بسم الله الرحمن الرحيم

Ministry of Environment and Energy
ލިބްސްގެ ތާވަ ތަންތަނާއި ތަނަވަސް ތަކެތި ބަލަ

Environmental Protection Agency
ތަންތަނާއި ތަނަވަސް ތަކެތި ބަލަ

ކ.ހަނިމާދޫ ފަރާތުގައި ހަނގުރާ ހަދާ ތަންކޮށް ތަރައްގީ ކުރުމުގެ ނިންމުން

ތަކުރުދ ބަޔާން

ތަކުރުދ ކުރެވޭ ތަން Proposed Reef Scaping Project at Eastern Beach Hulhumale, Kaafu Atoll, Maldives

ތަކުރުދ ކުރާ ފަރާތުގެ ނަން Hassaan Abdul Muhsin ފޯނު ނަންބަރ 7901665

ތަކުރުދ ކުރާ ފަރާތުގެ ސީދާ ގުޅުވުން EIA P02/2020 ތަކުރުދ ކުރި ތާރީޚް 05-07-2025

ތަކުރުދ ކުރާ ފަރާތުގެ ނަން URBANCO ފޯނު ނަންބަރ 7901665

ދައްކަންޖެހޭ ފީ ގޮތް ފަދަ ގޮތް 1 (5000ރ) ☐ ފަދަ ގޮތް 2 (10000ރ) ☐ ފަދަ ގޮތް 3 (20000ރ) y

ތަކުރުދ ކުރާ ލިޔުންތައް

	ތަކުރުދ ކުރާ ލިޔުންތައް	ފާހަގަ ކުރުން	
1	ހުށަހަޅާ ފޯމުގެ ކޮޕީ		☐
2	ތަކުރުދ ކުރާ ލިޔުން PDF		☐
3	ތަކުރުދ ކުރާ ތާރީޚް 25th December 2023		☐
4	ސުންގ ލިޔުން i &iv		☐
5	ތަކުރުދ ކުރާ ތާރީޚް 132		☐
6	ތަކުރުދ ކުރާ ގޮތް 11		☐
7	ހުށަހެޅި ގޮތް 10		☐
8	ތަކުރުދ ކުރާ ގޮތް 134-134		☐
9	ތަކުރުދ ކުރާ ގޮތް (ތަކުރުދ ކުރާ ފަރާތުގެ ގޮތް) 138		☐
10	ފެނުގައި ތަކުރުދ ކުރާ ގޮތް 39		☐
11	ތަކުރުދ ކުރާ ގޮތް 33		☐
12	ތަކުރުދ ކުރާ ގޮތް 26		☐
13	ތަކުރުދ ކުރާ ގޮތް 88		☐
14	ތަކުރުދ ކުރާ ގޮތް 120		☐
15	ތަކުރުދ ކުރާ ގޮތް 112		☐
16	ތަކުރުދ ކުރާ ގޮތް 123		☐
17	ތަކުރުދ ކުރާ ގޮތް 130-139		☐
18	ތަކުރުދ ކުރާ ގޮތް 141		☐
19	ތަކުރުދ ކުރާ ގޮތް ii		☐
20	ތަކުރުދ ކުރާ ގޮތް i		☐
21	ތަކުރުދ ކުރާ ގޮތް ii		☐
22	ތަކުރުދ ކުރާ ގޮތް		☐

ތ ކުރުދ ކުރާ ފަރާތުގެ ކ.ހަނިމާދޫ ތަކުރުދ ކުރާ ތަނުގައި ތަކުރުދ ކުރާ ގޮތް ފާހަގަ ކުރަމެވެ.

ތަކުރުދ ކުރާ ފަރާތުގެ ނަން URBANCO ގޮތް 14/May/2023 ސޮއި

ތަކުރުދ ކުރާ ފަރާތް

ތަކުރުދ ކުރާ ފަރާތުގެ ނަން ---------- ގޮތް ----------

ތަކުރުދ ކުރާ ފަރާތުގެ ދާއިރާ ☐

ސޮއި ---------- ނަން ----------

ތަކުރުދ ކުރާ ފަރާތުގެ ވަކީލު

ސޮއި ---------- ނަން ----------

Environmental Protection Agency
Green Building , 3rd Floor, HandhuvareeHingun
Male', Rep. of Maldives, 20392
Tel: [+960] 333 5949 [+960] 3335951
Fax: [+960] 333 5953
Email: secretariat@epa.gov.mv
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ތަކުރުދ ކުރާ ފަރާތް
ފ ހަނިމާދޫ، 3 ވަނަ ފަންގިފިލާ ހަންދުވަރީ ހިންގުމުގެ ތަނ
ދ ގުރ، ދިވެހިރާއްޖެ، 20392
ގ: (+960) 333 5949 (+960) 3335951
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ބ: secretariat@epa.gov.mv
ވ: www.epa.gov.mv

Proposed Reef Scaping Project
at Eastern Beach Hulhumale, Kaafu Atoll, Maldives

TOR No: 203-ECA/161/2022/30

Proponent
Housing Development Corporation

EIA Consultants
Hassaan Abdul Muhsin
(EIA P02/2020)
Mariyam Sunaina Mohamed
(EIA-T(B)01/2023)

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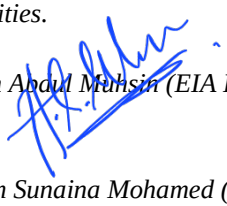
IV. Declaration of the consultants

We certify that the statements made in this EIA are true, complete, and correct to the best of our knowledge and abilities.

Hassaan Abdul Muhsin (EIA P02/2020)



Mariyam Sunaina Mohamed (EIA-T(B)01/2023)

بسم الله الرحمن الرحيم

ހައުސިންގ ޑިވެލޮޕްމަންޓް ކޯޕަރޭޝަން ލިމިޓެޑް
ހުޅުމާލެ، ދިވެހިރާއްޖެ

Housing Development Corporation Limited
HDC Building, Hulhumalé, Republic of Maldives

Letter no: HDC(161)-UBP/203/2023/22

May 11, 2023

Mr. Ibrahim Naeem,
General director,
Environmental Protection Agency,
Ministry of Environment and Energy,
Green Building,
Malé,
Republic of Maldives.

Dear Sir,

SUBJECT: DECLARATION AND COMMITMENT TO IMPLEMENT THE PROPOSED MITIGATION, MANAGEMENT ACTIONS, AND MONITORING AS PER THE PROPOSED ENVIRONMENT IMPACT ASSESSMENT (EIA)

The management of Housing Development Corporation Ltd endorses this EIA and assures that this EIA is accurate and complete, to the best of our abilities.

Further, we confirm our commitment to implement all mitigation and monitoring during the development phase as well as operation phase as specified in the impact assessment.

Yours Sincerely,

Shahid Ahmed Waheed
Director

VI. ސާރާ ޚުލާސާ

މި ރިޕޯޓަކީ އަސަރުކުރާ މިންވަރު ބެލުމުގެ ރިޕޯޓެކެވެ، ހުޅުމާލޭގެ އިރުމަތީ ފަރާތު ގޯތީގައި ކުރިއަށްގެންދަން ހުށަހަޅާ މަޝްރޫޢާ ކުރުމުގެ މަސައްކަތް ކުރިއަށް ގެންދިއުމުން ތިމާވެށްޓަށް ކުރާނެ އަސަރުތައް ދެނެގަނެ، މިކަމުގެ ސަބަބުން ތިމާވެށްޓަށް ކުރާ ނޭދެވޭ އަސަރުތައް ކުޑަކުރުމަށް، ފައިދާހުރި އަސަރުތަކުގެ މަންފާ އެންމެ ފުރިހަމަގޮތުގައި ހޯދޭނެ ގޮތް ބެލުމަށް ބާރުއަޅާފައިވާ އުސޫލުތަކާ ރިޕޯޓެވެ. މިރިޕޯޓުގެ ތަފްސީލުތަކާއި ދ ބޭނުމައި، ބާރުފައިވާ މިމަސައްކަތަށް މުޅިކަ ހިމެނިގެ ނަމާސަކުރަމުންދައި، މުޅިކަ އިންސާފާއި، ކަންތައްތަކުފައިވާ ސަރަހައްދެވެ.

މިރިޕޯޓު އެކުލަވާލާފައިވަނީ، ދިވެހިރާއްޖޭގެ ތިމާވެށި ހިމާޔަތްކުރުމާއި ދެމެހެއްޓުމުގެ ޤާނޫނު، ޤާނޫނު ނަންބަރު (93/4) ގެ ދަށުން އެކުލަވާލާފައިވާ ތިމާވެށްޓަށް އަސަރުކުރާ މިންވަރު ބެލުމުގެ ގަވާއިދު 2012 ގައި ބަޔާންކޮށްފައިވާ ކަންކަމާއި، މި މަޝްރޫޢު ކުރިއަށް ގެންދިއުމަށް ބޭނުންވާ ތިމާވެށްޓަށް އަސަރު ކުރާ މިންވަރު ބެލުމުގެ ރިޕޯޓް ތައްޔާރުކުރުމަށް އެންވަޔަރަންމަންޓް ޕްރޮޓެކްޝަން އެޖެންސީ (އީ.ޕީ.އޭ) އިން ދޫކޮށްފައިވާ ޓާމްސް އޮފް ރެފަރެންސްއާ އެއްގޮތަށެވެ.

މިމަސައްކަތަކީ ހުޅުމާލެއިގެ އިރުމަތީގެ މަގުގައިހުރި ޓްރާސަރގޭ ހުޅުމާލޭގެ އިރުމަތީ ފަރާތު މޫދުގައިވާ ދިރުމަކަށްގެ ނަސްލުތަން އިރުމަތީ ބަނދަރާ ފައިބައްކުރާ ގޯތިތަކަށް ބޭނުންކުރުމަށް، އާވާސް، އަސަރުހުރި ދިރުމަކަށްގެ ނަސްލުތަން އިމާރާތް ބަނދަރާ ފުރިހަމަކުރަން ގެނައުމެވެ. މަސައްކަތުގެ އިރުމަތީގެ މަސައްކަތުގެ މަސްޖިދު ޕްލާނަށް ކަމަށްވެފައި، މި މަސައްކަތް ފެށުމާއި ކަނޑުފާރީގެ ތަޅު މަސައްކަތުގެ ތަނުގެ ތަކުގެ ބޮޑު ބައެއް އެއްކަން ކަނޑައަޅާ ކަމަށް ބަލާ ދިރުމަކަށްގެ ހަރަކާތްތައް އިމާރާތްކުރުމުގައި މަސައްކަތުގެ ތެރޭގައިވެއެވެ. އެކަން ތަކުގެ އަޑަށް ތަނަކީ ދިރުމަކަށްގެ ހަރަކާތްތަކަށް އިމާރާތްކުރެވޭ. މި މަސައްކަތުގެ ތެރޭގައި ކުލަ ސަރަހައްދުތަކުގެ ގޮތުން، ހެދުމާއި ސަރަހައްދުގެ މަދުރަސާ ކަނޑުގެ ދިރުންތަކުގެ އިމާރާތް އެއްގޮތަށް ޕްރޮގްރާމް ހިންގާ، އަދި ފަރުތަކުގެ މަސައްކަތުގެ ހުރިހާ ގޮތް ސަރަހައްދުން ސަރަހައްދަށް. އެހެންކަމުން މި ސަރަހައްދަށް މިހާރުގެ ހާލަތުގައި ހުރިކަމާ ގުޅިގެންވާ ފަރުދަނޑު އަދި ފަރުތަކުގެ މަސައްކަތް ހަލާކުވުން މަސައްކަތްތަކުން އެއްވެސް އެކަށީގެން ސަރަހައްދުވެ.

މި މަޝްރޫޢު ހިންގުމަށް މެއިން ފަރިތަ ޓީމް ސަރަހައްދު، މި މަސައްކަތުން އަސަރުކުރާނެ ގޮތަކުން ތަފާތު ފަރުތަކަށް ބައްލަވާލުމަށް ތަކަލީފާ ފިޔަވަތް ހުށަހަޅާ ހުށަހެޅުމެވެ. އެކަމަކު ހިމެނޭ ތަކުގެ ގުޅުމާއި ފަރުގެ ހައިސިއްޔަތު ސަރަހައްދު، އިސްވެދެންނެވި ތަކަތަ ދިރުމާއި ދިރުމަށް ފައިދާ ދޭ، ފަރު ސަރަހައްދު، އަދި އާބާދީ ރަށްވެހިން ބޭނުންކުރާ ބަޔަކަށް އަރުވާ ހަމައަށް ސަރަހައްދު ހިމެނެއެވެ.

މި މަސައްކަތުގެ ބޭނުންތަކަށް ފައިދާތައް ފާހަގަކޮށްފައިވާ ކަންތަކުގެ ތެރޭގައި؛

1. ހުޅުމާލޭގެ ދަ ފިއަލަހެވޭ ފުރުތުގައި ތަރައްގީ ސަރަހައްދުން ދެ ދިއަލަތަން ބެރަށް ޒިޔާރަތްކުރުމުގެ ސަބަބުން މަސައްކަތް ބޮޑުކުރުމަށް އެހީތެރިވުން،
2. މިސަރަހައްދުގައި ޕްރޮޖެކްޓް ބޭނުންކުރުމުގެ ގޮތުގައި ހިމެނުން،
3. އަދި އިސްވެދެންނެވި ތަރައްގީގެ ނިޒާމީ ފަރުތަކުގެ ބަޔާއި ދާގަ ތަކެތި ކަމާ ފަރުތަކުގެ ފުލުހުން ބާރުވެ އެޖެންޑާ ބައިނަލްއަޤްވާމީ ސަރަހައްދުތަކުގެ ތަރުހީ އެހެން ސަރަހައްދު ބައިނަލްއަޤްވާމީ އެފަރުތަކުގެ ވަރުގަދަ އުފެދުން ދަރިވަރުން،

4. މީގެއިތުރުން، ފަޅު ސަރަހައްދު އަދި އާންމު ރައްޔިތުން މުދަލާއެކު ވޯޓަރސްޕޯޓް ކުޅިވަރު ހަދާފައިވާ ސަރަހައްދުގައި އެ ސަރަހައްދުގެއް ބޭނުންކުރާ ފަރާތްތަކުގެ ސަލާމަތާ ދިމާކުރާ ކަންކަން ދިރާސާކުރުން ނުރައްކާ ކަންތައްތައް އަދި ބޭނުންކުރާ ފަރާތްތަކާ ދިމާކުރާ ކަންކަން ދިރާސާކުރުން ހަރުކަ
ހާއި ހުރި މަސައްކަތްތަކަށް ބުރޫ އެރުން،

5. އަދި ދިރާސާގެ ހިކި ނުވާނަ ކިލަނިބަދަލުގެ ސަލާމަތާ އިންސާ ދުރާކަތެރީ މަރުވުމުގެ ފުރުސަތު ބޮޑުވުން.

މިމަޝްރޫއާގުޅޭ އަލިގައި މި މަޝްރޫޢު ހިންގުމަށް ހުށަހެޅޭ އިމާރާތުގައި ފަރުމާގެއިން ސަރަހައްދު މިމަޝްރޫޢާއިން ކަނޑައެޅިފައެވެ.
އަދި މި ސަރަހައްދު، ހުށަހެޅޭގައި މުދު ކުރިޔަށް ހިންގާ ފަރުމާއަށް ފާސްކޮށްފައިވެއެވެ.

މި މަޝްރޫޢުގެ ކަމާބެހޭ އެހެނިހެން ފަރުމާތަކުގެ ތެރޭގައި އެންވަޔަރަންމަންޓަލް ޕްރޮޓެކްޝަން އެޖެންސީ (އީ.ޕީ.އޭ) ގެ އެންވަޔަރަންމަންޓަލް ރިސާޗް ސެންޓަރ (އީ.އާރ.ސީ) ހިމެނެއެވެ. އަދި އީޕީއޭއާއި މިކަމުގައި ބައްދަލުކުރެވިއެވެ. އީޕީއޭއިން ވަނީ ޕްރޮޖެކްޓް ބޭނުންކުރާ ގޮތް ކަނޑައެޅުމަށް ތާރީޚު ހުށަހަޅާފައެވެ.

މިމަޝްރޫޢުގެ ޚަރަދުގެ ސާފުއިން ދާއިރާ ގޮތުގައި މަސައްކަތްކުރާ ސަރަހައްދު ފަޅުއަޑީގެ މައިގަނޑު ގޮތެއް ސާފުކުރެވިއެވެ. މަޝްރޫޢު ހިންގުމުގައި ސަރަހައްދުގެ ފަޅުއަޑި ބަދަލުވުމާއި ވެއްޔާއި ގާތަކުގެ ބަދަލުތައް ދިރާސާކޮށް، މި މަޝްރޫޢުގެ ސަރަހައްދުގެ ތިމާވެށީގެ ހާލަތު ދިރާސާކުރެވިފައިވެއެވެ.

މި މަޝްރޫޢުގެ ސަބަބުން ކުރިމަތިވާ ތިމާވެށީގެ ނޭދެވޭ އަސަރުތައް ކުޑަކުރުމަށް ފިޔަވަޅުތައް ހުށަހަޅާފައިވެއެވެ. އަދި ތިމާވެށީގެ ހާލަތު މޮނިޓަރކުރުމަށް ޕްރޮގްރާމެއް ހުށަހަޅާފައިވެއެވެ.

މީގެ އިތުރުން މަޝްރޫޢުގެ ތިމާވެށީގެ ހާލަތު ބެލުމަށް ފަރުމާ ކުރެވިފައިވާ މޮނިޓަރިންގ ޕްރޮގްރާމް ހިންގުމަށް ލަފާދެވިފައިވެއެވެ. އަދި މި އަސަރުތަކުގެ ނަތީޖާ ރިޕޯޓުކުރުމަށް ލަފާދެވެއެވެ.

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

urbanco

މިމަސައްކަތުގެ ސަބަބުން މުރަކަ އާއި ކުރި ސަރަހައްދަށް އެދިއާނެ އެއް ބަދަލު އައުމުން، ދިރޭތަކެތީގެ ނަސްލު އިތުރުވެ، އެދުވެގެންވާ ބަދަލުތަކެއް އަންނާނެކަމަށް ލަފާކުރެވެއެވެ. މި މަޝްރޫޢުގެ ތެރެއިން އިންސާނާ މުރަކަތައް ބެލެހެއްޓުމުގެ ސަބަބުން އިޤްތިޞާދީ އަދި އިޖްތިމާޢީ ފައިދާ މިސަރަހައްދަށް ލިބޭނެކަމަށް ލަފާކުރެވެއެވެ.

ތިމާވެއްޓަށް ކުރާނެ އަސަރު ދެނެގަތުން އެކަމަށް އެކަށީގެން ހައްލު ފަހި މި ރިޕޯޓްގައި ހުށަހަޅާފައެވެ. މިގޮތުގެމަތިން ބައެއް ކަންކަން ތިރީގައި ބަޔާންކޮށްފައި ވާނެއެވެ.

I. އެސަރަހައްދު ފެންކުރުން ކޮށުމުގެ ކުރިން، އެކަމުގެ ޕްލޭން އާއި ކޮންމަ ފެންމިނުގެ މައުލޫމާތު މި މަސައްކަތް ކުރާ ހުރިހާ މުވައްޒަފުންނަށް ސާފުކޮށް ކިޔައިދިނުން،
II. ކޮށުމުގެ މަސައްކަތް ކުރުމުގައި ކިސަޢު އަދި ރަނަ ފެތިގެން ދިޔުން ހުއްޓުވުމަށްޓަކައި، ފުރިހަ ނުވަތަ ހަރުދަނާގައި މަސައްކަތް ކުރުން،
III. ކިސަޢުގަނޑު ފެތިގެން ގޮސްފައިނުވަކަން ފެންނަހަމަ، މަސައްކަތް ހުއްޓާލުން،
IV. ކޮންނަން ޖެހޭ އިމުގެ ތެރޭގައި ކޮށުން،
V. މަސައްކަތުގައި ބޭނުންކުރާ އުޅަނދު މުދާގައި ދިއުމާސްކޮށާގައި މަދު، މަސައްކަތް ކުރާ ފަރާތްތަކަށް ސާފުކޮށްދިނުން،
VI. އެސަރަހައްދުން ނަގާ ވެލި ފަސްފުންޖެއްސުން ޖާގައިރު ފަސްފުނި ޖާގާ ސަރަހައްދު ބަންދުކޮށްފައި ބެހެއްޓުން، އަދި ފަސްފުނި އެއްލަނީ އަސްލަނީ ގޮތުގައިގެ ކުރިން ހިލަފުސް އުދުން ހުއްޓުވުމުގެ ގޮތުން ތަނަވަސް ލޮނުހިއްކާފައި ގޮތުގައިވުން،
VII. މުރަކަ ނަގާ ސަރަހައްދަށް އެރުން ސަރަހައްދުތަކުން ޖެހޭސިފަ ތަމާރަކޮށްފައިވާ ފުރުސަތު ކަޅުކުރުމަށްޓަކައި އެމަސައްކަތަށް އެތަނަން ފިނި ފަރާތްތަކުން ގެންގުޅޭ އާލާތްތައް ދުވެ ސާފުކުރުމަށްފަހު އެސަރަހައްދަށް ފިނުން،
VIII. މާދުން ނަގާ މުރަކަތަކަކި އެއްވެސް ބައެއް ޖެހިފައިވާ ނުވަތަ ބައްޓަމުގެ އަލާމާތް ނެތް މުރަކަތަކުގެ ކަރަވަރުކުރުން،
IX. މުރަކަތައް އެއްސަރަހައްދުން އަނެއްސަރަހައްދަށް ބަދަލު ކުރާ މުދަލާގައި، މި މަސައްކަތް ކުރުމަށް އެކަށީގެން ވާ ތަވްރީންއް ލިބިފައިވާ މީހުން ގެނެވިދާނަށް މި މަސައްކަތް ކުރުމަށް ގެންދިއުން،
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XI. މުރަކަ އާދޭކުރުން އިންސާ ދިގަނޑު ފުރާމަތަކުން ފުރިކާ މުރަކަ ކާ ޖަނަވާރު ސާފުކުރުމަށް ވަކިތަކަށް ރަވައިގެން ތަވަފުކުރުމުގެ މަސައްކަތް ކުރުން،
XII. މި ޕްރޮޖެކްޓް ގެނޭޖުކުރުމުގެ މަސައްކަތުގައި ނަގާ ފޮޓޯތައް މޮނިޓަރިން ވަރަށްގާގައި ބޭނުންކުރުން .

މިގޮތުގެ މަތިން މިމަޝްރޫޢުން ތިމާވެއްޓަށް އަސަރު ކުރާނެކަމަށް ފާހަގަކޮށްފައިވާ ކަންކަމަށް، ކުރާނެކަމަށް ލަފާކުރާ ނޫޅެވޭ އަސަރު ކުޑަކުރުމަށް އަދި ކުރާނެކަމަށް ލަފާކުރާ ފައިދާތަކުގެ އަސަރުން ލިބޭ މަންފާ އިތުރުކުރުން، އެފަދަ ފިޔަވަޅުތައް މިރިޕޯޓުގައި ބަޔާންކޮށްފައި ވާނެއެވެ.

މިރިޕޯޓުގައި ބަޔާންކޮށްފައިވާ މަސައްކަތުގެ ސަބަބުން ކުރިމަތިވެދާނެކަމަށް ލަފާކުރާ ނޭދެވޭ އަސަރުތައް ކުޑަކުރުމުގެ ގޮތުން ކަނޑައެޅިފައިވާ އުސޫލުތަކަށް މަޝްރޫޢުގެ އެދިއާނެ އަމަލުކުރުމަށް ލަފާދެވެ. މަޝްރޫޢުގެ އެދިއާނެ މިރިޕޯޓުގައި ކަނޑައެޅިފައިވާ މޮނިޓަރިންގެ ޕްރޮގްރާމްގެ ތަފާތު އެއްގޮތަށް ހިންގުމަށް ލަފާދެވެ.

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VII. Non-technical Summery

This report delves into the environmental concerns, impacts and mitigation measures that are associated with the proposed reef scaping project at K.Hulhumale. The scope of the Environmental Impact Assessment (EIA) is solely focused on the coral harvesting and coral propagation processes at Hulhumale.

The EIA was made in accordance with the 2012 EIA regulation made under the Environment Protection and Preservation Act (Act No.4/93). The proponent of this project is Housing Development Corporation. The intended goal of this project is to establish a hard-coral rich area that can further enhance the diversity of marine life, including fish, and other species that exist within the vicinity. As the proponent is the master planner for this region, the company aims to increase the economic and social activities of the island. As the proponent is the master planner for this region, this project works to increase the economic and social activities of the island which helps with reaching some of the major development objectives of the company. The proposed project develops a much needed and accessible area for public programs that raise awareness on marine life and tourism growth. Hence, the proposed location is an ideal outreach area for the public and a potentially suitable propagation area.

The Proponent discussed three main locations for the reef scape project with the local stakeholders; the water sports community, namely the Northern channel between Phase 1 and 2, a natural opening East of the channel area, the track area, and the locally designed-swimming area near the proposed water theme park area. However, the water sports community raised concerns about;

1. The Northern channel between Phase 1 and 2 being a high energy area with a daily alternating tide, direction and speed,
2. The area being difficult to manage the frames,
3. The natural opening East of the channel area being a popular path taken by surfers to move in to and out of the location therefore, if used for the project, it would block access to and from the area,
4. The swimming track area increasing the chances of anthropological impact on the corals and increases the hazard the corals pose on the locals who frequent the area, reducing the success of the project,
5. The sediment and low tide impact for the entire East side of Hulhumale reducing the chances of success of the project.

Nevertheless, the water sports community expressed full support for the project once a location would be finalized. Eventually, the proposed location on the Eastern side of Hulhumale was finalized, and the water sports community gave their support for this location.

Other stakeholders in this project include the Environmental Research Center (ERC) of the Environmental Protection Agency (EPA). EPA raised concerns about the use of frames and suggested exploring the possibility of using dead rocks as substratum by drilling. They also suggested placing substrate or growing corals in a nursery on land before transplanting them to the reef. Upon consultation with local experts, the necessity of proper circulation in the area was highlighted, and a decision was made to include excavation in the project. Further consultation with the public indicated that the proposed project is well-received. Survey of the natural environment shows that the area is dominated by rubble. Some minor coral types were observed in the vicinity of the proposed project propagation site. Survey of the proposed harvesting site shows that the site is dominated by numerous branching corals and massive coral forms.

This assessment has identified and evaluated the impacts of site excavation, coral harvesting, coral propagation, management and monitoring on the biological, social, and financial environment.

The excavation stage is recognized as a major contributor to the negative impacts if unmitigated on the marine biological environment and social environment, primarily due to the movement of heavy machinery, excavation, related sedimentation, and the impacts of the stockpile. These processes eventually lead to cracking and tearing of the pavement, revetment, geological skeleton of the island, sedimentation in the area, related fauna loss, erosion in the proposed area; while settling of the sand and major kick up of dry sand due to sedimentation.

Additionally, the overall impact of harvesting and transportation is negative on the biological environment. The impact on the microflora and fauna transportation through dive site exposure of the harvesters during the coral harvesting stage is assumed to be negative on the biological environment of the harvesting site. It is also assumed to be negative to the harvested portion, hence mitigation must be set in place.
The impact of propagation is positive for the site as it can potentially promote the general biodiversity of the region. Management and monitoring are assumed to eventually provide activities for the locals and promote economic opportunities. Thus, having a positive impact on the social and economic environment.
The mitigation measures for the identified major associated impacts are suggested. This includes the following:

1. Proper communication of the excavation plan and depth of excavation to the staff to ensure a standard is set.
2. Carry out excavation during low or mid tide to decrease sediment dispersion.
3. It is advised to halt the excavation in case of sediment plume to minimise the possibility of sediment plume spread.
4. Moreover, to ensure the excavation footprint is not breached and within the set-out area so that the project stays true to the proposal.
5. During the excavation component, the path for the movement of heavy machinery must be discussed and mapped out before the work is carried out to minimise footprint damage.
6. Ensure the stockpile is in an enclosed area and that it is properly dried before being transported to minimise the particulate matter pollution.
7. To ensure minimum exposure to pathogens at the harvesting site, all materials used must be washed thoroughly before diving.
8. Ensure that the harvested fragments are free from visible diseases to reduce the contamination of the planting site.
9. During the transplanting component, the collection and transportation must be done by trained individuals to ensure that the proper procedures are followed.
10. Size of the fragments must be within the standard to ensure that the fragments are farmable.
11. For regular removal of algae and herbivores, cleaning of the frames should be carried out as a management procedure.
12. Capture photos of the frames and record the difference during the recommended management frequency of 3 times per week by the management team and use those photos for monitoring purposes.

Furthermore, adequate mitigation measures are given to each of the identified impacts in this report.
It is recommended for the project proponent to abide by the procedures specified that can reduce the negative impacts defined in this ESIA. It is recommended for the project proponent to implement the specified monitoring program as per the specified schedule.

1. Introduction to the ESIA

1.1. Background and context

This Environmental Impact Assessment (EIA) addresses the proposed reef scaping project at k. Hulhumale', Maldives. The document is prepared in accordance to the relevant laws and regulations in Maldives. The scope of the EIA is limited to Coral propagation at Hulhumale'.

In this EIA, the baseline structure of the document is similar to that of leopold et al. (1971). Therefore, this EIA initiates with the statement of the objective, followed by the technologic possibilities for achieving the objective, proposed actions and alternatives, existing environment, alternative engineering plans, impact analysis, and recommendations, respectively (Figure 1).

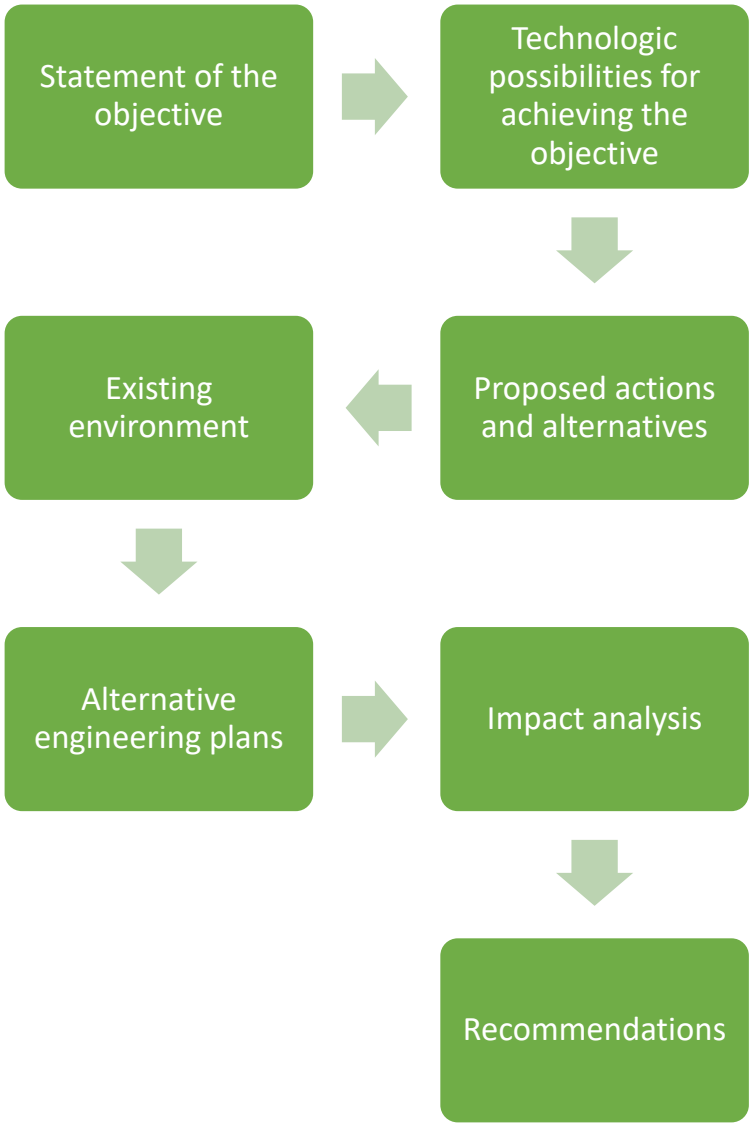

Figure 1: Base structure of the EIA

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1.2. Pattern of the EIA

With the grater structure of the EIA in mind, this EIA follows the following pattern (Figure 2).

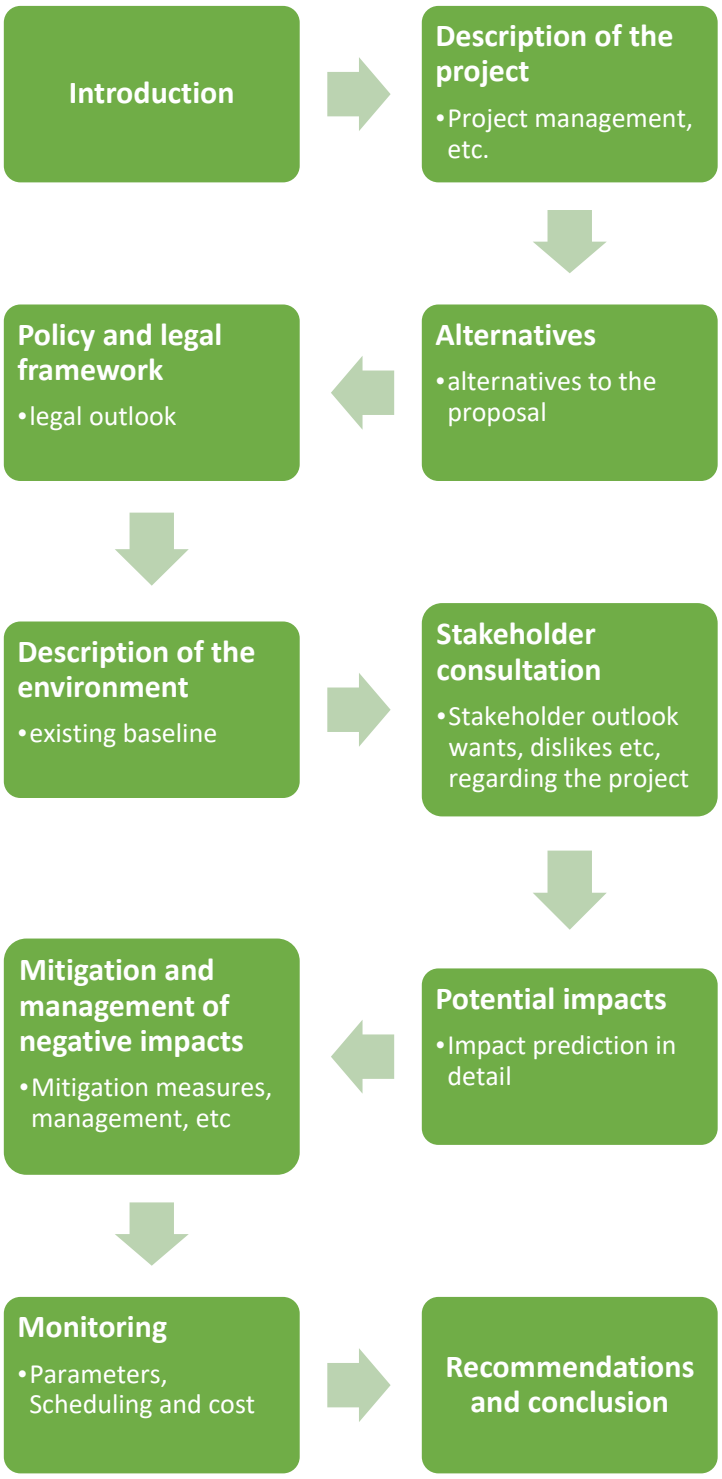

Figure 2 Pattern of the EIA

1.3. Purpose of the EIA

The objectives of the EIA are;

- To provide an assessment of the potential environmental effects of the proposed development, determine the activities that are likely to have a significant effect on the environment, to propose relevant and economically feasible means of avoiding, mitigating or compensating for the predicted negative effects of the project,
- To provide the necessary information about the site of development and other factors surrounding the development to EPA,
- To assess the proposal and how it has been developed to achieve a satisfactory level of environmental performance in line with the EIA regulation.

1.4. Project proposal

The scope of the EIA study is limited to the following actions.

1. Reef scaping
    a. Coral harvesting
    b. Coral propagation

The scoping meeting was held on 25th December 2022, after the screening decision statement (DS) (ref number: 203-ECA/161/2022/30), the scope in the form of Terms of reference, (TOR) (on page 132) was set during this meeting using with the screening document with the relevant stakeholders in attendance. The baseline data, impact predicted, and recommendations are in accordance to the above stated TOR.

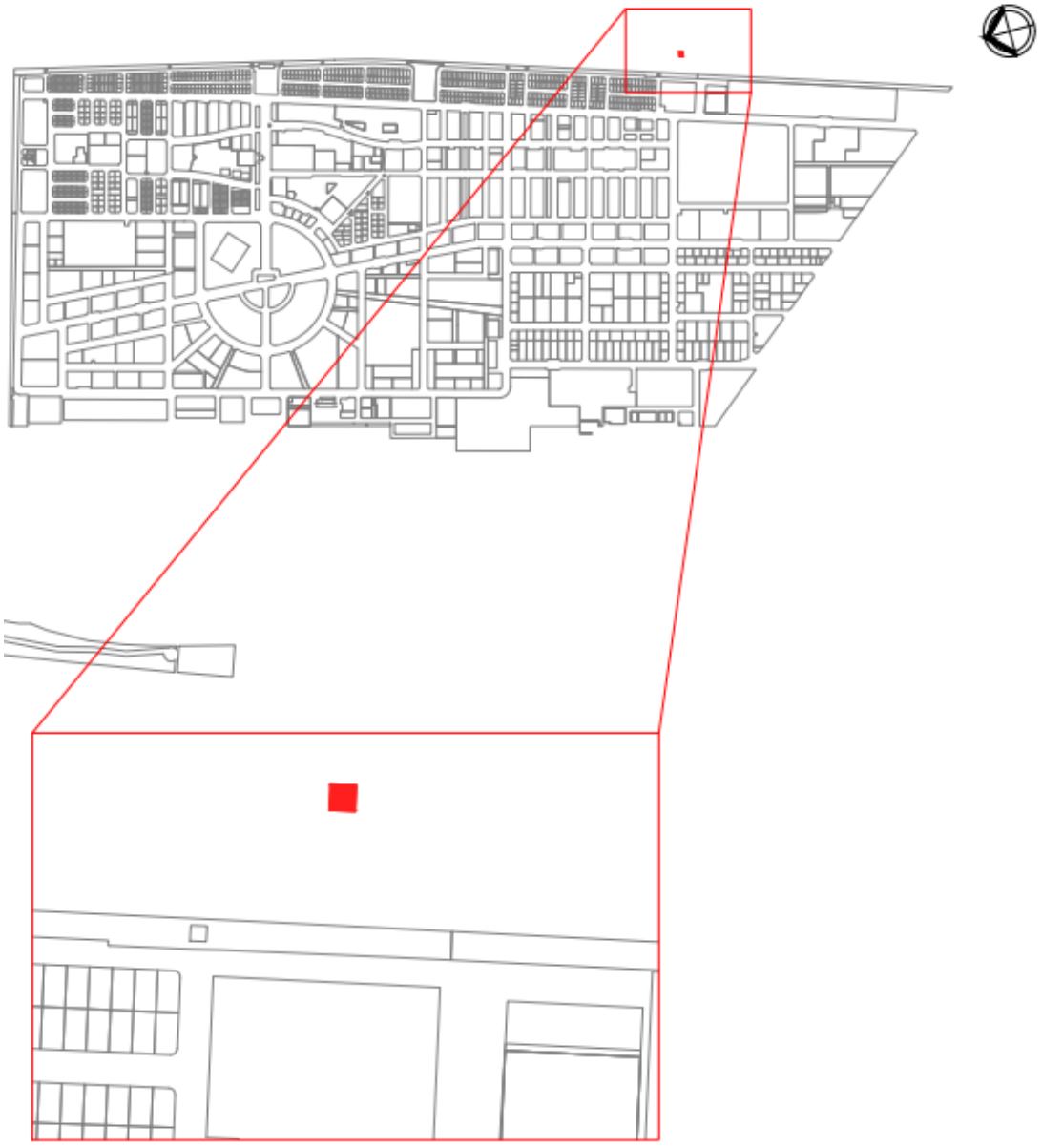

Figure 3 Project proposed location

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2. Introduction to the project

2.1. Project Setting

Hulhumale' being a reclaimed island has a diversity lacking the picturesque hard coral forms often desired by locals. A cause of this lack of diversity of the above stated desired coral forms is due to the area being reclaimed: primarily, and shoreline being modified, and expanded overtime.

The project is an effort by the proponent to collaborate with the locals, and local establishments, to give back a product that can potentially add to the existing diversity. The aimed product of the project is to establish a hard-coral rich area that can increase the diversity of fish and other wild life on site.

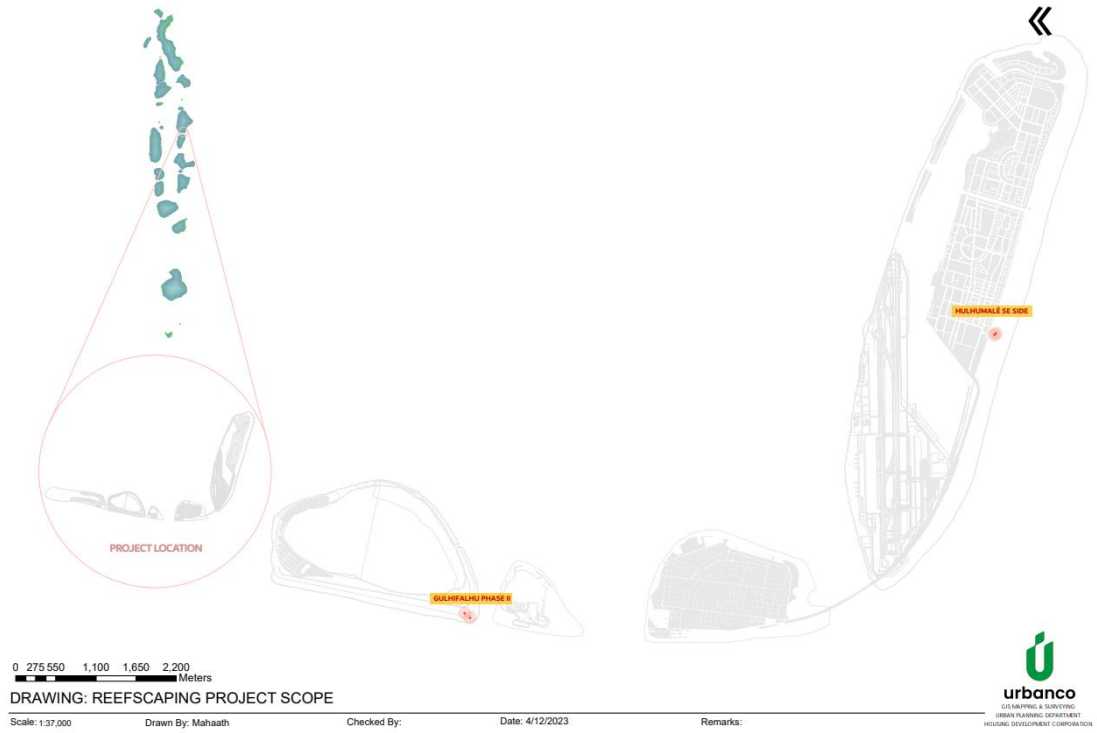


Figure 4 Project scope map

2.2. Objectives of the project

The general objectives of the project are;

1. potentially diversify the sedentary fauna of the project area,
2. through diversification attract non sedentary fauna to the project location,
3. manage and maintain the project, and
4. collaborate with potential research partners for research opportunities.

2.3. Justification of the project

1. The existing environment of different locations of the project area is provided in the respective section. The area has a diversity of macroalgae, especially algae forms which composes of calcifying algal thallus. The proponent, concerned locals, and local establishments, desire visible hard coral diversity in the area. Therefore, this is a way of achieving this goal.

2. The concerned local establishments specifically that of the tourism industry needs an accessible location for marine life awareness programs. Therefore, the location being accessible becomes the ideal outreach area to the public, the ideal propagation area.
3. The proponent as the master planner for the area, wishes to potentially increase the possibility of expanding the economic activities of the island. Thus, this project provides the perfect opportunity for the desired locals.

2.4. Project Proponent

The proponent for this project is Housing Development Corporation (HDC). Established in 2001, the proponent is a 100% state-owned enterprise, is the master developer, and regulator for the development of Hulhumalé investing in the infrastructure necessary for quality living and business prosperity.

The proponent undertakes projects ranging from residential, commercial, industrial, institutional, cultural, and hospitality.

Maldives merged greater Malé' industrial zone ltd ("GMIZL") into HDC in September 2019, adding the development and management of the nearby islands of Gulhifalhu and Thilafushi into the proponent's overall mandate. The proponent's vision is a leader in redefining quality living. The proponent's mission is to be a pioneer in establishing higher standards of living through intelligent, innovative, and sustainable developments in the Maldives.

2.5. Work duration

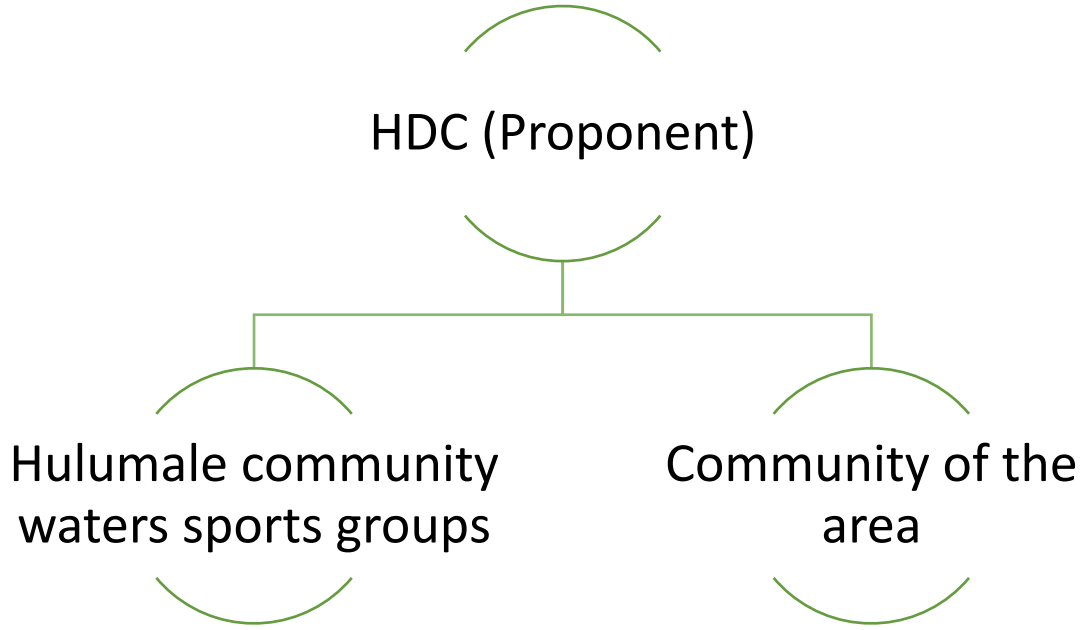
The proposed work is to commence after the predicted bleaching event. The work duration as of now is under the following categories. The schedule is presented in chart is presented Appendix Work schedule

Table 1 Work duration

Task Name	Duration
Planning and ESIA	118.88 days
Excavation	5.13 days
Settling days	90.13 days
Harvesting	1 day
Propagation	1 day
Management	1095 days

2.6. Project partners

The project partners for the project are shown below



2.7. Project Funding

The project funding is budgeted by the proponent for the component upon proposal by SRP section.

	TOTAL (MRF)
Item Total	141617.28
Monitoring Total	17455.44
Logistics and Meals (12 days)	55512
TOTAL MRF	214584.72

2.8. Study Methodology

The field studies have been undertaken using methods employed in EIA studies. The sites of marine assessment and water samples areas are provided in the Survey map.

2.8.1. Existing conditions

The existing conditions were described initially by reviewing relevant available data, next the material was cross-checked on-site images. This was followed by setting up a plan for consultation of the stakeholders. The stakeholder consultation was executed on site and in official settings. During the visit interested staff were invited for a survey field visit to further aid in identifying the problems and sharing the local hindrances; in this methodology the interested parties will point out on site, the significant points of interest for them. On site, all hindrances relevant to the project was recorded and photographed and if relevant used in the report.

2.8.2. Methodology used in description of the environment

The physical environment and the climate conditions were described using onsite data, and available data in literature. The climatic conditions were described by using data from the weather stations. The natural and biological environment was surveyed, data collected, analysed, and reported. The socioeconomic data was collected and analysed with the help of the locals and reported. The following are the details of the methodology used.

2.8.2.1. Ecology

2.8.2.1.1. Overall conditions

The overall site conditions were analysed using an ATS image post survey and post stakeholder consultation. This was done using a Phantom Pro drone and a complimentary application to grid out and stich the images.

2.8.2.1.2. Marine Environment

To access the marine benthic conditions, the survey team started off with a visual analysis, followed by the detailed benthic condition analysis of the impact zone, control zones, alternative zones and the footprint.

2.8.2.1.3. Visual analysis

The objective of the study was to get a general idea of the benthic condition of a general area of interest. Two surveyors swam side by side timing the phase, parallel to each other recording the findings. In this visual survey the observers looked for natural, and anthropological factors and noted down the general benthic substrate condition. The visual survey is also required to determine if further analysis is necessary. If the area lacks hard coral structures and sea grass. The data from the visual analysis is used which reports general depth, horizontal and vertical visibility, top layer identification, and substratum analysis.

2.8.2.1.4. Benthic condition

The objective of the survey is to collect baseline data for later comparison during the phases of monitoring. The locations selected after the timed swim on concerned locations were analysed. Noting down the benthic substrates namely; hard coral, nutrient indicator algae, rubble, other life forms, soft coral, sponges, sand, recently killed corals, sea grass, rocks, and silt on a 50m transect belt. Post survey locations were marked using a GPS unit.

2.8.2.1.5. Fish spotting

Fish spotting was carried out on the same locations as the benthic survey. On site, the surveyor allowed acclimatization for few minutes, during which the boat crew would stay far. After which fish encountered were recorded.

2.8.2.2. Water testing

Sea water and ground water testing was carried out on site using a YSI probe, and water samples were collected at around a depth of 3 m using a 500ml bottles. The sample sites were geo referenced.

2.8.2.3. Sediment traps

Sediment traps were places and collected after 5 days in the selected sites. The removed traps closed off with the PVC tops would be transported back for analysis. After filtering and drying in an oven for one hour at 90^0C, the samples were weighed using an electronic balance to the nearest gram. The sedimentation rate is calculated as mg of sediment per cm^2 per day, using the following Equation 1,

Equation 1 The equation used to calculate the sedimentation rate, where sediment weight = weight of collected sediment, number of days = the number of days of sampling, radius = the radius of the trap

$$\text{Sedimentation rate} = \frac{\text{sediment weight}}{(\text{number of days}) \text{x} (\pi r2)}$$

2.8.2.4. Stakeholder's consultation

All stakeholder consultation was conducted after an official request for the meeting. Some meetings were granted online while others were physical.

The local consultation was also extended where the stakeholders could join the team in a field survey showing the different issues relevant to the project. This helped in identifying the major issues.

2.8.2.5. Impact prediction

Environmental impacts are predicted by using checklists and its significances are evaluated by the use of matrices. Expert judgment and professional opinion as well as review of relevant EIA studies have also been widely used throughout the impact assessment and evaluation process. These methods are described in detail at the relevant section of this EIA Report.

3. Description of the proposed project

This section details the description of the project: project locations, boundary project, and main developments of the project.

3.1. Introduction to the project

Fringing the lower eastern side of Kaafu Atoll, the artificial island of Hulhumale' was developed on the natural reef flat north of Hululhe island. Therefore, the reef flat bio diversity has changed overtime to reflect an ecosystem suitable for the current existing environment.

The lack of variation in biodiversity is noted by the proponent, and would like to diversify contribute to increasing the bio diversity of the area.

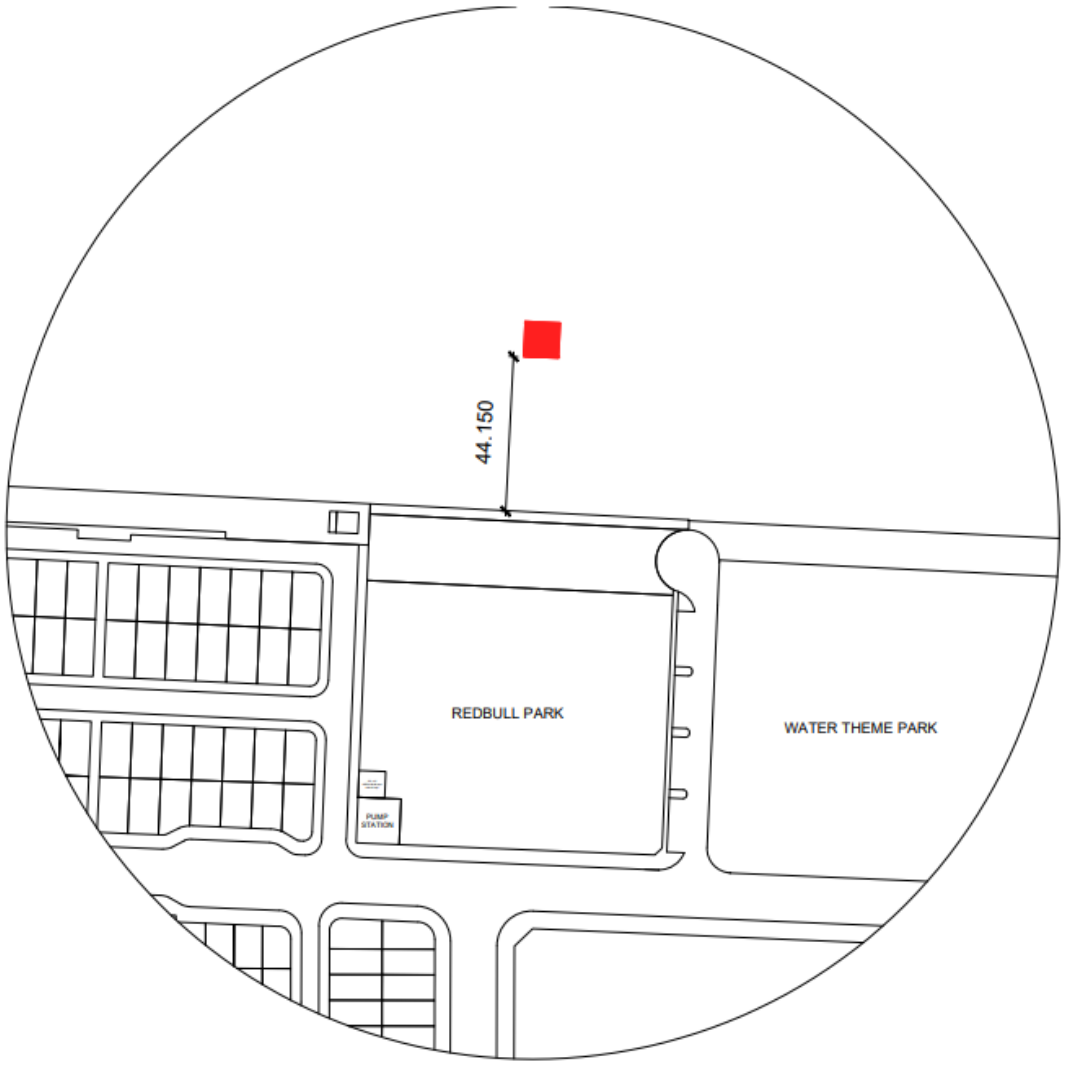


Figure 5 project proposed placement and location

3.2. Description of the method

The proposed project has the following major activities:

3.3. Methodology

3.3.1. Project breakdown and components

Work process	**Setting out location for excavation**	**Excavation**	**Boundary barrier**	**Fragment scouting, harvesting, framing**	**Onsight placement of the frames**	**Management**	**Monitoring**
Project phase	Construction	Construction	Construction	Construction	Operation	Operation	Operation
Overseer from the proponent	Planning division urban planning	Planning division urban planning	Planning division urban planning, SRP	Environment unit	Under MOU- under technical training water sports community and other community volunteers	Under MOU- under technical training water sports community	Social responsibility planning section-Environment Unit
Implementer through the proponent	GIS and survey	External party	Operations	Planning division urban planning, GIS and survey, SRP and environment unit from the proponent and partners	Staff from the proponent, and Project partners	Staff from the proponent for the management of the project, project partners	Staff from the proponent for the management of the project, Environment unit
Methodology	Location for excavation will be marked on the map using CAD georeferenced files. It will be transferred to a RTK system and a surveyor will traverse to location and peg using metal stakes which are visible on site	An excavator and a truck will be moved to the pegged location. Once on site, the pegged location will be approached using a predetermined path. The excavator will be followed by the truck to a feasible distance. One on the pre-determined path, the location will be excavated. The excavated material will be moved back, using the truck to a to a pre-determined temporary stock pile area near the beach. One on the beach, the sand will be left as a stockpile for 2 days to drain the salt water. Once the sand is dry enough to not drip on the road during transportation, the sand will be loaded on to a truck using a loader, moved to main stockpile locations where the proponent stores sand from the footprint of buildings.	Once excavation is set, a barrier to mark the excavated deep area must be marked by buoys and locally sourced rock from the location. The buoys will be tied to barrier substratum fixtures, given slack to compensate for the tide and the locally sourced rocks will be placed on the flat to show a clear barrier.	**Scouting** Fragment scouting will be carried out by the scouting diver team. The objective is, • if there is a proposed development for the area, then ideally source colonies for harvesting, • if the proposed area has no work proposed, and if the area provides enough harvested material, then ideally, from each harvesting colony 40% will be harvested so that the rest of colony can survive. Once a feasible location is identified, then the location is geo tagged using a GPS and sent to the project team. **Harvesting** During harvesting, ideally the material will be taken is as large as possible, this will ensure easy transportation and survival Transportation will be carried out using dive crates designed with non-pours bases Water circulation will be carried out using crates of water, flushing and cleaning as fit. **Propagation** Propagation will be carried out using fragments tied to the substratum frame.	**Post fragment fixture placement** To implement this methodology, the proponent must fix the structures on to the frame. Afterwards the frame can be moved to location, And placed for growth. **Pre-fragment fixture placement** To implement this methodology, the proponent must move the frame to location, fix the structures on to the frame. Afterwards the frame can be moved to location, And placed for growth.	The management of the project will be carried out by a team of divers dedicated to cleaning and removing predators on the structures. The management team will also record the status of the frames in the form of a catalogue, identifying every frame on the photo and showing the difference before and after the process. This catalogue will be recorded in the form of images and stored for analysis in monitoring.	Monitoring will be carried out using the catalogue of images. If need be, an analysis of the development will be carried out using the images near the scaled photos. Water samples will be taken from the site and sent to MWSC for further analysis. Sediment traps laid on location will be collected and analysed as per the requirements or turbidity will be measured using the said water sample or secchi disks.

Work process	Setting out location for excavation	Excavation	Boundary barrier	Fragment scouting, harvesting, framing	Onsight placement of the frames	Management	Monitoring
				Ideally the divers will try to ensure proper distribution of species on each frame. Mars Assisted Reef Restoration System for coral propagation will be adopted as the main methodology.			
Work material	CAD files GPS system Stakes Hammer	Excavator Truck Loader	GI pipe, Yatch rope Buoy Local rock	Dive gear Crates Hammers Chisel	Frames Cabe ties Dive gear Crates Hammers Chisel Reef boots	Bushes Tweezers Slates for notes String Camera Ruler	Water sampling bottles Sediment traps Camera secchi disk with string.
Health and safety gear	Buoyancy jackets Reef shoes Reflector jackets	Buoyancy jackets Reef shoes Reflector jackets Safety shoes Communication radio lights	Buoyancy jackets Reef shoes Reflector jackets Mask Fins Snorkel	Semi SMB First aid box Emergency water Emergency buoy Resting Buoy Redundant air supply Man over board forms and system	Semi SMB First aid box Emergency water Emergency buoy Resting Buoy Redundant air supply Man over board forms and system	Semi SMB First aid box Emergency water Emergency buoy Resting Buoy Redundant air supply Man over board forms and system	Semi SMB First aid box Emergency water Emergency buoy Resting Buoy Redundant air supply Man over board forms and system
Skill / Staff	Project manager Surveyor, Unskilled labour	Project manager Licenced excavator operator Licenced loader operator Licenced truck operator	Project manager Unskilled labour	First response diver Dive Master / instructor Licenced divers	First response diver Dive Master / instructor Licenced divers Environment specialist	First response diver Dive Master / instructor Licenced divers Environment specialist	First response diver Dive Master / instructor Licenced divers Environment specialist
Labour requirements	Permanent survey mark GPS coordinates Stakes made or modified for the work Team to assist in the deploying of the stakes Project manager's work station.	Maintenance team Spill management team Excavator pathway directions Night time working gear	A design for the barrier placement. A feasible work methodology A team leader An equipment manager	A clear work methodology A dive objective An equipment manager	A clear work methodology An equipment manager Cameras Systems to analyse the data	Management methodology An equipment manager Cameras Systems to analyse the data	A monitoring methodology An equipment manager Cameras Systems to analyse the data
Justification	PSMs are to be referred to and required or the accurate placement of the barrier. GPS coordinates will have to be	Maintenance team to assist Spill management team to mitigate damages Pre-determined excavator path for minimum damage to the geo lining on the beach and benthos.	Physical boundary set for the safety of the workers and locals. A team leader to manage the team An equipment manager to maintain the development.	Work methodology to specify the work barriers and safety measures for the team A dive objective to clearly define the depth of harvest and the location of harvest. An equipment manager to manage, specify and release the gear.	A work methodology to ensure success of introduction. An equipment manager to manage, specify and release the gear. A camera to gather data Designated system to analyse the data	A work methodology to ensure success of management An equipment manager to manage, specify and release the gear. A camera to gather data Designated system to analyse the data	A work methodology to ensure success of monitoring. An equipment manager to manage, specify and release the gear. A camera to gather data Designated system to analyse the data
Duration	12 days for setting out	3 days for excavation + 90 days for sediment settling	12 days	6 days for scouting + 1 day for placement	1 day for placement	3 years	Every 12 days
Budget allocated for the component	Staff on pay roll	As per CSR component and inhouse equipment	Staff on pay roll	77691	77691	77691	Staff on pay roll

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3.3.2. Comparison of Coral Reef Electrotherapy against Mars Assisted Reef Restoration System for coral propagation

	Electric Reefs (ER)	Mars Assisted Reef Restoration System (MARS)
Methodology summery	Steel frame structures are introduced in the desired shape onto the reef flat. Once introduced, the structures are provided with Safe Extra Low Voltage (SELV) current that promotes natural limestone that coral reef organisms prefer to settle on. Two electrodes are used for electrolysis: an anode with a negative charge and a cathode with a positive charge. The two electrodes are positioned a short distance away from one another, with the cathode positioned on the bottom of the seabed and the anode suspended just above. To power the electrodes, energy can be supplied by plug-ins from nearby land or from renewable energy sources, such as windmills and solar panels (Wolf H . Hilbertz, 1996) . The heat produced by the electric currents at both electrodes allows for the extraction of carbonic acid and the release of carbon dioxide to the ocean.	The strategy involves using steel structures that are made locally and attaching locally sourced coral fragments to them. These structures are then anchored together to create a web-like pattern across the rubble beds and surrounding coral ecosystems. The web provides stability and weight and is firmly secured into the substrata using long steel stakes that are hammered into the reef. When installed correctly, this method is incredibly strong and can withstand powerful wave energy
Cost of development	The cost of development is high in comparison to Mars as it involves procurement and establishment of a reliable power source (local, solar PV panels, ocean current or tidal energy turbines) in addition to the structural features placed.	Moderate in comparison to ER. Cost mainly consists of the preparation of the steel frames to be welded into web like structures and coated with a resin layer followed by sand.
Cost of operation	The cost of operation is high in comparison to Mars as the system requires ongoing electricity to maintain the voltage current that promotes natural limestone growth.	Low in comparison to ER, as the system does not require any technical components.
Cost of management	High is comparison to Mars due to any repair or replacement of electrical components such as solar panels or any other power source components.	Moderate in comparison to ER, to replace any damaged structures or coral fragments followed by the standard monitoring procedures such as removal of herbivores.
Cost of monitoring	Moderate due to periodic monitoring of water quality and other environmental factors to ensure that the natural limestone formation process is occurring as expected.	Moderate due to standardised periodic inspections to ensure that the steel structures and coral fragments remain securely anchored to the seabed.

In light of the above comparison, the proponent for the MARS methodology for propagation.

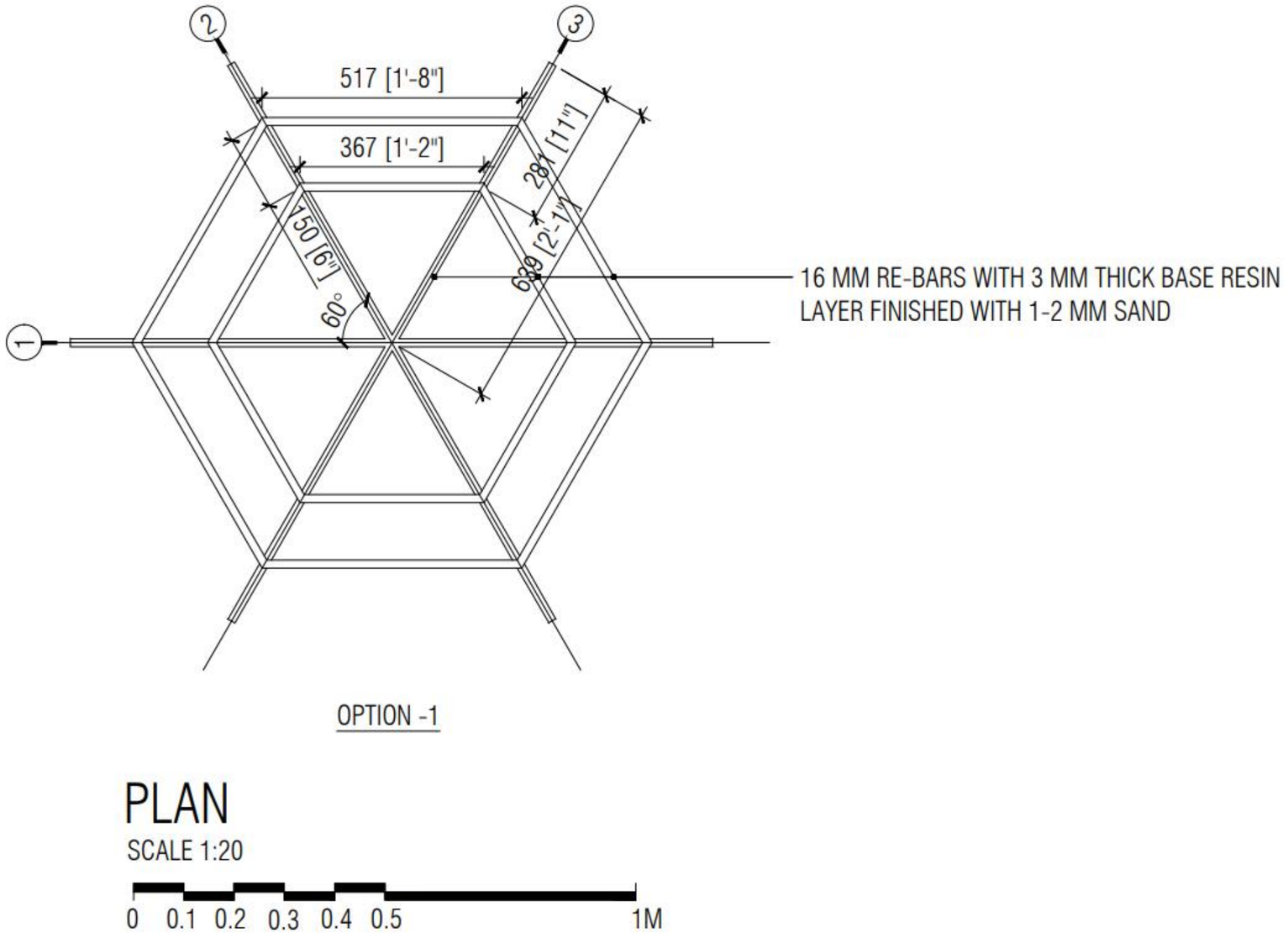

Figure 6 Proposed coral frame top view

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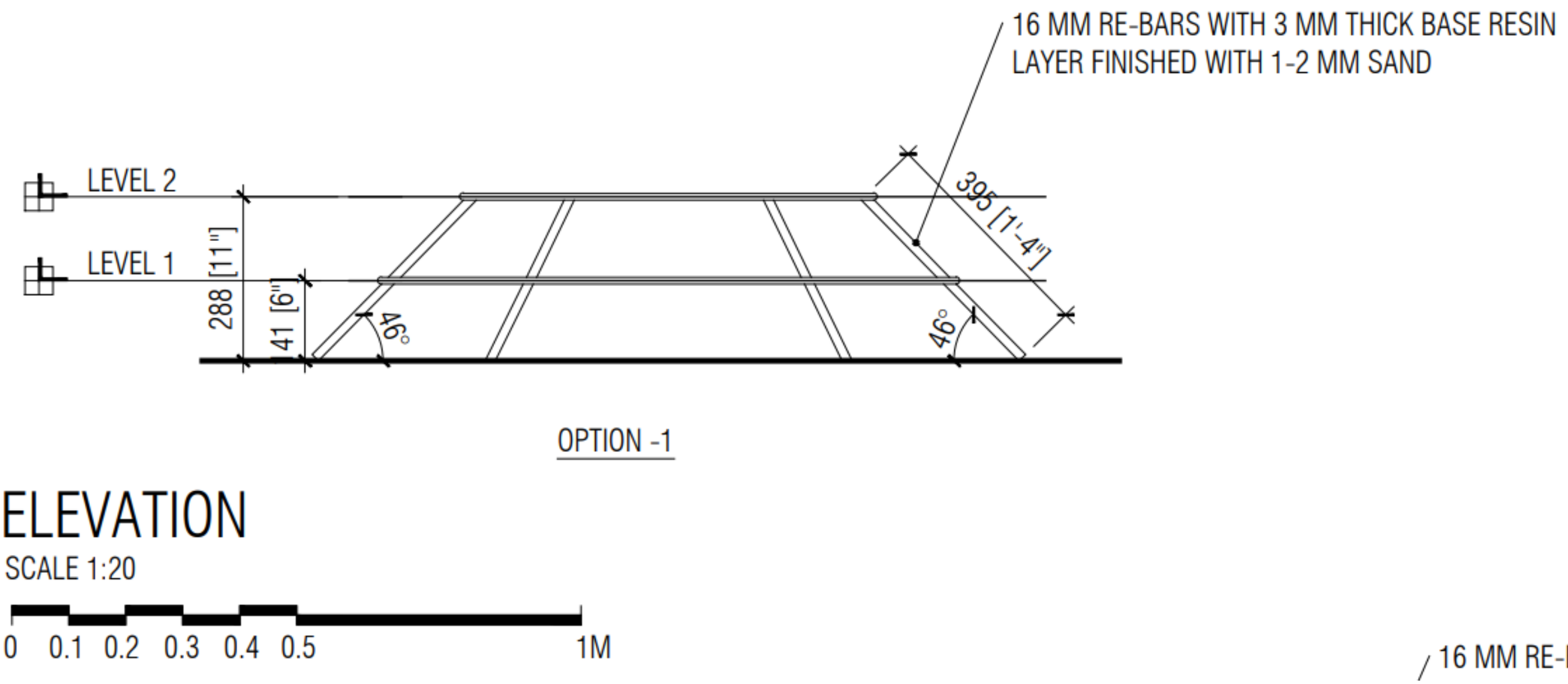
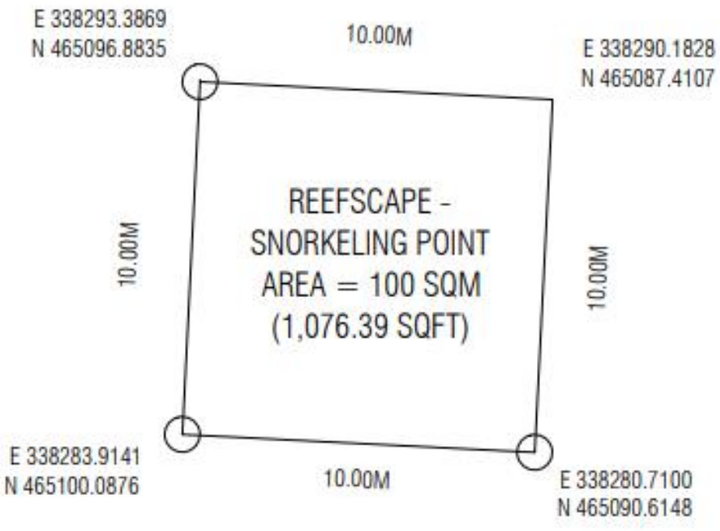


Figure 7propose coral frame, side view



NOTE: PLEASE NOTE THAT THIS IS NOT A SURVEYED MAPS. THE COORDINATES ARE SUBJECT TO CHANGE.
DEPTH OF EXCAVATION: 2M

Figure 8 Excavation dimensions and relative coordinates

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3.3.3. Emergency plan in case of spills

The proponent must ensure that the contractor has an emergency plan, an emergency coordinator and the alternative emergency coordinator.

3.3.3.1. Overall emergency plan

The overall emergency plan must be site specific and drafted upon by the contractor and the proponent considering the features of the island and the available facilities of the island. The emergency plan must be understood and followed by all staff. A typical emergency plan must include the following.

- The emergency plan should be followed and executed without delay in case of an emergency.
- Safety Sign Boards and Safety lights must be installed at the work site.
- Fire Extinguishers must be installed at work site.
- All staff must learn the basis of the emergency plan.
- Assembly points must be decided prior to mobilization
- Points of relief must be equipped with medical kits and fire safety kits
- Spill kits must be installed near the storage sites and in easily accessible areas.
- Alarms must be installed and tested
- Informed drills must be carried out at a schedule.
- All staff must be informed that they could call in an alarm.
- All emergency coordinators should be trained well with the alternative.
- In case of an emergency the point of reference must be the coordinator or the alternative.
- In case of an emergency, the emergency coordinator or the alternative must be informed primarily
- All staff must strictly follow the instructions of the emergency coordinator.
- Authorities must be informed by the coordinator or the alternative

The contractor is required to take the following measures to ensure minimal pollution in case of a spill.

- Use serviced machinery to reduce toxic emissions
- Service the machines in use during the work process.
- Keep spill kits on the island and portable spill kits on the machines
- Bund all necessary lubricants and oils stored on site.

3.3.3.2. Emergency plan for spill response breakdown

Spills on construction sites can have drastic consequences to people and the environment.

After a thorough analysis of the action at hand, the responsible party is to follow the action plan as specified. However, the best form of action is prevention. Therefore, the following spill prevention measures must be implemented on site. In case of a spill, all mitigation should abide by 2021/R-22.

3.3.3.3. Spill Prevention Measures

The following general precautionary measures shall be applied to all construction works areas to minimize the risk of accidental spillage:

3.3.3.3.1. General Precautions

- Maintain good site housekeeping practices and ensure all materials, chemicals and wastes are properly stored and placed in appropriate disposal areas onsite at the end of each day.
- Avoid disorder and storage of unnecessary materials in working areas.
- Open flames and smoking shall be prohibited within the construction site; smoking may be permitted only at designated smoking areas.
- Stacked containers should be secured from falling.
- Large / heavy containers should be stored on the floor as far as possible to prevent falling.
- Warning signs, fences and locks where appropriate should be deployed for storage place of hazardous materials, chemicals, fuel and oil, etc.

3.3.3.3.2. Construction Materials

Unexpected release of large amounts of suspended solids, in case of accidents, human negligence or mechanical failure would result in adverse water quality and marine ecology impacts. Hence, precaution and prevention measures are required to minimize the risk of such accidental spills. The following measures shall be applied to all construction vessels involving transport of materials that may give rise to unexpected release of large amounts of suspended solids:

3.3.3.3.3. Construction Materials

- Prior to transport of fill materials;
    - Bottom opening of barges shall be fitted with tight fitting seals to prevent leakage of material.
    - Vessels shall be regularly inspected to ensure no leakages and any leakages shall be repaired quickly prior to mobilisation of the vessels.
    - Barges or hoppers shall not be filled to a level which will cause overflow of materials or pollution of water during loading or transportation.
    - Excess materials shall be cleaned from the decks and exposed fittings of barges and hopper dredgers before the vessels are moved.
    - Adequate freeboard shall be maintained on barges to reduce the likelihood of decks being washed by wave action.
- During transport;
    - Vessels shall follow the pre-defined routes and marine traffic arrangements to minimise the risk of collision.
    - Vessels shall follow the designated entry / exit points into and out of the construction site boundary.
    - Vessel speeds shall be limited to 10 knots or less within the construction works area and hotspots.
    - Transits of vessels operating within the construction works areas will be monitored and managed

3.3.3.3.4. Chemicals, Oils and Fuels

For chemicals, oils and fuels required and used onsite, the following measures shall be applied:

- For procurement;
    - Label all chemical storage containers and tanks in accordance with the EPD ‘Code of Practice on the Package, Labelling and Storage of Chemical Wastes’.
    - An up to date list of chemicals, chemical waste and fuel oil should be maintained.
- For storage;
    - Suitable containers should be used which are resistant to the stored oil fuel, chemical / chemical waste to avoid leakage.
    - Containers should be checked before use and container lids should be closed tightly to avoid leakage of chemicals and chemical waste.
    - Chemical waste storage areas should be in a designated area that is sheltered on at least 3 sides and the top, and is locked and kept clean and free from obstruction.
    - Incompatible chemicals should be separated.
    - Chemical, oil and fuel containers should be kept under eye level as far as possible.
    - Drip trays or bunds should be used for storage containers of chemicals and oil / fuel tanks and should have a capacity equal to 110 % of the storage capacity of the largest tank.
    - Chemical storage area and drip trays should be inspected daily to ensure the containers are in good condition and there are no openings which oil / chemicals can possibly leak

out. Any damage / openings to the storage area and drip trays should be repaired or replaced immediately.
    - Where chemicals are temporarily taken outside the sheltered chemical storage area, the chemicals including the drip trays / bund should be covered by waterproof tarpaulins and kept free of rainwater.

- For transfer / transport;
    - Pumps should be used to transfer large quantities of oil, fuel, chemical / chemical wastes instead of pouring.
    - Oil, fuel, chemical / chemical wastes should be transferred slowly to prevent spillage or overfilling.
    - Suitable trolley should be used to transport chemicals / chemical wastes to other location.

For use;

- Chemical quantities / dosage required during each use shall be carefully calculated / measured to prevent any excess chemicals being generated and released.
- Drilling fluid used in drilling activities should be reconditioned and reused as far as possible Safety measures during construction.

The proposed project site is on an uninhibited island. The proponent and the contractor are responsible for the safety of the staff, and visitors; health and safety rules must be followed strictly.

- The project site and the work area must be fenced.
- Safety signs and boards must be installed at work site.
- Fire extinguishers must be installed at site.
- The proponent and the contractor will ensure that all the supervisors are trained and qualified to identify, report, response to, and mitigate any health code violation on site.
- The proponent, contractor and other supervisory bodies will ensure all the health and safety procedures are followed while in the project site.
- All the precautions and steps will be taken to ensure the safety of the employees. Safety gear will be worn all the time.
- The proponent must ensure that the contractor provides numerous first aid kits on site. This is of the uttermost importance as the island has a health centre and the closet hospital is at best 40 minutes away in the atoll capital.
- The proponent must ensure that the contractor trains enough staffs in basic first aid drills both terrestrial and marine. Hence making these staff available throughout the project work hours while setting the duty roster.
- The proponent must ensure that the contractor reports all medical emergencies to the hospitals.
- If the use of the equipment requires licenses or special permits, the contractor should ensure the staff are licensed.
- All tools and equipment will be handled by competent staff.
- All staff must be trained to follow the emergency plan
- Health checks and safety checks will be administered before commencement of work.
- All project activities will be carried out in the presence of a qualified supervisor.
- The staff will be trained in fire extinguishing drills and appropriate fire extinguishing equipment will be placed at easily accessible points.
- Flammable material if stored on site, will be stored at site appropriately.
- Any tools stored on site will be stored appropriately.
- Oils, grease and lubricants will be stored as specified above in section.

3.4. Summary of inputs and outputs

The overall material inputs and the overall material outputs of the development are given in the

Material	Work material inputs	Input sources	Source / Type	Obtained By
Work material	CAD files GPS system Stakes Hammer	In house	HDC, GIS and Survey team	Procurement
	Excavator Truck Loader	External	CSR approach	Planning, SRP, staff
	GI pipe, Yatch rope Buoy Local rock	In house	Purchased and from the warehouse.	Planning, SRP, staff,
	Dive gear Crates Hammers Chisel Bushes Tweezers Slates for notes String Camera Ruler Semi SMB First aid box Emergency water Emergency buoy Resting Buoy Redundant air supply Man over board forms and system	Rent	external vendor	Planning, SRP, staff,
	Buoyancy jackets Reef shoes Reflector jackets	In house	Purchased	Planning, SRP, staff,
	Safety shoes Communication radio Lights Mask Fins Snorkel	In house	Purchased	Planning, SRP, staff, HR
Skill / Staff	Environment specialist Surveyor GIS specialist Project manager Surveyor, Unskilled labour for earth works Project manager for implementation of the proposal. Unskilled labour	In house	HDC, GIS and Survey team	Planning, SRP, staff, HR
	Licenced excavator operator	External	External vendors	Planning, SRP, staff, HR

	Licenced loader operator Licenced truck operator			
	First response diver Dive Master / instructor Licenced divers	External	External vendors	Procurement

The following are the outputs.

Material	Products and waste material	Anticipated quantities	Method of disposal
Project's outputs	Maps Charts Setting out files	Un able to compute the amount.	Not required
Construction debris output	Sand Rubble	30 000 CBM	Stockpile at stockpile location
Construction debris.	Rope trimmings, sewage, and other general waste.	Negligible	Construction waste to be taken to waste management site at MSO Hulhumale.
	General waste from the movement.	Negligible	Ask the professionals to manage their own waste. Inevitable collected waste, to be moved to the waste management area at MSO Hulhumale.
	Frame and cable debris from the management process.	Negligible	Management waste to be managed with the general waste and sent to the WAMCO collection point to Thilafushi.

4. Stakeholder's consultation

4.1. Introduction

The effective execution of the proposed project heavily relies on the engagement of stakeholders. Consultation with all pertinent parties, including public consultation, relevant government authorities, and community members, has been an essential component of this EIA. The objective of this chapter is to provide an overview of the stakeholder consultations that were carried out.

4.1.1. Water Sports Community

On 1st November 2022 HDC met with the water sports community in Hulhumale to discuss the methodology of the project

Date of consultation	1st November 2022
Venue	Think Tank
Name of Stakeholders	Water Sports Community
Introduction	Consultation meeting on project and to get input and Feedback from stakeholder
Summary of discussion	Project Overview • A brief introduction and project presentation were shared with the water sport community. • HDC discussed three main locations for the Reefscape project: South of Chanel, the Track Area, and the Man-Made Swimming Area/Water Theme Park Area. • The water sport community raised concerns about the South Chanel location, which is a popular surfing spot and has high energy and low tide conditions. • The Track Area was also discussed, with concerns raised about the hazardous water sport path, potential accidents due to anthropological factors, and sediment build-up. • The Man-Made Swimming Area/ Water Theme Park Area was noted to have shallow waters at low tide and issues with water quality and sediment build-up. • The water sport community expressed full support for the project once a location is finalized. • HDC will make a final decision on the location, and once approved, will proceed with a Memorandum of Understanding (MOU)

4.1.2. Water Sports Community

On 1st November 2022 HDC met with the water sports community in Hulhumale to discuss the methodology of the project

Date of consultation	8th November 2022
Venue	Real Estate Meeting Room
Name of Stakeholders	Water Sports Community (Aloha Beach Buddies, Beach Club)

Introduction	Consultation meeting on project and to get input and Feedback from stakeholder
Summary of discussion	Project Overview • A brief introduction and project presentation were shared with the water sport community. • HDC discussed three main locations for the Reefscape project: South of Chanel, the Track Area, and the Man-Made Swimming Area/Water Theme Park Area. • The water sport community raised concerns about the South Chanel location, which is a popular surfing spot and has high energy and low tide conditions. • The Track Area was also discussed, with concerns raised about the hazardous water sport path, potential accidents due to anthropological factors, and sediment build-up. • The Man-Made Swimming Area/ Water Theme Park Area was noted to have shallow waters at low tide and issues with water quality and sediment build-up. • The water sport community expressed full support for the project's final location.

4.1.3. Marine Journal

On 19th December 2022, HDC met with the Marine Journal NGO to discuss the methodology of the project

Date of consultation	19th December 2022
Venue	Think Tank
Name of Stakeholders	Marine Journal
Introduction	Consultation meeting on project and to get input and Feedback from stakeholder
Summary of discussion	Project Overview • A brief introduction and project presentation were shared with Marine Journal • MNU students have a significant amount of equipment that will need to be used in managing the environment. • Data gathered from this pilot project can be used for future projects. • While current data is crucial, other factors are also essential to consider. • Beach monitoring and beach profiling can be done, and Marine Journal has expressed willingness to assist in these areas. • The main focus of the project will be on Porites rus, but Marine Journal is happy to assist with screening for additional species. • It was noted that achieving balance in the project is challenging, but it is essential to strive for it. • The social component of the project will involve raising awareness and gathering information

4.1.4. EPA

On 19th December 2022 HDC met with EPA to discuss the methodology of the project

Date of consultation	19th December 2022
Venue	HDC Bureau Meeting room
Name of Stakeholders	EPA (Rilwan)
Introduction	Consultation meeting on project and to get input and Feedback from stakeholder
Summary of discussion	Project Overview • Brief introduction and project ppt were shared with EPA • Concerns were raised by EPA regarding the use of frames and the need for more environmentally friendly alternatives. • Suggestions were made by EPA to explore the possibility of using dead rocks as frames by drilling and placing substrate, or growing corals in a nursery on land before transplanting them to the reef. • It was noted that this approach could be implemented within a year, subject to HDC's capacity and financial resources. • The availability of suitable coral species should be assessed, and a long-term sustainable plan should be developed, ideally spanning five years. • The possibility of diversifying the project further was discussed by HDC, with a preference for locally sourced or reclaimed materials. • It was recommended by EPA that methodologies be based on the MMRI Manual, which contains helpful tips and guidance. • EPA suggested HDC to collaborate on the "Rasfari" coral propagation work. • A coral propagation training program is available in January at a cost of $1500, should HDC be interested

4.1.5. Reef Scapers

On 27th December 2022 HDC met with the reefscapers to discuss the methodology.

Date of consultation	27th December 2022
Venue	HDC Bureau Meeting room
Name of Stakeholders	Reef Scapers (Marie Saleem, Thomas Le Berre)
Introduction	Consultation meeting on project to get input and Feedback

Summary of discussion	Project Overview • Brief introduction and project ppt were shared with reef scapers • It was suggested that a man-made track can be something to be considered and public opinion regarding this would be required to see whether they would accept moving these rocks to have a snorkelling area built. • The new suggested location – Reefscapers think it is a possibility, sand is going under the corals, incoming water is good quality and can work, if no excavation • The possibility of rubble and sand going in there was discussed • The design of excavation would have to be solid for the sand to settle within a predictable time such as one week. • The heart shaped area was good for this project to be taken place by the reefscapers • A location of channel was discussed • Best area to create an attraction would be near the bridge. However, HDC mentioned that there is sypher effect there and would be hard to manage. • Another location HDC suggested was the swimming track area however sedimentation would be an issue. Moreover, since this is an area where a lot of water sport activities takes place hence would be hard to manage as well. • HDC suggested to excavate 3 or 4 meters from the suggested area near the man-made track. • Reefscapers stated that there would be little sedimentation at the bottom middle and it can be put on the edge, and it should be fine.

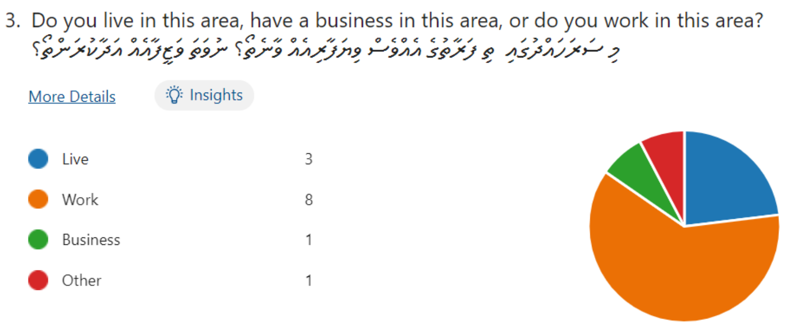
4.1.6. Consultation with General Public

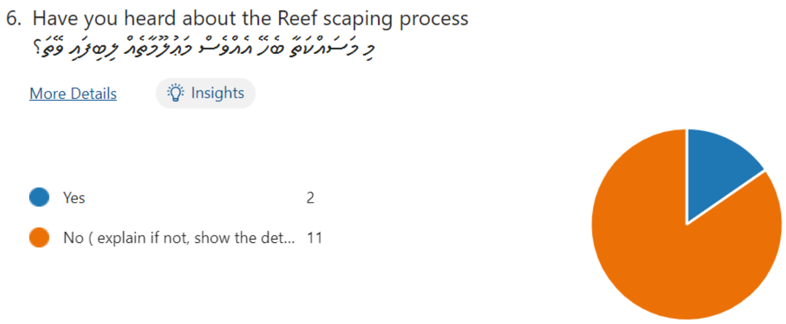
On 6th April 2023 HDC met with some individuals from the public near the proposed site (Red bull Park) in Hulhumale to get a better understanding of their views and concerns with respect to different components of the project

Date of consultation	6th April 2023
Venue	Red Bull Park Area
Name of Stakeholders	General Public
Introduction	Consultation meeting on project and to get input and Feedback from stakeholder
Summary of discussion	• Project Overview • A brief introduction of the project and the different components will consist of were given initially before the start of the survey.

	• Questions were asked about what their views are regarding the project and how it would impact them as an Individual or a business. • The component of sand being stockpiled in that general area temporarily was explained to these individuals separately to identify what kind of impacts the construction phase of the project would have. • Generally, everyone believes that this is a good development. • Suggestions were given by Deep Blue water sports business to; make the area larger than the current proposal, and to be aware of the low tides for the project design. • Despite the general public expressing concerns regarding the potential impact of the sand stockpile, including issues such as dust pollution and disruption of the scenery, they deemed it a minor sacrifice in light of the positive development it could bring about.

The following are the outputs form the survey





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7. A component of the this project is to excavate a 100 SQM area for a depth of 2m. Do you like the idea of excavation on this site?
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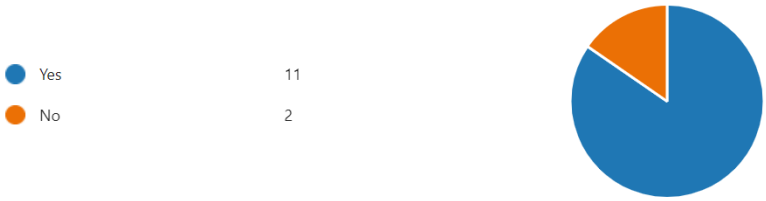
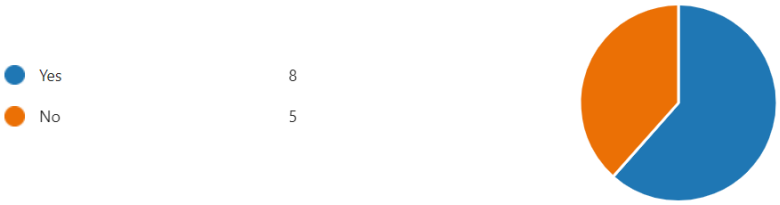
More Details Insights



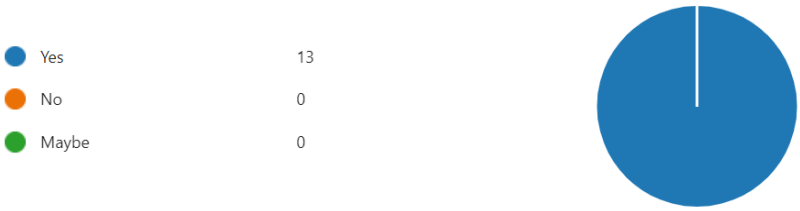
8. The excavated sand will be stockpiled in this area temporally. Do you like the idea of a stockpile for few days?
؟ ވެ ގަބޫލުކުރަންތަ ކަނޑާ ގޮތަށް ލިބޭ ވެލި ތަކެއް ކުރިން ބަހައްޓާ ގޮތަށް ވެ ؟

More Details Insights



10. Do you like this development?
؟ ވެ ގަބޫލުކުރަނީ ތަރައްޤީ ގެ ގޮތަށް ތިބާ

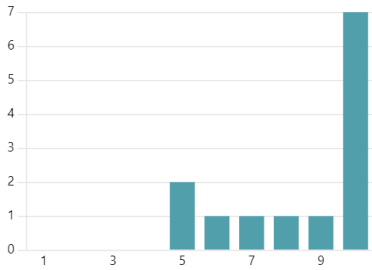
More Details



14. Can you rate this development?
؟ ވެ ތަރައްޤީ ގެ ގޮތަށް ތިބާ ދެނީ ކިހާ ދަރަޖަ ކަށް ހެ

More Details Insights

8.46
Average Rating



15. Will this have an impact on the business / work?
ލިބިދާނެ ތަކެއްޗާ / ވިޔަފާރިއާ ގުޅުންހުރި ތަކެއްޗަކަށް ތަހައްދަށް ލިބިދާނެ ގޮތެއް ހުރިތަ؟

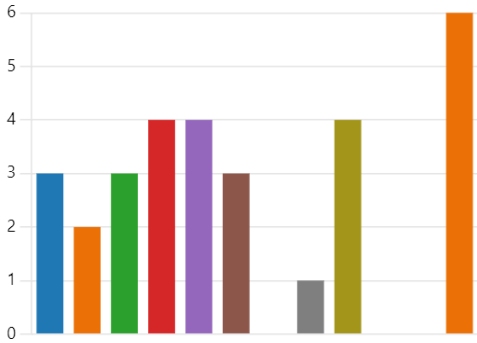
More Details Insights

Yes	9
No	4
Maybe	0

16. What sort of impact would you anticipate?
ކޮންފަދަ ގޮތެއް ލިބިދާނެ ކަމަށް ތަހައްދަށް ބަލަނީ؟

More Details

lack of buisness	3
more business due to constructi...	2
dust due to stockpile	3
Noise pollution	4
Dust pollution	4
Death of fishes	3
Impact to scenery	0
oil pollution	1
site distruction	4
space occupation and lack of pl...	0
Death of corals	0
Other	6



4.2. Outcomes of the consultation

Based on the meetings held the following are the decisions;

- the proposed location was finalised to the eastern side of Hulhumale',
- the methodology was set to MARRS system, and
- the excavation to be completed as proposed by the expert and be ready to implement harvesting and propagation by August 2023 to allow the coral bleaching period to pass.

5. Policy and legal framework

5.1. Introduction

The following section addresses the legal, policy, administrative framework for the environmental management and some regulatory guidelines and standards relevant for the proposed project. All the activities during both development and operation stage of the proposed project will be carried out in accordance with existing plans, policies, guidelines, laws and regulations of Maldives in addition to relevant international conventions to which Maldives is a party to.

5.2. Relevant, Environment Legislation

5.2.1. Environment Protection and Preservation Act (Act no. 4/93)

This Act set the basic principles and rules for the protection of the environment in the Maldives and whereby the Environmental guidance shall be provided by the authorized government bodies. Under this Act Environmental Impact Assessments (EIA) is mandated to be undertaken for all development projects that may have an undesirable impact on the environment. This addresses the disposal of oil, waste, and toxic gas or any substance that may have harmful effects on the environment within the Maldivian territory. it also deals with the penalty for breaching the law, and damaging the environment. The following articles are relevant during the undertakings of this project:

1. Article 2 states that the instructions for environmental protection will be given from the competent authority and everyone must respectfully follow these instructions
2. Article 3 states that all matters relating to environmental protection and preservation must be handled by the Ministry of Planning, Human Resource and Environment (MPHRE);
3. Article 4 states that the Ministry of Planning, Human Resources and Environment shall be responsible for identifying protected areas and natural reserves and for drawing up the necessary rules and regulations for their protections and preservation.
4. Article 5 states that any projects which pose significant impacts to the environment, an EIA report has to be made and submitted to the MPHRE. The projects which require an EIA and the regulation must be made by MPHRE;
5. Article 6 states that if any project is found to cause significant adverse impacts, MPHRE have the right to stop the project;
6. Article 7 states that any waste, oil or hazardous gas must not be dumped into any part of the Maldives, however, if strictly needed to be disposed it should be disposed of in an area designated by the Government. If such hazardous gas, waste or oil is to be disposed by combustion, it should be done in a way it does not impact human health and environment;
7. Article 9 states that any party who violates this law or any regulation under this law is punishable to no more than MVR 100 million according to the offence. The fine will be applied by the MPHRE.
8. Article 10 states that any offence to this law or any regulation under this law or any action resulting in environmental damage, the compensation for such damages can be taken through judicial processes.

5.2.2. 1st addendum to Environmental Protection and Preservation Act (4/93) law no 12/2014

Article 3 and 11 of the Environmental Protection and Preservation Act (4/93) of Maldives is amended as follows: -

Under article 3, all matters relating to environmental protection and preservation must be handled by the Ministry charged with implementation of environmental policy.

Relevance to the project: the project is carried out in Maldives, hence must abide by all the regulatory requirements set forth.

5.3. Relevant Regulations and Guidelines

5.3.1. Environmental Impact Assessment Regulations 2012

The decision to go forward with an EIA will be decided upon the screening process. which dictates a category and the scope of the EIA. The proponent and the proponent's consultant (who is a registered consultant) will meet the EPA and stakeholders in a scoping meeting which will approve the TOR which will set the limits for the EIA. The EIA will start with the baseline studies, impact prediction and finally reporting the findings with impact mitigation and monitoring program. The EIA report will be reviewed by EPA, where a decision note will be given accordingly. After approval the project proponents will be required to follow the monitoring and implement the mitigation measures prescribed in the EIA.

5.3.2. Environmental Impact Assessment 2012 and Amendments

The EIA Regulation, which came into force in 2007, has been revised and this revised EIA Regulation is currently in force since May 2012. The Regulation sets out the criteria to determine whether a development proposal is likely to significantly affect the environment and is therefore subject to an EIA. Schedule D of the EIA Regulation defines the type of projects that would be subject to EIA. The main purpose of this Regulation is to provide step-by-step guidance for proponents, consultants, government agencies and the general public on how to obtain approval in the form of an Environmental DS.

5.3.3. 2nd addendum to the Environmental impact Assessment Regulation 2012

With the 2nd addendum to the environmental impact assessment regulation 2012, there were some procedural changes made to the EIA process. The most important was the shifting of tourism related development projects EIAs to the Ministry of Tourism. Other than that, slight changes were made to the process such as the finalization of the TOR during the scoping meeting (article 11(b)) and changes in the fees for the review processes under three different categories (article 7(c)).

5.3.4. 3rd addendum to the Environmental Impact Regulation 2012

One of the main modifications to the EIA regulation is that the EIA consultants are classified into 2 categories. To be eligible for a category A consultant, the applicant should hold a minimum of level 7 qualification in an environment related field recognized by the Maldives National Qualification Framework. Likewise, to be eligible for a category B consultant, the applicant should hold a minimum of level 7 qualification in specific fields relevant for the nature of the project recognized by the Maldives National Qualification Framework. As such, this report is prepared by registered category A EIA consultants.

5.3.5. 4th addendum to the Environmental Impact Regulation 2012

One of the main modifications to the EIA regulation is that the exclusive list for EIAs were changed such that EIAs are not required for reclaimed lands until three years from the reclaimed date unless the project involves dangerous chemicals, oil storage, incinerators, release of toxic chemicals to atmosphere, and fiberglass works.

Relevance to the project: The current project, upon screening was categorized by EPA as a project that requires an ESIA.

5.3.6. Regulation on protected species (2021/R-25)

The regulation is designed to record, manage, maintain and promote the conservation of selected species, its diversity and their gene pool in the existing environment of the Maldives.

The purpose of this regulation is to:

a) Ensure preservation and conservation of the existing biota, its habitat, the integrated ecosystem's integrity and natural resources;
b) Ensure establishment of robust, inclusive, transparent regulations in nominating and managing the protected species;
c) To recognise key environmental species and their ecosystems;
d) Protect globally endangered species, cooperate with the global effort for conservation of the said species and contribute at a national level to achieve the conservation of the said species;
e) Establish protection and preservation of selected species and ban carrying out any activity that can potentially harm the protected species in nature;
f) Establish and manage a database of protected species;
g) Establish and manage a database that can reflect the status of endangered and endemic species;
h) Promote participation and awareness of the general public in determination and establishment of protected species:
i) Develop and make firm the policies that analyses and studies protected species.

Relevance to the project: This project deals with corals and the marine environment that can contain organisms and ecosystem facilities recognised and red listed by IUCN, and decided by CBD as an organism that needs conservation.

5.3.7. Regulation on Sand and Coral Mining

This regulation covers the ban on sand, coral, and aggregate mining from cost al zones, and uninhibited islands that have been leased.

Relevance to the project: The project notes, identifies and strictly follows the ban on coral mining from house reef, and atoll rim which has existed since 26 September 1990

5.3.8. Regulation of Dredging and Land Reclamation (2013/R-15), (2014/R-13)

2013/R-15 Since 2nd April 2013 the regulation of Dredging and Land Reclamation is in effect with the aim of reducing environmental impacts associated with dredging activities in islands, and reefs across Maldives

2014/R-13 Since 9th February 2014, through the amendment 2014/R-15, clause 13, (ﷺ) it was declared that the cabinet could allow a project if they identify the project to be of social, and economic importance given that the proponent fulfil the following;

- Carry out an extensive baseline study of the protected area
- The organisms and the fragile ecosystem of the protected area must be;
  - Relocated
  - Acclimatized to site of relocation
  - Should be monitored according to a management plan
  - the monitoring plan must be approved
- Preparation, and implementation of a management plan for a similar area larger than the site or number of areas as approved by the government.
- Identify the impact the proposed change will have on the water table, implement recovery actions, and monitor the changes and report to the authorities.
- Identify potential flood episodes due to changes, and develop a flood drainage system on the island.

Relevance to the project: This project has an excavation component, a reef flat modification component. Hence, must consider the biodiversity.

5.3.9. Regulation for Protection and Preservation of Island Vegetation and Flora in the Maldives (2022/R-92)

This regulation defines the procedures for uprooting and replanting of vegetation in Maldives protecting, preserving and conserving the flora and fauna of Maldives.

The purpose of the regulation is:

1. Encourage proper propagation of vegetation, in order to enhance and conserve the vegetation of Maldives.
2. Protect, conserve and manage significant and old vegetation identified in the islands of Maldives.
3. To decentralize the management of felling, uprooting, excavating, and translocation of vegetation.
4. To determine and define, the procedures necessary for the management of felling, uprooting, excavating, and translocating of vegetation to mitigate the possible negative impacts on the total green percentage of the island, the natural beauty of the island, and the overall environment.
5. To ensure that vegetation felling, uprooting, excavation and translocation is only opted in cases that proves to be the only and final option and ensure that the processes are managed, monitored and reported.

Relevance to the project: The project does not have a terrestrial vegetation movement component. However, the project understands and recognises and follows the regulation.

5.3.10. The Environmental Liability regulation (Regulation 2011/R-9)

This regulation is also pursuant to Environment Protection and Preservation Act of Maldives (4/93). The regulation is aimed at maintaining equal standards for reprimanding and enforcing environmental liabilities, fines for those who violate the rules and regulations and give guidance to those who are involved in the implementation process of the regulations pursuant to Preservation Act of Maldives

(4/93). Provide the basis for levying fines on environmentally damaging violations to avoid environmental deterioration, extinction of biological resources, environmental degradation and wastage of natural resources. One of the key objectives of the environmental liability regulation is also to practice polluter-pay- principles in the Maldives.

Relevance to the project: Apply with respect to the environmentally relevant aspects of the construction and operation phase, the proponent shall take all practical measures to ensure that the mitigation proposed in this EIA is followed.

5.3.11. Construction Site Health and Safety Regulation (2019/R-156)

The regulation was published by Ministry of National Planning and Infrastructure on 30th January 2019 as supporting document to National Construction Act (4/2017). The purposes of the regulation are

To define the minimum Health and Safety precautions that needs to be practiced to ensure the Health and Safety of workers and the public.

To define the fines and actions that will be taken against the parties that do not follow the regulation.

Ministry of National Planning and Infrastructure will be the implementing authority of the regulation. The regulation defines the responsibilities of the contractor and fines for breaching the regulation. As per the regulation it is mandatory for the contractor to carry out the following:

A. To provide Personal Protection Equipment (PPE) to all workers.
B. To conduct Health and Safety Inductions sessions for all workers.
C. All workers must complete the Health and Safety Training when they start work at a company.
D. All contractors must have a Health and Safety Plan and Emergency Plan and workers must be trained to follow the both plans.
E. Contractor must ensure all the works are carried out as per Health Safety Plan.
F. Contractor must install Health and Safety Boards at the Works site. Warning signs and speed limits should be installed accordingly at the site.
G. Contractor must ensure the safety of adjacent properties next the work site and take all necessary precautionary measures to prevent damages to nearby properties.
H. Contractor must provide safe passage for the public when the works are carried out on public places and roads.
I. All work sites must have a Health and Safety Supervisor to assess the health and safety of site and compile reports. He must record all accidents on site and inform the head office.

Relevance to the Project: The project must follow regulation to ensure a safe working environment for the workers, volunteers, and staff. The project will follow all the requirements of the regulation at all mediums; land and sea, to ensure the Health and Safety of workers and the Public.

5.3.12. Public health emergency regulation (2020/R40)

The guideline defines the procedures to follow in case of a public health emergency.

Relevance to the project: The proponent is responsible for the general health of the staff involved. Hence must follow the procedures accordingly.

5.3.13. Regulation on treatment of the diseased in case of a contagious disease (2020/R34).

The guideline dictates the best practice for management and treatment of the diseased in case of suspected or confirmed contagious pathogen.

Relevance to the project: The project is carried out on an inhibited island. Given the current climate of reoccurring COVID 19 cases, other health emergencies, etc. The contractor must be informed and prepared for the proper procedure for such an unfortunate event.

5.3.14. Regulation on isolation and quarantine facility standards (2020/R35), amendment 1 (2020/R-76)

The regulation and the amendment define the requirements, and standards of the mandatory quarantine facilities for isolation of incoming, potential cases, and outgoing staff.

Relevance to the project: The contractor is required to follow the guideline to prepare proper quarantine facilities.

5.3.15. Regulation on waste management (58-R/2013), amendment 1 (10-R/2014), amendment 2 (29-R/2014), amendment 3 (90-R/2017), amendment 4 (63-R/2018), and amendment 5 (109-R/2021),

The waste management policy ensures that the Maldivians are well aware of the waste management techniques and maintains cleanliness as well as the natural aesthetics and clean air quality of the country is well maintained. Under this policy, all the inhabited islands need to implement a waste management plan and manage all the wastes generated from that island in accordance with that policy.

The policy was framed keeping in mind a healthy environment which is solid waste free. Ensuring safe disposal of Solid waste, chemicals and hazardous industrial waste. Encouraging recycling, and reducing of waste generated. It also allows development of guidelines on waste management and disposal and advocate enforcing such guidelines.

Relevance to the project: This project will comply with this guideline such that any waste generated during the construction and operation phases of this project will be dealt with in accordance with the waste management plans of HDC and the government

5.4. Relevant permits

5.4.1. EIA decision Statement

The DS is to be issued by EPA to allow commencement of the project giving clearance and go ahead by the government.

Relevance to the project: This project is one that requires an EIA, hence requires a DS to either allow the project to go ahead or to stop the project.

6. Description of the environment

6.1. Introduction

This section assembles, evaluates and presents the environmental baseline relevant to the project. The section includes, detailed methodologies of the study with the findings. To describe the existing environment, the report sub divides environment to physical, biological and social. Wherein, the existing physical environment geology and geomorphology, hydrography/hydrodynamics, ecology, socio-economic environment, and hazard vulnerability is further described.

6.2. Study area and Survey Locations

Details of the study area and survey locations are given below. After analysing the project area, some survey sites were pre-selected referring to development concept data while others were selected upon site visit after consulting with the stakeholders.

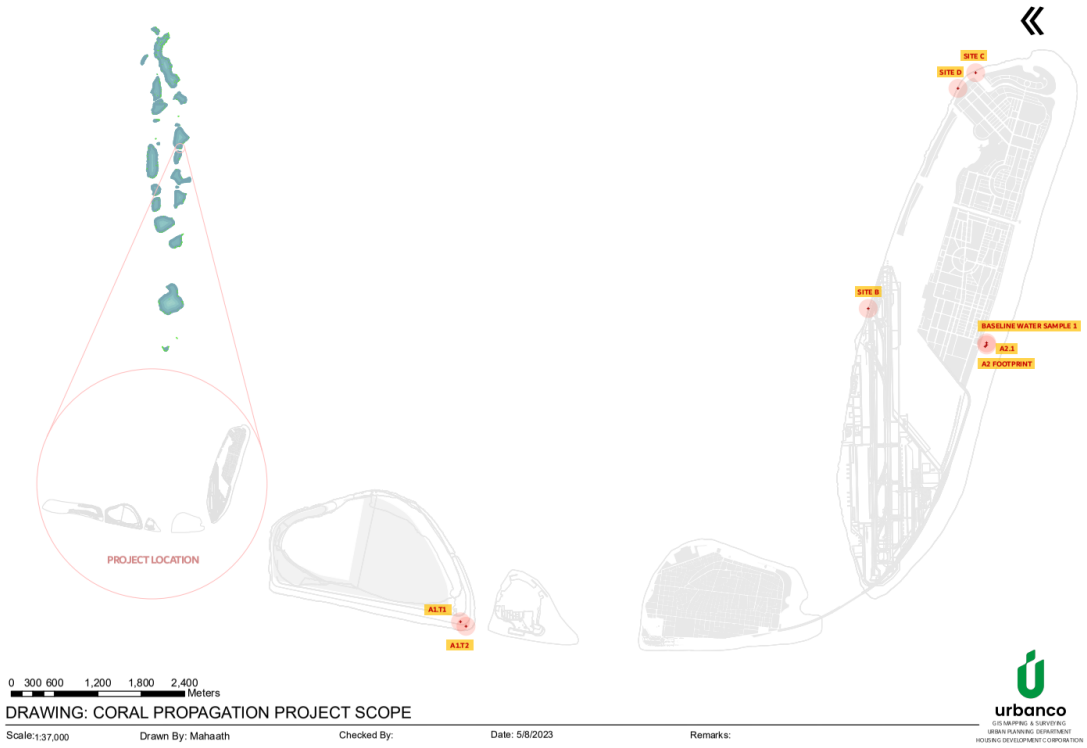


Figure 9 Survey map

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

6.3. Physical Environment

6.3.1. Climate

6.3.1.1. General Climate

A typical tropical monsoon climate is enjoyed throughout the year in Maldives. The south-west monsoon occurs between mid-May to November and the north-east occurs between January to March. The North-East monsoon is dryer than the South West Monsoon. The transition period of southwest monsoon occurs between March and April while that of northeast monsoon occurs from October to November (Table 2). The temperature ranges from 27 till 31°C daily, where the maximum mean dry temperature is 30.4°C and minimum mean dry temperature is 25.7°C. (Meteorology, 2006). Rainfall patterns in the Maldives is dictated by the Indian ocean Monsoons. The rainfall averages at 2,124 mm annually where the south receives more rain than the north.

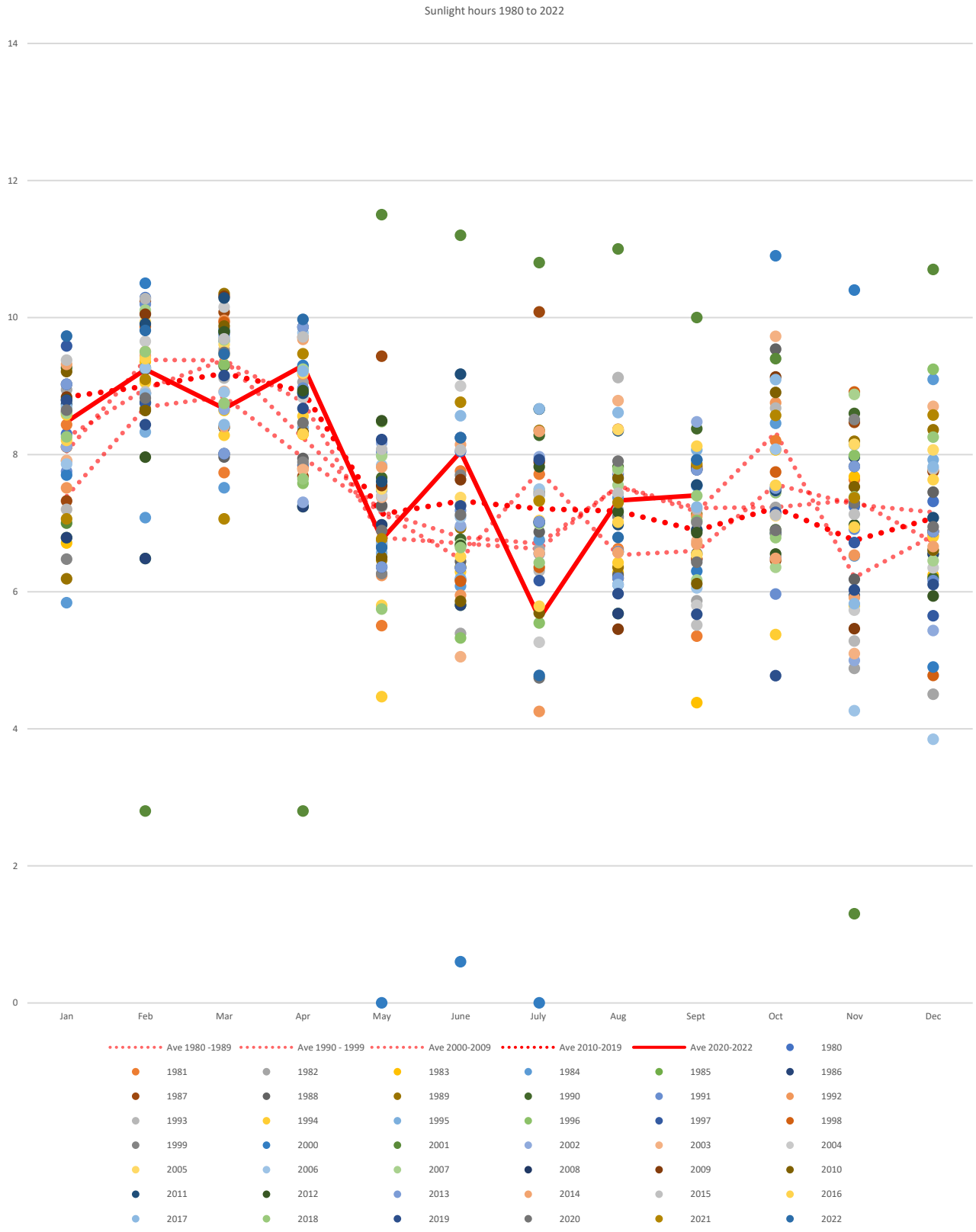
Table 2 months and the seasons associated with them

Season	**Dhivehi name**	**Month**
NE-Monsoon	*Iruvai*	December
NE-Monsoon	*Iruvai*	January
NE-Monsoon	*Iruvai*	February
Transition period 1	*Hulhangu Halha*	March
Transition period 1	*Hulhangu Halha*	April
SW-Monsoon	*Hulhangu*	May
SW-Monsoon	*Hulhangu*	June
SW-Monsoon	*Hulhangu*	July
SW-Monsoon	*Hulhangu*	August
SW-Monsoon	*Hulhangu*	September
Transition period 2	*Iruvai Halha*	October
Transition period 2	*Iruvai Halha*	November

The project area *K Hulhumale is* in the general climate as the rest of the Maldives with minute differences which will be discussed in this section.

6.3.1.2. Sunshine hours

The data from 1981 to 2022 from the Maldives metrological services shows that the average sunshine hours for the region is earlier in the year than later in the year. This trend is true for each 10-year average.


Sunlight hours 1980 to 2022
14
12
10
8
6
4
2
0
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept
Oct
Nov
Dec
Ave 1980 -1989
Ave 1990 - 1999
Ave 2000-2009
Ave 2010-2019
Ave 2020-2022
1980
1981
1982
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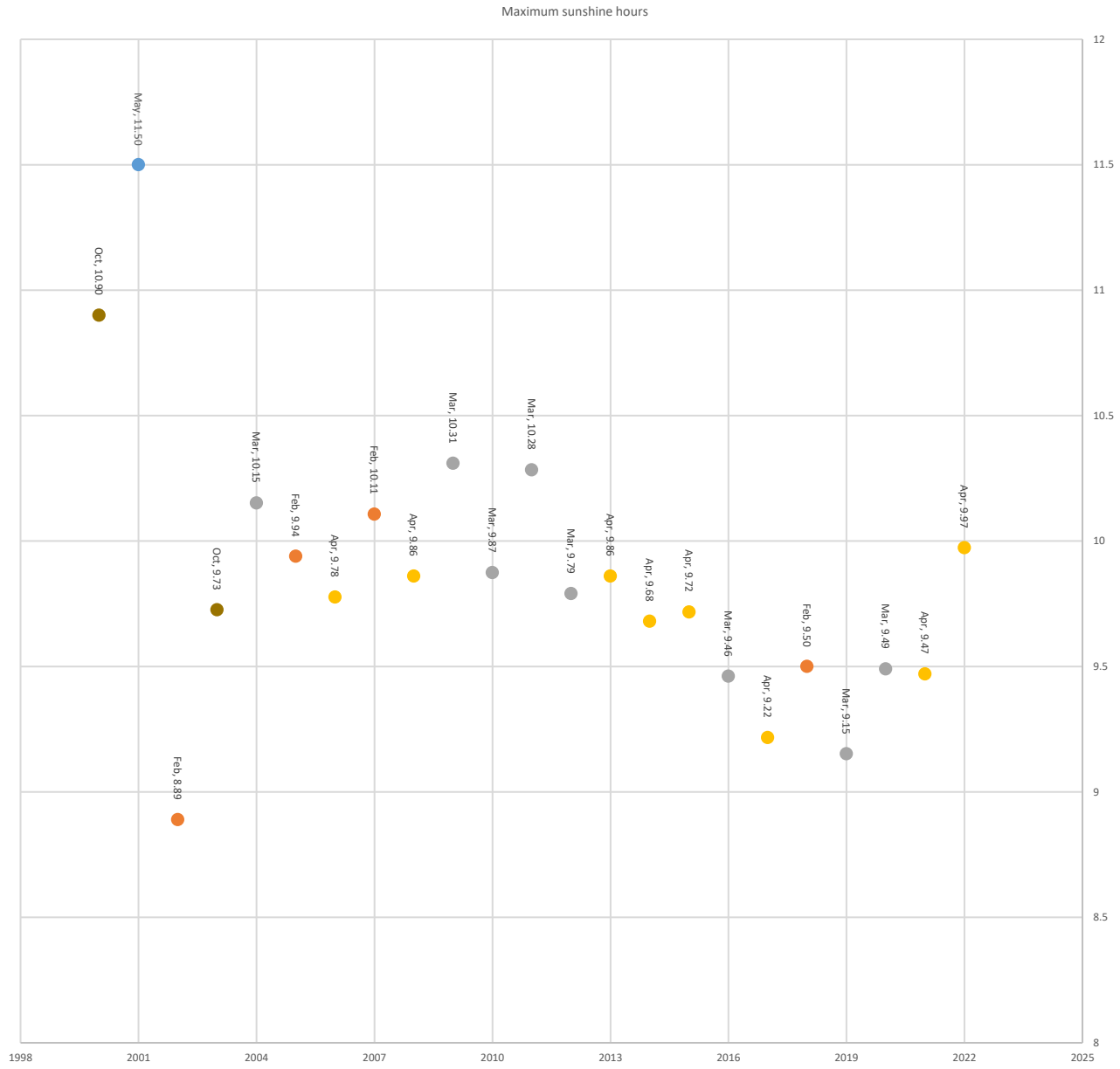
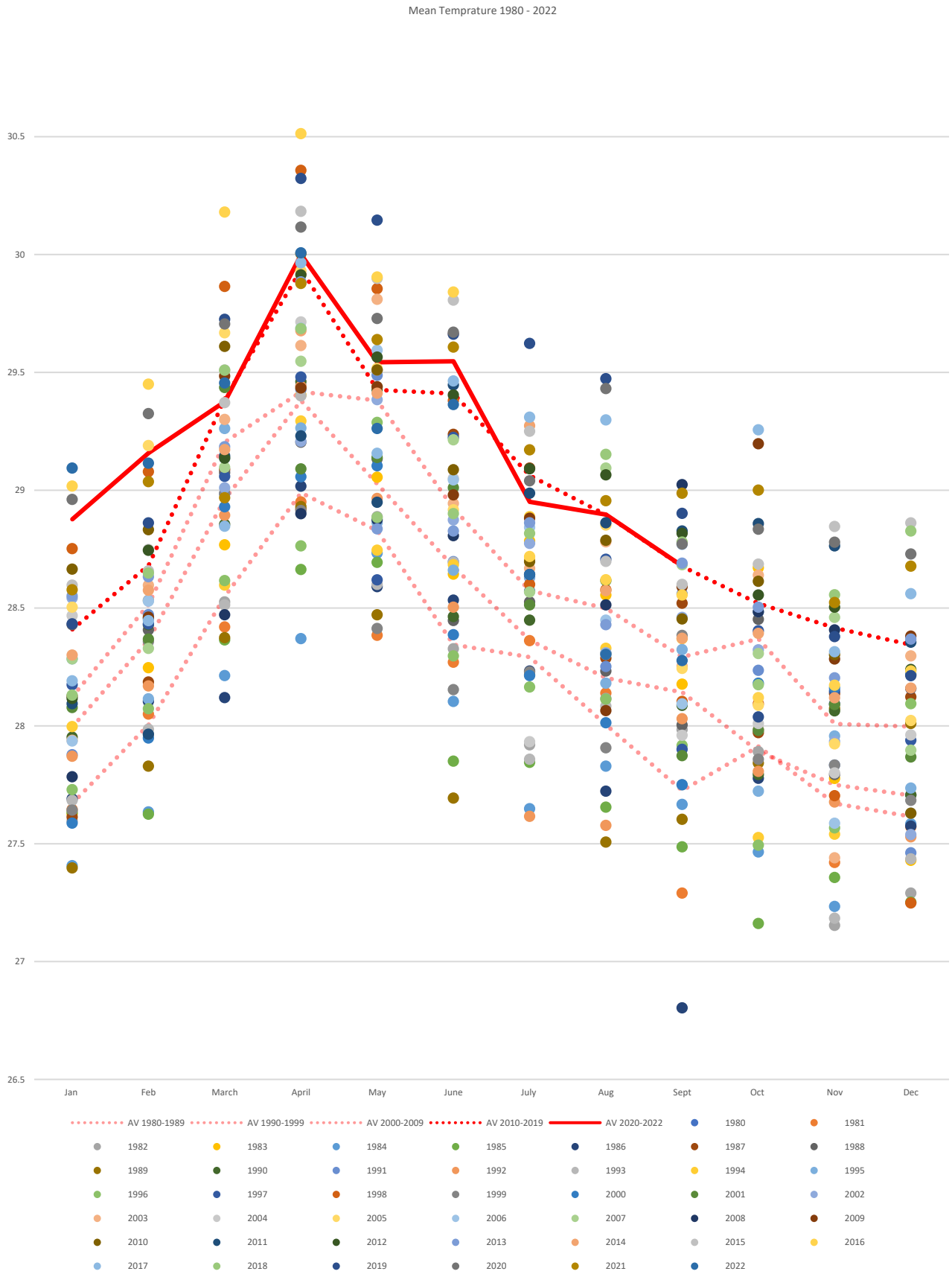
2021
2022

Since 2010 till 2019, the maximum average sunshine hours are recorded on March of 2011, that is 10.283 Hours. Looking back 20 years, the maximum average sunshine hours is on May 2001. An analysis of the pattern of the past 20 years shows that except for the years 2000 and 2003, the maximum mean sunshine hours can be seen between February and May.



6.3.1.3. Temperature

The general temperature of Maldives does not show large fluctuation when it come to the difference between day, night and seasons; due to the abovementioned monsoon climate and the tropical position of the chain of islands. Furthermore, the flat topography and a lack of high risen earth ensures a consistent temperature throughout.


Mean Temprature 1980 - 2022
30.5
30
29.5
29
28.5
28
27.5
27
26.5
Jan
Feb
March
April
May
June
July
Aug
Sept
Oct
Nov
Dec
AV 1980-1989
AV 1990-1999
AV 2000-2009
AV 2010-2019
AV 2020-2022
1980
1981
1982
1983
1984
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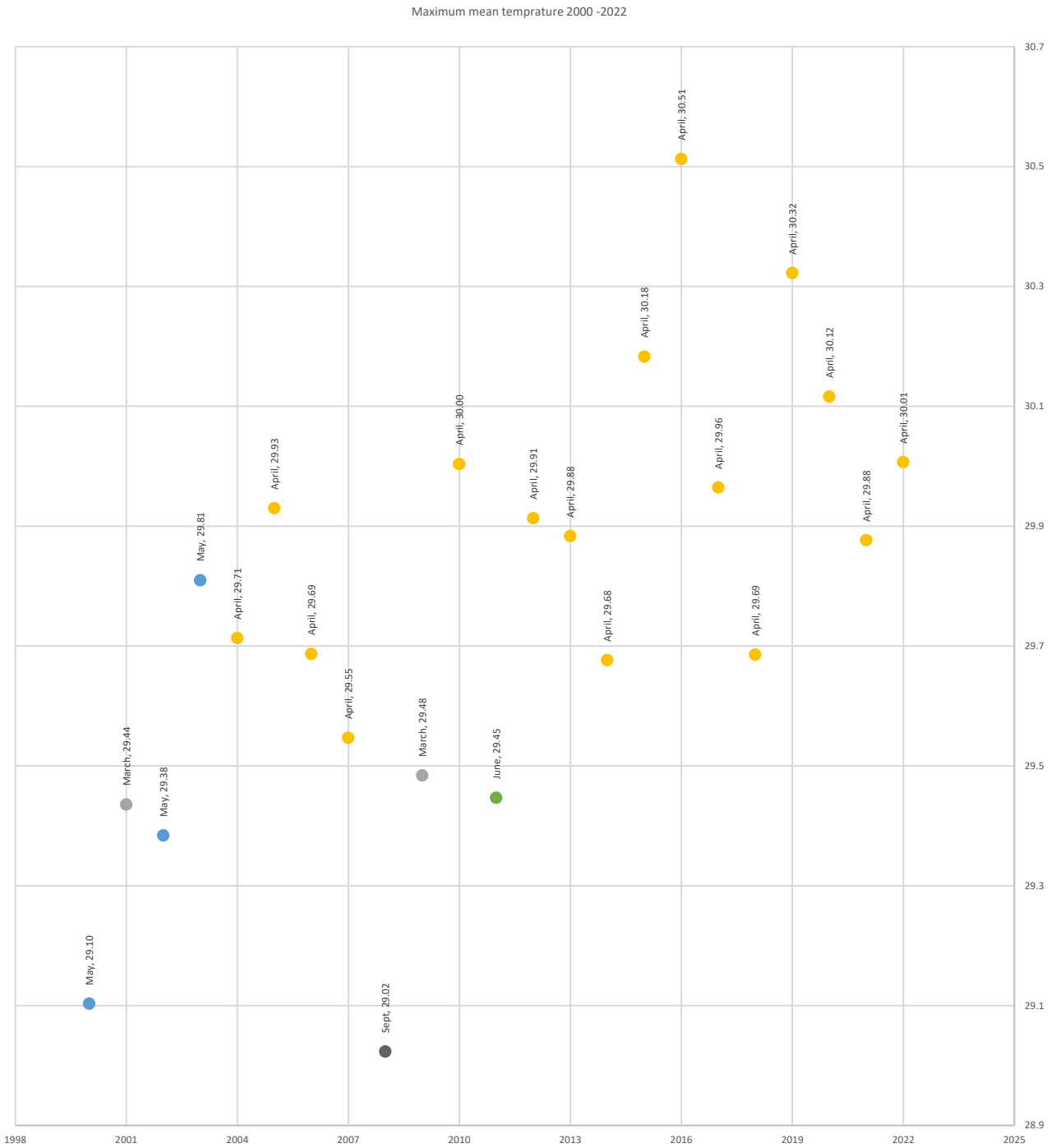
2020
2021
2022

The mean temperature analysis of the past 40 years shows a similar pattern in temperature. The mean temperature of each decade shows a gradual raise in temperature overtime, while the general pattern is the same.

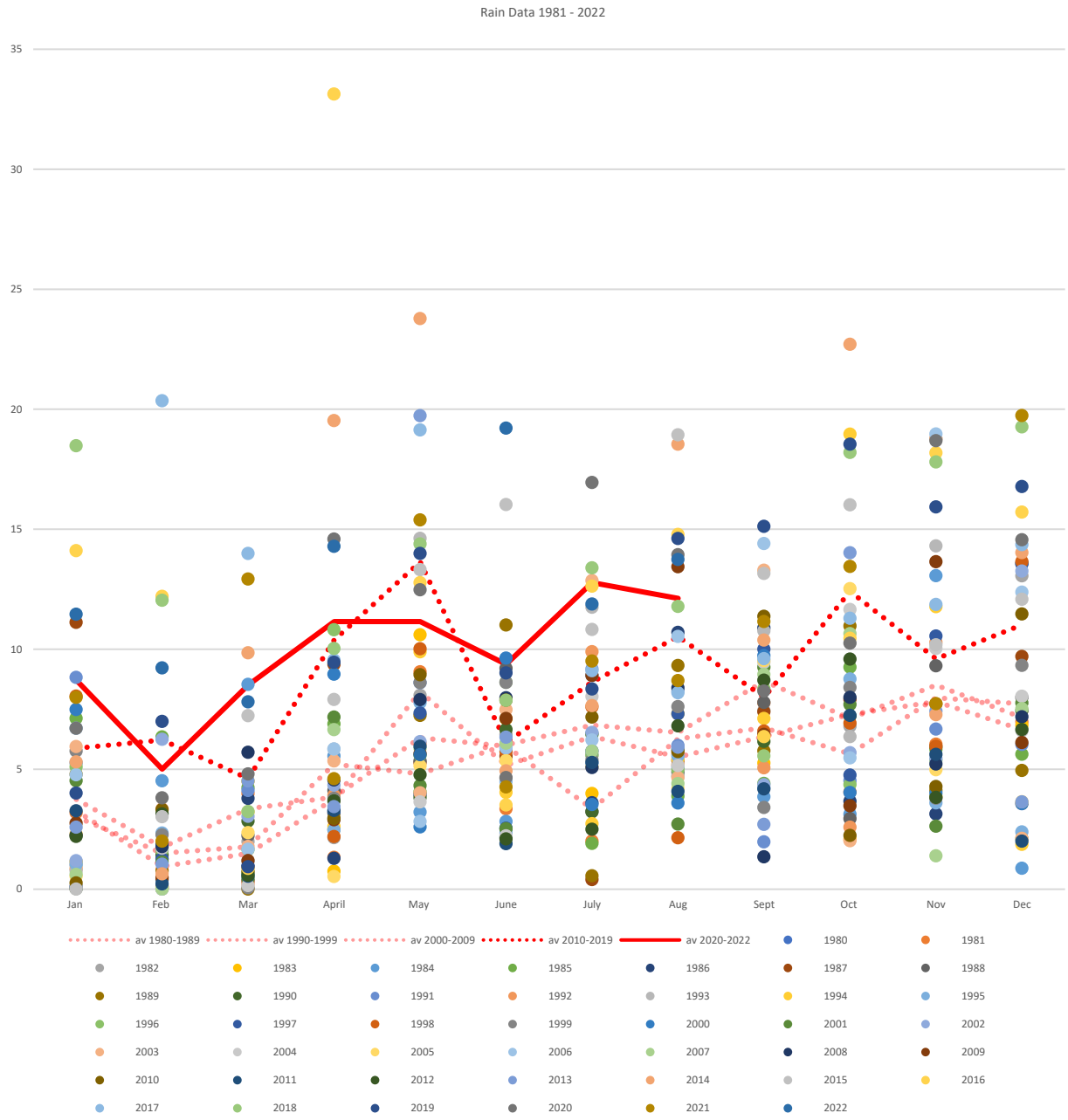


An analysis of the maximum mean temperatures since 1980, shows that except for the year 2008, and 2011, the hottest months are April and May.

6.3.1.4. Rainfall

The rain falls ranges in different parts of the Maldives depending on the monsoonal cycles. The southwest monsoon; wet season is from mid-May to November where rapid rain in large quantities is expected. As per the National Bureau of Statistics Laamu, Gaafu and Seenu had the more rain in comparison to the north.

In the greater Male' area, until 2009, a pattern in the mean average rainfall can be observed. The pattern is observed throughout the 30-year period from 1980. Within the 10 years period between 2010 and 2019, a change in the pattern in rainfall can be observed were in, elevated peaks can be seen in the amount of overall rain throughout. The trend can be seen starting from 2020



6.3.1.5. Wind

Located in the equatorial region of the Indian Ocean, Maldives enjoys a generally mild monsoon. However, winds do pick up to storms and line squalls, but the area is generally a cyclone fee area. The monsoon climate is driven by the atmospheric pressure differences that arise because of rapid warming or cooling of the Tibetan Plateau relative to the Indian Ocean (Hastenrath, 1991; Fein & P, 1987). As per the observations of NASEER, 2003, the Maldivians monsoon patterns show consistency for the past two decades. His analysis shows that the wind speed is usually higher on the months May till October in central Maldives while the monsoon is significantly stronger in the central and the northern region in comparison to the south.

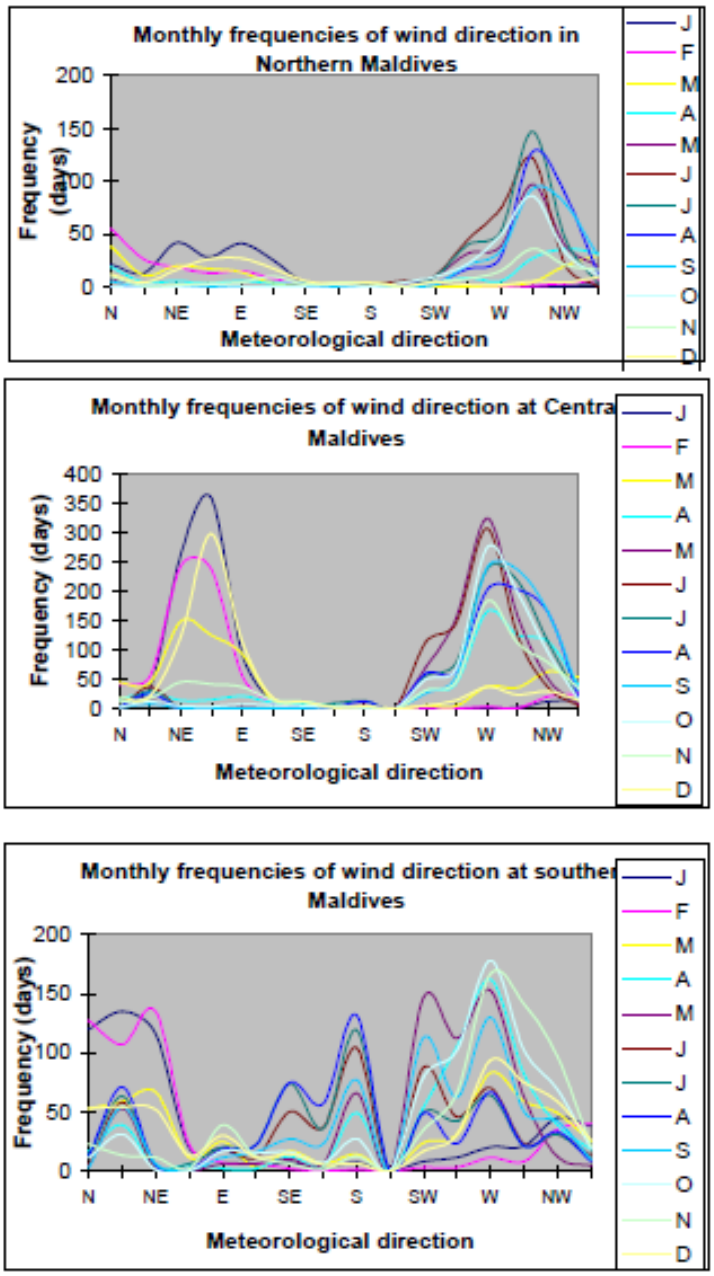


Figure 10 monthly frequencies of wind direction central and south (NASEER, 2003)

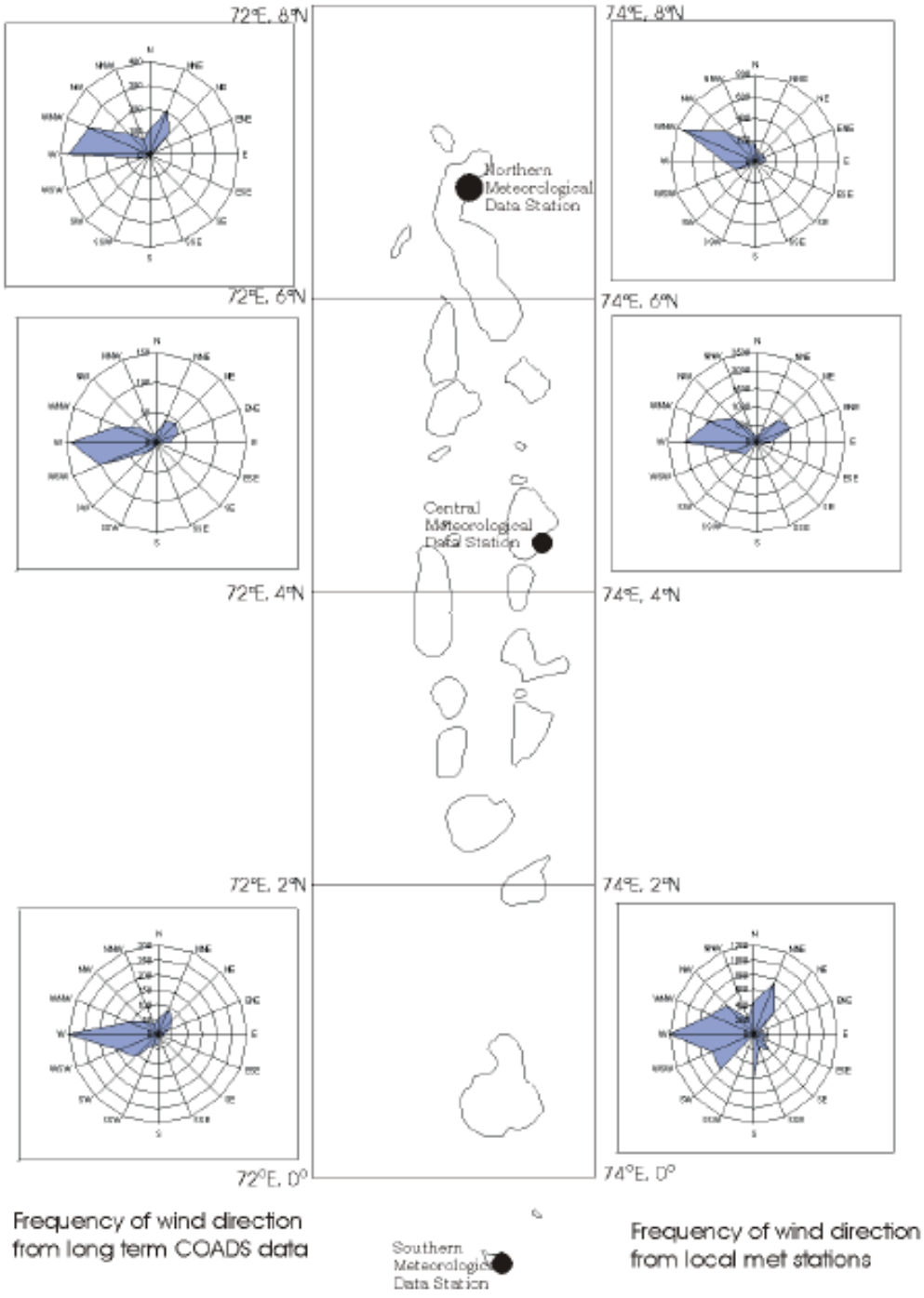


Figure 11 Comparison of local and long-term wind frequencies (NASEER, 2003)

The wind data is borrowed form NASEER, 2003 is shown in *Figure 10*, *Figure 10*, and *Figure 11*, and respectively.

6.3.2. Geology and geomorphology

There are 1200 naturally formed coralline low laying islands in Maldives and cays where in except for the island of *Fuvahmulah* is a part of a larger atoll. The islands are classified into 25 atolls. The islands are elevated steeply from the surrounding sea floor of 2500-3000 m deep to the east and 2800 – 4200 m deep to the west. The sea in between the atolls are around 200 m deep (Naseer & Hatcher, 2000).

It is hypothesised that Maldives lies on a volcanic basement of depth 2000 m that pore out between Laccadives and Chagos Band and during Cretaceous and early Cenozoic times moved northward to form a submarine ridge. It is believed the islands have been exposed to 27 glacial sea level cycles with eustatic sea level fluctuating by more than 120 m at various times resulting in many "karst-induced" coral reef formations and geomorphological structures. (Rudie & Tim, 2014).

6.3.2.1. Island geomorphology

Since the reclamation of Hulhumale' the island has been modified to extend to the northern tip of the reef flat till the reef slope. During this modification, 2 major sediment shifts were observed. The longshore sediment moment back and forth in the north south orientation and the predominantly westerly sediment movement on the easterly direction into the inner atoll.

2001

2005

2009

2014

2014

2016

There is an observable sediment movement south of the islandalong the causeway .

2020

2022

Figure 12 Aerial development progress of Hulhumale' from 2001 till 2022

6.3.2.2. Sedimentation

The following are the rate of sedimentation on the propagation site. The sedimentation is set against the daily sedimentation of 15 mg/cm2/day.

It must be noted that the turbidity of the area changes with the tide almost twice per day on the location.

Table 3 Sedimentation data

Location	Rate of sedimentation unit mg/cm2/day.
Propagation site A1 Footprint	0.162349
Propagation site A2 T1	0.189652

6.3.2.3. Profiles

The profiles are attached to the appendix for clarity. The profile shows that of a typical high beam structure, that ranges from +0.40 to +1.50 m above MSL. Past the general toe, the reef flat is irregular rising at the crest, which is the general shape at all the profiles. Which stagnates the water in the basin and allows limited circulation.

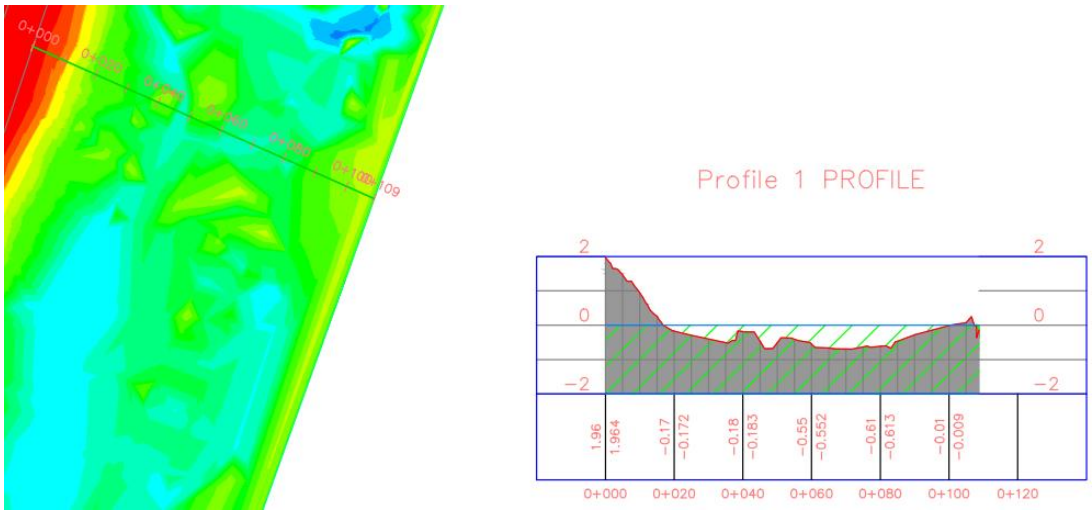


Figure 13 Profiles Infront of the residential area near the project area

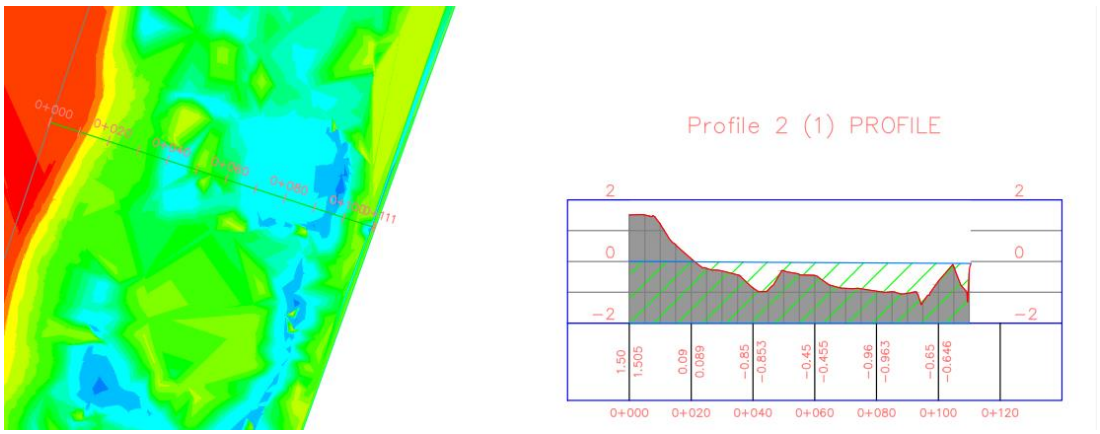


Figure 14 Profile of the project area

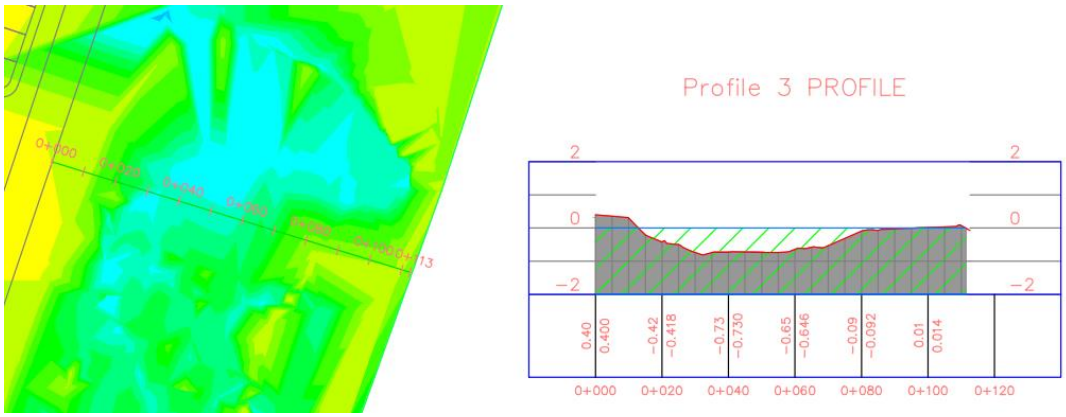


Figure 15 Profile, south of the project area

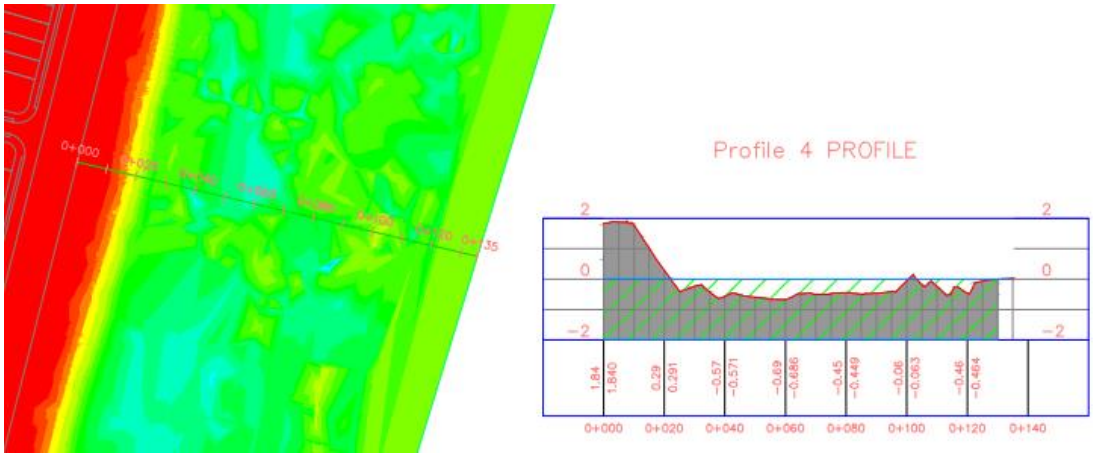


Figure 16 Profile, further north as a control to observe any difference if any.

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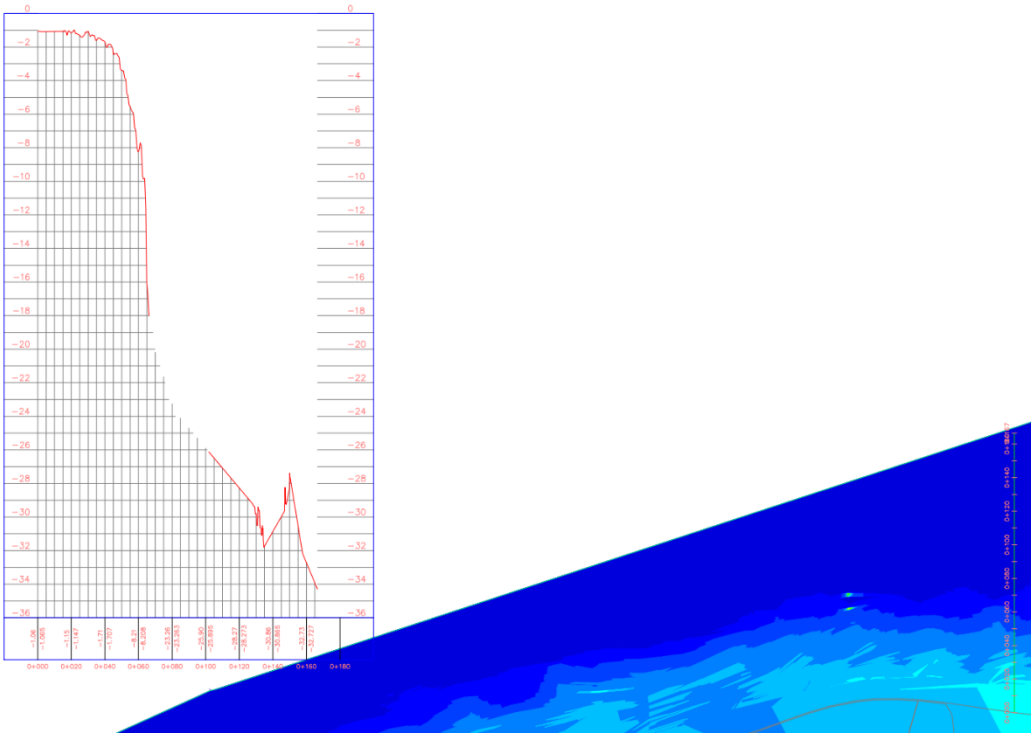


Figure 17 profile B of the northern tip of Hulhumale

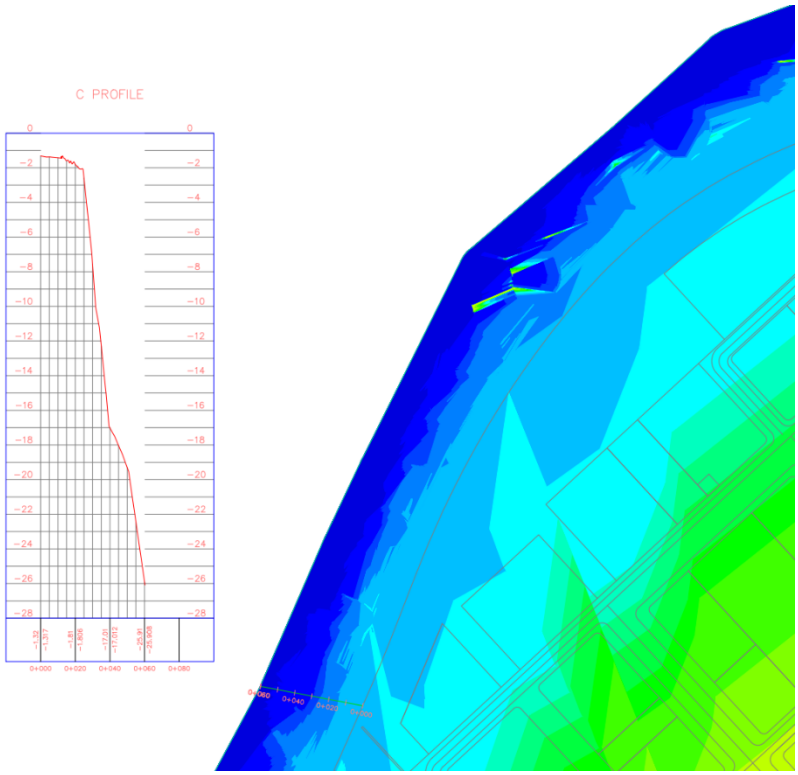


Figure 18 Profile C of the north western side of Hulhumale

6.3.3. Cut fill profiles and report

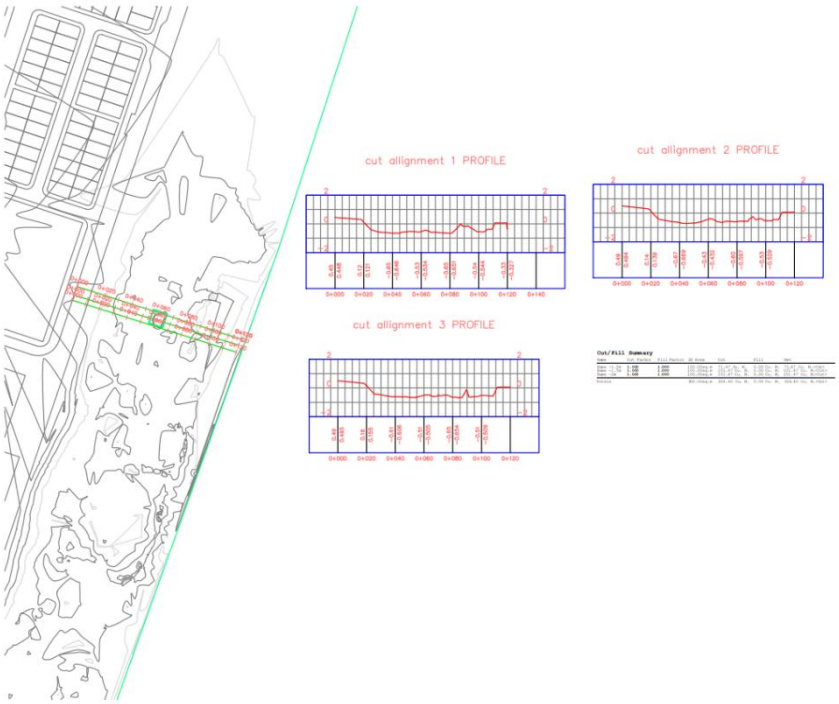
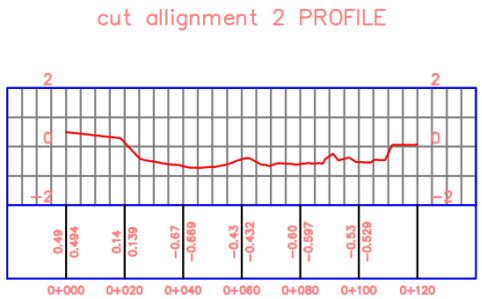


Figure 19 Overview of the cut fill report and the profiles



An analysis of the section shows that the base is approximately -0.5m below MSL. Investigations were carried out to cut the existing base to -1.2m,-1.5m and -2m. while the area of the cut footprint is fixed at 100 SQM.

The cut volume as per the setup in this proposal is 71.47CuM, 101.47 CuM, or 151.47 CuM respectively.

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
Base -1.2m	1.000	1.000	100.00sq.m	71.47 Cu. M.	0.00 Cu. M.	71.47 Cu. M.<Cut>
Base -1.5m	1.000	1.000	100.00sq.m	101.47 Cu. M.	0.00 Cu. M.	101.47 Cu. M.<Cut>
Base -2m	1.000	1.000	100.00sq.m	151.47 Cu. M.	0.00 Cu. M.	151.47 Cu. M.<Cut>
Totals			300.00sq.m	324.40 Cu. M.	0.00 Cu. M.	324.40 Cu. M.<Cut>

Figure 20 Cut fill report

6.3.4. Hydrography/hydrodynamics of the project site

6.3.4.1. Tides

The tides of the Maldives (Table 4) are generally mixed and semi-diurnal. Neap and spring tides are approximately 0.3 m and 1.0 m respectively. In the central Atolls, maximum spring tide range is 1.1 m. A seasonal mean sea level fluctuation in reginal mean sea level with an increase of about 0.1 m during February to April and a decrease of 0.1 m during September to November can be seen. Like in many Atolls semidiurnal tides are experienced in the proposed project site. The tides are largely based on the shape, depth and location of the site.

Table 4 Datums at station 108, source: https://uhslc.soest.hawaii.edu/stations/?stn=108#levels

Datum	Value at Station Datum	Description	Value MSL corrected
Status	14-Nov-22	Processing Date	
Epoch	26-Aug-1989 to 31-Dec-2001	Tidal Datum Analysis Period	
MHHW	2.229	Mean Higher-High Water (m)	0.337
MHW	2.159	Mean High Water (m)	0.267
MTL	1.893	Mean Tide Level (m)	0.001
MSL	1.892	Mean Sea Level (m)	0
DTL	1.88	Mean Diurnal Tide Level (m)	-0.012
MLW	1.628	Mean Low Water (m)	-0.264
MLLW	1.532	Mean Lower-Low Water (m)	-0.36
STND	0	Station Datum (m)	-1.892
GT	0.697	Great Diurnal Range (m)	-1.195
MN	0.531	Mean Range of Tide (m)	-1.361
DHQ	0.07	Mean Diurnal High-Water Inequality (m)	-1.822
DLQ	0.096	Mean Diurnal Low Water Inequality (m)	-1.796
HWI	Unavailable	Greenwich High Water Interval (in hours)	
LWI	Unavailable	Greenwich Low Water Interval (in hours)	
Maximum	2.623	Highest Observed Water Level (m)	0.731
Max Date & Time	27-May-2021 09	Highest Observed Water Level Date and Hour (LST)	
Minimum	1.113	Lowest Observed Water Level (m)	-0.779
Min Date & Time	25-May-1990 01	Lowest Observed Water Level Date and Hour (LST)	
HAT	2.462	Highest Astronomical Tide (m)	0.57
HAT Date & Time	26-Apr-1990 09	HAT Date and Hour (LST)	
LAT	1.242	Lowest Astronomical Tide (m)	-0.65
LAT Date & Time	14-Nov-1989 13	LAT Date and Hour (LST)	
LEV	1.838	Switch 1 (m)	-0.054
LEVB	1.786	Switch 2 (m)	-0.106

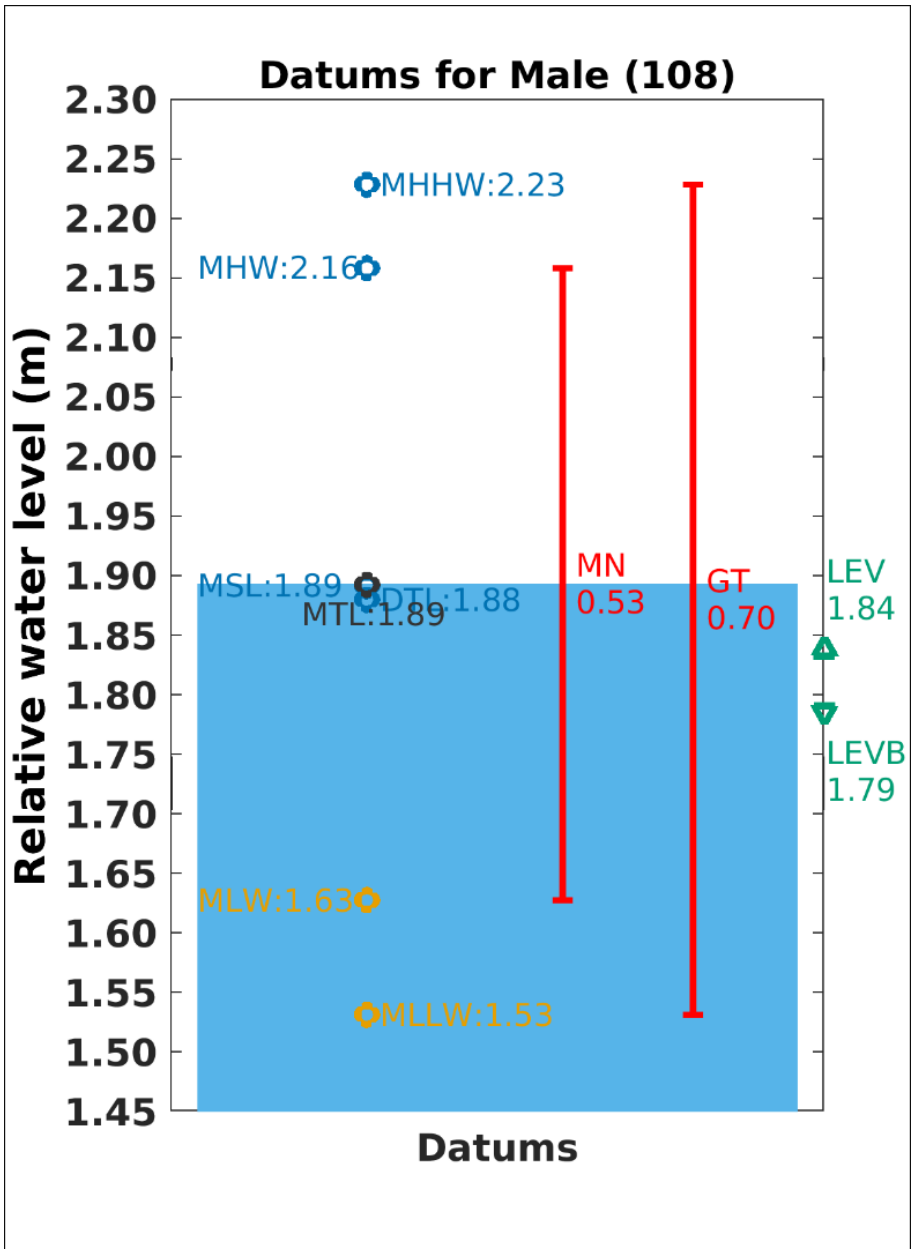
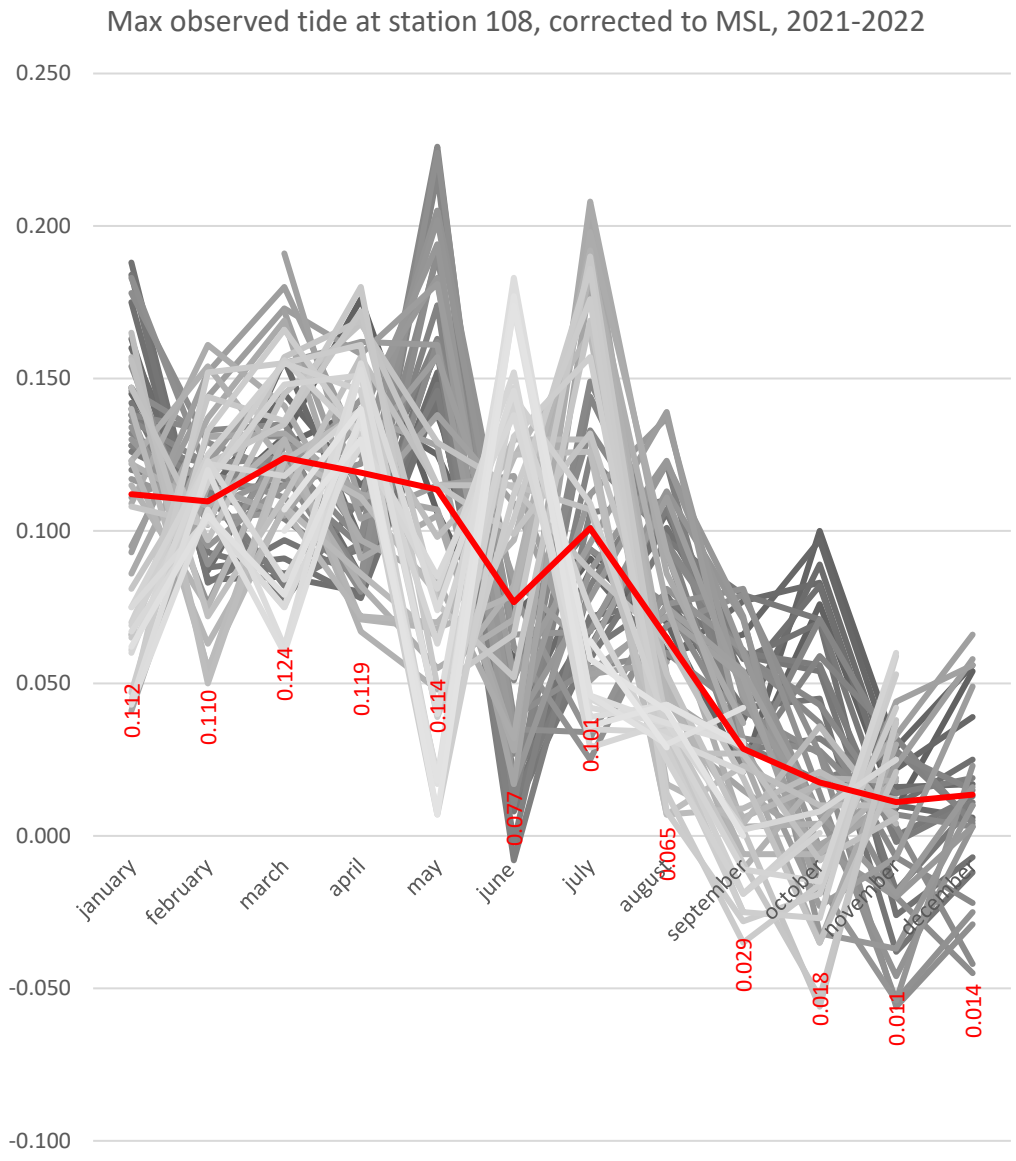


Figure 21 diagram showing the Datums for 108, source: https://uhslc.soest.hawaii.edu/stations/?stn=108#levels

The motion of the moon and the sun is reflected in the astronomical tides with a range of periodicities. 0.64 m is the highest astronomical tide recorded above the MSL and -0.56 m was the lowest astronomical tide recorded below MSL. Maldives has a general variation of 1.2 m from the lowest to the highest tide. At low tide the movement of water is very low and is an ideal time to conduct marine development works in general.

An analysis of the monthly maximum tide of 2021 and 2022 shows that the general pattern observed for the high tide for the area over the year is, generally high on the month of January to march, and a slow mean low tide as the months progresses.



6.3.4.2. Currents

The systems that affect the sea around the Maldives are, oceanic currents, tidal currents, wind induced, and wave induced currents. the geography, and geology of the Maldives in the Indian ocean ensures a strong constant flow of water through the atolls. Towards the equator in the Arabian sea, the winds become indicative of the ocean surface currents. Thus, during monsoon the wind become a major factor affecting current velocity and direction. Hence, wind induced currents can dominate. From January to March, the westerly flowing currents tend to dominate and from May to November easterly currents tend to dominate. In April and December, the changes in the current flow of patterns occur.

The tidal currents are the horizontal water movement associated with the vertical movements of the rise and fall of the tide. The tidal currents are westward in ebb and eastward in flood.

Localised to the project site, the wave induced currents form an important factor effecting the current.

On site, drogues were released and retrieved to measure the currents of the area it was observed that the currents are dominated by the action of the tide. During the time of sampling, the action of the tide brought

the drogues to the shoreline and moved the drogues across the sampling area towards the north during rising tide. On recession, the drogues move in the southern direction and away from the shoreline.

Table 5 Drogue data form site

#	Drogue name	GPS location		Direction	Speed
		Start point	End point		
01	Drogue 1	43 N, 338336.47 m E, 465170.57 m N	43 N, 338306.97 m E, 465237.64 m N	NNE	0.0023m/s
02	Drogue 2	43 N, 338330.99 m E, 465163.33 m N	43 N, 338261.60 m E, 465111.84 m N	SSW	0.0023m/s

6.3.4.3. Waves

Two monsoon periods govern the swell and wind waves experienced in the Maldives. The swells and wind waves experienced by the Maldives are conditioned by the prevailing biannual monsoon wind directions, and are typically strongest during April – July in the southwest monsoon period. During this season, swells generated north of the equator with heights of 2- 3m with periods of 18-20 seconds have been reported in the region. The proposed project site shows maximum wave action as the project site faces the east.

6.3.4.4. Water quality

Sea water was tested in the lab at Male' water and sewerage company (MWSC). The sites analysed are presented in the survey map. The overall conditions are presented in table below.

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
Quality Assurance Building, 1st Floor, Male' Hingun, Villimale', Male' City, Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

LB-TEST-090

WATER QUALITY TEST REPORT
Report No: 500195771

Customer Information:
Housing Development Corporation Ltd

HDC Building, 3rd Floor
Male 20120

Report date: **19/04/2023**
Test Requisition Form No: **900197343**
Sample(s) Recieved Date: **17/04/2023**
Date of Analysis: **17/04/2023 - 17/04/2023**

Sample Description ~	W1	**TEST METHOD**	**UNIT**
Sample Type ~	Sea Water		
Sample No	83238018		
Sampled Date ~	10/04/2023 08:00		
PARAMETER	**ANALYSIS RESULT**		
Physical Appearance	Clear with particles		
Conductivity *	52600	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	µS/cm
pH *	8.1	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	34.64	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Total Dissolved Solids	26300	Electrometry	mg/L
Total Suspended Solids	<5 (LoQ 5 mg/L)	HACH Method 8006	mg/L
Turbidity *	0.177	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU

Keys: µS/cm : Micro Seimen per Centimeter, **‰** : Parts Per Thousand, **mg/L** : Milligram Per Liter, **NTU** : Nephelometric Turbidity Unit

Checked by
Nashath Ali
Laboratory Executive

Approved by
Nihaz A. Zahir
Assistant Quality Manager

Notes:
Sampling Authority: Sampling was not done by MWSC Laboratory.
This report shall not be reproduced except in full, without written approval of MWSC.
This test report is ONLY FOR THE SAMPLES TESTED.
~ Information provided by the customer. This information may affect the validity of the test results.
*Parameters accredited by EIAC under ISO/IEC 17025:2017

********** END OF REPORT **********

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
Quality Assurance Building, 1st Floor, Male' Hingun, Vilimale', Male' City, Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

LB-TEST-090

WATER QUALITY TEST REPORT

Report No: 500195772

Customer Information:
Housing Development Corporation Ltd

HDC Building, 3rd Floor
Male 20120

Report date: **19/04/2023**
Test Requisition Form No: **900197343**
Sample(s) Recieved Date: **17/04/2023**
Date of Analysis: **17/04/2023 - 17/04/2023**

Sample Description ~	W2		
Sample Type ~	Sea Water		
Sample No	83238019		
Sampled Date ~	10/04/2023 08:00	**TEST METHOD**	**UNIT**
PARAMETER	**ANALYSIS RESULT**		
Physical Appearance	Clear with particles		
Conductivity *	52700	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	µS/cm
pH *	8.1	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	34.77	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰

Keys: µS/cm : Micro Seimen per Centimeter, **‰** : Parts Per Thousand

Checked by
Nashath Ali
Laboratory Executive

Approved by
Nihaz A. Zahir
Assistant Quality Manager

Notes:
Sampling Authority: Sampling was not done by MWSC Laboratory.
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*Parameters accredited by EIAC under ISO/IEC 17025:2017

********** END OF REPORT **********

6.3.5. Ecology

To provide a better description of the environment, as a part of the literature review governmental databases and local knowledge was reviewed and described. The detail study of the site that followed focused on gathering site specific data and the data for the areas that fall under the footprint of the proposed project location, and surrounding impact zone.

Figure 22 A1 site map

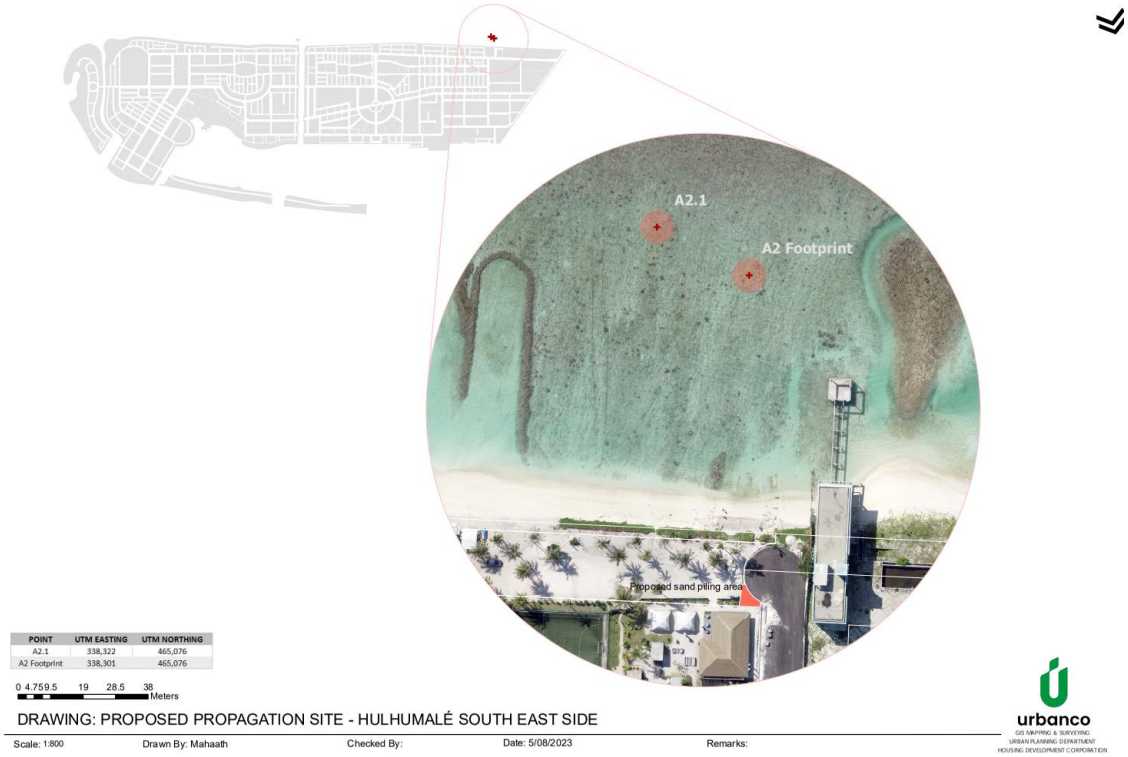

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Figure 23 A2 Site map

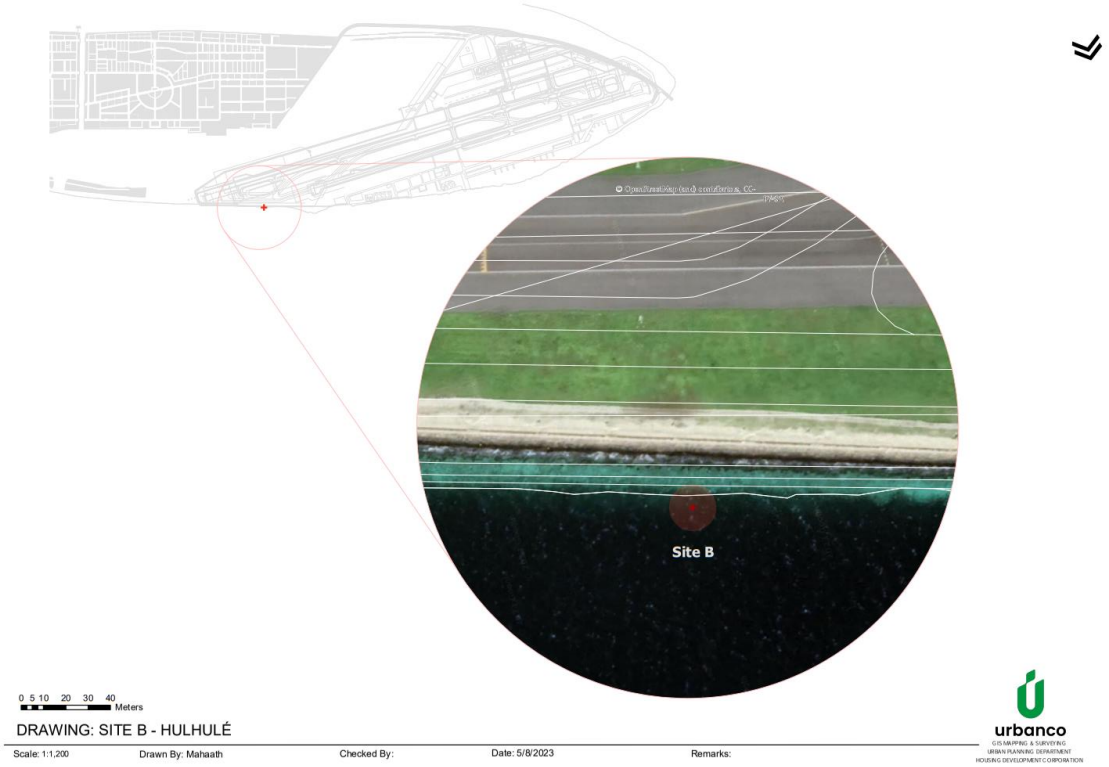

Figure 24 B site map

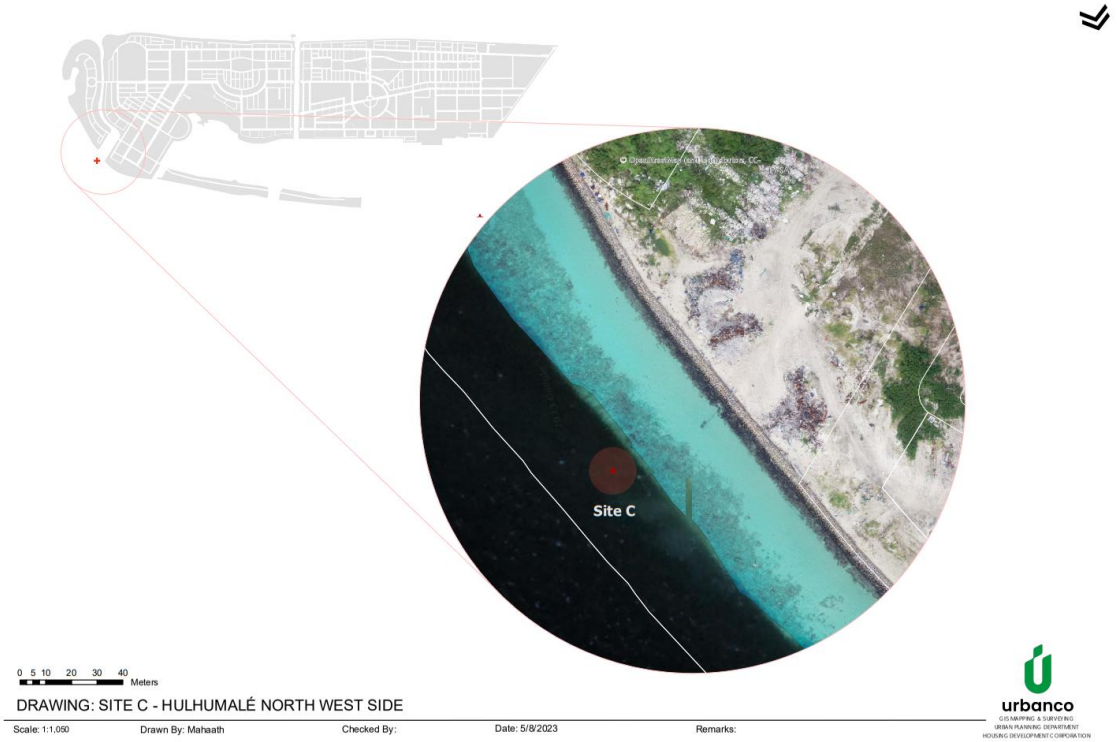

Figure 25 C site map

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Figure 26 D site map

6.3.5.1. Overall conditions

Site A1 is the coral propagation site. An area south of the location is generally used by the locals for recreational activities. Currently the site does not have a specified use.

Figure 27 Drone image of the proposed project area.

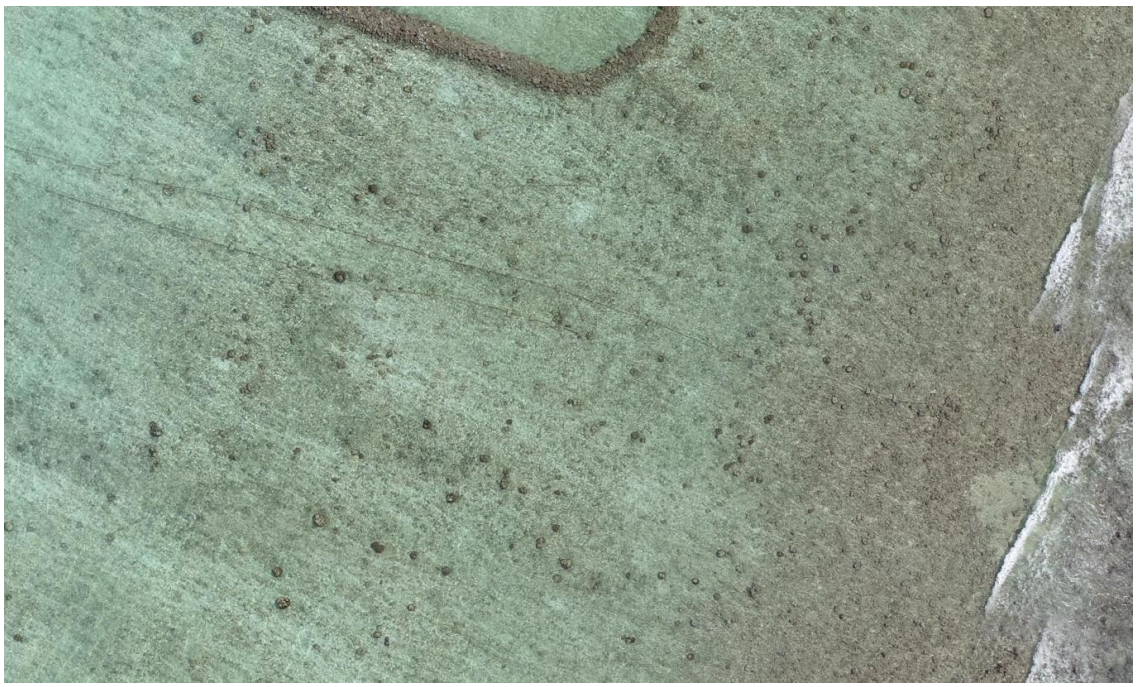

Figure 28 Proposed excavation area

Further analysis of the location shows that the location has a relatively flat terrain. The details of the profiles can be seen on 6.3.2.2 above.

An analysis of the proposed stockpile area shows an area that is used by the locals to access the zone. Hence, the stockpile is proposed to be placed avoiding this access area.

Figure 29 footprint location for the stockpile

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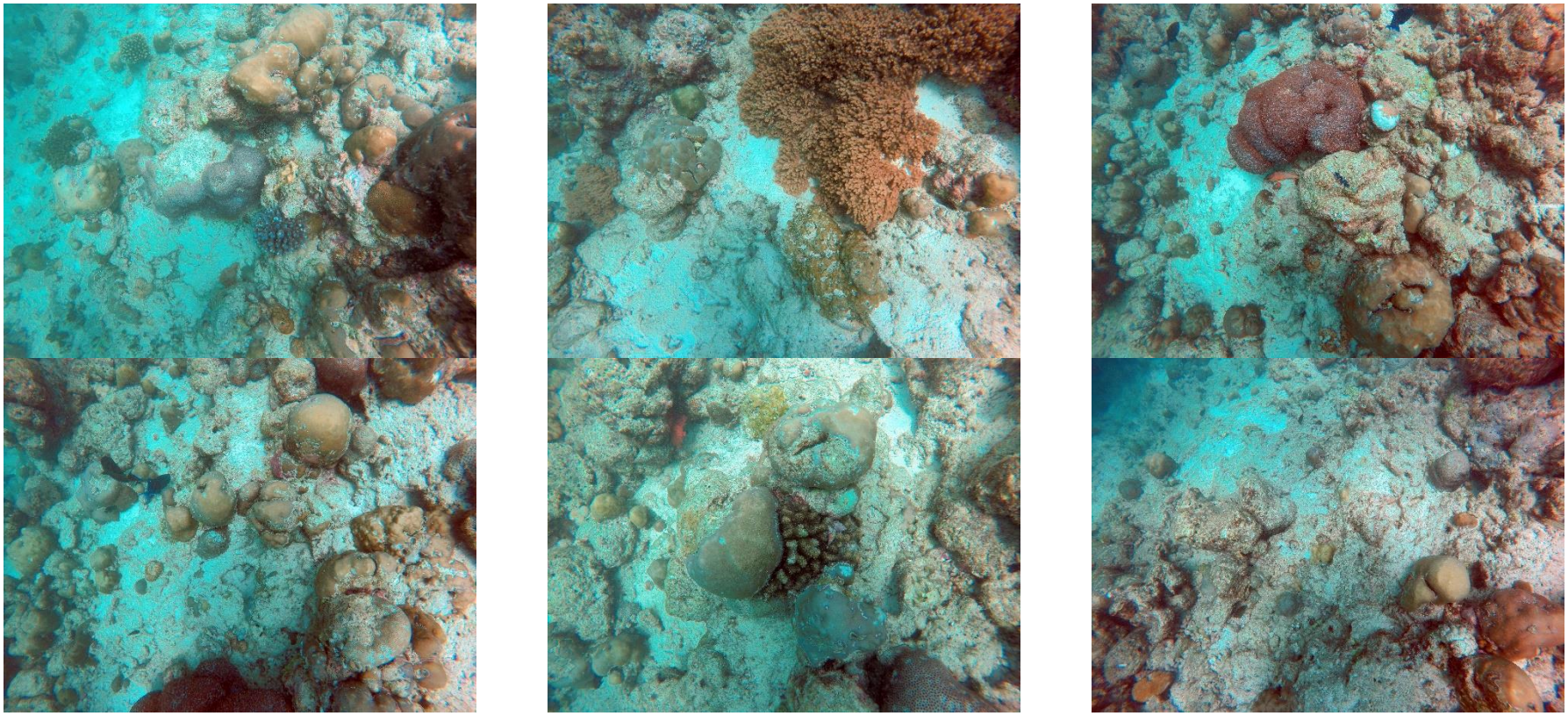
6.3.5.2. Benthic condition

The following is an analysis of the benthic cover of the sites marked on the map.

6.3.5.2.1. Site A1 GPS location 4.171458864 73.47778935

6.3.5.2.2. T1



This site is one of the proposed harvesting sites. Located on the south eastern tip of gulheefalhu reef. the anallysis of the tranect on site showed that rock substratum dominated with 28.33% of the transect, followed by corals at 35% of the transect. At different depressions, and pockets, sand had accreted in the area during the time of the survey hence, the percentage of transect covered by sand came up to 25%.

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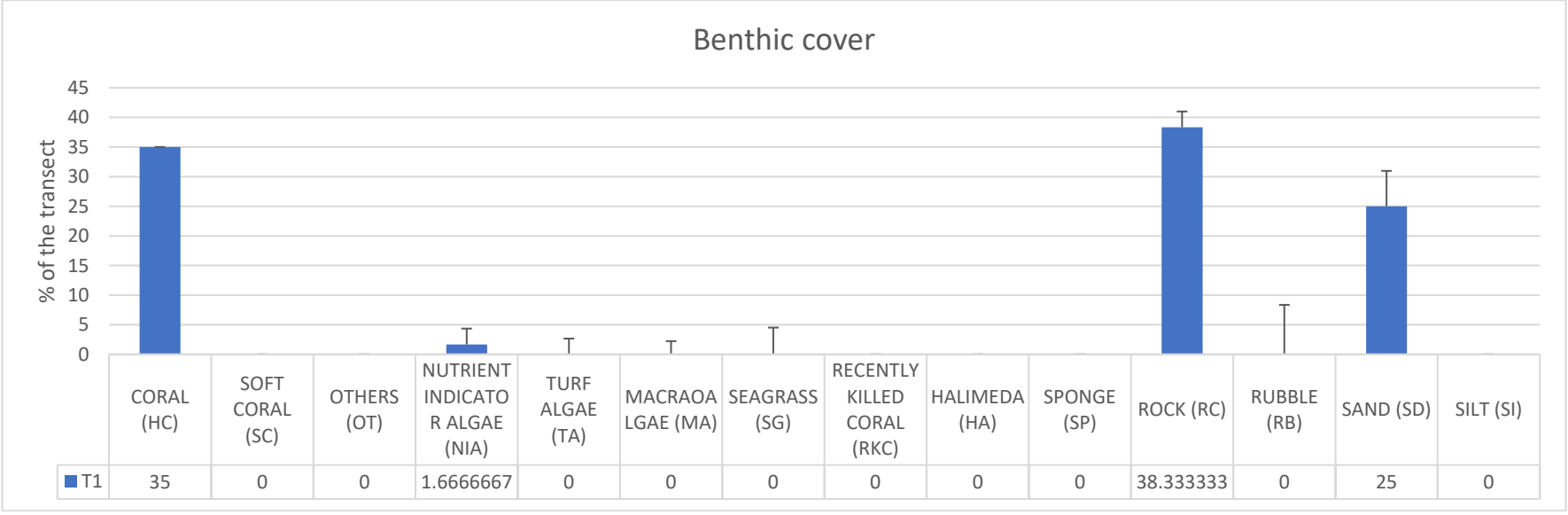
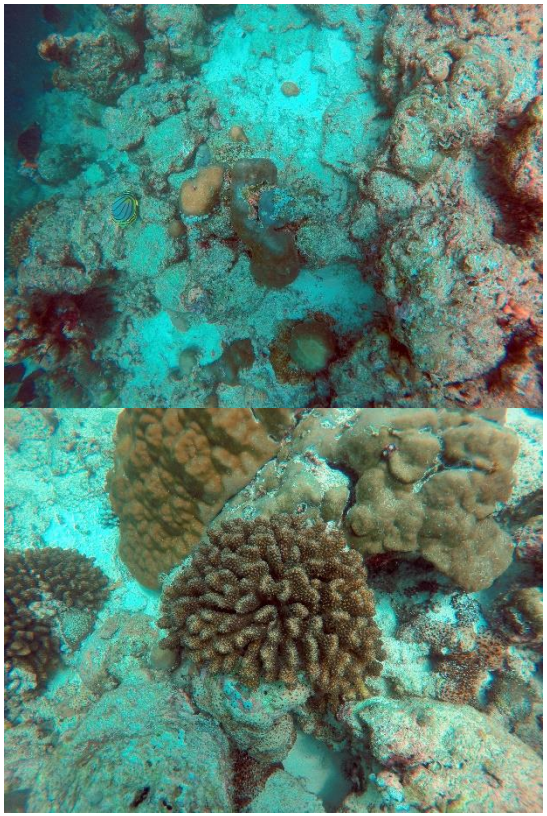


A genus analysis of the transect shows a majority of prites, followed by pocillopora followed by coscinaraea. Other genus observed on site are; Psammocora, Leptoria, and Acropora .

6.3.5.2.3. T2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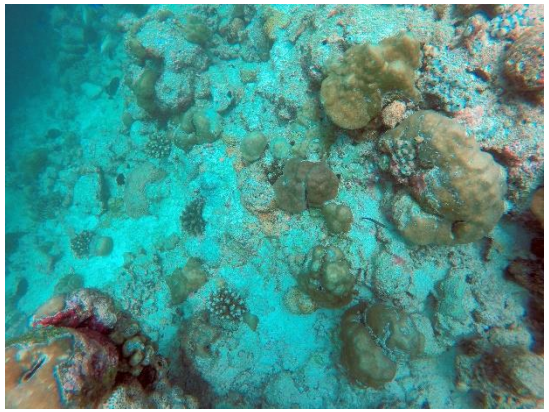
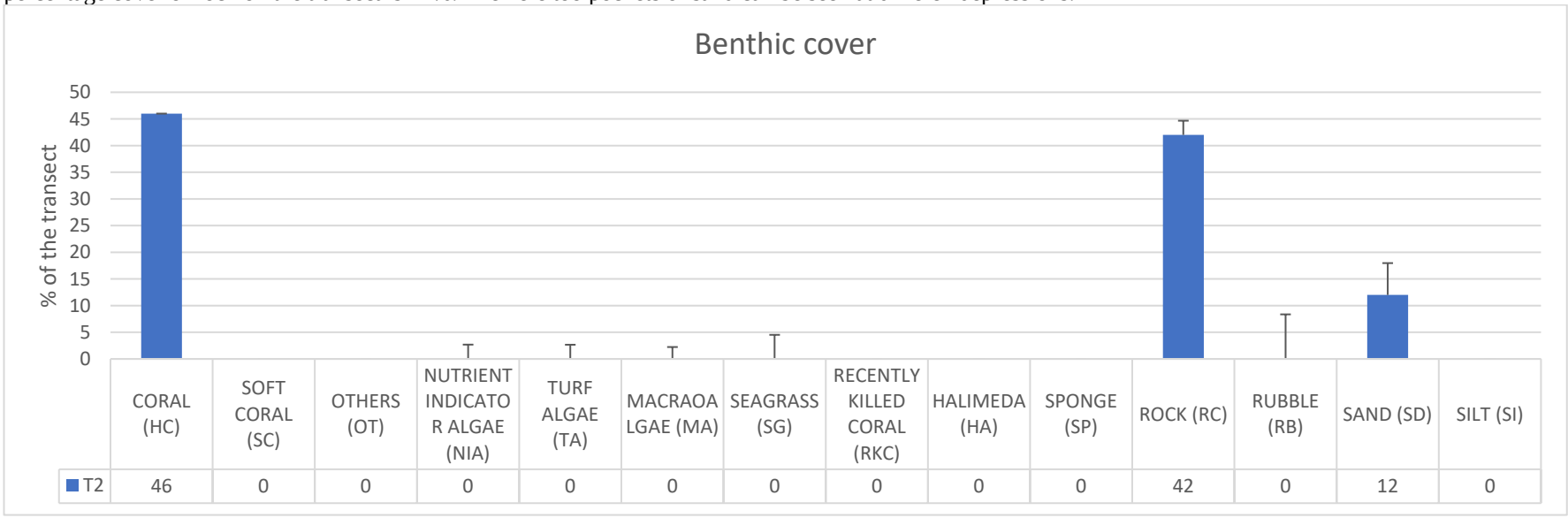


This is also another site selected for harvesting in the same trejectory and orientation west of T1, A1. Here the percentage cover of coral on the transect is 46% and the percentage cover of rock on the transect is 42%. The here too pockets of sand can be seen at differen depressions.

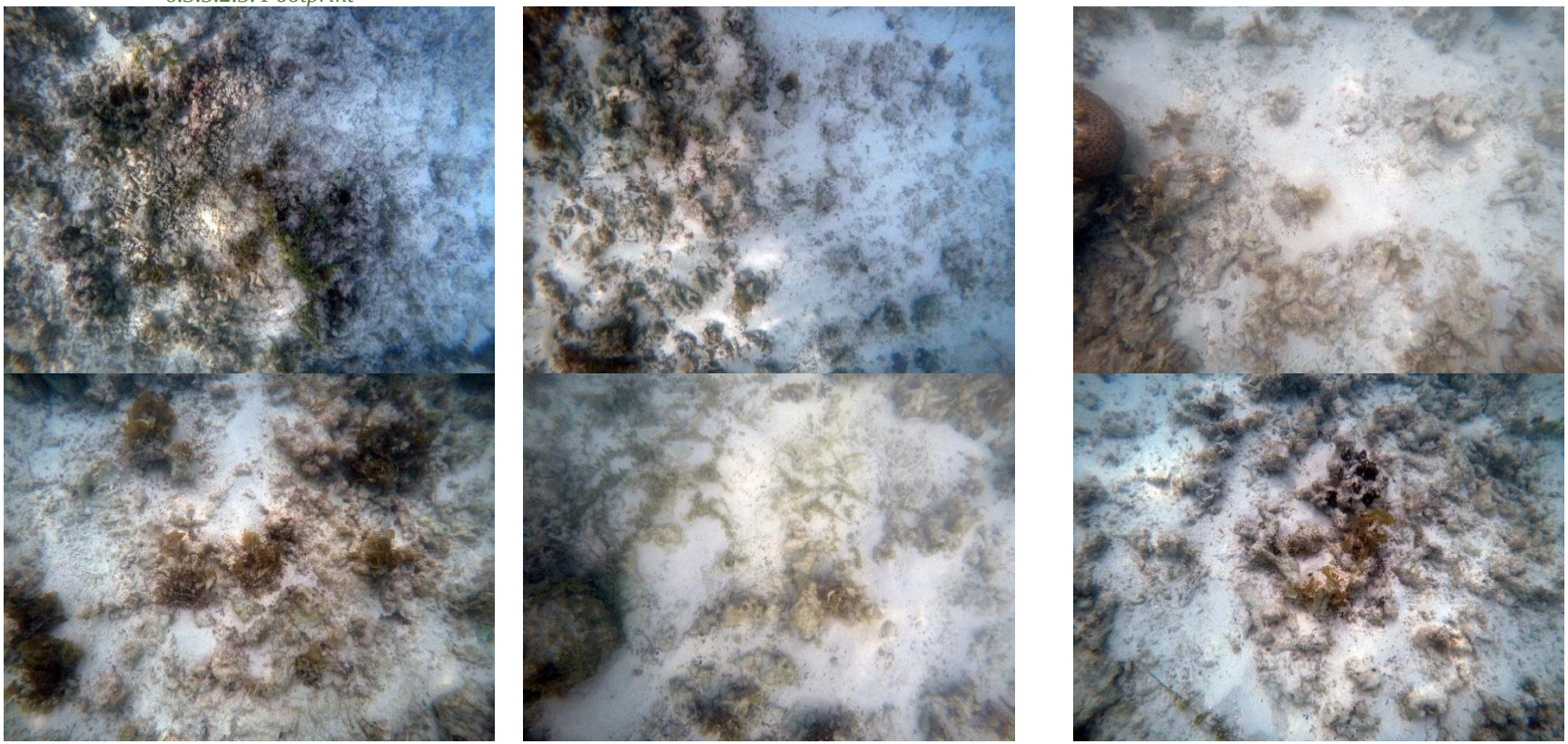


	CORAL (HC)	SOFT CORAL (SC)	OTHERS (OT)	NUTRIENT INDICATOR ALGAE (NIA)	TURF ALGAE (TA)	MACRAOALGAE (MA)	SEAGRASS (SG)	RECENTLY KILLED CORAL (RKC)	HALIMEDA (HA)	SPONGE (SP)	ROCK (RC)	RUBBLE (RB)	SAND (SD)	SILT (SI)
T2	46	0	0	0	0	0	0	0	0	0	42	0	12	0

Here too the genus analysis of the transect shows a majority of prites, followed by pocillopora followed by coscinaraea. Other genus observed on site are; Psammocora, Leptoria, and Acropora .

6.3.5.2.4. Site A2 GPS location 4.206248606 73.54329904

6.3.5.2.5. Footprint



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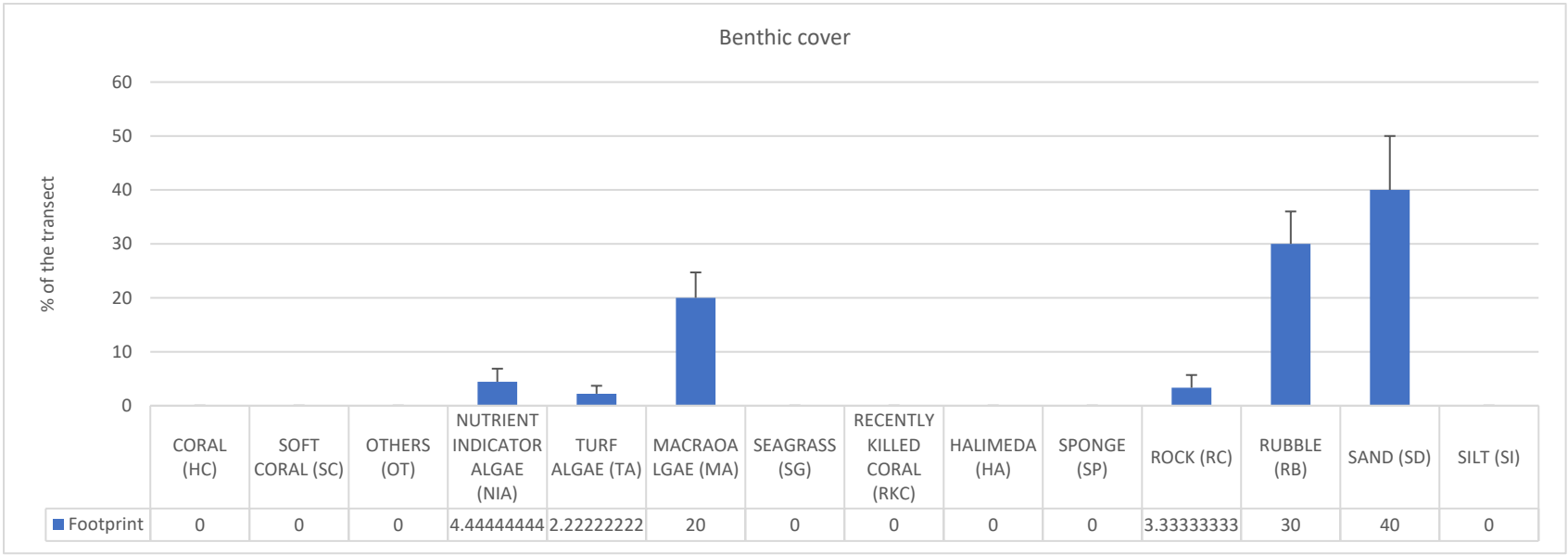
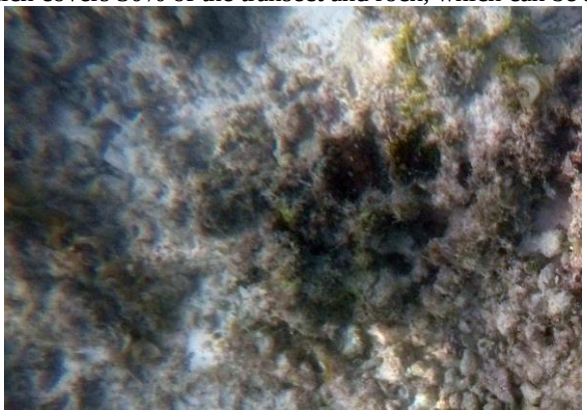


This is the site of proposed propoagation. The location has avariety of macro algae, nutrient indicator algae and truf algae. The substratum is mostly sand which dominates the transect at 40% followed by rubble which covers 30% of the transect and rock, which can be seen within the sand pockets on the reef flat.


Wile sampling no significant substaum hard coral was observed on the transect. However, in the location prites can be observed.

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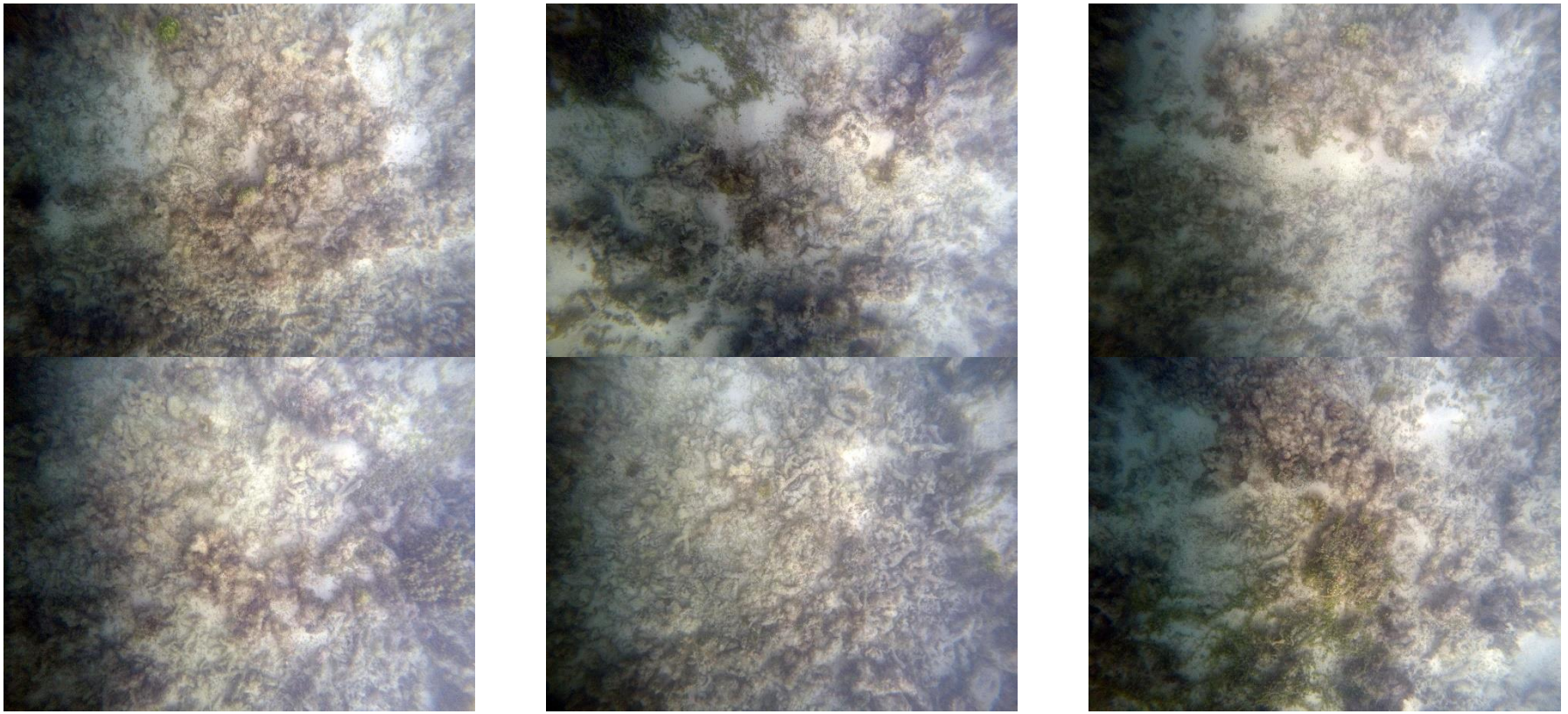
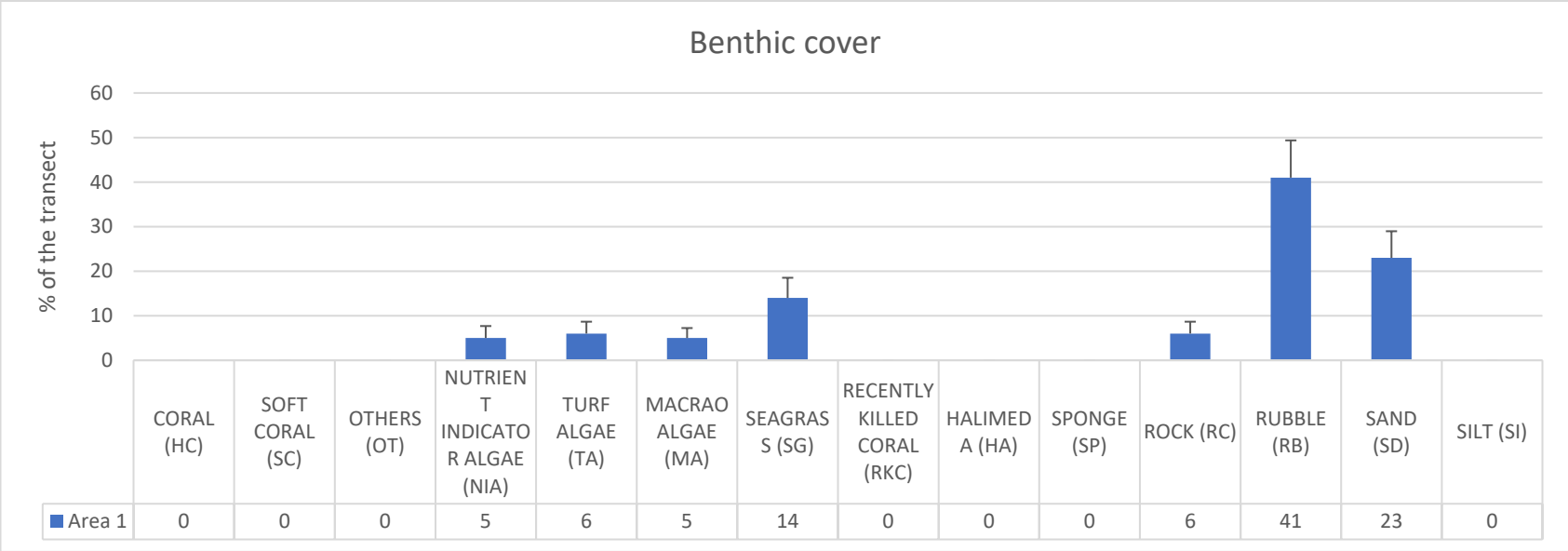
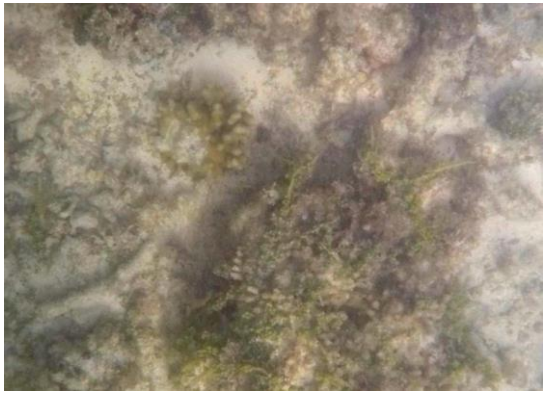
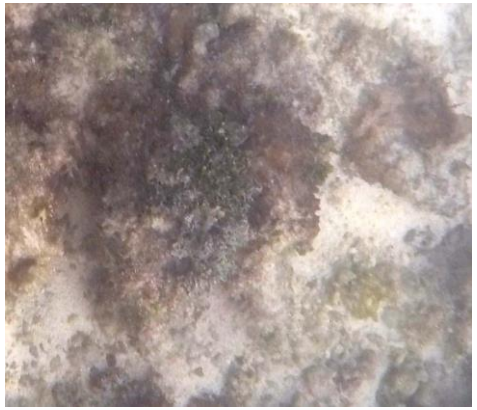
6.3.5.2.6. Site A2.1





Similarly on the sencond transect taken on site, the transect was dominated by rubbel at 41%, followed by sand at 23%. Seagrass can be seen holding some of the substrate on site and in the mix. Macro algae, Nutrient indicator algae and Turf algae can also be seen. From within the algae Padina spp on site dominated and can be seen all over the area.





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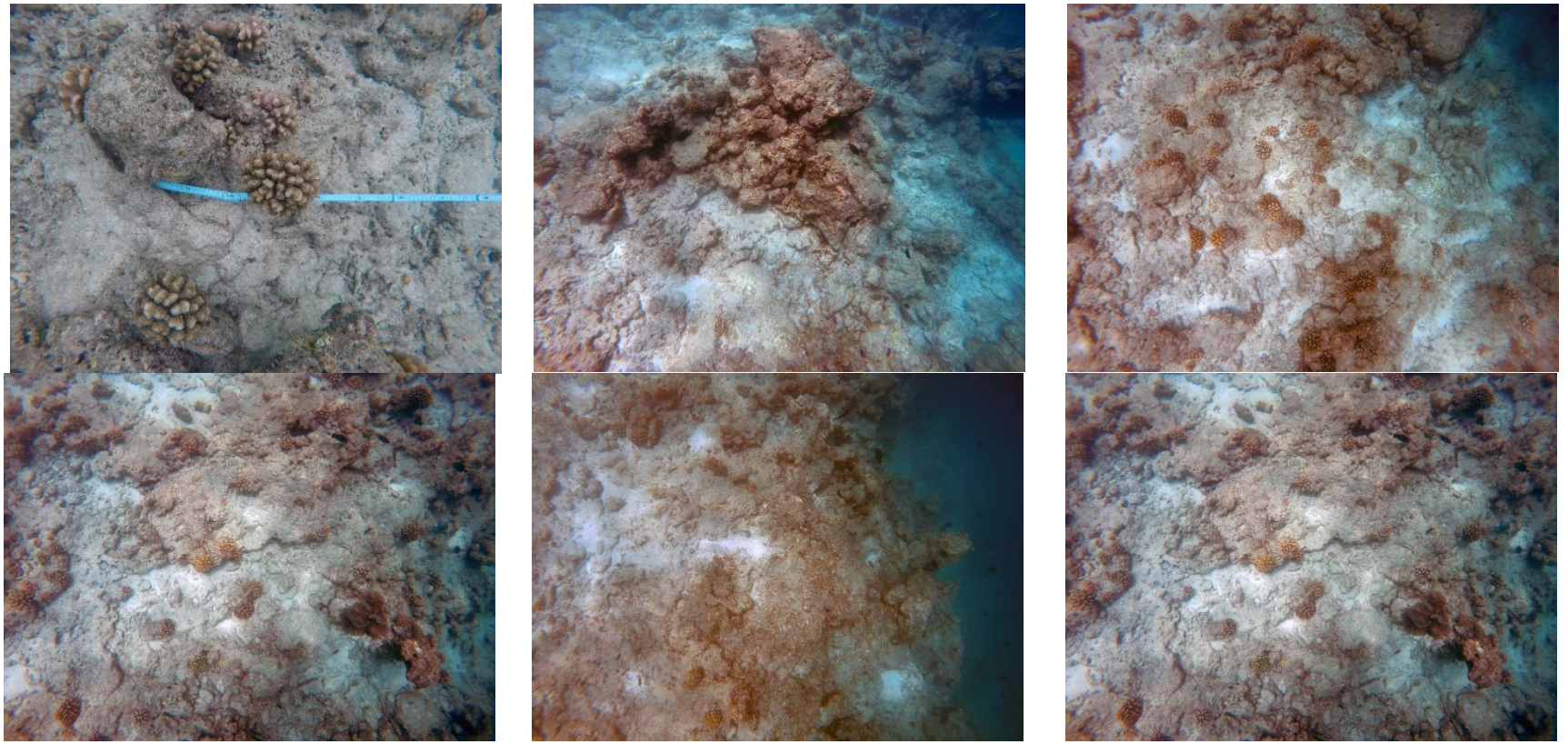
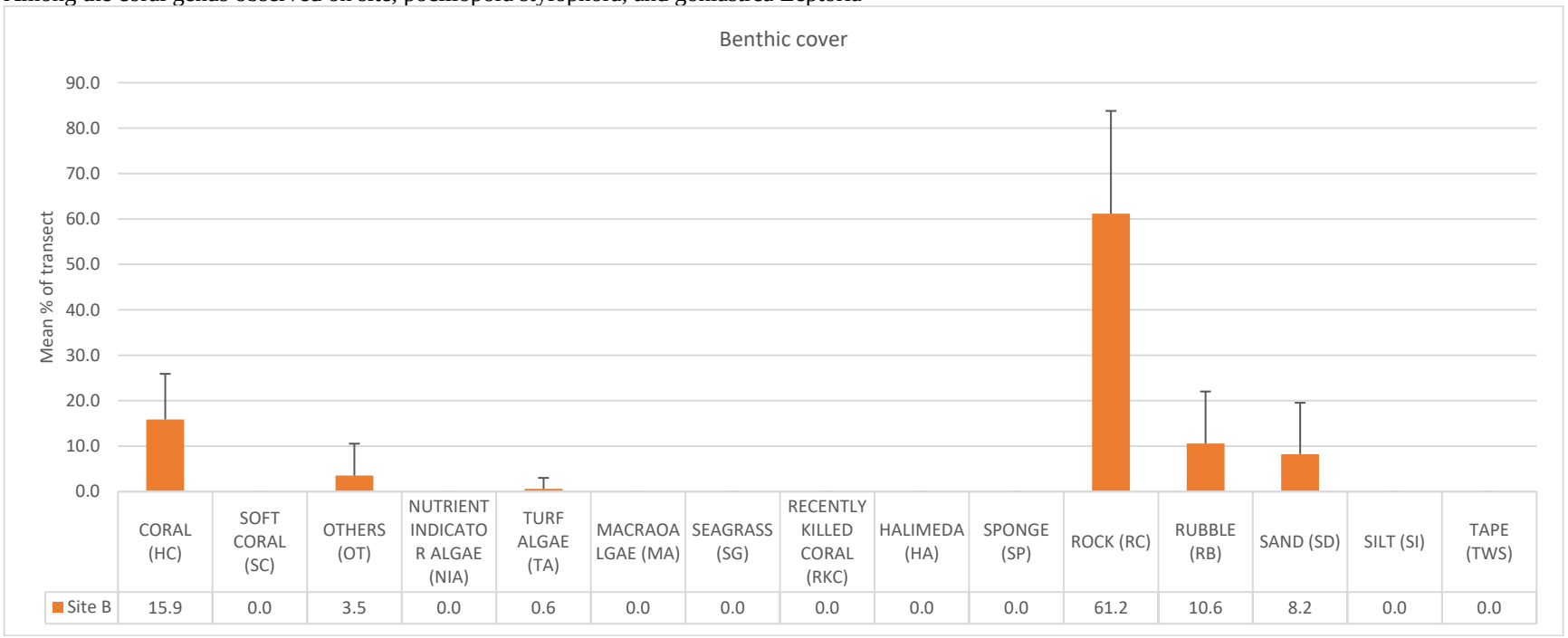
6.3.5.2.7. Site B GPS location 4.210781 73.528532



Predominantly dominated by rock, this site was surveyed to check the availability of harvest material. The benthic cover analysis shows 61.2% of the transect is rock, 15.9% of the transect is coral, and 0.6% Turf algae. Considering the loose substrate on the substratum, 10.6% is rubble and 8.2% is sand.

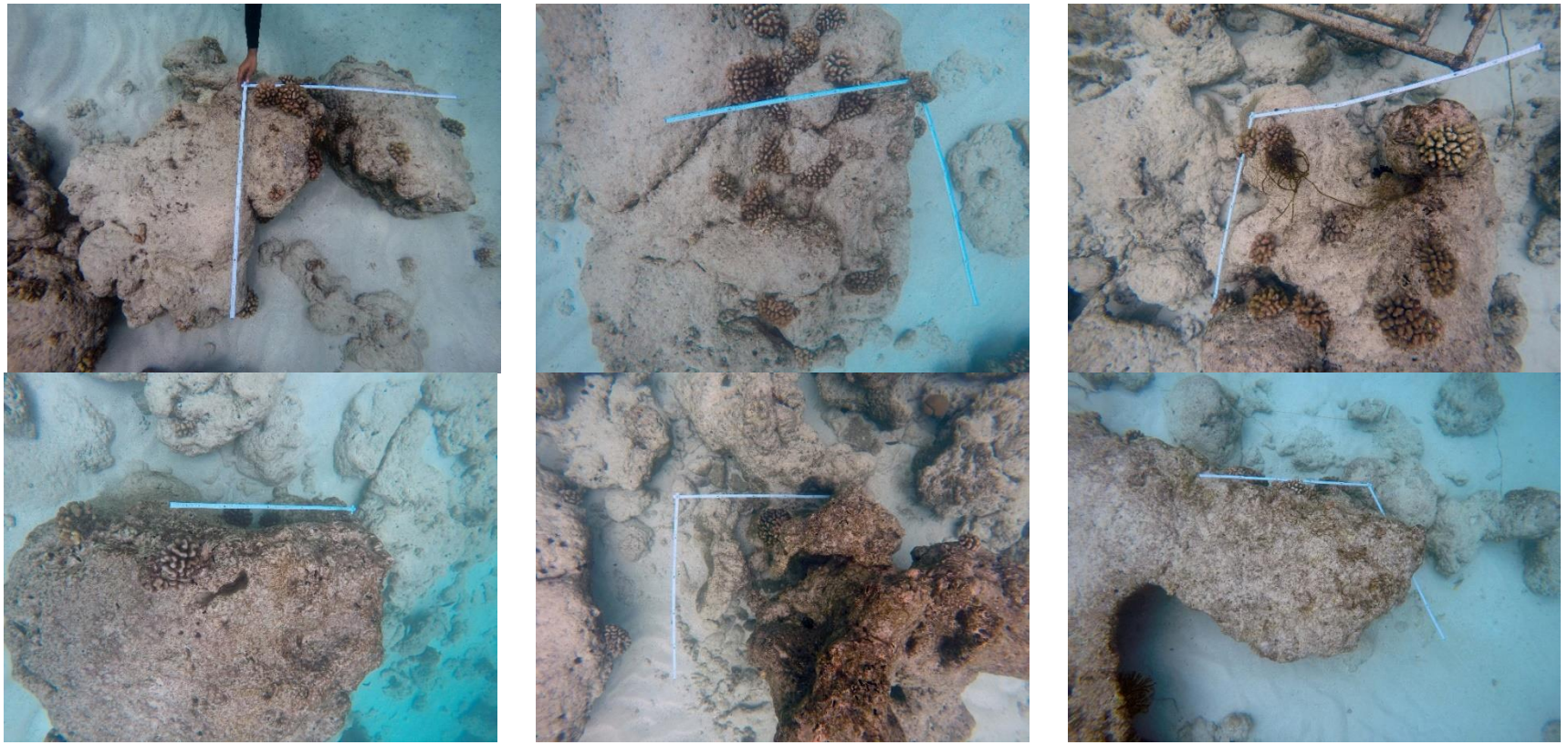


Among the coral genus observed on site, pocillopora stylophora, and goniastrea Leptoria

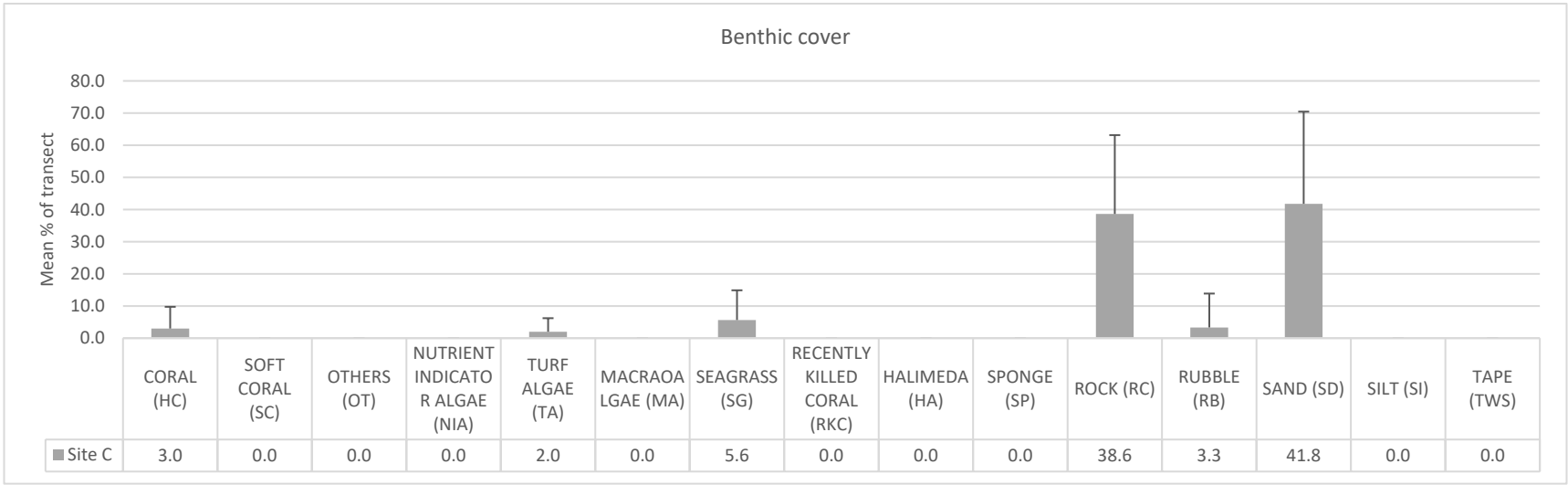


	CORAL (HC)	SOFT CORAL (SC)	OTHERS (OT)	NUTRIENT INDICATOR ALGAE (NIA)	TURF ALGAE (TA)	MACRAOALGAE (MA)	SEAGRASS (SG)	RECENTLY KILLED CORAL (RKC)	HALIMEDA (HA)	SPONGE (SP)	ROCK (RC)	RUBBLE (RB)	SAND (SD)	SILT (SI)	TAPE (TWS)
Site B	15.9	0.0	3.5	0.0	0.6	0.0	0.0	0.0	0.0	0.0	61.2	10.6	8.2	0.0	0.0

6.3.5.2.8. Site C GPS location 4.240333 73.541867



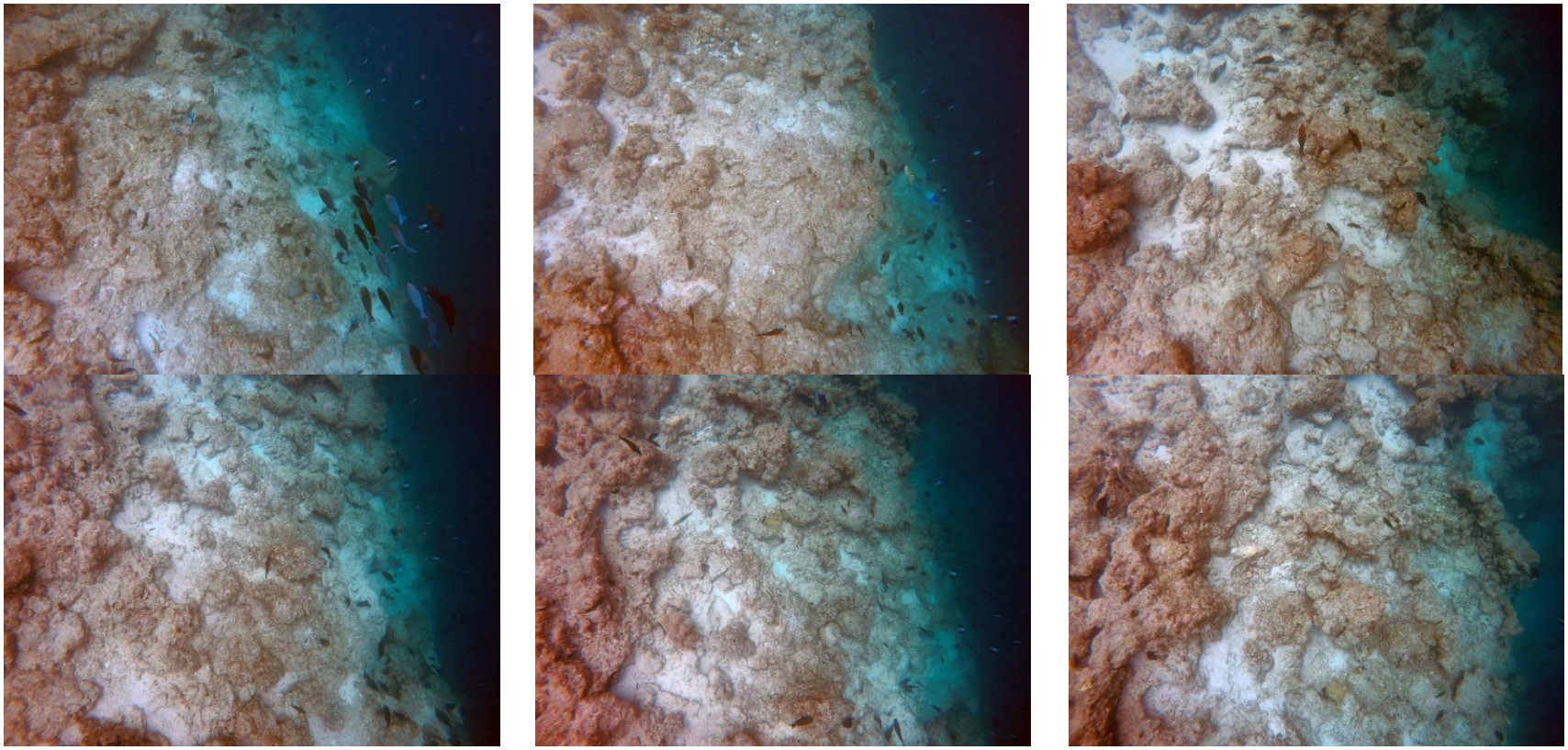
Predominantly dominated by rock and sand this site was also surveyed to check the availability harvest material and the possibility of implementation of project on site. Analysis of the transects show that 3% of the transect is coral, 38.6% is rock and 41.8% is sand.



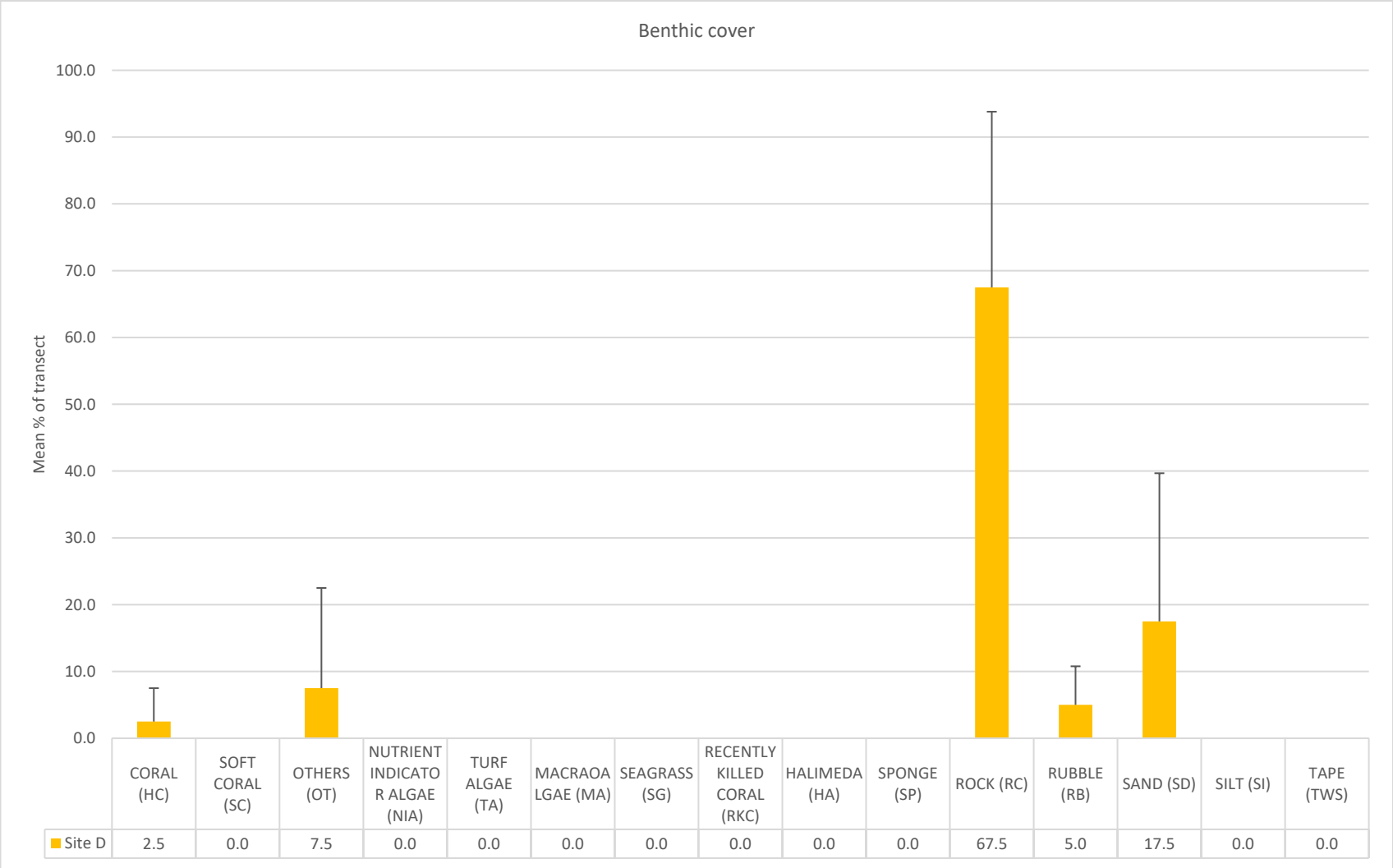
	CORAL (HC)	SOFT CORAL (SC)	OTHERS (OT)	NUTRIENT INDICATOR ALGAE (NIA)	TURF ALGAE (TA)	MACRAOALGAE (MA)	SEAGRASS (SG)	RECENTLY KILLED CORAL (RKC)	HALIMEDA (HA)	SPONGE (SP)	ROCK (RC)	RUBBLE (RB)	SAND (SD)	SILT (SI)	TAPE (TWS)
Site C	3.0	0.0	0.0	0.0	2.0	0.0	5.6	0.0	0.0	0.0	38.6	3.3	41.8	0.0	0.0

Among the coral genus observed on site, pocillopora dominated the site. Stylophora, astrocoeniidae, astreopora and goniastrea were observed on site.

6.3.5.2.9. Site D GPS location 4.238367 73.539666



Predominantly dominated by rock, the analysis of the transect shows that rock covered 67.5% of the transect. The overall coral percentage on site is 2.5%. Furthermore, it must be noted that the percentage of coral observed were congested to a single location.



Among the coral family observed on site, pocilloporidae dominated the site. Family Poritidae , Genus Prites was observed on site.

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6.3.5.3. An overall marine analysis

The following shows an overall area analysis and the percentage of the genus on the transect. This is not limited to hard coral.

Table 6 Family and genus count per transact.

Family name	Genus name	Site A1 T1	Site A1 T2	Site B	Site C	Site D	Propagation site A1	Propagation site A2 T1
Pocilloporidae	pocillopora	25	27	77	76	89		
	stylophora			23	1			
Astrocoeniidae	Stylocoeniella				16			
	astreopora				3			
Merulinidae	goniastrea				3			
	Leptoria				1			
Poritidae	Prites	40	36			11	100	100
Acroporidae	Acropora	5	4					
Coscinaridae	coscinaraea	16	16					
Psammocoridae	Psammocora	9	7					
Merulinidae	Leptoria	5	10					

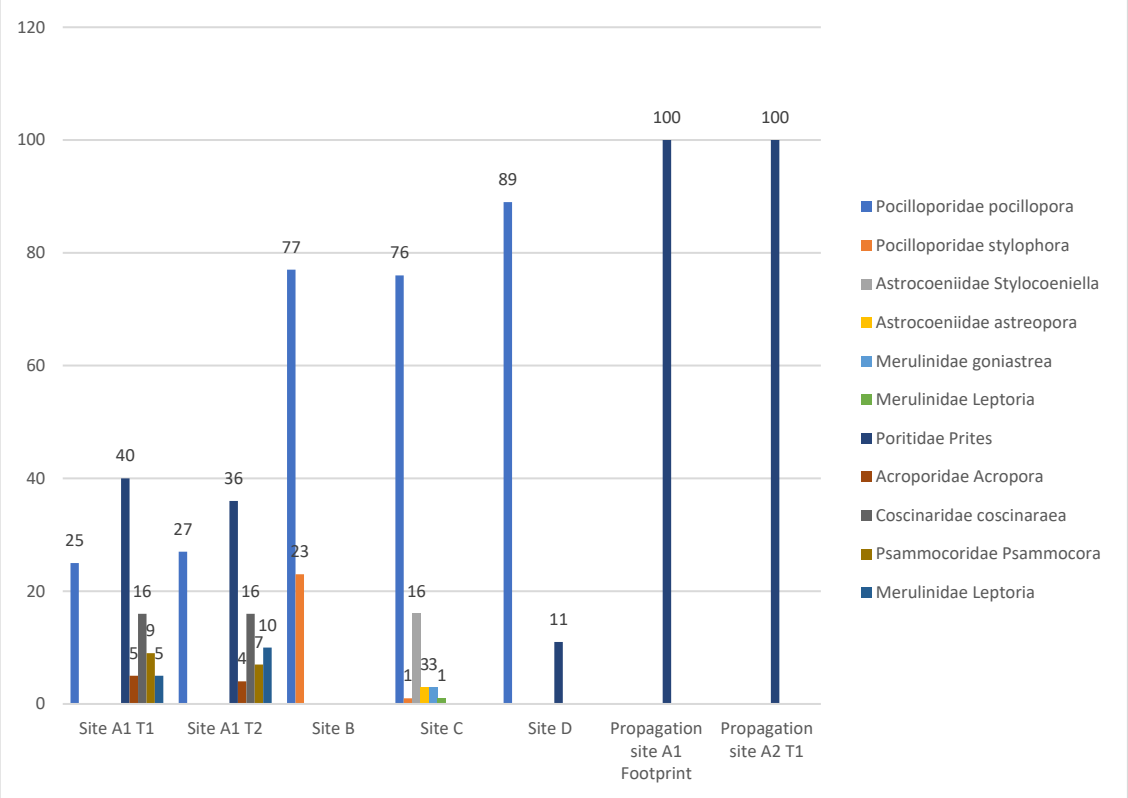


Figure 30 Family and genus count per area

6.3.5.4. Fish spotting

The presence of fish in an aquatic environment is a complicated feature which depends on time, tide, anthropological impact, availability of food, weather, breeding season, habitat etc. The data acquired in the study must be considered as a snapshot of the conditions that are present.

6.3.5.5. Findings

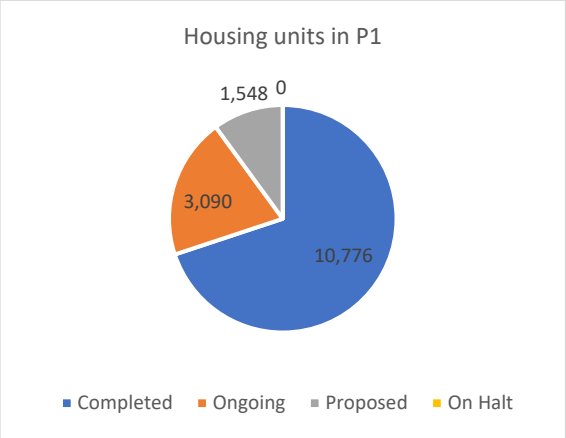
Table 7 Fish encountered

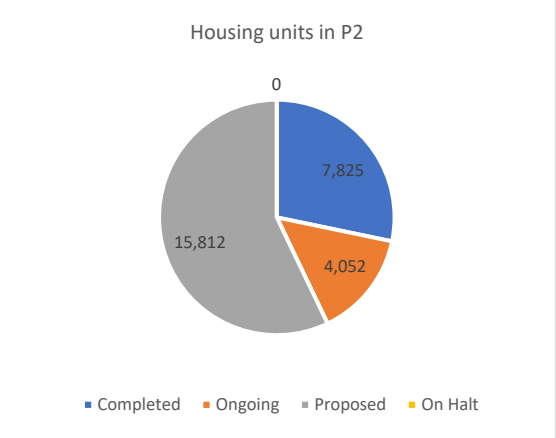
Name	Site A1 T1	Site A1 T2	Site B	Site C	Site D	Propagation site A2 Footprint	Propagation site A2 .1
Titan Trigger fish	Y		Y	Y			
Squirrelfishes					Y		
Sweetlips				Y			
Moorish Idol	Y	Y	Y	Y	Y		
Jacks and Trevallies	Y	Y	Y	Y	Y	Y	Y
Butterfly fishes	Y	Y		Y			
Blue steak Cleaner Wrasse					Y		
Anemonefishes							
Pomacentridae	Y	Y					
Grouper	Y	Y	Y	Y	Y		
Blue surgeon	Y	Y	Y	Y	Y		
Puffer fish							Y
Eel			Y		Y	Y	

6.4. Socio-economic environment

The island of *K. Hulhumale*, is located at the east facing ridge of the atoll. The north eastern side of the island is surrounded by the open ocean. The western side of the island faces the inner side of the atoll.

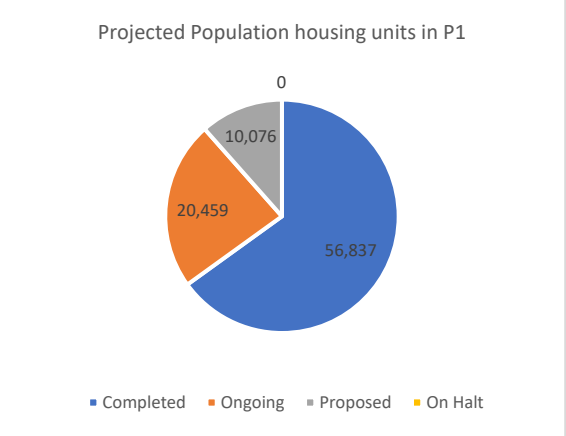
6.4.1. Island Population and housing

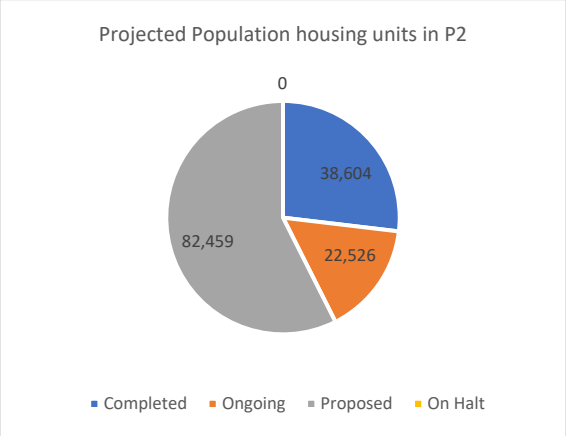




Phase 1 and Phase 2 of the Hulhumale' is planned to hold 15,413 and 143,589 households respectively. Currently of the developments on P1 70% is complete, 20% is on going and 10% is proposed. On Phase 2, 28% is complete, 15% is ongoing and 57% is proposed.

6.4.1.1. Population

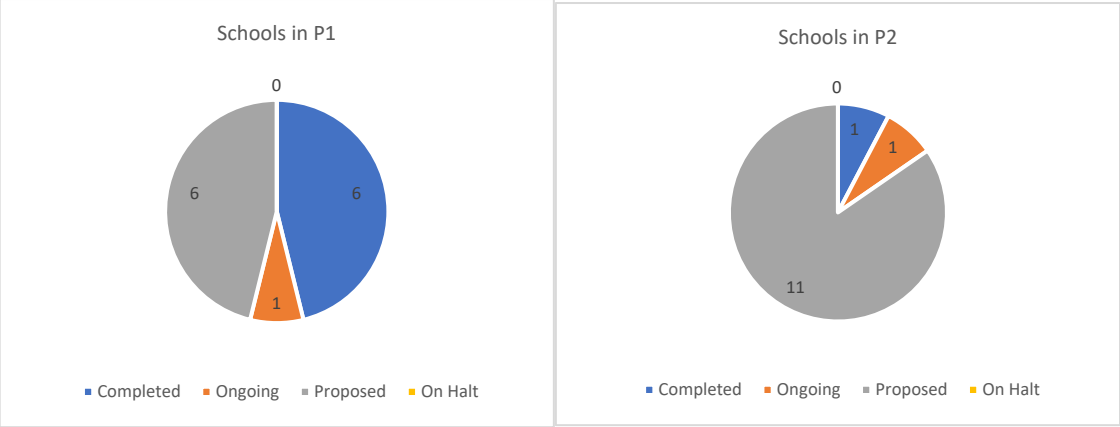




When it comes to the projected population, P1 is designed to hold a total of 87,372 and P2 is designed to hold 143,589. Here on P1, 65% of the projected population has housing available. 23% of the population will be accommodated once the developments are complete and 12% of the population's housing is proposed. For phase 2, 26.8% of the projected population has housing complete, 15.6% of the population's housing is being developed and 57.42% of the population has the housing proposed.

6.4.1.2. Education

To cater for the need for access to education at different neighbourhoods in Hulhumale', schools are distributed throughout the island. Among the proposed 13 schools at Hulhumale' phase 1, 6 are complete, one is under development, and the rest are still being planned. From the 13 proposed at phase 2, 1 is complete, 1 is ongoing and the rest are being planned.



6.4.1.3. Health

As of writing this report, Hulhumale' is one of the only islands in Maldives apart from the capital, Male' that locals come in for medical needs due to the presence of good medical facilities.

In Hulhumale phase 1 there are 2 hospitals; Treetop hospital, owned by Crown Company Pvt ltd, a private company registered by the number C-0015/1983 under the economics ministry of Maldives, and Hulhumale' hospital, owned by the government of Maldives.

6.4.1.4. Electricity, Water and Swage

The main electricity provider for both the islands is STELCO. Owned by the government.

6.4.1.5. Transportation

The island is one of the most accessible islands in Maldives. The island can be reached by airplane, as it is connected to the city, and also can be reached through boat due to the availability of docking locations on the eastern side.

6.5. Hazard vulnerability

The hazard risk assessment of the area was derived from the hazard profile published in the Base Line Study Report, Shaviyani Atoll, Maldives (UNISDR-ADRRN, 2005).

6.5.1. Tsunamis.

Tsunami hazard is mostly from the east. Understandably this is due to the active state of the tectonic plates at the east.

Historically, Maldives has been affected by three earthquake sources in the Indian Ocean. Of the total 85 Tsunamis generated since 1816, 67 originated from the Sumatra subduction zone in east and the remaining 13 from the Makran coast zone in north and Carlsburg Transform fault zone in south. Hence, islands along the eastern fringe of the atolls faces a grater hazard than the western. *Hulhumale*, opens up to the east along with the other islands on the eastern fringe, are in the highest hazard zones. The island is in hazard zone 5, where the probable wave height is 320-450cm (Table 8)

Table 8 Tsunami hazard zone and wave height (UNISDR-ADRRN, 2005)

Hazard Zone	Range of probable maximum wave height
1	<30 cm
2	30-80 cm
3	80-250 cm
4	250-320 cm
5	320-450 cm

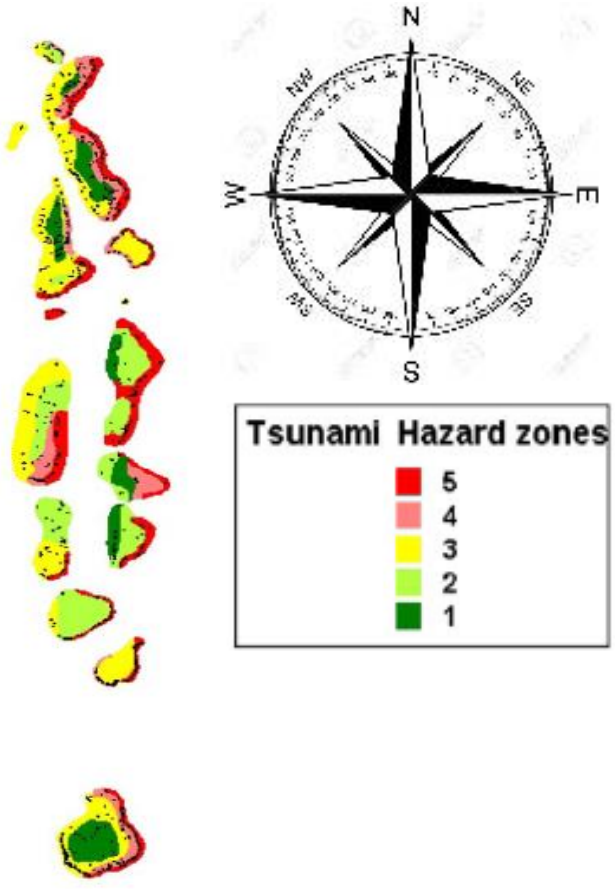


Figure 31 Tsunami hazard zones, (UNISDR-ADRRN, 2005)

6.5.2. Storms.

The cyclone hazard zone for Maldives is highest in the north. Historical records indicate that during 1877 to 2004, eleven cyclones crossed Maldives. Where the frequency reduces as we move towards the south. Hence, the northern atolls are at a higher hazard from cyclonic winds and storm surge (UNISDR-ADRRN, 2005)

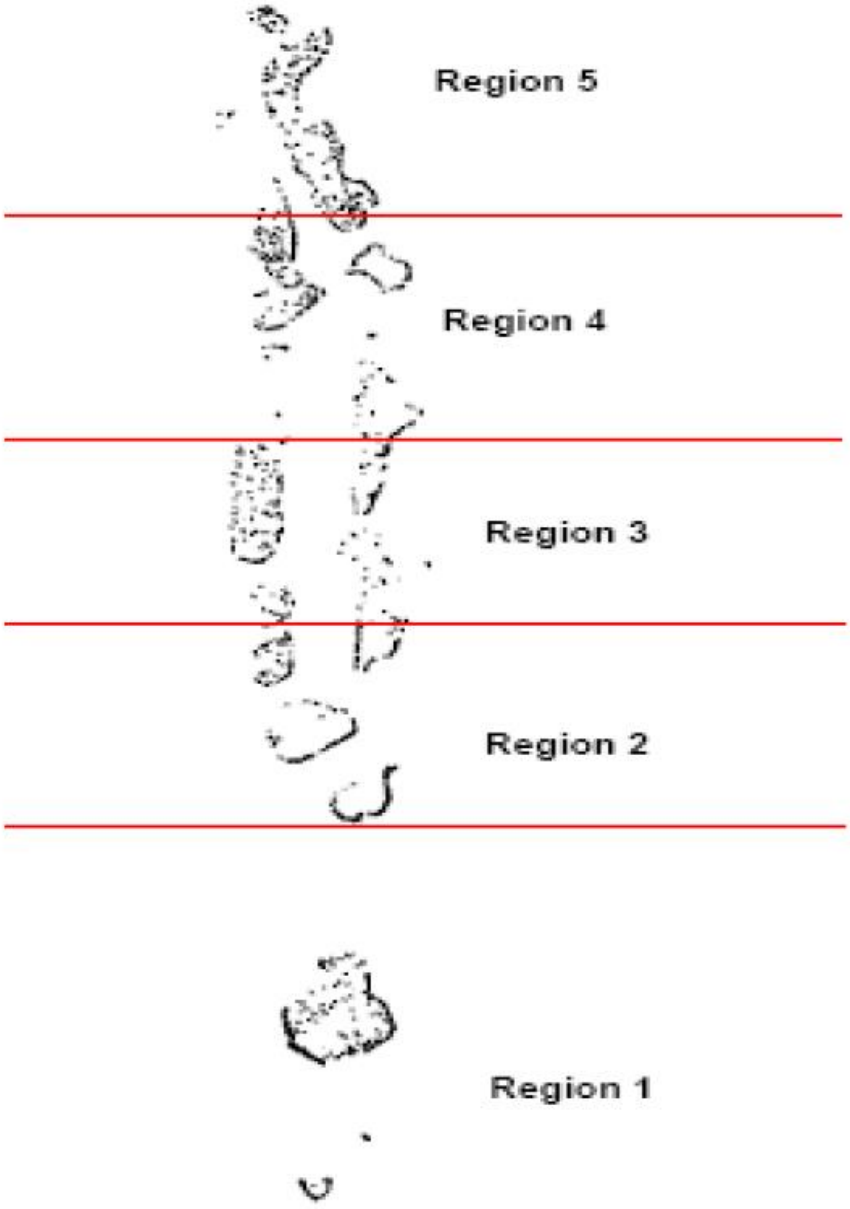


Figure 32 Cyclone hazard zones, (UNISDR-ADRRN, 2005)

Table 9 Cyclone hazard zone in Maldives and the probable maximum wind speed (UNISDR-ADRRN, 2005)

Hazard Zone	Probable Maximum Wind Speed	Saffir Simpson Scale
1	0.0	0
2	55.9	0

3	69.6	1
4	84.2	2
5	96.8	3

The island is in region 3 of the hazard zone where the maximum probable wind speed is medium

6.5.3. Storm tide hazard

Local storms are high in the Maldives. Usually accompanied by rainfall and high waves. In general, the southern parts of the islands are mostly affected during April and December, which is the interim period between northeast and southwest monsoon season. (*Figure 33*), (UNISDR-ADRRN, 2005).

Figure 33 Surge hazard zones, (UNISDR-ADRRN, 2005)

Table 10 Hazard zones and specific conditional data (UNISDR-ADRRN, 2005).

Hazard Zone	Pressure drop hPa	Storm Surge Height	Average Tide height (m)	Storm tide (M)
1	-	-	-	-
2	15	0.45	0.93	1.38
3	15	0.60	0.93	1.53

4	30	0.99	0.98	1.97
5	30	1.32	0.98	2.30

The island is exposed to the eastern fringe due to the its eastern location. The surge hazard data shows that the island falls under the surge hazard zone 3.

6.5.4. Earth quake Hazard

The islands in Seenu, Gavini, and Gaafu are at the hazard zone of a seismic activity. Otherwise, the entire country is in the low seismic hazard zones. (UNISDR-ADRRN, 2005)

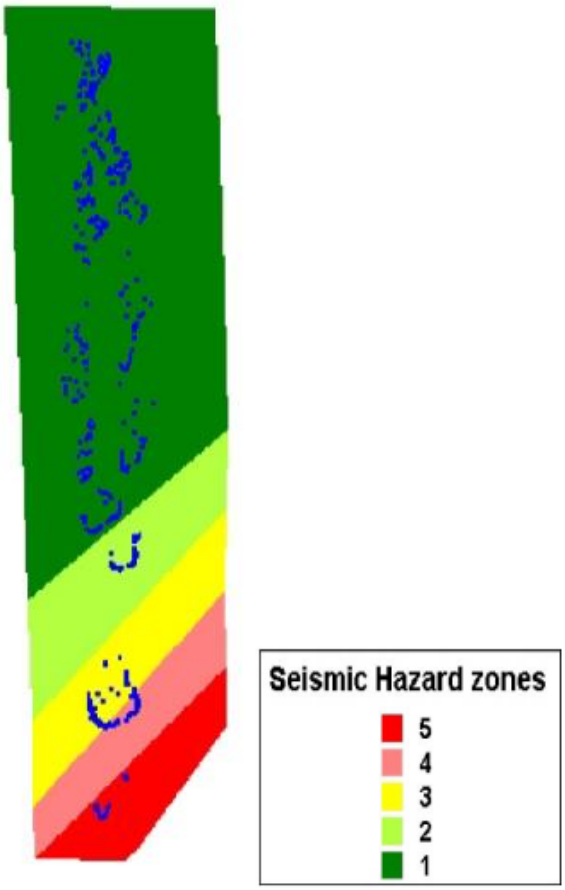


Figure 34 the seismic hazard zones for Maldives (UNISDR-ADRRN, 2005).

The island falls under the seismic hazard zone 1 hence has a MMI value range for 475 year return period of less than 4.5.

Table 11 the seismic hazard zones for Maldives (UNISDR-ADRRN, 2005)

Seismic hazard zones	MMI value range for 475 years return period
1	Less than 4.5
2	4.5 to 5
3	5.0 to 5.5
4	5.5 to 7.0
5	7.0 to 8.0

7. Potential Impacts

7.1. Introduction

In this section the objective is to investigate the potential impacts of the proposed project on the existing environment. The identification of an impact does not ensure the occurrence of the impact and it does not mean that it cannot be mitigated. However, it informs the authorities that the proponent is made aware of the impacts and the contractor is informed of the expected mitigation measures for the proposed project prior to awarding of the work.

7.2. Impact predication

Various methods of impact assessment are available. The assessor must understand and consider the proposed method, the baseline natural environment and the socioeconomic environment of the project while assessing the impacts.

The principle of Leopold matrix (Leopold, Clarke, Hanshaw, & Baisiey, 1971) has been used to classify the magnitude and importance of the possible impacts which may arise during the various stages of the proposed project. The dimensions of the matrix refer to the possible / foreseeable / probable impacts of the proposed work/project/activity) on the existing environmental conditions at the proposed work area. Leopold matrix lists numerous actions which cause impacts and environmental conditions. The current matrix is modified for the specific project.

The actions are evaluated in terms of magnitude of impact on the environment, significance of impact on the environment and the probability of impact as described in the paper by Josimović & Petric, 2014.

Table 12 Evaluation criteria, grading scale

Evaluated criteria	Designation	Scale
Impact probability	M	impact is possible (probability of less than 50%);
	V	impact is probable (probability of over 50%);
	I	impact is certain (100% probability).
Impact magnitude	+5	Highly significant positive change
	+4	Major positive change
	+3	Significant positive change
	+2	Moderate positive change
	+1	Slightly positive change
	0	No change
	-1	Slightly negative change
	-2	Moderate negative change
	-3	Significant negative change
	-4	Major negative change
	-5	Highly negative change
	+/-	Simultaneous positive and negative change
Impact significance	L	Limited impact on location
	O	impact of importance for municipality;
	R	impact of regional character;
	N	impact of national character;
	M	Impact of cross-border character.
Impact duration	P	Occasional/Temporary
	D	Long term/ Permanent

7.3. Limitations of impact prediction

Due to time constrains and scheduling, long term data necessary for impact prediction is unavailable. Thus, acting as a major limitation. Long term data is necessary to understand the complex systems of the project

area. A limited understanding of these unique features and how these features change over time and the impact the locals have on these features due to their activities and a lack of documented historical data is another limitation.

The possible bias in the available historical data, stakeholder's consultation and the proponent's information is also considered. The limited site-specific data on the species, types and forms of corals is another limitation to consider. Impact prediction is carried out using the available data during site visit. Hence, is another major limitation.

7.4. Impact Identification

Impact identification was carried out to ensure that all potentially significant impacts are identified and considered in the EIA process.

Several tools are available in the identification of impacts; checklists, matrices, network diagrams, and map overlays. In this EIA we have used checklists, and maps to identify the impacts significant to the EIA process.

			Actions that may cause an impact										
			Excavating the site for depth.			Harvesting from locations		Planting in the new location		Monitoring	Management		
			Excavation.	Stockpile.	Heavy machinery movement.	Harvesting	transportation	fragmenting	Transplantation the frame	Monitoring of the project	Fragment replacement for	Cleaning for the project
A. Physical and chemical characteristics	1. Earth	a. Mineral resources										
		b. Construction material										
		c. Soils	X	X								
		d. Land form	X		X							
		e. Force fields and background radiation										
		f. Unique physical features			X							
	2. Ground Water	a. Quality		X	X							
		b. Recharge										
	2. Marine Water	a. Quality	X		X					X	X	X
		b. Recharge										
	3. At	a. Quality (gases, particulates)		X								

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			Actions that may cause an impact									
			Excavating the site for depth.			Harvesting from locations		Planting in the new location		Monitoring	Management	
			Excavation.	Stockpile.	Heavy machinery movement.	Harvesting	transportation	fragmenting	Transplantation the frame	Monitoring of the project	Fragment replacement for	Cleaning for the project
		b. Climate (micro, macro)			X							
		c. Temperature										
	4. Processe	a. Floods										
		b. Erosion	X									
		c. Deposition (sedimentation, precipitation)	X		X							
B. Biological conditions	1. Flora	a. Trees		X	X							
		b. Shrubs		X								
		c. Grass										
		d. Crops										
		e. Microflora	X			X	X	X	X	X	X	X
		f. Aquatic plants										
		h. Endangered species	X									
		h. Barriers										
		i. Corridors										
	2. Fauna	a. Birds	X	X								
		b. Land animals, including reptiles										
		c. Fish and shellfish	X						X	X	X	X
		d. Benthic organisms	X									
		e. Insects		X								
		f. Microfauna				X	X	X	X	X	X	X
		g. Endangered species	X		X							

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			Actions that may cause an impact										
			Excavating the site for depth.			Harvesting from locations		Planting in the new location		Monitoring	Management	
			Excavation.	Stockpile.	Heavy machinery movement.	Harvesting	transportation	fragmenting	Transplantation the frame	Monitoring of the project	Fragment replacement for	Cleaning for the project
		h. Barriers										
		i. Corridors										
C. Cultural factors	1. Land use	a. Wilderness and open spaces										
		b. Wetlands										
		c. Forestry										
		d. Grazing										
		e. Agriculture										
		f. Residential		X								
		g. Commercial	X		X			X	X			
		h. Industrial										
		i. Mining and quarrying										
	2. Recreation	a. Hunting										
		b. Fishing	X									
		c. Boating										
		d. Swimming	X							X	X	X
		e. Camping and hiking										
		f. Picnicking						X	X			
		g. Resorts										
	3. Aesthetic	a. Scenic view and vistas		X					X			
		b. Wilderness qualities										
		c. Open space qualities		X								

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			Actions that may cause an impact									
			Excavating the site for depth.			Harvesting from locations		Planting in the new location		Monitoring	Management	
			Excavation.	Stockpile.	Heavy machinery movement.	Harvesting	transportation	fragmenting	Transplantation the frame	Monitoring of the project	Fragment replacement for	Cleaning for the project
		d. Landscape design		X								
		e. Unique physical features										
		f. Parks and reserves										
		g. Monuments										
		h. Rare and unique species or ecosystems										
		i. Historical or archaeological sites and objects										
		j. Presence of misfits										
	4. Cultural status	a. Cultural patterns (life style)	X	X	X				X			
		b. Health and safety		X					X			
		c. Employment						X	X			
		d. Population density										
	5. Man-made facilities	a. Structures										
		b. Transportation network (movement, access)										
		c. Utility networks										
		d. Waste disposal			X							
		e. Barriers										
		f. Corridors										
D. Ecological relationship		a. Salinization of water resources										
		b. Eutrophication										
		c. Disease-insect vectors										
		d. Food chains				X	X	X	X			

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			Actions that may cause an impact										
			Excavating the site for depth.			Harvesting from locations		Planting in the new location		Monitoring	Management		
			Excavation.	Stockpile.	Heavy machinery movement.	Harvesting	transportation	fragmenting	Transplantation the frame	Monitoring of the project	Fragment replacement for	Cleaning for the project
		e. Salinization of surficial material										
		f. Brush encroachment										
		g. Other										
E. Others	a. Economic impacts		X	X	X							

7.5. Impact prediction

7.5.1. Excavating the site for depth.

7.5.1.1. Physical and chemical characteristics

Impact of the proposed project on the earth, soil and land form due to heavy machine movement, excavation, and the temporary stockpile; on the residential area A, is inevitable. The movement of the excavator on location; area A and excavation area, will cause a major impact on the existing land infrastructure, the revetment, and main geological skeleton. This can result in cracking and tear of the pavement, revetment, and geological skeleton. The impact is certain, and if unmitigated, can extend beyond the location; area A and excavation area.

Excavation will also result in a land use change that can result in a negative impact on the land and sediment form. If this impact is left unmitigated, this can result in flow of sediment into the excavated site resulting in a form of a placement loss erosion, which restricts the interaction of the sediment with the shoreline (Kench, 2010).

The temporary stockpile, can change the top layer soil use of the area due to maximum spreading post drying. If left unmitigated, the impact can extend beyond the location; area A. The existing structure on the area is sandy. Therefore, if the grade of the material is like that on the stockpile area on area A, the impact may not be as sever.

Further, stockpiling, and relative machinery movement, will have an inevitable, impact on the proposed temporary stockpile area's, ground water lens. If left unmitigated, it would extend beyond the location. However, the impact may not be as significant as anticipated due to the proximity of the beach.

Excavation can result in a drop in the quality of marine water in the excavated zone. A kick up and release of sediment, increasing the turbidity of the site, with further mobilisation of nitrates, phosphates and sulphates, etc. If left unmitigated can extend to the region, magnifying the impact.

The proposed temporary stockpile introduction, and relative machinery movement can also result in an increase of the particulate matter in the micro climate, and result in a negative impact to the physical environment. This lowers the clarity of the air leading to air pollution; lowering the overall quality of the air and impacting the locals using and living in the area. If left unmitigated it can result in an increase in the particulate matter of the micro environment. Hence, must be mitigated accordingly.

The proposed excavation is likely to result in erosion as the beach which, as a system will reach an equilibrium overtime filling in depressions on the reef flat. This can lead to recession of the berm. Hence, the erosion observed can be considered a placement loss erosion (Kench, 2010).

7.5.1.2. Biological conditions

The excavation process will have an impact on the marine micro flora, and endangered species; if found on location and under the marine footprint. Excavation will physically remove the floral habitat for the micro flora on the reef flat that are attached to the substratum, this will have a negative impact on the species if present on location. If unmitigated it can extend beyond the locality. The same impact will be observed on the movement path. However, as the work area will be defined, the movement path damage will be limited to the footprint.

A high impact to the terrestrial flora is not anticipated due to machine movement, as the footpath will be managed. However, due to the impact on the stockpile on the water table and the footprint of stockpile, loss of few vegetation is anticipated.

Among the fauna, most marine species which are mobile will be able to flee, while the substratum-based species will be lost in the process. Although some species will flee the unfavourable conditions, it is uncertain that they will survive the migration without favourable or similar habitat. Hence, the impact for this component is scored conservatively.

Here most terrestrial species will be relatively safe due to the lack of riparian vegetation and other habitat that they might shelter in and accidently fall victim to during the construction process.

7.5.1.3. Cultural factors

The proposed excavation is to be carried out on a beach that is actively used by water sports service providers, and locals. Active excavation, and heavy machine movement will have a negative impact on the area land use. The area being a recreationally used area by the locals, there will be a direct negative impact on the commercial use during the time of construction.

Similarly, temporary stockpiling, drying and further movement of the dredged material on site can result in disruption of the residential activities on site. If unmitigated it can lead to potential negative feedback and public outrage from the community.

Recreation

Post excavation, it is likely to see a natural shift within the community to utilize the excavated area for swimming and potentially fishing. This is neither a negative nor a positive impact. However, it must be managed and if unmanaged can lead to potentially unnecessary, undesired activities on site. Hence, must be managed accordingly.

Aesthetics and human interest

The proposed temporary stockpiling in the area is likely to have an impact on the aesthetics of the area temporarily. The stockpiling if kept uncollected, unmoved, or unmitigated post drying can lead to sand blowout, leading to social negative feedback. Hence, must be mitigated.

Cultural status

Considering the cultural factors, machine movement, excavation, and stockpiling will likely have a temporary negative impact on the general lifestyle of the local service providers in the area. There can also be chances of accidents due to the stockpile; fall accidents, accidents on the road, etc. If this takes place, this will be a considerable negative impact of the project on the different cultural factors at play.

Man-made facilities and activities

During construction, there is a chance for the contractor to discard waste on location If waste is not properly managed. Such an impact can be significant; therefore, it must be managed. it must also be noted that the impact can be avoided and reversed.

7.5.1.4. Economic impacts.

Excavation, stockpiling, and other related activities with heavy machinery on location can lead to a lot of economic impacts. The usual activity will be hindered by dust, facades, construction workers, and related safety measures. If left prolonged for an extended time, it can lead to significant economic loss and hence negative impacts.

7.5.2. Harvesting from locations

7.5.2.1. Physical and Chemical characteristics

The harvest procedure is proposed at area B, the location is marine, isolated, and far from the sediment and too small of a scale to have an impact on the beach and hydrodynamics. Further, the development proposed under the ESIA for development on the area will have an impact on area B.

Recreational diving and other forms of aquatic activities does result in physical injuries to the reef, on the slope, flat and other coral structures Hawkins & Roberts, (1992) (1993).

7.5.2.2. Biological conditions

The impact harvesting will have on the micro flora / fauna is uncertain. In a study to check the effect of diving and diving hoods on the bacterial flora of the external ear canal and skin cultural factors by Brook, Coolbaugh, & Willscroft, (1982), found that post diving there was an increase of 46.9% of organisms on the skin. This study shows that there is an interaction between the immersed organism in the fluid and the fluid microbiome.

Although the above stated study was carried out else ware, this study is evidence of the interaction between the flora and fauna with that of the harvesters; divers, and their equipment. Therefore, prior to use, it is

important to ensure that the gear is washed and cleaned prior to introduction to the reef to avoid transmission of diseases to and from a site.

7.5.2.3. Ecological relationships

On the harvesting site, due to the control checks, small scale of the project, mitigation measures, and potential proposed management and training activities, it is unlikely that the 40% harvest per colony will have significant negative impact on the food chain. Further, the harvesting procedure limits the harvesting process to the top layers. Hence, it is unlikely that harvesting can significantly impact the food chain. But if left unmitigated, it can lead to a slightly negative loss, limited to the site of harvest which can be temporary.

7.5.3. Planting in the new location

7.5.3.1. Biological conditions

As proved by Brook, Coolbaugh, & Willscroft, 1982; there will be interaction of the micro flora and fauna with that of the introduced material. Further, studies show that with increased frequency of activities, corals show signs of diseases (Hawkins, et al., 1999). (Lamb & Willis, 2011). Therefore, introduction of this new biological and anthropological material to the site will likely have an impact on the propagation area.

The ultimate output desired in the project is to have a different environment in the area from the existing environment. Ideally, the proponent wishes to introduce more stony corals to the area. This introduction once self-contained will attract life forms both harmful and useful to the project, such as algae grazing fauna and other associated organisms and predatory fauna and associated organism. If executed and managed, the impact is certain, the change will be a major positive change, the impact will likely be limited to the location and the duration is uncertain.

Unless carefully analysed, while translocation there is a chance of introduction of diseases from the donor site, existing in the bio life forms, introduction of diseases carried from the dive gear, and the affinity to catch disease due to stress of movement. Hence, the impact is probable, if unmitigated the impact will be negative, limited to the location (due to the existing receiving site) and the duration uncertain

7.5.3.2. Cultural factors

According to Bayraktarov et al., (2019) the nonexclusive and often complementary, motives for coral reef restoration worldwide are; securing key reef ecosystem services (e.g. coastal protection, fisheries production, tourism), fulfilling legal and political requirements (e.g. reparations for environmental damage following ship groundings), preserving socio-cultural values associated with the reef, preserving biodiversity, and researching restoration techniques and reef ecological processes.

This is also very true to this proposal and has the chance of impacting all the facets listed above. This development will eventually have an impact on the social, tourism and other related factors. The business model proposed with the development is for the locals to allow a certain number of tourists to participate

in cleaning and managing the area, as well collecting the monitoring information for the area. This will eventually become a business that must be managed and mitigated by a central body within the organisation. If unmanaged has the potential to create social unrest as local businesses are involved in the process.

According to the Hein, et al., (2020), to sustain local tourism opportunities an ideal timeframe is under 3 years. This is due to the different engagement opportunities available. In this regard, it must be noted that the location as a garden can be displayed once the propagation can sustain itself. This duration must be communicated to all the stakeholders and the importance of this detail must be reminded periodically. If not, this can lead to negative associations and unrest within the stakeholders.

7.5.3.3. Aesthetics and human interest

Once the project is self-sustaining, it is likely to attract more viewers and interested parties to the location. If this is managed well, it can be a positive addition to the area.

There is also the chance of vandalism that can set the project back. Some locals may use the area to harvest material for artisanal home tanks. This can lead to unrest and disappointment within the stakeholders. To mitigate and manage this, clear transparency of the projects and the aspects of the project must be communicated to the locals.

7.5.3.4. Cultural status

Employment for transplantation is not expected for the development. However, in case it is implemented, employment will be managed and regulated with training to both the employees and local volunteers alike. This minimises the exposure of unqualified people to the location. Similarly, minimises the chances of health hazards and incidences due to the increased probability of accident. If unmitigated the health hazards can potentially lead to accidents that cannot be compensated.

7.5.3.5. Ecological relationships

Once the propagation is complete, there is the possibility of attraction of herbivores and other related organisms to flock the area and potentially increase the diversity of the area. This comes with the possibility alteration of the existing food chain in the area. The fact that transplants provided new habitats for coral-associated organisms i.e.: fish and invertebrates (Horoszowski-Fridman & Rinkevich, 2020), shows that addition of habitat will introduce organisms to the environment.

7.5.4. Monitoring and management (operation)

7.5.4.1. Physical and chemical characteristics

Monitoring and management for the project starts immediately with the development. Constant exposure of people to the location will have an impact on the physical and chemical characteristics of the marine footprint. Evidence of this can be observed by Wood, (2015) where, in laboratory, under controlled in-situ studies, fragments and cells from various species of hard coral have shown bleaching in response to

sunscreens. This shows that interaction between the diver and the medium of immersion takes place and as a result monitoring and managing can have an impact on the quality of the water and the biota of the project.

7.5.4.2. Biological conditions

The management of the location over time will favour the desired biota. Removing algae and predators will shift the biota in favour of the stony coral habitat. Conversely, this active management is designed to remove micro flora and fauna from the equation. As a result, the desired coral diversity will flourish. Hence, this will favour associated reef fauna.

7.5.4.3. Cultural factors

Once management and monitoring are established, employment for management and monitoring is expected for the development. Employment will be managed and regulated with training to both the employees and local vendors alike. This minimises the exposure of unqualified people to the location. Similarly, regular management using the employed staff, can increase the chances of health hazards and incidences due to the increased probability of accident. If unmitigated the health hazards can potentially lead to accidents that cannot be compensated.

Similarly, this active management can potentially have the chance of intruding into the recreational activities at site, and vice versa. Therefore, this component must be mitigated accordingly. If unmitigated, this clash can lead to local unrest and potential violence.

7.5.4.4. Ecological relationships

To understand how the ecosystem is evolving over time, regular surveys could be undertaken by monitoring the interactions between various species and the food chain. Due to the complex structure of the reef ecosystem, the eventual development will favour a niche aspect of the reef ecosystem, that will be impossible to predict at this point. However, this change, for the food chain can be beneficial if mitigated accordingly.

7.5.4.5. Economic impacts

The ecological succession and stability of the coral structure will take years before management can be stopped. This must be recognised, acknowledged, and communicated in order to retain funds and manage accordingly. If mitigated on a timely manner, the development will not have a negative impact due to active management practices.

It is crucial to monitor how project is affecting the neighbourhood and take action to mitigate any negative effects. Stakeholders should be involved in discussions to make sure they are aware of the projects' progress as well as any possibilities or obstacles

7.6. Impact evaluation

The following is the evaluation of the impacts for the proposal.

			Actions that may cause an impact										
			Excavating the site for depth.			Harvesting from locations		Planting in the new location		Monitoring	Management	
			Excavation.	Stockpile.	Heavy machinery movement.	Harvesting	transportation	fragmenting	Transplantation the frame	Monitoring of the project	Fragment replacement for the project	Cleaning for the project
A. Physical and chemical characteristics	1. Earth	a. Mineral resources										
		b. Construction material										
		c. Soils	I, -2, L, D	I, -2, O, D								
		d. Land form	I, -2, L, D		I, -2, L, D							
		e. Force fields and background radiation										
		f. Unique physical features			I, -4, L, D							
	2. Ground Water	a. Quality		I, -4, L, P	I, -5, L, P							
		b. Recharge										
	2. Marine Water	a. Quality	I, -4, L, D		I, -4, L, D					I, -4, L, D	I, -4, L, D	I, -4, L, D
		b. Recharge										
	3. Atmosphere	a. Quality (gases, particulates)		I, -2, O, D								
		b. Climate (micro, macro)			I, -2, O, D							
		c. Temperature										
	4. Processes	a. Floods										
		b. Erosion	I, -4, L, D									
		c. Deposition (sedimentation, precipitation)	I, -4, L, D		I, -4, L, D							

B. Biological conditions	1. Flora	a. Trees		V, -2, L, P	I, -1, L, P							
		b. Shrubs		I, +/-, L, P								
		c. Grass										
		d. Crops										
		e. Microflora	I, +/-, L, P			V, -4, L, D/P	V, -4, L, D/P	V, -4, L, D/P	V, -4, L, D/P	I, +3, L, D	I, +3, L, D	I, +3, L, D
		f. Aquatic plants										I, -3, L, D
		h. Endangered species	I, +/-, L, P									
		h. Barriers										
		i. Corridors										
	2. Fauna	a. Birds	M, +/-, L, P									
		b. Land animals, including reptiles	M, +/-, L, P									
		c. Fish and shellfish	I, -5, L, D						I, +2, L, D/P	I, +3, L, D	I, +3, L, D	I, +2, L, D
		d. Benthic organisms	I, -5, L, D									
		e. Insects	M, +/-, L, P									
		f. Microfauna	I, -5, L, D			I, -4, L, D/P	I, -4, L, D/P	V, -4, L, D/P	V, -4, L, D/P	I, +3, L, D	I, +3, L, D	I, +3, L, D
		g. Endangered species										
		h. Barriers										
		i. Corridors										
C. Cultural factors	1. Land use	a. Wilderness and open spaces										
		b. Wetlands										
		c. Forestry										
		d. Grazing										
		e. Agriculture										
		f. Residential		I, -5, L, D								
		g. Commercial	I, -3, L, D		I, -5, L, D			V, +4, L, D/P	V, +4, L, D/P			
		h. Industrial										

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	i. Mining and quarrying										
2. Recreation	a. Hunting										
	b. Fishing	I, +/-, L, D									
	c. Boating										
	d. Swimming	I, +/-, L, D							V, +/-, L, D/P	V, +/-, L, D/P	V, +/-, L, D/P
	e. Camping and hiking										
	f. Picnicking						V, +4, L, D/P	V, +4, L, D/P			
	g. Resorts										
3. Aesthetics and human interest	a. Scenic view and vistas		M, -2, L, D					V, +4, L, D/P			
	b. Wilderness qualities										
	c. Open space qualities		M, -2, L, D								
	d. Landscape design		M, -2, L, D								
	e. Unique physical features										
	f. Parks and reserves										
	g. Monuments										
	h. Rare and unique species or ecosystems										
	i. Historical or archaeological sites and objects										
	j. Presence of misfits							V, -4, L, D/P			
4. Cultural status	a. Cultural patterns (life style)	M, -2, L, P	M, -2, L, P	M, -2, L, P							
	b. Health and safety		M, -3, L, P					V, -4, L, D			
	c. Employment							V, +2, L, D			
	d. Population density										
5. Man-made facilities and activities	a. Structures										
	b. Transportation network (movement, access)										
	c. Utility networks										
	d. Waste disposal		M, -3,								

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				L, P								
		e. Barriers										
		f. Corridors										
D. Ecological relationships such as		a. Salinization of water resources										
		b. Eutrophication										
		c. Disease-insect vectors										
		d. Food chains				I, -2, L, D/P	I, -2, L, D/P	I, +2, L, D/P	I, +2, L, D/P		I, +2, L, D/P,	I, +2, L, D/P
		e. Salinization of surficial material										
		f. Brush encroachment										
		g. Other										
E. Others	a. Economic impacts		M, -3, L, P	M, -3, L, P	M, -3, L, P					M, -1, L, P	M, -1, L, P	M, -1, L, P

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7.7. Cumulative impacts

The cumulative impact of the project is presented below. The tables below show the predicated, cumulative impacts of the actions that may cause an impact on the environment.

7.7.1. Actions that may cause an impact

Excavating the site for depth.			Harvesting from locations		Planting in the new location		Monitoring	Management	
Excavation.	Stockpile.	Heavy machinery movement.	Harvesting	transportation	fragmenting	Transplantation the frame	Monitoring of the project	Fragment replacement for the project	Cleaning for the project
-39	-32	-32	-10	-10	2	2	4	6	2

7.7.2. Factors that will be impacted

A. Physical and chemical characteristics	-37	1. Earth	-12	c. Soils	-4
				d. Land form	-4
				f. Unique physical features	-4
		2. Ground Water	-9	a. Quality	-9
		2. Marine Water	-2	a. Quality	-2
		3. Atmosphere	-2	a. Quality (gases, particulates)	
				b. Climate (micro, macro)	-2
		4. Processes	-12	b. Erosion	-4
				c. Deposition (sedimentation, precipitation)	-8
B. Biological conditions	-17	1. Flora	-10	a. Trees	
				b. Shrubs	
				e. Microflora	-7
				f. Aquatic plants	-3
				h. Endangered species	
		2. Fauna	-7	a. Birds	
				b. Land animals, including reptiles	
				c. Fish and shellfish	5
				d. Benthic organisms	

				e. Insects	
				f. Microfauna	-12
C. Cultural factors	-5	1. Land use	-5	a. Wilderness and open spaces	
				f. Residential	-5
				g. Commercial	
		2. Recreation	4	a. Hunting	-4
				b. Fishing	
				d. Swimming	
				f. Picnicking	8
		3. Aesthetics and human interest	-12	a. Scenic view and vistas	
				c. Open space qualities	-2
				d. Landscape design	-2
				h. Rare and unique species or ecosystems	-4
				j. Presence of misfits	-4
		4. Cultural status	-11	a. Cultural patterns (life style)	-6
				b. Health and safety	-7
				c. Employment	2
		5. Man-made facilities and activities	-15	b. Transportation network (movement, access)	-4
				d. Waste disposal	-9
				f. Corridors	-2
D. Ecological relationships such as	4		4	d. Food chains	4
E. Others	-12	a. Economic impacts	-12		-12

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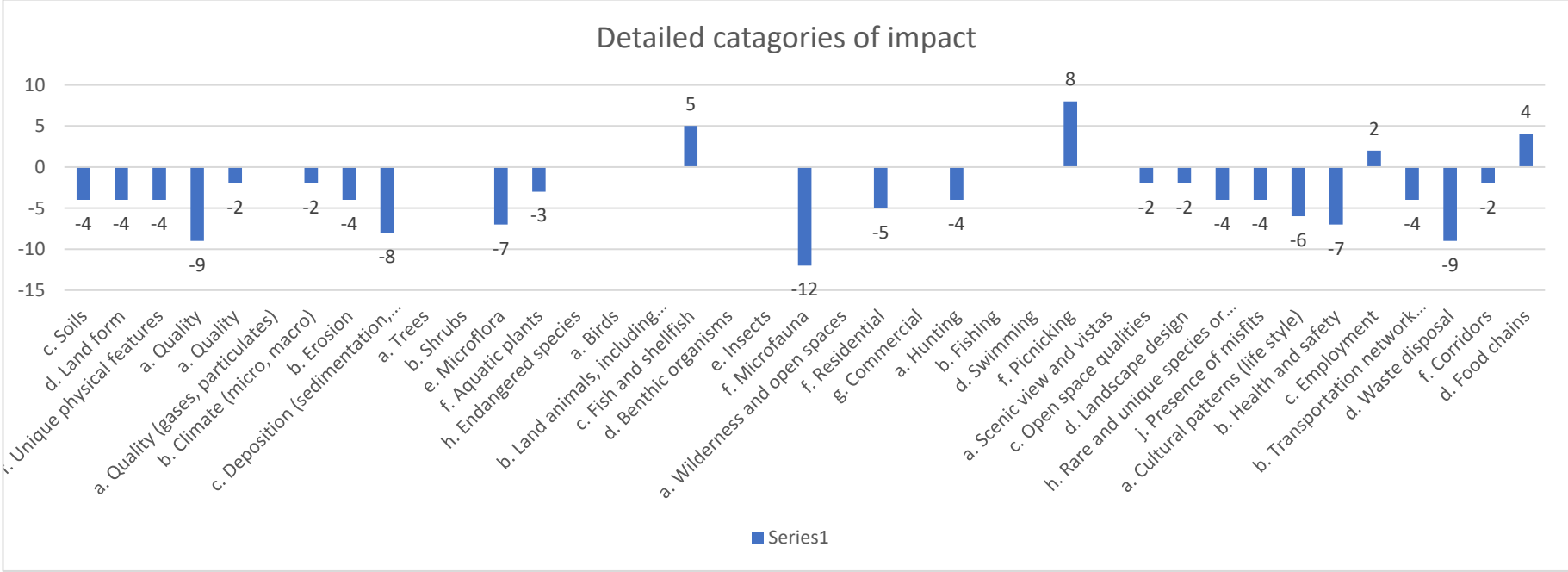
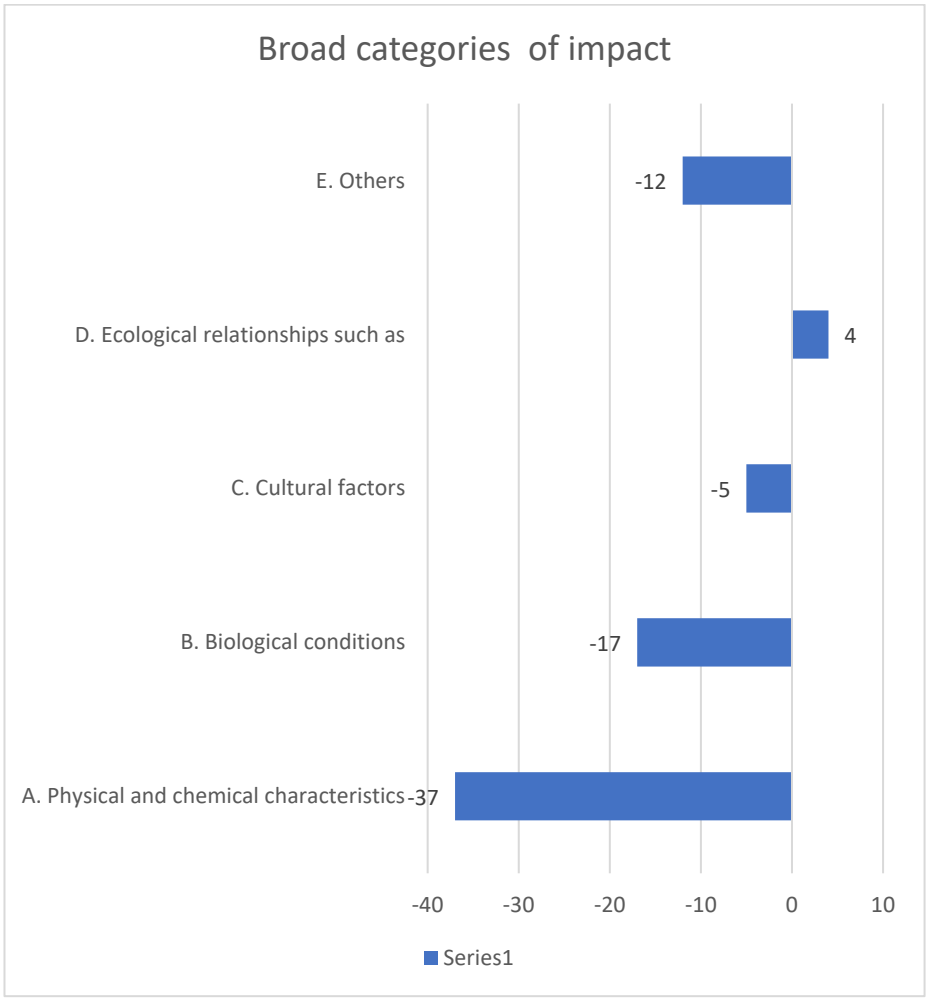
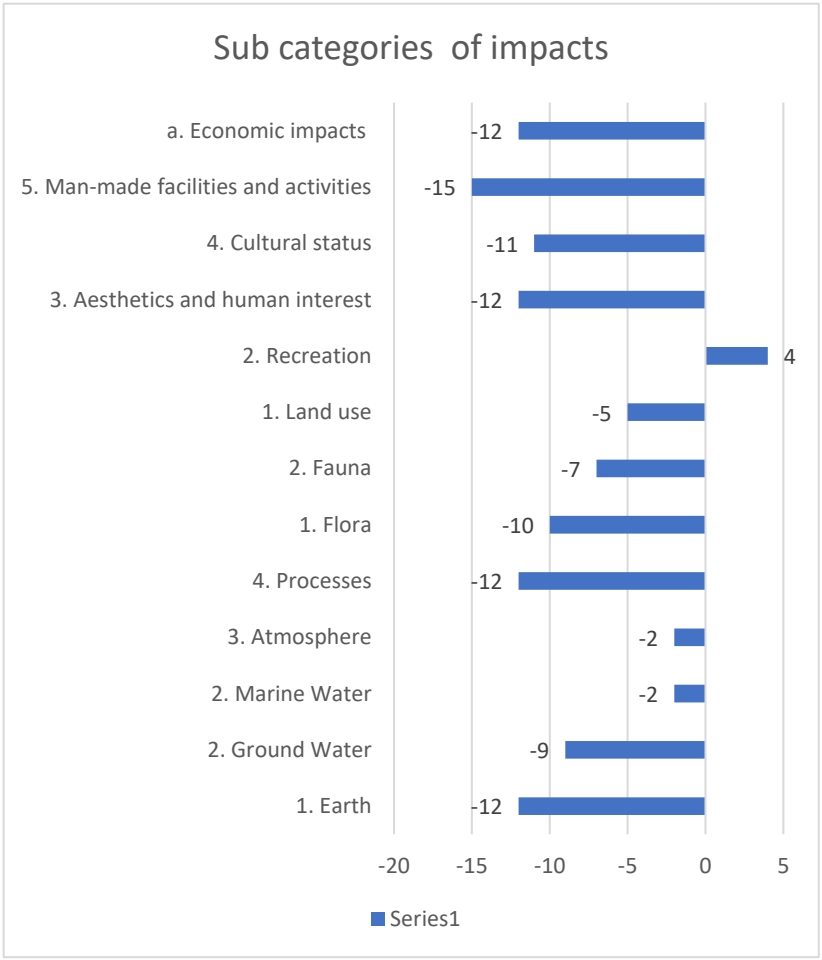


An analysis of the detailed categories show that the majority of the impact magnitude defined is negative. Analysis of the sub catagories show that the except for recreation all other involved categories have a cumulative negative impact. This is also true to the border categories of the development. The physical and chemical characteristics, has the highest negative cumulative impact of them all, followed by biological conditions, followed by economic factors and finally the cultural factors.





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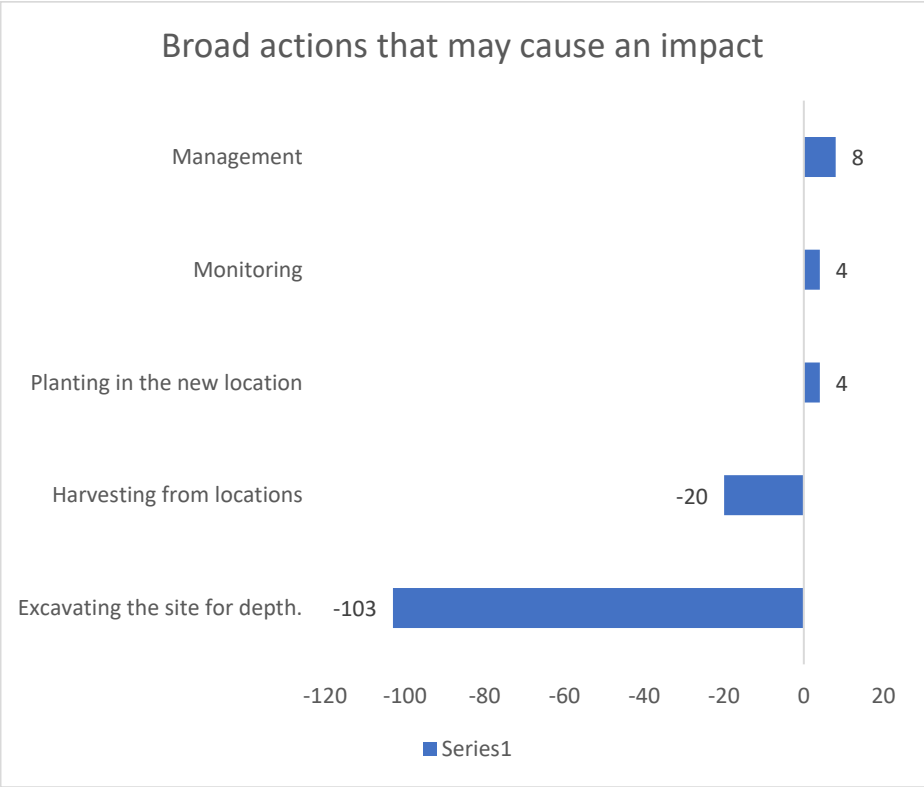
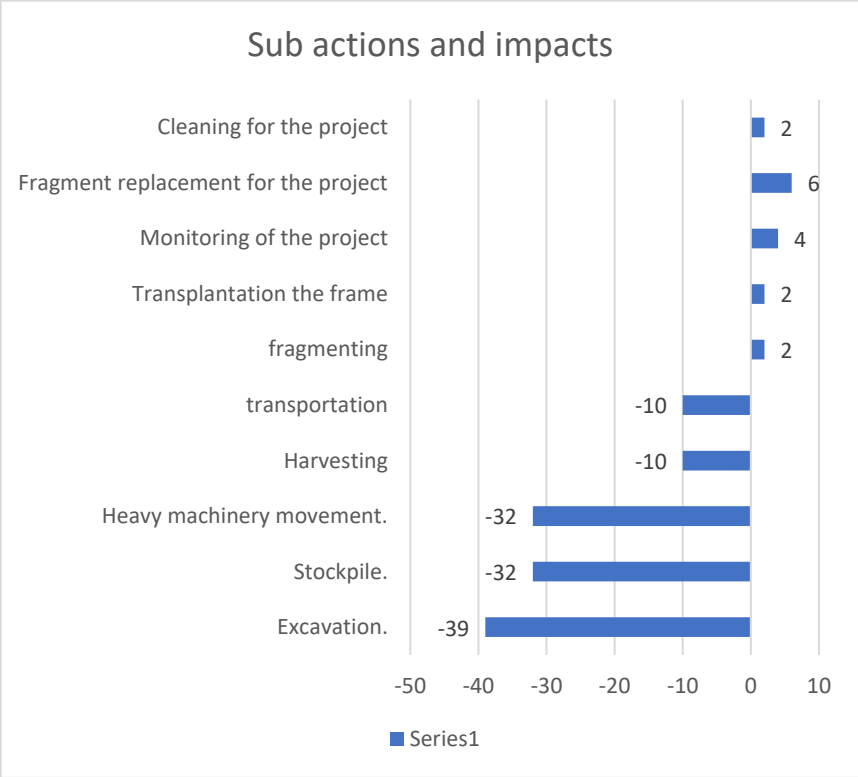




The highest cumulative impact of the project can be seen during construction. The excavation construction during the development has components such as excavation, stockpile and machine movement which if left unmanaged will have a major negative impact that must be mitigated. Similarly, the cumulative impact of harvesting and transportation is negative, and must be managed accordingly. Post harvesting, fragmenting, transplantation works in favour of the survival of the harvested component. As a result, the action if managed and the impacts mitigated, will be a cumulative positive impact. The same effect can be seen on the rest of the management procedures of the project.

7.1. Impact zone analysis.

The impact zone predicated is presented in the following chart. The zone covers a considerable marine and a component of terrestrial area.

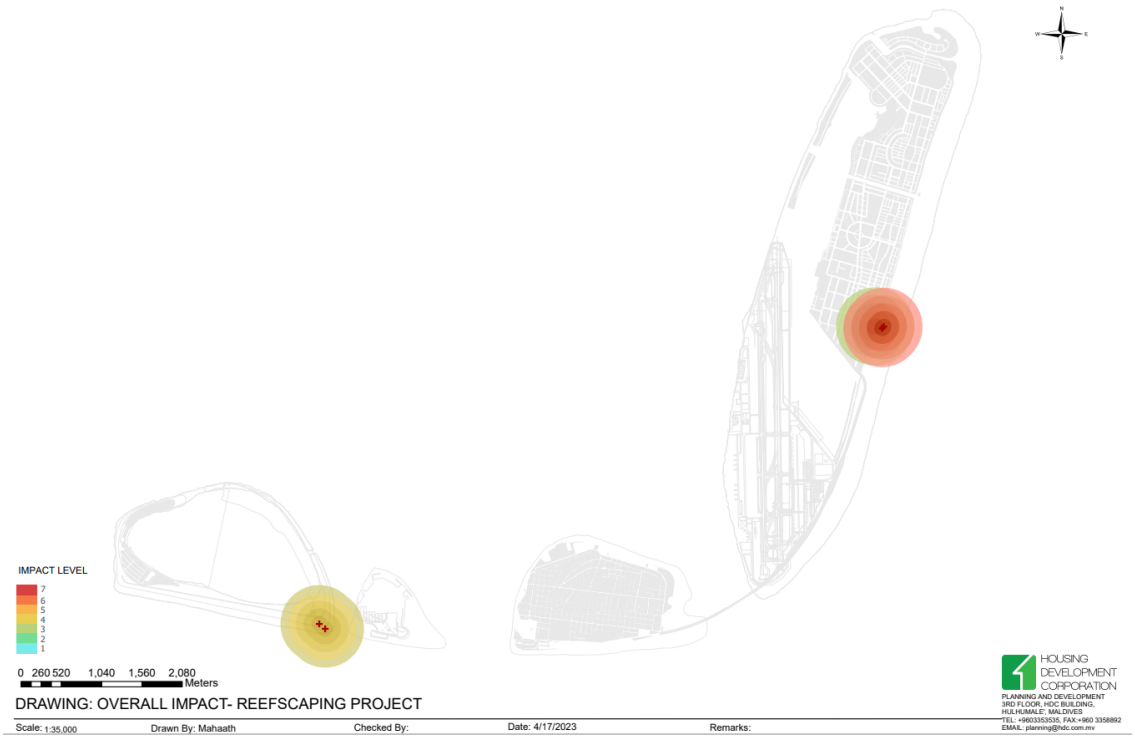


Figure 35 map showing the impact area for the entire scope

The estimated zone of impact is predicted to be the site of activity. It is likely that the initial process of harvesting work will have an impact of the site of harvest (Figure 36 Impact zone (reduced map)). Specific mitigation and management practices must be considered to preserve the integrity of the existing environment.

On the propagation side, the excavation work is more invasive, the impact is more permanent, the window of mitigation is narrow and the reach of the impact of the stockpile is more far reaching (Figure 37 Impact zone (reduced map)). Hence, mitigation and management is required for the development to benefit the locals and the proponent.

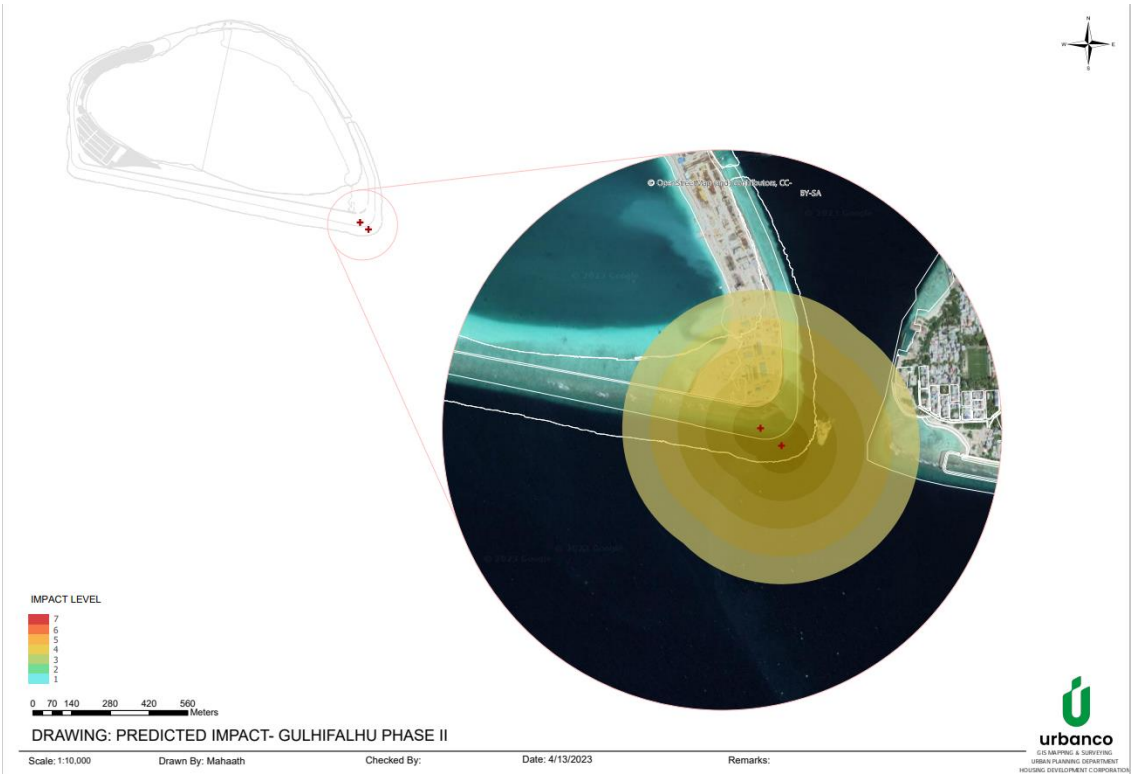


Figure 36 Impact zone (reduced map)

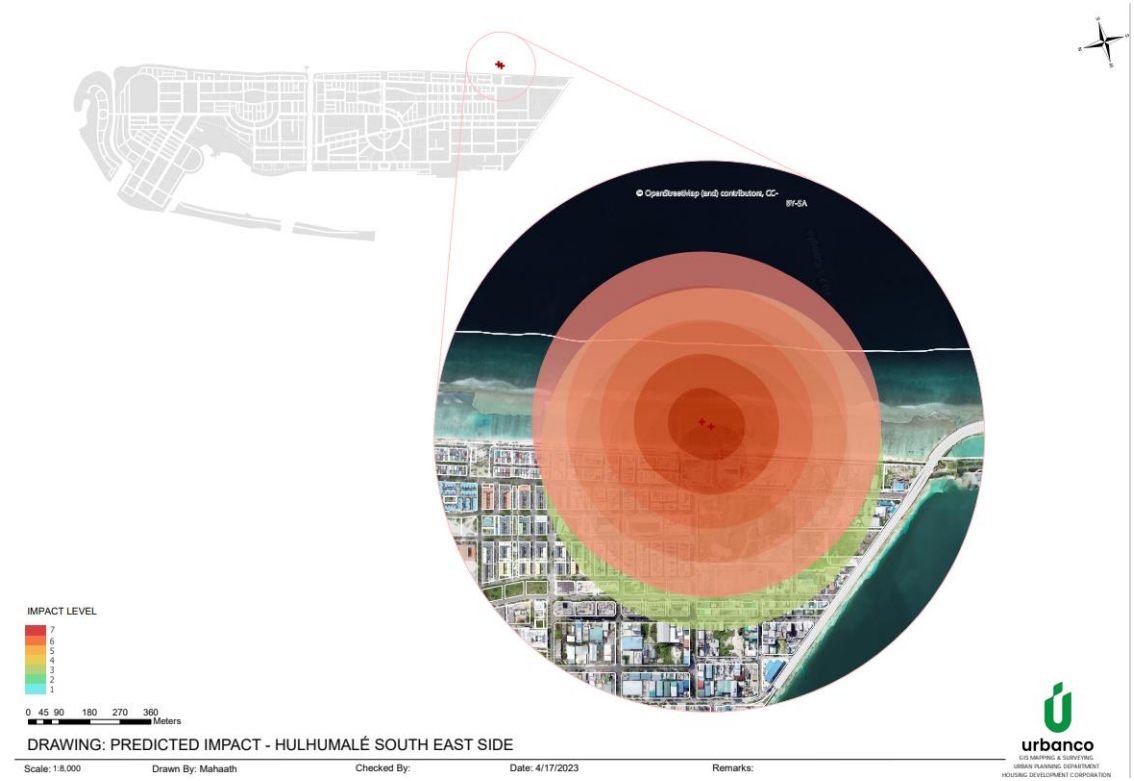


Figure 37 Impact zone (reduced map)

8. Mitigation of the negative impacts

Impact of the environment from various activities have been identified in the respective chapter. The mitigation measures for the possible impacts with the estimated cost of the measure have been suggested in this section.

8.1. Impact mitigation

8.1.1. Mitigation measures, Justification and cost

The mitigation measure associated with the project and linked activities are discussed in the following table.

Table 13 Significant impacts, mitigation measures and associated costs

Activity	Mitigation	Staff responsible	Justification	Cost in MVR
Excavating the site for depth.	Excavation plan and depth must be communicated to the excavation staff	SRP staff	So that the excavation is to the standard set and approved	No added cost
Heavy machinery movement.	the path of movement must be discussed and mapped out before the work can be carried out	Supervisor, operations, HDC	This minimises the footprint damage.	No added cost
	Provide warning signs and barriers around the work zone	Supervisor, operations, HDC	To protect workers and prevent accidents	No added cost
	Schedule machinery movement during low traffic times	Supervisor, operations, HDC	To minimize disruption to nearby residents	No added cost
Excavation.	Excavation must be carried out during low tide, or mid tide. Never at the receding and high tide. Provide warning signs and barriers around the work zone	Excavation staff and Supervisor HDC.	So that the sediment dispersion is minimised.	+ Overtime charges
	Halt excavation in case of sediment plume.	Supervisor HDC	So that the sediment plume does not spread.	+ Overtime charges
	Ensure excavation footprint is not breached and within the set-out area.	Excavation staff and Supervisor HDC.	So that the project stays true to the proposal.	+ Overtime charges
	Halt work, and report, and manage accordingly the damage to the beach infra skeleton if, the geo layer is compromised, if	Supervisor HDC, SRP staff HDC Environment analyst HDC.	So that the damage to the geo skeleton can be managed in a timely manner to	500,000.00

Activity	Mitigation	Staff responsible	Justification	Cost in MVR
	a cave-in occurs on the revetment layer, or if sudden berm recession occurs.	Engineer HDC	minimise further negative impact.	
	Implement sediment control measures such as silt fences and sediment basins to capture sediment and prevent it from leaving the area	Supervisor HDC	So that the sediment dispersion is minimised.	No added cost
Stockpile.	Ensure that the stockpile is in an enclosed area	Supervisor HDC	So that spill off is minimised. To prevent water runoff and contamination	No added cost
	Ensure that the stockpile is dried before transportation	Supervisor HDC	So that a road spill is minimised reduce the potential impact.	No added cost
	Ensure that the stockpile is not left in the location after drying.	Supervisor HDC, SRP staff	So that the particulate matter distribution is minimised.	No added cost
	Monitor the stockpile regularly	Supervisor HDC, SRP staff	To ensure proper storage conditions	No added cost
	Establish a buffer zone around the stockpile	Supervisor HDC, SRP staff	To prevent runoff from entering nearby waterways	No added cost
Harvesting from locations	Harvesting must be carried out early in the day.	SRP staff	So that the transportation and transplantation is carried in the late morning and the afternoon respectively.	No added cost
	All material used in the dive needs to be washed prior to the dive.	Harvesting team	So that the team does not become vectors to invisible pathogens.	Training fee + Overtime charges

Activity	Mitigation	Staff responsible	Justification	Cost in MVR
	All harvested must be without visible diseases.	Harvesting team	So that the material moved are without pathogens.	Training fee + Overtime charges
	All staff must be trained to harvest less than 40% of the colony.	Harvesting team	So that the harvested can recover and reproduce.	Training fee + Overtime charges
	All staff must be trained, briefed and re-trained in the harvesting method.	Harvesting team	So that minimum damage is done during harvesting.	Training fee + Overtime charges
Transportation	All staff must be trained in the best practice methods.	Harvesting team	So that the harvest is not lost	Training fee + Overtime charges
	All the staff must be trained to stop and refresh the water periodically.	Harvesting team	To promote proper circulation of the water.	Training fee + Overtime charges
	Proper land transportation must be coordinated.	Harvesting team	To minimise the stress to the harvested.	Training fee + Overtime charges
	Implement proper packing and handling techniques	Harvesting team	To prevent damage to the harvested organisms during transport	Training fee
Planting in the new location	Receptor site must be set with enough buoyant material to hold the harvested in the crates without the placing them on the reef flat.	Reception team	So that sediment do not move into the crates stressing out the harvest.	Training fee + Overtime charges
	Large enough team is required for the reception, and framing	Reception team	So that the harvested are completely framed within the duration	Training fee + Overtime charges
	Establish a monitoring program	Environment unit	To track the success of the planting and ensuring that the new organisms are thriving	No added cost
Fragmenting	Fragmenting must be carried out using clean	SPR team, reception team,	Ensure that the fragments are clean and free if	+3000.00 hammer cost

Activity	Mitigation	Staff responsible	Justification	Cost in MVR
	purpose-built narrow hammers	Operations teams	debris before transplantation	
	Train the staff for fragmentation and framing.	Environment unit	To reduce the risk of damage of the fragments	+ Overtime charges
	Size of the fragments must be to the standard	Environment unit	So that the fragments are farmable	No added cost
	Fragmenting must be carried out by trained staff.	Environment unit	Ensure that the fragments are clean and free if debris before transplantation	No added cost
Transplanting the fragments	The cable tie cuts are to be collected by a designated collector.	Reception team	Waste collection	+1000.00 for general waste management.
	Transportation of the full frames must be carried out by trained staff.	Reception team	To minimise the damage to the frames and to the staff during transportation.	No added cost
	The locations for the frames must be prepared for reception prior to placement.	Environment unit	To maximise all available natural functions.	+ Overtime charges
	The frames must be placed in strategic locations that can favour propagation	Environment unit	To ensure enhanced acclimatisation.	+ Overtime charges
Management	Management is to be carried out by designated staff using a duty schedule.	SRP staff + management team	To ensure regular management	+ Overtime charges
	Minimum management frequency is 3 times a week	SRP staff + management team	Due to the existing conditions at site.	+ Overtime charges
	Management team are to capture photos of the frames and record the difference on slates.	SRP staff + management team	To ensure recording of the growth.	+ Overtime charges
	Regular meetings should be held between management team and Environment unit	Environment unit + Management Team	To discuss any changes or updates to the environmental protocols	No cost added

Activity	Mitigation	Staff responsible	Justification	Cost in MVR
Cleaning	Cleaning of frames to be carried out as a management procedure.	SRP staff + management team	For regular removal of algae, and herbivores.	No cost added
	All cleaning material must be maintained and managed	SRP staff + management team	To minimise the impact on the micro flora and fauna.	+2000.00
	Proper waste management procedures should be followed for the disposal and cleaning material	SRP staff	-	No cost added
Fragment replacement	All fragment replacement must be carried post communication to the environment unit	SRP staff + management team	So that the environment protocols are not breached.	+ 20,000.00
Monitoring	Monitoring must be carried out by designated staff.	SRP unit + monitoring team	So that regular changes are communicated to the SPR unit	+ overtime charges
Health and safety	All marine activities must be carried out with the safety gear in place	SRP unit	To prevent accidents	
	All working staff must have a valid contract with the proponent.	SRP unit	To ensure proper care, financial mitigation, and management in case of a medical accident.	+ overtime charges
	All volunteers must be given a safety briefing and should not be brought on board without a medical staff at location. Emergency response plans should be in place of any accidents	SRP unit	To ensure proper care, financial mitigation, and management in case of a medical accident.	+ overtime charges
	All dive gear must be checked and managed post and pre-dive and must be procured from trusted vendors	SRP unit	To minimise harm to the divers.	No cost added.

9. Management actions

The management actions are presented below. It is important that the management actions are explored.

9.1. Management actions

The management actions are not limited to the actions specified. These are tied to the management actions of the impacts and mitigation measures. Since the management actions are tied to the mitigation measures, staff responsible and the cost of the management action remains the same.

Table 14 Significant management actions

Activity	Management action	Staff responsible
Excavating the site for depth.	Communicate the excavation plan to the excavation team	SRP staff
Heavy machinery movement.	Map out and approve the path of the vehicle movement. Establish a traffic management plan to ensure that the heavy machinery movement does not disrupt traffic flow Ensure all operators of these machinery are trained to reduce safety risks	Supervisor, operations, HDC
Excavation.	Produce a timetable that shows the excavation time and expected output form excavation during the window.	Excavation staff and Supervisor HDC.
	Setup a work monitoring protocol.	Supervisor HDC
	Ensure completion of setting out and ensure Ensure communication of setting out.	Excavation staff and Supervisor HDC.
	Communicate, the limit of tolerance for damages to the geo-skeleton to the supervisor Communicate the pathway for reporting the geo skeleton damages to the supervisor Communicate the possibilities for repair and the quality of repair with the project manager.	Supervisor HDC, SRP staff HDC Environment analyst HDC. Engineer HDC
Stockpile.	Communicate the need for enclosing the stockpile area.	Supervisor HDC
	Inform the need for a dry stockpile to be carried. Inform the need to clean the spill over if it occurs.	Supervisor HDC
	Inform the staff of the particulate matter kickup and prevention.	Supervisor HDC, SRP staff
Harvesting from locations	Inform the team of the need for an early event. Set up the schedule early in the day.	SRP staff
	Inform the divers of the concern. Plan to rinse the material accordingly.	Harvesting team
	Make sure that the harvested are checked prior to removal.	Harvesting team
	Train all staff on the protocol; harvest less than 40% of the colony.	Harvesting team
	Train and re-train all staff on the protocol for harvesting	Harvesting team
Transportation	Train all staff on the protocol; in the best practice methods of transportation.	Harvesting team
	Train all staff to stop and refresh the water periodically.	Harvesting team
	Communicate the transportation with the transportation team.	Harvesting team

Activity	Management action	Staff responsible
	Ensure the preparedness of the transportation team by the time the harvesting team dock on location.	
Planting in the new location	Communicate the plan with the propagation team. Ensure preparedness with the propagation team.	Reception team
	Communication of the reception procedure with the reception team.	Reception team
Fragmenting	Train all staff to carry out fragmenting using clean purpose-built narrow hammers	SPR section, reception team, Operations teams
	Train all staff on the protocol for fragmentation and framing.	Environment unit
	Train all staff on the protocol for standardising the size of the fragments	Environment unit
	Ensure that the staff understand that fragmenting must be carried out by the staff.	Environment unit
Transplanting the fragments	Ensure establishment of waste management team and protocol on site	Reception team
	Set up trained divers in place trained to carry the frames.	Reception team
	Communicate preparation of the placement location early in the day. Preferably simultaneously with the harvesting team	Environment unit
	Map out the location for placement of the frames.	Environment unit
Management	Procure services of a party of the management of the project.	SRP staff
	Identify and assign management staff.	SRP staff + management team
	Ensure enough staff are employed for the function.	SRP staff + management team
	Ensure that the staff are briefed of this requirement. Train the staff in naming and recording the photos.	SRP staff + management team
Cleaning	Ensure informing the staff of the need for cleaning. Ensure training the staff of the procedure.	SRP staff + management team
	Inform the staff of the waste management procedure for the process.	SRP staff + management team
Fragment replacement	Train the staff the of the replacement procedure.	SRP staff + management team + Environment Team
Monitoring	Assign staff for the monitoring process as per the regulation.	SRP section + monitoring team
Health and safety	Procure safety gear.	SRP section
	in the project are engaged to the Ensure all staff and other parties involved project through a legal agreement / understanding with the proponent so that medical is covered by the proponent.	SRP section + Health and Safety Unit

Activity	Management action	Staff responsible
	No volunteers should be asked to carry out any task of a contract staff. All non-staff volunteers should come into the project through the parties with a legal contract. All volunteers must be informed of the risks and lack of medical coverage for volunteers by the proponent apart form first aid.	
	Employee a trained medical staff.	SRP section + Health and Safety Unit + HR
	Request for the aid of organisations such as Maldivian red crescent.	SRP section
	Inform the staff to do a gear check at every juncture.	SRP section
Miscellaneous	All event management must be carried out considering refreshments, food and beverages and other basic necessities	SRP section

10. Alternatives

After consulting the proponent, and the stakeholders the following alternatives are proposed.

10.1. No project options

The no development option considers,

- No project options
- Alternative method of propagation
- Alternative site in the channel in between the two phases,
- Alternative site at the entrance channel

Action	Advantages	Disadvantages
No project option		
No excavation on site	No sediment plume No beach erosion No beach sediment shift No enhanced chance of damage to the geo skeleton.	Benthic topography; depth, does not support the divers and the frames
No harvesting on the sourcing site	No stress to on the coals due to the harvesters and harvesting	The area is in the impact footprint of reclamation, there is a chance of loss during reclamation.
No coral frames on site	No added obstacles and chance in the reef use.	No value added to the activities on site.
No enhancement of economic activities on site	No diversity of citizen science activities on site.	Lost economic diversity option.

The no development options are sound options that has advantages such as retention of the existing environmental conditions. At the same time, this removes the potential to expand the economic activities on the beach.

10.2. Alternative options

The following details the alternatives proposed.

10.2.1. Alternative method of propagation

This alternative is an alternative for the methodology. This alternative explores direct planting of the fragments to the substrate. Direct planting requires drilling the substrate and using an adhesive attaching the fragment on the reef flat hard substrate.

10.2.2. Alternative site in the channel in between the two phases,

This proposes to carry out the same project in the channel area. The channel are has an approximate depth of 2m deep and is subjected to the changing currents daily.

10.2.3. Alternative site at the entrance channel

This method proposes to carry out the project at the entrance channel. The entrance channel flat is 2m deep.

10.3. Analysis

Analysis was carried out giving a grade to each alternative on the basis of the technical feasibility, economic feasibility, and environmental outlook. All scores were considered giving importance to the existing environment.

The following table analyses the alternatives. And the table below grades the alternatives to look into preferences.

Table 15 Analysis of the alternatives

Alternative proposed	Technical feasibility	Economic feasibility	Environmental outlook
Alternative method of propagation	This alternative is technically possible. Enough substrate is present on site to carry out the methodology. However, this requires major substratum movement and limits the possibility of movement of the corals.	The cost of this change will be high. Hence, economically not feasible.	The substratum method has advantages that will benefit ecological functions for the region, but on this reef flat, may not be the best method due to factors such as tide, anthropological factor, and wave energy.
Alternative site in the channel in between the two phases,	Technically this limits the rate of work as all work hours will be limited to the calm in between the tides.	This assumes the methodology as being the same as the initial proposal. Hence, there is no cost added. However, this removes the possibility for any economic activity, as safety will be an issue.	The proposed location with the high current, and the proposed shifting tides daily, can be ideal for the success of the project.
Alternative site at the entrance channel	Technically this limits the rate of work and adds the expense of transportation.	This assumes the methodology as being the same as the initial proposal. Hence, there is no cost added. Further, this adds the possibility of economic activity for other dive institutions. but, limits the range of the local vendors on the eastern beach.	The proposed location with the shifting current, and the shifting tides daily, can be ideal for the success of the project.

Table 16 grading of the alternatives

Alternative proposed	Technical feasibility	Economic feasibility	Environmental outlook	Sum	Percentage
No project option	**5**	**5**	**5**	15	100
Alternative method of propagation	3	2	5	10	67
Alternative site in the channel in between the two phases,	1	1	3	5	33
Alternative site at the entrance channel	1	3	3	7	47

10.4. Preference

The highest score for the project was from the no project option as it is the most technically feasible, economically feasible as it avoids the cost and environmentally feasible as it prevents damage to the project location. However, it is dismissed as the proponent wishes to carry out the project and takes the component as a baseline.

The alternative method of propagation can be explored as it is the most technically, financially and environmentally sound proposal.

Among the alternative sites for propagation, the entrance channel will be preferred over the channel between the two phases due to the advantage over accessibility and safety.

11. Environmental Monitoring

The monitoring process is essential to all projects. The monitoring process will determine the level of change during the proposed work, and after the work is done. This also allows the proponent to adjustthe methodology depending on the changes observed.

The parameters that are required to be monitored for the project activities are included in the monitoring plan. The objective of the monitoring plan is to monitor and control the environmental effects of the proposed project Therefore, it is highly recommended that the contractor carries out the monitoring plan and present the report to EPA.

The major monitoring requirements are

A monitoring one month after the work commences. Followed by a monitoring every three months throughout the construction phase. And a monitoring every 6 months after completion. For one year. The details are in below

Table 17 monitoring requirements and costing

Monitoring requirement	**Parameter**	**Baseline**	**Method / technique**	**Frequency**	**Estimated cost**
Periodic monitoring to see changes in currents in the excavation zone.	Currents	Survey drogue data and local knowledge	Regular drogue	Every three months after construction up to one year Once an year for five years.	1500.00
Regular monitoring to using ATS images check the changes in costal morphology.	Costal Morphology	Study baseline beach patterns and construction phase work data	ATS image and secondary data on set	Every three months after construction up to one year Once an year for five years.	90000.00
Check to see if the sand moves into the excavated zone					
Regular monitoring to check the extent of sand and change in volume	Costal Morphology and beach profiles	Pre-excavation bathymetry			
Regular monitoring as specified to check changes in the breach profile	Beach profiles over the seasons	Survey profiles and construction phase work profiles.	ATS survey Profiles on set.		
Regular monitoring as specified to check changes in the path.	Foot path impact	Post construction monitoring	ATS images And on site imagery	Every three months after construction up to one year Once an year for five years.	5000.00

Monitoring requirement	Parameter	Baseline	Method / technique	Frequency	Estimated cost
Regular monitoring for sedimentation and increased turbidity.	Sedimentation and turbidity	Baseline sedimentation And turbidity data	Sediment traps Water samples	Every other month during construction.	20000.00
Regular monitoring of baseline benthic conditions	Benthic conditions	Baseline data	Reef check CPCE data	Every other month during construction Every three months after construction up to one year Once an year for five years.	15000.00
Check monitoring; baseline ground water.	Ground water table	Baseline data	MWSC tests and probe		
Ensure that proper waste management practices are present on site	Waste management	**	Visual observations Walk abouts interviews	Every other month during construction Every three months after construction up to one year Once an year for five years	

11.1. Monitoring costs

The proponent shall bear the cost of the monitoring. The proponent is to employ competent monitors, to complete the monitoring procedure as per the schedule. The estimated costs are not a fixed value and should be considered as a reference to the monitoring party.

11.2. Monitoring report format

The following is the monitoring report format expected for this project. The report will include details of the site, data collection and analysis methodologies, sampling frequency, and analysis. All data collected in the monitoring period shall be presented in the monitoring without bias.

Introduction
- Aims and Objectives

Existing conditions
- Terrestrial Environment (vegetation, groundwater)
- Coastal Environment (shoreline, currents, bathymetry)
- Marine Environment (coral reef heath)

Comparison with EIA Baseline Data

Impact Monitoring
- Ground water and seawater Quality
- Impacts on nearby habitats

Compliance Monitoring
- Water Quality monitoring
- Waste monitoring

Conclusion and Recommendations

12. Recommendation Conclusion

1. The methodology proposed in the project is the Mars Assisted Reef Restoration System for coral propagation. The system was chosen by the proponent as the system is cheap during the implementation and has a smaller footprint which is ideal for the scale of the project. Since the system is cheap in the implementation stage, the methodology is recommended.
2. the location for the project was a major point of discussion for the proponent with the stakeholders and experts. After weighing the pros and cons of the proposed development location, although the location is not ideal, if the project is to have a major social outreach component, and if the locals are to take ownership of the project, the proposed location can be used for the project given that the depth is attained by excavation. The depth of the location is likely to favour the chances of survival for the project. Hence, if the project is to proceed in this location, excavation is recommended.
3. During excavation, sedimentation is considered inevitable. The sediment must be contained at all costs. The mitigation and management measures address the impact. It is recommended for the proponent to mitigate the sediment spread as specified by the consultant.
4. At the stockpile location, if the proponent ignores the specific mitigation actions specified, it is likely that the locals on site will be impacted. It is recommended that the proponent follows the mitigation actions and move the stockpile to the location in the specified manner, at the specified time.
5. One of the goals of the project by the proponent is to enhance the socio-economic environment for the locals through the project. it is recommended for the proponent to stay true to the goal and engage the local community at the earliest.
6. Staff are recommended prevent volunteers from carrying out work specified to staff, and legally engaged parties as the proponent will not be able to provide health care apart form first aid for event / operation related injuries.
7. Since the project deals with living organisms, timing of the project accordingly is critical to the success of the project. Therefore, it is recommended that the management team communicate, simulate and evaluate the steps involved in harvesting and propagation.
8. The management will be extremely challenging for the project due to the environment. It is recommended that the proponent employee staff specifically for the management process to ensure success of the project.
9. It is recommended that the proponent specifically carry out the specified monitoring protocol for the project.
10. The project is an effort by the proponent to establish a hard-coral rich area that can further enhance the diversity of marine life, including fish, and other species that exist within the vicinity. This is also an effort by the proponent to increase the economic and social activities of the island which helps with reaching some of the major development objectives of the company. The proposed project if implemented, develops a much needed and accessible area for public programs that raise awareness on marine life and

tourism growth. If the project is to be implemented, it must be due to the potential for the project to provide social benefits to the local community.

13. Bibliography

Bayraktarov, E., Stewart Sinclair, P. J., Brisbane, S., Boström-Einarsson, L., Saunders, M. I., & Lovelock, C. E. (2019). Motivations, succes sand cost of coral reef restoration. *Restoration Ecology*, 981-999.

Brook, I., Coolbaugh, J. C., & Willscroft, R. G. (1982). Effect of Diving and Diving Hoods on the Bacterial Flora of the External Ear Canal and Skin. *JOURNAL OF CLINICAL MICROBIOLOGY*, 885-859.

H.C.P. Bell, C. (1940). *The Maldive islands. Monograph and the History, Archeology, and Epigraphy*. Colombo: Celon Govermnent Press.

Hawkins, J. P., & Roberts, C. M. (1992). Effects of recreational SCUBA diving on fore-reefslope communities of coral reefs. *Biol.Conserv*, 171-178.

Hawkins, J. P., & Roberts, C. M. (1993). Effects of recreational scuba diving on coral reefs: trampling on reef-flat communities. *J. Appl Ecol*, 25-30.

Hawkins, J. P., Roberts, C. M., Van'T Hof, T., De Meyer, T., Tratalos, J., & Aldam, C. (1999). Effects of recreational scuba diving on Caribbean coral and fish communities. *Conserv. Biol*, 888-897.

Hein, M., McLeod, I., Shaver, E., Vardi, T., Pioch, S., Boström-Einarsson, L., . . . Grimsditch, G. (2020). *Coral Reef restoration as a strategy to improve exosystem services; A guide to coral restoration methods.* United Nations Environment Programme.

Horoszowski-Fridman, Y. B., & Rinkevich, B. (2020). Active coral reef restoration in Eilat, Israel: Reconnoitering the long-term prospectus. *D. Vaughan (ed.) Active Coral Restoration*.

Kench, P. (2010). *Costal monitoring, reef island shoreline dynamics and management implications.* Male', Maldives.: Government of Maldives, MNPHI, MTCA, EPA.

Lamb, J. B., & Willis, B. L. (2011). Using coral disease prevalence to assess the effect of concentrating tourism activities on offshore reefs in a tropical marine park. *Conserv. Biol.*, 1044-1052.

Leopold, L. B., Clarke, F. E., Hanshaw, B. B., & Baisiey, J. R. (1971). *A procedure for evaluvating environmental impacts.* Washington: US Geological Survey.

Maldives Meteorological Service. (2019). Retrieved from http://www.meteorology.gov.mv/

NASEER, A. (2003). *The integrated growth response of coral reefs to environmental forcing: morphometric analysis of coral reefs of the Maldives. PhD,.* Dalhousie University.

Naseer, A., & Hatcher, B. (2000). Assessing the integrated growth response of coral reefs to monsoon forcing using morphometric analysis of reefs in the Maldives. *Proceedings 9th* (pp. 23-27). Bali, Indonesia: International Coral Reef Symposium.

National Bureau of Statitics . (2019). *National Bureau of Statitics* . Retrieved from Stastical Yearbook of Maldives : http://statisticsmaldives.gov.mv/yearbook/2019/#

Rudie, K. H., & Tim, G. (2014). *Fishies of the Maldives.* Cairns, Australia: Atoll Editions.

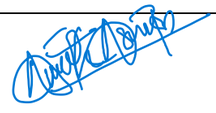
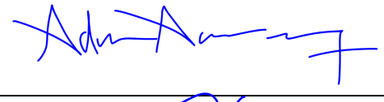
Saaneez, A., Abdul Muhsin, H., & Abdulwahhaab, M. (2019). *Second Addendum to the EIA lot the Prcposed Hdbour Re- Development Proiect at Kelaa, Haa Atoll.* Male, Maldives: Ministry of environment, Maldives.

UNISDR-ADRRN. (2005). *Building Resilience to Tsunamis in the Indian Ocean Base Line Study Report, Shaviyani Atoll, Maldives.* UNDP.

Wolf H . Hilbertz, T. J. (1996). Method of enhancing the growth of aquatic organisms, and structures created thereby.

Wood, E. (2015). *Impact of sunscreen on coral reefs.* Government of Sweden. Retrieved from https://www.icriforum.org/wp-content/uploads/2019/12/ICRI_Sunscreen.pdf

14. Team and role

Component covered or role	Name	Government issued licence	Category	Contact	Signature
Non-technical Summery Introduction to the ESIA Description of the proposed project Stakeholder's consultation Policy and legal framework Description of the environment Potential Impacts Mitigation of the negative impacts Management actions Alternatives Environmental Monitoring	Hassaan Abdul Muhsin	EIA P02/2020	A	7901665 hassaanabdulmuhsin@gmail.com	
Description of the environment	Mariyam Sunaina Mohamed	EIA T(B)01/2023	B	9873819 17sunai@gmail.com	
Non-technical Summery • Dhivehi and English compilation Description of the proposed project • Methodology analysis Stakeholder's consultation • Community Surveying • Result analysis	Hashma Hameed	-	-	7632012 hashmahameed@gmail.com	
All GIS works	Mahaath Abdulla	-	-	7244444 Mahaath.adbulla@gmail.com	
Project formulation Stakeholder's consultation • Community Surveying • Result analysis	Zulaikha Shabeen	-	-	7762289	
Project formulation Stakeholder's consultation • Community Surveying • Result analysis	Uza. Aishath Ashiya Shathir	PL-2023/13	-	9191949 aishathshathir@gmail.com	
Detail drawings	Adam Ameen	-	-	9371717	
Detail drawings	Mohamed Samah Mohamed	HPR2020354AR	-	9900036	

15. Appendix

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

15.1. Appendix TOR

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

No: 203-ECA/161/2022/30

Terms of Reference for Environmental Impact Assessment for Reef Scaping Project at Eastern beach Hulhumale, Kaafu Atoll, Maldives.

The following is the Terms of Reference (ToR) for undertaking the EIA of the **Proposed Reef Scaping Project at Eastern Beach at Hulhumale', Kaafu Atoll, Maldives.** The project proponent is **Housing Development Corporation**. The EIA consultant for the project is **Mr. Hassaan Abdul Muhsin (EIA P02/2020).**

While every attempt has been made to ensure that this TOR addresses all of the major issues associated with development proposal, they are not necessarily exhaustive. They should not be interpreted as excluding from consideration matters deemed to be significant but not incorporated in them, or matters currently unforeseen, that emerge as important or significant from environmental studies, or otherwise, during the course of preparation of the EIA report.

1. **Introduction and rationale –** Describe the purpose of the project and, if applicable, the background information of the project/activity and the tasks already completed. Objectives of the development activities should be specific and if possible quantified. Define the arrangements required for the environmental assessment including how work carried out under this contract is linked to other activities that are carried out or that is being carried out within the project boundary. Identify the donors and the institutional arrangements relevant to this project.

2. **Study area –** Submit a minimumA3 size scaled plan with indications of all the proposed infrastructures. Specify the agreed boundaries of the study area for the environmental impact assessment highlighting the proposed development location and size. The study area should include adjacent or remote areas, such as relevant developments and nearby environmentally sensitive sites (e.g. coral reef, sea grass, mangroves, marine protected areas, special birds' site, sensitive species nursery and feeding grounds).

3. **Scope of work** – The report should be categorised to the following components:

Task 1. Description of the proposed project – Provide a full description and justification of the relevant parts of the project work. The following should be provided (all inputs and outputs related to the proposed activities shall be justified):

- Project Justification
- Environmental monitoring during construction activities;
- Measures to protect environmental values during construction and once work is complete.
  Project management (include scheduling and duration of the project and life span of facilities; communication of construction details, progress, target dates, construction/operation/closure of labour camps, access to site, safety, equipment and material storage, fuel management and emergency plan in case of spills)

Master Plan Design Concept

a) Provide concept design of the coral nursery

Project Schedule

a) Provide a schedule outlining the proposed phasing, sequencing and duration of the components, including:
b) Key factors controlling the schedule and uncertainties relating to the project

Construction and Installation of Coral Nursery

a) Type of material and design of the nursery
b) Installation method
c) List of proposed harvest species, justification of the proposed species, how the proposed species will maintain the species diversity of the area.
d) harvesting area for fragments

Construction Management

a) Construction Waste Management
b) Description of the utility providers during construction and operation stage Waste management plan during operational phase

Task 2. Description of the environment – Assemble, evaluate and present the environmental baseline study/data regarding the study area and timing of the project (e.g. monsoon season). Identify baseline data gaps and identify studies and the level of detail to be carried out by consultant. Consideration of likely monitoring requirements should be borne in mind during survey planning, so that data collected is suitable for use as a baseline. As such all baseline data must be presented in such a way that they will be usefully applied to future monitoring. The report should outline detailed methodology of data collection utilized.

The baseline data will be collected before construction and from at least two benchmarks. All survey locations shall be referenced with Geographic Positioning System (GPS) including water sampling points, reef transects, vegetation transects and manta tows sites for posterior data comparison. Information should be divided into the categories shown below:

Climate

- Seasonal climate variations
- Temperature, rainfall, wind, waves and current patterns

Geology and geomorphology

- Bathymetry of the proposed reef scaping location (use maps);
- Offshore/coastal geology and geomorphology (use maps);

Hydrography/hydrodynamics (use maps)

- Tidal ranges and tidal currents;
- Wave climate and wave induced currents;
- Wind induced (seasonal) currents
- Sea water quality measuring these parameters: temperature, pH, salinity, Electrical Conductivity, coral cover at the proposed nursery sites, coral garden sites and a control location.

Biological Environment

- Coral cover at the proposed nursery sites, coral garden sites and a control location.
- Identify marine protected areas (MPAs) and sensitive sites such as breeding or nursery grounds for protected or endangered species (e.g. coral reefs, spawning fish sites, nurseries for crustaceans or specific sites for marine mammals, sharks and turtles). Include description of commercial species, species with potential to become nuisances or vector, and
- Quantitative benthic cover and fish census assessment of the house reef.

Hazard vulnerability:

- Risk of hurricane and storm surges;
- Vulnerability of area to flooding and storm surge.

Absence of facilities in the country to carry out the water quality tests will not exempt the proponent from the obligation to provide necessary data. The report should outline the detailed methodology of data collection utilized to describe the existing environment.

Task 3. Legislative and regulatory considerations – Identify the pertinent legislation, regulations and standards, and environmental policies that are relevant and applicable to the proposed project, and identify the appropriate authority jurisdictions that will specifically apply to the project. Legal requirements:

- Permit from Ministry of Fisheries, Agriculture and Marine Resources

Task 4. Potential impacts (environmental and socio-cultural) of proposed project, incl. all stages – The EIA report should identify all the impacts, direct and indirect, during and after construction, and evaluate the magnitude and significance of each. Particular attention shall be given to impacts associated with the following:

Impacts on the natural environment

- Loss of marine habitat, in the harvest area and propagation area due to the project.;
- Impact on coral reefs and benthic communities and affecting fish and shellfish etc.;
- Impacts of noise, vibration and disturbance;
- Impacts on unique or threatened habitats or species (coral reefs, sea turtles etc.), and
- Impacts on landscape integrity/scenery.

Impacts on the socio-economic environment

- Impacts of this project on the public, stakeholders and tourism ventures nearby.
- Impact of employment and income, potential for the locals due to the project

Construction related hazards and risks

- Pollution of the natural environment (e.g. oil spills, discharge of untreated waste water and solid waste, including construction waste);
- Risk of accidents and pollution on workers and local population, and
- Impacts on social values, norms and belief due to presence of components of the project / workers on local population.

The methods used to identify the significance of the impacts shall be outlined. One or more of the following methods must be utilized in determining impacts; checklists, matrices, overlays, networks, expert systems and

professional judgment. Justification must be provided to the selected methodologies. The report should outline the uncertainties in impact prediction and also outline all positive and negative/short and long-term impacts. Identify impacts that are cumulative and unavoidable.

Task 5. Alternatives to proposed project – Describe alternatives including the *"no action option"* should be presented. Determine the best practical environmental options. Alternatives examined for the proposed project that would achieve the same objective including the "no action alternative". This should include but not limited to alternative sites, alternative equipment/machinery, and alternative containment measures. All alternatives must be compared according to international standards and commonly accepted standards as much as possible. The comparison should yield the preferred alternative for implementation. Mitigation options should be specified for each component of the proposed project.

Task 6. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. These will include both environmental and socio-economic mitigation measures with particular attention paid to sedimentation control, and future changes in coastal processes. Measures for both construction and operation phase shall be identified. Cost the mitigation measures, equipment and resources required to implement those measures. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included.

Task 7. Development of monitoring plan -Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan. Ecological monitoring will be submitted to the EPA to evaluate the damages during construction, after project completion and every six months thereafter, up to one year and then on a yearly basis for two years after. The baseline study described in task 2 of section 2 of this document is required for data comparison. Detail of the monitoring program including the physical and biological parameters for monitoring, cost commitment from responsible person to conduct monitoring in the form of a commitment letter, detailed reporting scheduling, costs and methods of undertaking the monitoring program must be provided.

Task 8. Stakeholder consultation, Inter-Agency coordination and public/NGO participation) – Identify appropriate mechanisms for providing information on the development proposal and its progress to all stakeholders, government authorities such as MOT engineers/designers, development managers, staff and members of the general public. The EIA report should include a list of people/groups consulted, their contact details and summary of the major outcomes.

1. ERC Section (EPA)
2. Maldives Marine Research Institute (MMRI)

Presentation- The environmental impact assessment report, to be presented in digital format, will be concise and focus on significant environmental issues. It will contain the findings, conclusions and recommended actions supported by summaries of the data collected and citations f or any references used in interpreting those data. The environmental assessment report will be organized according to, but not necessarily limited by, the outline given in the Environmental Impact Assessment Regulations, 2012 and the subsequent amendments.

Timeframe for submitting the EIA report – The developer must submit the completed EIA report within 12 months from the date of this Term of Reference.

25th December 2022

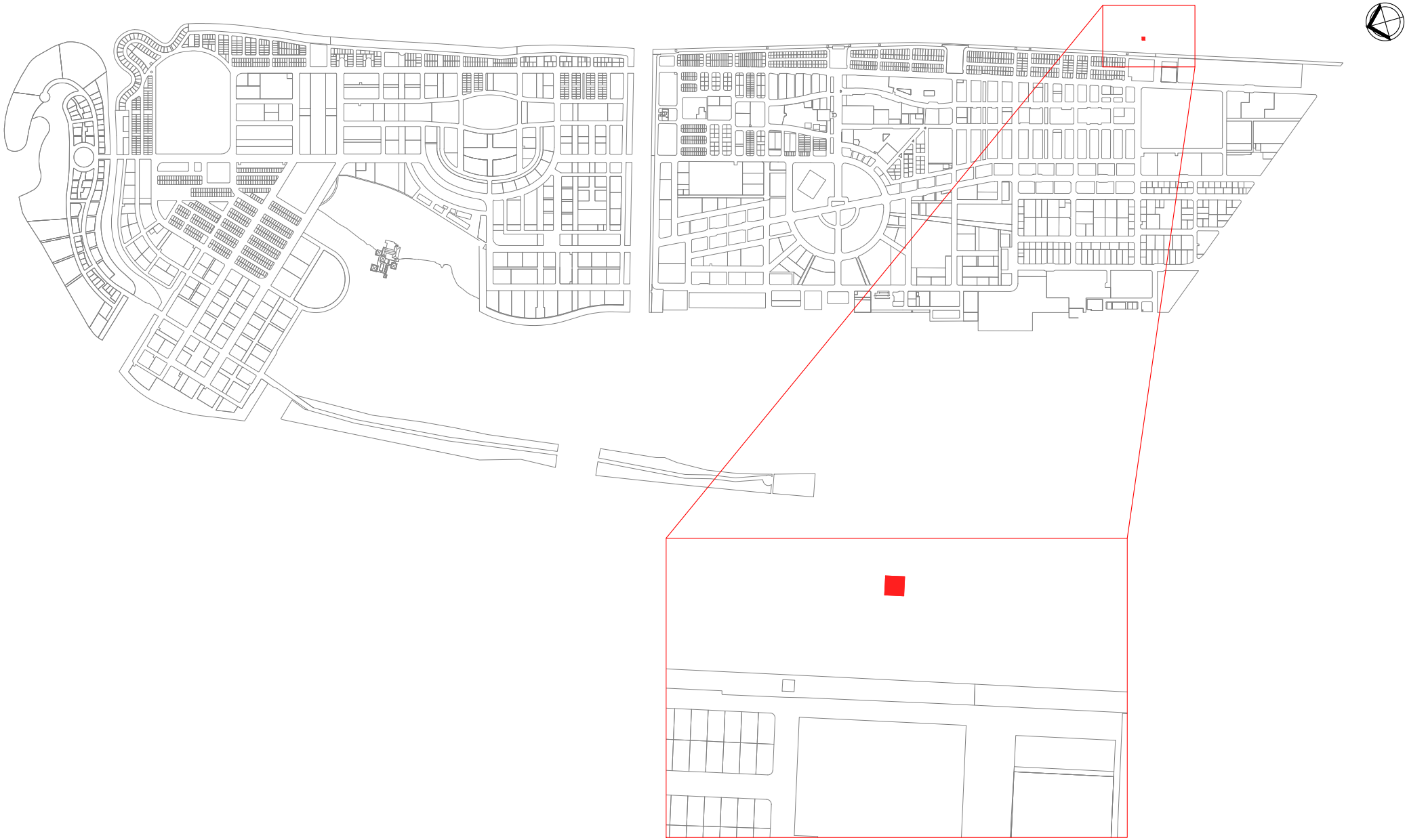
ENVIRONMENTAL PROTECTION AGENCY Male', Rep of Maldives

Appendix Concept drawings and Technical drawings

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

urbanco



PROJECT: REEFSCAPE - SNORKELING POINT

DRAWING: LOCATION MAP

Scale: N.T.S

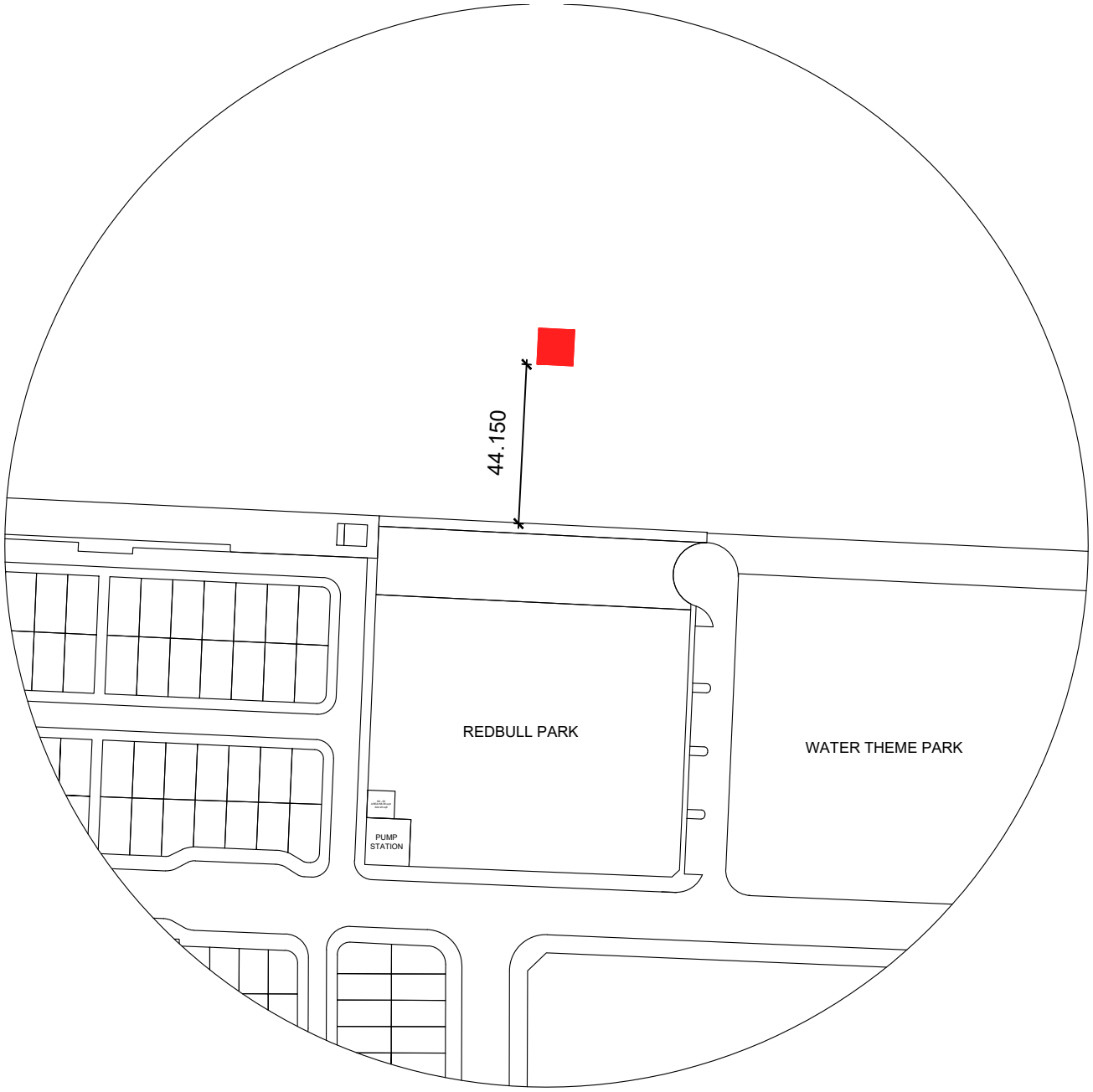
Drawn by: Ziya

Checked by:

Date: 11th January 2023

Remarks:

HOUSING DEVELOPMENT CORPORATION
PLANNING AND DEVELOPMENT DEPARTMENT
3RD FLOOR, HDC BUILDING HULHUMALE'
REPUBLIC OF MALDIVES
TEL. +(960)3353535, FAX +(960)3358892
EMAIL : planning@hdc.com.mv



PROJECT: REEFSCAPE - SNORKELING POINT

DRAWING: SITE CONTEXT PLAN

Scale: N.T.S

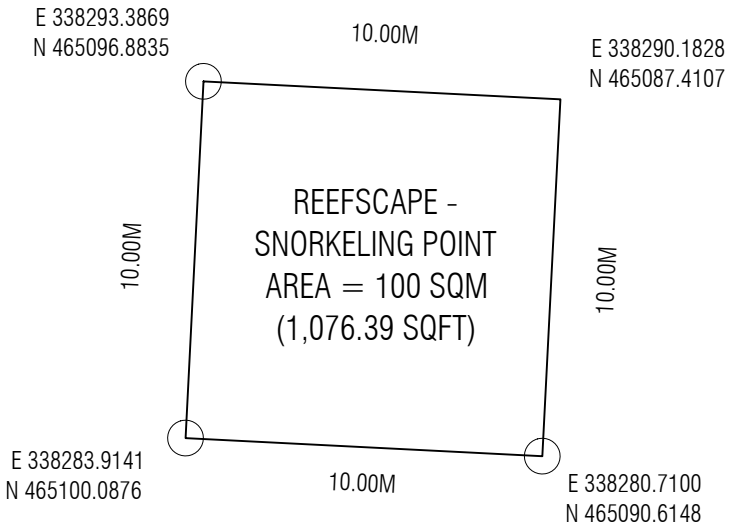
Drawn by: Ziya

Checked by:

Date: 11th January 2023

Remarks:

HOUSING DEVELOPMENT CORPORATION
PLANNING AND DEVELOPMENT DEPARTMENT
3RD FLOOR, HDC BUILDING HULHUMALE'
REPUBLIC OF MALDIVES
TEL. +(960)3353535, FAX +(960)3358892
EMAIL : planning@hdc.com.mv



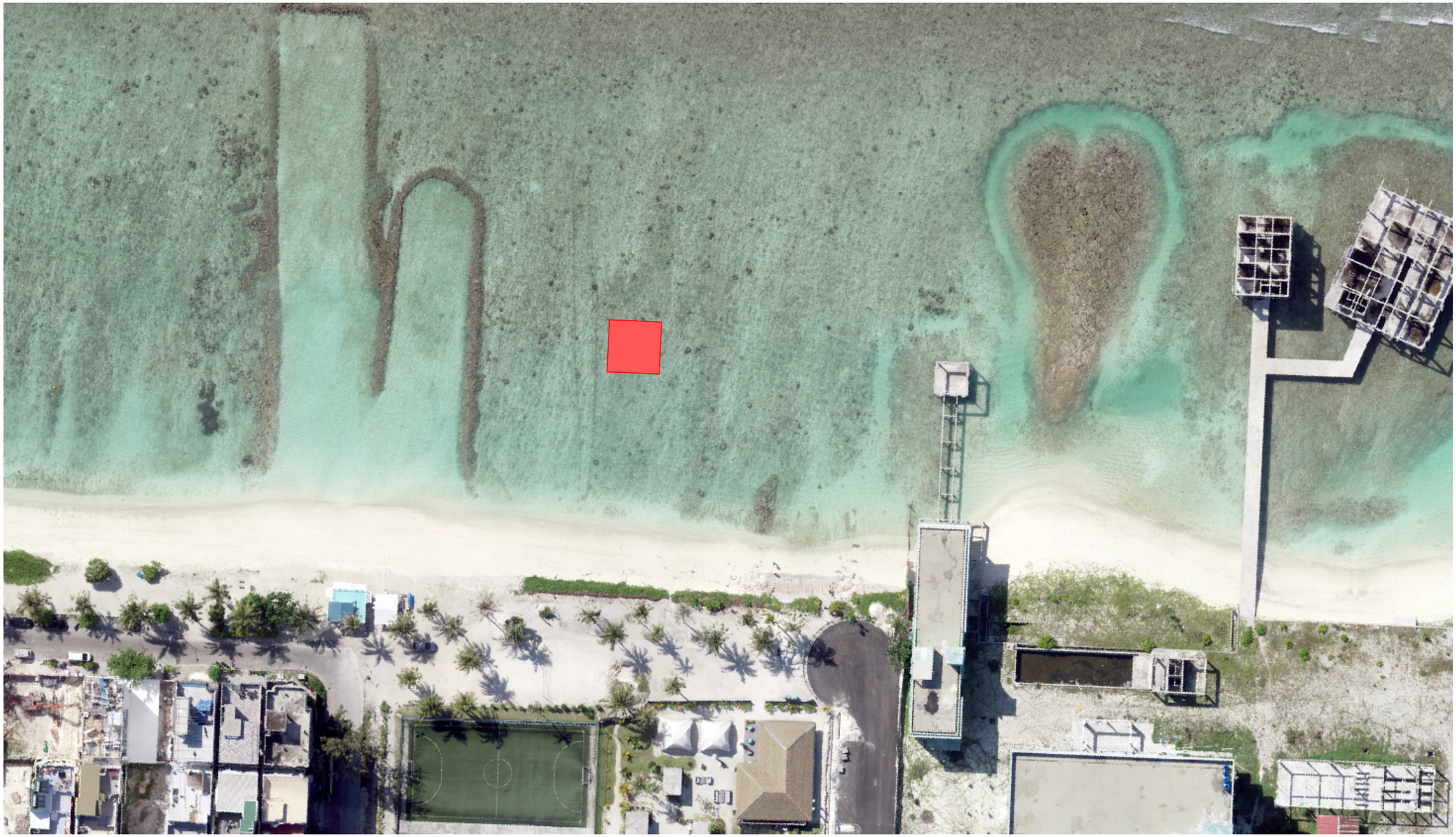
NOTE: PLEASE NOTE THAT THIS IS NOT A SURVEYED MAPS. THE COORDINATES ARE SUBJECT TO CHANGE.
DEPTH OF EXCAVATION: 2M

PROJECT: REEFSCAPE - SNORKELING POINT

DRAWING: PLOT MAP

Scale: N.T.S | Drawn by: Ziya | Checked by: | Date: 11th January 2023 | Remarks:

HOUSING DEVELOPMENT CORPORATION
PLANNING AND DEVELOPMENT DEPARTMENT
3RD FLOOR, HDC BUILDING HULHUMALE'
REPUBLIC OF MALDIVES
TEL. +(960)3353535, FAX +(960)3358892
EMAIL : planning@hdc.com.mv



0 3.25 6.5 13 19.5 26
Meters

DRAWING: REEFSCAPE SNORKELING PROJECT

Scale: 1:747 | Drawn By: Affaan | Checked By: | Date: 11/01/2023 | Remarks:

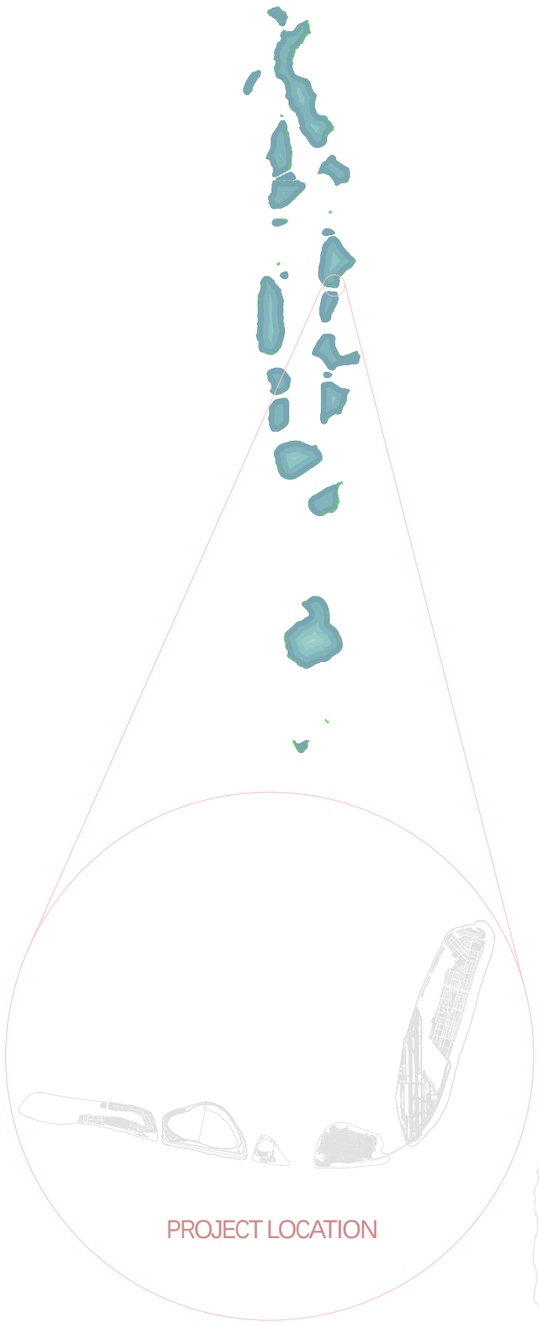
HOUSING DEVELOPMENT CORPORATION
PLANNING AND DEVELOPMENT
3RD FLOOR, HDC BUILDING,
HULHUMALE', MALDIVES
TEL: +9603353535, FAX:+960 3358892
EMAIL: planning@hdc.com.mv

15.2. Appendix Maps

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

urbanco

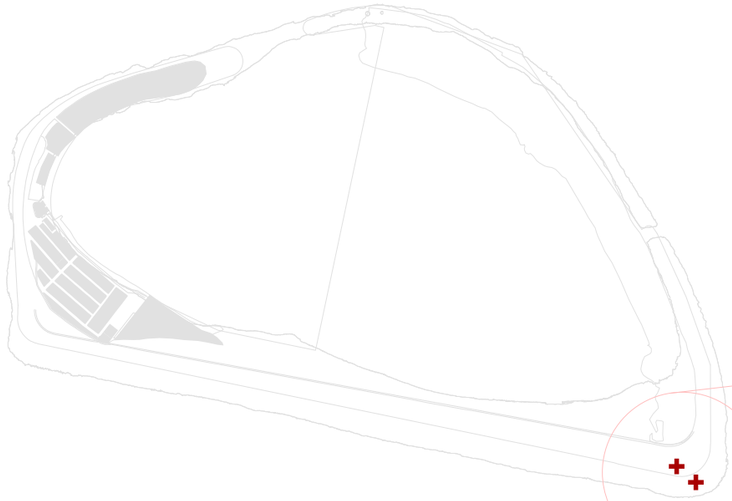


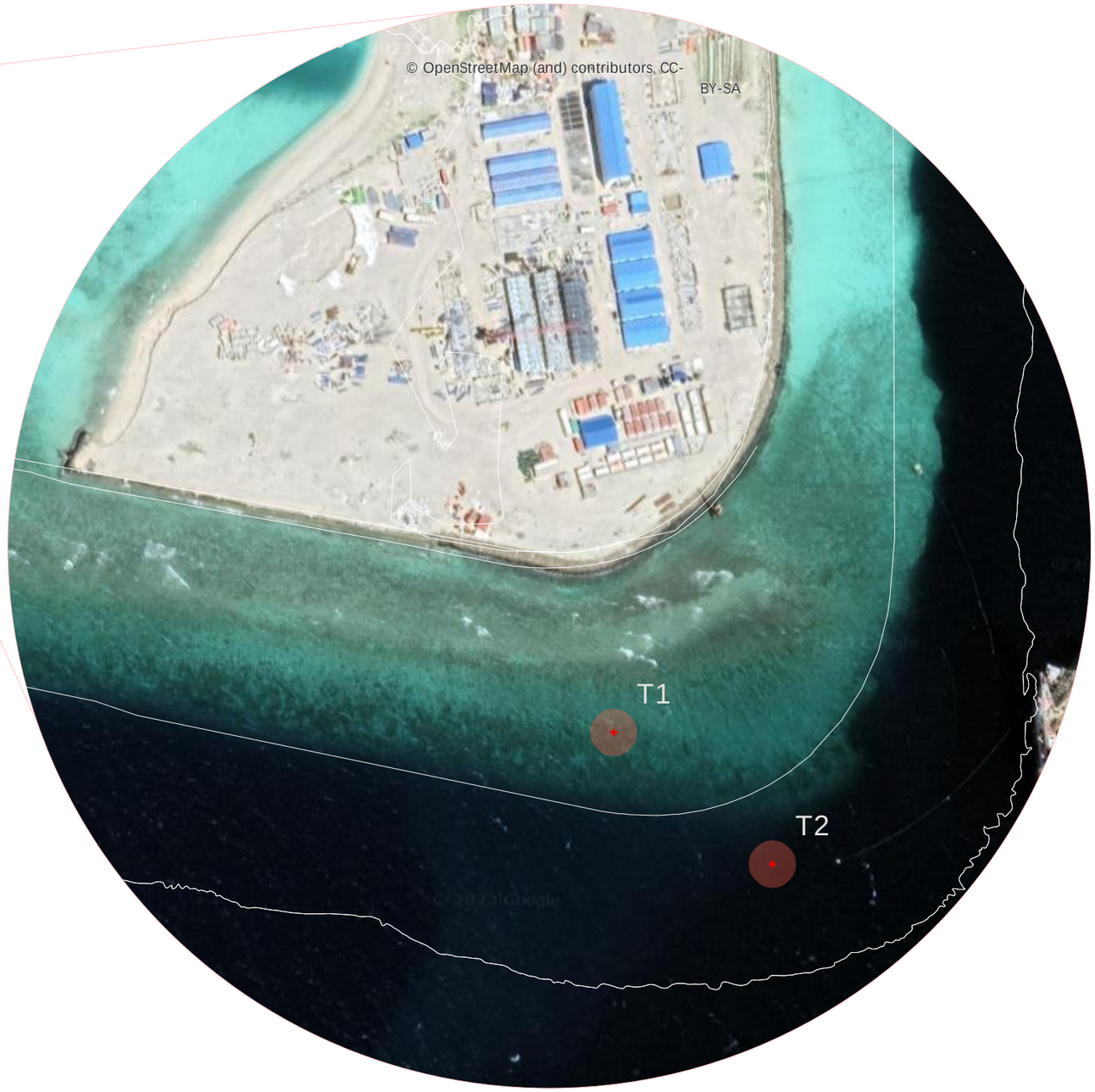
0 2 5 550 1,100 1,650 2,200
M t rs

DRAWING: REEFSCAPING PRO ECT SCOPE

Scal : 1:3 ,000 | Dra n B : Mahaath | Ch c d B : | Dat : 4 12 2023 | R mar s:

urbanco
GIS MAPPING & SURVEYING
URBAN PLANNING DEPARTMENT
HOUSING DEVELOPMENT CORPORATION





POINT	UTM EASTING	UTM NORTHING
T1	331,042	461,243
T2	331,118	461,180

0 15 30 60 90 120 Meters

DRAWING: PROPOSED HARVESTING SITE- GULHIFALHU PHASE II

Scal : 1:2,564 | Dra n B : Mahaath | Ch c d B : | Dat : 4 13 2023 | R mar s:

urbanco
GIS MAPPING & SURVEYING
URBAN PLANNING DEPARTMENT
HOUSING DEVELOPMENT CORPORATION

POINT	UTM EASTING	UTM NORTHING
A1	338,301	465,054
A2	338,322	465,076

0 4. 59.5 19 28.5 38
M t rs

DRAWING: PROPOSED PROPAGATION SITE - HULHUMAL SOUTH EAST SIDE

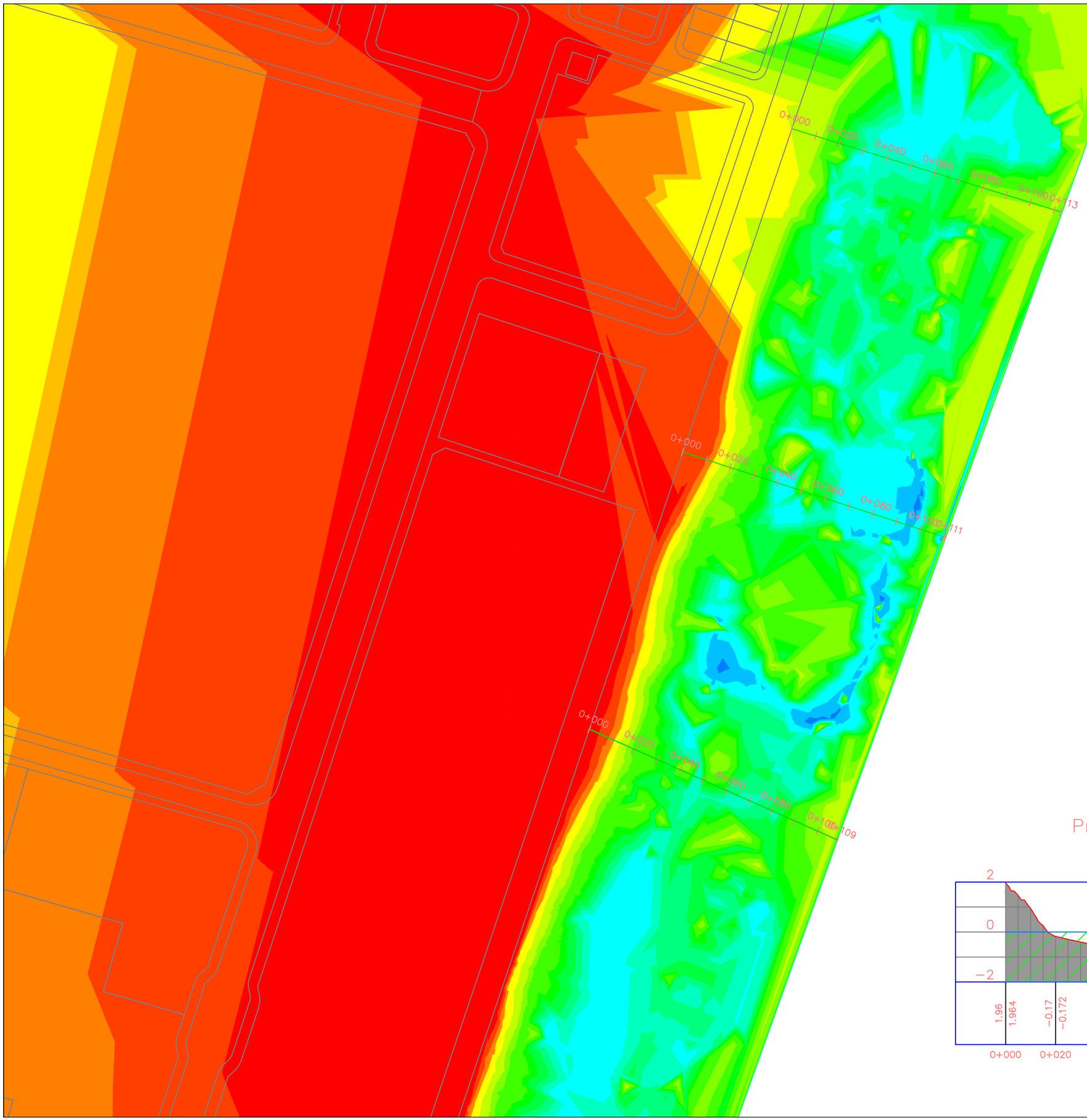
Scal : 1:800 | Dra n B : Mahaath | Ch c d B : | Dat : 4 1 2023 | R mar s:

urbanco
GIS MAPPING & SURVEYING
URBAN PLANNING DEPARTMENT
HOUSING DEVELOPMENT CORPORATION

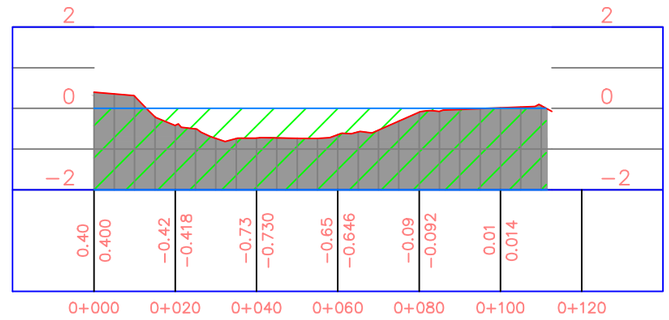
15.3. Appendix Profiles

Urban planning department,
GIS and Survey,
Environment Unit

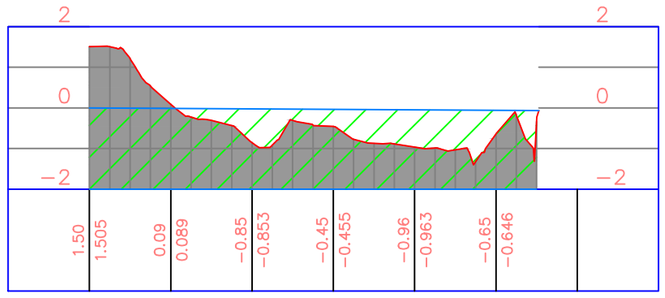
Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives



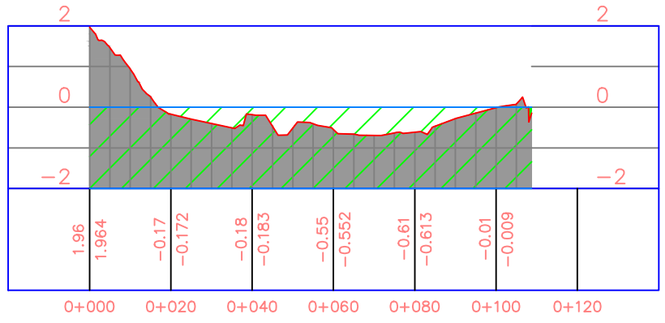
Profile 3 PROFILE



Profile 2 (1) PROFILE



Profile 1 PROFILE



0+000
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0+040
0+060
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0+100
0+120
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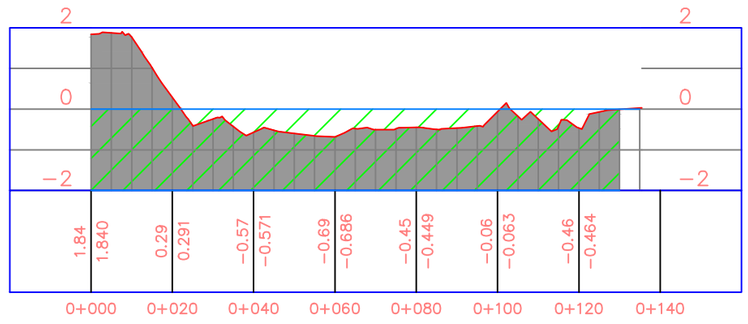
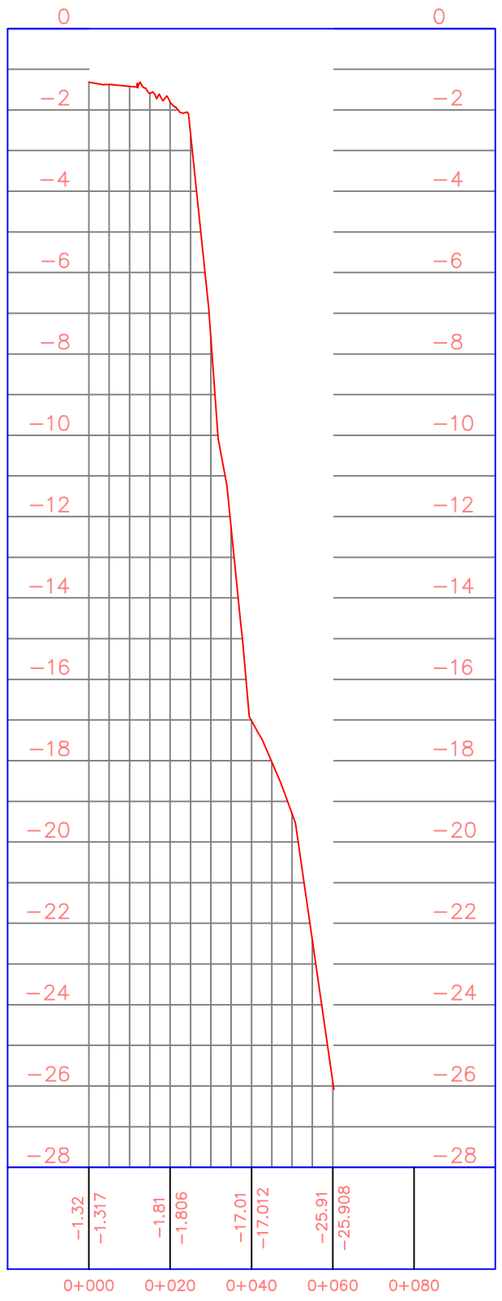
Profile 4 PROFILE



C PROFILE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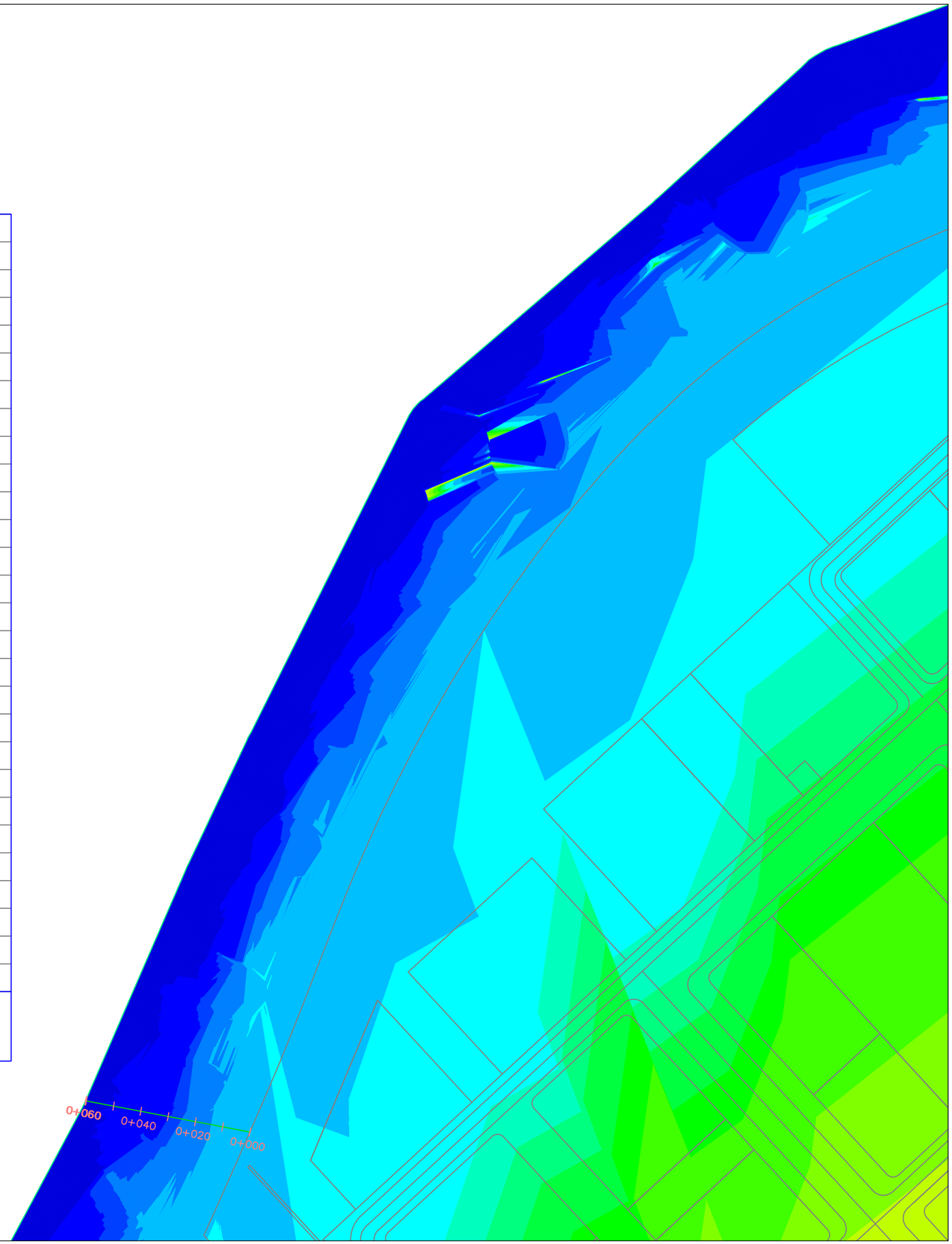
0+060
0+080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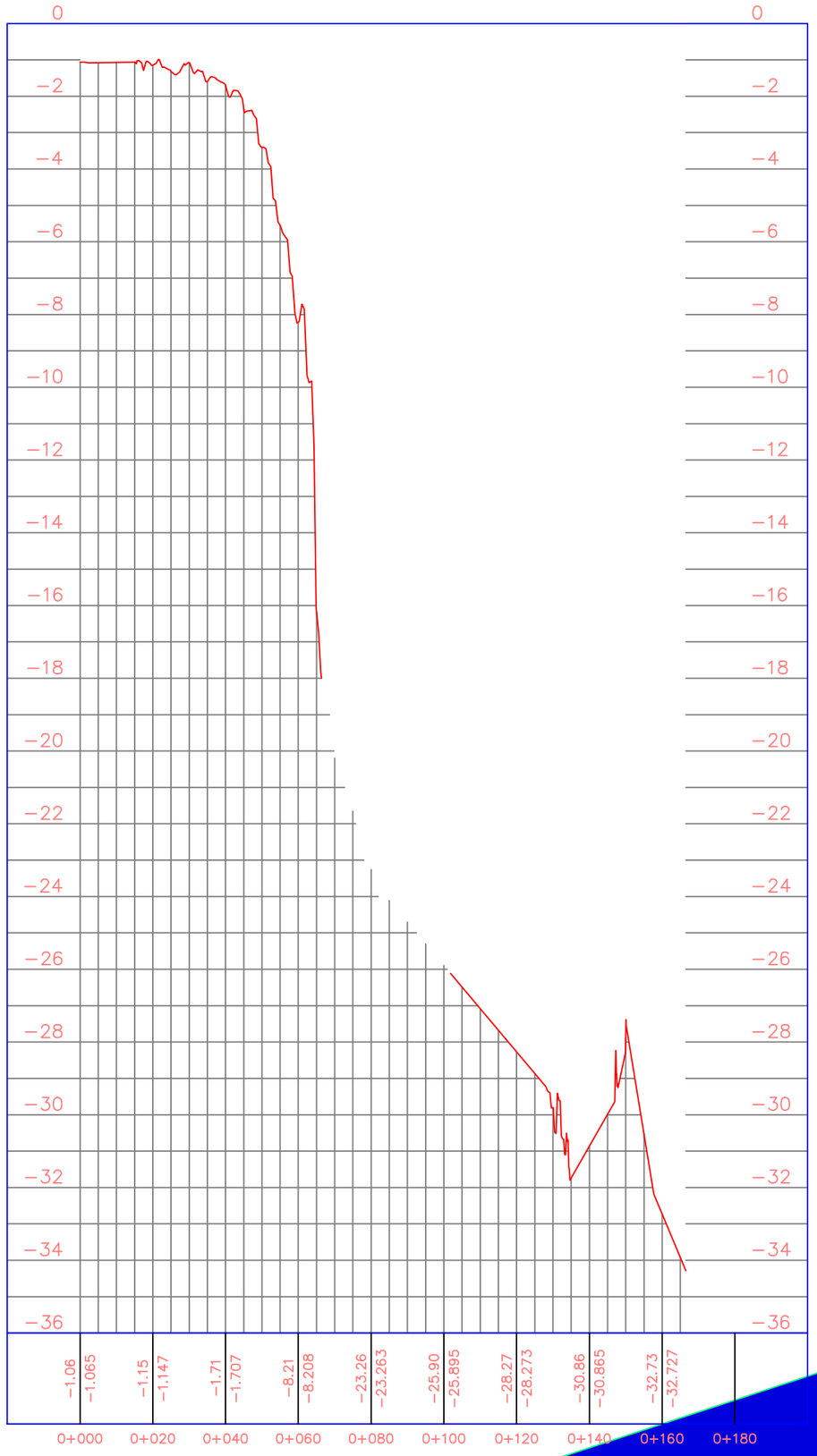
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−36
−1.06
−1.065
−1.15
−1.147
−1.71
−1.707
−8.21
−8.208
−23.26
−23.263
−25.90
−25.895
−28.27
−28.273
−30.86
−30.865
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−32.727
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0+060
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0+100
0+120
0+140
0+160
0+180

0+167
0+140
0+120
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Cut/Fill Report

Generated: 2023-01-23 14:58:28

By user: thorif

Drawing: C:\Users\thorif\Desktop\C:\Users\thorif\Desktop\Hulhumale bathymatry volume.dwg

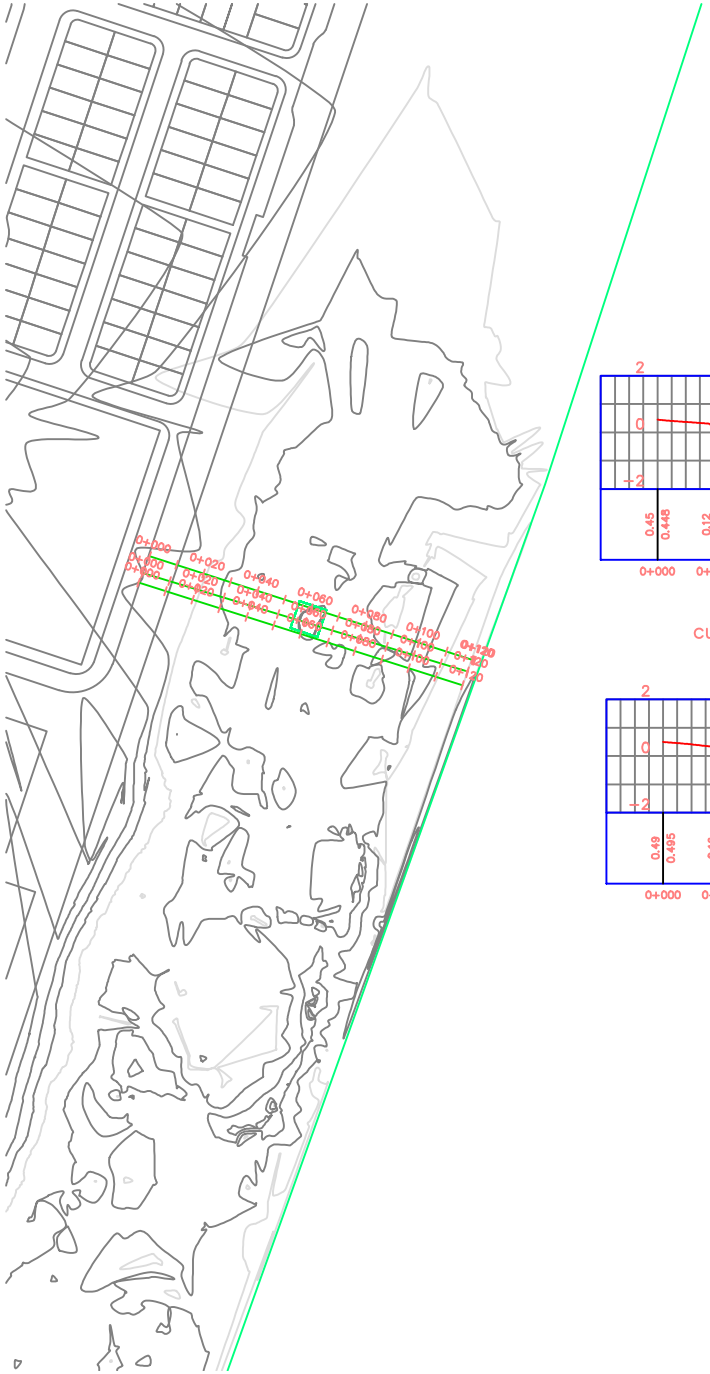
Volume Summary

Name	Type	Cut Factor	Fill Factor	2d Area (sq.m)	Cut (Cu. M.)	Fill (Cu. M.)	Net (Cu. M.)
Base -1.5m	full	1.000	1.000	100.00	101.47	0.00	101.47<Cut>
Base -2m	full	1.000	1.000	100.00	151.47	0.00	151.47<Cut>
Base -1.2m	full	1.000	1.000	100.00	71.47	0.00	71.47<Cut>

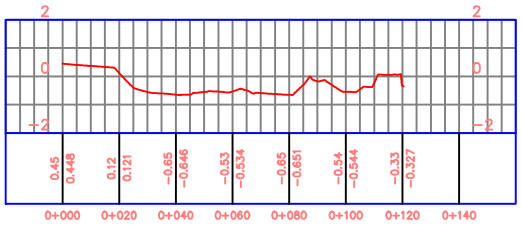
Totals

	2d Area (sq.m)	Cut (Cu. M.)	Fill (Cu. M.)	Net (Cu. M.)
Total	300.00	324.40	0.00	324.40<Cut>

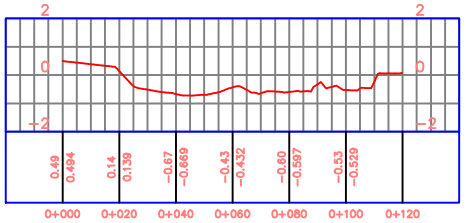
* Value adjusted by cut or fill factor other than 1.0



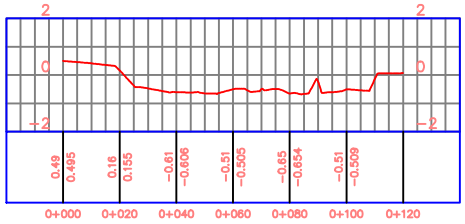
cut allignment 1 PROFILE



cut allignment 2 PROFILE



cut allignment 3 PROFILE



Cut/Fill Summary

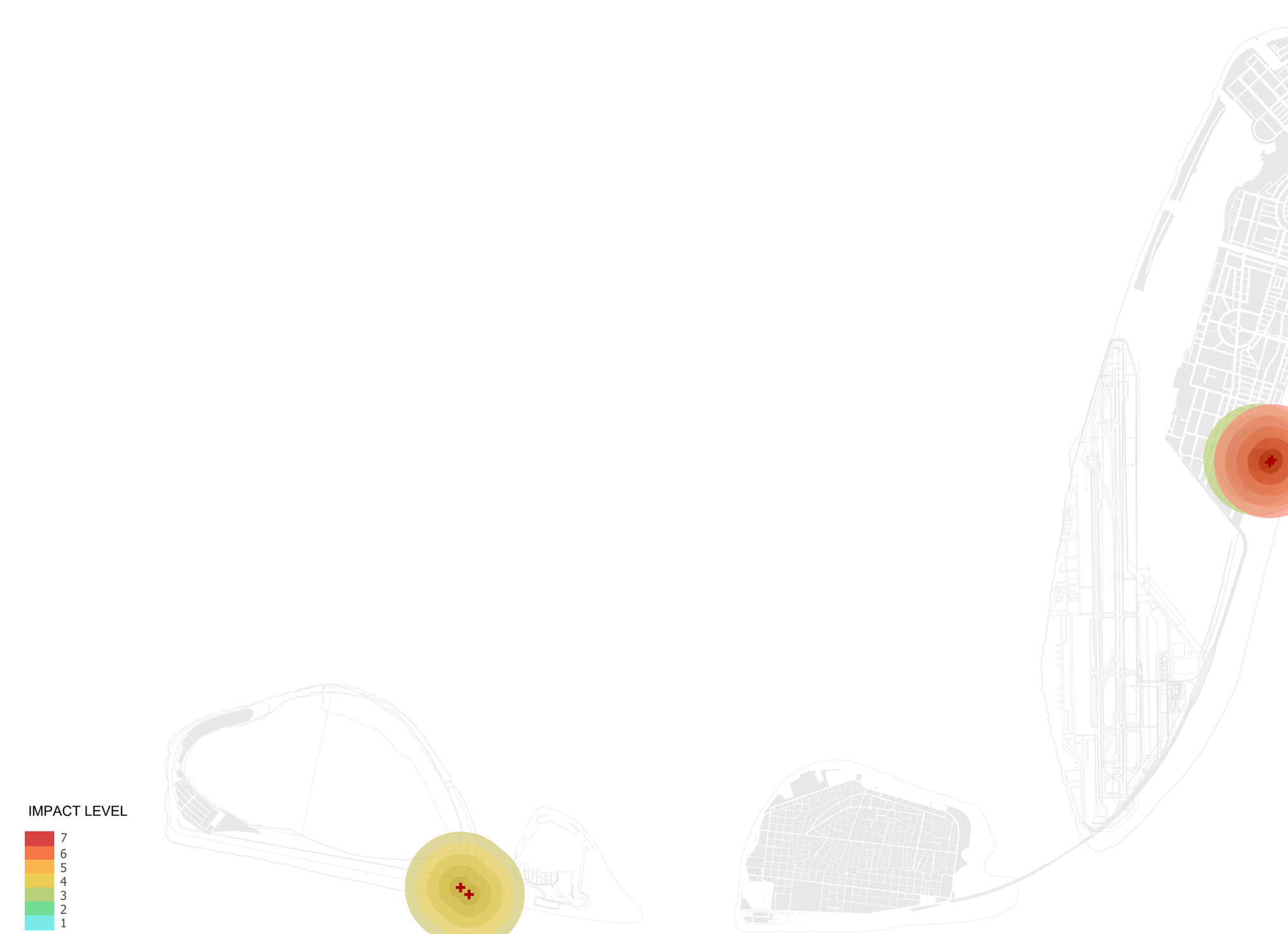
Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
Base -1.2m	1.000	1.000	100.00sq.m	71.47 Cu. M.	0.00 Cu. M.	71.47 Cu. M.<Cut>
Base -1.5m	1.000	1.000	100.00sq.m	101.47 Cu. M.	0.00 Cu. M.	101.47 Cu. M.<Cut>
Base -2m	1.000	1.000	100.00sq.m	151.47 Cu. M.	0.00 Cu. M.	151.47 Cu. M.<Cut>
Totals			300.00sq.m	324.40 Cu. M.	0.00 Cu. M.	324.40 Cu. M.<Cut>

15.4. Appendix Impact Maps

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

urbanco



DRAWING: OVERALL IMPACT- REEFSCAPING PRO ECT

Scal : 1:35,000

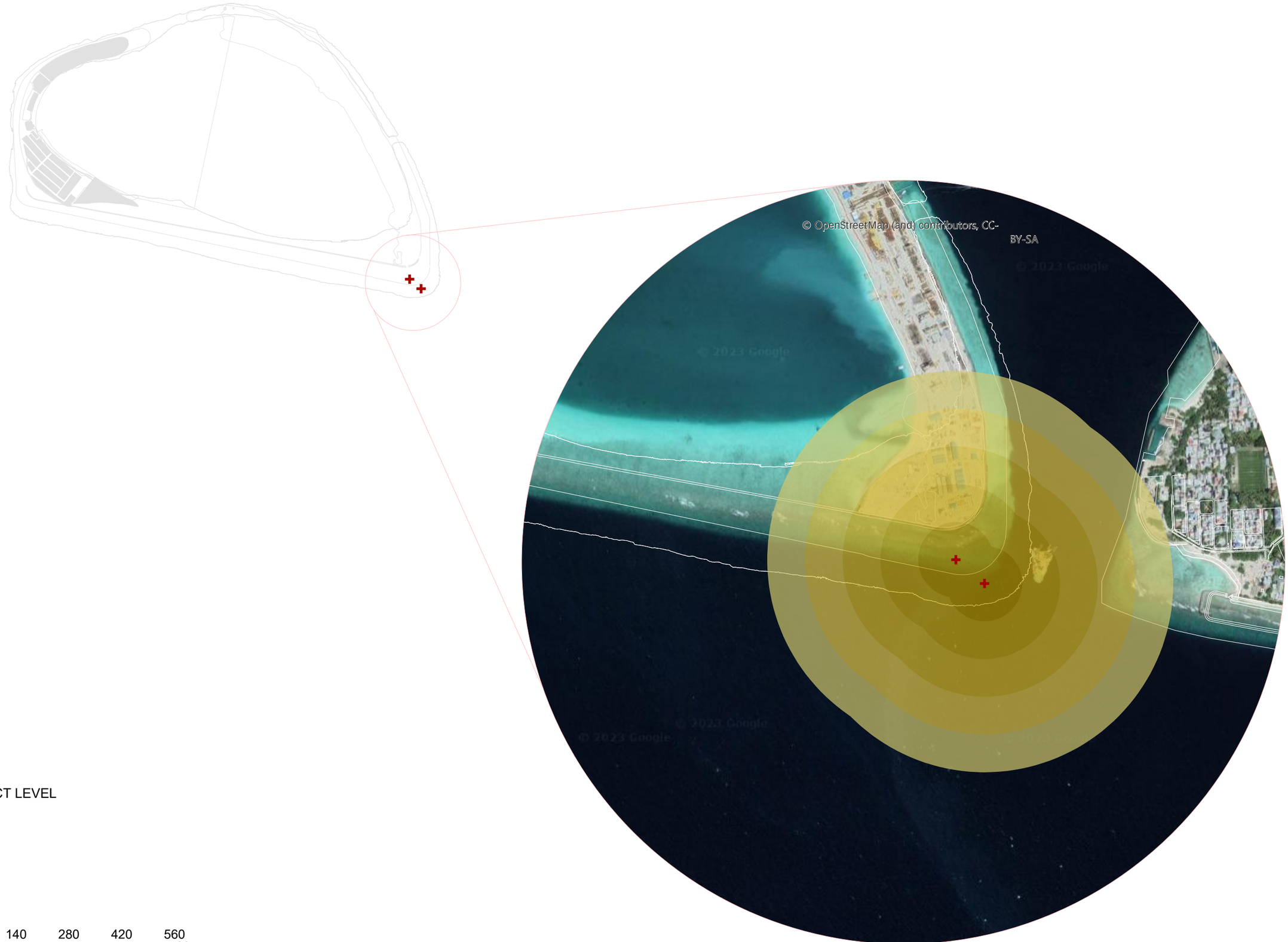
Dra n B : Mahaath

Ch c d B :

Dat : 4 1 2023

R mar s:

HOUSING DEVELOPMENT CORPORATION
PLANNING AND DEVELOPMENT
3RD FLOOR, HDC BUILDING,
HULHUMALE', MALDIVES
TEL: +9603353535, FAX:+960 3358892
EMAIL: planning@hdc.com.mv



IMPACT LEVEL

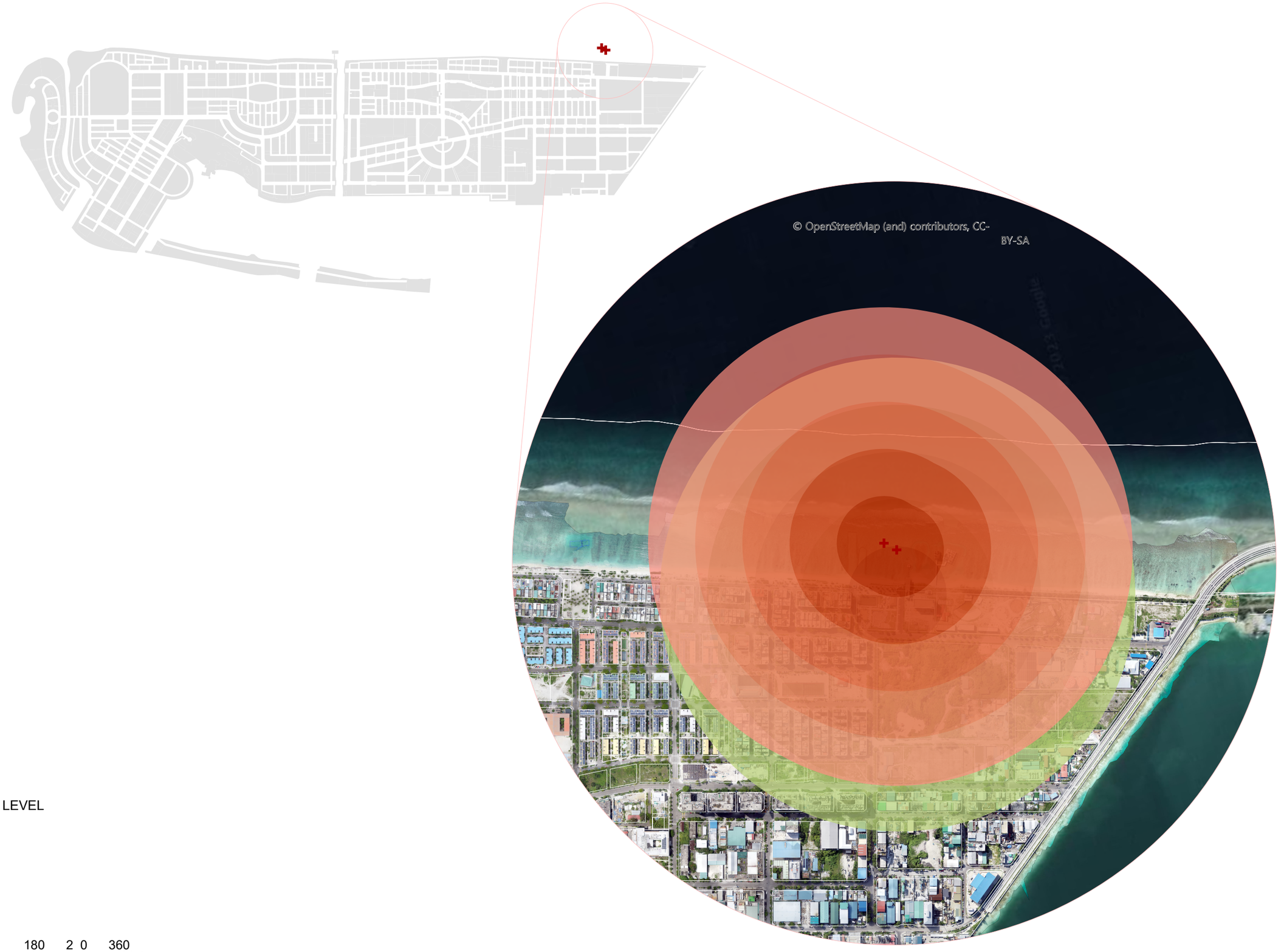
7
6
5
4
3
2
1

0 0 140 280 420 560
M t rs

DRAWING: PREDICTED IMPACT- GULHIFALHU PHASE II

Scal : 1:10,000 | Dra n B : Mahaath | Ch c d B : | Dat : 4 13 2023 | R mar s:

urbanco
GIS MAPPING & SURVEYING
URBAN PLANNING DEPARTMENT
HOUSING DEVELOPMENT CORPORATION



IMPACT LEVEL

7
6
5
4
3
2
1

0 45 90 180 2 0 360
M t rs

DRAWING: PREDICTED IMPACT - HULHUMAL SOUTH EAST SIDE

Scal : 1:8,000 | Dra n B : Mahaath | Ch c d B : | Dat : 4 1 2023 | R mar s:

urbanco
GIS MAPPING & SURVEYING
URBAN PLANNING DEPARTMENT
HOUSING DEVELOPMENT CORPORATION

15.5. Appendix Water Sample Test Report

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
Quality Assurance Building, 1st Floor, Male' Hingun, Vilimale', Male' City, Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

LB-TEST-090

WATER QUALITY TEST REPORT

Report No: 500195772

Customer Information:
Housing Development Corporation Ltd

HDC Building, 3rd Floor
Male 20120

Report date: **19/04/2023**
Test Requisition Form No: **900197343**
Sample(s) Recieved Date: **17/04/2023**
Date of Analysis: **17/04/2023 - 17/04/2023**

Sample Description ~	W2		
Sample Type ~	Sea Water		
Sample No	83238019		
Sampled Date ~	10/04/2023 08:00	**TEST METHOD**	**UNIT**
PARAMETER	**ANALYSIS RESULT**		
Physical Appearance	Clear with particles		
Conductivity *	52700	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	µS/cm
pH *	8.1	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	34.77	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰

Keys: µS/cm : Micro Seimen per Centimeter, **‰** : Parts Per Thousand

Checked by

Nashath Ali
Laboratory Executive

Approved by

Nihaz A. Zahir
Assistant Quality Manager

Notes:
Sampling Authority: Sampling was not done by MWSC Laboratory.
This report shall not be reproduced except in full, without written approval of MWSC.
This test report is ONLY FOR THE SAMPLES TESTED.
~ Information provided by the customer. This information may affect the validity of the test results.
*Parameters accredited by EIAC under ISO/IEC 17025:2017

********** END OF REPORT **********

Male' Water & Sewerage Company Pvt Ltd
Water Quality Assurance Laboratory
Quality Assurance Building, 1st Floor, Male' Hingun, Vilimale', Male' City, Maldives
Tel: +9603323209, Fax: +9603324306, Email: wqa@mwsc.com.mv

LB-TEST-090

WATER QUALITY TEST REPORT

Report No: 500195771

Customer Information:
Housing Development Corporation Ltd

HDC Building, 3rd Floor
Male 20120

Report date: **19/04/2023**
Test Requisition Form No: **900197343**
Sample(s) Recieved Date: **17/04/2023**
Date of Analysis: **17/04/2023 - 17/04/2023**

Sample Description ~	W1		
Sample Type ~	Sea Water		
Sample No	83238018		
Sampled Date ~	10/04/2023 08:00	**TEST METHOD**	**UNIT**
PARAMETER	**ANALYSIS RESULT**		
Physical Appearance	Clear with particles		
Conductivity *	52600	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	µS/cm
pH *	8.1	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	34.64	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Total Dissolved Solids	26300	Electrometry	mg/L
Total Suspended Solids	<5 (LoQ 5 mg/L)	HACH Method 8006	mg/L
Turbidity *	0.177	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU

Keys: µS/cm : Micro Seimen per Centimeter, **‰** : Parts Per Thousand, **mg/L** : Milligram Per Liter, **NTU** : Nephelometric Turbidity Unit

Checked by

Nashath Ali
Laboratory Executive

Approved by

Nihaz A. Zahir
Assistant Quality Manager

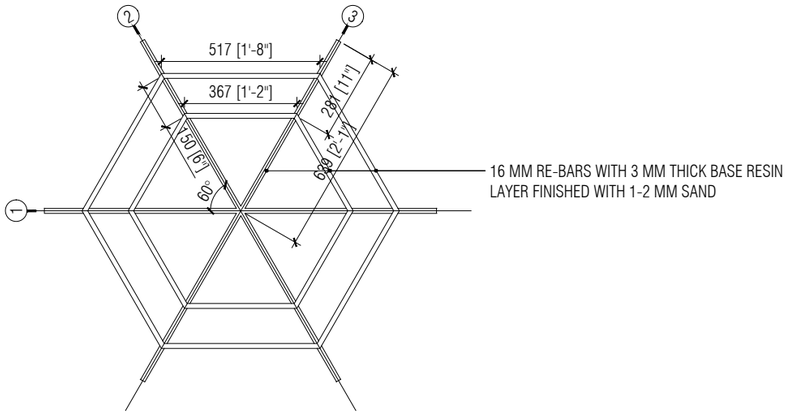
Notes:
Sampling Authority: Sampling was not done by MWSC Laboratory.
This report shall not be reproduced except in full, without written approval of MWSC.
This test report is ONLY FOR THE SAMPLES TESTED.
~ Information provided by the customer. This information may affect the validity of the test results.
*Parameters accredited by EIAC under ISO/IEC 17025:2017

********** END OF REPORT **********

15.6. Appendix: Coral Frame Design

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

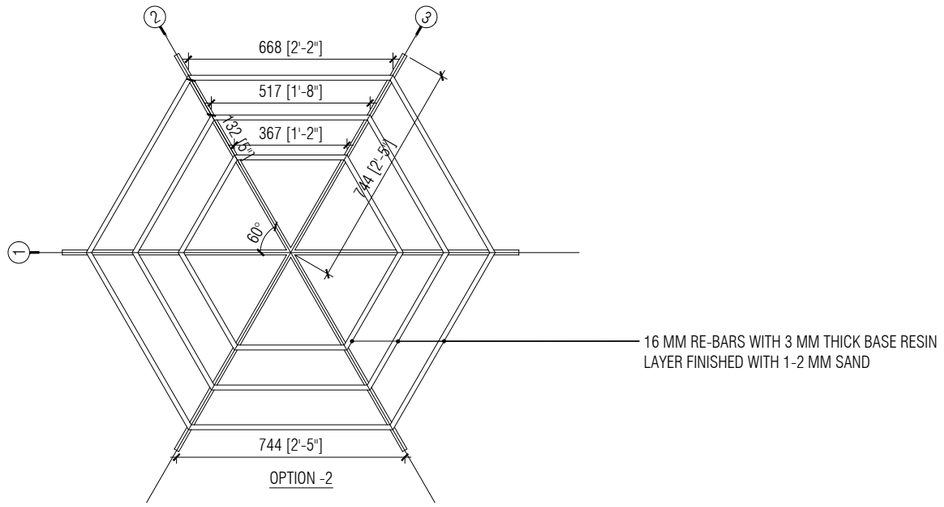


OPTION -1

PLAN

SCALE 1:20

0 0.1 0.2 0.3 0.4 0.5 1M



OPTION -2

PLAN

SCALE 1:20

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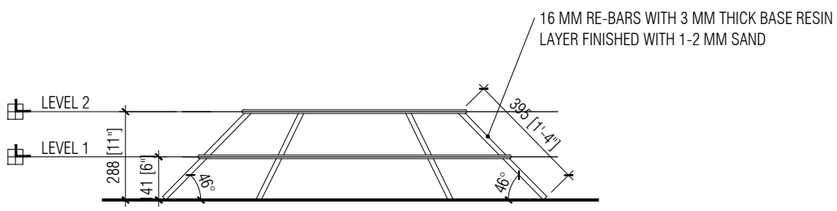

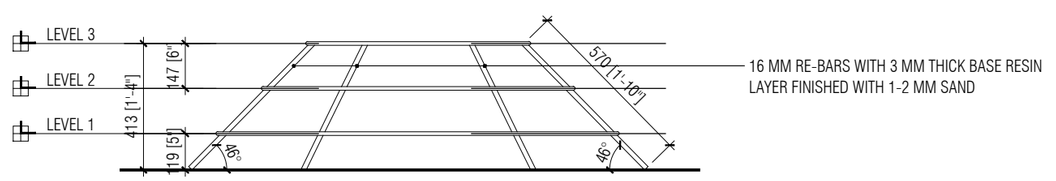

OPTION -1

ELEVATION

SCALE 1:20

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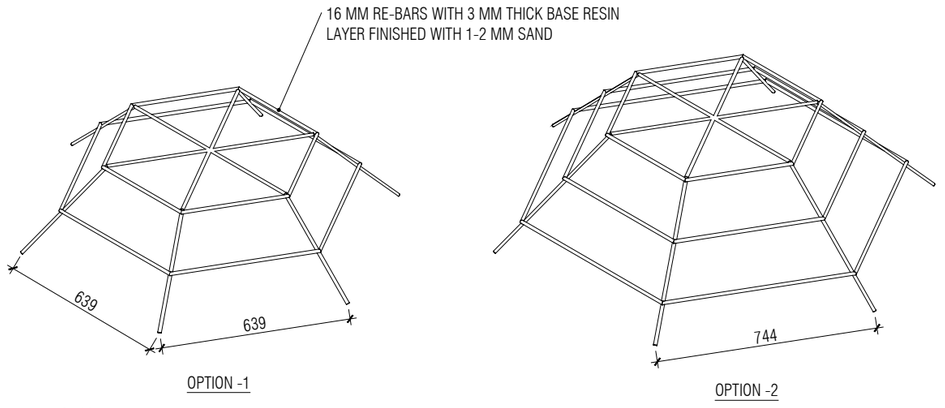
OPTION -2



OPTION -1

OPTION -2

AXONOMETRIC

HOUSING DEVELOPMENT CORPORATION
PLANNING AND DEVELOPMENT DEPARTMENT
THIRD FLOOR, HDC BUILDING HULHUMALE'
REPUBLIC OF MALDIVES
TEL. +(960)3353535, FAX +(960)3358892
EMAIL : planning@hdc.com.mv

CORAL FRAME
HULHUMALE'

DOCUMENT ID	XXXXX-SSSSS-YYYY-(NUMBER)	**VERSION**	1
DOCUMENT NAME	CORAL FRAME	**REVISION**	1
AUTHOR	ADAM AMEEN	**CREATED DATE**	15/09/2022
LAST UPDATED BY	ADAM AMEEN	**LAST UPDATED DATE**	15/09/2022
REVIEWED BY	MOHAMED SAMAH	**REVIEWED DATE**	15/09/2022
APPROVED BY	SAEED ADAM	**APPROVED DATE**	15/09/2022
INFORMATION CLASSIFICATION SCHEME	(Public, Open, Confidential, Confidential & Sensitive and Secret)		

REVISION HISTORY

VER.	DATE	REV.	REVISION
X	DD/MM/YYYY	Z	(DRAFT)
X	DD/MM/YYYY	Z	(FEEDBACK FORMS INCLUDED)
X	DD/MM/YYYY	Z	(MODIFIED FEEDBACK FORMS)
X	DD/MM/YYYY	Z	(REFORMATTED FEEDBACK FORM)

ARCHITECT	AHMED ASNADH
STRUCTURAL ENG.	HUSSAIN SALIQ
MECHANICAL ENG.	NAME
ELECTRICAL ENG.	NAME

SCALE

1:100

SHEET CONTENT

CORAL FRAME

SHEET NO.

AA-101

15.7. Appendix CV

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

Curriculum Vitae

1. **Name:** Hassaan Abdul Muhisn
2. **Date of Birth:** 22nd April 1989
3. **Nationality:** Maldivian
4. **Contact:** 7901665
5. **Education:**

2016 – 2018	M.Se In Environmental Science Chiang Mai University, Chiang Mai, Thailand.
2012 – 2012	University of Mysore B.Ed University of Mysore St.Joseph's College Of Education, Mysore, India
2008 - 2011	BSc (BTCZ) Programme in Bio-technology, Chemistry and Zoology University of Mysore St. Philomena's College, Mysore, India
2006 - 2008	Centre for Higher Secondary Education Male', Maldives Edexcel GCE A/L (Biology, Chemistry, Physics), HSC (Dhivehi, Islam)
2003 - 2005	Majeediyya School Male', Maldives Cambridge IGCSE (English, Maths), Cambridge GCE O/L (Physics, Biology, Chemistry, Computer Studies), SSC (Dhivehi, Islam)
1996 - 2002	Kalaafaanu School Male', Maldives Primary Schooling

6. **Languages**

Dhivehi
1. speaking, good 2. reading, good 3. writing, good

English
1. speaking, good 2. reading, good 3. writing, good

7. **Experience/ Employment Record**

Date of employment	*Employer*	*Details*
Since April 2022		***Position**: Environment Analyst HDC* ***Primary role:*** *Providing solution to HDC*
July 2020 to April 202	*Majeediyya School, Maldives*	***Position**: Teacher, Key stage 3* ***Primary role:*** *Teaching* *a) Key stage 3 (Grade 7)*
March 2018 to May 2020	*INSA.PVT.LTD*	***Positions held:** Environmental researcher, analyst., licenced consultant 2018*
Aug 2015 to Aug 2016	*MMPRC*	***Positions held:** Assistant Director* ***Primary role:*** *1. Connecting desk between MMPRC and MOT.*
Feb 2013 to Aug 2015	*Majeediyya School, Maldives*	***Positions held:** Teacher* ***Primary role:*** *1. Teaching* *a) Grade 9 and 10 (CIE)* *b) Grade 11 (IGCSE)* ***Sub tasks assigned:*** *2. Internal verifier* *a)B-tech sports* *b)B-tech arts* *3. Lead invigilator* *a) IGCSE exams*
Aug 2011, To Dec 2011	*Seamarc.pvt.ltd*	***Positions held:** Environment Analyst* ***Summary of Projects Undertaken:*** *1. Setting out, Landaa Giraivaru* *a) Sea wall near the main pool* ***Role:** Setting out survey* *2. Setting out , Cheval Blanc Randheli* *a) the water villas* *b) reclaimed islands* *c) arrival jetties* ***Role:** Setting out survey* *3. Cheval Blanc Randheli* *a) the coral propagation component* ***Role**: Setting out survey*
Dec 2005 - March 2006	*Sunset restaurant Paradise Island*	1.***Positions held:** Billing clerk*

Resort, Maldives	*Sunset Restaurant* *Paradise Island Resort,* Maldives

8. Qualifications, and trainings

17 September 2011	PADI Open water Sea explores dive school Bodufungandu magu *Male', Maldives*
6 March 2014	In service training Professional development Curriculum Application and Change
1 – 3 April 2014	Invigilator's Training Department of Public Examinations *Male', Maldives*
12 February 2015	In service training Professional development Specific learning difficulties and Mentoring *Male', Maldives*
31 March 2015	BTEC Internal Verification and Standardisations
23 April 2015	In service training Professional development Multiple Intelligence & Activity based learning. *Male', Maldives*
26 May 2015	PADI Speciality Diver Dive against Debris *Villa College Maldives* *Bodutakurufaanu magu* *Male', Maldives*
26 May 2015	PADI Reef Check Eco Diver Villa College Maldives Bodutakurufaanu magu Male', Maldives
27 March 2019	Environment consultant licence (permanent) EIA P02/2020, Category A Environmental Protection Agency

9. Publications

H.Abdul Mushin, I. Patawang, C. Phalaraksh, (2018) Chromosomal Aberrations Observed in two Fejervarya spp. living in Artisanal Mining Farms in Pichit Province, Thailand. Proceeding of ISER-107th International Conference on Environment and Natural Science (ICENS). February 10th 2018, Phuket, Thailand (Awaiting publication in JMES, Journal of Materials and Environmental Science (ISSN: 2028-2508))

11 Publications Worked

Completed	**Bio-diversity Survey** Kurimbee Mangrove area,
Completed	**Bio-diversity Survey** Conserving Kelaa's Kandoofa – a Biodiversity Mapping and Food Security Approach, for Ha Kelaa under the Global Environment Facility Small Grants Program OP6.

EIA		Supervisor	Proponent/ Contractor / main contact
2nd Jan 2023 – 24th Jan 2023 (author) Completed	EMP for the Proposed Development of a Wreck Dive Site at Kudagiri Island, Kaafu Atoll	**	**Proponent** Housing development Cooperation (HDC)
1st Sept 2022 – 13 October 2022	EMP for the Proposed Development of a Wreck Dive Site at Kubuladi Thila; Fiyavi Dive Point Project	**	**Proponent** Housing development Cooperation (HDC)
Oct 2021 (author) Under review at EPA	Environment Impact Assessment (EIA) for water supply development project at R.Rasmaadhoo, Maldives	**	**Proponent** Ministry of National Planning, Housing and Infrastructure (MNPHI). Mohamed Moosa Didi 7778246
			Client MICRON PVT LTD | C-0268/2005 Ali Najeeb 7774005
9th September 2019- 24th Oct 2021 (author) Completed	Environment Impact Assessment (EIA) for water supply development project at TH Burunee, Maldives	**	**Proponent** Ministry of National Planning, Housing and Infrastructure (MNPHI). Mohamed Moosa Didi 7778246
			Client MICRON PVT LTD | C-0268/2005 Ali Najeeb 7774005
		**	**Proponent**

25th Aug – 25th Oct 2021 (author) Completed	Environment Impact Assessment (EIA) for water supply development project at F. Feeali, Maldives		Ministry of National Planning, Housing and Infrastructure (MNPHI). Mohamed Moosa Didi 7778246 **Client** MICRON PVT LTD | C-0268/2005 Ali Najeeb 7774005
May 2021 (author) *Completed*	Proposed development of 12 story building at M.Pisthaage, 20012ø, Male'	**	Infinity Builders (SP-0814/2016)
May 2021 (author) *Completed*	EIA for the proposed development of access platforms, outdoor rendezvous area and community replantation of mangroves in the wetland at Kelaa, Haa Alif Atoll, Maldives	**	Kelaa Youth Forum (KYF) Proponent for Component A Island Development and Environment Awareness Society (IDEAS) Proponent for Component B
October 2020 *(Co- authored) completed*	Environmental Impact Assessment: for the Proposed shore protection, shoreline restoration, channel dredging and development of floating pontoon platform cages in the lagoon at N Karinmaa Vattaru, Maldives.	Mahfooz Abdull Wahhab (EIA P22/2016) 9994467 mahfoozabdullwahhab@gmail.com	Blackgold Investments Pvt Limited.
April 2020 *(Co- authored) completed*	Environmental Impact Assessment for a tourist resort and factory island development at Gulf lagoon, (4°16'40.06"N, 73°2l '7.27"E), Kaaf Atoll, Maldives.	Mohamed Zuhair (EIA P01/2015) 7776800 moh.zuhair@gmail.com	Gulf Craft Maldives Pvt Ltd Aiminath Thauma (aiminath.thauma@gulfcraft.com) Conbizz.Pvt Ltd Ali Akram (alimarka@gmail.com)
March 2020 *Co- authored) completed*	Environmental Impact Assessment: Proposed Harbour re-development at Bilehfahi, Shaviyani Atoll	Mahfooz Abdull Wahhab (EIA P22/2016) 9994467 mahfoozabdullwahhab@gmail.com	Maldives Transport and contracting Agency (MTCC) Mamdhooh Ali 7853929 Ministry of Planning and Infrastructure (MNPI) Shimya Moosa (7784150)
March 2020 *Co- authored) completed*	Environmental Impact Assessment: for the Proposed Harbour expansion Projects at Hulhumeedhoo and Hulhudhoo, Seenu Atoll	Mahfooz Abdull Wahhab (EIA P22/2016) 9994467 mahfoozabdullwahhab@gmail.com	Maldives Transport and contracting Agency (MTCC) Mamdhooh Ali 7853929 Ministry of Planning and Infrastructure (MNPI) Shimya Moosa (7784150)
February 2020 *(Co- authored) completed*	EIA for the development of a senior football ground, and a picnic area at Mulah, M. Atoll, Maldives.	Mahfooz Abdull Wahhab (EIA P22/2016) 9994467 mahfoozabdullwahhab@gmail.com	SASe Pvt Ltd Saudulla Ahmed 7771682
November 2019 *(Co- authored) completed*	Environmental impact assessment for the proposed harbour re-development and swimming area development project at Maamendhoo, Gaaf Atoll, Maldives	Mahfooz Abdull Wahhab (EIA P22/2016) 9994467 mahfoozabdullwahhab@gmail.com	SASe Pvt Ltd Saudulla Ahmed 7771682
October 2019 *(Co- authored) completed*	The second addendum to Environmental Impact Assessment: Proposed Harbour Re-development Project at Kelaa, Haa Alif Atoll,	Mahfooz Abdull Wahhab (EIA P22/2016) 9994467 mahfoozabdullwahhab@gmail.com	Maldives Transport and contracting Agency (MTCC) Mamdhooh Ali 7853929 Ministry of Planning and Infrastructure (MNPI) Shimya Moosa (7784150)
August 2019, *(Co- authored) completed*	Environmental impact assessment for the proposed harbour re-development project at Noomara, Shaviyani Atoll, Maldives	Mahfooz Abdull Wahhab (EIA P22/2016) 9994467 mahfoozabdullwahhab@gmail.com	SASe Pvt Ltd Saudulla Ahmed 7771682 Ministry of Planning and Infrastructure (MNPI) Shimya Moosa (7784150)
July 2019, *(Co- authored) completed*	Environmental impact assessment for the Proposed Access Channel in the Agricultural Island of Fenfuraaveli. Meemu Atoll, Maldives	Mahfooz Abdull Wahhab (EIA P22/2016) 9994467 mahfoozabdullwahhab@gmail.com	Bion PVT LTD Mohamed Aslam 9997112
April 2018, *(assisted in) completed*	Environmental impact assessment for second addendum to: Hulhule-Hulhumale connecting link road development project,North Male', atoll, Maldives	Mahfooz Abdull Wahhab (EIA P22/2016) 9994467 mahfoozabdullwahhab@gmail.com	Housing Development Cooperation (HDC)

Monitoring		Proponent
April 2018	Environmental monitoring report - Emboodhoo lagoon Development, south male' atoll report 6	SASe Pvt Ltd Saudulla,Ahmed,7771682
June 2018	Environmental monitoring report - Emboodhoo lagoon Development, south male' atoll report 7	SASe Pvt Ltd Saudulla,Ahmed,7771682
July 2018	Environmental monitoring report - Emboodhoo lagoon Development, south male' atoll report 8	SASe Pvt Ltd Saudulla,Ahmed,7771682
August 2018	Environmental monitoring report - Emboodhoo lagoon Development, south male' atoll report 9	SASe Pvt Ltd Saudulla,Ahmed,7771682
September 2018	Environmental monitoring report - Emboodhoo lagoon Development, south male' atoll report 10	SASe Pvt Ltd Saudulla,Ahmed,7771682
Monitoring Period: 27st September 2018 to 20th October 2018	Environmental monitoring report Emboodhoo lagoon Development, south male' atoll, Report 1	SASe Pvt Ltd Saudulla,Ahmed,7771682
Monitoring Period: 20th October 2018 to 22nd November 2018	Environmental monitoring report Emboodhoo lagoon Development, south male' atoll, Report No: 02	SASe Pvt Ltd Saudulla,Ahmed,7771682
Monitoring Period: 22nd November 2018 to 10th December 2018	Environmental monitoring report Emboodhoo lagoon Development, south male' atoll, Report 3	SASe Pvt Ltd Saudulla,Ahmed,7771682
Monitoring Period: 15th December 2018 to 15th January 2019	Environmental monitoring report Emboodhoo lagoon Development, south male' atoll Report 4	SASe Pvt Ltd Saudulla,Ahmed,7771682
Monitoring Period: 15thJanuary 2019 – 02ndFebruary 2019	Environmental monitoring report Emboodhoo lagoon Development, south male' atoll Report 5	SASe Pvt Ltd Saudulla,Ahmed,7771682
Monitoring Period: 02ndFebruary 2019 – 12thFebruary 2019	Environmental monitoring report Emboodhoo lagoon Development, south male' atoll Report 6	SASe Pvt Ltd Saudulla,Ahmed,7771682
Monitoring Period: 12th February 2019 to 3rd March 2019	Environmental monitoring report Emboodhoo lagoon Development, south male' atoll Report 7	SASe Pvt Ltd Saudulla,Ahmed,7771682
Monitoring Period: 3rd March 2019 to 20th March 2019	Environmental monitoring report Emboodhoo lagoon Development, south male' atoll Report 8	SASe Pvt Ltd Saudulla,Ahmed,7771682
Monitoring Period: 20th March 2019 to 20th April 2019	Environmental monitoring report Emboodhoo lagoon Development, south male' atoll Report 9	SASe Pvt Ltd Saudulla,Ahmed,7771682
Monitoring Period: 20th March 2019 to 20th April 2019	Environmental monitoring report Emboodhoo lagoon Development, south male' atoll Report 10	SASe Pvt Ltd Saudulla,Ahmed,7771682
Monitoring Period: 20th May 2019 to 20th June 2019	Environmental monitoring report Emboodhoo lagoon Development, south male' atoll Report 11	SASe Pvt Ltd Saudulla,Ahmed,7771682
4th March 2019	Blue beach construction monitoring work report 1	SASe Pvt Ltd Saudulla,Ahmed,7771682
20th March 2019	Blue beach construction monitoring work report 2	SASe Pvt Ltd Saudulla,Ahmed,7771682
20th April 2019	Blue beach construction monitoring work report 3	SASe Pvt Ltd Saudulla,Ahmed,7771682
20th May 2019	Blue beach construction monitoring work report 4	SASe Pvt Ltd Saudulla,Ahmed,7771682
20th June 2019	Blue beach construction monitoring work report 5	SASe Pvt Ltd Saudulla,Ahmed,7771682
25th July 2019	Blue beach construction monitoring work report 6	SASe Pvt Ltd Saudulla,Ahmed,7771682
7 March 2020	Baglioni environment monitoring report 1	Ali Mubeen 779079
1 April 2020	Kahssan Faru Construction Monitoring report 1	SASe Pvt Ltd Saudulla,Ahmed,7771682 **Client** *INSA.PVT.LTD* *Dr Mohamed Shareef, mo.shareef@insa-consultancy.biz*
22 October 2020	Kahssan Faru Construction Monitoring report 2	SASe Pvt Ltd Saudulla,Ahmed,7771682 **Client** *INSA.PVT.LTD* *Dr Mohamed Shareef, mo.shareef@insa-consultancy.biz*
7 September 2021	Kahssan Faru Construction Monitoring report 3	SASe Pvt Ltd Saudulla,Ahmed,7771682 **Client** *INSA.PVT.LTD* *Dr Mohamed Shareef, mo.shareef@insa-consultancy.biz*

10. **Academic referees**

Referee	Contact	Address
Dr Chitchol Phalaraksh PhD Environmental Toxicology	0817160209	Chiang Mai University | CMU · Department of Biology Chiang Mai Thailand.
Prof. Marcel.C. Enos	08212511992	St Joseph College of Education Jayalakshmipuram Mysore Karnataka India
Dr. Ruth Shantha Kumari T. M.Sc, Ph.D, M.Sc in Counselling & Psychotheraphy	9449086598 821- 4240930 stphiloszoo@gmail.com	St Philomena's Degree College, Bannimantap, Mysuru 570 015 Phone 0821-4240900 / 4240912 / 4240918 Fax 0821-4240950

11. Work references

Referee	Post during interaction	Contact
Dr. Mohamed Shareef	Managing Director, INSA Pvt Ltd	7775640, mo.shareef@gmail.com
Haris Mohamed	Managing Director, MMPRC	7761516
Mohamed Hamzeel	Chief Operations Officer, MMPRC	7903010
Aminath Sheeza	Assistant Principal, Majeediyya School	7784658
Aiminath Shahadha	Assistant Principal, Majeediyya School	ashaha1@hotmail.com
Anthirious Georgemary	Biology HOD, Majeediyya School	9144842, anthrrious@hotmail.com
Thomas Le Berre	Managing Director, Seamarc Pvt Ltd	960 7787642, thomas@seamarc.com

MARIYAM SUNAINA MOHAMED

Civil Engineer

CAREER OBJECTIVE

An enthusiastic and highly motivated recent engineering graduate, dedicated with a keen interest in this field who has a clear understanding of the roles and responsibilities associated with an engineer. On the technical side, I am able to accurately prepare designs and drawings. Backed by successful internship experience and knowledge of engineering theories, principles, specifications, and standards. Seeking a challenging career with a progressive organization that provides an opportunity to capitalize my technical skills and abilities in the fields of Engineering and Project Management.

+960 9873819 17sunai@gmail.com G.Agoohaa, Lonuziyaaraiy www.linkedin.com/in/MSMohamed

EDUCATIONAL QUALIFICATION

Bachelor of Civil Engineering (Honours)

Monash University Malaysia (MUM) |Subang Jaya, Malaysia| June 2018 – June 2022

- Graduated with Second Class Honours.

Pearson Edexcel International Advanced Level (IAL) & HSC

Centre for Higher Secondary Education (CHSE) |Male', Maldives| June 2015 – June 2017

- Physics (A), Statistics (A), Biology (B), Chemistry (B), Islam (A) & Dhivehi (A).

General Certificate of Education (GCE), International General Certificate of Secondary Education (IGCSE) & SSC

Aminiya School | Male', Maldives | January 2012 – October 2014

- Physics (A*), Chemistry (A*), Biology (A), Travel & Tourism (A), English as a Second Language

ENGINEERING EXPERIENCE

- Excellent research skills, which enabled me to finish a high-quality final year project.
- Planned the expansion of a Health Care Centre from concept to execution using Microsoft Projects.
- Conducted experiments in the laboratory for material testing.

PROFESSIONAL EXPERIENCE

Civil Engineering Intern

Housing Development Corporation (HDC) |Male, Maldives| Dec 2020 – Mar 2021

- Visited projects sites regularly during construction for on-site inspections.
- Collaborated with team members to write reports after surveying and site investigations.
- Participated in the weekly team meetings.
- Gained experience in reading engineering drawings. Analysed AutoCAD drawings for structural and road projects.

SKILLS

Personal Skills

- Creativity
- Good Team Player
- Communication
- Ability to Work under Pressure
- Leadership skills
- Time Management

Professional Skills

- Autodesk AutoCAD
- SketchUp
- ArcGIS
- ETABS
- MATLAB
- Microsoft Projects

PROFESSIONAL ASSOCIATIONS

- Member of Institute of Civil Engineers Monash (ICE-Monash).
- Member of Board of Engineers Malaysia

REFEREES

- Dr. Chua Yie Sue

  Lecturer, School of Engineering, Monash University Malaysia

  chua.yiesue@monash.edu

Hashma Hameed

Chemical Engineer

A quick learner and dynamic individual who is willing to adapt in order to complete a certain task.

hashmahameed@gmail.com

7632012

Raincrest, Hulhumale, Maldives

24 August 1997

linkedin.com/in/hashma-hameed-4a2a57152

EDUCATION

BACHELOR'S DEGREE
UNIVERSITY OF NOTTINGHAM MALAYSIA

09/2016 - 06/2020 *Malaysia*

Courses

- Masters in Engineering with Honors (MEng) in Chemical and Environmental engineering
- Students Election commission member
- Cultural societies Student representative at student council

A-LEVEL
CENTER FOR HIGHER SECONDARY EDUCATION

2014 - 2016 *Maldives*

Courses

- Edexcel IAL
- Subjects: Physics , Biology, Chemistry, Islam, Dhivehi
- Optional Subjects: Mathematics with Mechanics

WORK EXPERIENCE

Junior Environmnental Planner
Urbanco (Housing Development Corporation)

03/2023 - Present

Achievements/Tasks

- Assist to plan and conduct studies of the environment and of the population, distribution, structure and functional characteristics and behavior of plants and animals; aiding in the overall greening and urban planning
- Provide assistance to conduct ecological and environmental impact and monitoring studies, and prepare reports accordingly.
- Assist to review and evaluate proposals for land use and development plans and prepare recommendations.

Engineer
Ministry of Environment, Climate Change and Technology

04/2021 - 02/2023

Achievements/Tasks

- Implementation of energy efficiency standards and labelling program 'Hakathari program'.
- Run the public awareness campaign for Energy Efficiency.
- Provide technical assistance for the Energy department for renewable energy projects.

SKILLS

Autocad | Adobe Photoshop | Microsoft Word | Microsoft Excel | Microsoft Powerpoint | Event planning

INTERESTS

Photography | Painting | Travelling | Fishing | Sports

LANGUAGES

English ●●●●●

Dhivehi ●●●●○

ORGANIZATIONS

Zero Waste Maldives (NGO)
(01/2021 - Present)

Promote a Zero Waste Low Impact Lifestyle in the Maldives and to enable individuals, businesses, communities and government to send nothing to the oceans, landfills or incinerators.

WORK EXPERIENCE

Quality Assurance Intern
Male' Water and Sewerage Company

06/2019 - 09/2019

Achievements/Tasks

- Assisted with planning of quality assurance testing projects following functional specifications.
- Created and achieved product quality objectives and met product specifications.
- Researched new tools and technologies for potential use by quality assurance team.

Research Assistant
CDE Consulting PVT.LTD

07/2017 - 09/2017

Achievements/Tasks

- Helped in compiling EIA reports for companies
- Assisted in completing sedimentation sampling
- Attended site visits throughout Maldives for EIA projects

PROJECTS

Consultancy Services for Design of Regional Laboratory in Hdh.Hanimaadhoo for Epoch Associates (01/2021 - 09/2021)

- Conduct desk review of the local level regulatory water quality testing requirements set for water and sewerage services and international ISO certified laboratory testing requirements and related equipment's.

Consultancy Services for Design of Regional Laboratory in L.Fonadhoo for Epoch Associates (09/2021 - 12/2021)

- Conduct desk review of the local level regulatory water quality testing requirements set for water and sewerage services and international ISO certified laboratory testing requirements and related equipment's.

UNDP Small Grants program Plastic Innovation Project for Fuvahmulah City (08/2022 - Present)

- Improving the Effectiveness of Segregation of Waste in Fuvahmulah City of Maldives, towards a Zero Waste Future by Zero Waste Maldives

15.8. Appendix Work schedule

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

ID		Task	Task Name	Duration	2023	2024	2025	2026	2027	2028
1			Planing and ESIA	118.88 days						
2			Excavation	5.13 days						
3			Settling days	90.13 days						
4			Harvesting	1 day						
5			Propagation	1 day						
6			Management	1095 days						

Project: msproj11
Date: Sun 5/14/23

Task		Project Summary		Inactive Milestone		Manual Summary Rollup		Deadline	
Split		External Tasks		Inactive Summary		Manual Summary		Progress	
Milestone		External Milestone		Manual Task		Start-only		Manual Progress	
Summary		Inactive Task		Duration-only		Finish-only			

15.9. Appendix Letter of submission to Male City council

Urban planning department,
GIS and Survey,
Environment Unit

Housing Development Corporation
HDC Building, Ground Floor
Hulhumalé, Republic of Maldives

urbanco

Draft ESIA HDC

Hassaan Abdul Muhsin <Hassaan.Abdul@urbanco.mv>

Sun 5/14/2023 1:16 PM

To: secretariat@malecity.gov.mv <secretariat@malecity.gov.mv>

Cc: Shahid Ahmed Waheed <shahidahmed@urbanco.mv>;Zulaikha Shabeen <zulaikha.shabeen@urbanco.mv>;Hashma Hameed <hashma.hameed@urbanco.mv>;Hassan Akram <akram@urbanco.mv>

HI Tema Male City Council,

Please find attached the Draft ESIA as per the regulation 2012/R-27
EIA HDC Reefscaping draft for Male city council.pdf

Thanks

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