

Technical Guidance Document for Mangrove Planting Permitting and Management Plan

EAD-TMBS-TG-01





Document Change History

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Purpose of This Guidance Document

The Environment Agency–Abu Dhabi (EAD), as the Competent Authority for environmental permitting in the environmental field in Abu Dhabi Emirate, details in this guideline the permitting and management requirements for mangrove planting.



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List of Abbreviations

EAD	Environment Agency Abu Dhabi
EIA	Environment Impact Assessment
EPA	Environmental Permit Application
EHSMS	Environment, Health and Safety Management System
MSDS	Material Safety Data Sheet
NOC	No Objection Certificate
PER	Preliminary Environmental Review
SRA	Sector Regulatory Authority
UAE	United Arab Emirates



Definitions of Terms

Afforestation/Initial Afforestation: The establishment or creation of forests (mangroves and other trees) where no forest existed previously. It is thus distinct from restoration.

Area of Probable Impact: The extent of a physical area occupied by an environmental component that is likely to be impacted by at least one of the phases of the proposed planting project. The boundary of the area of probable impact is determined by measurements, previous studies, models, or best professional judgment and may vary by environmental component.

Assessment Area: The physical area that the consultant and proponent have identified for assessment of potential environmental impacts.

Change in ecological character: The human-induced adverse alteration of any ecosystem component, process, and/or ecosystem benefit/service.

Competent Authority: Shall mean the Competent Authority in the concerned Emirate, which is the Environment Agency – Abu Dhabi, in Abu Dhabi Emirate.

Contractor: Any individual, commercial entity, agency, group or department contracted by the Project Proponent to carry out any aspect of a mangrove planting project.

EAD: Environment Agency – Abu Dhabi.

Enhancement: "mangrove forest enhancement" or "enrichment plantings" refer to planting in areas with existing mangroves.

Environmental Component: Attribute or constituent of the environment (i.e. Marine Water; Waste Management; Geology, Seismicity, Soil, and Groundwater; Marine Ecology; Terrestrial Ecology; Noise; Traffic) that may be impacted by the proposed planting project.

Environmental Hazard: Any substance, physical effect, or condition with potential to harm people, property, or the environment.

Environmental Impact: Positive or negative impact that occurs to an environmental component as a result of the proposed project. This impact can be directly or indirectly caused by the project's different phases (e.g., construction and operation).

Hazardous Waste: Waste that poses potential harm to human health and the environment.

Mangroves: Salt-tolerant trees that grow in the shallow tidal waters of some coastal areas. The naturally-occurring species of mangrove (*Avicennia marina*) found in Abu Dhabi, locally called 'Qurm', is the grey or white mangrove.

Mangrove Planting NOC: Mangrove Planting No Objection Certificate. The permission issued by EAD to the Proponent which allows him or her to plant mangroves in the specified area of Abu Dhabi Emirate during the specified period. All activities relating to mangrove planting, including seed collection, afforestation, enhancement and restoration, associated with a development, will require an NOC as part of the approval process. The NOC constitutes an approval for mangrove planting, and is issued after an assessment of the Mangrove Planting Management Plan. NOCs are issued by EAD on a case by case basis.

Mangrove Planting: Mangrove Planting refers to all operations required to produce mangrove plantations, including seed collection, preparation of sites and seedling or sapling planting.

Mangrove Plantation: The area allocated or selected in which mangroves are planted through direct human intervention. In restoration or enhancement projects, plantations may overlap with existing mangrove areas, whether naturally occurring or planted.

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Mitigation: Mitigating ecological impacts refers to actions that minimise, reduce or offset project impacts (compensatory mitigation).

Plantation Site: The physical area within which all processes and activities of the proposed plantation will take place. The plantation area is equivalent to the plantation site.

Proponent: Any individual, commercial entity, agency, group or department responsible for the planning, funding and implementation of mangrove planting projects.

Residual Impact: A potential environmental impact that is associated with the proposed project that is not addressed as part of the recommended mitigation measures (i.e., is not mitigated as part of the proposed project).

Reforestation: The natural or intentional restocking of existing mangrove forests that have been depleted or removed by human activity, i.e. planting mangroves in areas where they already occur, following their intentional or natural removal.

Restoration: Actions or projects that promote a return to or toward original conditions and projects that improve the ecological character of the site without necessarily promoting a return to original/reference conditions. The term "restoration" applies to locations where natural habitat has previously existed or where an existing habitat is degraded.

Solid Waste: Rubbish, debris, garbage, and other discarded solid materials resulting from the project that are not classified as hazardous waste.



1. INTRODUCTION

A No Objection Certificate (NOC) for planting mangroves is required for any mangrove planting project in Abu Dhabi Emirate. NOCs for mangrove planting are issued by the Environment Agency-Abu Dhabi (EAD) on a case by case basis, following the review and assessment of a Mangrove Planting Management Plan.

Two types of approval will be issued depending on the planting project:

- Approval Type 1: A 'Mitigative Mangrove Planting' NOC an approval issued to plant mangroves as part of mitigation for a development project; and
- Approval Type 2: A 'Stand Alone Mangrove Planting' NOC.

Both types of approval require a Mangrove Planting Management Plan.

1.1 Purpose

The purpose of requiring a mangrove planting NOC for mangrove planting in Abu Dhabi Emirate is to ensure that mangrove planting takes place in areas where it will provide ecological benefit without adversely affecting other habitat types.

Mangrove ecosystems provide a number of key ecosystem services including creating shelters for wildlife, providing food and habitat that support fisheries and protecting from coastal erosion. EAD's goal, in line with the targets outlined in the Emirate of Abu Dhabi Biodiversity Strategy (2015-2019), is to protect existing mangrove ecosystems, and ensure that environmental impacts due to development are avoided, minimised and adequately mitigated.

EAD's objective of this guideline is to ensure that mangrove planting activities, either stand-alone or as a mitigation measure for development, are assessed with a "holistic ecosystem lens" of the marine landscape and the ecosystem processes needed for enhancing the conservation and functioning of *all* coastal habitats that contribute to the marine ecosystem. Mangrove planting, while it has clear benefits in some cases, should not adversely affect other key existing habitats - such as intertidal mudflats, which also provide important ecosystem services – intertidal habitats are important for key wading bird species (e.g. stints, plovers, sandpipers and godwits).

To facilitate the achievement of this objective, EAD requires proponents obtain a NOC for mangrove planting activities through the submission of a Mangrove Planting Management Plan for any mangrove planting activities in Abu Dhabi Emirate.

1.2 Mangrove Planting Permitting Requirements

A No Objection Certificate (NOC) for planting mangroves is required for any mangrove planting projects in Abu Dhabi Emirate. The context in which a proponent should apply for which NOC type is specified below, as is a summary of what a Mangrove Planting Management Plan should include.

Approval Type 1: Mitigative Mangrove Planting Projects NOC Conditions

Mitigative mangrove planting projects are projects associated with a development or infrastructure or industrial project for which mangrove planting is being proposed as a form of compensatory mitigation for environmental impact. Upon review of an Environmental Impact Assessment (EIA) or a Preliminary Environmental Review (PER), EAD will require the preparation and submission of a Mangrove Planting Management

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Plan if mangrove planting is being proposed as mitigation. Note that EAD reviews each mangrove planting project application on a case-by-case basis and may require further detailed information and a site visit to the proposed plantation site. If the footprint of the planting project is significant (i.e. planting projects requiring extensive coastal engineering and land preparation) EAD may either reject the planting project proposal or require that a PER be carried out specifically for the plantation.

Mitigative mangrove planting projects include afforestation (planting mangroves where they did not previously occur), enhancement (planting additional mangroves in an existing mangrove habitat) and rehabilitation (replanting mangroves in areas where they have been removed).

Approval Type 2: Stand-alone Mangrove Planting NOC

'Stand-alone' mangrove plantations are planting projects that are carried out for purposes other than mitigation of environmental impact. They include afforestation projects in areas where mangroves did not previously occur, or enhancement in areas where they had not been previously removed or impacted by development. This category also includes planting projects that may be proposed as part of a Master Plan or other urban development plan proposed by a Government Agency, or as part of landscaping projects for tourism developments and district plans.

Mangrove Planting Management Plan

A Mangrove Planting Management Plan is required for any mangrove planting project (and should be included with the NOC application – Type 1 or 2) and clearly states the current environmental conditions of the plantation site, provides details of the proposed plantation, provides an assessment of the potential and probable environmental impacts associated with the plantation, and recommends monitoring efforts at a level of detail that satisfies EAD. If the level of detail provided is not sufficient, or if the planting program is anticipated to not provide sufficient ecological benefits, then EAD may require further details, request that the proponent propose alternate forms of mitigation, or reject the planting project.

1.3 Procedure for obtaining an NOC for Mangrove Planting

To apply for and obtain an approval to plant mangroves in Abu Dhabi, project proponents should:

Phase 1 - Site Selection: Select a site based on physical features, land use and ownership and carry out a rapid site assessment to determine site suitability.

Phase 2 - Submit a Mangrove Planting Management Plan: Develop and submit the management plan by writing to <u>customerservice@ead.ae</u> or by using the eservices.ead.ae portal. On the eservices portal, complete and submit an application online describing the planting project and the plantation site, and upload the mangrove planting management plan and associated documentation. EAD will issue a response within 30 days. When the complete application and management plan have been received and reviewed, EAD may issue the NOC with general and specific conditions– or if the proposed plantation site is not accepted, the project proponent will be requested to re-apply and propose alternate sites or alternate forms of mitigation, or cancel the planting project. After receiving a response from EAD, a project proponent may request a meeting with EAD for clarification purposes. Details on the required contents of Mangrove Planting Management Plans are provided in Appendix A.

Phase 3 - Obtain an NOC: Upon revision and approval of a complete Mangrove Planting Management Plan, EAD may issue, at its discretion, an NOC for mangrove planting for the specified plantation site and period.

Phase 4 - Mangrove Planting: Planting should be carried out as per the area; plan and

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methods outlined in the Mangrove Planting Management Plan and comply with the conditions of the NOC. Project proponents should monitor and assess the plantation site in the short term every 6 months for a minimum of 2 years and submit the reports to EAD. Additionally, long term ecological monitoring reports should be submitted to EAD at the 5th and 10th year of the plantation. Monitoring reports should include details of the progress, density and health of the plantation, in addition to an assessment of the ecology (flora and fauna) present at the site.

Figure 1.1 below outlines the steps for obtaining a NOC for mangrove plantation projects, while Table 1.1 (overleaf) providing further information on each phase and requirements.

Figure 1.1: Steps for Obtaining Approval for Mangrove Planting





Table 1.1 Requirements for Mangrove Planting Projects: Mitigative vs Stand-alone

	ion for environmental impact due to pment	projects proposed for landscaping or other purposes.
	Phase 1: Site Selection	and Rapid Assessment
۶	Select and assess the proposed plantation site	 Select and assess the proposed plantation site
۶	Obtain permission from land owner (if applicable)	 Obtain permission from land owner/developer (if applicable)
>	In the EPA for your development project, mention the details of the proposed mitigative mangrove planting. During the environmental assessment stage, include as part of the required PER or EIA for the associated development project a plantation project description and justification of the mitigative mangrove planting program with site details and plantation site baseline assessment. Following preliminary approvals for you project, you will be asked to submit a Mangrove Planting Management Plan.	
	Phase 2: Creation and submission of	a Mangrove Planting Management Plan
~	Submit the management plan through customerservice@ead.ae.	the eservices.ead.ae portal or by writing to
>	The submitted Mangrove Planting Manageme methods and monitoring plan. Present the as justification for site selection and design. Follo in the TGD for Mangrove Planting Permitting	ent Plan should outline site baseline features, plantation sessment of the plantation site, plantation site map and ow the guidance on format, structure and content found and Management Plans.
	Phase 3: Obta	aining an NOC
>	NOCs are issued after a review and assess Each NOC issued will specify the conditions by the conditions of the NOC and the commi Plan.	nent of the Mangrove Planting Management Plan. of approval. Project proponents are required to abide tments stated in the Mangrove Planting Management
	Phase 4: Mangrove Planting carrie	ed according to conditions in NOC
>	Planting should be carried out as per the area Management Plan and comply with the condi monitored every 6 months for a minimum of to submitted to EAD according to the specific sc	a; plan and methods outlined in the Mangrove Planting tions of the NOC. The plantation site should be wo years, then at the 5^{th} and 10^{th} year with reports hedule included in the conditions of the NOC.

1.4 Key Principles of Mangrove Planting Permitting

The following key principles will be taken into account when assessing Mangrove Planting NOC applications:

- Habitat encroachment plantations should not adversely affect existing natural coastal habitats. As an example, mudflats act as resting and feeding habitat to many shorebirds. The function and provisioning role of this habitat would be severely compromised or lost if transformed into mangrove areas;
- Land tenure and ownership the onus is on the proponent to find available suitable land for mangrove plantations. Mangroves plantations should not



impede land/water access or community plans or developments;

- **Mangrove species** EAD recommends that only *Avicennia marina* be planted, due to lack of scientific evidence of the survival and environment benefit of planting other species in the UAE. For other species, the onus is on the proponent to provide evidence that the selected species for the plantation is indigenous to Abu Dhabi Emirate and can survive and naturally regenerate in the existing environmental conditions of Abu Dhabi Emirate without human intervention;
- **Plantation methodology** planting should be carried out with a good understanding of the ecological requirements of mangroves, and the processes which lead to their establishment and early growth. Planting guidelines are provided in this document in Appendix B to assist project proponents planting should be consistent with these guidelines;
- Land preparation plantations that require extensive coastal engineering should be avoided. A mangrove planting project should not have significant environmental impacts and costs that outweigh any potential benefits provided by the mangrove plantation; and
- Seed collection seed collection should be carried out sustainably and as per the quantity and sites approved by EAD. Seeds should be sourced from healthy mangroves in the Emirate of Abu Dhabi. Seed collection should not be carried out intensively at a single site; so as to not affect the natural regeneration at that site. The Project Proponent must hold the Mangrove Planting NOC when collecting seeds as it also constitutes a permission to collect seeds according to the specified conditions.



2. MANGROVE PLANTING NOC – PROJECT PHASES

This section presents detail on how to obtain a mangrove planting NOC.

2.1. Phase 1: Site Selection

Site selection is the first step for proposing mangrove planting in Abu Dhabi Emirate. It is vital to take into account the prevailing physical conditions at the planting site in order to accomplish plantation activities efficiently and successfully. Mangroves should be planted in areas where they have the highest change of growth and survival, and where their presence has a positive impact on the environment and the public.

Preliminary surveys of the area should be undertaken before embarking on the establishment of mangrove plantations. The topographic and environmental conditions, such as ground height level, slope, soil type, mud depth, wind and currents significantly impact the success of the mangrove plantation.

2.1.1. Criteria for site selection

Key criteria for plantation site selection, based on regional case studies of *A. marina* plantations (Shahid et al., 2004), are:

- 1. **Accessibility.** The site should be readily accessible for plantation and maintenance, with permissions received by the project proponent from the land owners if the plantation is to be carried out on private land or areas under specific jurisdiction;
- 2. **Daily tidal coverage.** The site should be inundated by water generated by the daily tides as a means of provision of basic requirement to the mangrove plants; the most suitable areas are tidal flats with muddy substratum and natural channels where regular inundations occur; and un-vegetated areas where mangroves occur or occurred in the past;
- 3. **Topography.** The site should be slightly sloping, draining tidal water back to the sea, unlike flat ground where the water stagnates. Suitable ground height level, usually at around mid-point of the tidal range is ideal for *A. marina*. The site should also be sheltered from strong winds and tidal currents that may seriously affect the survival and growth rate of mangrove saplings;
- 4. **Soil.** The soil should be well drained aerated, silty-clay loam, clay loam and sandyclay loam soils; and
- 5. **Pressure:** The site should be inaccessible to high numbers of grazing animals in its initial phases, and should be pollution-free in terms of household wastes, effluents, oil and other petroleum products and construction materials and rubbles. Land-use and future development plans should also be taken into consideration by consulting Urban Structure Framework Plans made available by the Abu Dhabi Urban Planning Council <u>www.upc.gov.ae</u>.

Plantations that require extensive dredging, land reclamation or other forms of coastal engineering and land preparation will have a low probability of being approved due to the associated significant impacts on existing and surrounding coastal habitats and biotic communities.

2.1.1.1. Accessibility

The selected site should be accessible during the entire period of the plantation and for monitoring up to two years post-planting. A preliminary site assessment should be carried out to determine existing and surrounding site features and land use. Permission letters from

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land owners will be required if the selected site is located on private land. Mangrove planting in protected areas is not permitted.

2.1.1.2. Daily Tidal coverage

Daily tidal coverage is achieved by planting at the appropriate ground height level. It is important that the site is situated where it is not subject to inundation too long after high tide. Conversely, the site should not be located too high above high tide level, as regular inundation is needed for mangroves to survive and grow. In practice this means that the best plantation sites are located between mean sea level and mean high tide level. *A. marina* is a pioneer mangrove species adapted to relatively harsh habitat conditions. Seaward sites (greater inundation zone) are preferable for this species. *A. marina* survives best at ground level 50 cm-100 cm lower than the height of high tide (spring tide). Around Abu Dhabi, the optimal conditions for their growth are between 0.6 and 0.8 metres above the New Abu Dhabi Datum (NADD), i.e. approximately mean sea level, or the mid-point of the tidal range.

2.1.1.3. Topography

A. marina should not be planted on the steep banks of creeks or excavated water channels. Completely flat ground is not a suitable site for establishing plantations either. *A.marina* is very sensitive to tidal wave action which destabilizes the rooting system of the seedlings. Plantations should be established on slightly sloping ground where there is no stagnation of tidal water. The site should ideally be sheltered, as strong winds and tidal currents seriously affect the survival and growth rate of mangrove plants. High velocity winds and tidal currents to pple the shoots and disturb the rooting system of young seedlings. It is therefore important to avoid open areas exposed to strong winds and tidal wave action for establishing plantations of *A.marina*.

2.1.1.4. Soil Type

Mangroves survive and grow best on well drained aerated, silty-clay loam, clay loam and sandy-clay loam soils. *A. marina* is adapted to a wide range of soils from sandy loam, to silt loam, to sandy clay loam. EAD has conducted a full soil survey for the Emirate of Abu Dhabi and the wider UAE, and this information can be accessed on <u>https://www.uaesis.ae/</u>.

2.1.1.5. **Pressure**

The selected site should be pollution-free in terms of household wastes, effluents, oil and other petroleum products and construction materials and rubbles. The site should be inaccessible to vehicles and to the public in initial phases to avoid disturbance. Grazing pressure should ideally be reduced at the early stages of the plantation. Camels and gazelles eat the tender foliage of young mangrove plants. If the proposed plantation site is accessible to these mammals, tree guards or fencing will be required as a NOC condition to avoid damage in the early stages of the plantation to maximise seedling survival. Examples of possible types of guards are shown in Figure 2.1 below. As the plantation matures, a level of grazing pressure can be allowed as this introduces a form of natural disturbance.



Figure 2.1: Examples of Seedling Protection



2.1.2 Delineation of Plantation Site and Scale

The plantation site should be clearly delineated while planning for the plantation. The delineation will help to measure and calculate the area (hectares) of the site, running length of fence (if needed), organize plantation operations efficiently, and plan for the number of seedlings/seeds required based on plantation density. The delineation of the site should take into account the planned spacing of the mangrove saplings. Mangroves should not be planted too closely together as this can result in stunting and also create an unnatural hydrology. Clusters of mangroves with sufficient space in between can be planted. Another option is to plant mangroves in a random pattern (no straight lines) with spaced plantings of 1.25-3 meters. Large spacing allows room for natural seedlings to establish themselves over time.

It is important to note that the success of the plantation is not determined by the density of planted mangroves or the size and scale of the plantation, but by how well these mangroves survive in the long term and begin to support a functioning ecosystem.

Key technical considerations to take into account in order to successfully design a beneficial mangrove plantation program are:

- Specific site selection that looks at the history of changes in the coverage of mangroves and changes in hydrology at specific potential restoration sites, and targets hydrologic restoration of these sites;
- Establishing quantitative and measurable success criteria; and
- Monitoring and reporting of progress toward achieving these success criteria, including reporting on lessons learned from both successes and failures (Lewis, 2009).

2.2. Phase 2: Developing and submitting a Mangrove Planting Management Plan

After assessing and selecting a site and obtaining the required land permissions and developing a preliminary plan for the plantation, the project proponent should submit a Mangrove Planting Management Plan using the eservices.ead.ae portal. EAD will issue its response after receiving a complete application and management plan, and reviewing it within 30 days. The objective of the Mangrove Planting Management Plan is to provide EAD with a sufficient description of the methods, location and long-term plan for a mangrove rehabilitation, enhancement or afforestation project. The Management Plan should include a description of environmental baseline conditions, the predicted benefits and impacts of the proposed plantation project, and the associated monitoring efforts for the proposed plantation at the specified plantation site. In keeping with the Standard Operating

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Procedures for Permitting of New Projects and Activities in Abu Dhabi, the Mangrove Planting Management Plan supports the goals of environmental protection and sustainable development; integrates environmental protection of existing natural coastal habitats at the earliest stages of planning an activity; predicts environmental consequences of a proposed activity, assesses whether the proposed activity provides ecological benefits; and provides for the involvement of government and other agencies in the review of proposed activities.

The findings and recommendations of the Mangrove Planting Management Plan should be documented clearly and concisely in the report and include necessary technical details. The usefulness of a Mangrove Planting Management Plan is measured by how well the plantation project is described and justified to provide evidence of net ecological benefits from the proposed plantation. A Mangrove Planting Management Plan should not make recommendations, decisions, or conclusions about the appropriateness or approval of the proposed plantation project.

2.2.1. Preparation of a Mangrove Planting Management Plan

The proponent of the proposed planting project is responsible for preparing and submitting a Mangrove Planting Management Plan, which should be performed by an EAD-approved and registered environmental consultancy (Class A) operating within Abu Dhabi Emirate, with proven background and experience in ecological assessments. A current list of registered consultants, specifying Class A consultants with respective competencies, can be obtained from the EAD website: <u>http://www.ead.ae/our-services/business-and-industry/</u>

A Mangrove Planting Management Plan should include, but should not be limited to, all of the details and requirements outlined in Section 2.3.1.1 of this guidance document. The proponent should use the checklist in Table 2.1 to ensure that all components and criteria are included and adequately addressed within the Mangrove Planting Management Plan. A Mangrove Planting Management Plan should adhere to the framework presented in Table 2.2 and described in Section 2.3.1.1 and Appendix A of this guidance document. Although the focus of the Mangrove Planting Management Plan should be the existing ecology and water quality at the site, additional sources of impacts such as noise, waste and air quality should be mentioned. These requirements are necessary to ensure that the land preparation and transport activities required for the plantation does not lead to negative environmental impact on the existing ecology. In cases where environmental impacts of the plantation outweigh the benefits provided, alternative locations or alternative mitigation projects should be considered.

In the case where existing baseline data is not available or not suitable to properly represent the baseline conditions of the area, baseline surveys may be required and should be incorporated into the Mangrove Planting Management Plan.

2.2.1.1 Checklist for Mangrove Planting Management Plans

Table 2.1 Checklist for Chapter-by-Chapter Review of a Mangrove Planting Management Plan

	Mangrove Planting Management Plan - Checklist								
Chapter 1—Executive Summary									
	Adequate summary of the proposed planting project								
Chapte	Chapter 2—Introduction								
	The project title, general project description, and project rationale								
	Contact details and information about the project proponent and consultants								



	Evidence of prior experience and technical qualifications specializing in silviculture or restoration of <i>A.marina</i>
	Description, including justification and project timeframe
Chapte	er 3—Project Description
	Description of the need for the proposed planting project (environmental benefits)
	Assessment of planting project consistency with key principles of Mangrove Planting Permitting
	Maps and descriptions of the location and scale of the proposed project, plantation site ownership and existing and surrounding land use, habitats presently at the proposed planting site and habitats surrounding the site (up to 0.5 or 1 km away from the center of the planned site). Justification of site selection and evidence of permission to plan if the site is located in a private area
	Description of the history of changes of the restoration site and description of the proposed plantation project (i.e., components, design, technology, processes, and activities)
	Description of the plantation site (basis for site selection, ground height level, ground slope, soil type, wind and currents, grazing pressure, demarcation of plantation site, seedling/seed quantity estimation, sourcing of saplings, verification of absence of trash, rubble or other pollution)
	Description of the mangrove species selected, planting methods and work procedures (sourcing of seeds and saplings, transportation of seedlings, plantation spacing, planting/working time, pit preparation, plantation protection). If species other than <i>A.marina</i> is being proposed, evidence of the suitability and natural survivorship of the plant without human intervention should be provided in the annexes
	Identification of project activities during all phases of planting (land preparation, planting, post planting) that are likely to cause disturbance to biotic communities at and around the site, and significant impacts to the environment. This should include a detailed description of raw materials, equipment/machinery used, pollution anticipated, and wastes generated at all phases of the plantation
	The project status and schedule and project organizational chart
Chapte	er 4—Environment, Impacts and Monitoring
	Description of the current environmental conditions (baseline conditions) for each environmental component and the data source(s)
	Base maps for spatial data to orient reviewers on the distribution of the various resources in the plantation site and in the area of probable impact (completed for each environmental component)
	Description of the potential environmental impacts associated with all phases of the proposed project (for both the project site and area of probable impact) for each environmental component, including the significance (i.e., magnitude, duration of change, permanence, and reversibility) of the impact(s)
	Acknowledgement and description of the potential cumulative environmental impacts for each environmental component, and specifically the mangrove planting, and description of the monitoring program for residual, non-mitigated impacts
	Detailed descriptions of both the short term and long term monitoring programs, including information on sampling design (frequency, intensity), who is responsible for the monitoring program, and reporting and documentation requirements. Monitoring program objectives, attributes, conditions, and indicators that will be measured as part of the monitoring program.
	Schedule of the submission of the short term plantation monitoring program (every 6 months for a minimum of first two years) and the long term plantation and ecological monitoring program (5th year and 10th year of planting)



Chapte	er 5—Project Alternatives
	Presentation of at least two acceptable restoration / mitigation alternatives to the current proposed plantation project
	Discussion of "no plantation" and "alternative location" options
	Objective comparison of the alternatives and reasons for the selection of the proposed planting project
Chapte	er 6—Statement of Commitments
	Commitment to maximizing the benefit and minimizing the environmental impact(s) of a proposed planting project
	Commitments to implement a plantation monitoring plan and a long-term ecological monitoring plan
	Adherence to EAD permitting regulations and procedures
Annex	es
	Annex 1- References
	Annex 2- Plantation Site map (Jpeg and shape files) indicating project boundary, existing and surrounding land use
	Annex 3- Plantation Site photos
	Annex 4- Letters of permission from private land owner (if applicable)
	Annex 5- Evidence of prior experience and technical qualifications specializing in silviculture of <i>A.marina</i>
	Annex 6- Information on the current condition of the environment (methodology, data, and results)
	Annex 7- Material Safety Data Sheets (if applicable)
Genera	al
	Logical organization of integrated and easy-to-review components, including annexes
	Include a list of abbreviations, definition of terms, and full references to sources of information
	Include a full suite of detailed maps (using standard formatting) describing the plantation project, plantation site and the area of probable impact at different scales
	Clarity (i.e., minimal technical terms, the adequate and appropriate use of graphics, text could be understood by non- specialists)
	Include positive and negative impacts of the proposed project (for objectivity)
	Ensure that adequate information is provided, so that EAD can gain a clear and complete understanding of the plantation site, the area of probable impact (for each environmental component), the proposed project, potential environmental impacts, mitigation options, and preferred monitoring program(s) associated with the proposed plantation project

2.2.1.2 Mangrove Planting Management Plan Format and Contents

This section provides guidelines on the format and content of the Mangrove Planting Management Plan to be submitted by the proponent to EAD. The Mangrove Planting Management Plan should have a title page and a Table of Contents, with the Table of Contents adhering to the framework and layout outlined in Table 2.2.

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Table 2.2 Standard Table of Contents for the Mangrove Planting Management Plan

Mangrove Planting Management Plan Table of Contents								
Table of Co	ontents							
List of Abbre	eviations							
Definitions of	of Terms							
List of Table	S							
List of Figure	es							
Chapter 1	Executive Summary	1.1 Project Description1.2 Summary of Findings						
Chapter 2	Introduction	2.1 Project Title and Proponent2.2 Plantation Consultants2.3 Plantation Description, Location and Rationale2.4 Justification and Project Timeframe						
Chapter 3	Project Description	 3.1 Statement of Need (ecological benefits) 3.2 Plantation Location and Scale 3.3 Evaluation of Project and Mangrove Plantation Principles 3.4 Plantation Methods 3.5 Status and Schedule 						
Chapter 4	Environment, Impacts and Monitoring	 4.1 Description of the Environment 4.2 Marine Water Quality 4.3 Geology, Hydrology, Soil and Groundwater 4.4 Fauna and Flora 4.5 Environmental Benefit & Impact Prediction and Evaluation 4.6 Mitigation Measures 4.7 Monitoring and Reporting 						
Chapter 5	Project Alternatives							
Chapter 6	Statement of Commitments							
Annexes								
Annex 1	References							
Annex 2	Plantation Site map (Jpe surrounding land use	eg and shape files) indicating project boundary, existing and						
Annex 3	Site photos							
Annex 4	If applicable, letters of po	ermission from private land owner						
Annex 5	Evidence of prior experie A.marina	Evidence of prior experience and technical qualifications specializing in silviculture of <i>A.marina</i>						
Annex 6	Information on the curre	nt condition of the environment (methodology, data, and results)						
Annex 7	Material Safety Data Sh	eets (if applicable)						



2.2.1.3 Mangrove Planting Management Plan – Detail

Further details on the contents of each chapter in the Mangrove Planting Management Plan are provided in Appendix A.

2.3 Phase 3: Obtaining an NOC for Mangrove Planting

Once EAD confirms receipt of all required documents and confirms that all information has been provided, the review of the Management Plan will begin. EAD officials will review the submitted Mangrove Planting Management Plan to verify that all chapters are complete and the report meets all of the stipulated requirements. The review of any health and safety elements required will be undertaken by the SRA, in conjunction with EAD and the Abu Dhabi Environment, Health, and Safety Centre (AD EHS Centre; i.e., the Competent Authority for the EHSMS Regulatory Framework).

A decision on whether or not to issue an NOC for mangrove planting will be made within 30 days of receiving a complete Mangrove Planting Management Plan. The project proponent will be notified by email of this decision and will be sent an NOC electronically. The NOC is issued with conditions that must be adhered to throughout the planting project.

2.4 Phase 4: Planting & Monitoring

After obtaining an NOC, project proponents and planting contractors should engage with registered mangrove nurseries to source seeds, seedlings or saplings, or should collect seeds as per the agreed quantity and locations specified in the Mangrove Planting Management Plan and in the conditions of the NOC. The Mangrove Planting NOC obtained for the project also serves as a permission to collect seeds according to the specified project period, volume and location.

Plantation methods should follow the guidelines attached in Appendix B. The plantation should be monitored every six months for a period of two years; followed by plantation health and ecological monitoring reports at the 5th and 10th year. Monitoring reports should be submitted to EAD as per the schedule specified in the conditions of the NOC.



APPENDIX A

Structure and Contents of Mangrove Planting Management Plans

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Structure and Contents of Mangrove Planting Management Plans

The following text describes the content that should be included in each of the chapters and sections of the Mangrove Planting Management Plan.

Title Page

Document Revision

List of Abbreviations

This section should include a list of abbreviations and acronyms used in the Mangrove Planting Management Plan. This list should be presented in a tabular format.

Definitions of Terms

This section should include a list of terms used in the Mangrove Planting Management Plan and their definitions.

List of Tables

This section should include a list of all the tables presented within the main body of the Mangrove Planting Management Plan and should indicate table numbers, table titles, and associated page numbers.

List of Figures

This section should include a list of all the figures presented within the main body of the Mangrove Planting Management Plan and should indicate figure numbers, figure titles, and associated page numbers.

Executive Summary

This should be a non-technical summary of the proposed plantation project and should provide significant findings from the environmental baseline data and impact assessments and the associated mitigation measures and monitoring efforts.

This short chapter should be in English and Arabic and should include the following sections, which are discussed below:

- Project Description; and
- Summary of Findings.

Project Description

This section should contain a short description of the proposed project including whether it is a mitigation or stand-alone project. This description should provide enough information for readers to understand the background, importance and scope of the proposed planting project.



Summary of Findings

This section should briefly describe the environmental impacts (whether positive or negative) associated with the proposed plantation project and the ways in which these impacts will be addressed through mitigation and monitoring efforts. The following information and findings should be included and described in this section:

- The types and magnitudes of the environmental impacts associated with the proposed project, including the main predicted benefits from the plantation and the justification for the project;
- The ways in which significant environmental issues will be resolved (with brief descriptions of the proposed mitigation measures and monitoring program);
- The residual, non-mitigated impacts (highlighting those that are irreversible or threaten flora or fauna); and
- The project advantages and disadvantages to the environment and society.

General conclusions or recommendations concerning the overall project should not be included in the Summary of Findings section.

Chapter 1—Introduction

Chapter 1 should include information, data, and details relevant to the proposed project and be organized according to the following sections, which are discussed below:

- Project Title and Project Proponent;
- Plantation Consultants and Contractors;
- Project Description and Rationale; and
- Project Background and Timeframe.

1.1 Project Title and Project Proponent

This section should include the name, address, telephone number, and fax number of the proponent's firm; the name and designation of the contact person who is responsible for the plantation project; the project's title; and a listing and brief description of any other plantation projects that the proponent has conducted, is currently conducting, or will conduct on the same site or adjacent to the current proposed plantation project. This section should also describe the proposed roles and responsibilities of key personnel (e.g., the project manager, the planting operations manager, subcontractors) who will be involved with monitoring performance and implementation of the proposed plantation's Management Plan.

1.2 Mangrove Planting Consultants and Contractors

This section should include the name, address, telephone number, and fax number of the consultant's and planting contractor's firm; the names of the team members from the consultant firm preparing the Mangrove Planting Management Plan; and the field(s) of expertise of the consultant firm and the individual team members.

1.3 Project Description and Rationale

This section should include a general description of the type and components of the proposed plantation project, the location and size of the plantation site, as well as a background and history of the plantation site. This section should also include the purpose and a rationale or justification for the proposed plantation.

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1.4 Justification of the Mangrove Planting Management Plan

This section should describe the proposed planting schedule and steps taken to develop the Mangrove Planting Management Plan. The following information should be included in this section:

- A list of the sequence of events and associated dates for the selection of mangrove planting as a stand-alone afforestation project or a mitigation project associated with a development; and
- A list and description of the main outcomes of meetings that have already occurred or a list of intended meetings with stakeholders, governmental departments, and other groups potentially impacted by or involved in the plantation in the area of the proposed plantation project.

Chapter 2—Project Description

Chapter 2 should include a detailed description of the proposed plantation with clear explanations of the need for the project and the location, scope, and activities associated with all phases of the project. This chapter should include the following four sections, which are discussed below:

- Statement of Need;
- Plantation Location and Scale;
- Plantation Methodology and Activity Descriptions; and
- Project Status and Schedule.

2.1 Statement of Need

This section should include a statement of need for the proposed plantation project and its compatibility with the Emirate of Abu Dhabi Biodiversity Strategy 2015-2020 (EAD, 2015). This statement should identify the reason for the project, demonstrate why the plantation project should be located at the proposed site, and demonstrate both ecological and if applicable, social benefits of the project.

2.2 Project Location and Scale

This section should fully describe the exact location and scale of the proposed project and should include location maps and other relevant visual information. The following information should be included and described in this section:

- Detailed site description, including the important features and site characteristics unique to the project site (e.g., natural vegetation areas, soils, geology, bodies of water);
- Detailed site history (timeline of changes in the ecological character of the site, and any past or ongoing development at or near the site);
- The planned area for the proposed plantation, including all areas of activity within the plantation site boundaries, addressing all phases (i.e., land preparation, planting, post-planting maintenance if relevant) of the project. This information should be detailed with text, maps, photographs, and/or tables;
- Coordinates and geographic boundaries of the plantation site using EAD's *Geographic Information Systems—Data Management Standards*;
- Detailed maps showing the following information:
 - Proposed plantation site and its immediate surroundings
 - Habitats on the planting site and within the surrounding area (radius of 0.5 or 1



km or more)

- Proposed plantation site within the context of the regional landscape
- Location of the proposed plantation within Abu Dhabi Emirate
- Proximity of the proposed project to national parks, protected areas, important bird areas, or any areas of known sensitivity or environmental importance; and
- General information about any known current or future proposed or planned project activities in surrounding areas (provide detail with text and maps, when possible). Such projects would include those being conducted by the proponent (and presented in Section 1.1) and by other proponents.

2.3 Project and Activity Descriptions

This section should describe and provide details on the proposed plantation and the project activities and equipment associated with the different phases of the plantation. If the footprint of the proposed planting project is large, EAD may require a Preliminary Environmental Assessment (PER). The information presented in this section should match the expected operations outlined in the plantation plan and should include the following:

- Detailed descriptions of the type, components, and phases of the proposed plantation;
- Detailed descriptions of the processes, methods and activities associated with the preparation, implementation, maintenance and monitoring of the proposed plantation;
- A list of utility types (e.g., electricity, water, waste treatment) that will be needed for the plantation activities used and whether these utilities are located on site or off site. Estimates of the quantity of services (e.g., electricity, water, waste treatment) that will be required or produced by the project should also be included. If the proposed project will require the direct or indirect use of groundwater for any project activities or processes, then this should also be described;
- Detailed descriptions (e.g., locations, amounts) of any alterations that will be made to the project site. Such alterations include, but are not limited to, groundwater dewatering, dredging, and infilling activities, as well as land excavation and leveling and filling (cut and fill) activities;
- A project organizational chart listing the people who are managing the main activities, phases, and components of the proposed project. For each person, this chart should provide his or her name, his or her roles and responsibilities, and the number of employees he or she is supervising;
- A list of all raw material and chemical quantities that will be used during all plantation activities (if applicable) of the proposed project and their associated purposes and functions. Material Safety Data Sheets (MSDSs) should be included in Annex 3 for all hazardous chemicals and raw materials;
- A description of the different wastes (e.g., hazardous, solid, liquid) and quantities that will be generated by project activities conducted during the all phases of the plantation (e.g. land preparation, excavation etc.);
- A list and description of all the origins of point source emissions and pollution (e.g., gases, liquids, solids, noise, light, increased sediment loads) produced by project activities conducted during the land preparation phase, planting phase and post-planting monitoring and maintenance phase; and
- A list that identifies all potentially polluting (emissions or noise) or



environmentally damaging equipment and machinery that will be used during the proposed plantation's preparation (e.g., bulldozers, dump trucks, generators).

2.4 Project Status and Schedule

This section should describe the current status of project implementation, the schedule and season of the proposed plantation and the components and phases therein. This section should also include a concise overview of the approval procedures and steps for the proposed plantation.

Chapter 3—Environment, Impacts, Mitigation, and Monitoring

Chapter 3 should provide a comprehensive description of the environment, impacts, mitigation, monitoring and risks associated with the proposed plantation project. More specifically, this chapter should describe the current environmental baseline conditions, the methodology or sources of information used to determine the baseline conditions, the potential benefits and impacts associated with the project, and the mitigation measures and monitoring efforts that will be used to reduce any negative impacts of the proposed project on the environment. These descriptions should be created for all environmental components that occur within or near the plantation site and should cover all applicable phases of the plantation.

Section 3.1 of Chapter 3 discusses the environmental components and the corresponding subsection number for each component as it should appear in the report. The remaining sections within Chapter 3 (i.e. Impacts, Mitigation, and Monitoring) are summary sections and address all the environmental components together.

3.1 Description of the Environment

This section should describe the current status (baseline condition) of the plantation site and the methods and/or sources of information used to determine the baseline condition. There should be specific emphasis on areas and conditions that may be directly and indirectly affected by the proposed plantations and its associated activities conducted during the plantation. Analysis should be performed to identify existing and valid and up to date baseline data that is in conformance with EAD standards (the Abu Dhabi EHSMS Regulatory Framework—Standards and Guideline Values should be referenced). In the case were existing baseline data is not available or not suitable to properly represent the baseline conditions of the area, baseline surveys may be required. If required, a scope of work document for the baseline survey which identifies baseline data needs and methods of baseline data collection maybe requested by EAD for inclusion in the Mangrove Planting Management Plan. The scope of work should also include a technical justification for the validity of the sampling frequency, locations, number of samples, and duration of sampling period in representing the baseline conditions of the area, including seasonal variations.

Every effort must be made to identify existing baseline data that characterize the current condition of the environmental component in the proposed plantation site or the surrounding area. Suitable data sources include results from previous baseline condition assessments conducted on the project site or data from studies, literature, or reference documents that describe the environmental condition of a sufficiently comparable site. For data from such sources, the Mangrove Planting Management Plan should contain a detailed description of the source and the methods used to collect the data (to the level of detail contained within the source document).

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Baseline conditions that should be addressed include existing physical, chemical, biological, socio-economic and land-use conditions. These conditions should be evaluated in the plantation area (i.e., site of proposed project) and in the area of probable impact (i.e., the extent of the area outside of the plantation area that is likely to be directly or indirectly impacted by the proposed project). Both the plantation site and area of probable impact should be clearly described and delineated with maps in the Mangrove Planting Management Plan. The area and scale of probable impact may differ by habitat type, biotic community or species, and such differences should be reflected in the maps for each component. EAD will carefully review the adequacy of the designated area of probable impact. Baseline data from a similar area may be used as a substitute for actual site-specific data if site-specific data are unavailable. If any of the components are incomplete, this must be noted in the Mangrove Planting Management Plan. Specific information that should be addressed in this section includes the following:

- **Marine Water Quality**. All relevant pollutants, contaminants, salinity, turbidity, and temperature should be assessed in both the water and sediments, and if applicable and available, information on bathymetry, currents, water flow patterns, and existing intakes and outfalls (at the project site and in the area of probable impact) should be presented;
- **Geology, Hydrology, Soil, and Groundwater.** General descriptions of the topography and regional and site-specific geology and hydrology (e.g., superficial deposits and bedrock, faults) should be included. The existing soils in the plantation site should be described. These descriptions should include relevant characteristics such as soil type, geotechnical properties (e.g., liquefiable, cavernous), and whether the soil is native or reclaimed/fill material. There should also be a description of the methods and sampling regime/locations used to determine the soil conditions;
- **Fauna and Flora.** There should be an evaluation and description of all habitats, ecosystems, and flora and fauna that could or will be impacted by the proposed project, with special emphasis on habitats, systems, and flora and fauna that are threatened, endangered, uniquely sensitive, or of regional or international importance. For flora and fauna, information on local, regional, national, and international abundance, habitat requirements, territory or home-range size, migration patterns, and other behavioral characteristics that could be impacted by the proposed project should also be included. The sources of the baseline data should ideally account for seasonal and annual variations in the presence and the abundance of flora and fauna; and
- **Maps**. Maps and other relevant visual information that orient reviewers to the distribution of important features and their proximity to the plantation site (covering the plantation site and area of probable impact) should be included in this section. All maps should adopt a consistent format that includes a title (indicating what the map shows, the location, and the date the map was produced), a legend, a scale bar, and a North arrow.

3.2 Environmental Benefit and Impact Prediction and Evaluation

This section should address the potential and anticipated positive and negative impacts of the proposed plantation on environmental components. This section should include the direct and indirect impacts in the plantation site and area of probable impact identified by the proponent, contractors, and consultants associated with the proposed project and through the environmental baseline assessment data or other sources. Impacts associated with all land preparation and plantation phases (if relevant) should be addressed. The following information should be included and described in this section:

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- All of the potential benefits and impacts of the plantation and their respective sources, including a description of the cause-and-effect relationships between planned project activities and the environmental impacts;
- The location of the impacts in relation to the project activities and site boundaries;
- The probable significance of predicted benefits and impacts (i.e., magnitude of change or effect). When possible, estimation or quantification of the impacts should also be included;
- Identification of the permanence and reversibility of the predicted benefits and impacts;
- The methods or approaches used to predict the benefits and impacts. It is best to use quantitative assessment whenever possible, giving ranges and confidence limits. When possible and relevant, a list of stated assumptions that affect the predicted impacts, their probability of occurrence, the time scale, and degree of impact should also be included;
- If a model is used to evaluate or determine the benefits or impacts on the ecology of the site, then the proponent should demonstrate that the model and data used to determine the impacts are appropriate for the current application and environmental component. To meet this need, there should be a full description of the model; the reason(s) for choosing that model; the origin of the data used in the model; descriptions and printouts of all model inputs, runs, and results; and an interpretation of the results. This information should clearly demonstrate the results, the way in which the results were derived, and that the results are accurate and applicable. This information should be included as an additional annex in the Mangrove Planting Management Plan;
- If no negative impacts are anticipated, then this should be stated, along with a supporting justification for the conclusion; and
- Evaluation and detailed descriptions of the potential impacts from surrounding land use on plantation success should be included. Impact from past, current, and foreseeable future industrial and non-industrial activities at and near the plantation site should be included. To address the potential environmental impacts, include a description of any project- related activities or processes that may be affected by any of the following:
 - Off-site adjacent facilities, projects, or activities within or near the area
 - Other project components, activities, and processes at the proposed project site
 - Additional projects planned at the site
 - New processes planned for the site.

Information that should be addressed for specific environmental components includes the following:

- **Marine Water Quality**. The probable impacts of the proposed plantation and project activities on the sediment quality, water quality, water temperature, and water currents and flows should be described and supported by appropriate hydrodynamic model(s).
- **Geology, Hydrology, Soil, and Groundwater**. There should be descriptions of the impacts of the proposed project on the soil and hydrology, and all relevant potential changes and possible sources of contaminants should be addressed. There should be a description of the potential impacts of the proposed project and project activities on the quality of the soil. Land alteration (e.g., cut and fill, dredging), land-use and project activities should be



addressed. Maps should be used to indicate the locations and extent of the potential impacts. For the Groundwater portion of this environmental component, there should be a description of project activities that will require the use and withdrawal of groundwater, along with estimates of groundwater withdrawals rates and amounts (and seasonality, if applicable). When applicable, the impacts of the proposed project on the groundwater should be supported by map(s) and appropriate groundwater model(s).

• **Fauna and Flora.** There should be an evaluation and description of the predicted benefits or impacts on all the habitats, ecosystems, and flora and fauna, with a special focus and increased detail on the ecosystems and flora and fauna that are threatened, endangered, uniquely sensitive, or of regional or international importance. Maps should be used to indicate the locations and extent of the potential impacts (both in the plantation site and area of probable impact).

3.3 Mitigation Measures

This section should outline mitigation measures to reduce any negative impacts on the area's ecology at all phases of the proposed plantation and should consist of the following sections, which are discussed below:

- Potential Mitigation Measures;
- Selected Mitigation Measures;
- Mitigation Measures to Address Cumulative Impacts; and
- Residual Impacts.

Potential Mitigation Measures

This section should list and describe all of the environmental impacts and identify a variety of potential mitigation measures that could be adopted to reduce the negative impact of the proposed plantation on the environment during all phases of the proposed plantation. This section should be developed with the Mangrove Planting Management Plan consultant and be presented in a tabular format. The following information should be included and described:

- The environmental impacts and their sources, locations, and significance (land preparation, noise levels during plantation activities, number of vehicles used, wastes resulting from the plantation project, etc.);
- Potential mitigation measures that could be adopted to address the impacts (more than one option can be presented); and
- If an impact cannot be mitigated, then this should be stated.

– Selected Mitigation Measures

This section should describe the mitigation measures that the project proponent will adopt to reduce the negative impacts of the proposed plantation project on the environment during all phases of the project. The selected mitigation measures should consist of practical, cost-effective measures that will sufficiently mitigate any negative environmental impacts. A brief description and justification for the selection of each mitigation measure should be provided. Specific information that should be included and described in this section includes the following:

• A comprehensive description of each recommended mitigation measure, the way in which the measure will reduce or ameliorate the environmental impact, and why the measure was selected over other options (consider costs and



reductions in environmental impact);

- Relevant diagrams and information on all technology, equipment, units, processes, and facilities that will be part of the mitigation measure to control the potential impacts. Information on the effectiveness (i.e., reductions that could be achieved under normal operations) of the technology, equipment, unit, process, or facility should also be included; and
- Descriptions of the ways in which each of the mitigation measures will be implemented, who will be responsible for implementing these measures, and the implementation schedule. This schedule should clearly demonstrate that the mitigation measure will be in place and in use before the project impacts are realized.

- Residual Impacts

This section should clearly identify and describe residual environmental impacts on the environmental component that will not or cannot be mitigated. It should consist of all impacts that will not be mitigated by the project proponent and include the following information:

- Justification for the absence of a mitigation measure (e.g., economic, mitigation not possible, minimal environmental impact); and
- Estimation of the environmental impact(s) that will likely occur without mitigation, addressing duration, extent, and intensity of impact(s).

3.4 Monitoring Program

This section should describe the monitoring program(s) that will be implemented to record plantation health. The monitoring program(s) should address all phases of the plantation project and both the plantation site and area of probable impact. The monitoring program should include environmental elements mentioned in sections 3.1 and 3.2 with specific focus on fauna and flora, and plantation growth and health.

The monitoring program and methods used to monitor the success of the plantation should be clearly outlined and described in this section. Specific details that should be addressed and described in this section include the following:

- Person(s) or the agency that is responsible for implementing, maintaining, and assuming financial responsibility for the monitoring program (include a detailed, documented process to show the ways in which the monitoring program is implemented and adhered to);
- Schedule for the monitoring program, including frequency and the number of site visits. Part of this scheduling should include a documentation system or process to record results from site visits. When relevant, maps and photographs of sampling locations and areas should be provided. After six months of planting and for a minimum of 2 years, survival data should be recorded seasonally. In case of mortality, it is important to investigate the underlying causes and initiate appropriate remedial measures. A minimum of two monitoring reports per year should be submitted to EAD. The monitoring report should include photos, % mortality, density, survival and growth (number of leaves per plant and the height of the sapling);
- Ecological monitoring is necessary in order to provide evidence that the plantation has provided ecological benefits in the long-term. Ecological monitoring is required at 5 years and 10 years after the planting activities are completed, with seasonal monitoring (summer and winter) at the 5 year and 10 year mark;
- System and requirements for periodic reporting (frequency of reporting



- and who is responsible for creating and filing the reports); and
- Actions that will be taken in case of high mortality or if the plantation is not meeting the desired or targeted benefits.

Chapter 4—Project Alternatives

Chapter 4 should list and describe alternative approaches or alternative restoration or mitigation options. This chapter's main objective is to target aspects of the plantation project that are likely to have the largest impact on cost and the environment and to provide examples of more beneficial alternatives to those aspects. At least two restoration or mitigation alternatives should be explored in depth, with any additional alternatives being covered in less detail. In addition, "no-plantation" and "alternative location" options should be presented. Descriptions of the alternatives should include the following information:

- Improved or new technology, equipment or planting methodology;
- Size/Scale;
- Location; and
- Implementation.

This chapter should conclude with a justification of the selected approach and components selected for the proposed plantation (i.e., why other mitigation or restoration options were not chosen or considered).

Chapter 5—Statement of Commitments

Chapter 5 should outline and reiterate commitments to monitor the survival and ecology of the plantation, as well as mitigate any negative environmental impacts and potential risks associated with land preparation or any other phase of planting activities, in adherence to EAD standard operating procedures and protocols. A summary of the environmental impacts outlined in Chapter 3, along with a detailed commitment to managing these impacts to acceptable levels, should be included (commitment should include details about mitigation, monitoring, and recording and reporting processes). A description should also be included that clearly details who is responsible for ensuring that the commitments are fulfilled. There should also be text that describes a commitment to adhering to the procedures and steps specific to EAD protocols and the process for preparing relevant documents. More specifically, this chapter should clearly state a commitment to the following:

- Providing EAD with all details related to the plantation, any future updates and modifications of plans or project activities, periodic seasonal plantation monitoring reports for the initial two years and seasonal ecological monitoring reports at 5 years and 10 years after planting; and
- Adhering to all EAD permitting regulations and procedures.

Annexes

Annexes should include all information not immediately relevant to the main text of the Mangrove Planting Management Plan. Annexes should include the following:

- Annex 1- References. This annex should include all references and sources used to develop the Mangrove Planting Management Plan;
- **Annex 2- Site map.** This map should be submitted in both JPEG and as shape files, indicating project boundary and existing site and surrounding land use;
- Annex 3- Site photos. Geo-referenced photos of the key features in and around



the site;

- Annex 4- Letters of permission from private land owner (if applicable). The letters should provide full details of the land owner and form of jurisdiction, specify the time period and activities permitted, and provide exact coordinates of the boundaries of the site allocated for planting;
- Annex 5- Evidence of prior experience and technical qualifications specializing in silviculture and/or restoration of *A. marina*. This should include CVs of all technical and management staff involved in carrying out and monitoring the plantation, as well as a record of past projects carried out by the planting company;
- Annex 6- Information on the current condition of the environment (methodology, data, and results). This annex should include relevant and detailed descriptions of the methodology, data, and results of the assessments or laboratory analyses used to establish the current condition of the environment in the proposed plantation site and area of probable impact. Included in this annex should be a full description of the current condition of each environmental component (product of assessments), sources of the information, and relevant maps and photographs not shown in Chapters 2 and 3 of the Mangrove Planting Management Plan; and
- Annex 7-Material Safety Data Sheets (if applicable). This annex should include all MSDSs associated with any hazardous materials (if applicable).

Additional annexes should be added as needed to support plantation management and monitoring methodology and output. EHS documentation, large-scale drawings and diagrams, checklists, log templates for monitoring, maintenance, and training can be included.



APPENDIX B

Mangrove Planting Guidelines (2015)



Mangrove Planting Guidelines (2015)

There are different techniques for planting. The most common method used in many countries of the world is direct planting of seeds / propagules (pre-germinated seeds while still attached to the mother tree) of *A. marina*. However, in the UAE, due to high tidal wave action (few sheltered coasts), predominantly sandy soils, and high summer temperatures, seeds / propagules are often carried away or suffer sunburn.

The direct planting of *A. marina* seeds / propagules should be restricted to sheltered sites having predominantly muddy soil. The seed / propagules should be planted in a small pit / hole. In general, nursery grown seedlings are recommended for planting bare or partially bare areas.

1. Planting Season

The harsh environmental and ecological conditions of the UAE limit the duration of the planting season considerably. The best time for planting any mangrove species depends on the availability of mature seeds / propagules of the species in question. Due to severe environmental conditions, it is recommended to plant seedlings instead of seeds or propagules to achieve a high success rate. Plantation activities should not be carried out during the summer months. The best planting seasons for *A. marina* are from February to April and October to November.

2. Seedling / Seed Quantity Estimation

After an NOC for mangrove planting is obtained from EAD, seeds/seedlings should be sourced according to the conditions of the NOC and the planned plantation density. The number of seedlings / seeds required should be calculated based upon the size of the proposed planted area and spacing of the plantation (plant to plant and row to row). Seeds should be collected from several local sites in order to increase genetic diversity within the planting stock and avoid introducing pressure on a single site. Seed collection should avoid disturbance to wildlife and mangroves.

Seeds from genetically isolated populations (mangrove sites that are significantly far or *A. marina* in other Emirates or countries) should not be used as it may risk eroding the genetic uniqueness of the local mangrove stock. Genetic studies have revealed that the populations of *A. marina* around Abu Dhabi are all closely related but have deviated from other populations around Arabia, including some of those on the East Coast of the UAE. This is due to Abu Dhabi mangroves being relatively isolated from those outside the Arabian Gulf (Maguire et al. 2000).



3. Seedling Selection Criteria

The specifications for selecting seedlings for field plantation are presented in Table 1.

Mangrove Species	Height (cm)	Pair of Leaves	Nursing Period
Avicennia marina	At least 30	5 pairs	4-5 months

Table 1. Specifications to Select Seedlings for Field Plantation

4. Transportation of Seedlings

Transportation of seedlings from the nursery to the plantation site is a crucial component of the planting operation. Depending upon the accessibility of the plantation site, seedlings may be transported by boat or truck. The seedlings should be carried in plastic or wooden crates as shown in Figure 1 and preferably transported on the same day of planting. Any waste generated from the seedling containers should be recycled or properly disposed of. Effort should be made to reduce the number of trips necessary for transporting seedlings to minimise emissions from vehicles and minimise the overall environmental impact of the plantation project.

Figure 1: Transportation of seedlings



Special care must be taken during loading and unloading of the seedlings (Figure 2). Mishandling may cause serious damage to the delicate shoots or roots of the seedling.







5. Plantation Spacing

Care must be taken avoid planting mangroves too closely together. It is common to plant mangroves at very close spacing – 25 cm to 100 cm apart. This can result in stunting of the mangroves, and also create a very unnatural hydrology and should be avoided. Planting mangroves with sufficient space in between is preferable. Another option is to plant mangroves in a random pattern (no straight lines) with spaced plantings of 1.25 - 2 meters. Large spacing allows room for natural seedlings to establish themselves over time. For general plantation purposes, *A. marina* seedlings should be planted at 3 x 3 m spacing on potentially good sites, and at a close spacing of 2 x 2 m on relatively poor sites, as shown in Figure 3.



Figure 3: Plantation spacing

Before planting operations start, it is necessary to demarcate the plantation spacing on the ground. Nylon ropes marked at fixed spacing with ribbons or knots are commonly used, as shown in Figure 4. The planting location of each seedling is marked with a shovel.







6. Planting / Working Time

It is important to note that mangrove planting activities cannot be carried out at fixed times or for fixed hours. Planting or working time entirely depends on the tidal regime. After every six hours, the tidal pattern changes, from low tide to high tide and vice versa as shown in Figure 5. Apart from this, there is about a 40 minutes daily backward shift in the tidal pattern time. It is therefore recommended to consult the local "Tide Tables" or observe the tidal pattern personally before organizing plantation operations on site. This will avoid wasting time and money.

Figure 5: Seedlings at low and high tide



Planting operations should be carried out during low tide only. Planting activities must be finished before the arrival of high tide in the plantation site.



7. Pit Preparation

Seedlings should be planted in pits or holes dug with a shovel. The depth of the pit must be same as the size of the seedling earth ball as shown in Figure 6. Planting seedlings in shallow pits will result in the toppling or washing away of seedling by high tides.

Figure 6: Pit preparation



Shovel-dug Pit

8. Removal of Seedlings from Containers

Seedlings must be removed from their containers before planting. If polythene bags are used, these can be cut away with a knife from both sides. With plastic pots, the seedlings may be removed gently by pressing the bottom of the pot as shown in Figure 7. Special attention should be paid not to break the earth ball, or cause damage to the roots. Plastic waste should be recycled or disposed of appropriately.



Figure 7: Removal of seedlings from containers



9. Planting Seedlings

After removing the seedling from the polythene bag / plastic pot, it should be inserted gently in the pit. It is important to ensure that the root collar of seedling is located at ground level. The empty portion of the pit should be filled with soil, and compacted to ensure that seedling does not topple over during high tide or when exposed to wind, and that it remains in a firm upright position. Figure 8 shows how seedlings are planted and fixed in the pits.

Figure 8: Planting seedlings





10. Monitoring

It is recommended that the plantations be monitored regularly to assess their success and growth rate. After six months of planting and for a minimum of 2 years, survival data should be recorded seasonally. In case of mortality, it is important to investigate the underlying causes and initiate appropriate remedial measures. The planned monitoring program should be included as part of the Mangrove Planting Management Plan submitted to EAD. Two monitoring reports per year should be submitted to EAD after the planting activities are completed. The monitoring report should include photos, % mortality, survival and growth (number of leaves per plant and the height of the sapling). Case studies for other regional areas indicate and average annual growth rate of 0.5m, measured as maximum height (Cookson et al; 2002).

The density of mangroves generally reduces with increasing maturity, as the bushes get bigger. A young, natural, well established stand could contain 10,000 bushes more than 1 metre tall per hectare. Stands of moderate maturity can be expected to thin down to about 2,000 bushes per hectare, and the most mature stands to around 1,000 per hectare. Any mangrove plantation should only be considered to be a success if it reaches at least moderate maturity. Figure 9 presents an example of some seedling monitoring activities.

Figure 9: Seedling monitoring





11. Restocking

Young mangrove plantations are susceptible to damage caused by many factors such as strong winds / cyclones, high tidal waves, strong currents, oil pollution, effluents, seaweeds, limpets, crabs, mud lobsters, barnacles, grazing and insects. Supplementary planting operations may be necessary if density is significantly reduced, in order to bring back the planted area to the desired density level.

12. Summary of Plantation Practices

The summarized details of plantation practices are shown in the Table 2. The work schedule for *A.marina* plantations are summarised in Figure 1 below.

Species	Site	Soil	Planting Season	Planting Time	Sourcing of Seeds/Se edlings	Seedling Selection	Spacing	Planting
Avicennia marina	Seaward. 50-100 cm lower than the high tide. Sheltered	Sandy- loam, silt- loam & sandy- clay- loam	February to April and October to November (use saplings grown from previous years)	Low tide period	August to September	30 cm and above, at- least 3 pairs of leaves	3x3 m on good sites, 2x2 m on poor sites	- Removal of seedlings from containers - Root collar rest at the ground level

Table 2. Summary of Plantation Practices



Table 3. A. marina work schedule

Work Schedule													
Species	Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avicennia marina	Selection of Plantation Sites and submission of Mangrove Planting Management Plan												
	Sourcing seeds/seedlings/saplings												
	Planting Period												



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