fleet of small dinghies/bakkies which operate from the shore and coastal harbours. Approximately 653 boats participate in the sector.

Block 5/6/7 is situated offshore of rock lobster Management Zones C, D, and F, and offshore of the depth range at which rock lobster is targeted. Thus, there was no fishing activity reported by the offshore or nearshore sectors within the licence block or Area of Interest for proposed exploration drilling between 2006 and 2020 (refer to Figure 7-77). **The closest fishing activity to the Area of Interest is approximately 50 km off Cape Point.**

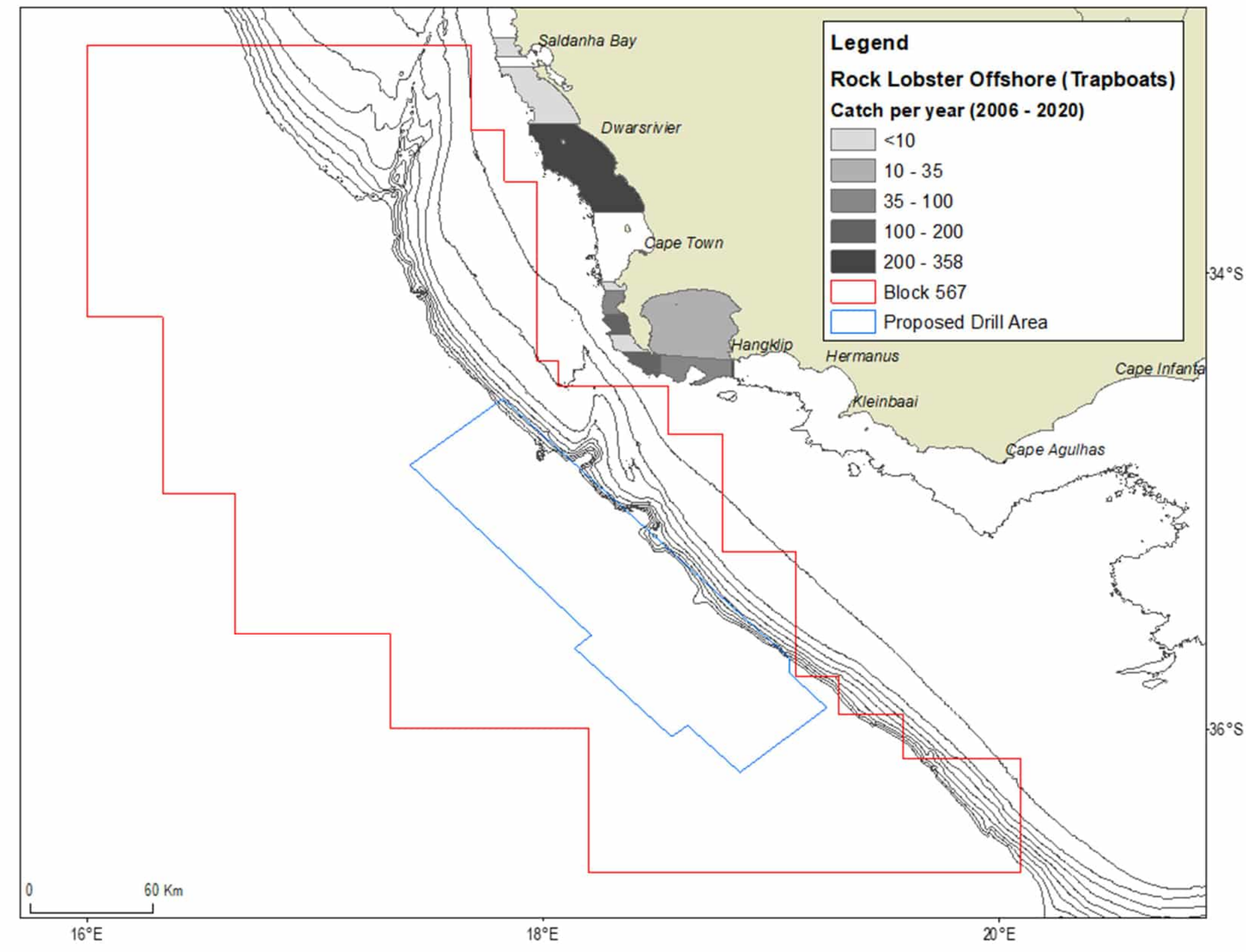

FIGURE 7-77: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF WEST COAST ROCK LOBSTER CATCH (2006-2020)

Source: CapMarine

7.8.10 South Coast Rock Lobster

The South Coast rock lobster (*Palinurus gilchristi*) occurs on the continental shelf of the South Coast inshore of 200 km but is restricted from operating far offshore by the Agulhas Current. Two areas are commercially viable to fish on the South Coast, the first is approximately 200 km offshore on the Agulhas Bank and the second is within 50 km of the shoreline between Mossel Bay and East London.

Figure 7-78 shows the spatial distribution of South Coast rock lobster fishing grounds in relation to Block 5/6/7 and the Area of Interest for proposed exploration drilling. Lobster fishing grounds situated on the Agulhas Bank lie adjacent to the eastern extent of the block; however, **there is no direct overlap of fishing grounds with either the licence block or the Area of Interest for proposed exploration drilling. The closest grounds are situated some 64 km from the proposed drilling area.**

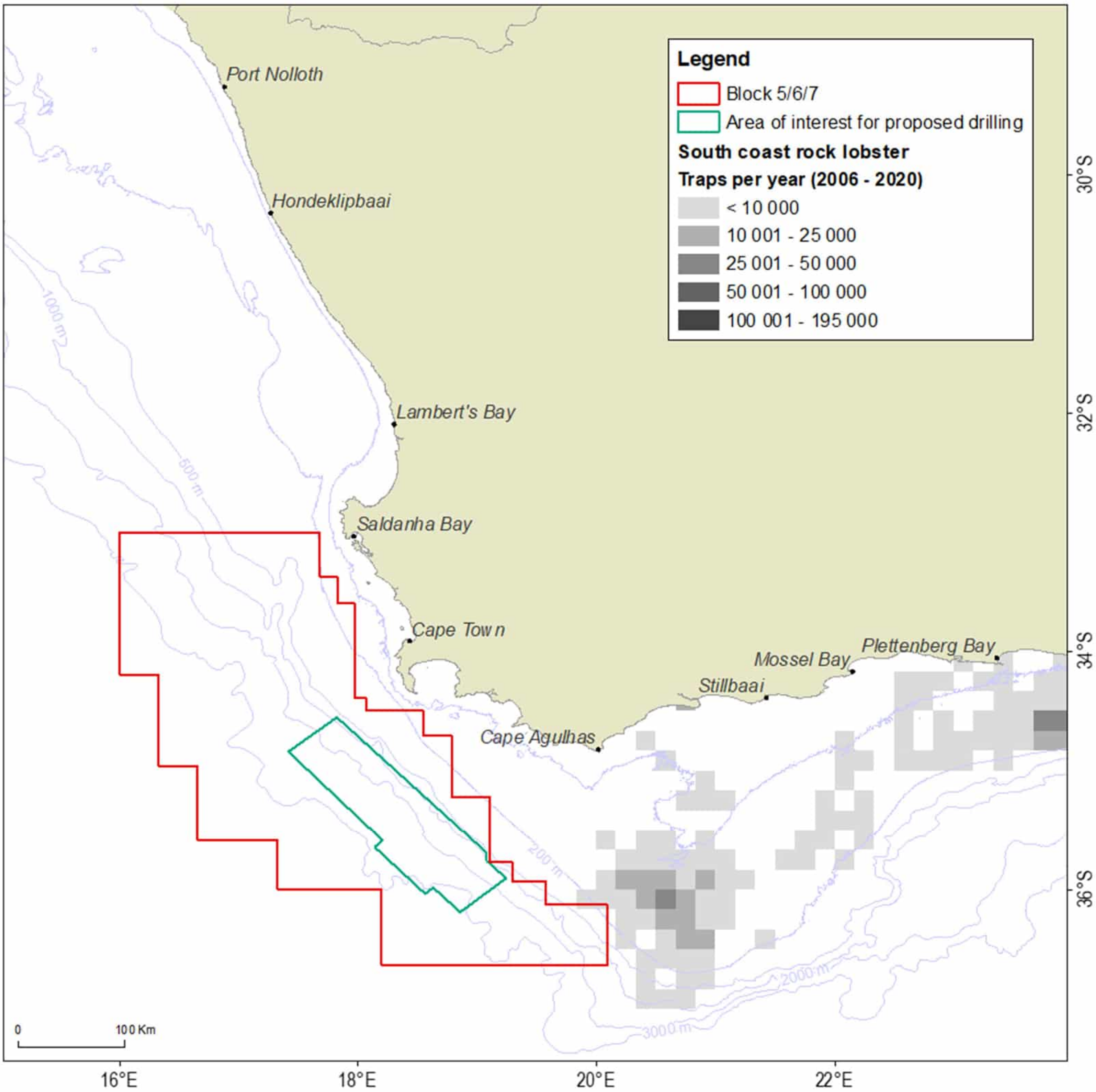

FIGURE 7-78: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF SOUTH COAST ROCK LOBSTER EFFORT (2006-2020)

Source: CapMarine

The South Coast rock lobster fishery is a deep-water longline trap fishery which entails the deployment of traps on the seafloor which are difficult to remove at short notice. Barrel-shaped plastic traps are set for periods ranging from 24 hours to several days. Each vessel typically hauls and resets approximately 2 000 traps per day in sets of 100 to 200 traps per line, which may be up to 2 km in length. Each line is weighted to lie along the seafloor and is connected at each end to a marker buoy at the sea surface. Vessels are large, ranging from 30 m to 60 m in length. Those with on-board freezing capacity will remain at sea for up to 40 days per trip, while those retaining live catch remain at sea between seven and 10 days before discharging at port.

7.8.11 Squid Jig

Chokka squid (*Loligo vulgaris reynaudii*) is distributed from the border of Namibia to the Wild Coast. Along the South Coast adult squid is targeted in spawning aggregations on fishing grounds extending from Plettenberg Bay to Port Alfred between 20 m and 120 m depths. The fishery is seasonal, with most effort conducted between November and March.

The main targeted areas are situated well away from Block 5/6/7 around Cape St Francis and Gqeberha; however, prior to 2016, sporadic fishing activity was reported off the South-West coast within the licence block (12 tonnes per annum between 2012 - 2015). Since 2016, there has been no catch reported within the licence block or the Area of Interest for proposed exploration drilling (see Figure 7-79).

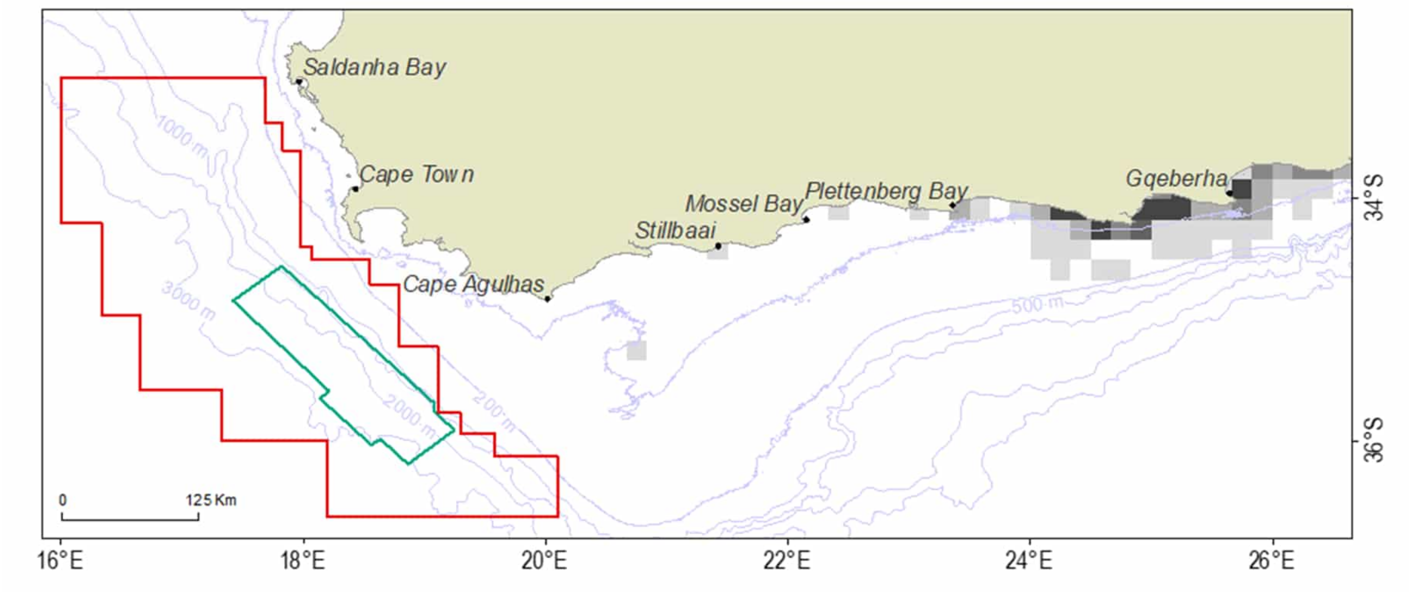

FIGURE 7-79: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF SQUID CATCH (2016-2020)
Source: CapMarine

The method of fishing involves hand-held jigs and bright lights which are used to attract squid at night. Vessels predominantly operate out of Cape St Francis and Gqeberha harbours.

The squid fishery is managed in terms of the Total Allowable Effort (TAE) allowed within the fishery, which in 2020/21 permitted 2 443 crew and 295 000 man-days of fishing during the season. There are two closed seasons totalling slightly more than four months: i) a permanent closed period of five weeks between October and November to allow for summer spawning; and ii) an additional three months in winter to prevent the man-days from exceeding the maximum. During the enforced annual five-week closure between October and November, DFFE undertakes a survey on spawning aggregations in the bay areas. The timing of closure is typically during March -May or April - June, which coincides with a drop in adult spawning activity and a reduction in catches.

7.8.12 White Mussels

White mussels are found in the intertidal zone of sandy beaches ranging from northern Namibia to the Eastern Cape of South Africa. Their abundance is highest along the West Coast because of the higher plankton production in that area compared with the rest of the South African coast, which is associated with upwelling of the Benguela Current. **Harvesting of white mussels is limited to seven areas along the West Coast** (see Figure 7-80), **the closest of which (between Melkbos and Bokpunt) is located between 107 km and 118 km to the north-east of the Area of Interest for proposed exploration drilling.**

Since 2007 this commercial sector has been managed by means of a TAE allocation of seven Right Holders (a Right Holder may have up to seven “pickers”), each harvesting within only one of the seven fishing areas along the West Coast. In 2013, the fishing Rights allocation process (FRAP 2013) for this fishery started and new Rights were granted in addition to those of some of the previous Right Holders. After an appeal process, 26 commercial Rights were confirmed in 2015, until December 2020. The Interim Relief sector was started in 2007 and during the 2013/2014 season, 1 995 Interim Relief permits were issued for the Western and Northern Cape combined. This sector is subject to a limit of 50 mussels per person per day. The recreational sector is also limited by a daily bag limit of 50 mussels per person per day.

It should be noted that not all the areas allocated are being harvested, and that the largest component of the overall catch of white mussels is that of the recreational sector, but these catches are not monitored.

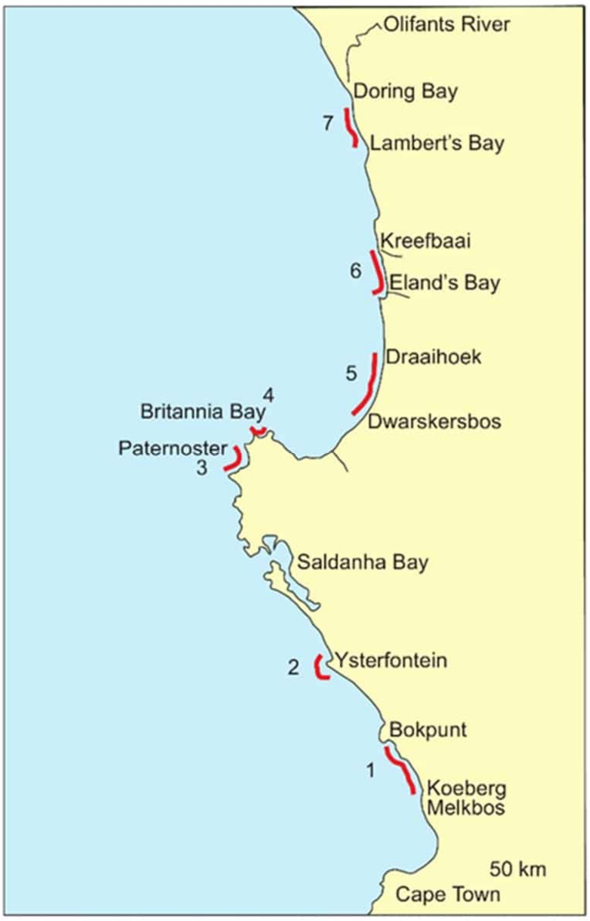

FIGURE 7-80: AREAS ALLOCATED FOR COMMERCIAL HARVESTING OF WHITE MUSSEL ALONG THE WEST COAST OF SOUTH AFRICA

Source: DFFE 2020

7.8.13 Oysters

The Cape rock oyster (*Striostrea margaritacea*) occurs on rocky reefs from Cape Agulhas to Mozambique and is targeted by the fishery along with smaller amounts of *Crassostrea gigas*. The harvesting of oysters is managed by DFFE within four broad areas namely, Southern Cape, Port Elizabeth, KwaZulu-Natal (KZN) North and KZN South. The coastal locations of boundaries between management zones for the Southern Cape area are shown in Figure 7-81.

Shore-based collectors pry oysters off rocks and sell the oysters locally. Harvesting takes place during spring low tides from the intertidal zone and shallow subtidal rocky reefs and areas of operation can be considered to extend from the shoreline to the 10 m depth contour.

Total catch in the Southern Cape region was at least 373 306 oysters in 2018. In 2019, there were 73 individuals listed with commercial rights to harvest oysters and these rights expired on 31 December 2020. From 1 January 2021 the sector was re-classified under the small-scale fisheries sector. Most oyster pickers sell to middlemen who in turn sell to local restaurants.

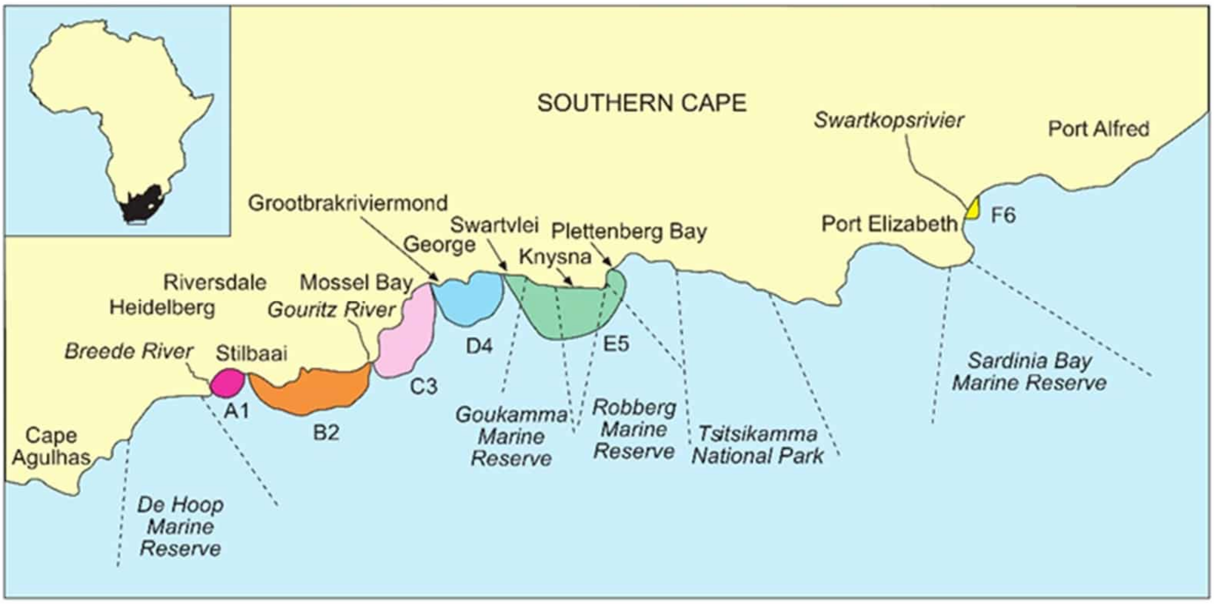

FIGURE 7-81: OYSTER FISHERY IN PORT ELIZABETH AND THE SOUTHERN CAPE. COLOUR AREAS DENOTE DEDICATED OYSTER COLLECTION ZONES

Note: Colour areas denote dedicated oyster collection zones
Source: DFFE 2020

7.8.14 Abalone

Abalone (*Haliotis midae*) are widely distributed around the South African coastline, from St Helena Bay on the West Coast to just north of Port St Johns on the East Coast. Once a lucrative commercial fishery, earning up to approximately R100 million annually at the turn of the century, rampant illegal harvesting and continued declines in the abundance of the resource resulted in the prohibition of recreational harvesting since 2003/4 and a total closure of the commercial fishery during the 2008/9 season. In 2010 the commercial fishery was reopened with an annual quota of 150 tonnes; however, this was reduced in 2013/14 to 96 tonnes and further reduced in 2019/2020 to 50.5 tonnes. Currently the fishery is commercial, however, DFFE proposes that 50% of the TAC be apportioned to small-scale fisheries, from 2021 (DFFE Government Gazette No. 1129, 23 October 2020)

Landings of abalone (kg), effort (hours) and catch per unit effort (CPUE) are managed by harvesting area (zones A to G) (see Figure 7-82). **Wild abalone may only be harvested by quota holders and are harvested by divers during specified harvesting seasons. The collection range is assumed to be from the coastline to 20 m depth contour, thus well inshore of the licence block and Area of Interest for proposed exploration drilling.**

In order to sustain and protect wild populations of abalone, they are bred in abalone farms along the South African coast. Land-based flow-through systems using pumped seawater are the most common abalone farming systems used in South African. Today there are 18 abalone farms along the South African coast, from Saldanha in the West Coast and along the South Coast up to the East Coast.

FIGURE 7-82: ABALONE FISHING ZONES A TO G, INCLUDING SUB-ZONES, AND DISTRIBUTION OF ABALONE (INSET)

Note: The experimental fisheries (2010/11-2013/14) on the western and eastern sides of False Bay and in the Eastern Cape are also shown. These areas within False Bay, included in the commercial fishery recommendations for 2017/18, are referred to as Sub-zone E3 and Sub-zone D3.
Source: DFFE 2020

7.8.15 Abalone Ranching

Abalone ranching is "where hatchery-produced seed are stocked into kelp beds outside the natural distribution" (Troell *et al.* 2006). Translocation of abalone occurs along roughly 50 km of the Namaqualand coast in the Northern Cape due to the seeding of areas using cultured spat (larvae) specifically for seeding of abalone in designated ranching areas (Anchor Environmental 2012). The potential to increase this seeded area to 175 km has been made possible through the issuing of "Abalone Ranching Rights" (Government Gazette, 20 August 2010 No. 729) in four concession zones for abalone ranching between Alexander Bay and Hondeklipbaai (Diamond Coast Abalone 2016) (see Figure 7-83). To date, seeding has only taken place in Zones 3 and 4, and not Zones 1 or 2. The maximum depth of seeding is considered to be approximately 10 m within each of the zones.

The licence block is situated 280 km south of ranching zone 4 (see Figure 7-83).

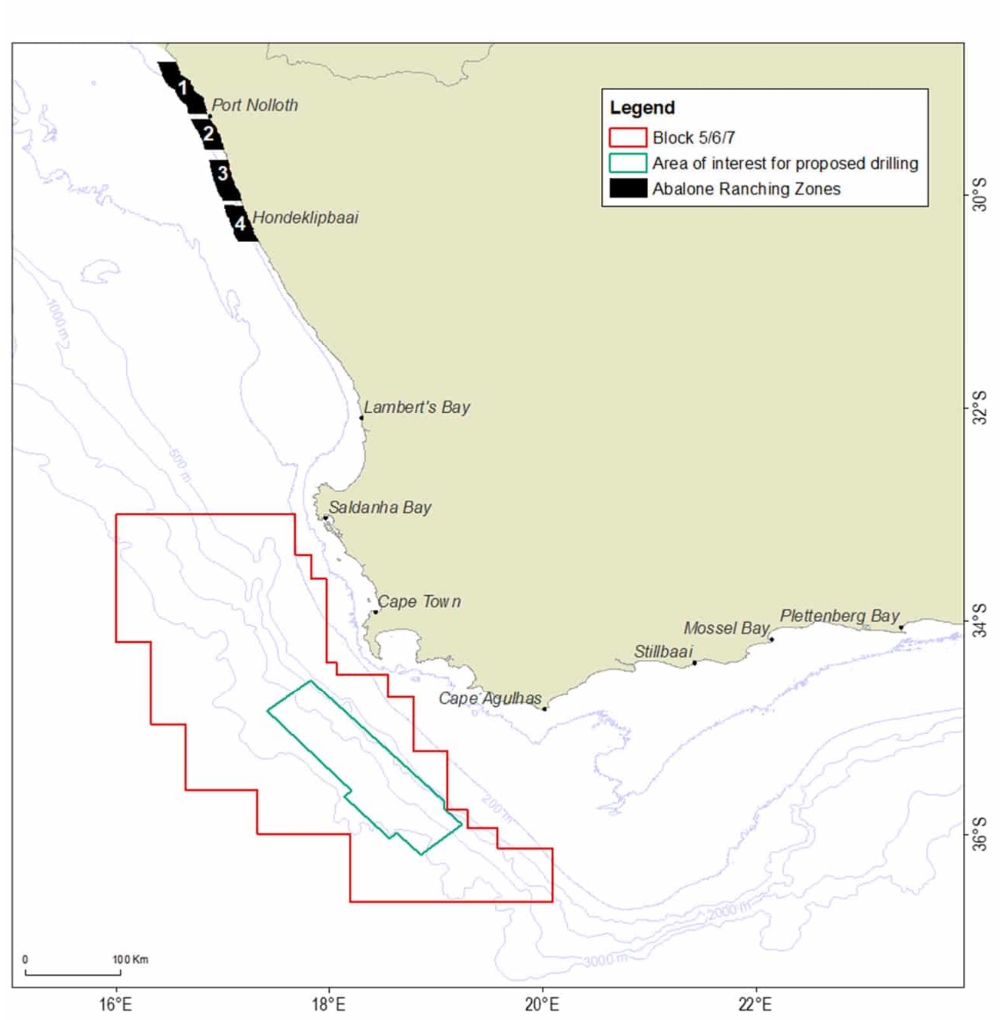

FIGURE 7-83: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO ABALONE RANCHING CONCESSION AREAS 1 – 4

Source: CapMarine

7.8.16 Beach-Seine and Gillnet Fisheries ("Netfish" Sector)

There are a several active beach-seine and gillnet operators throughout South Africa (collectively referred to as the "netfish" sector). Initial estimates indicate that there are at least 7 000 fishermen active in fisheries using beach-seine and gillnets, mostly (86%) along the West and South Coasts. These fishermen utilise 1 373 registered and 458 illegal nets and report an average catch of about 1 600 tonnes annually, constituting 60% harders (also known as mullet), 10% St Joseph shark and 30% "bycatch" species such as galjoen, yellowtail and white steenbras. Catch-per-unit-effort declines eastwards from 294 and 115 kg·net-day^{-1} for the beach-seine and gill-net fisheries respectively off the West Coast to 48 and 5 kg·net-day^{-1} off KwaZulu-Natal. Consequently, the fishery changes in nature from a largely commercial venture on the West Coast to an artisanal/subsistence fishery on the East Coast (Lamberth *et al.* 1997).

The fishery is managed on a TAE basis with a fixed number of operators in each of 15 defined areas (see Figure 7-84 for the fishing areas). The number of Rights Holders operating on the West Coast from Port Nolloth to False bay is listed as 28 for beach-seine and 162 for gillnet (DAFF 2021). Permits are issued solely for the capture of harders, St Joseph and species that appear on the 'bait list'. The exception is False Bay, where Right Holders are allowed to target line fish species that they traditionally exploited.

The beach-seine fishery operates primarily on the West Coast between False Bay and Port Nolloth (Lamberth 2006) with a few permit holders in KwaZulu-Natal targeting mixed shoaling fish during the annual winter migration of sardine (Fréon *et al.* 2010). Beach-seining is an active form of fishing in which woven nylon nets are rowed out into the surf zone to encircle a shoal of fish. They are then hauled shorewards by a crew of 6–30 persons, depending on the size of the net and length of the haul. Nets range in length from 120 m to 275 m. Fishing effort is coastal and net depth may not exceed 10 m (DAFF 2014b).

The gillnet fishery operates from Yzerfontein to Port Nolloth on the West Coast. Surface-set gillnets (targeting mullet) are restricted in size to 75 m x 5 m and bottom-set gillnets (targeting St Joseph shark) are restricted to 75 m x 2.5 m (da Silva *et al.* 2015) and are set in waters shallower than 50 m. The spatial distribution of effort is represented as the annual number of nets per kilometre of coastline.

The range of gillnets (50 m) and that of beach-seine activity (20 m) will not overlap with the licence block or all of which offers inshore of Block 5/6/7 and the Aera of Interest for proposed exploration drilling. Figure 7-85 shows the expected range of gillnet fishing activity off the west coast of South Africa.

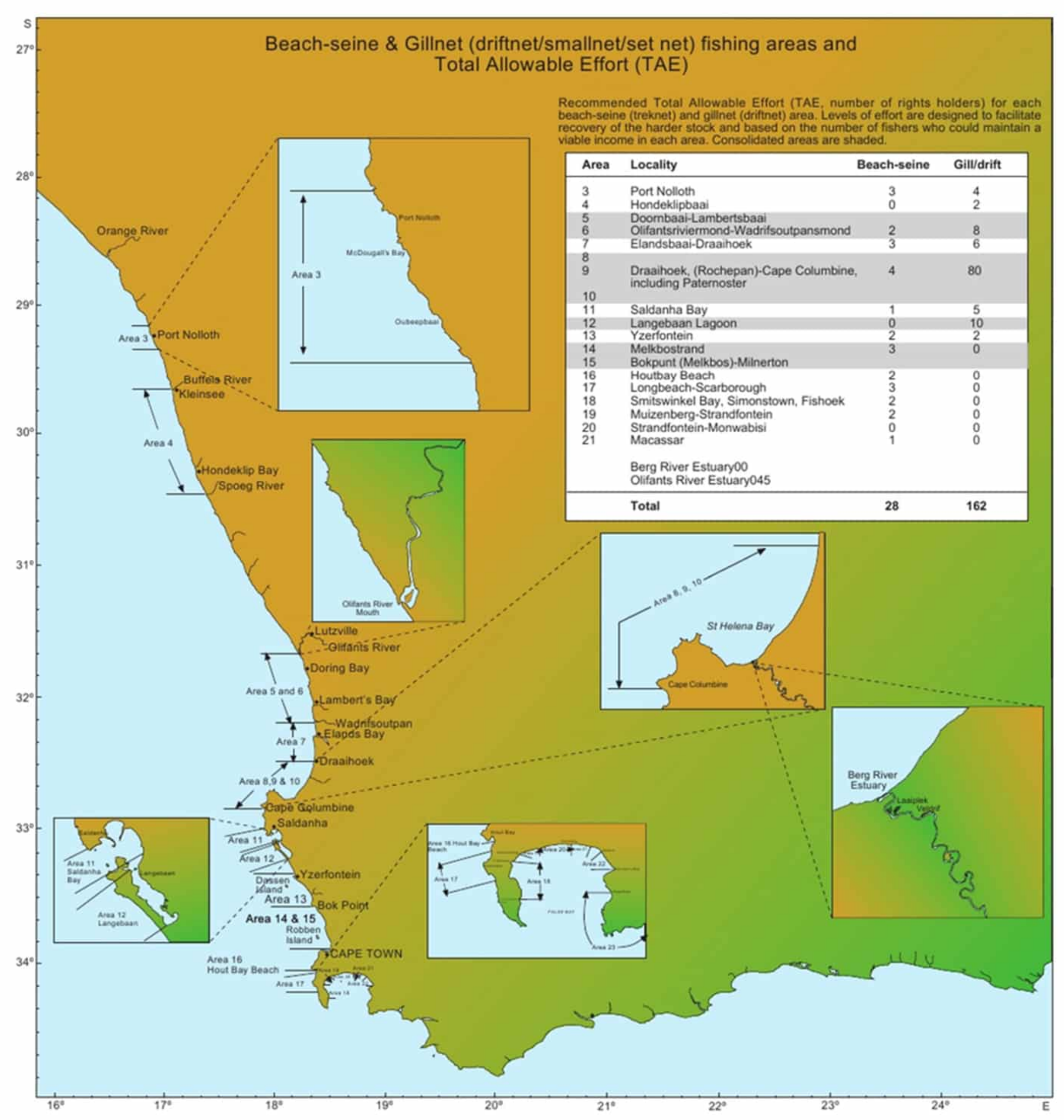

FIGURE 7-84: BEACH-SEINE AND GILLNET FISHING AREAS AND TAE
Source: DAFF 2014

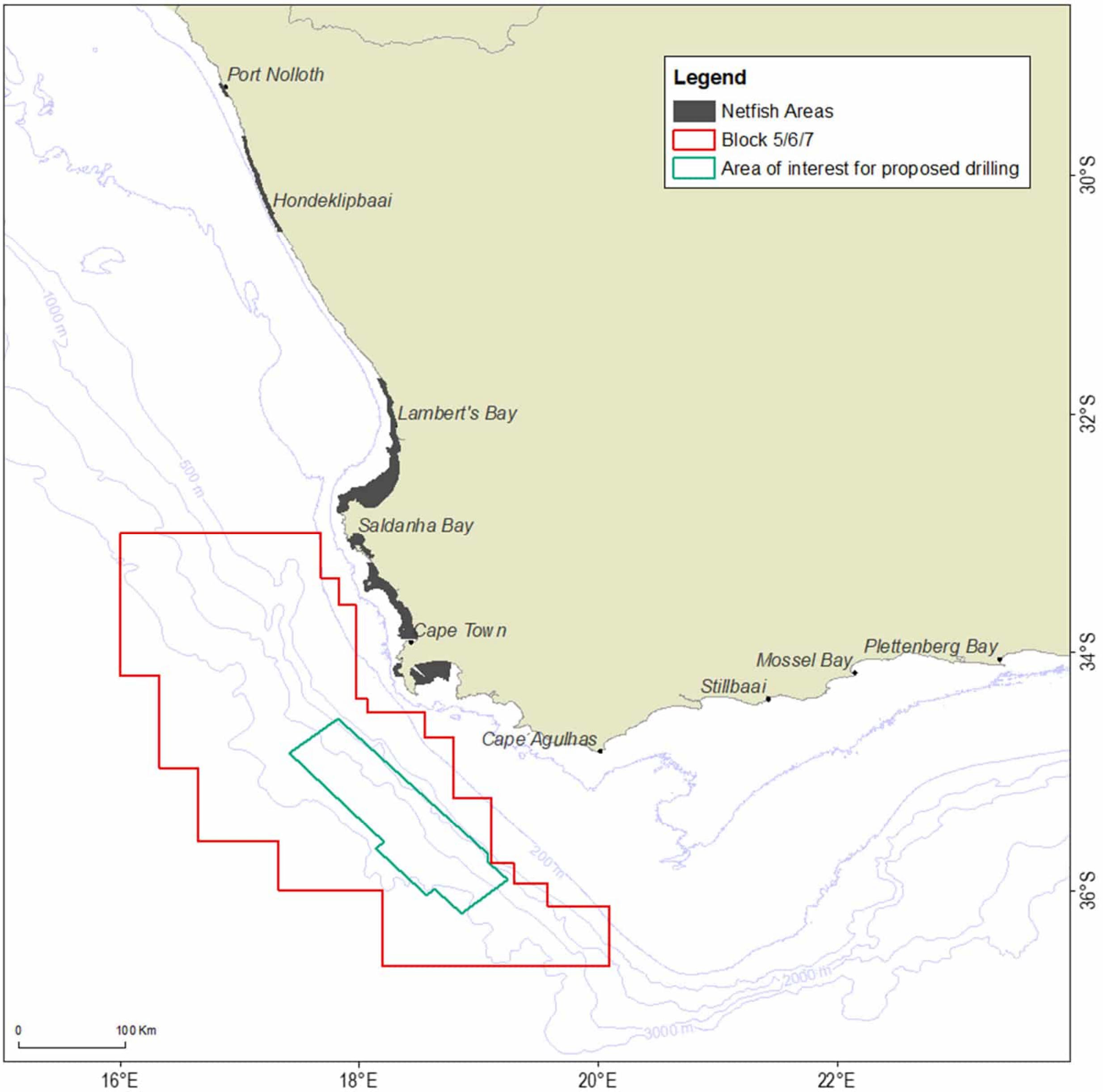

FIGURE 7-85: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE NETFISH (GILLNET AND BEACH-SEINE) FISHING AREAS

Source: DAFF 2016/17

7.8.17 Seaweed

The South African seaweed industry is based on the commercial collection of kelps (*Ecklonia maxima* and *Laminaria pallida*) and red seaweed (*Gelidium spp*.) as well as small quantities of several other species. In the Northern and Western Cape, the industry is currently based on the collection of beach-cast kelps and harvesting of fresh kelps. Beach-cast red seaweeds were collected in Saldanha Bay and St Helena Bay, but there has been no commercial activity there since 2007. *Gelidium* species are harvested in the Eastern Cape (DAFF 2014a).

The seaweed sector employs approximately 1 700 people, 92% of whom are historically disadvantaged persons. Much of the harvest is sun-dried, milled and exported for the extraction of alginate. Fresh kelp is also harvested in large quantities in the Western Cape as feed for farmed abalone. This resource, with a market value of about

R6 million is critically important to local abalone farmers. Fresh kelp is also harvested for high-value plant-growth stimulants that are marketed locally and internationally.

The South African coastline is divided between Port Nolloth and Port St Johns into 23 harvesting areas. Fourteen commercial seaweed harvesting rights are currently allocated and each concession area is limited to one right-holder for each functional group of seaweed (e.g., kelps, *Gelidium spp*. and *Gracilarioids*). **The Area of Interest fort proposed exploration drilling lies offshore of Kelp collection areas 5 – 11** (see Figure 7-86) **and the depth range at which divers can harvest kelp.**

Over the period 2000 to 2017, an average of 4560 tonnes per annum of dry harvested kelp (beach cast) and 367 tonnes per annum of wet harvested kelp were reported within collection areas 5 to 11. An additional 1 397 tonnes per annum of kelp was harvested for fertilizer. Amounts harvested within these collection areas amounts to approximately 98.5% of the total kelp harvests, nationally.

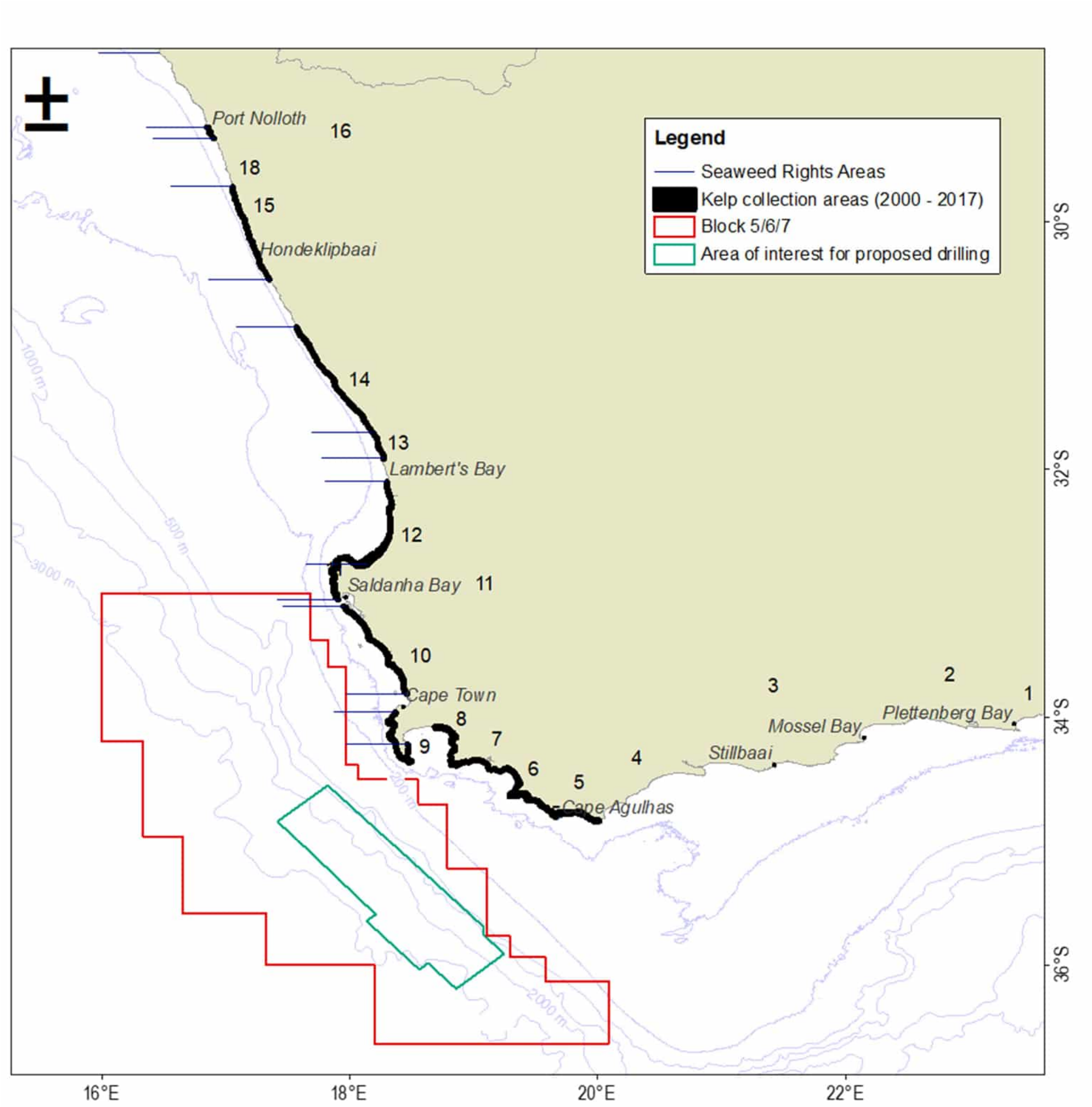

FIGURE 7-86: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO SEAWEED RIGHTS AREAS (NUMBERED) AND KELP COLLECTION AREAS

Source: DAFF 2016/17

7.8.18 Aquaculture / Mariculture

In support of the Government's Operation Phakisa to implement the National Development Goals and boost economic growth, a Strategic Environmental Assessment (SEA) was undertaken in 2019 (CSIR 2019) for the purpose of identifying and assessing aquaculture development zones (ADZs) to streamline and accelerate authorisation of aquaculture projects. Eight ADZs were proposed around South Africa's coastline of which three lie on the South Coast: Hermanus-Arniston, George-Gouritz and Port Elizabeth zones (see Figure 7-87). A rapid increase in the type and scale of aquaculture is expected over the next few years (DFFE 2019).

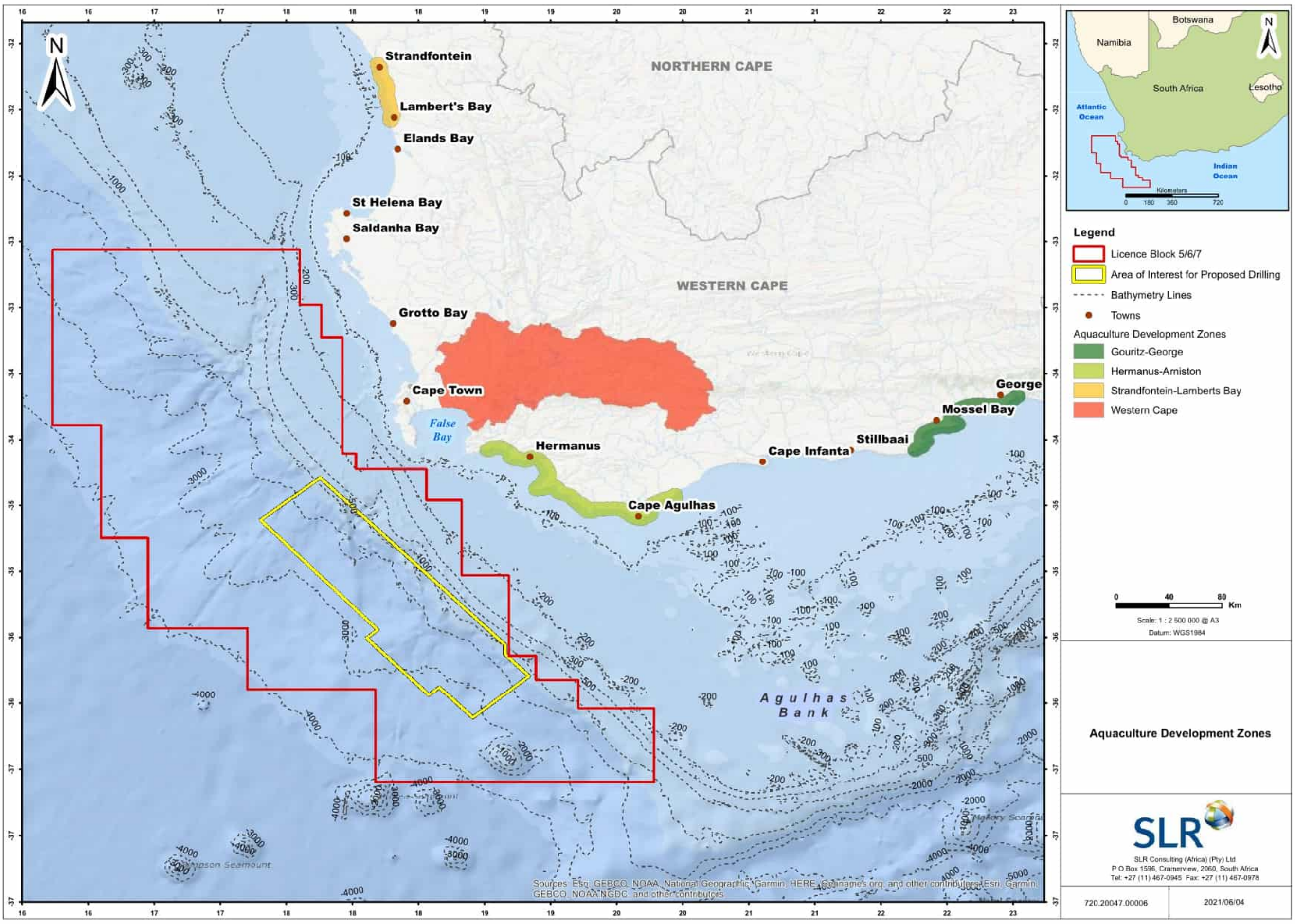

FIGURE 7-87: PROPOSED MARINE AQUACULTURE DEVELOPMENT ZONES (ADZS)
Source: DFFE 2019

Currently, 39 aquaculture farms operate in South Africa, with 12 located along the South Coast. Several farms produce multiple products, while 20 aquaculture operations produce abalone (some also produce seaweed as a by-product), 14 produce mussels, 12 produce oysters and five produce finfish, one of which is for the ornamental aquarium fish market (DFFE 2019).

Finfish currently farmed include dusky kob and yellowtail and the exotic salmonids (Atlantic salmon, Coho salmon and king salmon). The indigenous shellfish species currently being farmed include abalone, black mussel and oysters while alien shellfish farmed include brown mussel, Mediterranean mussel, Pacific oyster, two clam species (*Mactra glabrata*, *Venerupis corrugatus*), the scallops (*Argopecten purpurat*us and *Pecten sulciostatus*) (DFFE 2019). Abalone are typically farmed in land-based tanks with 'pump ashore' technology, while other shellfish are farmed on rafts or longlines offshore. Finfish are farmed in sea-based cages or land-based re-circulation systems (DFFE 2016).

Most of the farms are presently experimental or of a small-scale commercial nature and collectively produced only 3 592 tonnes in 2015 with 3 309 tonnes (92%) produced in the Western Cape. Mussels currently provide the highest biomass at 1 479 (Massy, *et al.* 2019). It may be expected that the scale of production at individual farms will increase over time along with the number of farms and the variety of products within the ADZ's, particularly of finfish (DFFE 2019).

Aquaculture operations nearest to the Area of Interest for proposed exploration drilling are at Kleinmond / Hermanus / Gansbaai (approximately 100 km north-east) and at the Saldanha ADZ (160 km north).

7.8.19 Small-Scale Fisheries

The concept of Small-Scale Fisheries (SSF) is a relatively new addition to the fisheries complexity in South Africa. The concept has its origin in a global initiative supported by the Food and Agricultural Organisation of United Nations (FAO). In South Africa, there is a long history of coastal communities utilising marine resources for various purposes. Many of these communities have been marginalized through apartheid practices and previous fisheries management systems. In 2007 government was compelled through an equality court order to redress the inequalities suffered by these traditional fishers. The development of a SSF sector aims in part to compensate previously disadvantaged fishing communities that have been displaced either politically, economically or by the development of large-scale commercial fisheries. This led to the development of the SSF Policy, which was gazetted in May 2019 under the Marine Living Resources Act, 1998 (No. 18 of 1998) and is only now (2021/22) in an advanced process of implementation. It is a challenging process that has been exacerbated by the conflict and overlap with another fisheries-related process of fishing rights allocations (known as Fishery Rights Allocation Process or "FRAP"). Neither process have, as of February 2022, been concluded and the issues at stake are highly politicised. The SSF does, however, overlap with other historical fisheries in South Africa and there are also legal challenges where the SSF rights allocations conflict with other established commercial fishing sectors, most notably the commercial squid fishing sector.

SSF fish to meet food and basic livelihood needs, but may also directly be involved in fishing for commercial purposes[28]. These fishers traditionally operate on nearshore fishing grounds to harvest marine living resources on a full-time, part-time or seasonal basis. Fishing trips are usually of short-duration and fishing / harvesting

[28] There is no formal designation of artisanal (or subsistence) fishing in South Africa, which is generally considered as fishing or resource extraction for own use. As fisheries have evolved and the commercial benefit realised, subsistence fishers have increasingly moved to commercialisation aimed at supporting their livelihoods. This group can now, therefore, also include shore and boat-based anglers and spear-fishers who target a wide range of line fish species, some of which are also targeted by commercial operations, skin divers who collect rock lobsters and other subtidal invertebrates, bait collectors (mussels, limpets, red bait) and non-subsistence collectors of intertidal organisms. The high value of many intertidal and subtidal resources (e.g. rock lobster, abalone and mussels) has resulted in an increase in their production through aquaculture and small-scale harvesting in recent years (Clark, Hauk, Harris, Salo, & Russell 2010).

techniques are labour intensive[29]. Many communities living along the coast have, over time, developed local systems of rules to guide their use of coastal waters (customary law). These fishers are generally localised and do not range far beyond the areas in which they reside.

SSF resources are managed in terms of a community-based co-management approach that aims to ensure that harvesting and utilisation of the resource occurs in a sustainable manner. The SSF is to be implemented along the coast in series of community co-operatives. Applicants for small-scale fishing rights must have a historical involvement in traditional fishing operations and show a historical dependence on deriving the major part of their livelihood from traditional fishing operations.

More than 270 communities have registered an Expressions of Interest with the DFFE. The location of these coastal communities and the number of fishers per community are shown in Figure 7-88. DFFE has split SFF by communities into district municipalities and local municipalities.

- In the **Northern Cape**, communities are grouped into the Namakwa district, comprising the Richtersveld and Kamiesberg local municipalities and there are **103 registered fishers** in the province.
- **Western Cape** districts include 1) West Coast (Berg River, Saldanha Bay, Cederberg, Matzikama and Swartland local municipalities; 2) Cape Metro; 3) Overberg (Overstrand and Cape Agulhas); and 4) Eden (Knysna, Bitou and Hessequa). In total there are **2 748 fishers registered** in the province.
- In the **Eastern Cape**, the communities are split up, broadly as 1) Nelson Mandela Bay, 2) Sarah Baartman, 3) Buffalo City, 4) Amathole, 5) O.R. Tambo and 6) Alfred Nzo. There are **5 154 fishers registered** in the province.
- **KwaZulu-Natal** has **2 008 registered small-scale fishers** divided by district into 1) Ugu, 2) Ethekwini Metropolitan, 3) Ilembe, 4) King Shwetshayo/Uthungula, and 5) Umkhanyakude.

Approximately 10 000 small-scale fishers have been identified around the coast. **The licence block is situated offshore of the West Coast, City of Cape Town and Overberg municipal districts. Between Saldanha Bay and Cape Agulhas, 68 communities have been registered for small-scale fishing rights, these co-operatives comprise a total of 2 031 fishers.** At this point in time, no discreet co-operatives are active, except for on the West Coast in Port Nolloth.

The SSF Policy requires a multi-species approach to allocating rights, which entails the allocation of rights for a basket of species that may be harvested or caught within particular designated areas. Co-operatives can only request access to species found in their local vicinity. DFFE recommends five basket areas:

1. Basket Area A –Namibian border to Cape of Good Hope – 57 different resources;
2. Basket Area B – Cape of Good Hope to Cape Infanta – 109 different resources;
3. Basket Area C – Cape Infanta to Tsitsikamma – 107 different resources;
4. Basket Area D – Tsitsikamma to the Pondoland MPA – 138 different resources; and
5. Basket Area E – Pondoland MPA to the Mozambican border – 127 different resources.

[29] The equipment used by small scale fishers includes rowing boats in some areas, motorized boats on the south and west coast and simple fishing gear including hands, feet, screw drivers, hand lines, prawn pumps, rods with reels, gaffs, hoop nets, gill nets, seine/trek nets and semi-permanently fixed kraal traps.

The mix of species to be utilised by small-scale fishers includes species that are exploited by existing commercial sectors viz; traditional linefish, west coast rock lobster, squid, hake handline[30], abalone, KZN beach seine, netfish (gillnet and beach-seine), seaweed and white mussel. An apportionment of TAE/TACs for these species will be transferred from existing commercial rights to SSF[31], whereas white mussels will become the exclusive domain of SSF. Species nominated for commercial use will be subject to TAE and/or TAC allocation. Species nominated for own use will be available to all members of a particular co-operative, but subject to output controls.

The SSF rights cover the nearshore area (defined in Section 19 of the Marine Living Resources Act, 1998 as being within close proximity of shoreline). SSF along the Northern Cape and Western Cape coastlines are typically involved in the traditional line, west coast rock lobster and abalone fisheries, whereas communities on the South Coast are involved in traditional line, squid jig and oyster harvesting. The small-scale communities on the West Coast, with long family histories of subsistence fishing, prioritise the harvest of nearshore resources (using boats) over the intertidal and subtidal resources (Clark, Hauk, Harris, Salo, & Russell 2010).

Snoek (*Thyrsites atun*), Cape bream / hottentot (*Pachymetopon blochii*) and yellowtail (*Seriola lalandi*) are important linefish species that are targeted by SSF operating nearshore along the West and South-West Coast of South Africa (refer to Section 7.8.8). Snoek is targeted by small-scale fishers during the snoek seasonal migration (between April and June), during which time they shoal nearshore and are, therefore, available by handline. Fishers also target West Coast rock lobster (*Jasus lalandii*) using hoopnets set by small "bakkies" on suitable reefs at a water depth of less than 30 m. Fishing activity may range up to 100 m water depth by the larger vessels that participate in the offshore commercial rock lobster trap sector (refer to Section 7.8.9). The harvesting of wild abalone along the South-West Coast is expected to range to a maximum water depth of 20 m (refer to Section 7.8.14). Catches of chokka squid (*Loligo vulgaris reynaudii*) off the South Coast rarely exceed a water depth of 60 m (refer to Section 7.8.11). The collection of oysters (*Striostrea margaritacea*) along the South Coast is confined to intertidal and shallow sub-tidal areas (refer to Section 7.8.13).

The small-scale fisheries off the West and South Coasts are unlikely to operate beyond a range of 15 km from the coastline, well in shore of the Area of Interest for proposed drilling.

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[30] Hake handline is a small subsector of the hake fishery and requires a fishing right apportionment. The fishery has in recent years not been active because of resource availability. It is perceived as having potential for allocation as part of the SSF and as part of their "basket".

[31] DFFE proposes that, commencing January 2021, 50% of the overall TAE and TAC for the traditional linefish and abalone sectors, respectively, will be apportioned to small-scale fishing whereas 25% of the overall TAE for squid will be apportioned to small-scale fishing (DEFF 2020).

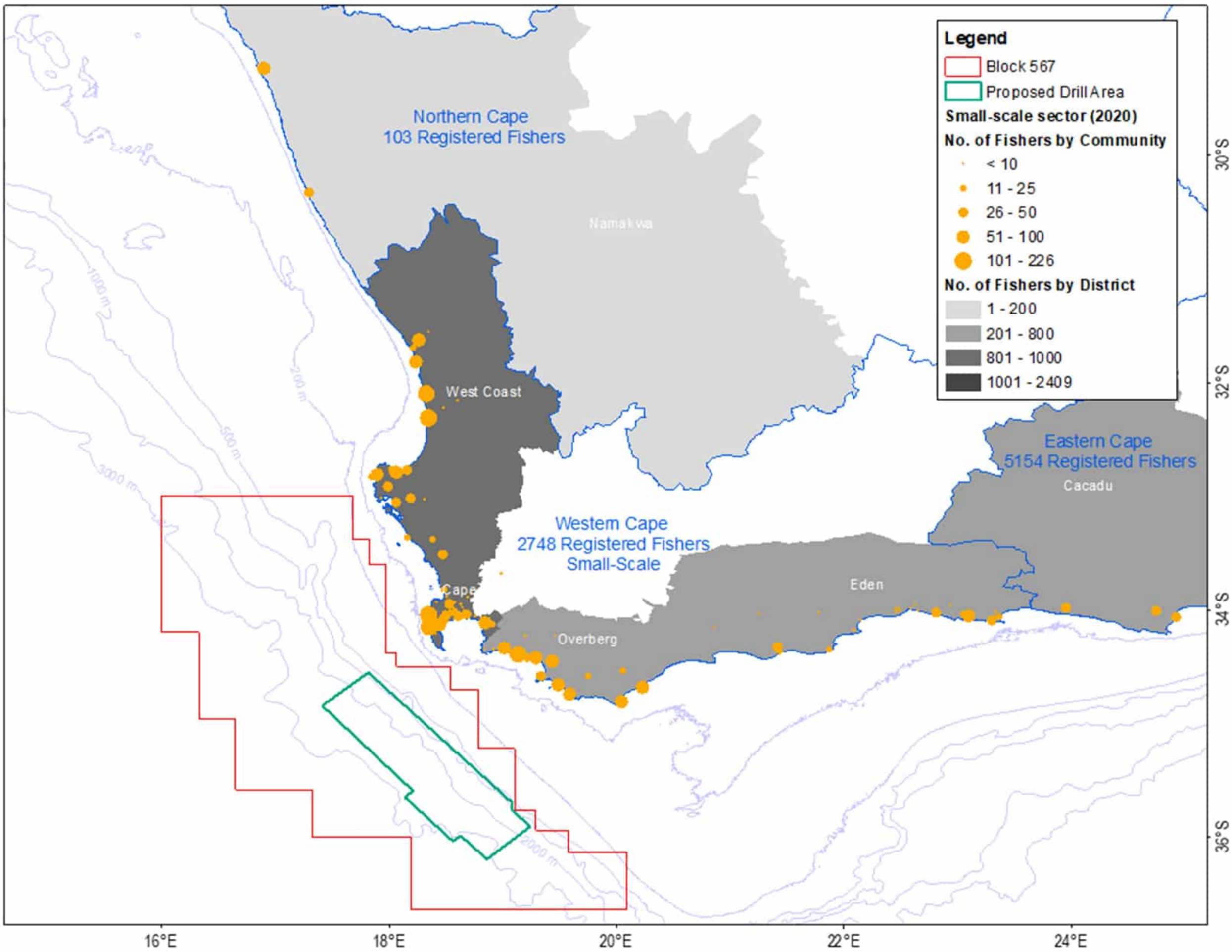

FIGURE 7-88: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE SPATIAL DISTRIBUTION OF SMALL-SCALE FISHING COMMUNITIES ALONG THE WEST AND SOUTH COAST

Source: CapMarine

7.8.20 Recreational Fishing

Recreational fishing is defined as non-commercial (not for profit). It is extensive around the coast and depends on vessel size. Offshore small recreational or pleasure vessels are limited by their certification – which varies from Category E (limited to a distance of 1 nautical mile from shore and 15 nautical miles from an approved launch site) to Category C (15 miles offshore), Category B (limited to day or night passages, but within 40 nautical miles of the coastline) to Category A (allowing for extended or ocean passage). Most recreational craft are Category C certified with some commercial recreational charter craft having a Category B certification. Thus, **most recreational or pleasure vessels would technically not be authorised to travel the 32 nautical miles (60 km) to the area of intertest for proposed exploration drilling.**

Recreational fishing includes subsets of numerous commercial, fisheries such as linefish, West and East Coast lobster, spearfishing, squid, abalone, crabs and many other species. Recreational fishers need permits and have restrictions on how much they can "take" seasonally and at anyone fishing event.

7.8.21 Illegal, Unreported and Unregulated (IUU) Fishing

In 1977 South Africa declared its EEZ, 200 nautical miles seaward from the coastal baselines. Following the coming into force of the United Nations Convention on Law of the Sea, 1982 (UNCLOS) on 16 November 1994, South Africa passed the Maritime Zones Act, 1994 (No. 15 of 1994) affirming its rights and obligations within its EEZ. In light of this, South African strictly regulates fishing activity within its own EEZ and the area is regularly patrolled by a fleet of Offshore Environmental Protection Vessels operated by DFFE. The South African Navy also patrols offshore regions, whilst the South African Police Service patrols areas within its jurisdiction (within 24 nm of the coast). Legislation also requires all foreign fishing vessels entering the South African EEZ to apply for an EEZ permit and vessels are required to switch on their Automatic Identification System (AIS), which is monitored by the DFFE Vessel Monitoring System (VMS) operations room.

Considering that Block 5/6/7 is situated predominantly offshore of the continental shelf in water depths exceeding 700 m, the risk of IUU fishing is, most likely, related to large pelagic longlining and large-scale tuna longline vessels. Vessels entering the EEZ to fish illegally, without reporting on its AIS, would be regarded with suspicion by other vessels operating legally in the area. Since Block 5/6/7 is located near well established and strictly regulated fishing grounds (including demersal trawl, tuna longline and tuna pole), any illegal fishing is unlikely to go unnoticed and any suspicious activity / vessels would more than likely be reported to the authorities.

Thus, whilst South Africa experiences difficulties with land-based coastal fish and abalone poaching activities, offshore areas are not considered viable for large-scale illegal fishing activity, especially in the Area of Interest for proposed exploration drilling.

7.8.22 Fisheries Research

7.8.22.1 Demersal Research Surveys

Trawl surveys of demersal fish resources are carried out twice a year by DFFE in order to assess stock abundance. Results from these surveys are used to set the annual TACs for demersal fisheries.

- The West Coast survey extends from Cape Agulhas (20°E) to the Namibian maritime boarder and takes place over the duration of approximately one month during January/February.
- The South-East coast survey (20°E – 27°E longitude) takes place in April/May.

Following a stratified, random design, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m isobath. On occasion, trawls are targeted in waters deeper than 1 000 m. Figure 7-89 shows the distribution of research trawls undertaken in relation to the licence block and area of interest.

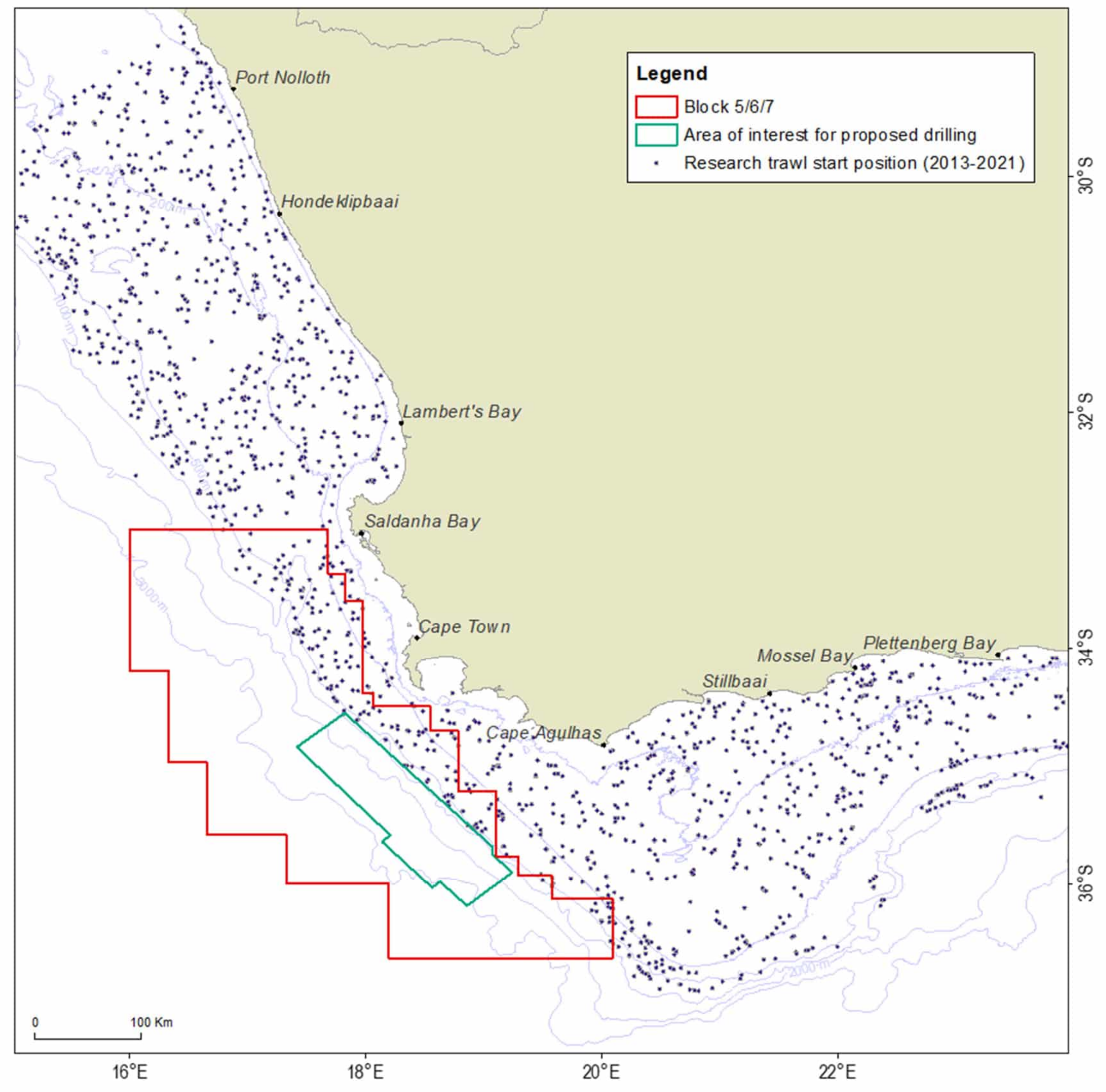

FIGURE 7-89: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO DEMERSAL RESEARCH SURVEYS (2013-2021)

Source: CapMarine

7.8.22.2 Small Pelagic Research Surveys

The biomass of small pelagic species is assessed bi-annually by an acoustic survey. The first of these surveys is timed to commence in mid-May and runs until mid-June, while the second starts in mid-October and runs until mid-December. The timing of the demersal and acoustic surveys is not flexible, due to restrictions with availability of the research vessel as well as scientific requirements.

During these surveys, the survey vessels travel pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m isobath. The surveys are designed to cover an extensive area from the Orange River on the West Coast to Port Alfred on the East Coast and the survey vessel progresses systematically from the northern border southwards, around Cape Agulhas and on towards the east. Figure 7-90 shows the research survey transects undertaken by DFFE in November 2020 and May 2021 in relation to the licence block and area of interest.

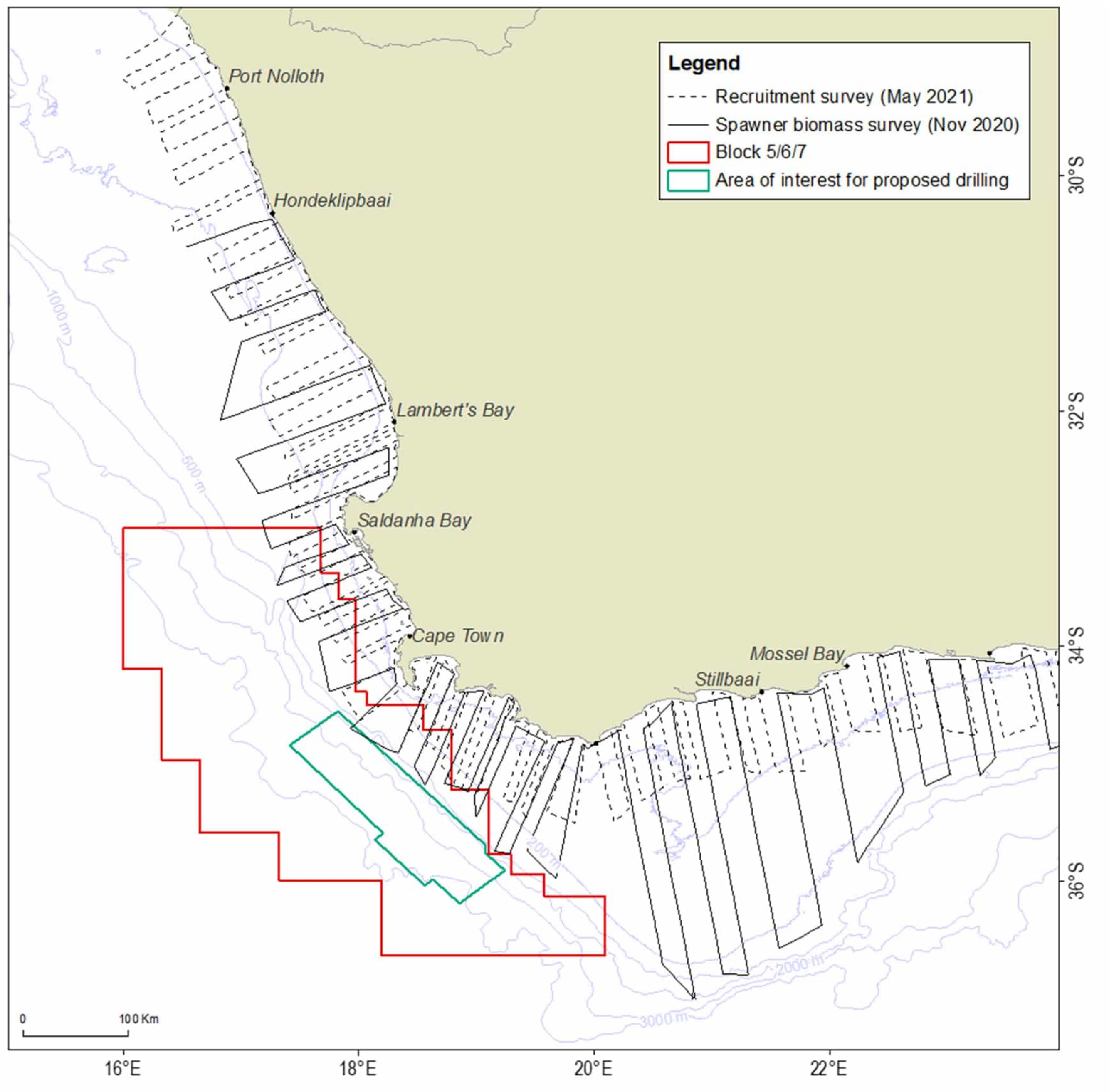

FIGURE 7-90: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO BIOMASS RESEARCH SURVEYS (NOVEMBER 2020 AND MARCH 2021)

Source: CapMarine

7.8.23 Summary of Fishing Activities in Project Area

Table 7-16 provides a list of fisheries sectors that operate off the South-West Coast, the seasonality of fishing effort by sector and relative intensity of fishing effort on a month-by-month basis within the project area.

TABLE 7-16: SUMMARY TABLE SHOWING SEASONAL VARIATION IN FISHING EFFORT EXPENDED BY EACH OF THE MAIN COMMERCIAL FISHERIES SECTORS IN SOUTH AFRICAN EEZ

Sector	Targeted Species	% Overlap with Area of Interest		Fishing Intensity by Month (H = high; M = Low to Moderate; N = None)											
		Effort	Catch	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Demersal Trawl	Hake, monkfish, kingklip, snoek	0.16	0.27	H	H	H	H	H	H	H	H	H	H	H	H
Midwater Trawl	Cape horse mackerel	0	0	H	H	H	H	H	H	H	H	H	H	H	H
Demersal Hake Longline	Hake, kingklip	0.1	0.12	M	H	H	H	H	H	H	H	H	H	H	H
Demersal shark longline	Shark species	0	0	M	M	M	M	M	M	M	M	M	M	M	M
Small Pelagic Purse-Seine	Sardine, anchovy, round herring	0	0	M	H	H	H	H	H	H	H	H	H	H	M
Large Pelagic Longline	Tuna species, swordfish and shark species	7.25	5.79	M	M	M	M	H	H	H	H	H	H	H	M
Tuna Pole-Line	Tuna species	12.54	13.74	H	H	H	H	H	M	M	M	M	M	H	H
Traditional Linefish	Snoek, hottentot, geelbek, kob, yellowtail	0	0	H	M	M	M	M	M	M	M	M	M	M	H
West Coast Rock Lobster	West Coast Rock Lobster	0	0	M	M	M	M	M	M	M	M	N	M	M	M
South Coast Rock Lobster	South Coast Rock Lobster	0	0	H	H	H	H	H	M	M	M	M	H	H	H
Squid Jig	Squid	0	0	H	H	M	N	N	N	M	M	M	N	N	H
Small-scale (line fish & rock lobster nearshore sectors)	Various	0	0	M	M	M	M	M	M	M	M	M	M	M	M
Demersal Research Survey (trawl)	Hake, monkfish, kingklip	-	-	M	M	N	N	M	M	N	N	M	M	N	N
Pelagic Research Survey (acoustic)	Small pelagic species	-	-	N	N	M	M	M	M	N	N	N	M	M	N

Source: CapMarine

7.9 OFFSHORE MARINE AND COASTAL INFRASTRUCTURE AND ACTIVITIES

7.9.1 Marine Traffic and Transport

A large number of vessels navigate along the West, South and East Coasts on their way around the southern African subcontinent. The majority of shipping traffic is located on the outer edge of the continental shelf (between 22 and 44 km offshore) (see Figure 7-91), with traffic inshore of the continental shelf along the South-West Coast largely comprising fishing vessels. Therefore, **a significant amount of ship traffic can be expected to pass through the inshore portion of Block 5/6/7, although to a slight lesser extent through the Area of Interest for proposed exploration drilling, as its inshore boundary is on the outer edge of the continental shelf.** Project vessels travelling between the Area of Interest and the onshore logistics base could thus interfere with this key shipping route.

Important harbours along the South-West Coast include Cape Town, Hout Bay, St Helena Bay, Saldanha Bay, Hermanus, Gansbaai, Struis Bay, Arniston and Still Bay.

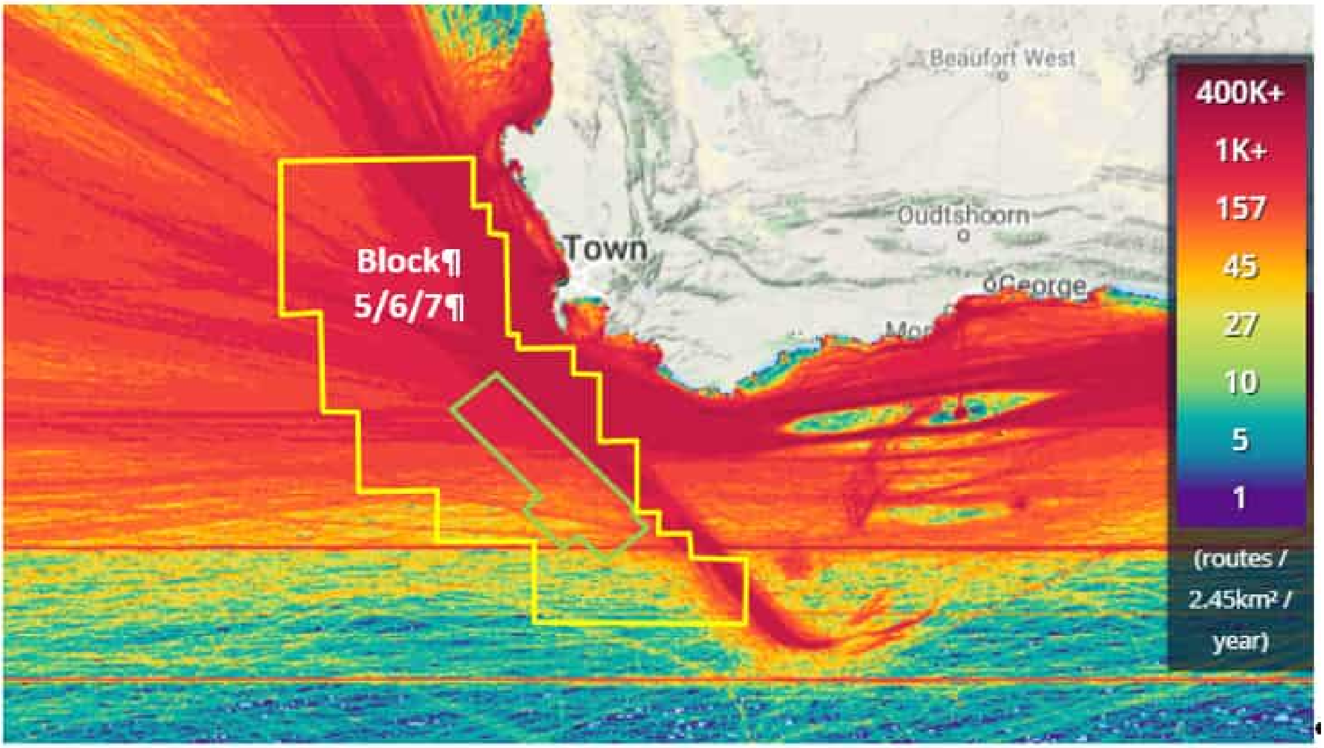

FIGURE 7-91: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO THE MAJOR SHIPPING ROUTES OFF THE SOUTH-WEST / SOUTH COAST

Source: http://www.marinetraffic.com/, accessed 26 May 2021

7.9.2 Exploration, Production and Mining

7.9.2.1 Oil and Gas Exploration and Production

Oil and gas exploration and production is currently undertaken in various licence blocks off the West, South and East coasts of South Africa (see Figure 7-92). **In the order of 358 wells have been drilled in the South African offshore environment to date** (based on shapefile provided by PASA in 2021), **the majority of which have been drilled off the South Coast on the Agulhas Bank. Two wells were previously drilled by Soekor within Block 5/6/7**; one of which was a "dry" well, while the other well showed signs of gas (see Figure 7-93).

There is no current development or production from the South African West Coast offshore. The Ibhubesi Gas Field (Block 2A) (off West Coast, approximately 220 km north of Block 5/6/7) **and Kudu Gas Field** (off southern Namibia) **have been identified for development. On the South Coast, PetroSA operates the F-A production platform**, which was brought into production in 1992. The F-A platform is located 85 km south of Mossel Bay in a water depth of 100 m. Gas and associated condensate from the associated gas fields are processed through the platform. The produced gas and condensate are exported through two separate 93 km pipelines to the PetroSA GTL plant located just outside the town of Mossel Bay.

7.9.2.2 Prospecting and Mining of Other Minerals

7.9.2.2.1 Glauconite and Phosphorite

Glauconite pellets (an iron and magnesium rich clay mineral) and bedded and peletal phosphorite occur on the seafloor over large areas of the continental shelf on the West Coast and South Coasts (see Figure 7-6). These represent potentially commercial resources that could be considered for mining as a source of agricultural phosphate and potassium (Birch 1979a & b; Dingle *et al.* 1987; Rogers and Bremner 1991).

Two prospecting areas for marine phosphate are located off the West and South-West Coasts. Green Flash Trading received its prospecting rights for Areas 251 and 257 in 2012/2013. **Block 5/6/7 overlaps with both these areas** (see Figure 7-94). An application to prospect for marine phosphate in the Outeniqua West Licence Area, offshore Mossel Bay, was submitted to the DMRE by Diamond Fields International Ltd in June 2013 (Morant 2013); however, there has been no further development in this regard.

7.9.2.2.2 Diamonds

Marine diamonds are mined along the West Coast from just south of Lamberts Bay to the Orange River mouth. Twenty diamond mining concessions have been established along the West Coast with each concession divided into four zones from the coast seaward (a, b, c & d). **The far northern portion of Block 5/6/7 overlaps with a vacant 'd' concession area** (see Figure 7-94)**; however, no deep-water diamond mining is currently underway in the South African offshore concession areas.** On the Namaqualand coast marine diamond mining activity is restricted to nearshore, diver-assisted operations from small, converted fishing vessels working in the a-concessions, which extend to 1 000 m offshore of the high-water mark.

7.9.2.2.3 Heavy Mineral Sands

Heavy mineral sands containing, amongst other minerals, zircon, ilmenite, garnet and rutile may be found offshore of the West Coast. Tronox's Namakwa Sands is currently exploiting heavy minerals from onshore deposits near Brand-se-Baai (approximately 385 km north of Cape Town).

De Beers Consolidated Mines (Pty) Ltd (DBCM) holds prospecting rights over various sea concessions off the West Coast for gold, heavy minerals, platinum group metals and sapphires. De Beers Marine (Pty) Ltd is, however, the operator of these prospecting areas. Applications for renewal for these rights have been granted and executed, in portions of Sea Concessions 2c – 10c. **These prospecting areas are located to the north of Blocks 5/6/7.**

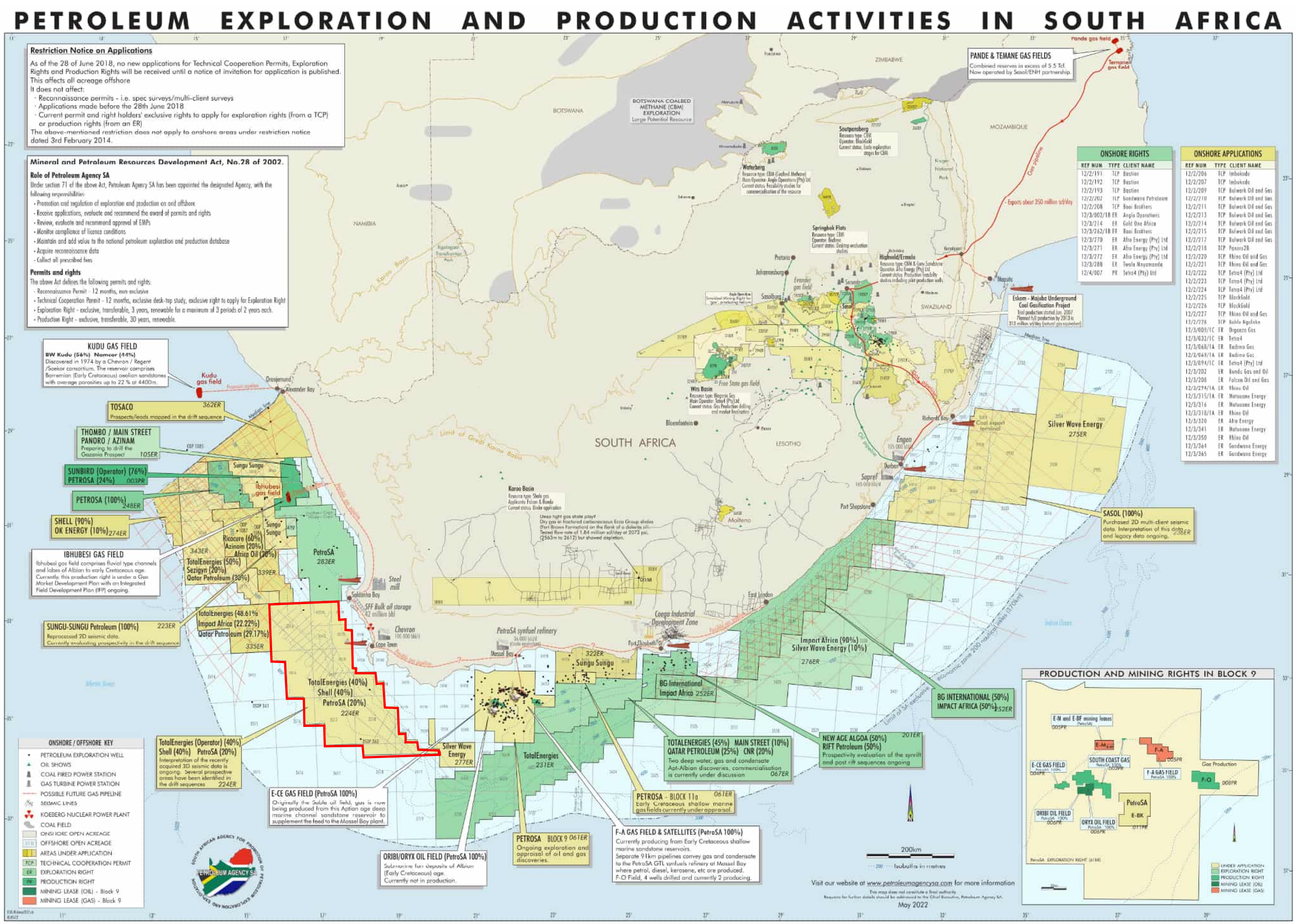

FIGURE 7-92: BLOCK 5/6/7 IN RELATION TO OTHER PETROLEUM LICENCE BLOCKS OFF THE COAST OF SOUTH AFRICA

Source: https://www.petroleumagencysa.com/images/pdfs/Hubmap0522.pdf, accessed 19 July 2022

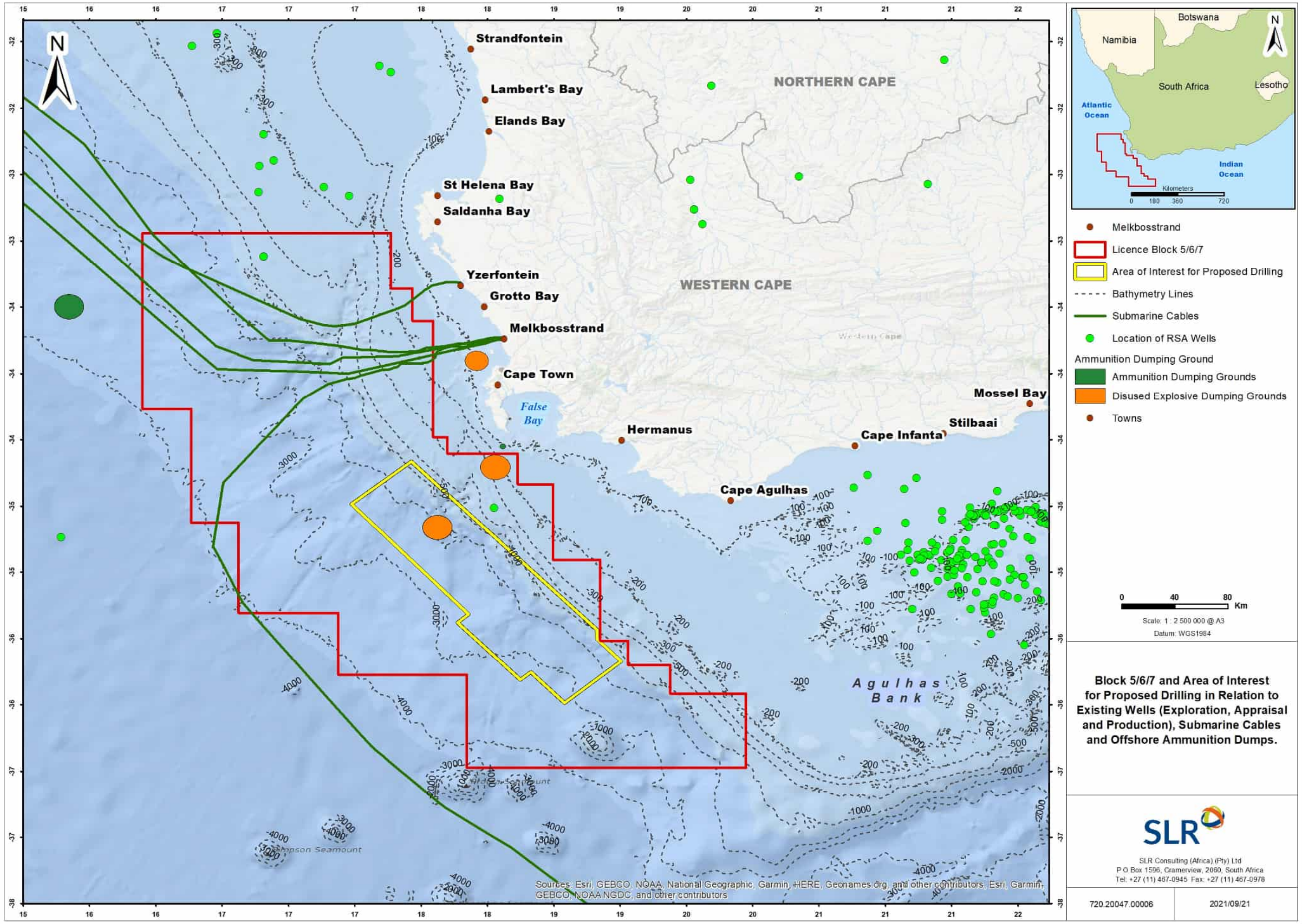

FIGURE 7-93: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO EXISTING WELLS (EXPLORATION, APPRAISAL AND PRODUCTION), SUBMARINE CABLES AND OFFSHORE AMMUNITION DUMPS

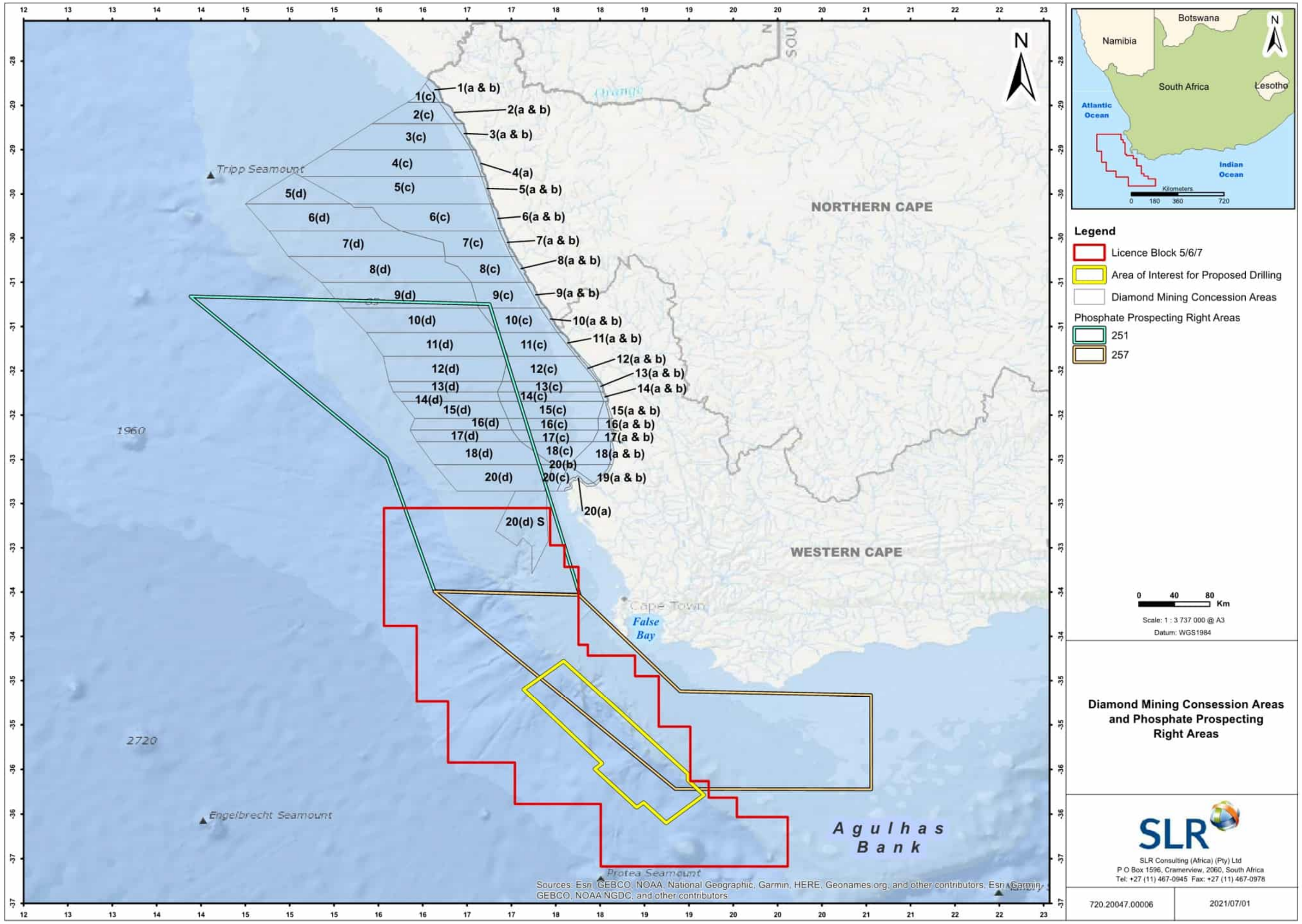

FIGURE 7-94: BLOCK 5/6/7 AND AREA OF INTEREST IN RELATION TO MARINE PHOSPHATE PROSPECTING RIGHT AREAS AND DIAMOND MINING CONCESSION AREAS

7.9.2.2.4 Manganese Nodules

Rogers and Bremner (1991) reported that manganese nodules enriched in valuable metals occur in deep-water areas (>3 000 m) on the South and East coasts. However, the nickel, copper and cobalt contents of the nodules fall below the current mining economic cut-off grade of 2%. **There is no current mining of manganese or phosphate resources offshore the South-West Coast region**.

7.9.3 Anthropogenic Marine Hazards

Hazards on the seafloor are identified in the Annual Summary of South African Notices to Mariners No. 5 or are marked on charts from the South African Navy or Hydrographic. These include ammunition dump sites, undersea cables and offshore renewable energy projects.

7.9.3.1 Ammunition Dump Sites

From the 1970s to 1995, expired or unusable ammunition such as naval shells and other explosive and non-explosive ammunition were dumped in designated marine ammunition dumps. Apart from the potential hazard associated with disturbing unexploded ammunition, corrosion may have led to leaching of lead, copper and other pollutants to the marine environment and inadvertent detonation may be physically destructive and may lead to smothering of benthic sea life (Harris *et al.* 2019).

The lack of information on the type, tonnage and condition of the dumped ammunition requires that future exploration and planned infrastructure (e.g., underwater cables, renewable energy infrastructure, etc.) be cognisant of these sites and avoid unnecessary disturbance.

Two ammunition dumps occur within Block 5/6/7, one of which also occurs in the Area of Interest for proposed exploration drilling (see Figure 7-93). **Approximately 2.6% of Area of Interest is covered by this ammunition dump. No drilling would be undertaken within this designated ammunition area.**

7.9.3.2 Undersea cables

There are several submarine telecommunications cable systems across the Atlantic and the Indian Ocean (see Figure 7-93), including:

- South Atlantic Telecommunications cable No.3 / West African Submarine Cable / South Africa Far East (SAT3/WASC/SAFE): This cable system is divided into two sub-systems, SAT3/WASC in the Atlantic Ocean and SAFE in the Indian Ocean. The SAT3/WASC sub-system connects Portugal (Sesimbra) with South Africa (Melkbosstrand). From Melkbosstrand the SAT-3/WASC sub-system is extended via the SAFE sub-system to Malaysia (Penang) and has intermediate landing points at Mtunzini East South Africa, Saint Paul Reunion, Bale Jacot Mauritius and Cochin India (www.safe-sat3.co.za).
- West Africa Cable System (WACS): WACS is 14 530 km in length, linking South Africa (Yzerfontein) and the United Kingdom (London). It has 14 landing points, 12 along the western coast of Africa (including Cape Verde and Canary Islands) and 2 in Europe (Portugal and England) completed on land by a cable termination station in London.
- African Coast to Europe (ACE): The ACE submarine communications cable is a 17 000 km cable system along the West Coast of Africa between France and South Africa (Yzerfontein).

- Equiano: A private subsea cable funded by Google that will start in western Europe and run along the West Coast of Africa, between Portugal and South Africa, with branching units along the way. The first phase of the project, connecting South Africa (at Melkbosstrand) with Portugal, is expected to be completed in 2021.
- 2Africa: The 2Africa subsea cable aims to interconnect Europe (eastward via Egypt), the Middle East (via Saudi Arabia), and 21 landings in 16 countries in Africa (including South Africa). The system is expected to go live in 2023/4.

There is an exclusion zone applicable to the telecommunication cables 1 nm (approximately 1.9 km) each side of the cable in which no anchoring is permitted. **Although five submarine cables pass through the northern portion of Block 5/6/7, they do not cross the Area of Interest for proposed exploration drilling** (see Figure 7-93).

7.9.3.3 Offshore renewable projects

No offshore renewable energy projects are active in South Africa currently. However, a study on offshore wind energy potential for the entire African continent indicated very good technical offshore wind energy potential for South Africa with **most of the offshore wind resources concentrated in coastal zones** (Elsner, 2019, cited in BSL, 2020).

7.10 CULTURAL HERITAGE AND SITES

South Africa is a multicultural country of approximately 60 million people. Its citizens speak more than 11 languages and hold a diversity of religious beliefs. These draw on the world's four major religions, as well as indigenous belief systems that contribute to the country's rich cultural heritage. Cultural heritage is globally defined as the cultural legacy passed from one generation to the next. It informs morality, sociality and biocultural relations. In heritage scholarship and conservation practice, a distinction is made between cultural and natural heritage. Heritage is also classified as either tangible or intangible. Tangible heritage includes sites, monuments, artifacts, and objects of cultural value. Intangible heritage consists of folklore, beliefs, values, rituals, symbolism and practices related to culture. Tangible and intangible heritage are not always divisible and, natural and cultural heritage may overlap.

7.10.1 Shipwrecks

At least 2 400 vessels are known to have sunk, grounded, or been wrecked, abandoned or scuttled in South African waters since the early 1500s (Gribble 2018). More than 1 900 of these wrecks are more than 60 years old and are thus protected under the National Heritage Resources Act, 1999 by the National Heritage Resources Agency as archaeological resources. All known shipwrecks off the coast of South Africa occur in waters shallower than 100 m within 50 km of the coast. **According to the South African Heritage Resources Agency (SAHRA) there are between 45 and 50 shipwrecks located around Robben Island, approximately 20 shipwrecks between Cape Town and Milnerton and approximately 20 shipwrecks between Milnerton and Saldanha Bay. All these known shipwrecks are in waters shallower than 100 m** (Sean Berry, SAHRA, *pers comm*., 3 October 2012). Although no wrecks have been identified in the Area of Interest based on the 2D and 3D seismic data acquired from Block 5/6/7 (see Section 6.2), **there are at least two suspected wrecks, the Argo (1942) and the Belgian Fighter (1942), that may occur within the proposed Area of Interest** (confirmed by SAHRA in its comment on the draft Scoping Report, July 2022)**.** These two vessels were torpedoed during WWII resulting in the loss of at least 23 lives. It is, thus, possible that oil and gas exploration in this area could detect a wreck or shipping remains, thereby contributing to archaeological knowledge. Although the likelihood of disturbing a shipwreck is very low, it is possible. Since the preference is to have a level surface area to facilitate spudding and installation of the wellhead, pre-drilling seabed survey will be undertaken using a Remotely Operated Vehicle (ROV) to detect any obstacles (incl. rock outcrops, shipwrecks, etc.) (Section 6.4.4.1). Thus, it is highly unlikely that any shipwrecks will be impacted. Mitigation will be included in the ESMP (as indicated in Table 8-4) that deals with the situation if a wreck is identified during the seabed survey. Mitigations includes:

- **In the event that a shipwreck is discovered during a pre-drilling site survey, TEEPSA will adjust the well location to avoid any shipwrecks identified in pre-drilling ROV surveys, and**
- **If any historic shipwreck objects are found before or after drilling commencement, which could potentially be impacted by the activity, work in the directly affected area should cease until the SAHRA has been notified and the operator has complied with any additional mitigation as specified by the SAHRA.**

7.10.2 Cultural Heritage and Spiritual Beliefs

Heritage conservation and management are complex because there are competing claims to culture and its preservation, as well as political pressure to inscribe dominant narratives of history. In addition, cultural groups are not socially pristine, meaning that, cultural boundaries are porous and result in cross-cultural exchange and reformulation of heritage practices and values. Furthermore, immigration is deepening cultural complexity, as new cultural groups arriving with their values and practices, engage with resident groups, further diversifying existing heritage.

South Africans have a very long relationship with the sea. Archaeological evidence in the form of shell middens which point to the exploitation by humans of marine resources around the South African coast, dates back into the Middle Stone Age, at least 30 000 years before the present and continues through the Later Stone Age and Iron Age (on the east coast) right up until, and beyond the arrival of Europeans on South African shores after the late 15th century. The available evidence suggests that the pre-colonial exploitation of marine resources and people's interaction with the sea was limited to the littoral and the intertidal zone. There is currently no archaeological evidence for the movement of pre-colonial people in South Africa in the marine environment, or the construction or use, prior to the arrival of Europeans, of watercraft in that environment (Tim Hart and John Gribble *pers. com.* 2022).

Since the beginning of the colonial presence in South Africa, there has been a tradition of boat-based fishing and marine resource exploitation and many of the small coastal communities have histories linked to this practice which date back many years. There has been a fishery based in Saldanha Bay since the early years of the Dutch settlement at the Cape, for example, and the small-scale fishers' village of Kassiesbaai at Arniston dates back to at least the early 19th century. There is thus a long tradition of boat-based colonial era fisheries with their attendant communities, particularly on the West Coast with its rich marine resources fed by the Benguela Current and within these communities there will have developed clear and strong traditions and beliefs related to their way of life (Tim Hart and John Gribble *pers. com.*).

Coastal and oceanic Intangible Cultural Heritage is holistic. It includes a variety of waterways that ultimately lead to the sea, these include: streams, rivers, pools, lakes and estuaries. These waterways are described as 'living' waters and are believed to play a critical role in spiritual and health management in indigenous (First Peoples and Nguni) groups specifically. The specific beliefs concerning these 'living' waters can be summarised as follows:

- The waters offer a spiritual domain.
- The waters contain the ancestral spirits of cultural communities.
- Ancestral spirits in the ocean reside on the seabed or seafloor.

- Belief in the ancestral world and the place of ancestors in waterways and other ecologically sacred places does not require a relinquishing of belief in an omnipresent God. The ancestors form part of a complex genealogy of which God is the head.
- Regular, consistent and frequent interaction take place with the coast and sea in order to secure the guidance and benevolence of ancestors, as well as spirits that reside in such living waters.

The impact on cultural and spiritual beliefs of both South Africa's coastal fishing communities and its indigenous peoples related to the sea will be investigated further in the Cultural Heritage Impact Assessment.