Ministry of Energy and Water

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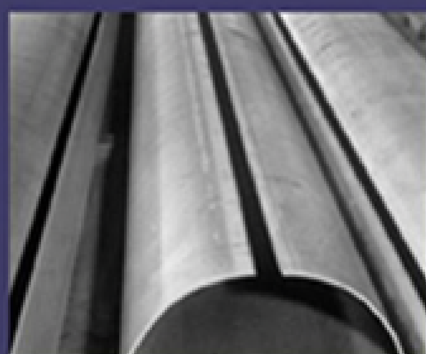
NOP 37 H

For Natural-Gas Treatment Facilities from Discoveries



Survey of Environmental Impact

Chapter 2 – Onshore Environment

October 2012

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Summary

Chapter 2 Examining the alternatives

Having completed the examination, it seems that there is **no one alternative that is clearly preferable to the others**. Each alternative has its advantages and its disadvantages, its possibilities and conflicts. The proposed facility can be established in any of the sites and coastal entry points to and from the sites. However, in each case there are issues to address and improve, and measures must be proposed to minimize impacts and reduce risk to people, environment, and landscape, should the specific alternative be adopted.

For each of the five examined proposed treatment facility sites we recommend the following set of components:

Dor site – coastal entry from Dor and ancillary pipeline to the Dor facility.

Ein Ayala site – coastal entry from Dor and ancillary pipeline to the Ein Ayala facility.

Hagit East site – coastal entry from Dor and southern route pipeline to Hagit facility.

Hadera WWTP site – coastal entry from Hadera and ancillary pipeline to Hadera WWTP on its eastern and northern part. Pipeline from the treatment facility to the transmission system - the southern route to the Harish natural gas station is preferable.

Meretz WWTP site – coastal entry from Nahal Alexander is preferable, and southern alternative of ancillary pipeline to Meretz WWTP is preferable. Pipeline from the treatment facility to the transmission system – on the only proposed route to Magal natural gas station. Despite the fact that the Neurim coastal entry may limit the facility to a single gas supplier, and the uncertainty surrounding stability of the coastal cliff, the environmental advantages of this coastal entry and its ancillary pipeline have led us to recommend continuing with detailed evaluation during the advanced planning stage and reserving this option in the plan.

Selecting a northern array and southern array

As the planning team was asked to recommend one northern array and one southern array, the team was faced with a dilemma:

Northern array – Ein Ayala scored a medium-high preference. Dor was ranked medium when all parameters were added up, but **Hagit East** was ranked low preference mainly due to considerations of risk, natural resources, and hydrogeology. We therefore do not recommend advancing this alternative.

Ein Ayala site complex is compatible on most parameters and even constitutes a form of recovery for the quarry and re-use of a disturbed cell. If this alternative is adopted – the site plan must apply risk-management that will consider the site-specific topography and climate conditions, as well as the interface with Road 4. Suitable protective measures must be applied.

The Dor complex is also suitable on most parameters but is inferior on aspects of landscape and visibility. Advancing this alternative means promoting a material visual change in landscape and compromising the region's nature and image. If this alternative is adopted, we recommend specialized landscape-sensitive architectural planning. This will be a complex challenge in view of the facilities in this project and the need to restrict the size of the grounds in future.

In conclusion, Ein Ayala is preferred for the northern array.

Southern array – There has been an extensive debate regarding the Meretz WWTP and Hadera WWTP sites. **Meretz WWTP complex ranked higher** although the site's exploration zone is part of the landscape complex in NOP 35, which is an important aspect of this alternative, and despite a certain inferiority regarding noise and air-pollution. To minimize modification of the landscape, a decision has been made in conjunction with the planners that advancing this site in the detailed plan **will be contingent on planning the main part of the treatment facility within the disturbed area, within the perimeter of an existing facility.** In this manner we are able to view the selection of the Meretz site as a form of rehabilitation of a disturbed cell, and re-use of the land. In addition, realizing the pipeline route to Meretz WWTP will require creative solutions such as horizontal drilling to prevent harming areas that are sensitive due to natural assets - Nahal Alexander area north and east of Road 2, the Kurkar ridge at Hirbat Samara, and the second Nahal Alexander crossing where it meets Road 20. **We recommend that implementation of this alternative will be contingent on applying horizontal drilling in these sensitive areas,** and that this will done under the detailed plan. The alternative pipeline route from Neurim is more environmentally suitable, but there is uncertainty regarding the Neurim coastal entry. We recommend continuing with detailed evaluation during the advanced planning stage and reserving this option in the plan.

Hadera WWTP complex ranked medium. This site is compatible on most parameters but is inferior on aspects of risk. Parts of it overlap a metropolitan park, and assigned land uses in the pipeline corridor partly overlap residential developments included in approved and to-be approved plans, and sensitive areas. If this site is advanced despite this, it will be necessary to improve boundary demarcation so as to minimize overlap with the park and public receptors in the existing industrial zone, as well as reduce the harm to sensitive areas along the pipeline route.

The table below summarizes the ranking and evaluation of the treatment facility elements:

Summary of receiving-station alternatives:

Alternative / Component of the treatment system	Dor North	Ein Ayala	Hagit East	Hadera WWTP	Meretz WWTP
Coastal entry	**Dor**	**Dor**	**Dor**	**Nahal Hadera**	**Preserve two pipeline corridors: Neurim and Nahal Alexander**
Transmission pipeline to the treatment facility			**Southern route alternative**		
Receiving and treatment facility					
Treated-gas transmission pipeline from the treatment facility				**Southern route alternative**	
Conclusion	**Medium-high preference**	**High preference**	**Low preference**	**Medium preference**	**Medium-high preference**

Table of Contents

Appendices

Appendix 1 – Pipeline, engineering aspects

Table of Figures

List of Tables

CHAPTER 2

EVALUATING THE ALTERNATIVES

2. Chapter 2 – Evaluating the alternatives

2.0 Introduction

This chapter examines the location alternatives based on the information presented in Chapter 1. Gas treatment site alternatives were evaluated according to array elements:

- Comparing coastal entry alternatives
- Comparing alternative pipeline corridors to the onshore treatment facility
- Comparing exploration zone alternatives
- Comparing alternatives for corridor from the onshore facility to the onshore transmission system

After evaluating all elements of each alternative, a treatment array with the highest score for aspects listed in this chapter was selected for each of the exploration zone alternatives:

a. Dor North

b. Ein Ayala

c. Hagit East

d. Hadera WWTP

e. Meretz WWTP

Alternatives were compared for all entry arrays and the proposed arrays were then ranked accordingly.

Methodology for evaluating the alternatives:

Alternatives were evaluated in three steps, as follows:

a. Comparison of the alternatives for each element of the onshore complex: (1) coastal entry, (2) gas transmission line to the treatment facility, (3) gas treatment facility, (4) treated gas transmission pipeline from the treatment facility on all evaluated aspects.

b. Selecting a preferred treatment array for each of the exploration zone alternatives(as noted, each complex contains elements 1-4, above).

c. Comparing the five alternatives for the complete complex, and ranking them according to the evaluated criteria.

This chapter also includes an engineering overview of gas treatment facilities, a description of the criteria used to evaluate the alternatives, and summarizing tables describing the evaluation results by criteria.

2.1 Methodology for presenting and evaluating the alternatives

Technological alternatives

A. General

This chapter describes the gas facilities evaluated under Chapters 1 and 2 of the Environmental Impact Survey. This chapter presents plans and requirements of the plan and treatment facility elements for the discovered onshore and offshore gas reservoirs. This chapter reviews all the engineering aspects of planning natural gas treatment facilities. It also includes a summary of the report prepared by PDI, which lists the facilities' data that are required to conduct this survey.

Environmental implications of the information brought here will be examined also in Chapters 3 and 4.

The planning team has concluded that the design consideration guiding this plan must be to create a facilitating plan for examining the offshore and onshore sites where it will be possible to treat gas. **The planning team views the need to assign to gas treatment grounds onshore as a design consideration that is crucial to the future of Israel's gas market.** This statement is one of the design considerations listed in the documents submitted to and approved by the National Council[1] in the previous stages of the process. Therefore, under the plan, gas treatment will be permitted both on and offshore while preserving flexibility regarding the scope of treatment. The survey will examine a development alternative that allows all gas treatment alternatives approved by the National Council both off and onshore. As recommended by the team, the plan adheres to the guiding principle establishing a coastal entry pressure that does not exceed 110 bar.[2] Similarly, regarding the onshore facility, for the purposes of this examination we have made the stringent assumption that the area assigned to onshore gas treatment will be 150 dunams.

During the following work stages the planning team will address the requirement for any expansion of the area assigned to gas treatment to be based on an engineer's opinion regarding the need for adding installations or other changes mandated by site-specific conditions.

The following list refers to a **representative facility** that has been developed based on currently available information; basic assumptions were made according to this information. Accordingly, **we evaluate a representative**

[1]During 2012
[2]As approved under NOP 37/a/2

facility that takes into account the <u>highest impacts</u> during establishment, operation, and dismantling, as follows:

- **Offshore** – assuming establishment of a **<u>full-treatment offshore facility.</u>**
- **Onshore** – **<u>assuming establishment of a full-treatment onshore facility with pressure not exceeding 100 bar</u>**.

The plan will also allow flexibility in supplier approach, such that every coastal entry will allow parallel operation of two separate production systems. Accordingly, each coastal entry will have two pipeline corridors and the facility will allow operation of two adjacent gas treatment systems, both operating at maximum reliability.

B. Gas system – General Background

Natural gas has been discovered in several offshore reservoirs off the Israeli coast: Noa and Mari across from Ashkelon; Tamar across Haifa; Dalit 60km from Hadera, and Leviathan which is probably much larger than the others discovered so far, as well as than some that have already been declared as discoveries. In view of the geological findings, further discoveries in Israel economic waters are likely.

A short explanation of the production process and use of natural gas follows, providing some background to the engineering description of the installations. This explanation will serve as background to the evaluation of the alternatives in the Environmental Impact Survey.

Raw natural gas emitted from a well head can be highly pressurized and it contains components such as water and additives that must be removed and treated, before the gas can be discharged into the transmission system. To understand the soil-related requirements of a gas treatment system we must analyze its chief components:

- **The production well** – located under the seabed, in the reservoir area. Planning and constructing the array of wells is not part of this plan.
- **Treatment system** – includes the pipeline from the reservoir to the treatment facilities, gas treatment facilities, and a connection to the transmission system (supply system) – **subject of this plan**.
- **Transmission system** – the existing and planned system for delivering gas from the supply system to the transmission system (for which the license-holder, INGL, is responsible), and to the distribution consumers (for which license-holding companies are responsible).

Unlike petroleum, which is relatively easy to transport and store, supplying gas does not require tank storage and it is delivered in pressurized pipelines (national transmission system), which are long enough to provide a constant storage reservoir for several hours. Gas can also be transported by liquefying it (LNG - liquid natural gas) and storing it in liquid form. These matters are outside the scope of this plan and are therefore not included in it.

When planning the gas supply system the following detailed data and specifications must be referred to: entry point into the transmission system, Swing, gas pressure in the wells, and quality of incoming gas (according to INGL procedures), customer requirements and specifications, and more. All these are critical components of the planning process.

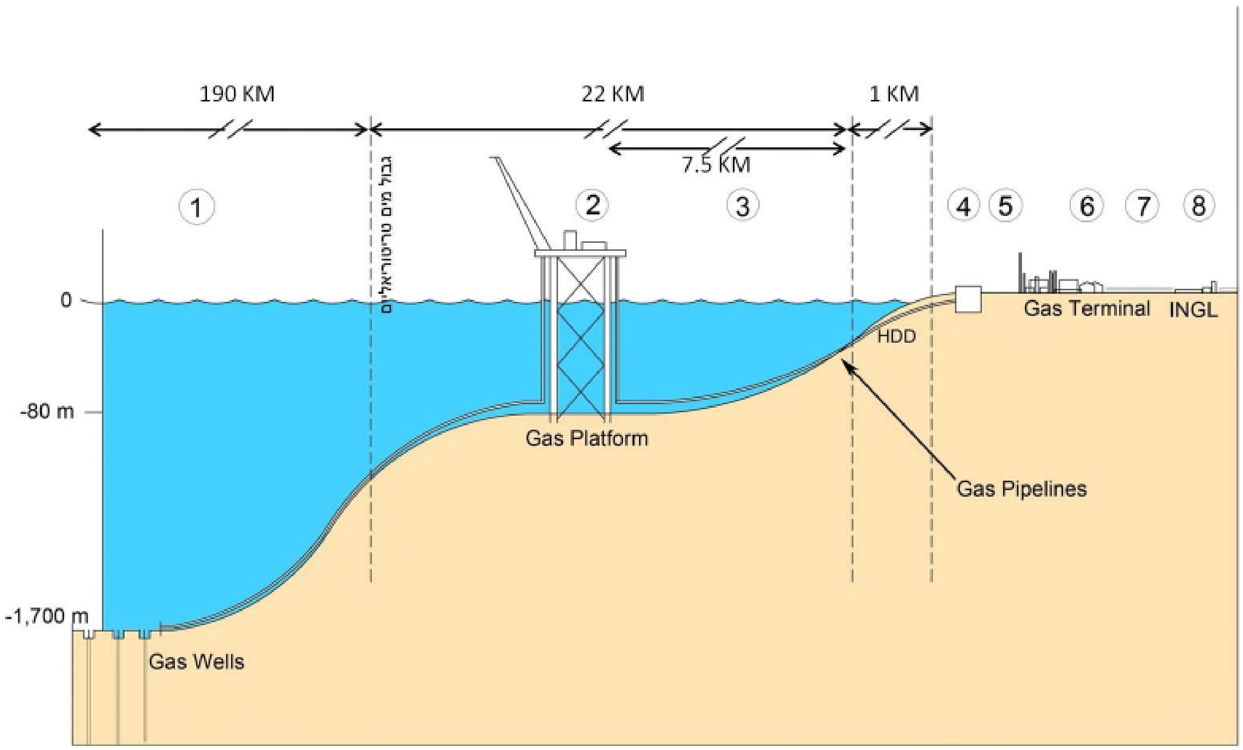
A separate **gas treatment chain** is planned for each field, specific to its properties: gas type and composition, incoming pressure, percentage of hydrocarbons (mainly of condensate), percentage of other substances if present, and amount of water in the gas. Each of these has a material impact on the gas treatment facility and on the soil and marine related requirements for establishing it.

Pre-treatment chain, from the wellhead to gas entry into the transmission system, is based on a working assumption of high methane levels, similar to that found in recent discoveries made off the Israeli coast. The treatment chain mainly includes dehydration and removal of liquids and solids from the gas so that it can be discharged into the transmission system compliant with the required quality standards. The treatment chain must also provide means of accurate metering and trouble-shooting.

Gas can be extracted from a well using a dedicated installation built for the specific well (mostly for large wells), but it is also possible to treat gas from several wells using a single installation. Designing a single installation that can receive gas from several fields simultaneously poses some technical challenges to engineers, because such a "shared" installation must be able to deal with the variations in raw gas composition and pressure differences, as well as be able to withstand discharge capacities from varying sources and different extraction schedules of each of the concession owners.

Gas treatment facilities serving Israel's gas system needs can be presented as installations that receive raw gas from reservoirs (at least most of them) located in the deep seabed, far from the shore. Gas is treated at these facilities and is discharged from them to the transmission system.

Figure 2.1-1: Treatment chain (schematic)



C. Components and properties of the gas treatment system

The gas treatment system comprises several components deployed between the point of entry into territorial waters and the connection to the inland national transmission system. These components are split into three reference spaces:

- Offshore components
- Coastal entry components
- Onshore components

The system shown in Figure 2.1-2 below is a schematic overview of the complexes in the technological alternatives under examination.

Figure 2.1-2: Gas system components

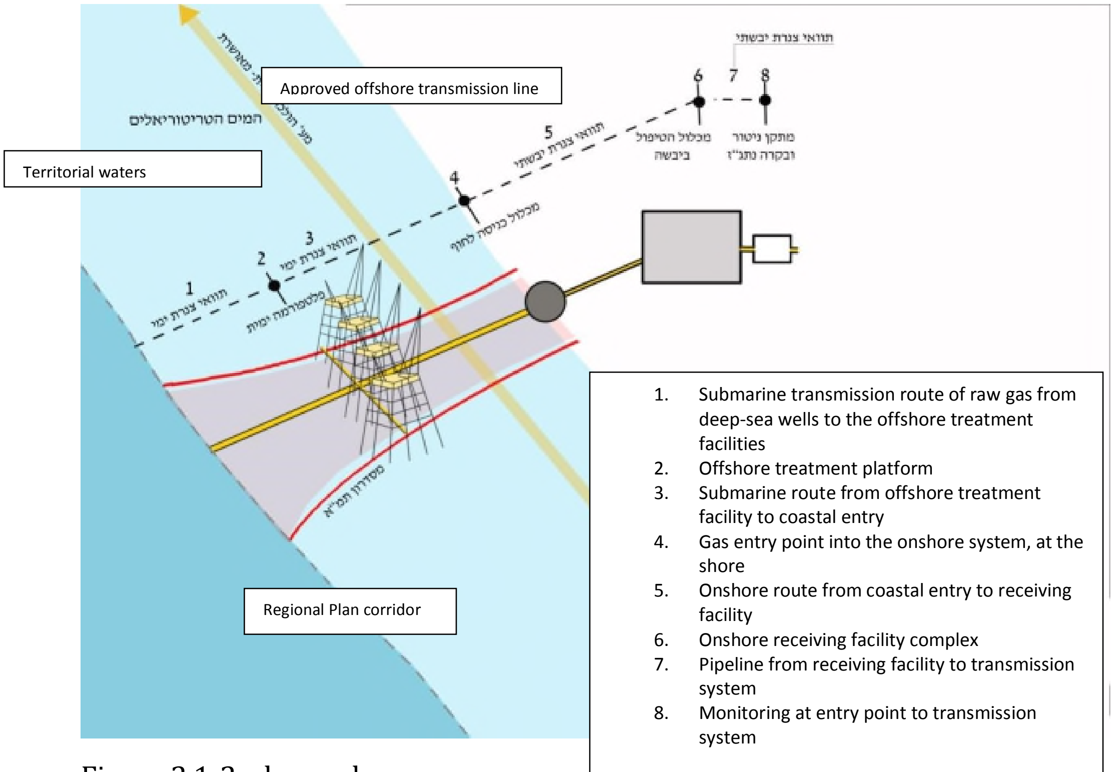


Figure 2.1-2, above, shows:

- **Offshore components**

1. Underwater pipeline strip from the territorial water line up to the treatment facility at sea.
2. Offshore gas treatment facility – offshore rig for treating gas on a marine structure (referred to as Platform(s)), rests on legs and anchored to the seabed with piles; requires drilling into the ground.
3. Underwater pipeline strip between the offshore facility and coastal entry point – route of delivery from the platform to coastal entry on shore.

- **Coastal entry components**

4. Coastal entry from the sea to land is arranged on a narrow strip of shore. Entry from sea to land is possible by horizontal drilling (HDD) under the surface for 1.5 km. This will allow pipeline entry at a distance of 300-400 m from the shoreline and up to 800-900 m into the sea.

- **Onshore components**

5. A pipeline strip between the onshore receiving facility – includes the pipeline strip between coastal entry and the treatment facility, as well as the safety valves adjacent to the coastal entry point.
6. Gas treatment site (referred to as: Onshore Treatment Facility).

7. Pipeline strip between the onshore treatment facility and the connection to the transmission company's (INGL) transmission system.
8. Monitoring installation at entry point into the transmission system – to monitor natural gas quality at entry point into the transmission system; its function is to control and measure gas quality and properties. This type of facility has been constructed by INGL in Ashdod to receive gas from Mari B and in Ashkelon, to receive gas from Egypt.

The present paper discusses an examination of the coastal entry components and the onshore components (Sections 4-8, above).

D. General overview of the technological alternatives and their properties

Following below is an explanation of the properties of the off and onshore gas treatment facilities evaluated in this survey at a level of detail appropriate for the Chapter 2 evaluation of the proposed alternatives.[3]

Working assumptions for designing the treatment facilities include:

- Gas pressure at coastal entry will not exceed 110 bar.
- The planned treatment site may serve more than one supplier, and provide for a number of wells with varying properties.
- The treatment facility will be designed to handle a capacity of up to 2 million cubic meters/hour.
- The plan will include treatment of all natural gas by-products.
- The plan does not include gas storage or liquefaction.
- Gas pressure on transporting to INGL must be 80 bar.

Description of technological alternatives at this stage is generic and intended to facilitate comparing the location alternatives in Chapter 2 of the Environmental Impact Survey. The description lists the central activities that must be conducted at the gas treatment terminal, assuming that a future operator will perform all or some of them at the offshore and/or onshore sites.

D.1 Onshore treatment

Onshore treatment facility, assuming that pressure reduction will take place at sea (the pressure reducing device will probably be on a rig;[4] if there are no other means of ensuring that gas pressure at coastal entry will not exceed 110 bar).

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[3]Dimensions quoted below regarding the alternatives are generic and refer to areas where gas will flow in pipelines or in the facilities. These dimensions are for preliminary planning only, intended to examine compatibility with conditions in Israel and with the examined offshore and onshore facilities. This planning does not replace site-specific planning, according to the site's dimensions and local conditions.

General specification

As noted above, for this survey's purposes, the entire processing procedure, except for pressure reduction, will take place at the onshore terminal.

The area assigned to the onshore terminal and the INGL transfer facility is approximately 150 dunams; it also includes an area for future compression facilities. Note that final dimensions of the facility will be defined according to the location that will be selected, and facility area is dependent on the facility's distance from the shoreline and on local topographic conditions. As noted, onshore exported pressure has been set to 80 bar. To allow a decrease in pressure throughout the terminal and mobilization of all gas processes, initial operational pressure for the slug catcher has been set to 100 bar. At a later stage, it will be necessary to reduce pressure (by compression) to maintain the flow from the reservoir.

The following **processing systems** are part of the terminal:

- Slug catcher – operates in three steps (3-phase) and a separation unit to receive fluids from the pipelines.
- Gas processing – gas processing installations with a capacity of 3X33%, entry pressure of 105 bar using a J-T expansion valve and a low-temperature separation process with monoethylene glycol (MEG) to prevent hydrate formation.
- Exported gas meter – gas is metered according to the financial agreement and discharged to the INGL system.
- Gas compression – a future compression system is included to maintain gas flow in the future. Recovery factor (RF) without compression with an average discharge profile of 1275 million standard cubic feet per day is 48%, i.e. 7.7 trillion cubic feet of gas. If compression is conducted at the onshore terminal, which allows coastal entry pressure to drop below 100 bar and the flow from the reservoir to increase, recovery factor will rise to 63%.Based on the recovery profile, onshore compression will become necessary starting in 2025.
- Storing and treating condensate.

Process support systems included in the terminal are: heating, air-cooling, flare, chemicals for production, gas for use on the platform, treating produced water, closed drainage.

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[4]See further details in the Appendix: http://www.moin.gov.il/SubjectDocuments/tama37_8/Appendix-Engineering1.pdf - App.c

Service systems included in the terminal are: open drainage, clean water, compressed air for cleaning, nitrogen, diesel, sewage, regeneration of MEG (offshore and onshore); fire water, electricity generation.

The **terminal** also requires the following **general systems** and items: process control, fire and gas detectors, emergency breaker, control room, local equipment room, engine control room, communications systems, closed-circuit TV, uninterrupted power supply, public address system/general alarm system, security fence and gate, offices and car park, work shop, storeroom, lab, rest area.

The following figures are illustrations of a facility for partial gas treatment that extends over a small portion of the required area. These figures have been designed for this document (evaluating the alternatives in chapter B of the survey). After the recommended alternatives are selected, they will be designed for full gas treatment at pressures that do not exceed 110 bar, with an effort made to minimize land consumption as far as possible.

Figure 2.1-3: Overall plan for the onshore facility

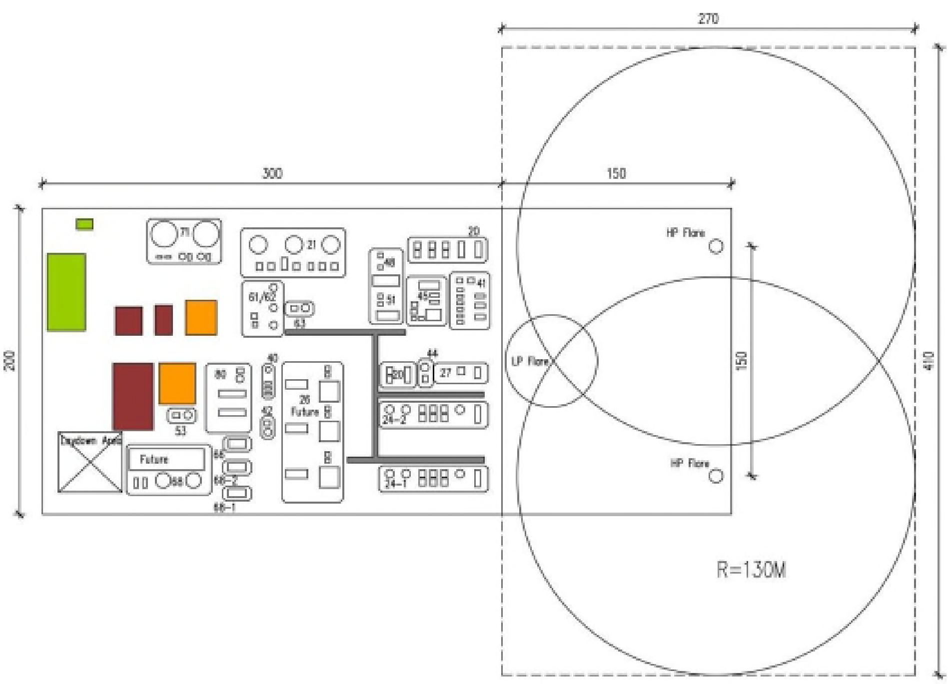
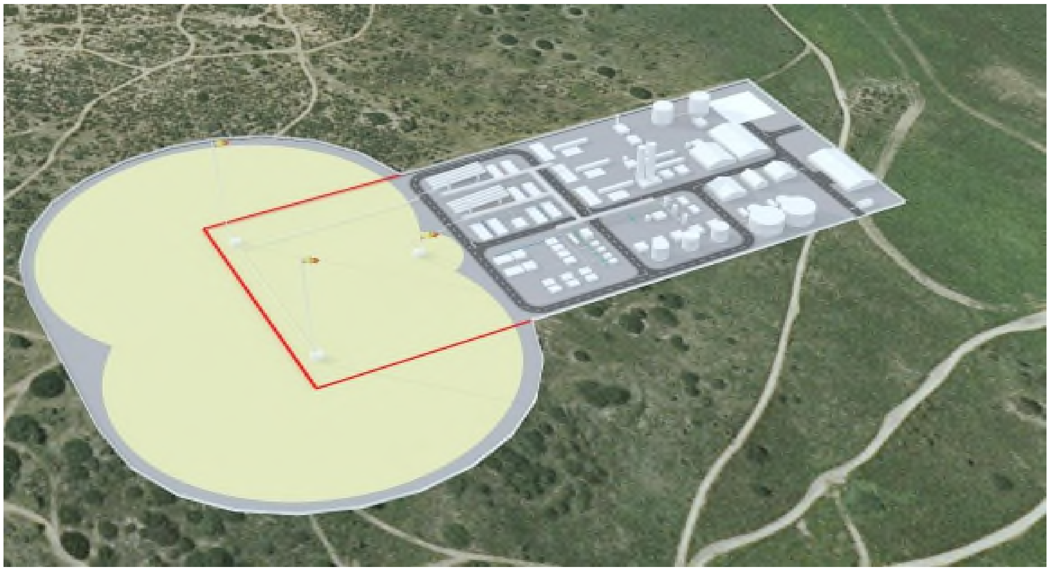


Figure 2.1-4: Simulation of an onshore facility



D.2 Maximum treatment in shallow water

Gas treatment at sea is conducted on an installation composed of several platforms.

The full offshore processing array provides full processing of gas, condensates, produced water, as well as future gas compression at sea without onshore gas treatment facilities (except for a metering device and a facility for receiving pig launchers). In addition there will be a storage facility and condensate transport facilities with a storage volume of 50,000 cubic meters.

General specifications

We are assuming that the offshore facilities' compound will be located at least 7.5 km from the shoreline and up to a depth in the sea of 100 m.

The offshore facilities' compound will include space for processing and treatment facilities capable of treating approximately 2 million cubic meters an hour, and will treat gas from a number of gas reservoirs and most of the by-products. It is likely that this quantity of gas will be delivered from several different reservoirs that are treated at a number of different facilities.

The proposed plan for the facilities is typical for reasonably shallow water and provides the rational element of a separate safety area.

The proposed onshore facility will have approximately four separate platforms connected by a bridge: the central processing platform (GPP), utility and living quarters platform (UQ), offshore pipe platform (RP), and compression platform (CP) that will be added in the coming years.

- The **GPP** contains equipment for monitoring dew point and condensate on the offshore GPP instead of on land. The platform is connected by bridge to the RP and provides gas conditioning, water removal, and facilities for regeneration of MEG together with stabilization of dew point and condensate. The GPP also contains a slug treatment installation. The preliminary GPP plan was designed to supply the following processing and safety functions: gas conditioning compliant with INGL requirements before metering and discharge to shore via a 36" gas pipe; gas export meter; condensate extraction and processing; flash compressing gas; pumping and storage; high and low pressure flare systems; heating system; gas system for use in the platform; and in addition the platform requires open and closed drainage valve systems.
- **The QU platform (according to the preliminary plan)** will be located further away from the RP and the GPP and will connect to the GPP with a bridge. The preliminary plan of the Q&U platform is intended to provide the following services, operational functions, support, and living quarters: medium cooling system; sea water; drainage outlets for non-hazardous

materials; clean water, compressed air/instrument air; nitrogen; diesel; wastewater; power generation; fire extinguishing water; control room; storeroom and workshop; crew quarters; helicopter landing pad; emergency evacuation. The platform will be fully manned with living quarters for 35 crew members.

- **RP – for high-pressure discharge pipelines and offshore pipelines** planned to ensure that the high-pressure discharge pipelines are located at a distance from the control room and crew quarters. The platform is intended to receive the three 16" surface discharge pipes from the well site; pressure reduction valves on the platform (throttles); high-pressure; low-pressure interface management; export pipe to 36" pipes, 8" pipe for condensate and additional MEG; J-tube pipe work for umbilicals to the well site. Device for receiving pig launchers for a 36" pipe. Pressure reduction will be conducted on this platform.
- **The future CP – also included in the proposed plan.** At a later stage, it will be necessary to reduce pressure (by compression) to preserve the flow from the field and maximize return from the reservoir. We therefore propose installing the future CP nearby, as well as a bridge to connect to the central GPP, which will be constructed after a few years of production (approximately 8 years). The preliminary compression platform plan is intended to supply gas compression when pressure at the wellhead during flow from the field (FWHP) reaches a state where free flow of gas (at the required pressure) is no longer possible from the processing, utility, and living quarters platform to the onshore terminal. In addition to the process connections, there will also be need for sea water, closed drainage outlets, flare head, instrument air, nitrogen cable, and electrical power terminations on the central GPP.

Figure 2.1-5: Demonstration of the marine area required to establish an offshore facility for offshore treatment

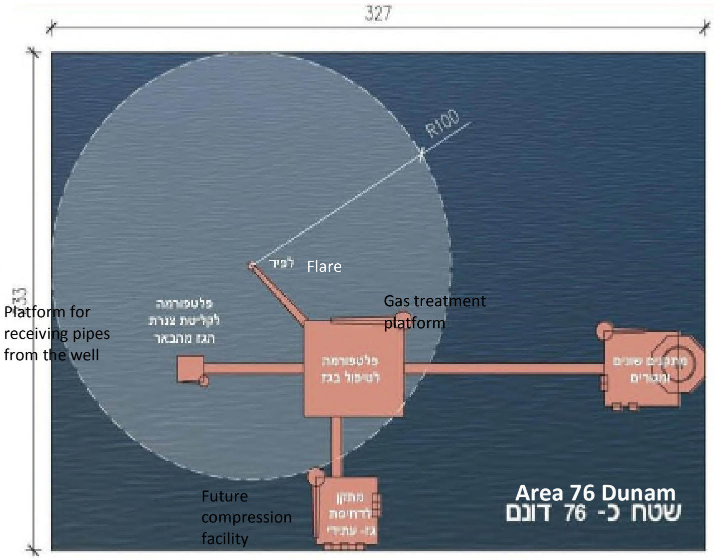


Figure 2.1-6: Simulation of an offshore facility for treatment at sea

Figure 2.1-7: Demonstration of the number of offshore treatment facilities derived from safety distances of 1.5 km

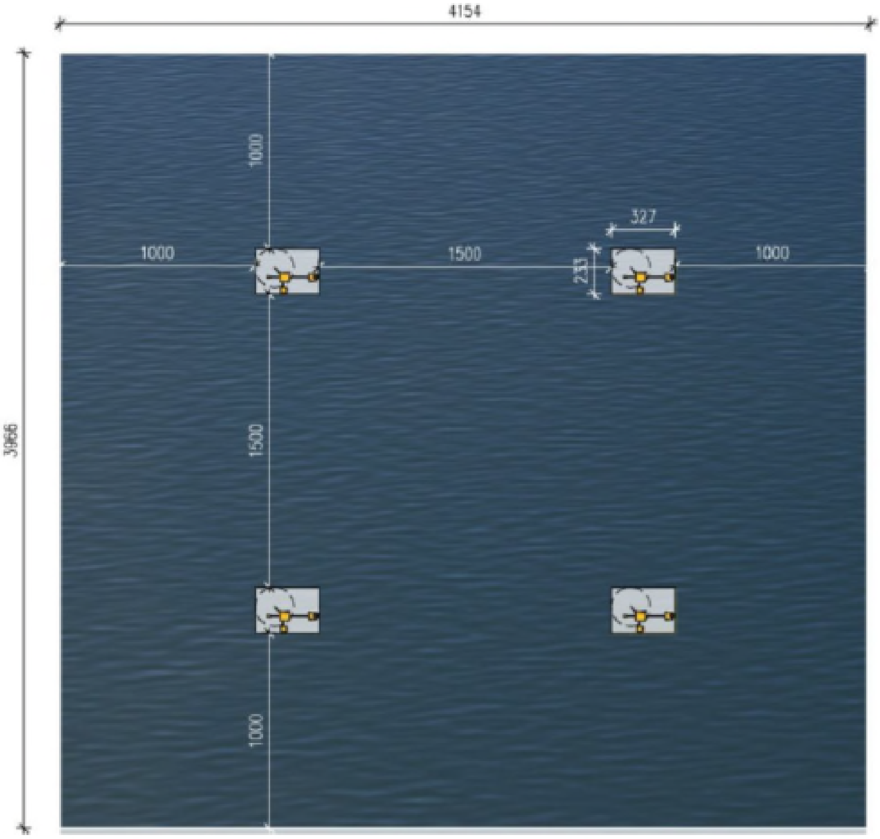


Table 2.1-1 below summarizes the description of the technological alternatives based on their dimensions and key properties

Table 2.1-1: Technological alternatives - key dimensions and properties

Name of alternative	Key dimensions and properties
Maximum treatment onshore with pressure reduction as sea	Onshore facility on an area of **135** dunams (exclusive of separation distances and safety radius) Approximately 3000 dunams (including separation distances and safety radius) + **15 dunams** for INGL receiving facility = 150 dunams Flare/vent height* - 100 m, heat radiation radius 130 m.

Name of alternative	Key dimensions and properties
Maximum treatment in shallow water and an onshore metering and receiving facility	Dimensions - area in the sea for treatment platform - 76 dunams. The area required for 4 facilities is in the range of 17,000 dunams, in view of the separation distances and vessel maneuvering space. Facility height - up to 80 m above sea level Flare/vent height* - 135 m above sea level, heat radiation radius 130 m.

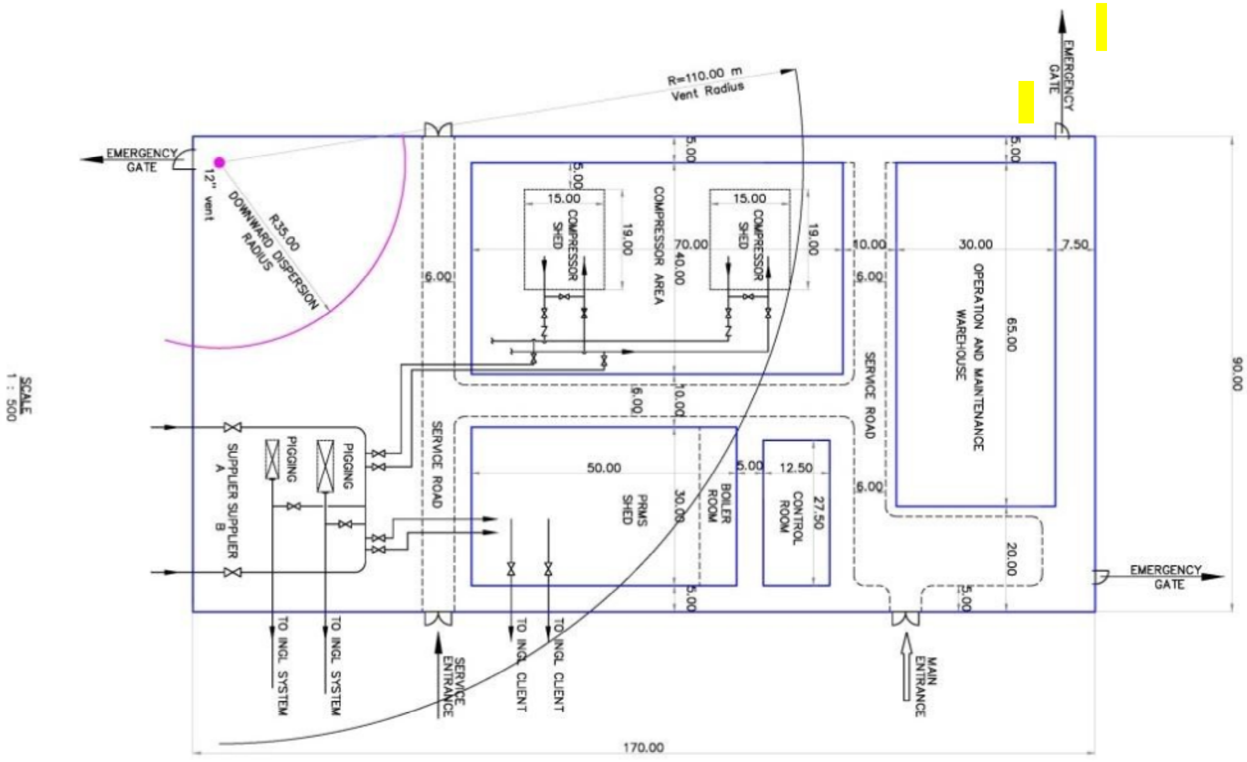
E. INGL monitoring and control station

Gas transmission and receiving system includes complex no. 8 – monitoring at the transmission system entry point (connection point and fiscal or custody transfer to NGTS), whose function is to control and measure gas quality and properties before it enters the national transmission system. INGL is constructing this system according to its own planning procedures.

The INGL receiving station area will be planned as close as possible to the receiving and supplementary treatment facility, and will allow entry of two separate suppliers into the transmission system. **An area of 15 dunams has been reserved in compliance with INGL requirements and the specification for required installations at a monitoring and control station.** The facility is shown in the figure below and includes the following components:

- Pipeline from the gas receiving and treatment facility
- Block-valve station
- Command and control room
- Pipeline from the INGL receiving facility to the national transmission system
- **Vent** - for venting gas
- **PRMS and boiler room** + option to connect to future consumer pipeline
- **Area for compressors.**
- Area for operations and maintenance

Figure 2.1-8: INGL monitoring and control facility



F. Pipeline and coastal entry system

F.1 Offshore pipeline route

- **Offshore pipeline route from the well to the offshore treatment facility**
  - A 16" diameter is the greatest diameter pipe that can be buried at the current depth. Our working assumption was that to supply the required 1700 million standard square feet per day from Leviathan three 16" discharge pipes will be needed.
  - In the absence of accurate bathymetric data, we have assumed that most of the rise of the discharge pipe to the continental shelf will take place toward its end, at a distance of 10 km from the shore.
- **Pipeline route from the offshore facility to the onshore facility (to the national transmission system)**
  - Onshore treatment with pressure reduction on the shallow waters platform.

A 36" pipe laid from the pressure reduction platform (gas pressure in the pipe must not exceed 110 bar[5]). A pipe with this diameter can supply the required 1700 million standard cubic feet per day.

- Maximum treatment in shallow water
  - 36" pipe for clean gas laid from the PUQ platform to the onshore terminal. Gas pressure in the pipe must be as close as possible to the operational pressure in the INGL transmission system (85 bar, but in any case not higher than 110 bar. A pipe with this diameter can supply the required 1700 million standard cubic feet per day.
  - 8" diameter condensate pipe connecting the PUQ platform to land

In the absence of accurate bathymetric data, we have assumed that most pipelines will be laid flat in the sea with a stable rising curve to shore along the last two kilometers.

[5]And compliant with the NOP 37/a/2 guidelines.

Table 2.1-2: Complete list of discharge pipelines and main pipelines

Option	Onshore treatment with pressure reduction at the shallow waters platform	Maximum treatment in shallow water
Discharge pipes from the wellhead to the platform	3 x 16" NPS*	3 x 16" NPS*
Gas pipeline to the shore	*1 x 36" NPS	1 x 36" NPS* (clean gas)
Condensate pipeline to the shore		1 x 8" NPS*
Produced water pipeline	1 x 10" NPS*	
MEG and/or condensate: from the shore to the platform (potential)	1 x 8" NPS*	1 x 8" NPS*
MEG: from the platform to the well site	3 x 4"	3 x 4"

*Nominal pipe size

Table 2.1-3: Key working assumptions when planning security of discharge

Item	Value
Range of operational pressure in the discharge pipe to PUQ platform	16-450 bar
Planned pressure from the discharge pipe to the PUQ platform	520 bar (approx. CITHP)
Temperature of sea water in the discharge pipe (working assumption)	10°C
Planned pressure for the onshore pipeline	110 bar in onshore processing 85 bar with full offshore processing
Temperature of sea water in the pipe (working assumption)	10°C
Maximum output	1700 million standard cubic feet per day
SWING	plus 0% minus 50% target

- **Burying offshore pipelines**

Pipelines connecting the offshore platforms to the rise up to the shore must be buried in the section located between the HDD exit point and water depth of 60m.

The pipelines are designed to avoid shifting as a result of waves and currents and to avoid damage by fishing equipment.

The offshore pipelines are usually laid on the seabed and are buried or shielded only when there is a specific reason to do so. Offshore pipelines are not buried and are not laid under the seabed.

If burying is required, depth is determined based on the soil and the selected equipment. Achievable trench depths are usually 3 m near the shore and 1-2 m for longer sections excavated after pipes were laid.

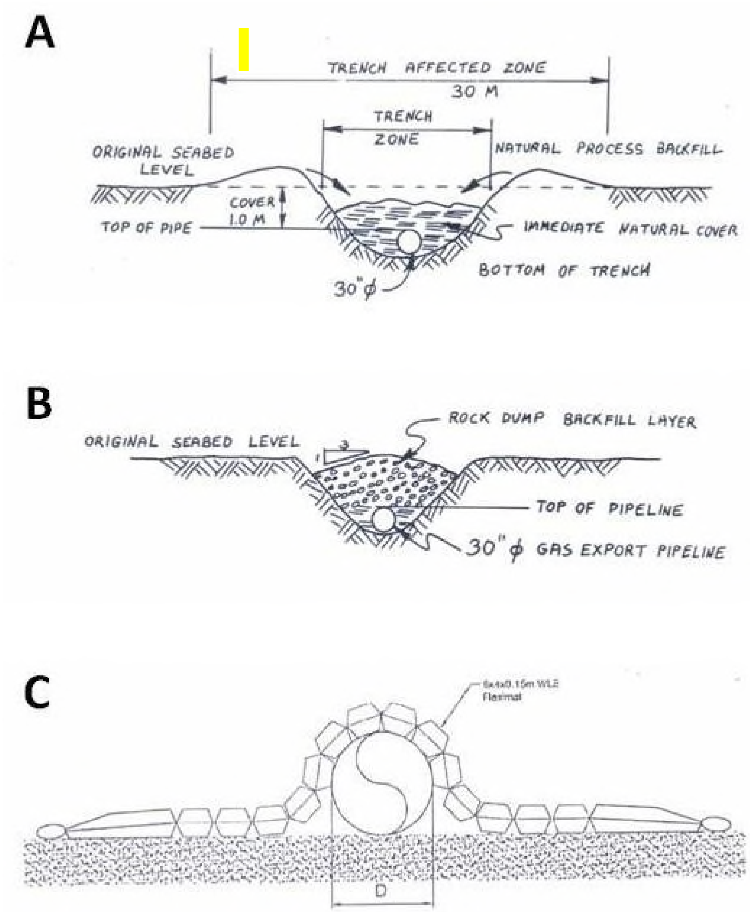
In areas where burying is impracticable, such as in sandstone ridges, pipes can be protected using the familiar method of placing several flexible mattresses above the pipeline to make dumping easier and provide additional stability to the pipe. Mattresses are usually composed of 0.2m thick concrete blocks held together by strong synthetic-fiber cords.

To protect it from waves, currents, fishing gear, and tourist activities, the communications cable will also be buried in the area proposed for burying the gas pipe. Burying the pipeline provides sufficient cover and protection, and its activity will proceed in a controlled manner without causing any environmental disruptions.

The following illustration describes two burial options:

1. Typical two-step burial trench.
2. Placing rocks on the pipeline for protection (known as rock dumping) if necessary, and if the area is affected by pipeline burial activity.

Figure 2.1-9: Various methods for burying/ running pipelines in the sea



F.2 Coastal entry

Technology for connecting the offshore pipeline to land – Coastal entry-work location: Entry must be located on a narrow strip of shore; as a result of limited availability of shores in Israel this is a critical route. At this stage we assume coastal entry work will be performed by horizontal directional drilling (HDD) technology.[6] At the pipeline crossing point there will be an underground horizontal drill of up to 1.5 km. This will allow entry at a distance of 300-400 m from the shoreline and up to 800-900 m into the sea.

This technique makes it possible to cover a greater depth and minimizes environmental disruption by the existing and future pipelines that will require this section of shore.

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[6]Considerations for choosing between the technologies will include topographical aspects, mutual constraints, environmental considerations at sea and on the shore, and additional criteria derived from adjacent land uses and the location options for the ESD control valve.

Figure 2.1-10: Simulation of horizontal drilling (HDD)

F.3 Shore block-valve station

An underground block-valve station will be built on a 2.5 dunam lot, approximately half a kilometer east of the shoreline (see Figure 2.1-11). The function of this station is to disconnect the offshore pipeline from the onshore pipeline for routine maintenance and in emergencies when the gas supply must be shut off for controlled venting.

The station is fenced in and includes several valves and a control room. The valves will be operated manually, or mechanically by electric or hydraulic motor, or using a mechanism that utilizes gas pressure in the system. Controls for opening and shutting off the valves must be manual and/or automatic.

Figure 2.1-11: Block-valve station proposal

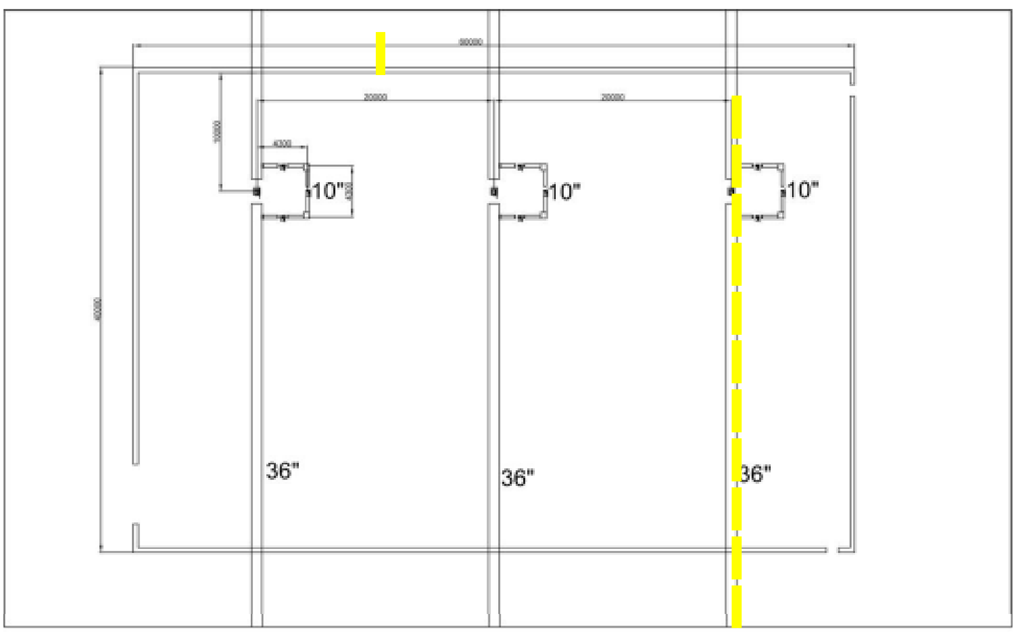

Figure 2.1-12: Example of a buried shore block-valve station on Den Helder beach in the Netherlands, connected via HDD to the offshore pipe

F.4 Onshore pipeline route

The following section describes the pipeline from coastal entry, through the onshore treatment facility, to the INGL national transmission system. The description includes the building-lines and right-of-way for outlining the onshore pipeline route.

- **Width of pipeline corridor**

  Pipeline corridor from coastal entry to the receiving facility, according to the various engineering technologies, contains the following lines:

  - Incoming gas line from the sea to final treatment at the receiving facility, with a diameter of up to 36".
  - Pipe for removing excess water.
  - Pipe for removing excess condensate[7].
  - Communications cable (optical fiber)

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[7] Condensate surpluses will be removed via the onshore or offshore transmission system. Offshore alternative - width of the pipeline strip from coastal entry to the onshore facility, includes an 8" pipe for removing condensate to the onshore facility, from there to be removed by ship. Onshore alternative - width of the pipeline strip from the eastern transmission system, includes space to run a condensate pipe to the eastern transmission system. According to NOP 37/B/8 a condensate pipe will run adjacent to the INGL gas pipeline and from there condensate will be discharged via the existing PEI lines to the ORL Haifa facility. Another alternative is to use the existing PEI pipeline in coordination with PEI.

- o Maintenance and control line (umbilical control cable) between the facility and the onshore facility.

  Treated gas will be transmitted from the receiving facility to the INGL national transmission system via two connections. Diameter of each gas pipe will be up to 36":

  - o Connection to the offshore transmission system.
  - o Connection to the onshore transmission system.

Accordingly, and compliant with the plans and pipe sections shown in Figures 2.1-13 to 2.1-15:

- **Width of coastal entry pipeline corridor** is 300-400 m (see above)**.**
- **Required width of the pipeline corridor from the coastal entry point to the receiving facility on land**(including treated-gas pipeline from the INGL offshore transmission system):[8]
  - o For the two supplier alternative is **60 m**[9] with the addition of 90 m for building lines (45 m on either side of the pipeline corridor) = **150** (see Figure 2.1-13).
  - o For the single-supplier alternative, corridor width is **40 m** with the addition of 90 m for building lines (45 m on either side of the pipeline corridor) = **130** (see Figure 2.1-14).

Required width of the pipeline corridor from the receiving and treatment facility to the INGL onshore transmission system, assuming a 36" diameter pipe is required, is 20 m, with the addition of 90 m for building lines = **110m** (see Figure 2.1-15). In addition, at this stage we are reserving the option to include the pipe for removing excess condensate in this strip.[10]

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[8]According to Standard SI 5664 the space between parallel pipes must be at least 0.4 m (see SI 5664-1 Section 8.1.5). However, if pipelines are not laid at the same time, the required distance is at least 5 m. Coordination is required with existing pipe owners as well as suitable protective measures to prevent wear, corrosion, and other possible failures (SI 5664-1 Section 6.5.6).

[9]This corridor width will allow entry of two suppliers at different periods, burial of up to 9 pipelines of varying diameters up to 36".

[10]In this context we note that INGL intends to reduce corridor width to 10 m when performance is completed so that in fact the statutory corridor will be 10 m. If the pipe for condensate surpluses is included in the corridor, corridor width will remain 20 m.

Figure 2.1-13: Two-supplier pipeline entry alternative

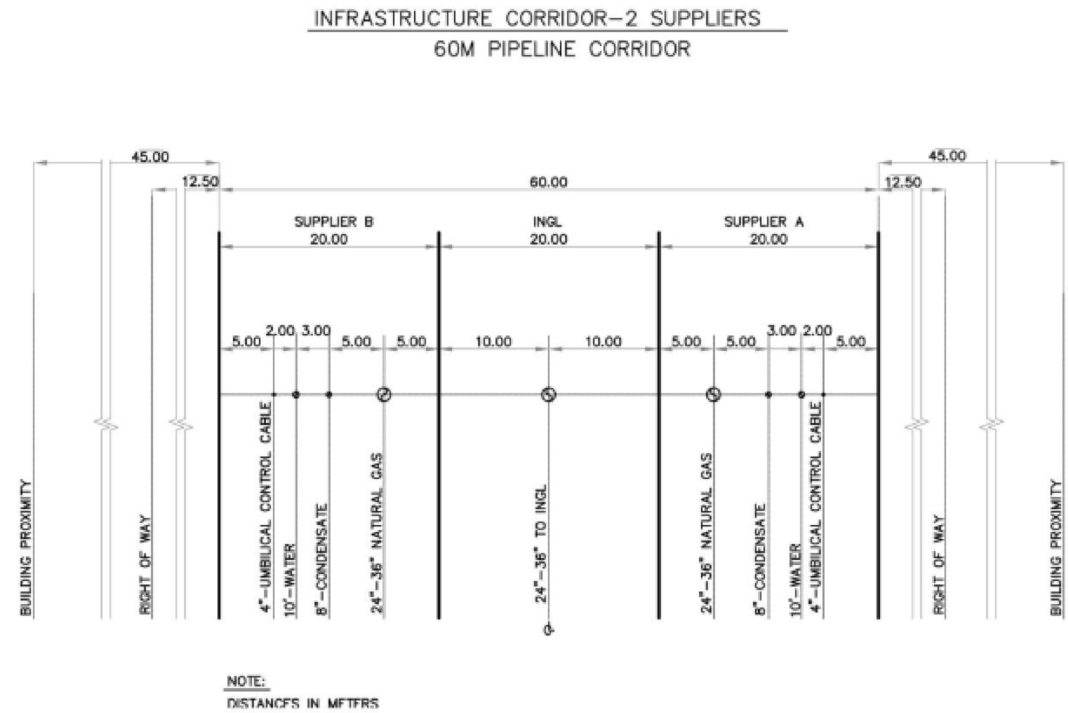


Figure 2.1-14: Single-supplier pipeline entry alternative

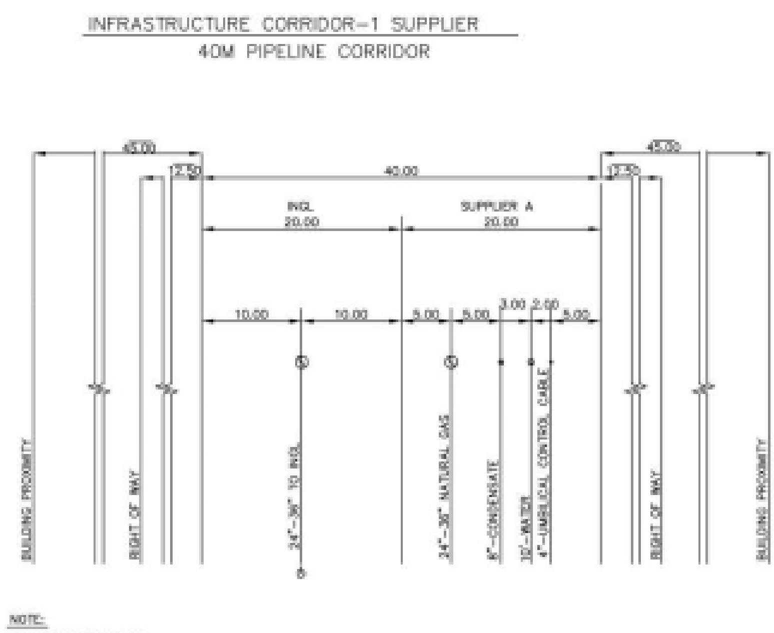
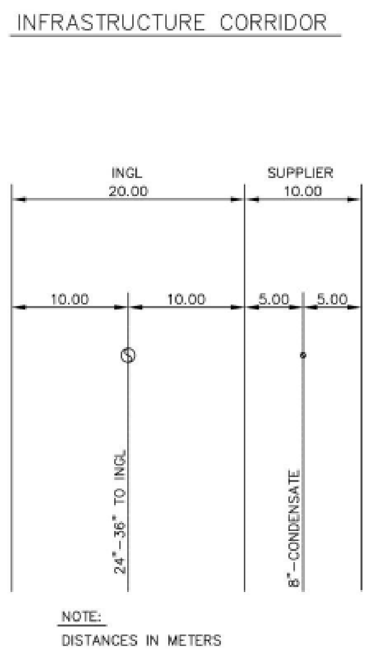


Figure 2.1-15: Required width of pipeline corridor from the receiving and treatment facility to the onshore transmission system



- **Proximity of gas pipeline to various onshore infrastructure (building lines)**[11]

The following tables provide the required building lines for the gas pipeline, allowing for separation between structures and infrastructure.

Table 2.1-4: Building lines from structures

Diameter	Proximity to building (m) 80-110 bar design pressure
24"	25
30"	35
36"	45

[11]See further information in Appendix 1.

Table 2.1-5: Proximity to infrastructure

Type of infrastructure	Horizontal distance	Vertical distances (on crossings)
Roads - motorways	Gas pipelines can be buried within the boundaries of the road building lines. They must not be buries within the boundary of the statutory right of way. Gas pipes must be placed at least 5 m from the edge of the road (unless a restriction is present in the road plan's guidelines). By-road, this distance can be a little as 1 m when coordinated and agreed with the appropriate authorities.	The default for motorway crossings is crossing perpendicular to the road axis, using a steel casing, at a minimal depth of 1.5 m unless otherwise agreed with the appropriate authorities. In any event, the top of the gas pipe must be buried at least 1.25 m from the pavement surface
Railways	8 m from the center of the track closest to the gas-pipe center, and 6 m from the earth embankment on which the track runs to the center.	On rail crossings the default is crossing perpendicular to the track axis using a steel casing at a depth of at least 1.25 m from the pavement surface, unless otherwise agreed with the appropriate authorities.
Power lines and power poles	Surface power lines 30-35 m (exclusive of parallel aspect). Underground power lines - distance of 5 m. Power pole - distance of 10 m.	
Fuel lines	In coordination with PEI they may be laid within the fuel strip (the strip is not statutory). In any event, instructions must be obtained from the infrastructure owner.	1 m beneath the pipe wall. In any event, instructions must be obtained from the infrastructure owner.
Communication lines	Not within the strip, at a distance of 2 m.	
Mekorot lines	Not within the strip, at a distance of 1 m. In any event, Mekorot requires a distance of 5 m from the water lines.	1 m under the pipe wall. In any event, instructions must be obtained from the infrastructure owner.
Wells and protective zones	Transmission of untreated gas and condensate through protective zones is prohibited; however, crossing these perimeters may be possible subject to the Ministry of Health relaxing the prohibition.	Requires specific inquiry into the pipeline's depth.

Type of infrastructure	Horizontal distance	Vertical distances (on crossings)
Flight routes and landing strip	Subject to coordination with the Civil Aviation Authority or Ministry of Defense.	
Distance form explosions (quarries)	100 m from explosion zone.	

- **Survey distances/line** – defines the horizontal distance measured from the natural gas pipeline (or station fence) in both directions. The survey's goal is to classify the area in which the pipeline corridor will be laid and it includes determining the safety coefficient for pipe gauge and other parameters required for the detailed plan for performance.

Table 2.1-7: Survey distances relative to pipe diameter and pressure

Diameter	Survey distance (m) 80-110 bar design pressure
95	24"
120	30"
140	36"

- **Steps of installing the pipeline**

During the pipeline installation phase the following elements must be addressed:

- o **Right of way** – the area in which performance contractors are permitted to execute activities required to lay the pipelines. This strip is established during the detailed plan phase and is not a statutory strip. The pipeline corridor is always contained within the right of way.

  Right of way width ranges between 10-20.5 m on either side of the pipe, as shown in the following table. The largest diameter that is currently known is 36".

Table 2.1-8: width of the pipeline strip and working strips

Pipe orientation	Number of suppliers	Width of the pipeline strip	Right of way width (on either side of the pipeline strip)
From the onshore treatment facility to the eastern transmission system	-	20 m	10 m
From coastal entry to the onshore treatment facility	1	40 m	12.5-15 m
	2 - Simultaneous array	60 m	15 m
	Stepwise array	60 m	20.5 m

Note that it is possible to reduce strip width in cases where gas pipelines are planned in environmentally or ecologically sensitive areas, or in the vicinity of infrastructure, structures, archeological sites, etc. All must comply with the route in the selected alternative. Note that, by default, the strip must be wide enough to allow executing the line using existing conventional methods, thus ensuring rapid execution of the line and savings in execution costs.

- **Depth for burying onshore pipeline**

According to SI 5664 onshore pipelines must be buried such that the top of the pipe is at least 1.2 m deep. In areas where the pipeline passes near sensitive areas, the pipeline can be laid at a greater depth which will reduce the building lines.

- **Access routes**

Access routes to and from the facility will be determined as part of the detailed plan. In addition, access routes to the work site and the rights of way will also be established. A right of way must serve, as far as possible, also as a service road.

In addition, and as far as possible, roads with an existing and regularized connection to Public Works Department routes should be used. E.g. access routes to Mekorot facilities or WWTPs, access routes to military installations, agricultural roads, etc. As far as possible, make use of land assigned to public use, existing agricultural roads or paths to reach the right of way. All the above must be coordinated with the appropriate authorities and land owners.

- **Staging areas**

Staging areas along the route of the pipeline strip are temporary and limited to the performance period. Staging areas are used to park heavy machinery, and store pipes. A 15 km pipe corridor route will require 2-3 staging areas of 2.5 to 4 dunams each. Staging areas will be identified at the detailed plan stage.

Additional staging areas will be needed at the HDD entry point for connecting the offshore line to land. The required area is 60X60 m where the drill starts (rig side).

G. Environmental impact from the technological alternatives

Activity of a gas processing facility has an environmental impact resulting from the physical aspects of the facility's size and land consumption and their spatial deployment in the sea and on land. Facility emissions also contribute to the facility's environmental impact.

This section evaluates the expected total environmental impacts for the generic alternatives: full treatment at sea and full treatment on land (addressing a two-supplier situation). Consequently, this evaluation addresses the highest expected environmental impacts for all the technological alternatives. As a rule, total emissions and wastewater are relative to the volume of processed gas; this will be the similar for offshore and onshore processing. The data below regarding types and quantities of materials will be re-examined during the detailed plan – in Chapters 3-5 of the survey.

G.1 General

Despite any efforts on the operator's part to reduce emissions, activity of a gas processing facility usually entails a variety of emissions (into the air and into the sea).[12] Expected emissions include:

- Hydrocarbon gas – the natural gas being produced.
- Hydrocarbon liquids – petroleum or condensate that condense out of the gas flow.
- Combustible products–- gas (or condensate) combustion products when used to generate heat and energy.
- Production chemicals – chemicals used to assist gas production.
- Treatment chemicals – chemicals used to treat emissions and effluent.
- Other chemicals – lubricants, hydraulic fluids, degreasers, chemical detergents etc. that are used in the operation and maintenance of facility equipment.

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[12]In the following document the term "emissions" refers to gaseous releases (to the atmosphere) and "discharges" refers to liquid phase releases (usually into water).

Emissions into the air (atmosphere)

The operator's goal is to minimize gas escaping into the atmosphere during routine operations. However, certain emissions may occur, as follows:

- Venting and flaring during processing

All processing facilities contain venting or flaring stacks used to dispose of hydrocarbons during operations. In most cases, both high-pressure routes (HP) and low-pressure routes are provides. Venting or flaring stacks are necessary for:

  - Relieving pressure at the facility in an emergency
  - Releasing gas over-pressure
  - Pressure control of sharp increases in pressure during operation (operating transients)
  - Removal of low-pressure gas flows
  - Combustion products

Approximately 1%-2% of the total extracted gas is used in gas processing, mostly for heating and generating electricity. In future, when gas compression will be required to maintain gas flow from the reservoir, additional combustion products will be produced during the increased production of electricity or by the turbines compression engines.

- Fugitive emissions

Even with high-level maintenance, minute leaks may occur from equipment at the gas processing facility. These emissions are referred to as fugitive emissions and they are emitted from valves, flanges, and pumps used in processing.

- Short-term and emergency operations

Atmospheric emissions can increase significantly during emergencies and short-term operations (e.g. pressure control during emergency shut-off), but their contribution to the total emissions from the facility are minor due to their short-term nature.

Discharging to the environment – sea and land

The operator's goal is to minimize liquids and chemicals escaping into the environment during routine operations. However, the following discharges into the environment may occur:

- Fluids leaking out of the processing work

  The liquids under discussion are not expected to leak during routine operations (mainly condensate).

- Removed water such as produced water

Produced water contains a wide range of chemical pollutants which must be removed before dumping.

- Other liquids, condensate (hydraulic fluid)

  The fluid is used in underwater hydraulic systems, which can be constructed to recycle the fluid or release it sea. Hydraulic fluids disposed of at sea are mostly water-based and contain antirust and paint (used to identify the leak); they mostly comply with specific environmental requirements. Substances such as methanol or hydraulic fluid are usually released in deep waters at the wellhead, which in this case are outside the territorial borders and are therefore not included in the scope of this study.

- Leaks of chemicals used in production

  In most cases, chemical leaks are not expected during routine operations. However, leaks may occur during maintenance, so suitable fluid containers must be used at the openings during maintenance work.

- Sanitary wastewater

  Wastewater must be treated as follows:

  - Wastewater from onshore facilities – discharged to the regular wastewater system.
  - Wastewater from the offshore facility – treated at an offshore wastewater treatment plant. Black water must be separated from gray water. After purification and cleaning, the effluent will be discharged into the sea.

- General leaks – e.g. lubricants

  General purpose chemicals that drain off facility equipment such as lubricants and coolants must be collected manually or drained into suitable containers of the appropriate volume. Some of the substances under discussion are incompatible with the facility's wastewater systems. These must be collected in separate containers for controlled removal or pre-treatment.

G.2 Water pollution

The evaluated technological alternatives include the extreme options of full treatment at sea and full treatment on land. Hydrological sensitivity of system components addresses the stringent option of full onshore treatment, which includes a higher risk of groundwater contamination. Based on currently available technologies, full offshore treatment still requires a small onshore treatment facility for extracting condensate residue from the system. Establishing such a facility at the coastal entry can increase the risk of groundwater contamination compared with the limited valve system required by the full onshore treatment alternative. Increasing the risk to the shore area is negligible when compared with the reduced risk resulting from eliminating the need for pipelines carrying condensate and onshore treatment facilities.

- <u>Condensate and other liquid components</u>

  Condensate is the liquid hydrocarbons that separate from the natural gas due to changes in pressure and temperature during transmission of gas from the reservoir to the surface separators.

  Gas condensate is similar to commercial benzene, with a higher hydrocarbon tail component, possibly greater than C30 hydrocarbons. In addition, ethane, LPG (propane and butanes can be sold as separate products) and aromatic hydrocarbons are additional hydrocarbon components that can be extracted from natural gas.

- <u>Treating produced water</u>

  - <u>Produced water</u> - All water extracted from the well together with the gas and condensate is defined as produced water. Produced water is formed because most gas reservoirs are surrounded by a deeper layer of water beneath the gas-water contact (GWC) point. Usually there are three types of processes for producing water from gas reservoirs:

    - Condensed water – water that has condenses out of the gas at the surface facilities

    - Formation water – water in the reservoir sand, above GWC, that is transmitted to the surface facilities together with the gas during extraction

    - Breakthrough water – water present in and beneath GWC that rises to the surface facilities as pressure in the reservoir drops

  - As a rule, water quantities rise after a few years as pressure in the reservoir drops. In low-pressure gas reservoirs the increased drop in pressure due to produced water will usually cause activity at the well to stop within a few weeks, and subsequently result in halting gas-production. The increased drop in pressure due to produced water will usually cause activity at the well to stop within a few weeks, and subsequently result in halting gas-production. Deep high-pressure and high-temperature (HP/HT) gas reservoirs can continue at full production rate despite significant water breakthrough.

  - <u>Recovering produced water</u> – Produced water is recovered at various stages of gas processing. Produced water from all sources is used for cleaning and removal.

Some of the produced water is in liquid phase and is removed from the gas using a slug catcher and/or the inlet separator. This water may contain monoethylene glycol (MEG) or methanol which must be recovered for reuse. A portion of the produced water is recovered as water vapor or tiny water droplets (mists); this portion is usually recovered downstream from the inlet separator. This water can be removed from the gas by a combination of compression and cooling or by dehydrating.

- Removal routes for produced water at the onshore terminal – to minimize environmental harm produced water must be cleaned before it is disposed of (see details in Chapters 3-5 of the survey).
- Removal routes for produced water at the offshore platform - Produced water is normally removed from offshore facilities via the following routes: (1) from the offshore facility into the sea, or (2) injection well. Means of removal are identical to those listed above.

  Note that the design array currently being examined in Israel does not address a facility for drilling an injection well, so in practice this solution will be difficult to implement.
- Treating produces water - Level of treatment of produced water depends on the selected route of removal, local regulations and implemented standards, as well as on the environment of the selected disposal site.

  Produced water must comply with several specifications before being released to the environment (or well). A number of treatment procedures or combined procedures are used to remove pollutants from produced water and treat produced water.

G.3 Air pollution

This section addresses air pollution caused by burning or venting gas.

- Gas removal system

  A safe system must be included in the design of a gas system for removing gas (by flaring or venting) from potential high-pressure sources and caused by increased gas flow and gas pressure.

  The full report explains the reasons an overpressure protection system and the associated removal systems are required on most processing facilities. These processes include routine operational venting to prevent gas leaks and incidents that might occur during pressure relief actions which could cause overpressure in the system, and subsequently venting of excess gas in the system.
- Comparing venting and flaring technologies

From a planning perspective there is not much to choose between venting and flaring. A venting stack can ignite during operation and it is therefore necessary to address the possibility that a stack will behave as a flare. Alternatively, a flare may fail to combust and cause cold venting of hydrocarbon gases. Accordingly, the height of the venting stack or flaring opening must be similar under each of the technologies.

Operator preferences, site location, costs, and corporate and government policies usually have significant impact in selecting an alternative. Due to concerns regarding greenhouse gas emissions and climate change, flaring is currently preferred over venting.

G.4 Chemicals used in producing natural gas

This section discusses chemicals commonly used to produce gas. Ethylene glycol or monoethylene glycol (MEG) and methanol are addressed in detail, and specialized production chemicals are discussed more generally. Thousands of chemicals are used in gas production and they are usually adjusted individually for each reservoir.

Instructions for treatment and removal of solvents and chemicals are usually included in laws, regulations, and national guidelines.

- <u>The need for chemicals in production</u>

  Extraction chemicals are used to activate the gas reservoir, at various points in the process, and in the utility systems to:

  - Prevent corrosion
  - Remove solids or prevent blockages in the pipelines and equipment
  - Improve or maintain performance of separation equipment
  - Disinfect water used in the process

  Chapters 3-5 present a characteristic although not comprehensive list of the types of chemicals used in production, processing, and the utility systems. Most chemicals are used in very small amounts and can be contained within the processing areas or in the protected compound where larger quantities of chemicals are stored. Some chemicals, mostly water-soluble ones, are removed via the produced water flow into the local environment – generally into the sea, far from the shoreline or near it.

- <u>Monoethylene glycol (MEG)</u>

  Because the gas flowing from the wells contains water, as temperature and pressure change, there is a risk that methane hydrates will form at various points along the processing chain. Hydrates act like ice on pipe work and cause blockages. It is therefore necessary to inject a hydrate-plug preventing substance at the well opening and at other points along the process. Under conditions prevalent in the Mediterranean Sea, MEG is usually used. But methanol may also be used at wellheads, mainly at well start up.

Some main features of MEG prevent hydrate build-up during gas processing, including issues associated with MEG regeneration. Despite this, some MEG will indeed be lost to the produced-water flow and removal will take place in deep waters on a distant offshore platform or at sea near the shore. Dispersion level of the removal operation depends on proximity to the shore and the chemicals' benefit to the marine environment.

It is important to store sufficient quantities of MEG for the underwater systems and the onshore applications. Onshore and offshore storage tanks must be placed in a bunded area capable of containing all the fluids in the tank in case of leak.

- Condensate – condensate can be stored under the same conditions as crude oil. In most cases three storage tank systems are required: (1) production; (2) storage with a quality assurance option while waiting for export; (3) export tanks.

  Condensate is flammable and must be stored in a suitable area; containment pallets are required for onshore tanks to prevent leaks, as well as suitable fire-extinguishing equipment.

  Onshore, means of storage are usually provided that are sufficient for 1-2 days, so that gas can still be produced if the condensate export route is closed. Offshore storage of condensate requires larger volumes and is dictated by the frequency and capacity of the shuttles. If condensate is discharged via pipeline from the platform to the shore, storage requirements are similar to those for onshore processing.

G.5 Noise

The main noise sources on the gas facility are: machinery with rotating components such as: air cooling fans compressors, pumps, power generators, ovens. This examination distinguishes between onshore and offshore noise.

- <u>Onshore noise</u>

  Government regulations usually limit environmental noise. There are also additional considerations regarding noise prevention required by WHO guidelines.

  In order to comply with the noise thresholds determined by the terms of the agreement, the operator must conduct noise prediction tests for processing and pipe work areas and implement noise mitigation methods as required.

- <u>Offshore noise</u>

The Ministry of Environmental Protection in Israel requires that every Environmental Impact Survey for marine projects also include an examination of potential impact of underwater noise on marine mammals.

In addition, noise from offshore pipe work must be coordinated with the Ministry of Defense.

As for occupational noise, noise monitoring will be required on manned offshore facilities, as required by HSSE regulations.

G.6 Safety and Risk Aspects

- Risk to population

  Onshore facilities relative to public receptors are accorded separation distances of 600 m, based on the test conducted in compliance with Ministry of Environmental Protection directive of June 12, 2011.

  Accordingly, all proposed onshore sites comply with this threshold requirement. Offshore sites do not pose a risk to fixed populations because the facilities will be further away than the required distance; however, a safety margin of 0.5 mile (approximately 600 m) has been taken from shipping routes.

- Distance from roads, high voltage and extra high voltage lines, and strategic facilities

  The goal is the greatest distance from roads, high voltage and extra-high voltage lines, which under certain conditions can be an ignition source. The same is true for strategic facilities so as to prevent reciprocal effects in case of a hazmat event. Under this survey, regulations will be formulated for the supplementary action required during the building permit stage, and which will specify:

  1. Restrictions on site development during the detailed plan stage.
  2. Measures of mitigating and reducing the likelihood of a hazmat incident.

  During the building permit stage an environmental document must be submitted which contains a quantitative risk assessment (QRA) and suggests solutions and protective measures (active and passive) in case of a hazmat incident.

G.7 Landscape and Visual Aspects

The facilities' main visual impact derives from their size and location relative to population centers, main roads, visitor centers, etc. Obviously, there is a difference in expected impact between the onshore and offshore facilities, because of the greater proximity to permanent centers and/or population attractors in land compared with the offshore facilities. However, most of the impact on landscape and the ability to minimize it depends on the facilities' location and on the existing landscape and natural conditions. The ability to minimize the visual impact depends largely on whether the site is located on open, level ground (offshore or onshore) or near other infrastructure facilities, or hidden in a hilly area. In general, the ability to rehabilitate landscape and/or reduce visual impact is greater for onshore facilities, depending of course on the distance of the offshore facility from the mainland.

G.8 Ecological Aspects

The ecological implications of establishing and operating the facilities are different for each of the technological alternatives, specifically regarding the amount of land that must be appropriated, and routine activity within and near the site, as well as on the pipeline route. The expected impact is linked to the amount of land taken up by the facility. Technological alternatives that take up more land are estimated to have a greater overall impact on habitats and ecological function, both offshore and onshore. However, most of the impact and/or ecological damage is due to the choice of location rather than land consumption. If the site is located in a sensitive area of some ecological significance, what are the effects of light pollution and how are they dealt with (e.g. using thermal or infra-red cameras), etc.

In general, establishing facilities under any of the technological alternatives will have an impact on the ecosystem that is commensurate with their spatial distribution at sea or on land. However, we note that the studies of several important matters such as invasive species colonizing artificial beds in the marine environment are still in their early stages. Being a rigid surface, the platform structure will attract colonizing organisms leading to the development of artificial reefs. Any exposed pipe work connecting the platform to the shore will also become a colonizing bed. Considering the fact that colonizing beds are a limited resource in the marine environment, it is highly likely that some of the species that will colonize the platform structure will be invasive species. On the other hand, research into expected impact on land is more abundant and many more cases have been examined in the literature. We therefore suggest that evaluation of expected ecological impact on land will be better substantiated that the evaluation of offshore impact.

Location Alternatives

This chapter provides a general description of the onshore site alternatives, coastal entry arrays, and the proposed pipeline corridor for each alternative. It also contains a review of the main features of each alternative. The alternatives are described according to the geographical location of the complexes and onshore facilities, from north to south (alternatives are shown in Chapter 1, Figure 1.1.1.3):

a. **Dor – including Dor North, Ein Ayala and Hagit East**

For this array the coastal entry point is on Dor beach, north of the existing NOP 37c gas pipeline.

The coastal entry point will be located near the fish farms; from there gas will be transmitted by pipeline to the various onshore location alternatives in this arrangement, and on to the eastern transmission system through Hagit station.

- **Dor North alternative**

The Dor North alternative is locate in the Carmel coastal plain, on agricultural land within the Hof Carmel regional council. A small portion of the exploration zone of this alternative is in the jurisdiction of the Fureidis local council.

The exploration zone for the facility extends over 300 dunams between Roads 2 and 4. This alternative is located east of Moshav Dor and Kibbutz Nachsholim, and west of Fureidis. This alternative's grounds are located 1.6 km east of the shoreline.

The route of the proposed onshore facility corridor is 7 km long and 60 m wide. The route will pass close by the Dor-Hagit NOP 37c approved transmission pipeline. The pipeline route traverses cultivated agricultural land, crosses Road 2, the coastal ridge, and the Tel-Aviv Haifa railway tracks. On the shore, adjacent to the proposed route, there is a block-valve station.

Corridor from the onshore facility to the onshore transmission system. Treated gas will be transmitted via the existing NOP 37c approved transmission pipeline route (Dor Hagit) which is 10.5 km long. This pipeline is adjacent to the treatment facility alternative and therefore the impact of the transmission system is negligible.

- **Ein Ayala**

The Ein Ayala quarry alternative is located down the south-western slopes of the Carmel ridge, and it is part of the quarried area of the Ein Ayala quarry, which extends over 150 dunams. Ein Ayala quarry is an active quarry which produces sand for plaster in the building industry.

The quarry is located in the jurisdiction of the Hof Carmel regional council. The site is located north of Fureidis, south-east of Moshav Ein Ayala, west of Moshav Ofer and north-west of Shfeya B and C quarries. The site perimeter is located 4 km east of the shoreline. The Ein Ayala site is being compared with the technological alternatives that have been approved for evaluation in this stage.

The route of the proposed onshore facility corridor is 7 km long and 60 m wide. The route is based on the Dor-Hagit NOP 37c approved transmission pipeline route. The pipeline route traverses cultivated agricultural land, crosses Road 2, the coastal ridge, Tel-Aviv Haifa railway tracks, Road 7011, and Road 4.

Corridor from the onshore facility to the onshore transmission system. Treated gas will be transmitted via the existing Dor Hagit NOP 37c approved transmission pipeline route, which is 8 km long. This pipeline is directly adjacent to the treatment facility alternative and therefore the impact of the transmission system is negligible.

- **Hagit East**

The Hagit East alternative is located on the south-eastern slopes of the Carmel ridge, bordering on Ramot Menashe, adjacent and east of the Hagit power station. The exploration zone of this alternative extends over the area enclosed between the power station on the east and Road 6, covering an area of 620 dunams. There are privately owned pasture land and poultry farms in this area. This alternative is located in the jurisdiction of the Hof Carmel regional council, north west of Kibbutz Ramot Menashe, south west of Moshav Elyakim, closely adjacent to the Elyakim military base firing ranges, and 12 km from the shoreline. The eastern national transmission system is located near this site.

The corridor route for the proposed onshore facility is divided into several sections and alternatives as follows:

From the coastal entry point on Dor beach to Ein Ayala quarry the route is based on the Dor-Hagit NOP 37c approved transmission pipeline route. This route matches the proposed route for the Ein Ayala alternatives (up to Road 4), as listed above. In this segment the pipeline route traverses cultivated agricultural land, crosses Road 2, the coastal ridge, Tel Aviv-Haifa railway tracks, Road 7011, and Road 4.

For the segment from Ein Ayala quarry eastward to the proposed onshore facility, there are two general alternative pipeline routes: a northern and a southern one. Both alternatives will have a pipeline strip that is 60 m wide. The two alternatives merge approximately 2 km west of the proposed site. A description of the alternatives and their features is shown below:

<u>Northern alternative route</u>. Approximately 16 km long (of which 6 km are close to the existing route) and most of it passing closely adjacent to the

existing INGL natural gas pipeline, south of the existing pipeline at the required distance.

Along most of its length, the pipeline route passes through agricultural land (mostly orchards) with dwarf shrub steppe in the periphery. In a few sections, the corridor crosses natural woodlands and open uncultivated hills that mostly serve as cattle pasture.

Southern alternative route. Approximately 17 km long (of which 5 km adjacent to the existing route, up to Road 4). Most of the proposed route passes through agricultural land carrying orchards, crops, and vineyards, and through existing dirt roads. Pipeline route exits south of Ein Ayala quarry passes through some open area near Shfeya C quarry and continues in a general south-easterly direction through land that is largely agricultural. Over a short section, the route crosses a dwarf shrub steppe gully, from there connecting to a central dirt path that passes north of Moshava Bat-Shlomo, between the farmed plots.

Corridor from the onshore facility to the onshore transmission system. The route is closely adjacent to the transmission system, and is located at the junction of existing gas infrastructure. The route connects westward to the sea, southward to Gezer, and north to Haifa and the Jordan Valley, so there is no need to plot another line to connect to the onshore transmission system.

b. **Hadera-Neurim array – this array includes the Hadera WWTP and Meretz WWTP alternatives**

This array proposes four alternatives for the coastal entry, at Nahal Hadera, Michmoret, Nahal Alexander, and Neurim. Gas will be transmitted from the coastal entry to the different onshore location alternatives, and from there treated gas will be transmitted to the eastern transmission system through Harish or Magal natural gas stations.

Nahal Hadera entry point – Under this alternative, the coastal entry point will be located south of the Nahal Hadera estuary, in the open areas east of and adjacent to the Orot Rabin power station.

Michmoret entry point – Under this alternative, the coastal entry point will be located on the southern portion of the Kurkar ridge, north of Michmoret (Hof Gdor nature reserve).

Nahal Alexander entry point – Under this alternative, the coastal entry point will be located in the Nahal Alexander estuary, south of Michmoret.

Neurim entry point – Under this alternative, the coastal entry point will be located on the Kurkar ridge, north of the Neurim police academy.

- **Hadera WWTP**

The Hadera WWTP alternative is located on agricultural land containing orchards, cultivated fields, and fish farms between Road 65 and Nahal Hadera, the Hadera north industrial zone, and the WWTP. This alternative extends over 560 dunams of land. The Hadera WWTP alternative is located north-east and north of Hadera residential areas, west of Kibbutz Gan-Shmuel, and east of the Orot Rabin power station (Hadera power station). This alternative is located 3 km from the shoreline. This site is in the jurisdiction of the Menashe regional council and the city of Hadera.

Corridor route to the proposed onshore facility. Three alternative pipeline corridors have been outlined for this system according to the coastal entry options: Nahal Hadera, Michmoret, and Nahal Alexander. However, it is possible to combine the routes, such that each coastal entry can connect to either of the two central pipeline strips proposed in this area. The pipeline corridor from entry point to the treatment facility will be 60 m wide, and from the treatment facility to the eastern national transmission system on the Gezer-Hagit line at Harish or Magal station, will be 20 m wide (excluding building lines). It will be possible to split the pipeline strips between two separate suppliers, making the width of each strip 40 m.

- Entry via Nahal Hadera, 3.5 km long. The route begins at the coastal entry point south of the Nahal Hadera estuary, near Orot Rabin power station, continues east through the sand dunes, crosses Road 2, and passes south of Heftziba farm. Next, the route crosses Road 4 (we propose crossing it by drilling due to the large amount of infrastructure at the site), up to the proposed treatment facility.
- Entry through Michmoret – Total route length under this alternative is 9 km. The route starts in the southern portion of the Kurkar cliff, north of Michmoret (Hof Gdor nature reserve). The block-valve station will be located in this area. From the block-valve station the route splits into two parallel alternatives which continue eastward (to Road 2) along existing dirt roads in the stabilized sandy areas and partially disturbed areas. After crossing Road 2 the route turns north, initially it will pass east of Road 2 parallel to the Hadera Park forest and the coastal railway track, up to the connection with the planned Road 9, where it will turn north and continue to the connection with the proposed alternative at Nahal Hadera array, west of Road 2 and near Heftziba farm.
- Array from Nahal Alexander – Total route length under this alternative is 12.5 km. The block-valve station is located in the Nahal Alexander estuary, south of Michmoret. The proposed

pipeline corridor parallels Nahal Alexander (along the hiking path) up to the point where the river meets the Kurkar ridge (Hirbat Samar is located here).At this point the route turns east, crossing Nahal Alexander. After crossing the river the route continues east on dirt roads along the river bank, on level ground, in largely uncultivated areas. Close to the railway tracks the route re-crosses the river. Close to the railway tracks the route re-crosses the river and then will turn north and pass east of the coastal railway track until it crosses the track and merges with the proposed route for the Michmoret alternative, in the direction of Hadera WWTP.

Corridor from the onshore facility to the onshore transmission system. From the treatment facility the route continues east and then splits into two alternatives near Road 65 in the area of Kibbutz Gan Shmuel: northern and southern. Both pipeline alternatives run parallel to each other passing through agricultural land in all the way to the planned station at Harish, alongside the national transmission system on the Gezer-Hagit line.

- Northern alternative route – Passes through open areas and agricultural land between Menashe regional council and Pardes Hanna; some of these areas are planned residential developments. In the area of Maanit the route turns south toward the Harish gas station. The northern route is 14.5 km long.
- Southern alternative route – Passes partly through agricultural land belonging to the Ramat Menashe regional council, adjacent to and north of Nahal Hadera, and up to Road 6. From Road 6 the route continues north toward Harish station, parallel to the road. Width of the pipeline strip for both alternatives is 20 m.

Both pipeline alternatives, the southern and the northern, are river environments: wetlands and groundwater springs, drainage trenches, and agricultural land (Batich marsh, Zeita marsh, Dumeira canals). For both alternatives, the proposed route avoids these sensitive areas as far as possible.

- **Meretz WWTP**

The Meretz WWTP alternative is located on agricultural land, closely adjacent to the Meretz WWTP. The exploration zone for this alternative is in the jurisdiction of the Emek Hefer regional council, and extends over an area of 1250 dunams. Several rural communities are located in the vicinity of this alternative, including: Ein Hahoresh, Givat Haim Meuhad, and Moshav Hogla west of the alternative; Hamapil and Ometz in the east; and Moshav Ahituv in the north-east. The regional Road 581 passes north of the alternative, but no major highways pass in its vicinity. Nahal

Alexander passes nearby, to the south. Aerial distance of the site from the shoreline is 9 km.

Corridor route to the proposed treatment facility: Four alternative pipeline corridors have been outlined according to the coastal entry options: Nahal Hadera, Michmoret, Nahal Alexander, and Neurim. However, it is possible to combine the routes, such that each entry can connect to either of the two central pipeline strips proposed in this area. The pipeline corridor from entry point to the treatment facility will be 60 m wide, except for the Neurim alternative, and from the treatment facility to the eastern national transmission system on the Gezer-Hagit line at Magal station, will be 20 m wide (excluding building lines). It will be possible to split the pipeline strips between two separate suppliers, making the width of each strip 40 m.

- Nahal Hadera entry – Total route length under this alternative is 17 km. The route begins at the coastal entry point south of the Nahal Hadera estuary (near Orot Rabin power station), continues east through the sandy areas, and turns south along Road 2, initially on the west side of the road, and crossing over to the east at Olga interchange, parallel with the Hadera Park forest and the coastal railway, up to the connection with the planned Road 9. From there the route continues east toward Meretz WWTP via one of the two alternatives described in the Michmoret route, below.
- Michmoret array – The route begins in the southern portion of the Kurkar cliff north of Michmoret (Hof Gdor nature reserve). The block-valve station will be located in this area. From the block-valve station the route splits into two parallel alternatives which continue eastward (to Road 2) along existing dirt roads in the stabilized sandy areas and partially disturbed areas. After crossing Road 2, the pipeline route in both alternatives continues east, passing through large natural expanses containing sand dunes, a national park, and a nature reserve. The sub-alternatives are described below:
- Northern alternative route (Michmoret A) – Total route length under this alternative is 13 km. This route is divided into two sub-alternatives:
- North of Breichat Yaar – The route passes between Hadera forest and Breichat Yaar nature reserve, on the outskirts of the eucalyptus forest. From there the route passes through agricultural land (mostly crops) and crosses Road 4. North of Elyakhin the route merges with the southern Michmoret B alternative which is based on the planned route of Road 9.

- South of Breichat Yaar – The route passes north of Emek Hefer industrial zone on the outskirts of a sandy, partially disturbed area. The proposed pipeline corridor parallels the planned road corridor for Road 9, and south of the Breichat Yaar nature reserve. Further on the corridor crosses Road 4, following the route of the planned Road 9. North of Elyakhin the route merges with the northern Michmoret A alternative.
- Southern alternative route (Michmoret B) –Total route length under this alternative is 13 km. The western portion of this alternative is based on Michmoret A alternative; before crossing the railway tracks eastward, the alternative turns south and passes parallel to the tracks on the east. From there, north of Nahal Alexander, it will connect to the Nahal Alexander alternative which passes north and closely adjacent to the river up to the Meretz WWTP alternative.

After the sub-alternatives converge, the route continues east over agricultural lands along the route of the planned Road 9, up to the point where it turns south toward Meretz WWTP and passes through agricultural land with orchards and cultivated crop land.

- Entry through Nahal Alexander – Total route length under this alternative is 10.5 km. Under this alternative, the block-valve station is located in the Nahal Alexander estuary, south of Michmoret. The proposed pipeline corridor is parallel to Nahal Alexander (along the hiking path) up to the point where the river meets the Kurkar ridge at Hirbat Samar. At this point the route turns east, crossing Nahal Alexander. After crossing the river the route continues east on dirt roads on the river banks, on level ground in largely uncultivated areas. Close to the railway tracks the route re-crosses the river. After crossing the river and tracks the proposed route continues near the northern river bank in cultivated crop land, along existing dirt roads, at the required distance from the river banks. Several agricultural structures, some abandoned, are located along the route. Near Meretz WWTP the proposed route passes between Nahal Alexander and Nachal Ometz until it reaches the proposed facility. Road length under this alternative is 10.5 km. Another alternative is to connect the route that begins at Nahal Alexander to the southern route of the Michmoret alternative (Michmoret A), and after crossing the railway tracks the route will continue north and connect with the proposed Michmoret A route. The connecting section is 2 km long and passes through land that is largely agricultural.

- Neurim entry – Road length under this alternative is 10.5 km. The block-valve station is located on the Kurkar ridge, north of the Neurim police academy. Width of the strip in this array is limited to 300 m and is suitable for one supplier only. From the coastal entry, the proposed pipeline corridor will cross Road 2, agricultural land, the coastal railway tracks, and pass Netanya WWTP on the south. Further on the route crosses Nahal Alexander, and before it crosses Road 4, it will merge with the proposed southern Nahal Alexander alternative. Consequently, the onshore strip in this alternative is 40 m wide, up to the connection with the proposed southern route under the Nahal Alexander alternative.

Corridor from the onshore facility to the onshore transmission system. Proposed route through the agricultural land of Emek Hefer, for 6 km up to the Magal natural gas station, or 13 km up to the Harish natural gas station, compliant with NOP 37/B/8.

2.1.1. Illustrations of the alternatives

Illustrations of location alternatives are shown in Chapter 1 Section 1.1.

For illustrations of the technological alternatives see Section 2.1, above.

2.1.2. Criteria for examining the alternatives

The following table presents in details the criteria used to evaluate the alternatives. These criteria expand on the suggestions in the guidelines to the survey. However, note that the planning team is preparing, concomitantly with the Environmental Impact Survey, a planning document to compare the alternatives based on additional non-environmental aspects such as finance, security, engineering, etc. These parameters are therefore being examined in the parallel document.

Note that all the alternatives examined in this survey have, in fact, passed the required threshold for all appropriate parameters and have been recommended in Stage 2 for advancement under the Environmental Impact Survey.

Consequently, this chapter attempts to choose the most preferable of these sites, and for each site and proposed pipeline route examine the advantages and disadvantages. Our final goal is to recommend the optimal arrangements that will lead to the least conflicts when applied in a detailed plan.

A detailed examination of each criterion applied to the facility alternatives is shown in Section 2.1.5.

Method for ranking the alternatives – An appropriate professional consultant has ranked the alternatives for each of the criteria on a three-level qualitative scale: preferred, medium, and inferior (color coded). Alternatives were qualitatively assessed based on their compliance with the listed considerations. The final step in the process is to recommend a preferred alternative for each of the system's elements based on the results, and finally to recommend complete systems.

Rationale against weighting – Environmental project plans and documents have various methods of evaluating and weighting alternatives. Weighting a criterion determines its value relative to other criteria. For example, visibility is assigned 15% and efficient use of land resources is assigned 10%.

The survey team debated the matter before coming to a decision, due to the project's sensitivity, disagreement between the parties involved, and the absence of an agreed upon and formulated theory for weighting the criteria. The present survey's team concluded that weighting the criteria would be inappropriate since parties with conflicting interests may always express their diverging organizational points of view concerning the proposed weighting.

Therefore, we decided it would be best to evaluate superiority/inferiority of each alternative for each criterion separately. Each evaluation would be supported by a detailed explanation and an overall assessment of the alternative's compatibility with the proposed development, and would address compliance or non-compliance with each criterion. This is a qualitative summary and is not based on weighting which could be subjective depending on the point of view of the evaluating party.

At the same time, some of the criteria may be assigned different levels of importance, but this relative importance will also be qualitatively analyzed and supported by an explanation. This level of importance will contribute to the overall understanding and to the analysis of the preferred alternatives.

Table 2.1.2: Criteria for examining the alternatives

Section	Topic	Sub-Topic	Definitions
1.	**Expected level of risk to population at the facility and in its vicinity**	Safety distances around the facility.	Working assumption: For receiving facilities – compliance with a threshold distance of 600 m from public receptors as required by the Ministry of Environmental Protection guidelines. Sites were evaluated by distance from population, roads, high voltage and extra high voltage lines, and strategic facilities. Pipelines must comply with requirements of SI 5664 parts 1 and 2.
2.	**Efficient use of land resources**	Comparing the alternatives by land consumption	For each of the site alternatives, land consumption is the same, approximately 150 dunams. Also the coastal entry point on the shore requires the same amount of land. Consequently, this criterion mainly addresses the alternative pipeline routes. **A shorter route that overlaps the boundaries of adjacent infrastructure, and does not require relocating existing and planned infrastructure to other areas, will receive a higher preference**.
3.	**Proximity to existing and planned infrastructure**	Power transmission lines	Treatment facility requires connection to the power grid. **Alternatives are ranked based on ease and length of the connection to the local power infrastructure. Simpler and shorter connections are preferable.**
		Proximity to the natural gas supply pipeline	The plan's location will be examined relative to the existing and planned gas system according to NOP 37 and its appendices. A greater degree of resemblance and compatibility between existing and planned systems and the alternative system, **make**

Section	Topic	Sub-Topic	Definitions
			the alternative preferable.
		Proximity to existing roads and highways	Treatment facility requires connection to the road infrastructure. Alternatives are ranked based on ease and length of the connection to the local road infrastructure. Simpler and shorter connections are preferable.
4.	**Earth surplus – total scope of earth works (classified by excavation and filler) for establishing the facility including optional solutions**		For this criterion, the scope of planned earth works, and excavation and filler ratios will be examined.
5.	**Natural resources**	Degree of harm to local habitats (onshore and offshore).	<u>Onshore</u> Level of harm caused by executing the plan to the following items, are examined: • Sensitive ecological systems within the test perimeter (sand, moist habitats, Kurkar red loam, springs and rivers directly adjacent to sensitive habitats in the area such as: vernal pools, wetlands, nature reserves) • Harm to special vegetation, including trees

Section	Topic	Sub-Topic	Definitions
			• Harm to important animal activity sites **Alternatives with the smaller degree of harm are preferable.** Offshore (to be included in the offshore environment survey) Compound areas designated for the platforms and pipeline routes will be examined according to the following criteria: 1. Proximity to marine nature reserves (declared or proposed) and national parks (close proximity or location within a reserve will receive a low priority) 2. Type of infrastructure in the alternative's area – hard bed (Kurkar or other rock) is a limited resource in the marine environment and supports rich and highly-valuable habitats (including the abrasion platforms located near the shore and which are an endangered habitat). Sandy beds are the type commonly found in the marine environment along the coast of Israel. Consequently, presence of a hard bed or proximity to one will receive a low ranking. 3. Presence of unique habitats: seagrass, abrasion platforms, reefs (sponges, worms, mollusks), deep-sea, canyons. Some habitats are endangered and their preservation is mandatory. 4. Fish breeding zones (such as grouper) – some fish are territorial and are known to have defined breeding zones. Some of these are rare species, so it is necessary to ensure that breeding grounds of species at risk are not harmed. 5. Presence of species at risk as defined in the Barcelona Convention and CITES, and of protected species as defined by Israeli law - plan areas must be checked for presence of

Section	Topic	Sub-Topic	Definitions
			such species. **Alternatives with a smaller degree of disruption of the listed criteria are preferable.**
		Facility compromises contiguity (fragmentation) of open spaces.	The plan's impact on ecological corridors, fragmentation, and creation of bottlenecks will be examined. **Pipeline alternatives with a smaller degree of harm and smaller potential for creating obstacles in the corridors are preferable.**
		Sedimentological aspects	Facility and coastal entry pipe work may have an impact on sand movement. **Pipeline alternatives with a smaller potential impact on sedimentation aspects are preferable.**
6.	**Air pollution - difference between alternatives regarding impact on air quality.**		Alternatives must be examined according to the current air quality status in the plan's vicinity; the impact on population must be examined by analyzing wind direction in a 10 km radius (the survey range). **Alternatives with currently higher air quality and lower impact on the population are preferable.**
7.	**Antiquity and heritage sites offshore and**	Proximity to archeological sites	Proximity to archeological sites was checked based on the Israel Antiquities Authority 2011 data layer for declared antiquity sites. **Alternatives that are further away from declared antiquity sites and/or are not expected to harm them, are preferable.**

Section	Topic	Sub-Topic	Definitions
	onshore.		
8.	**Integration of the facility in its environment in view of future land use and assigned land use.**	Compatibility with land uses and assigned land use	Examining alternatives in view of national, regional, and local outline plans as well as the detailed plans currently being advanced, for impact on and proximity to the pipeline route. **Alternatives that contain lower sensitivity assigned land uses (further from land uses that form public receptors, open areas, and environmentally significant natural assets), are preferable.** Note that when examining compatibility with assigned land use, incompatibility can be changed. A facility of national importance and urgency such as a gas treatment facility need not necessarily comply with the existing planning framework, which can be modified. At the same time, the relative ranking of the alternatives has been established according to the plans being advanced in the area.
		Directly adjacent to other land uses/infrastructure	**Alternatives that are directly adjacent to compatible land uses and/or other infrastructure facilities, are preferable.**
9.	**Leisure and recreation - degree of harm to land use for leisure and recreation**	Degree of harm to the outdoor experience	Examining the plan's impact on the outdoor experience at visited nature sites and hiking routes, and accessibility to these. Impact is examined on its physical proximity aspect (including proximity to planned leisure and recreation sites) and visual impact. **Alternatives with a smaller impact in these aspects are preferable.**

Section	Topic	Sub-Topic	Definitions
10.	**Landscape - visual**	Degree of disruption of landscape in open spaces	Accordingly, the facility's impact on the landscape (addressing its components e.g. venting stack, pipeline, boilers, etc.) will be examined on a local and regional scale. The analysis takes into account the area's natural topography, land cover properties, and potential for adhering to adjacent infrastructure which are already disrupting the region. In addition, the pipeline route will also be broken into segments that will be compatible with their respective landscape features, and examined for impact on landscape in highly-sensitive natural areas. **Alternatives with a smaller degree of impact on landscape and reduced prominence of the facility, are preferable.**
		Extent of site visibility from various locations in the area	Visibility and visual prominence of the facility in its proximal and distant surroundings as seen from local features. Aspects of landscape compatibility are: surrounding land uses and their features, distinguishing between visibility from residential areas and communities, from visitor centers and assets of national or regional importance, and the degree of exposure to traffic passing by on motorways or railways. **Alternatives with a lower visibility and prominence, are preferable.**
		Additional potential harm caused by ancillary infrastructure and its extent (roads, Mekorot lines	Examining the degree of harm to landscape as a result of establishing the plan's auxiliary infrastructure. **Alternatives with a smaller degree of harm are preferable.**
		Degree of harm to	Examining the possibility of reducing the degree of impact on landscape during the

Section	Topic	Sub-Topic	Definitions
		existing landscape from earth work associated with executing the facility	subsequent planning stages and during construction. **Alternatives with simpler and more efficient means of reducing harm to landscape, are preferable.**
11.	**Seismic**		Degree of seismic risk has been examined based on the existence within the proposed alternative of active or suspected active faults, horizontal soil accelerations expected on the surface, potential for soil failure and liquefaction, and risk of tsunami striking the site. Alternatives were ranked according to the following criteria: (a) Proximity (up to 200 meters) to an active fault is a risk that prohibits building; (b) Sensitivity of slopes to failure is a construction-prohibiting risk, but in some cases it is possible to find engineering solutions for protecting the structure; (c) Soil liquefaction is a risk that compromises soil stability, but in most cases the risk to a planned building can be neutralized using engineering solutions. (d) Increasing soil accelerations can compromise stability of the planned structure, but the risk can be minimized by applying engineering solutions. (e) Tsunami can compromise stability of the planned structure, and in some cases the risk can be minimized by applying engineering solutions. However, in the case of a gas facility, a tsunami would be considered a building-prohibiting risk. According to these assumptions each examined risk was ranked for each alternative. **Alternatives that are further away from an active fault are preferable. Alternatives**

Section	Topic	Sub-Topic	Definitions
			with a low risk of slope failure, low sensitivity to liquefaction, low soil accelerations, and low risk of tsunami, are preferable.
12.	**Noise**		Onshore - **Alternatives in which plan impact on noise levels at sensitive receptors is less, are preferable.** Offshore (included in the offshore environmental survey) - **Alternatives in which the plan's impact on defense systems and marine mammals is less, are preferable.**
13.	**Hydrogeology and soil**	Risk of groundwater and surface water reservoir contamination	Several parameters were selected to test the hydrological sensitivities of the alternatives; each parameter was weighted and an overall hydrological sensitivity was calculated. Two types of parameters were used: local parameters quantifying the risk of groundwater contamination, and regional parameters for groundwater sensitivity based on the maps associated with the national outline plans, legislation, regulations, and previous studies (Water Authority).Each alternative received a weighted hydrological sensitivity score based on the different parameters. **Alternatives with a smaller impact on surface water reservoirs and geohydrology are preferable.**
		Mutual influences between surface runoff and the facility's installation and drainage solution	Sensitivity to surface runoff – soil properties, precipitation, and properties of drainage basin, distance of the plan from shield areas defined in the NOP and their flooding surface, and the simplicity of the drainage solution. **Alternatives with a smaller impact on the drainage system and a simpler drainage solution are preferable.**

Section	Topic	Sub-Topic	Definitions
14.	**Potential for future expansion of the facility**		Future potential for expanding the facility to accommodate additional operators, considering engineering, environmental, landscape, and planning parameters. **Alternatives with a greater potential for future expansion, are preferable.**

2.1.3. Separation distances

Separation distances report is presented in Section 1.8, above. An examination of the safety aspects and risks is detailed in Section 2.1.5 a, below.

2.1.4. Landscape analysis

2.1.4.1. Describing the criteria

The following aspects were explored as part of the analysis of the visual impact of each of the proposed alternatives and the evaluation of the proposed facility's integration in its surroundings:

1. Visibility of the facility in its proximal and distant surroundings.
2. Expected impact of the facility on the region's image and on its visible landscape.

The following analysis takes into account the facility's features and components, the area's natural topography, and land cover properties. These features were examined in context of the land uses surrounding the facility, population centers and communities, visitor centers and assets of national or regional importance, and the degree of exposure to traffic passing by on highways or railways.

Alternatives were evaluated in four stages, as described below and in Figure 2.1.4-1.

Criteria for evaluating the alternatives:

a. **Description of the landscape and visual implications of the generic components of a gas treatment facility**
b. **Description of the way the summary landscape assessment was prepared for each alternative separately**
c. **Description of the way the planning alternatives were compared**

A. Criteria for evaluating the alternatives

The alternatives were analyzed according to the criteria as listed below, and ranked using a three-level scale:

- Significant impact on landscape
- Medium impact on landscape
- Minimal impact on landscape

Analysis of the impact of the block valve stations and pipeline route on landscape was also conducted according to the criteria listed above, and is presented after the analysis of each of the treatment facility location alternatives.

Following below are the criteria, the tools used to examine them, and the evaluation scale for each of the criteria:

1. **Degree of harm to the landscape aspect of open spaces**: Based on an analysis of landscape units conducted in Section 1.5, degree of harm to the landscape quality, fragmentation, and value of the open areas, after establishing the treatment facility were evaluated. An alternative that materially altered the character of the area (e.g. changing natural open spaces by placing an industrial facility in them, even if it is not highly visible) received the lowest score (Significant Impact on Landscape); an alternative which does not materially impact landscape but visually disrupts a landscape unit (e.g. placing an industrial installation in an agricultural area, closely adjacent to another infrastructure facility) received the middle score (Medium Impact on Landscape), an alternative which does not alter the nature of a landscape unit (e.g. an industrial installation in an industrial activity area) received a high score (Minimal Impact on Landscape). This criterion has key importance in assessing the alternatives.

Ranking	**Minimal impact on landscape**	**Medium impact on landscape**	**Significant impact on landscape**
Example	Placing an industrial installation in an industrial activity area	Adding an industrial facility in an agricultural area, most of the route lies in agricultural land, but closely adjacent to another infrastructure installation	Fragmentation of natural open spaces by adding an industrial facility

2. **Evaluating facility visibility and its significance from a number of points in the area:** The site's visual impact from a variety of viewpoints was evaluated by computer analysis (GIS), which took into account the topography and main land cover components to identify places from which the facility is visible in its entirety; places from which the facility is partially visible (components up to 12 m high); areas from which the highest components are visible (components up

to 35 m high), and areas from which only the vent / flare is visible (a narrow pole up to 100 m high).

Based on this computer analysis, a qualitative evaluation was conducted on the facility's visual impact, taking into account the sighting location's properties:

- Topography surrounding the facility
- Land uses and land cover, and their features, in the facility's visual basin
- Additional infrastructure installations in the vicinity
- Degree of 'visual noise' and other visual elements in the area
- Closed or open landscape
- Residential population centers
- Nature and landscape sites, visitor centers and assets of national or regional importance, such as the Carmel Park, the beach, and others
- Degree of exposure to passersby, for instance on highways, trains, etc.

Simulations and sections demonstrating visibility of the treatment facility from the overlooking areas were prepared for areas in which a high degree of visibility was identified and for visitor sites and population concentrations that overlook the alternatives. Simulations were prepared using two methods, each demonstrating different visual aspects of the facility, proximal and distant: (1) Simulations and sections from up to 1 km from the facility were prepared according to a detailed and updated survey conducted for the purposes of this study; (2) Simulations and sections of longer ranges were prepared based on information from the national GIS.

When ranking the alternatives for site visibility, we considered the visual impact of establishing the site and length of exposure: Population concentrations or visitor sites, from which the site is highly visible (e.g. visibility from residential communities, can harm the perceived quality of life of the local residents; high visibility from a visitor site or a nature reserve harms the site's content and the values experienced while visiting the site), were defined as "significant impact on landscape."

Longer exposure and/or greater degree of impact, can be expected to give the facility a more significant visual impact. Sites from which the facility is visible, but exposure is brief (passersby)/ sites from which the facility is visible but they are industrial or similar use sites/ visibility from areas where visibility is limited to a small population (e.g. high visibility from roads and highways could, under certain circumstances, be momentary) the harm to the landscape was defined to have a less significant impact on adjacent uses and was ranked "medium impact on landscape."

Sites from which only the tall components are visible (vent / flare) or there is no visibility- were defined as "minimal impact on landscape."

In addition to this, the possibility of reducing the facility's impact on landscape during subsequent planning stages and during construction was taken into account when analyzing the facility's visibility. Reducing impact can be addressed by sensitive outlining in the detailed plan and by applying landscape-masking measures. This criterion has key importance in assessing the alternatives.

Ranking	Minimal impact on landscape	Medium impact on landscape	Significant impact on landscape
Example	Visibility of vent only (minimal harm) No visibility (landscape not harmed)	Visibility from roads, Visibility from industrial zones	High visibility from residential communities, high visibility from visitor sites

Visibility analysis was conducted based on a study of the facility and its surroundings using topographical maps, orthophotos, and a tour of the alternatives' sites and surroundings. The analysis of each of the sites is supported with a graphical analysis including: photos of the surface, simulations, and visibility maps.

3. **How the facility integrates into its surroundings and its impact on the skyline:** facility integration in its surroundings was evaluated under "Degree of disruption of landscape in open spaces." Consequently, the present section examines the facility's impact on the skyline only.

   Facility integration with the skyline was evaluated using simulations and sections prepared for the criterion "Evaluating facility visibility from a number of points in the area." In processing the graphics, land cover components in the vicinity of the proposed site was taken into account.

Sites with prominent facility elements relative to the skyline (e.g. site is located in the heart of a level open space) were defined as "Significant impact on landscape." Sites with complete or partial masking of the facility or elements by land cover elements (e.g. cypress grove, topography) were defined as "Medium impact on landscape." Sites with no prominent facility elements relative to the skyline (e.g. site is located in an industrial area with many components of similar height dimensions) were defined as "Minimal impact on landscape."

In the case of this criterion, we emphasize that the flare, which is up to 100 m tall is a very slender component (its diameter is 50 cm) and its impact on skyline contiguity is relatively small.

This criterion has key importance in assessing the alternatives.

Ranking	**Minimal impact on landscape**	**Medium impact on landscape**	**Significant impact on landscape**
Example	Located in an industrial zone with elements of similar height	Masking the facility's components with land cover e.g. cypress groves	Located in the heart of a level open space

4. **Additional potential harm and its extent caused by ancillary infrastructure:** Civil infrastructure such as: motorways and access routes, water and sewage infrastructure, etc. also leave a footprint on landscape in their immediate surroundings. Use and/or proximity to existing infrastructure may significantly reduce the need for additional infrastructure and consequently the impact on landscape caused by the facility (e.g. using an existing access route). In addition, there will be a need to arrange staging areas for constructing the pipeline corridor.

These areas are exposed to landscape damage and some have a limited recovery capacity, despite the fact that the area will be temporarily disturbed and is expected to return to its original function after rehabilitation. Also of note, the detailed engineering plan and plotting the corridor route, as well as executing the work based on landscape principles will have an important influence on the landscape footprint derived from design of the infrastructure. For example, burying or constructing infrastructure corridors can significantly reduce the visual impact of the ancillary infrastructure.

Consequently, when evaluating potential harm to the landscape as a result of constructing ancillary infrastructure, features of the natural surroundings must be considered as well as the ability to make use of existing infrastructure. Areas where existing infrastructure and natural features cannot be used, and it is not possible to bury infrastructure in the subsoil will be ranked "significant impact on landscape."Areas in which partial use can be made of adjacent infrastructure and/or infrastructure can be buried under the detailed plan will be ranked "medium impact on landscape."Areas in which partial use can be made of adjacent infrastructure and/or infrastructure can be buried as part of the detailed plan will be ranked "minimal impact on landscape."This criterion has medium importance because we are assuming it is possible to find a solution for any infrastructure route that will be needed.

Ranking	**Minimal impact on landscape.**	**Medium impact on landscape.**	**Significant impact on landscape**
Example	It is possible to rely on existing infrastructure It will also be possible to bury infrastructure as part of the detailed plan	Partial use can be made of adjacent infrastructure and/or infrastructure can be buried as part of the detailed plan	Existing infrastructure and natural features cannot be used, and it is not possible to bury infrastructure in the sub-soil

5. **Degree of harm to current landscape as a result of earth works associated with establishing the facility:** Scope of damage to landscape from earth works is largely the derived from the facilities' detailed plan for the site. Therefore, the main component influencing the rank of each facility was the site's topography. We have assumed that a more level topography will require less earth works and harm to landscape will be smaller. This criterion was of secondary importance in evaluating the alternatives (see reference to earth works in Section 2.1.5-4, below).

Ranking	Minimal impact on landscape	Medium impact on landscape	Significant impact on landscape
Example	Minimal earth works	Moderate topography - medium extent	Complex topography - extensive

B. Description of the landscape-related and visual implications of the generic components of a gas treatment facility

Criteria listed in Section (1) above were evaluated after studying the facility and its expected impact on its surroundings by the defined generic components that are expected to be included in onshore treatment facilities:

- **Gas treatment facilities** – industrial pipelines and boilers that are not very tall and are not visible from far off. Maximum height of most such components is 12 m. The low pressure venting flare is much higher (up to 25 m) but as it is very slender it is not very prominent.[13]

  Subject to the properties of the detailed engineering plan, and for purposes of landscape analysis, we assumed there would be two components at the treatment facility for supplementary gas treatment, with a 6 m diameter and extending 35 m up.

- **High pressure flare –**100 m high, but because it is slender it is not highly prominent.[14]
- **Fences and security measures (concrete) –** depending on their height and nature of their detailed plan.
- **Structures such as offices, storerooms, and control rooms** – these might be visible, depending on their height and nature of their detailed plan.

[13]The low-pressure venting flare will be used only in emergencies, and not in routine circumstances.
[14]The high-pressure venting flare will be used only in emergencies, and not in routine circumstances.

Example of a gas dehydration installation

Example of a MEG regeneration installation

Treatment facility in Ashdod

Figure 2.1.4-2 shows a schematic section of a treatment facility's components.[15]

C. Individual landscape evaluation for each alternative

A qualitative summary assessment was prepared for each of the gas treatment site alternatives addressing the conclusions from the landscape evaluation of the criteria listed above. The landscape assessment also addresses measures not included in the landscape evaluation, such as masking capacity, landscape rehabilitation, and other elements derived from the detailed plan.

D. Summary of landscape evaluation – comparing the planning alternatives

The concluding evaluation of the landscape contains a comparison between the alternatives and their landscape footprint. The summary evaluation assumes that there is a clear preference for establishing the facility directly adjacent to

[15] This is not a scale illustration; location of site components is schematic and for illustration purposes only. Their final position will be determined in the detailed engineering plan.

industrial zones and infrastructure installations rather than out in the open. However, greater weight will be assigned to each alternative's impact on the landscape in the context of residential communities and visitor sites.

2.1.4.2. Fundamental landscape analysis

Analysis of the alternatives based on the criteria listed in Section 2.1.4.1, above, is shown below:

A. <u>Dor North alternative</u>

A.1 Degree of harm to open spaces' quality due to landscape aspects:

As listed in Section 1.5.1,the site proposed for the Dor North alternative is located on the narrow strip lying between the western foot of the Carmel ridge and east of the Kurkar ridges, along the sea shore. Land uses in the vicinity of the proposed site are typically agricultural, both open and enclosed (screens and greenhouses). Directly adjacent to the proposed site and to its south is a treated wastewater reservoir and a wastewater treatment plant.

On the one hand, the facility proposed in this alternative may fragment the agricultural land and open landscape of the Carmel coastal plain. However, division of the agricultural expanse by longitudinal and latitudinal routes and infrastructure facilities located near the proposed site, mitigates the degree of harm to open spaces quality.

In conclusion: the existing level of disturbance at the site and its surroundings, combined with the potential option of rehabilitating the agricultural areas near the proposed site, mean that the **Dor North alternative has a medium degree of harm** to open space quality due to landscape aspects.

A.2 Evaluating facility visibility and its implications from a number of points in the area:

This alternative's location on a plain near the shore and on the other side on the western slopes of the Carmel ridge makes this cell highly visible (see Figure 2.1.4-1). From the Carmel ridge communities (particularly those extending over the western slopes: Fureidis, Zichron Yaakov and Maayan Zvi),the facility and all its components are clearly visible having a prominent presence against the rural backdrop and impact the skyline as specified in the following section. However, in Zichron Yaakov visibility is mostly from the ridge edges, areas that serve as promenades but are not built up or residential.

For the Carmel coastal communities, as noted in Section 1.5, local topography, namely Kurkar ridges and intensive agricultural land cover, creates physical and visual obstacles which mitigate the facility's visual impact, leaving them largely with a view of the flare rising above the facility.

The topography and land cover (chiefly agricultural) in the site's immediate surroundings, in the plain between the Kurkar ridge to the west and the Carmel ridge to the east, create visibility of the higher components of the facility, which are 12 m high. Visibility of all facility components only exists from the east. Road 4, which lies at the foot of the Carmel ridge, has similar visibility.

As one moves further away from the site, from the Kurkar ridge eastward and from Ein Ayala northward the topographic obstacles alter visibility so that only components such as stacks, flare, and vent are visible. For travelers on Road 2 traveling along this section, which is excavated into the ridge, means that only the facility's tallest components are visible from the motorway. The elevated facility components are chiefly visible over the WWTP embankments from Road 2, on the elevated interchange at the junction with Road 70.

Road 70 is also exposed to relatively high visibility; elements 12 m high are visible from most parts of the road all the way to Fureidis junction. To travelers coming from the east, all site elements are highly visible from Fureidis junction to the southward curve of the road in Wadi Mileq.

In conclusion: High visibility of the site's components from the Carmel ridge communities and roads in the area mean the Dor North alternative **has a large impact on landscape** due to visibility of the site and it elements.

A.3 Facility integration into its surroundings and impact on the skyline:

The Carmel coastal landscape unit has unique landscape qualities due to the contact line with the agricultural plains and the Carmel ridge and cliffs on the east, and with the Kurkar ridges and sea in the west. The facility's integration into its surroundings is poor. It does not fit in with the agricultural landscape and compromises the characteristic view of agricultural plains against the backdrop of the Carmel cliffs. However, this impact is mitigated by the fact that this alternative is located directly adjacent to the WWTP (which contains elevated embankments and structures) and to agricultural structures, and is concealed behind agricultural installations and orchards. So it does not stand in the heart of open cultivated land.

The most significant impact on the horizon is for observers from the east, from the Carmel ridge communities and mostly from Fureidis, which although located 1.5 km away, is located entirely on the slope overlooking the examined site. There will be significant visibility over the entire site from most of the village homes and its upper streets as despite its distance it is center front on the landscape view, therefore compromising the skyline – a view of agricultural land and sea seen from the village and constituting one of its assets. The facility will also compromise the view from the northern neighborhoods of Zichron Yaakov (Givat Eden); however, unlike Fureidis, for most of the homes the site will be located on the margins of the view and not in its center.

The site is also visible to some extent from the surrounding roads, as listed in Section A.2. Although, with the exception of the elevated Zichron Yaakov interchange, most of the roads are low relative to the facility (Road 70, Road 4),or mostly hidden (Road 2), and the view from them toward the horizon is limited by land cover.

In conclusion: The site at this location does not fit in with the agricultural landscape, and it compromises the characteristic view of agricultural plains against the backdrop of the Carmel cliffs. However, this impact is somewhat mitigated by the immediate adjacency to a WWTP, infrastructure and agricultural structures, so it does not stand in the heart of open cultivated land. This alternative **ranks low** on the scale of facility integration in its surroundings and has a high impact on the skyline.

A.4 Additional potential harm and its extent caused by establishing ancillary infrastructure:

In the Dor North alternative full use can be made of existing infrastructure: the proposed site is located near access routes to the Dor and Nachsholim communities. Moreover, there are many dirt and agricultural roads crossing the site and its surroundings. It will be also possible to use the water and sewage infrastructure of the nearby communities, as well as the WWTP adjacent to the site. It will also be possible to bury infrastructure as part of the detailed plan. As the site is close to the shore and a new pipeline corridor will not be required, except for the limited section passing through the agricultural plain, the expected impact on landscape from building the pipeline is small. Accordingly, as most of the route already exists there will be no need to arrange staging areas for the pipeline. At the same time, the proposed block-valve station is located in a relatively out of the way natural area, with the exception of a nearby dirt road. Establishing the pipeline will require building an access route.

In conclusion, the impact on landscape of establishing ancillary infrastructure in the Dor North alternative is minimal.

A.5 Degree of harm to current landscape as a result of earth works associated with establishing the facility:

Under this alternative, the proposed site is located in a plain which means that earth works required to establish the facility will be minor. Other than that, most of the pipeline route passes through the existing INGL route so extensive work for establishing a pipeline corridor will not be necessary.

In conclusion, the Dor North alternative will not require significant earth works, **so that the impact of this aspect on the landscape will be minimal.**

B. The Ein Ayala alternative

B.1 Degree of harm to open spaces' quality due to landscape aspects:

The Ein Ayala quarry, which is the proposed site for the gas treatment facility, is currently an eyesore on the slopes of the Carmel ridge. The white quarry walls are visible from afar, as they are very prominent against the backdrop of the Carmel ridge woodlands.

For this alternative, the detailed engineering plan is an important component of the future landscape footprint that this alternative will leave behind. Leveling the ground, using quarry walls as screens and additional measures can help reduce the environmental footprint of this alternative. This will integrate the facility into the quarry and affect visibility from the Carmel coastal plain.

Subject to the detailed plan, visibility from the west may be reduced compared with current visibility. Landscape rehabilitation may reduce the contrast between the quarried walls and the green slopes, minimizing the site's landscape footprint. Establishing the facility in this area is expected to add to the visual impact on the Carmel slopes' landscape. However, due to the quarry's current high visibility, seen from the entire Carmel coastal plain, and mainly from the communities and roads, establishing the facility will not disturb the landscape significantly beyond its current condition, and might mitigate visibility and prominence of the area compared with the present quarry's high visibility.

In conclusion: The current quarry has a significant landscape footprint. Establishing a treatment facility within the quarry, using landscape rehabilitation measures may reduce the current environmental footprint. Consequently, placing the proposed treatment facility within the disturbed area **ranks the Ein Ayala alternative as having a medium degree of harm to open space quality** due to landscape aspects.

B.2 Evaluating facility visibility and its implications from a number of points in the area:

On the one hand, the alternative's location on the western slopes of the Carmel ridge, near the point where they meet the Carmel coastal plain, makes the facility highly visible in its surroundings. These include the Carmel coastal plain and travelers on the highways and local roads, mainly in the vicinity of the Zichron Yaakov interchange (junction of Road 2 and Road 4). Facility visibility from the Carmel ridge communities is largely limited to the higher elements of the facility (higher than 35 m). Despite intensive farming, most of the crops are low and do not contribute to concealing the quarry, except for the eucalyptus and cypress trees which screen the quarry from travelers on Road 4 and from nearby observers.

At the same time, analyzing visibility for the Ein Ayala alternative is complex, in view of its position inside a quarry which has an uneven surface and walls which defining the site perimeter. This is the reason that for this alternative, visibility analysis does not use computer-analyzed maps; visibility of this alternative was not represented reliably when considering the surface. For this alternative, visibility was analyzed using simulations, sections, and visits to the area only.

Note that the upper wall of the quarry is highly visible, but the lower portion is hardly exposed. Accordingly, placing the facility in the lower portion of the quarry will keep it invisible; it will be possible to improve things further in the detailed plan by restoring the upper wall and mitigating the quarry's visibility in the area.

In conclusion: The present quarry's high visibility together with the option to rehabilitate the landscape subject to the detailed plan (see Section B.1, above) may reduce the landscape impact of a gas treatment facility compared to the current situation. Furthermore, visibility of most site elements from the surrounding communities is relatively low; the site is exposed mostly to travelers on the highways, and the local communities have a view of the higher elements of the site. Consequently, **the Ein Ayala site was ranked as having a medium impact on the landscape**, due to site and component visibility.

B.3 Facility integration into its surroundings and its impact on the skyline:

The alternative is located in a sensitive area that has landscape potential, i.e. the contact line between the Carmel ridge and the Carmel coastal plain. However, its position inside a disturbed area (Ein Ayala quarry), inside the existing quarry pit, contributes to relatively good integration in the surroundings and minimal impact on the skyline. Most of the installations will be concealed in the pit or only visible from nearby, as described in Section A.2. The elevated installations will be partially visible from a distance, from the direction of the distant Road 2, and from the Carmel coastal communities, but will still be lower than the quarry's east wall and will not protrude above the ridge line. Landscape rehabilitation of the upper portion of the cliff may contribute to obscuring visibility of the facilities from the distance, and can greatly improve the area's appearance.

In conclusion: This alternative's position inside the existing quarry pit, in a disturbed area (Ein Ayala quarry), produces a **high** degree of integration into its surroundings and a minimal impact on the skyline.

B.4 Additional potential harm and its extent caused by establishing ancillary infrastructure:

The Ein Ayala alternative allows making full use of existing infrastructure: the proposed site is located near Road 4 (the old coastal road) from which a paved road leads to the quarry. In addition, it will be possible to use the water and sewage infrastructure of the nearby communities, to serve the quarry and its operators. Moreover, it will also be possible to bury infrastructure as part of the detailed plan. As the site is close to the shore and a new pipeline corridor will not be required, except for the limited section passing through the agricultural plain, the expected impact on landscape from building the pipeline is small. Accordingly, as most of the route already exists there will be no need to arrange staging areas for the pipeline. For required infrastructure for the block valve station see Section A.4 in the Dor North alternative.

In conclusion, the impact on landscape from establishing ancillary infrastructure in the Ein Ayala alternative is minimal.

B.5 Degree of harm to current landscape as a result of earth works associated with establishing the facility:

Under this alternative, the proposed site is located in the quarry pit within the Ein Ayala quarry. Establishing the facility will require leveling and foundation work in the quarry. Since the material in the quarry is currently used as raw material in the construction industry, it will be possible to make use of surpluses obtained from leveling the quarry. Furthermore, most of the pipeline route passes through the existing INGL route so extensive work for establishing a pipeline corridor will not be necessary. The remainder of the route passes through the plain requiring.

In conclusion, the Ein Ayala alternative will not require earth work outside the quarry, and will therefore have a **minimal impact on landscape in this aspect.**

C. Hagit alternative

C.1 Degree of harm to open spaces' quality due to landscape aspects:

The proposed site for the Hagit treatment facility is located in a distinctly hilly terrain crossed by river gullies and roads, with typical natural elements. The Hagit power station is located in the heart of this area closely adjacent to the proposed site.

Establishing the facility in this area will create a visually prominent addition to the natural landscape of the southern Carmel slopes where they meet the Ramot Menashe plateau. However, the site's proximity to an existing infrastructure facility which is clearly visible in its surroundings may mitigate the landscape disturbance and reduce the contrast between the facility and the surrounding natural landscape.

In conclusion: Establishing the proposed site will cause a high degree of harm the natural landscape. However, proximity to the existing power station significantly mitigates the landscape disruption which is why the **Hagit alternative has been ranked as having a medium degree of harm to open space quality** due to landscape aspects.

C.2 Evaluating facility visibility and its implications from a number of points in the area:

The alternative's location on the undisturbed natural southern slopes of the Carmel, on the one hand, and adjacent to a prominent infrastructure facility, on the other, makes this cell highly visible in it immediate surroundings. However, we must recall that site visibility derives largely from the existing infrastructure installation and not from the cell itself.

The proposed facility will be visible mainly from uninhabited areas and/or places that are not activity and/or hiking locations. In general, the facility is partially visible (based on elements higher than 12 m) to travelers on Road 6 and to some communities in the south-west of Ramot Menashe which face the facility. The facility is also exposed to the north-eastern residential areas of Zichron Yaakov; however, in this case the facility and its elements are visible from a distance and the direct visual impact is reduced. In practice, the Hagit power station forms a physical and visual obstacle, blocking out the facility's base from the west and the south-west, and mitigating the facility's prominence in the surrounding landscape.

Note that, despite its relative proximity, visibility from Elyakim is relatively limited and only exposes facility elements that are taller than 35 m.

In conclusion: Visibility of the proposed site from the surrounding communities is relatively low, although it is highly visible from the open spaces and the nearby junctions. Proximity to the existing power-station reduces the visual impact of the proposed site. Consequently, **the Hagit site was ranked as having a medium impact on the landscape,** due to visibility of the site and its elements.

C.3 Facility integration into its surroundings and its impact on the skyline:

This alternative is located in the heart of a dwarf shrub steppe. This natural open space has landscape value, is highly visible from the surrounding roads, and very prominent due to the natural surroundings and the spatial relationship between the hilly topography and the surrounding roads.

A facility located here will not merge with the natural landscape, and it contrasts with the natural environment and its qualities, and the traveler's experience on Road 70 in both directions – open space, natural and agricultural landscapes. However, this impact is somewhat mitigated by the immediate adjacency to the Hagit power station whose tall stacks are visible at a great distance and significantly compromise the skyline and the natural quality of the area.

The skyline is compromised mainly for travelers eastward, alternately, starting as far as Bat Shlomo interchange and up to the highest point in this area, Tut interchange, from which the entire site is visible and does not integrate with the natural surroundings. In contrast, travelers west will experience a less severe impact as the skyline is compromised on a shorter stretch of road nearer the site.

In conclusion: due to the contrast between the industrial installation and the area's natural quality, the facility's integration into its surroundings is **poor**, and it will be prominent from a great distance. Also, the skyline will be **highly** compromised.

C.4 Additional potential harm and its extent caused by establishing ancillary infrastructure:

Under the Hagit alternative it will be possible to make full use of existing infrastructure: the proposed site is located near Hagit power station and can utilize all ancillary infrastructures, including the access road from Road 70, water and sewage infrastructure, etc. Moreover, it will also be possible to bury infrastructure as part of the detailed plan. At the same time, as the site is very far from the shore there will be a need to arrange several staging areas for constructing the pipeline corridor. Preparing the staging areas and rehabilitating the landscape later will have a greater impact because the pipeline route passes through undisturbed nature. For required infrastructure for the block valve station see Section A.4 in the Dor North alternative.

In conclusion, the impact on landscape due to establishing ancillary infrastructure in the Hagit alternative is **medium to high**.

C.5 Degree of harm to current landscape as a result of earth works associated with establishing the facility:

The proposed site, under this alternative, is located in hilly terrain and will require earth works to level the ground and build foundations. In addition, rehabilitation work will also be required. Moreover, a significant portion of the pipeline route passes through woodlands and dwarf shrub steppe in hilly terrain. Consequently, the earth works required to build the pipeline and rehabilitate the landscape will be more complex than in agricultural lands.

In conclusion, the Hagit alternative will require more extensive earth works than other alternatives, so that the **impact of this aspect on the landscape will be great**.

D. Hadera WWTP

D.1 Degree of harm to open spaces' quality due to landscape aspects:

The proposed site for the treatment facility near Hadera WWTP is located in agricultural lands of cultural importance, where the northern Sharon joins the sandy areas and southern approaches of the Carmel ridge, which make this environment unique. Conversely, this alternative is located in cultivated agricultural land near existing and planned infrastructure installations and an intensive industrial zone; this severs this cell from its unique nature and helps merge it somewhat with the built-up elements around it.

The Nahal Hadera flooding plains in this area do not constitute a high-quality natural resource/asset and have lost most of their natural properties. The block-valve station will be located in this area. We estimate that establishing a facility in this specific location will not compromise the river's natural qualities. However, despite the many disturbances around it, the river remains pivotal to the open space that spans the coastal plain to the shore and there are several plans for its rehabilitation.

In conclusion: There is significant harm to the agricultural landscape as a result of establishing a treatment facility in Hadera, due to the cultural and landscape value of this terrain. Conversely, the immediate adjacency of the alternative to an intensively industrial area significantly mitigates landscape disruption, which is why the **Hadera** alternative has been ranked as having **a medium degree of harm to open space quality** due to landscape aspects.

D.2 Evaluating facility visibility, and its implications, from a number of points in the area:

Medium-high visibility of the site and its components is mostly in the elevated areas, the Kurkar ridges and the north-western hills of Hadera which are residential areas. Visibility of 12 m high elements is present also from the city's western localities, beyond the industrial zone, and from Kibbutz Gan Shmuel. In the other areas, the remaining elements of the facility are visible mainly from uninhabited open spaces which are not frequented by visitors, or else only the prominent elements of facility which are over 35 m high, are visible. This is partly due to the intensive agricultural land cover, and especially the cypress and eucalyptus groves in the fields and along Road 65, and to elevated Tel Zomera. All these form physical and visual obstacles to site visibility which mitigate the facility's impact on landscape and reduce its prominence within the open space and cultivated land.

The site's proposed location on the outskirts of the city's northern industrial zone, which has dominant industrial features, and in proximity to planned and existing infrastructure installations may mitigate the facility's appearance on the backdrop of the agricultural land the fish farms.

Elements taller than 35 m are visible from almost anywhere in Hadera and Gan-Shmuel and from a significant portion of Pardes-Hanna.

In conclusion: on the one hand, site components have medium-high visibility from Hadera's residential localities and from Road 65. On the other hand, the level topography and the fact that the site is enclosed by cypress groves and directly adjacent to the WWTP significantly mitigate the impact on landscape. As a result, the Hadera WWTP alternative is ranked as having **medium impact on landscape** due to site and element visibility.

D.3 Facility integration into its surroundings and its impact on the skyline:

The proposed site is located on an agricultural plain (well-established citrus orchards with cypress wind-breakers, and crops) near Hadera's WWTP and northern industrial zone, and south of most of the fish farms.

On the one hand, the facility's integration into the agricultural land surroundings is poor. On the other hand, the agricultural land features enclosed orchards and natural wind-breakers, and the facility is directly adjacent to WWTPs, and in close proximity to an industrial zone. This results in **medium-high** integration into its surroundings.

In conclusion, the area's level topography and enclosed landscape, its immediate adjacency to the WWTP and proximity to an industrial zone, and the option to embed the site in its surroundings provide it with a **high** degree of integration**.**

D.4 Additional potential harm, and its extent, caused by establishing ancillary infrastructure:

Under the Hadera WWTP alternative it will be possible to make full use of existing infrastructure: the proposed site is located near Meretz WWTP and can utilize all ancillary infrastructures, including: access route from Road 65, water and sewage infrastructure, etc. Moreover, it will be possible to bury infrastructure as part of the detailed plan. As the site is relatively close to the shore, there will be no need to arrange many staging areas for the pipeline. The pipeline route passes mostly through level agricultural land so the expected impact on landscape from building the pipeline is relatively small.

Also the block valve station has an existing access route via the access road to Nahal Hadera Park.

In conclusion, the impact on landscape from establishing ancillary infrastructure in the Hadera WWTP alternative is minimal.

D.5 Degree of harm to current landscape as a result of earth works associated with establishing the facility:

The proposed site, under this alternative, is located in a plain which means that earth works required establishing the facility will be minor. Also, the proposed pipeline corridor passes largely through level to moderately sloping agricultural land and will not require extensive earth works to install the pipeline and/or rehabilitate the landscape.

In conclusion, the Hadera WWTP alternative will not require significant earth works, so that the impact of this aspect on the landscape will be minimal.

E. Meretz WWTP

E.1 Degree of harm to open spaces' quality due to landscape aspects:

The proposed site from the treatment facility is located in a cell with a large agricultural expanse that has national landscape significance and is defined as a landscape complex in NOP 35. Its importance to landscape has increased as a result of the increased drive to develop and populate the Sharon, and it constitutes one of the largest and central agricultural expanses whose contiguity has been preserved with its agricultural elements intact. A wastewater treatment facility is located near the proposed site.

On the one hand, the facility proposed in this alternative may fragment the agricultural land and the high-quality open landscape in this area. On the other hand, fragmentation of the agricultural expanse by the infrastructure facility located near the proposed site mitigates, even if only slightly, the degree of harm to the quality of the open space.

In conclusion, contiguity of the open agricultural space, on the one hand, and the existing level of disturbance at the site and its surroundings, combined with the potential option of rehabilitating the agricultural areas near the proposed site, on the other, ranks the **Meretz WWTP alternative as having a medium degree of harm to open space quality** due to landscape aspects**.**

E.2 Evaluating facility visibility, and its implications, from a number of points in the area:

Similarly to the WWTP, and despite its prominence on the backdrop of the open expanses, the proposed site is for the most part not expected to be visible to its surroundings. This is due to the intensive agricultural elements in the area that include orchards, greenhouses, and cypress groves which create a physical and visual obstacle and mitigate the visibility of the proposed site and its surroundings to travelers on the roads and to the local communities. Despite this, most of the areas from which the site and its components are fully visible are the open spaces and agricultural lands, which are not actively frequented sites and/or population centers, except for residential areas in the local communities which are located on the slopes of the hills facing the facility.

High visibility of the site's elements is obtained in the eastern part of Kibbutz Ein Hahoresh, and visibility of the elements taller than 12 m is obtained in the north-western part of Moshav Ometz and Kibbutz Hamapil. However, this alternative's relative distance from these rural communities and the local roads contributes to mitigating the direct visual impact of the site. The more distant surrounding communities and the central and regional motorways have a view of the facility's prominent elements that are taller than 35 m, and in some cases only of the flare.

In conclusion: The surrounding communities will not experience high visibility; this is obtained mostly from the roads and open spaces in the area. Proximity to the Meretz WWTP somewhat reduces the visual impact of the proposed site. Despite high visibility from the open areas in the site's vicinity, in view of its low visibility from population centers and highways, **the Meretz WWTP site is ranked as having medium impact on landscape due to site and element visibility.**

E.3 Facility integration into its surroundings and its impact on the skyline:

The proposed site is located in the heart of level, open country, with an open landscape, near the Meretz WWTP. On the one hand, the facility's integration with the open-space agricultural surroundings is poor. On the other hand, the facility is directly adjacent to WWTPs, so integration with its surroundings ranks **medium.**

The site has medium-high impact on the skyline and the open agricultural landscape. However, because of its low visibility, and the fact that the existing infrastructure facilities have already disrupted the region's open landscape it is ranked as having **medium impact.**

In conclusion, based on the area's level topography and open landscape, on the one hand, and its location directly adjacent to a WWTP on the other, its degree of integration ranks **medium**.

E.4 Additional potential harm, and its extent, caused by establishing ancillary infrastructure:

Under the Meretz WWTP alternative it will be possible to make full use of existing infrastructure: the proposed site is located near Meretz WWTP and can utilize all WWTP ancillary infrastructures, namely, access path from Road 581, water and sewage infrastructure, etc. Moreover, it will also be possible to bury infrastructure as part of the detailed plan. The pipeline route passes mostly through level agricultural land so the expected impact on landscape from building the pipeline is relatively small. Moreover, although the site is very far from the shore and there will be a need to arrange several staging areas for constructing the pipeline corridor, as the area is agricultural and level in the most part, it will be possible to rehabilitate the area and return it to its original state. Under all four alternatives, the block-valve station has existing access routes, roads, and/or dirt paths. Under all alternatives, the proposed site of the block-valve station is less sensitive as far as landscape.

In conclusion, the impact on landscape from establishing ancillary infrastructure in the Meretz WWTP alternative is minimal.

E.5 Degree of harm to current landscape as a result of earth works associated with establishing the facility:

Under this alternative, the proposed site is located in a plain which means that earth works required to establish the facility will be minor. Also the proposed pipeline corridor passes largely through level to moderately sloping agricultural land and will not require extensive earth works to prepare the pipeline and/or rehabilitate the landscape.

In conclusion, the Meretz WWTP alternative will not require significant earth works, so that the **impact of this aspect on the landscape will be minimal**.

Section 2.1.5 (13) describes the landscape evaluation summary.

Figure 2.1.4-1: Methodology for evaluating the alternatives

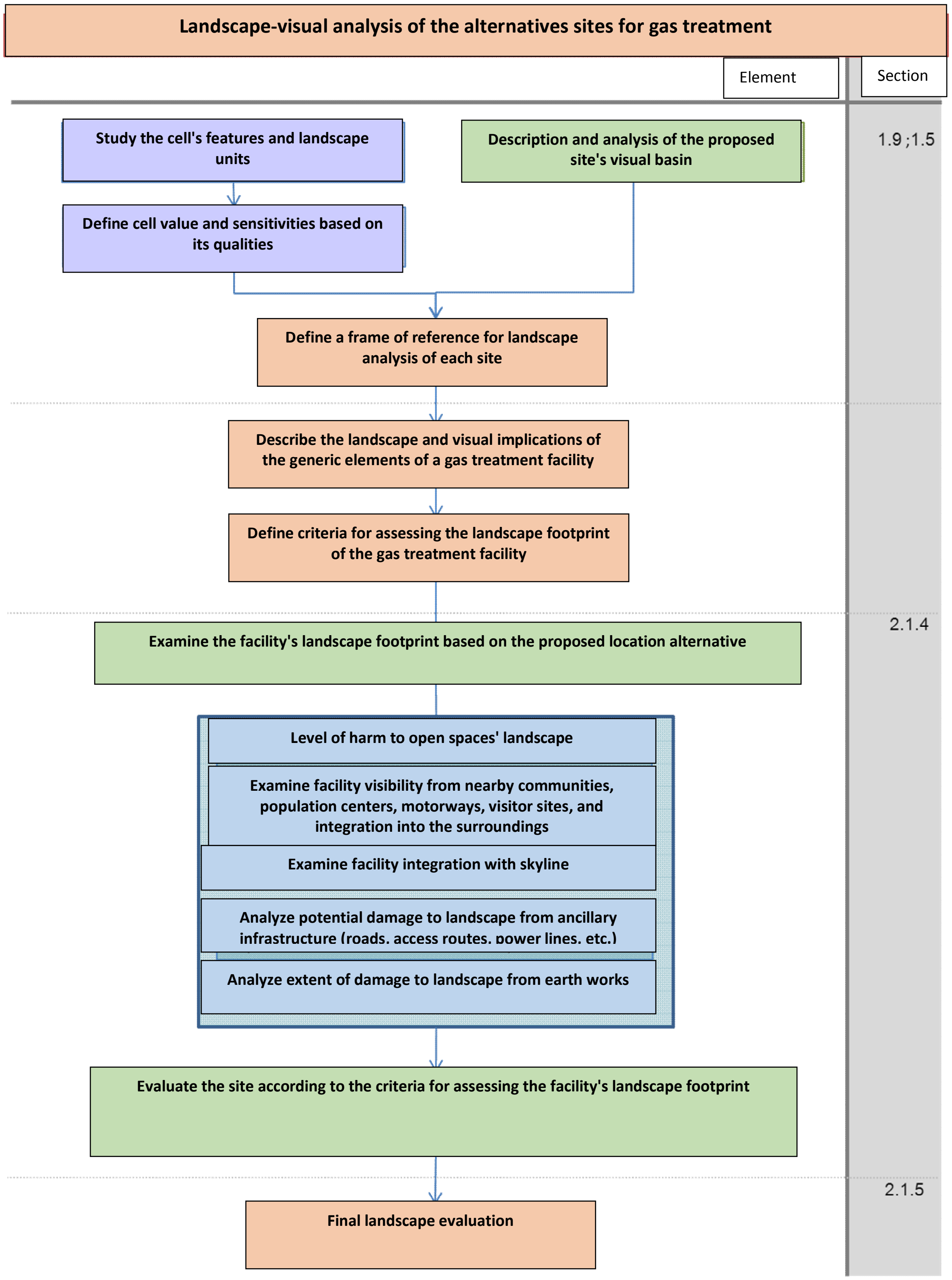

Figure 2.1.4-2: Schematic section of a treatment facility's components.

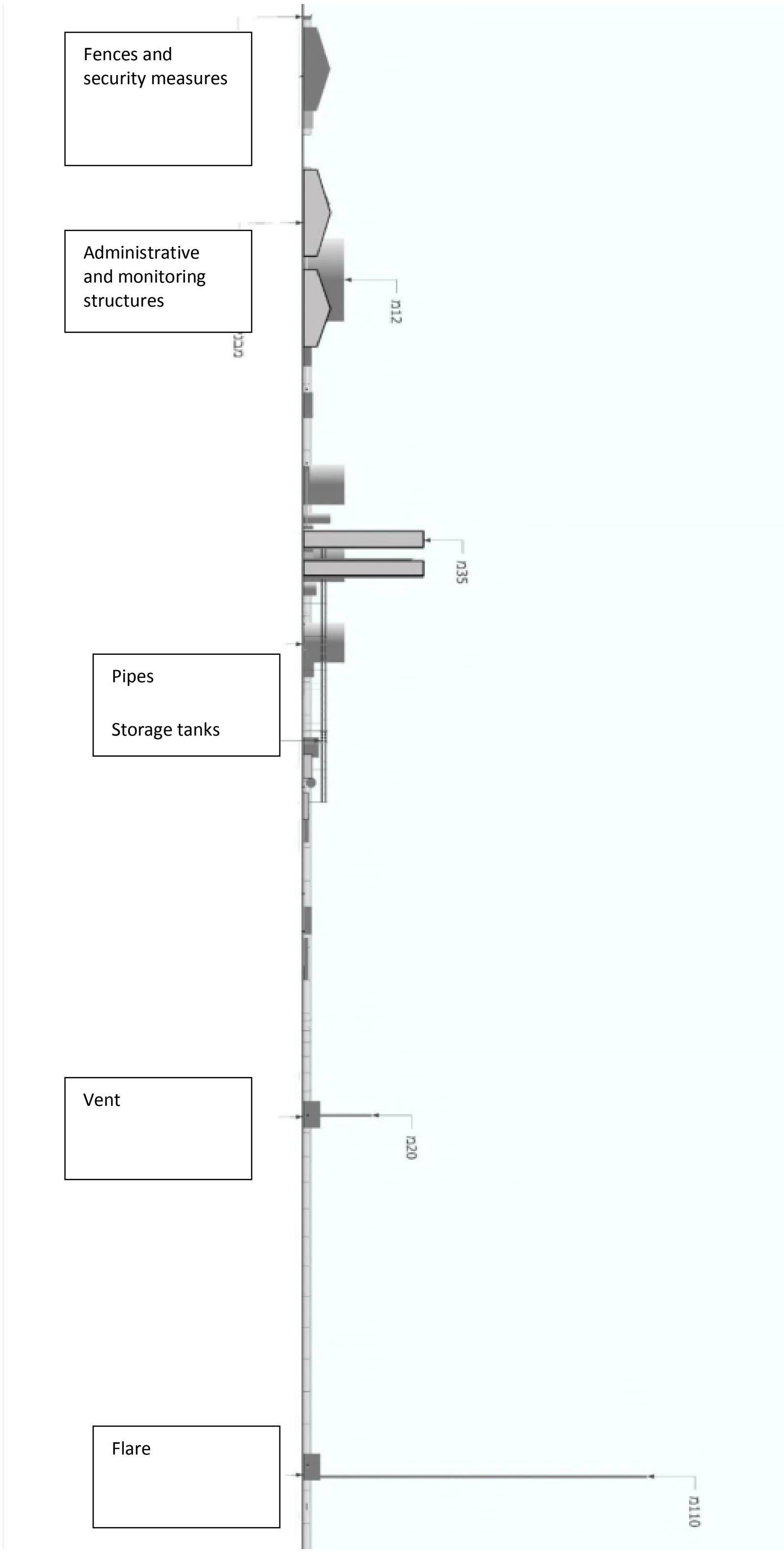

Figure 2.1.4-a: Analysis of Dor North visual basin

Figure 2.1.4-b: Analysis of Ein Ayala visual basin

Figure 2.1.4-c: Analysis of Hagit East visual basin

Figure 2.1.4-d: Analysis of Hadera WWTP visual basin

Figure 2.1.4-e: Analysis of Meretz WWTP visual basin

2.1.5. Examining the alternatives

A. Expected level of risk to population at the facility and in its vicinity

This section examines the treatment facility alternatives only; the pipeline to and from the facility must comply with requirements of IS 5664 Sections 1 and 2. The onshore alternatives under consideration at this stage of the work are Dor North, Ein Ayala, Hadera WWTP (which has been split into three sub-sections due to the structure of the examined area: the western side, Hadera WWTP north, Hadera WWTP east), and Meretz WWTP.

All of the alternatives comply with the requirement for a 600 m separation distance from population, except for the western part of the Hadera alternative which is 450 m from public receptors in the industrial zone (shopping center).

Dor North and Meretz WWTP are preferable as they are further away from permanent population centers, highways, and high and extra-high voltage power lines than the other alternatives.

Ein Ayala alternative – It is apparently possible to build the facility here, as the quarry structure creates an air flow (a type of Venturi effect) even during times when there is almost no air flow outdoors. If this alternative will be advanced, it will be necessary during the detailed plan stage to adjust the plan to the site's topography (create a Venturi structure), to the local wind regime and the interface with Road 4 on aspects of risks, such as distancing.

The Hagit alternative is indeed very far from permanent population centers but it is less preferable because of its relative proximity to motorways and its proximity to the power station. This could become a problem in case of explosion in either one of the sites, such that the other site is affected.

The Hadera-north alternative has a low preference because of its close proximity to motorways.

The Hadera east alternative has a low preference due to its proximity to the railway tracks and the high voltage power lines which pass alongside it and through it.

B. Efficient use of land resources

Differences between the alternatives based on land consumption. For each of the site alternatives, land consumption is the same, approximately 150 dunams. Also the coastal entry point on the shore requires the same amount of land (except for the Neurim alternative). Consequently, this criterion mainly addresses the alternative pipeline routes. A shorter pipeline route that overlaps the boundaries of adjacent infrastructure and does not require relocating these installations (existing and planned) to other areas, is preferable.

Pipeline alternatives were evaluated based on the land consumption aspect for each of the exploration zones:

- **Dor North –** the pipeline route to Dor is 2.5 km long and partly relies on the Dor-Hagit NOP 37c approved transmission pipeline route. In addition, treated gas will be transmitted through the existing transmission pipeline and there will be no need to lay an additional pipeline. High score.
- **Ein Ayala –** the pipeline route to Dor is 2.5 km long and partly relies on the Dor-Hagit NOP 37c approved transmission pipeline route. In addition, treated gas will be transmitted through the existing transmission pipeline and there will be no need to lay an additional pipeline. High score.
- **Hagit East –** From the coastal entry point on Dor beach to Ein Ayala quarry the route is based on the Dor-Hagit NOP 37c approved and existing transmission pipeline route. For the segment from Ein Ayala quarry and eastward to the proposed onshore facility, there are two basic alternative pipeline routes: a northern and a southern one. Both reach near the Hagit power station so there is no need to establish another line:
    - Northern alternative route - Approximately 16 km long and most of it passing directly adjacent to the existing INGL natural gas pipeline, south of the existing pipeline at the required distance. Low score.
    - Southern alternative route-Approximately 17 km long (of which 5 km are adjacent to the existing route). Most of the proposed route passes through agricultural land. Low score.
- **Hadera WWTP** – The pipeline from coastal entry to Hadera WWTP has three alternatives depending on the coastal entries,
    - Nahal Hadera – 3.5 km long. In part passes parallel to Nahal Hadera and existing and planned infrastructure as well as through an area designated as residential in the Hadera outline plan, in Heftziba and north of Givat Olga near Hadera Park. Placing the facility at this site will require relocating power corridors to prevent parallelism, or alternatively, shifting of the supply pipeline south at the expense of residential developments and placing restrictions on the permitted density. Medium ranking
    - Michmoret – 9 km long. The route turns north east of Road 2, parallel to the Hadera Park forest and the coastal railway track, up to the connection with the planned Road 9, where it will turn north passing within the perimeter of the business compound (plan Had/1300) which will have to be suitably adjusted, until the point where the route merges with the proposed Nahal Hadera array, west of Road 2 and near Heftziba farm. Low score.

- Nahal Alexander – 12.5 km long. The proposed pipeline corridor is parallel to Nahal Alexander. The route re-crosses the river near the railway tracks and then turns north and passes east of the coastal railway track until it crosses the track and merges with the proposed route for the Michmoret alternative, in the direction of Hadera WWTP. Low score.
- Eastward transmission pipeline for treated gas – This route has two alternatives, a northern and southern, that are 14 and 12 km long, respectively. The northern alternative passes near Road 65 and through agricultural land in the area of Pardes-Hannah-Maanit. The southern route passes mostly through agricultural land along Nahal Hadera. Both routes have a medium score.

- **Meretz WWTP** – The pipeline from coastal entry to Meretz WWTP has four alternatives depending on the coastal entries, for the alternatives from Nahal Hadera, Michmoret, Nahal Alexander, and the northern and southern alternatives:
  - Nahal Hadera – This alternative has two routes, northern and southern, 17 km long. The northern is partly parallel to Road 9, and the southern one parallels Nahal Alexander through agricultural land. Low score.
  - Michmoret – Both the southern and northern routes (described in Section 2.1, above) are 13 km long. As noted, most of the route passes through agricultural land. Medium score.
  - Nahal Alexander – The proposed northern and southern routes for this alternative are 14 and 10.5 km long, respectively, over the route described above. The northern route scores medium, and the southern route ranks high.
  - Neurim – The proposed route length under this alternative is 10 km. It traverses fields, passes near the Mabarot WWTP and merges with the proposed southern route of the Nahal Alexander alternative, north-east of Mabarot WWTP. High score.
  - Eastward transmission pipeline for treated gas – 6 km long up to the Magal natural gas station, or 13 km up to the Harish natural gas station, compliant with and closely adjacent to the gas route in NOP 37/B/8. The route passes through agricultural land and near Road 581. High score.

C. Proximity to existing and planned infrastructure

Since the gas treatment facility will require power, gas, and accessibility infrastructure, this criterion addresses only exploration zone alternatives and their proximity to existing and approved infrastructure:

(1) Power transmission

(2) Gas supply system

(3) Access routes and motorways

Environmental aspects refer mainly to efficient use of land resources, installing new infrastructure, and overlap with existing restrictions from these utilities.

- **Dor North -**
  - The Dor exploration zone is located 920 m from a high-voltage power line.
  - The zone is closely adjacent to the Dor-Hagit transmission line.
  - 600 m from Roads 2 and 4, 1.1 km from Road 70.

  High score

- **Ein Ayala -**
  - The Ein Ayala exploration zone is located 600 m from a high-voltage power line.
  - The zone is closely adjacent to the Dor-Hagit transmission line.
  - 200 m from Road 4, and 2 km from Fureidis junction.

  High score

- **Hagit East -**
  - The Hagit East exploration zone is closely adjacent to the power corridor, and an existing switching station is directly adjacent to the Hagit power station.
  - The zone is closely adjacent to the existing and planned gas supply system.
  - 250 m from Road 70 and near the Road 6 interchange.

  High score

- **Hadera WWTP**
  - A high-voltage power line passes through the exploration zone.
  - This alternative is located near the existing gas line, on the Israel American Paper Mills (IAPM) transmission route and has a 12" diameter under NOP 37 D. However, this route does not have the appropriate capacity.

- 60 m from Road 65, and 700 m from Road 4.

  <u>Medium score</u>

- **Meretz WWTP.**
  - 1850 m from an extra high-voltage power line which passes east of the alternative. However, it is possible to place a power line corridor in the agricultural lands and there is a nearby the power station connected to the transmission system.
  - The alternative is far from the national gas transmission system.
  - It will be possible to use the access route to Meretz WWTP incoming from Road 581.

  <u>High score</u>

D. Earth surpluses

An overall examination of the earth balance was conducted for the various alternatives, under Chapters 1 and 2 of the survey, addressing the receiving facilities and the pipelines.

- **Receiving facilities –** The gas receiving and treatment facilities in the Dor North, Hadera WWTP, and Meretz WWTP alternatives are located in level agricultural land and large earth surpluses are not expected there, nor will there be significant differences between them. The Hagit and Ein Ayala alternatives will require preparation work and work related to securing the site (mostly in Ein Ayala); these are expected to generate significant quantities of earth surpluses compared with the other alternatives. In this respect, earth works in the Hagit East alternative which is located in a hilly region, are expected to be more extensive than those in Ein Ayala.
- **Pipeline** – The work to bury the onshore pipeline generally follows these steps:
  - Trenching (digging a trench for the pipeline).
  - Bedding (spreading a 20 cm layer of sand under the pipeline).
  - Lowering (placing the pipelines in the trench).
  - Padding (covering the pipe all over with a 20 cm layer of sand).
  - Backfilling (refilling the trench from the locally excavated material).

After completing burial of the pipeline, excess excavated material is expected to remain, as shown in the table 2.1.5-d, below.

Note that a 20% deviation from the listed quantities is possible due to the slope of the trench, the amount of sand around the pipeline, increased volume of excavated soil compared with natural soil, etc.

The data in the table reflects the pipeline described in Section 2.1: Technologies Alternatives.[16]

In places where the natural soil is rocky, and digging or excavation generates rocks of various diameters, it is standard practice to limit the size of rock approved for backfilling the trenches to 15 cm. In such cases the soil can be sifted to remove the larger rocks, and imported material will be brought in to replace them.

The other option is to crush the stones to the required diameter for use as backfill material.

[16]Main transmission of up to 36" and 3 additional lines of 4", 8", and 10" for each supplier. If the main transmission lines' diameter is reduced, excavation surpluses are expected to drop proportionally. Note that 36" INGL pipeline was taken into account in each of the cases.

Table 2.1.5-d: Expected excavation surpluses from laying the pipeline for each of the alternatives

Alternative	Pipeline route alternative to the facility	Road length (km)	Earth surpluses per supplier[18] in thousands of m^3	Earth surpluses for two suppliers[17] in thousands of m^3	Pipeline route alternative from the facility to the onshore INGL eastern transmission system	Road length (km)	Earth surpluses for Supplier 1[1] in thousands of m^3	Earth surpluses for two suppliers[2] in thousands of m^3
Dor North		2.5.	13.7	22.5.				
Ein Ayala		7	38.5.	63				
Hagit East	Northern route	16	88	144				
	Southern route	17	935.	153				
Hadera WWTP	Nahal Hadera	35.	19.2	31.5				

[17]One supplier - Width of the right of way 65 m. Volume of earth surpluses (m3/m) 5.5 m^3.
[18]Two suppliers - Width of the right of way 85 m. Volume of earth surpluses (m3/m) 9 m^3.

Alternative	Pipeline route alternative to the facility	Road length (km)	Earth surpluses per supplier[18] in thousands of m^3	Earth surpluses for two suppliers[17] in thousands of m^3	Pipeline route alternative from the facility to the onshore INGL eastern transmission system	Road length (km)	Earth surpluses for Supplier 1[1] in thousands of m^3	Earth surpluses for two suppliers[2] in thousands of m^3
	Michmoret	9	49.5	81				
	Nahal Alexander	12.5	68.7	112.5				
					Northern route	14.5	79.5	130.5
					Southern route	12.5	68.7	112.5
Meretz WWTP	Nahal Hadera	23.5.	129.2	211.5				
	Michmoret	13	71.5	117				
	Nahal Alexander	10.5	57.5	94.5				
	Nahal Alexander +	12.5	68.7	112.5				

Alternative	Pipeline route alternative to the facility	Road length (km)	Earth surpluses per supplier[18] in thousands of m^3	Earth surpluses for two suppliers[17] in thousands of m^3	Pipeline route alternative from the facility to the onshore INGL eastern transmission system	Road length (km)	Earth surpluses for Supplier 1[1] in thousands of m^3	Earth surpluses for two suppliers[2] in thousands of m^3
	Michmoret							
	Neurim	10.5	57.7	94.5				
					Magal	6	33	54
					Harish	13	71.5	117

Removal of excavation surpluses

Surpluses must be removed to an approved disposal site, in accordance with the laws and regulations of the State of Israel.

If coordinated with the appropriate authorities, the surpluses may be dispersed over the right-of-way. Provided this is done before initiating work to renew the top soil and rehabilitate the area. If this is done, ground level will be elevated by a few centimeters compared with the natural level before work began. Consequently, there is no difference on this parameter between the proposed alternatives.

E. Natural resources

- **Degree of harm to local habitats (onshore and offshore).**

Coastal entries

1. General

All the alternatives are located within the sensitive shore environment which contains habitats of varying degrees of sensitivity (as described in Chapter 1). It is theoretically possible to identify in each alternative an area of relatively low sensitivity (disturbed, damaged, disrupted, wasteland) in which to place the shore receiving station. Therefore, when comparing the alternatives, the working assumption is that the station will be located in such areas. In addition, all the alternatives are located within the national ecological corridor which passes along the shore. Most alternatives are located in open spaces, in between development areas and relatively close to existing development, including motorways, buildings, and infrastructure. As a result, their impact on corridor function is relatively limited. In addition, the facility's features and small area is not expected to create significant fragmentation. Nevertheless, locations that do not require significant infrastructure and accessibility work are preferable.

Alternatives were evaluated according to the following criteria:

- **Range of ecological impact** – Receiving stations are not manned and active so they do not generate significant margin effects such as: lighting, noise, waste, etc. At the same time, some spatial impact is possible depending on the facility's position and sensitivity of the surroundings.
- **Harm to habitats –** Addressing a variety of habitats within the examined area, including their size and quality.
- **Ecological corridor –** whether the alternative is located in the national or local corridor.
- **Fragmentation of open spaces –** Degree of fragmentation associated with the station and access route's locations.

2. Evaluation of the alternatives

Dor alternative

Located within the fish farm area, which are most of them inactive; patches of Kurkar with natural vegetation. Several rare species have been documented, mainly in the western part. We assume that the station will be built in the eastern part where the inactive fish farms are located, and near the existing earth embankments. The plan area is agricultural (crops, orchards, greenhouses) with fish farms which are an activity site for birds and mammals. The area serves as a nesting ground for thicket birds and water and sea birds.

Conclusion: The fish farms are disturbed areas. It is possible to avoid harming unique plant species and there is no danger to the existing populations. The alternative is on the outskirts of a sensitive area due to bird activity and nesting, so its impact is relatively limited. The area is relatively homogeneous, which facilitates greater flexibility regarding station location.

Hadera alternative

The alternative is located in sandy areas, some in a high state of preservation, other are stabilized and disrupted, mainly in the northern and eastern parts of the alternative. The undisturbed areas are very sensitive and a relatively high level of animal activity was observed there (based on tracks and burrow signs). Included in the plan are high-quality sandy areas to the south, and Nahal Hadera Park along the river route which contains public-use development. In this respect, the impact on contiguity of the open spaces is relatively small.

Conclusion: In the sandy areas, which are highly sensitive, there is some risk of harm to reptile and rodent activity sites. The plan area is designated for development so the area taken up by sensitive habitats is expected to decline.

Michmoret alternative

The alternative is located in the sandy areas and red loam of the shore cliffs. Highly sensitive habitats are located in the northern parts starting at the shoreline, including the shore cliff, exposed sand dunes, and semi-stabilized sandy areas. Habitats with a relatively low sensitivity are located in the southern parts and include a disturbed area near the cliff, areas used as dumps, and roadside verges. Acacia saligna and Heterotheca subaxillaris are visibly spreading over these areas. The plan's area contains building in the south on the open spaces of the Sharon Park in the north and east.

Conclusion: This plan's area is highly sensitive; most low-sensitivity areas are inside or adjacent to sensitive areas so the useable area is relatively limited.

Nahal Alexander alternative

This alternative is located in an area with both sandy habitats and moist habitats. Vegetation in this varied area includes rare species. High-quality areas are located south of the service road leading to the river. Between this road and Road 2 there is a strip of disrupted habitats with high prevalence of alien and native invasive species. The plan's area contains built up areas to the north and Road 2 in the east. Nahal Alexander and the estuary sand dunes are to the south.

Conclusion: Located in disturbed area directly adjacent to roads and highways. No harm is expected to natural assets or the moist habitats. Keeping a distance from the river will prevent disturbance in the portion of corridor that runs alongside the river.

Neurim alternative

Most of the area in this alternative is disturbed by existing land uses. We assume that the station will be built in this area. The plan's environment is built up and therefore has low value.

Conclusion: No harm is expected to ecosystems and natural assets. There is no impact on the ecological corridor compared with current conditions.

Table 2.1.5-e below summarizes the ecological aspects of the coastal entry alternatives.

Table 2.1.5-E.1: Summary of receiving station evaluation

Subject	Criterion	Dor	Hadera	Michmoret	Alexander	Neurim	Conclusion
Natural resources	**Range of ecological impact of the facility in each alternative**	Located in a sensitive region. In the inactive fish farms, relatively limited impact	Located in a sensitive region. Some impact on the sandy areas is possible where animal activity has been observed	Located in a sensitive region. Some impact on habitats in this region is possible, which include sandy areas and a park forest.	Located in a sensitive region. Adhering to the local road grid and distancing from the river can reduce impacts.	Region is not sensitive. No impact is expected	Neurim alternative is clearly preferable. No significant differences between the remaining alternatives
	Degree of harm to the various habitats, natural assets, activity areas	Agricultural areas, including fish farms, and disturbed areas. No harm is expected to sensitive habitats.	Located in areas with stabilized sand and invasive vegetation. No harm is expected to sensitive habitats.	Located in areas with stabilized sand and invasive vegetation. Some harm is expected to sensitive habitats.	Located in wasteland containing invasive vegetation. No harm is expected to sensitive habitats.	Disturbed, damaged area. No harm is expected to natural assets.	Neurim alternative is clearly preferable (also compared with Dor alternative).
Contiguity and	**Relation to ecological**	Within a national corridor	Not within national corridor	Partly overlaps the national	Mostly overlaps the national corridor	Partly overlaps the national	Hadera alternative preferable

Subject	Criterion	Dor	Hadera	Michmoret	Alexander	Neurim	Conclusion
sensitivity of open spaces	**corridor**			corridor		corridor	
	The facility compromises contiguity (segmentation)of open spaces.	No fragmentation expected Contiguity will be somewhat reduced.	Fragmentation not expected in a developed area (existing routes) so not expected to impact contiguity.	No fragmentation expected, but some impact on contiguity is possible.	Fragmentation not expected (existing access routes) Positioning between road systems prevents compromising high-quality contiguous expanses	Fragmentation not expected. Does not overlap a contiguous stretch of open spaces.	Alternatives that are directly adjacent to development with access routes Neurim, Hadera, and Michmoret.
Summary of evaluation							Neurim is the preferred alternative. No significant differences between the remaining alternatives. Some impact is possible in each of them so they were all ranked medium feasibility. It seems that in

Subject	Criterion	Dor	Hadera	Michmoret	Alexander	Neurim	Conclusion
							Michmoret the available space is more limited, and potentially more complex. In Dor the area is relatively homogeneous allowing greater flexibility.

Comparing alternatives for the pipeline to the treatment facility.

1. General

Transmission line alternatives to the treatment facility were examined on two primary parameters:

a. Sensitivity of areas that the route traverses as defined in Chapter 1. The analysis also considered the fact that some disturbance would remain also after works are completed, due to the need for a maintenance road along the route.

b. Road length – In principle, a shorter route is preferable. However, route length must be examined mainly in view of the areas' sensitivity. Consequently, a short route that passes mostly through sensitive areas is not preferable to a longer route that passes through low-sensitivity areas.

In addition, there is a potential option to locally reduce impact by laying the pipeline in the subsoil in highly sensitive habitats such as Kurkar ridges.

A further parameter that was evaluated was whether the alternatives are located within an ecological corridor. In this respect, the potential impact of a buried pipeline is relatively low; fragmentation or blocking of the route is not expected and animal passage is not expected to be compromised. Most of the impact is expected during establishment of the facility. Therefore, this aspect is also included in the analysis although it is of lesser importance.

2. Evaluating the alternatives

The Dor array

<u>Dor</u>

The pipeline first crosses the Kurkar ridge followed by agricultural land with relatively low value. Removal of the treated gas from the site relies on the existing route and does require an additional eastward route.

Ecological corridors: passes through the outskirts of the coastal corridor.

Conclusion

<u>Disadvantages</u>: Crosses the Kurkar ridge (the ridge is partially disturbed due to mining in the past).

<u>Advantages</u>: Minimal harm, passes through agricultural land, short route, no need for a transmission line to the east.

<u>Ein Ayala</u>

The pipeline first crosses the Kurkar ridge then agricultural land with relatively low value. Removal of the treated gas from the site relies on the existing route and does require an additional eastward route.

Ecological corridors: passes through the outskirts of the coastal corridor.

Conclusion

Disadvantages: Crosses the Kurkar ridge (the ridge is partially disturbed due to mining in the past).

Advantages: Minimal harm, passes through agricultural land, short route, no need for a transmission line to the east.

Hagit East

The pipeline to Hagit has two alternatives (northern and southern) which split off south of Ofer Forest. Both alternatives cross the eastern Kurkar ridge at Dor and continue on through forest and woodlands on the Carmel ridge. These alternatives pass through areas that are ecologically highly sensitive, containing multiple natural assets including mature trees (dozens and hundreds of years old), wildflower blooms, and natural habitats. The route's impact in the western part, in the woodland areas, is expected to be significant because of its slow rate of rehabilitation, and the need for a service road that crosses the area. Of the two, the northern alternatives passes through a greater percentage of natural ground. Conversely, the southern alternative has been drawn over agricultural land and is therefore preferable.

Ecological corridors: both alternatives pass through the coastal corridor and the Carmel ridge corridor over most of their length.

Conclusion

Disadvantages: Significant harm to sensitive habitats, long routes, preference for the southern alternative.

Ranking for the Dor array: Preference for the Ein Ayala and Dor alternatives.

Hadera-Neurim array

Hadera WWTP

Route from Nahal Hadera array – passes through sensitive sandy areas mostly from the shore and up to Road 4. The alternative crosses dunes, semi-stabilized sand, and stabilized sand. These grounds are part of the Sharon Park and they contain many unique plant forms. The sandy areas in Heftziba are an important site for the butterfly Apharitis cilisae.

Conclusion

Disadvantages: Passes through dunes and sandy areas, crosses the Kurkar ridge, potentially harmful to natural assets, and to rare and protected species.

Advantages: Relatively short passage through sandy areas, planned on the verges of the sand block.

Route from Michmoret array – Long route through ecologically highly sensitive areas, mostly within the Sharon Park boundaries. Passage through variety of sensitive habitats – sand, Kurkar, wetlands, vernal pools. Many natural assets are located along the route. These include wildflower blooms, rare red plant species, and animal activity. Requires passage through Heftziba dunes.

Ecological corridors: the entire route passes through a corridor.

Conclusion

Disadvantages: Passes through sensitive areas, relatively long passage, harmful to natural assets, potential long-term harm.

Route from Nahal Alexander array – Impact is similar to that of the line from Michmoret station. Limited passage through sensitive sandy areas because the route lies on the outskirts of the block. Passage through the Sharon Park is similar to that of the Michmoret alternative. Requires passage through Heftziba sandy areas.

Ecological corridors: the entire route passes through a corridor.

Conclusion

Disadvantages: Passes through sensitive areas, relatively long passage, harmful to natural assets, potential long-term harm.

Ranking Hadera WWTP pipeline to the treatment facility – The preferred alternative is the one exiting the coastal receiving station at Nahal Hadera. This is the preferred alternative due to its location on the edge of the sandy areas and the relatively short passage. The southern alternatives exiting the Michmoret and Nahal Alexander station do not prevent harm to sensitive areas in the Nahal Hadera area (e.g. Heftziba dunes) and require passage through longer stretches of land. This makes them significantly inferior choices.

Meretz WWTP

The most sensitive areas are located between the coastal area and Road 4. Consequently, a route that minimizes harm to these areas and avoids crossing unique habitats and centers of natural assets is a preferable choice.

Route from Nahal Hadera

Northern alternative

The longest line, starting in the coastal sandy areas of Nahal Hadera, crosses the Kurkar ridge in Heftziba and continues a further 5 km south up to the connection with the southern lines at Michmoret station.

Long passage through ecologically highly sensitive areas, mostly within the Sharon Park boundaries. Passage through diverse sensitive habitats – dunes, Kurkar, wetlands, vernal pools. Many natural assets are located along the route. These include wildflower blooms, rare red plant species, and animal activity.

After crossing Road 2, there are two sub-alternatives. Both are inferior due to the need to cross further grounds in the Sharon Park, sandy areas, and the Breichat Yaar area. If drilling an underground passage is possible, then the northern alternative has a certain advantage because of the shorter segment on the southern boundary of Hadera forest.

Ecological corridors: the entire route passes through a corridor.

<u>Southern alternative</u>

The longest line, starting in the coastal sandy areas of Nahal Hadera, crosses the Kurkar ridge in Heftziba and continues a further 5 km south up to the connection with the southern lines at Michmoret station. Long passage through ecologically highly sensitive areas, mostly within the Sharon Park boundaries. Passage through diverse sensitive habitats – dunes, Kurkar, wetlands, vernal pools. Many natural assets are located along the route. These include wildflower blooms, rare red plant species, and animal activity. The route crosses highly sensitive areas in the Sharon Park which contains a unique variety vegetation. The passage south along the railway tracks, west of the Emek Hefer industrial zone, is largely through cultivated land which is less sensitive. In addition, the areas along Nahal Alexander and eastward have a low sensitivity.

Conclusion

<u>Northern alternative</u>

<u>Disadvantages:</u> Crosses diverse sensitive habitats which include dunes, Kurkar ridge, wetlands and moist habitats. Potential harm to a variety of ecosystems and rare red plant species. A substantially long pipeline of which a significant portion passes through sensitive habitats.

<u>Southern alternative</u>

<u>Disadvantages:</u> Passage through diverse sensitive habitats which include dunes, Kurkar ridge, and potential harm to a variety of ecosystems and rare red plant species. A substantially long pipeline of which a significant portion passes through sensitive habitats.

<u>Advantages</u>: Crossing the Breichat Yaar area is avoided, connects to Nahal Alexander in low-sensitivity areas.

Route from Michmoret

Northern alternative

This alternative has two sub-alternatives (southern and northern), both for crossing the Sharon Park west of Road 2 and for crossing the areas east of Road 2. The alternatives cross forest and grassy dwarf shrub steppe. There is a variety of species in this habitat with a relatively large proportion of rare red species. The northern alternative also passes partly through the coastal sands habitat.

Neither one of the secondary alternatives has a significant advantage over the other. It may be possible to lay the southern alternative over the existing dirt road and localized low-sensitivity areas (areas overtaken by Heterotheca subaxillaris). If drilling an underground passage is possible, then the northern alternative has a certain advantage because of the shorter segment on the southern boundary of Hadera forest.

Ecological corridors: The entire northern route passes through a corridor, and the northern route partially. Partial passage under northern alternative.

Southern alternative

This alternative has two secondary alternatives for crossing Road 2. Both alternatives pass through Sharon Park in which there are highly valuable ecosystems. Of the two, the northern alternative results in harm to a greater variety of habitats which also include sandy areas. In addition, its route through the park is longer so the potential for harm is greater too. The southern alternative contains partially disturbed areas, disrupted by the invasive species Heterotheca subaxillaris. It may be possible to chart some of the route through these areas. The passage south along the railway tracks, west of the Emek Hefer industrial zone, is largely through cultivated land which is less sensitive. In addition, the areas along Nahal Alexander and eastward have low sensitivity.

Conclusion

Northern alternative

Disadvantages: Passage through the heart of the Sharon Park, both west and east of Road 2. Crosses high-sensitivity areas containing many natural assets. Crossing takes a relatively long route.

Southern alternative

Disadvantages: Crosses Sharon Park and potential harm to sensitive habitats and natural assets.

Advantages: Passage through Sharon Park is relatively limited. Does not require crossing sandy areas and moist habitats in the Breichat Yaar area. Connection to the Nahal Alexander alignment passes through low-sensitivity areas.

If drilling an underground passage is possible without compromising Sharon Park grounds, then the southern alternative has an advantage.

Route from Nahal Alexander

Northern alternative

Pipeline exiting the coastal receiving station and passing very close to the Nahal Alexander bank throughout its length. Sensitivity of the sandy areas close to the river is lower due to the presence of land uses (hiking routes, eucalyptus grove, seaweed manufacturing plant) which affect local vegetation. The Kurkar ridge crossing area (Hirbat Samara) is relatively sensitive due to the narrowness of the strip between the ridge and the river. As the pipeline route extends north, it passes through highly ecologically valuable land in the Breichat Yaar area.

Southern alternative

Pipeline exiting the coastal receiving station and passing very close to the Nahal Alexander bank throughout its length. The route does not pass through sensitive areas of the dune park. Sensitivity of the sandy areas close to the river is lower due to the presence of land uses (hiking routes, eucalyptus grove, seaweed manufacturing plant) which affect local vegetation. The Kurkar ridge crossing area (Hirbat Samara) is relatively sensitive due to the narrowness of the strip between the ridge and the river. After crossing this strip the route passes almost exclusively through agricultural land, except for river-crossing areas.

Ecological corridors: the entire route passes through a corridor.

Conclusion

Northern alternative

Disadvantages: Requires passage through areas of high ecological value – Breichat Yaar, and crossing the Kurkar ridge and Nahal Alexander. Relatively long route.

Southern alternative

Disadvantages: Crosses the Kurkar ridge, crosses Nahal Alexander.

Advantages: Crosses relatively low-sensitivity areas, relatively short crossing, most of the routes passes through agricultural land, passes on the outskirts of the dune park on the outside.

Route from Neurim

The pipeline exist Neurim facility and passes along agricultural land and wasteland which have a low ecological value. North of the nature reserve are some agricultural installations; the pipeline route connects to the Nahal Alexander alternative at Hefer junction.

Ecological corridors: on its west the route is located outside the ecological corridor, and on its east within the boundaries of the corridor that passes through Hefer valley and Nahal Alexander.

Conclusion

Disadvantages: Crossing in the Bitan Aharon nature reserve area.

Advantages: Outside the sensitive dunes, most of the route lies in agricultural land, probably no need to cross into the nature reserve.

Relative ranking of the Meretz array:

In both cases the southern alternatives are preferred: Nahal Alexander alternative, and Neurim alternative. Of the two, Neurim has some advantage as it is located exclusively on agricultural land, and assuming it is possible to cross the Kurkar ridge at Bitan Aharon without compromising any natural assets. If a solution can be found to minimize the harm to the Hirbat Samara area in the Nahal Alexander alternative then the difference between the two is negligible.

Another potential possibility is the southern-most route of the Michmoret alternative which crosses a relatively short segment of the Sharon Park. As noted, if the pipeline can be laid underground then this has a higher preference. All the alternatives that require passage through the Sharon park grounds east of Road 2 are inferior compared with the other alternatives.

Evaluation of the alternatives after taking steps to avoid compromising sensitive areas

In principle, there is an option to cross sensitive areas underground by horizontal drilling. The area required to conduct the drill is relatively limited and mainly contains space for deploying the pipe and inserting it into the borehole.

We assume that the width of a dirt road is sufficient for this type of drilling.

Crossing the most sensitive areas (coastal area and the Sharon Park) will require drilling 1.5 km to 2.5 km, depending on the alternative. If necessary, several continuous drills must be conducted with entry and exit in locally disturbed areas.

If this technology is indeed feasible in each of the alternatives, and if the space required to implement it is very limited, then several additional alternatives become highly feasible: Nahal Hadera alternatives, Michmoret alternatives, and Nahal Alexander alternatives.

**We recommend that implementing alternatives that are have not scored high on feasibility should be contingent on applying this technology. This includes Hagit East (although feasibility is unknown).*

Table: 2.1.5-E.2 Summary of pipeline corridor evaluation from coastal entry to the treatment site

a	Dor	Ein Ayala	Hagit		Hadera WWTP			Meretz WWTP							Conclusion
			Northern route	Southern route	From coastal entry at Hadera	From coastal entry at Michmoret	From coastal entry at Nahal Alexander	From coastal entry at Hadera		From coastal entry at Michmoret		From coastal entry at Nahal Alexander		From Neurim coastal entry	
								Northern alternative	Southern alternative	Northern alternative	Southern alternative	Northern alternative	Southern alternative		
	Woodlands not compromised. Relatively limited harm in the fish-farm and Kurkar ridge areas.	Woodlands not compromised. Relatively limited harm in the fish-farm and Kurkar ridge areas.	Significant harm to habitats of the Mediterranean woodlands. Crosses the Kurkar ridge,	Significant harm to habitats of the Mediterranean woodlands. Crosses the Kurkar ridge,	Relatively limited harm	Major harm to very high-quality areas	Major harm to very high-quality areas	Major harm to very high-quality areas	Major harm to very high-quality areas	Major harm to very high-quality areas	Major harm to very high-quality areas	Major harm to very high-quality areas	Limited harm to sensitive areas	Limited harm to sensitive areas	Preferred alternatives are Dor, Ein Ayala and Neurim. Second preference to the Nahal Alexander alternatives (southern) for Meretz WWTP, and Nahal Hadera for Hadera WWTP.

a	Dor	Ein Ayala	Hagit		Hadera WWTP			Meretz WWTP							Conclusion
			Northern route	**Southern route**	**From coastal entry at Hadera**	**From coastal entry at Michmoret**	**From coastal entry at Nahal Alexander**	**From coastal entry at Hadera**		**From coastal entry at Michmoret**		**From coastal entry at Nahal Alexander**		**From Neurim coastal entry**	
								Northern alternative	**Southern alternative**	**Northern alternative**	**Southern alternative**	**Northern alternative**	**Southern alternative**		
h of -	Limited impact. Utilizes existing transmission pipeline	Limited impact. Utilizes existing transmission pipeline	Most of the route passes through sensitive habitats. Significant impact. Slow recovery in the woodland areas	Most of the route passes through sensitive habitats Significant impact. Slow recovery in the woodland areas	Relatively short route also in sensitive areas	Long route which crosses sensitive areas	Long route which crosses sensitive areas	Long route which crosses sensitive areas	Long route which crosses sensitive areas	Relatively long passage through sensitive areas	Relatively long passage through sensitive areas	Relatively long passage through sensitive areas	Relatively short passage through sensitive areas	Shortest route through sensitive area	Preferred alternatives are Dor, Ein Ayala and Neurim. Second preference to the Nahal Alexander alternatives (southern) for Meretz WWTP, and Nahal Hadera for Hadera WWTP.
ses	Partial, In the coastal area	Partial, In the coastal area In the coastal area	Most of route In the coastal and Carmel ridge areas	Most of route In the coastal and Carmel ridge areas	Partial under northern alternative. Entire	Entire length	Entire length	Entire length	Entire length	Partial under northern alternative.	Partial under northern alternative. Entire	Partial under northern alternative. Entire	Entire length	Partial	Some preference for the routes partially located in the corridor

a	Dor	Ein Ayala	Hagit		Hadera WWTP			Meretz WWTP							Conclusion
			Northern route	Southern route	From coastal entry at Hadera	From coastal entry at Michmoret	From coastal entry at Nahal Alexander	From coastal entry at Hadera		From coastal entry at Michmoret		From coastal entry at Nahal Alexander		From Neurim coastal entry	
								Northern alternative	Southern alternative	Northern alternative	Southern alternative	Northern alternative	Southern alternative		
					length under southern alternative					Entire length under the southern sub-alternative	length under the southern sub-alternative	length under the southern sub-alternative			
	High	High	Low	Low	Medium (if HDD is possible until after Road 4, then high)	Low	Low	Low	Low	Low (if HDD is possible until after Road 4 then high)	Low (if HDD is possible until after Road 4 then high)	Low (if horizontal drilling is possible until after Road 9 then high)	Medium (if HDD is possible until after crossing Hirbat Samara area then, high)	High	Neurim alternative is clearly preferable. For Hagit - the southern alternative preferred over the northern. As noted, using underground drilling technology improves all the

a	Dor	Ein Ayala	Hagit		Hadera WWTP			Meretz WWTP							Conclusion
			Northern route	Southern route	From coastal entry at Hadera	From coastal entry at Michmoret	From coastal entry at Nahal Alexander	From coastal entry at Hadera		From coastal entry at Michmoret		From coastal entry at Nahal Alexander		From Neurim coastal entry	
								Northern alternative	Southern alternative	Northern alternative	Southern alternative	Northern alternative	Southern alternative		
															alternatives and can significantly reduce the extent of harm.

Comparing exploration zone alternatives for a treatment facility

Dor North

Fauna and flora

Intensive agricultural activity is ongoing in the plan's range. There are no natural habitats so the plan is not expected to compromise natural assets. There is agricultural activity and a large industrial installation in the plan's surroundings. Sensitive habitats are relatively distant and are not expected to be affected by activities at the facility.

Ecological corridors

No impact is expected on national corridors and local passes. The examined range is directly adjacent to existing infrastructure and therefore does not create new fragmentation in contiguous cells, and does not create a barrier to movement of fauna.

Ein Ayala

Fauna and flora

This site is an active quarry with no ecosystem. Most of the areas are disturbed except for a remaining portion of the ridge on the west where local flora can be found. On the site's eastern boundaries are several plant formations such as planted forest and woodlands. Due to the its low position in the quarry, margin effects on the areas outside the plan range are expected to be very limited. No harm is expected to natural assets and ecosystems at this site.

Ecological corridors

The site is located on the outskirts of a national corridor which passes along the Carmel. Its currently disturbed, dysfunctional state and its position within the national ecological corridor on its outskirts, adjacent to national infrastructure, mean that no impact on corridor function is expected compared with the current situation.

Hagit

Fauna and flora

Habitats in the examined range support very diverse plant and animal species. The main habitat in this alternative's perimeter is grassy dwarf shrub steppe. The cells directly adjacent to the station and those hedged between the agricultural utilities are highly disturbed and exposed to grazing pressure. It is likely that intensity of endemic animal activity is lower in these areas. As one moves eastward, value increases and the expected harm is significantly greater. Areas to the south, down the slopes of Nahal Tut valley are high-value assets; development here may lead to material harm to animal and plant species. As it is located in the percolation and recharge zone of the Hagit and Tut springs, the Hagit alternative may have an impact on the springs' discharge. Drying out the springs or compromising their discharge can have a material impact on the river ecosystem and on endangered species populations.

<u>Ecological corridors</u>

This alternative is mostly outside the defined boundaries of the national ecological corridor. At the same time, plan area is in mountain gazelle terrain; the existing corridor is the only place in the region where the Carmel and Ramot Menashe populations can connect. The species has been observed within the alternative's boundaries so it can be reasonably assumed that the area serves as an activity and passage site. The alternative's impact on corridor function will be most significant in the eastern and southern grounds. The western cells are enclosed by surrounding infrastructure and do not create fragmentation or obstruct areas of activity, so they are expected to have a lesser effect. At the same time, margin effects (such as lighting), even if relatively limited, may disturb the gazelle population so their impact is greater here than in other areas.

Hadera

<u>Fauna and flora</u>

There are no natural habitats in the examined range except for Kurkar hills/ or a tel site on the eastern outskirts. Most of the land in this alternative is cultivated, the Kurkar hills are grazed. We assume that there will be no development in the hills so no direct harm to natural assets (including local plant and animal species) is expected. In addition, east of the plan is the Nahal Rushrashi gulley, which serves as a local passage.

Significant margin effects are possible if the site is located near Nahal Hadera.

<u>Ecological corridors</u>

This alternative is located within the boundaries of an ecological corridor along Nahal Hadera and the surrounding areas. The junction and transition points of several landscape units and habitats fall within this plan's range so it is important to maintain contiguity as far as possible. Placing the site near the river may disrupt the corridor to a greater degree so it is preferable to establish it directly adjacent to the existing WWTP in the citrus orchards to the east.

Meretz WWTP

<u>Fauna and flora</u>

The proposed alternative is located in a perimeter with low ecological value, mostly used for growing crops. In the south-west of the examined area are the moist habitats of Nachal Ometz, which are highly disturbed due to agricultural land use. There are moist habitats that rely on the reservoir system and fish farms along Nahal Alexander, which passes through the area. The principal of these is the fish pond site at Kfar Hahoresh, which sustains a moist habitat and is planned to become an ornithological center.

As noted, the site is not expected to physically harm habitats, and margin effects with an emphasis on lighting can be mitigated by various means so that they are confined to a relatively limited area.

Ecological corridors

The site is located within a national ecological corridor. The site's relative proximity to Nahal Alexander, which is an important passage in this corridor, and the agricultural-rural character of the area, may result in some impact mainly due to lighting. However, the site is directly adjacent to an existing installation, and if it is moved north of the existing installation (or within its perimeter) then the expected impact will be minimal. It is also possible to examine light-reducing measures so its impact is reduced.

Table 1.2.1.5-E.3 Summary ecological evaluation of treatment facility alternatives

Subject	Criterion	Dor	Ein Ayala	Hagit	Hadera WWTP	Meretz WWTP	Conclusion:
Natural resources	**Range of facility's ecological impact in each alternative**	Limited impact on agricultural habitats which are less sensitive	Limited impact that is not expected to go further than the site boundaries	Significant impact on dwarf shrub steppe and moist habitats. Potential impact on springs.	Limited impact on agricultural habitats which are less sensitive. Some impact is possible on ornithological sites in the vicinity	Limited impact on agricultural habitats which are less sensitive. Some impact is possible on ornithological sites in the vicinity	The preferred alternative is Ein Ayala followed by Dor North. Hadera and Meretz alternatives are less preferable, with no significant difference between the two. The Hagit alternative is inferior and its ecological impact is significant compared with the other alternatives.
	Degree of harm to diverse habitats, natural assets, and activity areas	Agricultural land - no natural habitats are compromised.	Disturbed quarry area - No harm is expected to natural habitats.	Dwarf shrub steppe areas - harm is expected to natural habitats of high value	Agricultural land and Kurkar hill - Some harm is possible to moist habitats around the fish farms.	Agricultural land - no natural habitats are compromised	The preferred alternative is Ein Ayala followed by Dor North. Hadera alternative has a wider variety of habitats, and is therefore somewhat inferior compared with the Meretz alternative. The Hagit alternative is inferior and its ecological impact is significant compared with the other alternatives.
		No harm is expected to natural assets such as unique plants, trees, and animal activity grounds.	There are no unique natural assets in the quarried area.	Harm to rare and protected plant species and some animal species is possible.	Moist habitat plant species around the fish farms including rare species. Possible presence of protected and rare plant species on the Kurkar hills	No harm is expected to natural assets such as unique plants, trees, and animal activity grounds.	The preferred alternative is Ein Ayala followed by Dor North. Hadera alternative has a wider variety of habitats and plant species, and is therefore somewhat inferior compared with the Meretz alternative.

Subject	Criterion	Dor	Ein Ayala	Hagit	Hadera WWTP	Meretz WWTP	Conclusion:
							The Hagit alternative is inferior and its ecological impact is significant compared with the other alternatives.
Contiguity and sensitivity of open spaces	**Relation to ecological corridor**	Outside the ecological corridor.	On the outskirts of the corridor in a disturbed area	Partly overlaps the national corridor.	Overlaps the national corridor in the agricultural-urban space	Overlaps the national corridor in the agricultural-rural space	The preferred alternative is Ein Ayala followed by Dor North. The Hadera alternative is located in an area with urban influences so to a certain extent it is preferable to the Meretz alternative, for this consideration.
	Fragmentation of the open spaces by the facility	Does not create new fragmentation	Does not create new fragmentation	There is an important animal pass and spatial corridor in the area.	Does not create new fragmentation	Does not create new fragmentation	The preferred alternative is Ein Ayala followed by Dor North. Hadera and Meretz alternatives are less preferable, with no significant difference between the two. The Hagit alternative is inferior and its ecological impact is significant compared with the other alternatives.
Conclusion		**Medium**	**High**	**Low**	**Medium**	**Medium**	

Transmission system from the treatment site to the national system

Dor North, Ein Ayala, and Hagit East

Treated gas from the treatment facility arrives at the existing gas system over the existing route and there is no need to locate an additional route.

Hadera WWTP

From Hadera WWTP the treated gas goes east via the two alternatives (northern and southern) as described in Section 2.1, above.

Northern route

The route through Hadera east interchange (Dameira marshes) northward will require crossing high-value moist habitats with a large variety of species including rare red species. Passage through the red loam around Pardes Hannah, with relatively low value, but unique vegetation may be present in the wasteland. In addition, there are old-growth trees in these areas such as individual Tabor oak.

Ecological corridors: The northern alternative lies outside the corridor on its east, in the Gan-Shmuel area.

Southern route

Passage through low-value agricultural land parallel to Nahal Hadera. This alternative is somewhat preferable as it avoids crossing moist habitats in the area of Hadera east interchange. This alternative crosses several secondary gullies that drain into Nahal Hadera but this is not expected to harm them.

Ecological corridors: The southern alternative passes entirely through the Nahal Hadera corridor.

Meretz WWTP

The route exiting Meretz WWTP passes along agricultural land and does not compromise natural assets and natural ecosystems.

Ecological corridors: The entire length of the route is located within the national ecological corridor which passes along Nahal Alexander.

Comparing the alternatives

The gas pipeline is a buried line. Consequently, it is not expected to compromise ecological corridors and animal passage. Some disruption may occur while work is ongoing, resulting in harm to unique habitats and natural assets. Moist habitats and rare species in the area of the Dameira pond may be harmed; the alternative passes partly through red loam habitats where rare species may potentially occur.

Table 2.15-E.4 Summary of ecological evaluation of pipeline alternatives from the treatment facility eastward

Subject	Criterion	Dor North	Ein Ayala	Hagit East	Hadera WWTP		Meretz WWTP	Conclusion
					Northern alternative	Southern alternative		
Natural resources	**Harm to sensitive habitats**	Treated gas from the treatment facility is delivered to the existing gas system and there is no need to lay an additional route			Harm to moist habitats, potential harm to red loam vegetation, will require relocating protected mature trees	Passes through agricultural land where there are no natural habitats or natural assets	Passes through agricultural land where there are no natural habitats or natural assets	Hadera northern alternative is inferior
	Road length and width of burial strip - general evaluation				Relatively long route including sensitive habitats	Relatively long route over agricultural land	Relatively short route through agricultural land	The Meretz alternative has some advantage due to the shorter distance, although there is no difference in ground features compared with the Hadera south alternative.
Open spaces	**Ecological corridors** **(passes through corridor)**				Partial	Entire length	Entire length	Some preference for the northern Hadera route which is partially located in the corridor

Subject	Criterion	Dor North	Ein Ayala	Hagit East	Hadera WWTP		Meretz WWTP	Conclusion
					Northern alternative	Southern alternative		
Conclusion:	**Feasibility**				Medium (if HDD is possible until after Road 4, then high)		Low (if HDD is possible until after Road 4, then high) Medium (if HDD is possible until after crossing Hirbat Samara area, then high)	Hadera northern alternative is inferior compared with the other two alternatives. Hadera southern alternative and Meretz alternative are highly feasible. As noted, the Meretz alternative is shorter but as the infrastructure will be buried, the difference is negligible.

- **Sedimentological aspects**

The sedimentological comparison of the alternatives relates to the coastal entry systems and is described in detail below:

Regarding sand movement, both on and offshore (perpendicular to the shore), and parallel to the shore, there is no difference between the Neurim and Dor beach alternatives. The distance between the southern alternative (Neurim) and the northern alternative (Dor) is only 25 km, so the wave climate at all points is almost identical and the change in the azimuth of the beach is also small.

Dor

There is a gas pipe coastal entry at the site, inserted using a method that is identical to HDD. After several years in place the pipe's impact on sediment balance is absolutely imperceptible. According to information received from the offshore pipe maintenance engineer,[19] the existing pipe is not exposed along any part of the horizontally drilled segment. High score.

Nahal Hadera

Also at this site there is a gas-pipe coastal entry which so far has not shown any sedimentological impact on this environment. However, the likelihood of this pipe becoming exposed is higher due to the site's proximity to the water outlet from the power station. Water flows into the sea above the pipeline route, so the possibility of the pipe becoming exposed does exist (note that an exploratory dive along the pipe in the summer of 2012 found no evidence of sand wash along the existing coastal entry pipe). Medium score.

Michmoret

There is insufficient information about the impact of HDD on the surface while work is ongoing. At this site, even the slightest effect can increase collapse of the nearby Kurkar ridge which is in a "near collapse" state. Low ranking

Nahal Alexander

It is possible, although less likely than at Nahal Hadera, that during exceptional flooding in Nahal Hadera, river water will flow above the pipe and the pipe will be exposed. Medium ranking

Neurim

The information for Michmoret can be quoted here – There is insufficient information about the impact of HDD on the surface during work. At this site, even the slightest effect can increase collapse of the nearby Kurkar ridge which is in a "near collapse" state. Low ranking

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[19] Information provided by Engineer Avri Shefler, member of the planning team and responsible also for maintenance of the offshore pipe.

F. Air pollution

The preferred receiving station site alternative was selected by comparing the 4 location alternatives as defined in Chapter 1 Section A.4. Each alternative was modeled for the following pollutants: nitrogen oxides, phosphorus dioxide, and benzene (using the AERMOD model for pollutant dispersion) defined by the Ministry of Environmental Protection. In selecting a preferred alternative the following factors were used to compare the alternatives (referred to as Comparison Factors):

(1) An area with pollutant concentrations that exceed the thresholds (based on the model results).

(2) Calculated maximum concentrations (excluding the illustration of nitrogen oxide (NO_X)point emissions and vehicle emissions in which the models produce unrealistically high results).

(3) Residential areas according to the assigned land use and land use map, shown in Figure 2.1.5-6, in which threshold values were exceeded.

Model results were compared for the following scenarios:

- Nitrogen oxide (NO_x) point emissions and vehicle emissions.
- Nitrogen oxide (NO_x) point emissions only.
- Phosphorus dioxide (SO_2) point emissions only.
- Benzene emissions from vehicles only.

Alternatives were ranked based on comparison of areas that exceeded the thresholds, calculations of maximum concentrations, and residential areas in which threshold values were exceeded. Ranking results are shown in Table 2.1.5-6.

Alternative were ranked based on a quantitative Excel model, developed by a professional consultant, for selecting the preferred receiving station site. Possible associations between the various comparison factors that were identified during this work are shown in Table 2.1.5-6. The comparison factors shown above were converted into quantitative information using a model. Each comparison factor was scored for its potential contribution to selection of the preferred alternative, and this was translated into a qualitative preference: (3) high; (2) medium; (1) low.

Table 2.1.5-F: Alternatives compared based on comparison factors

Alternative		Dor North and Ein Ayala		Hadera		Meretz WWTP		Hagit site	
Comparison factor	**Threshold**	**Result**	**Rank**	**Result**	**Rank**	**Result**	**Rank**	**Result**	**Rank**
NO_x - Area									
Area that exceeds the threshold for NO_x [square km]	Environmental value converted to hourly value - 818 microgram/m³*	136.9	2.	71.5	3	182.5	1	136.1	2
	Daily environmental value - 560 microgram/m³	10.25	1	0.64	3	5.13	2.	5.52.	2.
Residential Area - NO_x									
Residential areas in which NO_x threshold values were exceeded [square km]	Environmental value converted to hourly value - 818 microgram/m³*	5.60	3	9.46	2	23.10	1	4.27	3
	Daily environmental value - 560 microgram/m³	0.87	1	0.04	3	0.5	2.	0.24	3
NO_x - Point Emissions Area									
Area exceeding the threshold for NO_x from point emissions only [square km]	Environmental value converted to hourly value - 818 microgram/m³*	0	3	0.004	3	0.022	1	0	3
	Daily environmental value - 560 microgram/m³	Not exceeded							
Residential areas in which NO_x threshold values for point emissions only were exceeded [square km]	Environmental value converted to hourly value - 818 microgram/m³*	Not exceeded							
Results - NO_x point emissions									
Calculated maximum concentrations for NO_x point emissions only	Half-hour environmental value - 940 microgram/m³	343.5	3	1013	1	1159	1	471.2	3
	Daily environmental value - 560 microgram/m³	Not exceeded							
Area - SO_2									
The area that	Hourly environmental	0.17	3	5.6	2	9.51	1	0.47	3

Alternative		Dor North and Ein Ayala		Hadera		Meretz WWTP		Hagit site	
Comparison factor	**Threshold**	**Result**	**Rank**	**Result**	**Rank**	**Result**	**Rank**	**Result**	**Rank**
exceeds SO_2threshold [square km]	value - 350 microgram/m³								
	Target daily value - 20 microgram/m³	3.38	3	54.49	1	26.19	2	5.63	3
	Daily environmental value - 125 microgram/m³	0	3	0.11	1	0.11	1	0.005	3
	Annual environmental value - 60 microgram/m³	Not exceeded							
Residential area - SO_2									
Residential areas in which SO_2threshold values were exceeded	Hourly environmental value - 350 microgram/m³	0	3	0.25	3	2.03	1	0.001	3
	Target daily value - 20 microgram/m³	0.03	3	6.41	1	4.72	1	0.23	3
	Daily environmental value - 125 microgram/m³	SO_2 threshold values were not exceeded in the residential areas							
Results - SO_2									
Calculated maximum concentrations for SO_2	Hourly environmental value - 350 microgram/m³	449	3	2045	1	2341	1	972	3
	Target daily value - 20 microgram/m³	60.9	3	216	1	227.6	1	134.6	2
	Daily environmental value - 125 microgram/m³	Not exceeded							
Area - Benzene									
Area that exceeds benzene threshold [square km]	Target daily value - 3.9 microgram/m³	0.81	1	0.0004	3	0.98	1	0.07	3
	Annual target value - 1.3 microgram/m³	0.23	1	0	3	0.15	1	0.01	3
	Annual environmental value - 5 microgram/m³	Not exceeded							
Residential area - benzene									
Residential areas in which benzene threshold values were exceeded	Target daily value - 3.9 microgram/m³	0.19	1	0.0003	3	0.08	2	0.0003	3
	Annual target value -	0.05	1	0	3	0.03	2	0	3

Alternative		Dor North and Ein Ayala		Hadera		Meretz WWTP		Hagit site	
Comparison factor	**Threshold**	**Result**	**Rank**	**Result**	**Rank**	**Result**	**Rank**	**Result**	**Rank**
	1.3 microgram/m³								
Results benzene									
Calculated maximum concentrations for benzene	Target daily value - 3.9 microgram/m³	0.19	1	0.0003	3	0.08	2	6.4	2
	Annual target value - 1.3 microgram/m³	2.7	1	1.22	3	2.3	2	1.6	3
	Annual environmental value - 5 microgram/m³	Not exceeded							
Score summary			40		43		25		53
Rank of the alternative			**Medium**		**Medium**		**Low**		**High**

***The environmental value of 940 m³ meter was converted to 818 microgram/cubic meter using the formula listed in Chapter 1 of the survey.**

Based on the results of this study and as shown in Table 2.1.5-6 the preferred gas station alternative is the **Hagit alternative.** Note that in all alternatives at least one threshold was exceeded for the selected pollutants. The preferred alternative is the one that scored the highest and is the cleanest of all examined alternatives. At the same time, and as noted above, thresholds were exceeded also in this alternative.

Figure 2.1.5-F: Land uses and assigned land uses

G. Offshore and onshore antiquity and heritage sites

- Proximity to archeological and heritage sites

Alternatives were evaluated for this aspect in light of proximity to archeological sites as given in the antiquities layer from 2011, and heritage sites provided by the Council for Conservation of Heritage Sites in Israel in a conversation on September 13, 2012 and in writing on September 20, 2012 (listed in Section 1.9, above), as well as in comments to the Antiquities Authority, enclosed in Appendix D below.

Coastal entries

The coastal entry evaluation addresses antiquity sites and marine and coastal historic remains, as follows:

1. **Dor alternative** – The offshore strip passes through one of the most important and abundant sites of marine archeological finds; it contains ancient shipwrecks and cargo from the 4th century BC up to the Ottoman period. In addition to the legally declared and published antiquity sites, there are additional sites in the offshore corridor that are in the process of being declared. Low score.
2. **Hadera alternative –** south of Orot Rabin power station, multiple marine utilities, and low sensitivity as far as antiquity sites. The sensitive sites are located north of the power station. There are several declared sites in the offshore zone. Medium score.
3. **Michmoret and Nahal Alexander alternatives –** Several declared marine antiquity sites and a heritage site are present in this area. Medium score.
4. **Neurim alternative – The site borders on a marine antiquity site.** High score.

Pipeline to the treatment facility

Most of the proposed pipeline systems pass through antiquity sites; in the Heftziba area the pipeline is close to the Heftziba farm heritage site. The alternatives are ranked as follows:

1. **Dor North – t**he pipeline passes through several declared antiquity sites**;** there are no heritage sites around the route. Medium score.
2. **Ein Ayala –** the pipeline passes through several declared antiquity sites; there are no heritage sites around the route. Medium score.
3. **Hagit East** – this alternative has two secondary alternatives (southern and northern).There are several declared antiquity sites in both

alternatives; there are no heritage sites. Both alternatives score medium with a slight preference for the northern alternative.

4. **Hadera WWTP** – All the coastal entry pipelines pass through declared antiquity sites and through the heritage site at Heftziba farm. All alternatives score low with a slight preference for the Nahal Hadera route mainly due to the fact that it is shorter.

5. **Meretz WWTP –** This site has four pipeline alternatives from four different coastal entries. The routes from the Nahal Hadera, Michmoret, and Nahal Alexander coastal entries have 2 sub-alternatives (northern and southern). The southern option circles around Hefer valley from the north, and the southern continues south to Nahal Alexander and Meretz WWTP. The alternatives are ranked as follows:

    i. Route from Nahal Hadera – The pipeline passes through several declared antiquity sites in Caesarea and on Road 2; there are no heritage sites along the route. Both alternatives score medium.

    ii. Route from Michmoret – a limited number of antiquity sites both in the northern and in the southern alternatives; there are no heritage sites along the route. Both alternatives score high with a slight preference for the northern alternative.

    iii. Route from Nahal Alexander – A limited number of antiquity sites both in the northern and in the southern alternatives; there are no heritage sites along the route. Both alternatives score high with a slight preference for the northern alternative.

    iv. Route from Neurim – The alternative passes through a declared antiquity site near Bitan Aharon nature reserve, which contains rock-hewn tombs. Medium score.

Treatment facility alternatives

1. **Dor North** – There are no antiquity and heritage sites in the exploration zone. High score

2. **Ein Ayala** – there are no antiquity and heritage sites in the exploration zone. High score

3. **Hagit East – there are no heritage sites in the exploration zone.** There is a declared antiquity site in the exploration zone but it can be avoided by staying close to the western part of the zone. Medium score.

4. **Hadera WWTP –** there are no heritage sites in the exploration zone. There are declared antiquity sites in most of the eastern part of the exploration zone and outside Tel Zomera itself. Medium score

5. **Meretz WWTP** - there are no declared antiquity and heritage sites in the exploration zone. High score.

Pipeline alternatives from the treatment facility

1. **Dor North, Ein Ayala, and Hagit East** – Treated gas from the treatment facility arrives at the existing gas system and there is no need to locate an additional route.

2. **Hadera WWTP** – There are two pipeline alternatives for transmitting treated gas to the national transmission system (northern and southern). There are no heritage sites in either of the alternatives, and there are several antiquity sites in the pipeline area, with no special difference between the two alternatives. Medium score.

3. **Meretz WWTP** – There are several antiquity sites along the pipeline route and in the alternative's surveyed zone; there are no heritage sites along the route. Medium score.

Preventing and minimizing harm

In all alternatives it is possible to prevent/ minimize harm to antiquity sites by using HDD to insert the pipes into the subsoil. Building a cofferdam in the coastal entry – potential harm to the marine sites at the Dor alternative.

H. Facility integration in its surroundings in view of future land use and assigned land use

Evaluating the alternatives in view of land uses, and national, regional, and local outline plans. Alternatives that contain lower sensitivity land uses (further from land uses that are public receptors, as well as open areas, and environmentally significant natural assets), are preferable.

Note that when examining compatibility with assigned land use, incompatibility can be changed. A facility of national importance and urgency such as a gas treatment facility need not necessarily comply with the existing planning framework, as modifications are an option.

Treatment facility alternatives were also examined for immediate adjacency to other land uses. Alternatives that are directly adjacent to compatible land uses and/or other infrastructure facilities are preferable.

The planned gas transmission pipeline is underground. Its integration with land uses mainly refers to examining the need to place safety restrictions on existing land uses, immediate adjacency to existing and planned infrastructure, and reserved land, as described in Section 2.1.5-3, above. Consequently, this section evaluates pipeline alternatives compared with assigned land use only. For these aspects, alternatives were evaluated according to facility elements, as follows:

Coastal entry alternatives

Note that coastal entries are sensitive areas as they are defined and reserved as public leisure and recreation areas, due to their proximity to the offshore and beach environment. At the same time, the coastal entry impact is expected to be relatively small as the compound size is limited and mostly underground.

Table 2.1.5-1.H: The facility's integration into its surroundings, coastal entries

Criterion	Dor	Hadera	Michmoret	Nahal Alexander	Neurim
Compatibility with land uses	The block valve station in this area is planned in the fish farm area and is not expected harm to compromise current uses. Compatibility is high.	Near Hadera Park and the Hadera power station, in the dunes. Due to conflicting nature of these uses compatibility is medium.	Block-valve station in this area, north of Michmoret in a wasteland also used to access the beach. Compatibility is low.	Block-valve station planned in the Nahal Alexander park in the disturbed area (oxidation tanks) south of the college at Michmoret. Compatibility is medium.	The facility is planned in a training ground that serves several agencies. The area is located between Neurim boarding school and a police facility. Compatibility is high.
Assigned land uses	The plan perimeter covers a number of public open-space assigned uses (e.g. bathing beach, nature reserves, and parks). Compatibility is medium.	The plan perimeter covers a number of public open-space assigned uses (e.g. bathing beach, nature reserves, and parks). Some of this is planned to be converted to residences as part of the development north of Givat Olga. Compatibility is low.	The plan perimeter covers a number of public open-space assigned uses (e.g. bathing beach, nature reserves, and parks). A holiday park is planned in this area. Compatibility is low.	The plan perimeter covers a number of public open-space assigned uses (e.g. bathing beach, nature reserves, and parks). Compatibility is medium.	The plan perimeter covers a number of public open-space assigned uses (e.g. bathing beach, nature reserves, and parks). Compatibility is medium.

Pipeline route alternatives to the treatment facility

The pipeline route is underground. Its integration is mainly a matter of assigned land use, and of restrictions associated with laying the pipeline over the assigned land uses included in the surveyed plan. In addition, integration with assigned land uses, or lack of it, was also measured in view of the pipeline's proposed length. A longer pipeline will have greater assigned land use restrictions.

Table 2.1.5-H.2: Integration of the pipeline to the treatment facility with assigned land uses

Criterion	**Dor North**	**Ein Ayala**	**Hagit East**		**Hadera WWTP**			**Meretz WWTP**						
			Northern route	Southern route	From Hadera	From Michmoret	From Nahal Alexander	From Hadera		From Michmoret		From Nahal Alexander		From Neurim
								Northern alternative	Southern alternative	Northern alternative	Southern alternative	Northern alternative	Southern alternative	
Assigned land uses	Most of the pipeline route passes through open space land uses assigned to agriculture, nature reserves, and structural installations. Compatibility is high.		The route passes through land uses assigned to open spaces, agriculture, forest, nature reserves, excavation sites, and the outskirts of residential developments. Compatibility is medium.		The routes are located in several types of open space land uses ,urban development for industry, residences, and public institutions. Compatibility is low for all routes, with a preference for the route from Hadera which is shorter compared with the other alternatives. However, this is the only route with a material change of plans for residences and leisure and recreation, so its compatibility is low.			The routes cross several types of open space land uses and urban development for employment, residences, and public institutions, residential, and gas filling stations. Compatibility is low.		The route crosses all types of open space land uses, residential, recreational, and gas filling stations. Compatibility is low.	The route crosses open space assigned land uses, mostly agricultural assigned land use. Compatibility is medium.	The route crosses all types of open space land uses, residential, recreational, and gas filling stations. Compatibility is medium	The route's western section crosses road infrastructure and further on passes open-space land uses, mostly assigned to agriculture. Compatibility is medium.	The route passes through open space assigned land uses, civil utility installations, and the outskirts of a residential development. Compatibility is medium.

Treatment facility alternatives

Table 2.1.5-H.3: Facility integration into its surroundings, treatment facility alternatives

Criterion	Dor North	Ein Ayala	Hagit East	Hadera WWTP	Meretz WWTP
Compatibility with land uses	The Dor alternative is located in the heart of cultivated fields, directly adjacent to the WWTP and the effluent reservoir. This alternative breaks up contiguity of the agricultural lands and landscape in the area and its degree of integration into it surroundings is low.	Ein Ayala is located in an active quarry. Although the grounds surrounding the alternative are largely agricultural land natural, the proposed alternative is located inside the quarry and its compatibility with current use is high. In conclusion, the facility's integration into its surroundings is high.	The alternative is located in open spaces, east and directly adjacent to the Hagit power station. South and north of the alternative are agricultural structures which fragment the natural open spaces in this area. Compatibility is medium.	Most of this alternative's grounds are located in agricultural land north of Hadera WWTP and in the fish farms. Its eastern part lies mostly in agricultural land, most of it covered by mature citrus orchards. A gas treatment facility in this area has low compatibility with the current uses, because it is not possible to place the facility directly adjacent to the industrial zone, on the west, in view of the separation distances restrictions.	On the one hand the alternative is located on agricultural land near Meretz WWTP in contiguous agricultural land. Locating the facility in this area fragments the cultivated land; however, placing the facility in a disturbed area within the perimeter of an existing facility will reduce the harm to the locality's character, and the degree of integration of this alternative is high.
Assigned land uses	The site is located in agricultural land directly adjacent to the WWTP. The communities surrounding it are rural and/or farming communities. Establishing the facility here will terminate agricultural activity in the site perimeter. Establishing an infrastructure facility in a rural, agricultural area can change the area's character, making it more industrialized. Compatibility is medium.	The site is located in an active quarry surrounded by open spaces. The facility would be established in a disturbed area that has been approved for infrastructure, mining and excavation, and in future for rehabilitation. Due to proximity to Fureidis and the community's planning trends, establishing the facility in the quarry may have an impact on the future development of the town and its expansion to the north. Compatibility is	The site is located in an open space directly adjacent to the Hagit power station. Its eastern part has the limited advantage of being located among agricultural installations. Most of the area is assigned to agriculture, but it partly overlaps NOP 22 forest lands. The site is located at a significant distance from population centers. Compatibility is low.	The Hadera WWTP alternative lies mainly in the agricultural lands near the Hadera industrial zone, not directly adjacent to the industry and plant saturated section, and directly adjacent to the WWTP and a planned desalination plant. However, a metropolitan park is planned in the northern part of this alternative, based on Regional Outline Plan 6 (ROP 6), and leisure and recreation plans have been advanced.	The site is located in agricultural land directly adjacent to the WWTP. The communities surrounding it are rural. This site is part of the landscape complex and is located north of Nahal Alexander which is defined in NOP 34 B/3 as a river strip to be planned; no detailed plans are currently being advanced. Establishing an infrastructure facility in a rural, agricultural area can change the area's character, making it more industrialized. Compatibility is

Criterion	Dor North	Ein Ayala	Hagit East	Hadera WWTP	Meretz WWTP
		medium.			medium.
Directly adjacent	Directly adjacent to a wastewater treatment facility. Compatibility is medium.	Directly adjacent to the Ein Ayala quarry. Compatibility is medium.	The western part of the exploration zone is directly adjacent to agricultural installations and the Hagit power station; its compatibility is high. For the eastern part compatibility is low.	Directly adjacent to Hadera WWTP and in the west to Hadera industrial zone. The western part of the exploration zone is highly compatible and the in eastern part compatibility is medium.	Directly adjacent to Meretz WWTP - medium compatibility.

Pipeline route alternatives from the treatment facility

The pipeline route is underground. Its degree of integration with assigned land uses is related to the restrictions associated with laying the pipeline over the planned land uses included in the surveyed plan. In addition, integration with assigned land uses, or lack of it, was also measured in view of the pipeline's proposed length. Longer pipelines have greater restrictions on assigned land use.

Table 2.1.5-H.4: Integration with assigned land uses of the pipeline to the treatment facility

Criterion	Dor North	Ein Ayala	Hagit East	Hadera WWTP		Meretz WWTP
				Northern alternative	Southern alternative	
Assigned land uses	Treated gas from the treatment facility arrives at the existing gas system and there is no need to locate an additional route.			Most of the proposed route crosses agricultural open spaces in addition to planned residential areas and public institutions. Compatibility is low.		Most of the proposed route crosses agricultural open spaces in addition to the outskirts of residential developments. Compatibility is medium.

I. Leisure and recreation

- **Degree of harm to the outdoor experience**

Examining the plan's impact on visited nature sites and hiking routes, and accessibility to these. Impact is examined for physical proximity and its visual impact. This criterion evaluated coastal entry alternatives and treatment facility alternatives. The transmission pipeline is underground so it does not create restrictions on nature leisure sites; most of its impact is landscape related. This portion of the impact was analyzed under the visual and landscape evaluation and is not presented in this section.

The tables below present the evaluation of coastal entry and treatment facility alternatives for these aspects:

Coastal entry alternatives

As the block valve station is going to take up a very limited area of the subsoil, and most of its impact will result from placing a perimeter fence and night lighting in the sandy areas, its landscape-related implications on its surroundings are secondary.

Table 2.1.5-I.1 Degree of harm to outdoor experience, coastal entry arrays

Criterion	Dor	Hadera	Michmoret	Nahal Alexander	Neurim
Degree of harm to the outdoor experience	The block valve station is planned in an agricultural area and lies outside the range of hiking trails and sites. Compatibility is high.	The block valve station is planned in an open space south of Nahal Hadera Park, close to the Israel National Trail. Compatibility is medium.	The alternative is located in an open space north of Michmoret; part of it has been declared a nature reserve. A hiking trail passes through here. Compatibility is low.	The alternative is located in an open space south of Michmoret inside a national park and close to several hiking areas. Compatibility is low.	The block valve station is located in an area used for training by several agencies and does not serve as a hiking or recreation area. Compatibility is high.

Treatment facility alternatives

Evaluation of treatment facility alternatives impact on outdoor experience:

Table 2.1.5-I.2: Degree of harm to outdoor experience, treatment facility alternatives

Criterion	Dor North	Ein Ayala	Hagit East	Hadera WWTP	Meretz WWTP
Degree of harm to the outdoor experience	The exploration zone is located in open agricultural areas Most of the harm is landscape-related. Compatibility is medium.	The exploration zone is located in an active quarry with low proximity and visibility from hiking sites in the Carmel. Compatibility is high.	The exploration zone is in a natural area that serves as a hiking ground (Hagit single track, wooded and natural grounds) Compatibility is low.	Exploration zone is in the Nahal Hadera and Hadera industrial zone areas. The route of the Israel National Biking Trail is planned in this area. This area is currently largely disturbed, so adding the facility will have a minor added impact. Compatibility is medium.	Exploration zone is in an agricultural area near Meretz WWTP. If the facility will be placed in the disturbed area inside the existing facility perimeter, the degree of harm will be reduced compared with the currently situation. In this case compatibility is high.

J. Landscape-visual

Dor North

The alternative is located in the heart of agricultural land on the Carmel coastal plain, which is a narrow strip with a unique landscape transition from shoreline to Carmel ridge, most of it open spaces that are agricultural in nature. This alternative is directly adjacent to a WWTP, which when built several years ago compromised this region's image of an open agricultural space with high landscape value.

The site is visible mainly from the communities located on the west Carmel ridge: Fureidis, although over 1.5 km away, is located entirely on the slope overlooking the examined site. There will be significant visibility over the entire site from most of the upper village homes and streets. Despite its distance the site is center front of the view, and it will compromise the horizon which has a view of agricultural land and sea seen from the village and which constitutes one of its assets. The northern neighborhoods of Zichron Yaakov (Givat Eden) are more than 2 km from the site. Visibility from these neighborhoods will also be significant; however, unlike Fureidis, for most of the homes the site will be located on the margins of the viewed landscape and not in its center.

The site is also visible from Road 2 (Coastal Highway) mainly to travelers going north, and from the access road to the Kibbutz Nachsholim hotel and beach resort. Visibility is high from a short segment of Road 2, south of the site, because the highway passes over an elevated Kurkar ridge. However, the highway segment closest to the site was cut into the ridge, so the site is hidden from view here. The site is almost invisible from Road 70 (Fureidis junction-Zichron Yaakov interchange), and is hidden behind the WWTP from this direction. The site is currently not significantly visible from Road 9 east because the road is over 1 km distant, is not elevated, and is concealed behind agricultural installations and orchards. Nevertheless, consideration must be given to the fact that visibility will increase once Road 4 is shifted westward, as planned. The site is visible from a handful of hiking trails on the Carmel.

Moreover, because most of the pipeline route relies on the existing INGL route, and the proposed site is near existing utilities and will be utilizing them, the landscape-related impact from the ancillary infrastructure and leveling works will be limited.

From a landscape point of view, the site has low compatibility due to its high visibility, mainly from Fureidis and the Carmel ridge, and due to the fact that its establishment will reinforce the changed image of the area, which has gone from high landscape-value open agricultural land to industrialized area.

Ein Ayala

The alternative is located in a sensitive area that has landscape potential, i.e., the contact line between the Carmel ridge and the Carmel coastal plain. Its great advantage, however, is its position inside a disturbed area (Ein Ayala quarry), inside the existing quarry pit. Currently visible from the west are the top portion of the quarried wall, mounds of debris reserved for rehabilitating the disturbed area south of the site (piled up from work completed in the quarry and nearby projects), and the installation grounds near Road 4. All these are visible mainly to travelers on Road 2 (Coastal Highway), residents of the southern parts of Moshav Ein Ayala, and to a limited degree, also from the shore area and from Dor and Nachsholim communities despite their distance (over 3 km). Consideration must be given to the fact that the quarry may expand and its landscape footprint can be expected to grow.

Visibility of the facility in the quarry very much depends on the detailed plan; with good planning it can be fairly well concealed. Establishing the facility at this location signifies shutting down the quarry; if this is accompanied by landscape and ecosystem rehabilitation of the disturbed area to the south, the crest of the eastern cliff, and the roadside installations, the area's appearance will be greatly improved.

Moreover, because most of the pipeline route relies on the existing INGL route, and the proposed site is near existing utilities and will be utilizing them, the landscape-related impact from the ancillary infrastructure and leveling works will be limited.

From a landscape point of view, the site is highly compatible despite its visibility in view of the existing landscape disturbance and the fact that a wisely designed landscape-sensitive plan for the facility may improve the area visually. Furthermore, establishing the facility at this site is limited to the pit area and this is likely to prevent additional infrastructure installations from being added to the facility in future. At the same time, the implication is shutting the door on the possibility of rehabilitating the quarry as an open space, and permanently turning it into an industry-oriented area.

Hagit

This alternative is located west and directly adjacent to the Israel Electric Corporation's power station, Hagit. This alternative is located in the heart of a dwarf shrub steppe, which is a natural open space of landscape value. Despite the attempt to keep the power station back from the road when it was built, so that it would be concealed from the landscape, the site is prominently visible from afar. Its towering stacks contribute greatly to the contrast with the natural environment and its assets, open space, and natural and agricultural landscapes, and intrude on the traveling experience on Road 70 in both directions. Other than the anomalous power station, this driving route provides a landscape-rich traveling experience through natural and agricultural regions.

The site is distant and not visible from any community, with the exception of the elevated installations which are visible from the outskirts of Moshav Elyakim. However, it is highly visible from the highways (very short exposure time) – travelers on Road 70 (Fureidis-Yokneam), and travelers turning at Tut interchange (Road 6), mainly westward but also eastward. This is of special significance in view of the modifications to the highway's route and its significantly increased height once it will be connected to Road 6. This site is also very prominent in its surroundings and building it will reinforce the trend that is changing the region's character, and which began with the establishment of the power station and poultry farms.

In addition, the facility's proposed location and the extended pipeline corridor crossing hilly terrain and high-quality natural environment require adapting and preparing the area for the infrastructure and installations, including earth works. Accordingly, the landscape rehabilitation that will be necessary under this alternative will be greater.

From a landscape point of view, this alternative has medium-low compatibility. However, it is directly adjacent to a power station and is not very visible from any community. On the other hand it is highly visible from highways, prominently contrasts with its natural surroundings, and reinforces the current trend modifying the region's character. Moreover, adapting the facility and ancillary infrastructure to the area's natural features will have significant impact on landscape.

Hadera WWTP

This alternative is located south of Road 65 and east of Nahal Hadera junction, over level agricultural land (well-established citrus orchards with rows of cypress as wind-breakers, and crops), near Hadera's WWTP and northern industrial zone, and south of most of the fish farms.

The site might be visible from the north, from Road 65, depending on the site's exact location in the proposed area (in a range of 200-1000 m), and is concealed from travelers on Road 4 by the industrial zone. The further south the facility is placed in the proposed site, the more visible it is likely to be from the north-eastern neighborhoods of Hadera which are at least 1 km from the southern boundary of the site. The closer the facility is placed to the center of the compound, the more visible it is likely to be from Road 65 in the section where the road opens up to a view of the fish-farm which is a high-value landscape. It is possible to implement measures to conceal the facility, but these would compromise the existing landscape value.

In addition, because the pipeline route passes mostly through level agricultural land and the proposed facility is located near existing utilities and can utilize them, the landscape-related impact from the ancillary infrastructure and leveling works will be relatively limited.

From a landscape point of view, the site has medium compatibility; it is fairly out of the way, is not significantly visible from main roads, is directly adjacent to other installations, and integrates with the industrial zone features and WWTP. However, the facility might be more visible from residential areas in Hadera and from Road 65 to travelers going west. Concentrating on the western part of the examined site, as well as wise implementation of a landscape-sensitive detailed plan may facilitate site integration in its surroundings. It may also contribute to concealing the site by borrowing elements from the local agricultural landscape such as cypress wind-breakers and citrus orchards.

Meretz WWTP

This alternative is located in the heart of open and level agricultural, intensively cultivated crop land, between Kibbutz Hamaapil and Kibbutz Ein Hahoresh. The nearest communities are 1.5 km from the site and visibility of the site from there is negligible. The site is not visible from any main road, but might be visible from Road 581, depending on the facility's position within the site.

This site is agricultural and establishing the facility in this area can change the region's perceived character (open agricultural land) associated with Nahal Alexander, which is a pivotal leisure and recreation center in this region. In addition, this area is defined in NOP 35 as a landscape complex, which means it has an important landscape-related role in forming the country's image.

Because the pipeline route passes mostly through level agricultural land and the proposed facility is located near existing utilities and can utilize them, the landscape-related impact from the ancillary infrastructure and leveling works will be relatively limited.

From a landscape point of view, the site has medium compatibility. Despite the absence of high visibility from any community or main road the site may be prominent and out-of-place in its surroundings. Despite being directly adjacent to a WWTP it could change the face of the area from open agricultural land to industrialized area. At the same time, wise implementation of a landscape-sensitive detailed plan may facilitate site integration in its surroundings. In addition, during the detailed planning stage it will be necessary to examine the possibility of concealing the site from hikers coming from the pedestrian and cycling trails at Nahal Alexander. This can be achieved by borrowing elements from the local agricultural landscape, such as cypress wind-breakers and citrus orchards.

Table 2.1.5-J: Comparing the visual aspects of the alternatives

	The Dor complex			Hadera-Michmoret complex	
	Dor North	Ein Ayala	Hagit	Hadera WWTP	Meretz WWTP
Degree of harm to open spaces' quality due to landscape aspects	The existing level of disturbance at the site and its surroundings, combined with the potential option of rehabilitating the agricultural areas near the proposed site	The current quarry has a significant landscape footprint. Establishing a treatment facility within the quarry, may reduce the current environmental footprint	There is a high degree of harm to landscape in the natural areas; however, proximity to an existing power station significantly mitigates the harm to landscape	The agricultural land has landscape and cultural value. On the other hand, immediate adjacency to an intensively industrial area significantly mitigates the harm to landscape	The open agricultural land serves as a landscape complex in NOP 35. On the other hand there is immediate adjacency to the WWTP and the option to rehabilitate surrounding cultivated land
Evaluating facility visibility, and its implications, from a number of points in the area	High visibility of the site's components from the Carmel ridge communities to the east and from the surrounding motorways	Visibility of most site components from the surrounding communities is relatively low; the site is exposed mostly to travelers on the highways	Visibility of the proposed site from the surrounding communities is relatively low, although the site is highly visible from the open spaces and the nearby junctions	High visibility from Hadera residential communities, and from Road 65 Level topography, land cover, and immediate adjacency to WWTP appreciably mitigate the impact on landscape	Despite high visibility from the nearby open areas, due to low visibility from population centers and highways
How the facility integrates into its surroundings and its impact on the skyline	Does not merge with the agricultural landscape. This impact is mitigated by facility being directly adjacent to a WWTP, infrastructure, and agricultural structures, and it does not stand in the heart of open cultivated land	Excellent integration due to location inside an existing quarry pit its impact on the skyline is minimal	Contrast between the industrial installation and the area's natural quality, contribute to low integration. Skyline is expected to be highly compromised.	The area's level topography and enclosed landscape, its immediate adjacency with the WWTP and proximity to an industrial zone, and the option to merge the site into its surroundings	The area's level topography and open landscape, on the one hand, and directly adjacent to WWTP on the other

	The Dor complex			Hadera-Michmoret complex	
	Dor North	**Ein Ayala**	**Hagit**	**Hadera WWTP**	**Meretz WWTP**
Additional potential harm caused by ancillary infrastructure and its extent	Full use can be made of existing infrastructure	It is possible to rely on existing infrastructure	It is possible to rely on existing infrastructure; however, the site's distance from the shore will require staging areas for the pipeline passing through natural areas, some of which have a limited capacity for recovery	It is possible to rely on existing infrastructure	It is possible to rely on existing infrastructure
Degree of harm to current landscape as a result of earth work associated with establishing the facility	No significant earth works will be required	Does not require earth works outside the quarry	The proposed site is located in a hilly terrain Large scale earth works will be required	No significant earth works will be required	No significant earth works will be required
Final evaluation	**Compatibility is low**	**Compatibility is high**	**Compatibility is low**	**Compatibility is medium**	**Compatibility is medium**

Comparing the alternatives:

Landscape impact was compared for alternatives in the same complex: Dor system alternatives – Dor North, Ein Ayala and Hagit were evaluated relative to each other, and the Hadera-Michmoret system alternatives – Hadera WWTP and Meretz WWTP were evaluated relative to each other.

The Dor system:

The Dor alternative has a high impact on landscape mainly due to visibility: high visibility of the site's components from the Carmel ridge communities (Fureidis and Zichron Yaakov) and from Road 2, it also has a medium impact in the aspect of modifying the nature of a landscape unit. From a landscape point of view, this makes it the inferior of the three alternatives in the complex.

The Ein Ayala alternative has a low impact on landscape, and the wise implementation of a landscape-sensitive detailed plan may visually improve the site. Establishing the facility has low impact on visibility, and it may even have a beneficial impact in the aspect of modifying the nature of a landscape unit. The possibility exists because this is currently a disturbed area. From a landscape point of view, this alternative is clearly preferable over the others in this system.

The Hagit alternative has a medium impact on landscape, mainly due to the visibility aspect: high visibility of the site from Road 70, on the one hand, but from no other community or visitor site, on the other. Establishing this facility will have a medium impact in the aspect of modifying the nature of a landscape unit, due to its being directly adjacent to the power station and despite its being a valuable natural landscape unit.

Hadera-Michmoret system:

The alternatives examined in this system are located in level agricultural land and are very similar on most counts. They differ from each other in the degree of harm to open spaces' quality due to landscape considerations. Despite being directly adjacent to a WWTP, the Meretz WWTP stands in the heart of open cultivated land in a landscape complex. Conversely, the Hadera WWTP alternative is near the Hadera industrial zone in a more industrialized area; it is therefore preferable for landscape considerations.

K. Seismic

<u>Ranking the alternatives</u>

Alternatives were ranked based on the following assumptions:

a. Proximity (up to 200 meters) to an active fault is a risk that prohibits building;
b. Sensitivity of slopes to failure is a construction-prohibiting risk. Although, in some cases it is possible to find engineering solutions for protecting the structure.
c. Soil liquefaction is a risk that compromises soil stability, but in most cases the risk to a planned building can be minimized by using engineering solutions (this is specifically the case for the locations of these alternatives).
d. Increased soil accelerations can compromise stability of the planned structure, but the risk can be minimized by applying engineering solutions.

According to these assumptions each alternative was ranked for the evaluated risks. The weighted ranking is qualitative; alternatives with no expected risks or in which only soil acceleration is expected received a high score (green), alternatives that are sensitive to liquefaction scored medium (orange), and alternatives with a risk of surface tearing or slope failure scored low (red).

Coastal entry alternatives

Dor alternative

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	Dor coastal entry is located on a Kurkar ridge partially covered with a thin layer (5 m) of soft sediments (sands and clays). According to Zaslavsky et al. (2002)in the Dor coastal entry it is A=2-3
Surface tearing	No	
Liquefaction	Yes	According to Salmon et al. (2008) the Dor North alternative is located in areas with medium (on the shore) and low (east of the beach) liquefaction risk
Landslides	No	Slope angle does not exceed 5°
Tsunami	Yes	Tsunami is expected to strike in the coastal entry area

Final score: medium

Hadera alternative

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	Planned on a Kurkar ridge partially covered with a layer of soft sediments (sands, red loam, loam) that is up to 10 m thick. According to Zaslavsky et al. (2003), maximum acceleration coefficient in the Hadera coastal entry is A=2-3
Surface tearing	No	
Liquefaction	Yes	Liquefaction is expected in the plan range
Landslides	No	Slope angle does not exceed 5°
Tsunami	Yes	Up to 500 m from the shoreline therefore Tsunami is expected to strike in the coastal entry area

Final score: medium

Michmoret alternative

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	Planned on a Kurkar ridge partially covered with a layer of soft sediments (sands, red loam, loam) that is up to 10 m thick. according to Zaslavsky et al. (2003), maximum acceleration coefficient in the Hadera coastal entry is A=1-2
Surface tearing	No	
Liquefaction	Yes	Liquefaction is expected in the plan range
Landslides	Yes	There is a coastal cliff in the planned area of the Michmoret coastal entry (in its northern part); with a slope that is fairly steep (greater than 40°). For this slope, soil acceleration of at least 0.05g is necessary for the slope's stability to be compromised. Expected accelerations in the Michmoret coastal entry area are higher than this (Table 1-6-7-1) so rock slides are expected in the northern part of the coastal entry
Tsunami	Yes	There is a coastal cliff in the planned area of the Michmoret coastal entry (in its northern part); it rises 10 m above the beach, so it's eastern side is not expected to be struck by a tsunami

Final score: low

The Nahal Alexander alternative

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	Planned on a Kurkar ridge partially covered with a layer of soft sediments (sands, red loam, loam) that is up to 10 m thick. According to Zaslavsky et al. (2003), maximum acceleration coefficient in the Hadera coastal entry is A=1-2
Surface tearing	No	
Liquefaction	Yes	Liquefaction is expected in the plan range
Landslides	No	Slope angle does not exceed 5°
Tsunami	Yes	The Nahal Alexander coastal entry is located along the river so it is expected to be hit harder

Final score: medium

Neurim alternatives

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	According to Zaslavsky et al. (2003), maximum acceleration coefficient in the Hadera coastal entry is A=2-3
Surface tearing	No	
Liquefaction	Yes	The Neurim coastal entry is located in areas with medium sensitivity to liquefaction (on the beach) and very low sensitivity (at the crest of the coastal cliff)
Landslides	Yes	There is a coastal cliff in the planned area, with a slope that is fairly steep (greater than 40°). For this slope, soil acceleration of at least 0.05g is necessary for the slope's stability to be compromised. Expected accelerations in the Neurim coastal entry area are higher than this (Table 1-6-8-1) so rock slides are expected along the shore in the coastal entry area.
Tsunami	Yes	Tsunami is expected to strike in the coastal entry area.

Final score: low

Onshore alternatives

Dor North alternative

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	When calculating amplification, rock to a depth of up to 30 m from the surface must be taken into account. In the Dor alternative there is Pleistocene calcareous sandstone under the clay layer. Zaslavsky et al. (2009) lists shear wave velocities of 700-750 m/s for calcareous sandstone of this age. Accordingly, this unit must be classified as C soil (according to IS 413).
Surface tearing	No	
Liquefaction	No	No liquefaction is expected. Located in an area with a negligible sensitivity to liquefaction
Landslides	No	Slope angle does not exceed 5°
Tsunami	No	Dor North alternative is located 1.5 km from the beach

Final score: high

The Ein Ayala quarry alternative

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	No	According to the geological map, located in a hard rock site with exposed chalk so excessive amplification is not suspected. No suspected excessive amplification
Surface tearing	No	
Liquefaction	No	No liquefaction risk in the alternative's range.
Landslides	Yes	Rock and soil slides may occur in the alternative's range as a result of a seismic event.
Tsunami	No	Located at an elevation of 40-60 meters

Final score: low

Hagit alternative

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	No	No suspected excessive amplification
Surface tearing	No	
Liquefaction	No	No liquefaction potential in alternative's range
Landslides	No	Slope stability is not expected to be compromised
tsunami	No	At an elevation of 170-180

Final score: high

Hadera WWTP

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	The Hadera WWTP alternative is located on the verges of a local sedimentary basin containing soft sediments such as sand, loam, and clays; thickness is 0-45 m
Surface tearing	No	
Liquefaction	Yes	Water occasionally collects on the surface which keeps the shallowest soil/rock units saturated. Saturation of the sandy units is, therefore, possible. Expected soil accelerations in this alternative's range are 0.08-0.13g for different reference scenarios. Due to the described conditions there is a risk of liquefaction in the Hadera alternative.
Landslides	No	Slope angle does not exceed 5°
Tsunami	Yes	Threshold conditions for tsunami strike may exist in the area of the Hadera WWTP alternative

Final score: medium

Meretz WWTP

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	The soft layer in the Meretz WWTP alternative contains sand, loam, and clays; its thickness is 50-70 m.
Surface tearing	No	
Liquefaction	Yes	Risk of liquefaction exists mainly in the alternative's eastern part
Landslides	No	Slope angle does not exceed 5°
Tsunami	No	Located 8.5 km from the shore

Final score: medium

Pipeline alternatives

Pipeline to the treatment facility - Dor

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	Located on ridges composed of hard sediments and draws with soft sediments (sand, loam, and clays); total thickness up to 15 m. Amplification coefficient along the pipeline route according to Zaslavsky et al. (2002) is A=1-5
Surface tearing	No	Pipeline to the Dor treatment facility passes through an area in which there are no active faults
Liquefaction	Yes	Liquefaction is possible on the western end of the pipeline route. According to Salmon et al. (2008) the pipeline route to the Dor treatment facility is located in an area with low-very low liquefaction risk
Landslides	No	Slope gradient in area of the pipeline to the Dor treatment facility does not exceed 5°
Tsunami	Yes	There is a risk of tsunami striking at the most western edge of the pipeline to the Dor treatment facility

Final score: low

Pipeline to the treatment facility - Ein Ayala

In addition to the information listed for the route to Dor:

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	Amplification is expected along the pipeline route. According to Zaslavsky et al. (2002), maximum acceleration coefficient along the pipeline route is A=1-5
Surface tearing	No	
Liquefaction	No	No liquefaction is expected the western end of the pipeline route. According to Salmon et al. (2008) the pipeline route to the Dor treatment facility is located in an area with low-very low liquefaction risk
Landslides	Potential	Slope gradient through most of the pipeline route to Ein Ayala treatment facility does not exceed 5°. On its eastern end topography is similar to the treatment facility area, where slope failure is expected.
Tsunami	No	Planned at a distance of 2-3.5 km east of the shoreline, at an elevation of 7-60 meters

Final score: low

Pipeline to the Hagit (northern and southern alternatives) treatment facility

In addition to the information listed for Ein Ayala route:

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	In rivers with alluvial fill a small degree of amplification of soil vibrations is possible.
Surface tearing	No	
Liquefaction	No	No liquefaction risk in this alternative's range
Landslides	No	In some places, the pipeline route passes through areas with a slope gradient of 5-20°. In this slope and chalk subsoil. soil acceleration must be higher than 0.30g to compromise slope stability
Tsunami	No	Planned at an elevation of 30-180 m.

Final score: low

Pipeline route to/from the Hadera treatment facility

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	Planned on ridges composed of hard sediments and draws with soft sediments (sand, silt, and clays). Soft sediment thickness ranges between 0-60 m. Expected acceleration varies accordingly along the pipeline route
Surface tearing	No	
Liquefaction	Yes	Liquefaction may occur along the pipeline routes. According to Salmon et al. (2008), the pipeline route from Hadera WWTP treatment facility is located in an area with low-very low liquefaction risk.
Landslides	No	Slope angle does not exceed 5°.
Tsunami	In most cases not	Risk of tsunami strike at Nahal Alexander alternative

Final score:

- **Pipeline to the treatment facility:**
  - **For Hadera and Michmoret alternatives – medium**
  - **For the alternative from Nahal Alexander – low**
- **Pipeline from the treatment facility:**
  - **Northern and southern alternatives – medium**

Pipeline route to/from the Hadera treatment facility

Seismic risk factor	Is there a risk:	Notes
Accelerations and amplification	Yes	According to Zaslavsky et al. (2003), maximum acceleration coefficient along the pipeline route from the Meretz WWTP treatment facility eastward is A=2-3
Surface tearing	No	
Liquefaction	Yes	Due to the described conditions, liquefaction may occur along the pipeline routes. According to Salmon et al. (2008), the pipeline route from Meretz WWTP treatment facility is located in an area with low-very low liquefaction risk.
Landslides	No	Slope angle does not exceed 5°.
Tsunami	In most cases, not	Risk of tsunami strike at Nahal Alexander alternative

Final score:

- **Pipeline to the treatment facility:**
    - **For Hadera and Michmoret alternatives – medium**
    - **Alternative from Nahal Alexander – low**
- **Pipeline from the treatment facility: medium**

L. Noise

Alternatives were ranked for noise aspects based on the measurements and tables shown in Section 1.11, below, as follows:

The planned alternatives were evaluated on acoustic aspects according to the following criteria:

- Source-noise level at the receivers
- Compliance with noise regulations and noise criteria
- Background-noise level at the receivers. Note that in cases of a noise source that is active 24 hours a day, minimum noise levels at night should be considered
- Distance between noise source and receiver
- Noise-reducing elements in the transmission path such as topography, structures, etc.
- Suggested noise-reduction measures at source or on the transmission path

Obviously, each of the alternatives must comply with the noise regulations, and the facility, regardless of which alternative is selected, must be planned accordingly.

The main difference between the alternatives will be the difference between source noise (made by the facility at the noise receivers) and background noise. Alternatives at which source noise at the receiver is softer than the background noise are preferable.

The evaluation in this section is a theoretical one; nighttime noise levels were measured and the parameters listed above were applied without detailed calculations. Table 1.1.1-1 shows that nighttime noise levels at each of the alternatives falls within a narrow range of A-weighted 37.7-43.5 dB. At Elyakim higher noise levels were measured; however, we assume these are atypical values of the normal acoustic climate at night.

Apparently, the Emek Hefer-Meretz WWTP alternative is located near areas with very low daytime and nighttime background noise levels. Noise levels at the other alternatives are similar.

In the following list the alternatives are arranged in order of acoustic preference:

1. Dor North
2. Hadera WWTP
3. Hagit East
4. Ein Ayala
5. Meretz WWTP

M. Hydrology and hydrogeology

General

This section presents the weighted score for each of the evaluation categories, given to each of the location alternatives(treatment facility, coastal entry, and pipeline to and from the facility alternatives). This follows the review discussed in Section 1.7 of the survey.

Semi-quantitative model

The semi-quantitative model for quantifying the hydrological sensitivity of the plan area was developed by the survey's professional consultant. It is based on the understanding that specialized knowledge is required to quantify potential contamination of groundwater over a wide area that has varying hydrological and hydrogeological properties. This model allows us to compare the relative risk of contamination in various sections of the plan without referring to a specific source of contamination. The model is based on the regional DRASTIC model developed by the EPA in the US (1987) and on a local model prepared for the coastal aquifer by Sneh et al. (2004)[20] at the Geological Survey of Israel (GSI). There are 3 groups of parameters in the model:

1. Factors that could influence the extent of groundwater contamination
    c. Hydraulic barrier at the surface affecting hydraulic conductivity of the soil.
    d. Aquifer properties quantified by hydraulic conductivity of the porous medium.
    e. Presence of wells near the work area.

[20] A. Sneh, S. Wollman, S. Hoyland, D. Levitte, A. Bein (2004) Vulnerability of the coastal aquifer (Israel) to pollution from road runoff and other surface pollutants GSI/23/2004

f. Aquifer water quality near the surface.

g. Relation to potable water wells' protective zones.

h. Vertical distance (depth) between the surface and groundwater level.

2. Factors used to quantify the interaction between the plan and surface runoff:

a. Drainage basin properties - designated use of the area, basin dimensions, and land cover composition.

b. Geographical interaction between the alternatives and the rivers' impact bands according to NOP 37/B/3.

c. Existence of a drainage system in the vicinity.

3. The third group of parameters contains three factors taken from existing maps showing a number of national-level groundwater contamination risks:

a. Map of "Water-resource preservation areas" established by NOP 35 - Construction, Development, and Preservation (Chapter 10.2) which lists planning provisions for preserving groundwater in areas defined as preservation areas.

b. Map of "Fuel contamination hazard areas (Water Authority, 1992). This map divides the country into five levels of sensitivity to contamination from the surface. This map also serves to establish risk zones in the Water Regulations (Preventing Water Contamination Farms and Fuel Tanks) 5764-2004.

c. Map of "Groundwater vulnerability zones" provided for in NOP 34/B/4 - surface-water collection, reinjection, replenishing and protecting groundwater - divides the country into zones based on four levels or groundwater vulnerability.

For the evaluation of treatment facility alternatives, each evaluation factor was given a relative score comparing it with the other alternatives in the same group (treatment facility alternatives, pipeline alternatives, and coastal entry alternatives). Relative weight of each factor was determined by an expert opinion.

For coastal entry points the alternatives were compared for depth of groundwater level, type of soil, and special factors (groundwater flow direction).

For the pipeline route the alternatives were compared for presence of wells on the route, overlap with potable water wells protection zones, and interaction with aquifer.

Ranking the alternatives

For each of the treatment facility alternatives, we list below the main factors that contributed to a low/medium/high environmental compatibility score. The score reflects risk of groundwater and surface water contamination and the interaction between surface runoff and the facility infrastructure. Scores for the treatment facility, pipeline route, and coastal entry alternatives are summarized in the table below.

Treatment facility alternatives

Dor North

- Good hydrological barrier between the surface and the aquifer
- Groundwater quality is medium
- There are no wells or protective zones in the alternative's perimeter
- Distant from rivers
- Sensitivity based on existing maps is medium-high
- Large drainage basin

Overall score – High

Ein Ayala

- There are no wells in the alternative's perimeter
- Small drainage basin
- Distant from rivers
- Poor hydrological barrier between the surface and the aquifer
- Located within protective zone B
- Sensitivity based on existing maps is high

Overall score – Low

Hagit

- Poor hydraulic barrier
- Water quality is high
- Sensitivity based on existing maps is medium
- Close to rivers

- Groundwater at surface
- Risk of springs drying out as a result of excavation

Overall score – Low

Hadera WWTP

- South-western section is part of a flood plain
- Good hydrological barrier
- North-eastern section is located within the protective zones
- Proximity to the Nahal Menashe reinjection site
- Sensitivity based on existing maps is medium-high

Overall score – Medium

*Moving the facility away from the flood plain, the protective zones, and the Kurkar units will raise the score to high.

Meretz WWTP

- Good hydrological barrier
- Wells present in the alternative's perimeter
- Sensitivity based on existing maps is medium
- Located in flood plain

Overall score – Medium

The tables below summarize the coastal entry systems and the gas transmission pipeline:

Table 2.1.5-M.1 Hydrogeological evaluation of the coastal entry alternatives

Criterion	Dor array	Hadera-Neurim array			
	Dor	Hadera	Michmoret	Nahal Alexander	Neurim
Risk of groundwater and surface-water contamination	High	Low - flows east	Medium - hydraulic barrier	Medium - hydraulic barrier	Medium - hydraulic barrier
Impact on surface runoff into the facility's infrastructure and drainage solution	High	Low - flood plain	High	Low - flood plain	High

Table 2.1.5-M.2: Hydrogeological evaluation of pipeline-to-treatment facility alternatives

Criterion	Dor North	Ein Ayala	Hagit East		Hadera WWTP			Meretz WWTP						
			Northern route	Southern route	From Hadera	From Michmoret	From Nahal Alexander	From Hadera		From Michmoret		From Nahal Alexander		From Neurim
								Northern alternative	Southern alternative	Northern alternative	Southern alternative	Northern alternative	Southern alternative	
Risk of groundwater and surface-water contamination	High	Low	Low	Low	Medium	Medium	Medium	Low	Low	Low	Low	Low	Low	Low
Impact on surface runoff into the facility's infrastructure and drainage solution	High	High	High	High	Medium	Medium	Medium	Medium	Low	Medium	Low	Medium	Low	Low

Table 2.1.5-M.3: Hydrogeological evaluation of the pipeline-alternatives from-facility

<table>
<tr><th rowspan="2">Criterion</th><th rowspan="2">Dor</th><th rowspan="2">Ein Ayala</th><th rowspan="2">Hagit East</th><th colspan="2">Hadera WWTP</th><th rowspan="2">Meretz WWTP</th></tr>
<tr><th>Northern alternative</th><th>Southern alternative</th></tr>
<tr><td>Risk of groundwater and surface-water contamination</td><td colspan="3" rowspan="2">Gas discharged eastward and to the Hagit power station will not require laying an additional pipeline route</td><td>Low</td><td>Medium</td><td>Low</td></tr>
<tr><td>Impact on surface runoff into the facility's infrastructure and drainage solution</td><td>High</td><td>Low</td><td>Low</td></tr>
</table>

N. Potential future expansion of the facility

Future potential for expanding the facility to accommodate additional operators, based on weighted engineering, environmental, landscape, and planning considerations. Alternatives with a greater potential for future expansion are preferable.

- **Dor North –** Assigned land uses in the exploration zone are agricultural, meaning that future expansion of the facility is possible on engineering and environmental grounds. However, expanding the facility will further modify the landscape from agricultural to industrial. Medium compatibility.
- **Ein Ayala** –The proposed site is located within an existing quarry partly surrounded by natural areas that are environmentally significant. This precludes future expansion without overstepping the proposed perimeter. Low compatibility.
- **Hagit East** – The proposed site is located on agriculture-assigned land with environmental qualities; it will require earth works and will further compromise the landscape, ecosystem, and hydrogeology. Low compatibility.
- **Hadera WWTP** – The area is designated as agricultural in part, and metropolitan park in part, directly adjacent to the planned expansion of Hadera industrial zone and Hadera WWTP. Expansion will not materially change the situation from the currently planned one. High compatibility.
- **Meretz WWTP** – The exploration zone is located in an area designated as agricultural, and that has medium landscape and environmental value. There are also no special engineering restrictions on future expansion. High compatibility.

2.1.6. Evaluating the criteria

Due to the project's complexity and sensitivity, evaluation is qualitative and the various parameters were not weighted. At the same time, based on the opinion of the planning team, some aspects which might in future constitute obstacles or create significant delays were given precedence. These include separation distances, natural assets, and material modification of the landscape, whereas other factors such as seismic considerations and earth excesses can be addressed with relatively simple engineering or design solutions.

Alternatives that were more compatible on the tested criteria have a higher preference for development (high score).

If an alternative is neither superior nor inferior compared with the other alternatives, it scored medium preference for development (medium score).

Alternatives rated as inferior for the tested criterion and less compatible scored low preference (low score).

For convenient viewing of the evaluation conclusions, the following key has been used:

High priority – green highlight

Medium priority – yellow highlight

Low priority – red highlight

Thus, the final row of each table looks like this:

High priority alternative	Low priority alternative	Medium priority alternative

Alternatives were evaluated according to all the criteria listed above; **ranking is relative to the other alternatives and is not an absolute value**.

Table 2.1.6-1: Evaluation of coastal entry - summary

Section	Subject	Criterion	Dor array	Hadera-Neurim array			
			Dor	Hadera	Michmoret	Nahal Alexander	Neurim
A.	Natural resources	Degree of harm to local habitats ecological aspects	Medium	Medium	Medium	Medium	High
		Sedimentological aspects	High	Medium	Low	Low	Low
B.	Antiquity and heritage site offshore and onshore.	Proximity to archeological sites.	Low	Medium	Medium	Medium	High
C.	Integration of the facility in its environment in view of future land use and assigned land use.	Compatibility with land uses and assigned land use	High	Low	Low	Medium	High
D.	Leisure and recreation	Degree of harm to the outdoor experience	High	Medium	Low	Low	High

Section	Subject	Criterion	Dor array	Hadera-Neurim array			
			Dor	Hadera	Michmoret	Nahal Alexander	Neurim
E.	Seismic	Degree of seismic risk evaluated based on the existence within the proposed alternative of active or suspected active faults, horizontal soil accelerations expected on the surface, risk of soil failure and soil liquefaction, and risk of tsunami striking the site.	Medium	Medium	Low	Medium	Low
F.	Hydrogeology and soil	Risk of groundwater and surface-water contamination and impact on surface runoff into the facility's infrastructure and drainage solution	High	Low	Medium	Medium	Medium
	Conclusion:		High priority	Medium priority	Low priority	Medium priority	Medium priority due to uncertainty concerning stability of the cliff

Table 2.1.6-2: Evaluation of pipeline routes to treatment facility - Summary

Section	Subject	Criterion	Dor North	Ein Ayala	Hagit East		Hadera WWTP			Meretz WWTP						
					Northern route	Southern route	From Hadera	From Michmoret	From Nahal Alexander	From Hadera		From Michmoret		From Nahal Alexander		From Neurim
										Northern alternative	Southern alternative	Northern alternative	Southern alternative	Northern alternative	Southern alternative	
A.	Efficient use of land resources	Comparing the alternatives based on land consumption	High	High	Low	Low	Medium	Low	Low	Low	Low	Medium	Medium	Medium	High	High
B.	Earth surpluses	Total scope of earth works (classified by mining and backfill) for establishing the facility including optional solutions	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Medium
C.	Natural resources	Degree of ecological harm to habitats	High	High	Low Preference for the southern alternative.		Medium	Low	Low	Low	Low	Low	Low	Low	Medium	High

Section	Subject	Criterion	Dor North	Ein Ayala	Hagit East		Hadera WWTP			Meretz WWTP						
					Northern route	Southern route	From Hadera	From Michmoret	From Nahal Alexander	From Hadera		From Michmoret		From Nahal Alexander		From Neurim
										Northern alternative	Southern alternative	Northern alternative	Southern alternative	Northern alternative	Southern alternative	
D.	Antiquity and heritage site	Proximity to archeological sites	Medium	Medium	Medium Preference for the northern alternative		Low Preference for the alternative from Hadera			Medium	Medium	High Preference for the northern alternative		High Preference for the northern alternative		Medium
E.	Integration of the facility in its environment in view of future land use and assigned land use	Compatibility with land uses	High	High	Medium	Medium	Low	Low	Low	Low	Low	Low	Medium	Medium	Medium	Medium
F.	Seismic	Degree of seismic risk based on the existence within the proposed alternative of active or suspected active faults, horizontal soil accelerations	Low	Low	Low	Low	Medium	Medium	Low	Medium	Medium	Medium	Medium	Low	Low	Medium

Section	**Subject**	**Criterion**	**Dor North**	**Ein Ayala**	**Hagit East**		**Hadera WWTP**			**Meretz WWTP**						
					Northern route	Southern route	From Hadera	From Michmoret	From Nahal Alexander	From Hadera		From Michmoret		From Nahal Alexander		From Neurim
										Northern alternative	Southern alternative	Northern alternative	Southern alternative	Northern alternative	Southern alternative	
		expected on the surface, potential for soil failure, soil liquefaction, and risk of tsunami striking the site														
G.	Hydrogeology and soil	Risk of groundwater and surface-water contamination and impact on surface runoff into the facility's infrastructure and drainage solution	High	Medium	Medium	Medium	Medium	Medium	Medium	Low	Low	Low	Low	Low	Low	Low

Section	**Subject**	**Criterion**	**Dor North**	**Ein Ayala**	**Hagit East**		**Hadera WWTP**			**Meretz WWTP**						
					Northern route	Southern route	From Hadera	From Michmoret	From Nahal Alexander	From Hadera		From Michmoret		From Nahal Alexander		From Neurim
										Northern alternative	Southern alternative	Northern alternative	Southern alternative	Northern alternative	Southern alternative	
CONCLUSION:			High priority Some preference for Dor due to short route and hydrogeological considerations		Low priority Some preference for southern route due to lesser degree of harm to sensitive natural assets		Low priority with preference for the pipeline route from Hadera			Low priority	Low priority	Low priority	Medium-low priority	Low priority	Medium priority	High priority

Table 2.1.6-3:Treatment facility site evaluation - summary

Section	Subject	Criterion	Dor	Ein Ayala	Hagit East	Hadera WWTP	Meretz WWTP
A.	Expected level of risk to population at the facility and in its vicinity	Safety distances around the facility, distance from population, roads, high voltage and extra high voltage lines, and strategic facilities.	High	Medium	Low	Low	High
B.	Proximity to existing and planned infrastructure	- Power transmission lines - Proximity to the natural gas supply pipe work - Proximity to existing routes and highways	High	High	High	High	High
C.	Earth surpluses	Total scope of earth works (classified by mining and fill) for establishing the facility including suggested solutions.	High	Medium	Low	High	High
D.	Natural resources	Degree of harm to local habitats (onshore and offshore) and ecological aspects	Medium	High	Low	Medium	Medium
E.	Air pollution	Difference in impact on air quality between alternatives.	Medium	Medium	Medium	Medium	Low
F.	Antiquity and heritage site	Proximity to archeological and heritage sites	High	High	Medium	Medium	High

Section	Subject	Criterion	Dor	Ein Ayala	Hagit East	Hadera WWTP	Meretz WWTP
G.	Integration of the facility in its environment in view of future assigned land use.	Compatibility with land uses	Low	High	Medium	Low	High If the facility will be placed in a disturbed area inside the perimeter of an existing facility
		Compatibility with assigned land uses	Medium	Medium	Low	Medium	Medium
		Directly adjacent to other uses	Medium	Medium	High if placed in the western part	Medium	High If the facility will be placed in a disturbed area in the perimeter of an existing facility
H.	Leisure and recreation	Degree of harm to the outdoor experience	Medium	High	Low	Medium	High If the facility will be placed in a disturbed area in the perimeter of an existing facility
I.	Landscape - visual	Degree of disruption of landscape in open spaces	Low	High	Medium	High	Medium

Section	Subject	Criterion	Dor	Ein Ayala	Hagit East	Hadera WWTP	Meretz WWTP
J.	Seismic	Degree of seismic risk evaluated based on the existence within the proposed alternative of active or suspected active faults, horizontal soil accelerations expected on the surface, Risk of soil failure and soil liquefaction, and risk of tsunami striking the site.	High	Low	High	Medium	Medium
K.	Noise	Onshore - Alternatives, in which plan impact on noise levels at sensitive receptors is smaller, are preferable.	Medium	Medium	Medium	Medium	Low
L.	Hydrogeology and soil	and impact on surface runoff into the facility's infrastructure and drainage solution	High	Medium	Low	Medium	Medium
M.	Potential for future expansion of the facility		Medium	Low	Low	High	High
Conclusion:			Medium priority	Medium high priority	Low priority	Medium	Medium priority

Section	Subject	Criterion	Dor	Ein Ayala		Hagit East	Hadera WWTP	Meretz WWTP
			This alternative's most prominent drawback is its landscape aspect. Advancing this alternative means promoting a material visual change in landscape and compromising the region's nature and image. If this alternative is adopted, we recommend specialized landscape-sensitive architectural planning.				priority	This site has a certain advantage over the Hadera WWTP alternatives, if it is advanced based on utilizing disturbed areas on the grounds of the existing facility.

<u>Table 2.1.6-4: Summary of evaluation of the pipeline routes from the treatment facility</u>

Section	Subject	Criterion	Dor	Ein Ayala	Hagit	Hadera WWTP		1
						Northern alternative	Southern alternative	
A.	Efficient use of land resources	Comparing the alternatives based on land consumption	Gas will be discharged eastward and to Hagit power-station via the existing Dor-Hagit pipeline. It does not require locating an additional pipeline route.	Gas will be discharged eastward and to Hagit power-station via the existing Dor-Hagit pipeline. It does not require locating an additional pipeline route.	The pipeline at Hagit goes all the way to the power station and the eastern gas-transmission route. It does not require locating an additional pipeline route	Medium	Medium	High
B.	Earth surpluses	Total scope of earth works (classified by mining and backfill) for establishing the facility including suggested solutions				Medium	Medium	Medium
C.	Natural resources	Degree of harm to local habitats (onshore and offshore) and ecological aspects				Medium	High	High
D.	Antiquity and heritage site offshore and onshore.	Proximity to archeological sites				Medium	Medium	Medium
E.	Integration of the facility in its environment in view of future assigned land use.	Compatibility with assigned land uses				Low	Low	Medium

Section	Subject	Criterion	Dor	Ein Ayala	Hagit	Hadera WWTP		1
						Northern alternative	Southern alternative	
F.	Seismic	Degree of seismic risk evaluated based on the existence within the proposed alternative of active or suspected active faults, horizontal soil accelerations expected on the surface, Risk of soil failure and soil liquefaction, and risk of tsunami striking the site				Medium	Medium	Medium
G.	Hydrogeology and soil	Risk of groundwater and surface water contamination, and impact on surface runoff into the facility's infrastructure and drainage solution				Medium	Medium	Low
Conclusion:						Medium priority with preference for southern route		High priority

2.1.7. Description of the evaluation criteria

See details in Section 2.1.5, above.

2.1.8. Quantitative criteria

For criteria, and method of calculating and evaluating the alternatives, see Section 2.1.5, above.

2.1.9. Micro-alternatives

Section 2.1 – Technological Alternatives, above, reviews the basic alternatives for gas treatment and their generic spatial articulation. After location alternatives have been selected and concomitantly with the detailed plan (in Chapters 3-5 of the Survey), the generic plan of the selected location alternatives and the station's micro-alternatives will be adjusted. This examination will be exploring options of minimizing environmental impact based on the alternatives' physical properties.

2.1.10. Summary of the Evaluation

The task of recommending suitable sites in which to develop receiving and natural gas treatment facilities is challenging, largely due to the complexity of the systems, the number of options (coastal entries, pipeline routes, and treatment facilities) and the variety of factors that were evaluated.

The evaluated criteria included a full range of environmental-landscape considerations that are commonly practiced in plan projects. In addition, we have noted that the planning team is preparing, concomitantly with the Environmental Impact Survey, a planning document to compare the alternatives based on additional non-environmental aspects such as economic, security, and, engineering considerations. These factors are therefore being examined in the parallel document. Together, both documents will assist the planning and environmental agencies in making the best possible decisions on all facets under discussion.

Note that all alternatives examined in this survey have in fact, passed the required threshold for all appropriate factors, and have been recommended for advancement under the Environmental Impact Survey at Stage 2 of the work.

Consequently, this chapter's goal is to select the preferred sites, explore the advantages and disadvantages of each of the sites and proposed pipeline routes, and ultimately recommend the optimal systems that will lead to the least conflicts when the detailed plan is applied to them.

Having completed the examination, it seems that **there is no expressly compatible location alternative**, **compared with the other alternatives.** Each alternative has its advantages and its disadvantages, its possibilities and conflicts. The proposed facility can be established in any of the sites and coastal entry points to and from the sites. However, in each case there are issues to address and improve, and measures must be proposed to minimize impacts and reduce risk to people, environment, and landscape, should the alternative be adopted.

For each of the five examined proposed treatment facility sites we recommend the following set of components:

Dor site – Coastal entry from Dor and ancillary pipeline to the Dor facility.

Ein Ayala site – Coastal entry from Dor and ancillary pipeline to the Ein Ayala facility.

Hagit East site – Coastal entry from Dor and southern route pipeline to Hagit facility.

Hadera WWTP site – Coastal entry from Hadera and ancillary pipeline to Hadera WWTP on its eastern and northern part. Pipeline from the treatment facility to the transmission system – the southern route to the Harish natural gas station is preferable.

Meretz WWTP site – Coastal entry from Nahal Alexander is preferable, and southern alternative of ancillary pipeline to Meretz WWTP is preferable. Pipeline from the treatment facility to the transmission system – on the only proposed route to Magal natural gas station. Due to environmental advantages of coastal entry and pipeline from Neurim, and despite the fact that this coastal entry may limit the facility to a single gas supplier, and the uncertainty regarding stability of the coastal cliff, we recommend that the detailed assessments are continued at the advanced planning stage and that this alternative is retained and reserved in the plan.

Selecting a northern array and southern array

As the planning team was asked to recommend one northern array and one southern array, here, too, the team was faced with a difficult dilemma:

Northern array – Ein Ayala was ranked medium-high preference. Dor was ranked medium when all parameters were added up, and **Hagit East** was ranked low preference mainly due to considerations of risk, natural resources, and hydrogeology. We therefore do not recommend advancing this alternative.

Ein Ayala site complex – is compatible on most parameters and even constitutes a form of recovery for the quarry and re-use of a disturbed cell. If this alternative is adopted, the site plan must apply risk-management that will consider the site-specific topography and climate conditions, as well as the interface with Road 4. Suitable protective measures must be applied.

Dor site complex is also suitable on most parameters, but is inferior on aspects of landscape and visibility. Advancing this alternative means promoting a material visual change in landscape and compromising the region's nature and image. If this alternative is adopted we recommend using specialized landscape architectural planning to overcome this highly complex challenge in view of the nature of the installations, and future restrictions on the area size.

We therefore conclude that for the northern system, Ein Ayala is preferable.

<u>Southern array</u> – There has been an extended debate regarding the Meretz WWTP and Hadera WWTP sites. **Meretz WWTP complex ranked higher** although the site's exploration zone is part of the landscape complex in NOP 35, which is an important aspect of this alternative, and despite a certain inferiority regarding noise and air-pollution. In an effort to minimize landscape modification a decision has been made, in conjunction with the planners, that advancing this site in the detailed plan **will be contingent on planning the main part of the treatment facility within the disturbed area, in the perimeter of an existing facility.** In this manner we are able to view the selection of the Meretz site as a form of rehabilitation of a disturbed cell, and re-use of the land. In addition, realizing the pipeline route to Meretz WWTP will require creative solutions such as horizontal drilling to prevent harming areas that are sensitive due to natural assets - Nahal Alexander area north and east of Road 2, the Kurkar ridge at Hirbat Samara, and the second Nahal Alexander crossing where it meets Road 20. **We recommend that implementing this alternative will be contingent on conducting such drills in the sensitive areas** and on including this work in the detailed plan. The alternative pipeline route from Neurim is more environmentally suitable, but there is some uncertainty concerning the coastal entry from Neurim. We recommend continuing with detailed evaluation during the advanced planning stage and reserving this option in the plan.

Hadera WWTP complex ranked medium. This site is compatible on most parameters but is inferior on the primary counts of risk. Part of it falls within the perimeter of a metropolitan park and assigned land uses in the pipe area partly overlap sensitive-area plans, and residential developments according to approved, and preparation-stage plans. If this site is advanced despite this, it will be necessary to try and improve the boundaries so that overlap with the park and public receptors in the existing industrial zone is minimized, and damage to sensitive areas along the pipeline route is kept to a minimum.

As noted above, alternatives were evaluated in three steps, as follows:

a. Comparison of the alternatives for each element of the onshore complex: (1) coastal entry, (2) gas transmission line to the treatment facility, (3) gas treatment facility, (4) treated gas transmission pipeline from the treatment facility on all evaluated aspects.

b. Selection of a preferred treatment system for each of the exploration zone alternatives (as noted, each complex contains elements 1-4, above).

c. Comparing the five alternatives for the complete complex, and ranking them according to the evaluated criteria.

The table below summarizes the ranking and evaluation of the treatment facility elements:

Table 2.10: Summary and scores for treatment systems

Alternative / Component of the treatment system	Dor North	Ein Ayala	Hagit East	Hadera WWTP	Meretz WWTP
Coastal entry	Dor	Dor	Dor	Nahal Hadera	Preserve two pipeline corridors: Neurim and Nahal Alexander
Transmission pipeline to the treatment facility			Southern route alternative		
Receiving and treatment facility					
Treated gas transmission pipeline from the treatment facility				Southern route alternative	
Conclusion	Medium-high preference	High preference	Low preference	Medium preference	Medium-high preference

Appendices

Appendix 1: Pipeline – Engineering Aspects

1. Introduction

In the Environmental Impact Survey of onshore sites for establishing natural gas treatment facilities – NOP 37/H – the pipeline route has been evaluated as an integral part of the proposed sites and their environmental impact. The first step was to outline a tentative route connecting the coastal entry to the facility, and the facility to two connection points on the national transmission system, one on the eastern line (Gezer-Hagit) and the second on the western line, through the sea.

Design of the tentative pipeline route in the planning-environmental document presented to the National Board on July 3, 2012 was based mainly on the standards and engineering requirements for the pipeline strip and on the route's compliance with the national, regional, and local outline plans, best possible compatibility and immediate adjacency with road and infrastructure and other utilities, land features, and other aspects.

In evaluating an onshore site alternative, the pipeline route was given priority both for its impact on the environment and for its feasibility. A pipeline route with greater feasibility, compatibility with land features and sensitivities, compatibility with planning and engineering parameters, will integrate more readily with the general transmission system. Consequently, a pipeline route will confer an advantage to an alternative if it is better integrated into its environment and if the degree of disturbance caused by establishing it is more limited. Conversely, a pipeline route with significant potential obstacles will lower an alternative's ranking.

Accordingly, the planning team conducted an in-depth re-evaluation of the initial proposed route, including a site tour, meetings with professional consultants, studying the land features and properties, addressing engineering aspects (e.g. the pipeline strip and engineering restrictions associated with establishing the route), addressing environmental and ecological aspects (e.g. animal passages, habitats, open spaces, and natural assets with a high environmental and ecological sensitivity), addressing planning aspects (e.g. compatibility with road and other infrastructure such as power transmission lines, fuel lines, wells, and protective zones), and addressing feasibility and implementation aspects (e.g. costs, availability, and setting up, etc.). Moreover, the pipeline-route evaluation was based on an outline of planning-environmental principles which is presented later in this paper.

The evaluation's findings were helpful in identifying potential hurdles along the route. The evaluation included a process of route improvement, and formulating and evaluating alternative routes.

The planning document below presents the process of outlining the pipeline route. We start with the methodology which includes the planning team's design concepts and principles, and the main considerations in outlining the route. Next, we present a description of the pipeline route for each site / complex, which includes a review of the route's properties, a reasoned evaluation of the selection based on all considerations, a list of potential obstacles, and a list of the differences between the route alternatives, if these exist.

This document is a background document for the Environmental Impact Survey and will be included in the Appendix.

2. Pipeline route: General description and main properties

This chapter presents the engineering assumptions and conditions, as well as planning, environmental, ecological, and feasibility principles used by the planning team to outline the pipeline strip alternatives from the coastal entries to the onshore treatment facilities, and from the facilities to the national transmission system.

2.1 Engineering aspects of laying the pipeline route

Engineering aspects address the following parameters: pipeline corridor from the sea to the on-shore receiving facility, pipeline corridor from the treatment onshore receiving facility to the INGL transmission system, building lines.

2.1.1 Width of pipeline corridor

- The pipeline corridor from the coastal entry to the receiving facility compliant with the various engineering technologies contains several lines:
  - Incoming gas line from the sea to final treatment at the receiving facility, diameter up to 36"
  - Pipe for removing excess water
  - Pipe for removing excess condensate[1]

[1]Excess condensate will be removed via an offshore or onshore transmission system. Offshore alternative - width of the pipeline strip from coastal entry to the onshore facility, includes an 8" pipe for removing condensate to the onshore facility, from there to be removed by ship. Onshore alternative - width of the pipeline strip to the eastern transmission system, includes space to run a condensate pipe to the eastern transmission system. In addition, according to NOP 37/B/8 a condensate pipe will run adjacent to the INGL gas pipeline and from there condensate will be discharged via the existing PEI lines to the ORL-Haifa facility. Another alternative is to use the existing PEI pipeline in coordination with PEI.

- o Communications cable (optical fiber)
- o Maintenance and control line Umbilical control cable – between the offshore facility and the onshore facility

- Treated gas will be transmitted from the receiving facility to the INGL national transmission system using two connections:
  - o Connection to the offshore transmission system
  - o Connection to the onshore transmission system

  Diameter of each gas pipe will be up to 36"

- Accordingly, and compliant with the plans and pipeline sections described in Figures 2.1-1 – 2.1-3:
  - o **Width of the pipeline corridor at the coastal entry** is 300-400 m
  - o **Required width of the pipeline corridor from coastal entry point to the onshore receiving facility** (treated-gas pipe from the receiving facility to the INGL national transmission system):
    - For the two-supplier alternative:**60 m**[2] with the addition of 90 m for building lines (45 m on either side of the pipeline corridor) = **150** (see Figure 2.1-1).
    - For the single-supplier alternative: corridor width is **40 m** with the addition of building lines (45 m on either side of the pipeline corridor) = **130** (see Figure 2.1-2).
  - o **Required width of the pipeline corridor from the receiving and treatment facility to the onshore INGL transmission system**, assuming a 36" diameter pipe is required, is 20 m, with the addition of 90 m for building lines = **110m**. In this context we note that INGL intends to reduce corridor width to 10 m when performance is completed so that in fact the statutory corridor will be 10 m (see Figure 2.1-3).

Note: In planning the required width of the pipeline corridor we planned a wider than required strip to preserve flexibility during performance. This was done due to conditions on the ground and the design concept prescribing immediate adjacency to infrastructure as far as possible. However, at this point a detailed coordination of infrastructure has not been conducted. Some of the proposed routes are parallel or perpendicular to other infrastructure, and some utility companies require a specific distance between their infrastructure and the gas

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[2]This corridor width will allow entry of two suppliers at different periods, burial of up to 9 pipelines of varying diameters up to 36".

pipeline. All these may contribute to reducing the corridor width during the detailed plan and performance.

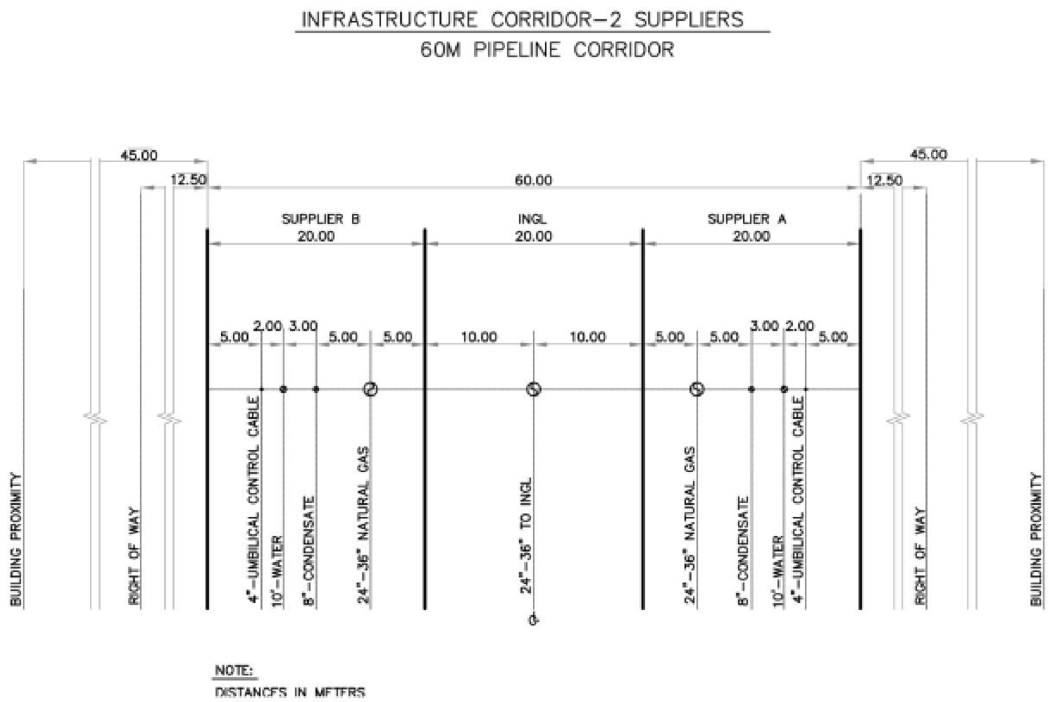


Figure 2.1-13: Two-supplier alternative

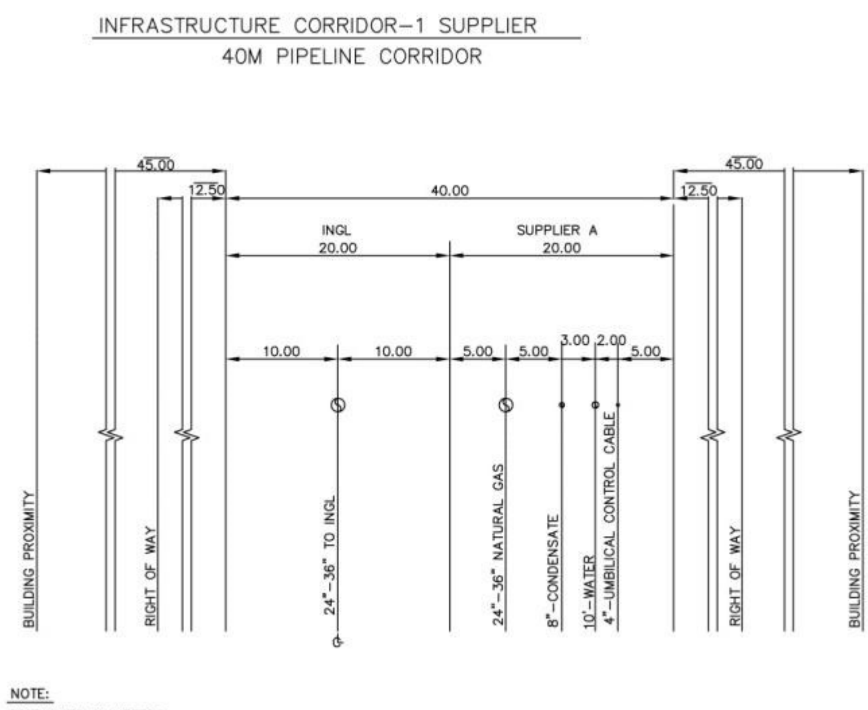


Figure 2.1-14: Single-supplier alternative

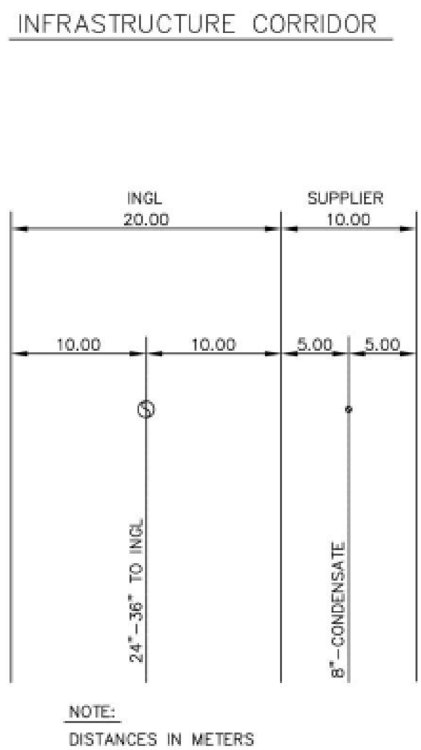


Figure 2.1-15: Required width of the pipeline corridor from the receiving and treatment facility to the onshore transmission system

2.1.2 Proximity of gas pipeline to various onshore infrastructure (building lines)

The following tables provide the required building lines from the gas pipeline.

- **Building lines from structures**

  The building proximities define the horizontal distance between the natural gas pipeline (or station fence) (e.g. block valve stations) and the outer edge of the residential building, buildings with significant infrastructure value..." (See IS 5664-2 F 3.2 1b). However, during the statutory/NOP stage this distance must be determined from the edge of the pipeline corridor and not from the center of the expected pipe. This will make it possible to plan and perform the gas line over the entire corridor area and still maintain the standard-required building lines (will not necessarily pass through the center line of the required corridor).

Table 2.1-1 below (Table F6 in Israeli Standard IS5664) shows the standard building line distances for this type of project. Distances, in meters, are based on the external diameter of the pipe and the planned pressure. In special cases, the standard allows reducing the building lines by half ("flexibility") subject to increasing pipe gauge and applying one of these two measures: (1) increasing cover height to 2 m, (2) installing concrete panels over the pipe. As noted above, this flexibility is only permitted in special cases where for various reasons it is impossible to comply with the standard building lines.

Table 2.1-1 Building lines from structures, as defined in IS 5664-2

Diameter	Proximity for building (m)80-110 bar design pressure
24"	25
30"	35
36"	45

- **Building lines from roads**

  Gas pipelines may be buried within the boundaries of the road building lines. They must not be buried within the boundary of the statutory right of way.

  Roads – building line 0, directly adjacent to the plan's blue line, unless a restriction is present in the road plan's guidelines. In any event, the pipeline must be constructed at least 5 m from the edge of the road. The pipeline can be laid within the building lines of the road. If the road in question is a by-road, this distance can be a little as 1 m when coordinated and agreed with the appropriate authorities (IS 5664 Section 6.5.4). On road crossings the default is crossing perpendicular to the road axis using a steel casing at a depth of at least at least 1.25 m from the pavement surface, unless otherwise agreed with the appropriate authorities.

  Railways – The parallel safety distance for railway tracks on the ground is 8 m from the center of the track nearest to the center of the gas pipe and 6 m from the track embankment to the center of the pipe (see IS 5664 Section 6.5.5). On rail crossings the default is crossing perpendicular to the track axis using a steel casing at a depth of at least 1.25 m from the pavement surface, unless otherwise agreed with the appropriate authorities.

- **Building lines from infrastructure**

  According to Standard IS 5664 the gap between parallel pipelines must be at least 0.4 m (see IS 5664-1 Section 8.1.5). However, if pipelines are not laid at the same time, the required distance is at least 5 m. Coordination is required with existing pipeline owners as well as suitable protective measures to prevent wear, corrosion, and other possible failures (IS 5664-1 Section 6.5.6).

Table 2.1-2 below lists the required distances from infrastructure:

Type of infrastructure	Horizontal distance	Vertical distances (on crossing segments)
Power lines and power poles	Surface power lines 30-35 m (exclusive of parallel aspect). Underground power lines distance of 5 m, power pole distance of 10 m	
Fuel lines	In coordination with PEI placing pipelines within the fuel strip is permitted (the strip is not statutory). In any event, instructions must be obtained from the infrastructure owner	3 m beneath the pipeline wall. In any event, instructions must be obtained from the infrastructure owner
Communication lines	Outside the strip, at a distance of 2 m	
Mekorot lines	Outside the strip, at a distance of 1 m. In any event, Mekorot requires a distance of 5 m from water lines	1 m beneath the pipeline wall. In any event, instructions must be obtained from the infrastructure owner
Wells and protective zones	Transmission of untreated gas and condensate through protective zones is prohibited. However, passing through these perimeters is subject to Ministry of Health relaxing the prohibition	Examine the route's required depth
Flight routes and landing strip	Subject to coordination with the Civil Aviation Authority or Ministry of Defense	
Distance from explosions	100 m from explosion zone	

- **Survey distance/ line**

  Survey distance defines the horizontal distance measured from the natural gas pipeline (or station fence) in both directions. The survey's goal is to classify the area in which the pipeline corridor will be laid. The survey includes examining land uses in this area to determine the safety coefficient for determining pipe gauge and other parameters required by the detailed plan for performance. Survey distance (m) is based on the external diameter of the pipe and the planned pressure. Note that during the statutory/NOP stage, this distance must be measured from the edge of the corridor and not from its center. The reason is that the pipe may eventually be planned or built on the outer edge of the corridor (i.e., not necessarily in the center of the approved corridor (see IS 5664-2 F 3.2 1a).

Table 2.1-3 below (Table F4 in Israeli Standard IS 5664-2) shows the standard survey by pipe diameter and pressure:

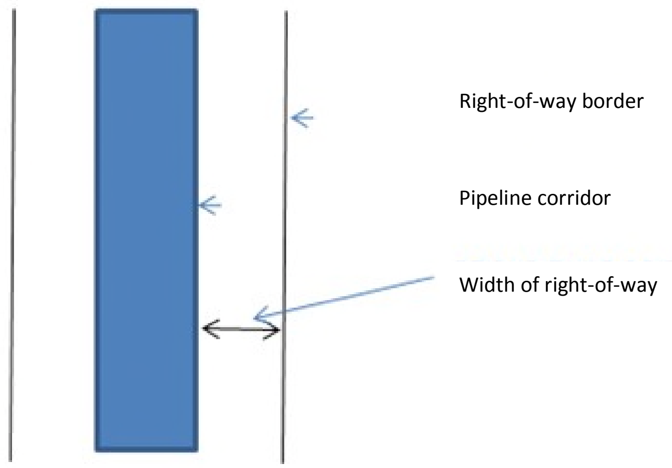
Diameter	**Survey distance (m) 80-110 bar design pressure**
24"	95
30"	120
36"	140

2.1.3 Steps of installing the pipeline

During the pipeline installation phase the following elements must be addressed:

- **Right of way**

  Right of way is the area in which performance contractors are permitted to conduct activities required for laying the pipelines. This strip is established during the detailed plan phase and is not a statutory strip. The pipeline corridor is always contained within the right of way. While work is ongoing this strip is on loan from its owners by virtue of the building permits, and existing activities must be stopped. Right of way width is usually derived from the planned pipe diameter and from the number of planned lines. A greater number of pipelines planned in the perimeter will require a wider right of way. See Figure ??? below, which shows the general structure of the pipeline strip.



At this point, the widest pipe will be 36" in diameter. Accordingly, required widths of the right of way strip are listed in **Table 2.1-4**, below.

Pipe width	Number of pipelines	Number of suppliers	Width of the right of way
36"	1	1	10 m from the pipe axis
36"	2	1	12.5-15 m on each side
36"	3	2 - Simultaneous array	15 m on either side of the pipeline strip (recommended)
36"	3	2-Stepwise array	20.5 m on either side of the pipeline strip (recommended)

Note, however, that it is possible to reduce the strip width in cases where gas pipelines are planned in environmentally or ecologically sensitive areas or in the vicinity of infrastructure, structures, archeological sites, etc. Note that by default the strip must be wide enough to allow executing the line using existing conventional methods, thus ensuring rapid execution of the line and saving on execution costs.

- **Road and rail crossings**

  The pipeline must, as far as possible, cross roads and railway tracks at a right angle. A decision must be made concerning the possible need for protection from third-party interference. This additional protection will include a layer of concrete, concrete panels, and additional cover or a clear warning sign installed on the pipe. Separation distances between the pipelines are not specified but should be sufficient to prevent damage during construction and operation (see IS 5664-1 Section 6.5.3).

- **Depth for burying onshore pipeline**

  According to IS5664 onshore pipelines must be buried such that the top of the pipe is at least 1.2 m deep. In areas where the pipeline passes near sensitive areas, the pipeline can be laid at a greater depth which will reduce the building lines.

- **Access routes**

  Access routes to and from the facility will be determined as part of the detailed plan. In addition, access routes to the work site and the rights of way will also be established. A right of way must serve, as far as possible, also as a service road.

  In addition, greatest possible use will be made of roads that are currently connected to Netivei Israel (National Transport Infrastructure Company Ltd.) e.g. access routes to Mekorot facilities, WWTPs, access routes to military installations, agricultural service roads, etc. As far as possible, make use of land assigned to public use (*matrukha*), existing agricultural roads or paths to reach the right of way. All the above must be coordinated with the appropriate authorities and the land owners.

- **Staging areas**

  Staging areas along the route of the pipeline strip are temporary and limited to the performance period. Staging areas are used to park heavy machinery, store pipelines, and for the field offices of the project administration and contractors. A 15 km long pipe corridor will require 2-3 staging areas of 2.5 to 4 dunams each.

  Staging areas will be identified at the detailed plan stage.

  Additional staging areas will be needed at the HDD entry point for connecting the offshore line to land. The required area is 60X60 m where the drill starts (rig side).

2.2 Land features – topography, landscape units and environment

It will be preferable both for environmental and engineering considerations to lay the pipeline route on level ground as far as possible, with a preference for agricultural or disturbed areas with clayey soil. A pipeline corridor route over hill margins or slopes will require earth works to level the right of way, driving up pipeline cost and entailing complex rehabilitation work. Calcareous or rocky soil will require more costly excavation works compared with burying the pipeline in softer soil that does not require excavation.

Features of the natural environment and their ecological value

In selecting a pipeline route, sensitivity and value of the open spaces must be addressed as these are impacted during performance and construction as well as during operations and maintenance of the pipeline. It is preferable to minimize as far as possible passage through valuable and sensitive areas; however, we are agreed that it is acceptable to route the pipeline also through nature reserves and national parks. Accordingly, the pipeline route proposed by the planning team has been designed, as far as possible, according to the following order of priority:

- Preference for passage through agricultural land, on existing service roads
- Routing directly adjacent to disturbed areas and/or other infrastructure.
- Routing on the verges of rivers, outside the river flood plain and sensitive habitats (maintaining a distance from the active bank area). Making a distinction between a river with natural features such as Nahal Tut and a river that has lost some of its natural qualities, such as Nahal Hadera.
- Routing through undisturbed areas – natural grounds, routing through margins (including margins of ecological passage).

In addition, local elements over the pipeline strip have been addressed, such as unique habitats, including springs, rare species, natural assets, etc.

Since some of the onshore site alternatives are located in areas of high environmental value, more careful study is required to identify a suitable route and find ways of addressing potential sensitive assets or obstacles on the ground. Despite this, any area disturbed during pipeline burial work will have its landscape and ecosystem rehabilitated as far as possible.

In highly sensitive areas, the planning team suggests routing the pipeline through an infrastructure tunnel in order to minimize harm to sensitive natural areas.

2.3 Planning Aspects

This evaluation addresses land uses and assigned land uses along the proposed route and in its immediate surroundings as well as the impact of and restrictions imposed by the pipeline route on future development.

Actual land use features including agricultural activity, built-up environment, etc.

- Routing through agricultural land and maintaining building line distances according to IS5664, is preferred
- This evaluation examines the extent to which the area is actively used by visitors and hikers and/or for other uses, as well as the manner/degree of disturbance as a result of pipeline work and/or the permanent stage

In addition, the plan in general and the pipeline route specifically require evaluation for compatibility with the approved plans (at various levels), with planning trends, and future development policies in the region. Accordingly, subjects/areas that require changes to the current plan to adjust them to the pipeline route, and areas that will require relaxing any restrictions must be specified. This will require maintaining established building lines from residential areas, and keeping track of plans that restrict infrastructure development, specifically according to other infrastructure plans. If the planning aspect is likely to become an obstacle, this must be shown.

2.4 Feasibility aspects

This evaluation of the feasibility of the onshore facility and outlining the pipeline is based on a number of criteria.

Investigation of **land uses** in the vicinity and perimeter of the proposed pipeline strip, including part of the infrastructure lines in the surroundings. This investigation assisted in deciding on and adapting the pipeline route to existing land cover, and keeping it compliant with accepted standards so that plan **feasibility and complexity of implementation** (both engineering and planning aspects) could be evaluated. In view of this, we also evaluated possible future encounters with conflicts and obstacles in the next stages of each alternative route.

Furthermore, after selecting the planning alternatives, aspects such as real estate, compensation, and detailed coordination with agencies, various parties, and stakeholders will be addressed.