Technical Specification for
At Tina

1. SITE DESCRIPTION

1.1 Location

Governorate/ Region	Ash Sharqiyah
Wilayat	Sur
Distance from the Centre of Wilayat	Inside of Sur City
Nearest Locality	Sur
Fame of the Site/ Distinctive Features	Sur City
Facilities in the Site	None
Features of Surrounding Areas	Residential area

1.2 Natural Conditions

Climate Zone	Sharqiyah Zone
General Terrain	Flat plain
Geological Features	This tidal inlet forms a large shallow area of mudflats. Mangroves are mainly limited to the central southern edges at At Tina and Batah.
Soil	**(No. 1)** Surface soil of this area has basically a silty, clayey, loam texture. There is a water channel in this area. The area on western part of the water channel is used for playground and soils of this area are compact, fine sand. Shallow (50-70cm) and fine sand soils are covering the coastline of northeast beach. Soils at mangrove plantations are relatively deep and fine textured. Soil colours are greyish both in surface and subsurface layers with anaerobic condition. Water is stagnating during low tide at vegetation area. Details are shown in attached table **"Attachment 4: Soil Profile in At Tina (Sur) "** and **"Attachment 9: Soil Profile Samples in At Tina (Sur) Site No. 1".** **(No. 2)** This area topographically has a very gentle slope from jutted mountain to water channel. The area on Site No. 2 is covered by deep, sandy soil through layers with aerobic condition. Soil colours in surface layer are relatively bright yellowish and brownish colours. While, soil colours in subsurface are greyish. Many shell fragments are contained in subsurface layers at deeper than about 40cm. Upper tidal land, lying along the foothill of jutted mountain, has sandy soil and high salinity ground water (9%). According to the observation of surviving mangrove trees planted, only the trees on water channel are surviving and it seems that the water stress during low tide may have an effect on plant growth. In the mid-tidal area between jutted mountain and water channel, the topographical condition is almost flat. Stagnant water is on the surface and salinity of groundwater was not much different with surface water (almost 4%). Soils are deep and sandy through layers, and keeping aerobic condition. And there are many small water channels on this flat area. The soils on these channels are always saturated. The areas along the water channel are also sandy and deep.

	Details are shown in attached table **"Attachment 4: Soil Profile in At Tina (Sur)"** and **"Attachment 9: Soil Profile of Samples in At Tina (Sur) Site No. 2".** **(No. 3)** The area of Site No.3 topographically has a very gentle slope. Western part of this area is covered by coarse sand on surface, and coarse sand and a great many shell fragments on subsurface with aerobic condition. Shallow soils are observed on the foothill of northern mountain. On the other hand, the eastern part of the area is covered by big round stones and rocks. Details are shown in attached table **"Attachment 4: Soil Profile in At Tina (Sur)"** and **"Attachment 9: Soil Profile of Samples in At Tina (Sur) Site No. 3"**.
Water	**(No. 1)** During low tide, salinity of surface water was 4.2% and DO was about 2mg/l. Water circulation by tide was not good and salinity of surface water may change by conditions. Details are shown in attached table **"Attachment 5: Surface Water Quality in Khawr At Tina (Sur)"**. **(No. 2)** There were no significant constraints on the water quality of surface water. Value of salinity and COD was 4.1% and less than 2mg/l, respectively. Details are shown in attached table **"Attachment 5: Surface Water Quality in Khawr At Tina (Sur)"**. **(No. 3)** Surface water was clear. Details are shown in attached table **"Attachment 5: Surface Water Quality in Khawr At Tina (Sur)"**.
Fauna	Small fish (blennies) were observed. Fishing nets were common in the main channels of the mangroves. The landward zone around the mangroves contained holes of fiddler crabs (*Uca inversa*) in densities of about 100/m^2 while among the mangrove prop roots, the mud snail, *Cerithidea cingulata*, and holes of another fiddler crab (*Uca lactea*) occurred in densities of about 150/m^2. Two other species of crab were also recorded here, (*Eurycarcinus orientalis, Metapograpsus thukuhar*). Two more crustacean species occurred in the wet mud adjacent to the mangroves. The mangrove structure appeared more developed at At Tina. In the main channels, filamentous algal mats were abundant (*Lingbya* sp), covering the edges and becoming thicker towards the entrance to the bay. Under the algae the sediment of compact shelly sand and mud was a black anoxic layer. Only annelid worms were found in the sediment. Mud snails (*Cerithidea cingulata*) occurred on the surface and alpheid and penaeid shrimps and annelid worms occurred in side pools. Where the khawrs reach the main bay small areas of rocks are covered by oysters (*Saccostrea cucullata*) up to the high tide level. In the deep sandy substrate of the open Sur lagoon, the bivalves, *Dosinia alta*, and a large venus shell (*Amiantis umbonella*) were collected. Invertebrates recorded included 8 species of crustaceans. During winter, several hundred gulls and terns roosted on sandbanks in the middle of the lagoon while greater flamingos, waders and herons were numerous at the mouth of each khawr (17 species, 265 birds). Three species of molluscs were recorded.

Flora	On sandy areas around Sur lagoon two species of halophytic plants (*Suaeda*) were collected; however, At Tina and Batah were surrounded by a rocky shoreline or open sandflats and sabkha without vegetation. The drainage channels with mangroves along the edges contained algal mats especially near the entrance to the bay. These were blown in from across the bay and smothered young mangroves and the mudflats especially in the winter. The mangrove structure appeared more developed at At Tina where a nursery for mangrove seedlings has been built. The ground is more level here. At At Tina to the east, there are several water channels and the ground forms raised banks between them where mangrove bushes are still quite small.
Impacts from the Surrounding Areas	The main issue at Sur is water quality in the lagoon. Any leakage of domestic sewage into the lagoon will increase nutrients in the water and lead to degradation of the environment with algal growth and deoxygenation. The mats of filamentous algae are already a sign that nutrients may be too high. Fishing nets were common in the main channels of the mangroves. Management of waste discharge into the lagoon is required. The old septic tanks in old Sur town and old sewage pipelines need to be assessed and sealed if leakage is found. The new housing development proposed on the mainland between At Tina and Batah should have a sewage collection system that prevents any leakage into the lagoon.

1.3 Socio-economic Situation

Population of the Wilayat (2001)	65 thousand
Population of the Nearest Locality (1993)	41 thousand
Main Economic Activities	Fishery
Infrastructure	The area is developed as a recreational park near At Tina. Residents near the site. Nursery is established near Batah.
Main Usage	Used for recreational activities for people in the Sur city as well as tourists to Oman
Community Interference with the Area	Housing Development Plan near Batah. Landfill by local people for house construction. MRMEWR issued warning for this activity.
Cultural Significance	None

1.4 Legal Setup and Development Plans

Land Ownership and Land Use Designation	N/A
Development Plans in the Site and the Surrounding Area	Housing development project
Existing Conservation Proposal	None

2. PROGRAMME AND PROJECT

2.1 Prerequisite

Legal Setup for Land Use Control	See 4.2 Required Action for Conservation and Management
Facility Development Control	No permanent structure in NR, except hide for bird watching, sign and information boards, and boardwalk or pedestrian bridge. Footpath should be designated but not paved. No permanent commercial buildings such as restaurants, hotels, shops and mechanised amusement facilities in the park development area. Basic activities in this park are relaxation and picnicking. Partial lighting for safety only. Utilities lines (water and electricity should be at a minimum) and setback at 150 m from the edge of Mangrove.

2.2 Description of Programmes

Facility Development Programme	(1) Visitor service and information facilities development.
Restoration and Afforestation Programme	(2) Mangrove planting project
Monitoring Programme	(3) Mangrove monitoring project (4) Soil and Water Monitoring Project (5) Fauna and flora monitoring project (6) Pollution monitoring project (7) Monitoring project on legal setup and development plans
Public Awareness Programme	It will include an educational programme for school children and conservation campaign for residents of the Wilayat. Required materials and facilities are (8) Pamphlets and posters distributed to the residents, (9) Information boards describing significance of the natural environment.

2.3 Implementation Mechanism

Projects	Responsible Agencies	Implementing Body/ Agencies	Related Agencies
(1) Visitor service and information facilities development.	MRMEWR	Wilayat Sur	MCI
(2) Mangrove planting project	MRMEWR	Wilayat Sur	
(3) Mangrove Monitoring Project	MRMEWR	Wilayat Sur	
(4) Soil and Water Monitoring Project	MRMEWR	Wilayat Sur	
(5) Fauna and Flora Monitoring Project	MRMEWR	MRMEWR/ Omani Institute for Birds	
(6) Pollution Monitoring Project	MRMEWR	Wilayat Sur/ MRMEWR	
(7) Monitoring Project on Legal Setup and Development Plans	MRMEWR	Wilayat Sur/ MRMEWR	
(8) Pamphlets and posters distributed to the residents	MRMEWR	MRMEWR	MOE
(9) Information boards	MRMEWR	MRMEWR	MOE

2.4 Implementation Schedule

Project No.	1 st	2 nd	3 rd	4 th	5 th	6th	7th	8th	9 th	10 th
(1)										
(2)										
(3)										
(4)										
(5)										
(6)										
(7)										
(8)										
(9)										

3. IMPLEMENTATION PLAN

3.1 Restoration and Afforestation

3.1.1 Existing Mangrove Area

Location and Area	No natural mangrove vegetation areas. Seedlings were transplanted at tidal shores in March 2001. Areas of transplantation were 11,000m^2 in whole Sur area. **(Figure 2 Location Map)**
Conditions of Existing Mangrove	Many transplanted trees are dead. Few trees are surviving but not healthy. (Site No.1) Some of the transplanted trees in 2001 are surviving but they are not healthy. The second transplanted trees are growing well. (Site No.2) No mangrove vegetation. (Site No.3)

3.1.2 Plantation Area

Tidal Condition	Normal
Wave and Wind	South wind in summer, north wind in winter, 20% wave frequency in summer, 40% in winter
Flood	Every 5-10 years
Water Salinity and pH	Salinity; 4.1 ~ 4.2, pH; 7.9 (**"Attachment 5: Surface Water Quality in At Tina"**)
Soil Conditions	At At Tina area, soils are deep and sandy except the area of (No. 1). Surveyed data is in the **"Attachment 4: Soil Profile in At Tina"** of this technical specification.
Potential Area	**(No. 1)** No Potential. **(No. 2)** Very gentle shore along water channel. See "**Figure 3 Planting Map**". There are wide potential areas between water channel and shore near the foothill for new plantation. Upper shore near the foothill is not suitable due to high elevation. On this tidal zone, the ministry tried to plant new seedlings at near water channel and on flat tidal area. They are growing healthy. But the countermeasure against floating alga and/or seaweed may be necessary.

	(No. 3) Shore on eastern half of the area. See "**Figure 3 Planting Map**". Soil of this area is coarse sand. The shore on western half of this area has potentiality for mangrove plantation. Eastern half and the area along the coast have difficulties for plantation due to the stony and shallow soils. The countermeasure against floating alga and/or seaweed may be necessary.

Table 3.1 Location and Areas of Potential Planting Area(s)

	Designated Area	Area (ha)
Area-1	(1) in Figure 3 Planting map (Site No.2)	5.6
Area-2	(1) in Figure 3 Planting map (Site No.3)	2.5

3.1.3 Planting Schedule

Total Planting Area	8.1 ha
Planting Season and Timing	January ~ February
Seed/ Seedlings Supply Source and Location	Plant nurseries are in operation and taking a role of a seedling supply station for the regions of Ash Sharqiyah.
Planting Method	Start from on Site No. 3 and select areas with Site No. 2 alternately. Select grid spacing area (50m x 50m) and plant in a random order. Detailed technical guidelines should refer to the **"Technical Guideline for Afforestation"** attached with this technical specification.

Table 3.2 Planting Schedule

Year	1 st	2 nd	3 rd	4 th	5 th	6th	7th	8th	9 th	10 th	Total
Planting area-1											
Planting area-2											

Table 3.3 Seeds/ Seedling Supply Schedule

Year	1 st	2 nd	3 rd	4 th	5 th	6th	7th	8th	9 th	10 th	Total
Season/ time	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	
Planting area (ha)	0.95	0.95	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	7.88
Number of seeds/ seedlings (thousands)	9.5	9.5	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	78.8

3.1.4 Conservation Area

Area of Land Use	None

3.1.5 Required Action for Conservation and Management

Inspection	Daily observation by management body, 2 to 4 times of inspection by MRMEWR (Mangrove Information Centre)
Cleaning	Management Body
Replantation of Seedlings Growing Bad, Dead or Washed Away	MRMEWR (Mangrove Information Centre) for 5 years after plantation.
Service for Associated Facilities	Regularly by management body

Patrol and Enforcement	Daily ordinary patrol by a police office of Wilayat is required, and the park management body regularly inspects facilities conditions and littering and waste disposal to the ground and water in the area.
Restoration and Rehabilitation Work	The mangrove plantation work in the planting area described in the previous section is necessary.
Facilities Required for the Conservation and Management Activities	Directional signs along the highway and entrance to the access road(s), guide signs, and information boards can be seen in the area to explain the significance of the area and major flora and fauna. Footpath and boardwalk for observation of wildlife as well as mangrove are also necessary.

3.2 Monitoring

3.2.1 Mangrove

Monitoring Method	Label trees for monitoring. Monitor mangrove by using the attached **"Attachment 1: Field Monitoring Sheet for Mangrove"**. Planting mangrove: First 4 years: tree height, canopy X:Y After 4 years: follow monitoring sheet
Frequency	Planting mangrove: First 4 years: annual monitoring After 4 years: every 2 years
Monitoring Target	Planting mangrove: Select 20 trees at random and monitor them.
Baseline Data	No Baseline data

3.2.2 Soil and Water

Monitoring Method	Monitor soil and water in and around mangrove plantation by using attached table "**Attachment 3: Field Monitoring Sheet for Soil and Water (At Tina in Sur)**".
Frequency	Soil: (New plantation area) Before plantation and Every two years after plantation (Existing mangrove area) Every 2 Years Water; Every year (Outflow water at low tide should be measured.)
Monitoring Target	At least twice a year
Baseline Data	See attached table **"Attachment 4: Soil Profile in At Tina"** and **"Attachment 5: Surface Water Quality in At Tina".**

3.2.3 Fauna and Flora

Monitoring Method	Monitor fauna and flora by using the attached **"Attachment 6: Field Monitoring Sheet for Fauna and Flora and Pollution"**. For the observation of birds, an institute that is studying birds in Oman can be the best institute to take a part of the monitoring work by sub-contract base.
Frequency	At least twice a year
Monitoring Target	**Attachment 6**
Baseline Data	The result of field reconnaissance of fauna and flora is shown in **"Attachment 7: Result of Field Reconnaissance of Fauna and Flora in At Tina"**.

3.2.4 Pollution (garbage and waste)

Monitoring Method	Monitor pollution by using the attached **"Attachment 6: Field Monitoring Sheet for Fauna and Flora and Pollution".** Water Quality and Soil Sample Tests should be carried out by MRMEWR.
Frequency	At least twice a year
Monitoring Target	**Attachment 6**
Baseline Data	**See "Attachment 7: Result of Field Reconnaissance of Fauna and Flora and Pollution in At Tina".**

3.2.5 Change on Legal Setup and Development Plans

Frequency	At least once a year
Monitoring Target	Land Ownership, Land Use Designation, Development Plans in the Site and Surrounding Area

Figure 1 Key Map

Figure 2 Location Map

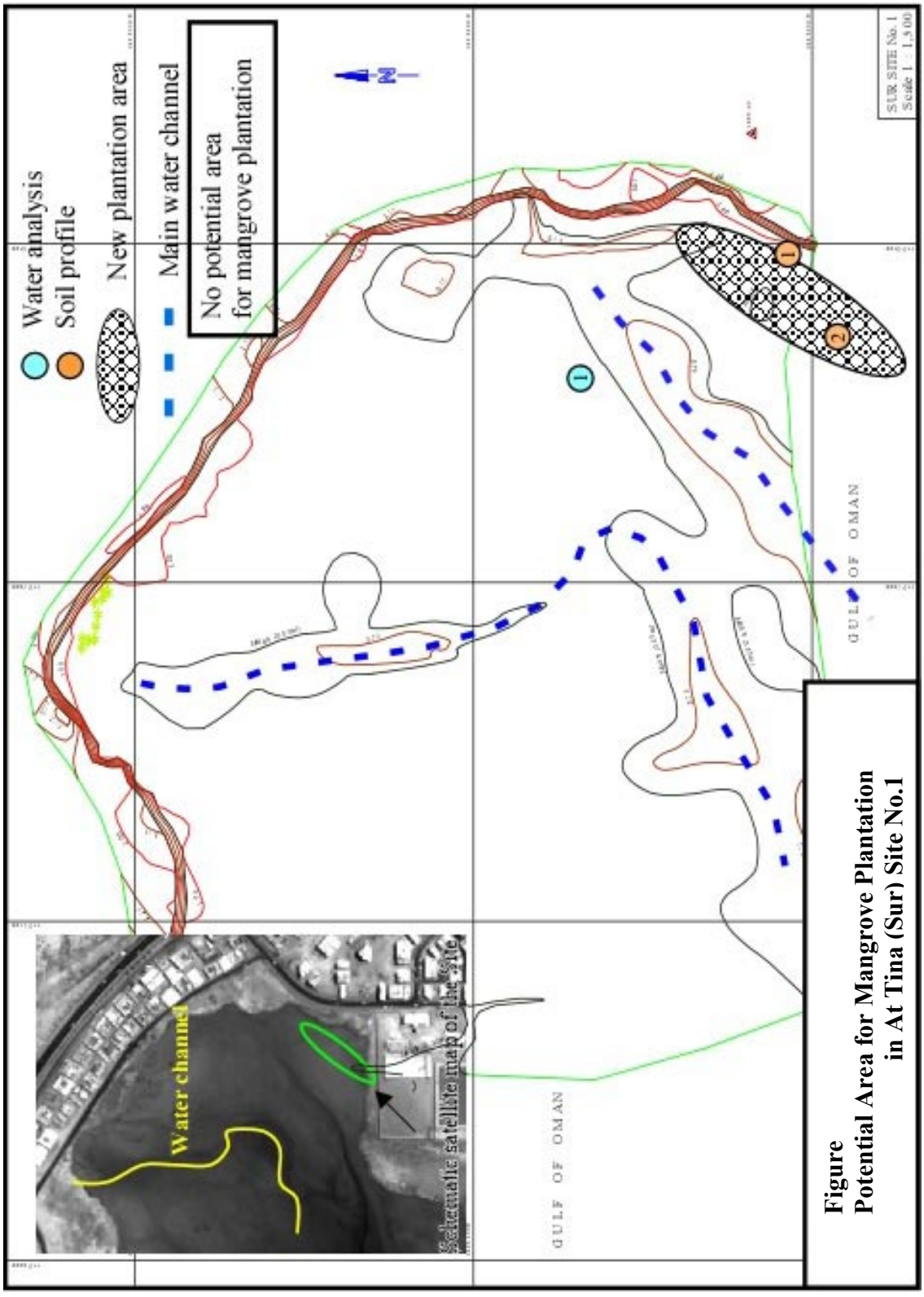


Figure 3 Planting Map (Site No. 1)

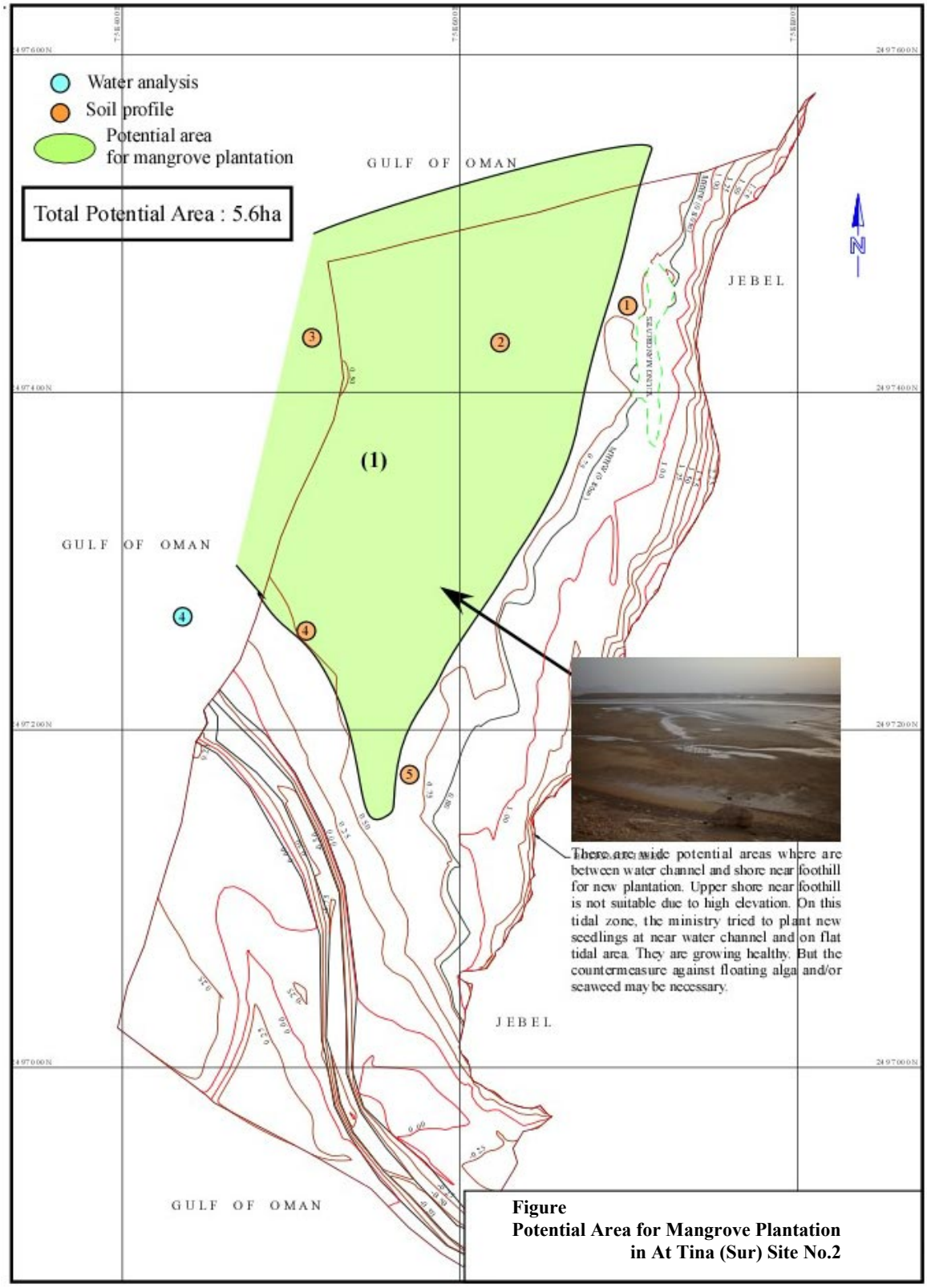


Figure 3 Planting Map (Site No.2)

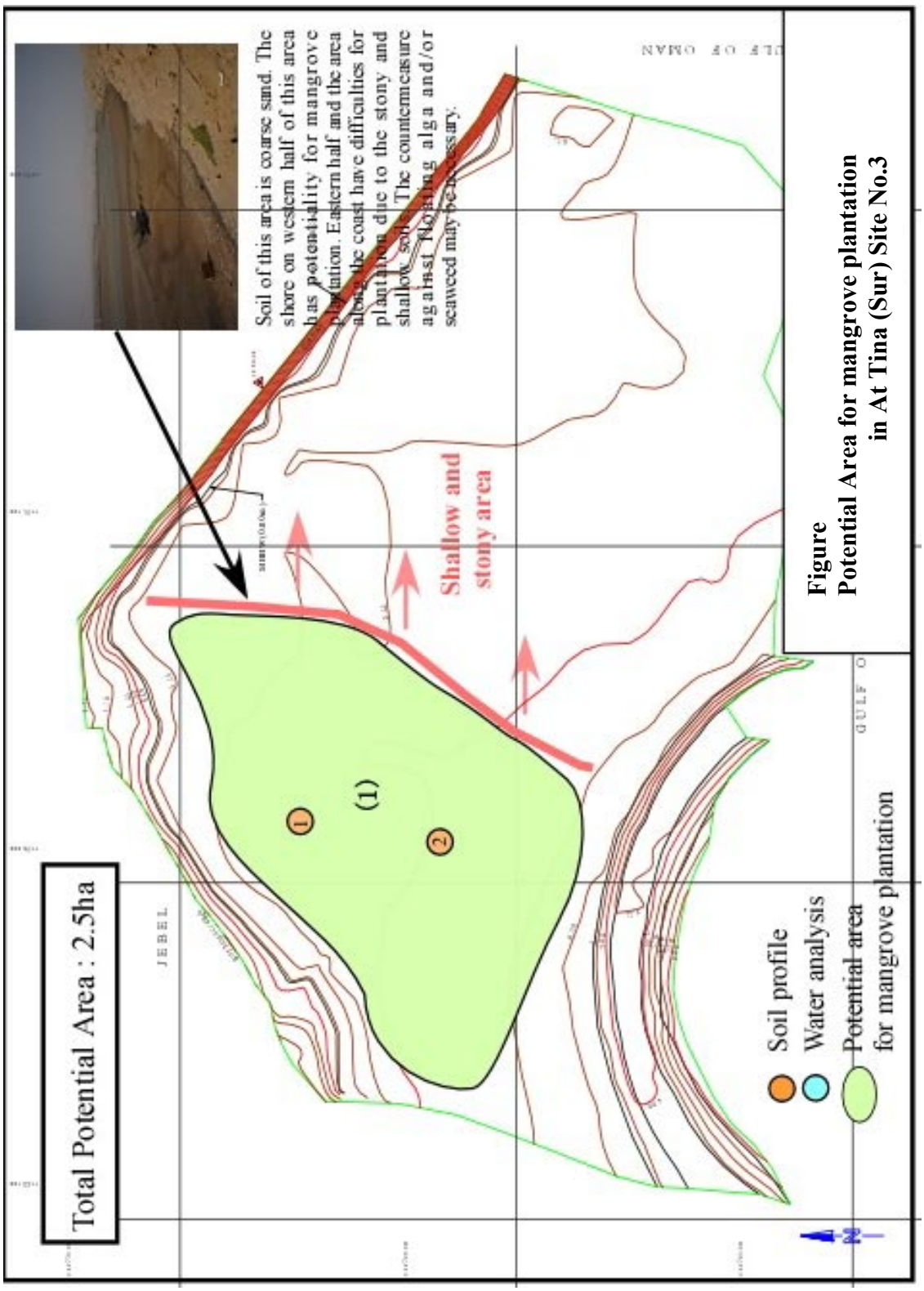


Figure 3 Planting Map (Site No. 3)

Attachment 1: Field Monitoring Sheet for Mangrove (At Tina (Sur))

Mangrove Observation Records

1) Identification No.

2) Location by GPS (WGS 84, UTM)

Easting: _____

Northing: _____

3) Photograph No. _____

Memo:
(specific information or data significant for the tree will be written here)

4) Observation of tree size and shape

a) Tree Height (cm) _____

b) Trunk diameter near bottom (cm) _____

c) Live branches at the position about 1.3m off the centre of tree bottom (painted)

Branch/ limb diameter measured in cm

1		2		3		4	
5		6		7		8	
9		10					

5) Observation of tree history, health and environment

a) History

Tree shape: _____

Sign of cut in the past: _____

b) Health

Nodes with leaves: _____

Inter-node length: _____

Leaf length: _____

Leaf colour: _____

Looks / die back: _____

c) Environment

Soil depth / texture: _____

Surface water Salinity: _____

Ground level: _____

Position: _____

Note:

Attachment 3: Field Monitoring Sheet for Soil & Water (At Tina (Sur))

Location	
Date / time:	/ ,200 :
Recorder	

General Condition in plantation area:

(garbage, rubbish, leaf, alga, crab, shell, etc)

●Soil ○ Water

(1) Soil Condition

		New planted area	New planted area	Young Mangroves① planted by MRMEWR
Coordinate	Easting			758500
	Northing			2497450
Surface condition				
Soil Texture	0-10cm			
	30-40cm			
	50-60cm			
Soil Colour	0-10cm			
	30-40cm			
	50-60cm			
Root development				
Depth of surface humus				
Free water	GWL* (cm)			
	pH			
	Salinity (%)			

Soil colour by Munsell notation, GPS*:by UTM of WGS84 GWL: Ground water level

(2) Surface Water Quality (Observation time: :)

		Mid khawr ② on water channel	Inner Khawr ③ near plantation
Coordinate	Easting	758520	759420
	Northing	2497000	2498360
Surface waste			
pH			
Salinity (%)			
Temperature (C)			
DO (mg/l)			
Turbidity / Colour			

Attachment 4: Soil Profile in At Tina

Profile No.	Location	Coordinate (UTM)		Ground Water			Texture			Soil Colour		Hardness	
		Easting	Northing	Depth (cm)	pH	Salinity (%)	Surface (0-30cm)	Sub-surface (30-60cm)	Deep layer (>90cm)	Surface (0-30cm)	Sub-surface (30-60cm)	Surface	Sub-surface
Su1-1	(Site No.1) Inmost swamp area of Sur bay, in plantation area	759447	2498204	-	8.1	4.6	Loamy	Sandy	Sandy	Grey	Dark greenish grey	Loose	Very friable
Su1-2	(Site No.1) Inmost swamp area of Sur bay, beside plantation area	759452	2498255	-	8.2	4.7	Loamy/ Sandy	Sandy/ Loamy	Loamy	Olive grey	Brown - grey	-	-
Su2-1	(Site No.2) Upper tidal area near foothills	758704	2497450	30	7	9.5	Sand	Sand	N.A.	Yellow brown-olive black	Grey	Very friable	-
Su2-2	(Site No.2)Upper tidal area near new plantation at mid-swamp area	758644	2497443	-	8	4.8	Sand	Sand	N.A.	Greyish olive	Olive black	-	-
Su2-3	(Site No.2)Tidal area near new plantation beside water course	758511	2497455	13	7.5	4.1	Sand	Sand	N.A.	Yellow brown-dark greyish yellow	Greyish olive - grey	Very friable	-
Su2-4	(Site No.2) Southern upper tidal beside water course	758509	2497251	17	7.9	4.1	Sand	Sand	Sand	Olive brown	Olive black	Very friable	-
Su2-5	(Site No.2) Upper tidal area near tip of cape	758575	2497166	46	7.5	6.1	Sand	Sand	Sand	Yellowish brown – dark greyish yellow	Greyish olive	Very friable	-
Su3-1	(Site No.3)Mid-tidal area at site	759008	2497255	3	8	4	Sand	Sand	N.A.	Yellowish brown - olive brown	-	(Very friable)	(Very friable)
Su3-2	(Site No.3) Upper tidal area near foothills	759000	2497181	5	7.9	4	Sand	Sand	N.A.	Brown - olive brown	Grey	(Friable)	(Friable)

Data of hardness in parenthesis by hand observation

Attachment 5: Surface Water Quality in At Tina (Sur)

No.	Location	Coordinate		Colour/ Visibility	pH	Salinity (%)	Tempera-ture (C)	DO (mg/l)	COD (mg/l)	NO3 ($mgNO^3/l$)
		Easting	Northing							
1	Near Nismah Bridge	-	-	±	8.1	4.1	29.4	7.60	-	-
2	Sea water outside of Sur bay	-	-	Clear	8.1	4.0	27.3	6.70	-	-
3	Inmost of Sur bay at Site No.1	759424	2498356	±	7.9	4.2	-	-	2+-	0
4	Water channel at new transplantation site at Site No.2	758464	2497446	Clear	7.9	4.1	-	-	0-2	0

Attachment 6: Field Monitoring Sheet for Fauna and Flora and Pollution (At Tina)

Location At Tina, Sur	**Date**
Time	**Tide**
Recorder	

Bird counts: species: number:

Expected winter birds: gulls and terns at low tide, waders, herons, flamingo
Expected summer birds: gulls and terns at low tide, waders, flamingos, herons

Pollution:
Evidence of: solid waste (garbage), liquid waste, oil.
Water quality: clear/muddy/green/salinity
Fishing: nets/etc

Domestic/feral animals:

Vegetation:
Surrounding land:

Channel:

Animals:
Landward fringe:
In the mangroves:
Channel:

Other comments:
Algal mats may reflect high nutrient levels in the lagoon

Attachment 7: Result of Field Reconnaissance of Fauna and Flora and Pollution in At Tina (Sur)

Field Monitoring Sheet for Fauna and Flora and Pollution Sample (1)

Location	At Tina, Sur	**Date**	30/12/2002
Time	09.00	**Tide**	Low tide
Recorder	N.V. Clarke		

Bird counts: species: 17 number: 265
Several hundred gulls and terns roosted on sandbanks in the middle of the lagoon while flamingo, waders and herons were numerous at the khawr mouth.
Conspicuous bird species: Curlew, Flamingo, herons

Pollution:

Evidence of:	solid waste (garbage), liquid waste:	garbage from houses
Water quality:	clear/muddy/green/salinity	clear
Fishing: nets		some

Domestic/feral animals: dogs

Vegetation:
At Tina is surrounded by open sandflats and sabkha without vegetation. The drainage channels with mangroves along the edges contained algal mats (*Lyngbya majuscula*) near the entrance to the bay. Other algae included *Ulva fasciata,* and *Chaetomorpha crassa*. The mangrove is regenerating.

Animals:
The central channel that extends furthest landward to the road was investigated. The upper mud zone around the mangroves had holes of fiddler crabs (*Uca inversa*) in densities of about 100/m^2. Among the mangrove prop roots of the upper channel, the sediment is filled with fibrous mangrove roots and black mud, and the mud snail, *Cerithidea cingulata.* and holes of another fiddler crab (*Uca annulipes*) occurred in densities of about 150/m^2. The purple xanthid crab (*Eurycarcinus orientalis*) also occurred here. No bivalve molluscs were found in the sediment at the channel edge. Wet mud and small pools had holes of 2 more crab species (*Serenella leachii* and *Macrophthalmus depressus*). An alpheid shrimp and annelid worm were also recorded. As two channels meet an area of young mangrove bushes (1 – 2 m high) provides about 40% cover over the muddy sand. Among the prop roots the snail, *Cerithidea*, reaches densities of 250/m^2, and crab holes (*Uca annulipes*) occur on raised mud patches. The sediment is a dark colour (anaerobic) under the surface and only 1 bivalve (*Dosinia alta*) was found. A brownish filamentous alga was growing attached to the prop roots.

In the main channel, filamentous green algal mats were abundant, covering the edges and becoming thicker towards the entrance to the bay. Under the algae the sediment of compact, shelly sand and mud was a black colour (anaerobic). Only annelid worms were found in the sediment. Mud snails (*Cerithidea cingulata*) occurred on the surface. Some fish, shrimps (*Palaemon* sp) and a portunid swimming crab were observed in the water. Abundant medusae (cf *Cassiopea andromeda*) were found in the adjacent channel. Where the khawr reaches the main bay a small area of rocks is covered by oysters (*Saccostrea cucullata*) up to the high tide level.

Other comments: Algal mats may reflect high nutrient levels in the lagoon

Field Monitoring Sheet for Fauna and Flora and Pollution Sample (2)

Location	At Tina, Sur	**Date**	26/07/03
Time	13.00	**Tide**	Mid tide
Recorder	N.V. Clarke		

Bird counts: species: 7 number: 250
Several hundred waders were feeding on the mudflats, gulls and terns roosted on sandbanks in the middle of the lagoon and herons were numerous at the khawr mouth.

Pollution:

Evidence of: solid waste, liquid waste:		A lot of garbage (e.g. plastic bags, dead goats) from the nearby houses
Water quality:	clear/muddy/green/salinity	clear
Fishing: nets		some

Domestic/feral animals: dogs

Vegetation:
Khawr Sleimiya is surrounded by open sandflats and sabkha without vegetation. The drainage channels with mangroves along the edges contained algal mats near the entrance to the bay.

The mangrove is regenerating between several channels.

Animals:
The upper mud zone around the mangroves had numerous holes of fiddler crabs and mud crabs (*Uca inversa*, *Uca annulipes* and *Macrophthalmus depressus*). Among the trees three more crab species occurred (*Eurycarcinus orientalis, Metopograpsus messor* and *Perisesarma guttatum*).

Mangrove crab (*Scylla serrata*) is reported from the channels here, but now rare. The small Pup fish or Kilifish, *Aphanius dispar,* was common in the channel.

Where the khawr reaches the main bay a small area of rocks is covered by oysters (*Saccostrea cucullata*) up to the high tide level.

Other comments:
Algal mats (*Lyngbya majascula*) may reflect high nutrient levels in the lagoon.

Attachment 8: Site Photos (At Tina, Site No. 1)

General Condition

Land reclamation and garbage

Northern corner of site

Mangrove Vegetation

Dwarf transplanted trees

Soil Condition

Inmost swamp area of Sur bay, in plantation area (Profile No. Su1-1)

Inmost swamp area of Sur bay, beside plantation area (Profile No. Su1-2)

Attachment 8: Site Photos (At Tina, Site No. 2)

General Condition

Shore on downstream

Shore on upper stream

Mangrove Vegetation

Transplanted trees at high tide

Transplanted trees on high elevation area

Soil Condition

Western upper area near new plantation beside water channel (Profile No. Su2-3)

Upper swamp near tip of cape (Profile No. Su2-5)

Attachment 8: Site Photos (At Tina, Site No. 3)

General Condition

Shore on west area of site

Rocky shore on east area of site

Soil Condition

Mid-swamp at site (Profile No. Su3-1)

Upper swamp near foothill (Profile No. Su3-2)

Attachment 9: Soil Profiles in At Tina (Sur) Site No. 1

(Profile Su1-1)

Location		Inmost swamp area of Sur bay, in plantation area		
Coordinate (UTM)			Easting: 759447	Northing: 2498204
Physiographic position		Lower marine terrace	Topography	Flat
Soil Classification			Typic Psammaquents	
Parent material		Marine deposit	Depth of free water	Surface water
Vegetation/ mangrove/ other		No vegetation except transplanted mangrove trees Observation of core sample *1		
Description of soil profile *2)				
C	0-3cm	Olive grey (10Y 6/2), silty, clayey and slightly sticky consistency; few very small roots; clear boundary		
C	3-25cm	Grey (10Y 4/1), silty, clay loam with loose, massive structure and sticky consistency; many black (10Y 2/1) mottles; few shell fragment; clear boundary		
C	25-37cm	Dark greenish grey (10GY 4/1), fine sand with loose massive structure; many dark greenish grey (10GY 3/1) mottles; very small roots; few shell fragments; gradual boundary		
C	37-48cm	Dark greenish grey (7.5GY 4/1), very friable, loamy sand with massive structure and slightly sticky consistency; common shell fragments; gradual boundary		
C	48-78cm	Dark greenish grey (7.5GY 5/1), very friable, loamy sand with massive structure and slightly sticky consistency; few shell fragments		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation

(Profile Su1-2)

Location		Inmost swamp area of Sur bay, beside plantation area		
Coordinate (UTM)			Easting: 759452 Northing: 2498255	
Physiographic position		Lower marine terrace	Topography	Flat
Soil Classification			Typic Psammaquents	
Parent material		Marine deposit	Depth of free water	Surface water
Vegetation/ mangrove/ other		No vegetation Observation of core sample *1		
Description of soil profile *2)				
C	0-4cm	Olive grey (10Y 5/2), sandy loam with massive structure and slightly sticky consistency; few shell fragments; gradual boundary		
C	4-23cm	Olive grey (10Y 5/2), loamy sand with massive structure; common grey (10Y 4/1) mottles; few shell fragments; clear boundary		
C	23-46cm	Olive brown (2.5Y 4/4), loamy sand with massive structure; common brown (10YR 4/4) mottles; clear boundary		
C	46-72cm	Grey (10Y 5/1.5,) silty loam with massive structure and slightly sticky consistency; many olive brown (2.5Y 4/4) mottles; diffused boundary		
C	72-98cm	Grey (10Y 4/1), silty, clay loam with massive structure and sticky consistency; few shell fragments; gradual boundary		
C	98-106cm	Grey (10Y 4/1), loamy sand with massive structure and slightly sticky consistency; few shell fragments		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation

Attachment 9: Soil Profiles in At Tina (Sur) Site No. 2

(Profile Su2-3)

Location		Western upper tidal area near new plantation beside water channel		
Coordinate (UTM)			Easting: 758511	Northing: 2497455
Physiographic position		Middle marine terrace	Topography	Flat
Soil Classification			Typic Psammaquents	
Parent material		Marine deposit	Depth of free water	13cm
Vegetation/ mangrove/ other		No vegetation		
Description of soil profile *2)				
C	0-18cm	Olive brown (2.5Y 4/3), loose, coarse sand with single grain structure; few shell fragments; gradual, smooth boundary		
C	18-30cm	Dark olive (5Y 4/2), coarse sand with single grain structure; many shell fragments; clear, smooth boundary		
C	30-42cm	Grey (7.5Y 4/1), coarse sand with single grain structure; many shell fragments		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation

(Profile Su2-5)

Location		Upper swamp near tip of cape		
Coordinate (UTM)			Easting: 758575	Northing: 2497166
Physiographic position		Upper marine terrace	Topography	Gentle slope
Soil Classification			Typic Psammaquents	
Parent material		Marine deposit	Depth of free water	46cm
Vegetation/ mangrove/ other		No vegetation		
Description of soil profile *2)				
C	0-18cm	Yellowish brown (2.5Y 5/4), very friable, coarse sand with massive structure; few shell fragments		
C	18-38cm	Dark greyish yellow (2.5Y 5/2), very friable, coarse sand with massive structure; common shell fragments		
C	38-45cm	Greyish olive (5Y 4.5/2), coarse sand with massive structure; common shell fragments		
C	45-72cm	Grey (7.5Y 4/1), coarse sand with massive structure; common shell fragments		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation

Attachment 9: Soil Profile Samples in At Tina (Sur) Site No. 3

(Profile Su3-1)

Location		Mid-tidal area at site		
Coordinate (UTM)			Easting: 759008	Northing: 2497255
Physiographic position		Lower marine terrace	Topography	Flat
Soil Classification			Typic Psammaquents	
Parent material		Marine deposit	Depth of free water	30cm
Vegetation/ mangrove		No vegetation		
Description of soil profile *2)				
C	0-6cm	Yellowish brown (2.5Y 5/6) and olive black (5Y 3/2) coarse sand and thin layers with single grain structure; clear, smooth boundary		
C	0- 27cm	Olive brown (2.5Y 4/4), coarse sand with single grain structure; great many shell fragments; clear, smooth boundary		
C	27-33cm	Yellowish grey (2.5Y 5/1), coarse sand with single grain structure; great many shell fragments		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation

(Profile Su3-2)

Location		Upper tidal area near foothill		
Coordinate (UTM)			Easting: 759000	Northing: 2497181
Physiographic position		Lower marine terrace	Topography	Flat
Soil Classification			Typic Psammaquents	
Parent material		Marine deposit	Depth of free water	5cm
Vegetation/ mangrove		No vegetation		
Description of soil profile *2)				
C	0-6cm	Brown (10YR 4/4) and olive black (7.5Y 3/1) coarse sand and thin layers with single grain structure; clear, smooth boundary		
C	6-36cm	Olive brown (2.5Y 4/3), coarse sand with single grain structure; great many shell fragments; clear, smooth boundary		
C	36-39cm	Grey (7.5Y 4/1), coarse sand with single grain structure; great many shell fragments		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation

Technical Specification for
Batah

1. SITE DESCRIPTION

1.1 Location

Governorate/ Region	Ash Sharqiyah
Wilayat	Sur
Distance from the Centre of Wilayat	Inside of Sur City
Nearest Locality	Sur
Fame of the Site/ Distinctive Features	Sur City
Facilities in the Site	None
Features of Surrounding Areas	Residential area

1.2 Natural Conditions

Climate Zone	Sharqiyah Zone
General Terrain	Flat plain
Geological Features	This tidal inlet forms a large shallow area of mudflats. Mangroves are mainly limited to the central southern edges at At Tina and Batah.
Soil	**(No. 4)** Sites No.4 and No.5 area located on the mouth of wadis. On site No.4, natural dense mangrove vegetation has grown on this khawr. Generally, the area on upper khawr has deep and fine soil texture. Soils of no vegetation area on upper khawr have deep and clayey texture. The area of mangrove vegetation at upper area of khawr is covered by loamy soil on surface but sandy in subsurface. On the area at front of mangrove vegetation at bay side, fine, sandy soils lie on surface, with covering of algae also. Salinity of groundwater on upper khawr is higher (5.5%) than the area under mangrove and bay side (4.5%). Details are shown in attached table **"Attachment 4: Soil Profile in Batah (Sur)"** and **"Attachment 9: Soil Profile of Samples in Batah (Sur) Site No. 4".** **(No. 5)** Natural dense mangrove vegetation has grown on this khawr. At the tidal areas in front of mangrove vegetation at bay side, a smallamount of algae is covering the surface but new young seedlings have developed rapidly. Soils in this area are deep–sandy loam in surface and sand in subsurface. In mangrove bush, surface soils are clayey and dark in colour, but soils in subsurface are sandy. Condition of groundwater shows similar condition with the area of Site No. 4. But groundwater near end of mangrove vegetation at upper khawr is very salty, sometimes more than 10% in salinity. Details are shown in attached table **"Attachment 4: Soil Profile in Batah (Sur)"** and **"Attachment 9: Soil Profile of Samples in Batah (Sur) Site No. 5".**

Water	**(No. 4)** Water was clear. Water channel under mangrove area was 4.5% in salinity, 6.9mg/l in DO and less than 2mg/l in COD. Details are shown in attached table **"Attachment 5: Surface Water Quality in Batah"**. **(No. 5)** There were no significant constraints on the water quality of surface water. Salinity of surface water in mangrove bush was 4.4% and the value of DO was 8.2 mg/l. Details are shown in attached table **"Attachment 5: Surface Water Quality in Batah"**.
Fauna	Small fish (blennies) were also observed. The landward zone around the mangroves contained holes of fiddler crabs (*Uca inversa*) in densities of about 100/m^2 while among the mangrove prop roots, the mud snail, *Cerithidea cingulata,* and holes of another fiddler crab (*Uca lactea*) occurred in densities of about 150/m^2. Two other species of crab were also recorded here (*Eurycarcinus orientalis, Metapograpsus thukuhar*). Two more crustacean species occurred in the wet mud adjacent to the mangroves. The mangrove structure appeared more developed at At Tina. In the main channels, filamentous algal mats were abundant (*Lingbya* sp), covering the edges and becoming thicker towards the entrance to the bay. Under the algae the sediment of compact, shelly sand and mud was a black anoxic layer. Only annelid worms were found in the sediment. Mud snails (*Cerithidea cingulata*) occurred on the surface and alpheid and penaeid shrimps and annelid worms occurred in side pools. Where the khawrs reach the main bay small areas of rocks are covered by oysters (*Saccostrea cucullata*) up to the high tide level. In the deep sandy substrate of the open Sur lagoon the bivalves, *Dosinia alta*, and a large venus shell (*Amiantis umbonella*) were collected. Invertebrates recorded included 8 species of crustaceans. Several hundred gulls and terns roosted on sandbanks in the middle of the lagoon while greater flamingos, waders and herons were numerous at the mouth of each khawr (17 species, 265 birds). 3 species of molluscs were recorded.
Flora	On sandy areas around Sur lagoon two species of halophytic plants (*Suaeda*) were collected; however, At Tina and Batah were surrounded by a rocky shoreline or open sandflats and sabkha without vegetation. The drainage channels with mangroves along the edges contained algal mats especially near the entrance to the bay. These were blown in from across the bay and smothered young mangroves and the mudflats especially in the winter. The mangrove structure appeared more developed at Batah where a nursery for mangrove seedlings has been built. The ground is more level here. At Batah to the east, there are several water channels and the ground forms raised banks between them where mangrove bushes are still quite small.
Impacts from the Surrounding Areas	The main issue at Sur is water quality in the lagoon. Any leakage of domestic sewage into the lagoon will increase nutrients in the water and lead to degradation of the environment with algal growth and deoxygenation. The mats of filamentous algae are already a sign that nutrients may be too high. Fishing nets were common in the main channels of the mangroves.

	Management of waste discharge into the lagoon is required. The old septic tanks in old Sur town and old sewage pipelines need to be assessed and sealed if leakage is found. The new housing development proposed on the headland between At Tina and Batah should have a sewage collection system that prevents any leakage into the lagoon.

1.3 Socio-economic Situation

Population of the Wilayat (2001)	65 thousand
Population of the Nearest Locality (1993)	41 thousand
Main Economic Activities	Fishery
Infrastructure	The area is developed as a recreational park near At Tina. Residents near the site. Nursery is established near Batah.
Main Usage	Used for recreational activities for people in the Sur city as well as tourists to Oman
Community Interference with the Area	Housing Development Plan near Batah. Landfill by local people for house construction. MRMEWR issued warning for this activity.
Cultural Significance	None

1.4 Legal Setup and Development Plans

Land Ownership and Land Use Designation	N/A
Development Plans in the Site and the Surrounding Area	Housing development project
Existing Conservation Proposal	None

2. PROGRAMME AND PROJECT

2.1 Prerequisite

Legal Setup for Land Use Control	See 4.2 Required Action for Conservation and Management
Facility Development Control	No permanent structure in NR, except hide for bird watching, sign and information boards, and boardwalk or pedestrian bridge. Footpath should be designated but not paved. No permanent commercial buildings such as restaurants, hotels, shops and mechanised amusement facilities in the park development area. Basic activities in this park are relaxation and picnicking. Partial lighting for safety only. Utilities lines (water and electricity should be at a minimum) and setback at 150 m from the edge of mangrove.

2.2 Description of Programmes

Facility Development Programme	(1) Visitor service and information facilities development.
Restoration and Afforestation Programme	(2) Mangrove planting project
Monitoring Programme	(3) Mangrove monitoring project (4) Soil and Water Monitoring Project (5) Fauna and flora monitoring project (6) Pollution monitoring project (7) Monitoring project on legal setup and development plans
Public Awareness Programme	It will include an educational programme for school children and conservation campaign for residents of the Wilayat. Required materials and facilities are (8) Pamphlets and posters distributed to the residents, (9) Information boards describing significance of the natural environment.

2.3 Implementation Mechanism

Projects	Responsible Agencies	Implementing Body/ Agencies	Related Agencies
(1) Visitor service and information facilities development.	MRMEWR	Wilayat Sur	MCI
(2) Mangrove planting project	MRMEWR	Wilayat Sur	
(3) Mangrove Monitoring Project	MRMEWR	Wilayat Sur	
(4) Soil and Water Monitoring Project	MRMEWR	Wilayat Sur	
(5) Fauna and Flora Monitoring Project	MRMEWR	MRMEWR/ Omani Institute for Birds	
(6) Pollution Monitoring Project	MRMEWR	Wilayat Sur/ MRMEWR	
(7) Monitoring Project on Legal Setup and Development Plans	MRMEWR	Wilayat Sur/ MRMEWR	
(8) Pamphlets and posters distributed to the residents	MRMEWR	MRMEWR	MOE
(9) Information boards	MRMEWR	MRMEWR	MOE

2.4 Implementation Schedule

Project No.	1 st	2 nd	3 rd	4 th	5 th	6th	7th	8th	9 th	10 th
(1)										
(2)										
(3)										
(4)										
(5)										
(6)										
(7)										
(8)										
(9)										

3. IMPLEMENTATION PLAN

3.1 Restoration and Afforestation

3.1.1 Existing Mangrove Area

Location and Area	Mouths of two khawrs located at Batah area are covered by mangrove. Total area of mangrove vegetation is **58 ha** approximately. **(Figure 2 Location Map)**
Conditions of Existing Mangrove	Mangrove trees have extended rapidly after the announcement of legal conservation 15 years ago. Mangroves at this area are basically healthy. Particularly the trees at beach front of khawrs, except for mats of alga Lyngbya at channel entrance, are tall and in good condition. The tallest trees reach more than 6 m. Many seedlings are developing at the tidal zone of two khawrs. Wide tidal zone in front of eastern khawr are covered by many healthy seedlings. Many seeds are observed after flowering season. Garbage is dumped at shorefront near Sukaykira village.

3.1.2 Plantation Area

Tidal Condition	Normal
Wave and Wind	South wind in summer, north wind in winter, 20% wave frequency in summer, 40% in winter
Flood	Every 5-10 years
Water Salinity and pH	Salinity; 4.5 %, pH; 8.0 **("Attachment 5: Surface Water Quality in Batah")**
Soil Conditions	Basically sandy soil at the area, silty soil near present vegetation. Surveyed data is in the **"Attachment 4: Soil Profile in Batah"** of this technical specification.
Potential Area	**(No. 4)** Bay side of khawr. See "**Figure 3 Planting Map**". Mangrove forest has developed on this area. In the bay side area of khawrs between Site No. 4 and Site No. 5, deep and fine sands cover the tidal land. But generation and expansion of seedlings is relatively poor. This condition is due to water flow. Seeds may not reach this area. This area will be a potential area for new plantation. **(No. 5)** Bay side of khawr. See "**Figure 3 Planting Map**". Mangrove forest has developed on this area. In the bay side area of khawrs between Site No. 4 and Site No. 5, fine sands cover the tidal land. But generation and expansion of seedlings is relatively poor. This condition is due to water flow. Seeds may not reach this area. This area will be a potential area for new plantation.

Table 3.1 Location and Areas of Potential Planting Area(s)

	Designated Area	Area (ha)
Area-1	(1) in Figure 3 (Site no.4)	2.1
Area-2	(1) in Figure 3 (Site no.5)	2.1

3.1.3 Planting Schedule

Total Planting Area	4.2 ha
Planting Season and Timing	January ~ February
Seed/ Seedlings Supply Source and Location	Plant nurseries are in operation and taking a role of a seedling supply station for the region of Ash Sharqiyah.
Planting Method	Start from the area near Site No. 5. Extend toward Site No. 4. Detailed technical guidelines should refer to the **"Technical Guideline for Afforestation"** attached with this technical specification.

Table 3.2 Planting Schedule

Year	1 st	2 nd	3 rd	4 th	5 th	6th	7th	8th	9 th	10 th	Total
Planting area-1											
Planting area-2											

Table 3.3 Seeds/ Seedling Supply Schedule

Year	1 st	2 nd	3 rd	4 th	5 th	6th	7th	8th	9 th	10 th	Total
Season/ time	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	Jun~Aug	
Planting area (ha)	0.46	0.46	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	3.8
Number of seeds/ seedlings (thousands)	4.6	4.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	38

3.1.4 Conservation Area

Area of Land Use	Housing Development Area

3.1.5 Required Action for Conservation and Management

Inspection	Daily observation by management body, 2 to 4 times of inspection by MRMEWR (Mangrove Information Centre)
Cleaning	Management Body
Replantation of Seedlings Growing Bad, Dead or Washed Away	MRMEWR (Mangrove Information Centre) for 5 years after plantation.
Service for Associated Facilities	Regularly by management body
Patrol and Enforcement	Daily ordinary patrol by a police office of Wilayat is required, and the management body regularly inspects facilities conditions and littering and waste disposal to the ground and water in the area.
Restoration and Rehabilitation Work	The mangrove plantation work in the planting area described in the previous section is necessary.
Facilities Required for the Conservation and Management Activities	Directional signs along the highway and entrance to the access road(s), guide signs, and information boards can be seen in the area to explain the significance of the area and major flora and fauna. Footpath and boardwalk for observation of wildlife as well as mangrove are also necessary.

3.2 Monitoring

3.2.1 Mangrove

Monitoring Method	Existing mangrove: Label trees for monitoring. Monitor mangrove by using the attached **"Attachment 1: Field Monitoring Sheet for Mangrove"**. Planting mangrove: First 4 years: tree height, canopy X:Y After 4 years: follow monitoring sheet
Frequency	Existing mangrove: Every 2 years Planting mangrove: First 4 years: annual monitoring After 4 years: every 2 years
Monitoring Target	Existing mangrove: 1) Sm-OT2: Coordinate Easting 758436 /Northing 2495452 2) Sm-OT3: Coordinate Easting 758570 /Northing 2495479 3) Sm-OT5: Coordinate Easting 758591 /Northing 2495633 4) Sk-OT1: Coordinate Easting 757908 /Northing 2496287 5) Sk-OT2: Coordinate Easting 757882 /Northing 2496283 6) Sk-OT3: Coordinate Easting 757808 /Northing 2496273 Planting mangrove: Select 20 trees at random and monitor them.
Baseline Data	Baseline data and monitoring trees are listed in **"Attachment 2: List of the Observed Points in Batah (Sur)"**.

3.2.2 Soil and Water

Monitoring Method	Monitoring soil and water in and around mangrove vegetation by using attached table "**Attachment 3: Field Monitoring Sheet for Soil and Water (Batah in Sur)**"
Frequency	Soil: (New plantation area) Before plantation and every two years after the plantation Water; Every year (Outflow water at low tide should be measured.)
Monitoring Target	At least twice a year
Baseline Data	See attached table **"Attachment 4: Soil Profile in Batah"** and **"Attachment 5: Surface Water Quality in Batah"**.

3.2.3 Fauna and Flora

Monitoring Method	Monitor fauna and flora by using the attached **"Attachment 6: Field Monitoring Sheet for Fauna and Flora and Pollution"**. For the observation of birds, an institute that is studying birds in Oman can be the best institute to take a part of the monitoring work by sub-contract basis.
Frequency	At least twice a year
Monitoring Target	**Attachment 6**
Baseline Data	The result of field reconnaissance of fauna and flora is shown in **"Attachment 7: Result of Field Reconnaissance of Fauna and flora and Pollution in Batah"**.

3.2.4 Pollution (garbage and waste)

Monitoring Method	Monitor pollution by using the attached **"Attachment 6: Field Monitoring Sheet for Fauna and Flora and Pollution"**. Water Quality and Soil Sample Tests should be carried out by MRMEWR.
Frequency	At least twice a year
Monitoring Target	**Attachment 6**
Baseline Data	See **"Attachment 7: Result of Field Reconnaissance of Fauna and Flora and Pollution in Batah"**.

3.2.5 Change on Legal Setup and Development Plans

Frequency	At least once a year
Monitoring Target	Land Ownership, Land Use Designation, Development Plans in the Site and Surrounding Area

Figure 1 Key Map

Figure 2 Location Map

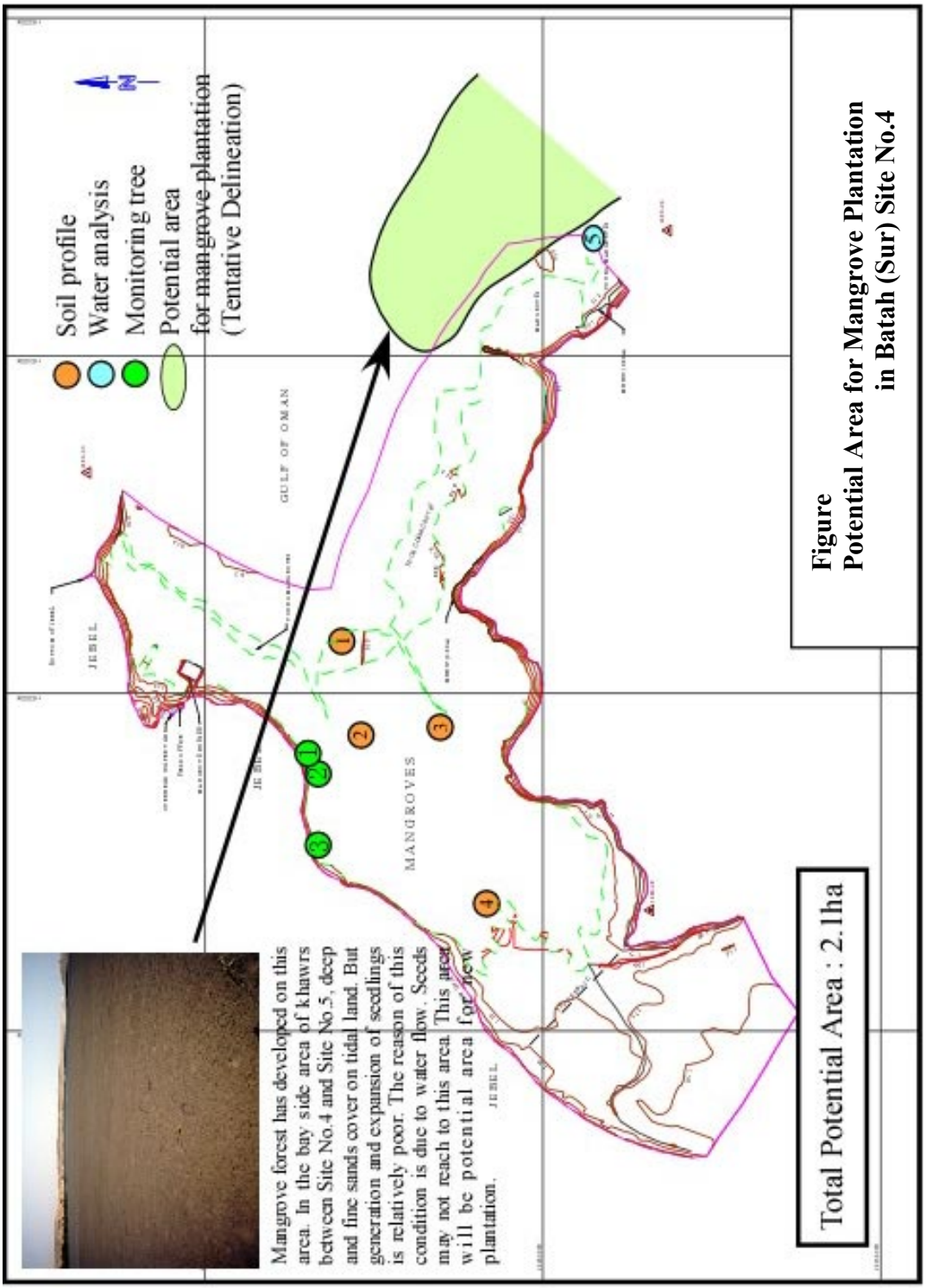


Figure 3 Planting Map (Site No. 4)

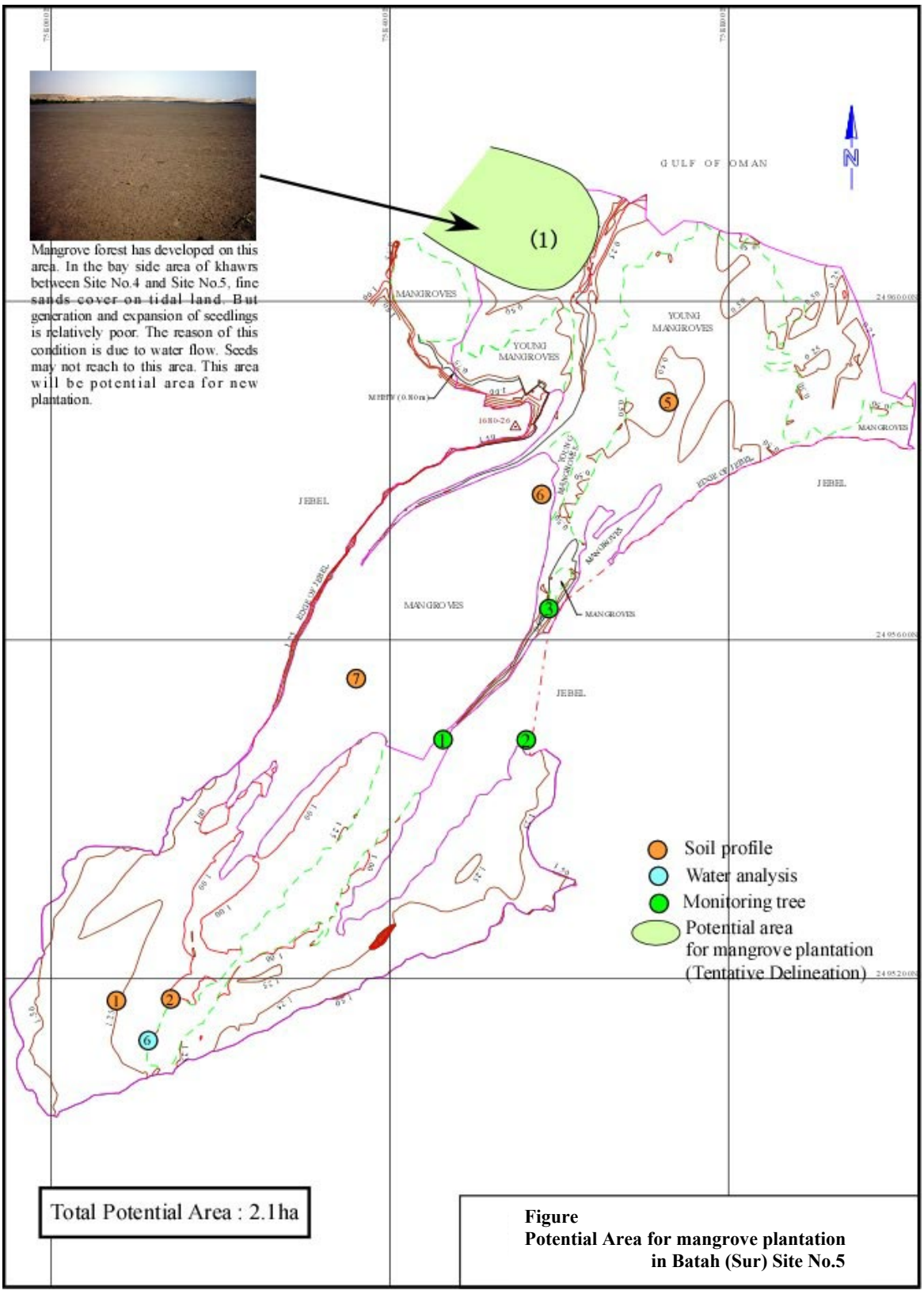


Figure 3 Planting Map (Site No. 5)

Attachment 1: Field Monitoring Sheet for Mangrove (Batah)

Mangrove Observation Records

1) Identification No.

2) Location by GPS (WGS 84, UTM)

Easting: _____

Northing: _____

3) Photograph No. _____

Memo:
(specific information or data significant for the tree will be written here)

4) Observation of tree size and shape

a) Tree Height (cm) _____

b) Trunk diameter near bottom (cm) _____

c) Live branches at the position about 1.3m off the centre of tree bottom (painted)

Branch/ limb diameter measured in cm

1	2	3	4
5	6	7	8
9	10		

5) Observation of tree history, health and environment

a) History

Tree shape: _____

Sign of cut in the past: _____

b) Health

Nodes with leaves: _____

Inter-node length: _____

Leaf length: _____

Leaf colour: _____

Looks / die back: _____

c) Environment

Soil depth / texture: _____

Surface water Salinity: _____

Ground level: _____

Position: _____

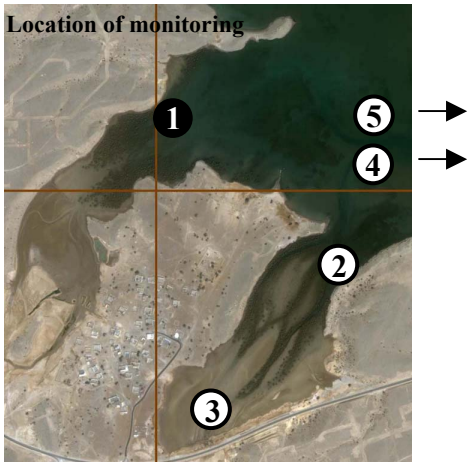
Note:

Attachment 2: List of the Observed Points in Batah

Khawr	Tree Number	Monitoring Trees	Date of Observation	Coordinate (UTM)		Photo Number	Height (cm)	Diameter (cm)										Remarks
				Easting	Northing			Trunk near bottom	Live branches at the position about 1.3m off the centre of tree bottom (DBH: Diameter Breast Height)									
									1	2	3	4	5	6	7	8	9	10	
Slaymiyah	Sm-OT1		23 Jul '02	758459	2495490		567		21	21	19	19	17	13	10	10	9.5	8	6 more branches
Slaymiyah	Sm-OT2	1	23 Jul '02	758436	2495452	batahtree1a & 1b	552		23	20	16	14	14	13	13	13	13	12	9 more branches
Slaymiyah	Sm-OT3	2	30 Dec '02	758570	2495479	batahtree2a & 2b	464		19	18	16	13	11	11	11	8.8	8	8	4 more branchs
Slaymiyah	Sm-OT4		30 Dec '02	758603	2495560		483		20	17	17	13	13	12	11	11	11	11	3 more branches
Slaymiyah	Sm-OT5	3	30 Dec '02	758591	2495633	batahtree3a & 3b	502		20	17	9.8	8.9	8.2	6.8	5.7	5.5			
Slaymiyah	Sm-OT6		30 Dec '02	758750	2495534		569		21	20	19	19	18	12	12	11	11	8.8	8 more branches
Skaykirah	Sk-OT1	4	22 Jul '02	757908	2496287	batahtree4a	580	60	25	21	17	10	6.5	6	6	5	5	5	
Skaykirah	Sk-OT2	5	22 Jul '02	757882	2496283	batahtree5a & 5b	600	65	23	22	13	13	12	10	5				
Skaykirah	Sk-OT3	6	22 Jul '02	757808	2496273	batahtree6a	495	100	27	23	19	16	11	9	9	8.5	6.5	6.5	2 more branches
Skaykirah	Sk-OT4		23 Jul '02	757710	2496129		315		12	12	12	12	10	8	8	7.5	5.5	5	4 more branches
Skaykirah	Sk-OT5		23 Jul '02	757683	2496086		260		12	11	10	10	7.5	7	6.5	6	6	5	1 more branch
Skaykirah	Sk-OT6		23 Jul '02	757670	2495956		195												
Skaykirah	Sk-OT7		23 Jul '02	757867	2496006		605		16	15	14	14	14	13	9	9	8	6.5	4 more branches
Skaykirah	Sk-OT8		23 Jul '02	757932	2496053		656		29	26	23	13	13	13	10	9			
Skaykirah	Sk-OT9		23 Jul '02	758287	2495487		490												
Skaykirah	Sk-OT10		23 Jul '02				465												

Attachment 3: Field Monitoring Sheet for Soil & Water (Batah)

Location	
Date / time:	____/____,200____ ____:____
Recorder	



●Soil ○ Water

General Condition in plantation area:

(garbage, rubbish, leaf, alga, crab, shell, etc)

(1) Soil Condition

		New planted area	New planted area	Exist. mangrove area ①
Coordinate	Easting			757900
	Northing			2496230
Surface condition				
Soil Texture	0-10cm			
	30-40cm			
	50-60cm			
Soil Colour	0-10cm			
	30-40cm			
	50-60cm			
Root development				
Depth of surface humus				
Free water	GWL* (cm)			
	pH			
	Salinity (%)			

Soil colour by Munsell notation, GPS*:by UTM of WGS84 GWL: Ground water level

(2) Surface Water Quality (Observation time: :)

		Khawr mouth ②	Upstream khawr ③	Sea water ④	Mouth of Sur Bay ⑤
Coordinate	Easting	758570	758150	-	-
	Northing	2495600	2495150	-	-
Surface waste					
pH					
Salinity (%)					
Temperature (C)					
DO (mg/l)					
Turbidity / Colour					

Attachment 4: Soil Profile in Batah

Profile No.	Location	Coordinate (UTM)		Ground Water in profile			Texture			Soil Colour		Hardness	
		Easting	Northing	Depth (cm)	pH	Salinity (%)	Surface (0-30cm)	Sub-surface (30-60cm)	Deep layer (>90cm)	Surface (0-30cm)	Sub-surface (30-60cm)	Surface	Sub-surface
Su4-1	(Site No.4) Front of dense mangrove tree at bay side	758051	2496222	0	7.5	4.5	Sand	Sand	Sand	Olive black	Olive black	(Friable)	(Friable)
Su4-2	(Site No.4) In dense trees near mouth of khawr	757907	2496226	-			Clayey/ loamy	Sandy	Sandy	Olive black	Olive black	(Very friable)	(Friable)
Su4-3	(Site No.4) Central area of vegetation	757788	2496126	0	7.5	4.5	Loamy	Sandy	Sandy	Olive black - grey	Olive grey - dark grey olive	(Very friable)	(Friable)
Su4-4	(Site No.4) At end vegetation at upper swamp	757756	2496056	30	7.5	5.5	Sandy/ loamy	Sandy	Loamy	Olive brown	Grey	(Loose)	(Friable)
Su5-1	(Site No.5) Open swamp at upper wadi near road to Had	758082	2495171	-	7.3	>10	Clayey	Clayey	Clayey	Yellowish brown	Olive brown	Firm	Firm (34-49cm) very friable
Su5-2	(Site No.5) Under inmost mangrove tree at wadi water course near road to Ras Al Hadd	758149	2495163	-	8.2	4.4	Loamy	Loamy	Loamy	Yellowish brown	Grey	(Loose)	(Friable)
Su5-5	(Site No.5) New vegetation area at mouth of khawr	758703	2495849	-			Loam	Sand	Sand	Olive grey - black	Olive black	(Friable)	(Friable)
Su5-6	(Site No.5)In dense trees near mouth of khawr	758581	2495792	-			Clay/ Sand	Sand	Sand	Black	Dull yellowish brown	-	-
Su5-7	(Site No.5) Open swamp near middle water course	758355	2495555	-	7.3	5.6	Clayey	Clayey	Sand	Olive brown - dark olive brown	Greyish olive	(Loose)	-

Attachment 5: Surface Water Quality in Batah

No.	Location	Coordinate		Colour/ Visibility	pH	Salinity (%)	Tempera-ture (C)	DO (mg/l)	COD (mg/l)	NO3 ($mgNO^3/l$)
		Easting	Northing							
5	In mangrove swamp at site No.5	758501	2495796	±	8.0	4.5	30.3	6.90	0-2	0
6	Inmost water channel near mangrove at site No.4	758149	2495163	±	8.2	4.4	34.3	8.2	-	-

Observation Date: 18-20 May, 2003

Sama table shows on A'Tina and Batoha

Attachment 6: Field Monitoring Sheet for Fauna and Flora and Pollution (Batah)

Location Batah, Sur	**Date**
Time	**Tide**
Recorder	

Bird counts: species: number:

Birds are mostly near the entrance to the large lagoon.
Expected winter birds: Gulls and Terns, herons, waders, flamingos
Expected summer birds: waders, flamingos

Pollution:
Evidence of: solid waste (garbage), liquid waste
Water quality: clear/muddy/green/salinity
Fishing: nets

Domestic/feral animals:

Vegetation:
Surrounding land:
Channel:

Animals:
Landward fringe:
In the mangroves:
Channel edge:

Other comments:

Attachment 7: Result of Field Reconnaissance of Fauna and Flora and Pollution in Batah

Field Monitoring Sheet for Fauna and Flora and Pollution Sample (1)

Location	Batah, Sur	**Date**	30/12/2003
Time	15.00	**Tide**	falling tide
Recorder	N.V. Clarke		

Bird counts: species: 17 number: 265
Birds near the entrance of the khawr to the bay included: 50 Gulls and Terns; 15 herons (Grey, Western Reef, Great white egret, little egret); and about 200 waders (including 80 redshank, 10 greenshanks, 20 curlew).
Conspicuous bird species: Flamingo, Curlew

Pollution:

Evidence of:	solid waste (garbage), liquid waste,	Garbage (plastic bags)
Water quality:	clear/muddy/green/salinity	clear
Fishing: nets		common in channels

Domestic/feral animals: dogs

Vegetation:
Khawr Sukaykira is surrounded by a rocky shoreline or open sand flats and sabka with very little vegetation.
The drainage channels with mangroves along the edges contained algal mats (*Lyngbya majascula*) especially near the entrance to the bay. This can cover young mangrove seedlings and slow down their growth.
Mangroves are regenerating here with many young trees and a nursery has been built to allow planting activities around the lagoon.

Animals:
The landward zone around the mangroves contained holes of fiddler crabs (*Uca inversa*) in densities of about 100/m^2 in the sandy sediment. Among the mangrove prop roots near the channel, the sediment is filled with fibrous mangrove roots and black mud, and the mud snail, *Cerithidea cingulata*, and holes of another fiddler crab (*Uca lactea*) occurred in densities of about 150/m^2. The xanthid crab (*Eurycarcinus orientalis*) and a grapsoid crab (*Metapograpsus thukuhar*) also occurred here. The mangrove structure appeared more developed than the mangroves to the east.
In the main channel, under the algae, the sediment of compact, shelly sand and mud was a black colour. Only annelid worms were found in the sediment. *Cerithidea cingulata* occurred on the surface and shrimps (*Alpheus* sp, *Palaemon* sp) and annelid worms occurred in side pools. In the deep, sandy substrate of the open Sur lagoon *Dosinia alta* and a large venus shell (*Amiantis umbonella*) were collected.

Other comments:
Algal mats occurred at the mouth and in channel possibly indicating high nutrients.

Field Monitoring Sheet for Fauna and Flora and Pollution Sample (2)

Location	Batah, Sur	**Date**	26/07/03
Time	12.00	**Tide**	falling tide
Recorder	N.V. Clarke		

Bird counts: species: 5 number: 25
Birds were mostly at the entrance to the bay and included waders (redshank, godwit, whimbrel) and herons

Pollution:

Evidence of:	solid waste (garbage), liquid waste,	Garbage (plastic bags)
Water quality:	clear/muddy/green/salinity	clear with algae
Fishing: nets		some in channels

Domestic/feral animals: dogs

Vegetation:
Khawr Sukaykira is surrounded by a rocky shoreline or open sandflats and sabkha without vegetation.
The drainage channels with mangroves along the edges contained algal mats (*Lyngbya majascula*) especially near the entrance to the bay.
Mangroves are regenerating. Nursery is producing seedlings.

Animals:
The landward zone around the mangroves contained holes of fiddler crabs (*Uca inversa, U. annulipes*) and mud crabs (*Macrophthalmus depressus.* Among the mangrove prop roots near the channel, the mud snail *Cerithidea cingulata* and the purple crab (*Eurycarcinus orientalis*) and a grapsoid crab (*Metapograpsus thukuhar*) occurred. The mangrove structure appeared more developed than at Batah to the east.
In the main channel, under the algae, the sediment of compact, shelly sand and mud was a black colour. *Cerithidea cingulata* occurred on the surface and shrimps (*Alpheus* sp, *Palaemon* sp) and annelid worms occurred in side pools. In the deep, sandy substrate of the open Sur lagoon *Dosinia alta* and a large venus shell (*Amiantis umbonella*) were found.

Other comments:
Algal mats were abundant at mouth and in channel.
Siltation of lagoon may be increasing.

Attachment 8: Site Photos (Batah)

Site No.4

General Condition

Vegetation at mouth of khawr

Vegetation at upstream khawr

Mangrove Vegetation

Seeding trees

Young seedling at mouth of khawr

Soil Condition

In front of dense mangrove tree at bay side (Profile No. Su4-1)

In dense trees near mouth of khawr (Profile No. Su4-2)

Attachment 8: Site Photos (Batah)

SiteNo.5

General Condition

Vegetation of upstream khawr

Vegetation of downstream khawr

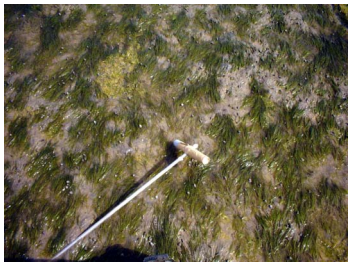
Mangrove Vegetation

New seedlings at mouth of khawr

Vegetation and aerial roots on shore of water channel

Soil Condition

Under inmost mangrove tree at wadi water course near road to Ras Al Had (Profile No. Su5-2)



New vegetation area at mouth of khawr (Profile No. Su5-5)

Attachment 9: Soil Profiles in Batah (Sur)

Site No.4

(Profile Su4-1)

Location		In front of dense mangrove tree at bay side		
Coordinate (UTM)			Easting: 758051	Northing: 2496222
Physiographic position		Lower marine terrace	Topography	Flat
Soil Classification			Typic Psammaquents	
Parent material		Alluvial deposit	Depth of free water	Surface water
Vegetation/ mangrove		Young mangrove seedlings. Algae cover soil surface. Observation of core sample *1		
Description of soil profile *2)				
C	0-4	Olive black (5Y 2.5/2), fine sand with massive structure; common shell fragments; gradual smooth boundary		
C	4-29	Olive black (7.5Y 3/2), fine sand with massive structure; black (7.5Y 2/1) and brown (10YR 4/4) mottles; many shell fragments; diffused, smooth boundary		
C	29-45	Olive black (7.5Y 3/2), fine sand with massive structure; great many shell fragments; diffused, smooth boundary		
C	45-62	Olive black (7.5Y 3/2), fine sand with massive structure; few shell fragments		
C	62-100	Fine sand (by soil auger)		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation

(Profile Su4-2)

Location		In dense trees near mouth of khawr		
Coordinate (UTM)			Easting: 757907	Northing: 2496226
Physiographic position		Lower terrace	Topography	Gentle slope
Soil Classification			Typic Fluvaquents	
Parent material		Alluvial deposit	Depth of free water	Surface water
Vegetation/ mangrove		Dense mangrove vegetation Observation of core sample *1		
Description of soil profile *2)				
A	0-2	Olive brown (2.5Y 4/4), silty clay with massive structure and sticky consistency, abrupt boundary		
C	2-10	Olive black (7.5Y 4/1), sandy loam with massive structure and slightly sticky consistency; common olive black (7.5Y 3/1) mottles; many fine and small roots; few shell fragments; gradual boundary		
C	10-29	Olive black (10Y 3/2), loamy sand with massive structure; few olive black (10Y 3/1) mottles; many fine and small roots; few shell fragments; gradual boundary		
C	29-43	Olive black (10Y 3/2), loamy sand with massive structure; common fine roots; common shell fragments		
C	>43	Loamy sand (by soil auger)		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation

Attachment 9: Soil Profile of Samples in Batah (Sur)

Site No. 5

(Profile Su5-2)

Location		Under inmost mangrove tree at wadi water course near road to Ras Al Had		
Coordinate (UTM)			Easting: 758149	Northing: 2495163
Physiographic position		Upper terrace	Topography	Gentle slope
Soil Classification			Typic Fluvaquents	
Parent material		Alluvial deposit	Depth of free water	Surface water
Vegetation/ mangrove		Scattered mangrove on water course Observation of core sample *1		
Description of soil profile *2)				
A	0-6cm	Yellowish brown (2.5Y 5.5/3) loam with massive structure and sticky consistency; clear boundary		
C	6-38cm	Yellowish brown (2.5Y 5/3), sandy loam with massive structure and slightly sticky consistency; many brown (7.5YR 4/4) and grey (7.5Y 4/1.5) mottles; common small, fine roots; gradual boundary		
C	38-55cm	Grey (7.5Y 4/1), silty loam with massive structure and sticky consistency; many dark brown (10YR 4/4) mottles; few fine roots; few shell fragments; gradual boundary		
C	55-93cm	Yellowish grey (10Y 4/1.5), silty, clay loam with massive structure and very sticky consistency; few fine roots; few organic matter; gradual boundary		
C	93-104cm	Yellowish grey (10Y 4/1), silty, clay loam with massive structure and very sticky consistency, few organic matter		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation

(Profile Su 5-5)

Location		New vegetation area at mouth of khawr		
Coordinate (UTM)			Easting: 758703	Northing: 2495849
Physiologic position		Lower marine terrace	Topography	Flat
Soil Classification			Typic Psammaquents	
Parent material		Alluvial deposit	Depth of free water	Surface water
Vegetation/ mangrove		Young mangrove seedlings Many algae and survived seaweeds on soil surface		
Description of soil profile *2)				
A	0-4cm	Olive grey (10Y 4/2), silty loam		
C	At 10cm	Black (10Y 2/1), sandy loam		
C	At 40cm	Olive black (10Y 3.5/1), fine sand		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation

Technical Specification for
Khawr Quq

1. SITE DESCRIPTION

1.1 Location

Governorate/ Region	Ash Sharqiyah
Wilayat	Sur
Distance from the Centre of Wilayat	30 km
Nearest Locality	Ras Al Had
Fame of the Site/ Distinctive Features	Turtle reserve area
Facilities in the Site	None
Features of Surrounding Areas	Ras Al-Had area is designated as Turtle Reserve

1.2 Natural Conditions

Climate Zone	Sharqiyah Zone
General Terrain	Flat plain
Geological Features	Clarke (1986) proposed this area as a scenic reserve, including the turtle nesting beaches and the two large tidal inlets, Khawr Quq and Khawr Hajar, which form an enclosed body of water; a narrow strip of land separates the two parts. There are both sandy and rocky shores.
Soil	Deep and sandy soil layers cover the tidal area of Khawr Quq. But soil depths of southern coast adjacent to rocky hill are shallow (less than 10 m) up to about 5 m away from rock outcrops. Soil at inmost khawr is relatively fine textured. The areas planted mangrove trees by this Study Team has gentle slope. Water channel is running on the middle of Khawr Quq from east to west. Salinities of ground water are not much different with surface water (approximately 4%). Details are shown in attached table **"Attachment 4: Soil Profile in Khawr Quq"** and **"Attachment 9: Soil Profile of Samples in Khawr Quq"**.
Water	Salinity of water in Khawr Quq was about 4%. The values of DO were more than 7 mg/l. There were no significant constraints for water quality. Details are shown in attached table **"Attachment 5: Surface Water Quality in Khawr Quq"**.
Fauna	The rocks are covered by oysters (*Saccostrea cucullata*) up to the high tide level. The sand was coarse grained with shell fragments. A white, shelly sandbar supported beach ghost crabs (*Ocypode saratan*) while wet sand contained burrows of another species (*Ocypode jousseaumei*). Slightly more muddy sand contained the small burrows (120/m^2) of fiddler crabs (*Uca lactea*). A tube-building worm and bivalves (*Dosinia alta*) were found in the sediment. Birds included Waders (Godwit, Whimbrel, Sand Plover) and Grey Heron. Invertebrates recorded 1 crustacean species. 7 birds were counted belonging to 3 species. 2 mollusc species were found.
Flora	Most of Khawr Quq is surrounded by a rocky shoreline without vegetation but some sandy areas supported three halophytic plants, *Suaeda vermiculata, Atriplex leucoclada var. inamoena* and *Zygophyllum qatarense*. Total plant cover was about 15% in drier sandy areas. No mangroves occur in Khawr Hajar but they do occur in nearby Khawr Jaramah.
Impacts from the Surrounding Areas	Resort development would affect environmental condition in the future.

1.3 Socio-economic Situation

Population of the Wilayat (2001)	65 thousand
Population of the Nearest Locality (1993)	1.9 thousand
Main Economic Activities	Fishery
Infrastructure	Palace of Abu Dhabi Princess is located here.
Main Usage	Fishing, tourism
Community Interference with the Area	Tourism development is planned.
Cultural Significance	None

1.4 Legal Setup and Development Plans

Land Ownership and Land Use Designation	The turtle reserve, which was proclaimed by Royal Decree 25/96, encloses 120 square km and includes the khawrs of Hajar, Quq and Jaramah. It is managed by the Directorate-General of Nature Conservation of the Ministry of Regional Municipalities and Environment. The management plan details a programme of use with minimum disturbance to turtle nesting beaches involving the local community in tourism projects and the sustainable use of resources.
Development Plans in the Site and the Surrounding Area	Resort development area
Existing Conservation Proposal	Clarke (1986) proposed this area as a scenic reserve, including the turtle nesting beaches and the two large tidal inlets, Khawr Quq and Khawr Hajar, which form an enclosed body of water; a narrow strip of land separates the two parts.

2. PROGRAMME AND PROJECT

2.1 Prerequisite

Legal Setup for Land Use Control	Set a distinct boundary of Turtle Reserve (see 4.2 Required Action for Conservation and Management)
Facility Development Control	No permanent structure in Turtle Reserve, except hide for bird watching, sign and information boards, and boardwalk or pedestrian bridge. Footpath should be designated but not paved. No permanent commercial buildings such as restaurants, hotels, shops and mechanised amusement facilities in the park development area. Basic activities in this park are relaxation and picnicking. Partial lighting for safety only. Utilities lines (water and electricity should be at a minimum) and setback at 150 m from the edge of mangrove.

2.2 Description of Programmes

Facility Development Programme	(1) Temporary nursery construction, (2) Visitor service and information facilities development.
Restoration and Afforestation Programme	(3) Mangrove planting project
Monitoring Programme	(4) Mangrove monitoring project (5) Soil and water monitoring project (6) Fauna and flora monitoring project (7) Pollution monitoring project (8) Monitoring project on legal setup and development plans
Public Awareness Programme	It will include an educational programme for school children and conservation campaign for residents of the Wilayat. Required materials and facilities are (9) Pamphlets and posters distributed to the residents, (10) Information boards describing significance of the natural environment.

2.3 Implementation Mechanism

Projects	Responsible Agencies	Implementing Body/ Agencies	Related Agencies
(1) Temporary Nursery construction	MRMEWR	MRMEWR	
(2) Visitor service and information facilities development.	MRMEWR	Wilayat Sur	MCI
(3) Mangrove planting project	MRMEWR	Wilayat Sur	
(4) Mangrove Monitoring Project	MRMEWR	Wilayat Sur	
(5) Soil and Water Monitoring Project	MRMEWR	Wilayat Sur	
(6) Fauna and Flora Monitoring Project	MRMEWR	MRMEWR/ Omani Institute for Birds	
(7) Pollution Monitoring Project	MRMEWR	Wilayat Sur/ MRMEWR	
(8) Monitoring Project on Legal Setup and Development Plans	MRMEWR	Wilayat Sur	
(9) Pamphlets and posters distributed to the residents	MRMEWR	MRMEWR	MOE
(10) Information boards	MRMEWR	MRMEWR	MOE

2.4 Implementation Schedule

Project No.	1 st	2 nd	3 rd	4 th	5 th	6th	7th	8th	9 th	10 th
(1)										
(2)										
(3)										
(4)										
(5)										
(6)										
(7)										
(8)										
(9)										
(10)										

3. IMPLEMENTATION PLAN

3.1 Restoration and Afforestation

3.1.1 Existing Mangrove Area

Location and Area	No mangrove trees (**Figure 2 Location Map**)
Conditions of Existing Mangrove	No mangrove

3.1.2 Plantation Area

Tidal Condition	Normal
Wave and Wind	South wind in summer, north wind in winter, 20% wave frequency in summer, 40% in winter
Flood	Every 5-10 years
Water Salinity and pH	Salinity; 4.0 %, pH; 8.7 ("**Attachment 5: Surface Water Quality in Khawr Quq**")
Soil Conditions	Sandy soil at whole khawr. Surveyed data is in the "**Attachment 4: Soil Profile in Khawr Quq**" of this technical specification.
Potential Area	See **Figure 3 Planting Area.** Except the areas on water channel, there are no significant constraints for new mangrove plantation. The areas near coastline (within 5m) are shallow. The seedlings transplanted by the team are growing well.

Table 3.1 Location and Areas of Potential Planting Area(s)

	Designated Area	Area (ha)
Area-1	(1) in Figure 3	0.6

3.1.3 Planting Schedule

Total Planting Area	0.6 ha
Planting Season and Timing	January ~ February
Seed/ Seedlings Supply Source and Location	Seed from existing mangrove area at Khawr Jaramah Seedling from temporary nursery in this Khawr
Planting Method	Start from south shore of the khawr. Move to north shore of the khawr. Detailed technical guidelines should refer to the **"Technical Guideline for Afforestation"** attached with this technical specification.

Table 3.2 Planting Schedule

Year	1 st	2 nd	3 rd	4 th	5 th	6th	7th	8th	9 th	10 th	Total
Planting area-1											

Table 3.3 Seeds/ Seedling Supply Schedule

Year	1 st	2 nd	3 rd	4 th	5 th	6th	7th	8th	9 th	10 th	Total
Season/ time		Jan/Feb	Jan/Feb	Jan/Feb	Jan/Feb	Jan/Feb	Jan/Feb				
Planting area (ha)		0.1	0.1	0.1	0.1	0.1	0.1				0.6
Number of seeds/ seedlings (thousands)		1	1	1	1	1	1				6

3.1.4 Conservation Area

Area of Land Use	Turtle Reserve Area

3.1.5 Required Action for Conservation and Management

Inspection	Daily observation by park management body, 2 to 4 times of inspection by MRMEWR (Mangrove Information Centre)
Cleaning	Management Body
Replantation of Seedlings Growing Bad, Dead or Washed Away	MRMEWR (Mangrove Information Centre) for 5 years after plantation.
Service for Associated Facilities	Regularly by Management Body
Patrol and Enforcement	Daily ordinary patrol by police of Wilayat is required, and the management body regularly inspects facilities conditions and littering and waste disposal to the ground and water in Turtle Reserve areas.
Restoration and Rehabilitation Work	The mangrove plantation work in the planting area described in the previous section is necessary.
Facilities Required for the Conservation and Management Activities	Directional signs along the highway and entrance to the access road(s), guide signs, and information can be seen on boards in the Turtle Reserve area to explain the significance of the reserve and major flora and fauna. Plant Nursery not only for this site but also for mangrove planting site in the vicinity is required. Footpath and boardwalk for observation of wildlife as well as mangrove are also necessary.

3.2 Monitoring

3.2.1 Mangrove

Monitoring Method	Select and label trees for monitoring. Monitor mangrove by using the attached **"Attachment 1: Field Monitoring Sheet for Mangrove"**.
Frequency	Planting mangrove: First 4 years: annual monitoring After 4 years: every 2 years
Monitoring Target	Planting mangrove: Select 20 trees at random and monitor them.
Baseline Data	No Baseline data

3.2.2 Soil and Water

Monitoring Method	Monitoring soil and water in and around mangrove plantation by using attached table "**Attachment 3: Field Monitoring Sheet for Soil and Water**".
Frequency	Soil: (New plantation area) Before plantation and Every two years after plantation Water; Every year (Outflow water at low tide should be measured.)
Monitoring Target	**Attachment 3**
Baseline Data	See attached table **"Attachment 4: Soil Profile in Khawr Quq"** and **"Attachment 5: Surface Water Quality in Khawr Quq"**

3.2.3 Fauna and Flora

Monitoring Method	Monitor fauna and flora by using the attached **"Attachment 6: Field Monitoring Sheet for Fauna and Flora and Pollution."** For the observation of birds, an institute that is studying birds in Oman can be the best institute to take a part of the monitoring work by sub-contract basis.
Frequency	At least twice a year
Monitoring Target	**Attachment 6**
Baseline Data	The result of field reconnaissance of fauna and flora is shown in **"Attachment 7: Result of Field Reconnaissance of Fauna and Flora and Pollution in Khawr Quq"**.

3.2.4 Pollution (garbage and waste)

Monitoring Method	Monitor pollution by using the attached **"Attachment 6: Field Monitoring Sheet for Fauna and Flora and Pollution."** Water Quality and Soil Sample Tests should be carried out by MRMEWR.
Frequency	At least twice a year
Monitoring Target	**Attachment 6**
Baseline Data	See **"Attachment 7: Result of Field Reconnaissance of Fauna and Flora and Pollution in Khawr Quq"**.

3.2.5 Change on Legal Setup and Development Plans

Frequency	At least once a year
Monitoring Target	Land Ownership, Land Use Designation, Development Plans in the Site and Surrounding Area

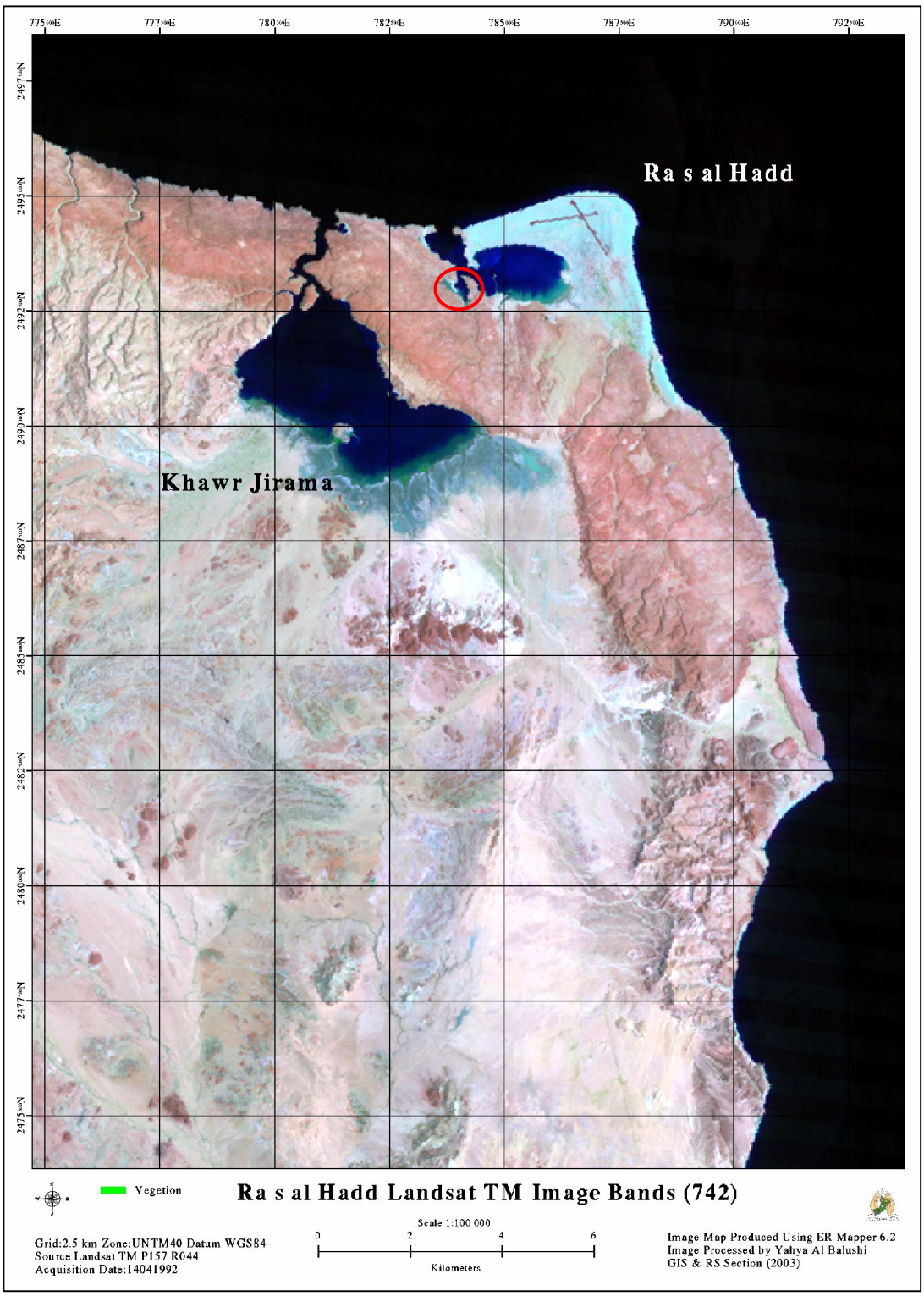


Figure 1 Key Map

Figure 2 Location Map

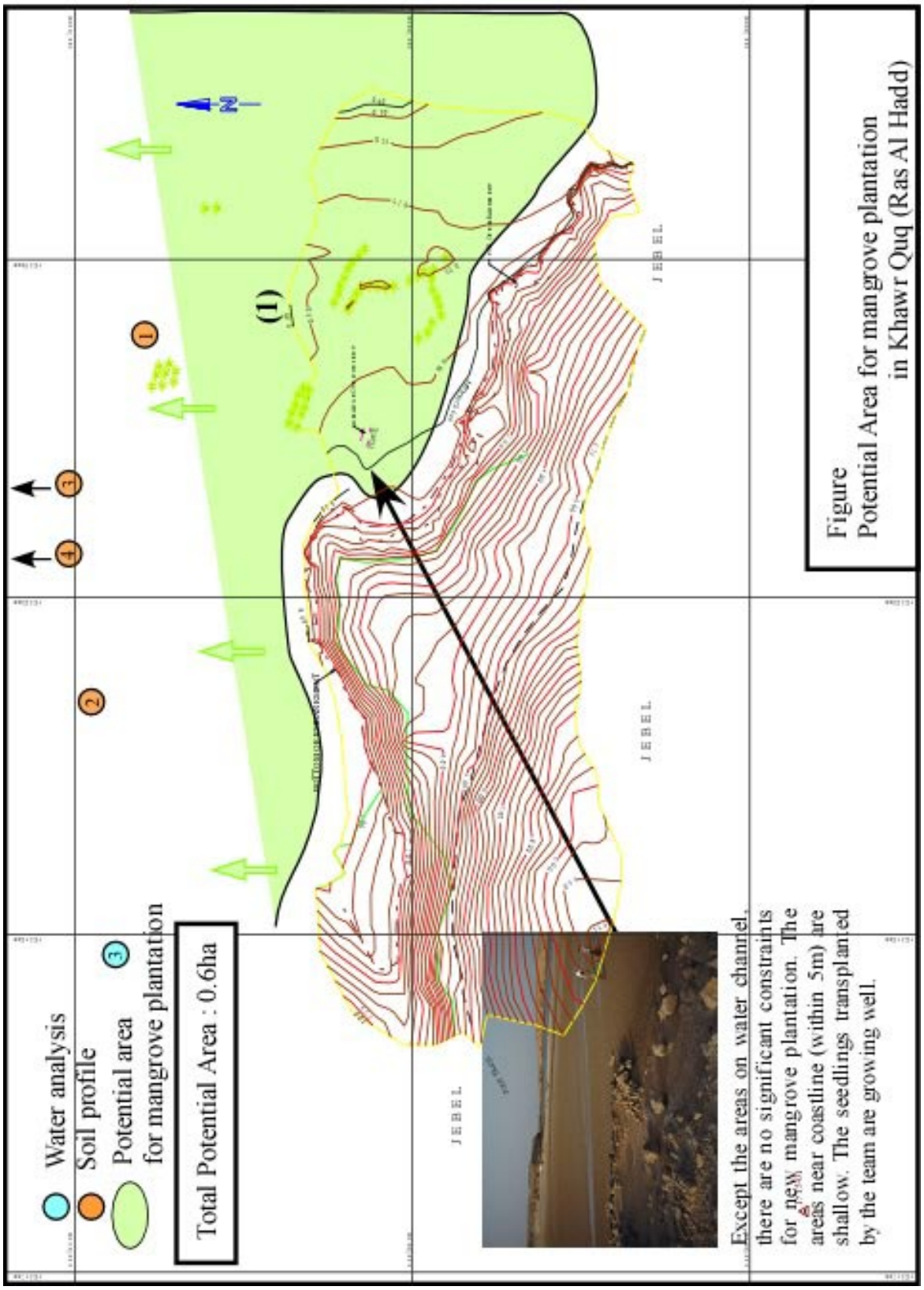


Figure 3 Planting Map

Attachment 1: Field Monitoring Sheet for Mangrove (Khawr Quq)

Mangrove Observation Records

1) Identification No.

2) Location by GPS (WGS 84, UTM)

Easting: _____

Northing: _____

3) Photograph No. _____

Memo:
(specific information or data significant for the tree will be written here)

4) Observation of tree size and shape

a) Tree Height (cm) _____

b) Trunk diameter near bottom (cm) _____

c) Live branches at the position about 1.3m off the centre of tree bottom (painted)

Branch/ limb diameter measured in cm

1		2		3		4	
5		6		7		8	
9		10					

5) Observation of tree history, health and environment

a) History

Tree shape: _____

Sign of cut in the past: _____

b) Health

Nodes with leaves: _____

Inter-node length: _____

Leaf length: _____

Leaf colour: _____

Looks / die back: _____

c) Environment

Soil depth / texture: _____

Surface water Salinity: _____

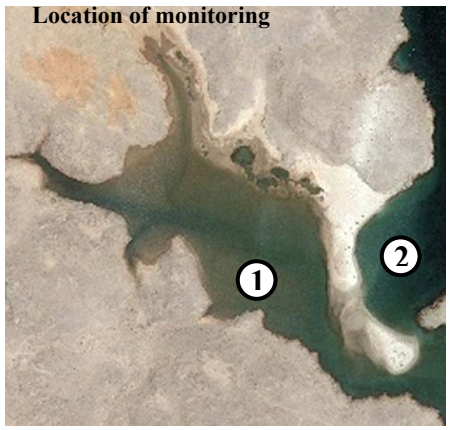
Ground level: _____

Position: _____

Note:

Attachment 3: Field Monitoring Sheet for Soil & Water (Khawr Quq)

Location	
Date / time:	/ ,200 :
Recorder	



●Soil ○ Water

General Condition in plantation area:

(garbage, rubbish, leaf, alga, crab, shell, etc)

(1) Soil Condition

		New planted area	New planted area
Coordinate	Easting		
	Northing		
Surface condition			
Soil Texture	0-10cm		
	30-40cm		
	50-60cm		
Soil Colour	0-10cm		
	30-40cm		
	50-60cm		
Root development			
Depth of surface humus			
Free water	GWL* (cm)		
	pH		
	Salinity (%)		

Soil colour by Munsell notation, GPS*:by UTM of WGS84 GWL: Ground water level

(2) Surface Water Quality (Observation time: :)

		Khawr mouth ① (Sea water at Khawr Quq)	Mid khawr ②
Coordinate	Easting	784100	783828
	Northing	2493120	2493159
Surface waste			
pH			
Salinity (%)			
Temperature (C)			
DO (mg/l)			
Turbidity / Colour			

Attachment 4: Soil Profile in Khawr Quq

Profile No.	Location	Coordinate (UTM)		Ground Water			Texture			Soil Colour		Hardness	
		Easting	Northing	Depth (cm)	pH	Salinity (%)	Surface (0-30cm)	Sub-surface (30-60cm)	Deep layer (>90cm)	Surface (0-30cm)	Sub-surface (30-60cm)	Surface	Sub-surface
1	Southern shore near abandoned nursery	783888	2493109	45	7.7	5.3	Sandy	Sandy		Dull yellowish brown	Dull yellowish brown	Friabe	Very friable
2	Southern shore of water channel	783828	2493159	12	7.7	4.8	Sand	Sand	Sand	Dull yellowish brown	-	-	-
3	Northern mid-shore near water channel (20m)	783863	2493163	17	4.7	4.9	Sand	Sand	Sand	Yellowish brown	Dull yellowish orange	Friabe	-
4	Northern upper shore 50m from water channel	783856	2493192	18	6.8	6.7	Sand	Sand	Sand	Olive brown	Dull yellow	Friable	(Firm)
5	Southern shore adjacent (10m) to water channel	783753	2493202	41	7.3	5.2	Sand	Sand	Sand	Dull yellowish brown	Dull yellowish brown - grey	Friable	Friable

Data of hardness in parenthesis by hand observation

Attachment 5: Surface Water Quality in Khawr Quq

No.	Location	Coordinate (UTM)		Colour/ Visibility	pH	Salinity (%)	Tempera-ture (C)	DO (mg/l)	COD (mg/l)	NO3 ($mgNO^3/l$)
		Easting	Northing							
2	Khawr Quq sea water	-	-	Clear	8.5	3.9	30.3	7.90	-	-
3	Swamp water in Khawr Quq	783763	2493382	Clear	8.7	4.0	33.1	8.15	-	-

Observation Date: 16-17 May, 2003

Attachment 6: Field Monitoring Sheet for Fauna and Flora and Pollution (Khawr Quq)

Location	Khawr Quq	**Date**	
Time		**Tide**	
Recorder			

Bird counts: species: number:

Expected winter birds: Waders (Godwit, Curlew, sandpipers, plovers), herons,
Expected summer birds: Waders (Bar-tailed Godwit, Whimbrel, plovers, redshank), herons

Pollution:

Evidence of:	solid waste (garbage), liquid waste, oil.
Water quality:	clear/muddy/green/salinity
Fishing:	nets

Vegetation:

Animals:

Domestic/feral animals:

Other comments:

Attachment 7: Result of Field Reconnaissance of Fauna and Flora and Pollution in Khawr Quq (Khawr Quq)

Field Monitoring Sheet for Fauna and Flora and Pollution Sample (1)

Location	Khawr Quq	**Date**	28/12/2002
Time	12.00	**Tide**	Low tide
Recorder	N.V. Clarke		

Bird counts: species: 3 number: 7
Birds' numbers were low: Waders and grey heron

Expected winter birds: Waders (Godwit, Curlew, sandpipers, plovers), herons,
Expected summer birds: Waders (Bar-tailed Godwit, Whimbrel, plovers, redshank), heron,

Pollution:

Evidence of:	solid waste (garbage), liquid waste, oil.	none
Water quality:	clear/muddy/green/salinity	clear
Fishing:	nets	none

Vegetation:
Most of Khawr Quq is surrounded by a rocky shoreline without vegetation but some sandy areas supported three halophytic plants, *Suaeda vermiculata, Atriplex leucoclada var. inamoena* and *Zygophyllum qatarense*. Total plant cover was about 15% in drier sandy areas.

The khawr has deep enough sediment to try planting mangroves. The seeds should come from Khawr Jaramah.

Invertebrates:
The rocks are covered by oysters (*Saccostrea cucullata*) up to the high tide level. Slightly muddy sand contained the small burrows (120/m^2) of fiddler crabs (*Uca annulipes*). Smaller holes of a tube-building annelid worm (Oweniidae) were numerous (50/m^2) and bivalves (*Dosinia alta* – 10/m^2) were found in the sediment.

Domestic/feral animals: none seen but village nearby

Other comments:

Field Monitoring Sheet for Fauna and Flora and Pollution Sample (2)

Location	Khawr Quq	**Date**	26/07/03
Time	14.00	**Tide**	Low tide
Recorder	N.V. Clarke		

Bird counts: species: 6 number: 60
Birds were waders (Bar-tailed Godwit, Whimbrel, plovers, redshank) feeding on the mudflat and one osprey.

Pollution:

Evidence of:	solid waste (garbage), liquid waste, oil.	none
Water quality:	clear/muddy/green/salinity	clear
Fishing:	nets	none

Vegetation:
Most of Khawr Quq is surrounded by a rocky shoreline without vegetation but some sandy areas supported three halophytic plants, *Suaeda vermiculata, Atriplex leucoclada var. inamoena* and *Zygophyllum qatarense*.

Animals:
The rocks are covered by oysters (*Saccostrea cucullata*) up to the high tide level.

Slightly muddy sand contained the small burrows (120/m^2) of fiddler crabs (*Uca annulipes*) with larger burrows of *Ocypode jousseaumei*.

Tube-building annelid worm (Oweniidae) were numerous and bivalves (*Dosinia alta* were found in the sediment.

Mullet fish were abundant in the water.

Domestic/feral animals: none seen but village nearby

Other comments:
Some mangrove seedlings planted, 70% survival after 1 year.

Attachment 8: Site Photos (Khawr Quq)

General Condition

Area near mouth of khawr

Area of upstream of khawr

Mangrove Vegetation

Healthy transplanted seedlings

Soil Condition

Southern shore of water channel (Profile No. 2)

Southern shore adjacent (10m) to water channel (Profile No. 5)

Attachment 9: Soil Profile of Samples in Khawr Quq (Ras Al Had)

(Profile No. Had/Quq- 2)

Location		Southern shore of mid-water course		
Coordinate (UTM)			Easting: 783828	Northing: 2493159
Physiologic position		Lower marine terrace	Topography	
Soil Classification			Typic Psammaquents	
Parent material		Marine deposit	Depth of free water	12cm
Vegetation/ mangrove		No vegetation		
Description of soil profile				
C	0-18cm	Dull yellowish brown (10YR 5/4) coarse sand with massive structure; few shell fragments		
C	Up to 100	Sand		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation

(Profile No. Had/Quq- 5)

Location		Southern shore adjacent (10m) to mid-water course		
Coordinate (UTM)			Easting: 783753	Northing: 2493202
Physiologic position		Middle marine terrace	Topography	Gentle slope
Soil Classification			Typic Psammaquents	
Parent material		Marine deposit	Depth of free water	41cm
Vegetation/ mangrove		No vegetation		
Description of soil profile				
C	0-23cm	Dull yellowish brown (10YR 5/4), friable, loamy sand with massive structure; few shell fragments; diffused smooth boundary		
C	23-48cm	Dull yellowish brown (10YR 5/3), friable, loamy sand with massive structure; few brown (7.5YR 4/4) mottles; common shell fragments; clear, smooth boundary		
C	48-55cm	Grey (5Y 4.5/1), coarse sand with massive structure; many shell fragments		
C	55-100cm	Coarse sand (by soil auger)		

*1: Descriptions of structure and boundary are estimated from limited observation of core sample.
*2: Texture was classified at field by visual and touching observation