

## Business Bay – Dubai Creek Extension -Construction Management, Challenges and Results Part II – Project Details

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### Abstract

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**Purpose:** This paper describes and details the construction methodology and project management challenges during the execution of the creek extension water canal in the city of Dubai. This paper is a continuation of Part I under the title: Business Bay – Dubai Creek Extension - A man-made water canal dredged and extended to form a Waterfront Development within the Urban Fabric of Dubai City [1].

**Approach:** This paper demonstrates the day –to-day construction challenges with their resolution. By building an additional 13km of water canal, many challenges and obstructions were encountered during the construction operations of the project. From 11 million m<sup>3</sup> of excavated material, to road crossings, services and utilities diversions, high levels of underground water table, logistics management, all the way to connecting the creek with the Arabian Gulf.

**Findings:** Detailing some of these challenges and their solution shall be the focus of this paper. Starting from the excavated material, where the solution was to re-use the material for grading purposes across both sides of the new water canal. Another challenge was the road crossings and the process to divert the traffic then execute the works which includes deep excavations and building the quay wall. Several studies and extensive coordination was carried out with authorities to overcome this challenge. The underground water was a main obstacle to the construction works since the water table level was high in the area. All these challenges and much more had to be studied thoroughly and engineered prior commencing the works at site.

**Originality/ value:** the study will help to expand the knowledge on construction complexity of such mega projects by exploring challenges and studies in order to validate the pragmatism and constructability of the water canal to ensure insignificant disruptions on the surroundings.

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**Keywords:** Construction Management, Water Canal, Project Management, Dubai Creek, Construction Challenges

### Introduction

Dubai is located on the Eastern coast of the Arabian Peninsula, in the south west corner of the Arabian Gulf. The city is well known for its rich culture, diversity, and popularity. With thriving business community, luxurious hotels, sophisticated infrastructure, Dubai managed to be a very attractive city to tourists and businessmen receiving millions of leisure and business visitors each year [2].

Dubai Creek is a saltwater creek located in the Dubai city. The creek divides the city in to two main districts (Deira and Bur Dubai). The original creek was extended up to the wildlife bird's sanctuary, and then extended another 13Km in 2005 in order to connect it with the Arabian Gulf [3].

The creek initially was used to receive small vessels and fishing boats coming from India and Iran. The government realized the need to enlarge the creek depth in order to receive larger vessels to expand their trading business in 1961 and 1970 [4]. In 2003, the decision was made to connect the existing creek with the Arabian Gulf to form full navigational canal which will be a touristic destination as well as a real-estate development on both sides of the new water canal. The focus of this paper will be the methodology and challenges during the construction of the 13km man-made water canal connecting the existing creek with the sea.

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**Figure (1) Existing Creek and new creek extension**

Source: <http://www.halcrow-sh.com>

### **Project Planning**

In 2004, the designs and studies of the master plan and the phasing strategy were completed, and the outcome of the initial recommendation was to concentrate on the creek extension works. The water canal that will be excavated is approx. 13 km long and a width that varies between 80m (under the bridges) and 500m with a depth of 7.5m. The extension of Dubai creek will be tidal and passes through 5 phases to join the Arabian Gulf. The excavated material will be used for site grading and leveling on both sides of the new water canal to +3.50m above sea level and the bottom of the creek extension will be at -4.00m below sea level; the quay wall height will be 7.50m which will allow certain vessels and boats to sail through the water canal.

During the detailed design and tender documents preparation, several site surveys and investigations were carried out to highlight the site restrictions and challenges in order to be captured in the final designs and tender documents.

The focus of this paper will be 3 major construction challenges as defined below:

#### *A. Project Stages & Phasing Strategy*

*-Horizontal movement*

*-Road crossing*

*-Excavated Material*

#### *B. Water Quality and water modeling*

*-Underground water table levels*

*-Construction impact on the existing creek water*

*-Impact on the wildlife sanctuary*

#### *C. Creek final alignment*

*-Quay wall and block placing*

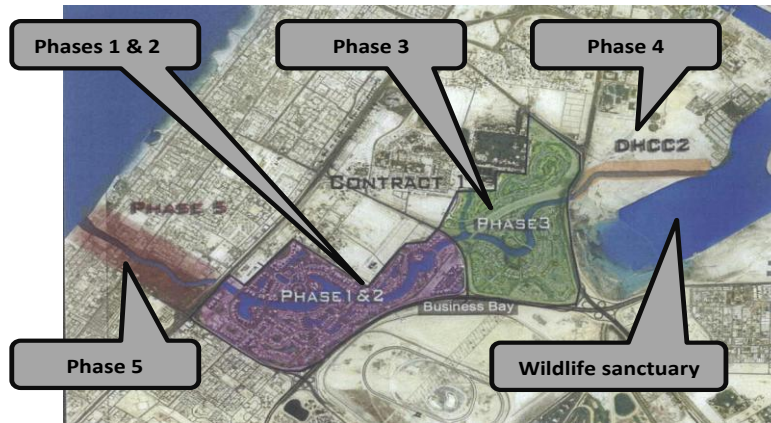
*-Sequence of construction*

*-Connecting the creek with the Arabian Gulf*

### **A. Project stages and phasing strategy**

Part of the detailed designs as described above in the intro, is to realize the project stages and phasing strategy to overcome the challenges and to be able to carry out the job with minimum disruptions to the surroundings.

Figure (2) Creek Extension Phasing Plan, Phase 1 & 2 (Business Bay), Phase 3, Phase 4, Phase 5



Source: Hammad, Ahmed, Business Bay – Dubai Creek Extension, P6, Figure 5

The overall creek extension project was based on five phases which were governed by the surrounding roads as shown in figure 1 and the below table:

Table 1: length of Creek Extension [5]

Phase	Limits	Length in Km
Phases 1 & 2	Sheikh Zayed Road to Financial Center Road	6.2
Phase 3	Financial Center Road to OudMetha Road	1.2
Phase 4	OudMetha Road to the original Creek (Wildlife sanctuary)	2.4
Phase 5	Sheikh Zayed Road to Arabian Gulf	3.3
Total Length		13.1

The road crossings scope was a major challenge on this project due to heavy traffic and the need to carry out a detailed infrastructure design and utilities diversions which was a separate scope and was covered under a different contractor since the appointed contractor was for the creek extensions works solely. The road crossings were carried out after the creek extension works which were completed in 2007.

Figure (3) Road Crossings



Source: Dubai Properties Group, Arial Photos, Project file

In addition to the above phasing strategy, a project staging plan was carefully introduced and reviewed by the team to study the execution methodology, logistics plan, and to control the project budget as follows:

- Stage 1: to build the creek extension water canal for phases 1, 2, 3 & 4
- Stage 2: site grading
- Stage 3: infrastructure, roads and services
- Stage 4: public areas including parks and plazas, schools, community centers, religious places and so on

### B. Creek Water Quality & Water modeling

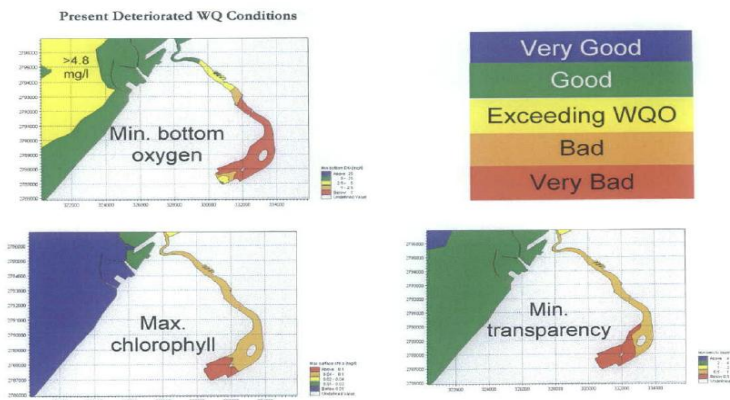
The water quality modeling was a key study carried out during the design stage to help the team to understand the water movement and the water quality level as well as the impact on the new developments viewing the creek which will dictate the new creek alignment and depth. The study was based on historical data retrieved from the authorities of the current creek water quality conditions in relation to Oxygen levels, Chlorophyll, and Transparency. This data was simulated in special software looking at several creek options, widths, depths and other factors.

The initial study was to understand the water quality of the existing creek prior any extension works in order to recognize the impact (positive and negative) and to realize the expected water quality of the new creek.

An extensive study of the creek hydrodynamics and water quality modeling was carried out in order to:

- Assess the impact of the new creek extension on the existing creek and wildlife sanctuary.
- Provide sustainable water quality in the new creek extension.
- Support the Environment Impact Assessment which was essential to assess the environmental consequences of the new creek extension project prior to the final decision to move forward with this major development.

**Figure (4) Original Creek water quality modeling**



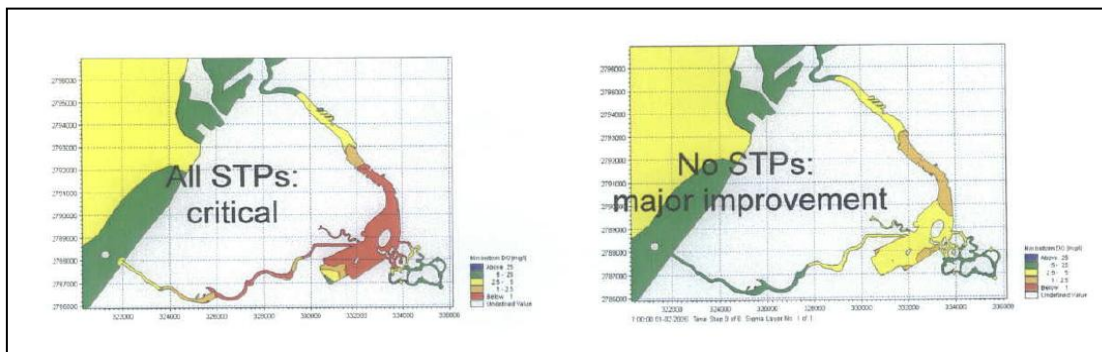
Source: Dubai Properties Group, hydrodynamic model, Project file

From figure 4 readings, the original water quality was not in a good condition and main reasons were:

- Confined water with limited water exchange since the original creek stops at the wildlife sanctuary which limits the water exchange and introducing oxygen to the lower levels of the creek through tidal mechanism.
- High nutrient loading due to sewage treatment plant discharge from one of the major STP's in Dubai.
- Other emergency sewage treatment plants discharge.

The water modeling simulation was reviewed after introducing the new creek extension as in figure 5.

**Figure (5) New Creek extension water quality modeling**



Source: Dubai Properties Group, hydrodynamic model, Project file

Major findings from the water quality simulation:

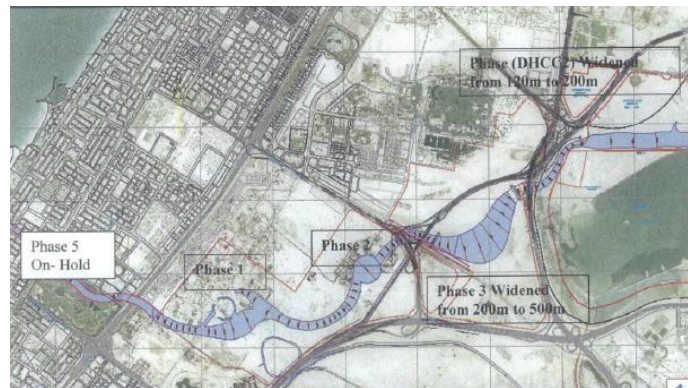
- No direct adverse water quality impact of the new creek extension on the original creek.
- Present sewage treatment plants causes critical conditions for the original creek, wildlife sanctuary, the new creek extension and ultimately the Business Bay project.
- New creek extension construction activities will not impact the water quality of the original creek.
- Tidal current speed will increase up to 15-25% when the full creek extension works are completed and connected to the Arabian Gulf.

### C. Creek Final Alignment

The water quality modeling study supported the developer with the decision to implement the new creek extension works since it will enhance the current conditions of the water quality.

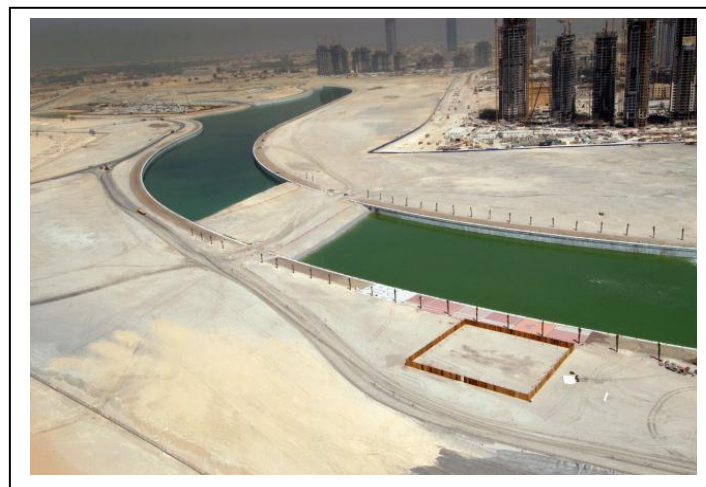
The study of the new creek extension concluded with the final creek alignment, width and depth as per figure 6.

**Figure (6) Final Creek extension alignment**



Source: Dubai Properties Group, Arial Photos, Project file & [www.halcrow-sh.com](http://www.halcrow-sh.com)

**Figure (7) Site photo – Final alignment**



Source: Dubai Properties Group, Arial Photos, Project file

The edges of the creek were designed as a quay wall consisting of 4 concrete blocks staggered to form the edge of the creek supported by its heavy concrete weight and allowing the water to penetrate between the block gaps to reduce water pressure on the quay wall. A geotextile material will be separating the blocks from the soil which will hold the soil fines from seeping in to the water. The final creek bid to be excavated up to minus 4m below sea level and the coping level will be at 3.5m above sea level.



**Figures9&10 Site Photo - dewatering ponds**

Source: Dubai Properties Group, Arial Photos, Project file

- Excavations:** 6 million m<sup>3</sup> of material which was initially expected to be cleared out from the water canal to reach the creek bid of -4DMD. Also by increasing the scope of work and changing the creek width at some areas, the total excavated material extended up to 11 million m<sup>3</sup>, and the excavations were carried out in stages; stage 1 is to excavate the full width of the water canal up to water table level, this activity was essential to set the canal out line, also to allow time to lower the underground water, and to manage the logistics of the excavated material to be moved and spread across the site. Stage 2 is to excavate up to the foundation level of the quay wall on both sides of the canal; stage 3 is removing the bulk material between both sides of the canal up to the final design level of the creek i.e. -4DMD. The excavated material was a major issue for the contractor and the developer. For the contractor this activity is time consuming and requires disposing of 11 million m<sup>3</sup> of sand to an approved site by authorities. For the developer, this will be an additional cost since each m<sup>3</sup> will cost as per the contract approx. US\$ 10. The decision which was made by the team is to use this material for general site grading for the Business Bay development to form a leveled area of +3.5DMD; however, this decision has forced the master planners to redesign all levels of infrastructure, plot entry levels, and roads. Nevertheless, the cost saving was worth the effort. Also, the excavated material was used for all roads embankments and site works.

**Figures(11&12)Site Photo - excavations activities**

Source: Dubai Properties Group, Arial Photos, Project file

- Quay Wall Block placing:** the blocks were made out of pre-cast concrete since it was designed without any steel or rebar to avoid corrosion over the years in order to protect the block. Around 25,000 blocks were required to be placed on both sides of the water canal. A logistic plan was set by the team to establish a pre-cast yard at the beginning of the project located in the middle of the water canal to avoid any impact on the infrastructure and roads works and to allow future developers to start their developments at any time.

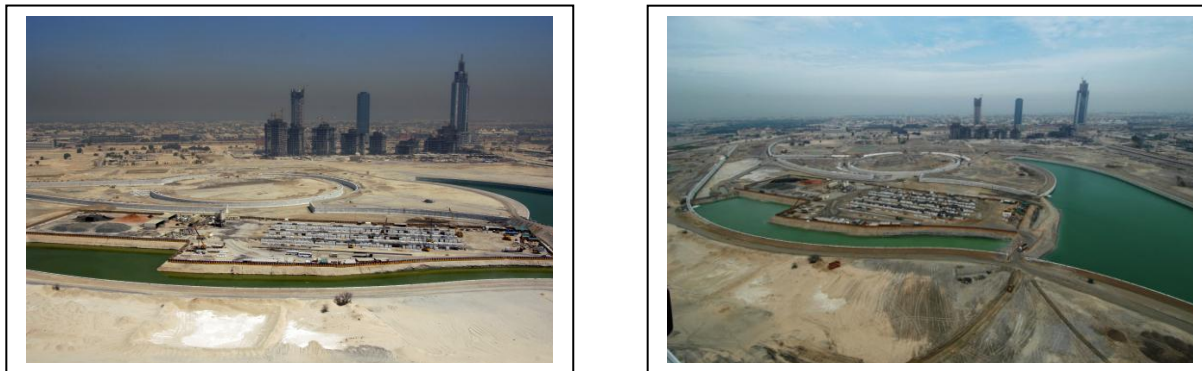
At start of block production, the production rate was 50 blocks per day then reached to 110 blocks per day at the peak of the project to cope with the aggressive project schedule. A batching plant was established at the pre-cast yard for blocks casting to reduce the waiting time of concrete supply which helped the production progress.

**Figures (13&14)Site Photo Blocks placing**



Source: Dubai Properties Group, Arial Photos, Project file

**Figures (15&16)Site Photo pre-cast yard**



Source: Dubai Properties Group, Arial Photos, Project file

4. **Promenade construction:** at the outer side of the quay wall, a 10m of promenade was designed to provide pedestrian walkway. Beneath the promenade and to support the quay wall blocks stability, rock fill was laid down surrounded by crushed rocks to work as filter layer. All this was covered by geotextile layer to hold fine soil and aggregates from seeping into the creek which will cause settlement in the soil under the promenade.

**Figures (17&18)Promenade before and after completion**



Source: Dubai Properties Group, Arial Photos, Project file



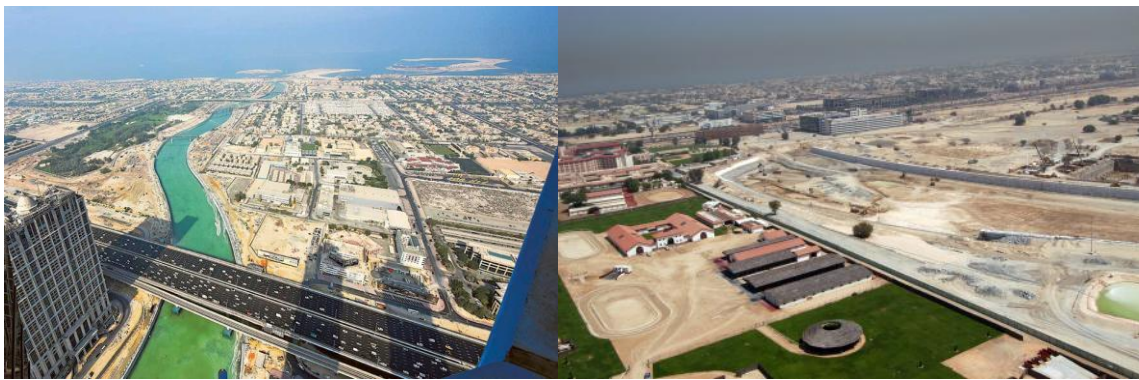
After completing the quay wall works and surveying the bottom level of the creek, dewatering pumps were turned off and the water was pumped back from the temporary ponds to the newer water canal (the new creek).

The infrastructure (roads, bridges, services, and utilities) followed by the construction of the buildings (on both sides of the new creek) was carried out by 3<sup>rd</sup> party investors and developers to form the new development of the Business Bay.

### Connecting the Creek with the Arabian Gulf

Phase 5 was the last phase of the project and was the most sophisticated phase since it requires road crossing through Sheikh Zayed road which is considered one of the busiest roads in Dubai. It connects Dubai city all the way to Abu Dhabi. This phase was difficult to be carried out by the developer and was handed over to the government of Dubai and was managed and supervised by the Roads and Transportation Authority in 2016.

**Figures (19&20) Sheikh Zayed Road before and after water canal crossing**



Source: [https://gulfnews.com/uae/transport/dubai-canal-opens-on-wednesday&Dubai Properties Group, Aerial Photos, Project file](https://gulfnews.com/uae/transport/dubai-canal-opens-on-wednesday&Dubai%20Properties%20Group,%20Aerial%20Photos,%20Project%20file)

The creek was finally connected to the Arabian Gulf in 2017 to achieve the original vision and having a full navigational water canal from the old Dubai creek to the sea.

**Figure (21) Creek connection to the Arabian Gulf Figure (22) Creek connection to the Arabian Gulf**



Source: <https://www.constructionweekonline.com>



Source: <http://dubaieye1038.com/photo-satellite-image-of-the-dubai-water-canal/>

### Summary:

This paper describes the final detailed designs along with the execution methodology and the actual construction activities which were carried out to build the Business Bay Creek extension. By excavating 11 million m<sup>3</sup> of material and spreading them on both sides of the creek, a major problem was solved and millions of dollars were saved. Connecting the original creek with the new creek was a major operation due to the volume of water that will flood in to the new creek. A special engineering solution was applied to overcome this challenge and to connect the creek at phase 4 with the original creek.

The connection of the creek was in phase 4 which is at the boundaries of the wildlife sanctuary. At this location, the concrete quay wall was not an option, therefore, the team had to think of another design solution which is more environmental friendly; the solution was a revetment design which contains rocks and geotextile was implemented along the wildlife sanctuary borders. The variances of width along the new creek between 80m and 500m have created a natural water feature which blended smoothly in the urban of the city and created a smooth transition between the original creek and the new creek extension.

Constructing such mega project required extensive engineering and planning strategy which shall benefit engineers and developers when carrying out such project in the future.

**Acknowledgment:**

Special thanks to Prof. Dr. Arch. Rizeq N. S. Hammad, Jordan University, Amman, Jordan for his support, review and encouragement

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