

Figure 5-18: Climate graph of Beirut at 65 m above sea level (Historical data between 1982-2012)

As for the wind records, the figure below (Figure 5-19) shows the wind rose for Beirut city representing how annual wind speed and direction are distributed. The data presented in the wind rose indicates that the wind direction with the highest frequency within the study area is from the southwest to northeast with a speed of greater than 5 km/h occurring most of the times (418 h/year). In addition, strong winds occur during winter and spring mainly from December to April while periods of calm winds usually occur from June till October⁵.

⁵ Meteoblue website. (2020). Climate Beirut. Available at https://www.meteoblue.com/en/weather/historyclimate/climatemodelled/beirut_lebanon_276781. Accessed on 16/4/2020

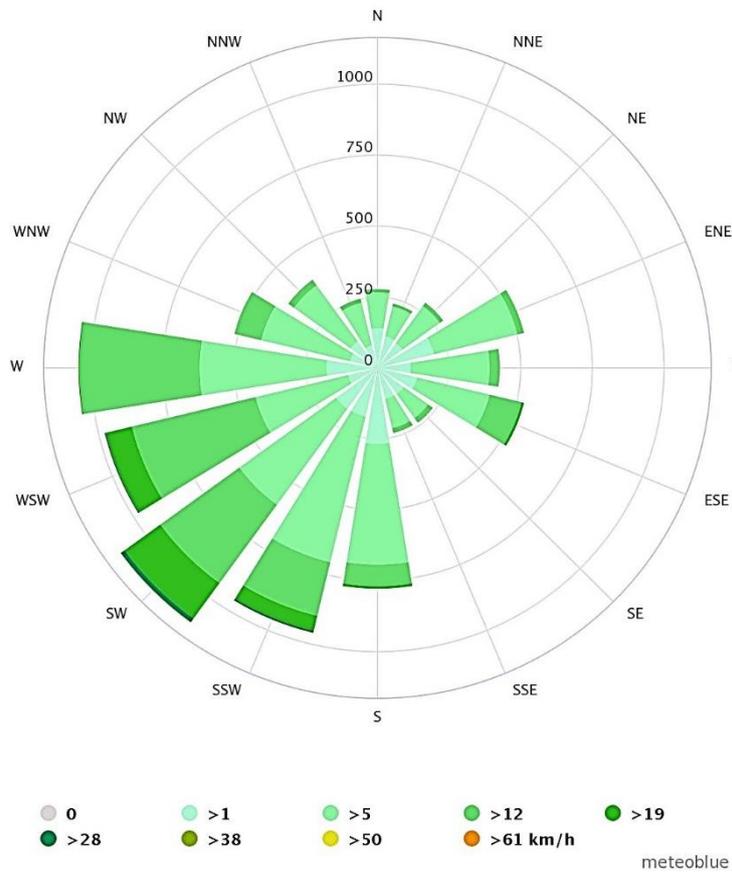


Figure 5-19: Wind Rose of Beirut

Additional data on climate in the area will be obtained from the closest metrological station which is located at the Rafic Hariri International Airport (RHIA) at an altitude of 27.5 meters above sea level and around 6.5 km away from the proposed WWTP site. This is considered representative for the project site as the coastline in Lebanon generally experiences similar weather patterns and this station is the closest one where data is available. Information will also be obtained from other publications such as strategic environmental assessments or EIAs in the area.

In addition, a climate change resilience assessment will be undertaken in which climate hazards will be identified for the specific project such as flood, heat, drought, sea level rise, storms, erosion, ground stability, soil salinity, etc. and then the sensitivity of project in these variables will be identified taking into account current and future climate data. At this step, full identification of the current climate data as well as the future climate data will be presented (i.e. rainfalls, temperature, winds, etc.).

5.4.3. Hydrogeology and Water Resources Quality

Figure 5-20 shows the Bathymetric map of Lebanon that was prepared by the National Council for Scientific Research (CNRS). The continental shelf in Lebanon is narrow. It does not exceed 3 km between Enfe and Ras Beirut and the coastal plain is almost non-existent. However, in comparison with the continental shelf between Enfeh and Akkar (18 km) and between Ras Beirut and Naqoura (7

km), the Enfe-Ras Beirut is the narrowest⁶. A special characteristic of the Lebanese continental shelf is the presence of deep submarine canyons with steep walls, sinuous valleys, v-shaped cross sections and relief that resemble to the biggest land canyons. The deep sea canyon play an important role in maintaining the functions of the benthic and pelagic ecosystems as well as in ensuring the regular exchange between the shallow waters of the continental shelf and the deep waters of the deep ocean⁷. Several maps have been prepared within the framework of the CANA Project. The Beirut Canyon Contours Raster Map has showed that Beirut Canyon directly sinks at 100 m off the sea boulevard having nearly a rectangular shape where steep edges are formed. Furthermore, studies of the contours raster map of the continental shelf and slope northern Beirut showed that at 65 m, the geological limit northern the Beirut platform can be identified and is oriented East-West. The limit of this map is very close to the port of Beirut at the isobaths - 20 m. The presence of some geological interleaves every 2 m are useful and can reveal the forms of different localized structures.

⁶ EU/GFA/GEUS/ELARD/GOL. (2020). Technical Assistance to Support the Government of Lebanon's Preparation of Exploiting and Producing Offshore Oil and Gas Resources. Strategic Environmental Assessment (SEA) for Exploration and Production Activities Offshore Lebanon, SEA Report, Volume 1.

⁷ CNRS. (2014). CANA Project. Unpublished.

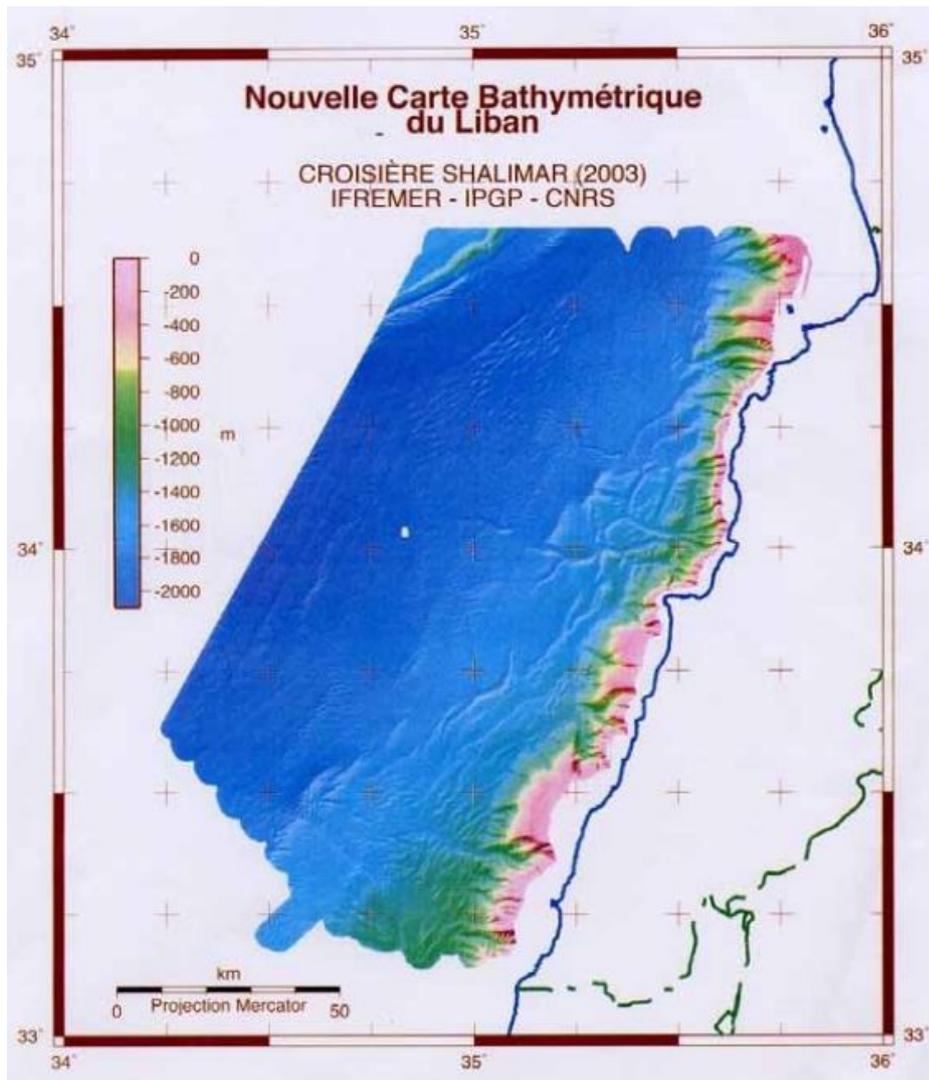


Figure 5-20: Bathymetric Map of Lebanon

Source: CNRS. (2014). CANA Project. Unpublished.

According to Lebanon's National Physical Master Plan, the project site located on the coast does not contain any vulnerable water resources⁸. The nearest water resource is the Beirut River, which is in close proximity to the project site and discharges into the Mediterranean Sea. The drainage volume of Beirut River to the sea is estimated at around 90 to 100 million cubic meters per year, mostly during the winter season. However, during the summer season, the riverbed completely dries out and only receives wastewater⁹. Figure 5-21 represents the major rivers and springs within the General Area of Influence of the study.

⁸ CDR. (2005). NPMPLT. National Physical Master Plan of the Lebanese Territory. Map of Water Resource Vulnerability. Final Report.

⁹ APEC (2010). Bourj Hammoud Municipality. Organization Study of Bourj Hammoud Industrial Zone. Architecture Planning and Engineering Consultants.

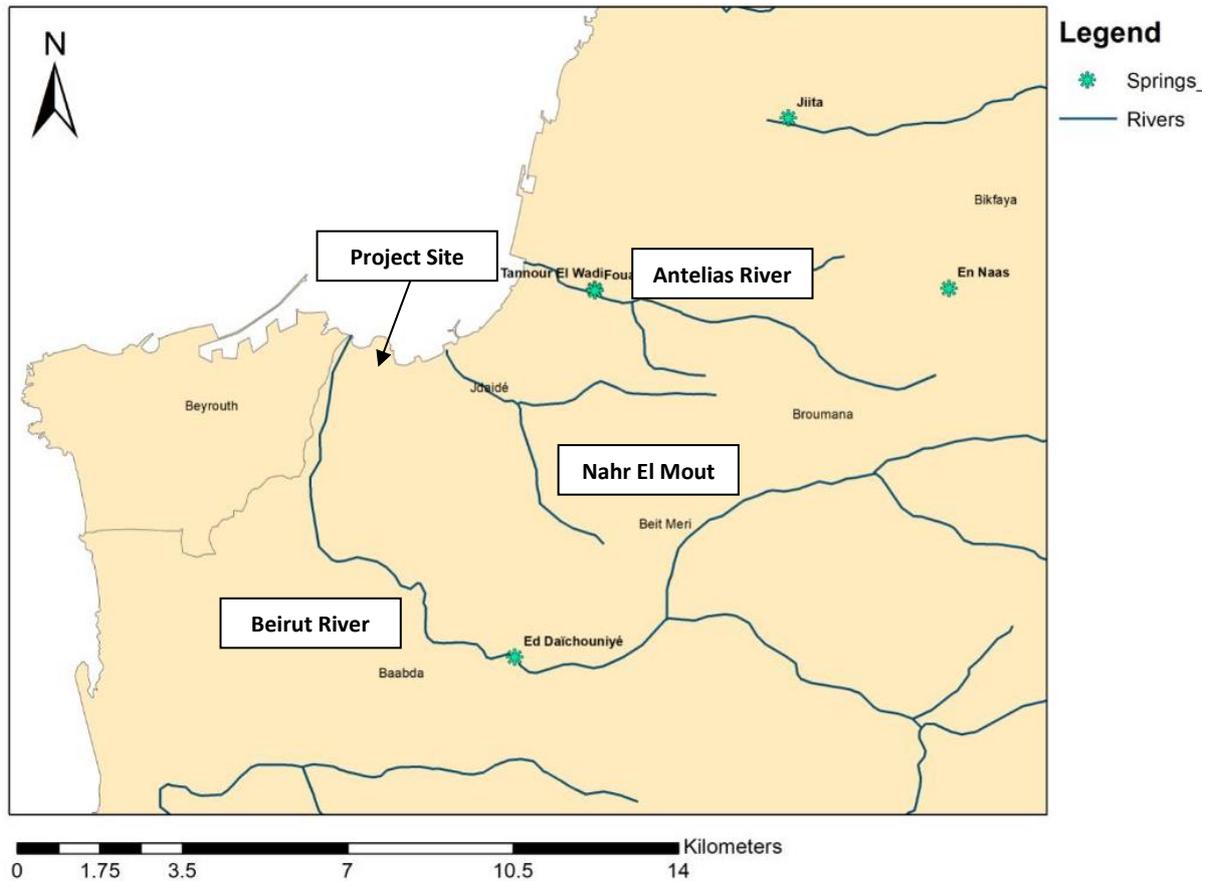


Figure 5-21: Major Rivers and Springs within the General Area of Influence

However, the coast of Bourj Hammoud has been for decades exposed to pollution from dumping of untreated industrial and municipal sewage, slaughterhouse wastes, and the leachate from the solid waste landfill that still leaks to the sea¹⁰.

The Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP) was approved by the contracting parties in 2016. Monitoring biodiversity and non-indigenous species, pollution and marine litter, coast and hydrography are the principles for an adequate integrated monitoring that were mentioned in Decision IG. 22/7. A list of ecological objectives and indicators were developed by IMAP. The objectives related to water quality are eutrophication, pollution and marine litter¹¹. The associated IMAP indicators could be found in Table 5-3 below.

Table 5-3: IMAP Ecological Objectives and Indicators Related to Water Pollution

Ecological Objectives	IMAP Indicators
Eutrophication Human-induced eutrophication is prevented,	Common Indicator 13: Concentration of key nutrients in water column

¹⁰ APEC. (2009). Bourj Hammoud. Brief City Profile by Diran Harmandayan. Architecture Planning and Engineering Consultants

¹¹ UNEP/MAP. (2017). Mediterranean Quality Status Report 2017. United Nations Environment Programme/Mediterranean Action Plan

Ecological Objectives	IMAP Indicators
especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms and oxygen deficiency in bottom waters.	Common Indicator 14: Chlorophyll-a concentration in water column
Pollution: Contaminants cause no significant impact on coastal and marine ecosystems and human health	Common Indicator 17: Concentration of key harmful contaminants measured in the relevant matrix (related to biota, sediment, seawater)
	Common Indicator 18: Level of pollution effects of key contaminants where a cause and effect relationship has been established
	Common Indicator 19: Occurrence, origin (where possible), extent of acute pollution events (e.g. slicks from oil, oil products and hazardous substances), and their impact on biota affected by this pollution
	Common Indicator 20: Actual levels of contaminants that have been detected and number of contaminants which have exceeded maximum regulatory levels in commonly consumed seafood
	Common Indicator 21: Percentage of intestinal enterococci concentration measurements within established standards
Marine litter: Marine and coastal litter do not adversely affect coastal and marine environment	Common Indicator 22: Trends in the amount of litter washed ashore and/or deposited on coastlines
	Common Indicator 23: Trends in the amount of litter in the water column including micro plastics and on the seafloor
	Candidate Indicator 24: Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds, and marine turtles

Source: UNEP/MAP, 2017

Table 5-4 represents a description of the sampling locations that were taken within Bourj Hammoud area for purpose of the IMAP report from August till December of 2019 while Figure 5-22 shows the sampling locations with respect to the location of the Daoura/Bourj Hammoud WWTP.

Table 5-4: description of sampling locations within Daoura/Bourj Hammoud area under IMAP report

Code	Distance from Land (m)	Distance from Land (m)	Longitude	Latitude	Location	Maximum Depth	Type
DORA - 10	350	350	35.54905	33.907922	Dora	11	Open Sea
DORA-30	800	800	35.54845	33.9119	Dora	30	Open Sea
DORA-100	1500	1500	35.5457	33.92045	Dora	100	Open Sea