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Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

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<input type="checkbox"/>	313	15 ޕްރޮޖެކްޓްގެ ސަރުކާރުގެ ނަންބަރު
<input type="checkbox"/>	331	16 ޕްރޮޖެކްޓްގެ ސަރުކާރުގެ ނަންބަރު
<input type="checkbox"/>	-	17 ޕްރޮޖެކްޓްގެ ސަރުކާރުގެ ނަންބަރު
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<input type="checkbox"/>	xxii	19 ޕްރޮޖެކްޓްގެ ސަރުކާރުގެ ނަންބަރު
<input type="checkbox"/>	xxi	20 ޕްރޮޖެކްޓްގެ ސަރުކާރުގެ ނަންބަރު
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13th August 2023

H M H I Company Pvt Ltd

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August 2023

ENVIRONMENTAL IMPACT
ASSESSMENT FOR THE PROPOSED
RESORT DEVELOPMENT PROJECT AT
BODUKAASHIHURAA, ALIF DHAAL
ATOLL



ECO-TECH
CONSULTANCY



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I. TABLE OF CONTENTS

I. TABLE OF CONTENTS	II
II. LIST OF TABLES	XIV
III. LIST OF FIGURES	XVII
IV. CONSULTANTS DECLARATION.....	XXI
V. LETTER OF COMMITMENT AND DECLARATION OF PROPONENT.....	XXII
.VI ސަލާމަތުގެ ބަލާމު ސަލާމަތުގެ ބަލާމު	XXIII
VII. EXECUTIVE SUMMARY	XXV
1. INTRODUCTION.....	27
1.1 Structure of the EIA	27
1.2 Project Objectives	28
1.3 Need for the Project	28
1.4 Summary of Impact Assessment Methodology	28
1.5 List of similar project EIAs reviewed.....	29
1.6 Purpose of this EIA.....	30
1.7 The EIA Process	30
1.8 The Consultant	31
1.9 The Proponent.....	31
1.9.1 Contact details of Focal Point of the Proponent	32
2. METHODOLOGY	33
2.1 EIA report formulation	33

2.1 Site-specific baseline data collection methods	34
2.1.1 Water quality	34
2.1.2 Noise	35
2.1.3 Structural Environment	35
2.1.4 Air Quality	35
2.1.5 Socioeconomic Environment	35
2.1.6 Bathymetry	35
2.1.7 Shoreline	36
2.1.8 Terrestrial Megafauna	36
2.1.9 Terrestrial Vegetation	37
2.1.10 Current measurement	37
2.1.11 Benthic Substrate Analysis	38
2.1.12 Fish Census	39
2.1.13 Coastal Environment	39
2.1.14 Hazard Vulnerability	39
2.2 Limitations in data collection methods	39
2.3 Data gaps	41
2.4 Uncertainty in data	41
2.5 Management of Uncertainties and Data Gaps	42
2.6 Geographic Coordinates for all sampling locations	42
3. STATUTORY REQUIREMENTS	46
3.1 Laws, Policies and Strategic Action Plans	46

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

3.1.1 Environmental Protection and Preservation Act (4/93).....	46
3.1.2 Maldives Tourism Act (2/99).....	47
3.1.3 Maldives Fifth Tourism Master Plan	48
3.1.4 Waste management policy	49
3.1.5 Waste management Act (24/2022).....	49
3.1.6 Maldives Energy Act (18/2021).....	50
3.1.7 Maldives Energy Policy and Strategy 2016.....	52
3.1.8 Water and sewerage Act (8/2020).....	53
3.1.9 Utility Regulatory Authority Law (26/2020).....	57
3.1.10 The National Water and Sewerage Strategic Plan (The NWSSP 2020-2025).....	59
3.1.11 Decentralization Act (7/2010).....	61
3.1.12 National Strategic Action Plan.....	63
3.1.13 Public Health Protection Act (7/2012).....	63
3.1.14 Immigration Act (1/2007).....	63
3.1.15 Anti-Human Trafficking Act (12/2013).....	64
3.1.16 National Biodiversity Strategy and Action Plan.....	65
3.1.17 Climate Emergency Act (9/2021).....	65
3.1.18 Heritage Act (12/2019).....	66
3.2 Regulations	67
3.2.1 Environmental Impact Assessment Regulation 2012 (2012/R-27)	67
3.2.2 Waste Management Regulation (2013/R-58)	72
3.2.3 Regulation on Environmental Liabilities (2011/R-9)	75

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

3.2.4 Regulation on Safety Standards for Construction Work (2019/R-156).....	77
3.2.5 Groundwater extraction and disposal regulation (2021/R-20).....	80
3.2.6 Regulation on uprooting, cutting and transportation of palms and trees	83
3.2.7 Regulation on management and conservation of water resources (2021/R-22)	85
3.2.8 Regulation on protection of environmentally sensitive areas (2018/R-78)	86
3.2.9 Regulation on Construction Material Import and Production Control	87
3.2.10 Regulation on Construction Material and Construction materials testing facilities.....	87
3.2.11 Regulation on Preserving greenery and Vegetation in the Maldivian Islands (2022/R-92).....	87
3.2.12 Regulation on Use, Handling, and Storage of Oil	88
3.2.13 Regulation on stone, sand and coral mining	88
3.2.14 Regulation on dredging and land reclamation (2013/R-15)	89
3.2.15 Heritage Preservation Regulation (2020/R-37)	90
3.2.16 Built environment regulations.....	92
3.2.17 Maldives National Building Code (2019/R-1020).....	93
3.3 Guidelines and Technical Specifications	98
3.3.1 Guideline for Uprooting, Cutting and Transportation of Palms and Trees (published on 06 th June 2017).....	98
3.3.2 Guideline for power system approval	99
3.3.3 Waste Incinerator Guideline	99
3.3.4 Requirement for Fire Prevention Equipment in the building.....	100

3.4 International Conventions, Plans and Programs	104
3.4.1 United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol	104
3.4.2 Paris Agreement.....	105
3.4.3 The Vienna Convention for the Protection of the Ozone Layer	105
3.4.4 The Montreal Protocol on Substances that Deplete the Ozone Layer	106
3.4.5 Agenda 21	106
3.4.6 Sustainable Development Goals	107
3.4.7 Convention on Biological Diversity (CBD)	108
3.4.8 Washington Declaration on Protection of the Marine Environment from Land-based Activities	108
3.4.9 Regional plans and programs.....	109
3.5 Required Permits and Approvals	109
3.6 Compliance of the Proposed Proposal to Statutory Requirements	109
4. PROJECT DESCRIPTION.....	111
4.1 Project location and sensitive environmental areas	111
4.2 Project overview	112
4.3 Project components.....	113
4.3.1 Guest, public area and support facilities	113
4.3.2 Water facility	115
4.3.3 Sewerage facilities	123
4.3.4 Coastal works.....	147
4.3.5 Powerhouse and renewable energy	151

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

4.3.6 Waste management Centre	155
4.3.7 Vegetation Clearance	157
4.3.8 Tasks already completed.....	159
4.4 Project inputs and outputs.....	160
4.5 Project Management	163
4.5.1 Temporary material storage and labour quarters	163
4.5.2 Labour requirement.....	163
4.5.3 Construction and operational phase waste management	164
4.5.4 Measures to protect human health during construction and operation	165
4.5.5 Potential accident and hazard scenarios and how to manage them	167
4.5.6 Decommissioning	174
4.5.7 Project duration and schedule of implementation.....	174
5. EXISTING ENVIRONMENT	175
5.1 The Maldivian Setting.....	175
5.1.1 Geology and Geomorphology.....	177
5.1.2 Waves.....	179
5.1.3 Currents.....	181
5.1.4 Tides.....	181
5.2 Climatic Conditions	182
5.2.1 Temperature	183
5.2.2 Rainfall.....	184
5.2.3 Wind.....	187

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

5.3 Marine Environment of A.Dh Bodukaashihuraa	192
5.3.1 General Island Setting.....	193
5.3.2 Currents and Coastal Dynamics.....	194
5.3.3 Seasonal Erosion.....	199
5.3.4 Bathymetry.....	200
5.3.5 Seabed Sediments	200
5.3.6 Benthic Substrate	201
5.3.7 Fish Census	210
5.3.8 Coastal Environment.....	213
5.3.9 Marine Water Quality	217
5.4 Terrestrial Environment of Bodukaashihuraa	218
5.4.1 Structural Environment at Project Site	219
5.4.2 Ground Condition	221
5.4.3 Ground Water Quality.....	223
5.4.4 Vegetation	225
5.4.5 Terrestrial Megafauna.....	229
5.4.6 Air Quality	229
5.4.7 Noise	238
5.5 Socioeconomic Environment.....	239
5.5.1 Demography for Alif Dhaal atoll.....	239
5.5.2 Demography for A.Dh. Hangnaameedhoo	240
5.5.3 Income Situation and Distribution.....	241

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

5.5.4 Healthcare Facilities.....	247
5.5.5 Accessibility and Public Transport	249
5.5.6 Public utilities at A.Dh. Hangnaameedhoo	250
5.6 Hazard Vulnerability.....	250
5.6.1 Storms	251
5.6.2 Cyclonic Winds.....	252
5.6.3 Storm Surge	253
5.6.4 Flooding	254
5.6.5 Seismic Activity.....	257
5.6.6 Tsunami.....	258
6. STAKEHOLDER CONSULTATION	260
6.1 Consultation Method.....	260
6.1.1 Invitations	260
6.1.2 Consulted Date and Venues	261
6.1.3 Contact Details for all Participants attended to Consultations.....	261
6.1.4 Attendance Sheets for Consultation Meetings or proof of consultations	261
6.1.5 Proof of Invitations sent out for not responded stakeholders	264
6.2 Consultations Undertaken.....	267
6.2.1 MMRI	268
6.2.2 MoT.....	270
6.2.3 NDMA	271
7. POTENTIAL IMPACT ANALYSIS	272

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

7.1 Impact Assessment Methodology	272
7.2 Justification for selected Impact Prediction and Assessment Method.....	276
7.3 Limitations and Uncertainties in Impact Prediction and Assessment Method	276
7.4 Construction Phase Impacts	278
7.4.1 Mobilization impacts – Direct damage to benthos and sedimentation	279
7.4.2 Mobilization Impacts - Noise.....	280
7.4.3 Mobilization impacts – Dust.....	280
7.4.4 Mobilization impacts – Oil spills at sea.....	281
7.4.5 Mobilization impacts – Oil spills on ground.....	281
7.4.6 Mobilization impacts – workforce; covid episode, negative social impacts, illegal labor	282
7.4.7 Generation of site clearance, demolition and constructional waste.....	282
7.4.8 Vegetation clearance.....	283
7.4.9 Vibration impacts.....	283
7.4.10 Air quality – GHGs.....	284
7.4.11 Air quality – Dust.....	284
7.4.12 Noise pollution.....	285
7.4.13 Groundwater quality – oil and chemical spills	285
7.4.14 Groundwater quality – salinization.....	286
7.4.15 Impacts on marine environment.....	286
7.4.16 Impacts on terrestrial environment – soil and ground	287
7.4.17 Impacts on coastal environment.....	288
7.4.18 Risk of accidents and pollution on workers.....	288

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

7.4.19 Landscape integrity/ scenery.....	289
7.4.20 Socio-economic impacts	289
7.5 Operational Phase Impacts.....	289
7.5.1 Air Quality - GHGs.....	291
7.5.2 Air quality; dust	291
7.5.3 Noise pollution.....	292
7.5.4 Ground and marine water quality; negative.....	292
7.5.5 Impacts on marine environment.....	293
7.5.6 Impacts on hydrodynamics	293
7.5.7 Impacts on coastal environment.....	294
7.5.8 Impacts from vibration.....	294
7.5.9 Impacts from waste	294
7.5.10 Health and safety of working staff.....	295
7.5.11 Impacts on landscape integrity and scenery.....	296
7.5.12 Socio-economic impacts- negative	296
7.5.13 Socio-economics – positive	296
7.5.14 Risk of Hazards - storm surge.....	297
7.5.15 Risk of Hazards – Sea level rise	297
7.5.16 Risk of Hazards - fire and other workplace accidents	297
7.6 Impact Boundary.....	298
8. OPTIONS ASSESSMENT	300
8.1 Options.....	300

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

8.1.1 Option 1: Maintain status-quo	300
8.1.2 Option 2: Intake water method for the desalination plant.....	300
8.1.3 Option 3: Storage tank material	303
8.1.4 Option 4: Alternative Sewerage treatment methods	304
8.1.5 Option 5: Solar as renewable energy	307
8.1.6 Option 6: Alternative sewer outfall.....	307
8.2 Preferred Options	308
8.2.1 Mitigation measures for preferred option	310
9. ENVIRONMENTAL MANAGEMENT.....	311
9.1 Proposed Mitigation Measures	311
9.1.1 Construction Phase.....	311
9.1.2 Operational Phase	320
9.2 Location for silt screen placement	327
9.3 Location for replanting trees	327
9.4 Justification for the selected mitigation measures	328
9.5 Effectiveness of mitigation measures	328
9.6 Risk Management and Incident Response	328
9.7 Sustainable Development Management Policy	328
9.8 Managing Uncertainties in Impact Prediction	329
9.9 Environmental Monitoring.....	329
9.9.1 Monitoring Parameters.....	330
9.9.2 Environmental Monitoring Report Submission Schedule	332

9.9.3 Environmental Monitoring Report Format	333
10. JUSTIFICATION AND CONCLUSION	334
11. ACKNOWLEDGEMENTS	336
12. APPENDICES	337
Appendix A. References	338
Appendix B. List of Abbreviations	343
Appendix C. Terms of Reference.....	345
Appendix D. Approved Concept.....	346
Appendix E. Detailed Work Schedule	347
Appendix F. Water Quality Assessment Results	348
Appendix G. Format for Fuel Handling Procedure.....	349
Appendix H. Format for Health and Safety Manual	350
Appendix I. Format for Emergency Preparedness and response Plan.....	351
Appendix J. Evidence of EIA Report Submission to Atoll Council	352
Appendix K. Land and Hydrographic reports	353

II. LIST OF TABLES

Table 1: Reef condition categories based on % live coral cover.	38
Table 2: uncertainties and data gaps in collected data and how it was managed	42
Table 3: Geographic coordinates for all sampling location at Bodukaashihuraa	42
Table 4. Permits and Approvals required for the proposed development.....	109
Table 5: Approximate vegetation that needs to be removed.....	157
Table 6: Major project inputs.....	160
Table 7: Major project outputs.....	161
Table 8. Work profile required for implementation of the proposed project.....	164
Table 9: mean tidal variations in the Maldives (Riyaz, 2016).....	182
Table 10: The four seasons in the Maldives. Source (Danish Hydraulic Institute, 1999).	187
Table 11: beaufort wind scale	188
Table 12: Major benthic categories.....	202
Table 13. Percentage of substrate subcategories at Bodukaashihuraa project area	204
Table 14: coastal environment of eastern side of Bodukashihuraa.....	214
Table 15: marine water quality optimal ranges.....	217
Table 16: marine water quality test results for Bodukaashihuraa.....	218
Table 17: Condition and use of buildings near and on project site.....	219
Table 18: ground water quality optimal ranges	224
Table 19: Groundwater quality test results (parameters exceeding URA standards are highlighted in red)	224
Table 20: vegetation found on transects	225

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Table 21: Scientific names and Dhivehi name for vegetation species encountered on Bodukaashihura..... 227

Table 22: air quality optimal ranges 234

Table 23: detailed air quality reference ranges 235

Table 24: ambient air quality at surveyed locations 237

Table 25: ambient noise levels in Bodukaashihuraa..... 239

Table 26: invitations sent out to stakeholders..... 260

Table 27: consultation date, time and venues 261

Table 28: contacts of all stakeholders consulted..... 261

Table 29: Attendance sheets (if any) and email proof for stakeholder consultations 261

Table 30: proof of invitation sent out to stakeholders 264

Table 31: outcomes of the consultation with MMRI..... 268

Table 32: outcomes of the consultation with MoT 270

Table 33: outcomes of the consultation with NDMA..... 271

Table 34. Impact assessment matrix (Wild Environment, 2012)..... 274

Table 35. Grading scale of the characteristics of impacts 275

Table 36. Predicted impacts and anticipated significance of impacts during construction phase of the project..... 278

Table 37. Characteristics of predicted impacts during the construction phase of the project 279

Table 38. Predicted impacts and anticipated significance of impacts during operation phase of the project 289

Table 39. Characteristics of the predicted impacts during the operation phase of the project ... 290

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Table 40: proposed mitigation measures for the identified impacts during the construction phase of the proposed project..... 312

Table 41: proposed mitigation measures for the identified impacts during the operation phase of the proposed project..... 321

Table 42. Environmental monitoring plan proposed for the proposed development 330

Table 43. Monitoring schedule recommended for the proposed development assuming that the project commences in March 2024 and completes on May 2025..... 332

III. LIST OF FIGURES

Figure 1: Drogue deployed at sea for current measurement (left) and hand-held GPS used to geo-reference sampling locations..... 38

Figure 2: sampling locations at A.Dh. Bodukaashihuraa 45

Figure 3: Location of proposed project island of ADh. Bodukaashi hura 111

Figure 4:Partial print of the proposed concept design. 112

Figure 5:Proposed brine and sewer outfall 119

Figure 6: Brine diffuser details 119

Figure 7: Anchoring details 120

Figure 8: Access Channel partial print..... 147

Figure 9:Proposed burrow site..... 148

Figure 10: Alternative burrow site..... 148

Figure 11: Example: Excavator on a barge, Photo taken Wednesday 2nd October 2019, Ha.Kelaa, Maldives, Harbour works, MTCC. 149

Figure 12: Location of groynes..... 149

Figure 13: Location of Groynes 150

Figure 14: Similar groynes established in Maldives (Photo from Trip Advisor.com) 150

Figure 15: Location for proposed temporary material storage and accommodation at Bodukaashihuraa..... 163

Figure 16: spill response procedure 172

Figure 17 : Shows all the major tectonic plates and their general movements..... 177

Figure 18: Shows the general bathymetry of Maldives (riyan Pte.Ltd, 2013)..... 178

Figure 19: Shows some morphological features in an island system (Kench, P S; Brander, R W, 2006). 179

Figure 20: Ten year mean monthly wave height and direction for the central Maldives. Source: Young (1999). 180

Figure 21: Location of A.Dh. Bodukaashihuraa with respect to Hulhule’ meteorological center 183

Figure 22. Mean, minimum, and maximum monthly temperatures for Hulhule’ from 1975 to 2022 (Data obtained from the Maldives Meteorological Service)..... 184

Figure 23. Mean monthly rainfall (mm) for Hulhule’ from 1975 to 2022 (Data obtained from the Maldives Meteorological Service)..... 186

Figure 24. Mean wind speeds for Hulhule’ from 1975 to 2023 (Data obtained from the Maldives Meteorological Service)..... 190

Figure 25: Maximum wind speeds for Hulhule’ from 1975 to 2023 (Data obtained from the Maldives Meteorological Service)..... 192

Figure 26. Location of Bodukaashihuraa in Alif Dhaal atoll..... 194

Figure 27. Approach of wind and swell waves to Bodukaashihuraa in NE monsoon..... 195

Figure 28: approach of wind and swell waves to Bodukaashihuraa in SW monsoon 196

Figure 29: measured currents around Bodukaashihuraa 198

Figure 30: Aerials pictures of Bodukaashihuraa over the past years (adopted from google earth) 199

Figure 31: seabed sediments on the reef flat at Bodukaashihuraa 201

Figure 32: Major substrate categories of all transects and their mean (top left)..... 203

Figure 33: Subcategories of each transect and their mean..... 208

Figure 34: benthic substrates at the surveyed location in Bodukaashihuraa 209

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Figure 35: Total abundance (right) and relative abundance (left) of fish at Bodukaashihuraa reef 210

Figure 36: abundance of fish at the surveyed locations in Bodukaashihuraa reef flat 213

Figure 37: Typical soil profile 222

Figure 38: soil profiles at project site 223

Figure 39: vegetation found at the surveyed locations on Bodukaashihuraa..... 228

Figure 40: global estimated of major aerosol classes, figure adopted from (Ferrero, 2018)..... 231

Figure 41: population of Alif Dhaal atoll in 2022 ((Statistical Yearbook, 2023)..... 240

Figure 42: population growth rate from year 2006-2014 in Maldives (Statistical Yearbook, 2023) 240

Figure 43: registered population in A.Dh. Hangnaameedhoo from 2017 to 2022 (Isles, 2023) 241

Figure 44: shows population size at A.Dh. Hangnaameedhoo from 1985 to 2022 (Isles, 2023) 241

Figure 45: resident employed population by sector (Maldives Population & Housing Census, 2014) 242

Figure 46: average number of earner by sector from the main Job (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016)..... 243

Figure 47: average number of earners by Atoll, 2016 (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016)..... 244

Figure 48: average monthly income per earner (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016)..... 245

Figure 49: earners aged 15 and above population by sex and locality, 2016 (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016) 246

Figure 50: unemployment rate by locality, 2006 & 2014 (Maldives Population & Housing Census, 2014) 247

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Figure 51: Regional and main referral facility found in each zone (Maldives Health Statistics, 2020). 248

Figure 52: Healthcare facilities available in each zone (Maldives Health Statistics, 2020)..... 249

Figure 53: Registered vessels by locality (Statistical Yearbook of Maldives, 2018) 250

Figure 54: Cyclonic wind hazard map of the Maldives; from red to green, red being the highest at risk (Multihazard Risk Atlas of Maldives, 2020) 253

Figure 55: Storm hazard map of the Maldives from pink to green, pink being highest risk (Multihazard Risk Atlas of Maldives, 2020) 254

Figure 56: Rainfall anomalies for Hulhule’ from 1975 to 2022 with the 10-year moving average. Red lines indicate +1 and -1 standard deviations from the mean. (Data obtained from the Bureau of Meteorology, Maldives). 256

Figure 57 Seismic hazard zoning map of the Maldives from green to red, red being the highest at risk (Multihazard Risk Atlas of Maldives, 2020) 258

Figure 58: Tsunami hazard zoning map of Maldives (Multihazard Risk Atlas of Maldives, 2020) 259

Figure 59: estimated impact boundary for the proposed project 299

Figure 60: Sample image of an RTP tank..... 304

Figure 61: Alternative outfall location..... 308

Figure 62: Potential location for placement of silt screens during construction of the resort 327

IV. CONSULTANTS DECLARATION

We hereby declare that the statements made in this EIA report are true, complete and correct to the best of our knowledge and available information at the time of writing the report.

Name: Mahfooz Abdul Wahhab (Lead Consultant)

Date: 11th August 2023

Sign: 

Name: Ibrahim Rashihu Adam (Co-Consultant)

Date: 11th August 2023

Sign: 

V. LETTER OF COMMITMENT AND DECLARATION OF PROPONENT



بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

ދިވެހިރާއްޖޭގެ ޖުމްހޫރިއްޔާ ގުޅިގެން
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H. M. H. I Company PVT LTD
Nanreethimaage, Rep. of Maldives

Reg no: C-836 /2007. H.Sentalam (8FL / C),Abadhah Ufaa magu,K Male'20037

Declaration of the proponent

As the representative of the proponent of the proposed development I guarantee that I have read the report thoroughly and that to the best of my knowledge all information provided here is accurate and complete. In addition, I confirm our commitment to making sure that the contractor implements all mitigation measures proposed in the present report and adhere to the monitoring schedule given.

Name: moosa Ibrahim

Signature: 

Date: 13/08/2023





بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

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ސަރުކާރުގެ ސަރަޙައްދުގައި ހިންގާ ޕްރޮޖެކްޓްތަކުގެ ބޭނުންކުރުމުގެ ތެރެއިން

H. M. H. I Company PVT LTD
Nanreethimaage, Rep. of Maldives

Reg no: C-836 /2007. H.Sentalam (8FL / C),Abadhah Ufaa magu,K Male'20037

Mr. Ibrahim Naeem
Director General
Environment Protection Agency
Male'
Maldives
13/08/2023

Dear Mr. Naeem,

Re: Environmental Impact Assessment for the Proposed Resort Development Project
at Bodukaashihuraa, Alif Dhaal Atoll

As per the requirements of the EIA regulation, we hereby confirm our commitment to implement the mitigation and monitoring measures according to what is proposed in the EIA report attached herewith.

Your sincerely

Moosa Ibrahim

HMHI Company Pvt. Ltd.



VII. EXECUTIVE SUMMARY

The purpose of this EIA is to critically analyze and assess the potential environmental impacts associated with the proposed project to a luxury resort at ADh.Bodukaashihura and propose the solutions and preferred alternatives as well as mitigation measures to minimize any negative impacts whilst trying to derive the maximum positive impacts from the project.

The proposed resort is to be constructed at A.Dh Bodukaashi huraa. The Island is located on the Eastern rim of Alif Dhaalu Atoll and there are no environmentally sensitive or protected sites within 5km of the project island. The government of the Maldives has leased the island of Bodukaashihura for the purposes of developing a luxury resort. Therefore, the project entails the development of guest facilities such as, Beach Villa, Pool Beach Villas, Beach Suites, Water villas, Pool water villas, Water suites, Reception lobby, boutique and front office, Pool Bar and Swimming Pool, All Day Dining Restaurant, Specialty Restaurant, Lagoon Bar, Grill Restaurant, Recreation Centre , Spa Main, Spa Treatment Rooms, Gymnasium, Dive Centre, Water Sports Center, Arrival Pavilion, Jetty head Pavilion and Badminton Court. The project also entails the development of back of house facilities such as Executive Staff Rooms, Laundry Stores, Senior Staff rooms, Resort Admin office Junior staff room, Staff Dining, Kitchen, staff recreation, Service centre (Power and Water facilities), waste management facility, Mosque, Housekeeping stores (land), Housekeeping stores (water), Radio hut, Clinic, water storage tanks, Fuel Storage (1 diesel tank and 1 petrol tank) and Sewage treatment plant that would ensure the operation of such a facility. As such the resort will have total build up area of 8,849.19 sqm which is 28.61% of the total land area. Furthermore, the project also includes the reclamation area of around ten thousand square meters and establishment of related shore protection measures.

The major regulatory requirements for the project involve obtaining the EIA decision statement to go ahead with the project as per the EIA regulation, following with the legislations pertaining to tourism, electricity provision, waste management, water and sewerage services and dredging. In order to assess the existing environment of the project site, various aspects were

studied under the EIA. Some of them are, marine and terrestrial biodiversity, air quality, noise, socioeconomic environment, water quality and hazard vulnerability.

The major impacts highlighted for the construction phase of the project is the damage to benthos and sedimentation, impacts from vegetation clearance, impacts on air quality, groundwater salinization, impacts on marine and coastal environment. The major impacts during operational phase are on air quality, marine environment, hydrodynamics, and the beneficial socioeconomic impacts. Major mitigation measures proposed in the construction phase include measures to lower sedimentation and vegetation removal impacts, ensuring shortest vehicle route in mobilization, vehicles are maintained properly, avoiding unnecessary use of vehicles, taking dust suppression actions such as spraying water on ground, restriction of work hours to during day time following oil and chemical handing procedures and having emergency spill clean-up crew at site. And during operational phase it is proposed to ensure that the generators at the powerhouse are well maintained, ensure optimal operations at the waste management center at all times, raising chimney above the canopy of the island, ensure leak detection systems are working and ensure leak repairs are done timely to avoid further incidents, ensure timely outfall inspections and attend to repairs timely if need be and monitoring the water quality of the supplied water to ensure safety of the supplied water.

Main alternatives that were studied were the no-project option, renewable energy integration, alternative intake method for the desalination plan, alternative material for storage tanks, alternative sewer treatment technology and alternative location for outfalls. The environmental monitoring formulated in the EIA includes to monitor marine environment, groundwater, turbidity, waste generation, incident occurrence and noise generation during construction phase and air quality, groundwater, supply water monitoring, waste, shoreline, marine environment and incident occurrence during operational phase of the project.

The socioeconomic benefits during the operations outweigh the negative impacts of the construction phase of the proposed project. Hence, with the alternative and mitigation measures outlined in the report, it is recommended to proceed with the project as planned.

1. INTRODUCTION

1.1 Structure of the EIA

This Environmental Impact Assessment (EIA) addresses the potential impacts of the proposed development on the physical, biological, environmental and socio-economic aspects of the development area in addition to providing safeguards to reduce any environmental effects.

In addition to forming a basis for the assessment and approval of the proposed project, this EIA provides the community and government authorities with information on all aspects of the proposal. The EIA has been divided into following sections;

- **Section I - III: CONTENTS-** Provides hyperlinks to various sections, figure and table of the EIA report.
- **Section IV - V: DECLARATIONS-** Provides the Proponent and Consultant's declaration for the EIA report.
- **Section VI - VII: EXECUTIVE SUMMARY-** Provide a brief non-technical summary of key finding of the EIA report.
- **Section 1: INTRODUCTION-** Provides an outline of the structure and purpose of the EIA as well as objectives of the proposed development.
- **Section 2: METHODOLOGY-** Describes the detailed methods used for data collection on the existing environment and baseline conditions.
- **Section 3: STATUTORY REQUIREMENTS-** Outlines the relevant legislative requirements pertaining to the proposed project.
- **Section 4: PROJECT DESCRIPTION-** Describes the proposed development in detail.
- **Section 5: EXISITING ENVIRONMENT-** Describes the present conditions of the physical components of the study area and sets baseline conditions.
- **Section 6: STAKEHOLDER CONSULTATION-** Provides details on the consultation process and parties consulted for this study.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- **Section 7: POTENTIAL IMPACT ANALYSIS-** Describes the prevailing environmental characteristics and constraints of the site and locality being investigated and an assessment of the potential environmental impacts associated with the proposed development.
- **Section 8: OPTIONS ASSESSMENT-** Discusses all the available alternatives for the project and justifies the preferred option.
- **Section 9: MITIGATION MEASURES-** Outlines the mitigation measures that would be implemented to reduce any potentially adverse impacts.
- **Section 10: ENVIRONMENTAL MONITORING-** Outlines the environmental management monitoring parameters that would be used to monitor the changes.
- **Section 11: JUSTIFICATION AND CONCLUSION-** The conclusions drawn from the proposed project and impact analysis with the justification of the preferred options.
- **Section 12: ACKNOWLEDGEMENTS-** Highlights the parties which had contributed to the preparation of this EIA report.
- **Section 13: APPENDICES-** Supporting documents and information are provided as appendices to this EIA.

1.2 Project Objectives

The primary objective of the proposed project is to establish a luxury resort at ADh. Bodukaashi huraa.

1.3 Need for the Project

The current proposal is to develop the Island of A.Dh Bodukaashi Huraa as luxury tourist resort. The proponent has acquired the Island for tourism through due process and wishes to establish the required facilities of the resort

1.4 Summary of Impact Assessment Methodology

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

The scoping meeting for the proposed project was held at the EPA on 18th June 2023. The project proponents, EIA consultants and all other relevant stakeholders attended this meeting. The scope of the meeting as discussed at the meeting were approved and the ToR issued on the 19th June 2023 (the approved ToR is attached in appendix section Appendix C).

Based on the approved ToR the proponent and the consultants have conducted a risk-based environmental review as part of the planning process. Data has been drawn from a wide range of sources, including existing similar project EIA reports, baseline data, consultations with stakeholders, existing legislations, professional judgement and expertise of the consultants. Impacts were identified based on the locations of the project components as well as type of service to be provided. The detailed impact assessment methodology is described under chapter 7.

1.5 List of similar project EIAs reviewed

As part of relevant literature review for impact prediction as mentioned in the above section the following project EIAs were reviewed;

- Environmental Impact assessment for the development of B. Voavah as a Luxury Tourist Resort
- Environmental Impact assessment for the proposed refurbishment of water villas project at Angaga island resort and spa, south ari atoll
- Environmental impact assessment for additional water villa, expanding existing water villas and associated works in Lhaviyani Kanuhura
- Environmental impact assessment for upgrading of water system, powerhouse and maintenance dredging at Lhaviyani Kanuhura.
- Environmental Impact Assessment for the proposed 300 TPD RO Plant installation and Borehole construction at Lh. Kanuhura
- EIA for upgrade works for Dive Center, Boat yard and workshop in Gili Lanlanfushi
- EIA for Partial Renovation and Upgrade works in Four Seasons Landaa Giraavaru
- EIA for partial renovation and upgrade works of Six Senses Laamu
- EIA for the partial renovation and upgrade works of Four Seasons Kuda Hura

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- EIA for the upgrading of RO plant at Asseyri Prison, K. Himmafushi
- EIA for the Establishment of Water and Sewer system at A.Dh Dhigurah
- EIA for the Proposed shore protection, shoreline restoration, channel dredging and development of floating pontoon platform cages in the lagoon at N. Karinmaa Vattaru, Maldives
- EIA for Powerhouse relocation at Ha. Dhihdhoo
- EIA for the Establishment of Sewer system at ADh Dhangethi
- EIA for the proposed Quay Wall and Jetty at Ukulhas, Alif Alif Atoll
- Environmental Impact Assessment for the operation of standby generations in STELCO Hulhumale' old powerhouse facility and their grid connection
- Environmental Impact Assessment for the construction of a Waste Management Facility in K. Maafushi

1.6 Purpose of this EIA

The purpose of this EIA is to critically analyze the environmental and socio-economic impacts which may arise due to the construction and operation of the proposed project. After analyzing the impacts, it would be then possible to suggest proper mitigation measures to prevent/reduce any negative impacts and to enhance any positive impacts. The study involves evaluation of baseline conditions, prediction of the likely impacts, stakeholder consultation and design mitigation measures.

1.7 The EIA Process

The EIA process in the Maldives is coordinated by the Environmental Protection Agency (EPA) of the Maldives in order to ensure that environmental considerations are included in decisions regarding projects which may have an adverse impact on the environment.

The first step in the process involves screening (for the projects that may have significant impacts on the environment which are listed as projects requiring an EIA under appendix D of the EIA regulation 2012, an EIA application shall be provided to EPA and upon review EPA will call

for the scoping meeting) of the project to determine whether a particular project warrants preparation of an EIA. Based on this decision, the EPA then decides the scope of the EIA which is conferred to the project proponents, the consultants as well as any relevant stakeholders to the project at a scoping meeting. A document ideally encompassing the issues and impacts that have been identified during the scoping meeting will then be issued known as the Terms of Reference (ToR). The consultant then prepares the EIA in accordance with the ToR and/or the range of issues identified during the scoping process. Once the findings of the EIA has been reported to the EPA, it gets reviewed following which an EIA Decision Statement (DS) is issued to the proponent who is responsible for implementing the project according to the DS and undertake appropriate environmental monitoring if required and report to the EPA.

Note; due to the covid19 situation scoping meetings are held online.

1.8 The Consultant

The EIA was prepared by Eco-Tech Consultancy, which is an environmental and information technology consultancy firm registered in the Maldives on 2021. The company specializes in providing environmental solutions to clients. However, the company's services are not just limited to Environmental Impact Assessment, Environmental Monitoring Reports and Environment Management Systems, with their partners they provide land surveying and IT solutions as well. Within the short period Eco-Tech Consultancy has completed a total of 30 assignments that includes Environmental Impact Assessment reports, Environmental Monitoring Reports and RO Plant registrations.

The following registered EIA Consultants of Eco-Tech Consultancy were involved in the preparation of this EIA report;

- Mahfooz Abdul Wahhab, Consultant registration no: P22/2016 (Lead Consultant)
- Ibrahim Rashihu Adam, Consultant registration no: P06/2017

1.9 The Proponent

The proponent of this project is HMHI Company Pvt Ltd.

1.9.1 Contact details of Focal Point of the Proponent

Name: Moosa Ibrahim
Designation: Managing Director
Mobile No: 7778100
E-mail: admin@hmhicompany.com

2. METHODOLOGY

This chapter describes the EIA report formulation method and the methods used to collect and analyze site-specific baseline data along with the potential limitations and uncertainty in data collection methods.

2.1 EIA report formulation

The three main guiding principles that was utilized in the formulation of this EIA report was the Environment Impact Assessment Regulation 2012, the approved Terms of Reference, and the EIA writing guideline 2012. Supporting principles were adopted from the UNEP EIA Training Resource Manual 2002 and AS/NZS ISO 3100:2009 Risk management principles and guidelines. Lastly project information was used in determining the locations for baseline studies.

The contents in the chapters of this EIA report were as per the appendix E of the EIA regulations 2012 and the approved ToR. The EIA layout and structure is as per the EIA writing guideline. The baseline data which was collected in accordance with the ToR and EPA data collection guidelines as much as possible. The detailed methodology employed for baseline data collection is described in the following section 2.1.

All the legislation pertaining to the proposed development was studied through the published legislations under the Maldivian governments gazette and relevant government bodies websites.

Stakeholder consultation were done via public hearing for the EIAs that require public consultations and through face-to-face meeting or online meetings or via email communications.

The potential impacts were identified and analysed as per the method described in chapter 7.

Alternative were analysed based on its technical viability, economic feasibility, legal compliance, environmental practicability and social acceptability.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Preferred mitigation measures were determined based on the most significant impacts, where the mitigation measures would mitigate the adverse impacts or amplify the positive impacts further.

Similarly monitoring parameters were also determined based on the most significant impacts that could have adverse impacts to the environment.

Conclusion was justified by comparing the project need and the envisaged environmental impacts associated with the project.

2.1 Site-specific baseline data collection methods

All site-specific data were collected on 9th and 10th July 2023, except for site D12, where this site was studied on 14th August 2023. The climatic conditions at the sampling times were light to moderate winds from the west at a speed of 11.3 Knots.

2.1.1 Water quality

3 Groundwater samples were taken. All groundwater samples were collected from dug wells on the island during the survey. 9 marine water samples were collected (Refer to Table 3 and Figure 2 for sampling locations and respective GPS coordinates). Samples were collected in 500 mL plastic and 300ml glass bottles. Plastic and glasses bottles by first rinsing the bottle with the sampling water three times. Marine water samples were collected just below the surface. Marine water samples were collected on 10th July 2023 between 10:00 to 12:30 hours, and ground water sample collected on 10th July 2023 between 09:00 to 09:45 hours.

Samples were then sent to Maldives Water and Sewerage Company's (MWSC) water quality assurance laboratory in a chilled ice box for testing.

2.1.2 Noise

Noise level was measured using a sound meter. Sound was measured for 1 minute at the desired location and the maximum and minimum was recorded on 09th July 2023 between 17:20 to 16:30 (Refer to Table 3 and Figure 2 for sampling locations and respective GPS coordinates).

2.1.3 Structural Environment

The structural environment of the proposed project site was visually inspected and qualitative notes were taken on the type, number and quality of existing infrastructure.

2.1.4 Air Quality

Air quality was measured using a hand-held temperature / humidity / PM2.5 / PM10 / HCHO / TVOC / CO / CO₂ / AQI Air Detector. To avoid any bias from the surveyor the meter was left at each site for at least one minute to acclimatise before taking the reading. Readings were recorded on 09th July 2023 between 17:20 to 16:30 (Refer to Table 3 and Figure 2 for sampling locations and respective GPS coordinates).

2.1.5 Socioeconomic Environment

The most recent socio-economic data was obtained from Maldives Population and Housing Census 2022 and 2014, which was used to describe the demography, main economic activities, amenities, community needs and historical sites.

2.1.6 Bathymetry

“For Bathymetric survey, a fiber glass boat with an out-board engine was used. the survey boat was hired by considering its shallow draught and the agility to access through difficult turns. Bathymetric system was setup on right side of the boat. 0.75m pole was attached to the hull of survey vessel where 0.3m was submerged with sounding transducer attached to the tip of

submerged pole. On top of the pole GR5 GPS receiver was attached. Field controller connecting to GNSS receiver and eco sounder data streaming from both instruments at the same time.

The survey area requested was loaded to field controller. Where possible the survey path followed a grid of pre-determined transects set perpendicular to the general seabed contours with few adjacent lines in order to delineate the gradient changes. This method provided overlaps in data for validations. On completion of the transects, the data was checked on board to identify areas of low or missing coverage. These areas were resurveyed until coverage was complete. While maintaining a constant suitable speed all the measurements were logged to field controller continuously throughout the survey

Points were exported from the controller and loaded to AutoCAD Civil 3D software for data processing and drafting. As it is to be expected with sounding instruments anomalies in the data did occur during the survey becoming more numerous at turning point at the end of transects. These anomalies were easily identified when TIN surface was created on CIVIL 3D. Once the data has been cleaned and confirmed TIN surface was labelled and represented with color bands.” (MapScape, 2023)

2.1.7 Shoreline

“A total of 3 permanent survey marks (PSMs) were used as reference coordinates for the island survey. The exact coordinates of each PSM were recorded using Topcon GR5 RTK GPS system. Markers were placed over the PSMs and drone images were taken. The photos were processed using Agisoft Photoscan Professional to create a georeferenced aerial image. The low tide, high tide and vegetation line was drawn on the aerial image using surfer 14” (Mapscape, 2023).

2.1.8 Terrestrial Megafauna

Any terrestrial species encountered during the survey was recorded to give an indication of the terrestrial fauna on the island. For birds even if the species was not visually found, hearing of calls were noted as the species being present.

2.1.9 Terrestrial Vegetation

A 30 m long transect was laid at the desired location and the trees touching or crossing the transect line above (higher branches) were counted. In order to give an indication of the maturity of the trees the estimated height of the trees was given in 4 storeys (ground, 0-2m, 2-4m, and >4m). The locations of vegetation transect are given in Figure 2 and respective GPS coordinates on Table 3.

2.1.10 Current measurement

A drogue constructed from plastic plates joined together by bolts to make four fins (Figure 1) to catch the currents, were used to measure currents. The drogue was deployed for a few minutes, the start and end location of the drogue was geo-referenced. The distance travelled was later calculated and the speed of currents determined. Drogue runs were done at 8 different locations (the locations of current measurement are shown on Figure 2 and respective GPS coordinates on Table 3).



Figure 1: Drogue deployed at sea for current measurement (left) and hand-held GPS used to geo-reference sampling locations

2.1.11 Benthic Substrate Analysis

CPCe software was used to assess the benthic substrate, which is one of the most widely used tools for marine assessments (Kohler & Gill, 2006). 15 pictures were taken at each respective site from which 10 photos are chosen for analysis (Refer to Table 3 and Figure 2 for sampling locations and respective GPS coordinates). CPCe used 25 points on each photograph to point out the substrate found at each point. The software calculates the percentage of each substrate for the 10 photographs. The method is repeated to take 8 transects at different locations.

Percentage live coral cover was used as an indicator to categorize the condition of the reef (Table 1). The categories were used from (Rizmaadi, et al., 2018), with an additional category of very poor. The site D12 was studied on a different date as such this site was not included in the overall statistics.

Table 1: Reef condition categories based on % live coral cover.

Category	% Live coral cover
Very poor	0%-10.9%
Poor	11%-24.9%
Moderate	25%-49.9%
Good	50%-74.9%

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Exceptional	75%-100%
-------------	----------

2.1.12 Fish Census

The number of fish encountered while swimming for 5 minutes in a straight line on the reef were all counted to get the total abundance, except for site D12, where at this site a video was taken which was later analyzed to count the number of fishes observed as such this site was removed from the overall statistics. Fish census were carried out at the 8 locations where benthic substrate analysis were undertaken (Refer to Table 3 and Figure 2 for sampling locations and respective GPS coordinates). The fishes were identified using the (Fishes of the Maldives, 2003), (FishBase, 2023), (Kuitert, 2014), and (Coleman, Godfrey, Bridge, & Moritz, 2019). After identification of the fishes, the abundance of each species for all sites was calculated along with the relative abundance for each family.

2.1.13 Coastal Environment

A visual inspection was undertaken at 4 different locations along the beach to describe the coastal environment of the Island. Attention was given on identifying the types of beach sediments, visually observing the size of beach sediments, and organisms present on the beach.

2.1.14 Hazard Vulnerability

The vulnerability of the proposed project site to storms, cyclonic winds, storm surge, seismic activity and tsunami were determined based on the disaster risk profile for Maldives 2006 and multi-hazard risk atlas of Maldives 2020. Risk of flooding was determined by analysing available rainfall data from the nearest meteorological station.

2.2 Limitations in data collection methods

There are several sources of uncertainty and limitations in any data collection method, some of which we aren't even aware of it. Nonetheless, the possible sources of uncertainty and limitations for the methods used to collect data for this EIA is described below.

Firstly, the water quality tests were not done on-site, therefore the results may not reflect the actual physical parameters of water for example temperature.

Air quality and noise measurements were taken only at one time. While these parameters may change depending on the time and the season. Furthermore, the air quality reference ranges to which the collected data are compared to are for averages or exceedance for a set time (1 hour or 8 hour) but the readings that we have taken is a one time reading.

Noise measurements were taken for a short period of time and during daytime only. The noise levels may be very different at night time.

Vegetation clearance was estimated by counting the trees on an overlaid georeferenced model of the Island. As such the undergrowth will not be accounted for and hence the vegetation clearance will be an under estimate.

The terrestrial fauna surveys were only focused on mega fauna and hence did not include groups like insects.

Data for income situation and distribution on an atoll level was not up-to-date, hence information for previous years was used to estimate the income status of the region. Therefore, the obtained representation of income situation and distribution for the region might not reflect the actual situation.

Coastal environments were studied only at one time. While it may change depending on the time of day and season.

Current measurements were taken only at one time. While currents may change depending on the time and the season.

During benthic substrate analysis, the category of the substrate is very subjective and hence different analyzers may perceive a substrate category differently. To avoid this human bias, one analyzer has analyzed all the transects for this EIA.

Fish census were taken only at one time, while the abundance of fish may differ with tide, day, night and with season. Furthermore, since the fish census was done via snorkeling only the fish mostly living at 0-5m depth would be recorded. Finally, the abundance of fish was calculated based on the numbers only without factoring in the size or mass of the fish which could lead to misinterpretation of the total biomass of the different groups of fishes.

2.3 Data gaps

The most contrasting data gap is the lack of long-term site-specific data and the data that was taken under this EIA was also a snapshot of the full environmental setting as can be seen evidently from the above section. Namely, these data gaps include; lack of site-specific hazard risk analysis, climatic conditions, currents in both seasons, seasonal erosion patterns, fish census data for different tides and seasons.

2.4 Uncertainty in data

The first and foremost uncertainty in any data arises from the data collection method as it is impossible to devise a sampling method that is devoid of error. Hence any physical, chemical or biological parameter that is measured will have an error or uncertainty from the data collection method itself as no method by nature is 100% accurate. Additional uncertainties to the sampling method arises from the instrument used, these include the instruments resolution, accuracy and precision errors. Thirdly the human error that will be imposed when a person measures a parameter using a specific sampling method by using a particular instrument. Other factors include the time and environment.

Some of the results presented in this report are given with a confidence interval. The confidence interval is calculated at 95%, which means that we are 95% confident that the true value lies within the range given. Uncertainty could be calculated like this for certain parameters as some of the results provided are from third party data which does not have information of accuracy and precision. And in other cases, it is not possible to calculate as the measurements are only discreet data describing a varying parameter. In these types of cases the initial value obtained

is given. Caution must be taken when using this type of data, as it is this type of data that usually warrants long-term studies.

2.5 Management of Uncertainties and Data Gaps

Due to the abovementioned limitations, data gaps and uncertainties, the following assumptions were made;

Table 2: uncertainties and data gaps in collected data and how it was managed

Data	Sources of Uncertainty	Data Gap	Assumption (how it was managed)
Hazard risk	Modelling errors due to imperfect understanding of the natural setting and lack of long-term data	No site-specific data	The available broadscale hazard risk analysis of the Maldives was used to determine the site-specific hazard risk at the proposed project site.
Temperature, rainfall, wind	Equipment precision errors Human error	No site-specific data	Regional climatic conditions from the meteorological centre for wind, rain, temperature was assumed true for the proposed project location.
Water quality parameters	Off-site testing Equipment precision errors Human error	Data lacking for both seasons	The tested water quality parameters (except for temperature) in the laboratory was assumed to be the onsite conditions.

2.6 Geographic Coordinates for all sampling locations

The coordinates for all sampling locations are shown in Table 3 and Figure 2 below.

Table 3: Geographic coordinates for all sampling location at Bodukaashihuraa

Code	Type	Location	GPS Coordinates	
			Easting	Northing
D1	Refers to location D1 of water sample, drogue run, fish census and benthic transect	(Project Construction site) Jetty Pavilion	272807.00	428421.00
D2	Refers to location D2 of water sample, drogue run, fish census and benthic transect	(Project Construction site) Outfall location	272916.00	428395.00

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

D3	Refers to location D3 of water sample, drogue run, fish census and benthic transect	(Project Construction site) Proposed borrow area	272678.00	428660.00
D4	Refers to location D4 of water sample, drogue run, fish census and benthic transect	(Project Construction site) Water Villa jetty	272586.00	428978.00
D5	Refers to location D5 of water sample, drogue run, fish census and benthic transect	(Project Construction site) Intake location	273097.00	428801.00
D6	Refers to location D6 of water sample, drogue run, fish census and benthic transect	(Project Construction site) Outfall alternative	273388.00	428477.00
D7	Refers to location D7 of water sample, drogue run and benthic transect	(Project Construction site) Borrow area alternative	273168.00	428558.00
D8	Refers to location D8 where area was observed and pictures taken	Alternative jetty pavilion	272826.60	428475.04
D9	Refers to location D9 where area was observed and pictures taken along with water sample	Specialty restaurant	272839.11	428550.19
D10	Refers to location D10 where area was observed and pictures taken	Seaplane arrival jetty	272989.74	428763.17
D11	Refers to location D11 where area was observed and pictures taken	Water villa jetty	272720.29	428939.94
D12	Refers to location D12 of fish census and benthic transect	Access channel	272932.00	428949.00
C	Refers to location C of water sample, drogue run, fish census and benthic transect	Western lagoon	272304.00	429038.00
GC	Ground water sample at location GC	(Control site) Near Mosque	272911.00	428634.00
G1	Ground water sample at location G1	(Project Construction site) Near Utilities	272872.00	428702.00
G2	Ground water sample at location G2	(Project Construction site) Near Grill restaurant	272844.00	428754.00
VT1	Refers to location VT1 of vegetation transect and visual terrestrial animals count	(Project Construction site) Near Grill restaurant	272809.00	428760.00
VT2	Refers to location VT2 of vegetation transect and visual	(Project Construction site)	272871.00	428646.00

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

	terrestrial animals count	Near Radio hut		
VTC	Refers to location VTC of vegetation transect and visual terrestrial animals count	(Control site) Near Dive centre	272865.00	428748.00
CE1	Refers to location CE1 of visual observation of coastal environment	(Project Construction site) North tip of Island	272828.00	428825.00
CE2	Refers to location CE2 of visual observation of coastal environment	(Project Construction site) West side of Island	272828.00	428696.00
CE3	Refers to location CE3 of visual observation of coastal environment	(Project Construction site) South tip of Island	272933.00	428585.00
CE4	Refers to location CE4 of visual observation of coastal environment	(Project Construction site) East side of Island	272865.00	428748.00
N1	Refers to location N1 of Noise measurement	(Project Construction site) Near Utilities	272872.00	428702.00
N2	Refers to location N2 of Noise measurement	(Control site) Near Mosque	272911.00	428634.00
AQ1	Refers to location AQ1 of Air quality measurement	(Project Construction site) Near Utilities	272872.00	428702.00
AQ2	Refers to location AQ2 of Air quality measurement	(Control site) Near Mosque	272911.00	428634.00

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll



Figure 2: sampling locations at A.Dh. Bodukaashihuraa

3. STATUTORY REQUIREMENTS

This section describes the statutory requirements relevant to the proposed proposal. Section 3.1 describes all the relevant laws, policies and strategic action plans that must be complied to for this proposal. Section 3.2 describes all the pertinent regulations, section 3.3 all the guidelines and section 3.4 describe all the international conventions that the Maldives are a party to.

3.1 Laws, Policies and Strategic Action Plans

This section describes the applicable laws, policies and strategic action plans pertaining to the proposed development.

3.1.1 Environmental Protection and Preservation Act (4/93)

The Environmental protection and Preservation Act of the Maldives was enacted to protect the environment and its resources for the current and future generations. Relevant articles under this law pertaining to the proposed project are:-

- Article 2 states that the instructions for environmental protection will be given from the competent authority and everyone must respectfully follow these instructions;
- 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);
- Article 4 states that MPHRE must declare protected sites and species and formulate the regulations to manage them. If any other party wants to declare a protected site or species they must be registered in the MPHRE and managed according to regulations made by the Ministry;
- 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;

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Article 6 states that if any project is found to cause significant adverse impacts, MPHRE have the right to stop the project;
- Article 7 states that any waste, oil or hazardous gas must not be dumped into any part of the Maldives, however, if strictly needs 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;
- Article 8 states that any hazardous waste must not be disposed into any part of the Maldives. Before trans-boundary transfer of such waste, approval must be taken from the Ministry of Transport and Communication by writing to the Ministry at least 3 months beforehand.
- 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.
- Article 10 states that any offence to this law or any regulation under this law or any action resulting in environment damage, the compensation for such damages can be taken through judicial processes.

3.1.1.1 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.

3.1.2 Maldives Tourism Act (2/99)

This act encompasses the issues related to the development of tourism in the Maldives. It came into effect on the November, 1999, repealing the Law on Tourism in the Maldives (Act No.

15/79) and the Law on Leasing of Uninhabited Islands for the Development of Tourist Resorts (Act No. 3/94). Act No. 15/79 was the primary legislation that was passed by the Citizen’s Majlis in November 1979 and the main aim was to provide for the collection of a bed tax from the visiting tourists and to control their movement in the Maldives. While this Act only dealt with tourist resorts, hotels and guest houses, the amended act (Act No. 2/99) incorporates the determination of zones where tourism development can occur, as well as the development and management of marinas and the operation of tourist vessels, diving centers and travel agencies. This is evidence that the tourism industry has expanded since the enactment of the initial laws, both in magnitude and in the diversity of facilities that are provided for the visiting tourists.

The environmental legislation that directly applies to the development is outlined under article 15 (a) and (b). Article 15 (a) provides for the felling of Ruh’s and trees, dredging of lagoons, reclamation of land or any other activity that may cause permanent change to the natural environment of an island leased as a tourist resort. It states that the activities mentioned above can only be carried out after obtaining written permission from the Ministry of Tourism and in accordance with the relevant regulations.

Under Article 15 (b), a justification has to be provided for such an activity, as well as an environmental impact assessment, which has to be submitted to and approved by the Ministry of Housing and Environment.

There are several regulations under the Maldives Tourism Act (Law No. 2/99) and those pertaining to the environment are presented below.

3.1.3 Maldives Fifth Tourism Master Plan

The Maldives fifth Tourism Master Plan comprises of 15 goals. Which are:

- Maximise the benefits of tourism to all atoll communities
- Communicate the full potential of Maldives to existing and new audiences
- Offer new products and experiences
- Build climate resilience and protect natural assets
- Enhance energy security and achieve net zero emissions

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Provide outstanding transport services
- Attract and retain a world class tourism workforce
- Accelerate investment and innovative finance
- Regulatory reforms to make it easier to do business
- Accelerate 360 digitisation
- Whole-of-government prioritisation of tourism
- Advanced data analytics and insights
- Strengthen health, safety, and security systems
- Establish transformational tourism industry standards
- Ensure tourism is accessible for all

3.1.4 Waste management policy

With the implementation of waste management policy 2015, the 2011 and 2007 policy is void. The waste management policy which came into effect on 2015 is to ensure 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.

3.1.5 Waste management Act (24/2022)

The waste management act came into force in 18th December 2022 with the main objectives of implementing sustainable waste management, establish waste management standards, minimize negative impacts from waste to the environment and human health. The act outlines the principles for waste management, roles and responsibilities of the relevant institutions.

3.1.6 Maldives Energy Act (18/2021)

The Maldives Energy Act was published on 11th October 2021 with the aims to regulating power production, power usage, electricity services, protecting the rights of customers, detailing the rights and responsibilities of service providers, upkeeping the quality of services, regulating power tariff rates, promoting renewable energy, facilitate sustainable development of the energy industry in a manner that is environmentally friendly, resilient to the impacts of climate change, facilitate reduction in GHG emissions, economically feasibility. Relevant notable articles under this law pertaining to the proposed project are:-

- Chapter 1 – Introduction. the following are some aspects highlighted under the chapter.
 - Energy sector policy:
 - Shall be formulated and gazetted.
 - All involved in electricity service provision shall adhere to it.
 - Policy shall be reviewed and revised in every 5 years.
 - Energy sector plan:
 - 10-year plan on the energy sector development shall be formulated.
 - All licensees for electricity service provision shall provide a plan on service provision to the Ministry.
- Chapter 2 relates to the Roles and Responsibilities of the institutions, under which the following are highlighted:
 - Responsibility of the Ministry:
 - Facilitation of electricity services at an affordable rate in all inhabited islands, facilitating the investments for the sector,
 - Provision of technical assistance to island councils,
 - Implementing the international commitments relative to the sector,
 - Formulation of regulations and ensuring sustainable levels of electricity services are received to all inhabited islands.
 - The Authority and Responsibility of the Regulator:
 - Enforcement of regulations,
 - Licensing,

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Tarrif setting,
- Monitoring and revision,
- Regulating of service providers,
- Formulating of standards relevant to the sector etc.
- Roles and responsibilities of island councils.
- Responsibility of other entities to provided assistance for the enforcement of the act.
- Chapter 3 is regarding the renewable energy. The following are discussed in the chapter
 - Ownership
 - Development
 - Target setting
 - utilising the space required for renewable energy
 - providing preference to renewable energy.
- Chapter 4 deals with petroleum and petroleum products. It details the following aspects regarding petroleum and petroleum products
 - Licensing and its relevant details
 - Quality Assurance
 - Stock Management
 - Environmental protection and general public health safety
 - Regulatory aspects for vessels carrying petroleum and petroleum product
- Chapter 5 deals with production of power and provision of its services, the following are some aspects highlighted under the chapter
 - Service provider and customer rights
 - Provision of services
 - Licensing
 - Responsibilities of service providers
 - Provision of services for personals with financial vulnerabilities
 - Monitoring
 - Inspections
 - Tariff settings

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Application of services
- Quality assurance
- Termination of services
- Emergency power cut
- Vandalism and disruption of services
- Ownership
- Chapter 6 deals with economising electricity and its efficient use, the following are some aspects highlighted under the chapter
 - Energy saving and its efficiency
 - Information collection
 - Formulation of regulation and guidelines
 - Energy efficiency certifications
 - Energy auditing
 - Annual energy report
 - Ill practices in electricity usage
- Chapter 7 highlights regarding the transition from previous legal framework of the energy sector.

3.1.7 Maldives Energy Policy and Strategy 2016

Maldives Energy Policy and Strategy 2016 consists of revised policies derived from Maldives Energy Policy and Strategy 2010. The 9 policies are reduced to 5 key policy statements.

- Strengthen the institutional and regulatory framework of the energy sector
- Promote energy conservation and efficiency
- Developing and enforcing standards for exhaust emissions for power plants, vehicles and vessels that use fossil fuel in order to improve air quality
- Increase the share of renewable energy in the national energy mix
- Improve the reliability and sustainability of electrical services and maintain universal access to electricity

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Devising means to reliably meet energy demands in a consistent manner assuring security and reliability of supply
- Improve the operational performance of service providers to manage the electrical power infrastructure
- Increase efficiency of the energy systems and quality of energy services provided
- Review and regularly implement electricity tariff adjustments
- Develop and update an integrated system management and expansion plan for utilities
- Increase national energy security
- Ensure environmentally safe and adequate storage, supply and distribution of fuel to meet the demand.

3.1.8 Water and sewerage Act (8/2020)

The water and sewerage Act was published on 05th August 2020 with the aims to provide safe water and sanitation services to the general public by implementing guidelines for providing water and sanitation service, operation and maintenance of water and sewer facilities, and other related guidelines. Relevant articles under this law pertaining to the proposed project are:-

- Article 5 states that, to provide the water and sanitation services entitled for every citizen of Maldives, it is the duty of the government to implement the following;
 - establishing facilities required to provide water and sanitation services sustainably
 - ensuring that safe water and adequate sanitation services are provided
 - overcoming any hindrance to provide water and sanitation service
 - establishing standards for water and sanitation service
 - ensuring that the water and sanitation service providers follow the set standards
 - researching and developing the water and sanitation sector
- Article 6 states that the water and sanitation policies shall be declared by the Minister as advised by the President. These policies shall be made available to the general public.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

All parties involved in the water and sanitation sector must fully comply with these policies.

- Article 7 states that Utility Regulatory Authority shall be responsible to implement this law.
- Article 8 states the duties of the Ministry in detail. These include drafting the polices, laws and regulations required to implement this law, establishing water and sanitation facilities in all inhabited Islands of the Maldives within 05 years of implementation of this law, ensuring that proper sewerage facilities are established on tourist and other industrial islands, and all the works to develop the water and sanitation sector.
- Article 9 states that the Council has the authority to declare the fees that could be taken from the water and sanitation service in accordance with the Utility Regulatory Authority and Governments policies and regulations. Additional responsibilities of the Council include; monitoring the third party water and sanitation service provider, monitoring environmental impacts due to water and sewer systems, providing information about water and sanitation service on the Island to the Competent Authorities, ensuring that enough water is available to the living population of the Island, and providing water and sanitation service via a licensed third party.
- Article 10 states the points that must be included in the third party agreement mentioned in article 9.
- Article 11 states the duties of Utility Regulatory Authority, which is to give licenses to all water and sewerage facilities in the Maldives and monitoring them.
- Article 15 states that the licensed all water and sanitation service providers must submit a plan to provider water and sanitation service annually with an implementation report which specifies; (1) water quality, (2) lost water, (3) service interruption, (4) costs, (5) revenue generated, and (6) CSR activities.
- Article 18 states that the groundwater presents in Tourism, Industrial and Reclaimed Islands are protected.
- Article 19 states that the groundwater presents in Tourism, Industrial and Reclaimed Islands cannot be used for commercial purposes. For existing agricultural Island a

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

period of 2 years must be given for them to install RO plants and for inhabited islands, RO plants must be installed for agricultural field larger than 10,000 m².

- Article 20 states that any activity that contaminates the ground water is prohibited. Exclusive of this clause is using fertilizer for agricultural purpose and installing septic tanks in households. The article further states that fuel and other chemicals must be handled properly such that spills do not occur and if a spill occurs, the proponent must be responsible for clean-up. Finally, it is prohibited to dispose water which contains fuel and chemicals from Engine maintenance to the sea.
- Article 21 states that dewatering must be done in accordance with the regulations made under this law.
- Article 22 states that it is prohibited to dispose brine into ground or wetlands. Further, mixing of permeate water and rain water must be done according to set guidelines of the Utility Regulatory Authority.
- Article 24 states that there must be 05 days of water stored in case of emergency by all the service providers. Emergency water storage must be allocated in reference to the living population on the island, available water, and land availability for water storage.
- Article 25 states that operating license for water and sanitation service must be issued after the EIA process.
- Article 27 states that power required for the operation of RO plants must be from renewable energy sources. However, a period of 05 years shall be given to existing RO plants for transition. Nonetheless during an emergency situation due to a disaster on in case of renewable energy system failure, power from Diesel generators could be used.
- Article 28 states that rain water must be included as much as possible in the provision of Desalinated water.
- Article 29 states that it is the duty of the water and sanitation service provider to do all works required to provide the service in the assigned region for them. Additional responsibilities include; providing reports to Utility Regulatory Authority, upgrading water and sewerage facilities according to new technology, providing the first house connection free of charge, and water testing to ensure quality of water.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Article 30 states that the water and sanitation service provider reserved the right to prohibit certain substances being disposed into the sewer system, installing meters, and entering households and commercial places.
- Article 31 states that the water facilities on inhabited islands of the Maldives must be established in accordance with MFDA’s regulations. Additional points under this article include; the established water systems must have the capacity to test for water quality and disinfect, and it is the responsibility of the building’s owner to establish measure to manage pressure in tall buildings, if a license for providing water has already been issued to an inhabited Island a second RO plant by another party could be installed with the approval of the Utility Regulatory Authority.
- Article 32 states that the Ministry shall declare publicly the Islands which require an STP and duration for establishing STP’s on these Islands. On the islands where the Ministry has declared that an STP is required, on these islands sewerage services must only be provided with an STP. However, during an emergency situation due to flooding, disposal of this storm water is allowed without the involvement of an STP. Additional points include; Disposing of water from dewatering to the sewerage network is prohibited and technical specification for sewerage facilities must be made by the Utility Regulatory Authority.
- Article 34 states that an agreement must be made prior to giving approval to any water and sanitation service provider and this agreement must be registered in the Utility Regulatory Authority.
- Article 35 states that all water and sewer systems in the Maldives must be operated after registering in the Utility Regulatory Authority.
- Article 36 states that water and sewer services in inhabited Islands of the Maldives must be given after taking the operating license from the Utility Regulatory Authority.
- Article 37 states that an exclusive operating license could only be given after getting the written approval from the president as advised by the Parliament if it is needed for the betterment of the country.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Article 38 states the requirements of the operating license, these include; operation and maintenance of water and sewer systems in accordance with the regulations set by the Utility Regulatory Authority, implementing the business plan mentioned in article 41(a-2), reporting, and fulfilling other requirements set by the Utility Regulatory Authority.
- Article 41 states that the procedures for obtaining the operating license must be publicly made available. The article further details the information the service provider must submit while applying for the operating license.
- Article 42 states that the fees for water and sewer for inhabited Islands will be declared by the Utility Regulatory Authority.
- Article 43 states that the service provider must submit a performance report to the Utility Regulatory Authority, Council, and Ministry annually
- Article 44 states that customers have the right to report any complaints regarding the service provider to the Utility Regulatory Authority.
- Article 45 states that the Utility Regulatory Authority has the right to investigate the service provider of any misconduct or even if the Utility Regulatory Authority deems necessary.
- Article 60 states that if there are any overlaps with other laws regarding water and sanitation, this law shall take precedence.
- Article 61 states that with the implementation of this law, the articles pertaining to water and sanitation services under the law on general public services (4/96) is void.

3.1.9 Utility Regulatory Authority Law (26/2020)

This Utility Regulatory Authority Law was drafted to establish an Authority that will oversee the general public services given in the Maldives. The specific objectives of this law include;

- Ensure that the general public services given in the Maldives are provided sustainably
- Ensure that general public services are given efficiently and with minimal damage to the environment

- Ensure that general public services are given at adequate standards
- Create a competitive environment to develop general public services in the Maldives
- Draft and implement regulations on general public services
- Regulate the general public service providers
- Create awareness on the rights of the customers and the service providers

This law has 16 chapters. Chapter 1 states the objectives of the law, Chapter 2 states the responsibilities of the Utility Regulatory Authority, Chapter 3 states how the board of directors are to be established and their responsibilities, Chapter 4 states the organizational structure of the Utility Regulatory Authority, Chapter 5 states the responsibilities of the Minister, Chapter 6 states details about operating licenses, Chapter 7 states how tariffs are to be implemented, chapter 8, 9 and 12, 13, 14 states the rights of the Utility Regulatory Authority in relation to monitoring service providers, Chapter 10 states the discipline that the Utility Regulatory Authority must have, Chapter 11 states guides on conflict resolution, Chapter 15 states the budget and reporting by the Utility Regulatory Authority, Chapter 16 states the changes in existing institutional framework such as the transfer of Maldives Energy Authority and EPA Water, Sanitation and Waste section to the Utility Regulatory Authority. Relevant articles under this law pertaining to the proposed project are:-

- Article 4 states all the responsibilities of the Utility Regulatory Authority. The most important responsibilities include; giving operating license to service providers, implementing all laws and regulations pertaining to general public services and ensuring that the service providers abide by them, implementing tariff, drafting and implementing regulation and guidelines for providing general public services.
- Article 23 states that a license must be obtained in order to provide any general public service in the Maldives.
- Article 24 states that the license for general public services will be given by the Utility Regulatory Authority.
- Article 25 states that an exclusive operating license will only be given after getting the written approval from the president as advised by the Parliament if it is needed for the betterment of the country.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Article 29 states that the fees taken for general public services must be as per the approved tariffs from the Utility Regulatory Authority.
- The Service providers must strictly follow the directions of the Utility Regulatory Authority as mentioned in chapters 8, 9, 12, 13, and 14.

3.1.10 The National Water and Sewerage Strategic Plan (The NWSSP 2020-2025)

The NWSSP 2020-2025 is an action plan made under the article 14(a) of Water and Sewerage Act (8/2020). The strategies and targets included in the action plan is derived from the National Strategic Action Plan 2019-2023 endorsed by the Government in 2019. The vision of this action plan is to ensure equitable access to safe water and improved sewerage serviced for all. The mission is to provide efficient, effective and reliable water supply and sewerage services, promote conservation and management of the water resources, and to develop sector capacity for sustainable management of resources and services. The action plan has 6 policy goals with its associated target in order to reach the vision. These are;

- Policy 1: Ensure access to safe water supply and adequate sewerage services
 - Target 1.1: By 2020, Water and Sewerage Act is ratified
 - Target 1.2: By 2020, Utility Regulatoryy Authority (URA) for integrated utility services is functional
 - Target 1.3: By 2021, Water and Sanitation coordination committee is functional
 - Target 1.4: By 2023, all water and sewerage utility providers have an operating license
- Policy 2: Adopt cost-effective and environment-friendly water and sewerage infrastructure
 - Target 2.1: By 2020, a standard mechanism to foster private sector investment in the water and sanitation sector will be in effect
 - Target 2.2: By 2023, all inhabited islands, will have access to safe water supply and sewerage facilities

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Target 2.3: By 2023, 30% of energy consumption for water and sewerage facilities across the Maldives will be met with renewable energy
- Policy 3: Build sector capacity in water resources, water supply and sewerage services
 - Target 3.1: By 2023, at least 60% of technical staff in utility service providers are licensed (/ By 2023, all technical staff operating and maintaining the water and sewerage facilities will have at least certificate level 3 qualification and will be licensed)
 - Target 3.2: By 2023, at least 40 engineers will be trained in water and sanitation related field
 - Target 3.3: By 2023, at least 30% of all employees working in water and sewerage facilities in each island shall be women
 - Target 3.4: By 2022, collaborative partnership arrangements will be made with at least 3 local/international educational institutes for capacity building of water and sewerage sector programmes and services
 - Target 3.5: By 2024, two (2) staff at each island or city council will be trained for overall utility operational services, governance and best practices
- Policy 4: Strengthen advocacy and awareness programs on water resources, water supply and sewerage
 - Target 4.1: By 2022, public perceptions on safe water and sanitation practices improved by 33% compared to 2018 levels
 - Target 4.2: By 2023, at least 40% of households phased out single-use bottled water use
 - Target 4.3: By 2023, WASH awareness programs targeting to island functionaries, front line workers, CBOs and NGOs that are active in all island communities are carried out
- Policy 5: Protect and conserve natural water resources
 - Target 5.1: By 2023, water resource conservation and management plans are implemented in all inhabited islands.
- Policy 6: Build flood resilient island communities
 - Target 6.1: By 2021, identify and map flood prone islands

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Target 6.2: By 2022, develop and enforce design criteria's and guidelines for flood mitigation

3.1.11 Decentralization Act (7/2010)

This act was drafted in accordance to the article 8 of the Constitution of Maldives in order to declare the Institutions required to decentralize the governing of Maldives. The Institutions that would be established under this Act are; Local Councils, Atoll Councils, and City Councils. The Act specifies the jurisdiction of all of these Institutions. Relevant articles under this law pertaining to the proposed project are:-

- Article 8(b) states that it is the duty of the Atoll Council to inform the project proponents, of the general public's suggestions and concerns for any developmental projects within its jurisdiction.
- Article 8(g) states that it is the duty of the Atoll Council to allocate land for investments that promote social and economic growth within its jurisdiction in accordance with the built environment and any other relevant regulations.
- Article 23(c) states that it is the duty of the Local Council to implement developmental projects that the government assigns to the Council.
- Article 23(d) states that is the duty of the Local Council to properly monitor and report on developmental projects that are being carried out on the Island to the respective Ministry.
- Article 23(i) states that is it the duty of the Local Council to allocate land for developmental projects as advised by the Atoll Council in accordance with the LUP and Built Environmental Regulations.
- Article 68 states that the Local Councils must be involved in the planning stage of any developmental projects.
- Article 69 states that, if an EIA is required for any developmental project, an EIA must be done for the project and the report must be shared with the Atoll Council. Further,

the project proponent must share with the Atoll Council the potential environmental impacts mentioned in the report along with the proposed mitigation measures.

3.1.11.1 8th amendment to Decentralization Act

With the 8th amendment to the Decentralization Act, Local Councils were given additional authority. Relevant articles under this amendment pertaining to the proposed project are:-

- Article 68 was amended as follows; Local Councils must be involved in the planning stage of any developmental projects. Further, if an EIA is required for any developmental project, an EIA must be done for the project and the report must be shared with the Local Council. Further, the project proponent must share with the Local Council the potential environmental impacts mentioned in the report along with the proposed mitigation measures.
- Article 69 was amended as follows; for PSIP projects, if the total value of the project is less than 5 million rufiyaa, then those projects must be implemented through the Local Council. For Projects higher than 5 million rufiyaa, the government agency could still implement the project via the Local Council under certain set guideline by the government agency.
- An additional section was also added to Article 69 which states that;
 - 69-1(a) the Councils must provide the following general public services; (1) electricity, (2) water, and (3) Sanitation.
 - 69-1(b) the general public services must be given in accordance with the competent authority's guidelines and regulations.
 - 69-2(a) if the general public services are to be provided via a third party, an agreement must be made between the Council and the third party service provider.
 - 69-3 (a) electricity, water and sewerage facilities must be established in accordance with the LUP.

3.1.12 National Strategic Action Plan

The Strategic Action Plan (SAP) of the Government of Maldives is a central policy framework and planning document that guides the overall development direction of the Maldives for the next five years. The SAP consolidates the current Government’s manifesto pledges with existing sectoral priorities. The SAP serves as the main implementation and monitoring tool to track the progress of the delivery of the Government’s policies and development priorities. The SAP is formally rolled out into the line ministries’ day to day operations from 1 October 2019. The SAP consists of 5 Sectors and 33 subsectors.

3.1.13 Public Health Protection Act (7/2012)

The purpose of this act is to establish policies for protection of public health, identify persons responsible for protection of public health, define how public health protection policies will be implemented and establish policies to limit basic rights ensured under the Maldives Constitution to Maldivians and people living in Maldives to necessary extents to protect public health. Chapter 5 of the act outlines health hazards, eliminating risk, reporting health hazards, and order of things that can be done and not done in relation to a building. Chapter 6 of the act outlines the procedures for declaring state of emergency.

3.1.14 Immigration Act (1/2007)

This act lays down the rules for the departure and entry of Maldivian Nationals and foreign Nationals. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 3; all persons shall enter the Maldives from an authorised port, unless a person is compelled to do otherwise, due to sudden natural causes, or an emergency which is beyond the control of the person. Persons departing from the Maldives shall also depart from an authorised port unless in cases of emergency as stated above.
- Article 7; (a) A foreign national may enter the Maldives if he/she can produce a valid passport and a valid permit of entry. (b) A foreign national may leave the Maldives

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

provided that he/she has a valid passport. (c) Pursuant to subsection (a), a foreign national may enter the Maldives, unless as stated otherwise in the Regulations made under this Act, by filling a disembarkation form as specified in the Regulations and by submitting it with the passport to an immigration officer, and upon the leave to grant a permit of entry for the Maldives. (d) A foreign national may depart from the Maldives, unless as stated otherwise in the Regulations made under this Act, by filling an embarkation form as specified in the Regulations, and submitting it with the passport to an immigration officer and upon the leave to grant departure.

- Article 8; (a) For the purposes of this Act, permits to remain in the Maldives shall be divided into the following eight types;

- (1) Tourist Visa
- (2) Diplomatic Visa
- (3) Student Visa
- (4) Business Visa
- (5) Dependant Visa
- (6) Work Visa
- (7) Resident Visa
- (8) Special Visa

(b) The permits specified in subsection (a) are subject to the Regulations made under this Act.

3.1.15 Anti-Human Trafficking Act (12/2013)

This act was enacted to combat human trafficking in the Maldives in order to protect human rights and human dignity. As per international best practices this act includes three main components of criminalization, prevention and rehabilitation of victims, making human trafficking a criminal offense in the Maldives. The law also strictly prohibits forced labor and fraudulent recruitment. The main objective of this act include;

- Preventing human trafficking in the Maldives
- Establish crimes of human trafficking and prescribe the punishments
- Provide for prosecution of perpetrators under this act
- Providing protection and assistance to victims of human trafficking
- Promote and protect the human rights of trafficked victims
- Engage in cooperation with local and international NGOs working against human trafficking to combat human trafficking

3.1.16 National Biodiversity Strategy and Action Plan

The National Biodiversity Strategy and Action Plan 2016-2025 (NBSAP 2016-2025) seeks to ensure that threats to biodiversity are addressed, biodiversity is conserved, sustainably used and benefits arising from them are shared equitably. It also encompasses ways of addressing gaps, challenges and constraints highlighted in earlier sections. It is a living document that will have the capacity to adapt to changes in national conditions, capacities and to the changes in the international arena.

3.1.17 Climate Emergency Act (9/2021)

Climate Emergency Act was enacted in the Maldives in order to tackle the dangers that Maldives and its citizens face due to climate change. This act aims to bring forth regulations and mitigation measures to face the impacts of climate change, and to make Maldives a leading nation in advocating for action on climate change. It also aims to make the country carbon neutral while reaching its sustainable development goals.

- Article 2 states that Maldives should be a carbon neutral country by the year 2030, offsetting the same amount of carbon as those emitted. Any changes to the regulations can only be brought in consideration of new scientific findings and changes in international climate mitigation policies.
- Article 5 states that an action plan must be created to analyse the current situation and strategies to reach the climate goals in the country. The action plan must include

regulations to make the country carbon neutral and resilient to climate change, adaptation and mitigation measures to respond to climate impacts, implementation of climate adaptation and mitigation in developmental plans, methods of monitoring of greenhouse gas emissions, development and implementation of renewable energy and its storage, and the roles of the government and other related bodies in strategizing and reaching climate mitigation goals.

- Article 7 states that any emissions from flights and ships travelling through Maldives under circumstances not stated in the law will not be considered when calculating total national emissions.

3.1.18 Heritage Act (12/2019)

This law aims at safeguarding the perpetuation of items and sites of historical significance to future generations and ensures the documentation, preservation, and protection of cultural heritage.

- Article 2 states that portable heritage items, historic constructions or buildings, historic sites, and any cultural skills or talent all fall under heritage to be protected under this law. It also defines each category and states that they will be valued by the importance of their inheritance to future generations.

Article 3 states that all policies regarding heritage protection will be made under the guidance of the president. Under this law, ‘Department of Heritage’ was renamed ‘National Center for Cultural Heritage’.

- Article 5 states that a catalogue of all heritage artefacts and sites must be published and reviewed to update once every 2 years.
- Article 6 states that a written permit must be obtained from the NCCH if any artefacts are to be moved from its place of origin. If any artefacts are found being moved without necessary permits, they must be detained immediately, and NCCH must be informed. It also states that any historical buildings or heritage sites must have a boundary marked and disclosed at protected. If any work needs to be carried out that encroaches this boundary, a permit must be acquired from the NCCH

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Article 6 also states that NCCH will determine the ownership of heritage artefacts and sites and their guardians.
- Article 7 states that the following heritage items and sites legally belong to the government:
 - All artefacts and sites under the legal custody of the government at the time of passing of this legislature;
 - All artefacts and sites legally renounced by their owners which meets the requirements outlined in this legislature;
 - Any artefacts or sites historically important which have not yet been found within the maritime boundary of Maldives, be it in water or on land.
- Article 7 also states that in order to claim ownership of an artefact or site, one must inform the local council. If any items or sites are not claimed, they will be considered government property until someone claims ownership. If a historical item is found on a land leased by the government, all works must be halted on site until the items are assessed by NCCH.
- Article 8 states that all names historically given to islands, lagoons, reefs, and other places must be documented by NCCH without any changes. Paperwork for developmental plans carried out in such places must include these names.
- Article 10 states that any damages caused to heritage artefacts or sites can be fined, depending on its value, an amount between MVR10,000 and MVR1,000,000.

3.2 Regulations

This section describes the applicable regulations pertaining to the proposed development.

3.2.1 Environmental Impact Assessment Regulation 2012 (2012/R-27)

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 general public on how to obtain approval in the form of an Environmental DS. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 6 states that when government agencies propose a project, while finalizing the location for the project, they should reflect on the criteria's mentioned in Schedule B of this regulation. Furthermore, they should reflect on all the laws and regulations pertaining to environmental protection in the Maldives as well as international conventions, plans and programs to which Maldives is a party to.
- Article 7 states that the proponent must apply for an Environmental DS prior to commencement of any developmental project in accordance with article 8 of this regulation.
- Article 8 states that the proponent must apply for a screening if the developmental project is not listed in the inclusive list for EIAs (Schedule D of this regulation). If the proposed developmental project is listed under Schedule D of this regulation, then the proponent must submit an EIA application form.
- Article 11 states that a scoping meeting must be conducted and a ToR must be agreed upon by the proponent and the competent authority.
- Article 12 states that the EIA report must be written as per the approved ToR and the report must be a technical report with scientifically proven alternatives, impacts, and mitigations.
- Article 13 states that the competent authority must assign two independent reviewers to review the submitted EIA report and within 28 working days the competent authority must issue an Environmental DS or for additional information.
- Article 14 states that the Environmental DS must be; (1) Approval with the condition that the proponent follows the proposed mitigation measures (2) EIA report rejection due to poor quality of the report (3) Rejection of the proposal by the competent authority due to potential irreversible negative impacts. The approval has a validity of 1 year. If the proponent could not start the works within one year of the approval due to force major, then the competent authority could give an extension.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Article 15 states that if the proponent is not contented with the DS, then the proponent may apply to review the DS.

Since the enactment of the EIA regulation in 2012 there have been five amendments to the regulation. These five amendments are discussed below;

3.2.1.1 1st amendment to the Environmental Impact Assessment

Regulation 2012 (2013/R-18)

The first amendment to the EIA regulation 2012 involved the establishment of a guideline for fining environmental offences under article 20. According to the guideline fines are as follows; (1) MVR 20,000 for first offence (2) MVR 60,000 for second offence (3) MVR 120,000 for 3rd offence (4) MVR 200,000 for repeated offences after the 3rd time.

3.2.1.2 2nd amendment to the Environmental Impact Assessment

Regulation 2012 (2015/R-174)

With the 2nd amendment 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 (article 4). The detailed amendments made to the relevant articles are discussed below;

- Article 7 was amended to have three categories of review period as follows; (1) MVR 5000 for a 15 day review period, (2) MVR 5000 for a 10 day review period, (3) MVR 5000 for a 05 day review period
- Article 8 was amended to have 5 categories of Environmental DS for screening as follows; (1) Environment Management Plan, (2) Initial Environmental Examination, (3) Environmental Impact Assessment, (4) Approval to go forth with the screened project, and (5) Approval to go forth with the project according to the mitigation measures proposed by EPA.
- Article 9 was amended to have 3 categories of Environmental DS for an IEE as follows; (1) Environmental Impact Assessment report if the project is anticipated to have major

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

environmental impacts, (2) Environment Management Plan, (3) Approval to go forth with the project if the project is not anticipated to have major environmental impacts.

- Article 14 was amended to have a guideline for extending the Environmental DS as follows; (1) Extension for Environmental DS must be applied by the proponent with the justification for the delay, (2) If extension was applied before the deadline for Environmental DS, an extension shall be granted without a fine, (3) If extension was applied within one month of the deadline for Environmental DS, a fine of MVR 5000 will be charged, (4) If extension was applied within 2 month of the deadline for Environmental DS, a fine of MVR 10,000 will be charged, (5) an extension shall not be granted if applied after 2 months of the deadline for Environmental DS, (6) extension for environmental DS shall be granted for a maximum of 1 year and only once. Further points were added to article 14 to set out the guideline for applying, review and issuing Environment DS for addendums. In this regard a proponent can apply for an addendum for an approved EIA report if; (1) it has not been 5 years since the Environmental DS was issued, (2) scope change, (3) works within 500 m of the proposed project.
- Schedule D of the regulation was amended to exclude all tourism related projects and some further changes to the list of project were also made.
- Schedule U was added to the regulation. For the projects under this schedule, approval to go ahead with the project will be granted once the proponent submits a commitment to implement the mitigation measures prescribed by EPA. There project are; (1) maintenance dredging without any changes to the initial footprint, (2) removing vegetation by local plot owners, (3) clearing roads for new housing plots after getting approval from island Council, (4) drilling borehole on land for extracting water.

3.2.1.3 3rd amendment to the Environmental Impact Regulation

2012 (2016/R-66)

One of the major amendments to the EIA regulation with this amendment is that the EIA consultants are classified into 2 categories (article 16). 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. Additional detailed amendments made to the relevant articles are discussed below;

- Article 5 was amended to mention the implementing agency to be EPA on behalf of the Ministry.
- Article 6 was amended such that except for EMP and Environmental monitoring reports, all other reports under this regulation shall be made by a registered EIA Consultant. Further points were added to the article which mentions to submit data which could be used for environmental monitoring and the proponent must inform the Ministry in writing prior to commencement of the project once the approval has been granted for a project.
- Article 11 was amended such that while applying for EIA, the ToR must be submitted in an editable format along with the application form and project brief. Furthermore, it is now mentioned that that the ToR must be agreed upon during the scoping meeting and that only another registered EIA Consultant could replace the projects EIA Consultant if he cannot attend the scoping meeting, and the proponent could apply for an extension on the validity of the ToR during a 1-year period from the scoping meeting date.
- Article 13 was amended to include more guidelines on how to manage the EIA review process. An additional point was also added which gives the authority to EPA to conduct a review meeting with the Consultant and Proponent if they deem necessary.
- Article 14 was amended to include 2 more points which states that the Environmental DS must have the parameters for the environmental monitoring report and the schedule. The Ministry could ask the proponent to submit environmental monitoring reports up to 5 years or more if the Ministry deems necessary. Additionally, the proponent must share the Environmental DS with the Contractor and a copy of this Environmental DS and a copy of the approved EIA report must be made available at the project site.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Article 20 was amended to include the guideline on how to penalize offences under this regulation.

3.2.1.4 4th amendment to the Environmental Impact Regulation

2012 (2017/R-7)

Under this amendment the Schedule U which was added under the 2nd amendment to the EIA regulation (2015/R-174) was amended to include two more type of projects; (5) all projects except for the projects mentioned in point N of this schedule for newly reclaimed areas on natural islands until three years from the reclaimed date, (6) all projects except for the projects mentioned in point N of this schedule for newly reclaimed islands until three years from the reclamation date. The projects mentioned in point N of this schedule are any project that involves dangerous chemicals, oil storage, incinerators, release of toxic chemicals to atmosphere, and fiber works. However, if the reclaimed lands were to be populated then any major developmental project shall be subjected to EIA.

3.2.1.5 5th amendment to the Environmental Impact Regulation

2012 (2018/R-131)

With this 5th amendment, Tourism related developments are again included under this regulation. Additionally, the Schedule D was amended to include tourist resort development and tourist hotel developments in the inclusive list for EIAs.

3.2.2 Waste Management Regulation (2013/R-58)

The waste management regulation dictates the principles needed to follow when handling waste. The aim is to minimize adverse impacts to the environment and human health from waste. Under this regulation, island councils are required to make a waste management plan and submit it to the competent authority. This plan must be reviewed at least every five years. Relevant articles under this regulation pertaining to the proposed project are:-

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Article 8 states that hazardous waste are specified in Schedule J and under no circumstance should it be burned or disposed off in any area of the Maldives. While transporting hazardous waste, it must be in a closed container without any leaks. Further a sign must be on the container, specifying that it is hazardous waste. The import of any hazardous waste mentioned in Schedule J to Maldives is an offense.
- Article 11 states that waste generated at islands must be disposed off in areas specified for the purpose or areas approved by competent authority. Disposal of waste to following areas is prohibited under this regulation and is an offense;
 - Mangroves
 - Island Lagoon
 - Reef
 - Lagoon(falhu)
 - Finolhu
 - Beach
 - Vegetation line
 - Harbor
 - Park
 - Road

Approval to dispose waste to areas not approved by competent authority will be given under following circumstances;

1. Waste is disposed as a measure to protect human health
2. Situation created by natural disaster or a state of emergency

Approval to manage waste at household level is not required for the following actions;

1. Waste segregation at household
2. Composting at household

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Article 12 states that anybody responsible for public sites must place and manage a dustbin. The waste in these dustbins must be managed according to this regulation. Disposal of waste to public sites (besides the dustbin) is an offense.
- Article 16 states that approval must be taken from the competent authority for the following waste management works
 1. Waste collection
 2. Transportation of waste by land and sea
 3. Waste treatment
 4. Storage of waste
 5. Management of waste disposal sites
 6. Landfill
 7. Handling of hazardous waste

The number of waste management approvals for a particular area or areas will be decided by the competent authority based on the following;

1. Waste generation
 2. Economic gains from waste management actions
 3. Environmental protection requirements for the area
- Article 25 states that waste must be transported from one place to another in accordance with the standards set in schedule A of this regulation. If waste is to be removed from an Island, it should be taken to a regional waste management facility.

3.2.2.1 1st amendment to waste management regulation (2014/R-

10)

This amendment only included the amendment of dates to start implementing articles of this regulation (article 4).

3.2.2.2 2nd amendment to waste management regulation (2014/R-10)

This amendment also only included the amendment of dates to start implementing articles of this regulation (article 4). The date to implement the articles 13, 14, and 16 were amended to 05th October 2014.

3.2.2.3 3rd amendment to waste management regulation (2017/R-90)

This amendment included amendments to the schedule A and K of this regulation. Further article 25 was amended to include that action will be taken against parties which does not transport waste according to the standards set under this regulation.

3.2.2.4 4th amendment to waste management regulation (2018/R-63)

With this amendment the most notable, was the establishment of a system for fining offences under this regulation under Schedule N. Further article 25 was amended such that waste that needs to be removed from an Island must be taken to the nearest waste management center.

3.2.2.5 5th amendment to waste management regulation (2021/R-109)

With this amendment the most notable, was that waste management responsibility can be assigned to Councils and waste management plans need to be made at Island level.

3.2.3 Regulation on Environmental Liabilities (2011/R-9)

This regulation was made in order to emphasize on sustainable development according to Article 22 of the Constitution of the Republic of Maldives 2008 and penalize environmental

offences to the regulations made under Environmental Protection and Preservation Act (4/93) in the intention to prevent such offences. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 5 states that this regulation will be implemented by the EPA on behalf of the Ministry of Environment, Climate change and Technology.
- Article 7 states that, if there is a potential environmental damage or if there was an environmental damage due to a project, then the proponent must report to the Competent Authority and take measures to prevent such damages. The Competent Authority must assert to the proponent to implement mitigation measures.
- Article 8 states that, instead of the proponent under following circumstances the Competent Authority reserves the right to implement measures to prevent or mitigate environmental damages;
 - In an emergency
 - The proponent did not implement the mitigation measures prescribed by the Competent Authority under article 7
 - The proponent must bear the cost of implementing the mitigation measures mentioned in article 7 and for inspection visits from the Competent Authority
- Article 9 states that, for potential environmental damages imposed for works done by getting written approval from a government institution or advice, the cost of mitigation measures implemented maybe reclaimed from the government institution that gave the approval.
- Article 10 and 11 states that, if the Competent Authority found that there were environmental damages due to the actions of anybody, the Competent Authority could ask them to submit the mitigation measures that could be implement along with the information mentioned in Schedule 6 of this regulation.
- Article 12 states that the proponent has the right to review the decisions of the Competent Authority to the Minister if;
 - The environmental damages were not due to the actions of the proponent

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- If the decisions of the Competent Authority regarding the environmental damages were questionable by the proponent
- If the environmental damage was imposed due to the proponent following a regulation
- If the environmental damage was imposed due to a third party while the proponent was diligently following all the mitigation measures
- Article 13 states that the Competent Authority has the right to visit and inspect the project sites, take copies of the documents photographs, and samples.
- Article 14 states that when inquired by the Competent Authority about information regarding any investigations under this regulation, correct information must be provided by the inquired entity or person.
- Article 15, 16 and 17 states the procedures for fining offences for environmental liabilities.

3.2.4 Regulation on Safety Standards for Construction Work (2019/R-156)

This regulation was made under the Building Act (4/2017) with the aims to improve working conditions for laborers and to protect the general public from potential health hazards due to construction activities. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 5 states that the following are Contractors responsibilities;
 - If the contractor's work exceeds MVR 1,500,000 a health and safety plan has to be prepared and followed for the safety of employees as well as the public.
 - While handling construction materials, must ensure the safety of the workers and the general public
 - Informing the workers of any potential health hazards during construction works
 - Have an emergency response plan
 - Ensure that works are proceeding in accordance with the health and safety plan
 - Providing personal protective equipment for workers and they must be trained to use the equipment

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Ensure construction site is safe for the workers and general public
- Ensure that there is no disturbance to the general public from the construction site
- Ensure waste is managed properly at the worksite
- Ensure that the construction materials are properly stored
- Ensure that safety boards and signs are installed around the construction site
- Article 6 states that if the contractor's work exceeds MVR 1,500,000 an emergency response plan must be made and the following must be fulfilled accordingly;
 - Emergency response plan must be made available at the constructions site
 - Inform the workers on the emergency response plan and its protocols
 - Have at least 2 emergency response drills every year
 - Ensure that a first aid personnel is always available at all times at the construction site
 - First aid kit must be readily available at the construction site
 - Ensure that the equipment's in the first aid kit is in proper condition
 - Installing safety boards at the construction site
 - Contacts for Emergencies must be available on a notice board at the construction site
- Article 7 states that the contractor must appoint a safety supervisor with more than five years of experience for the project.
- Article 8 states that the responsibilities of the site safety supervisor is to carrying out daily site inspections to ensure the proper measures are being taken to ensure safety and to report to the contractor/Competent Authority if the measures are not being implemented.
- Article 9 states that if the contractor's work exceeds MVR 5,000,000, the contractor must have an insurance policy taken to compensate for any damages to the workers and the surrounding people.
- Article 10 states that all contractor's must ensure that the general public is protected from the construction site by doing the following;
 - Installing pedestrian detour boards

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Ensure construction materials and equipment’s are stored in a way that does not pose any difficulties to the general public
- Installing safety boards, fences, tapes, sheets to protect the general public
- Article 11 states that the contractor should ensure that workers are always using personal protective equipment when on site. These include safety helmets, safety boots, safety goggles, noise cancellation headphones, gloves, masks, safety belt, and other safety equipment’s necessary as per the type of work.
- Article 12 states that all construction sites must be fenced off. The article also explains in details how the fence must be erected.
- Article 13 states that the contractor must ensure the required safety equipment’s are provided to the works if they are handling hazardous substances.
- Article 14 explains in detail the safety procedures that must be followed while working at higher than 3 m.
- Article 15, 16, and 17 explains in detail the safety measures that must be taken while working on an overhead platform, roofs, and ladders.
- Article 18, 19 explains how scaffolding are to be used.
- Article 20, 21, 22, 23 states the safety measures that must be followed for using electrical equipment’s,
- Article 24 states that the contractor must implement a chemical handling procedure for handling chemicals. The article also explains in details what is to be included in the chemical handling procedure.
- Article 25, 26, 27, 28 states the safety measures that must be followed while working with asbestos, gas cutters, and compressed gas welding.
- Article 29 states that, if there are flammable materials at the construction site, fire prevention equipment must be made available.
- Article 30, 31, and 32 states the safety measures that must be followed for using equipment’s powered by mechanical power and electricity, cranes,
- Article 33 states the safety measures that must be followed for while working in closed spaces.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Article 34 states the measures that must be followed while decommissioning a building.
- Article 35 states the construction materials must be stored within a close area. Approval must be taken from the Competent Authority to store at the designated area and the approval must be shown on a board.
- Article 36 states the measures that must be followed while loading and unloading materials to a construction site.
- Article 37 and 38 explains the requirements for the safety board and other signs that must be installed at construction sites.
- Article 39 states that, when an accident occurs at a construction site, it must be immediately reported to the police. The record of accidents must be maintained by the contractor.
- Article 49 states that, if there is no entity responsible for implementing the measures mentioned under this regulation, then the proponent shall be responsible for implementing the measures. The proponent must report any offences against this regulation to the Ministry.
- Article 50 states that with the enforcement of this regulation the Male' Planning Regulation Chapter 3 is void.

3.2.5 Groundwater extraction and disposal regulation (2021/R-20)

The groundwater extraction and disposal regulation is enacted with aim of minimizing impacts to groundwater while carrying out dewatering activities. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 4 and 5 states that for any building construction or industrial use can only extracted and used after getting written approval from the competent authority, however, water can be extracted for domestic wells placement and cleaning
- Article 6 states that dewatering must be done only after getting the necessary approval from the competent authority. The proponent must inform the people living with 100

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

meters of the dewatering activity via the council using the application form mentioned in annex 1 of this regulation.

- Article 7 states that an administrative fee of MVR 100 has to be paid to the competent authority when submitting the form mentioned in article 7.
- Article 8 states that water samples must be tested from a certified laboratory and their results attached with the form in this regulations annex 1. The results must not be more than 45 days old from the tested date. The following parameters must be tested;
 - pH
 - Temperature, °C
 - TDS, mg/l
 - Dissolved Oxygen, mg/l
 - Electrical Conductivity, μS/cm
 - Turbidity, NTU
 - Salinity, ppm
 - Ammonia, mg/l
 - Fecal Coliforms 0/100
 - Hydrogen Sulphide, mg/l
 - Nitrates, mg/l
 - Phosphates, mg/l
 - Hydrocarbon, mg/l
 - Oil and grease, mg/l

If any of the parameters cannot be tested, then it should be mentioned in writing from the laboratory.

- Article 10 states that the approval for dewatering will be issued from the competent authority. Dewatering approval will be given for 28 consecutive days including public holidays. It also states that approval of discharge of groundwater to the sea must be given only in places where groundwater recharge is not feasible or where recharging might result in damage to the residents and the environment. For larger projects

involving dewatering at different places, the places from where dewatering can be started with 28 consecutive days must be submitted as a single approval. The period of approval will be decided based on the following;

- Size of proposed water discharge area
- Water quality
- Work schedule
- Method of water discharge
- Water discharge area
- Article 11 states that designated impact radius from water discharge is 30 meters from the discharge point if the the water is not recharged within the aforementioned radius. The proponent must inform the houses within this radius by writing before 24 hours. During dewatering activities if a damage is caused to any of the houses within this radius, the proponent has to take responsibility and also if any of the houses face any difficulties getting groundwater from their wells the proponent has to provide no more than 250 liters of water per household or equivalent amount in payment.
- Article 11 states that an option other than draining water into the ground will be considered if the water quality tests mentioned in article 9 of this regulation shows that the waters quality is not adequate. Furthermore, it is stated that if a pipeline is to be established for the dewatering, the pipeline pathway shall be approved by the council. Moreover, ti is the responsibility of the proponent to maintain and decommission the pipeline after the dewatering period is over.
- Article 13 states that for any reason if the site engineer believes that the dewatering works will not be finished within the approval period, then the proponent must fill the form on annex 3 of this regulation and submit to competent authority before 3 days (the 3 days will be counted excluding public holidays) of approval deadline. Upon receipt of the form and associated documents the competent authority will issue the approval within 2 working days. However, extension will be granted if the original approval

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

granted under article 10 of this regulation is less than 6 months old, if more than 6 months then a new approval must be requested.

- Article 14 states that a non-refundable fee has to be paid to the competent authority according to following principle;
 - For the first 28-day approval MVR 500 per day
 - For the first addition of days to the approval MVR 1000 per day
 - For the second addition of days to the approval MVR 1500 per day
 - For the third addition and onwards with an increasing rate of MVR 2000 per day

However, if the works were delayed due to a natural hazard or bad weather, without any fee days will be added. These types of days will be decided by considering the information from the respective authority.

- Article 14 states that the competent authority has to maintain records about the dewatering approvals they give. If a sewerage service provider gives service of water discharging from dewatering activities, then they must provide those dewatering activity details before the 10 of each month for the previous month's activities.
- Article 15 states that the competent authority has the full discretion to stop any dewatering activities ongoing via formal documentation. Furthermore, it also states that the authority shall be indemnified from any claims arising from the halting of works.

Article 16 states that competent authority must inform the proponent via writing if they go against regulations.

3.2.6 Regulation on uprooting, cutting and transportation of palms and trees

This regulation was implemented on 1 February 2006 by the Ministry of Environment, Climate change and Technology, Energy and Water. The primary purpose of the regulation is to control and regulate large-scale uprooting, removal, cutting and transportation of palms and trees from one island to another. According to the regulation, certain types of trees and plants that have unique attributes are prohibited to be removed from its natural environment. Also, uprooting and removal of a vast number of trees and palms are subjected to an EIA, which is required to be

submitted to the EPA and written approval is required prior to implementation of the project. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 3 states that the following types of vegetation is prohibited to be removed;
 - Vegetation found from 15 m inland of the vegetation line
 - Vegetation found on and around 15 m of wetlands and mangroves
 - Vegetation found on any protected areas of the Maldives
 - Any protected trees
 - Vegetation which has environmentally unique characteristics
- Article 5 (a) states that, to clear large number of trees for any purpose, an EIA must first be done and approval from the competent authority must be obtained. Article 5 (b) states that, if trees are to be transported with soil, the allowable limit is an 8-inch x 10-inch black bag. Article 5 (e) states that, trees larger than what is mentioned in article 8 (a) of this regulation, must be transported with only the soil in their root balls. Article 5 (f) states that, if machinery is to be used for uprooting trees, no damages must be done to any trees besides the trees concerned for uprooting.
- Article 6 states that, if the total number of a particular species of tree is less than 05 on an island, then this species of tree can only be transported with a special permit from the Ministry of Environment, Climate change and Technology. Furthermore, this applies to trees on which birds roost or live in inhabited and uninhabited islands.
- Article 7 states that, the maximum number of trees which could be removed from an island shall be declared by the Ministry of Environment, Climate change and Technology, based on the existing numbers of trees on the Island.
- Article 8 states that, coconut trees taller than 15 feet and other trees taller than 8 feet, their limit for removal is 10 trees, to uproot greater than 10 trees require an approval from Ministry of Environment, Climate change and Technology. Smaller trees could be removed by taking an approval from Island Council and the limit for uprooting is less than 1/3rd of the trees present in the area. For any purpose uprooting and transport of trees must be done under the supervision of the Island Council on inhabited Island; personnel responsible to manage the island in case of uninhabited Island.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Article 9 states that, after uprooting trees, the holes must be backfilled with soil. It is prohibited to put in any waste into the holes.
- Article 10 states that, any offences against this regulation will be punishable under Act 4/93 accordingly.

3.2.6.1 1st amendment to regulation on uprooting, cutting and transportation of palms and trees (2014/R-7)

The amendment to this regulation has specified a set of categories and any tree falling under these categories is not allowed to be removed unless it is a project of the government, approved by the parliament. Relevant articles under this law pertaining to the proposed project are:-

- Article 3 was amended such that the prohibited trees for removal could be removed for a project approved by the parliament with the condition that the proponent must plant 6 trees for each tree removed instead of 2. Furthermore, a monitoring plan must be made and the proponent must implement it.
- Article 11 was amended to mention that this regulation will be enforced by the EPA on behalf of the Ministry of Environment, Climate change and Technology.

3.2.7 Regulation on management and conservation of water resources (2021/R-22)

This regulation has been formulated under the Article 17,18,19,20 and 23 of the Water and Sewerage Act (08/2020). The main purpose of the regulation is to ensure sustainable use, conservation, protection, improvement, and beneficial use of the water resources. Relevant articles under this regulation pertaining to the proposed project is:

Article 6:

- None shall do any harm or damage to the water resources.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Groundwater and other naturally occurring water resources on the islands, shall not be utilised for any economic or business use.
- Dewatering for building construction shall be carried out as per the relevant regulation.

Article 10: All activities shall be carried out in a manner that would not contaminate the water resources in accordance to the clause 20 of the water and sewerage act (08/2020)

Article 12: Spillage of any oil and chemical to the ground is prohibited. Oil and chemical shall be store in shaded, appropriately bunded areas and in a manner that even if the total volume of the dedicated storage is leaked, the leaked volume is able to be recovered without contamination of the soil or the groundwater. Transfer of oil and chemical on land must be carried out with appropriate safety measures to prevent spillage. Discarding of waste oil and chemicals must be carried out in a manner that does not contaminate any of the water resource, and at a facility that is approved by the regulator.

Article 17: All responsibilities of rectification of a polluted groundwater resource from spillage of oil and chemicals shall be borne by the polluter. Any incidence of groundwater pollution from oil and chemical spillage should be reported to the regulator within 24 hours. The rectification works shall be carried as per the instruction of the regulator.

3.2.8 Regulation on protection of environmentally sensitive areas (2018/R-78)

This regulation was under article 4 of the Environmental Protection and Preservation Act (4/93) in order to declare standards to declare areas for protection, manage protected areas, establish environmentally sensitive areas, establish a network of protected areas, create public awareness and participation in management of protected areas, protection and preservation of Maldivian biodiversity for future generations. According to this regulation there are 7 types of protected areas; (1) Internationally recognized areas, (2) Strategic Nature Reserve, (3) Wilderness area, (4) National Park, (5) Natural Monument, (6) Habitat / Species Management area, and (7) Protected Area with Sustainable use. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 12 states that a management plan must be made in order to manage the protected areas. This management plan must reflect on the developmental plans for the region.

3.2.9 Regulation on Construction Material Import and Production Control

The purpose of the regulation is to control the quality of imported and produced materials that are used in the construction industry. The regulation specifies the materials which would be controlled under the regulation in its annex 1. Furthermore, the regulation details out the registration requirements, permits, procedures, quality controls and applicable fine of those that breach the regulation.

3.2.10 Regulation on Construction Material and Construction materials testing facilities

Under the regulation all contractors involved in the construction industry are to be registered. The regulation includes the requirements of contractor's registration, grading, implications on participating in international tenders, insurance, project licenses, Joint venture registrations, responsibilities of the registered contractors and applicable fine for breaching the regulation.

3.2.11 Regulation on Preserving greenery and Vegetation in the Maldivian Islands (2022/R-92)

The purpose of this regulation is to encourage to plant more trees and increase greenery in the islands, protection of old trees, decentralisation of the approval process for removal of vegetation, reduction of environmental impact from vegetation removal and strengthen the reporting process of vegetation removal. According to the regulation, any tree beyond the age of 50 is protected under the regulation. The registry of trees must be maintained by the council. In islands leased for tourism and other economic ventures, the proponent must report the vegetation details annually to EPA. Furthermore, coastal vegetation belt of 20 meters must be ensured in each

island. For any activity that involves removal 50-200 trees, approval of the agency must be acquired and for any activity that involves removal of more than 200 trees, an EIA must be carried out.

3.2.12 Regulation on Use, Handling, and Storage of Oil

The purpose of the regulation is to reduce fire hazards caused by the mishandling of oil, to raise awareness on the proper handling methods of oil and to standardize the infrastructure of oil handling and storage facilities.

- Article 2 of the regulation details out all the aspects of vehicles that handle and transport oil on land.
- Article 3 deals with all the aspects of petrol handling in storage areas and service centres.
- Article 4 highlights the aspects of fuel handling in diesel and kerosene service centres.

Article 5 highlights the aspects of fuel pipeline from storage to meters

3.2.13 Regulation on stone, sand and coral mining

This regulation specifies the articles regarding stone, sand and coral mining from the lagoons, reefs, and other areas and the conservation of these resources.

- Article 2 states that any stone, sand, or coral mining activities must be carried out after obtaining the required approval from the relevant authorities. If these activities are carried out in the inhabited islands and other leased uninhabited islands, these activities must comply with and Law on Stone, Sand and Coral Mining in Inhabited Islands (77/78) and Law on the Uninhabited Islands (20/98).
- Article 3 states that stone mining from any area of the Maldives is prohibited.
- Article 4 states that coral mining is prohibited from the following areas;
 - Islands and its beaches leased for industrial purposes
 - Areas on and beyond the atoll reef edge

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Coral mining during dredging activities in harbour development projects, and beach / reef cleaning activities in industrial islands, approved by the relevant government authorities are excluded in this article.
- Articles 5 states that the sand mining from the islands leased for industrial purposes are prohibited. Permission to mine sand may be given for all other islands and those islands which lie on independent reef systems from other inhabited islands

3.2.14 Regulation on dredging and land reclamation (2013/R-15)

Regulation on Dredging and Land Reclamation was formulated under the Environment Act and this regulation came into force in 2013. The main purpose of the regulation is to minimize the negative environmental impacts from dredging and reclamation activities in islands and reefs across Maldives.

According to the regulation, all dredging and reclamation activities must be approved by the Environmental Protection Agency in writing. Application process for the permit for the reclamation and dredging includes the submission of the adequate information of the project to Environmental Protection Agency along with a scaled before and after map.

The regulation defines the rationales for reclamation and dredging as those absolutely necessary for social, economic developments. Under this regulation, dredging is restricted in the following areas:

- 500m from the ocean side reef edge
- 50m from island vegetation line
- Environmentally protected areas

Under this regulation, land reclamation is restricted within 200m of an environmentally protected area. And also, land reclamation cannot exceed beyond the 30 percent of the house reef area.

1st Amendment to regulation on Dredging and Land Reclamation (2014/R-13)

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

It is prohibited to undertake dredging and reclamation activities within the a radius of 200 meters of any place stated under the Clause 13 (noonu), section 4 of the regulation.

However, if the cabinet decides it be so for a development project, the proponent cold carry out dredging and reclamation in such places under the following conditions:

- 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

3.2.15 Heritage Preservation Regulation (2020/R-37)

This regulation is brought forth under article 11 of Heritage Act (12/2019) to determine, protect, and preserve the heritage of Maldives.

- Article 4 states that cultural heritage can be portable artefacts, historical buildings, historical sites, and cultural skills or talents such as “kasabu viyun”.
- Article 5 states that the value of a heritage item or site will be determined depending on its historical importance, age, category, preservation of authentic condition, and amount of damage.
- Article 6 states that National Center for Cultural Heritage must be informed within 48 hours via the respective island (if from an inhabited island) or atoll council (if from an an inhabited island) if any historical items or sites that could be a heritage item or site

is found. Portable artefacts must immediately be handed over to the island or atoll council without any damage.

- Article 6 also states that if the landowner refuses NCCH from assessing the site or items found or refuses to adhere to NCCH’s advice on how to deal with items or site, NCCH can acquire a court order under the Heritage Act (12/2019).
- Article 8 states that a 50 feet distance surrounding a heritage site will be protected. And if this distance cannot be acquired, then an adequate distance will be determined by NCCH and council after assessing the importance of the site. No developmental plans aside from those decided by NCCH can be carried out in this area without approval from NCCH.
- Article 9 states that if anybody wishes to excavate or search for heritage artefacts from a predicted historical site, necessary permits must be taken from NCCH.
- Article 12 states no heritage artefacts can only be moved within the country or abroad by its legal owner or guardian with permit from NCCH.
- Article 16 states that:
 - Damaging historical artefacts or sites will be fined an amount between MVR200,000 and MVR1000,000, and trying to damage one will be fined an amount between MVR10,000 and MVR 500,000.
 - Changing the authentic form of any heritage artefacts or sites will be fined an amount between MVR100,000 and MVR800,000, and trying to change one will be fined an amount between MVR10,000 and MVR 300,000.
 - Illegally importing or exporting heritage artefacts of Maldives or any other country will be fined an amount between MVR100,000 and MVR500,000, and trying to import or export will be fined an amount between MVR10,000 and MVR 100,000.
 - Excavating sites to acquire valuable artefacts without the permission of NCCH will be fined an amount between MVR10,000 and MVR100,000, and trying to excavate without permission will be fined with MVR10,000.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Not informing NCCH or the local council when an artefact or site is found while excavating any area in Maldives will be fined with an amount between MVR10,000 and MVR100,000.
- Spreading false rumors or information regarding heritage artefacts will be fined an amount between MVR10,000 and MVR50,000.

3.2.16 Built environment regulations

This regulation underlines the general guidelines for inhabited islands, uninhabited islands and islands used for other purposes to plan the development accordingly based on population, size, the type of works done on the island and other factors that should be taken into account. All islands are categorized according to the above-mentioned factors to regulate the development activities. Relevant articles under this regulation pertaining to the proposed project are:-

- Article 1.2 states that the Ministry of Housing and Urban Development shall be responsible for monitoring and implementation of Land Use Planning under this regulation with the directions from other relevant government Authorities.
- Article 12 states that if there are any environmentally sensitives sites on any island it shall be protected. However, this does not mean that these areas should be left untouched without any use, rather these areas shall be made use for recreational purposes or some other beneficial purpose without damaging these sites.
- Article 12.2 states that a 20 m buffer zone must be set around all Islands from the coast. However, at harbor area or other commercial areas, if adequate land is unavailable this buffer zone could be reduced.

Annex 1 of the regulation;

- Article 5.4 states that a minimum of 200 feet buffer zone must be set from an STP to residential areas, recreational areas, parks, social spaces, or any places that produce food or drink (fish drying, water storage tank).
- 5.5.1 states that maximum area that can be allocated for a powerhouse is 45m x 45m.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- 5.5.2 states that a distance of at least 200ft shall be kept between the residential area and the powerhouse.
- 5.5.3 states that if the criteria mentioned above is not met for the island, the Ministry of Housing and Urban Development shall be consulted.
- Article 5.6 states that land for Desalination plants shall be allocated by the Ministry of Housing and Urban Development as advised by Ministry of Environment, Energy and Water.

3.2.17 Maldives National Building Code (2019/R-1020)

The Maldives National Building Code R-1020 has been published in the year 2019 and consists of the following chapters.

Part I: building code for type 1 buildings.

- Clause A1 (Classified users): For the purposes of this building code, Type 1 Buildings are classified according to type, under seven categories. A building with a given classified use may have one or more intended uses. The seven categories are:
 - Housing
 - Communal residential
 - Communal non-residential
 - Commercial
 - Industrial
 - Outbuildings
 - Ancillary
- Clause A2 (Interpretation): In PART II of building code unless the context otherwise requires, words shall have the meanings given under this Clause
- Clause B1 (Structure): The objective of this provision is to:
 - Safeguard people from injury caused by structural failure,
 - Safeguard people from loss of amenity caused by structural behaviour, and
 - Protect other property from physical damage caused by structural failure

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Clause B2 (Durability): The objective of this provision is to ensure that a Type 1 Building will, throughout its life, continue to satisfy the other objectives of this code
- Clause C1(means of escape): The objective of this provision is to:
 - Safeguard people from injury or illness from a fire while escaping to a safe place
 - Facilitate fire rescue operation
- Clause C2 (spread of fire): The objective of this provision is to:
 - Safeguard people from injury or illness when evacuating a Type 1 Building during fire.
 - Provide protection to fire service personnel during firefighting operations.
 - Protect adjacent household units and other property from the effects of fire.
 - Safeguard the environment from adverse effects of fire
- Clause C3 (structural stability during a fire): The objective of this provision is to:
 - Safeguard people from injury due to loss of structural stability during fire, and
 - Protect household units and other properties from damage due to structural instability caused by fire.
- Clause C4 (access & facilities for the fire services): The objective of this provision is to:
 - Provide reasonable facilities to assist fire fighters in the protection of life
 - Enable fire appliances to gain access to the building.
- Clause D1(access routes): The objective of this provision is to:
 - Safeguard people from injury during movement into, within and out of Type 1 buildings,
 - Safeguard people from injury resulting from the movement of vehicles into, within and out of Type 1 buildings, and
 - Ensure that people with disabilities are able to enter and carry out normal activities and functions within Type 1 buildings.
- Clause D2 (mechanical installations for access): The objective of this provision is to:
 - Safeguard people from injury and loss of amenity while using mechanical installations for movement into, within and out of Type 1 buildings,

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Safeguard maintenance personnel from injury while servicing mechanical installations for access, and
- Ensure that people with disabilities are able to carry out normal activities and processes within Type 1 buildings
- Clause E1(surface water): The objective of this provision is to:
 - Safeguard people from injury or illness, and other property from damage, caused by surface water
 - Protect the outfalls of drainage systems.
- Clause E2 (external moisture): The objective of this provision is to safeguard people from illness or injury which could result from external moisture entering the Type 1 building
- Clause E3 (internal moisture): The objective of this provision is to:
 - Safeguard people against illness or injury which could result from accumulation of internal moisture
 - Protect household units and other properties from damage caused by free water from occupancy in the same building.
- Clause F1(hazardous agents on site): The objective of this provision is to safeguard people from injury or illness caused by hazardous agents or contaminants on a site
- Clause F2 (hazardous building materials): The objective of this provision is to safeguard people from injury and illness caused by exposure to hazardous building materials.
- Clause F3 (hazardous substances and processes): The objective of this provision is to safeguard people from injury or illness, and other property from damage, caused by hazardous substances or processes in buildings
- Clause F4 (Safety from Falling): The objective of this provision is to safeguard people from injury caused by falling
- Clause F5 (Construction and Demolition hazards): The objective of this provision is to safeguard people from injury, and other property from damage, caused by construction or demolition site hazards.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Clause F6 (lighting for emergency) : The objective of this provision is to safeguard people from injury due to inadequate lighting being available during an emergency
- Clause F7 (warning systems) : The objective of this provision is to safeguard people from injury or illness due to lack of awareness of an emergency
- Clause F8 (signs) : The objective of this provision is to:
 - Safeguard people from injury or illness resulting from inadequate
 - identification of escape routes, or of hazards within or about the Type 1 building,
 - Safeguard people from loss of amenity due to inadequate direction, and
 - Ensure that people with disabilities are able to carry out normal activities and processes within buildings
- Clause G1(personal hygiene) : The objective of this provision is to:
 - Safeguard people from illness caused by infection or contamination,
 - Safeguard people from loss of amenity arising from the absence of appropriate personal hygiene facilities, and
 - Ensure people with disabilities are able to carry out normal activities and processes within Type 1 buildings.
- Clause G2 (laundrying) : The objective of this provision is to ensure:
 - Adequate amenities for people to do laundrying, and
 - That people with disabilities are able to carry out normal activities and processes within Type 1 buildings
- Clause G3 (food preparation and prevention of contamination) : The objective of this provision is to:
 - Safeguard people from illness due to contamination,
 - Enable hygienic food preparation without loss of amenity, and
 - Ensure that people with disabilities are able to carry out normal activities and processes within Type 1 buildings
- Clause G4 (ventilation) : The objective of this provision is to safeguard people from illness or loss of amenity due to lack of fresh air.
- Clause G5 (interior environment) : The objective of this provision is to:

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Safeguard people from illness caused by excessive air temperature,
- Safeguard people from injury or loss of amenity caused by inadequate activity space,
- Ensure that people with disabilities are able to carry out normal activities and processes within Type 1 buildings
- Clause G6 (airborne and impact sound) : The objective of this provision is to safeguard people from illness or loss of amenity as a result of undue noise being transmitted between abutting occupancies
- Clause G7 (Natural Light): The objective of this provision is to safeguard people from illness or loss of amenity due to isolation from natural light and the outside environment.
- Clause G8 (Artificial light): The objective of this provision is to safeguard people from injury due to lack of adequate lighting.
- Clause G9 (Electricity): The objective of this provision is to ensure that: In Type 1 buildings supplied with electricity, the electrical installation has safeguards against outbreak of fire and personal injury
- Clause G10 (Piped service) : The objective of this provision is to safeguard people from injury or illness caused by extreme temperatures or hazardous substances associated with building services.
- Clause G11(gas as an energy source): The objective of this provision is to:
 - Safeguard people from injury arising from the use of gas as an energy source,
 - Safeguard people and other property from the risk of fire or explosion, and
 - Safeguard people from loss of amenity due to the gas supply being inadequate for the intended use.
- Clause G12 (water supplies): The objective of this provision is to:
 - Safeguard people from illness caused by infection from contaminated water or food,
 - Safeguard people from injury due to the explosion of a pressure vessel or from contact with excessively hot water,

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Ensure that people with disabilities are able to carry out normal activities and functions within Type 1 buildings
- Clause G13(Foul water) : The objective of this provision is to:
 - Safeguard people from illness due to infection or contamination resulting from personal hygiene activities, and
 - Safeguard people from loss of amenity due to the presence of unpleasant odours or the accumulation of offensive matter resulting from foul water disposal
- Clause G14 (industrial liquid waste) : The objective of this provision is to safeguard people from injury or illness caused by infection or contamination resulting from industrial liquid waste
- Clause G15 (solid waste) : The objective of this provision is to safeguard people from injury or illness caused by infection or contamination from solid waste
- Clause H1 (energy efficiency) : The objective of this provision is to facilitate efficient use of energy.

3.3 Guidelines and Technical Specifications

This section describes the applicable guidelines and technical specifications pertaining to this proposed project.

3.3.1 Guideline for Uprooting, Cutting and Transportation of Palms and Trees (published on 06th June 2017)

This guideline was made under Article 5(a) of the regulation on uprooting, cutting and transportation of palms and trees, to specify the guideline for giving approval to uprooting, cutting and transportation of trees. Relevant articles under this guideline pertaining to the proposed project are:-

- Article 3 states that while giving approval for uprooting, cutting and transportation of trees for any project, the following must be fulfilled;
 - The project strictly requires land clearance

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- The budget for the project has been approved
- Approval from the relevant government body for the project
- Article 4 states that, in order to obtain approval for uprooting, cutting and transportation of trees under this guideline, the proponent must apply for approval from EPA through the application form on Schedule 1.
- Article 5 states the procedure for giving approval for uprooting, cutting and transportation of trees. The first step is for the proponent to submit information on the type, size, numbers and location of trees to EPA. If there are no prohibited trees to be removed in the area and if the total number of trees to be removed is less than 200 or the land clearance area is less than 8250 m², then approval shall be given under this guideline with a set of mitigation measures to be followed by the proponent.

3.3.2 Guideline for power system approval

The guideline for power system approval highlights the sets of information required to be submitted to URA for the approval process which includes details about the generation system, generator control panel and distribution panel, fuel system, distribution network, electric cable, firefighting system and lighting protection, EIA of the generation facility, tariff and rules and regulations of powerhouse for consumers.

The registration process of the newly constructed powerhouse will commence as soon as the construction of the powerhouse is completed.

3.3.3 Waste Incinerator Guideline

The waste incinerator guideline (WIG) of the EPA Maldives came into effect in 2016 aimed at facilitating the construction and operation of incinerators safely and to mitigate the adverse environmental and health impacts that may arise. The objective of the guideline is to prevent or limit, as far as practicable, negative effects on the environment, in particular pollution by emission into air, soil, surface and groundwater, and the resulting risks to human health, from combustion of waste using incinerators.

As per article 4.1 of the WIG, the site for waste incinerators must be selected in ways that it would not pose any hazard to the surrounding environment and the local community. The proposed project complies with this article such that the chimneys of the powerhouses will be installed far away from the residential area and sensitive land uses. Additionally, the site is selected so that the prevailing winds carry the emitted gases away from the residential area/island. Preconstruction environmental clearance permits and monitoring will be carried out at the proposed location and background emissions established in order to enable future changes to be identified.

3.3.4 Requirement for Fire Prevention Equipment in the building

This is a guideline enforced by the Ministry of Defense and National Security of the Maldives which sets out a list of requirements and standards that need to be met in fire prevention equipment provided in buildings prone to fire hazards. As the whole guideline pertains to any power generating facility, hence to this project, the main points have been highlighted as follows:-

- **Hose reel:** Should comply with the specified standards under the guideline. The overall width of the reel should be no more than 850mm. The overall height of the Reel should be less than 850mm including Hose and integral Flexi guide for hose withdrawal guide. The overall depth of the hose reel should be no more than 150mm. The colour of the Reel should be Red, fitted with an operating instruction plate. The Hose Reels nozzle retainer or hose guide and the inlet valve should be fitted at a height of about 900mm above floor level;
- **Hose reel cabinets:** The hose reel cabinet should be Recess mounting type with or without glass-paneled door for use with the above-mentioned sized Hose Reels. Hose Reel Cabinet dimension should be no more than 900mm in width, 900mm in height, 160mm in depth (including door). The colour of the cabinet should be Red. Special permission should be taken for other Colour. Recessed Latch Type handle should be installed. Hose reel signage should be in accordance with BS 5499 or any other equable International Standard. Fixing hole should be provided;

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- **Water supply for hose reel system:** Should be such that when the two topmost reels in the building are used simultaneously, each should provide a jet of about 6 m in length and will deliver less than 0.5 L. Minimum storage required for the hose reel is 2275 L and 1137.5 L up to a maximum of 9100 L for each additional reel. Tanks supplying water for domestic purposes should not be used as a suction tank for hose reel installation. The pipings for the supply of water for hose reel should be in and out galvanized schedule 40. Diameter of the piping should not be less than 50 mm;
- **Hose reel booster pump system:** Hose reel booster pump set, complete with in and out galvanized steel pipework with or without expansion vessels;
- **Fire extinguishers:** 2kg CO₂ stored pressure Extinguisher approved to BS EN 3. Aluminium Alloy Body approved to BS5045 Part 3 or any other equable International Standard. Red body with black band or Black colored head cap, swivel Horn, English screen. Fully charged. 6 Kg DCP Extinguisher (Gas Cartridge Type) approved to BS EN 3 or any other equable International Standard. Blue Body Headcap, English Screen, Fully charged. 9 Liter Water Extinguisher (Gas Cartridge Type) approved to BS EN 3 or any other equable International Standard. Red Body Headcap, English Screen, Fully charged. Fire Extinguishers should be located in conspicuous positions on brackets or stands where they will be readily seen by person. The carrying handle of larger heavier extinguishers should be about 01m from the floor level. But smaller extinguishers should be mounted so as to position the handle 1.5m from the floor level;
- **Cabinets for fire extinguishers:** Cabinets for fire extinguishers should be of stainless steel with or without glass-fronted doors. The colour of the cabinet should be Red or to suit the requirements of architectural surroundings. Recessed Latch Type handle should be installed. Fire Extinguisher Single Cabinets dimension should be no more than 190mm in width, 640mm in height, 180mm in depth (including door). Fire Extinguisher Double Cabinets dimension should be no more than 440mm in width, 640mm in height, 180mm in depth (including door);
- **Fire Blankets:** Fire Blankets should be certified to BS EN 1869: 1997 or any other equable International Standard. Fire Blankets should be extremely flexible and drape easily the slim pack of fire blanket should be Red or White;

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- **Dry riser gate valve:** Dry riser gate valve to BS 5041/2, or any other equable International Standard, Gunmetal c/w Padlock strap, blank cap and chain. Inlet 2 ½” ASA 150 F/F. Outlet 2 ½” Inst. Female couplings to BS 336. Colour red;
- **Dry riser outlet box:** Dry riser outlet box for Dry Riser gate valve. Construction should be similar to BS 5041. Standard finish colour Red. Dry Riser outlet cabinet dimension should be as specified in the guideline;
- **Pumping in breeching:** Twin pumping in breeching, approved to BS 5041, or any other equable International Standard, Gunmetal inlets 2 x 2 ½” BS Instantaneous Male Coupling c/w non-return valves. Outlet 4” ANSI 150 F/F flange;
- **Dry riser inlet box:** Dry Riser inlet box for horizontal/vertical pattern. Double inlet to BS 5041 or any other equable International Standard finish color Red. Dry riser inlet cabinet dimension for flush mounting should be as specified in the guideline.
- **Air release valve:** Air release valve, Gunmetal, Inlet 1” BSP Male;
- **Piping for dry riser system:** The Piping for Dry Riser System should be In and Out Galvanized schedule 40. The diameter of the Piping should be not less than 100mm.
- **Fire doors:** All fire doors should be opened to the direction of the flow of people while on emergency. These doors should be installed with a self-closing device including the Panic Latch. These Panic Latch devices should conform to BS 5725 Pt 1 or any other equable International Standard. Fire doors conforming to the method of construction as stipulated in the guideline;
- **Fire exit signs:** Photoluminescent Fire exit signs should sign each Fire Exit Door. The Symbol height should be no more than 100mm;
- **Fire detection and alarm system:** Fire Detection and Alarm System should conform to BS 5839 or any other equable International Standard. Fire Detection and Alarm System should be Analogue Addressable System with mimic diagram. A system in which signals from each detector and/or call point are individually identified at the control panel. Fire Detection and Alarm System should consist of Automatic Detectors, Manual Call Points, Control and Indicating equipment, etc. It should also cover System capable of providing signals to initiate, in the event of fire, the operation of ancillary

services such as fixed fire extinguishing systems and other precautions and actions. Main Fire Control Panel should be located at the reception and the Repeater Panel should be located in the guardroom;

- **Installation and testing of wet riser system:** Wet rising systems shall be provided in every building in which the topmost floor is more than 30.5 meters above the fire appliance access level. A hose connection shall be provided in each firefighting access lobby. Wet risers shall be of minimum 152.4 millimeters diameter and shall be hydrostatically tested at a pressure 50% above the working pressure required and not less than 14 bars for at least twenty-four hours. Each wet riser outlet shall comprise standard 63.5 millimeters instantaneous coupling fitted with a hose of not less than 38.1 millimeters diameter equipped with an approved typed cradle and a variable fog nozzle. A wet riser shall be provided in every staircase which extends from the ground floor level to the roof and shall be equipped with a three-way 63.5 millimeters outlet above the roofline. Each stage of the wet riser shall not exceed 61 metres unless expressly permitted by D.G.F.S but in no case exceeding 70.15 meters;
- **Wet or dry rising systems for buildings under construction:** Where either wet or dry riser system is required, at least one rise shall be installed when the building under construction has reached a height of above the level of the fire brigade pumping inlet with connections thereto located adjacent to a useable staircase. Such riser shall be extended as construction progress to within two floors of the topmost floor under construction and where the designed height of the building requires the installation of wet riser system fire pumps, water storage tanks, and water main connections shall be provided to serve the riser;
- **Wet riser booster pump system:** Wet riser booster pump set, complete with In and Out galvanized steel pipework with or without expansion vessel and specified in the guideline;
- Symbols, as well as installation of firefighting systems on the basis of building usage, are outlined on the table in the guideline; and

- All equipment mentioned above should be approved by the Maldives National Defense Force (MNDF) fire and rescue services before installation. Special permission should be taken if different from the guideline specifications.

3.4 International Conventions, Plans and Programs

This section describes international conventions, plans and programs that are relevant to the proposed development.

3.4.1 United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol

UNFCCC is the first binding international legal instrument that deals directly with the threat of climate change. It was enacted at the 1992 Earth Summit in Rio de Janeiro and came into force on the 21st of March 1994.

Signatory countries have agreed to take action to achieve the goal outlined in Article 2 of the Convention which addresses the “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.” Thus all Parties to the Convention are committed under Article 4 to adopt national programs for mitigating climate change, promote sustainable management and conservation of greenhouse gas (GHG) sinks such as coral reefs, to develop adaptation strategies, to address climate change in relevant social, economic and environmental policies, to cooperate in technical, scientific and educational matters and to promote scientific research and exchange of information.

The Kyoto Protocol entered into force on the 16th of February 2005 and is an international and legally binding agreement to reduce GHG emissions globally. It strengthens the Convention by committing Annex I Parties to individual, legally-binding targets to achieve limitations or reductions in their GHG emissions. Maldives has signed and ratified both the Convention and the Protocol.

3.4.2 Paris Agreement

The Paris Agreement is also an agreement within the framework of the UNFCCC dealing with GHG emission mitigation, adaptation and finance proposed to start in the year 2020. Upon opening for signatories on 22 April 2016, 180 UNFCCC members have signed the treaty (including Maldives), however, only 22 of which ratified it so far which is not enough for the treaty to enter into force yet. The aim of the convention as described in Article 2 of the treaty is “enhancing the implementation” of the UNFCCC through:-

- i. Holding the increase in global average temperature to well below 2° C above pre-industrial level and to pursue efforts to limit the temperature increase to 1.5° C above pre-industrial levels, recognising that this would significantly reduce the risk and impacts of climate change;
- ii. Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and lower GHG emissions development in a manner that does not threaten food production; and
- iii. Making finance flows consistent with a pathway towards low GHG emissions and climate resilient development.

3.4.3 The Vienna Convention for the Protection of the Ozone Layer

The Vienna Convention for the Protection of the Ozone Layer is a multilateral environmental agreement which entered into force in 1988. It acts as a framework for the international efforts to protect the ozone layer. In 2009, the Vienna Convention became the first convention of any kind to achieve universal ratification. The objective of the Convention were for the Parties to promote cooperation by means of systematic observations, research and information exchange on the effects of human activities on the ozone layer and to adopt legislative or administrative measures against activities likely to have adverse effects on the ozone layer. Maldives has signed and ratified this convention and adheres to it.

3.4.4 The Montreal Protocol on Substances that Deplete the Ozone Layer

The Montreal Protocol on Substances that Deplete the Ozone Layer (a protocol to the Vienna Convention for the Protection of the Ozone Layer) is an international treaty designed to reduce production and consumption of ozone depleting substances in order to phase out the production and abundance of substances that are responsible for depletion of the ozone layer. This protocol entered into force on 1 January 1989. Since its adoption, it has undergone 8 revisions and the Maldives abide by 4 of those addendums mentioned below:-

- The London Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1990);
- The Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1992);
- The Montreal Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1997); and
- The Beijing Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer (1999).

3.4.5 Agenda 21

Agenda 21 is a non-binding voluntary implemented action plan of the United Nations (UN) with regards to sustainable development. It is a comprehensive plan of actions taken globally, nationally and locally by organizations of the United Nations System, Governments and Major Groups in every area in which humans impact on the environment. It is also an outcome of the Earth Summit (UN Conference of Environment and Development) held in Rio De Janeiro, Brazil in 1992. Maldives is among the 178 countries which adopted this action plan. Out of the 4 sections it is grouped into, the proposed development pertains to:-

- i. Section I: *Social and Economic Dimensions* which is directed towards combating poverty, especially in developing countries, changing consumption patterns,

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- promoting health, achieving a more sustainable population and sustainable settlement in decision making; and
- ii. Section II: *Conservation and Management of Resources for Development* which includes atmospheric protection, combating deforestation, protecting fragile environments, conservation of biodiversity, control of pollution and the management of biotechnology and radioactive wastes.

3.4.6 Sustainable Development Goals

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests.

The Sustainable Development Goals are:

- No Poverty
- Zero Hunger
- Good Health and Well-being
- Quality Education
- Gender Equality
- Clean Water and Sanitation
- Affordable and Clean Energy
- Decent Work and Economic Growth
- Industry, Innovation, and Infrastructure
- Reducing Inequality
- Sustainable Cities and Communities
- Responsible Consumption and Production

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Climate Action
- Life Below Water
- Life On Land
- Peace, Justice, and Strong Institutions
- Partnerships for the Goals

3.4.7 Convention on Biological Diversity (CBD)

The Convention on Biological Diversity (CBD), formally known as the Biodiversity Convention, is a multilateral treaty which entered into force on 29 December 1993. The convention has 3 main goals:-

- i. Conservation of biodiversity;
- ii. Sustainable use of its components; and
- iii. Fair and equitable sharing of benefits arising from genetic resources.

The objectives of the convention is to develop national strategies for the conservation and sustainable use of biodiversity.

3.4.8 Washington Declaration on Protection of the Marine Environment from Land-based Activities

Maldives is a signatory to the Washington Declaration on Protection of the Marine Environment from Land-based Activities which intends at setting a common goal sustained and effective action to deal with all land-based impacts upon the marine environment, specifically those resulting from sewage, persistent organic pollutants, radioactive substance, heavy metals, oils (hydrocarbons), nutrients, sediment mobilization, litter and physical alteration and destruction of habitat.

3.4.9 Regional plans and programs

In addition to the international treaties and conventions, Maldives is also a key player in the formulating and adopting of various regional plans and programs to protect the environment by actively participating in activities organised by several regional bodies. As such, Maldives is committed to the following which pertains to the proposed project: -

- South Asian Association for Regional Corporation (SAARC) Environment Action Plan adopted in Male’ in 1997;
- SAARC Study on Greenhouse Effect and its Impacts on the Region;
- South Asian Regional Seas Action Plan and Resolutions concerning its implementation (1994); SAARC Study on Causes and Consequences of Natural Disasters;
- South Asian Seas Program; and
- Male’ Declaration on Control and Prevention of Air Pollution and its likely Transboundary Effects for South Asia (1998).

3.5 Required Permits and Approvals

The following permits and approvals shall be obtained from the relevant authority prior to commencement of construction phase of the project:-

Table 4. Permits and Approvals required for the proposed development

Permits/Approvals	Approving Agency/Authority	Status
EIA Decision Statement	EPA	Ongoing through the current EIA
Concept Approval	Ministry of Tourism	Acquired
Registration of facilities of RO plant and powerhouse	URA	To be applied for once construction is completed

3.6 Compliance of the Proposed Proposal to Statutory Requirements

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

All statutory requirements pertaining to this project shall be adhered to by the proponent during detail design phase, construction and operational phase. Furthermore, any changes to the legislative framework shall be considered and required changes shall be brought to project components as necessary.

4. PROJECT DESCRIPTION

This chapter describes the specific components of the proposed project in detail as per the approved ToR which is given the appendix section Appendix C of this EIA report.

4.1 Project location and sensitive environmental areas

The proposed resort is to be constructed at A.Dh Bodukaashihuraa. The Island is located on the Eastern rim of Alif Dhaalu Atoll and there are no environmentally sensitive or protected sites within 5km of the project island.

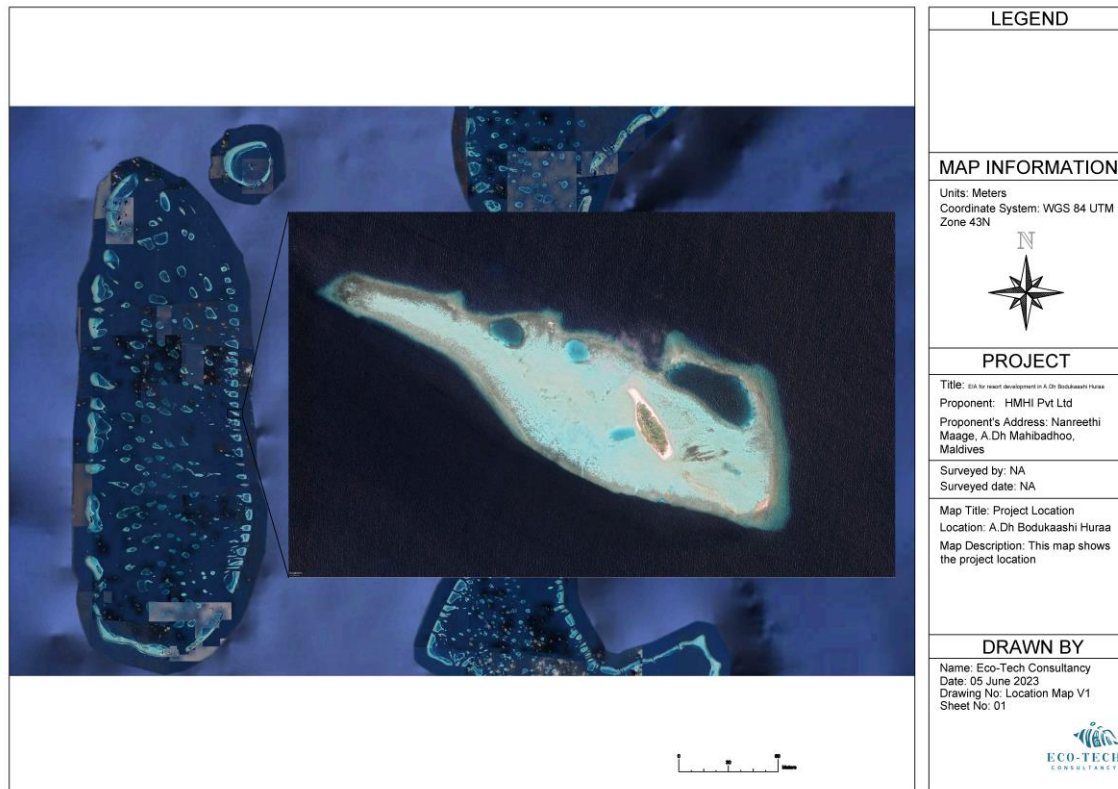


Figure 3: Location of proposed project island of ADh. Bodukaashi hura

4.2 Project overview

The government of the Maldives has leased the island of Bodukaashihura for the purposes of developing a luxury resort. Therefore, the project entails the development of guest facilities and the back of house facilities that would ensure the operation of such a facility. As such the resort will have total build up area of 8,849.19 sqm which is 28.61% of the total land area. A partial print of the approved concept is provided below. The full concept is provided in the appendices.

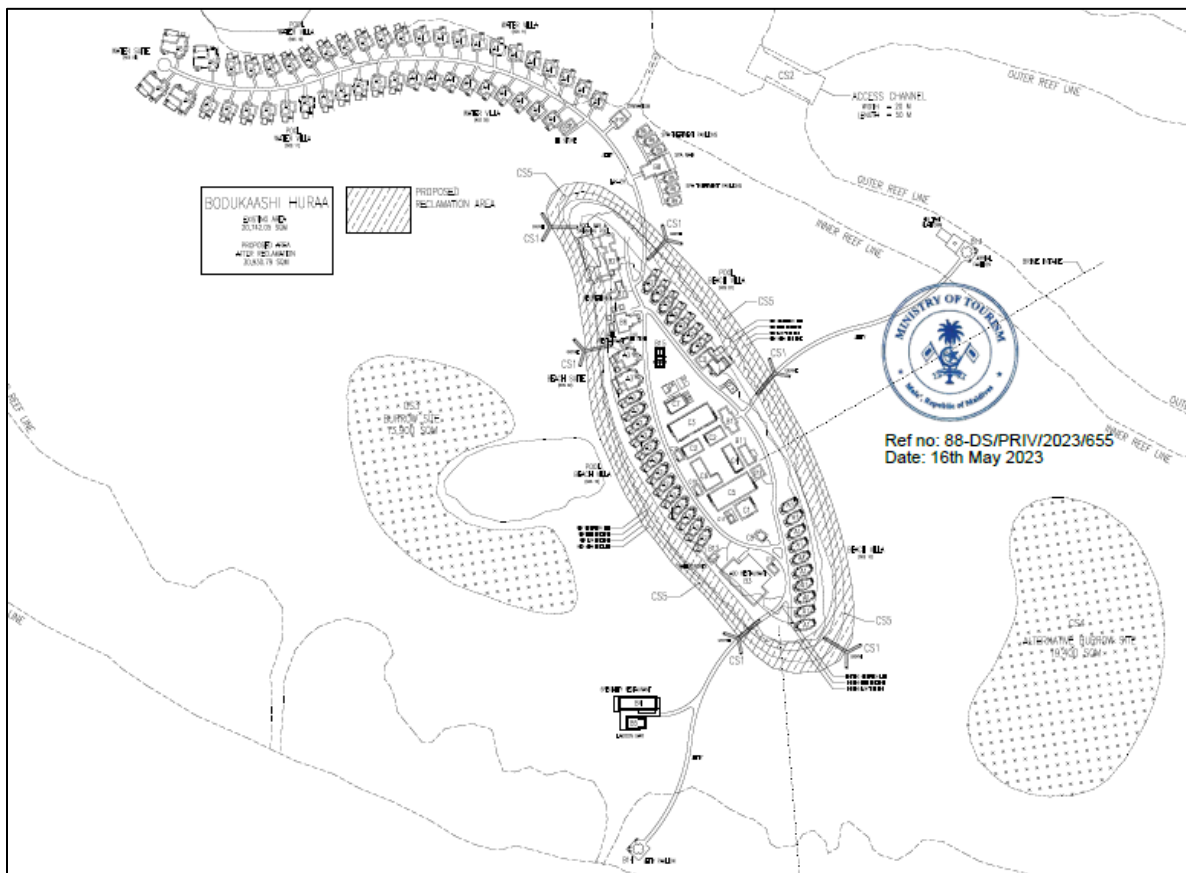


Figure 4: Partial print of the proposed concept design.

4.3 Project components

This section describes in detail the project activities that are likely to cause significant impacts to the environment.

4.3.1 Guest, public area and support facilities

The following guest, public area and support facilities will be established under the proposed project

4.3.1.1 Guest lodging

A total of 77 rooms which comprising of 154 beds will be established under the proposed project. Categorisation of the guest lodging facilities are provided below:

- 10 Beach Villas – 65.32 sqm per unit
- 20 Pool Beach Villas – 65.32 sqm per unit
- 2 Beach Suites – 138.38 sqm per unit
- 20 Water Villas – 54.50 sqm per unit
- 21 Pool Water Villas – 54.50 sqm per unit
- 4 Water Suites – 117.64 sqm per unit

4.3.1.2 Public areas

A total of 15 designated public areas will be established under the proposed project. They are:

- 1 Reception lobby, boutique and front office – 102.13 sqm
- 1 Pool Bar and Swimming Pool – 174.51 sqm
- 1 All Day Dining Restaurant – 590.98 sqm
- 1 Speciality Restaurant – 175.93 sqm
- 1 Lagoon Bar – 76.81 sqm

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- 1 Grill Restaurant – 163.93 sqm
- 1 Recreation Centre – 72.73 sqm
- 1 Spa Main – 151.15 sqm
- 6 Spa Treatment Rooms – 38.08 sqm per unit
- 1 Gymnasium – 57.93 sqm
- 1 Dive Centre – 62.23 sqm
- 1 Water Sports Center – 18.91 sqm
- 1 Arrival Pavilion – 38.88 sqm
- 1 Jettyhead Pavilion – 38.88 sqm
- 1 Badminton

4.3.1.3 Support facilities and services infrastructure

The following support facilities will be established under the proposed project

- 1 Director’s Bungalow – 164.59 sqm
- 1 GM and RM Bungalow – 110.08 sqm
- 2 Executive Staff Rooms – 93.94 sqm
- 1 Laundry Stores and Senior Staff rooms - 354.78 sqm
- 1 Resort Admin office and Junior staff room – 110.41 sqm
- 1 Junior staff room – 364.78 sqm
- 1 Staff Dining, Kitchen and staff recreation - 182.14 sqm
- 1 Service centre (Power and Water facilities) – 106.80 sqm
- 1 Recycle house – 15.04 sqm
- 1 Mosque – 24.36 sqm
- 4 Housekeeping stores (land) – 19.60 sqm
- 1 Housekeeping stores (water) – 47.53 sqm
- 1 Radio hut – 55.95 sqm
- 1 Clinic – 41.82 sqm
- 2 water storage tanks – 16sqm per unit

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Fuel Storage (1 diesel tank and 1 petrol tank) – 40.50 sqm
- Sewage Treatment Plant – 28.07 sqm

4.3.2 Water facility

The 03 nos 200 TPD RO plant will be used to produce sufficient water to meet all of the water demand. There will be two tanks to store water, each tank containing 300 tons volume.

4.3.2.1 RO plant

RO plant with a capacity of 600 TPD (200 x 3) will be established RO plant. Feedwater for the plant will be taken through a beach-well constructed on the north eastern side of the island.

4.3.2.1.1 Pre-treatment

The raw water from bore well will pass through primary filtration system which consists of filter or screen filter of 50 microns and bag filter with 5 microns. The primary filtration removes dirt, dust and other sediments in raw water before being fed to RO membranes. The primary filtration system protects high pressure pump and RO membranes from very fine particles.

The raw water may contain high amount of hardness which may tend to precipitate when concentrated by RO membranes. Thus, with the use of synthetic antiscalents it is possible to operate with a positive Langlier Saturation Index (LSI), a method of determining the scaling or corrosive potential of water based on the level of saturation of calcium carbonate. The antiscalents dosing shall be added to the pre-treatment consisting of an electronic dosing pump & HDPE/FRP solution preparation tank.

4.3.2.1.2 Reverse Osmosis Filtration

The pre-treated water will be led into the RO plant, where high pressure pumps will pump in pressurized water through pressure vessels with spiral wound RO membranes. Spiral wound

reverse osmosis membranes filters the feed water, producing 40 percent of fresh water and the rest as concentrated brine or reject water.

The quality and quantity of permeate shall be supervised by the conductivity meter and flow meter. When the permeate water quality drops below the preset level, it will automatically divert to drain preventing low quality water to the storage tank. Furthermore, the plant shall be equipped with flow meters for feed water and permeates as well as pressure transmitter/switches shall be incorporated so that it can automatically stop the plant in case of failure of feed water (low inlet pressure) and back pressure in the permeate line (high outlet pressure).

4.3.2.1.3 Post treatment

The product water or permeate from the RO process is passed through a Degassifier to remove the dissolved Hydrogen Sulphide. It is then diverted to the storage tank by pumping. A disinfectant solution (Hypo Chloride) will be dosed in to the inlet water pipeline of the storage tank. The disinfectant dosing pump system is a system that feed with set points in order to maintain a constant level of disinfectant in the distributed water.

4.3.2.1.4 Description of RO plant operation

The operation of RO plant will be in two modes i.e. Automatic Mode and the Manual Mode. Below is a small description of the two modes.

4.3.2.1.4.1 Automatic mode

To start up the plant, operator has to select the operation mode to automatic. After that the microprocessor in the control panel will take care of the whole process until it is fully started. Success operation of each process triggers to follow the next process. Therefore, failure of one process will fail the next process, thus fails the startup. This is a safety precaution made during programming of the processor.

The starting sequence of the plant is as follows:

- Selection of the Automatic Mode by the operator.
- Starting of the feed water (bore well) pump. As this pump starts the sensor/transmitter checks the pressure across the Sand filter and the bag filter. If it is not within the set limits the plant will be tripped for the necessary action like backwashing of sand filter or changing of the bag filters. If it is through then it follows the next step.
- After the feed water is circulated through the membranes for the set time period to removes the airlocks. The pressure in the system will be raised to a few bars. After a time delay the next step will be triggered.
- Starting of the High Pressure (HP) pump. The HP pump speed will increase gradually until it reaches the set limit. This is to control the high starting current of the motor. As this is started the transmitters/sensor in the HP line will monitor the pressure increase of the system. If it goes beyond setting the plant will be tripped as a safety precaution. It will monitor the membrane inlet pressure, pressure difference across the membrane modules, conductivity of the permeate etc.
- When the plant is stabilized, the permeate bypass valve will close and permeate valve in the permeate line will open and let the product water to flow to the Degassifier, dosing system and storage tank
- Treated Water storage tank is proposed to store water from RWH system and
- R.O. plant system. Pumped distribution system is proposed. Two pumps; one pump is in operation and the other work as standby is proposed. The control system designed to maintain the constant pressure in the network hence standby pump will start automatically in any instance if the set pressure cannot be maintained by the pump in operation.

4.3.2.1.4.2 Manual Operation

Basically, in the manual operation each stage of the whole process will have to start and stop manually. This is risky since minimal alarms and protection is active.

Protections

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

The following protections are available in the system.

- Prevent operation of the plant with very low or no water flow to the system
- Very High pressure to the membranes
- Blockage/high pressure of the permeate line
- Low Quality water going in to the tanks

Alarms

The system will be designed and programmed to give the following alarms. Alarm LED will be ON in the control panel.

- Feed pump Failure
- Low feed pressure
- High Pressure Pump Failure
- High Membrane Inlet Pressure
- High Permeate Conductivity

4.3.2.1.5 Power supply

RO plants and equipment's will primarily be running from Island Power source. However, a Generator set to accommodate the power requirements as a backup system with capacity to run up to 8 hours will be established with capacity run in case of power failure from the Island Power Source.

4.3.2.1.6 Brine Disposal

A brine disposal line would be laid to dispose the reject water from RO plant deep into the sea. It is proposed to lay OD 160mm PE100 PN16 PE pipe. The location of the brine outfall pipeline is provided in Figure 4. The

Figure 7 provide the anchoring details while Figure 6 provides the diffuser details.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

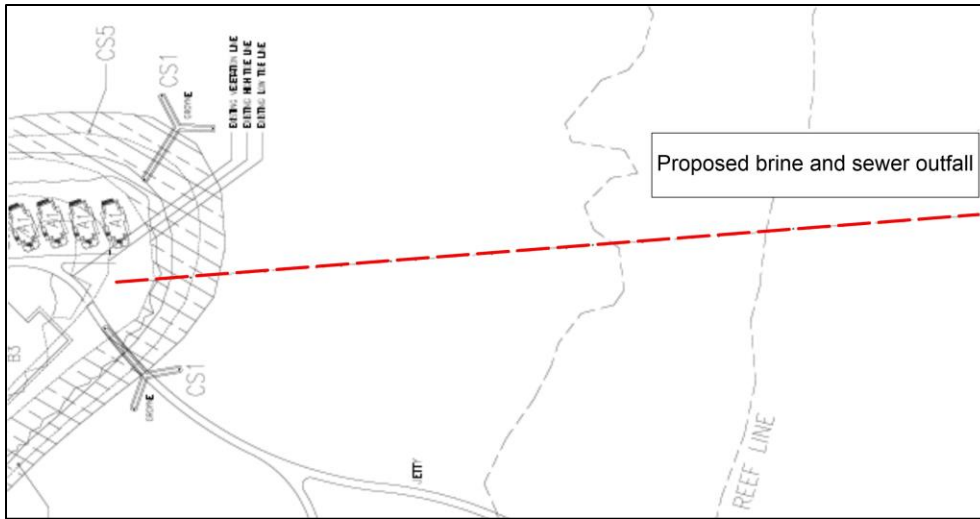


Figure 5: Proposed brine and sewer outfall

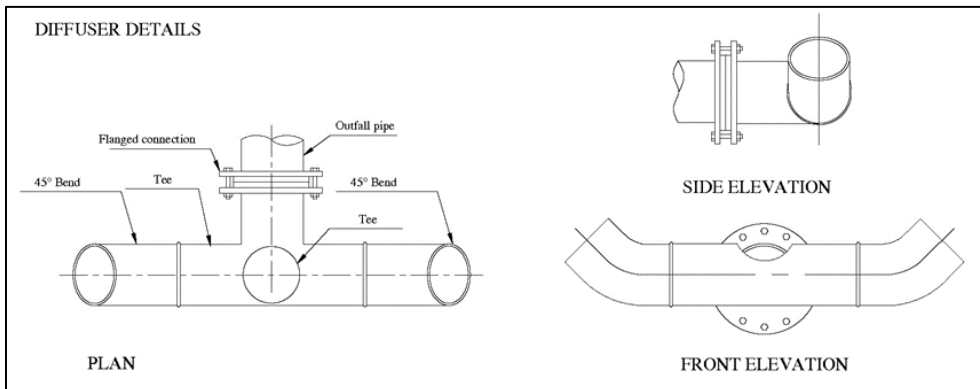


Figure 6: Brine diffuser details

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

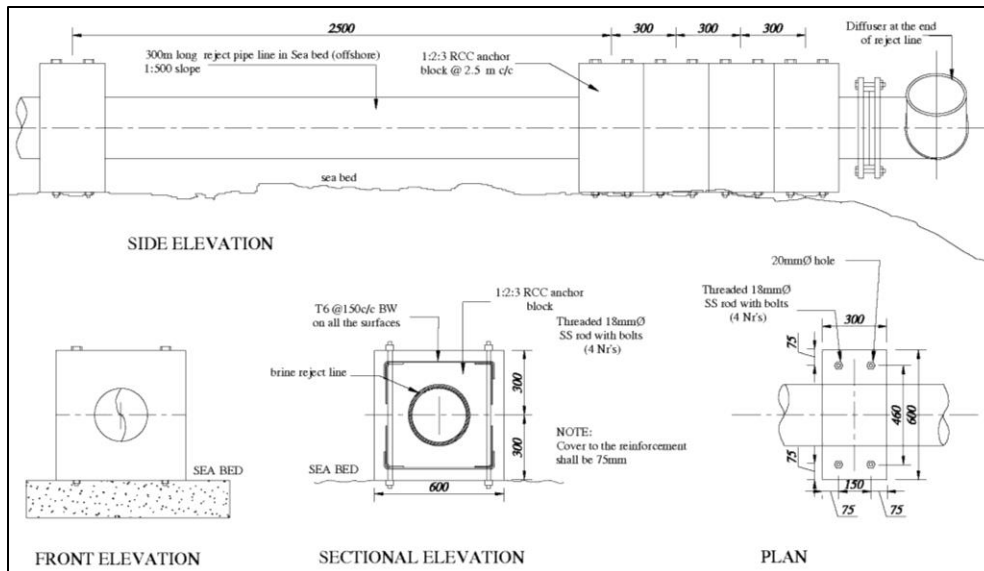


Figure 7: Anchoring details

4.3.2.1.7 Disinfection

The term ‘disinfection’ means the destruction of inactive organisms in water to such low levels that no infection of disease results when the water is consumed for drinking purpose. For small plants the following disinfectants are commonly used.

<p>Ultra-violet radiation</p>	<ul style="list-style-type: none"> • Ultraviolet radiation is suitable for disinfection of water which is free from suspended matter, turbidity and color. It is more effective against bacteria than viruses and bacterial spores. UV is best suited to ground waters which require disinfection only. • For Project Island disinfection by Ultraviolet (UV) radiation is proposed for RWH system and chlorination is proposed for RO system
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<p>Products releasing chlorine e.g. calcium hypo chlorite (Ca(OCl)2) sodium hypochlorite (NaOCl), chlorine tablets</p>	<ul style="list-style-type: none"> • Sodium hypochlorite solution is available as a household disinfectant (bleach) under many brand names. It can be produced by electrolysis of brine and can be used for water work purpose; it is a clear solution containing 14-15% available chlorine. It can be supplied in small container or in bulk but loses its chlorine strength when exposed to atmosphere or sunlight. • Dosing of hypochlorite can be achieved by positive displacement, reciprocating diaphragm pumps.
<p>Calcium hypochlorite in powder form commonly known as ‘Bleaching Powder’ is widely used for disinfection of water supplies</p>	<ul style="list-style-type: none"> • A measured quantity of bleaching powder is mixed in the water tank and allowed to settle. The supernatant containing chlorine is drawn off and diluted to the dosing concentration in the storage tank. The supernatant is injected into the water to be treated by means of positive displacement, reciprocating pumps of the diaphragm type or constant level feeders. • Bleaching powder is an unstable compound and loses its available chlorine on storage. All these considerations make its use uneconomical

4.3.2.1.8 Output water quality

The output quality of the desalination plant shall comply to the supply water quality standards. The following parameters need to be tested in accordance to the below mentioned timelines during the operational phase.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

4.3.2.1.8.1 Daily tests

Parameter	Reference range
Free Chlorine	0.04 - 0.2 mg/l
pH	6.5 - 8.5
Physical Appearance	Clear & Colorless
Electrical Conductivity	<1000 μ s/cm
Total Coliform	0/100ml CFU
Fecal Coliform	0/100ml CFU
Turbidity	<1 NTU
Total Dissolved Solids	<500 mg/L

4.3.2.1.8.2 Monthly tests

Parameter	Reference range
Chlorides	<200 mg/l
Nitrates	<50 mg/l
Ammonia	<0.02 – 2.50 mg/l
Iron	<0.3 mg/l
Hydrogen Sulphide	0.05 mg/l
Total Hardness	<75 mg/l
Suspended Solids	5-750 mg/L

4.3.2.1.8.3 Bi-annual tests

Parameter	Reference range
Total viable count at 22°C	100/1ml CFU
Total viable count at 37°C	20/1ml CFU

4.3.2.1.8.4 Annual tests

Parameter	Reference range
Anionic detergents	0.002 - 0.275 mg/l
Arsenic	<0.01 mg/l
Boron	<0.3 mg/l
Bromine	0.05 – 4.50 mg/l
Cadmium	<0.003 mg/l
Calcium hardness	<60 mg/l
Chromium	<0.05 mg/l
Copper	<2 mg/l
Cyanide	<0.07 mg/l
Enterococci	0/100ml CFU
Fluoride	<1.5 mg/l
Lead	<0.01 mg/l
Manganese	0.1 mg/l
Mercury	<0.001 mg/l
Phenolic compounds	0.002 - 0.2 mg/l
Phosphate	<5mg/l
Potassium	0 – 50 mg/l
Salmonella Typhi	0/100ml CFU
Shigella spp.	0/100ml CFU
Sodium	<200 mg/l
Sulphate	<250 mg/l
Total petroleum hydrocarbon	0 mg/l
Vibrio Cholerae	0/100ml CFU

4.3.2.1.8.5 Emergency response

In case of failure of the desalination plant, the backup RO plant would start to function. In case the backup RO plant fails to function, supply water is to be provided to the island before the existing water storage runs out. This process would be continued until the all the RO plants are repaired and back to operations.

4.3.3 Sewerage facilities

The proposed project involves establishing a gravity-based sewer network and sewer facilities at the island. The selected is conventional system, the main components of the system are the pump station, network and a sewerage treatment plant with effluent disposing pipeline to open sea via sea outfall. Outfall pipe is inclined to a depth below 6m from MSL.

4.3.3.1 Excavation and Dewatering

The Maldives is a unique environment with respect to construction of wastewater systems due to the extremely high-water tables which on average are between 0.5 and 1.5m below ground level. Because of this, extensive dewatering is required during construction and installation of pipe networks which increases in intensity as depth increases. In addition, the instability of the prevailing sand/soil conditions of Coral Atoll Islands makes excessive dewatering extremely hazardous as increased dewatering with depth removes significant quantities of sand/soil further exacerbating the unstable soil conditions. Previous experience of sewer construction in the Maldives has indicated that excavation depths in excess of 3.5m are not recommended for conventional dewatering methods to avoid the risk of undermining and trench collapses.

Given the instability of the sand/soil conditions, trench shoring is to be used to maintain the vertical integrity of the sidewalls. All water removed during excavation for trenching and construction will be disposed of inland from the excavation for re-percolation back into the water table as outlined in the URA guidelines.

4.3.3.2 Sewerage Treatment Plant

The details of the proposed STP is given below. The process flow is taken from jet inc commercial plant. Although the exact brand of the treatment plant is not known at the moment, it would be similar to the following process flow. Furthermore, key maintenance activities and best practices in the operations of the aforementioned STP are detailed. This is due to the fact that the STP operations will be one of the most environmentally sensitive functions of the system during the operational phase.

4.3.3.2.1 The treatment processes

The proposed Wastewater Treatment Plant employ a biological process known as "extended aeration" or "aerobic digestion." In this process incoming wastewater enters an aeration tank where the contents are thoroughly mixed and aerated by large volumes of air which are pumped into the tank under pressure. As the air bubbles rise to the surface, oxygen is transferred

to the tank liquids. Aerobic bacteria present in the activated sludge in the tank use this oxygen to convert the wastewater to inoffensive, clear, odorless liquids and gases. Sometimes this process is referred to as "wet burning" because the bacteria actually destroy the wastewater by using oxygen, just as fire uses oxygen to burn trash. After the treated liquid leaves Aeration Tank, it is held in a "settling" tank, which provides a quiescent zone for clarification. Here any partially treated particles settle to the tank bottom and are returned to the aeration tank for further treatment. This settling produces a clear, highly treated liquid which is ready for final discharge. Many refinement sand options can be used with extended aeration plants - especially with the larger ones. However, the basic process used in all extended aeration plants is as described here.

4.3.3.2.2 *Extended aeration plants*

Basically, extended aeration plants can be divided into four main elements. These elements are:

- Pre-Treatment
- Aeration
- Settling
- Optional Equipment

4.3.3.2.3 *Pre-treatment*

In this first stage, a pre-treatment device is used to physically break down the wastewater and trap untreatable material such as plastic or metal before it can enter the plant. The three basic types of pre-treatment devices are bar screens, comminutors, and trash traps. Bar screens are used to trap large objects and prevent them from entering the plant.

A comminutor is a wastewater grinder designed to grind or shred large solids into smaller pieces. Comminutors should have a bar screen by-pass for additional protection.

The third type of device is a pre-treatment tank or trash trap. Here untreatable material is settled out and organic solids are pre-treated and broken down both physically and bio-chemically before being passed on to the aeration tank.

4.3.3.2.4 Flow equalization

The aerated flow equalization chamber distributes the influent evenly over the course of a day. This optimizes the efficiency of the treatment plant. Even distribution is accomplished with time-dose pumps that are equipped with high water alarm.

4.3.3.2.5 Aeration

In the aeration tank, "aerobic digestion" or "wet burning" takes place. Here the pre-treated incoming wastewater is mixed and aerated by air diffusers, located in the bottom of the tank. These diffusers inject ample air to meet the oxygen demand of the aerobic digestion process as well as mix the entire tank contents.

4.3.3.2.6 Settling

The next step in the process takes place in the settling compartment. Here there is no circulation so any remaining solids can settle to the tank bottom and be returned to the aeration chamber by the sludge return.

4.3.3.2.7 Wastewater Disinfection system

Proposed wastewater disinfection system is a complete non-mechanical, gravity operated chlorine dispensing system, consisting of a Tablet Feeder and disinfection tablets. The system is capable of providing chlorination of flows up to 100,000 gallons per day.

4.3.3.2.8 De-Chlorination system

The de-chlorination System uses a compact, lightweight tablet feeder and long-lasting sodium sulfite tablets to remove chlorine in proportion to the flow of treated wastewater. Furthermore, the system is capable of providing chlorination of flows up to 100,000 gallons per day. Moreover, the system can de-chlorinate gas, liquid or tablet chlorinated wastewater. The systems tablets contain 85-90% active sodium sulfite.

4.3.3.2.9 “Spray” foam control system

Foam develops in many plants because of the mixing action and the large amounts of air being diffused into the aeration tank. During plant start-up, foam exists in almost all plants, but once activated sludge develops, this foaming normally subsides. On installations where organic loading is high or where a lot of detergents are used, such as restaurants or laundromats, foaming may be constant. In these cases, a spray system should be installed.

Basically, Foam Control System consists of a pump, piping, and spray nozzles. The pump transfers the clear liquid from the settling compartment to the spray nozzles, arranged above the surface of the aeration chamber. A fine spray produced by the nozzles knocks down the foam and prevents its build-up.

All Spray Systems are also equipped with a wash-water outlet which is convenient for cleaning and maintaining the plant.

4.3.3.2.10 Surface skimmer

Surface skimmers are used to remove any floating particles or material from the surface of the final settling tank. After it is removed, the material is returned to the aeration chamber for further treatment.

Skimmers are usually made up of an intake pipe and an air lift, which is an air-powered pumping device. The intake pipe is installed flush with the surface to draw in any floating particles and the air lift is used to pump these particles back to the aeration chamber.

Surface skimmers should be used wherever grease will be encountered. They are also extremely helpful maintenance tools because they eliminate the need for manually cleaning the settling tank surface. Most authorities feel they should be installed wherever possible.

4.3.3.2.11 Time clocks

The wastewater treatment plant is equipped with a 24-hour time clock that controls the plant's "on" and "off" cycles throughout the day. These time clocks permit a great variety of time

cycles to be programmed during any 24-hour period, but once the program is chosen it remains the same for every day in the week. This is satisfactory for most loadings. The 24- hour time clock is available as an option on the 2000 Series plants. Certain installations such as schools, swimming pools, or churches have great fluctuations in flow and require longer treatment periods on some days than on others. For these installations, a seven day time clock can be installed to permit different time cycles for different days of the week.

4.3.3.2.12 Standby Equipment

Duplicate mechanical components for stand-by operation are sometimes required. The plants are designed so that these duplicate mechanical components alternate operation, allowing no single set of components to sit idle for long. This special alternation keeps the "stand-by" equipment in as fine a running order as the other set of components and eliminates "freezing" and other problems that always seem to plague mechanical equipment that is not used for long periods of time.

4.3.3.2.13 Sludge-holding tank

Sludge is pumped into the holding tank through auxiliary piping which is connected to the plant's sludge-return pump. The sludge is held here until it is hauled away or else it is returned to the plant for final treatment. Holding tanks equipped with “air seal diffusers” and is referred to as aerated sludge- holding tanks and are the most common type. Aerating a sludge- holding tank provides some treatment and eliminates the possibility of odor. All sludge -holding tanks have overflows that lead back into the treatment plant.

4.3.3.2.14 Flow meters

Flow meters or flow measuring weirs are optional devices used on plants where it is necessary to accurately determine plant flows.

4.3.3.2.15 Plant start-up

Wastewater treatment plant start-up is simply balancing the plant's variable capacities, such as mixing, aeration, and running time, against the load of the facility it serves. Since no two plant loads are ever exactly alike, it is impossible at the time a plant is installed to pre-set it to do the best job it is capable of. At first, all the operator can do is analyze the load, choose the correct plant size, and make some initial equipment settings. From here on out it is a matter of observing the plant's performance closely for up to ten weeks, and making adjustments based on these observations. Fine tuning a plant to accommodate the influent load is called plant "start-up." Plant start - up must be successfully completed before any plant will do the job it was intended to do. There is no question about the fact that all plants must receive regular start-up attention if they are to perform correctly. A conscientious start-up program will quickly bring a plant up to peak operating efficiency, but if there is no start-up program, or if it is drawn out or stopped, the plant will really never be efficient.

During start-up, the plant must be given daily attention by the operator or a representative, and it should be inspected frequently by the Service Provider / supplier. Normally the start-up period for a plant will last approximately ten weeks.

4.3.3.2.16 Activated Sludge

The incoming wastewater contains dormant bacteria that are quickly stimulated to activity by the abundant supply of oxygen in aeration tank. These bacteria are able to quickly absorb and digest the organic material in wastewater and they are the primary element in activated sludge. Since the aeration tank provides an ideal environment for the bacteria, they multiply rapidly and are soon plentiful enough to oxidize or "burn up" all wastewater that enters the plant. Activated sludge draws the very fine suspended particles in solution to it, just as a magnet draws iron particles. Often this suspended material is so small that it would not normally settle out by gravity. But because of this magnetic characteristic, as the sludge settles to the bottom of the final compartment, it takes the fine suspended matter with it, just as if a filter were being passed down through the liquid. Naturally, this is a great improvement over ordinary gravity settling.

A great deal of the time taken in plant start-up is spent developing a good activated sludge culture. In some situations, such as the early opening of a restaurant, the owner may want to accelerate the start-up process. This can be done by "seeding" the plant which is accomplished by taking sludge from a plant already in operation and adding it to the new plant. Although seeding can speed up a start-up program, it should be remembered that even a "seeded" plant will deteriorate and not work properly if it does not receive the necessary start-up adjustments.

4.3.3.2.17 Hopper Maintenance

During its development, activated sludge is very stringy and tends to cling and build up on the slanted walls of the hopper. Therefore, during the first few weeks of plant operation, the hopper should be gently scraped each day with a squeegee. This scraping should move the sludge in a slow, gentle motion to the bottom of the hopper. Never stir or push the sludge quickly because it may then float to the surface, in which case it will have to be dipped out and put back into the aeration chamber. Floating solids also increase the solids level near the surface and reduce the quality of the effluent.

If sludge is allowed to build up in the hopper, eventually large chunks will break loose, sink to the bottom, and clog the sludge return. A clogged return will result in poor wastewater treatment because of the lack of sludge in the aeration tank, and in a very poor effluent because of the abnormally high solids in the final tank. Naturally, a major malfunction such as this prolongs the start-up period too. After the activated sludge is fully developed, it becomes less stringy and does not tend to build up on the hopper walls.

When this occurs, it will be possible to eliminate daily hopper scraping. However, this can only be determined by careful examination. Although the hopper eventually will not have to be scraped every day, it should never be left unattended for longer than a week.

4.3.3.2.18 Air, mixing and cycle adjustments

Both the level of dissolved oxygen and the degree of mixing within Aeration Chamber are determined by the amount of air being diffused. For this reason, adjusting the aeration rate is the principal technique in plant start-up.

Minor air adjustments to provide even mixing can be made by regulating the individual valves for each diffuser bar assembly. Larger air adjustments, to alter the aeration rate, require the use of a time clock. These time clocks regulate the air supply by controlling the "on" and

"off" cycles of the blower. Time clocks are factory set to operate fifteen minutes out of every half hour and, although they can run longer or on other settings, they should never be set to operate less than 50% of the time.

The individual air valves should be used to regulate the air flow to provide even mixing. Even mixing simply means that the air should move the tank contents so that they are rolling evenly all along the tank wall. The valves should never be "throttled down," however. If the aeration rate needs to be reduced or increased, it should be done primarily by regulating the time clocks. By using a time clock to regulate the aeration cycle rather than throttling down the valves, it is possible to maintain high mixing velocities in the aeration chamber and still control and maintain a desired level of dissolved oxygen.

Any increase or reduction in the time cycle should equal 10% of the total running time. After a change is made, the plant should always be permitted to run at least 48 hours before any further adjustment. If the adjustment has been sufficient, improvement should be evident in the plant effluent within 48 hours.

4.3.3.2.19 Sludge return rates

An important factor in the treatment process is the return of the settled, activated sludge from the settling tank to the aeration tank. Sludge-Return Assembly, located in the final settling tank, is operated with air from the blower. This air is injected into the sludge-return assembly near the bottom of the hopper, causing settled sludge to be drawn in and up the pipe, where it is

discharged back into the aeration chamber. A small valve installed on the sludge-return air-line is used to adjust the return rate. Jet's sludge-returns are capable of pumping in excess of the total daily plant flow but normally they are adjusted to pump considerably less.

Initially the sludge-return air-line valve should be turned all the way open. It should be left open for the first week or until the plant begins building up solids. This can be determined by the appearance and odor of the mixed liquor. As solids start to develop, the contents of the aeration chamber should lose their gray color and appear light brown. They should also develop a somewhat "earthy" odor and, as they continue to build up, the color should change to a richer brown.

An excessive sludge-return rate will cause the plant to lose solids over the weir. This can be easily detected by observing the effluent. If the sludge return is pumping too fast, it does not give the sludge time to settle, and creates a flow through the final tank which stirs up the solids and causes them to be discharged from the plant. If this happens, the air valve should be turned down one quarter turn each day until the plant stops losing solids. On the other hand, the return should never be adjusted too low and this should be checked by seeing that the end of the sludge-return outlet is never less than 1/4 full.

Always reduce the sludge-return rate slowly and carefully, because reduced return rates increase the chance of clogging. If clogging occurs, it can be corrected by back-washing, but before the correction it will have resulted in sharply lowered plant efficiency and a poorer quality effluent

4.3.3.2.20 Startup adjustments

Adjustments of a Plant during the start-up period are based mainly on the appearance of the plant and its effluent. Rates of aeration and sludge return should be adjusted until the plant reaches a level of efficient operation. The check list given here contains the start-up information needed to make plant adjustments and give each plant the "fine tuning" it needs to operate at peak efficiency.

The operators should have a focus on the following

- HOPPER: Scrape gently every day during start-up.

4.3.3.2.23 Inspect Sludge return

An air-lift sludge return, which uses air produced by the blower, pumps sludge from the settling chamber back into the aeration chamber. sludge-return pumps are equipped with an air valve that you should use to adjust the return rate. Check the sludge-return rate by seeing that the end of the sludge-return outlet is never less than 1/4 full. This rate is the minimum required to keep the plant in balance and will reduce chances of the return plugging up. The return may be set to operate at any point above the 1/4 mark that works best for the plant.

Occasionally a sludge return will clog. Usually this is because the settling hopper has not been well maintained. When this happens, the quickest and easiest way to unplug it is to backwash it. Backwashing is a simple operation in which you shut off the sludge flow for a short time and force large volumes of air back through the sludge return to blow any clogged material out the intake end. To backwash a sludge return, turn the large liquid-sludge control valve, if so equipped, in the sludge-return line "off" and turn the small air valve to the full "open" position. This will force air back through the air lift and out the intake. In extreme cases when the normal volume of air is not enough, you may shut off other air valves in the system so a larger supply of air will be available for the backwash operation. To do this, simply shut off the valves for the individual diffuser bars, but be sure to note their settings before you change them so you can adjust them back to the original position. The 2000 series plants and some of the smaller 3000 series plants do not have liquid sludge -control valves. However, the procedure for back-washing these plants is also quite easy. First, shut the sludge-return air valve "off" and remove the plug in the tee, located at the top of the air-lift pipe. Now inflate a "plumber's stopper" below the tee and turn the air back on. The plumber's stopper will close the line here, just like a valve, and the air will be forced back out the intake of the pump, clearing the blockage.

4.3.3.2.24 Clean and Adjust weir

During every plant maintenance inspection, operator should check the weir to see that it is skimming evenly over its entire surface and clean it to keep it free of sludge build-up. Weirs are designed so they may be adjusted from side to side or end to end, and these adjustments may be

by repacking the valve with grease or by installing a new rubber washer. Always shut the electrical power off before inspecting any mechanical or electrical equipment. Please ensure to keep the operators hands and all objects away from the equipment until you have shut off the main circuit breaker.

4.3.3.2.28 Inspect V-Belt.

Check the tension on the V-belt to be sure it is not slipping by turning the unit off, letting it come to a complete stop, and then turning it back on. If the belt is too loose, the pulley on the motor will turn several times before the blower pulley starts to turn. If this happens, shut off the main circuit breaker and tighten the belt, then check it again. Belts should be checked weekly because new ones stretch at first and all belts wear and loosen as they are used.

4.3.3.2.29 Inspection of electrical controls

You should check all time clocks once a week to be sure they are set for the correct time of day. All the disposable fuses for optional equipment should also be inspected weekly and replaced if necessary. Once a year, completely check over the electrical panel. Replace any worn or frayed leads and securely tighten all conduit fittings and connectors.

4.3.3.2.30 Servicing pre-treatment device

If a comminutor or bar screen is installed, operator should check and clean it daily. Follow the specific instructions for these devices given in their individual information sheets.

When a pre-treatment tank or "trash trap" is used, it requires an yearly inspection for blockages near the inlet and outlet. Pre-treatment tanks need not be pumped unless they have received a large quantity of untreatable material such as sand, rocks, metal, etc. They are designed to filter out untreatable materials as well as to break down and pre-treat wastewater before it enters the plant. They are not designed to prevent organic solids from passing through, as a septic tank is, and for this reason they do not have to be pumped as often as septic tanks.

4.3.3.2.31 Sample effluent

Operator should inspect the plant effluent daily to ensure that it is clear and odor-free. Weekly, the effluent should be given a relative stability test, which will indicate the level of treatment.

4.3.3.2.32 Repainting

Operator should check, clean and spot-paint all metal surfaces, at least once a year. This is normally a very short job.

4.3.3.2.33 Clean-up

The plant and surrounding area should be cleaned daily. When the plant is equipped with a wash-water outlet or if there is a water supply nearby, you should wash down the piping and inside sidewalls of the plant. Grass and weeds should be kept at least 3" away from the edge of the plant and the surrounding grade should always be maintained at least 3" below the tank top.

Once a month, you should lubricate all locks and hinges on the plant grating and equipment enclosures. Always be sure to replace and lock all panels and grating sections before leaving

4.3.3.2.34 Routine equipment maintenance

Equipment in a wastewater treatment plant requires a certain degree of maintenance just as all other mechanical equipment does. Plants have been designed to perform well with as little maintenance as possible. The service steps outlined there are not difficult but are absolutely necessary to ensure proper plant operation and long equipment life.

Always shut off the electrical power before inspection of any of the mechanical or electrical equipment. Ensure to keep any personal and all objects away from the equipment until have the main circuit breaker on the control panel has been shut off. Check the manufacturer's equipment manuals provided for additional information.

4.3.3.2.35 Blower

Positive displacement blowers are used to supply air to tile treatment plant. These blowers contain two impellers, mounted on parallel shafts that rotate in opposite directions. As the impeller passes the blower housing inlet, it traps a small quantity of air between itself and the blower housing. It carries this air around to the outlet and discharges it.

Gears are installed on the end of each shaft to control the position of the impellers, with relation to each other, and thus maintain the clearances needed to assure maximum air flow efficiency, minimum wear, and long life. Since there is no contact between the impellers and the inside of the blower, internal lubrication is not needed and water sealing is not required. In fact, the blower is not able to handle liquids.

The blower gear housing should be checked weekly to be sure it is filled with synthetic oil (P/N 813-106) of correct viscosity. To do this, shut the blower off, remove the breather plug (25) and the oil overflow plug (21). Fill the reservoir up to the overflow hole. Do not over fill. Then replace the plugs.

Bearings at the gear housing end of the blower are lubricated with oil splashed from the gears, but the bearings at the drive end need to be manually lubricated with grease every month. Use the grease gun and recommended grease listed in the Blower Operation Manual. Always remember to replace the yellow lubrication caps and square drain plugs when you are finished.

4.3.3.2.36 Motor

Clean all dust away from the ventilating openings on the motor shell at least once every month.

The motor bearings should be re-lubricated every five years. To do this, remove the motor end bells and clean old grease from the bearings and end bells. They must be kept completely free of dirt! Repack the bearings with GE D6A2C5 grease or equivalent and fill the lubrication cavity one-third full of grease. DO NOT overdo it, excessive or too frequent lubrication may damage the motor. This grease may be obtained through any GE motor repair station.

Well-maintained motors normally do not require repair, but if a motor does fail or if you are not equipped to re--lubricate it, fast, dependable service for your motor or any other component can be obtained through your Distributor.

4.3.3.2.37 Pressure relief valve

Pressure-relief valves are installed on all blowers to prevent excessive pressures from building up when valves are closed or partially closed during plant operation or maintenance. These relief valves are simple in construction and require very little attention. They should, however, be kept clean and they should be checked monthly to be sure no dirt or rust has accumulated that would interfere with their free operation To service them, simply remove the weights, take off the removable cap, clean all surfaces and apply a light coat of oil to the inside of the cap and the outside of the valve.

4.3.3.2.38 Air filter or inlet filter silencer

Air inlet filters are installed on all blowers to reduce noise and clean incoming air. Air filters should be cleaned monthly and when possible, two filters should be alternated in use so that one can be operating while the other is being soaked and cleaned. The filter can be cleaned by blowing it dry with an air gun.

4.3.3.2.39 Time clock

A time clock is installed in the proposed plant to control its operation. The 24-Hour dial has quarter-hour divisions and AM/PM indications. The time switch is programmed by pushing the captive trippers to the outer ring position for the entire period that the load is to be turned "ON", i.e., fifteen minutes for each tripper on the 24- Hour dial. When the tripper is pushed to the inside, the switch is in the "OFF" position. The main control panel timer is factory set to "OFF" for 15 minutes each day during the low flow period. The main and standby blowers alternate operation after every "OFF" cycle.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

A 7-day time clock is provided. They have a patented skip-a-day feature that permits omission of any day or days of the week. This second clock permits two separate daily cycles, either of which may be used any day of the week.

Check the time clock trippers once a year to be sure they are either fully engaged or disengaged. If they are not fully engaged, they may turn the blower "on" during what should be an "off" period or vice versa. Also check the terminals of the clock once a year to make sure they have not loosened. Blower is "on" when clock trippers are pulled out and "off" when they are in

4.3.3.2.40 Pulleys and V Belts

Pulleys and V-belts are used to transfer power from the motor to the blower. The V-belts need to be kept just tight enough to prevent slipping. Never over-tighten a belt because this will considerably reduce its life. To insure maximum life from each belt, the pulleys must be kept in perfect alignment. They can be aligned by placing the flat side of a level against the front face of both pulleys, loosening the motor mounting bolts and rotating the back of the motor until both pulleys are flat against the level. If possible, it is an excellent idea to always keep an extra belt on hand as a spare.

4.3.3.2.41 Alternative to STP function failure

In case of emergency, whereby the STP fails to function, the STP will be bypassed and the sewage will go directly to the outfall. In such instances, the proponent shall make sure to repair the STP as soon as possible.

4.3.3.3 Outfall

The prime structure in a sea outfall system is the outfall itself. The stretch of pipe through which effluent leaves the outfall is known as the diffuser. The function of a diffuser is to mix the low-density waste with high density sea water at the bottom (about 5 to 100 m). At this point the plume will spread horizontally & disperse with little or no visual effects. When the wastewater enters the marine environment from the diffuser it is buoyant & tends to rise. This effluent initially

travelling horizontally after leaving the holes or ports, in the diffuser, gradually ascends on a more vertical path. Throughout its path, whether largely horizontal or vertical, the effluent mixes with the ambient sea water. What was initially a highly concentrated wastewater becomes progressively more and more diluted with increasing distance of movement through the sea water.

4.3.3.3.1 Design factors

The following are the design factors regarding the outfall

- The overall design of an outfall system concerns location (& depth) of diffuser
- Determination of pipe & port sizes so that the effluent is efficiently passed at desired flow rates
- Hydraulic computations to compute the energy required at the shore line to transport desired flows to & out of the diffuser
- Type of pipe materials & joints that can be used & which combinations are suitable for specific types of situations
- Installation and Anchoring: Installation & anchoring of outfall & diffusers is especially important if strong currents prevail & additional problems such as erosion scour or transport to bed load. Outfall pipes are rock ballast or anchored to the sea bed
- Diffusers: Diffusers must disperse the effluent efficiently & evenly to achieve good mixing. Knowledge of density & temperature gradient as well as current & wind conditions that influence the dispersion in receiving waters is necessary
- Information of a geological nature is of vital importance to the design of the outfall. Sea bed materials must be able to support the pipe. Sub-bottom condition must also be known for the near-shore zone. The outfall will probably be buried to protect it from wave induced water motion. Whether there is bedrock close to the bottom or not is an important consideration.
- The stability of the bottom may be required the stability of the bottom material & of the beach area is of great concern. Since the natural cut of beach & near shore sediments under storm.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Currents in the area are strong which will bring about significant advection and dispersion of the initial plume.

4.3.3.3.2 Technical Aspects

Outfall Configuration: The various outfall configurations available are single round port discharge with closed manifold, multiple diffuser arrangement. Since flow is less, single round port discharge with closed manifold configuration is considered as it is easiest terminus to build and maintain.

Sizing/Capacity: High density polyethylene (HDPE) pipe (black color) is proposed for submerged buried outfall. HDPE (PE100, PN16) is relatively light with a density slightly less than that of seawater. Its big advantage is that it is flexible and can be easily deployed.

Outfall Depth: The deeper the outfall better is the mixing. Outfall need to be at least 5.0 m deep below the low tide level for treated effluent.

Sewage Plume: Hydraulic performance of outfall is usually quantified in terms of the dilution. A minimum initial dilution of 100:1 is common for the ocean outfall superior to conventional waste treatment plants.

There are several mechanisms which govern the dilution characteristics of an ocean outfall. These are usually considered separately in three phases.

- Initial dilution which occurs in the 1st few minutes as the waste stream leaves the outfall diffuser & rises in the water column
- Horizontal transport
- Dispersion of the sewage field Kinetic reactions which take place in the sea

Initial dilution occurs due to 3 effects; jet mixing due to the momentum of the sewage stream as it leaves the diffuser part, the buoyancies effect resulting from density differences between the sewage & the ambient ocean water (temp. & salinity differences) which causes the sewage field to rise upward in the water column as an expanding plume, thus mixing with the sea water & finally the current effect causing the lateral entrainment of flash sea water into the sewage

plume. The sewage plume may rise to the water surface or may be trapped below the surface depending on the degree of stratification of the water column. The horizontal transport and dispersion are governed by the local current regime & eddy diffusion (Lateral mixing due to eddy currents).

The pipeline will be ballasted with concrete ballast blocks, running on the surface of the lagoon bed; the pipe passing through the coral reef shall be placed on the reef exposed, but ballasted suitably with pre-cast concrete blocks 1 m intervals at the shoreline to prevent displacement. The weight of the ballast can be determined depending on the wave impact after an engineering design. The rest of the pipe line shall be laid till it reaches an average depth of 10 m below MSL and ballasted with 1800 kg concrete ballasts at 3m intervals. Following the emergence of the pipeline at the required depth, it will be secured with an anchor block of 2,500 kg in weight. A “T” head diffuser will be fixed to the discharge end of the OOF pipeline to increase dilution performance and dispersion of effluent. The diameter of the proposed pumping main is 160mm OD black PE100 HDPE pipes, complying with the URA Guideline

4.3.3.3 Effluent Discharge standard

The effluent discharge to the deep sea shall comply to the standards set by the EPA. The maximum allowable concentrations in domestic and industrial waste water for discharge into the deep sea is summarised in the table below.

(b) No blockage of any outlet nozzles.

This can be carried out by divers although this is accompanied by substantial health and safety concerns (e.g., diving in contaminated waters, wave action, and decompression requirements for deep diving). If possible, it is preferred to carry out inspections using remotely operated vehicles. The frequency of maintenance inspections will depend on a range of factors such as environmental conditions and construction materials. Often, annual inspections are adopted. These would be detailed in the operation and maintenance manual that will be produced by the contractor at the end of civil phase of the project.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

around the whole island. For this, a proposed burrow site of 13,900 sqm and an alternative burrow site of 19,400 sqm is noted under the approved concept design. Partial prints of the proposed and approved burrow sites are provided below. An estimate of 60,043.98 m³ of sand will be required to reclaim the said area to a design elevation of +1.5 m.

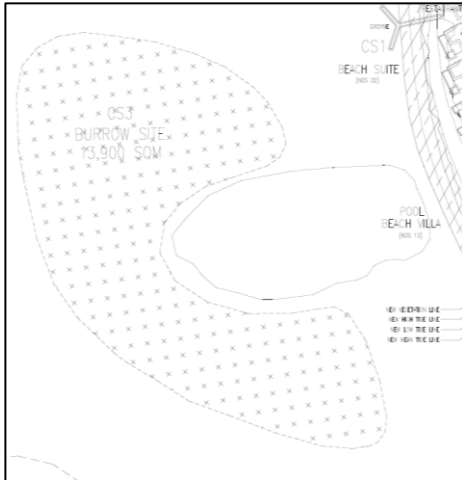


Figure 9: Proposed burrow site.

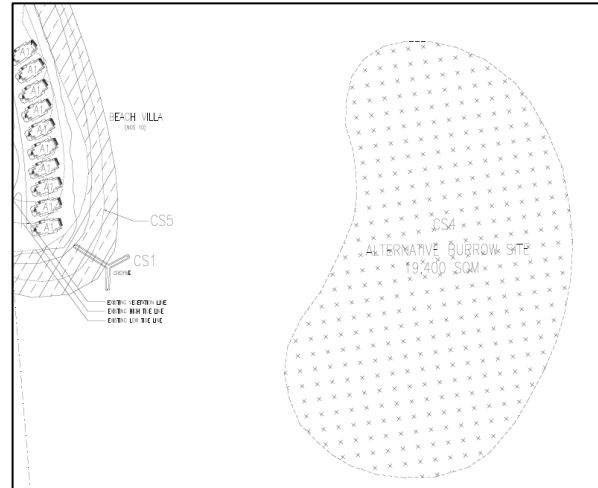


Figure 10: Alternative burrow site

4.3.4.3 Equipment and method used for dredging

Methodology	Dredging will commence once the barge is anchored using the spud poles. Dredging will be carried on the barge. The dredged material would be used to reclaim the designated areas. In this project, to ensure safe dredging and sedimentation control, mitigation measures specified will be implemented.
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<p>Supporting method file</p>	 <p>Figure 11: Example: Excavator on a barge, Photo taken Wednesday 2nd October 2019, Ha.Kelaa, Maldives, Harbour works, MTCC.</p>
<p>Equipment</p>	<p>The proposed methodology will utilize one backhoe excavator.</p>

4.3.4.4 Shore Protection

For shore protection and stabilisation, 6 T-shaped groynes will be established around the island, three on either side of the island. The groynes will be of rock boulders in order to easily shift them if need be. Partial prints of the groyne locations are shown in the figures below.

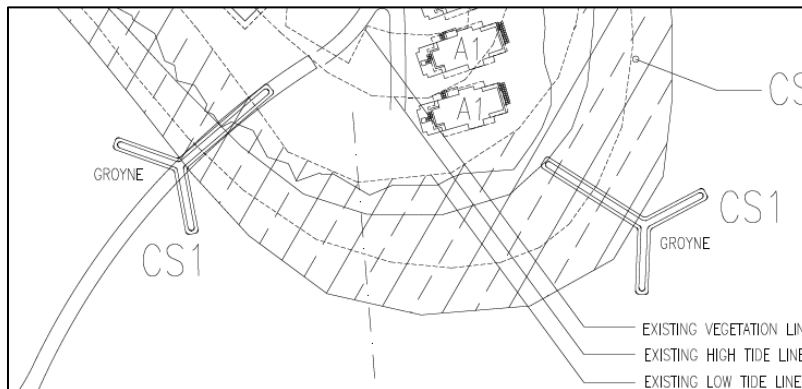


Figure 12: Location of groynes

4.3.5.2 Doors and Windows

Aluminum doors, windows and glass walls as well as aluminum frames will be anodized in accordance with BS 1615 or BS 3987. Sections of aluminum profiles will not be less than 50 mm deep and 2 mm thick. Door and window elements will be fixed to the structure by means of separate rectangular hollow galvanized steel or aluminum frame.

For air conditioning rooms, the aluminum windows will have double glazing. Glass wall on the wall, between the control room and the Genset room will have triple glazed.

All doors will have design to mitigate noise and heat by using necessary insulation material or techniques.

4.3.5.3 Roof and Wall Cladding system

All the walls and roofs will have insulated sandwich cladding. The roof and wall cladding will be multi-layered protected metal system consisting of a galvanized steel substrate, heavy epoxy base coat and high build exterior weather coat of polyurethane.

It is expected that the design will mitigate the noise propagation outside the building. All walls and roof will provide delta 35 dB noise reduction.

The cladding will be sealed with a non-drying, non-corrosive permanently elastic preformed metal sealing tape capable of performing at a temperature up to 100° C.

The external weathering sheet will be secured to the galvanized sub-girths or structural support with stainless steel hexagon headed self-tapping screws, each with an integral Ethylene Propylene Die Memonoma (EPDM) washer bonded to a dished aluminium washer.

Flashings required in connection with the external weather skin will be formed from > 0.5 mm thick material similar to claddings material.

Profiled filler pieces will be provided at all terminal positions on the roof and sidewall areas. The fillers will be of polyethylene form and be immune to birds and insect attack.

4.3.5.7 Measures to increase power efficiency

Efficient diesel generator governor system and running time, and scheduled maintenances (de-carbonizing, top overhaul, full overhaul, and filter changes) at manufacturer recommended running intervals.

4.3.5.8 Safety components

4.3.5.8.1 Safety boards;

Posters outlining the rights and responsibilities of workers, supervisors, and employers as well as providing an emergency phone number to report critical injuries will be displayed at a conspicuous place. Additionally, printed color posters of work attires in English and *Dhivehi* script shall be displayed

4.3.5.8.2 Fire safety system;

Fire safety measures shall be designed and implemented in accordance with the requirement for fire prevention equipment in buildings enforced by the Ministry of Defense and National Security of the Maldives.

4.3.5.8.3 Lightning protection system.

It will be ensured that the measures meet the minimum requirements for lightening safety.

4.3.5.9 Fuel Management

- Reinforce concrete retaining wall is proposed to be constructed which will contain the volume of fuel during emergency spills
- Day tanks will be equipped with flow-meters and level detection. Tank will be installed with 150 mm concrete base;

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Fuel pipe line: GI Pipelines conforming to international standards. Pipes will be laid 300 mm above ground level. Leak detection and echo-sounding in main tanks and lines will be equipped with flow-meter; and
- Fuel to be transferred from transport vessel by barrels on a pickup truck to fuel tank at power house.
- Waste lubricant oil shall be stored in the store room in a closed labelled container over concrete floor. Waste lubricant oil will be transported to nearest regional waste management center.
- An air-cooling system will be utilized by all the generators for cooling of the systems.

4.3.5.10 Safety measures during construction and operation

All necessary precautions will be taken to protect personal and property from hazards due to falls, injuries, toxic fumes, or other harm. During construction works the necessary safety signboards will be put up in working areas. Further, safety gear would be used by laborers, for instance, safety boots and hard hats. All painting and corrosion protection work, including inside the building will be performed under strict safety conditions.

All necessary precautions will be taken to protect personal and property from hazards due to falls, injuries, toxic fumes, or other harm. All painting and corrosion protection work, including inside the building will be performed under strict safety conditions.

4.3.6 Waste management Centre

Only organic waste will be managed at the island and all the inorganic waste will be shipped to nearest regional waste management center. As such waste segregation will happen on island. The organic waste that is supplied to the waste management facility will be fed to the biodigester. Recycling is also planned to be conducted in the facility. The inorganic waste will be further segregated into plastic, metal glass and other prior to shipping to the nearest regional waste management center. Bottle crushers and wood chippers will be utilized to minimize the volume of the waste. For the transfer of waste from the resort to regional waste management facility, if the

WAMCO outer island waste collection mechanism is operational by then, this method is preferred, otherwise from the harbor the waste will be transferred on proponent's own vessel. Other resources such as wheeled waste bins, vehicles for waste transfer within the island and other smaller equipment such as petrol chain saw etc. would be available at site during the operational period.

As for operating in unfavorable conditions, for the organic waste, if the primary biodigester fails, the waste will be transferred to standby one. If any equipment fails and needs repair, and the waste management facility cannot cater for the organic waste during this time, those waste will be safely shipped to the nearest regional waste management facility.

4.3.7 Vegetation Clearance

Table 5 shows the approximate number of vegetation that needs to be removed for this project.

Table 5: Approximate vegetation that needs to be removed

Species	Number	Building No.	Building
<i>Pemphis acidula</i>	39	A1	Beach Villas
<i>Scaevolo taccada Roxb.</i>	110	A1	Beach Villas
<i>Pandanus tectorus</i>	3	A1	Beach Villas
<i>Scaevolo taccada Roxb.</i>	41	C10	Housekeeping stores-Land
<i>Scaevolo taccada Roxb.</i>	37	B3	All day dining restaurant
<i>Pemphis acidula</i>	11	B3	All day dining restaurant
<i>Cyperus polystachyos</i>	42	B3	All day dining restaurant
<i>Scaevolo taccada Roxb.</i>	16	C9	Mosque
<i>Scaevolo taccada Roxb.</i>	14	C1	GM & RM Bungalow
<i>Guettarda Speciosa L.</i>	3	C1	GM & RM Bungalow
<i>Pandanus tectorus</i>	9	C1	GM & RM Bungalow
<i>Scaevolo taccada Roxb.</i>	15	C11	Radio hut
<i>Pandanus tectorus</i>	23	C5	Junior staff rooms
<i>Scaevolo taccada Roxb.</i>	18	C5	Junior staff rooms
<i>Hibiscus tiliaceus</i>	7	C5	Junior staff rooms
<i>Guettarda Speciosa L.</i>	9	C12	Clinic
<i>Pandanus tectorus</i>	7	C12	Clinic
<i>Scaevolo taccada Roxb.</i>	20	C6	Staff dining, kitchen & staff recreation
<i>Hibiscus tiliaceus</i>	13	C6	Staff dining, kitchen & staff recreation
<i>Hibiscus tiliaceus</i>	20	C4	Resort admin office & junior staff rooms
<i>Pandanus tectorus</i>	11	C4	Resort admin office & junior staff rooms

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

<i>Hibiscus tiliaceus</i>	20	B11	Dive centre
<i>Scaevolo taccada Roxb.</i>	30	C2	Executive staff rooms
<i>Calophyllum inophyllum</i>	2	C2	Executive staff rooms
<i>Pandanus tectorus</i>	26	C2	Executive staff rooms
<i>Scaevolo taccada Roxb.</i>	18	B1	Reception lobby, boutique & front office
<i>Guettarda Speciosa L.</i>	5	B1	Reception lobby, boutique & front office
<i>Pandanus tectorus</i>	11	B1	Reception lobby, boutique & front office
<i>Scaevolo taccada Roxb.</i>	90	C3	Laundry stores & senior staff rooms
<i>Scaevolo taccada Roxb.</i>	20	C7	Service centre (Generator & Desalinator)
<i>Pandanus tectorus</i>	7	C7	Service centre (Generator & Desalinator)
<i>Pandanus tectorus</i>	10	D1	Desalinated water storage tanks
<i>Hibiscus tiliaceus</i>	11	D1	Desalinated water storage tanks
<i>Scaevolo taccada Roxb.</i>	12	C8	Recycle house
<i>Hibiscus tiliaceus</i>	5	C8	Recycle house
<i>Pandanus tectorus</i>	3	C8	Recycle house
<i>Hibiscus tiliaceus</i>	11	D3	Sewage treatment plant
<i>Scaevolo taccada Roxb.</i>	12	B15	Badminton
<i>Pandanus tectorus</i>	7	B15	Badminton
<i>Hibiscus tiliaceus</i>	1	B15	Badminton
<i>Pemphis acidula</i>	31	A2	Pool Beach villas
<i>Scaevolo taccada Roxb.</i>	106	A2	Pool Beach villas
<i>Cocos nucifera L.</i>	2	A2	Pool Beach villas
<i>Scaevolo taccada Roxb.</i>	70	A3	Beach suites
<i>Pemphis acidula</i>	9	A3	Beach suites
<i>Pandanus tectorus</i>	17	B6	Grill restaurant
<i>Scaevolo taccada Roxb.</i>	12	B6	Grill restaurant
<i>Scaevolo taccada Roxb.</i>	30	B7	Recreation centre

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

<i>Scaevolo taccada Roxb.</i>	170	B2	Pool bar & swimming pool
<i>Tournefortia argentea/Messerschmidia argentea</i>	7	B2	Pool bar & swimming pool
<i>Pemphis acidula</i>	11	B2	Pool bar & swimming pool
<i>Scaevolo taccada Roxb.</i>	150	A2	Pool beach villas
<i>Guettarda Speciosa L.</i>	20	A2	Pool beach villas
<i>Hibiscus tiliaceus</i>	14	A2	Pool beach villas
<i>Pemphis acidula</i>	12	A2	Pool beach villas
<i>Cocos nucifera L.</i>	4	A2	Pool beach villas
<i>Pandanus tectorus</i>	8	A2	Pool beach villas
<i>Hibiscus tiliaceus</i>	11	C0	Director's bungalow
<i>Cocos nucifera L.</i>	1	C0	Director's bungalow
<i>Scaevolo taccada Roxb.</i>	70	C0	Director's bungalow
<i>Scaevolo taccada Roxb.</i>	40	D2	Fuel farm
<i>Scaevolo taccada Roxb.</i>	570		Roads
<i>Pemphis acidula</i>	60		Roads
<i>Guettarda Speciosa L.</i>	80		Roads
<i>Hibiscus tiliaceus</i>	32		Roads
<i>Pandanus tectorus</i>	48		Roads
<i>Cocos nucifera L.</i>	1		Roads
<i>Scaevolo taccada Roxb.</i>	13		Temporary material storage
<i>Hibiscus tiliaceus</i>	3		Temporary accommodation
<i>Pandanus tectorus</i>	6		Temporary accommodation
<i>Scaevolo taccada Roxb.</i>	20		Temporary accommodation

4.3.8 Tasks already completed

The approval for the concept design has been obtained from the Ministry of Tourism. Furthermore, a small labour quarter has been established for the island supervisory personals at the temporary site. Construction works of the temporary material storage has also started. The

metal framework of the temporary material storage with metal poles fastened with brackets has been completed.

4.4 Project inputs and outputs

The following two tables details the estimated project inputs and outputs for the works to be undertaken in the proposed project.

Table 6: Major project inputs

Input resource(s)	Source/ type	Qty/Volume	Source of resource
Construction phase			
Man Power	Local and expatriate	Large numbers	Proponent
Water	Mobile RO plant	120 litres per person per day for workforce Other construction works	Local purchase or import
Power	Mobile generator set	Large quantities	Local purchase or import
Machinery and equipment	General construction machinery and equipment (Excavator, Truck, Concrete mixer, General construction tools, Small lorry, forklift, Barge, Dewatering pump, total station, level gage, EF welding machine, Drilling Rig, Crane etc.)	Medium quantities	Local rent/ purchase or import
Construction Material	Concrete works: reinforcement steel bars, river sand, cement, aggregates	Large quantities	Local purchase or import
	Temporary site setup: Galvanized pipes, roofing sheets, cement, sand, timber, spun piles	Small quantities	Local purchase or import
	Electrical: electrical cables and wires, DBs, MMCBs and MCBs, PVC pipes, light weight, telephone cable CAT 5, PVC conduits, 4 core armored cables, PP-R pipe, Multi pump, UPVC (T1000, T600) for sewerage grid	Large quantities	Local purchase or import
	Water and Sewer: HDPE pipes, pumps,	Large	Local purchase or

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

	control panels, inspection chambers, aerobic tanks	quantities	import
	Finishing: floor and wall tiles, gypsum boards, calcium silicate boards, zinc coated corrugated metal roof, paint, varnish, lacquer, thinner, dry walls, carpet etc.	Large quantities	Local purchase or import
Nose and mouth covering (COVID19)	Face masks	Large quantities	Local purchase or import
Operation phase			
Electricity	Electricity grid	Large quantities	Proponent
Operators	Staff	Small numbers	Proponent
Maintenance material	Required for maintenance; lube oil, fittings, pipes, etc.	Small quantities	Proponent
Fuel	For electricity generation	Large quantities	Proponent
Water	From RO plant – for all water needs	Large quantities	Proponent

Table 7: Major project outputs

Project outputs	Method of generation/Qty	Method of control
Construction phase		
Construction wastes	Waste oils Wastewater Greenhouse gases, effluents General waste from workers – 44.2 kg per day	Green waste gathered at a local site and construction and waste oil transferred to Thilafushi for disposal.
Noise	Localized to the project site	Unavoidable, but could be minimized by limiting working hours to daytime only and completing the project within the earliest possible duration.
Operation phase		
Infrastructure: Beach Villa Pool Beach Villas Beach Suites Water villas Pool water villas Water suites Reception lobby, boutique and front office	10 20 2 20 21 4 1	The EIA proposed mitigation measures implemented during the project progress to reduce environmental impacts.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Pool Bar and Swimming Pool	1	
All Day Dining Restaurant	1	
Specialty Restaurant	1	
Lagoon Bar	1	
Grill Restaurant	1	
Recreation Centre	1	
Spa Main	1	
Spa Treatment Rooms	6	
Gymnasium	1	
Dive Centre	1	
Water Sports Center	1	
Arrival Pavilion	1	
Jettyhead Pavilion	1	
Badminton	1	
Director's Bungalow	1	
GM and RM Bungalow	1	
Executive Staff Rooms	2	
Laundry Stores and Senior Staff rooms	1	
Resort Admin office and Junior staff room	1	
Junior staff room	1	
Staff Dining, Kitchen and staff recreation	1	
Service centre (Power and Water facilities)	1	
Recycle house	1	
Mosque	1	
Housekeeping stores (land)	4	
Housekeeping stores (water)	1	
Radio hut	1	
Clinic	1	
water storage tanks	2	
Fuel Storage (1 diesel tank and 1 petrol tank)	1	
Sewage treatment plant	1	
Reclaimed area	10,188.74 sqm	
Coastal protection - Groynes	6	
Electricity	From generators	NA
Waste oil	From mechanical equipment's, machinery and vehicles	Stored in barrels and transported to Thilafushi.
Waste in operational phase	operations	Managed in the waste management facility, any waste that is not able to cater in the on-island facility will be transferred to Thilafushi. All waste management activities shall adhere to the related regulations.
Waste water	From workers	Treated by STP and flushed through the outfall

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Clean up the spill
- Report the incident

4.5.4 Measures to protect human health during construction and operation

The proposed project site is on an uninhabited 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.
- 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

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- 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.

Mosquitoes, high temperature and drowning prevention measures are taken on site. Drugs are sprayed and mosquito nets are used in the accommodation area; Appropriate drugs are prepared in case of heatstroke. To prevent drowning, a strict management system is to be formulated and performed under supervision. Additionally, fencing the project site, set up entrance and exit, and arrange safety and civilization management personnel for on-site management.

Basic first aid facilities and safety gears shall be made readily available by the contractor during the construction phase of the project as per the regulation on safety standards for construction work. In case of an emergency, the workers shall be taken to nearest island health center and in case of major incidents they shall be taken to a hospital in the greater Male' region (IGMH / Tree top / ADK / Dharumavantha/ Hulhumale' hospital).

Special consideration will be given to take all possible preventive measures of the current pandemic of Covid-19 during the construction and operation phase of the project. As such, the recommendations of the Health Protection Agency will strictly be enforced whilst sensitisation sessions will be undertaken to internal controls of health and safety to all the work force

During the operational phase basic first aid facilities and safety gears shall be made readily available to the working staff at the facilities. Occupation health and safety guidelines shall be strictly followed by all personnel.

4.5.5 Potential accident and hazard scenarios and how to manage them

Potential hazard scenarios during this project include oil/chemical spills and injury to workers. Some of the potential hazard which are relevant to specific operations of the project has been described above (actions in case of RO plant failure, action in case of STP failure, fire safety of powerhouse, waste management equipment failure). These potential hazard scenarios and how to manage them are detailed in the emergency preparedness and response plan and the health and safety plan.

4.5.5.1 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.

4.5.5.1.1 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.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- 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 in order 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.

4.5.5.1.2 Emergency plan for spill response at the proposed project location

Spills on construction sites can have drastic consequences to people and the environment. Specifically on natural, moderate current, diverse, and remote zone such as the proposed island.

After a through analysis of the action in 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.

4.5.5.1.2.1 General Precautions

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

- 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.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- 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.

4.5.5.1.2.2 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;

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 mobilization 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;

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Vessels shall follow the pre-defined routes and marine traffic arrangements to minimize 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

4.5.5.1.2.3 Chemicals, Oils and Fuels

For chemicals, oils and fuels (if used for the excavators, etc.) 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 located 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.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- 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.

4.5.5.1.2.4 Spill response

Effective spill response comes down to the reediness of the contractor to a potential event. This in effect enables the contractor to respond to any related un identified event as well. Spill response simplified can be shown in as below.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll



Figure 16: spill response procedure

In this specific project, three major types of spill involved are listed.

Construction Phase		
Spill Types	Land Based Activities	Marine based Activities
Fuel/ Oli	✓	✓
Chemicals	✓	✓
Fill materials	✓	✓

Locating and Reporting

In case of machinery operators, a part of their training includes maintenance and, emergency action, and reporting in case of break, failure, and spill. In addition, all staff must be trained to identify, quantify, contain temporarily, and report a spill. Emergency containment actions must be taken accordingly. Emergency kits available must be used as fit.

Locating and Reporting

In case of machinery operators, a part of their training includes maintenance and ,emergency action, and reporting in case of break, failure, and spill. In addition , all staff must be trained to identify, quantify, contain temporarily, and report a spill. Emergency containment actions must be taken accordingly. Emergency kits available must be used as fit.

Emergency kit must contain	Personal protective gear
	Universal Chemical pads
	Acid neutralizers
	Disposable bags
	Broom and Dustpan
	Floating curtains
	Bund Curtains

Reporting must have the following parameters;

Staff form, report spill	Date, Time, Staff.....Comments	Type of spill
	.....	Source of spill
	.....	location
	Containment action taken	Estimated time of break
	.....	Time of notification to the response head
	.....	Staff name, report spill
	
Operator form report spill	Date, Time, Staff.....Comments	Vehicle number
	.....	location
	.....	Malfunction
	Containment action taken	Type of spill
	.....	Source of spill
	.....	Estimated time of break
	.....	Time of notification to the response head

After reporting, the response head must follow directions from the government to the fullest extent.

4.5.6 Decommissioning

Once the project has been completed, construction team leaves the site after performing the required site clearance. Any waste will be transported to Thilafushi waste management center for disposal. All heavy machinery brought to the site will be demobilized.

4.5.7 Project duration and schedule of implementation

The construction will commence once the EIA process and detail drawings has been completed. Estimated date is March 2024. Construction works is expected to be completed by May 2025. Refer to Appendix E for a detailed work plan of the proposed project. The entire project is estimated to be completed within 14 months from project commencement date.

5. EXISTING ENVIRONMENT

This chapter describes the existing environmental conditions of the proposed project site. Sections 5.1 describes the general environmental condition of the Maldives and 5.2 outlines the general climatic conditions by analyzing data from the meteorological center of the Maldives. Sections 5.3 to 5.4 details the specific environmental conditions at the proposed project site.

5.1 The Maldivian Setting

Maldives, officially known as the Republic of Maldives and sometimes referred to as the Maldivian Islands, is an island nation (Zahid, 2011) consisting of nearly 1192 islands on a double chain of 26 natural atolls (administratively divided into 20 atolls), 80-120 km wide, in the Laccadive Sea in the Indian Ocean (State of the Environment 2004, 2004). Elevating less than 3 meters above mean sea level, with 80% of land area less than 1 m, Maldives is the flattest country in the world. The total area is about 107,500 km² of which roughly 300 km² of landmass (Zahid, 2011), with a population of about 338, 434 (as per September 2014 census) (Maldives' Population Dynamics: Policy Prospects for Human Growth and Opportunity, 2016) spread over 194 inhabited islands (Statistical Yearbook of Maldives 2010, 2010). Stretching 860 km from latitude 7°6'35"N, crosses the Equator to 0°42'24"S, and lies between 72°32'19"E and 73°46'13"E longitude (Zahid, 2011). These coral Atolls are located on the 1600 km long Laccadives-Chagos submarine ridge extending into the central Indian Ocean from the SW coast of the Indian sub-continent (State of the Environment 2004, 2004).

The Atolls vary greatly in shape and size as well as the characteristics of the Atolls, reefs and reef islands vary considerably from north to south. The northern atolls are broad banks, discontinuously fringed by reefs with small reef islands and with numerous patch reefs and faros in the Lagoon whereas in the southern atolls, faros and patch reef are rarer in the Lagoon, continuity of the atoll rim is greater and a larger proportion of the perimeter of the Atolls is occupied by islands. The islands also differ depending on location, form and topography. The islands vary in size from 0.5 km² to around 5.0 km² and in shape from small sandbanks with sparse

5.1.1 Geology and Geomorphology

Earth’s crust, called the lithosphere, consists of 15 to 20 moving tectonic plates. The plates can be considered as cracked shell that rest on the hot and molten rock of Earth’s mantle and fit closely against one another. The heat from radioactive processes within the planet’s interior causes the plates to move toward and away from each other which is known as tectonic shifts (NOAA, 2021).

Maldives is located on the Indo-Australian plate which is among the 7 major plate tectonic boundaries found on Earth. The Indo-Australia plate which is a combination Australian and Indian Plates covering a total area of about 58,900,000km². However, they are generally considered to be two separate plates (Earthhow, 2021).

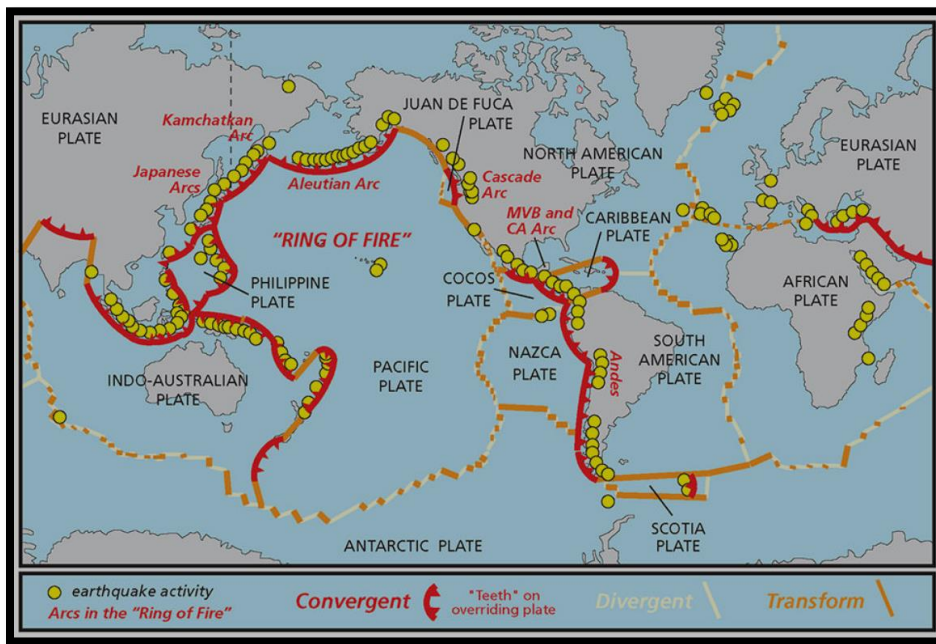


Figure 17 : Shows all the major tectonic plates and their general movements

Maldives is an archipelago of islands. Maldives is made up of 26 natural chain of atolls covering over 90000 square kilometer in the sea. The islands stretch for 822 km from north to

Most of the islands have high peripheral storm berms formed due to overwash with maximum elevations of 2.2m above mean sea level (MSL). The present-day beach is deposited against the vegetation line of the island. The seaward boundary is defined by a distinct break in slope associated with the transition from unconsolidated beach sediment to the fixed reef flat substrate in which beach and shoreline move freely. Beach width varies considerably for each individual island (Kench, P S; Brander, R W, 2006).

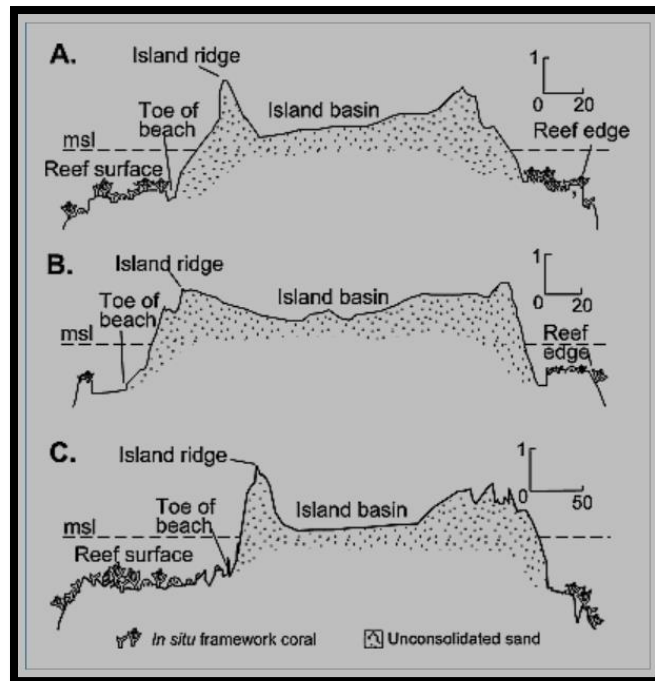


Figure 19: Shows some morphological features in an island system (Kench, P S; Brander, R W, 2006).

5.1.2 Waves

Hydrodynamics features in Maldives have been very poorly studied. (Young, 1999) shows wave climate data for a ten-year period for each world regional zone. Wave height was measured by satellite (Radar Altimeter), whereas a global wave model was used to precise wave directions. It indicates that the dominant swell approaches from southerly directions (Figure 10). On a

5.1.3 Currents

In the Indian Ocean the Maldivian archipelago has relatively stronger currents (Riyaz, 2016). Current speeds in the channels between the atolls can vary between 0.51-0.77 m/s while the currents in the channels within the atolls are stronger and the E-W oriented channels having the strongest currents between 1.5-2.6 m/s (Rober Gordon Univeristy, 2011).

In the Maldives currents are predominantly caused by the complex interaction of oceanic currents, tidal currents and local wind induced currents. The major current that flows through the Maldives is caused by the monsoonal winds. During the SW monsoon the currents flow from W-E and during the NE monsoon from E-W (Rober Gordon Univeristy, 2011). Other factors which influence the currents are waves, local bathymetry and topography. The resultant currents at a specific location in the Maldives is determined by the complex interaction among the aforementioned factors.

Tidal currents are caused by the horizontal movement of water which is caused by the regular rise and fall of the sea level due to tides (Riyaz, 2016). The strength of the tidal currents are determined by the tidal ranges and follow the same periodicities as the tide meaning the tidal currents would be weaker during low tide and vice versa. In general, the tidal currents flow eastward during flood and westward during ebb.

5.1.4 Tides

The tides in the Maldives are semi-diurnal with diurnal inequalities meaning there are two high and two lows everyday with different heights (Rober Gordon Univeristy, 2011). In addition to the daily variation in tides, there are variations in tides due to the lunar cycle which are caused by the varying gravitation pull of the moon due to the position of the moon. When the moon and the sun is aligned in a straight line the gravitational pull is greatest and this causes a spring tide. When the moon and the sun are aligned at 90⁰ their combined gravitational pull is at the minimum and this causes a neap tide.

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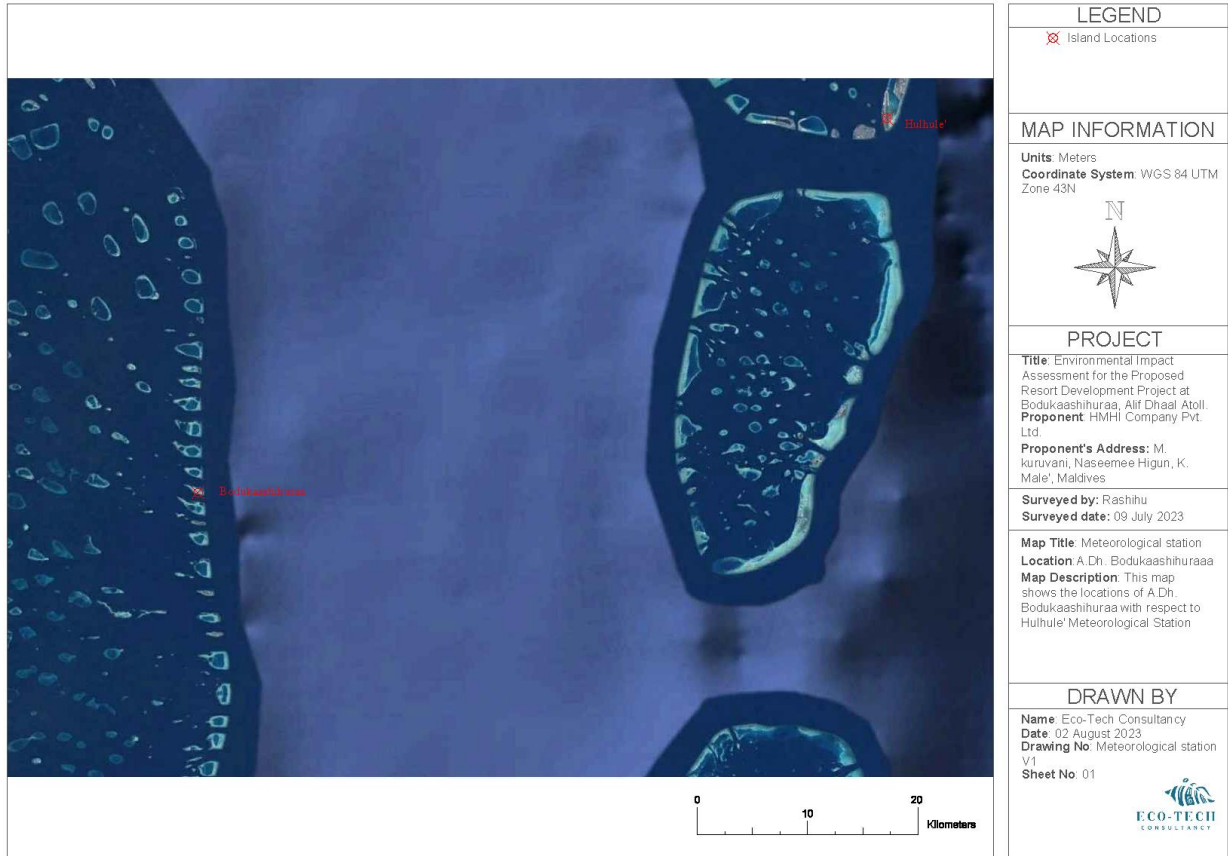


Figure 21: Location of A.Dh. Bodukaashihuraa with respect to Hulhule' meteorological center

5.2.1 Temperature

Analysis of temperature data shows that the variation in temperature throughout the year is generally very minimal, however, daily temperature ranges from 34.9°C during the day to 19°C at night. Looking at the monthly variation in temperature, the highest temperature was recorded for the month of April from the meteorological station in Hulhule' reading 31.8°C over the past 48 years. With regards to the minimum temperature, the lowest temperature at Hulhule', 25.4°C was recorded for November.

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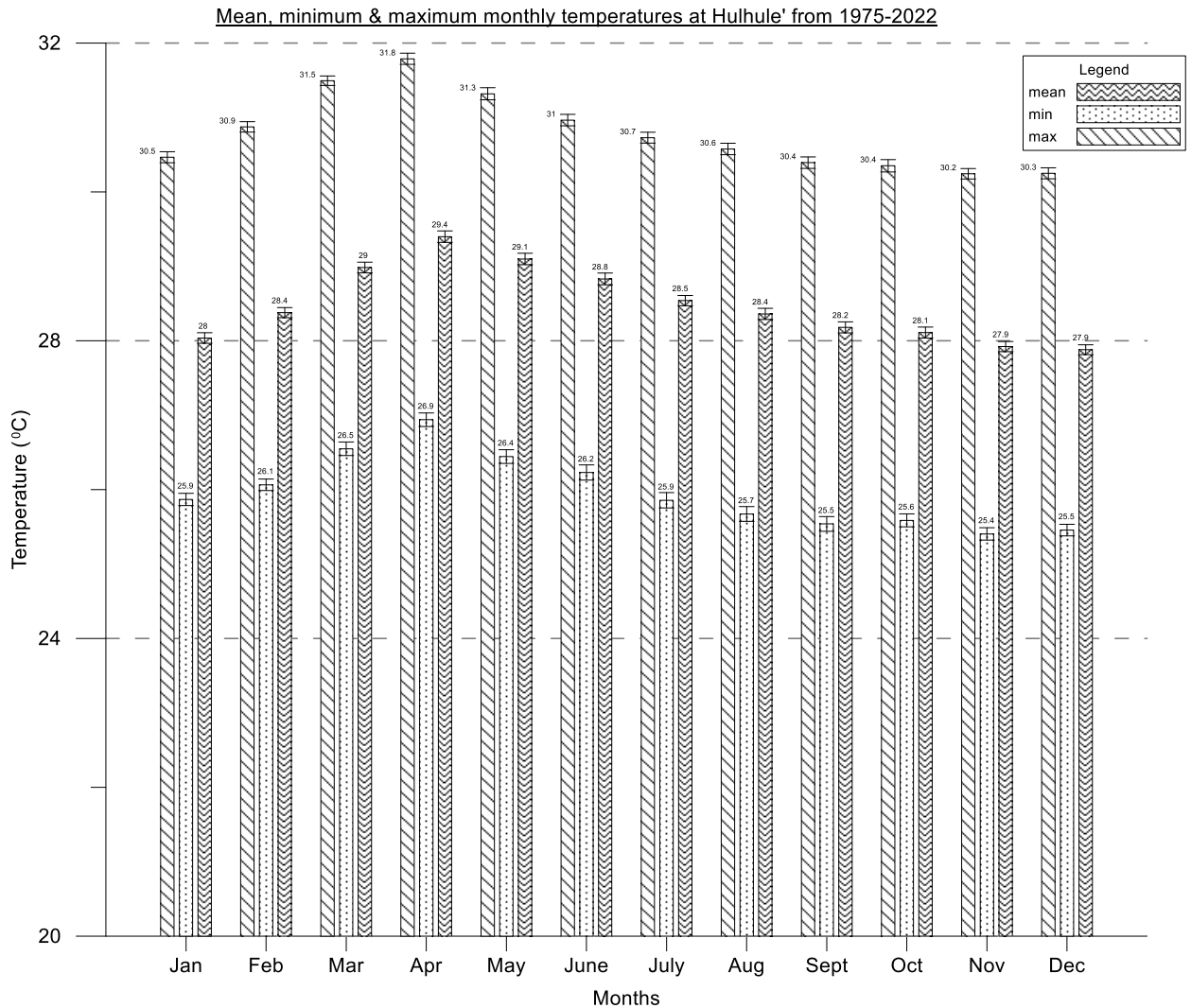


Figure 22. Mean, minimum, and maximum monthly temperatures for Hulhule' from 1975 to 2022 (Data obtained from the Maldives Meteorological Service)

5.2.2 Rainfall

Maldives experiences a monsoonal climate due to it being located on the equator. The wet season (Northeast monsoon) marked from mid-May to November and the dry season (Southwest

monsoon) from January to March used to see distinct rainfall patterns. Climate change has made the monsoons and rainfall patterns slightly unpredictable the past few years, but the trends have stayed fairly similar. Analysis of rainfall data from 1975 to 2022 at Hulhule’ meteorological station shows that the mean monthly rainfall follows the traditionally defined seasons with most rain occurring from May to December and little rain falling outside these months. The highest amount of rain was observed during the month of October with approximately 237 mm of rain on average and the lowest rain was experienced in February, averaging only about 40.3 mm of rain over the past 48 years.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

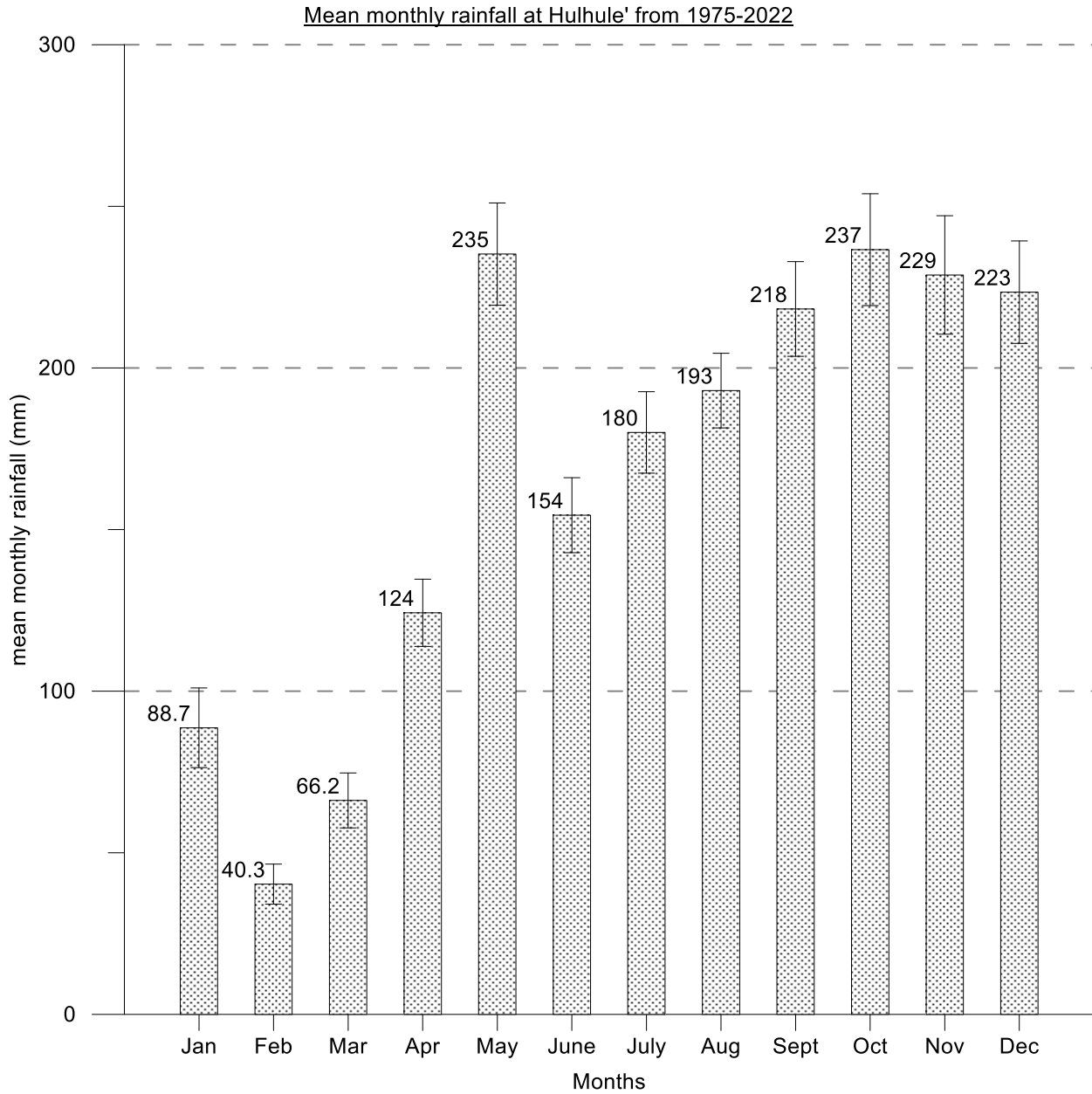


Figure 23. Mean monthly rainfall (mm) for Hulhule' from 1975 to 2022 (Data obtained from the Maldives Meteorological Service)

5.2.3 Wind

Climate in the Maldives is dominated by the Indian monsoon climate South West (SW) monsoon and North East (NE) monsoon. The Indian monsoon system is one of the major climate systems of the world, impacting large portions of both Africa and Asia.

The period of the year during which prevailing winds are from south to westerly direction is known as the SW monsoon (Kench, Parnell, & Brander, 2009). The period during which prevailing winds are from north-easterly directions is known as NE monsoon. Transitions from NE to SW monsoon and vice versa are distinctly different from SW or NE monsoon. During these transition periods the wind becomes more variable.

The SW monsoon lasts between May and September while the NE monsoon lasts between December and February. The period between March and April is the transition period from the NE monsoon to SW monsoon known locally as the Hulhangu Halha, while the transition period from SW monsoon to NE monsoon is known as Iruvai Halha. Iruvai Halha is from October to November (Table 9). SW monsoon is generally rough and wetter than the NE monsoon. Storms and gales are infrequent in this part of the globe and cyclones do not reach as far south as the Maldivian archipelago.

Table 10: The four seasons in the Maldives. Source (Danish Hydraulic Institute, 1999).

Season	Month
NE-Monsoon	December
	January
	February
Transition Period 1	March
	April
SW-Monsoon	May

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

	June
	July
	August
	September
Transition Period 2	October
	November

By analyzing the available wind data from the meteorological station, a windrose was drawn (Figure 24 and Figure 25). The wind speed classes have been categorized according to the beaufort wind scale (Trujillo & Thurman, 2016). According to this scale wind speeds of 4-6 knots are light breeze, 28-47 knots are gales and wind speeds greater than 48 knots are considered as storm. The following table shows the beaufort wind scale.

Table 11: beaufort wind scale

Beaufort number	Descriptive term	Wind Speed (knots)
0	Calm	0-1
1	Light air	1-3
2	Light breeze	4-6
3	Gentle breeze	7-10
4	Moderate breeze	11-16
5	Fresh breeze	17-21
6	Strong breeze	22-27

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

7	Near gale	28-33
8	Gale	34-40
9	Strone gale	41-47
10	Storm	48-55
11	Voilent storm	56-63
12	Hurricane	64 +

Looking at the mean wind speeds and direction for Hulhule’, it was observed that the strongest winds occur from W and WNW directions (in the SW monsoon) and NE, ENE, and E direction (in the NE monsoon). Winds from the South and SE were less prevalent and with comparatively low speeds. Majority of the times, winds occur at a speed of 7 to 16 kn which is generally known as gentle to moderate breeze. Mean wind speeds above 22 kn occurred from the Western quadrant (W and WNW) to a very low occurrence.

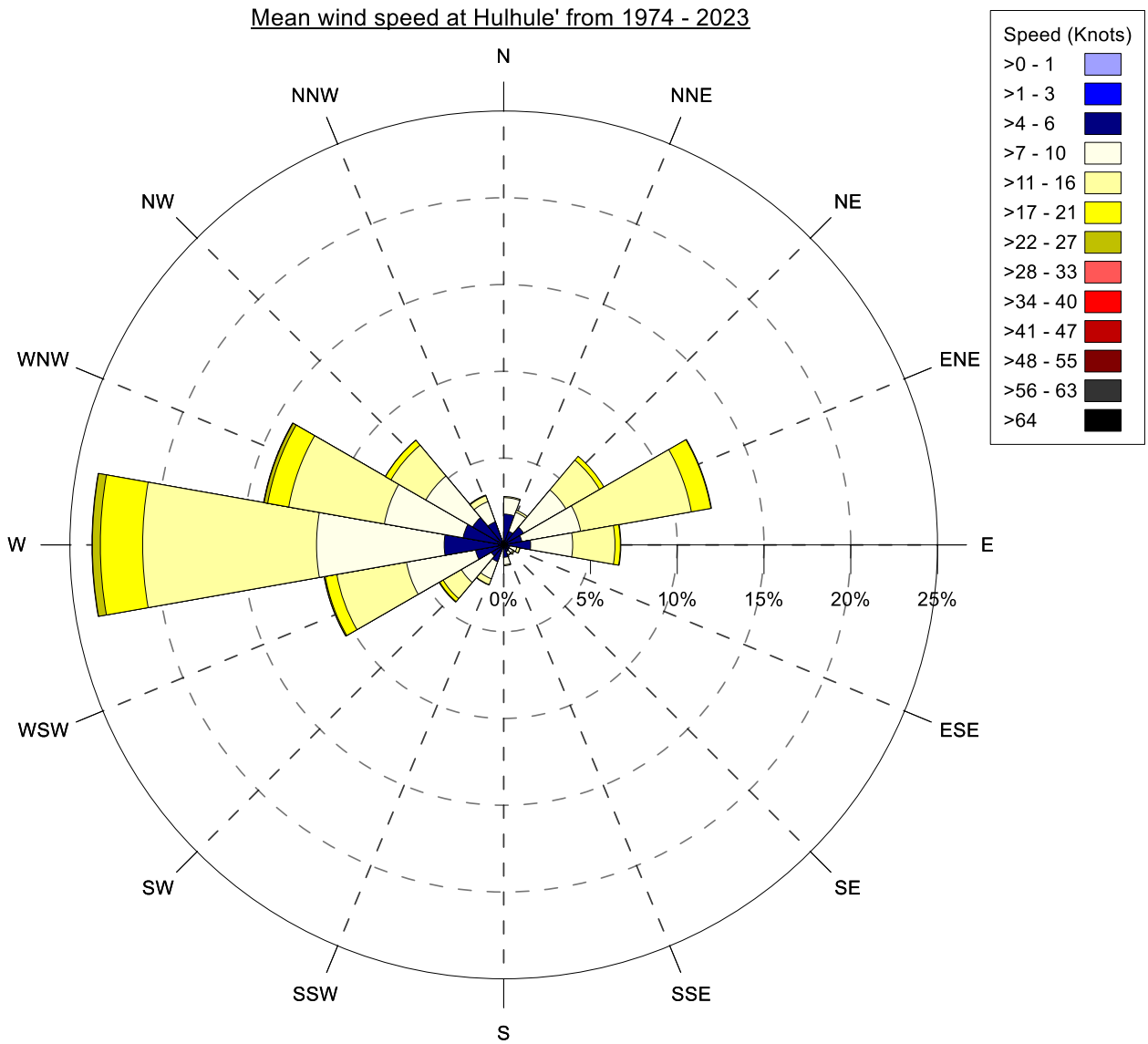


Figure 24. Mean wind speeds for Hulhule' from 1975 to 2023 (Data obtained from the Maldives Meteorological Service)

With respect to maximum wind speeds, visual inspection of the wind rose plot coincides with that of the mean wind speeds. Approximately 2% of the times, wind speeds had gone as high as > 40 kn at this region. The highest recorded maximum wind speed for the region was 62 kn on

03rd November 1978 during the data collection period. The most common maximum wind speed is between 7-27 kn.

Wind rose plots for both maximum and mean wind speeds show that winds from the West are dominant (24 % and 22% of the times respectively).

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

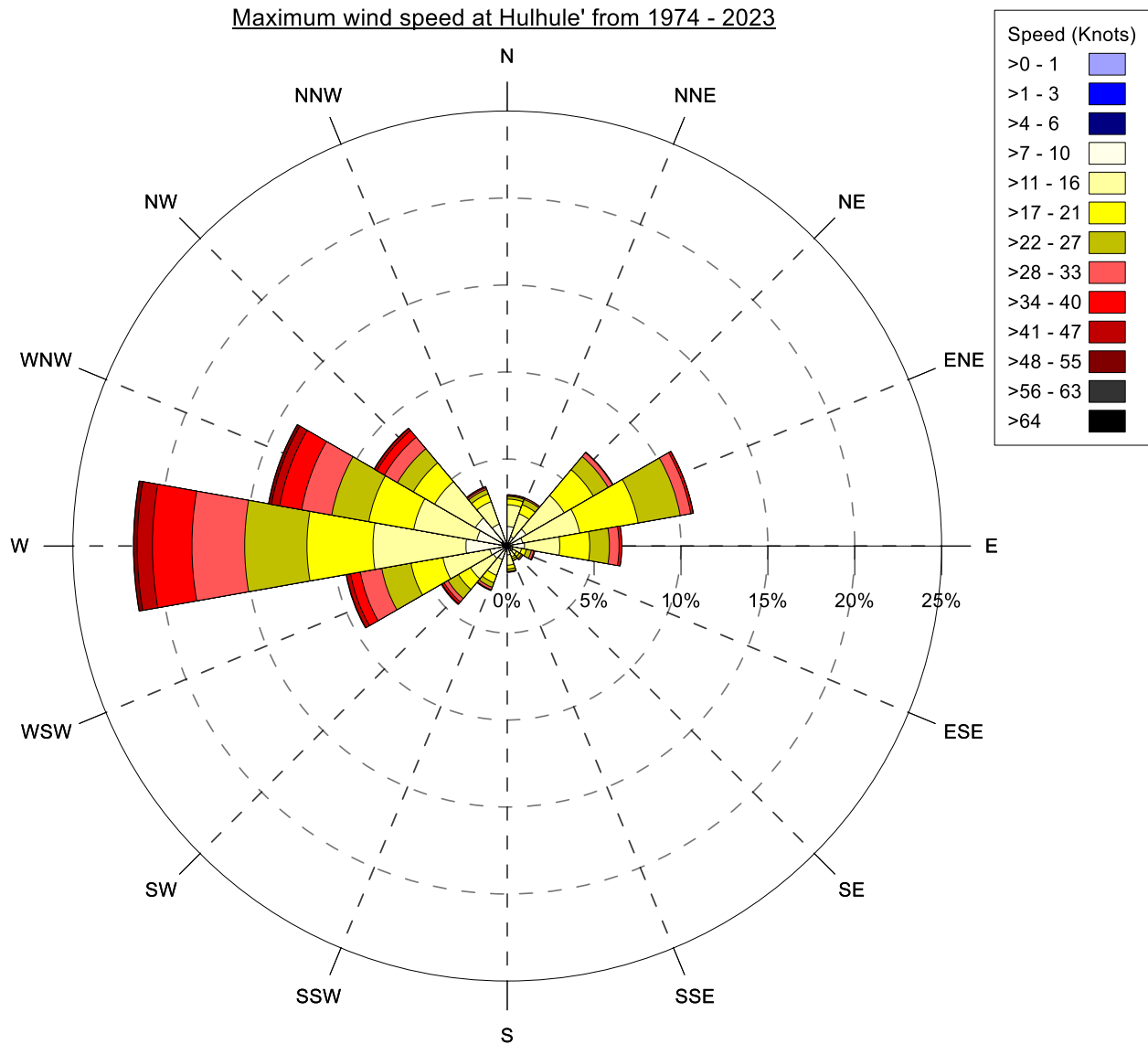


Figure 25: Maximum wind speeds for Hulhule' from 1975 to 2023 (Data obtained from the Maldives Meteorological Service)

5.3 Marine Environment of A.Dh Bodukaashihuraa

This section describes the site-specific marine environmental conditions of the proposed project site. The general setting of A.Dh. Bodukaashihuraa seasonal erosion, coastal environment, bathymetry, sea bed sediments, benthic substrates, fish census, and marine water quality near the proposed project site is presented.

5.3.1 General Island Setting

Located in the Alif Dhaal Atoll, Bodukaashihuraa is situated at a distance of 72.88 km from K. Hulhule'. It is located on eastern periphery of Alif Dhaal atoll at geographic coordinates of 72°28'72.00 m E and 4°28'702.00 m N. The reef system hosts only the project island. The land area of A.Dh. Bodukaashihuraa is about 2.07 Ha.

Although the Island is an uninhabited Island, there is considerable human interventions as the Island is being used as picnic Island. Facilities that are established for the visitors include toilet, benches, tables, chairs and barbeque grills (see Table 17 for detailed account of existing structures on the Island).

From an ecological succession perspective, the Island seems to be at an early stage, as the Island does not host significant hard wood species. The vegetation of the Island is mostly comprised of *Scaevola taccada* Roxb. (Magoo). Very few mature trees (approximately less than 10) of *Cocos nucifera* L. (Ruh) are found on the Island. Very few hard wood species and dense vegetation was only found towards the center of the Island.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

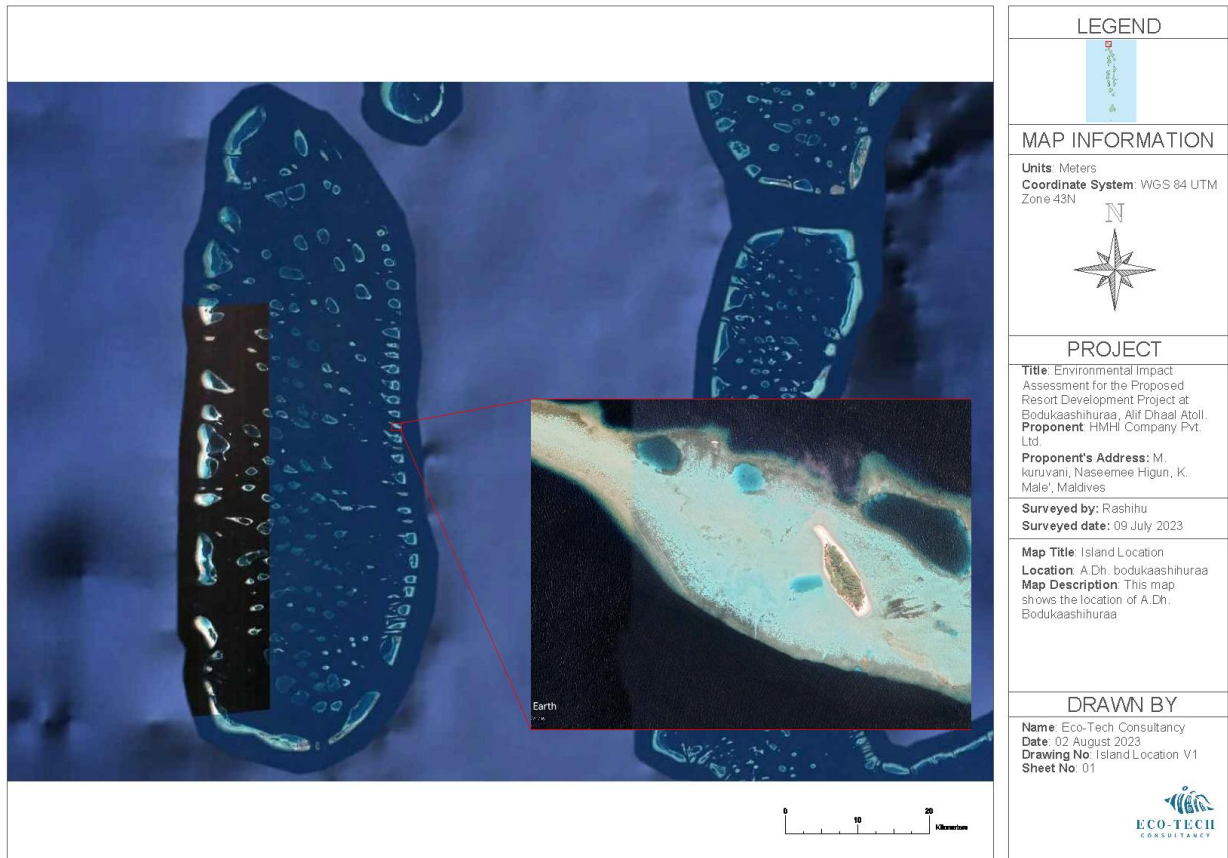


Figure 26. Location of Bodukaashihuraa in Alif Dhaal atoll.

5.3.2 Currents and Coastal Dynamics

Bodukaashihuraa is located on the eastern rim of Alif Dhaal atoll. To the S-SE direction of the island, there are many islands and reefs along with Vaavu atoll that would obstruct the incoming swells from SE direction. Furthermore, as there are many islands and reef systems further South of the island, the intensity of the Swell waves reaching the Island in the NE monsoon would be low.

During the NE monsoon the winds predominantly blow from the ENE direction. Towards this direction there are no Islands or Reefs nearby. However, Kaafu atoll can be located further out

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

in that same direction. Even though Kaafu atoll is present, the distance between the island and the atoll great hence, the effective fetch from this direction would be very high and as such the Island would experience strong wind waves from this direction.

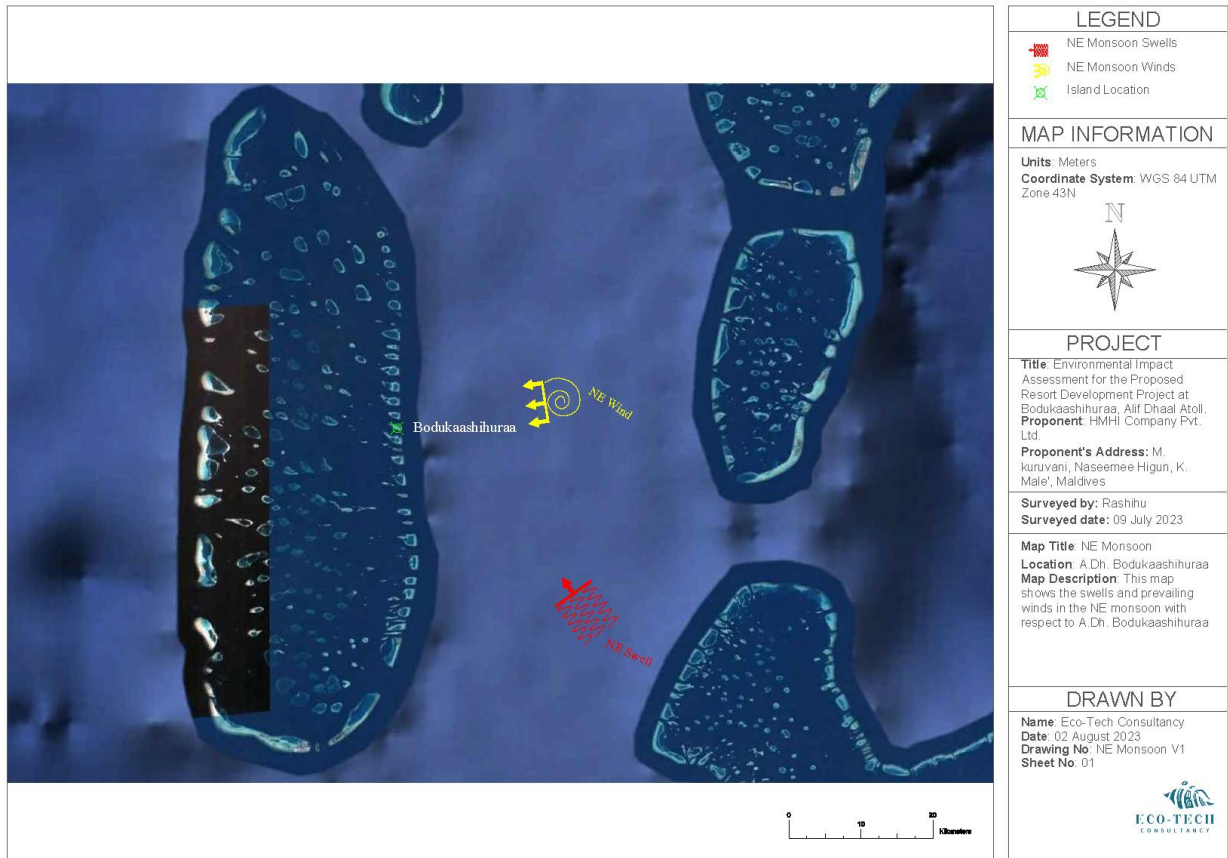


Figure 27. Approach of wind and swell waves to Bodukaashihuraa in NE monsoon

During the SW monsoon, swells would approach the island from south to SW directions. To the S-SW lies a part of Alif Dhaal Atoll with extensive reef systems and islands, the intensity of swell waves reaching the island from this direction would be low.

The strongest winds during SW monsoon comes from the W direction. In this direction there are a few reef systems and Islands within the Atoll basin, therefore wind waves generated

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

within the Atoll basin would approach the Island with low to moderate resistance decreasing the strength of the wind waves within the atoll.

Overall, the strongest waves to A.Dh. Bodukaashihuraa would most likely come from the ENE and western direction.

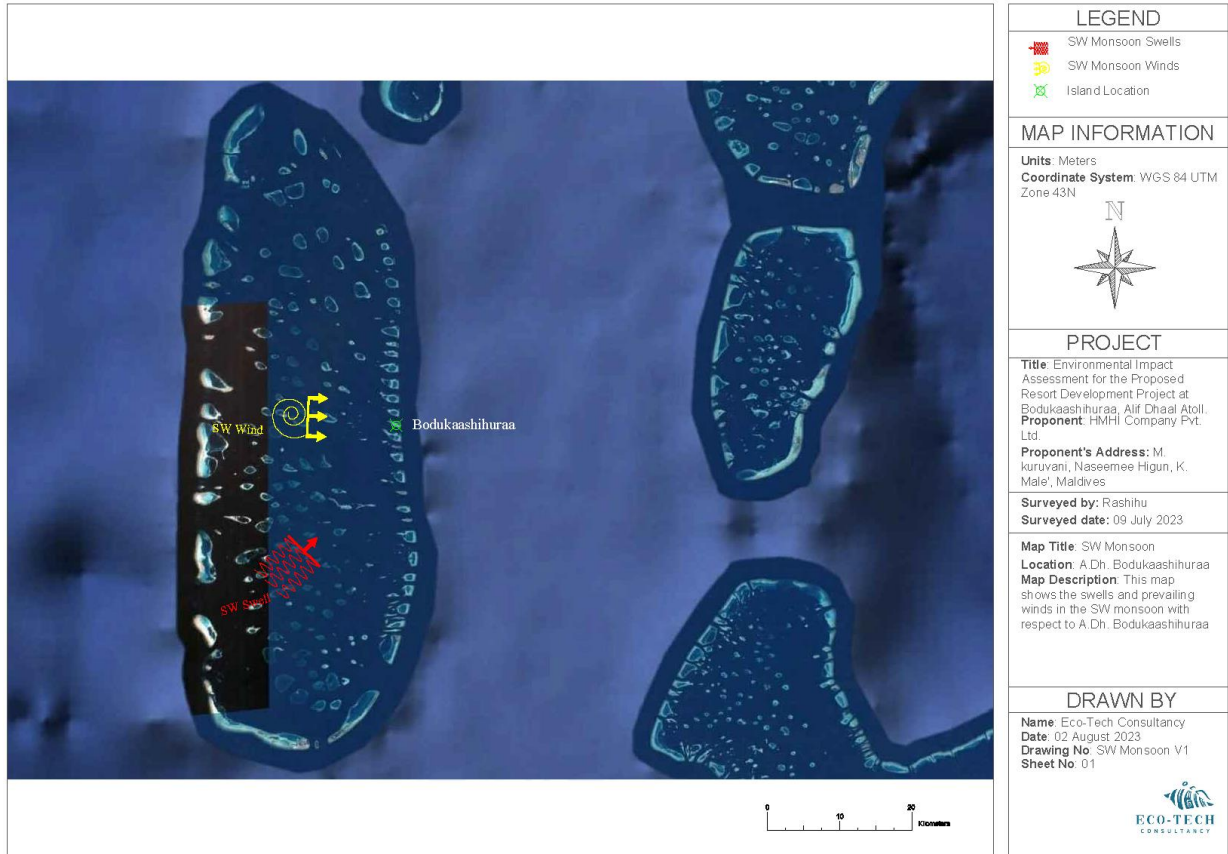


Figure 28: approach of wind and swell waves to Bodukaashihuraa in SW monsoon

The current measurements were taken during the SW monsoon when the general pattern of currents through the Maldives is from west to east and currents generally flow eastwards during high tide. During data collection period the tide was shifting from high to low tide. The results show an eastward flowing current as expected of the SW moon. The eastward flowing current

seems to have high current speeds on the south side of the island with 0.111 m/s being the strongest speed recorded from the drogue run.

Schematic diagrams showing the measured current patterns on Bodukaashihuraa reef is shown in below.

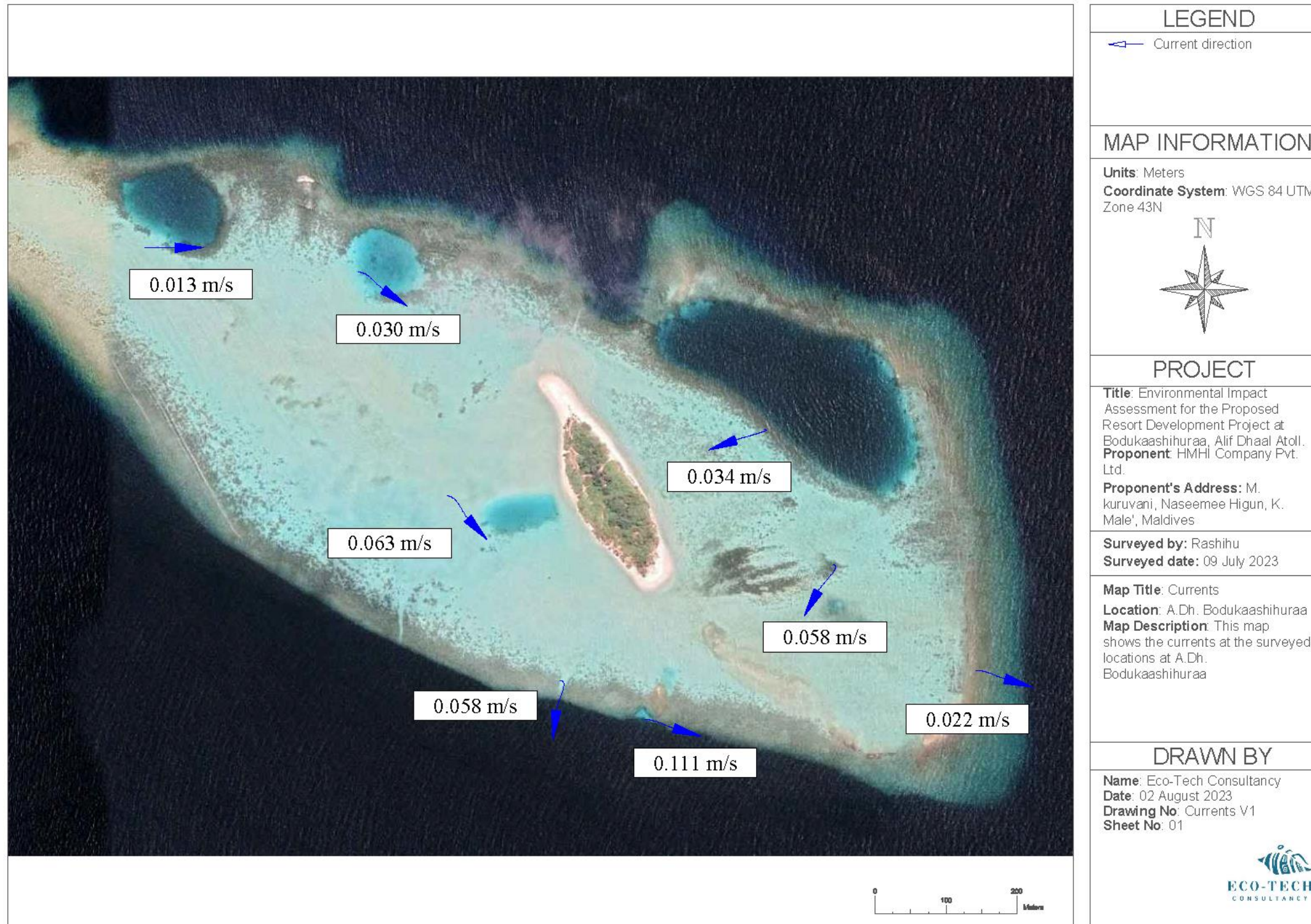


Figure 29: measured currents around Bodukaashihuraa

5.3.3 Seasonal Erosion

From the aerial images it can be observed that Bodukaashihuraa exhibit significant changes to the shoreline between seasons. According to the images there is constant change in island's shape due to the erosion and accretion patterns of the island.



Figure 30: Aerials pictures of Bodukaashihuraa over the past years (adopted from google earth)

During the survey visit to the Island signs of erosions was observed on the Eastern side of the Island and according due to managers of the Island, this Island is currently facing continued severe erosion on the Eastern side for the past years.

5.3.4 Bathymetry

The island reef flat is very shallow, from the shoreline of the Island until the reef edge, the maximum depth was less -1.5 meters in depth. The detailed bathymetry report is given in appendix K.

5.3.5 Seabed Sediments

Upon visual inspection of the seabed sediments on the reef flat of the Island from different locations, it was observed that sediments overall are coarser near the edge of the reef and finer towards the shoreline.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

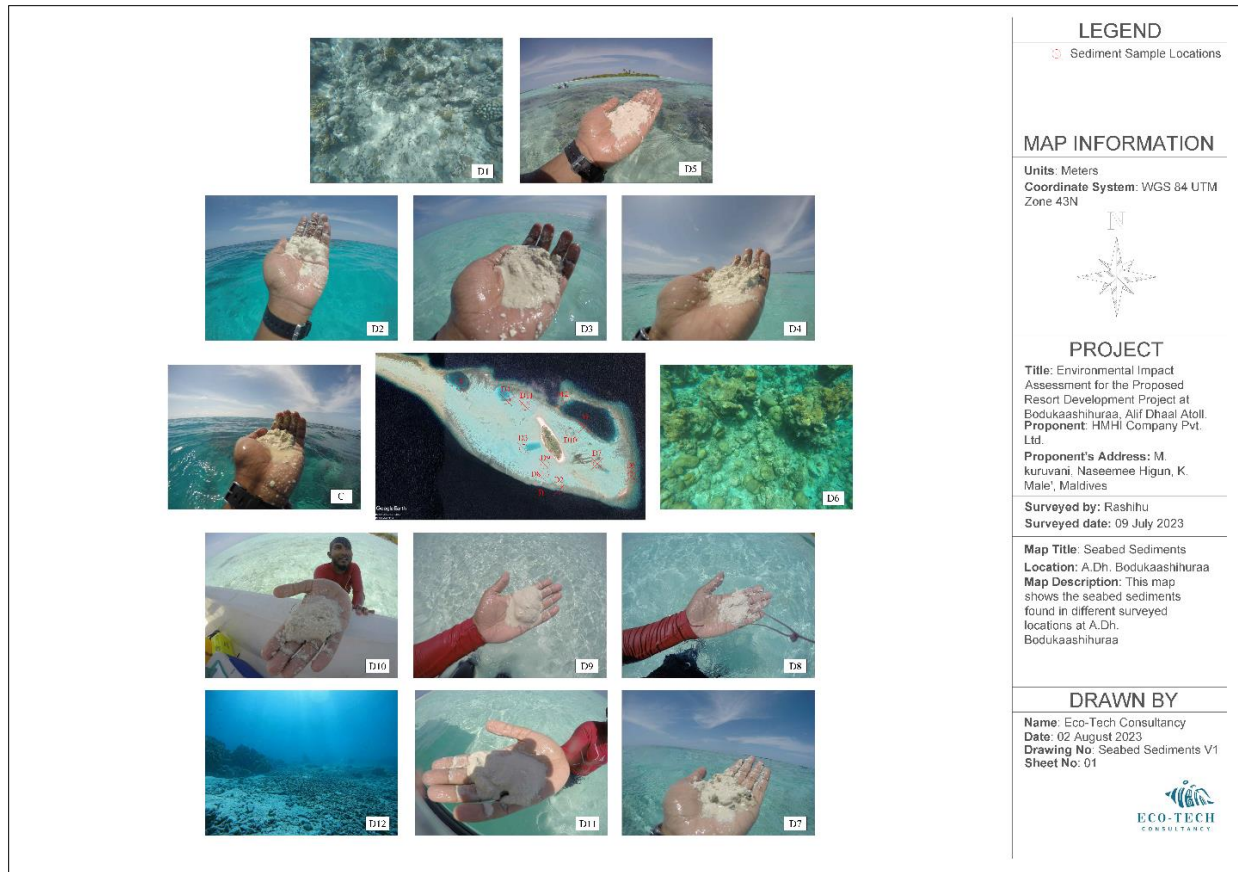


Figure 31: seabed sediments on the reef flat at Bodukaashihuraa

5.3.6 Benthic Substrate

During the snorkeling session, it was observed that most of the surveyed sites had overall poor live coral cover, with exception the of sites D1, D6 and C.

5.3.6.1 Major coral categories

The results show that the mean live coral cover of the studies sites was low (11.9%), the dominant substrate is rock (33.4%) followed by rubble (30.9%). Live coral cover was highest at

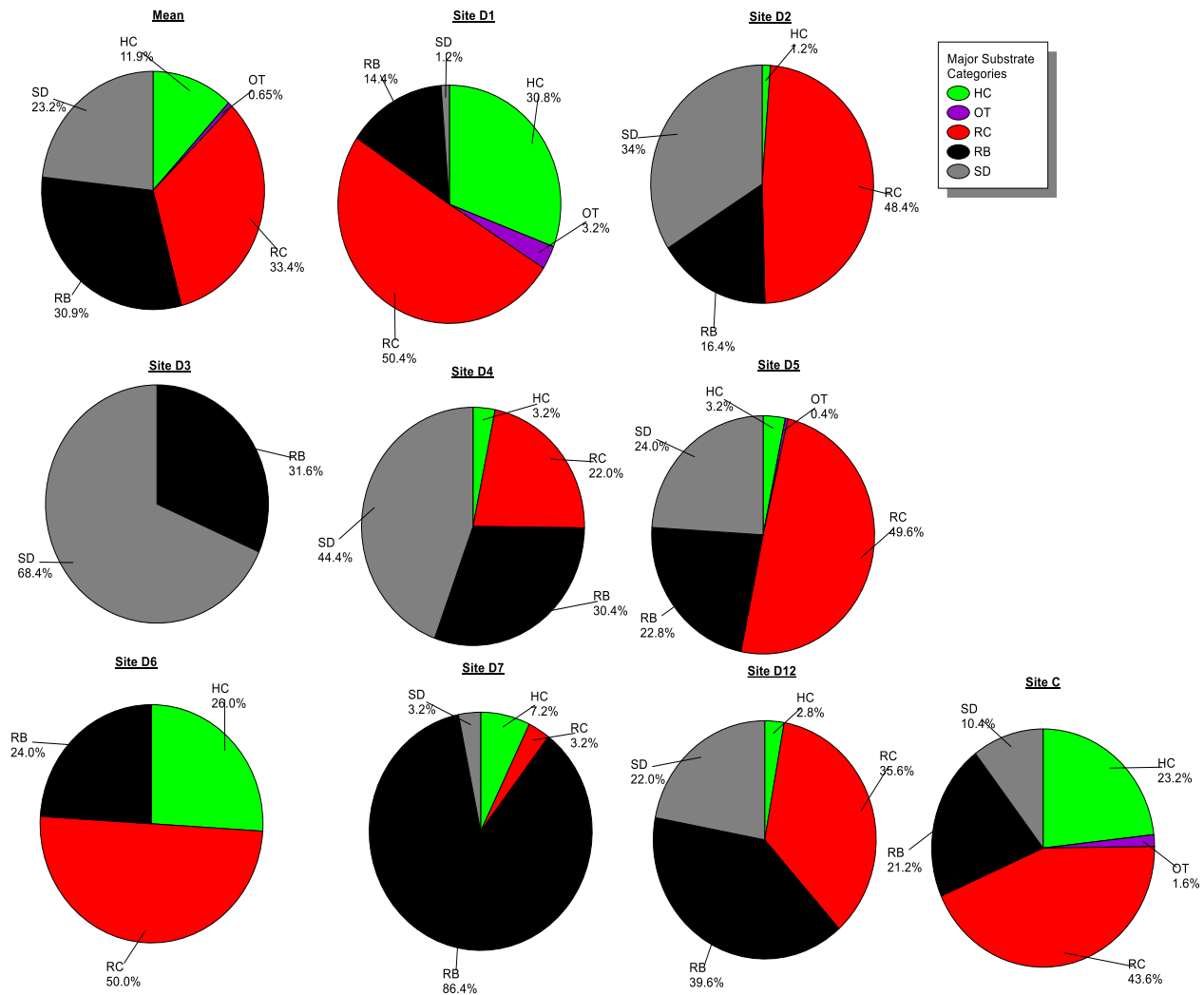
Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Site D1 (30.8%) followed by Site D6 (26.0%) and Site C (23.2%). The detailed percentages of coral cover in transects are shown in Table 12 and Figure 32 below.

Table 12: Major benthic categories

MAJOR CATEGORY (% of transect)	C	D1	D2	D3	D4	D5	D6	D7	D12	Mean	CI 95%+	CI 95%-
Coral (HC)	23.2	30.8	1.2	0.0	3.2	3.2	26.0	7.2	2.8	11.9	16.3	7.4
Soft Coral (SC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Others (OT)	1.6	3.2	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.7	1.1	0.2
Nutrient Indicator Algae (NIA)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Recently Killed Coral (RKC)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sponge (SP)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rock (RC)	43.6	50.4	48.4	0.0	22.0	49.6	50.0	3.2	35.6	33.4	41.1	25.7
Rubble (RB)	21.2	14.4	16.4	31.6	30.4	22.8	24.0	86.4	39.6	30.9	39.1	22.7
Sand (SD)	10.4	1.2	34.0	68.4	44.4	24.0	0.0	3.2	22.0	23.2	31.9	14.5
Silt (SI)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll



Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Rock dominated the reef flat with 33.15% followed by rubble at 30.90%. Details are shown in Table 13 and Figure 33 below.

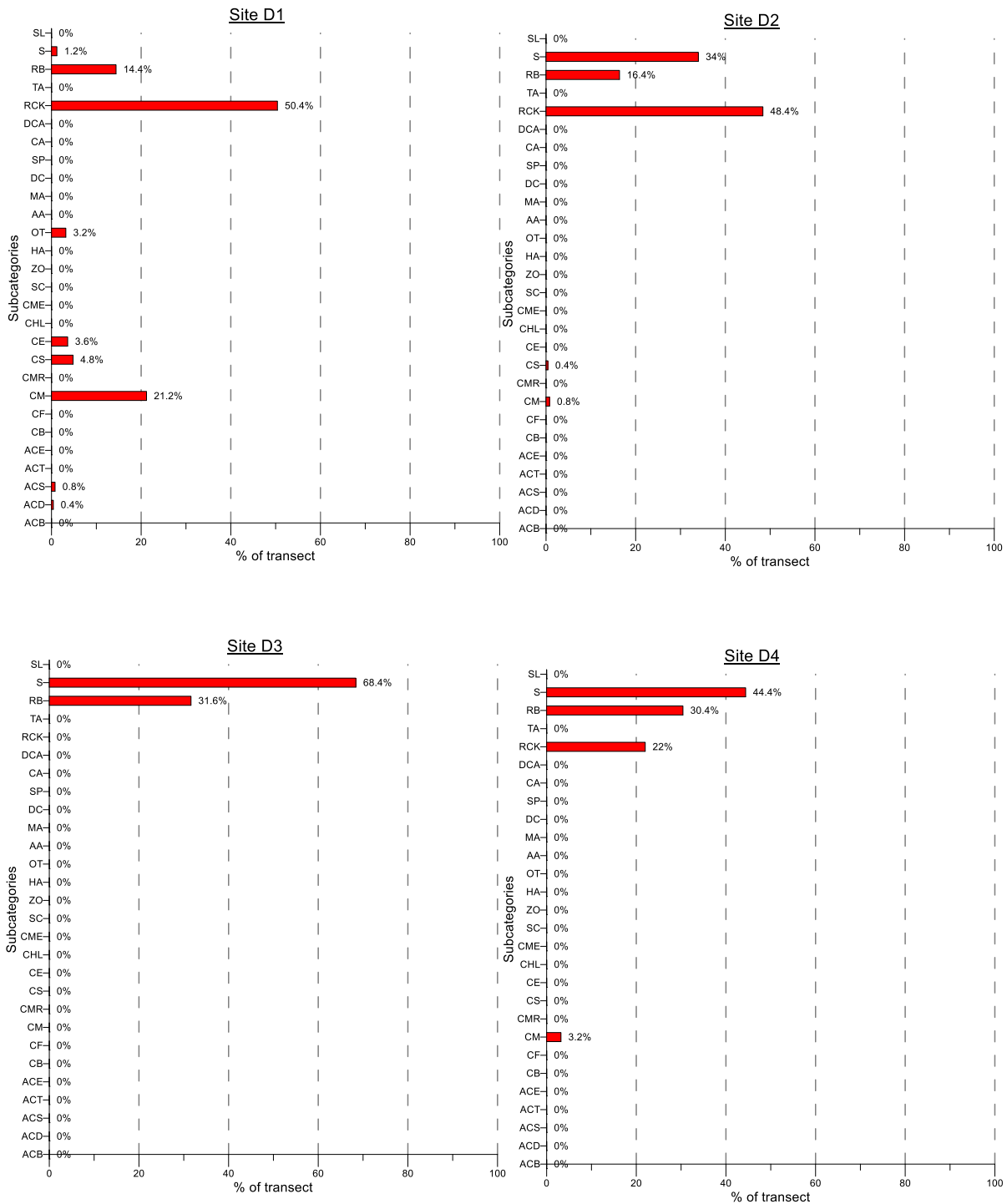
Table 13. Percentage of substrate subcategories at Bodukaashihuraa project area

SUBCATEGORIES (% of transect)	C	D1	D2	D3	D4	D5	D6	D7	D12	Mea n	CI 95% +	CI 95% -
Acropora Branching (ACB)	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.10	0.00
Acropora Digitate (ACD)	0.40	0.40	0.00	0.00	0.00	0.40	0.00	0.80	0.00	0.25	0.36	0.14
Acropora Submassive (ACS)	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.20	0.00
Acropora Tabular (ACT)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Acropora encrusting (ACE)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coral Branching (CB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coral Foliose (CF)	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.10	0.00
Coral Massive (CM)	1.60	21.20	0.80	0.00	3.20	2.80	26.00	0.40	2.80	7.00	10.67	3.33
Coral Mushroom (CMR)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coral Submassive (CS)	20.40	4.80	0.40	0.00	0.00	0.00	0.00	6.00	0.00	3.95	6.45	1.45
Coral encrusting (CE)	0.00	3.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.90	0.00
Heliopora (CHL)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Millepora (CME)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Soft Coral (SC)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zoanthid (ZO)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Halimeda (HA)	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.05	0.10	0.00
Other (OT)	1.60	3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	1.02	0.18
Algal Assemblage (AA)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Macroalgae (MA)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dead Coral (DC)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sponges (SP)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Coralline Algae (CA)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dead coral with Algae (DCA)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

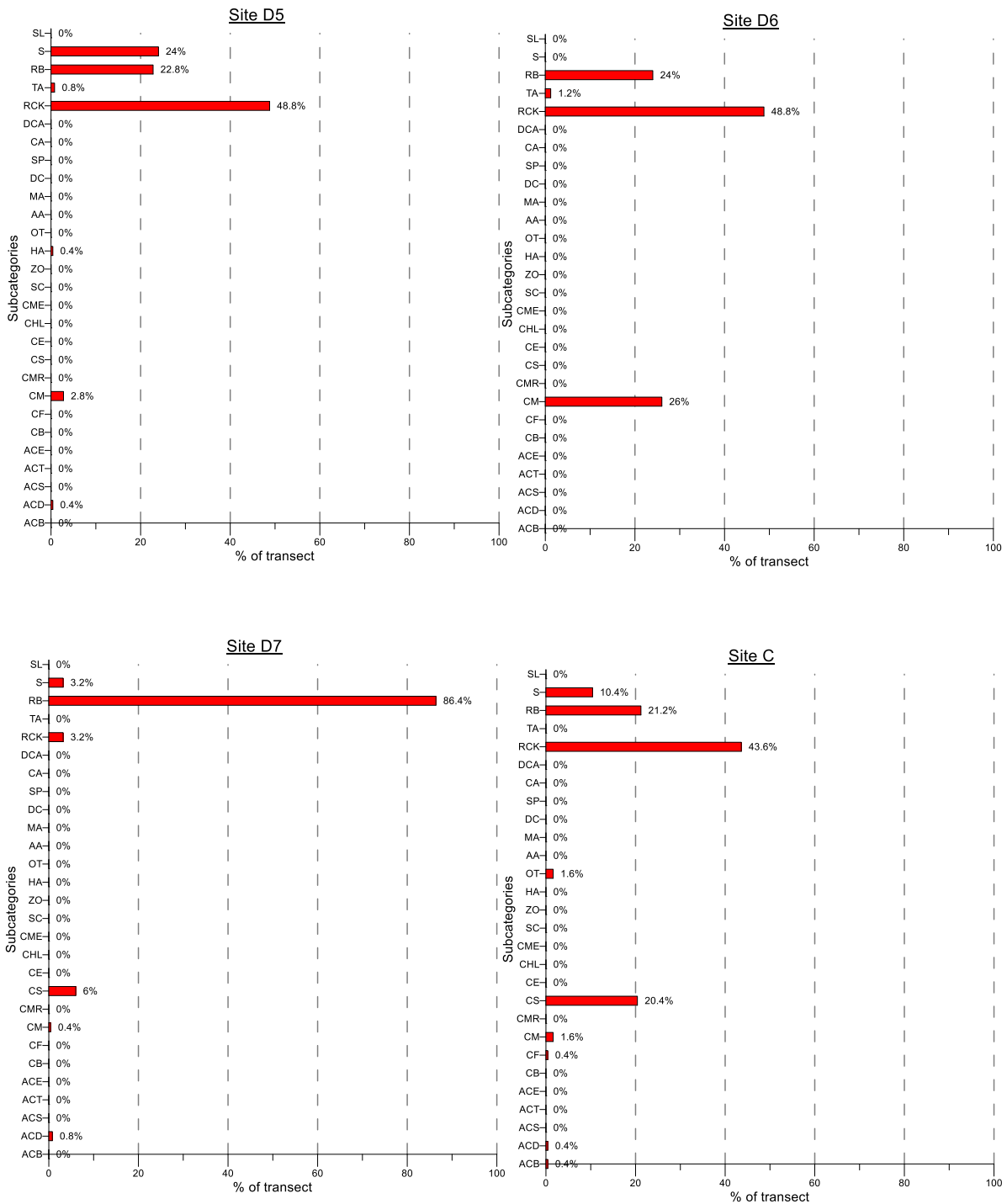
Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Rock (RCK)	43.60	50.40	48.40	0.00	22.00	48.80	48.80	3.20	35.60	33.15	40.77	25.53
Turf Algae (TA)	0.00	0.00	0.00	0.00	0.00	0.80	1.20	0.00	0.00	0.25	0.42	0.08
Rubble (RB)	21.20	14.40	16.40	31.60	30.40	22.80	24.00	86.40	39.60	30.90	39.11	22.69
Sand (S)	10.40	1.20	34.00	68.40	44.40	24.00	0.00	3.20	22.00	23.20	31.86	14.54
Silt (SL)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll



Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll



Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

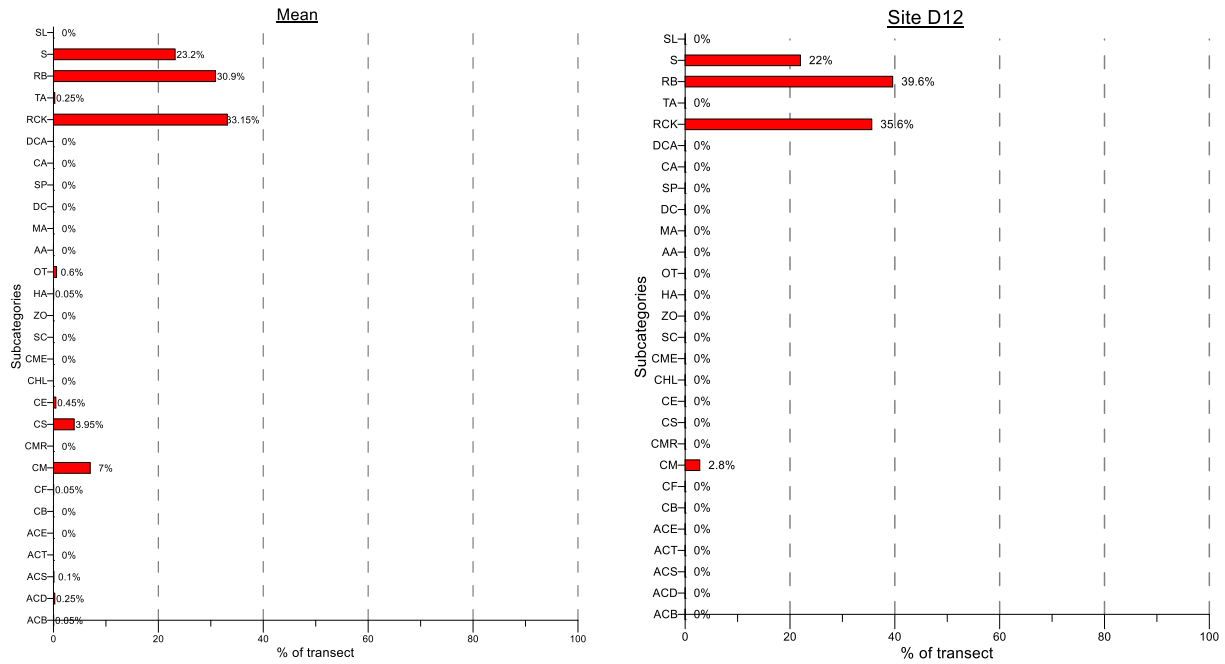


Figure 33: Subcategories of each transect and their mean

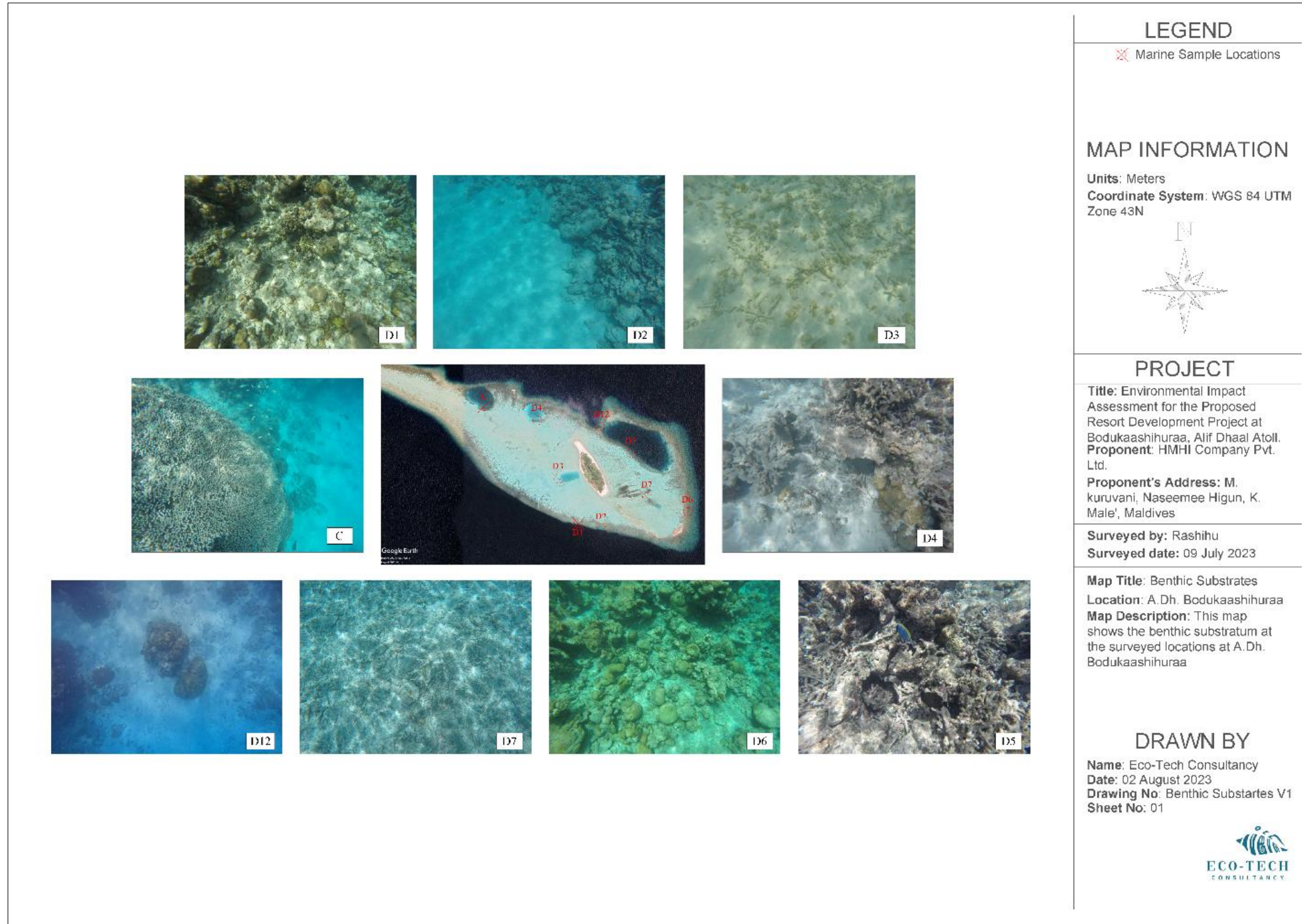


Figure 34: benthic substrates at the surveyed location in Bodukaashihuraa

5.3.7 Fish Census

A total of 4426 individuals were recorded at the studied sites on the reef flat of Bodukaashihuraa from the 8 fish visual census that were conducted, they represent 49 species from 44 genera, and 22 families. The most abundant species was *Spratelloides delicatulus* (abundance 3050).

The most abundant families of fish were *Clupeidae* (relative abundance 68.45%) followed by *Pomacentridae* (relative abundance 12.63%).

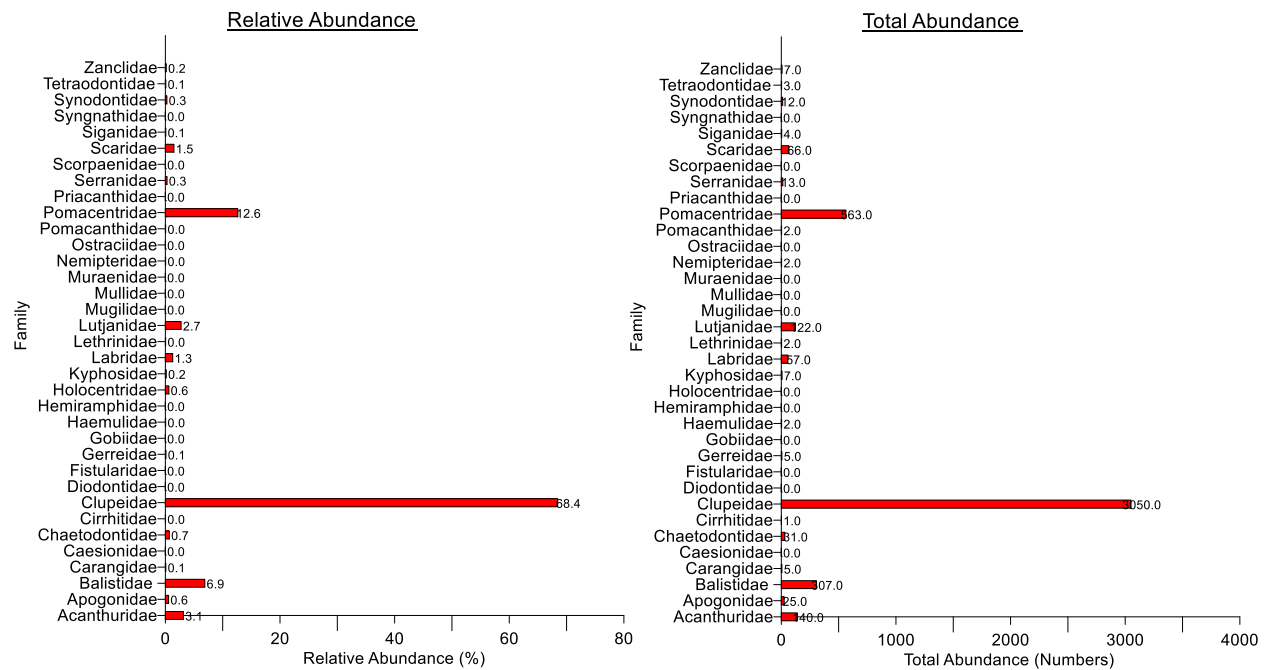
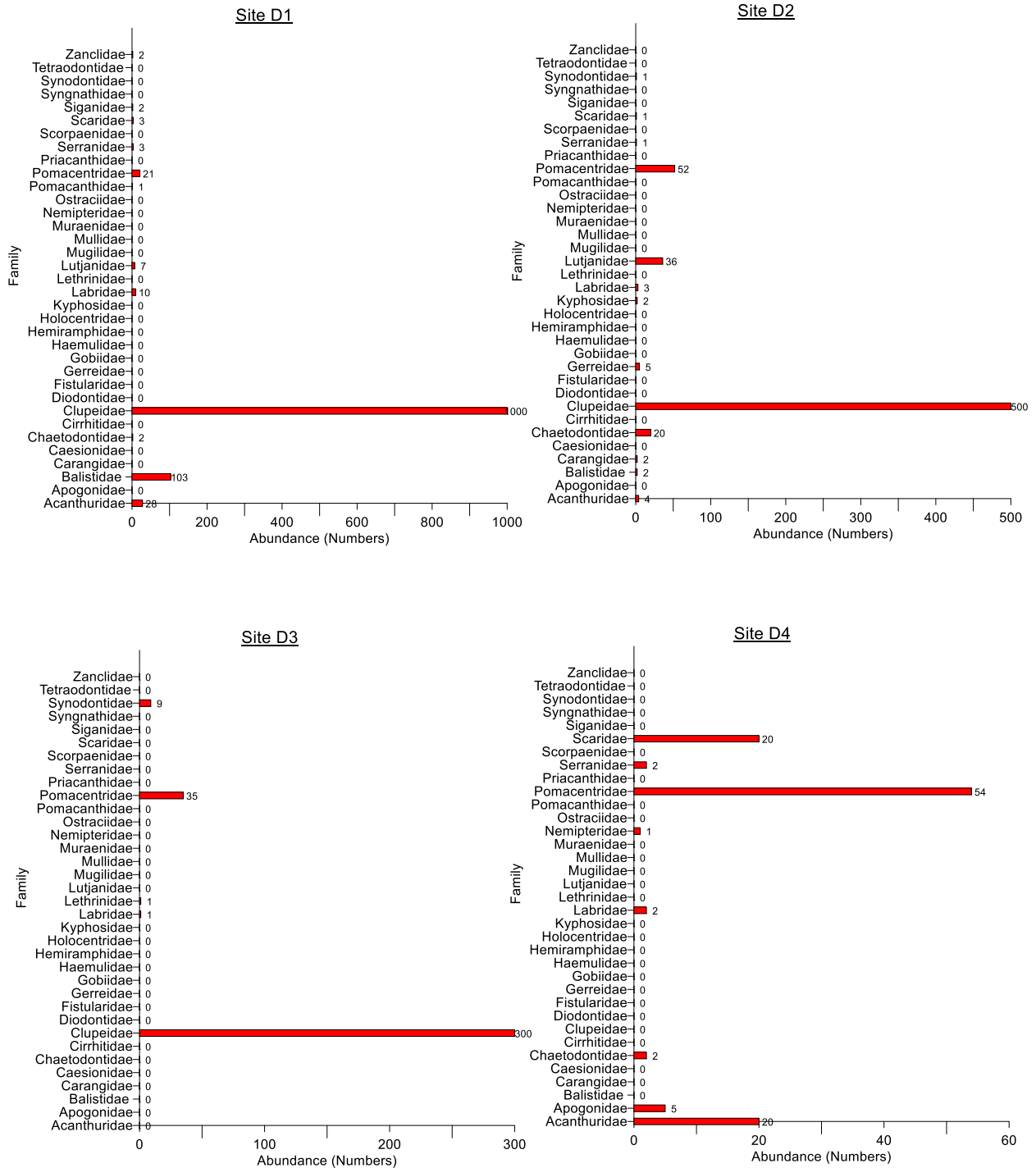


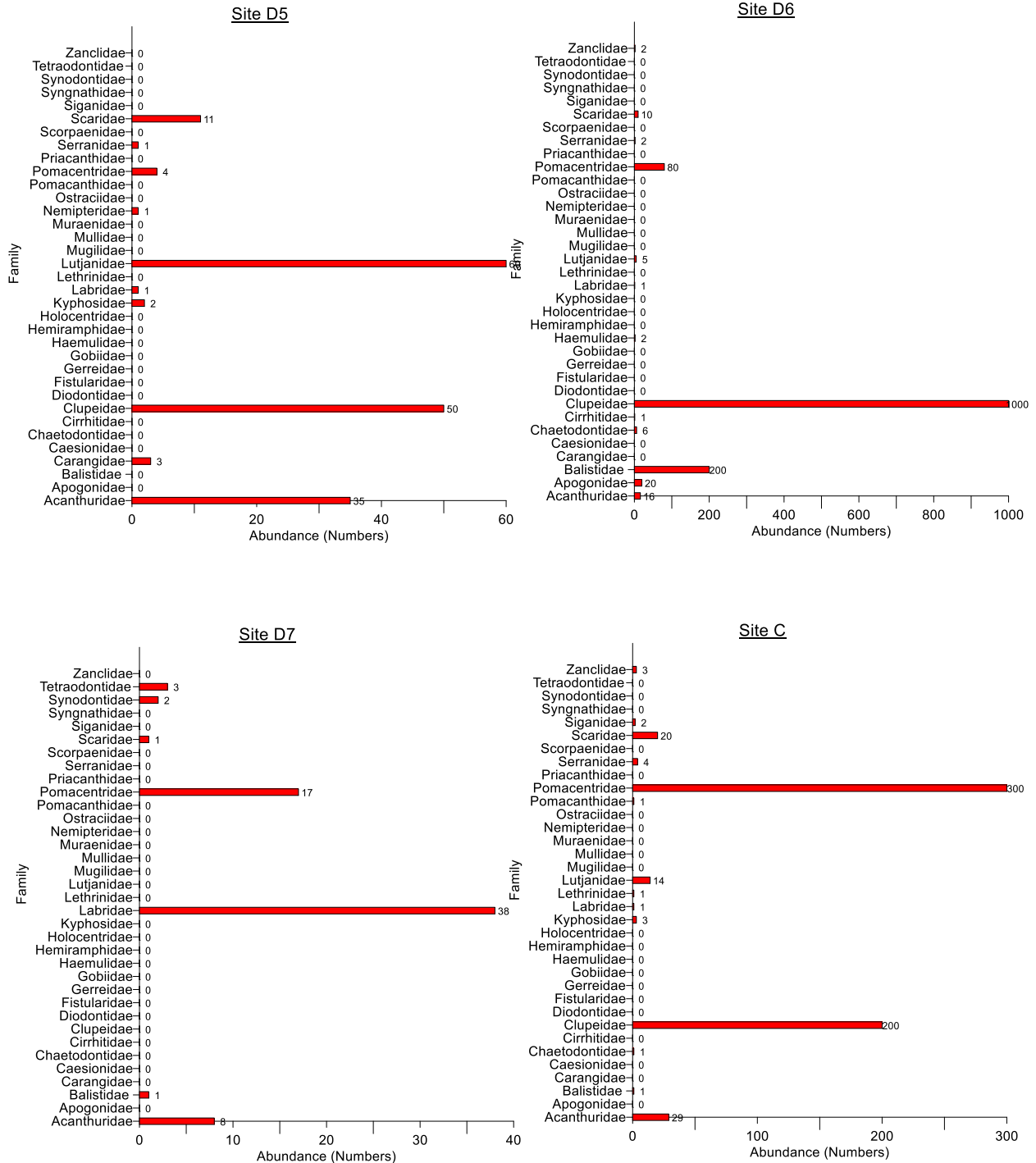
Figure 35: Total abundance (right) and relative abundance (left) of fish at Bodukaashihuraa reef

Site C had the highest fish diversity with 14 families while site D3 displayed the lowest with 5 families.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll



Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll



Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

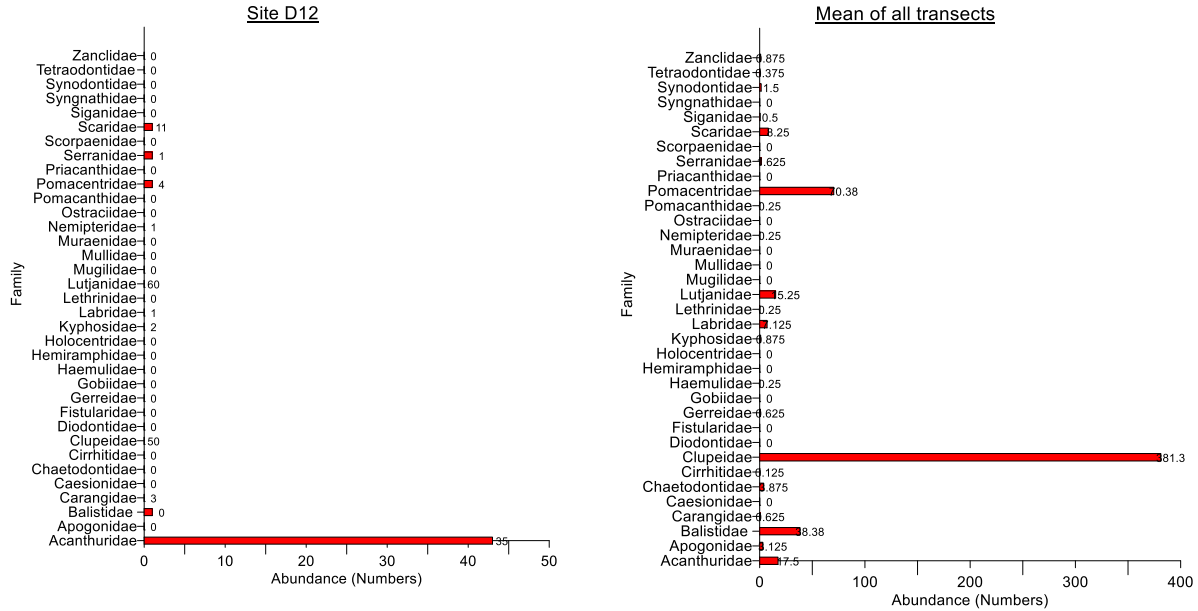


Figure 36: abundance of fish at the surveyed locations in Bodukaashihuraa reef flat

5.3.8 Coastal Environment

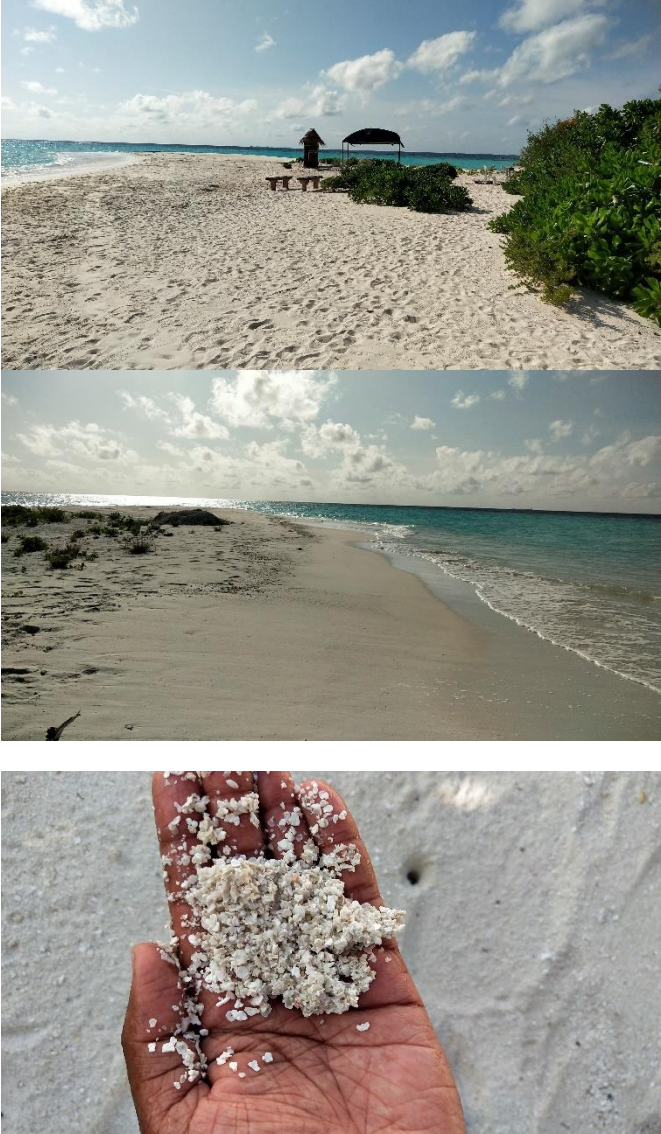
The coastal vegetation of Bodukaashihuraa is characteristic of typical coastal vegetation of Maldivian Island with *Scaevolo taccada Roxb.*, *Guettarda Speciosa L.*, *Pandanus tectorus*, *Hibiscus tiliaceus* and *Cyperus polystachyos*. On the beach *Ocypode ceratophthalmus* (ghost crabs) were found and in the undergrowth of the vegetation *Gallus gallus domesticus* (chicken) were found. Additionally, a flock of *Sterna sumatrana* (Kirudhooni) were observed on the northern tip of the island.

At the surveyed locations along the coast of the island, the beach sediments were coarser towards the toe and fine sand at the berm around the island. Erosion was observed on the east side of the island, most likely the eroded sediments were carried with the currents and settling at the


Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

northern and southern tips of the island. A detailed remark of the observations at each surveyed area is given below.


Table 14: coastal environment of eastern side of Bodukashihuraa

Site	Observations	Picture
CE1	<p>Animals observed; <i>Gallus gallus domesticus</i> (chicken) footprint and ghost crabs were observed. No crab holes were observed which may be a result of high tide or the crabs were few in number. A flock of around 20 <i>Sterna sumatrana</i> (Kirudhooni) at the northern tip of the island were encountered.</p> <p>Characteristics of the beach; Lots of Halimeda washed up with very few Marine shells. The beach had very gentle slope.</p> <p>Characteristics of beach sediments; fine sand on berm, coarse sand is at the toe. Its plausible that Halimeda is one of major contributors to the coarse sand found at the beach.</p>	


Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

<p>CE2</p>	<p>Animals observed; Crab holes were observed with few marine shells, and <i>Gallus gallus domesticus</i> (chicken).</p> <p>Characteristics of beach sediments; beach slope was steeper than CE1 but still gentle.</p> <p>Observed size of beach sediments: Fine sand on berm and coarse sand on the toe</p>	
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Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

<p>CE3</p>	<p>Animals observed; Few crab holes with very few marine shells were observed.</p> <p>Characteristics of beach; Gentle beach slope.</p> <p>Observed size of beach sediments: fine sand on berm and coarse on toe.</p>	
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Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

<p>CE4</p>	<p>Animals observed; <i>Gallus gallus domesticus</i> (chicken) trails, very few crab holes, no marine shells.</p> <p>Characteristics of beach; Gentle beach slope, signs of erosion.</p> <p>Characteristics of beach sediments; Very fine sand on berm and coarse sand at the toe, but not as much as other sites.</p>	
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5.3.9 Marine Water Quality

Marine water quality was compared with a set of internationally agreed optimal ranges as follows;

Table 15: marine water quality optimal ranges

Location	Optimal Range	Reference
pH	8.0-8.3 *Levels below 7.4 pH cause stress	EPA
Salinity (%)	3.2% - 4.2%	GBRMPA, 2009

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Turbidity (NTU)	3-5 NTU >5 NTU causes stress	Cooper et al. 2008
Total suspended solids (mg/L)	NA	NA

Marine water test results from MWSC water quality assurance laboratory is attached in Appendix F of this report.

All parameters tested was within the optimal range in all sampled locations. pH was same at all locations at 8.2. Salinity was also fairly similar across all surveyed locations. TSS (at less than 5 mg/L) and Turbidity (close to 0.1 NTU at most locations) was also fairly similar with the exception of site D2 where there was a spike in turbidity at 0.419 and TSS of 13 mg/L.

Table 16: marine water quality test results for Bodukaashihuraa

Location	D1	D2	D3	D4	D5	D6	D7	D9	C
Temperature (°C)	23.0	22.8	22.6	22.7	22.9	22.5	22.6	22.6	22.8
pH	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2	8.2
Salinity (%)	3.399	3.371	3.344	3.373	3.397	3.346	3.376	3.419	3.379
Turbidity (NTU)	<0.1	0.419	0.272	0.119	0.161	0.115	0.113	0.195	0.131
Total suspended solids (mg/L)	<5	13	<5	<5	<5	5	<5	<5	<5

*Ex-situ temperature readings



5.4 Terrestrial Environment of Bodukaashihuraa

This section describes the site-specific terrestrial environmental conditions of the proposed project site. The structural environment, ground condition, air quality, noise levels, types of vegetation and ground water quality results are presented.






5.4.1 Structural Environment at Project Site

As the Island is being used as a picnic Island, there are some facilities established for the visitors such as barbeque grills, benches, huts, tables and chairs. However, there is only one major modification made on the island which is the staff accommodation. The modification includes accommodation, kitchen and storage room. Additionally, a small chicken farm was also built in close proximity. A material storage hut is currently under construction on the south beach of the island. The condition and use of the buildings are summarized on the Table 17.




Table 17: Condition and use of buildings near and on project site

Building name	Location	Condition	Use	Pictures
Accommodation with kitchen and toilet	North of the island	-properly maintained	For accommodation	
Toilet	North of the island	-properly maintained	Toilet services for the visitors	

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Storage hut	North of the island	-properly maintained	For storage	
Mosque	North of the island	-properly maintained	Used by the staff and visitors for Prayer	
Small chicken farm	North of the island	-properly maintained	Raising chicken	
Material storage	South of the island	-Under construction	For material storage	
Benches	Northern side of the Island	-good	Used by picnickers	

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Huts	Northern side of the Island	-good	Used by picnickers	
Tables and chairs	Northern side of the Island	-good	Used by picnickers	
Barbeque grill	Northern side of the Island	-good	Used by picnickers	

5.4.2 Ground Condition

Ideally, soil has 5 different master horizons or layers which is O, A, E, B, and C, where O is the organic horizon (Soil Management, n.d.), A-horizon which contains significant organic matter, E-horizon which is the eluviation zone where organic matter accumulation has not occurred, B-horizon which is the zone of maximum clay accumulation, C-horizon which is a subsurface layer of soil forming parent materials which could be weathered rock, unconsolidated sediments or loose sands, and R-horizon which is not soil and is the hard bedrock (Figure 37)

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- O = The layer of organic matter on the surface of a mineral soil
- A = Topsoil. The mineral soil horizon on the surface with organic matter and low clay
- E = The horizon of maximum leaching. Not in all soils, but if present, is located just below the "A" horizon
- B = Subsoil. Horizon most often located below A horizon. The zone of maximum clay accumulation
- C = Weathered rock. Lies below the "A" and/or "B" horizons and has NOT been acted upon by the soil forming processes
- R = The hard, consolidated rock beneath the soil

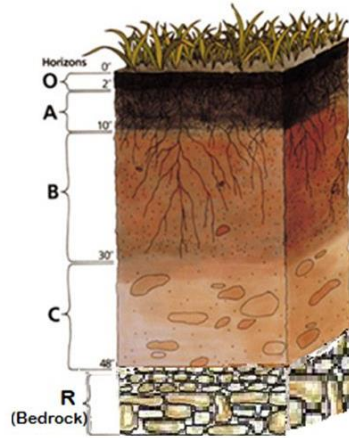


Figure 37: Typical soil profile

Soil profiles were taken from the wells that was dug to obtain the groundwater samples at sites GC, G1 and G2. At all three locations only one distinct horizon was visible, which was the B-horizon. The difference was the thickness of this layer. At site GC the thickness was 50 cm, G1 was 85 cm and G2 was 43 cm. Below this layer was the ground water level.



Figure 38: soil profiles at project site

5.4.3 Ground Water Quality

Ground water quality was compared with the URA supply water quality standard guideline value as follows: -

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Table 18: ground water quality optimal ranges

Parameter	Optimal Range	Reference
Temperature(0C)	NA	URA
pH	6.5-8.5	URA
Electrical Conductivity (max allowable range)	<1000 μ s/cm	URA
Electrical Conductivity (recommended range)	300 - 700 μ s/cm	URA
Total Dissolved Solids (max allowable range)	<500 mg/L	URA
Total Dissolved Solids (recommended range)	150 - 350 mg/L	URA
Dissolved Oxygen	NA	URA

Groundwater test results from MWSC water quality assurance laboratory is attached in Appendix F of this report.

All of the parameters except for conductivity were within the optimal ranges. Conductivity was very high at all tested locations; a probable explanation can be that the island is too small in size to have a proper freshwater lens.

Table 19: Groundwater quality test results (parameters exceeding URA standards are highlighted in red)

Location	GC	G1	G2
Temperature(0C)	22.6	22.8	22.8
pH	7.3	7.3	7.1
Salinity (%)	1.437	0.664	1.029
Conductivity (μ S/cm)	23700	11660	17480
Dissolved Oxygen (mg/L)	8.79	7.96	6.45

*Ex-situ temperature readings

5.4.4 Vegetation

11 different types of vegetation species were found on Bodukaashihuraa at the vegetation transect and land clearance locations, the scientific name and Dhivehi names of these are listed in Table 21.

At vegetation transect 1 which is near the proposed Grill restaurant, there was sparse vegetation with a very few mature *Cocos nucifera L.* Trees above 4m were mostly *Scaevolo taccada Roxb.*, *Guettarda Speciosa L.* and *Cyperus polystachyos.*

At vegetation transect 2 which is near proposed Radio hut, had dense vegetation. This area is mostly composed of *Scaevolo taccada Roxb.* and *Calophyllum inophyllum.* The transect was unable to continue due to dense vegetation after the 20m mark.

The control transect was on the east side near proposed Directors’ bungalow. The vegetation transect had *Hibiscus tiliaceus*, *Pandanus tectorus* and *Guettarda Speciosa L.* as major vegetation.

Table 20: vegetation found on transects

Vegetation transect 1 Code: VT1 (Near proposed Grill restaurant) Canopy height: Estimated 30 m				
Distance (m)	Ground	1 st Storey (0-2 m)	2 nd Storey (2 -4m)	3 rd Storey (4 m >)
0-5		<i>Scaevolo taccada Roxb.</i> <i>Pemphis acidula</i> Tropical vines		
5-10		<i>Scaevolo taccada Roxb.</i> <i>Pemphis acidula</i> Tropical vines <i>Guettarda Speciosa L.</i>		
10-15	<i>Cyperus polystachyos</i>	<i>Scaevolo taccada Roxb.</i> Tropical vines		
15-20	<i>Cyperus polystachyos</i>			

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

20-25	<i>Cyperus polystachyos</i>	<i>Scaevolo taccada</i> <i>Roxb.</i> <i>Cocos nucifera L.</i> <i>Morinder citrifolia</i> <i>Hibiscus tiliaceus</i>		
25-30		<i>Cocos nucifera L.</i>	<i>Hibiscus tiliaceus</i> <i>Scaevolo taccada</i> <i>Roxb.</i> <i>Morinder citrifolia</i>	
Vegetation transect 2 Code: VT2 (Near proposed Radio hut) Canopy height: Estimated 30 m				
0-5	<i>Cyperus polystachyos</i>	<i>Cordia subcordata</i> <i>Scaevolo taccada</i> <i>Roxb.</i> <i>Pemphis acidula</i> Vines		
5-10	<i>Cyperus polystachyos</i>	<i>Scaevolo taccada</i> <i>Roxb.</i> <i>Pemphis acidula</i> Vines		
10-15		<i>Calophyllum inophyllum</i> <i>Scaevolo taccada</i> <i>Roxb.</i> Vines <i>Guettarda Speciosa</i> <i>L.</i> <i>Pemphis acidula</i>		
15-20	<i>Cocos nucifera L.</i>	<i>Calophyllum inophyllum</i> <i>Scaevolo taccada</i> <i>Roxb.</i>		
20-25	Inaccessible due to dense vegetation			
25-30				
Vegetation transect 3 Code: VTC (Near proposed Director's Bungalow) Canopy height: Estimated 30 m				
0-5		<i>Scaevolo taccada</i> <i>Roxb.</i> <i>Pandanus tectorus</i> <i>Guettarda Speciosa</i> <i>L.</i>	<i>Pandanus tectorus</i> <i>Guettarda Speciosa</i> <i>L.</i>	

5.4.5 Terrestrial Megafauna

During the surveys on the island *Gallus gallus domesticus* (chicken) and *Amaurornis phoenicurus* (*Kanbili*) were encountered. The chicken was introduced to the island last year by the people managing the island.

5.4.6 Air Quality

Air pollution can become an environmental problem in the future, primarily as a byproduct of increasing number of vehicles, increase in construction sites and increase in population. Furthermore, with gradual increase in population density, the impact on air quality due to pollution of the island would gradually increase. Hence, it is very important to monitor air quality on an island level when tourism is a major contributor to the island's economy. Eight major air pollutants are highlighted in this study to monitor the air quality. These are Methyl aldehyde or Formaldehyde (HCHO), Total Volatile Organic Compounds (TVOC), PM2.5, PM10, Carbon Monoxide (CO), Carbon dioxide (CO₂), Sulfur Dioxide (SO₂), and Nitrogen Dioxide (NO₂).

5.4.6.1 HCHO

Formaldehyde is an organic compound with the chemical formula HCHO. This compound is widely used in cosmetics, clothing, construction materials, disinfectants and preservatives (Friedman, 2022). This gas can also be generated by smoking indoors. The expected health effects due to prolonged exposure to formaldehyde and the recommendation optimal ranges are provided in Table 10.

5.4.6.2 TVOC

TVOC is the measure of total amount of volatile organic compounds in the air. A volatile organic compound (VOC) is a substance that has high vapor pressure but low water solubility (Chen, 2022), which means that VOC is a solid or liquid compound that can emit gases due to its volatile nature. Anthropogenic sources of VOCs are paint, lacquers, pesticides, cleaning supplies,

building materials and furnishings, printers, adhesives, varnishes, nail polish, wax, organic solvents, disinfectants, air fresheners etc. VOCs are also naturally emitted from biological activity in the marine environment.

5.4.6.3 PM2.5 and PM10

Particulate matter or PM gives an indication of the level of pollution in the air. PM is a mixture of solid particles and liquid droplets found in the air; aerosols. Particles which are large or dark enough particles such as dust, dirt, soot or smoke can be seen via naked eye. Others, however, are so small they can only be detected using an electron microscope. Aerosols or PM originate from both natural and anthropic sources.

Primary natural sources are emitted directly and are usually large (>1 μm), these include volcanic eruptions, forest fires, mineral dust, sea salt, pollen and biological debris (Millero, 2013). Primary anthropogenic sources are also emitted directly and are also usually large (>1 μm), these include powerhouses, automobiles, agricultural lands, construction sites, unpaved roads, fields, smoke stacks or fires (United States Environmental Protection Agency, n.d.). Whether the particles were anthropogenic or natural in origin, they sometimes undergo gas reactions and gas to particles conversion in the atmosphere to form fine (<100 nm) particles also known as photochemical smog, which is a secondary source of particles in the atmosphere. Additional secondary sources of particles come from biological activity in the marine environment such as Sulfates from Dimethyl sulphide and Organic aerosol from biogenic Volatile Organic Compounds (VOC). Among all the sources sea salt by far contributes to the atmospheric PM the most. This should be especially prevalent in the Maldivian setting as the sea would be always less than 500 m from any given location.

TABLE 2.20 Global Emission Estimates for Major Aerosol Classes

Source	Estimated Flux, Tg yr ⁻¹	Reference
Natural		
Primary		
Mineral dust		Zender et al. (2003)
0.1–1.0 μm	48	
1.0–2.5 μm	260	
2.5–5.0 μm	609	
5.0–10.0 μm	573	
0.1–10.0 μm	1490	
Seasalt	10,100	Gong et al. (2002)
Volcanic dust	30	Kiehl and Rodhe (1995)
Biological debris	50	Kiehl and Rodhe (1995)
Secondary		
Sulfates from DMS	12.4	Liao et al. (2003)
Sulfates from volcanic SO ₂	20	Kiehl and Rodhe (1995)
Organic aerosol from biogenic VOC	11.2	Chung and Seinfeld (2002)
Anthropogenic		
Primary		
Industrial dust (except black carbon)	100	Kiehl and Rodhe (1995)
Black carbon	12 ^a	Lioussé et al. (1996)
Organic aerosol	81 ^a	Lioussé et al. (1996)
Secondary		
Sulfates from SO ₂	48.6 ^b	Liao et al. (2003)
Nitrates from NO _x	21.3 ^c	Liao et al. (2004)

^aTg C. The oceans are one of the most important sources of atmospheric aerosols [1000–10000 Tg per year, although this includes giant particles (2–20 μm diameter) that are not transported very far]. Just above the ocean surface in the remote marine atmosphere, sea salt generally dominates the mass of both supermicrometer and submicrometer particles.

^bTg S.

^cTg NO₃.

Figure 40: global estimated of major aerosol classes, figure adopted from (Ferrero, 2018)

Therefore, when we measure PM, it would always show the natural and anthropogenic sources together. Furthermore, (Budhavant, et al., 2015) have shown that transboundary pollution is much more prevalent than local pollution in the Maldives. However, this is not to say that there are no local sources of pollution as one study conducted by (Colombo, et al., 2014) showed that Persistent Organic Pollutants (POPs) were present in Maldivian soil exceeding international guidelines which originated from waste combustion. Hence it is very important to monitor the changes during construction and operational stage of the projects to determine whether there is an influx of anthropogenic PM.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

The potential for health problems caused by PM is directly related to the size of the PM. Small particles which are less than 10 μ m in diameter pose the greatest problem as they can penetrate deep into the lungs and even enter the blood stream. Numerous scientific studies have linked exposure to PM to variety of health problems to lungs and heart. They include:-

- Premature death in people with respiratory or heart diseases;
- Myocardial infarction;
- Arrhythmias;
- Decreased lung function;
- Aggravated asthma; and
- Increased respiratory symptoms, such as irritation of the airways, coughing or difficulty in breathing (United States Environmental Protection Agency, n.d.)

Particles can be carried over long distances by wind and then settle on ground or water surfaces. Depending on their chemical composition, this settling can lead to:-

- Making open water sources acidic;
- Changing nutrient balance in coastal waters;
- Depleting nutrients in soil;
- Damaging sensitive forests and farm crops;
- Affecting the diversity of ecosystems; and
- Contributing to acid rain effects.

Measure of particle pollution includes:-

- PM₁₀: inhalable particles, with diameters that are generally 10 μ m or smaller; and
- PM_{2.5}: fine inhalable particles with diameters that are generally 2.5 μ m and smaller (United States Environmental Protection Agency, n.d.).

5.4.6.4 CO

Carbon monoxide is an odorless gas that is deadly if inhaled. The most common source of CO is combustion either from fires or appliances that burn gas, wood or oil. Symptoms of CO

lead to development of asthma and respiratory infections. NO₂ with other NO_x can react with other chemicals in the atmosphere to form ozone, particulate matter and cause acid rain.

5.4.6.8 Air quality optimal ranges

Currently there are no air quality standards established in the Maldives, therefore the standards set by the US EPA has been used to compare the data collected from the surveyed locations as given below.

Table 22: air quality optimal ranges

Pollutant	Optimal Range	Reference
Carbon Monoxide (CO)	<9 ppm	US EPA (EPA, NAAQS Table, 2022)
Carbon dioxide (CO ₂)	<10,000 ppm indoors and Roughly 400 ppm outdoors	US (Minnesota) (MNDOLI, 2022)
TVOC	<0.5 mg/m ³ (500 µg/m ³) given only for indoors	US Green Building Council (Chen, 2022)
Nitrogen Dioxide (NO ₂)	<0.053 ppm	US EPA (EPA, NAAQS Table, 2022)
HCHO	<0.1 ppm (120 µg/m ³) given only for indoors	USA (California) (Friedman, 2022)
PM _{2.5}	<12.0 µg/m ³	US EPA (EPA, NAAQS Table, 2022)
PM ₁₀	<150 µg/m ³	US EPA (EPA, NAAQS Table, 2022)
Sulfur Dioxide (SO ₂)	<0.5 ppm	US EPA (EPA, NAAQS Table, 2022)

The above table is a simplified version of the detailed reference ranges (of US EPA given below) in order for ease of comparison due to the limited quality of the data collected because of the lack of data collection time and equipment employed for this survey.

The US EPA has identified two types of national ambient air quality standards; primary standards that relate to public health protection for example sensitive groups of asthmatics,

children and elderly and secondary standards that relate to protection of physical environment for example buildings, vegetation, crops, animals, and decreased visibility.

Periodically these standards are reviewed and revised. The most recently established standards are listed below (accessed on December 2022).

The units of measure for the standards are parts per million (ppm), parts per billion (ppb), micrograms per cubic meter of air ($\mu\text{g}/\text{m}^3$)

Table 23: detailed air quality reference ranges

Pollutant	Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)	primary	8 hours	9 ppm	Not to be exceeded more than once per year
		1 hour	35 ppm	
Carbon Dioxide (CO ₂)	Indoor	8 hour	10,000 ppm	Average concentration should not exceed 10,000 ppm and average concentration over 15minute period should not exceed 30,000 ppm. >5000 ppm exposure for prolonged periods can cause headache, dizziness, nausea. >40,000 ppm is immediately dangerous to life as it can cause asphyxiation.
	Outdoor	Not given	About 400 ppm	Depends on traffic and industrial activity Concentration at Mauna Loa on 28 th November 2022 was at 417.31 ppm (NOAA, 2022)
TVOC (Total amount of Volatile organic compounds)	Indoor	Not given	<0.5 mg/m ³ (500 $\mu\text{g}/\text{m}^3$)	<0.3 mg/m ³ = low concern 0.3-0.5 mg/m ³ = Acceptable 0.5-1.0 mg/m ³ = Marginal 1-3 mg/m ³ = High, could cause Eye, nose and throat irritation, headaches, damage to liver, kidney and central nervous system etc..
HCHO (Formaldehyde gas)	Indoor	Not given	<0.1 ppm	0.1-3.68 ppm detected indoors >0.01 ppm = mid irritation or allergic sensitization in some people >0.5 ppm = irritation to eyes & mucous membranes > 1.0 ppm = possible nasopharyngeal cancer 3.0 ppm = respiratory impairment and damage Approx. 0.0001 mg/m ³ = Cancer risk level of 1 in 1-million 0.004 mg/m ³ = ATSDR chronic MRL 203 mg/m ³ = LC-50: Lethal concentration for rats 400 mg/m ³ = LC-50: Lethal concentration for mice
	Outdoor	Not given	Not	11-20 ppb detected outdoors in urban areas

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Pollutant	Primary/ Secondary	Averaging Time	Level	Form	
			given		
Nitrogen Dioxide (NO ₂)	primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	
	primary and secondary	1 year	53 ppb (0.053 ppm)	Annual Mean	
Particle Pollution (PM)	PM _{2.5}	primary	1 year	12.0 µg/m ³	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m ³	annual mean, averaged over 3 years
	PM ₁₀	primary and secondary	24 hours	35 µg/m ³	98th percentile, averaged over 3 years
		primary and secondary	24 hours	150 µg/m ³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO ₂)	primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	
	secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year	

5.4.6.9 Air quality at surveyed locations

Among the tested indicator pollutants, all were within the optimal range at all locations except for PM_{2.5} with 24 ug/m³ in both locations.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Table 24: ambient air quality at surveyed locations

Code	Location	Parameters									
		Temp. (°C)	Humidity (%RH)	PM2.5 (ug/m ³)	PM10 (ug/ m ³)	CO (ppm)	NO ₂ (ppm)	SO ₂ (ppm)	TVOC (mg/ m ³)	HCHO (mg/ m ³)	CO ₂ (ppm)
AQ 1	Near new utilities	30	83	24	28	3	0	0	0.006	0.001	409
AQ 2	Near new mosque	30	83	24	27	3	0	0	0.003	0.004	401

5.4.7 Noise

Noise, defined as unwanted sound, is perceived as an environmental stressor and nuisance and is associated with physical, mental and psychological stresses in humans. Exposure to continuous noise over 85-90 dB over a lifetime can lead to progressive hearing loss with an increased threshold of hearing sensitivity. Indirect effects of noise pollution include inducing non-auditory effects such as sleep disturbance and annoyance which eventually lead to stress responses, then symptoms and possibly illness. Noise exposure during sleep may increase blood pressure, heart rate and finger pulse amplitude as well as body movements. Physiological symptoms associated with noise exposure include nausea, headache, argumentativeness, mood changes and anxiety (Stansfeld & Matheson, 2003).

Noise levels requisite to protect public welfare and health against hearing loss, annoyance and activity interference as identified by the EPA of the United States specified noise levels of 70 dB as the level of environmental noise which will prevent any measurable hearing loss over a lifetime. Likewise, levels of 55 dB outdoors and 45 dB indoors are identified as preventing activity interference and annoyance. The latter are considered those which will permit spoken conversation and other activities such as sleeping, working and recreation which are part of the daily human activities (EPA Identifies Noise Levels Affecting Health and Welfare, 2016).

Children in particular are extremely vulnerable to both auditory and non-auditory health effects of noise. Studies of children exposed to environmental noise have consistently found effects on cognitive performance, decreased motivation, cardiovascular effects, endocrine disturbances as well as noise annoyance (Stansfeld & Matheson, 2003).

Table 25 shows the ambient noise level near the proposed utility area and control location. The geographic coordinates for the locations are given in Figure 2 and Table 3. Noise levels was fairly similar at both locations with maximum noise recorded at site N1 at 57.8 dB. Higher noise was triggered due to natural causes in both locations from wave breaking.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Table 25: ambient noise levels in Bodukaashihuraa

Code	Time	Location	Noise level (dB)		Observations
			Min	Max	
N 1	13:53	(Project construction site) Near Proposed Utilities	48.6	57.8	Waves breaking
N2	13:53	Control (Near proposed mosque)	51.1	54.7	Waves breaking

5.5 Socioeconomic Environment

This section describes the socioeconomic environment of the A.Dh. Hangnaameedhoo and Alif Dhaal atoll. Information on socioeconomic status was obtained from Maldives Population and Housing Census 2022 and 2014 and Isles website.

5.5.1 Demography for Alif Dhaal atoll

From 2006 to 2014 the population has increased moderately at an annual population growth rate of 18.2%. The population from year 2006 to 2014 increased from 6,921 to 8,183. According to the latest publications for 2022 Alif Dhaal Atoll have a registered population of 12,003 where 6,218 are males and 5,785 are females (Statistical Yearbook, 2023).

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

According to Isles website A.Dh. hangnaameedhoo had a decrease in registered population numbers on 2017 to 2022 which was from 736 to 416 individuals respectively. The local population that lives in island have gradually increased over the years from 1995 to 2022 according to isles publications (Isles, 2023).

Population	Maldivians			Foreigners		
	Female	Male	Total	Female	Male	Total
Census - 2022	207	209	416	8	60	68
Registered Poulation - 2017	347	389	736	-	-	-

Figure 43: registered population in A.Dh. Hangnaameedhoo from 2017 to 2022 (Isles, 2023)

Year	Maldivians			Foreigners		
	Female	Male	Total	Female	Male	Total
1985	141	118	259	-	-	-
1990	175	153	328	-	-	-
1995	215	179	394	-	-	-
2000	226	213	439	-	-	-
2006	245	213	458	-	-	-
2014	240	240	480	6	31	37
2022	207	209	416	8	60	68

Figure 44: shows population size at A.Dh. Hangnaameedhoo from 1985 to 2022 (Isles, 2023)

5.5.3 Income Situation and Distribution

With the unavailability of sufficient data regarding the income situation and distribution of the island specifically, Maldives population and Housing Census 2014 and Household Income & Expenditure Survey (HIES) 2016 report published by National Bureau of Statistics were used to reflect on the current income status in terms of atoll locality.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

According to Census 2006, manufacturing industry provided the most employment opportunities to the residents of Maldives. However, tourism being the most rapidly expanding industry and being the highest contributing sector to the Maldivian GDP, the results of Census 2014 revealed its vital role in creating employment opportunities for the country. More than a fifth of the employed Maldivians are engaged in the tourism industry and of the total employed, 27,837 or 14 percent work in the resorts (Maldives Population & Housing Census, 2014).

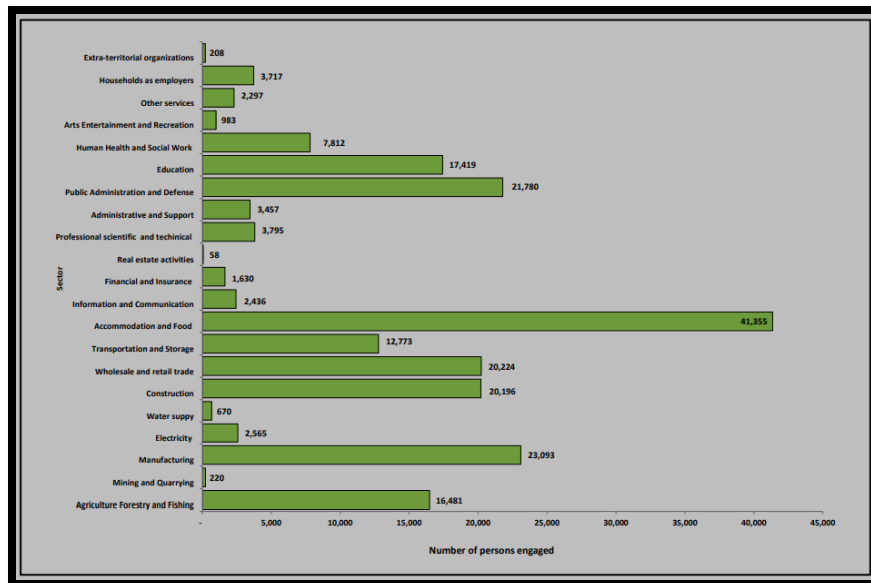


Figure 45: resident employed population by sector (Maldives Population & Housing Census, 2014)

HIES 2016 report states that out of the working age population (15 years and above) of Maldives, 66 percent were income earners. Earners also include those people not in employment but receives transfer incomes (eg: basic pension for the elderly). The report highlighted that on average 4.7 earners of Alif Dhaal Atoll generates income in water, sewer, waste and remediation activities sector and 4.2 from construction, activities of the household, information and communication (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016). This might not reflect Alif Dhaal atoll income distribution specifically as the atoll is more diverse, but a rough estimate can be determined of how the income generated is distributed in the atoll. The details of earner distribution on an atoll level are provided below.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Locality	Average number of earner by sector from the main Job																							
	A – Agriculture, forestry and fishing	B – Fishing	C – Mining and quarrying	D – Manufacturing	E – Electricity, gas, steam and air conditioning supply	F – Water supply; sewerage, waste management and remediation activities	G – Construction	H – Wholesale and retail trade; repair of motor vehicles and motor-cycles	I – Transportation and storage	J – Accommodation and food service activities	K – Information and communication	L – Financial and insurance activities	M – Real estate activities	N – Professional, scientific and technical activities	O – Administrative and support service activities	P – Public administration and defence; compulsory social security	Q – Education	R – Human health and social work activities	S – Arts, entertainment and recreation	T – Other service activities	U – Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	V – Activities of extraterritorial organizations and bodies		
Republic	2.9	2.9	3.0	3.0	2.8	3.1	3.1	3.2	3.0	3.1	2.8	3.4	3.0	3.3	2.7	3.0	3.0	3.0	3.9	3.2	2.8	4.0		
Male'	3.5	3.4	0.0	3.1	2.8	3.5	3.0	3.3	3.1	3.1	2.8	3.6	3.0	3.3	2.7	3.2	3.4	3.1	3.9	4.2	3.0	0.0		
Atolls	2.9	2.9	3.0	2.9	2.8	2.7	3.2	3.1	2.8	3.1	3.0	2.5	0.0	2.2	2.8	2.8	2.8	2.9	3.8	2.4	2.6	0.0		
HA	2.9	2.8	3.9	3.4	3.1	5.0	2.7	3.0	2.3	2.7	0.0	0.0	0.0	2.0	2.6	2.8	3.0	2.2	1.5	1.8	3.2	0.0		
Hdh	2.7	2.9	2.0	2.7	2.8	0.0	4.2	3.3	2.8	2.8	2.6	4.0	0.0	1.0	3.3	2.5	2.4	2.7	0.0	2.4	3.5	0.0		
Sh	3.0	2.9	1.7	2.8	2.6	0.0	3.1	3.0	2.6	3.2	0.0	1.0	0.0	0.0	3.2	2.7	2.8	2.8	3.0	2.0	1.5	0.0		
N	2.5	2.1	4.0	2.8	2.7	0.0	4.5	2.7	3.1	2.3	0.0	0.0	0.0	3.0	2.1	2.4	2.6	2.6	0.0	0.0	1.8	0.0		
R	2.4	2.3	0.0	2.3	2.3	2.0	1.9	2.6	1.9	2.5	2.4	0.0	0.0	0.0	3.0	2.4	2.6	2.8	4.0	3.1	1.6	0.0		
B	2.5	2.3	2.0	2.1	2.5	0.0	2.5	3.6	2.8	3.4	3.0	5.0	0.0	0.0	2.3	2.7	3.0	2.6	0.0	2.0	3.4	0.0		
Lh	2.3	2.5	0.0	2.4	3.0	1.5	2.7	2.7	2.9	1.9	1.7	1.9	0.0	2.9	0.0	2.8	2.6	2.6	0.0	1.0	2.9	4.0		
K	3.6	3.6	0.0	3.1	3.2	4.0	3.5	5.1	3.1	4.0	2.5	0.0	0.0	0.0	3.3	3.8	3.5	3.7	4.5	5.0	1.6	0.0		
AA	3.2	3.7	4.0	3.9	3.4	1.0	2.2	3.4	4.2	3.9	0.0	0.0	0.0	0.0	1.3	3.2	3.2	4.5	4.4	0.0	4.2	0.0		
Adh	3.7	3.6	4.0	3.5	2.8	4.7	4.2	3.9	4.0	3.3	4.2	3.0	0.0	2.5	4.0	3.3	3.5	3.9	2.0	2.6	4.2	0.0		
V	2.7	2.8	0.0	2.9	2.9	2.0	3.6	2.8	2.3	3.1	6.0	4.0	0.0	0.0	2.8	3.1	2.8	3.7	3.3	0.0	1.7	0.0		
M	3.4	3.4	0.0	3.7	4.3	0.0	2.8	3.2	3.3	6.0	3.0	4.0	0.0	0.0	2.7	3.3	3.3	3.1	0.0	2.2	1.0	0.0		
F	3.4	3.3	0.0	3.4	2.2	3.2	3.4	3.2	5.5	3.9	0.0	5.0	0.0	0.0	4.1	3.3	3.5	3.7	0.0	2.9	0.0	0.0		
Dh	3.6	3.6	0.0	3.3	3.7	3.0	4.1	3.3	4.9	2.5	0.0	3.5	0.0	0.0	3.2	3.0	3.1	2.7	13.0	3.0	4.4	0.0		
Th	2.6	2.4	3.0	3.0	3.2	0.0	2.9	2.8	3.3	3.7	0.0	2.0	0.0	2.0	2.0	2.9	2.6	3.0	0.0	2.5	3.5	0.0		
L	2.7	2.8	0.0	3.0	2.7	2.6	4.2	3.6	3.3	4.0	5.0	1.6	0.0	0.0	3.3	3.2	3.4	3.2	0.0	2.5	5.0	0.0		
GA	2.1	2.1	3.0	3.1	1.8	4.0	1.3	2.4	2.2	2.8	0.0	1.0	0.0	1.0	3.8	2.0	2.6	2.3	0.0	3.5	1.6	0.0		
Gdh	2.4	2.5	2.0	3.1	2.6	0.0	3.4	3.2	2.6	3.9	2.6	1.6	0.0	0.0	2.7	2.7	2.7	2.2	0.0	1.9	3.0	0.0		
Gn	2.4	2.0	0.0	3.8	2.4	0.0	2.0	2.1	1.6	2.1	2.3	4.1	0.0	2.3	3.5	2.2	2.5	1.9	4.0	2.4	1.2	0.0		
S	2.7	2.9	0.0	2.4	2.3	0.0	2.4	2.8	2.0	2.3	2.4	1.4	0.0	0.0	1.6	2.2	2.5	2.7	1.0	0.0	2.3	0.0		

Figure 46: average number of earner by sector from the main Job (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016).

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

HIES 2016 report further highlighted that, Haa Alif Atoll has the highest number of earners on average with 3.1 person per household, earning approximately 8,065MVR per earner. The following figures provides the atoll level breakdown with respect to average number of earners and their average income (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016).

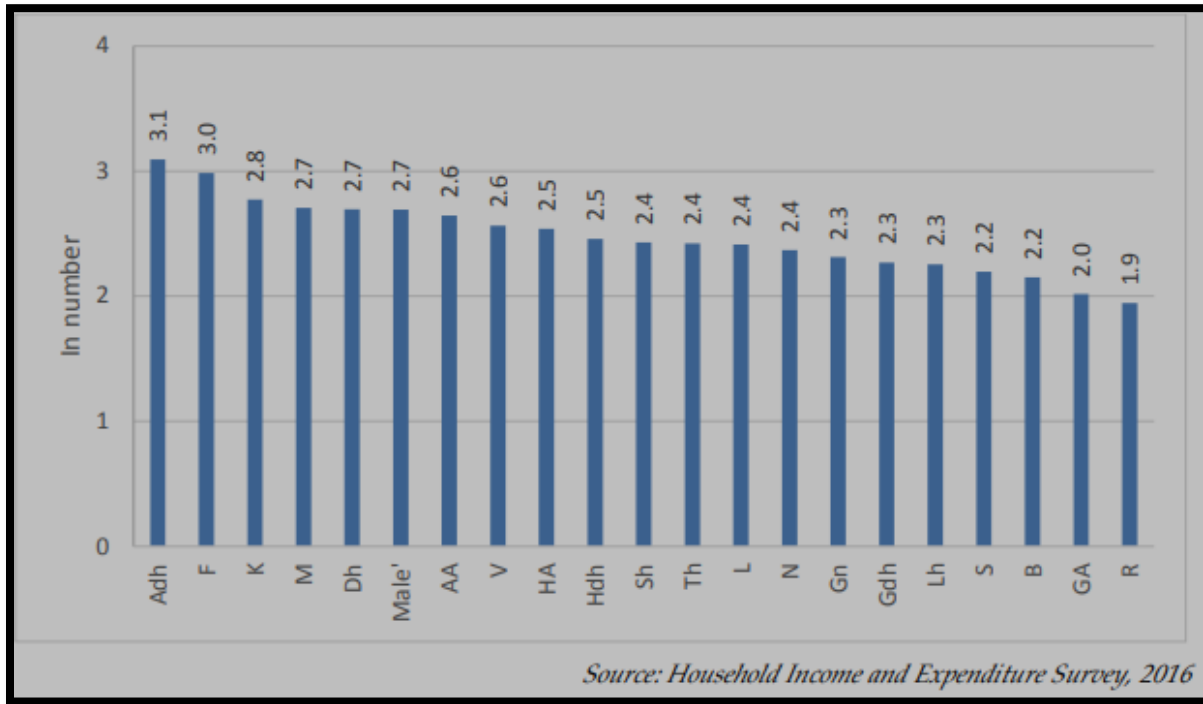


Figure 47: average number of earners by Atoll, 2016 (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016).

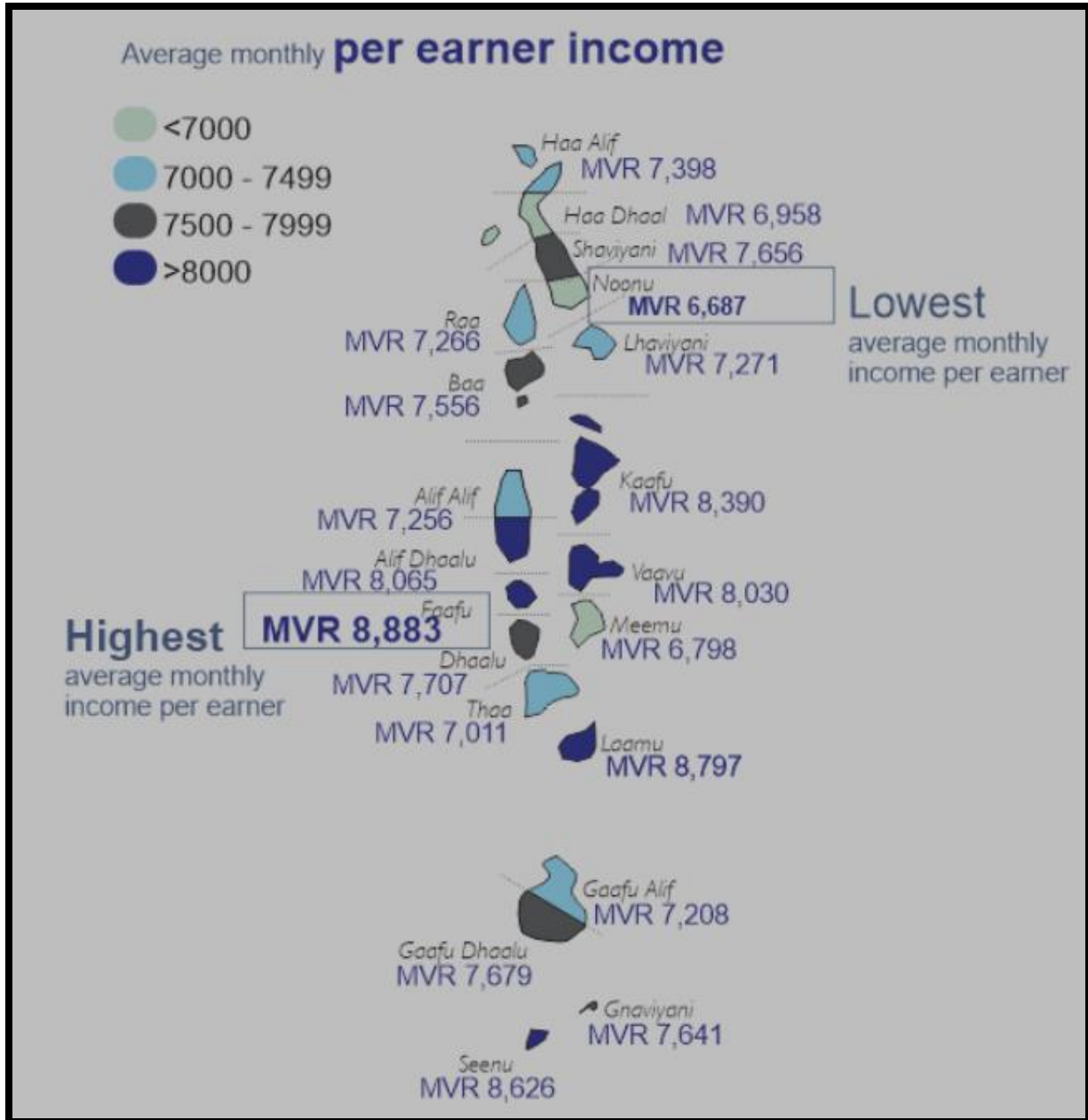


Figure 48: average monthly income per earner (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016).

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Moreover, figure provided below compares the earners by sex as a proportion of 15 years and above population of the respective sex. On average 79% of the 15 years and above male population are earners in Maldives. Alif Dhaal Atoll is one of the atolls which reportedly have 80% of 15 years and above male population as earners. Furthermore, it is reported that around 62% of 15 years and above female population in Alif Dhaal Atoll were recorded as earners (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016).

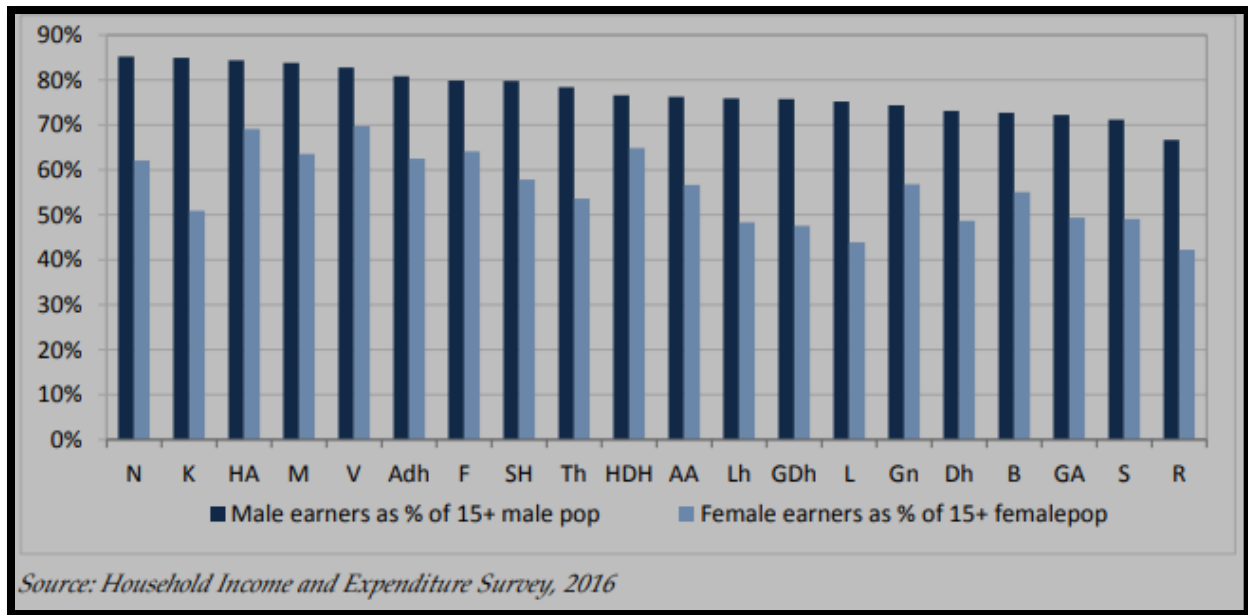


Figure 49: earners aged 15 and above population by sex and locality, 2016 (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016)

When it comes to unemployment rates, all the Atolls with the exception of Addu (S), Gnaviyani (Gn), Male’ Atoll (K), Faadhippolhu (Lh) and Male’ shows lower unemployment rates in 2014 compared to 2006. Alif Dhaal Atoll reported an unemployment rate of approximately 3.2 % in 2014 according to HIES Analytical Report (Household Income and Expenditure Survey (HIES) Analytical Report: Household Income, 2016).

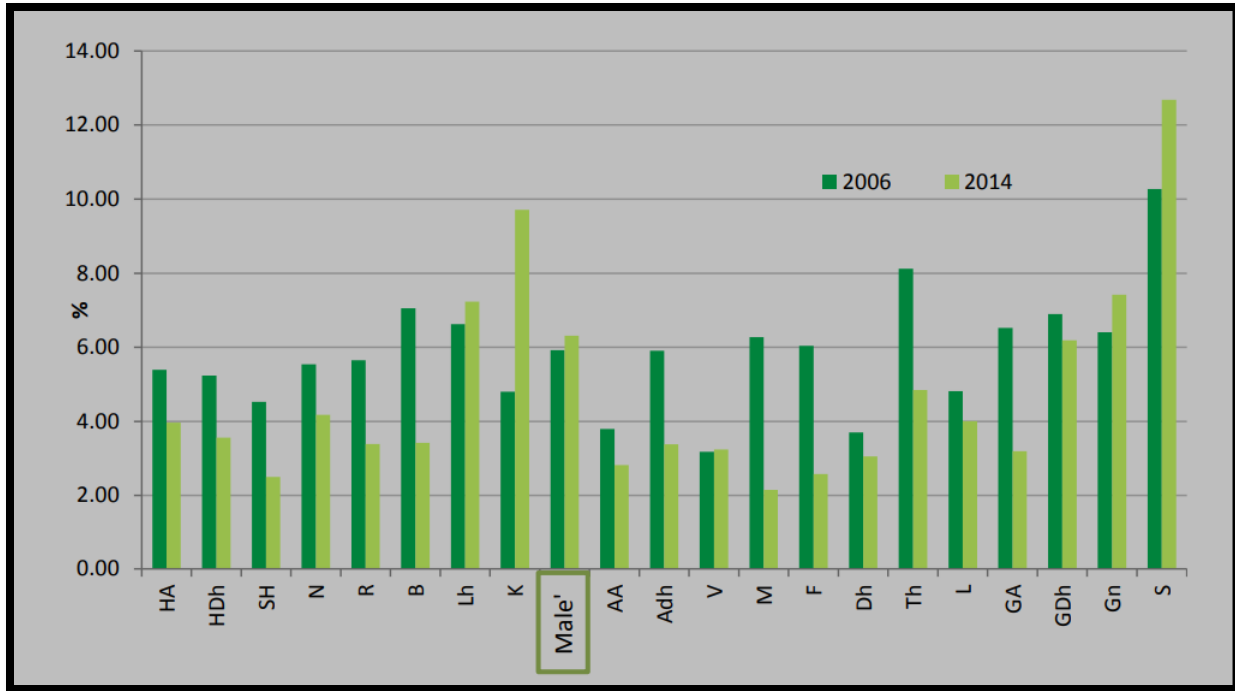


Figure 50: unemployment rate by locality, 2006 & 2014 (Maldives Population & Housing Census, 2014)

5.5.4 Healthcare Facilities

The following figure shows which regional and referral facility is available in each zone. Alif dhaal Atoll is located in zone 3. Zoning starts from the north.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

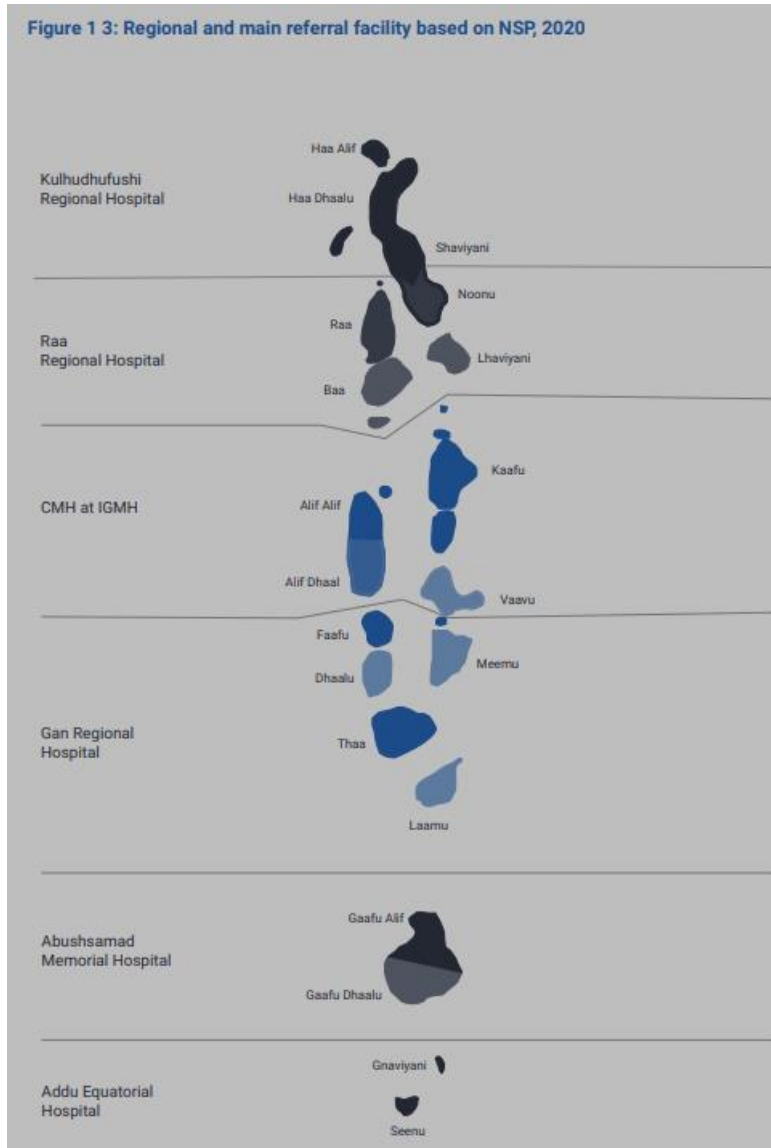


Figure 51: Regional and main referral facility found in each zone (Maldives Health Statistics, 2020).

Zone 3 where Alif dhaal Atoll is located have 38 public infrastructures with 6 hospitals and 31 healthcare centers. In the private sector 44 resort clinics, 61 allopathic clinic and 16 alternative clinic were reported highest in number. This can provide a general idea of which facilities are available in the region.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Table 1-2: Number of facilities by zones, 2020¹

Category	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6	Total
Private	9	33	158	12	12	16	240
Resort Clinic	5	27	44	7	8	1	92
Allopathic Clinic	3	4	61	4	3	11	86
Alternative Clinic			16				16
Dental Clinic			10	1			11
Optical Clinic	1		7			2	10
Laboratory		2	6		1		9
Psychotherapy & Social Service Center			7				7
Hospital			5			1	6
E.N.T Clinic			1			1	2
Physiotherapy Clinic			1				1
Public	41	46	38	42	18	5	190
Health Centre	38	41	31	37	16	3	166
Hospital	3	4	6	5	2	2	22
Allopathic Clinic		1	1				2
Total	50	79	196	54	30	21	430

Figure 52: Healthcare facilities available in each zone (Maldives Health Statistics, 2020).

5.5.5 Accessibility and Public Transport

According to the statistical yearbook of 2018 Alif Dhaal Atoll has 25 registered vessels. The atoll has 12 launches, 9 *Dhoni* and 4 small boats (*Bokkura*).

from theoretical analysis (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006). Likelihood of storm hazards for the island under concern are analyzed using this disaster risk management study done by the UNDP and likelihood of flooding is analyzed using rainfall data from the nearest meteorological center to each island. Some project site specific data are also obtained from consultation with the relevant stakeholders.

5.6.1 Storms

In addition to monsoonal heavy rains and strong winds, hazardous weather events which regularly affect the Maldives are tropical storms or tropical cyclones and severe local storms (thunder storms/thunder squalls) (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

Every so often, tropical cyclones hitting the Maldives are highly destructive due to associated strong winds that exceed a speed of 150 km/hr, heavy rainfall of above 30-40 cm in 24 hrs and storm tides that often exceed 4-5 m. Strong winds often damage vegetation, houses, communication networks and roads. Heavy rainfall is associated with serious flooding. Cyclonic winds can sometimes cause a sudden rise in sea level along the coast, leading to a storm surge. The combined effect of surge and tide, which is known as ‘storm tide’, can cause catastrophic events in low lying areas, flat coasts and islands such as the Maldives (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

Hazards associated with thunder storms include strong winds often exceeding a speed of 100 km/hr, heavy rainfall, lightning and hail. Such thunder storms are very frequent in the equatorial region, which is where the Maldives lie, however, they are less violent at this region. Moreover, land areas are more frequently hit by thunder storms than the open ocean. Strong winds generated by severe local storms generate large wind-driven waves which are hazardous for the Maldives (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

5.6.2 Cyclonic Winds

Studies of historic data suggests that even though the northern islands of the country were affected by weak cyclones which formed in the southern part of Bay of Bengal and the Arabian Sea, in general the Maldives islands were less prone to tropical cyclones. According to the cyclonic wind hazard zone classification, the north most islands represent the highest risk region and the hazard risk decreases moving down south (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

On a scale of 1-5, with 5 being the highest risk zone, A.Dh Bodukaashihuraa falls under the moderate-risk zone (Figure 26) (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

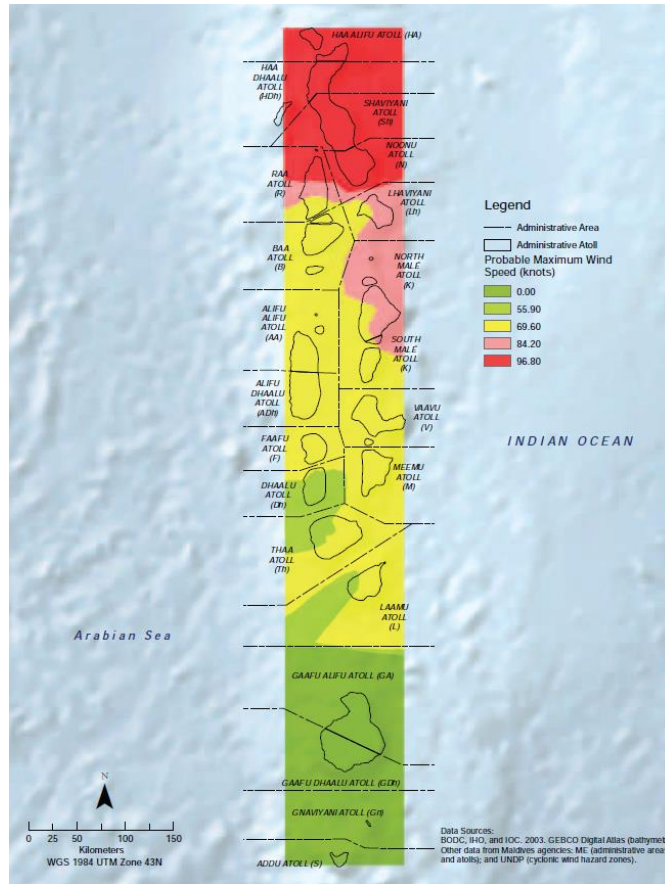


Figure 54: Cyclonic wind hazard map of the Maldives; from red to green, red being the highest at risk (Multihazard Risk Atlas of Maldives, 2020)

5.6.3 Storm Surge

According to the bathymetric surveys of the entire Maldives, the ocean slope towards the eastern side is steeper than the west coast which indicates that the eastern islands of the Maldives are more vulnerable to higher surge hazard compared to the western islands. Accordingly, the country has been divided into 5 broad storm surge hazard zones from 1-5, with 5 being the highest risk category. According to this zoning, A.Dh. Bodukaashihuraa is in Very low risk zone (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

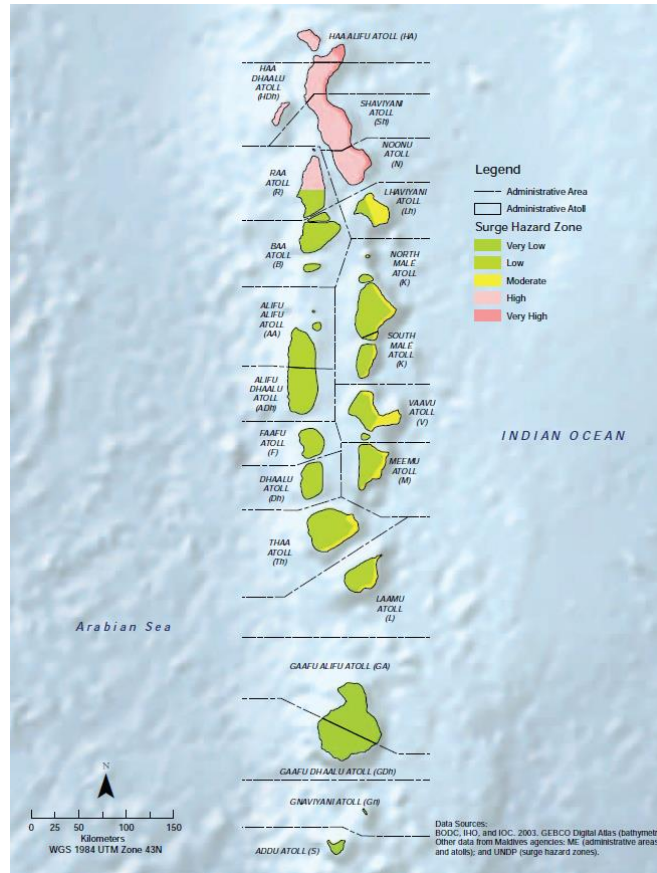


Figure 55: Storm hazard map of the Maldives from pink to green, pink being highest risk (Multihazard Risk Atlas of Maldives, 2020)

5.6.4 Flooding

Rainfall data from Hulhule’ meteorological station representing the study area has been used to analyze the flood and drought years at this region. Data has been standardized against the overall mean. Deducing from standard deviation of rainfall from long-term mean, it can be concluded that if the difference between long-term mean and standard deviation is >1 , that corresponding year is a flood year whereas if this difference is <-1 it may be considered a drought year.

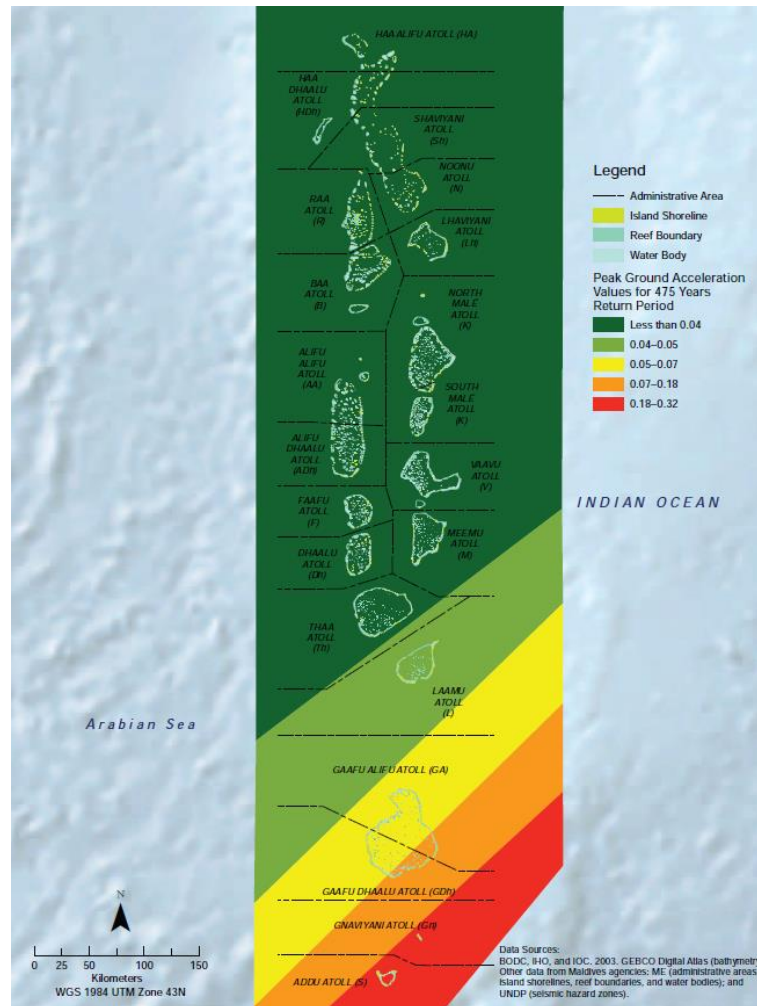
Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Geographically, Bodukaashihuraa is located at the central quadrant of the Maldives near Hulhule’ meteorological station. Analysis of rainfall data from Hulhule’ station showed that this part of the Maldives experienced more heavy rainfall (25) years than rain deficient (22) years. As for flooding, 7 years observed rainfall >1 standard deviation from the long-term mean (Figure 56) indicating that flooding is an uncommon occurrence at this part of the Maldives. The 10-year moving average predicts that 2023 will receive higher than normal rainfall.

5.6.5 Seismic Activity

Seismic waves are created when the earth’s lithosphere releases a sudden burst of energy shaking the surface of the planet. Earthquakes are manifested when fault lines or tectonic plates move due to these seismic waves. When this occurs at large magnitudes at the seabed, it can cause tsunamis. Only three major events of magnitude above 7.0 had struck the region between 1979 and 2004 (Developing a Disaster Risk Profile for Maldives, Volume 1: Main report, 2006).

A.Dh. Bodukaashihuraa is located in the Northern region which is in the lowest risk zone.



Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

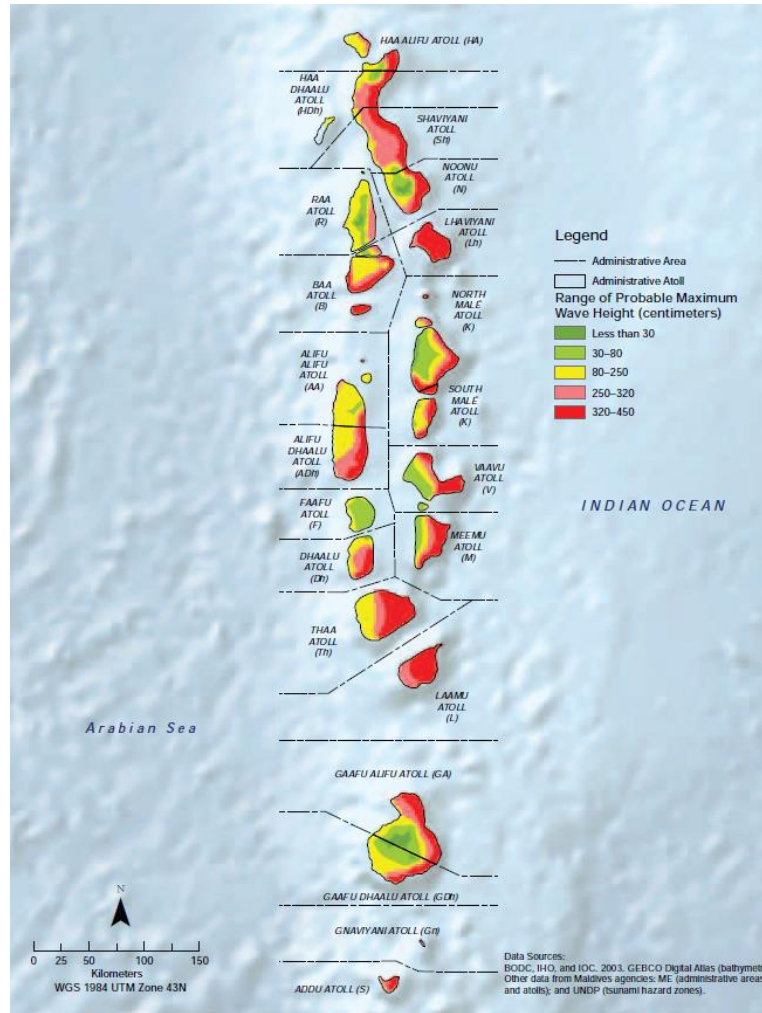


Figure 58: Tsunami hazard zoning map of Maldives (Multihazard Risk Atlas of Maldives, 2020)

6. STAKEHOLDER CONSULTATION

This section describes the stakeholder consultation method and the summary of the outcomes from each of the consulted stakeholders.

6.1 Consultation Method

An email request for stakeholder consultation was sent out to the relevant stakeholders with the approved ToR and a project brief. If the stakeholder wishes for a stakeholder consultation meeting, a meeting was supposed to be held at a convenient time and venue. An option was also given to provide the recommendations and suggestions regarding the proposed project to us in writing, whereby the stakeholder could send us an email highlighting their concerns and recommendations.

6.1.1 Invitations

The following table highlights the email requests sent out to stakeholders inviting for the stakeholder consultations. For the stakeholders that did not respond, the table shows the date at which the invitation was initiation sent and any follow up reminders. The proof for the invitations and reminders is given in the section 6.1.4 under the table Table 29.

Table 26: invitations sent out to stakeholders

Stakeholder	Initial Invitation Sent Date	Reminders	Responded Date
MMRI	06 th July 2023	None	11 th July 2023
NDMA	06 th July 2023	None	17 th July 2023
MoT	06 th July 2023	None	16 th July 2023
Alif Dhaal Atoll Council	06 th July 2023	17 th July 2023 20 th July 2023 2 nd August 2023 (2 calls)	None
A.Dh. Hangaameedhoo Council	06 th July 2023	17 th July 2023 20 th July 2023 8 th August 2023 2 nd August 2023 (1 call) 8 th August 2023 (1 call)	None

6.1.2 Consulted Date and Venues

The following table gives the consulted date, time and venues for each responded stakeholder(s).

Table 27: consultation date, time and venues

Stakeholder	Date	Time	Venue
MMRI	11 th July 2023	08:02 AM	E-mail response
MoT	16 th July 2023	11:36 AM	E-mail response
NDMA	17 th July 2023	10:00 - 10:20AM	E-conference

6.1.3 Contact Details for all Participants attended to Consultations

The following table gives the contact details of all participants which have attended the consultation meeting(s) for this EIA or contributed via email or letter response.

Table 28: contacts of all stakeholders consulted

Stakeholder	Name	Designation	Contact
Coral Reefs Section, MMRI, Ministry of Fisheries, Marine Resources and Agriculture	Hana Amir	Marine Biologist	hana.amir@mmri.gov.mv 3028708
Environment Unit, Ministry of Tourism	Mohamed Sinan	Environment Officer	sinan@tourism.gov.mv 3022236
National Disaster Management Authority	Fazeela Jaufaru	Development and Resilience Officer	fazeela.jaufaru@ndma.gov.mv 3333 402 9760669

6.1.4 Attendance Sheets for Consultation Meetings or proof of consultations

The following table shows the attendance sheets for consultation meetings (if any) and email proof of consultations with stakeholders.

Table 29: Attendance sheets (if any) and email proof for stakeholder consultations

Stakeholder	Attendance Sheet
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Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

<p>MMRI</p>	<p>Fathimath Hana Amir <hana.amir@mmri.gov.mv> To: Mahfooz Abdul Wahhab <mahfooz@ecotechconsultancy.com>, Ecosystems_mmri <ecosystems@mmri.gov.mv> Cc: Ecosystems_mmri <ecosystems@mmri.gov.mv>, Info_mmri <info@mmri.gov.mv>, "secretariat@ecotechconsultancy.com" <secretariat@ecotechconsultancy.com>, "rashihu@ecotechconsultancy.com" <rashihu@ecotechconsultancy.com> Tue, Jul 11, 2023 at 8:02 AM</p> <p>Dear Mahfooz,</p> <p>Please find MMRI's standard and project specific comments below:</p> <ul style="list-style-type: none"> • As a standard, MMRI recommends keeping an eye on the bleaching predictions (https://coralreefwatch.noaa.gov/product/vs/gauges/maldives.php). We strongly recommend reducing work at watch, halting any work if bleaching exceeds level 1 along with close and continuous monitoring of the reef if there is any sort of alert including "watch". Furthermore, we strongly urge that work be halted on observation of impact and stress of the reef at any of the project sites. • When is the project due to start? <ul style="list-style-type: none"> ◦ If it is when the EIA is complete, please give us a rough estimate when you expect the EIA to be completed and the project commence after. ◦ If the project is due in the Months of Feb-May, we strongly advise close monitoring of the reef for any impact and mitigate as much as possible. This is a period of known thermal stress and coral bleaching and additional stress from developments can affect reef health and recovery of all reefs in proximity to the project site. ◦ If the project is due in the months of Jan-April and Oct-Dec, we strongly advise close monitoring of the reef for any impact and mitigate sediment impacts as much as possible. This is a period of known coral spawning and too much stress can prevent spawning events which can affect reef health and recovery. • Have marine surveys been carried out at the reef and reefs near the project sites? We generally recommend the following for EIA projects. <ul style="list-style-type: none"> ◦ If surveys have been carried out what are the results of the survey? ◦ We strongly recommend surveying at a minimum of four locations (with replication) within each impact zone for each habitat at the project site at a minimum of two depths. This includes surveys of the benthos, coral recruitment, fish, invertebrates and water quality parameters to the highest resolution possible. We strongly urge corals to be recorded to genera and recording size class for fish surveys as this is a major reclamation and dredging project. • Are there any live corals in the project impact (access channel, reclamation area, shore protection (area) <ul style="list-style-type: none"> ◦ If there are live corals, are there plans to relocate any live corals or alternatively to use them for coral restoration project? <ul style="list-style-type: none"> ▪ Please note that the development and running of any marine restoration projects, including coral restoration/coral gardening/seagrass restoration requires a project permit from the Ministry of Fisheries, Marine Resources and Agriculture. ▪ If they are being translocated, we recommend that they be translocated to an area with the same or similar habitat, conditions, and communities. • Has the borrow area for the project been identified? • What are the plans for the dredge material from the access channel? • Can you confirm where the outfalls are located?
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Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

<p>MoT</p>	<p>sinan@tourism.gov.mv <sinan@tourism.gov.mv> Sun, Jul 16, 2023 at 11:36 AM To: Mahfooz Abdul Wahhab <mahfooz@ecotechconsultancy.com>, Ibrahim Fikree <ibrahim.fikree@tourism.gov.mv>, es@tourism.gov.mv Cc: "Ibrahim R. Adam" <rashihu@ecotechconsultancy.com>, Eco-Tech Consultancy <secretariat@ecotechconsultancy.com></p> <hr/> <p>Dear Mahfooz,</p> <p>Greetings from the Ministry of Tourism!</p> <p>With regards to your email and the TOR received, requesting for a stakeholder consultation to carry out the EIA for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll, please find the below comments;</p> <ul style="list-style-type: none"> • The project shall be carried out in accordance with the approved master plan ref: 88-DS/PRIV/2023/655 dated 16/05/2023 • Address all the terms highlighted in the approved ToR (Ref: 203-ECA/471/2023/337 dated 19th June 2023) of this project. • To minimize environmental damage special care and protection measures need to be undertaken during the project implementation stage. • Proper and effective mitigation measures should be implemented during the project implementation stage. • Include all possible information (permits/approvals) issued by the relevant authorities for the project. • Proper waste management mechanisms should be in place during construction and operational phase of the project. • Undocumented or illegal labors shall not be allowed during the construction and operational stage. • Proper health and safety measures and emergency first aid shall be provided to the project team. • Adequate temporary facilities including labor accommodation, electricity, water, site office and temporary storage area shall be provided during the implementation phase of the project. • Should fulfill all regulatory requirements prior to the commencement of the project activities.
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Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

NDMA	<p>Mahfooz Abdul Wahhab <mahfooz@ecotechconsultancy.com> Mon, Jul 17, 2023 at 10:34 AM To: Fazeela Jaufaru <fazeela.jaufaru@ndma.gov.mv> Cc: Eco-Tech Consultancy <secretariat@ecotechconsultancy.com>, "Ibrahim R. Adam" <rashihu@ecotechconsultancy.com></p> <p>Dear Fazeela,</p> <p>Attached please find the meeting minutes for the meeting held today. Please edit accordingly (if any).</p> <p>Best Regards,</p>  <p>Mahfooz Abdul Wahhab Managing Director Eco-Tech Consultancy Pvt. Ltd M. Husnoovilaa, Unigas Magu, Male', 20296, Kaafu Atoll, Maldives Website: www.ecotechconsultancy.com (+960) 9994467</p> <p>[Quoted text hidden]</p> <p> 230717 Outcomes of Stakeholder Consultation_NDMA_Bodukaashihuraa.docx 150K</p> <hr/> <p>Fazeela Jaufaru <fazeela.jaufaru@ndma.gov.mv> Mon, Jul 17, 2023 at 10:46 AM To: Mahfooz Abdul Wahhab <mahfooz@ecotechconsultancy.com> Cc: Eco-Tech Consultancy <secretariat@ecotechconsultancy.com>, "Ibrahim R. Adam" <rashihu@ecotechconsultancy.com></p> <p>Dear Mahfooz,</p> <p>Please find the attached meeting minutes document with a minor change.</p> <p>Best Regards.</p>
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6.1.5 Proof of Invitations sent out for not responded stakeholders

The following table shows the proof of email invitations sent out for the stakeholders that did not respond.






Table 30: proof of invitation sent out to stakeholders

Stakeholder	Partial print of invitations sent out
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Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

<p>Alif Dhaal atoll council</p>	<p>8/8/23, 7:10 PM Gmail - Request for Stakeholder Consultation for EIA for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal ...</p> <p> Ibrahim R. Adam <rashihuadam@gmail.com></p> <hr/> <p>Request for Stakeholder Consultation for EIA for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll</p> <p>5 messages</p> <hr/> <p>Mahfooz Abdul Wahhab <mahfooz@ecotechconsultancy.com> Thu, Jul 6, 2023 at 9:28 AM To: admin@adh.gov.mv Cc: "Ibrahim R. Adam" <rashihu@ecotechconsultancy.com>, Eco-Tech Consultancy <secretariat@ecotechconsultancy.com></p> <p>Dear Sir,</p> <p>We are currently in the process of formulating the EIA for the development of a resort in A.Dh Bodukaashihuraa. After the scoping, EPA has identified you as a relevant stakeholder to be consulted regarding the proposed project. As such we would like to have a stakeholder consultation with you regarding the project or you could also send your comments in writing to this email to be incorporated in our report.</p> <p>Following are the main discussions and suggestion made during the consultation meeting;</p> <ul style="list-style-type: none"> • What are the specific regulatory compliances that the proponent of this proposed project must adhere to under Atoll Council ? • What are the specific concerns or suggestions that Atoll Council has in regards to the proposed project that you wish to relay to the proponent ? • Is there any environmentally sensitive area near the proposed project site ? <p>Best Regards,</p> <p> ECO-TECH CONSULTANCY</p> <p>Mahfooz Abdul Wahhab Managing Director Eco-Tech Consultancy Pvt. Ltd M. Husnoovilaa, Unigas Magu, Male', 20296, Kaafu Atoll, Maldives Website: www.ecotechconsultancy.com (+960) 9994467</p>
	<hr/> <p>Mahfooz Abdul Wahhab <mahfooz@ecotechconsultancy.com> Thu, Jul 6, 2023 at 9:37 AM To: admin@adh.gov.mv Cc: "Ibrahim R. Adam" <rashihu@ecotechconsultancy.com>, Eco-Tech Consultancy <secretariat@ecotechconsultancy.com></p> <p>Dear Sir,</p> <p>Apologies for the write up regarding the clarification points, it should as this;</p> <p>Following are the points that we would like to clarify from your side;</p> <ul style="list-style-type: none"> • What are the specific regulatory compliances that the proponent of this proposed project must adhere to under Atoll Council ? • What are the specific concerns or suggestions that Atoll Council has in regards to the proposed project that you wish to relay to the proponent ? • Is there any environmentally sensitive area near the proposed project site ? <p>Best Regards,</p> <p>https://mail.google.com/mail/u/0/?ik=0aa1e23893&view=pt&search=all&permthid=thread-f:1770643973769296414&simpl=msg-f:17706439737692964... 1/3</p>

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

	<p>8/8/23, 7:10 PM Gmail - Request for Stakeholder Consultation for EIA for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal ...</p> <div style="text-align: center;">  <p>ECO-TECH CONSULTANCY</p> </div> <p>Mahfooz Abdul Wahhab Managing Director Eco-Tech Consultancy Pvt. Ltd M. Husnoovilaa, Unigas Magu, Male', 20296, Kaafu Atoll, Maldives Website: www.ecotechconsultancy.com (+960) 9994467</p> <p>[Quoted text hidden]</p> <hr/> <p>Mahfooz Abdul Wahhab <mahfooz@ecotechconsultancy.com> Thu, Jul 6, 2023 at 1:22 PM To: admin@adh.gov.mv Cc: "Ibrahim R. Adam" <rashihu@ecotechconsultancy.com>, Eco-Tech Consultancy <secretariat@ecotechconsultancy.com></p> <p>Dear Sir,</p> <p>Apologies, I missed the attachments in my previous mail.</p> <p>Best Regards,</p> <div style="text-align: center;">  <p>ECO-TECH CONSULTANCY</p> </div> <p>Mahfooz Abdul Wahhab Managing Director Eco-Tech Consultancy Pvt. Ltd M. Husnoovilaa, Unigas Magu, Male', 20296, Kaafu Atoll, Maldives Website: www.ecotechconsultancy.com (+960) 9994467</p> <p>[Quoted text hidden]</p> <hr/> <p>3 attachments</p> <ul style="list-style-type: none">  230605 Project brief_EIA_Resort Development_A.Dh Bodukaashihuraa.pdf 1209K  230617 scoping ppt_Resort developmnet at ADh. Bodukashi Huraa .pdf 577K  230619 Approved ToR_EIA for the Proposed Resort Development Project at ADh. Bodukaashihuraa.pdf 632K <hr/> <p>Ibrahim R. Adam <rashihu@ecotechconsultancy.com> Mon, Jul 17, 2023 at 12:59 PM To: admin@adh.gov.mv Cc: Eco-Tech Consultancy <secretariat@ecotechconsultancy.com>, Mahfooz Abdul Wahhab <mahfooz@ecotechconsultancy.com></p> <p>Dear Sir,</p> <p>Kind reminder for the previously mentioned consultation request. Waiting for your response at your earliest convenience.</p> <p>https://mail.google.com/mail/u/0/?ik=0aa1e23893&view=pt&search=all&permthid=thread-f:1770643973769296414&simpl=msg-f:17706439737692964... 2/3</p>
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Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

<p>A.Dh. Hangnaameedhoo council</p>	<p>8/9/23, 5:25 AM Gmail - Request for Stakeholder Consultation for EIA for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal ...</p> <p> Ibrahim R. Adam <rashihuadam@gmail.com></p> <hr/> <p>Request for Stakeholder Consultation for EIA for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll 5 messages</p> <hr/> <p>Mahfooz Abdul Wahhab <mahfooz@ecotechconsultancy.com> Thu, Jul 6, 2023 at 9:31 AM To: info@hangnaameedhoo.gov.mv Cc: "Ibrahim R. Adam" <rashihu@ecotechconsultancy.com>, Eco-Tech Consultancy <secretariat@ecotechconsultancy.com></p> <p>Dear Sir,</p> <p>We are currently in the process of formulating the EIA for the development of a resort in A.Dh Bodukaashihuraa. After the scoping, EPA has identified you as a relevant stakeholder to be consulted regarding the proposed project. As such we would like to have a stakeholder consultation with you regarding the project or you could also send your comments in writing to this email to be incorporated in our report. Furthermore, if you could provide socioeconomic data of the Island in the attached file, it would be greatly appreciated.</p> <p>Best Regards,</p> <p> ECO-TECH CONSULTANCY</p> <p>Mahfooz Abdul Wahhab Managing Director Eco-Tech Consultancy Pvt. Ltd M. Husnoovilaa, Unigas Magu, Male', 20296, Kaafu Atoll, Maldives Website: www.ecotechconsultancy.com (+960) 9994467</p> <p> 230603 Socioeconomic info required from council.docx 172K</p> <hr/> <p>Mahfooz Abdul Wahhab <mahfooz@ecotechconsultancy.com> Thu, Jul 6, 2023 at 1:23 PM To: info@hangnaameedhoo.gov.mv Cc: "Ibrahim R. Adam" <rashihu@ecotechconsultancy.com>, Eco-Tech Consultancy <secretariat@ecotechconsultancy.com></p> <p>Dear Sir,</p> <p>Apologies I missed the attachments in my previous mail.</p> <p>Best Regards,</p> <p> ECO-TECH CONSULTANCY</p> <p>Mahfooz Abdul Wahhab Managing Director Eco-Tech Consultancy Pvt. Ltd M. Husnoovilaa, Unigas Magu,</p> <p>https://mail.google.com/mail/u/0/?ik=0aa1e23893&view=pt&search=all&permthid=thread-f:1770644185125597501&simpl=msg-f:17706441851255975... 1/3</p>
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6.2 Consultations Undertaken

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Stakeholder consultations were undertaken with the MMRI, NDMA and MoT. The summary of outcomes is given for each stakeholder below and the responses from the proponent for the concerns raised.

6.2.1 MMRI

The table below shows the concerns, suggestions and recommendations made by MMRI regarding the proposed project along with the responses for the concerns (if any) which were raised.

Table 31: outcomes of the consultation with MMRI

Concerns / Suggestions raised	Response
As a standard, MMRI recommends keeping an eye on the bleaching predictions (https://coralreefwatch.noaa.gov/product/vs/gauges/maldives.php). We strongly recommend reducing work at watch, halting any work if bleaching exceeds level 1 along with close and continuous monitoring of the reef if there is any sort of alert including "watch". Furthermore, we strongly urge that work be halted on observation of impact and stress of the reef at any of the project sites.	These mitigation measures will be incorporated into the EIA report.
When is the project due to start? If it is when the EIA is complete, please give us a rough estimate when you expect the EIA to be completed and the project commence after. If the project is due in the Months of Feb-May, we strongly advise close monitoring of the reef for any impact and mitigate as much as possible. This is a period of known thermal stress and coral bleaching and additional stress from developments can affect reef health and recovery of all reefs in proximity to the project site. If the project is due in the months of Jan-April and Oct-Dec, we strongly advise close monitoring of the reef for any impact and mitigate sediment impacts as much as possible. This is a period of known coral spawning and too much stress can prevent spawning events which can affect reef health and recovery.	March 2024. These mitigation measures will be incorporated into the EIA report.
Have marine surveys been carried out at the reef and reefs near the project sites? We generally recommend the following for EIA projects.	Fish census, benthic substrate analysis, and currents have been studied at all construction sites.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

<p>If surveys have been carried out what are the results of the survey?</p> <p>We strongly recommend surveying at a minimum of four locations (with replication) within each impact zone for each habitat at the project site at a minimum of two depths. This includes surveys of the benthos, coral recruitment, fish, invertebrates and water quality parameters to the highest resolution possible. We strongly urge corals to be recorded to genera and recording size class for fish surveys as this is a major reclamation and dredging project.</p>	<p>The raw data indicate that the reef of Bodukaashihuraa has a very diverse fish community at most of the locations.</p>
<p>Are there any live corals in the project impact (access channel, reclamation area, shore protection area)?</p> <p>If there are live corals, are there plans to relocate any live corals or alternatively to use them for coral restoration project?</p> <p>Please note that the development and running of any marine restoration projects, including coral restoration/coral gardening/seagrass restoration requires a project permit from the Ministry of Fisheries, Marine Resources and Agriculture.</p> <p>If they are being translocated, we recommend that they be translocated to an area with the same or similar habitat, conditions, and communities.</p>	<p>Access channel; Yes Reclamation area; No Shore protection area; No</p> <p>The EIA consultants recommend to translocate them or use them in coral restoration project.</p>
<p>Has the borrow area for the project been identified?</p>	<p>Yes, the proposed burrow area is on the western side of the island, while the alternative on the eastern side, the locations are already marked on the concept approval.</p>
<p>What are the plans for the dredge material from the access channel?</p>	<p>The sand from the access channel dredging will be used to reclaim the proposed area on the Island.</p>
<p>Can you confirm where the outfalls are located?</p> <p>We strongly recommend that this be directed to a location with good water flow and the possibility of a buildup is minimal.</p>	<p>Outfall is proposed to be discharged out of the reef from the southern end of the Island as marked on the concept approval. The final location of the outfalls will be recommended based on the current speeds.</p>
<p>As this project has a major reclamation component:</p> <p>we strongly recommend close monitoring and either halting or slowing work where the impacts or stress is observed.</p> <p>We strongly recommend the implementation of relevant mitigation measures from the start of the project</p>	<p>The consultants also recommend to submit monitoring reports to EPA during construction and operational phase of the project as per the monitoring schedule that will be prescribed under this EIA report. Proper mitigation measures will be proposed for the proponent to follow during the construction and operation phase of the project under this EIA report.</p>

6.2.2 MoT

The table below shows the concerns, suggestions and recommendations made by MoT regarding the proposed project along with the responses for the concerns (if any) which were raised.

Table 32: outcomes of the consultation with MoT

Concerns / Suggestions raised	Proponents Response
The project shall be carried out in accordance with the approved master plan ref: 88-DS/PRIV/2023/655 dated 16/05/2023	The project will be carried out in accordance with the approved EIA which will be prepared as per the approved master plan for the resort development
Address all the terms highlighted in the approved ToR (Ref: 203-ECA/471/2023/337 dated 19th June 2023) of this project.	The EIA will cover all aspects highlighted in the ToR
To minimize environmental damage special care and protection measures need to be undertaken during the project implementation stage.	The mitigation measures highlighted in the EIA report will be followed
Proper and effective mitigation measures should be implemented during the project implementation stage.	
Include all possible information (permits/approvals) issued by the relevant authorities for the project.	The EIA report will include a list of permits issued
Proper waste management mechanisms should be in place during construction and operational phase of the project.	Waste management will be as per the waste management regulations and guidelines
Undocumented or illegal labors shall not be allowed during the construction and operational stage.	The project management team will ensure that all workers hired are as per best practices
Proper health and safety measures and emergency first aid shall be provided to the project team.	Will ensure these are fulfilled
Adequate temporary facilities including labor accommodation, electricity, water, site office and temporary storage area shall be provided during the implementation phase of the project.	
Should fulfill all regulatory requirements prior to the commencement of the project activities.	

6.2.3 NDMA

The table below shows the concerns, suggestions and recommendations made by NDMA regarding the proposed project along with the responses for the concerns (if any) which were raised.

Table 33: outcomes of the consultation with NDMA

Concerns / Suggestions raised	Proponents Response
Is the proposed outfall site studied?	Yes, the bathymetry and marine assessments (benthic substrate analysis, fish census, currents) have already been done.
Is an STP included in the development of this resort?	Yes, STP is proposed to be established.
Will adequate amount of sand be sourced from the burrow area and what will happen to extra dredge material.	The sand from the access channel construction will be first used for the reclamation. Additional sand required will be sourced from the burrow area until the required reclamation area is fulfilled so that additional sand will not be dredged from the burrow area.
Is there a dewatering plan during the construction of the pump stations for the sewer system?	Currently there is no dewatering plan as the pump station locations are not finalized. However, dewatering permit will be acquired from EPA during the construction of the pump stations and dewatering will be carried out as per the existing regulations.
How will power be acquired during the construction phase of the project?	A stand-by gen-set will be installed at the Island, along with a small RO plant.
How will waste be managed during construction?	Waste will be designated at specific storage areas and compiled to be shipped routinely to Thilafushi for disposal.
Will there be a storm water drainage system for the reclamation area?	It is not certain at this stage as the design are not finalized. But the concern regarding storm water drainage will be relayed to the design team.
Ensure that all the workers are provided with PPE, safety hats and shoes	These mitigation measures will be incorporated into the EIA.
Warning sign boards to be established and provide adequate lighting during work to maintain workplace safety	
Workers shall be trained on evacuation procedures	
A mitigation plan shall be made	
There is no site-specific recent disaster risk profile for any nearby Islands to the project site.	-

7. POTENTIAL IMPACT ANALYSIS

The impacts from any project can be categorized into two broad categories; constructional and operational impacts. Constructional impacts are the potential impacts which might arise during the construction stage of the proposed project. Operational impacts are the potential impacts which might arise once the newly constructed project facilities become operational.

7.1 Impact Assessment Methodology

The proponent and the consultants have conducted a risk-based environmental review as part of the planning process (Risk Management-Principles and Guidelines, 2011). Data has been drawn from a wide range of sources, including existing similar EIA reports. Similar EIA reports reviewed for the formulation of this EIA include but not limited to the reports mentioned under section 1.5.

The impact assessment was conducted based on professional judgment and expertise of the consultants as well as evaluation of the baseline data and consultation with the stakeholders. This provides an outline on how to identify potential impacts associated with the proposal and evaluate the likelihood and consequences. The impact assessment methodology utilized was also consistent with the methodology outlined in AS/NZS ISO31000 (AS/NZS ISO 31000 : 2009 Risk management - Principles and guidelines, 2009).

The first stage of this methodology was to identify potential impacts. To ensure that all potential impacts were identified, it was important that any specific environment and/or community impact issues were determined based on the locations of the project components as well as type of service to be provided (Wild Environment, 2012). As such, the impacts identified were:-

1. Construction Phase Impacts:-

- Mobilization impacts- Direct damage to benthos and sedimentation
- Mobilization impacts- Noise
- Mobilization impacts- Dust

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Mobilization impacts- Oil spills at sea
 - Mobilization impacts- Oil spills on ground
 - Mobilization impacts- workforce; covid episode, negative social impacts, illegal labor
 - Generation of site clearance, demolition and constructional waste
 - Vegetation clearance
 - Vibration impacts
 - Air Quality-GHGs
 - Air Quality-Dust
 - Noise Pollution
 - Groundwater quality- oil and chemical spills
 - Groundwater quality- salinization
 - Impacts on marine environment
 - Impacts on terrestrial environment- soil and ground
 - Impacts on coastal environment
 - Risk of accidents and pollution on workers
 - Impacts on landscape integrity and scenery
 - Socio-economic impacts
2. Operational Phase Impacts:-
- Air Quality- GHGs
 - Air Quality- dust
 - Noise Pollution
 - Ground and marine water quality- negative
 - Impacts on marine environment
 - Impacts on hydrodynamics
 - Impacts on coastal environment
 - Impacts from vibration
 - Impacts from waste
 - Health and safety of working staff

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Impacts on landscape integrity and scenery
- Socio-economic impacts - negative
- Socio-economic impacts - positive
- Risk of hazards- storm surge
- Risk of hazards- sea level rise
- Risk of hazards- fire and other workplace accidents

The significance of impacts was assessed using the following matrix (Table 34).

Table 34. Impact assessment matrix (Wild Environment, 2012)

Likelihood	Consequences				
	Minimal (1)	Minor (2)	Moderate (3)	Major (4)	Catastrophic (5)
Remote (1)	Negligible	Negligible	Very low	Low	Medium
Unlikely (2)	Negligible	Very low	Low	Medium	High
Possible (3)	Very low	Low	Medium	High	Very high
Likely (4)	Low	Medium	High	Very high	Significant
Certain (5)	Medium	High	Very high	Significant	Significant

Characteristics of the impacts on Table 35 is used to determine the consequences (minimal (1), minor (2), Moderate (3), Major (4), Catastrophic (5)) of each identified impact. For each specific consequence there is 5 likelihood categories (Table 34). Therefore, if an impact has Moderate (3) consequence but a likelihood of Remote (1), then that impact would have “very low” significance. However, if the likelihood is Certain (5) then the impact would have “Very high” significance

Criteria used for assessing the identified impacts are as follows. Note that likelihood and consequences were judged based on the design consideration for the proposed development. These criteria were measured against the impact (if the impact occurred), to ecological and/or human health (Wild Environment, 2012):-

- Likelihood:-
 - Remote- May occur only in exceptional circumstances;
 - Unlikely- Could occur at some time;
 - Possible- Might occur at some time;

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Likely- More likely to happen than not (i.e. a probability of > 50 %); and
- Certain- Will probably occur in most circumstances.
- Consequences:-
 - Minimal- Impact has no significant risk to environment either short term or long term;
 - Minor- The impact is short term and causes very limited risk to the environment;
 - Moderate- Impact gives rise to some concern, may cause long term environmental problems but are likely short term and acceptable;
 - Major- Impact is long term, small scale and environmentally risky. Impact severely damages the environment; and
 - Catastrophic- Impact is long term and irreversible, large scale and detrimental to the environment.

The likelihood measures the probability of occurrence of an event whereas consequences evaluate the significance of impact on the environment in the event of an incident. Based on the likelihood and consequences for each of the identified impacts, the significance level is determined (Table 34).

Impact characteristics such as the type of impact, nature of the impact, impact range, impact duration as well as reversibility of the impacts were assessed using the grading scales for which are given on Table 35 below.

Table 35. Grading scale of the characteristics of impacts

Characteristic of impact	Grading	Explanation
Type	Direct	Direct impacts without intervening factors or intermediaries
	Indirect	Triggered by but not immediate effect of the proposed project
Nature	Positive	Impacts resulting in a desirable effect
	Negative	Impacts resulting in an undesirable effect
	Cumulative	Impacts of an action when combined with impacts from projects or actions that have been undertaken recently or will be carried out in the near future.
Range	Local	Impacts limited to project site
	Island	Impacts of importance at island level
	Atoll	Impact of importance at Atoll level

	Nation	Impacts of national character
Duration	Short-term	Occurring over a short period of time
	Intermittent	Impacts occurring at irregular intervals
	Long-term	Occurring over a long period of time
	Continuous	Impacts occurring continuously
Reversibility	Reversible	Previous state (or equivalent) can be restored
	Irreversible	Not able to alter the consequence of impact

7.2 Justification for selected Impact Prediction and Assessment Method

The most common methods of impact prediction include the usage of checklist, matrices, networks, overlays, GIS and computer expert systems. The use of any single method has its disadvantages for instance checklist maybe easy to understand and use but it does not distinguish between direct and indirect impacts (UNEP, 2002). Matrices are good for displaying EIA results and links actions to impacts however have the disadvantage of double-counting of impacts. Networks can distinguish between direct and indirect impacts but can be very complex. Overlays are good at displaying spatial impacts but does not address impact duration and probability. GIS and computer expert systems are good for impact identification and spatial analysis but requires a lot of data.

The employed method in this EIA is a combination of all of the above-mentioned methods with the addition of profession judgement of the consultant from past experiences that provide an easy and simple method to analyze impacts with limited data. The method can distinguish between direct, indirect and cumulative impacts while linking project activities to impacts. The method distinguishes impacts that can realistically be detrimental to the environment by linking consequences of an impact to its probability of occurrence. Finally, this method consumes very less time and hence rapid assessments can be made which is especially advantageous in the Maldives where EIA consultants are expected to complete EIAs in a very short duration.

7.3 Limitations and Uncertainties in Impact Prediction and Assessment Method

Risks and uncertainties are inherent in any environmental and ecological problem-solving technique and needs to be acknowledged and incorporated in any decision-making process. Risk is the chance that an adverse outcome occurs while uncertainty arises from an imperfect understanding of a system due to uncertainty about facts (McAlpine, et al., 2010). Our understanding of the environment is limited mainly due to the lack of long-term data and complexity of the ecosystem. For example, the assessments were done during one season and impacts are predicted based on these assessments. However, how the magnitudes of these impacts and how they behave in nature during the other season is quite uncertain.

The potential environmental impacts from the proposed project are all predicted, hence there may be variables affecting the accuracy of these impacts due to natural variations such as site conditions and uncertainties in scales and magnitudes. While every attempt has been made to accurately predict the potential impacts from this project, there are unforeseen and uncertain factors which might cause deviations in the impacts outlined herein. For instance, a natural phenomenon.

Moreover, assessment of existing conditions requires a benchmark against which these conditions can be compared, however, lack of such benchmarks is a great hindrance to analyzing the environmental impacts in some instances. In addition to this, limited time availability and lack of available factual information are among major limitations to impact predictions. In the Maldives, more often than not, limited availability of published information on environmental and social environment of the islands has led to the dependency on verbal communication with locals and other stakeholders which are not always very accurate.

To add, a major uncertainty arises from the lack of information about the project activities from developers which leads to assumptions being made based on the experience of consultants, for example the proposed development will be designed and built conforming to international standards, the working staff at the facility will be well trained, will follow O&M procedures and operational plan diligently and the prescribed mitigation measures in this EIA report will be followed by the proponent

Anyhow, based on the risk assessment outlined above, the environmental impact assessment is set out below:-

7.4 Construction Phase Impacts

This section describes the significance (Table 36) and impact characteristics for the construction phase impacts.

Table 36. Predicted impacts and anticipated significance of impacts during construction phase of the project

Potential Impacts	Likelihood	Consequence	Significance
Mobilization impacts- Direct damage to benthos and sedimentation	Certain	Major	Significant
Mobilization impacts- Noise	Certain	Minor	High
Mobilization impacts- Dust	Possible	Minor	Low
Mobilization impacts- Oil spills at sea	Possible	Moderate	Medium
Mobilization impacts- Oil spills on ground	Possible	Major	High
Mobilization impacts- workforce; covid episode, negative social impacts, illegal labor	Possible	Moderate	Medium
Generation of site clearance, demolition and constructional waste	Possible	Moderate	Medium
Vegetation clearance	Certain	Catastrophic	Significant
Vibration impacts	Remote	Moderate	Negligible
Air Quality-GHG's	Certain	Catastrophic	Significant
Air Quality-Dust	Certain	Minor	High
Noise Pollution	Certain	Minor	High
Groundwater quality- oil and chemical spills	Possible	Major	High
Groundwater quality- salinization	Certain	Major	Significant
Impacts on marine environment	Certain	Catastrophic	Significant
Impacts on terrestrial environment- soil and ground	Certain	Major	Significant
Impacts on coastal environment	Certain	Major	Significant
Risk of accidents and pollution on workers	Possible	Catastrophic	Very High
Impacts on landscape integrity and scenery	Certain	Catastrophic	Significant
Socio-economic impacts	Possible	Minor	Low

Impacts during construction phase of the project are mainly anticipated to be short-term and reversible (Table 37) as most impacts will last only for the duration of the construction phase of the project.

the corals on the sides of the access channel maybe destroyed during the mobilization. Additionally indirect damages are envisaged from the turbidity and sediment plume that will be generated during the mobilization activities. The range of the impact would be localized to the area around the mobilization route. The impact is expected to be short-term as the mobilization will be completed within a short period of time. This impact is irreversible as the destroyed corals would take a long time to grow back. Considering the aforementioned characteristics of the impact, the consequences from the impact is considered major. The likelihood of this impact occurring is certain as the corals on the footprint of barge mobilization route will be destroyed. Therefore, the significance score for this impact is significant.

7.4.2 Mobilization Impacts - Noise

Noise is expected to be generated due to the direct activities of the project from the mobilization of barge, high-bed excavator and other heavy vehicles, machinery and materials to the Island. The impact is expected to be negative as the noise generated may scare away birds and other species that are sensitive to loud noises. The impact is also relevant for marine environment as loud noises may negatively impact vagile organisms causing it to flee. The range of the impact would be localized to the area around the mobilization route and the temporary site setup location within the Island. The impact is expected to be short-term as the mobilization will be completed within a short period of time. This impact is reversible as once the mobilization is over, the impact ceases, the birds and marine organisms that were scared away would potentially return. Considering the aforementioned characteristics of the impact, the consequences from the impact is minor as it does not pose a significant risk to the environment. The likelihood of this impact occurring is certain as noise would definitely be generated during the mobilization activities. Therefore, the significance score for this impact is high.

7.4.3 Mobilization impacts – Dust

Dust is expected to be generated when the vehicles are operated within the Island. The impact is negative as the dust generated may become a nuisance to the working staff and in some

cases continued exposure to dust may cause allergic reactions in people who are sensitive to dust. The range of the impact would be localized to the mobilization route within the Island. The impact is expected to be short-term as the mobilization will be completed within a short period of time. This impact is reversible as once the mobilization is over, the impact ceases. Considering the aforementioned characteristics of the impact, the consequences from the impact is minor as it does not pose a significant risk to the environment. The likelihood of this impact occurring is possible as the Island is a vegetated uninhabited Island, the humous layer of the soil and the leaf litter above would minimise release of dust. Also, any dust released will be very localized due to vegetation and as there are no residents except the workforce there won't be a nuisance to the public. Therefore, the significance score for this impact is low.

7.4.4 Mobilization impacts – Oil spills at sea

The potential for oil spills at sea arises due to the direct activities of this project from the operation of barge and vehicles. Indirect impacts are also envisaged to marine life due to pollution from spills reducing the marine water quality. The impact is of negative nature as the marine environment would be polluted. However, the impact would be localized to the mobilization route. The impact is expected to be short-term as the mobilization would be completed on a short period of time and reversible as water quality will revert back to normal but the damages done to marine organisms during the deteriorated water quality period may not. Considering the aforementioned characteristics of the impact, the consequences from the impact is moderate. The likelihood of this impact occurring is possible, hence the significance score for this impact is medium.

7.4.5 Mobilization impacts – Oil spills on ground

The potential for oil spills on ground arises due to the direct activities of this project from the operation of vehicles on land. The impact is of negative nature as the groundwater would be polluted. However, the impact would be localized to the mobilization route. The impact is expected to be short-term as the mobilization would be completed on a short period of time. The impact is considered irreversible as contaminated groundwater takes a long time to recover and a lot of

impacted hence the range is local. The impact is short-term and reversible as will be alleviated once waste is removed. However still considering that improper management of waste could pollute the surrounding environment, the consequences were considered moderate. The likelihood of this impact occurring is possible as there is always potential for workers negligence to properly manage waste. The significance score for this impact is medium.

7.4.8 Vegetation clearance

This impact arises due to the direct activities of the project which requires removal of vegetation for construction of the infrastructures on the Island. The impact is of negative nature as the vegetation cover of the Island will be reduced. The impact is of Island level range as a huge area of vegetation is required to be removed in order to construct the infrastructures on the Island. The impact itself is short-term as the land clearance works will be completed in a short duration. However due to the huge scale of vegetation clearance required, it is not possible to replant the lost trees within a short period of time and hence is considered irreversible and long-term impact. Hence, the consequences from this impact were considered as catastrophic. The likelihood of this impact occurring is certain as trees on the footprint of the infrastructures will be cleared. The final significance score for this impact is significant.

7.4.9 Vibration impacts

This impact arises due to the direct activities of the project from the operation of vehicles. The impact is of negative nature as the vibrations may damage any nearby buildings. The range of this impact is local as the buildings adjacent to any operating heavy vehicles or machinery will be impacted. This impact would be intermittent as vibration would be generated during operation of heavy vehicles and machinery only and will cease once the operation stops (reversible). Since vibrations could cause structural damages to buildings, the consequences from this impact were considered at moderate level. The likelihood of this impact occurring is remote as there are no buildings within the Island. The final significance score for this impact is negligible.

7.4.10 Air quality – GHGs

Impacts on air quality during the constructional phase is a direct impact generally credited to operation of machinery and equipment which require electricity and vehicles which burn fuel. The main contributor would be the operation of barge/tug boats or other heavy vehicles that will be used to transfer heavy machinery and equipment to the project site. Additionally, the high bed excavator, dump truck and other machinery that use fuel for power during the construction works. The negative impact to air quality would be due to the release of GHGs and any other air pollutants to the atmosphere. Release of GHGs into the atmosphere during the construction phase is low when compared to the nations carbon budget but it would still contribute to the nations carbon budget. As such, the effects of the released GHGs concerns the entire Nation, the range of this impact was considered at National level. Even though GHGs will be released for a short period of time, regardless this would contribute to the GHG emission of the nation; hence the cumulative nature of this impact. And since the released GHGs will stay in the atmosphere for a long period of time this impact was considered long-term. The rise in concentration of GHGs in the atmosphere has been a huge global environmental issue which is responsible for global warming, ocean acidification and many other irreversible environmental issues. Considering the aforementioned characteristics of the impact, the consequences from the impact is considered catastrophic as it is long term, irreversible, large scale and detrimental to environment. The likelihood of this impact occurring is certain as GHGs would definitely be generated from the operation of machinery. Therefore, the significance score for this impact is significant.

7.4.11 Air quality – Dust

Impacts on air quality during the construction phase also arise due to the release of dust during excavation for foundations and pumpstation construction and trenching for pipes of water, sewer system and cables for powerhouse. The impact is of negative nature as it pollutes the air and cause nuisance to workers. However, the range of the impact would be limited to the project sites. This impact would be intermittent as dust would be generated during operation of heavy machinery only. This impact is reversible as dust would not be generated once the construction works are

completed. Therefore, the consequences from this impact are minor. The likelihood of this impact occurring is certain as dust would definitely be generated from the operation of machinery. Therefore, the significance score for this impact is high.

7.4.12 Noise pollution

Similar to air quality, impacts on noise level during the constructional phase is a direct impact generally credited to operation of machinery, equipment and vehicles. The highest noise would most likely be generated from the excavator that would be used to load and unload the heavy machinery and equipment at the project site and operation of vehicles/machinery for excavation of seabed during the dredging for access channel and reclamation works. Furthermore, on land during the construction of proposed guest lodging, public area, support facilities and service infrastructures of the resort. The impact is of negative nature as it has the tendency to disturb workers and wild life nearby on land. Additionally, the noise generated underwater may scare away the marine life in close proximity of the project site. The range of the impact will be localized to a small area surrounding the project site at irregular intervals as noise would be generated when heavy machinery is operational and would cease once operation of machinery stops, hence the consequences from this impact is deemed minor. The likelihood of this impact occurring is certain and the final significance score for this impact is high.

7.4.13 Groundwater quality – oil and chemical spills

Impacts to ground water quality during the constructional phase is a direct impact credited to the operation of land-based machinery that will be used during the construction of the proposed infrastructures. The impact arises from the potential for occurrence of oils and chemical spills during the operation of machinery and construction works. Even though it could be minimized with regular maintenance, in the event that oils and chemicals do spill, the impacts could have moderate to major negative effects on the groundwater quality due to porous nature of soil on the Island. The range of the impact will be localized to a small area surrounding the project sites. The impact itself is expected to be short-term as construction of infrastructures will be completed in a

short period of time, however if a spill does occur, the effects would be irreversible as contaminated groundwater takes a long time to recover. Hence the consequences from this impact are deemed major. The likelihood of this impact occurring is possible and as such this impact scored a significance rating of high.

7.4.14 Groundwater quality – salinization

Another direct impact to groundwater quality arises due to dewatering for laying foundation for the proposed infrastructures, during construction of pumpstations and pipe laying for sewer system. The impact is of negative nature as dewatering causes groundwater salinization. The range of the impact will be localized to a small area surrounding the project sites where dewatering is carried out. The impact itself is expected to be short-term as dewatering will be completed in a short period of time, however the effects to groundwater is considered irreversible. hence the consequences from this impact are deemed major. The likelihood of this impact occurring is certain and as such this impact scored a significance rating of significant.

7.4.15 Impacts on marine environment

Impacts on the marine environment due to this project arises from four aspects; firstly, direct damage to sessile marine organisms. Secondly, from turbidity and sedimentation from the dredging and reclamation works. Thirdly, indirect impacts arising from increasing GHGs. Fourth is from the potential for oil and chemical spills during the construction works at sea. Direct damages to sessile marine organisms and benthic substrates can be caused from the operation of the excavator during the mobilization and construction of the access channel (dredging), outfall, dredging and reclamation of the Island. Turbidity and sedimentation are caused due to the sediment plume that will be generated due to the operation of the excavator and due to excavation of seabed. The sediment plume will impact corals and other marine organisms. The negative impacts include stress on photosynthetic organisms due to increased turbidity as a result of re-suspension of excavated material. Increased turbidity levels of the water decrease intensity of light through the water column which reduces photosynthesis rates. In addition, sessile marine organisms maybe

smothered due to sedimentation which could again hinder its metabolic processes increasing stress on them further. The end result is the loss of marine biodiversity for example baitfish which could in turn impact fisheries. While the contribution to GHGs from this project may be negligible, it is the cumulative nature of the impact that is concerning which arises from global warming and ocean acidification. The reason why there is so much concern about global warming is that it increases the temperature of the oceans as the ocean absorbs more heat. While many of the fishes may be able to tolerate the rise in temperature, the corals are less tolerant. Nonetheless many of the reef fish species depend on the coral reef as a home and few fish species even depend directly on the corals for food and shelter. In a recent paper published by (Strona, et al., 2021) states that in a hypothetical world where coral reefs are not present the local tropical fish richness across the globe would decline by half. Ocean acidification is the process by which the pH of the oceans decreases due to more dissolving of CO₂ from the atmosphere into the oceans (Ferrero, 2018). Apart from impacts from temperature, the corals and other Calcium Carbonate skeleton based marine organisms are at great risk as lower pH would mean that these organisms would have a hard time maintaining their Carbonate skeletons. Therefore, just as higher temperatures threaten the marine organisms, ocean acidification also threatens marine life to a great extent. Hence the range of this impact is considered at national level with long-term impacts which are irreversible, giving this impact a consequence rating of catastrophic. The likelihood of this impact occurring is certain and the final significance rating is significant.

7.4.16 Impacts on terrestrial environment – soil and ground

Impacts to soil and ground are envisaged due to direct activities of the project. Compaction of ground is anticipated due to operation of heavy machinery. Excavation, trenching and paving works will also compromise the soil profile. The indirect impact from the compaction of ground maybe flooding due to reduced percolation of rainwater. The effect maybe exuberated due to the reclaimed land area. The impact is of negative nature and with a range limited to the project sites. While the impact itself is short-term as the construction works will be completed within a set period, the impacts from soil compaction is long-term. The impact was as considered

irreversible. Hence the consequences from this impact are deemed major. The likelihood of this impact occurring is certain and as such the final significance score for this impact is significant.

7.4.17 Impacts on coastal environment

Impacts on the coastal environment are envisaged due to the direct activities of the project which involves reclamation of land. During the reclamation of land around the entire Island, the inter tidal zone will be destroyed. The impact is of negative nature and spanning the entire Island. While the impact itself is short-term as the reclamation works will be completed within a set period, the impacts from the destruction of the coastal zone is long-term. The impact was as such considered irreversible. Hence the consequences from this impact are deemed major. The likelihood of this impact occurring is certain and as such the final significance score for this impact is significant.

7.4.18 Risk of accidents and pollution on workers

As typical of any construction project, there lies the risk of accidents and pollution on workers from this project as well due to the construction activities. There is always the inherent risk of health and safety due to workplace incidents. Furthermore, due to improper living conditions provided to the workers by the proponent as this is very common in the Maldives. The proponent must ensure that the workers are well taken care of. The impact is of negative nature as any accidents in work place or improper living conditions at provided will lead to health risks to workers. The range of the impact is limited to project site and small surrounding area, hence it is extremely important to monitor unauthorized access into the project sites. The impact itself is short-term and reversible as once construction is finished the impact is alleviated, however is considered irreversible as injuries to people can be fatal. Hence the consequences from this impact are deemed catastrophic. Since the likelihood of these impacts are possible given that proper mitigation measures would be followed, the final significance of this impact is very high.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Ground and marine water quality- negative	Unlikely	Catastrophic	High
Impacts on marine environment	Certain	Catastrophic	Significant
Impacts on hydrodynamics	Remote	Catastrophic	Medium
Impacts on coastal environment	Likely	Catastrophic	Significant
Impacts from vibration	Unlikely	Major	Medium
Impacts from waste	Unlikely	Minor	Very Low
Health and safety of working staff	Possible	Major	High
Impacts on landscape integrity and scenery	Certain	Major	Significant
Socio-economic impacts - negative	Certain	Major	Significant
Socio-economic impacts - positive	Certain	Catastrophic	Significant
Risk of hazards- storm surge	Possible	Major	High
Risk of hazards- sea level rise	Unlikely	Major	Medium
Risk of hazards- fire and other workplace accidents	Unlikely	Major	Medium

Unlike constructional impacts, operational impacts are anticipated to be more long-term but irreversible (Table 39). It should be noted that with the application of proper mitigation measures as outlined in section 9.1 of this report, almost every negative impact could be minimized.

Table 39. Characteristics of the predicted impacts during the operation phase of the project

Potential Impacts	Type	Nature	Range	Duration	Reversibility
Air Quality- GHGs	Direct & Indirect	Negative	Nation	Continuous	Irreversible
Air Quality- dust	Direct	Negative	Local	Continuous	Reversible
Noise Pollution	Direct	Negative	Local	Long-term	Reversible
Ground and marine water quality- negative	Direct & Indirect	Negative	Local	Long-term	Irreversible
Impacts on marine environment	Direct	Negative	Local	Short-term	Reversible
Impacts on hydrodynamics	Direct	Negative	Island	Long-term	Irreversible
Impacts on coastal environment	Direct		Island	Long-term	Irreversible
Impacts from vibration	Direct	Negative	Local	Long-term	Irreversible
Impacts from waste	Direct	Negative	Local	Long-term	Reversible
Health and safety of working staff	Direct	Negative	Local	Long-term	Reversible
Impacts on landscape integrity and scenery	Direct	Positive	Island	Long-term	Irreversible
Socio-economic impacts - negative	Direct	Negative	Atoll	Long-term	Reversible
Socio-economic impacts - positive	Direct & Indirect	Positive	Atoll	Long-term	Reversible
Risk of hazards- storm surge	Direct	Negative	Island	Long-term	Irreversible
Risk of hazards- sea level rise	Direct	Negative	Island	Long-term	Irreversible

Risk of hazards- fire and other workplace accidents	Direct	Negative	Island	Long-term	Irreversible
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7.5.1 Air Quality - GHGs

Impacts to air quality arises from the direct activities of the project from the operation of the powerhouse. The negative impact to air quality would be due to the release of GHGs and any other air pollutants to the atmosphere. Release of GHGs into the atmosphere during the operational phase is low when compared to the nations carbon budget, however it would still contribute to the nation’s overall carbon budget and hence the range of this impact was considered at national level. The impact would be continuously occurring as long as the powerhouse is in operational condition but would cease if the powerhouse operations stops or the resort. However, the already released GHGs will stay in the atmosphere for a long period of time and would contribute to global warming, ocean acidification and other related cumulative environmental impacts, as such the impact was considered irreversible. Considering the aforementioned characteristics of the impact, the consequences from the impact is considered catastrophic as it is long term, irreversible, large scale and detrimental to environment. The likelihood of this impact occurring is certain, hence the significance score for this impact is significant.

7.5.2 Air quality; dust

Impacts to air quality due to the release of dust (and soot) arises from the direct activities of the project from the operation of the waste management center and powerhouse. The impact is of negative nature as release of dust would be a nuisance to nearby workers. The impact range is localized to the powerhouse and waste management center location on the resort. It is anticipated that minimal dust would be generated as proper mitigation measures will be implemented for the operation of the powerhouse and waste management center. The impact would be continuously occurring as long as the powerhouse is in operational condition. But dust from waste management center is anticipated to be intermittent. The impact is reversible as released dust would quickly disperse in the open Maldivian setting and also due to the fact an adequate chimney will be

installed in the powerhouse. Furthermore, release of dust would cease if the operations halts. Hence, the consequences from this impact are minor. The likelihood of this impact occurring is possible, hence the significance score for this impact is low.

7.5.3 Noise pollution

Noise pollution arises due to the noise generated from the direct activities of the project from the operation of gensets at the powerhouse, pumps in the water and sewer system, heavy machinery in the waste management center and guest activities of the resort. Furthermore, noise is expected to be generated at the seaplane arrival pavilion and service jetty from the incoming seaplanes and vessels. The impact is of negative nature as the noise would be a nuisance to workers nearby and also the noise may disturb wildlife such as birds. The impact range is localized to a small area surrounding the project sites. The impact at the seaplane arrival pavilion and service jetty would be intermittent but continuous noise would be generated from the powerhouse and water system as long as they are operational. The impact is reversible as the noise generated would cease upon discontinuation of the operations. Hence, the consequences from this impact are minor. The likelihood of this impact occurring is certain, hence the significance score for this impact is high.

7.5.4 Ground and marine water quality; negative

Negative impacts to ground and marine water quality arises due to the potential for leaks and spills to occur in the utilities established and the jetties. The negative impact would be the contamination of water due to the leakage of sewerage, and oil/chemical spills at the jetties from vessels. And oil/chemical spills at the powerhouse workshop during maintenance and during transfer of fuel to the fuel storage tanks. Additionally, from the leachate management system at the waste management center and during operations for example washing of bins. Depending on where the leakage occurs, the range of this impact maybe local or at Island level. If the leaks occur at the jetty, it contaminates marine waters. However, if the leaks occur within the utilities on land, then it may contaminate the groundwater. While the impact may occur for a short duration as the

management would quickly rectify any leaks or spills, any unnoticed or unidentified leaks would continue to detriment water quality. Furthermore, as contaminated groundwater from any leaks would take a long time to recover and contamination of marine water quality could lead to irreversible impacts, this impact was considered as a long-term and irreversible impact. As such the consequences from this impact is considered catastrophic but it is unlikely to occur as proper systems and mitigation measures would be installed and implemented at the utility systems and harbor, hence the final significance rating for this impact is high.

7.5.5 Impacts on marine environment

Impacts on marine environment is envisaged due to the discharge of sewer and brine from the outfalls. Although the effluents discharged will be quickly diffused, it would still cause significant deterioration of the marine water quality at the outlet. The main change in the chemical parameters of marine water would in the BOD due to the faecal matter in the sewerage. High BOD concentration would favour the growth of green algae at the outfall location which might inhibit coral growth. Furthermore, anions like sulphates and phosphates maybe present in sewerage which come from the washing powders used at laundry, would alter the pH of the water which might intern alter the composition of the microbial communities. Lastly the high saline brine will increase the salinity at the outlet which will negatively impact corals and other marine organisms that are sensitive to changes in salinity. The impact is considered long-term and irreversible. Hence, the consequences envisaged are catastrophic and with a likelihood of certain the impact scored a significance rating of significant.

7.5.6 Impacts on hydrodynamics

Impacts on hydrodynamics is envisaged due to the direct activities of the proposed project which involves the construction of jetties and over water villas. The impact is of negative nature as the columns may hinder the natural flow of water. The impact is of Island level importance as this has the potential to cause erosion of the Island. The impact would be long-term and irreversible. Hence, the consequences envisaged are catastrophic but the likelihood of this impact

occurring is remote as the jetties and overwater villas are away from the Island and is not expected to significantly alter the flow of water around the Island. Hence the impact scored a significance rating of medium.

7.5.7 Impacts on coastal environment

Impacts to the coastal environment is anticipated due to reclamation. During the reclamation the existing beach and intertidal zone will be fully reclaimed along with any existing organisms. A new beach and intertidal zone will be formed once the system reaches an equilibrium state. Organisms like crabs may return. However, the continued recreational activities of the resort on the beach will mean that the coastal environment will never return to as it was before. Furthermore, recreational activities like snorkelling may damage the corals as inexperienced or accidental damage to corals is likely from tourists if the activities are not supervised and managed properly. The impact is of Island level important as the coastal environment surrounding the entire Island will be affected due to the resort operations. The impact would be long-term and any damages irreversible. The consequences from this impact are catastrophic. The likelihood of this impact occurring is likely. The final significance rating of this impact is significant.

7.5.8 Impacts from vibration

The impact arises due to the direct activities of the project from the operation gensets at the powerhouse and pumps in the water, sewer system. The impact is of negative nature and localized to the project site. The impact is considered long-term and irreversible as it will be very costly to construct new infrastructure in the event there was significant structural damage to nearby infrastructures due to vibrations. The consequences from this impact are major. However, the likelihood of this impact occurring is unlikely. As such the significance of this impact is medium.

7.5.9 Impacts from waste

This impact arises due to the direct operation of the utilities. Waste oil will be generated from the operation of powerhouse. Organic waste and non-organic waste will be generated during

the operational stage of the resort. The impact is of negative nature as if the waste water, waste oil, organic waste, sludge generated from STP is not managed properly it could lead to environmental issues. For example, bad odour from organic waste. The range of the impact will be local as the waste from the resort would be taken to the waste management centre and STP of the resort. The impact will be long-term as waste would be generated as long as the resort is in operation and would cease once the operation of either the utilities or the resort stops. The consequences from this impact are minor as this resort will be fully equipped to manage the waste. Hence, a scenario where the resort is unable to manage waste is unlikely to happen. Hence, the final significance score for this impact is very low.

7.5.10 Health and safety of working staff

This impact arises due to the direct operations of the utilities of the resort. During maintenance and cleaning of pump stations, and sewer network, the working staffs is at a risk of major health issues in case safety gear is not used. The risks include contact with harmful disease-causing agents, inhalation of gases which may lead to even respiratory infections. As for the staff working in the RO plants, during the operation and maintenance works, the risks include coming in contact with chemicals causing skin irritation and inhalation of fumes which may lead to even respiratory infections. In the case of the powerhouse staff, they may be exposed to high noise and oil/chemicals during maintenance works. The staff at the waste management centre maybe exposed to bad odour and chemicals. The impact is of negative nature as this poses significant health risks to the workers. This impact is limited to the staff which will engage in the aforementioned activities and for a long period of time as the staff would be continuously working every day. The impact is irreversible as any injuries to working staff would have lifelong health implications. Therefore, the consequences from this impact are “major” but the likelihood of it occurring is possible, earning a significance rating of high.

7.5.11 Impacts on landscape integrity and scenery

This impact arises from the direct activities of the project from the operation of the utilities and resorts guest lodging infrastructure. One could argue that the impact is of negative nature as the natural beauty will be compromised with the addition of the resort’s infrastructures under this EIA and due to the vegetation clearance. It is expected that with the adaption of modern architecture and finishing, a luxurious guest lodging infrastructures will be created upon completion of the project that will undoubtedly improve the land scape integrity and scenery of the Island. The range of this impact would be at Island level as the entire Island and surrounding marine environment will be affected. The impact will be long-term and irreversible. Hence, the consequences envisaged are major positive and the likelihood of this impact occurring is certain, giving this impact a significance rating of significant.

7.5.12 Socio-economic impacts- negative

Negative impacts to socioeconomics are envisaged due to the direct activities of the project to the previous resource users of the Island. For instance, people that have previously used the as a picknick Island cannot do so now. Additionally, bait fishers, reef fishers and snorkelling visits from nearby tourism ventures or locals. The range of this impact would be at Atoll level with long-term implications. The impact is considered reversible the access to the Island and surrounding waters can be easily granted. The consequences from this impact are major negative as the Atoll locals loses a valuable resource and with a likelihood of certain, the significance of this impact is significant.

7.5.13 Socio-economics – positive

Positive impacts are envisaged to the socioeconomics due to direct activities of the project to the proponent as the proponent will have easy safe access to the Island. Furthermore, all the utilities and infrastructures required to run the resort will be established. Additionally, there is the potential for job opportunities for people from nearby Islands to work on the resort, of course this depends entirely on the proponent. The range of this impact would be at Atoll level with long-term

implications. The impact is considered reversible as once the operation of utilities ceases or the resort infrastructures gets compromised the impact ceases. The consequences from this impact are catastrophic positive as this allows the proponent to efficiently manage the operations at the resort and with a likelihood of certain, the significance of this impact is significant.

7.5.14 Risk of Hazards - storm surge

Bodukaashihuraa Island is located at a very low-risk zone for local storm surges compared to the rest of Maldives. The impact is of negative nature as a storm surge event may cause elevated sea levels and with strong waves could damage the villas or flood the infrastructure of the resort. While the impact maybe localized to the villas and utilities, any damages to these infrastructures could in turn impact the entire resort as they may not be able to provide services to the guests. As such the impact range was considered to be at Island level. Any damages due to a storm surge event may be long-term and irreversible depending on the gravity of damages. The consequences from such an event are major but with the possible likelihood of occurrence, this impact significance is high.

7.5.15 Risk of Hazards – Sea level rise

With the accelerated sea level rise due to global warming, the risk of hazards due to an event like storm surge as described in the above section is more probable. While the impacts due to this hazard is evaluated for the proposed project, sea level rise could potentially impact the entire resort as such the range of this impact is considered at Island level. This hazard has long-term and irreversible environmental implications. The consequences from such an event are major but with the unlikely likelihood of occurrence as the infrastructures would be elevated adequately above the sea level (even with projected increase in sea level), this impact significance is medium.

7.5.16 Risk of Hazards - fire and other workplace accidents

This impact arises due to the direct operations of the utilities and arrival jetties of the resort. Potential workplace accidents include electrocution during servicing of electrical equipment's,

chemical spills during servicing of utilities, vehicle flipping into the sea from the jetty, fire in the utilities or vessels in the jetty etc. All of these hazards are negative in nature as it poses health risk to workers in addition to damages to the infrastructures. The impact is of Island level range, long-term and irreversible. The consequences from this impact are major but the likelihood of occurrence is unlikely as proper mitigation measures will be implemented in the resort operations, hence the significance of these hazards is medium.

7.6 Impact Boundary

As shown in Figure 59 primary impact area for the project is the footprint of the proposed infrastructures. The secondary impact area is the area that will be impacted by the sediment plume. Additionally, areas surrounding the infrastructures on land will be subjected to secondary impacts like noise and air pollution.



Figure 59: estimated impact boundary for the proposed project

conductivity shall reach 50,000 μ S/cm at 35m depth, if not it shall be drilled to reach the required conductivity. Detailed methodology for borehole drilling is provided below. Given that the current intake line is quite long with the aforementioned disadvantages of the using lagoon intake, it is preferred to use boreholes for the current project.

8.1.2.1 Borehole drilling method

Location of the bore hole shall be worked out from the approved drawing and marked on the top of the existing ground profile. Drilling shall be carried out at these marked locations. 5m X 5m area surrounding the drilling location shall be cleaned before set up of drilling machine.

Two mud pit(1.0X0.5X0.5 M) shall be made by using shovel and spade in front of drilling location and connected each other by a drain and canvas lining shall be done to prevent fluid loss. Drilling mud shall be prepared by mixing of bentonite with water with a proportion of 1:2 before 12 hours of starting of borehole. Thickness of the mud shall be controlled as per the strata encountered during drilling. If there is severe caving encountered during drilling through a particular stratum then 150gm poly-anionic cellulosic polymer shall be used by mixing with 50 Kg bentonite and 100 liter water. Drilling rig is placed on the drilling spot with proper platform and verticality alignment of the machine is done by using spirit level. During the whole drilling process this is checked frequently to maintain the verticality and alignment of borehole.

After attaching the mud pump and drilling machine with 50 mm hoses drilling shall be started with 300 mm reamer bit up to the loose formation or overburden and 350mm DIA steel temporary casing will be placed up to the hard formation. The depth of outer casing shall be decided as per geological strata encountered at site.

After placing of temporary outer casing up to required depth drilling shall be continued with rotary mud circulation with 300 mm drag & rock roller bit. The suitable bit to be employed according to the hardness of lime rock.

Soil and rock samples shall be collected from return water from borehole at every 1.5 m interval or change of strata. Soil/rock samples will be preserved in polythene bags marked with borehole number and depth and date of collection. Bore Log shall be prepared as per the sample

received during drilling from different depth. Soil samples shall be kept 3 months for future references if required.

After drilling is completed to 35 meter depth hole shall be flushed well until most of drilled particles are removed from hole prior to install the casing. The standard threaded type bore well pvc casings to be installed with necessary screened casings according to the strata of the location. The screened casings to be placed in target aquifer to obtain the maximum yield of the well.

After casings are placed the filter gravel of 4-6mm to be packed up the required height through grain pipe. Commonly the height of the filter pack to be 1.5m above the screen casing. After poring the filter pack surging and bailing to be done with drilling machine to compact the filter media.

Flushing of borehole shall be carried out after installing the filter pack by using the compressed air until sand particles are less than 2mg per liter of water.

The 24 hour yield test to be carried out by using multi stage pump and water levels to be taken as prior to pumping, while pumping and after pumping. The water level drawdowns and recoveries to be recorded as per the instructions of hydro-geologist. A digital water meter to be installed at pumping main to record the output and this readings to be marked on an every hour with water level of the well. The pumping water to be delivered and disposed at minimum 100m from the test well. Once the pumping test is conducted the records to be submitted to the geologist to decide and recommend the pump installation depth and safe yield.

After completion of pumping test the borehole head will be closed and locked for safety and perimeter fence to be install to avoid unwanted stress pass.

At final stage of pumping test water sample shall be collected in a sterilized 1liter capacity bottle from outgoing water of borehole and sample shall be sent to chemical lab within a day for chemical and micro biological testing as per specification. The following tests of water like pH, EC, Temperature, Taste, Odor & Color shall be conducted at site and that report shall be submitted along with drill-log.

Daily Progress Report (DPR) shall be submitted regular basis. After completion of borehole drilling log along with stratification, ROP, casing details and water analysis at site shall be submitted. Laboratory Water & Soil Testing reports shall be provided after completion of the relevant tests

8.1.3 Option 3: Storage tank material

As per the proposed method, there are 2 separate tanks to be built for the proposed project. With the correct material, the tanks could be built with the option to increase the vertical height of tanks if need be to increase the storage at a later time. This could be done by rolled, tapered panel (RTP) tanks.

These tanks are easy to construct and low maintenance. The tank construction procedure is as follows:

- Tank installation begins with the “starter” ring that is anchored to the foundation. Next, the tank jacks are located in position
- Field installation begins with the top ring of the tank attached to the synchronized hydraulic screw jack system. The specialized jacking system is anchored to both the concrete foundation and the tank “starter” ring
- Sidewall sheets are added from the ground level until each ring assembly is completed. The installed tank structure is then raised with the jacks and the next lower ring assembly is installed. The process is repeated until the tank is completed

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

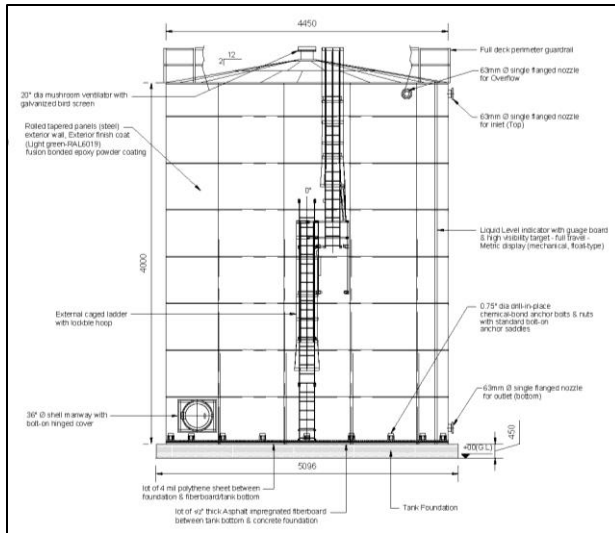


Figure 60: Sample image of an RTP tank

8.1.4 Option 4: Alternative Sewerage treatment methods

The three common options for sewerage treatment process are given below.

- Aerobic Treatment Process; Extended Aeration Plants, MBBR, SBR
- Anaerobic Treatment Process (U.A.S.B. Reactor Systems), and,
- Mobile Sewage Treatment Plants (Fluidized Bed Reactors).

8.1.4.1 Extended Aeration System

The advantages and disadvantages of the above Aerobic treatment processes are as follows:

Advantages:

- Plants are easy to operate, as many are manned for a maximum of two or three hours per day.
- Extended aeration processes are often better at handling organic loading and flow fluctuations, as there is a greater detention time for the nutrients to be assimilated by microbes.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Systems are easy to install, as they are shipped in one or two pieces and then mounted on an onsite concrete pad, above or below grade.
- Systems are odor free, can be installed in most locations, have a relatively small footprint, and can be landscaped to match the surrounding area.
- Extended aeration systems have a relatively low sludge yield due to long sludge ages, can be designed to provide nitrification, and do not require a primary clarifier.

Disadvantages

- Extended aeration plants do not achieve de-nitrification or phosphorus removal without additional unit processes.
- Flexibility is limited to adapt to changing effluent requirements resulting from regulatory changes.
- A longer aeration period requires more energy.
- Systems require a larger amount of space and tankage than other "higher rate" processes, which have shorter aeration detention times

8.1.4.2 Sequencing batch reactors (SBR)

Advantages

SBRs can consistently perform nitrification as well as de-nitrification and phosphorous removal.

SBRs have large operational flexibility.

- The ability to control substrate tension within the system allows for optimization of treatment efficiency and control over nitrogen removal, filamentous organisms, and the overall stability of the process.
- Since the entire unit processes are operated in a single tank, there is no need to optimize aeration and decanting to comply with power requirements and lower decant discharge rates.
- Sludge bulking is not a problem.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Significant reductions in nitrate nitrogen can occur by incorporating an anoxic cycle in the system.
- SBRs have little operation and maintenance problems.
- Systems require less space than extended aeration plants of equal capacity.
- SBRs can be manned part time from remote locations, and operational changes can be made easily.
- The system allows for automatic and positive control of mixed liquor suspended solids (MLSS) concentration and solids retention time (SRT) through the use of sludge wasting.

Disadvantages

- It is hard to adjust the cycle times for small communities.
- Post equalization may be required where more treatment is needed.
- Sludge must be disposed frequently.
- Specific energy consumption is high.

8.1.4.3 Moving Bed Biofilm Reactor (MBBR)

Advantages

- Wastewater Solution for Space Constraints
- Resistant to Shock Loads
- Works Quickly with a Low Hydraulic Retention Time

Disadvantages

- Manual monitoring
- Skilled experts
- Escaping carriers

The preferred alternative is the proposed method of extended aeration system due to the mentioned advantages over the other similar system.

8.1.5 Option 5: Solar as renewable energy

Solar energy is one of the cleanest and easily accessible renewable energy sources available in Maldives. Solar Photovoltaic Panels are used to harness and transform the continuous flow of energy from the sun to electricity. Unlike diesel power plants, no harmful greenhouse emissions are released into atmosphere when electricity is generated from the Solar Panels. Therefore, it is proposed to incorporated solar pv to cater partial of the electricity needs of the resort.

8.1.6 Option 6: Alternative sewer outfall

The following Figure 61 highlights the area of proposed alternative outfalls.



Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Figure 61: Alternative outfall location



As shown in

Figure 61 the alternative outfalls are proposed for the eastern side of the island. The alternative outfall site requires more pipe length, hence it would be more expensive in comparison to the proposed option. Furthermore, the alternative site has lower recorded currents (0.022 m/s) than the proposed location (0.111 m/s) portraying greater mixing potential at the proposed location than the alternative. Moreover, the alternative location has a high very coral cover of 26% whilst the proposed location only has a live coral cover of 1.2%. Therefore, in terms of environmental and economic standpoint, the proposed sewer and brine outfall sites are preferred

8.2 Preferred Options

Due to the aforementioned reasons, the alternatives of proceeding with the project in comparison to the no project option, borehole is preferred as the intake option and the proposed sewer treatment methodology is preferred. For the outfall location, the proposed outfall location is

preferred as per the reasons mentioned in section 8.1.6. As for the material for the tanks, since there is not such a huge environmental impact due to the options and the increases in the potential capital cost of the project, the preference of this options is left for the proponent. Lastly, for the incorporation of renewable energy, the option is preferred but to be implemented later at another development phase of the resort due to the increase in the capital expenditure.

8.2.1 Mitigation measures for preferred option

No new impacts were identified for the preferred option, hence the mitigation measures outlined in the chapter 9.1 shall be followed.

9. ENVIRONMENTAL MANAGEMENT

This section describes the environmental and operational management systems and plans for the proposed development including practical mitigation measures for all identified impacts, a risk management plan, measures for sustainable development as well as environmental monitoring programs.

9.1 Proposed Mitigation Measures

The mitigation measures outlined in Table 27 and Table 28 below is proposed with due consideration to their cost effectiveness and feasibility to be implemented. The mitigation measures mainly relate to handling practices, design and quality of the proposed development and appropriate trainings which would ensure that environmental impacts would be minimized as effectively as possible.

It is the responsibility of the implementing agency to adhere to the proposed mitigation measures and bear any costs related to establishing them. If the proponent hires a contractor, then it is the responsibility of the proponent to include these mitigation measures in the project contract.

9.1.1 Construction Phase

The following table describes the preferred mitigation measures for the identified impacts during the construction phase of the proposed project.

Table 40: proposed mitigation measures for the identified impacts during the construction phase of the proposed project

Impact	Mitigation Aspect	Proposed Mitigation Measures	Timing	Required manpower	Expertise	Equipment	Technology	Estimated Cost	Implementing Agency	Performance Indicator
Mobilization impacts- Direct damage to benthos and sedimentation	Minimize direct damage to benthos	Anchorage of barges and carrier vessels should be limited to a smaller area	During mobilization	Boat Captain	Boat captain that understands bathymetry and knows how to use GPS aided navigation	GPS, Eco-Sounder	Bathymetry and global positioning	GPS and Eco-Sounder prices may vary depending on brand, typical price ranges are from 500 USD to few thousand. Typical salary of a boat captain is between MVR 20,000 to MVR 35,000 per month	Proponent	Length and extent of mobilization route
		Take shortest mobilization route with least coral cover	During mobilization	Boat Captain	Boat captain that understands bathymetry and knows how to use GPS aided navigation	GPS	Global positioning	GPS and Eco-Sounder prices may vary depending on brand typical ranges are from 500 USD to few thousand. Typical salary of a boat captain is between MVR 20,000 to MVR 35,000 per month	Proponent	Length and extent of mobilization route
	Sedimentation control	Take deepest route to the project construction site while mobilizing the barge	During mobilization	Boat Captain	Boat captain that understands bathymetry and knows how to use GPS aided navigation	GPS, Eco-Sounder	Bathymetry and global positioning	GPS and Eco-Sounder prices may vary depending on brand typical ranges are from 500 USD to few thousand. Typical salary of a boat captain is between MVR 20,000 to MVR 35,000 per month	Proponent	Extent of sediment plume created
Mobilization impacts- Noise	Reduce noise disturbance from mobilization of barge, heavy vehicles, machinery and materials	Restrict mobilization to daytime	Continuous during construction phase	Project Manager, Drivers	Experienced project manager to plan mobilization activities	Computer	Project management software	The salary of a project manager would vary depending on the proponent, typical salary of a project manager can range from MVR 25,000 to MVR 50,000. The cost of a computer may vary depending on the brand and computing power, typically one could get a basic desktop computer from around USD 300 to USD 600. The price of microsoft projects perpetual license is for about USD 620.	Proponent	Complains from staff or tourists for disturbance
		Avoid unnecessary use of machinery			Diligent staff					Machinery in optimal condition
		Ensure shortest mobilization route is chosen			Experienced project manager to plan mobilization activities					Complains from staff or tourists for disturbance
		Ensure mobilization in one go as much as possible to avoid repeated transfer of materials or vehicles			Experienced project manager to plan mobilization activities					Injuries to hearing among staff
Mobilization impacts- Dust	Minimize release of dust	Ensure shortest vehicle transfer routes are established within the Island	Continuous during construction phase	Project Manager, Drivers	Experienced project manager to plan access routes	Computer	Aerial imagery of the Island	The cost of a computer may vary depending on the brand and computing power, typically one could get a basic desktop computer from around USD 300 to USD 600.	Proponent	Extent of dust released
Mobilization impacts- Oil spills at sea	Minimise likelihood of oil spills occurring during operation of barge and vehicles at sea	Ensure that there is no leakages from any of the vessels or vehicles and that the structural integrity of the vessels/vehicles in optimal condition	Prior to mobilization	Marine Engineer	Engineer that is capable of thorough inspections	leak detection and structural integrity inspection equipment	Inspection of structural integrity of vessels/vehicles	Cost of leak detection and structural integrity inspection equipment on vessels can vary depending on the specific equipment and its capabilities	Proponent	Spills or leaks at sea/land

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Mobilization impacts- Oil spills on ground	and on land. Contain any spills that does occur (if any).	Have emergency oil spill cleanup crew on standby	Continuous during construction phase	Oil spill cleanup crew, Operator	Vehicle operator that is able to detect leakages	Spill cleanup materials	Spill cleanup technology	The cost of spill cleanup operations can vary widely depending on the size, location of spill, type of substance spilled, etc. Small spills on land/water can cost from few thousand o tens of thousands of dollars. Medium spills on coastal waters can cost from tens of thousands to several hundred thousand dollars	Proponent	Water quality assessments to detect contamination
Mobilization impacts- workforce; covid episode, negative social impacts, illegal labor	minimize likelihood of a covid episode due to the mobilization of workforce, avoid social negative impacts and prevent illegal labor	Screening as per HPA guidelines	Prior to mobilization	HR staff	HR staff that can read PCR tests	PCR test kit	PCR testing at an HPA approved facility	The cost of PCR test may vary depending on the institution from which it is done, typical ranges are USD 30 to USD 100 per test	Proponent	Complains from staff or tourists for disturbance
		Illegal or undocumented labors shall not be allowed	Prior to mobilization	HR staff	HR staff that is aware of immigration policies	Office	Office administration	The salary for an HR staff may vary depending on the proponent, typically a mid level HR staff salary is from MVR 12,000 to MVR 18,000 per month		Verified immigration documents
		Laborers shall be supervised by the site supervisor to avoid any socially or culturally or legally unacceptable behavior	Prior to mobilization	Supervisor, HR staff	Capable supervisor	No additional equipment required	No additional technology required	The salary of a site supervisor can vary depending on the proponent, typical salary is from MVR 15,000 to MVR 25,000 per month		Number of Complains
		Laborers shall be made aware of the sociocultural and legally unacceptable behavior	Prior to mobilization	HR staff	HR staff that can conduct awareness sessions and that is aware of Maldivian sociocultural norms and legal setting	Projector, Computer	Presentation	The salary of a site supervisor can vary depending on the proponent, typical salary is from MVR 15,000 to MVR 25,000 per month		Behavior of workers
Generation of site clearance, demolition and constructional waste	Prevent littering and pollution of surrounding environment	Ensure efficient planning of project activities to ensure minimal waste generation and management of any waste generated on-site by segregation, reuse, recycling as much as possible	Prior to mobilization	Project Manager, Drivers	Experienced project manager	Waste collection and transfer equipment	Waste reuse or recycling	The salary of a project manager would vary depending on the proponent, typical salary of a project manager can range from MVR 25,000 to MVR 50,000. The prices of waste collection and transfer equipment's are highly variable depending on the type, brand, specifications and size. A rear-loading garbage truck price is typically between USD 100,000 to USD 300,000. Compactors and balers are between USD 1000 for small portable units to 10k to 1000k USD for larger units. A 10 cubic yard skip container can cost between USD 1000 to USD 2000.	Proponent	No waste in the open
		Following existing waste management legislations	Continuous during construction phase							
		Ensure efficient waste transfers to minimize accidental disposal/spillage	Continuous during construction phase							
		Designate waste collection/storage areas to minimize littering	Continuous during construction phase							

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

		Solid waste, oil and hazardous materials needs to be carefully handled and transported in sealed containers	Continuous during construction phase								
Vegetation clearance	Reduce the number of trees removed and minimize number of trees completely removed from the Island	Removed vegetation should be disposed as green waste	Prior to construction	Excavator operator, Lorry driver	Driver that can drive in difficult environment	Excavator, Lorry, Waste transfer vessel	Digging and uprooting trees	Price of excavators depend on brand, size and specifications. A mini excavator that is suitable for landscaping can be for USD 20,000 to USD 90,000. A pickup trucks price maybe between USD 20,000 to USD 50,000. A 70 feet waste transfer vessel can be between USD 500,000 to USD 2 million depending on the specifications.	Proponent	No waste in the open	
		Replanting any trees that can be replanted	Continuous during construction phase	Excavator operator, Lorry driver	Operator that can uproot and plant trees	Excavator, Lorry, supports	Planting trees	Supports for trees can be either wooden or metal stakes. The prices will vary depending on the size. The prices maybe between USD 1 to USD 10 per stake.	Proponent	Number of trees replanted	
		All vehicles and machinery must be restricted to the proposed access tracks and sites	Continuous during construction phase	Project Manager, Drivers	Experienced project manager to plan access routes	Computer	Aerial imagery of the Island		The cost of a computer may vary depending on the brand and computing power, typically one could get a basic desktop computer from around USD 300 to USD 600.	Proponent	Percentage of untouched vegetation on the Island
		Only removing plants on the footprint of development.	Prior to construction	surveyor	Surveyor that can establish boundaries of development footprint	GPS	RTK GPS		Rover RTK GPS prices maybe between USD 5000 to USD 20,000 depending on the brand and specifications. The salary of a surveyor may vary depending on the proponent, typical salary maybe between MVR 15,000 to MVR 35,000.	Proponent	Extent of vegetation cleared beyond development footprints
Vibration impacts	Minimize damage to buildings	Ensure the access routes for vehicles are not too close to buildings being constructed	Prior to construction	Project Manager, Drivers	Experienced project manager to plan access routes and delimiting boundaries of infrastructures	Computer	Aerial imagery of the Island	The cost of a computer may vary depending on the brand and computing power, typically one could get a basic desktop computer from around USD 300 to USD 600.	Proponent	Complains from staff or tourists for disturbance	
Air Quality-GHG's	Minimize release of GHGs	Use of fuel low sulfur content	Continuous during construction phase	Procurement Manager	Procurement of low sulfur content fuel.	Low sulfur fuel	Equipment and machinery should able to handle low sulfur fuel	The price difference between low sulfur content fuel and normal fuel can vary depending on the region. As of May 2023 the global average price for low sulfur fuel is around USD 1.1 to USD 1.5 per liter and the global average price for gasoline is around USD 1.2 to USD 1.6 per liter.	Proponent	Concentration of air pollutants in project areas	

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

		Avoid unnecessary use of machinery		Project Manager, Supervisor	Efficient planning of project activities. Supervising.	Computer	Project management software	The salary of a project manager would vary depending on the proponent, typical salary of a project manager can range from MVR 25,000 to MVR 50,000. The cost of a computer may vary depending on the brand and computing power, typically one could get a basic desktop computer from around USD 300 to USD 600. The price of microsoft projects perpetual license is for about USD 620.		Hours of operation
		Daily maintenance of vehicles and machinery		Mechanical Engineer	Capable of maintenance of vehicles and machinery	Spares and tools	Detection of faults and rectifying them	The approximate average salary of a mechanical engineer is MVR 290,000 per year. The cost of spares and tools required for the maintenance of machinery/equipment's is not known at this stage and should be included in the project value. The costs maybe obtained by consulting with the manufacturer or qualified service provider.		Vehicles in optimal condition
Air Quality- Dust	Minimize release of dust	Cover the waste on the transfer vehicles and ensure shorted transfer routes are taken	Continuous during construction phase	Laborer, Driver	Experienced Project Manager	Covering cloth, Waste Transfer Vehicles	Waste transfer vehicles that is able to operate in unpaved and challenging environment	A rear-loading garbage truck price is typically between USD 100,000 to USD 300,000.	Proponent	Level of dust at construction sites
		spraying the ground before excavation works with water		Laborer	Laborer who is able to operate water horse	Water horse, water pump, water supply, Electricity	RO	Cost of RO plants may vary depending on brand, size and specifications. Typically the price of a 10T RO plant is from USD 5000 to USD 50,000.		
		Ensuring that the trenches are backfilled as soon as possible by finishing works efficiently		Project Manager, Laborers	Experienced Project Manager	Excavator	No additional technology required	A mini excavator that is suitable for landscaping can be for USD 20,000 to USD 90,000.		
Noise Pollution	Minimize noise generated and duration of noise generated. Limit the noise generation hours to times that will cause minimum disturbance.	Usage of heavy machinery and equipment should be restricted to smaller areas (eg take the shortest route possible when accessing to work site)	Continuous during construction phase	Project Manager	Experienced project manager	Computer	Project management software	The salary of a project manager would vary depending on the proponent, typical salary of a project manager can range from MVR 25,000 to MVR 50,000. The cost of a computer may vary depending on the brand and computing power, typically one could get a basic desktop computer from around USD 300 to USD 600. The price of microsoft projects perpetual license is for about USD 620.	Proponent	Measurement of noise levels around construction sites
		Park the heavy machinery within the work site (if possible) to avoid unnecessary transfer								
		Ensure project is completed as soon as possible								
		Restrict working hours to daytime only								
Groundwater quality- oil		Establish Oil/chemical handling procedures and ensure no spills occur	Continuous during	Environmental safeguard	Environmental officer	Oil spill cleanup kits	Spill cleanup technology	The cost of spill cleanup operations can vary widely depending on the	Proponent	Spills and remediation

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

and chemical spills	Minimize risk of oil and chemical spills	Workers should be well trained about proper use of machinery and equipment relevant to them	construction phase	officer and oil spill cleanup crew		and chemical handling procedures		size, location of spill, type of substance spilled, etc. Small spills on land/water can cost from few thousand o tens of thousands of dollars. Medium spills on coastal waters can cost from tens of thousands to several hundred thousand dollars. Typical salary of an environmental safeguard officer is between MVR 15,000 to MVR 30,000 per month.		
		Have emergency oil spill cleanup crew on standby during construction								
		All machinery and equipment should be well maintained to avoid accidental spillage								
Groundwater quality-salinization	Minimize groundwater salinization from dewatering	Water extracted from dewatering should be recharged back to the ground to a designated area after checking the water quality	Continuous during construction phase	Laborers, Environmental safeguard officer	Environmental officer	Pump, water horse	Water quality testing	Typical salary of an environmental safeguard officer is between MVR 15,000 to MVR 30,000 per month. Water testing costs are depended on the parameters being tested. The costs can be obtained from MWSC laboratory.	Proponent	Groundwater salinity
		Efficient planning of foundation and pipe laying works to ensure least number of dewatering days	Prior to dewatering	Project Manager, Laborers	Experienced project manager	Computer	Project management software	The salary of a project manager would vary depending on the proponent, typical salary of a project manager can range from MVR 25,000 to MVR 50,000. The cost of a computer may vary depending on the brand and computing power, typically one could get a basic desktop computer from around USD 300 to USD 600. The price of microsoft projects perpetual license is for about USD 620.	Proponent	Number of dewatering days
Impacts on marine environment	Minimize direct damages to benthic substratum.	Limit access routes of vessels, excavators and heavy machinery to a small area	Continuous during construction phase	Environmental safeguard officer, Project Manager	Environmental officer, Experienced project manager	Dingy, GPS, Computer	Global positioning, aerial imagery	Typical salary of an environmental safeguard officer is between MVR 15,000 to MVR 30,000 per month. The salary of a project manager would vary depending on the proponent, typical salary of a project manager can range from MVR 25,000 to MVR 50,000.	Proponent	Extent of direct damages to surrounding reef
		Avoid dragging of anchors over the sea bed and should be carefully placed at the exact location								
		Ensure all project activities remain within the project boundary								
	Take permit from MMRI for coral translocation (if any) and ensure that they be translocated to an area with the same or similar habitat, conditions, and communities.	Continuous during construction phase	Environmental safeguard officer, laborers	Environmental officer, workers that can work in the marine environment	Dingy, snorkeling kits, coral frame, cable ties	Coral transplantation by using coral frames	Depending on the size and specifications of the coral frame, the price can vary between USD 50 to USD 350 per frame.			
Minimize sedimentation and control the sediment plume triggered during construction.	Use of sedimentation control measures such as sand bunds and silt screens	Prior to dredging	Environmental safeguard officer, laborers	Environmental officer	silt screen	sediment control	Depending on the size, material and features of the silt screen the prices may vary. A basic silt screen made of polypropylene fabric maybe available for USD 0.50 per square foot, while reinforced PVC material screen may cost USD 2 to USD 3 per square foot.	Proponent	Extent of sediment plume created	

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

	Dredge material shall be stockpiled at a designated area and the stockpiled material shall be protected or is placed in geotubes	Continuous during dredging	Environmental safeguard officer, laborers	Environmental officer	Geotube, excavator	No additional technology required	The cost of geotube may vary depending on the material and specifications. Typically the cost is from USD 3 to USD 20 per cubic foot.	Proponent	Extent of sediment plume created
	Ensure all work is carried out during low tide and in calm weather conditions	Continuous during construction	Project Manager	Experienced project manager	Computer	Project management software	The salary of a project manager would vary depending on the proponent, typical salary of a project manager can range from MVR 25,000 to MVR 50,000. The cost of a computer may vary depending on the brand and computing power, typically one could get a basic desktop computer from around USD 300 to USD 600. The price of microsoft projects perpetual license is for about USD 620.	Proponent	Extent of sediment plume created
	Halt construction if sedimentation is too high	Continuous during dredging	Environmental safeguard officer, laborers	Environmental officer	Sediment traps	Sedimentation measurement	A PVC sediment trap could be made roughly for USD 20.	Proponent	Sedimentation rate higher than 15 mg/cm3/day
Mitigate or avoid spillages	Following fuel/chemical handling procedures	Continuous during construction	Environmental safeguard officer, laborers	Environmental officer	Fuel/chemical handling procedures	No additional technology required	The cost of spill cleanup operations can vary widely depending on the size, location of spill, type of substance spilled, etc. Small spills on land/water can cost from few thousand o tens of thousands of dollars. Medium spills on coastal waters can cost from tens of thousands to several hundred thousand dollars. Typical salary of an environmental safeguard officer is between MVR 15,000 to MVR 30,000 per month.	Proponent	Number of spills
	Emergency cleanup crew shall be on standby at all times	Continuous during construction	Spill cleanup crew	Spill cleanup	Spill cleanup materials	Spill cleanup technology		Proponent	Test of water quality
Minimize stress on corals	Keep an eye of coral bleaching predictions. Reduce work at watch, halting any work if bleaching exceeds level 1 along with close and continuous monitoring of the reef if there is any sort of alert including "watch". Work to be halted on observation of impact and stress of the reef at any of the project sites.	Continuous during construction phase	Environmental safeguard officer	Environmental officer	Dingy, snorkeling kits, Underwater camera	Underwater photography	Typical salary of an environmental safeguard officer is between MVR 15,000 to MVR 30,000 per month.	Proponent	Coral bleaching
	If the project is due in the Months of Feb-May, ensure close monitoring of the reef for any impact and mitigate as much as possible. This is a period of known thermal stress and coral bleaching and additional stress from developments can affect reef health and recovery of all reefs in proximity to the project site								

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

		Trenched material should be stockpiled at a designated area		Environmental Safeguard Officer					Reusable gowns: USD 30 to USD 100 per gown. These prices may vary highly depending on the brand, quality and quantity purchased.		
		Backfilling any trenches made during the day before night by careful planning of pipe laying works		Environmental Safeguard Officer							
		Safety lights at night to avoid people from falling into open trenches		Environmental Safeguard Officer							
		Shoring for adjacent buildings during excavation if there is any risk of collapse	Prior to construction	Environmental Safeguard Officer							
Impacts on landscape integrity and scenery	Minimize aesthetically displeasing view for any people that can see project area	Project area shall be fenced off and informing of the project construction works	Prior to construction	Laborers	No additional expertise required	Aluminium sheets, metal poles	No additional technology required	The cost of a fence may vary highly depending on the materials used. An aluminium fence may cost from USD 20 to USD 50 per linear foot.	Proponent	Number of Complains	
Socio-economic impacts	Increase the chance of local workers/ contractors being hired	Work with locals and local businesses so that the needs of the project can be addressed by them	Prior to construction	Project manager, HR/PR staff	People skills	Computer	Ads, presentations	The salary for an HR staff may vary depending on the proponent, typically a mid level HR staff salary is from MVR 12,000 to MVR 18,000 per month	Proponent	Local workers hired	
		Inform the local businesses about the construction works and its schedule	Prior to construction	Project manager, HR/PR staff	People skills	Computer	Ads, presentations				
		Give priority to local contractors	Prior to construction	HR staff	No additional expertise required	No additional equipment required	No additional technology required				

9.1.2 Operational Phase

The following table describes the preferred mitigation measures for the identified impacts during the operational phase of the proposed project.

Table 41: proposed mitigation measures for the identified impacts during the operation phase of the proposed project

Impact	Mitigation Aspect	Proposed Mitigation Measures	Timing	Required manpower	Expertise	Equipment	Technology	Estimated Cost	Implementing Agency	Performance Indicator
Air Quality-GHG	Reduce volume of GHGs released	The generators at powerhouse of resort is well maintained	Continuous during operations	Mechanical engineer, laborers	Servicing of gen-sets	Spares, specialized tools and equipment's required for maintenance work	workshop facilities	The cost of maintenance for generators will vary depending on the brand, frequency of maintenance, availability of spare parts and maintenance personnel. A general estimate for a basic annual maintenance service for a small generator is for roughly USD 500, while large generators can be for thousands of USD.	Proponent	Percentage contribution of renewable energy
Air Quality-dust	Ensure dust, bad odor, VOCs and other pollutants are not released	Ensure optimal operations at the waste management center at all times	Continuous during operations	Operations Manager	Management skills	Computer	Operations software	A typical salary for a operations manager would be between MVR 15,000 to MVR 35,000 per month based on their qualifications and responsibilities. The cost covering material for the waste transfer vehicle shall be included in the operational costs.	Proponent	Air quality parameters in within thresholds
		Ensure that waste is transferred in a closed vehicle	Continuous during operations	Operations Manager	Management skills	Covering material	No additional technology required			
		All exhaust pipes will be fitted with filters and according to URA standards at the powerhouse	Design stage	Design consultant	Engineering	Filters, Computer	Designing software	A typical salary for a operations manager would be between MVR 15,000 to MVR 35,000 per month based on their qualifications and responsibilities. The cost of an exhaust filter may vary depending on type, size and specific requirements of the powerhouse. Without knowing these details it is difficult to provide an estimate and hence the cost shall be included within the project value.		
		Raising the chimney height above canopy of the island	Design stage	Design consultant	Engineering	Chimney, Computer	Designing software			
		Well maintenance of exhaust pipes and the filters	Continuous during operations	Workers	No additional expertise required	Cleaning equipment's, Computer	Maintenance logs	A typical salary for general staff would be between MVR 10,000 to MVR 20,000 per month based on qualifications and responsibilities.		
		Dislodging of soot or any harmful chemicals should be immediately reported	Continuous during operations	Environmental safeguards officer	Environmental management	Visual inspection, Computer	Logs	Typical salary of an environmental safeguard officer is between MVR 15,000 to MVR 30,000 per month.		
		Blower with vent pipe installed at the pump stations	Design stage	Design consultant	Engineering	Blower system, Vent pipe, Computer	Designing software	A typical salary for a operations manager would be between MVR 15,000 to MVR 35,000 per month based on their qualifications and responsibilities. The cost of blowers in pumpstations may vary depending on the brand, size etc. A general estimate is between a few thousand to tens of thousands of dollars for a blower system.		
		Aerators installed in pump stations	Design stage	Design consultant	Engineering	Aerators, Computer	Designing software			

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Noise Pollution	Minimize noise generated	Ensure that the heavy machinery at WMF is operated during daytime	Continuous during operations	Operations Manager	Management skills	Computer	Operations management software	A typical salary for a operations manager would be between MVR 15,000 to MVR 35,000 per month based on their qualifications and responsibilities.	Proponent	Noise level
		Ensure shortest waste transfer route is chosen and the route will cause least disturbance	Continuous during operations	Operations Manager	Management skills	Computer	Operations management software			
		Waste transfers can be schedule to daytime	Continuous during operations	Operations Manager	Management skills	Computer	Operations management software			
	Regular servicing and maintenance of pumps and generators	Continuous during operations	Technical staff	Capable of mechanical/electrical servicing works	Spares, specialized tools and equipment's required for maintenance work	workshop facilities	A general estimate for a basic annual maintenance service for a small generator is for roughly USD 500, while large generators can be for thousands of USD. The cost of maintenance for pumps in a pump station may vary depending on type of maintenance task to be done. Some of the common maintenance tasks include regular cleaning and inspection, lubrication which can cost from a few hundred to few thousand dollars per year.	Proponent		
	Powerhouse to be soundproofed	Project planning stage	Engineer	Civil engineering	Soundproofing materials	Sound attenuation	The cost of soundproofing a powerhouse may vary depending on the size of the powerhouse, the level of noise reduction required, the materials used. The cost of soundproofing can be as much as 20-30% of the cost of the powerhouse itself. General estimate is from few thousand dollars to tens of thousands of dollars or more.	Proponent, URA		
Ground and marine water quality-negative	Minimize risk of leaks within the utility systems	Ensure that leak detection systems are working	Continuous during operations	Technical staff	Water and sewer technicians	No additional equipment required	Leak detection	A typical salary for a operations manager would be between MVR 15,000 to MVR 35,000 per month based on their qualifications and responsibilities. Typical salary for technical staff maybe between MVR 10,000 to MVR 20,000. The cost of spares and specialized tools are highly variable and details are not available at this stage to provide an estimate as such these costs shall be included within the operational costs.	Proponent	Logs
		Routine maintenance and monitoring of the utility system	Continuous during operations	Technical staff	Water and sewer technicians	O&M equipment's	No additional technology required			Logs
	Minimize risk of leachate, waste water and storm water percolating into the ground	Ensure that leachate collection and treatment, waste water and storm water management systems are installed within the WMF	Prior to operations	Design consultant	Engineering	Computer	Designing software			Reports
		In case of leakages, proper maintenance shall be done to prevent further leaks	Continuous during operations	Technical staff	Water and sewer technicians	Spares, specialized tools and equipment's required for maintenance work	workshop facilities			Leakages

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Minimize risk of leachate, waste water and storm water washing into the nearby marine environment	Ensure proper operation and maintenance of systems of WMF	Continuous during operations	Operations Manager	Management skills	Computer	Operations management software			Condition of infrastructures and facilities		
	Ensure that waste transfer vehicles are closed vehicles such that waste is not exposed	Continuous during operations	Operations Manager	Management skills	Computer	Operations management software			Leakages		
	Materials used for the project shall be inspected and approved by supervision engineers to ensure their water tightness and leak proof	At project planning stage	Engineer	water and sewer engineer	material testing equipment	workshop facilities			Logs		
	Proper leak testing shall be carried out prior to the operation of the systems and the rectification measures shall be implemented in areas where leaks are found	Commissioning	Engineer	water and sewer engineer	Pressure testing equipment	pressure test			Logs		
	Account for the storm water flow during the final detail design of the sewer system	Design stage	Design consultant	water and sewer engineer	Computer	Designing software			Overflows		
	Account for the increases in flow in the final design of the sewer system	Design stage	Design consultant	water and sewer engineer	Computer	Designing software			Overflows		
	Monitor pumpstations in close proximity to shoreline and if the area is eroding, implement approximate shore protection measures	Continuous during operations	Workers	No additional expertise required	Visual inspection, Computer	Logs			Erosion		
	water quality monitoring according to operation and maintenance manual	Continuous during operations	Environmental safeguards officer	Environment management	Water sampling equipment's	water testing facility			Reports		
Groundwater quality-positive	Encourage protection and preservation of groundwater resources	Implement IWRM principles	At the design stage	Design consultant	Engineering	Computer	IWRM concepts	The salary for a design consultant may vary depending on their experience, qualification and proponent. Typical salaries maybe from MVR 20,000 to MVR 35,000 per month	Proponent	water quality	
Impacts on marine environment	Minimize deterioration of marine water quality at outfall discharge location	Ensure outfall pipes are directed to a location of good water flow and doesn't allow for a buildup that can detrimentally affect the marine habitat.	Continuous during operations	Environmental safeguards officer	Environment management	Diving equipment, underwater camera, Water sampling equipment's	Logs		Typical salary of an environmental safeguard officer is between MVR 15,000 to MVR 30,000 per month. Marine water testing as per operating license shall be included within the operational costs.	Proponent	water quality
		Wastewater shall be treated prior to disposal									
		Ensure the condition of the outfall is good and functional									
		Marine water testing according to operating license and EIA									

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Impacts on hydrodynamics	Ensure no scouring behind coastal structures	Routine monitoring to see if there is scouring and apply protection measures if necessary	Continuous during operations	Staff who can snorkel	Swimming	Snorkeling equipment and underwater camera	Underwater photography	The cost of underwater camera maybe highly viable depending on factors such as image quality, resolution, depth rating, features, and brand. The cost of basic models are around USD 100 and several thousand dollars for high-end professional cameras.	Proponent	Underwater photos
	minimize erosion	If there is significant changes in currents resulting in erosion, immediately report to authorities and coastal engineer for advise	Continuous during operations	Environmental safeguards officer, Surveyor, engineer	Environment management, land surveying, coastal engineering	Drone, Drogue	using aerial imagery to draw shorelines	Typical salary of an environmental safeguard officer is between MVR 15,000 to MVR 30,000 per month. Georeferenced aerial model of the Island may cost about USD 2000 to USD 3500.	Proponent	Erosion
		Explore options for beach nourishment in case of erosion	Project planning stage	Coastal Engineer	Coastal engineering	Computer	Engineering software	The salary for a coastal engineer may vary depending on their experience, qualification and proponent. Typical salaries maybe from MVR 20,000 to MVR 35,000 per month		
		Ensuring the outer vegetation zone is well maintained	Continuous during operations	Workers	Landscaping and gardening	Landscaping equipment's	No additional technology required	The cost of landscaping and gardening can vary depending on size of the area, the complexity of the design, the types of plants and materials used, and the region. A small scale landscaping project can cost between USD 2000 to USD 5000.			Vegetation on the outer perimeter of Island
Impacts on coastal environment	Minimize impacts to corals	Inform tourists of the importance of coral reefs and to be careful not to touch or damage corals	Continuous during operations	Environmental Safeguard Officer	Environmental management	Computer	Presentations, leaflets	Typical salary of an environmental safeguard officer is between MVR 15,000 to MVR 30,000 per month. Georeferenced aerial model of the Island may cost about USD 2000 to USD 3500.	Proponent, EPA, MoT	Health of coral reef
Impacts from vibration	Ensure no buildings are damaged due to vibrations	Ensure shortest waste transfer routes are taken	Continuous during operations	Operations Manager	Management skills	Computer	Operations management software	A typical salary for a operations manager would be between MVR 15,000 to MVR 35,000 per month based on their qualifications and responsibilities.	Proponent, URA	Vibrations
		Design of powerhouse shall reduce vibrations	Project planning stage	Engineer	Civil	Computer	Designing software	Typical salary of a civil engineer is from MVR 15,000 to MVR 25,000 per month		
		Ensure that a 200 ft buffer zone is established around the powerhouse	Project planning stage	Engineer	Civil	Computer	Designing software			
Impacts from waste	Ensure waste is managed properly	Ensure the waste management center and STP is functioning as per the national standards	Continuous during operations	Operations Manager	Management skills	Computer	Operations management software	A typical salary for a operations manager would be between MVR 15,000 to MVR 35,000 per month based on their qualifications and responsibilities.	Proponent	Logs
		Waste oil should be well contained and stored safely at a designated area	Continuous during operations							
		Waste oils should be taken to Thilafushi for proper disposal at	Continuous during operations							

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

		regular intervals or sold as per company policies								
Health and safety of working staff	Minimize risk of workplace accidents	Ensure staff are provided with PPE	Continuous during operations	HR staff	Health and safety	PPE equipment's	No additional technology required	The salary for an HR staff may vary depending on the proponent, typically a mid level HR staff salary is from MVR 12,000 to MVR 18,000 per month	Proponent	Staff wearing PPE at all times
Impacts on landscape integrity and scenery	Ensure that the infrastructures are operating at optimal conditions such that the scenery is not compromised any further	Routine maintenance such that the outlook of the new infrastructures are at optimal condition	Continuous during operations	Technical staff	Technicians in relevant field	Spares, specialized tools and equipment's required for maintenance work	No additional technology required	The salary of technical staff may vary depending on the field. A general estimate is MVR 15,000 to MVR 30,000 per month.	Proponent	Outlook of infrastructures
Socio-economic impacts - negative	Minimize impact to previous resource users	After discussions with previous resource users, allowing them access to gather resources from the surrounding waters in way that does not disrupt the resorts operations	Project planning stage	Project Manager, Natural resource use planner	Community development skills	Computer	Natural resource use planning	A typical salary for a natural resource use planner maybe between MVR 20,000 to MVR 35,000 per month.	Proponent, MoT, Atoll Council	Access for resource users
Socio-economic impacts - positive	Ensure that the infrastructures and facilities are operating at optimal conditions	Routine maintenance such that the infrastructures and facilities are operational at optimal condition	Continuous during operations	Technical staff	Technicians in relevant field	Spares, specialized tools and equipment's required for maintenance work	No additional technology required	A typical salary for a natural resource use planner maybe between MVR 20,000 to MVR 35,000 per month.	Proponent	Condition of infrastructures and facilities
		All machinery and equipment's shall conform to international minimum standards	Project planning stage	Procurement consultant	Knowledge in relevant field of water/sewer/waste/coastal	Computer	No additional technology required	A typical salary for a procurement consultant is roughly MVR 370,000 per year.	Proponent	
		Ensure that the utilities, infrastructures, and access channel is designed taking into consideration for the projected increase in their use in the future	Project planning stage	Design consultant	Consultant in relevant field of water/sewer/waste/coastal	Computer	Designing software	A typical salary for a design consultant maybe between MVR 20,000 to MVR 35,000 per month.	Proponent, URA	
		Obtain all the legal approval and permits for the operation of all utilities	Prior to operations	Manager	Knowledge in relevant field of water/sewer/waste/coastal	Computer	No additional technology required	A typical salary for a manager maybe between MVR 15,000 to MVR 25,000 per month.	Proponent, URA	Operating license
		Ensure that in the design of all facilities, there is adequate access for heavy vehicles to move	Project planning stage	Design consultant	Consultant in relevant field of water/sewer/waste/coastal	Computer	Designing software	A typical salary for a design consultant maybe between MVR 20,000 to MVR 35,000 per month.	Proponent	Accidents
		Ensure that systems are installed to manage by-products from waste management center and STP	Project planning stage	Design consultant	Consultant in relevant field of water/sewer/waste/coastal	Computer	Designing software	A typical salary for a design consultant maybe between MVR 20,000 to MVR 35,000	Proponent	Sludge management

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

		If leachate is intended to be disposed, it shall comply with the wastewater quality standards of URA	Project planning stage	Design consultant, Environmental safeguard officer	Environmental management	Water sampling equipment's	water testing facility	Typical salary of an environmental safeguard officer is between MVR 15,000 to MVR 30,000 per month. Water sampling costs shall be included within operational costs.	Proponent, URA	water quality
		have detailed operation and maintenance manuals for the utilities	Prior to operations	Engineer	Knowledge in relevant utility field	Obtain manuals from manufacturer	No additional technology required	A typical salary for an engineer maybe between MVR 20,000 to MVR 35,000 per month.	Proponent, URA	O&M manuals
		have a detailed operations plan made to the utilities	Prior to operations	Engineer, design consultant	Knowledge in operations of utilities and coastal infrastructures	Computer	No additional technology required	A typical salary for a design consultant maybe between MVR 20,000 to MVR 35,000 per month.	Proponent, URA	Operations plans
		Detailed process flow shall be made for the utilities and harbor operations detailing how all the processes will be undertaken and vehicles pathways within the them	Prior to operations	Engineer, design consultant	Knowledge in operations of utilities and coastal infrastructures	Computer	No additional technology required	A typical salary for a design consultant maybe between MVR 20,000 to MVR 35,000 per month.	Proponent	Process flow diagrams
Risk of hazards- storm surge	Minimize damages from storm surge event and sea level rise	Ensure that the structural integrity of the infrastructure holds	Continuous during operations	Technical staff	Technicians in relevant field	Underwater camera, diving equipment's	No additional technology required	The salary of technical staff may vary depending on the field. A general estimate is MVR 15,000 to MVR 30,000 per month.	Proponent	Logs
Risk of hazards- sea level rise		Ensure that the coastal structures are adequately elevated above the mean sea level and anticipated increase in sea level due to a storm surge event/sea level rise	Prior to construction	Design consultant	Consultant in relevant field of water/sewer/waste/coastal	Computer	Designing software	A typical salary for a design consultant maybe between MVR 20,000 to MVR 35,000 per month.		Elevated coastal infrastructure
Risk of hazards- fire and other workplace accidents	Minimise risk of fire and other workplace accidents	Ensure all firefighting and lightning protection equipment's/systems are installed in all facilities and operational for example smoke detectors, fire extinguishers	Continuous during operations	Environmental safeguards officer	Health and safety, environmental science	PPE, Manuals	No additional technology required	Typical salary of an environmental safeguard officer is between MVR 15,000 to MVR 30,000 per month. Cost of PPE equipment's and manuals shall be included within operational costs.	Proponent	Health and safety manuals, Emergency Response plans, Chemical handling procedures, logs
		Ensure personal protective equipment is made available to all staff and they use them properly								
		Establish emergency preparedness response plans, health and safety manuals, fuel handling procedures								
		Ensure emergency procedures, O&Ms are readily available								
		Ensure staff are adequately trained for emergencies, health and safety procedures, oil/chemical handling								
		Rescue buoys with rope available on the jetties								
	All personnel must strictly abide COVID 19 guidelines set by HPA – social distancing, wearing masks and regular hand washing or sanitization									

9.2 Location for silt screen placement

Silt screens may be placed as shown in the figure below during the construction of the propose resort in order minimize the impact of sediment plume.



Figure 62: Potential location for placement of silt screens during construction of the resort

9.3 Location for replanting trees

Although the Island is currently mostly covered with vegetation with little room to plant any further trees, upon reclamation, the vegetation removed during the land clearance can be used to vegetate the reclaimed area. Therefore, the proponent shall give priority to replant trees removed during the land clearance on the Island as much as possible and divert any extra trees uprooted during this project to vegetation replantation programs from nearby Islands or to resorts.

9.4 Justification for the selected mitigation measures

The abovementioned mitigation measures for the construction and operational phase of the project were selected as those mitigation measures requires the least additional manpower, expertise, equipment, technology, and costs. Additionally, because the mitigation measures fulfil the initial principle of avoidance followed by minimisation in the cases where the impact could not be avoided and lastly compensation in those cases where avoidance and minimisation were not possible.

9.5 Effectiveness of mitigation measures

The effectiveness of proposed mitigation measures in the Maldivian setting is very difficult to ascertain due to the lack of monitoring data that is available. As such the full effectiveness of the proposed mitigation measures will be determined by the follow-up surveillance of the performance indicators that is highlighted for each mitigation measure and by monitoring of the parameters that is highlighted in section 9.9.1 under the Table 42.

9.6 Risk Management and Incident Response

Risk management procedures in this project are strengthened by adopting a more systematic risk management approach to safety. This is achieved by identifying all foreseeable impacts (as stated in section 7 of this report), assessing the risk of each impact and providing a means to control the impacts (mitigation measures).

9.7 Sustainable Development Management Policy

The design and implementation of the project ensures that the proposed project is sustainable. As such, measures adopted to promote sustainable development include some guiding principles as well as components incorporated into the project design. These include:-

- Ensure environmental compliance with the Governmental policies and regulations;
- Protect people, property and the local environment;

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Reduce ecological impacts of the services provided; and
- Increase customer satisfaction.

9.8 Managing Uncertainties in Impact Prediction

Uncertainty is an integral part of an EIA as EIA preparation involves prediction. The two types of uncertainties associated with the EIA process include those associated with the process and those associated with predictions. With the former, the question is whether the most important impacts have been identified and whether the recommendations will be acted upon. In order to reduce such uncertainties, a wide range of stakeholders have been consulted (Section 6) in the EIA process in order to minimize the risk of missing important impacts. For the latter, the uncertainty is in the accuracy of the findings. This can be improved by research and quality of the survey, and by follow-up monitoring.

It should also be noted that even though EIA cannot give a precise picture of the future, it enables uncertainties to be better managed and is an aid to better decision making.

9.9 Environmental Monitoring

Monitoring is an essential part of the EIA and project implementation and serves 3 purposes:-

- Ensures that the proposed mitigation measures are being implemented;
- Evaluates whether the proposed mitigation measures are working effectively; and
- Validates the accuracy of models or projections that were used during impact assessment process.

The purpose of monitoring is to compare the predicted impacts with that of the actual impacts, particularly if the impacts are either very important or the scale of the impact cannot be predicted accurately. The results of monitoring can then be used to manage the environment, particularly to highlight problems early on so an action can be taken.

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Monitoring should not be seen as an open-ended commitment to data collection and to minimize the expenses associated with collecting unnecessary data, the data collection should cease when the need for monitoring ceases. Therefore, it is important that a proper monitoring schedule is adhered to. Conversely, monitoring may also indicate the need for more intensive study. The information obtained from monitoring can be extremely useful for future EIAs in making them more accurate as well as more effective.

9.9.1 Monitoring Parameters

The baseline data collection for the proposed development was undertaken in July 2023. Baseline surveys were conducted to determine the reference range, so that comparisons can be made during the monitoring to determine the change.

All monitoring activities must be carried out under supervision of a registered EIA consultant. Details of the monitoring program are given in Table 42 below.

It is the responsibility of the implementing agency to adhere to the monitoring program and bear any costs related to reporting them.

Table 42. Environmental monitoring plan proposed for the proposed development

Parameter	Locations	Method	Indicators	Frequency	Cost / MRF	Staff requirement
CONSTRUCTION PHASE						
Marine environment	Construction sites and Control	Water quality test Benthic substrate Analysis Fish census	Compare with baseline	Every 3 months during construction	15000	2 surveyors
Ground water	Construction sites, and Control	Water quality test	Compare with baseline	Every 3 months during construction	8000	1 surveyor
Turbidity	Construction sites and Control	Water quality test	Compare with baseline	Every 3 months during construction	500	1 surveyor

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Waste	Construction sites	Visual inspection	Improper management of waste	Every 3 months during construction	500	1 surveyor
Accidents	Project site	Workplace accidents	Number of incidents	Every 3 months during construction	1000	1 surveyor
Noise	Project site and Control	Decibel meter or any other equipment that can measure sound levels	Compare with baseline	Every 3 months during construction	500	1 surveyor
OPERATIONAL PHASE						
Air quality	Powerhouse and Control	Air quality measurement	Compare with baseline	Every 3 months after construction for 1 year and annually for 5 years	12000	1 surveyor
Ground water	Powerhouse, Pumpstations, and Control	Water quality test	Compare with baseline	Every 3 months after construction for 1 year and annually for 5 years	8000	1 surveyor
Supply water monitoring	RO Outlet, Storage tank Inlet, Storage tank outlet, Distribution network	Water quality test	Compare with URA supply water standards	Testing frequency as per URA standards	25000	2 surveyors
Waste	Resorts waste management center	Visual	Management of waste at WMC	Every 3 months after construction for 1 year and annually for 5 years	1000	1 surveyor

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

Monitoring report during operation – 6	June-27
Monitoring report during operation – 7	June-28
Monitoring report during operation – 8	June-29
Monitoring report during operation – 9	June-30
Monitoring report during operation – 10	June-31

9.9.3 Environmental Monitoring Report Format

Following is the environmental monitoring report format expected for this project. The report will include the details of the methods used to collect data, sampling sites, sampling frequency, results and analysis. All data collected in the monitoring period shall be presented in the monitoring report without bias and data shall be compared with the baseline values presented in this EIA report. For the preparation of this monitoring report a surveyor and an environmental consultant will be required.

Introduction

Purpose of the monitoring report

Introduction of consultant and proponent

Methodology

Describe the methods used to collect data

Sampling sites

Geographic coordinates

Results

Present results for the monitoring period

Comparison with baseline

Conclusion

Specify if environmental thresholds are being exceeded

Propose any additional mitigation measures

10. JUSTIFICATION AND CONCLUSION

The purpose of this EIA is to critically analyze and assess the potential environmental impacts associated with the proposed project to a luxury resort at ADh.Bodukaashihura and propose the solutions and preferred alternatives as well as mitigation measures to minimize any negative impacts whilst trying to derive the maximum positive impacts from the project.

The proposed resort is to be constructed at A.Dh Bodukaashi huraa. The Island is located on the Eastern rim of Alif Dhaalu Atoll and there are no environmentally sensitive or protected sites within 5km of the project island. The government of the Maldives has leased the island of Bodukaashihura for the purposes of developing a luxury resort. Therefore, the project entails the development of guest facilities such as, Beach Villa, Pool Beach Villas, Beach Suites, Water villas, Pool water villas, Water suites, Reception lobby, boutiq and front office, Pool Bar and Swimming Pool, All Day Dining Restaurant, Specialty Restaurant, Lagoon Bar, Grill Restaurant, Recreation Centre , Spa Main, Spa Treatment Rooms, Gymnasium, Dive Centre, Water Sports Center, Arrival Pavilion, Jettyhead Pavilion and Badminton Court. The project also entails the development of back of house facilities such as Executive Staff Rooms, Laundry Stores, Senior Staff rooms, Resort Admin office and Junior staff room, Junior staff room, Staff Dining, Kitchen, staff recreation, Service centre (Power and Water facilities), waste management facility, Mosque, Housekeeping stores (land), Housekeeping stores (water), Radio hut, Clinic, water storage tanks, Fuel Storage (1 diesel tank and 1 petrol tank) and Sewage treatment plant that would ensure the operation of such a facility. As such the resort will have total build up area of 8,849.19 sqm which is 28.61% of the total land area. Furthermore, the project also includes the reclamation area of around ten thousand square meters and establishment of related shore protection measures.

The major regulatory requirements for the project involve obtaining the EIA decision statement to go ahead with the project as per the EIA regulation, following with the legislations pertaining to tourism, electricity provision, waste management, water and sewerage services and dredging. In order to assess the existing environment of the project site, various aspects were studied under the EIA. Some of them are, marine and terrestrial biodiversity, air quality, noise, socioeconomic environment, water quality and hazard vulnerability.

The major impacts highlighted for the construction phase of the project is the damage to benthos and sedimentation, impacts from vegetation clearance, impacts on air quality, groundwater salinization, impacts on marine and coastal environment. The major impacts during operational phase are on air quality, marine environment, hydrodynamics, and the beneficial socioeconomic impacts. Major mitigation measures proposed in the construction phase include measures to lower sedimentation and vegetation removal impacts, ensuring shortest vehicle route in mobilization, vehicles are maintained properly, avoiding unnecessary use of vehicles, taking dust suppression actions such as spraying water on ground, restriction of work hours to during day time following oil and chemical handling procedures and having emergency spill clean-up crew at site. And during operational phase it is proposed to ensure that the generators at the powerhouse are well maintained, ensure optimal operations at the waste management center at all times, raising chimney above the canopy of the island, ensure leak detection systems are working and ensure leak repairs are done timely to avoid further incidents, ensure timely outfall inspections and attend to repairs timely if need be and monitoring the water quality of the supplied water to ensure safety of the supplied water.

Main alternatives that were studied were the no-project option, renewable energy integration, alternative intake method for the desalination plan, alternative material for storage tanks, alternative sewer treatment technology and alternative location for outfalls. The environmental monitoring formulated in the EIA includes to monitor marine environment, groundwater, turbidity, waste generation, incident occurrence and noise generation during construction phase and air quality, groundwater, supply water monitoring, waste, shoreline, marine environment and incident occurrence during operational phase of the project.

The socioeconomic benefits during the operations outweigh the negative impacts of the construction phase of the proposed project. Hence, with the alternative and mitigation measures outlined in the report, it is recommended to proceed with the project as planned.

11. ACKNOWLEDGEMENTS

Consultants would like to extend sincere gratitude to everyone who have contributed to this report. Thanks are due to the stakeholders who kindly contributed their expertise and fair judgement regarding this project. Representatives of proponent are highly appreciated for their generosity in providing any requested information for the compilation of this EIA report.

12. APPENDICES

APPENDIX A. REFERENCES

- (2023). Retrieved from FishBase: <https://www.fishbase.se/>
- AS/NZS ISO 31000 : 2009 Risk management - Principles and guidelines. (2009). Standards Australia / Standards New Zealand.
- Belopsky, A. V., & Droxler, A. W. (2004). Geologic Setting of the Maldives. In *Seismic Expressions and Interpretation of Carbonate Sequences: The Maldives Platform, Equatorial Indian Ocean* (Vol. 49). American Association of Petroleum Geologists. doi:<https://doi.org/10.1306/St49974>
- Budhavant, K., Andersson, A., Bosch, C., Krusa, M., Murthaza, A., Zahid, & Gustafsson, O. (2015). Apportioned contributions of PM 2.5 fine aerosol particles over the Maldives (northern Indian Ocean) from local sources vs long-range transport. *Science of The Total Environment*, 536, 72-78. doi:<https://doi.org/10.1016/j.scitotenv.2015.07.059>
- Carbon monoxide poisoning. (2022, July 1). Retrieved December 6, 2022, from NHS: <https://www.nhs.uk/conditions/carbon-monoxide-poisoning/>
- Chen, D. (2022, July 26). *What is TVOC and When is it Safe?* Retrieved December 5, 2022, from 1311 Jackson Ave Dental: <https://www.jacksonavedental.com/post/tvoc-levels>
- Coleman, N., Godfrey, T., Bridge, T., & Moritz, C. (2019). *Marine life of the Maldives: Indian Ocean*. Atoll Editions, Cairns, Australia.
- Colombo, A., Bettinetti, R., Strona, G., Cambria, F., Fanelli, R., Zubair, Z., & Galli, P. (2014). Maldives: An archipelago that burns. A first survey of PCDD/Fs and DL-PCBs from human activities. *Science of The Total Environment*, 497-498, 499-507. doi:<https://doi.org/10.1016/j.scitotenv.2014.08.013>
- Contestabile, P., Lauro, E. D., Galli, P., & Vicinanza, D. (2017). Offshore Wind and Wave Energy Assessment around Malè and Magoodhoo Island. *Sustainability*, 9(613). doi:[doi:10.3390/su9040613](https://doi.org/10.3390/su9040613)

- Kench, P. S., Parnell, K. E., & Brander, R. W. (2009). Monsoonally influenced circulation around coral reef islands and seasonal dynamics of reef island shorelines. *Marine Geology*, 266, 91-108. Retrieved from <http://linkinghub.elsevier.com/retrieve/pii/S0025322709002035>
- Kohler, K. E., & Gill, S. M. (2006). Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. *Computers & Geosciences*, 32(9), 1259-1269. Retrieved from <http://linkinghub.elsevier.com/retrieve/pii/S0098300405002633>
- Kuiter, R. H. (2014). *Fishes of the Maldives: Indian Ocean*. Atoll Editions, Carins, Australia.
- (2020). *Maldives Health Statistics*. Male' City: Ministry of Health.
- (2014). *Maldives Population & Housing Census*. Male': Ministry of Finance & Treasury.
- (2016). *Maldives' Population Dynamics: Policy Prospects for Human Growth and Opportunity*. Male': United Nations Population Fund.
- MapScape. (2023). *Methodology for bathymetry*.
- Mapscape. (2023). *Methodology for shoreline*.
- McAlpine, C. A., Seabrook, L. M., Rhodes, J. R., Maron, M., Smith, C., Bowen, M. E., . . . Cattarino, L. (2010). Can a problem-solving approach strengthen landscape ecology's contribution to sustainable landscape planning? *Landscape Ecology*, 28(8), 1155-1168.
- Millero, F. J. (2013). *Chemical Oceanography* (4 ed.). CRC Press.
- MNDOLI. (2022, March 10). *Carbon Dioxide (CO2)*. Retrieved December 5, 2022, from Minnesota Department of Health: <https://www.health.state.mn.us/communities/environment/air/toxins/co2.html>
- (2020). *Multihazard Risk Atlas of Maldives*. Male': Ministry of Environment, Climate Change and Technology & ADB.
- Nitrogen Dioxide (NO2) Pollution*. (2022, August 2). Retrieved December 6, 2022, from US EPA: <https://www.epa.gov/no2-pollution/basic-information-about-no2>

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

- Stansfeld, S. A., & Matheson, M. P. (2003). Noise pollution: non-auditory effects on health. *British Medical Bulletin*, 68, 243-257.
- (2004). *State of the Environment 2004*. Male': Ministry of Environment & Construction.
- (2023). *Statistical Yearbook*. Male' City: Maldives Statitital Bureau of statistics.
- (2010). *Statistical Yearbook of Maldives 2010*. Male': Department of National Planning.
- (2018). *Statistical Yearbook of Maldives*. Male' City: National Bureau of Statistics.
- Strona, G., Lafferty, K. D., Fattorini, S., Beck, P. A., Guilhaumon, F., Arrigoni, R., . . . Parravicini, V. (2021). Global tropical reef fish richness could decline by around half if corals are lost. *Proc. R Soc. B*, 288(20210274). Retrieved from <https://doi.org/10.1098/rspb.2021.0274>
- UNEP. (2002). *EIA Training Resource Manual*.
- United States Environmental Protection Agency. (n.d.). *Particulate matter (PM) pollution*. Retrieved from United States Environmental Protection Agency: <https://www.epa.gov/pm-pollution/particulate-matter-pm-basics>
- Wild Environment. (2012). *Environmental Impact Assessment for Proposed Clinical Waste and Fluorescent Tubes Storage Facility at Blocks 7 and 8, Section 7, 41 Alderson Place, Hume ACT, Australia*. Australia.
- Young, I. R. (1999). Seasonal Variability of the Global Ocean wind and Wave Climate. *nternational Journal of Climatology*, 19, 931-950.
- Zahid. (2011). The influence of Asian monsoon variability on precipitation patterns over the Maldives PhD thesis. New Zealand: University of Canterbury.

APPENDIX B. LIST OF ABBREVIATIONS

AS/NZS : Australia / New Zealand Standard	274
AS/NZS ISO : Joint Australian New Zealand International Standard.....	33
CBD : Convention on Biological Diversity	107
CO : Carbon Monoxide.....	228
CO2 : Carbon dioxide	228
DS : Decision Statement	31
EIA : Environmental Impact Assessment	27
EPA : Environmental Protection Agency	30
GHG : Greenhouse gas	103
HCHO : Methyl aldehyde or Formaldehyde.....	228
HIES : Household Income & Expenditure Survey	240
IT : Information Technology	31
MFDA : Maldives Food and Drug Authority	55
MFMRA : Ministry of Fisheries, Marine Resources and Agriculture.....	269
MMRI : Maldives Marine Research Institute	259
MNDF : Maldives National Defense Force	103
MoT : Ministry of Tourism.....	259
MPHRE : Ministry of Planning, Human Resource and Environment	46
MWSC : Male’ Water and Sewerage Company.....	217
NDMA : National Disaster Management Authority.....	259

APPENDIX C. TERMS OF REFERENCE

No: 203-ECA/471/2023/337

Terms of Reference for the Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll.

This is the Terms of Reference (ToR) issued following the scoping meeting held on **18th June 2023** for undertaking the **Environment Impact EIA for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll**. The proponent of the project is **HMHI Company Pvt. Ltd.** The Consultant of the project is **Mr. Mahfooz Abdul Wahhab (EIA P22/2016)**.

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 of the project and the tasks already completed. Clearly identify the rationale and objectives to enable the formulation of alternatives. Define the arrangements required for the environmental assessment and if relevant, including how work carried out under this contract is linked and sequenced with projects executed by other consultants, and how coordination between other consultants, contractors, government institutions will be carried out. List the donors, and the institutions the consultant will be coordinating with, and the methodologies used. This should include (but should not be limited to) the following.
 - Name and contact details of the Proponent
 - Rationale and background to the project
 - Aims and objectives of the project.
- 2. Study area** – Submit a minimum A3-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 of the facility. The study area should include adjacent buildings and related infrastructure, nearby environmentally sensitive sites (e.g., mosque). Relevant developments in the areas must also be considered including residential areas, all economic ventures and cultural sites.
- 3. Scope of work** - Identify and number tasks of the project including preparation, construction and decommissioning phases.

Task 1. Description of the proposed project – Provide a full description and justification of the relevant parts of the project, using maps at appropriate scales where necessary. All inputs and outputs related to the proposed activities shall be justified. Provide the following details:

- Project justification

The main activities of the resort development are:

- Land clearance (up to 20% of island vegetation);
- Channel dredging and jetty construction;

- Infrastructure construction including power house, water desalination plant, sewerage plant, oil storage tanks and waste management facility;
- Construction and operation of guest lodgings, accommodation, restaurants, spa, sports and marine centre facilities (include an A3 land use map);
- Environmental monitoring during construction activities;
- Measures to protect environmental values during construction and operation phase;

Land clearance:

- Define the total area of cleared vegetation;
- Methods of clearance and vegetation waste disposal.

Dredging at channel

- Location and size of channel
- Justification for the selection of these locations;
- Method and equipment used for dredging
- Justification for selecting the methods and equipment;
- Duration of dredging activity;

Water desalination plant:

- Location, desalination capacity, technology and water quality monitoring system;
- Pipeline construction methods, scheduling and drawings;
- Justification for the location of the water intake and brine outfall pipelines;
- Emergency water supply plan.

Power supply plant and oil storage:

- Location and size of generators and facility;
- Fuel transportation technique and volume required;
- Fuel storage;
- Emergency power supply plan;
- Low energy consumption ventures and awareness.

Sewerage plant:

- Plant location, capacity and justification;
- Water collection points and pipeline drawings;
- Describe operations for dewatering excavations for pump stations and sewer trenches;
- Describe rainwater collection and mechanisms used to avoid pipe leakages protecting ground water contamination;
- Discharge water quality testing system, leakage detection system and emergency plan;
- Justify outfall site selection including the distance from the reef and depth of the pipe using oceanographic and ecological information. Currents and waves ought to quickly disperse the discharged water with little to no impacts on marine ecosystems and economic activities. Illustrate the extent of the sediment plume. The public and stakeholders should support the location of the outfall site.
- Describe equipment needed and construction methods for laying the offshore pipeline including handling transportation.
- Detail solid waste disposal mechanisms, and equipment.

- Specify materials, equipment, heavy machinery, staff estimate (quantity and period of time), key personnel positions, intermittent technical expertise required;
- Specify an emergency plan if the system fails.

Waste management facility:

- Location justification, carrying capacity, materials to be collected and equipment required for waste reduction and recycling.
- Transportation mechanisms and costs;
- Recycling ventures and awareness activities within the resort.

Guest Accommodation and facilities

- List of types and area of the guest facilities and accommodations
- Structural design and excavation requirements for the structures
- Construction methods and scheduling

Revegetation:

- Details of the nursery where the source trees will be grown shall be supplied.
- Details of large tree sources (domestic or import).
- If vegetation is to be supplied from inhabited islands, approvals from those island councils are required and the details of the number of trees should be provided.

Jetties:

- Location justification, capacity and design;

Health and safety

- Availability of basic first aid facilities
- Availability of safety gears
- Proposed measures to be taken in case of oil spills in the marine environment.

Temporary facilities:

- Construction methods, scheduling and operation of temporary facilities including temporary jetty, power generation, oil storage, water supply, wastewater treatment, accommodation facilities, waste management and decommissioning.
- Temporary site location (including material storage)
- Accommodation for workers and details of the utilities at the site

Project Management

- Labour requirements and (local) labour availability;
- Housing of temporary labour
- Waste management during construction and operation
- Waste fuel and oil management details
- 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).

Task 2. Description of the environment – Assemble, evaluate and present the environmental baseline study/data regarding the study area and timing of the project (eg: monsoon season). Identify baseline data gaps and identify studies and level of detail to be carried out by the 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.

All data must be collected as per the requirements of the EPA Data Collection Guideline (published on www.epa.gov.mv). 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

- Temperature, rainfall, wind, waves and tides
- Risk of hurricanes and storm surges.

Geology and geomorphology

- Shoreline (high tide and low tide line) and vegetation line of the island.
- Offshore/coastal geology and geomorphology (use maps).
- (Seasonal) patterns of coastal erosion and accretion.

Hydrography/hydrodynamics

- Tidal ranges and tidal currents.
- Wave climate and wave induced currents around the island, particularly at the project site.
- Wind induced (seasonal) currents.
- Seawater quality at potential impact locations and from at least one control location measuring temperature, salinity, pH, turbidity and TSS.

Ecology

- Benthic characteristics/habitats and fish community within the impact zone with photographic evidence.
- Details of the vegetation at the project area
- Groundwater quality from inland development sites and control sites in the island, measuring these parameters: temperature, pH, salinity and Total Dissolved Solids (TDS), Dissolved Oxygen (DO), and Electrical Conductivity.
- 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 vectors.

Socio-economic environment – nearest inhabited island

- Demography: total population, sex ratio, density, growth and pressure on land and marine resources;
- Income situation and distribution
- Economic activities of both men and women (e.g. fisheries, home gardening, fish processing, employment in industry, government);
- Seasonal changes in activities;
- Accessibility and (public) transport to other island;
- Services quality and accessibility (water supply, waste/water disposal, energy supply, social services like health and education);

- Community needs;

Hazard vulnerability:

- 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. Include permits and approvals in the EIA document.

- Dredging permit from EPA
- Approval from the Ministry of Tourism

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 terrestrial vegetation and fauna from land preparation works.
- Impacts on marine habitats including damages to coral reefs and seagrass communities, fish stocks, protected areas and protected species.
- Changes in erosion/sedimentation patterns, which may impact shore zone configuration/coastal morphology.
- Temporary sediment dispersal in water column (turbidity at the dredging site, reclamation areas and related to shore protection activities), possibly resulting in changes in visibility, smothering of coral reefs and benthic communities and affecting fish and shellfish etc.
- Impacts on ground water table and quality as a result of construction and operation activities (leaching of salts in the deposited sediments and change in ground water quantity);
- Impacts on landscape integrity/scenery.

Impacts on the socio-economic environment

- Impacts on employment and income, potential for local people to have (temporary or long term) job opportunities (and what kind) in the execution of the works.
- Disturbance to local natural resource users such as fishing areas, other tourism ventures.
- Impacts to nearby resorts and dive sites.
- Level of protection against hazards like sea level rise, storm surges, etc.
- Impacts of the works in fishing activities (disturbance);
- Impacts on employment and income, potential for local people to have (temporary) job opportunities (and what kind) in the execution of the works;
- Impacts on food and nutrition security (fisheries, agricultural activities, supply of other food);
- Social services like health and education;
- Employment and economic opportunities and diversification;
- Increased demands on natural resources and services (domestic water supply, wastewater disposal, treatment systems, solid waste disposal systems, energy supply, etc);

- Social destabilization of the island community, and
- Monitoring of socioeconomic and demographic development.
- Impact on equity (economic activities, employment, income).

Construction related hazards and risks.

- Pollution of the natural environment (e.g., oil spills, discharge of untreated wastewater and solid waste, including construction waste);
- Risk of accidents and pollution on workers and local population, where applicable.

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 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” for the project or project activities that have been identified to have major negative impacts. All alternatives must be compared according to international and commonly accepted standards as much as possible. The comparison should yield the preferred alternative for implementation. The EIA report may investigate possibilities for the following among alternatives:

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. Mitigation measures to avoid or compensate habitat destruction, e.g., temporal sediment control structures, coastal protection structures to reduce erosion, coral reconstruction and MPA replacement areas. 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. An Environmental management plan for the proposed project, identifying responsible persons, their duties and commitments shall also be given. In cases where impacts are unavoidable arrangements to compensate for the environmental effect shall be given.

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. Monitoring reports shall be submitted to the Ministry of Tourism to evaluate the damages during construction, after project completion and every three months thereafter throughout the construction phase. Details of the monitoring programme 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 programme must be provided.

- Water quality, especially turbidity
- Erosion and accretion changes
- Temporal sedimentation rates on nearby coral reefs, benthic system and seagrass beds

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 Ministry of Tourism. The EIA report should include a list of people/groups consulted and summary of the major outcomes. Consultations with the following parties shall be undertaken in particular.



- MMRI
- NDMA
- Alif Dhaal Atoll Council
- ADh. Hangnaameedhoo Council
- Ministry of Tourism

Summarize the issues identified during the consultation process, include responses by the proponent to the issues raised and discuss the stakeholder input that has been incorporated or addressed in the EIA. Concerns that were raised by the stakeholders but not considered in the EIA, must be justified by the proponent.

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 for 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 Regulation 2012.

Timeframe for submitting the EIA report – The developer must submit the completed EIA report within 6 months from the date of this Term of Reference.

19th June 2023



APPENDIX D. APPROVED CONCEPT

BODUKAASHI HURAA
South Ari Atoll, Maldives

ITEM	BUILDING / FACILITY	ROOMS / UNIT	TOTAL ROOMS	NO UNIT	UNIT AREA	TOTAL AREA
A GUEST LODGING						
A1	Beach Villas	1	10	10 unit	65.32 sqm	653.20 sqm
A2	Pool Beach Villas	1	20	20 unit	65.32 sqm	1,306.40 sqm
A3	Beach Suites	1	2	2 unit	138.38 sqm	276.76 sqm
A4	Water Villas	1	20	20 unit	54.50 sqm	1,090.00 sqm
A5	Pool Water Villas	1	21	21 unit	54.50 sqm	1,144.50 sqm
A6	Water Suites	1	4	4 unit	117.64 sqm	470.56 sqm
TOTAL			77 Rooms		154 Beds	
B PUBLIC AREA						
B1	Reception Lobby, Boutique & front Office		1 unit	102.13 sqm	102.13 sqm	
B2	Pool Bar & Swimming Pool		1 unit	174.51 sqm	174.51 sqm	
B3	All Day Dining Restaurant		1 unit	590.98 sqm	590.98 sqm	
B4	Specialty Restaurant		1 unit	175.93 sqm	175.93 sqm	
B5	Lagoon Bar		1 unit	76.81 sqm	76.81 sqm	
B6	Grill Restaurant		1 unit	163.09 sqm	163.09 sqm	
B7	Recreation Centre		1 unit	72.73 sqm	72.73 sqm	
B8	Spa Men		1 unit	151.15 sqm	151.15 sqm	
B9	Spa Treatment Rooms		6 unit	38.08 sqm	228.48 sqm	
B10	Gymnasium		1 unit	57.93 sqm	57.93 sqm	
B11	Dive Centre		1 unit	62.23 sqm	62.23 sqm	
B12	Watersports Centre		1 unit	18.91 sqm	18.91 sqm	
B13	Arrival Pavilion		1 unit	38.88 sqm	38.88 sqm	
B14	Jettyhead Pavilion		1 unit	38.88 sqm	38.88 sqm	
B15	Badminton					
C SUPPORT FACILITY						
C0	Director's Bungalow		1 unit	164.59 sqm	164.59 sqm	
C1	GM & RM Bungalow		1 unit	110.08 sqm	110.08 sqm	
C2	Executive Staff Rooms		2 unit	93.94 sqm	187.88 sqm	
C3	Laundry Stores & Senior Staff Rooms		1 unit	364.78 sqm	364.78 sqm	
C4	Resort Admin Office & Junior Staff Rooms		1 unit	110.41 sqm	110.41 sqm	
C5	Junior Staff Rooms		1 unit	364.78 sqm	364.78 sqm	
C6	Staff Dining, Kitchen & Staff Recreation		1 unit	182.14 sqm	182.14 sqm	
C7	Service Centre (Generator & Desalinator)		1 unit	106.80 sqm	106.80 sqm	
C8	Recycle House		1 unit	15.04 sqm	15.04 sqm	
C9	Mosque		1 unit	24.36 sqm	24.36 sqm	
C10	Housekeeping Stores - Land		4 unit	19.60 sqm	78.40 sqm	
C10A	Housekeeping Stores - Water		1 unit	47.53 sqm	47.53 sqm	
C11	Radio Hut		1 unit	55.95 sqm	55.95 sqm	
C12	Clinic		1 unit	41.82 sqm	41.82 sqm	
D SERVICES INFRASTRUCTURE						
D1	Desalinated Water Storage Tanks		2 nos	16.00 sqm	32.00 sqm	
D2	Fuel Farm - 1 Diesel Tank & 1 Petrol Tank		1 nos	40.50 sqm	40.50 sqm	
D3	Sewage Treatment Plant		1 nos	28.07 sqm	28.07 sqm	
TOTAL BUILT UP AREA					8,849.19 sqm	
EXISTING LAND AREA					20,742.05 sqm	
PROPOSED RECLAMATION AREA					10,188.74 sqm	
TOTAL LAND AREA					30,930.79 sqm	
TOTAL BUILT UP PERCENTAGE					28.61 %	
BEACH LENGTH					835.63 m	

BODUKAASHI HURAA
EXISTING AREA
20,742.05 SQM
PROPOSED AREA
AFTER RECLAMATION
30,930.79 SQM

PROPOSED RECLAMATION AREA



Ref no: 88-DS/PRIV/2023/655
Date: 16th May 2023

BODUKAASHI HURAA
NORTH ARI ATOLL, MALDIVES
SCALE: 1:1500

COASTAL STRUCTURES LEGEND

CODE	NOS	ITEM
CS1	06	GRONE
CS2	01	ACCESS CHANNEL
CS3	01	BURROW SITE
CS4	01	ALTERNATIVE BURROW SITE
CS5	01	PROPOSED RECLAMATION AREA

AMENDMENTS

NO	DESCRIPTION

DESIGN

PROJECT
BODUKAASHI HURAA
SOUTH ARI ATOLL, MALDIVES
CLIENT
HMHI PVT. LTD.

SHEET
MASTERPLAN

PROJNO
P-04-23
REV
01
DATE
16 MAR 23

GX ASSOCIATES
PRIVATE LIMITED
KORUMBAI WALK, WALK 20-01, MALDIVES
TEL: 338075, 338665 FAX: (960)334882

APPENDIX E. DETAILED WORK SCHEDULE

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

APPENDIX F. WATER QUALITY ASSESSMENT RESULTS

WATER QUALITY TEST REPORT
 Report No: 500196931

Customer Information:
 Eco-Tech Consultancy Pvt Ltd
 M. Husnoo villa, Unigas Magu,

Report date: **18/07/2023**
 Test Requisition Form No: **900198096**
 Sample(s) Recieved Date: **11/07/2023**
 Date of Analysis: **11/07/2023 - 11/07/2023**

Sample Description ~	GC	G1	G2	TEST METHOD	UNIT
Sample Type ~	Sea Water	Sea Water	Sea Water		
Sample No	83240579	83240580	83240581		
Sampled Date ~	10/07/2023 09:30 AM	10/07/2023 09:30 AM	10/07/2023 09:30 AM		
PARAMETER	ANALYSIS RESULT				
Physical Appearance	Pale yellow with particles	Pale yellow with particles	Yellow with particles		
Conductivity *	23700	11660	17480	Method 2510 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	µS/cm
pH *	7.3	7.3	7.1	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	14.37	6.64	10.29	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Temperature	22.6	22.8	22.8	Electrometry	°C
Total Dissolved Solids	11870	58300	8740	Electrometry	mg/L
Dissolved Oxygen (DO)	8.79	7.96	6.45	In-house Test method (Adapted from HACH BOD LDO® Probe (Model LBOD10101) manual)	mg/L

Keys: µS/cm : Micro Seimen per Centimeter, ‰ : Parts Per Thousand, °C : Degree Celcius, mg/L : Milligram Per Liter

Checked by



Aminath Sofa
 Senior 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 *****

WATER QUALITY TEST REPORT
 Report No: 500196930

Customer Information:
 Eco-Tech Consultancy Pvt Ltd
 M. Husnoo villa, Unigas Magu,

Report date: **18/07/2023**
 Test Requisition Form No: **900198096**
 Sample(s) Recieved Date: **11/07/2023**
 Date of Analysis: **11/07/2023 - 12/07/2023**

Sample Description ~	Bodukaashihura D1	D2	D3	TEST METHOD	UNIT
Sample Type ~	Sea Water	Sea Water	Sea Water		
Sample No	83240570	83240571	83240572		
Sampled Date ~	10/07/2023 09:30 AM	10/07/2023 09:30 AM	10/07/2023 09:30 AM		
PARAMETER	ANALYSIS RESULT				
Physical Appearance	Clear with particles	Clear with particles	Clear with particles		
pH *	8.2	8.2	8.2	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	33.99	33.71	33.44	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Temperature	23.0	22.8	22.6	Electrometry	°C
Total Suspended Solids	<5 (LoQ 5 mg/L)	13	<5 (LoQ 5 mg/L)	HACH Method 8006	mg/L
Turbidity *	<0.1 (LoQ 0.1 NTU)	0.419	0.272	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU

Keys: ‰ : Parts Per Thousand, °C : Degree Celcius, mg/L : Milligram Per Liter, NTU : Nephelometric Turbidity Unit

Checked by



Aminath Sofa
 Senior Laboratory Executive

Approved by



Nihaz A. Zahir
 Assistant Quality Manager

Notes:

Sampling Authority: Sampling was not done by MWSC Laboratory.
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 This test report is ONLY FOR THE SAMPLES TESTED.
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WATER QUALITY TEST REPORT
 Report No: 500196930

Customer Information:

Eco-Tech Consultancy Pvt Ltd
 M. Husnoo villa, Unigas Magu,

Report date: **18/07/2023**
 Test Requisition Form No: **900198096**
 Sample(s) Recieved Date: **11/07/2023**
 Date of Analysis: **11/07/2023 - 12/07/2023**

Sample Description ~	D4	C	D5	TEST METHOD	UNIT
Sample Type ~	Sea Water	Sea Water	Sea Water		
Sample No	83240573	83240574	83240575		
Sampled Date ~	10/07/2023 09:30 AM	10/07/2023 09:30 AM	10/07/2023 09:30 AM		
PARAMETER	ANALYSIS RESULT				
Physical Appearance	Clear with particles	Clear with particles	Clear with particles		
pH *	8.2	8.2	8.2	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	33.73	33.79	33.97	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Temperature	22.7	22.8	22.9	Electrometry	°C
Total Suspended Solids	<5 (LoQ 5 mg/L)	<5 (LoQ 5 mg/L)	<5 (LoQ 5 mg/L)	HACH Method 8006	mg/L
Turbidity *	0.119	0.131	0.161	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU

Keys: ‰ : Parts Per Thousand, °C : Degree Celcius, mg/L : Milligram Per Liter, NTU : Nephelometric Turbidity Unit

Checked by



Aminath Sofa
 Senior Laboratory Executive

Approved by



Nihaz A. Zahir
 Assistant Quality Manager

Notes:

Sampling Authority: Sampling was not done by MWSC Laboratory.

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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

WATER QUALITY TEST REPORT

Report No: 500196930

Customer Information:

Eco-Tech Consultancy Pvt Ltd
 M. Husnoo villa, Unigas Magu,

Report date: **18/07/2023**

Test Requisition Form No: **900198096**

Sample(s) Recieved Date: **11/07/2023**

Date of Analysis: **11/07/2023 - 12/07/2023**

Sample Description ~	D6	Bodukaashihura D7	D9	TEST METHOD	UNIT
Sample Type ~	Sea Water	Sea Water	Sea Water		
Sample No	83240576	83240577	83240578		
Sampled Date ~	10/07/2023 09:30 AM	10/07/2023 09:30 AM	10/07/2023 09:30 AM		
PARAMETER	ANALYSIS RESULT				
Physical Appearance	Clear with particles	Clear with particles	Clear with particles		
pH *	8.2	8.2	8.2	Method 4500-H+ B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Salinity	33.46	33.76	34.19	Method 2520 B. (adapted from Standard methods for the examination of water and waste water, 23rd edition)	‰
Temperature	22.5	22.6	22.6	Electrometry	°C
Total Suspended Solids	5	<5 (LoQ 5 mg/L)	<5 (LoQ 5 mg/L)	HACH Method 8006	mg/L
Turbidity *	0.115	0.133	0.195	HACH Nephelometric Method (adapted from HACH 2100N Turbidimeter User Manual)	NTU

Keys: ‰ : Parts Per Thousand, °C : Degree Celcius, mg/L : Milligram Per Liter, NTU : Nephelometric Turbidity Unit

Checked by



Aminath Sofa
 Senior Laboratory Executive

Approved by



Nihaz A. Zahir
 Assistant Quality Manager

Notes:

Sampling Authority: Sampling was not done by MWSC Laboratory.

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This test report is ONLY FOR THE SAMPLES TESTED.

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

APPENDIX G. FORMAT FOR FUEL HANDLING PROCEDURE

Following is the fuel handling procedure format expected for this project. The procedure shall include the following;

Introduction

Name and contacts of the applicable facility

Major aims and objectives

Applicability and scope

Proposed fuel delivering and dispensing procedure for construction phase

Proposed fuel delivering and dispensing procedure for operational phase

Emergency Protocols

In case of spills

APPENDIX H. FORMAT FOR HEALTH AND SAFETY MANUAL

Following is the health and safety manual format expected for this project. The manual shall include the health and safety policy of the proponent, roles and responsibilities of key personnel, detailed health and safety procedures.

Introduction

Name and contacts of the applicable facility

Major aims and objectives

Applicability and scope

Health and safety policy

Roles and responsibilities

Organizational chart

Describe in detail the responsibilities of each personnel

Health and safety procedures

Describe in detail the health and safety procedures for all key works at the applicable facility for instance procedure for;

handling electrical appliances

chemical handling

preventive procedures

employee behavior and attitude

handling accidents

training

waste disposal

latest first aid procedure

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

APPENDIX J. EVIDENCE OF EIA REPORT SUBMISSION TO ATOLL COUNCIL



Mahfooz AbdulWahhab <mahfoozabdullwahhab@gmail.com>

Environmental Impact Assessment for the Proposed Resort Development Project at Bodukaashihuraa, Alif Dhaal Atoll

1 message

Mahfooz Abdul Wahhab <mahfooz@ecotechconsultancy.com>

Sun, Aug 13, 2023 at 6:55 AM

To: admin@adh.gov.mv

Cc: "Ibrahim R. Adam" <rashihu@ecotechconsultancy.com>, Eco-Tech Consultancy <secretariat@ecotechconsultancy.com>

Dear Sir,

Please follow the link below for the captioned EIA report.

https://drive.google.com/open?id=1YF6JtsgbKkiF4dJjLE4cokkM8z0PwhBn&usp=drive_fs

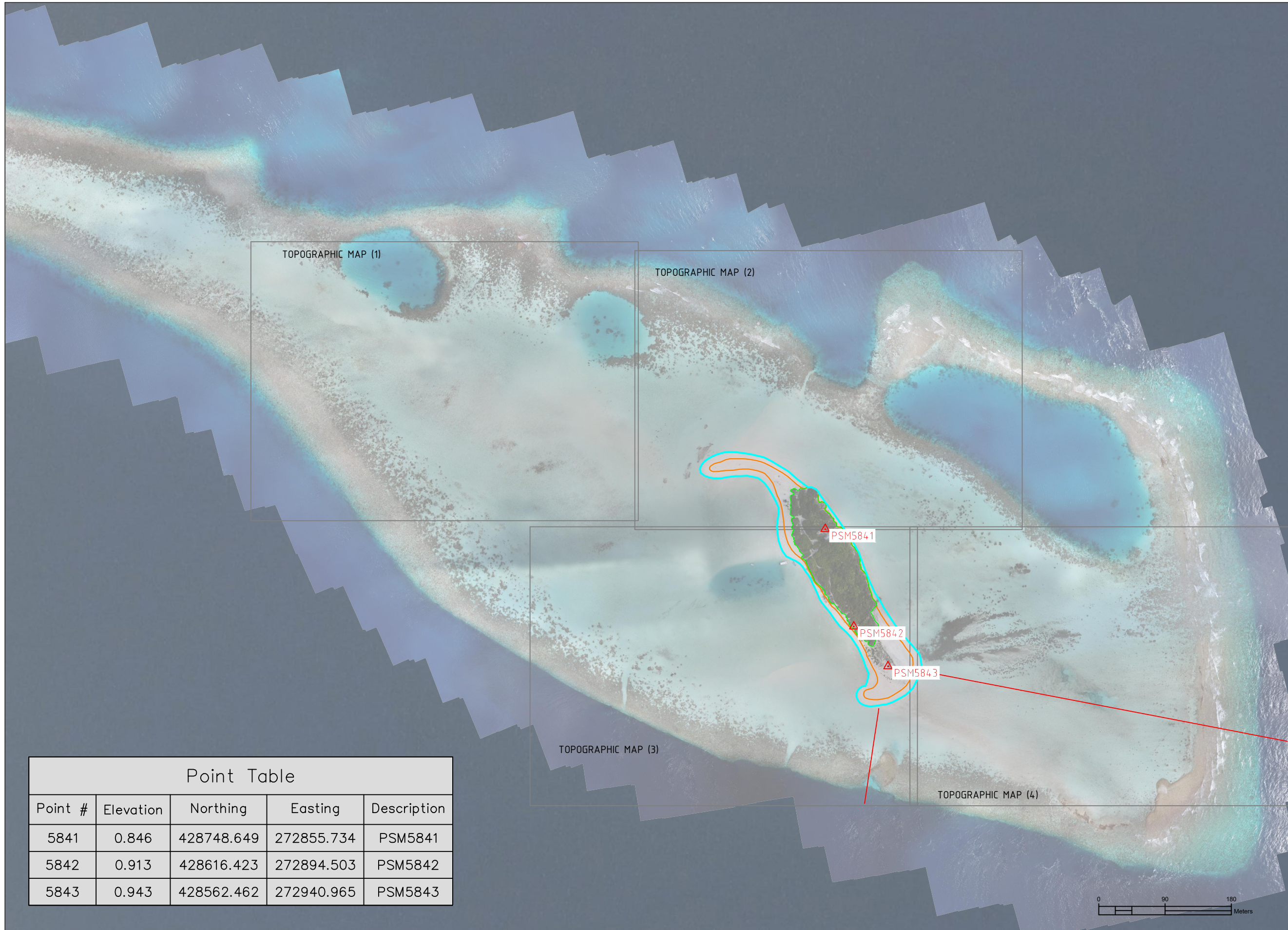
Best Regards,




Mahfooz Abdul Wahhab
Managing Director
Eco-Tech Consultancy Pvt. Ltd
M. Husnoovilaa, Unigas Magu,
Male', 20296, Kaafu Atoll, Maldives
Website: www.ecotechconsultancy.com
(+960) 9994467

APPENDIX K. LAND AND HYDROGRAPHIC REPORTS


BODUKAASHIHURAA ENV STUDY



Point Table				
Point #	Elevation	Northing	Easting	Description
5841	0.846	428748.649	272855.734	PSM5841
5842	0.913	428616.423	272894.503	PSM5842
5843	0.943	428562.462	272940.965	PSM5843



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EMAIL: INFO@MAPSCAPE.NET



LEGEND

- ▲ PSM
- HIGH TIDE LINE
- LOW TIDE LINE
- VEGETATION LINE

NOTE

- UNITS IN METERS
- WGS84 UTM ZONE 43 COORDINATE SYSTEM
- GNSS RTK POSITIONING AND AERIAL PHOTOGRAMMETRY FOR TOPOGRAPHY
- GNSS RTK POSITIONING AND ECO SOUNDER FOR BATHYMETRY

REVISIONS

-	-
-	-
-	-
-	-
-	-

PROJECT TITLE

BODUKAASHIHURAA ENV STUDY

CLIENT

HMHI COMPANY PVT LTD

DRAWING TITLE

SURVEY MAPS

SHEET TITLE

INDEX MAP

SURVEYOR S/L #
AHMED NASHID BP02006

SURVEYED DATE 3/14/2023

DRAWN BY NASHID,SAEED

DRAWN DATE 15 JUL 23

SCALE 1:5000

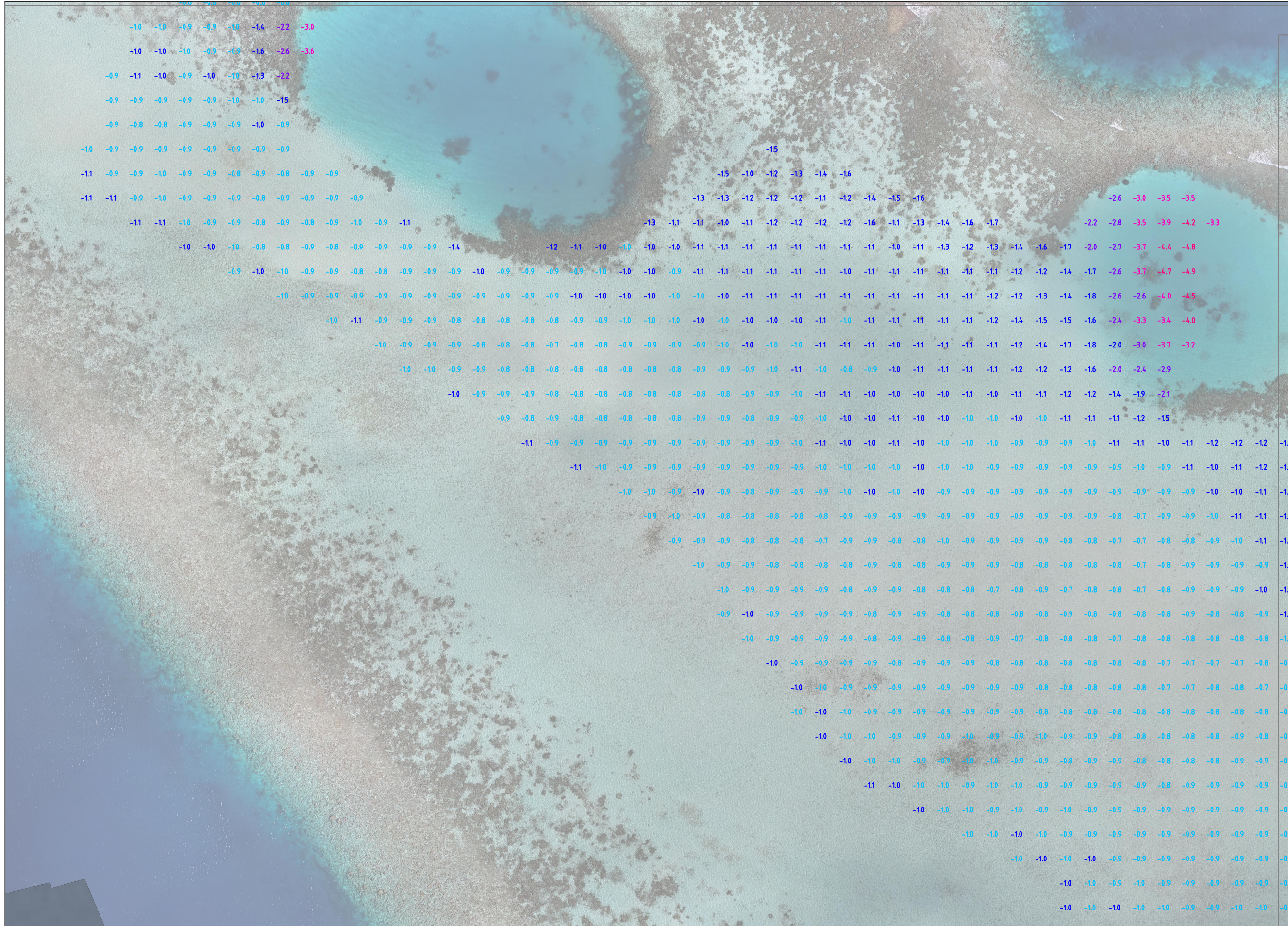
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DRAWING NUMBER

MS/2023/236

PAGE 1 OF 5

BODUKAASHIHURAA ENV STUDY



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LEGEND

NOTE

- UNITS IN METERS
- WGS84 UTM ZONE 43 COORDINATE SYSTEM
- GNSS RTK POSITIONING AND AERIAL PHOTOGRAMMETRY FOR TOPOGRAPHY
- GNSS RTK POSITIONING AND ECO SOUNDER FOR BATHYMETRY

REVISIONS

NO.	DESCRIPTION
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PROJECT TITLE

BODUKAASHIHURAA ENV STUDY

CLIENT

HMHI COMPANY PVT LTD

DRAWING TITLE

SURVEY MAPS

SHEET TITLE

BATHY MAP (1)

SURVEYOR S/L #
AHMED NASHID BP02006

SURVEYED DATE 3/14/2023

DRAWN BY NASHID, SAEED

DRAWN DATE 16-Jul-23

SCALE 1:1000

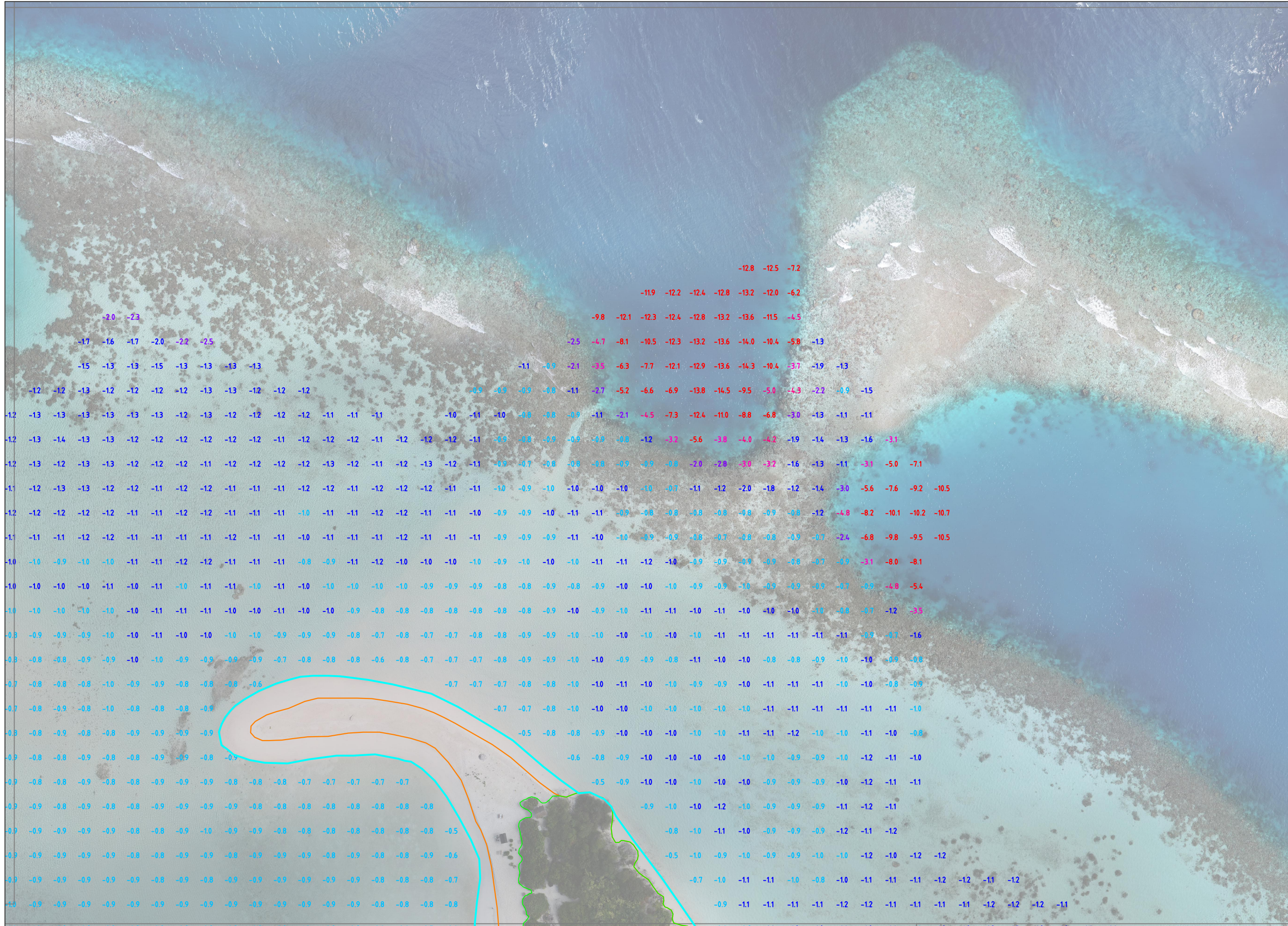
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LEGEND

NOTE

- UNITS IN METERS
- WGS84 UTM ZONE 43 COORDINATE SYSTEM
- GNSS RTK POSITIONING AND AERIAL PHOTOGRAMMETRY FOR TOPOGRAPHY
- GNSS RTK POSITIONING AND ECO SOUNDER FOR BATHYMETRY

REVISIONS

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PROJECT TITLE

BODUKAASHIHURAA ENV STUDY

CLIENT

HMHI COMPANY PVT LTD

DRAWING TITLE

SURVEY MAPS

SHEET TITLE

BATHY MAP (2)

SURVEYOR S/L #
AHMED NASHID BP02006

SURVEYED DATE 3/14/2023

DRAWN BY NASHID, SAEED

DRAWN DATE 16-Jul-23

SCALE 1:1000

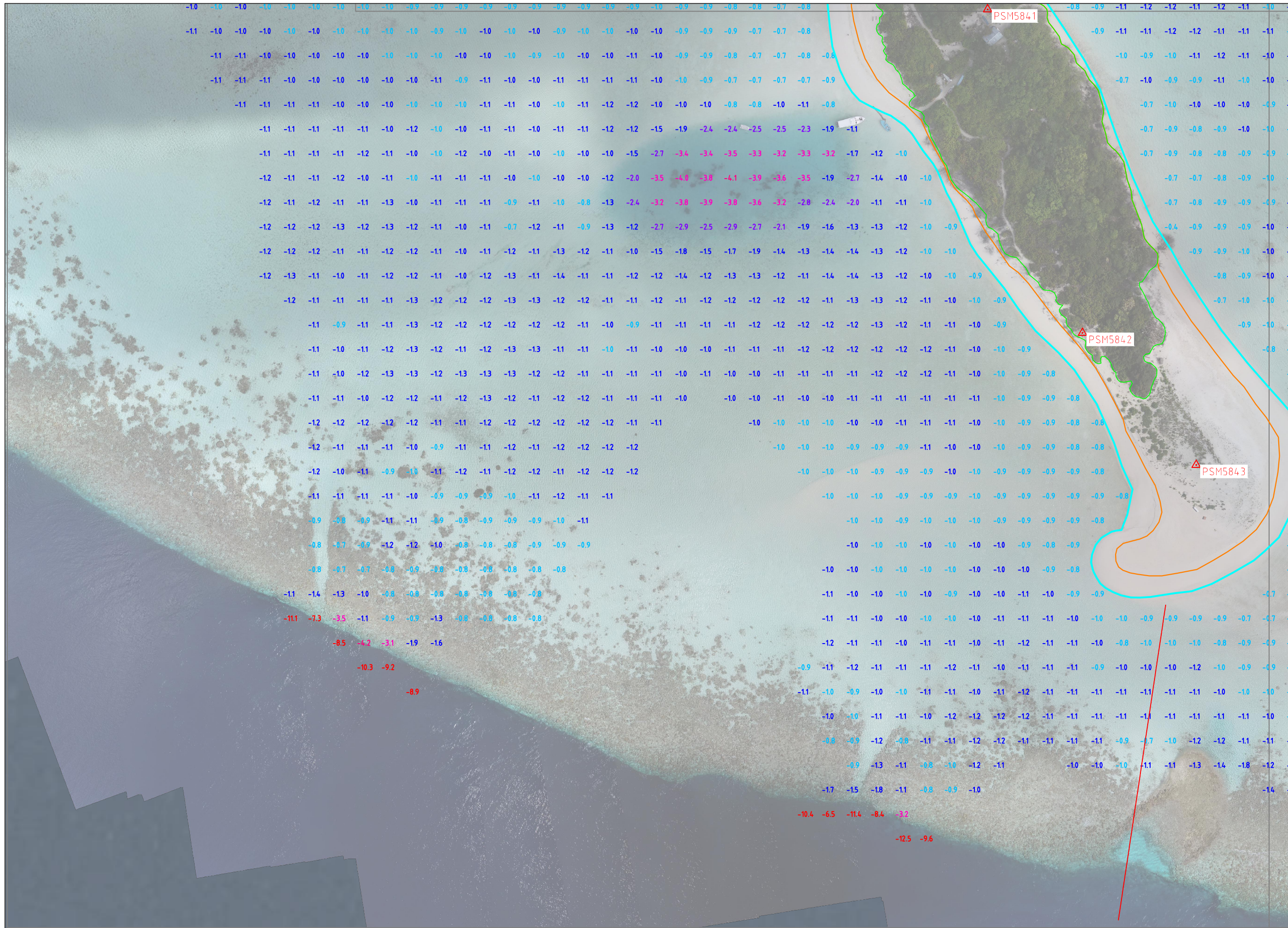
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LEGEND

NOTE

- UNITS IN METERS
- WGS84 UTM ZONE 43 COORDINATE SYSTEM
- GNSS RTK POSITIONING AND AERIAL PHOTOGRAMMETRY FOR TOPOGRAPHY
- GNSS RTK POSITIONING AND ECO SOUNDER FOR BATHYMETRY

REVISIONS

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PROJECT TITLE

BODUKAASHIHURAA ENV STUDY

CLIENT

HMHI COMPANY PVT LTD

DRAWING TITLE

SURVEY MAPS

SHEET TITLE

BATHY MAP (3)

SURVEYOR S/L #
AHMED NASHID BP02006

SURVEYED DATE 3/14/2023

DRAWN BY NASHID, SAEED

DRAWN DATE 16-Jul-23

SCALE 1:1000

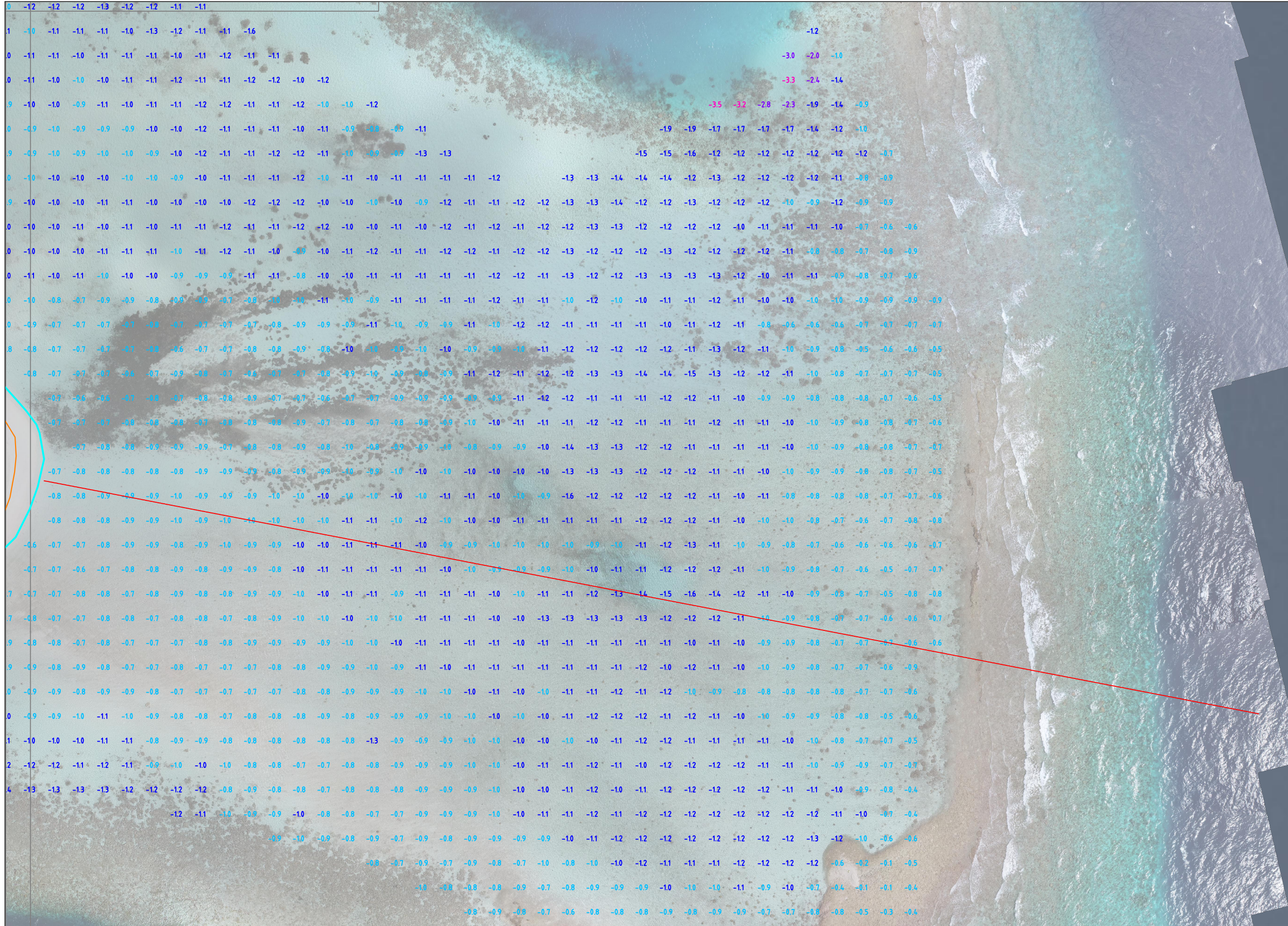
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LEGEND

NOTE

- UNITS IN METERS
- WGS84 UTM ZONE 43 COORDINATE SYSTEM
- GNSS RTK POSITIONING AND AERIAL PHOTOGRAMMETRY FOR TOPOGRAPHY
- GNSS RTK POSITIONING AND ECO SOUNDER FOR BATHYMETRY

REVISIONS

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PROJECT TITLE

BODUKAASHIHURAA ENV STUDY

CLIENT

HMHI COMPANY PVT LTD

DRAWING TITLE

SURVEY MAPS

SHEET TITLE

BATHY MAP (4)

SURVEYOR S/L #
AHMED NASHID BP02006

SURVEYED DATE 3/14/2023

DRAWN BY NASHID,SAEED

DRAWN DATE 16-Jul-23

SCALE 1:1000

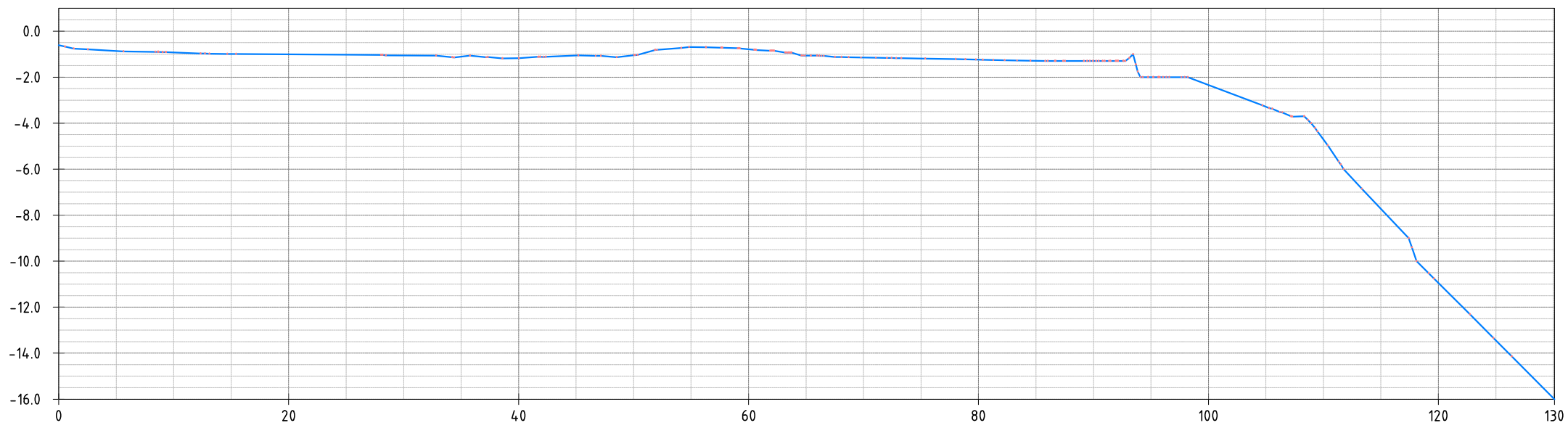
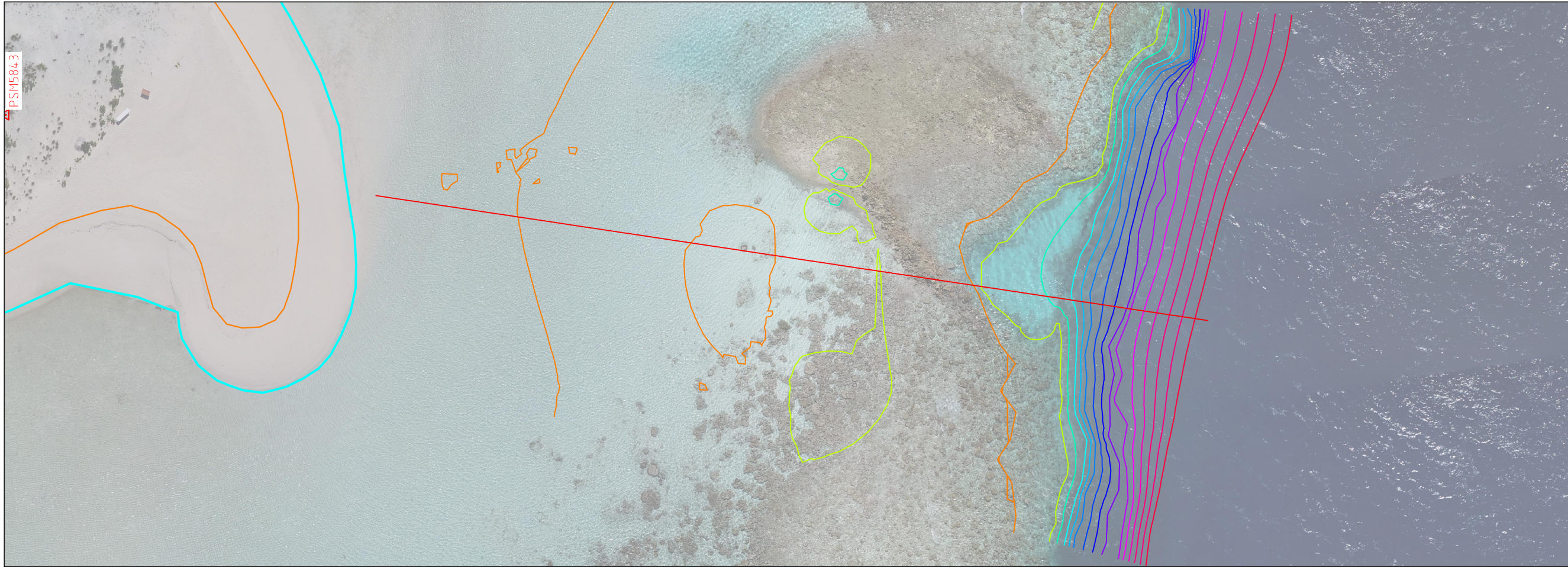
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PAGE 5 OF 7

BODUKAASHIHURAA ENV STUDY



OPTION 1



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LEGEND

NOTE

- UNITS IN METERS
- WGS84 UTM ZONE 43 COORDINATE SYSTEM
- GNSS RTK POSITIONING AND AERIAL PHOTOGRAMMETRY FOR TOPOGRAPHY
- GNSS RTK POSITIONING AND ECO SOUNDER FOR BATHYMETRY

REVISIONS

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PROJECT TITLE

BODUKAASHIHURAA ENV STUDY

CLIENT

HMHI COMPANY PVT LTD

DRAWING TITLE

SURVEY MAPS

SHEET TITLE

PROFILE (1)

SURVEYOR S/L #
AHMED NASHID BP02006

SURVEYED DATE 3/14/2023

DRAWN BY NASHID, SAEED

DRAWN DATE 16-Jul-23

SCALE 1:1000

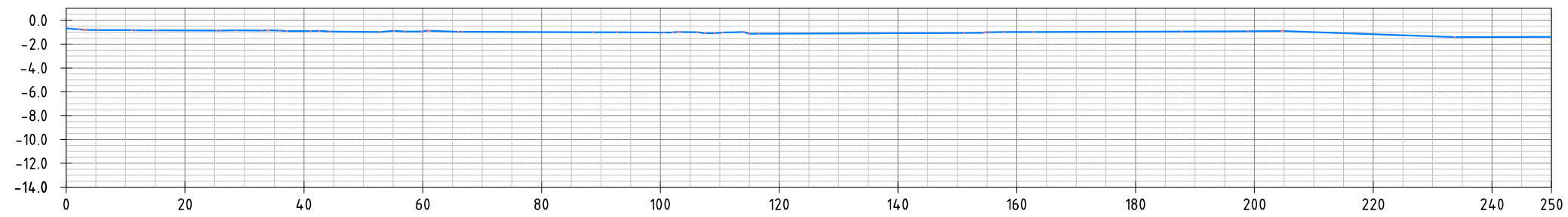
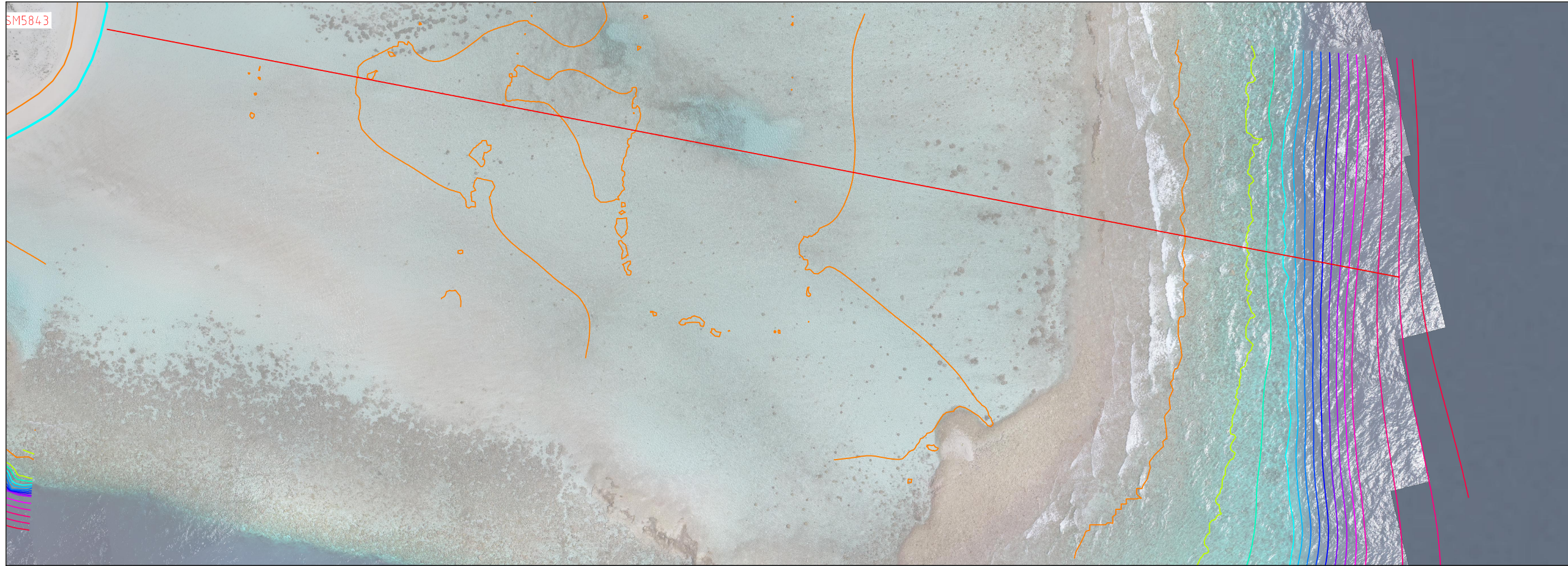
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DRAWING NUMBER

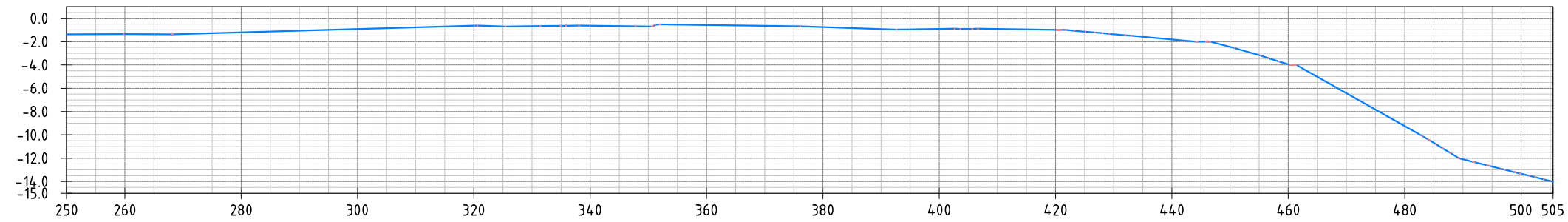
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PAGE 6 OF 7

BODUKAASHIHURAA ENV STUDY



OPTION 2



OPTION 2



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LEGEND

NOTE
 - UNITS IN METERS
 - WGS84 UTM ZONE 43 COORDINATE SYSTEM
 - GNSS RTK POSITIONING AND AERIAL PHOTOGRAMMETRY FOR TOPOGRAPHY
 - GNSS RTK POSITIONING AND ECO SOUNDER FOR BATHYMETRY

REVISIONS

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-	-
-	-

PROJECT TITLE

BODUKAASHIHURAA ENV STUDY

CLIENT

HMHI COMPANY PVT LTD

DRAWING TITLE

SURVEY MAPS

SHEET TITLE

PROFILE (2)

SURVEYOR S/L #
AHMED NASHID BP02006

SURVEYED DATE 3/14/2023

DRAWN BY NASHID, SAEED

DRAWN DATE 16-Jul-23

SCALE 1:1000

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