Lagoon residential and recreational developments case study 2: Al Khiran Pearl City, Kuwait

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Abstract

Feasibility studies for sea city development on fifteen potential sites along the Kuwait coastline were carried out from 1987 to 1989. The conclusion of these studies was that six sites were suitable for major development of waterside cities, involving large scale excavation, dredging and reclamation works. A paper by Ealey, Holmes and Clark, which described the feasibility studies, was presented to the International Conference on Marinas at Southampton in 1989.

Work commenced on planning and environmental impact assessment for one of the six sites, at Shuwaikh in Kuwait City. This work was halted by the invasion of Kuwait in 1990. After the liberation of Kuwait, the authorities in Kuwait were reluctant to sanction the development at Shuwaikh, but Council of Ministers approval was obtained for four of the sites, one being at Al Khiran.

Work was commenced on a Master Plan for the Al Khiran site in 1994, but this was stopped later that year, due to lack of favourable support from the Authorities. Work commenced again on planning in 1997, and a new Master Plan was prepared. This new Master Plan has been presented to the Municipal Authorities for approval.

Site location

The site for the Al Khiran Pearl City development is adjacent to the Arabian Gulf coastline, some 85km south of Kuwait City, at N 28° 39' E 48° 23'. It is some 13km north of the border with Saudi Arabia. The site is situated to the south of the Ras Al Zawr promontory and lies immediately to the west of the existing Khiran Resort and extends over an area of approximately 6400 hectares.
The existing site contains two shallow creeks. One lies to the north of Khiran Resort (Khor Al A'ma), running some 4.5 km in a north-westerly direction, and the other (Khor Al Mufattech) to the south of Khiran Resort. The creeks have generally shallow water depths, increasing to approximately 4m below datum at their entrances.

The site terrain is very gently undulating and generally sandy. A number of weak rock ridges and outcrops are in evidence. In particular, there is a rocky ridge running down the coast and a series of outcropping ridges approximately 1.5km inland from the coastline.

**Existing development and infrastructure**

Al Khiran has been a popular recreation destination for several years. The Al Khiran Resort provides a highly popular weekend and holiday destination, which is often fully booked.

Private chalets have been built in a speculative and unplanned way along the existing shoreline and along the edges of the creeks. This has restricted public access to the coast, altered the natural environment, and placed considerable demands on the infrastructure.

The Mina Azzour Power Plant is to the north of the site, located on the coast. A series of high voltage power lines radiate from it and their alignment has to be safeguarded, or the lines may in places be rerouted.
Coastal Engineering and Marina Developments

The main north/south motorway is located just to the west of the site boundary and forms the main route between Kuwait City and the border with Saudi Arabia. An existing road leads from the motorway to the Al Khiran resort, and three single carriageway roads access the coastal chalets. There are several other tracks and telephone lines crossing the site, and their alignment will either have to be safeguarded or altered.

Existing oil and gas facilities and concessions are to be found adjacent to the site.

Much of the existing coastal fringe is already developed and in private leasehold ownership. The rights of existing owners and their access to the sea have to be respected. The master plan has therefore to accommodate existing development and integrate it into the proposed new infrastructure and development.

Development requirements

Planning Objectives

Al Khiran Pearl City is anticipated to have a population in excess of 100,000 when it is completed.

The primary objective is to develop Al Khiran Pearl City as a unique and attractive water-based development that encompasses local cultural traditions; tempers the harsh environment with good quality construction, landscaping and recreation facilities; and sets a high standard for waterside development in the Middle East.

The principal asset of the site is the opportunity to form large bodies of water from fairly flat and featureless sabkha, and to use excavated material to alter the site topography. This should be exploited to the full to maximise water access and to add interest to the site.

The development should have a positive impact on the ecosystem of the area. Marine and bird life will be encouraged to flourish through careful water management and improved ground cover from extensive and varied landscaping.

The development will be large and it will be essential to make it a unique and interesting City with a strong sense of place. This should be achieved by imaginative configuration of the water area, and by an overall design concept which has sufficient flexibility for adaptation and change. Extensive landscaping will be used to ameliorate the harsh environment and to give unity and identity to residential areas.

To enhance the attractions of the development a full range of facilities, including leisure and recreation, will be provided so that a self-contained community can thrive and flourish.

The layout of water areas should maximise water frontage for residential development. This is achieved by use of bays, inlets and islands.

The master plan should provide a variety and interest to the configuration of water areas that is compatible with site topography and prevailing wind and tidal flows. The design of the water area should take advantage of wind direction and
tidal flows to drive the exchange of water through the network of channels to ensure water replenishment and avoid water stagnation.

Existing coastal development and infrastructure should be integrated with the proposed development.

Marinas should be located near to the coast to facilitate navigation. An extensive network of navigation channels is proposed and, in order to facilitate access for larger craft, marinas should be located on the main channels near to coastal access. Location of commercial plots around marinas will enable them to be more easily identified from the water.

Bridges between islands should be carefully positioned so that navigation is not restricted. Bridges high enough to permit navigation of high masted craft are expensive to construct, are intrusive to the environment, and should not be located over main navigation channels.

Community facilities should be located where they will be easily accessible to all residents.

Public beaches should be provided for those without direct access to the water. Private courtyards with recreation facilities should be allocated for those plots that are not close to the shore.

The use of excavated and dredged material for ground modeling should be a priority from the start of development, together with the establishment of structure landscaping.

**Landscape Strategy**

The site has a bleak setting on the edge of the desert and needs to be visually screened to give an oasis of calm tranquillity from its harsh surroundings.

The site should be sheltered from the strong dust carrying winds to improve the microclimate.

Landscape within the development should be used to provide visual interest and identity and to give a distinctive character to different neighbourhoods.

Good quality materials should be used for both hard and soft landscaping.

**Employment**

In the very early stages of development most people will be temporary residents visiting the city at weekends and holidays, with employment in other parts of the country. However, as the city grows and attracts a more permanent population, the range of employment opportunities is also likely to increase.

Initially employment will focus on service jobs in retailing, leisure, catering, development maintenance and domestic service. As the city matures, opportunities for employment in education and health will also increase. It is unlikely that industrial or government employment will be significant. It is very likely, however, that Al Khiran Pearl City will provide first homes for a number of people employed in the oil and petroleum sector.
Phasing

The design layout should be structured so that each phase constitutes an integrated whole and is not dependent on later phases for its viability.

Existing wind and hydrodynamic environment

Winds

The wind rose for Kuwait Airport is shown in figure 2. It is drawn from meteorological records from May 1986 to April 1997. During this period there is a gap in the records corresponding to the invasion and occupation of Kuwait, and the data therefore covers an aggregate total of 10 years records.

The winds in the northern part of the Arabian Gulf are predominantly northwesterly and are referred to locally as 'Shamal'. Due to the fact that the general pattern of barometric pressure is similar both in summer and winter, the Shamal persists throughout the year. Thus winds from the northwest quadrant occur for some 43% of the time. There are, however, slight variations in the direction of the Shamal according to season, and winds frequently blow from the north quadrant, occurring for some 16% of the time. Southeasterly and southerly winds are generally associated with the short spring and autumn seasons (March to April and October to November) and occur for about 22% of the time. Winds from the southwest quadrant are generally of low intensity, and blow in an offshore direction.

Figure 2. Wind Rose
Tides

The tides within the Arabian Gulf are complex, ranging from semi-diurnal through 'mixed' to diurnal. The tidal range reduces from north to south along the Kuwait coastline. In Kuwait Bay the tides are semi-diurnal with the range being as high as 4.2m during spring tides and as low as 0.5m during neaps. Further south, near Mina Shuaiba, the tides are mixed, with a maximum range of about 3.1m. At the coastline at Khiran the tides are mixed with substantial semi-diurnal inequality, with a mean tidal range of about 1.6m, and about 2.2m at springs.

Currents

The currents in the Arabian Gulf are as complex as the tides. The high evaporation, low rainfall, and low water inflow from rivers leads to a circulation pattern that is typical for marginal seas in arid zones. Temperature cross sections in the Straits of Hormuz have indicated that cold water enters the Gulf on the north-eastern side and warm water leaves the Gulf on the south-western side. It is thought that there is a major anti-clockwise circulation system in the Gulf, which includes weak south-westerly flow over the Arabian shallow shelf.

The importance of wind effects on the current circulation pattern is not certain, but local wind effects can modify tide driven currents.

Adjacent to the Arabian Gulf coast of Kuwait the currents are generally parallel to the coastline. Data from studies at Shuaiba power station indicate that tidal currents off Mina Shuaiba are generally less than 0.5m/s. This same data indicated a net southerly drift of about 0.04m/s caused by the overall circulation in the Gulf.

Waves incident to a coastline at an angle will generate an alongshore current, which for a beach will be significant to sediment transport, as such wave induced currents will have higher velocities than both tidal and wind induced currents, particularly in very windy conditions. The sediment transport at the coastline at Khiran is predominantly in a north to south direction, which is indicated by the natural coastline features.

Wave Conditions

Wave conditions on the strongly embayed coastline of Kuwait are variable, depending on the shoreline orientation and exposure. However, nowhere can the wave climate be considered to be severe. The dominant wave direction is from the northwest to northeast sector, as would be expected from the wind conditions, with wave heights less than 1m for 95% of the time, and with wave period 3 to 5 seconds. Wave studies carried out by the Kuwait Institute for Scientific Research for the oil loading facility at Ras Al Zawr indicated that offshore maximum wave heights of 3m should be expected at least annually. The same study indicated an extreme wave height of 4m with a period of 8 seconds.

Winds acting on the fetch within the development will generate waves within the enclosed water bodies. Waves will also be generated by propeller and jet powered boats, and these waves can be sufficient to erode exposed beaches.
The principal elements that have determined the master plan layout are as follows:
- Existing coastal development and infrastructure adjacent to and within the development area.
- Land ownership and boundaries
- The tidal creeks (Khor Al 'Ama and Khor Al Mufatteh) whose opening to the sea are fixed by existing development.
- The topography, natural features and characteristics of the site.
- Prevailing wind direction and tidal flows.
- Maximising water access and frontage.
- Landscape and open-space hierarchy.
- Road layout and hierarchy
- Utility provision.

Figure 3. Master Plan
Existing Creeks

The site includes the existing creeks, which form key elements or constraints to development of the master plan. Their existing alignments and openings to the sea have to be respected as they form part of the natural topographic evolution of the site. In addition, the openings to the sea are fringed with existing chalets in private ownership. In developing the master plan the creeks have retained their significance and importance to the existing developments, as well as being important to the new Al Khiran Pearl City.

Other Topographical and Natural Features

In preparing the master plan the 'natural grain' of the site has been followed in terms of its natural features and characteristics. Though the site is generally flat and featureless sabkha, there are several rock outcrops and higher areas that have been retained because they are local landmarks and will form the basis of a more varied and interesting landform. These include two prominent rock ridges to the south of the Khor Al Muffateh.

Along the western part of the site the land begins to rise and this will form an area of hillside development using excavated material from dredging and excavation of the water areas.

Prevailing Wind Direction and Tidal Flows

The prevailing wind direction and tidal flows have formed a major influence on the way the master plan has evolved. The aim has been to work with the natural forces of nature and the bays and inlets have been aligned to benefit from the tides and the prevailing direction of wind.

In developing such a large area of water it is essential that the water is replenished by tidal and wind natural flushing processes, to facilitate water exchange, and eliminate possible areas of stagnant water.

Maximising Water Access and Frontage

The clear aquamarine-coloured water of the Arabian Gulf is the main asset of the site and provides an attraction and focus for the development. Experience throughout the world, and in other parts of the Middle East, has shown that villas with good water access and frontage are the most popular. In the general waterside area of the site it is planned that seventy percent of the villas will have a water frontage.

The two existing creeks and two new channels link the three separate water areas with the sea. It is intended to form an additional channel at the most southerly end of the site to enhance tidal water exchange with the sea, if this proves to be required by later detailed analysis of water flows. The areas of water have been configured with a series of bays and inlets and a network of channels, enabling a total of approximately 7,500 waterside plots to be built.

In preparing the master plan, bays and inlets have been formed in a varied...
way to create a series of ever changing views and vistas. Privacy has been maintained by making the channels 125 to 200 metres wide.

The master plan has been designed so that it can be divided into discrete stages of development and so that each phase of development will not be dependent on the completion of later phases, which may not be built for twenty or thirty years.

**Residential Areas**

A residential hierarchy has been adopted to give coherence and structure to the development. A range of services and facilities will be provided that will form an important component of a well-planned resort.

The smallest neighbourhood unit is the KCU (Kindergarten Community Unit) which serves about 500 plots, or approximately 3750 people. A KCU includes two local mosques, local shops, a kindergarten, public garden, and associated car parking.

The next level in the hierarchy of facilities is a PCU (Primary Community Unit) which comprises 3 KCU's and serves approximately 1,500 plots, or approximately 11,000 people. Facilities comprise two primary and intermediate schools, public garden, shops and car parking. Seven PCU's are proposed in the master plan.

An NCU (neighbourhood community unit) is provided for every two PCU's with a comprehensive range of facilities, and will serve 3,000 plots, or approximately 22,000 people. Intermediate and secondary schools are included as well as a full range of shops, a clinic, major mosque and public garden. Other facilities include a gas station, bus terminal, main substations and telephone exchange. Six NCU's are proposed in the master plan.

Land has been reserved for a city centre development on the western edge of the site. It will act as a link and focal point to Al Khiran New Town. It is likely to be developed when both cities are well established with settled populations.

In the general waterside areas, a large proportion of internal plots, without direct water access, have been grouped to focus on a community beach. A number of these community beaches have been provided along the shore line in different configurations so that everyone has water access, and an interesting and varied water edge can be created.

Internal plots, which are not within easy reach of beach, have been grouped around communal gardens, which could have a range of facilities such as tennis courts and swimming pools.

Hillside plots have been located on higher ground to the west and south of the development where excess fill from dredging and excavation will be used to form a more varied topography. Linear areas of landscaping will be provided between plots to act as a foil to the built form.

In total 15,000 residential plots are proposed in the master plan, of which 11,000 are in the waterside zones. The city centre would be further developed for a range of commercial, commercial residential, shopping and recreation facilities as the demand arises in the future.
Figure 4. Phasing of the Development

Two marinas have been provided, one at the north inlet, and the other at the south inlet. These marinas will be of 600-berth capacity.

Commercial plots have been located adjacent to marinas and large public beaches. These will also provide a range of apartments and hotel suites for those requiring rented or short stay accommodation. Higher buildings at these locations will also provide interesting and varied focal points within the townscape.

Phasing of the development

The Master Plan has been derived so that at the completion of each phase or part of phase, the development will not depend on any facilities, infrastructure and utilities to be installed in subsequent phases. This is most important, to ensure that the community grows in a steady and organic manner.

There are four principal phases, each divided into a number of part phases. These are shown in the phasing plan in figure 4.

The first phase is divided into five parts, and represents the initial growth of the development based on the Khor Al Mufatteh and Khor Al 'Ama, and the new
north channel. At the completion of the first phase, the development will have grown to a substantial waterside residential community of around 3,000 residential plots, complete with all neighbourhood facilities, as well as marina and leisure facilities.

The second phase is divided into two parts, and completes the northern waterway system. At the completion of the second phase, the development will have grown to approximately 6,400 residential plots.

The third phase is divided into three parts, and represents the development of the southern waterway system. At the completion of the third phase, the development will have grown to approximately 11,000 residential plots.

The fourth phase is divided into four parts, and comprises the development of the city centre, the western and southern ridges of hillside residential development, and the light industrial zone to the west of the Texaco concession area. It is quite possible that some parts of the fourth phase will be built at an earlier stage. For example, development of an area of the light industrial zone could start as soon as sufficient demand is generated for such activities as maintenance of buildings, appliances and cars. The growth of the city centre and of the northern hillside residential zone might begin as soon as phase 2 is completed. At the completion of the fourth phase, the development will have grown to approximately 15,300 residential plots.

The plan offers considerable flexibility in the development of Al Khiran Pearl City, and it is not essential to the growth of the development that the phasing is carried out in strict sequence. It will be readily possible to modify the extent and order of the phasing to suit the precise needs of the development as it progresses.

Figure 5. Aerial Perspective of Phase 1
Any change in the order or extent of phasing will need to take into account the hydraulic considerations of the waterways, but these restrictions are not unduly limiting, providing the waterways grow in a progressive manner, and providing consideration is given to limiting flow velocities in channels.

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