

ROAD AND TRANSPORTATION MASTERPLAN

PALESTINE

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IV.4Maritime Transport

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1 Introduction

The following chapter introduces the proposals for maritime transport sector included in NTMP. Proposals description is preceded by an overview of existing maritime transport sector in Palestinian territories, and the presentation of current sector's trends and port requirements.

2 Overview of Maritime Transport Sector

2.1 Existing Maritime Transport Infrastructure

Currently the only infrastructure for maritime transport is represented by the fishery port of Gaza that serves the fishing sector and accommodates approximately 750-800 fishing boats of various sizes. The current port configuration shows several concerns, such as:

- Low water depth within the harbour basin;
- Poor conditions of breakwaters;
- Absence of piers for fishing vessels;
- Presence of a sewage outlet inside the harbour basin.

Among the concerns listed above, particular attention needs to be paid to water depth. Indeed, water depth ranges between 4m and 8m AMSL inside the harbour basin. As a result of sediment transport, and the absence of maintenance dredging in proximity of the harbour mouth, the depth is approximately of 4m AMSL. Such water depth does not allow the safe navigation of ships with drafts greater than 5m.

Detailed information on current conditions of the fishery port of Gaza City and in general about maritime transport sector, including geo-technical characteristics and morphology of the Gaza coastline, is presented in ¶AX.1 – *Diagnostic Analysis of Palestinian Transport Sector*.

2.2 Present Competitive Situation for Palestinian Maritime Transport Facilities

Thanks to its geographical position, Gaza Strip can play either a competitive or a complementary and co-operational role within the regional maritime transport framework. The achievement of these two different goals mainly depends on: 1) Dimensioning and Functioning, and; 2) Trade freedom level.

Whether in competition or in cooperation with existing established Ports (i.e. Port Said and Port El Arish in Egypt, Ashdod and Haifa in Israel), a new Commercial Port in Gaza Strip would require also the pre-requisite of autonomy, indispensable for acting as engine for national development and regional competitiveness.

Detailed information on the closest commercial ports of Middle East Region is presented in ¶AX.1 – *Diagnostic Analysis of Palestinian Transport Sector*.

2.2.1 Gaza Fishery Port Current Competitive Situation

The current competitive position of the Fishery Port of Gaza, vis a vis other (commercial) ports in the region is nil except for fishing, as its main activity but marginal improvements (as further discussed) could restore a satisfactory, although primary and emergency level of commercial and passenger traffic functionality, subject to easing restrictions.

In the beginning of April 2016, Israel has allowed fishing limits to be brought out to 9 nautical miles, well beyond the 6 nautical miles Fishing Limit, enforced by IDF (Ceasefire Agreement –

November 2012); as a result, immediate improvements in quality and quantity of fishing was experienced.
Considering the current and growing urban limitations, the Fishery Port of Gaza could hardly become a viable commercial port, hence it is essential to suggest an alternative location for the new commercial port.

Figure 1. Fishery Port of Gaza Aerial View from Google Map



2.2.2 New Gaza Commercial Port Current Competitive Position

The proposed Gaza Commercial Port in addition to the existing Gaza Fishery Port will represent the Mediterranean gateway to Palestine.

In relation to other existing ports in the region, the future Gaza Commercial Port, competitive or complementary and Co-Operative position mainly depends on:

- Its dimensional and operational functionality;
- Its interconnectivity capacity and speed;
- Inherent levels of guaranteed trade freedom and security.

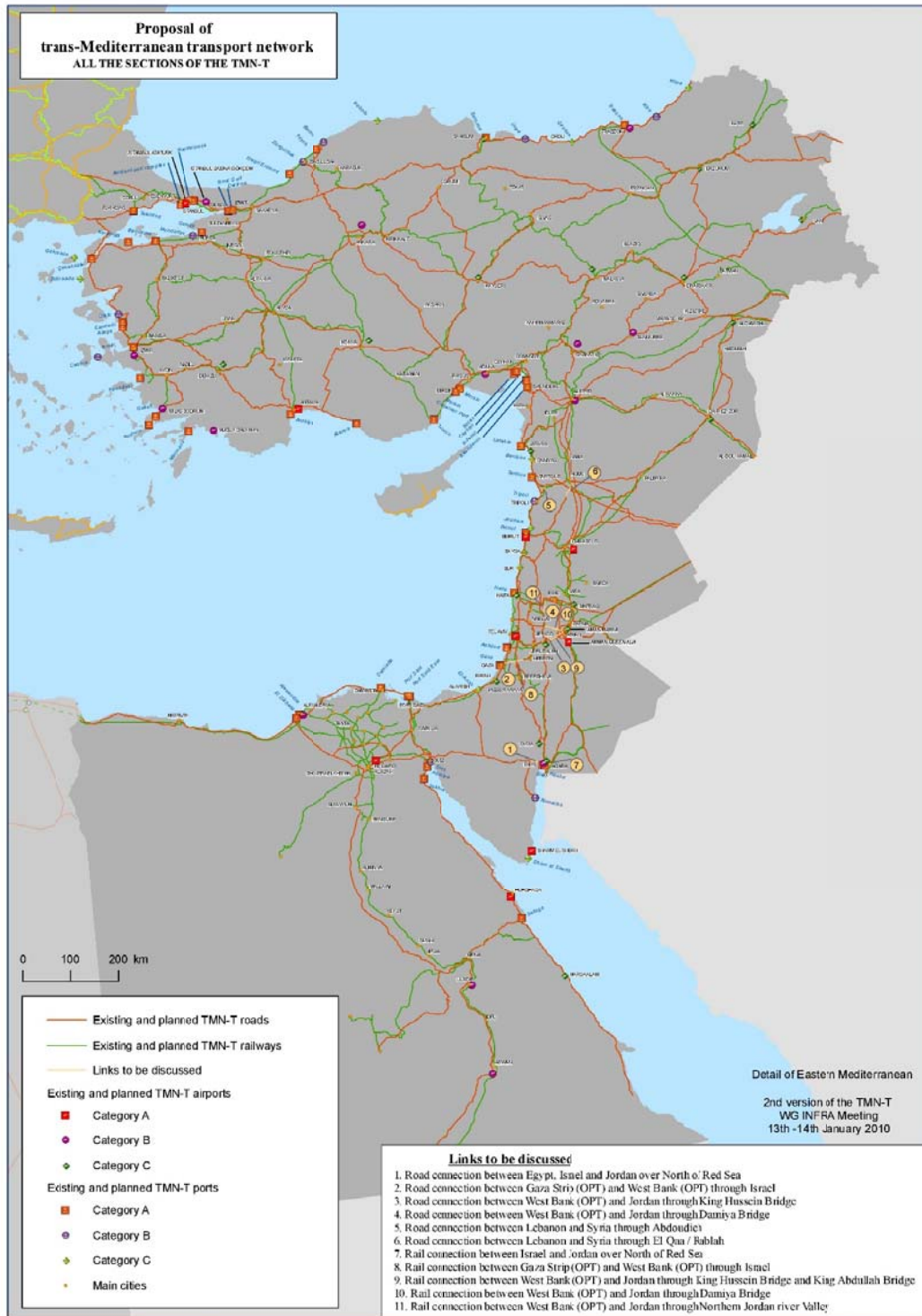
Whether in competition or in cooperation with other more established Ports of Said, El Arish, Ashdod and Haifa, the Gaza Commercial Port needs to satisfy other National pre-requisites of:



- Sovereignty and autonomy,
- Potential for national development and regional competitiveness
- Instrument for positive urban, industrial and social development
- Tool for improvements of local and national economy

The relevant and competitive location and context, within the Eastern Mediterranean setting, is reflected in the following map of the proposal of trans-Mediterranean transport network (TEN-T Map). The map represents the current and programmatic internationally shared vision, according to which, Gaza Commercial Port is considered of primary importance (Category A) like Ashdod and Haifa; while Al Arish Port is considered of third level or of Category C. Basic feasibility and viability aspects, providing quantitative as well as qualitative answers to inward and outward Freight and Passengers demand and competitive services, vis a vis other neighbouring Ports, is described in the following chapter.

Figure 2. The Proposal of Trans-Mediterranean Transport Network (TMN-T)





2.3 Maritime Transport Trends, Port Requirements and Traffic Forecasts

The provision of a renewed Seaport is herein considered as priority which achievement is organized in phases¹, with the aim of reducing construction time and costs. Due to the presence of several commercial ports specialized in container transshipment (i.e. Port Said, Haifa, and Beirut) close to Gaza Strip, the new commercial port should be designed mainly for the import/export of products to/from the West Bank and Gaza Strip and the neighbouring countries. Assessment of expected annual tons per each of the development phases considered in the NTMP is shown hereafter.

Tab 1. Maritime Traffic Forecasts 2016 – 2045 (Annual Tons)

Phases	Infrastructure Works	Annual Tons
Phase 1A	Upgrading of Existing Gaza Fishing Port (Stage 1)	2,689,118
Phase 1	Upgrading of Existing Gaza Fishing Port (Stage 2)	6,813,043
Phase 2	Construction of New Gaza Commercial Port	12,368,394
Phase 3	-	16,688,640
Phase 4	-	21,699,816

The analysis of the handling of goods of other important ports in Middle East, highlighted as the ratio between the number of mobilized container per year and the population, stands between 0.05 and 0.1. Consequently, the new commercial port must be able to withstand a traffic 500,000-1,000,000TEU/year (standard-size container). Furthermore, the new commercial port must also meet the traffic requirements related to RoRo vessels, general cargo, and dry bulk. The overall traffic can be estimated as follows:

Tab 2. Overall Estimated Maritime Traffic by Type (t/year)²

Maritime Traffic Type	Overall Estimated Traffic (t/year)
RoRo	500,000
General Cargo	1,050,000
Dry Bulk	450,000
Liquid Bulk	2,000,000

Annual berthside crane capacity, berth productivity/m and the stacking area capacity in TEU/m² staking area/year, will probably vary considerably between the different container ports (Thoresen, 2014):

- The annual berth container crane capacity varies approximately between 50,000-350,000TEU/year, with an average of 110,000TEU/year;
- The annual berth productivity/m berth front varies approximately between 500-2,500TEU/berth m per year, with an average of 1,000TEU/berth m per year;
- The annual container stacking area capacity in TEU/m² per year varies approximately between 0.5-7.0TEU/m² per year, with an average of 2.0TEU/m² per year.

Consequently, based on the above mentioned average unitary values, and considering that the stacking area is approximately between 50-75% of the total area of a container terminal, the new commercial port's container (capacity 500,000TEU/year) should be equipped at least with:

¹During the first stage, the commercial activities could be carried on through Ro-Ro vessels. During the second stage, breakwaters could be extended to allow the construction of deep-water berths for container and bulk vessels to be implemented.

² Ibidem.



- Total area of about 400,000 m²;
- Stacking area of 250,000 m²;
- 6 cranes;
- 500 m of quay.

Regarding the RoRo traffic, for a typical RoRo vessel with a cargo size of 1,000t, a parking area of 12,500m² is required, hence 117,000m² are necessary for general cargo.³ Finally, concerning dry bulks, an area of 2,500m² is requested for marble and an area of 5,000m² is requested for grain silos. Altogether, the surface of the new commercial port must be at least, 537,000m².

During an initial phase, the port will not be equipped with specialized docks but with three berths at least: (1) A RoRo berth; (2) a multipurpose berth, and(3) a liquid bulk facility. The three berths and yard area should be able to handle the following annual tonnage:

Tab 3. Annual Tonnage to be handled at New Gaza Commercial Port by Type

Maritime Traffic Type	Overall Traffic To Be Handled (t/year)
RoRo	87,000
Container	14,500
General Cargo	215,300
Dry Bulk (grain)	92,000
Dry Bulk (marble)	100,000
Liquid Bulk	366,000

On the basis of the above mentioned needs, several sites and layouts have been studied for the new Gaza Commercial Port, and taken into account in order to permit an appropriate implementation of port infrastructures within the NTMP multi-modal proposal.

In any case, the rehabilitation of the existing fishing port is strongly suggested within Phase 1 (For more details, refer to ¶III – Road and Transportation Master Plan Overview) for the immediate needs of: Fishery; Emergency (RoRo), and; Leisure.

The following table and chart show the forecast for the import and export of good via the new commercial port of Gaza during the 4 phases of the development of the NTMP.

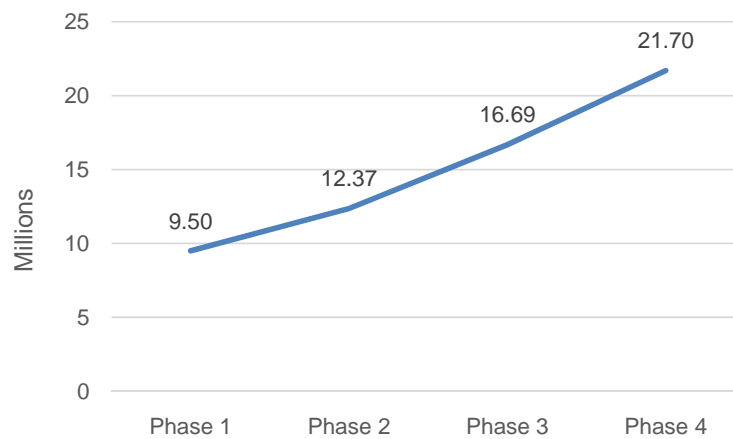
Tab 4. Maritime Traffic Forecasts (Import and Export)by Phase

	Import West Bank (Tons)	Import Gaza Strip (Tons)	Export West Bank (Tons)	Export Gaza Strip (Tons)
Phase 1	6,305,523.6	1,589,749.6	1,392,874	214,014
Phase 2	7,659,729.6	2,520,070.6	1,707,930	480,664
Phase 3	9,668,266.0	3,933,188.6	2,198,425	888,760
Phase 4	11,737,676.2	5,922,667.7	2,536,413	1,503,059

³ Smaling (1996)



Figure 3. Maritime Traffic Forecasts (Import and Export) by Phase (Tons)



3 Maritime Transport Proposal

The overall NTMP proposal for maritime transport sector consists of the following two main actions:

- Rehabilitation of existing Gaza Fishery Port, and:
- Construction of a new Gaza Commercial Port.

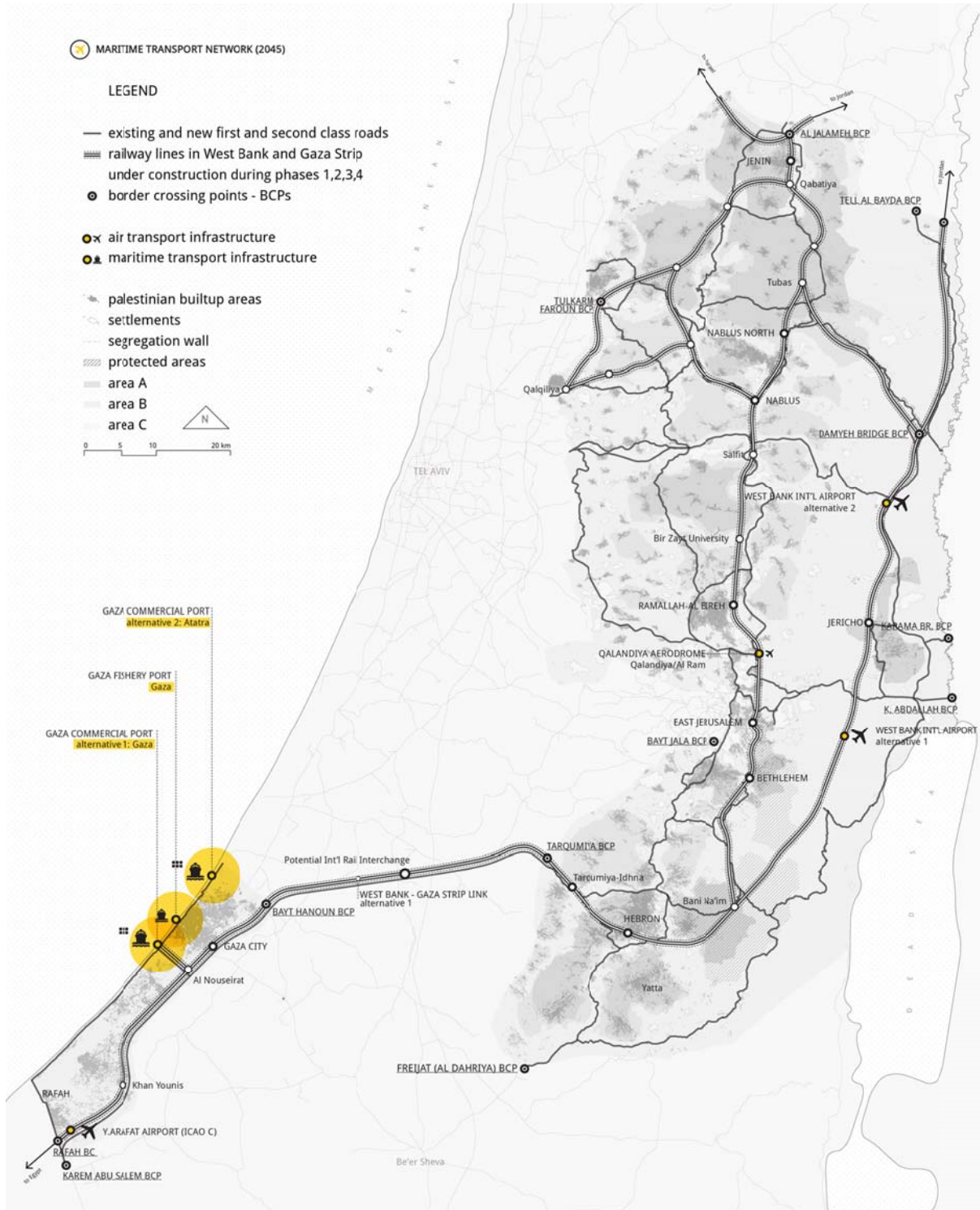
The rehabilitation of existing Gaza Fishery Port is proposed for Phase 1A (2-year investment plan) and is herein presented with two different layouts.

The construction of a new Gaza Commercial Port is proposed for Phase 1 with 2 alternatives, located along the coast of Gaza Strip.

The following chapter provides more details on main actions on which the entire NTMP proposal for maritime transport sector is based on.

Before presenting in details the main actions and proposals for maritime transport sector, the overall NTMP proposal is illustrated in the following figure.

Figure 4. Maritime Transport Network (2045)





3.1 Gaza Fishery Port Rehabilitation in Phase 1A (2-Year Investment Plan: end of 2016 – 2018)

For the rehabilitation of the existing fishing port, two layouts are proposed (Layout 1 and Layout 2) to guarantee fishing and leisure activities, in addition to the implementation of areas to be used for emergency freight, requiring a depth of 8m AMSL.

The main works for the proposed layouts are:

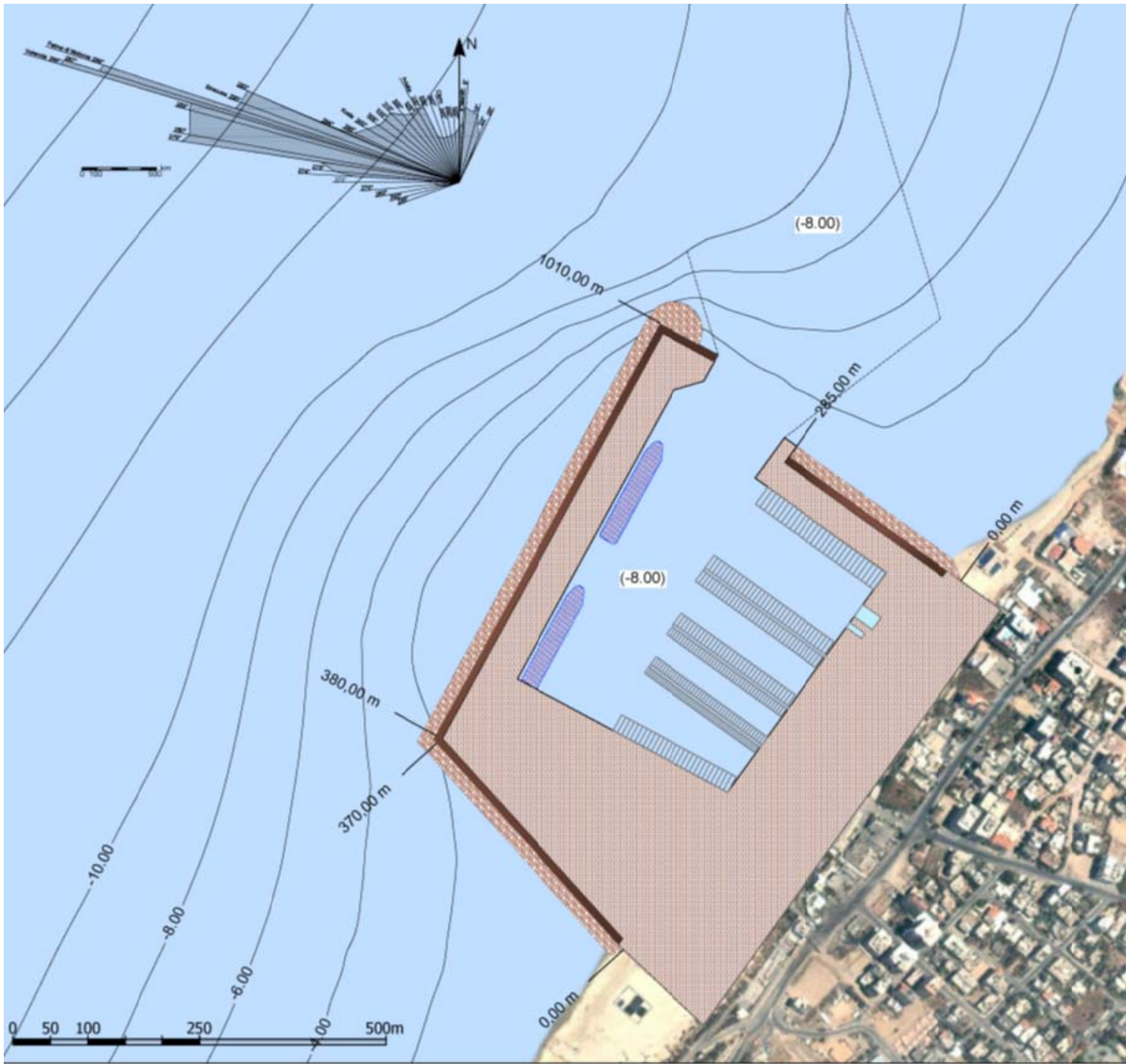
- The rehabilitation of the existing breakwaters;
- The rehabilitation and the expansion of the existing quay;
- The implementation of docks for berthing of fishing vessels;
- The construction of facilities for ship maintenance;
- The dredging of the basin area.

The rehabilitation of the main characteristics of Layout 1 and Layout 2 are reported in the following table while their plans are shown in the subsequent figures.

Tab 5. Main Characteristics of Proposed Layouts for Rehabilitation of Gaza Fishery Port

	Harbour Mouth Width	Harbour Basin Area	Operational Forecourts	Quay Length	Number of Fishing Boat Moorings	Occupied Coast Length	Depth	Cost [M€]
	[m]	[m ²]	[m ²]	[m]	[-]	[m]	[AMSL]	
Layout 1	155	135,500	210,000	1,480	288	670	8	67
Layout 2	166	198,900	156,870	1,900	895	687	8	68

Figure 5. Rehabilitation of Existing Fishery Port in Gaza: Layout 1.⁴

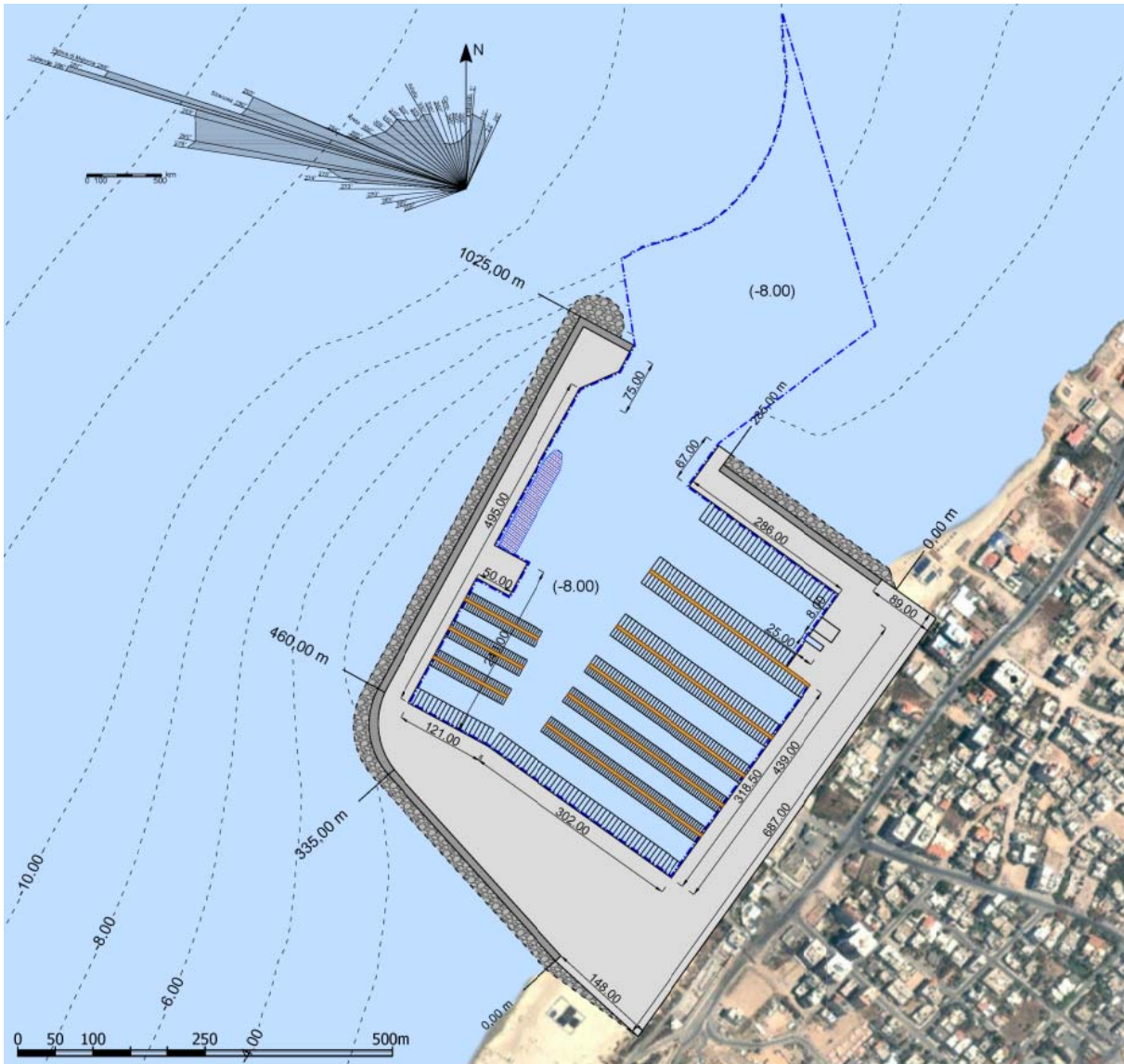


Total Estimated Costs: 67,000,000€⁵

⁴ Source: Map data: Google, DigitalGlobe

⁵ For more details about costs, refer to: *AX-8 Maritime Transport: Study Maps and Cost Analysis*

Figure 6. Rehabilitation of Existing Fishery Port in Gaza: Layout 2⁶



Total Estimated Costs: 68,000,000€⁷

⁶ Source: Map data: Google, DigitalGlobe

⁷ For more details about costs, refer to: AX-8 Maritime Transport: Study Maps and Cost Analysis



Layout 1 is designed in order to have large areas dedicated for the emergency freight, whereas Layout 2 holds a higher number of fishing boat moorings, as requested by Port Authority.

Layout 2 is considered the most convenient solution, since it gives fishery sector a short-time implementable chance of development.

In both cases, sufficiently extended areas are taken into consideration fulfilling the following needs:

- Slip boat;
- Dry docks;
- Fish processing;
- Water treatment plant.

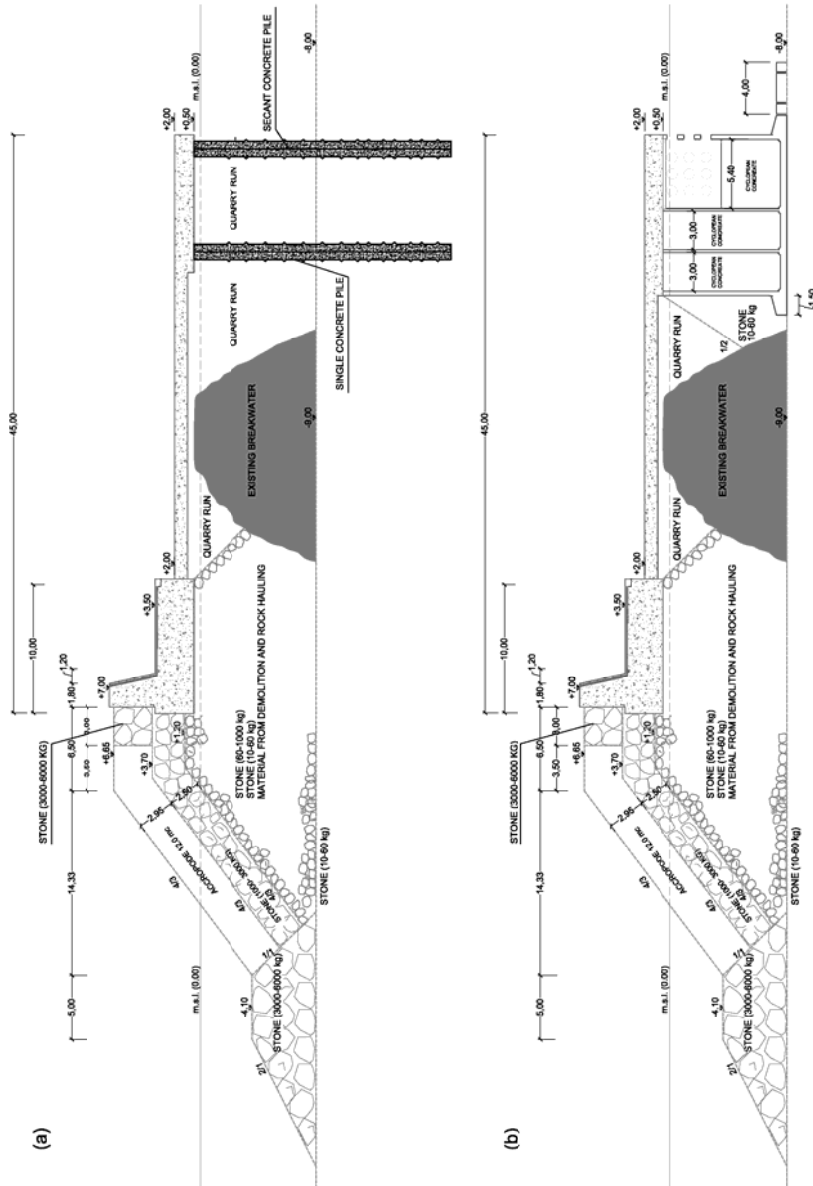
Finally, two options are presented for the rehabilitation of the existing breakwaters:

- a) Breakwaters rehabilitation with implementation of secant piles⁸, and;
- b) Breakwaters rehabilitation through the use of precast concrete caissons.⁹

⁸ Preferred option in case seabed presents rocky outcrops close to the shoreline.

⁹ Preferred options in case very shallow rocky substrate is present.

Figure 7. Main Breakwater Cross-Section Alternatives



3.2 New Commercial Port Construction in Phase 1 (2019 – 2024)

3.2.1 New Commercial Port Alternatives Assessment

Two different alternatives for the new Gaza Commercial Port are proposed. For each of them a phase-based development is considered, where: (1) a first stage, in Phase 1A (2-year investment plan), consists in the rehabilitation of the existing fishery port, and; (2) a second stage, in Phase 1, envisages the implementation of the new commercial port.¹⁰

- Alternative 1: New Gaza Commercial Port in Gaza, Central Gaza Strip
- Alternative 2: New Gaza Commercial Port in Atrata, Northern Gaza Strip.

Figure 8. Alternative Locations for New Gaza Commercial Port



A SWOT analysis follows, presenting a preliminary evaluation of the two proposed alternatives.

¹⁰ The considered phase-based development derives from World Bank suggestions (2004).



Tab 6. SWOT Analysis for New Gaza Commercial Port - Alternative 1 (Gaza)

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> • Site location already approved by PNA; • Sufficient on-shore logistics park area available; • Land reclamation from sea available with restrained costs; • Ease of road and rail connection with main transport corridor; • Free and secured navigational entrance to port; • No coastal or navigational threat to neighbouring countries. 	<ul style="list-style-type: none"> • Coastal erosion on Northern Gaza shore to be prevented; • Wadi Gaza treatment needed to avoid waste trapping into sea.
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> • Good position for urban integration and synergic development; • Synergic development of existing water treatment plant; • Synergic development of existing power plant. 	<ul style="list-style-type: none"> • On-shore logistics park area available but threatened by uncontrolled occupations.

Tab 7. SWOT Analysis for New Gaza Commercial Port - Alternative 2 (Atatra)

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> • Landreclamation from Sea available with restrained costs; • Sufficient on-shore logistics park area available. 	<ul style="list-style-type: none"> • Site location to be approved by PNA; • Large usable land portion currently defined as national "Green Zone"; • Problematic coastal erosion prevention on Israelishores; • Relative ease of road/rail main transport corridor connection; • Limited urban integration synergic development; • Close location to international border, imposing eventual restrictions for big vessels manoeuvres.
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> • Industrial park development of North Gaza; • Jobs creation for North Gaza Strip. 	<ul style="list-style-type: none"> • On-shore logistic park area available but locally controlled -maintained for security/defence purposes; • Israel fishing limiting K Zone extended to navigational channel.

Beside the SWOT Analyses, a set of main environmental issues is introduced. Indeed, both Alternatives present impacts on the environment, mainly related to the following aspects:

- Increasing of vehicle traffic and noise;



- Water quality within the port;
- Long-shore coastal sediment transport.

Increasing of Vehicle Traffic and Noise. The increasing of vehicle traffic and noise induced by the port activities is relevant but can be reduced through the provision of some impact mitigation actions that could be included in the port design.

Water Quality within the Port. Concerning water quality within the port, an appropriate port layout shall be adopted in order to avoid stagnation and ensure, through the use of specific devices, better water circulation, during periods characterized by modest changes in tide levels.

Long-shore Coastal Sediment Transport. Particular attention shall be paid to the design of an appropriate system of by-pass of the sediments. Sediments dynamics in Gaza Strip were surveyed and assessed; the survey results showed that the Gaza Strip coast is characterized by a net sediment transport towards the north. In this framework, the construction of a new port will cause an advance of the coastline in the south beach and a retreat of the north beach, as already observed in the existing fishing port. In order to avoid these negative impacts on the coast, a by-pass of the sediments system, that transfers the accumulation of sand from the up drift beach toward the down drift beach, is suggested.

The choice of the by-pass system must be done as a result of a careful long-shore sediment transport evaluation. When the needed by-pass volume is rather small (until 50,000m³/year) a simple system with the help of trucks might be considered, while when the by-pass volume is larger, a permanent pipeline could be used to transport sand (as slurry) from one side to the other. In the past, several systems to get the sand 'into the pipeline' in the up-drift area have been tested.¹¹

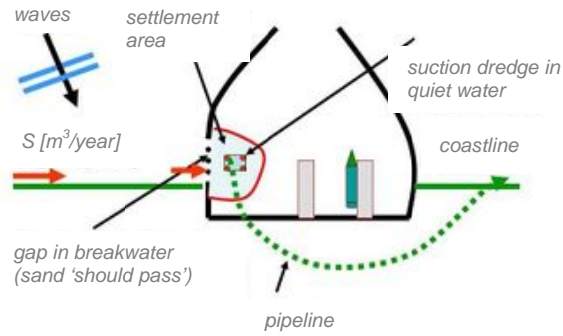
- A gap in the up-drift breakwater in order to catch the upcoming sand and to create a quiet area for a (small) dredge;
- An additional offshore breakwater to create a quiet area. Such systems showed some limits because a continuous inflow of sediment in the catchment area is not guaranteed;
- A system with a trestle perpendicular to the coast with a movable suction device with a suction pipe is preferred.

The three systems listed above are illustrated in the pictures presented in the following pages.

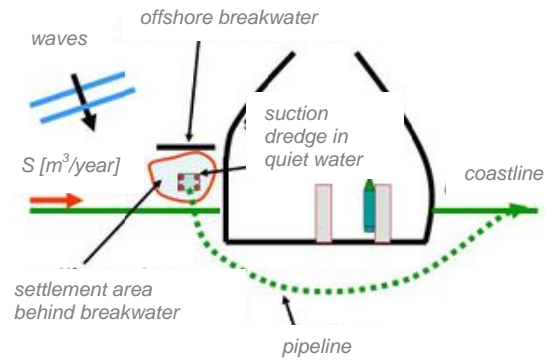
¹¹ Van de Graff, 2013.

Figure 9. Systems to get 'sand into pipeline'¹²

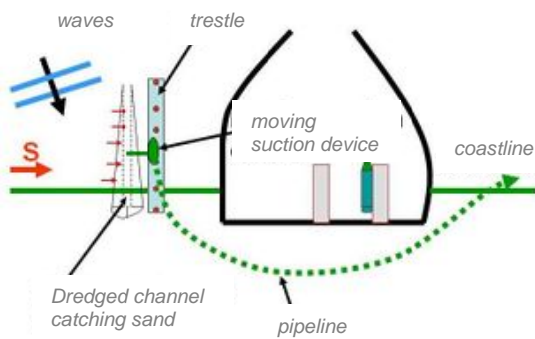
System (1) Port with Gap in the Breakwater



System (2) Port with Additional Offshore Breakwater



System (3) Port with a Trestle



¹²Source: Van de Graff, 2013.

Figure 10. Trestle of Tweed River Sand By-pass System¹³



This preliminary assessment of the proposed alternatives, conducted with the SWOT Analysis and the definition of the main environmental issues is useful to understand the limitations that each of the proposed alternatives for a new Gaza Commercial Port would entail. The comparison between the two proposed alternatives is synthetically reported in the table below. The green cells represent the best solution, vice versa the red cells represent the worst solution, and the yellow cells indicate that the alternatives do not show significant differences.

Tab 8. Comparison Between the Two Proposed Alternatives

	Alternative 1	Alternative 2	Note
Site location already approved by PNA	YES	No	Alternative 1 site was already approved by PNA
Coastal erosion impact	High	High	Both alternatives determinate the erosion of beach. This erosion may be counteracted by adoption of by-pass system. Alternative 2 would more likely cause erosion phenomena on the Israeli beach
Jobs creation for North Gaza Strip	Yes	Yes	Both the site are less than 10 km from the centre of Gaza
Impact on "Green Zone";	No	High	Alternative 2 is located in a land portion currently defined as national "Green Zone"
On-shore logistics park area available	Yes	Yes	For the alternative 1 on-shore logistics park area available but threatened by uncontrolled occupations For the alternative 2 On-shore logistic park area available but locally controlled - maintained for security/defence purposes;
Proximity to international border	No	Yes	The port of alternative 2 is close to Israeli border
Urban integration	High	Low	The port of alternative 1 is close to Gaza City
Impacts determined by the fishing limits	Low	High	For the alternative 2 Israel fishing limiting K Zone extended to navigational channel.
Impacts Wadi Gaza	High	No	For the alternative 1 it is necessary Wadi Gaza treatment to avoid waste trapping into sea.
Ease road and rail connection	High	low	The port of alternative 1 is close to principal connecting systems
Distance from Karem	Medium	High	Alternative 2 would be in the farthest

¹³Source: www.tweedsandbypass.nsw.gov.au/



Abu Salem BCP			location from Karem Abu Salem BCP, that is currently the only border crossing used for freight purposes
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On the basis of the above considerations, Alternative 2 (Atatra) results less convenient than Alternative 1 (Gaza). Hence, an in-depth analysis is herein presented for Alternative 1.

3.2.2 Alternative 1: New Gaza Commercial Port in Gaza

The construction of new Gaza Commercial Port in Gaza (4km south from the geographical centre of Gaza City) benefits of the presence of on-shore areas where new facilities can be easily settled. It is worth pointing out that for this location, all the needed licenses (environmental, etc.) as well as all the necessary areas are already immediately available thanks to a previous design of port (2000).

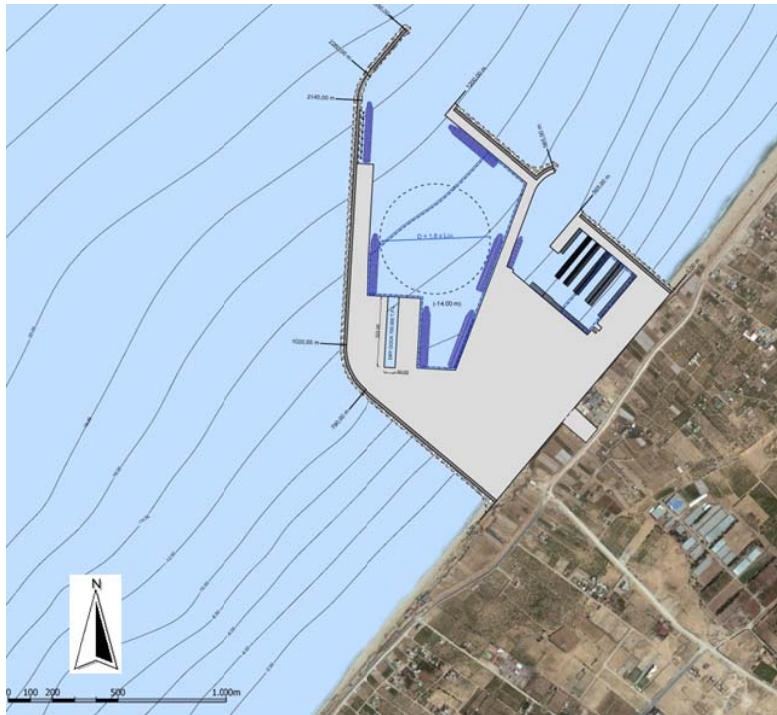
Eleven layouts for the new Commercial Port in Gaza are herein presented; the following table shows their main characteristics, while the figures reported in the successive pages show their layouts.

Tab 9. Main Characteristics of the Proposed Layouts for New Commercial Port in Gaza

Layout Names	Harbour mouth width	Harbour Basin area	Operational forecourts	Quay length	Number of fishing boat moorings	Occupied Coast length	Cost ¹⁴
	[m]	[m ²]	[m ²]	[m]	[-]	[m]	[M€]
AS	230	1,266,170	1,056,100	6,621	392	1,590	618.8
BS	275	809,600	979,100	5,820	429	1,270	543.0
CS	260	875,870	949,500	6,100	320	1,500	592.9
DS	360	1,212,170	1,287,500	4,700	350	2,000	670.5
ES	250	675,800	768,600	4,000	405	1,250	488.9
FS	380	1,212,480	988,570	4,690	398	1,590	590.4
GS	380	1,063,000	949,100	6,560	530	1,590	585.7
HS	360	594,700	742,420	5,610	572	1,200	499.7
IS	380	718,570	851,410	5,710	572	1,250	512.4

¹⁴ For more details about costs, refer to: *AX-8 Maritime Transport: Study Maps and Cost Analysis*

Figure 11. Layout A-S of the New Commercial Port in Gaza Area¹⁵



¹⁵ Fig 11-19 Source: Map Data: Google, DigitalGlobe.

Figure 12. Layout B-S of the New Commercial Port in Gaza Area

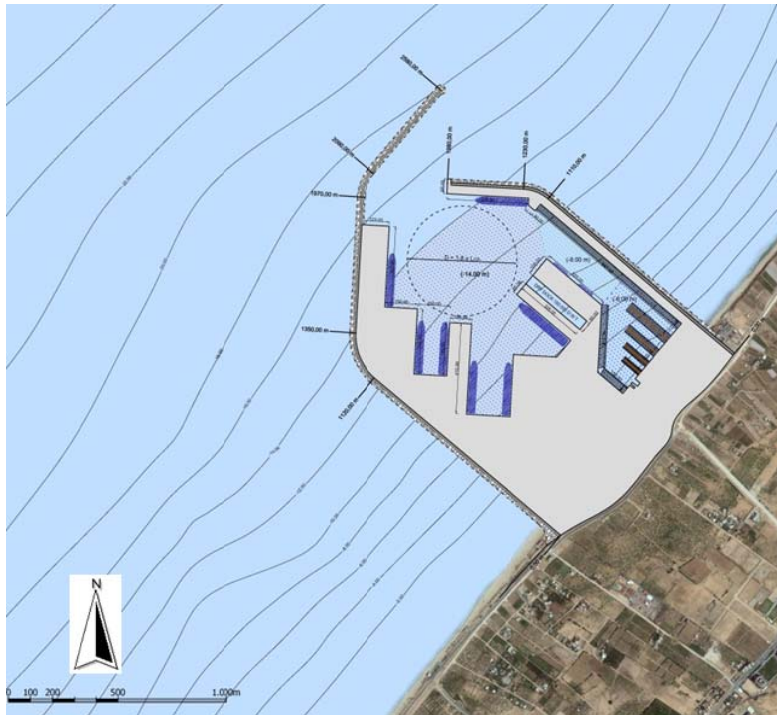


Figure 13. Layout C-S of the New Commercial Port in Gaza Area

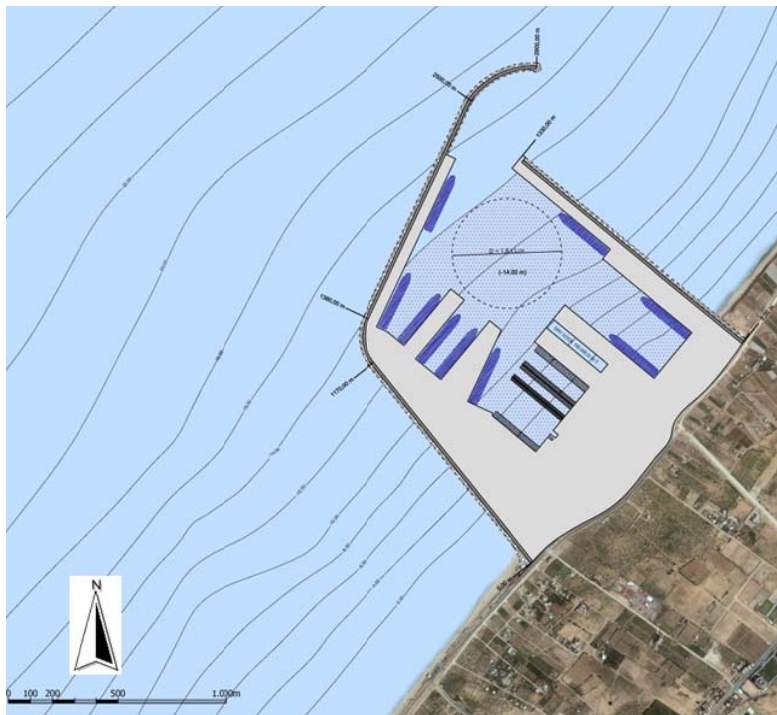


Figure 14. Layout D-S of the New Commercial in Gaza Area

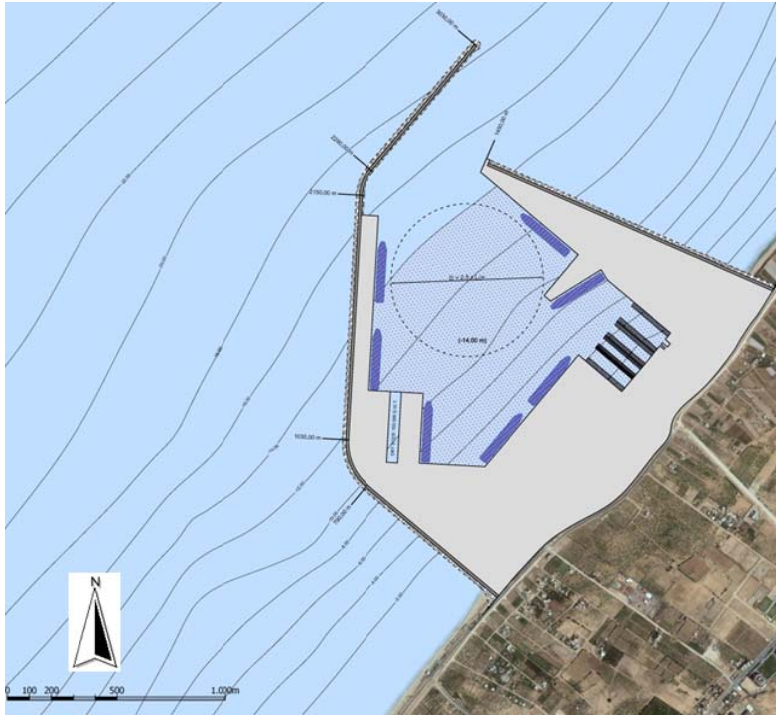


Figure 15. Layout E-S of the New Commercial Port in Gaza Area

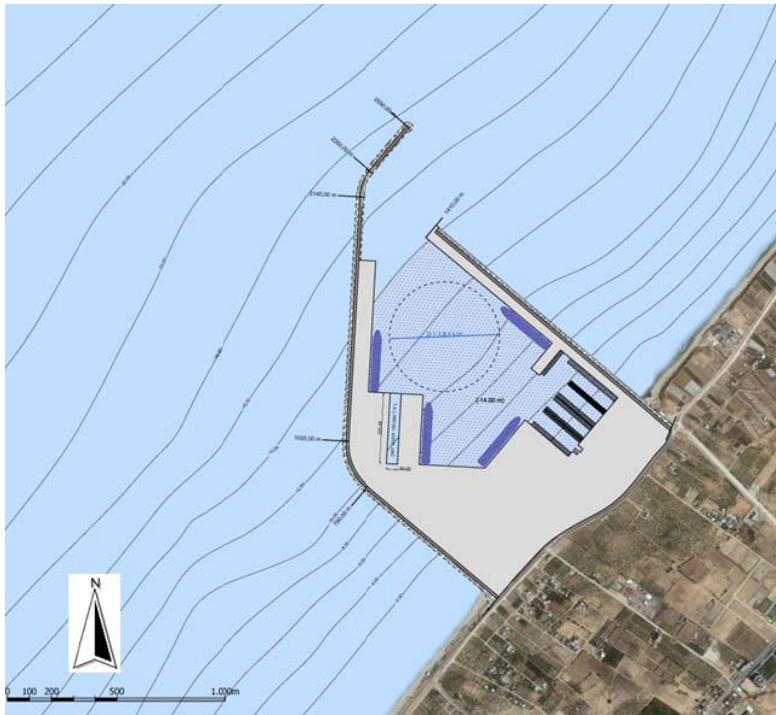


Figure 16. Layout F-S of the New Commercial Port in Gaza Area

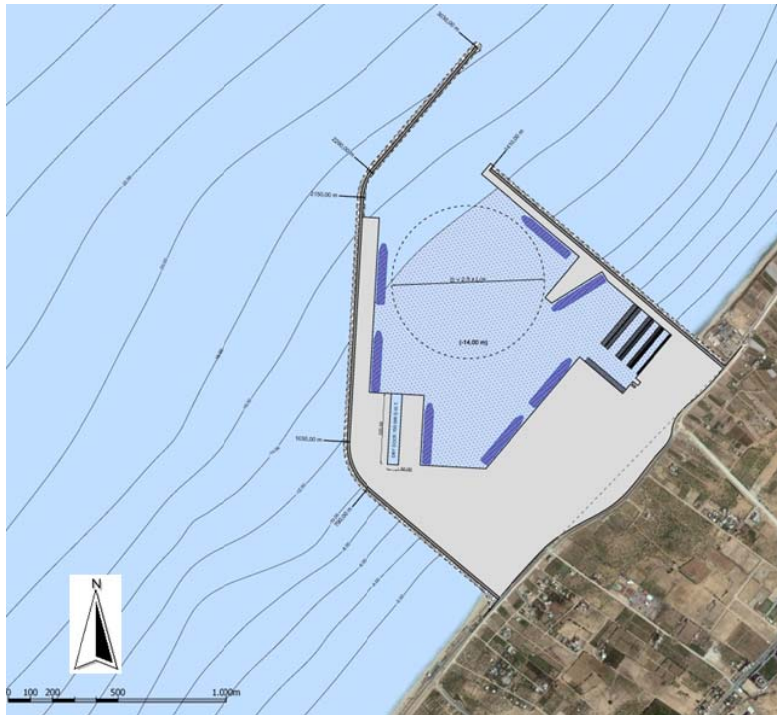


Figure 17. Layout G-S of the New Commercial Port in Gaza Area

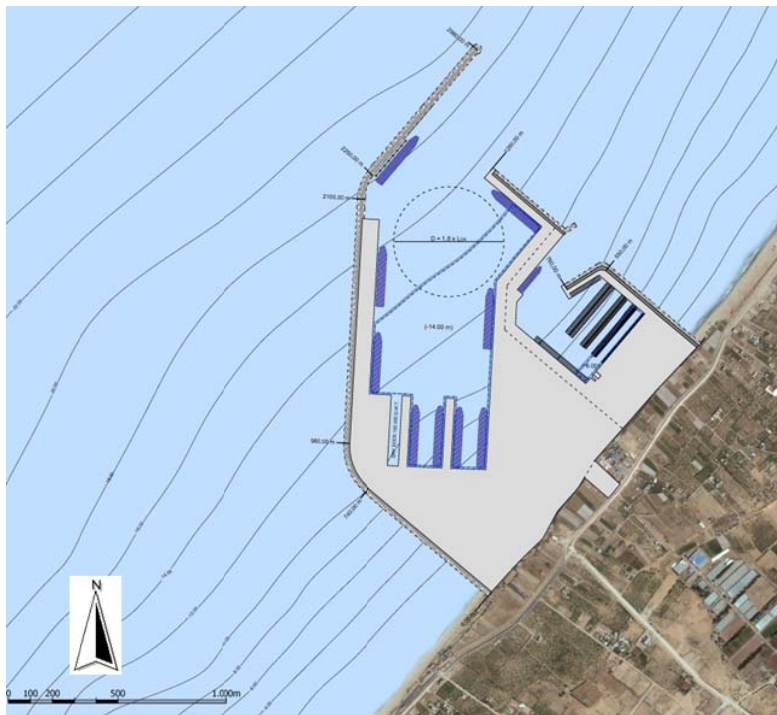


Figure 18. Layout H-S of the New Commercial Port in Gaza Area

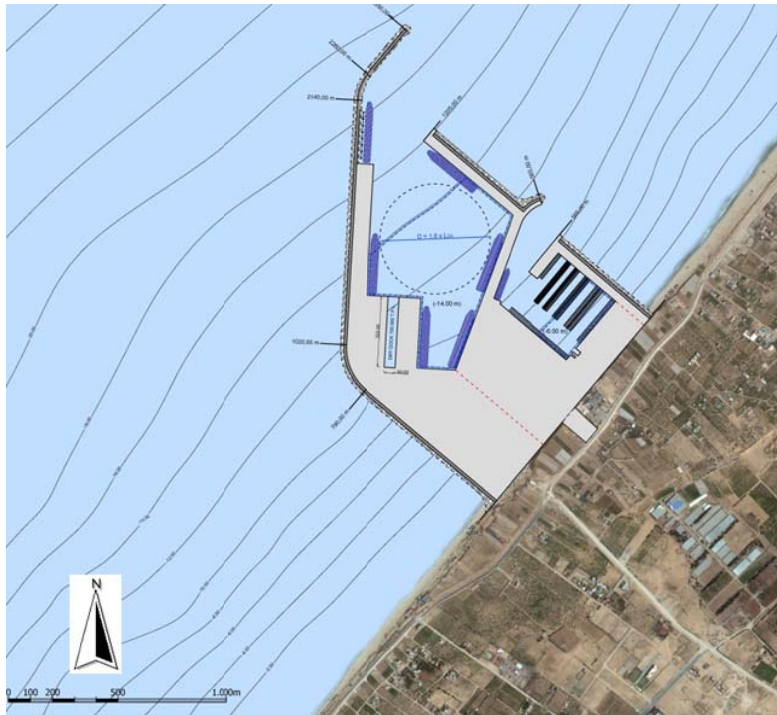
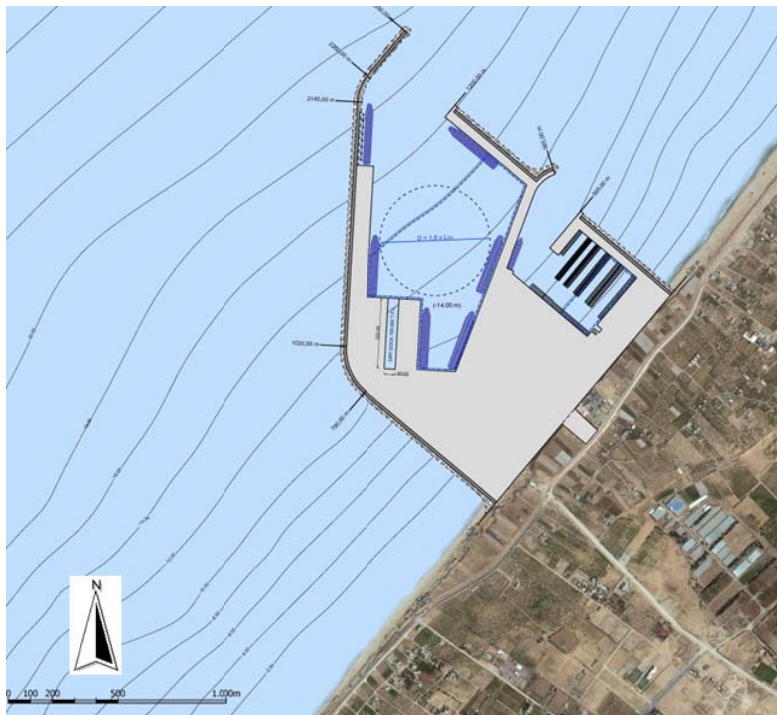


Figure 19. Layout I-S of the New Commercial Port in Gaza Area





The design of all proposed layouts includes both a commercial area with a depth of 14m AMSL and an area reserved for fishing vessels with a depth of 6m AMSL.

The layouts are characterized by:

- harbour basin in the range 594,000-1,260,000m²;
- operational forecourts in the range 742,000-1,287,000m²;
- quay length in the range 4,000-6,600m;
- number of fishing boat mooring in the range 320-572;
- dry dock.

Layouts A-S, G-S, H-S, and I-S allow the separation of commercial routes from fishing one. Layout G-S is also characterized by a liquid bulk terminal.

However, for appropriate separation of the storage areas, only the configurations with an operational forecourt area larger than 900,000m² shall be considered. Moreover, according also to Port Authority indications, layout G-S is fully suitable as new Gaza Commercial Port since it allows the separation of commercial routes from fishing ones, as requested by Gaza Port Authority.



4 Security Issues

The rehabilitation of the existing Fishery Port in Gaza, as well as the implementation of the New Gaza Commercial Port are among the most important and strategic projects foreseen by NTMP. Security-related strategies need to be taken into attentive consideration during planning and design process.

For more details, refer to ¶AX.7 – Security Issues that provides the following security recommendations:

- Seaport and maritime transport security measures;
- Infrastructure security recommendations;
- Proposals of restricted areas and handling cargo;
- Seaport Border Crossing Points control.