

Environmental Impact Assessment

Document Stage: Updated
Number: 51077-003
August 2023

Maldives: Greater Malé Waste-to-Energy Project – Waste to Energy Plant (Part I)

Appendices

Prepared by the Ministry of Environment, Climate Change and Technology for the Ministry of Finance and the Asian Development Bank. This is an updated version of the draft originally posted in July 2020 available on <https://www.adb.org/projects/documents/mld-51077-003-eia-2>.

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74/RPT/ 04706

TEST REPORT

Report No: (7422)168-0276

Jun 30, 2022

Page 1 of 2

Attn: Mr. Sujith Sudhakaran

Customer: Alke Alkatas Joint Venture (Pvt) Ltd
Address : H.H. Moomiyaage, 5A, Asaree Hingun, 20265 Male, Maldives:
Date of Sample Received: Jun 17, 2022
Date of Testing Started: Jun 17, 2022
Date of Testing Completed: Jun 24, 2022
Sample Description: **Sample Received as:**
A water samples contained in sealed plastic containers

Sample Identified by the Client as:
Water Sample (1.5L, 1L, 500ml x 2 bottles)
SW-7

Sample Drawn By BVCPS NO

Photo of the Submitted Sample



Bureau Veritas Consumer Products Services Lanka (Pvt) Ltd.

No. 570, Galle Road, Katubedda, Morotawa, Sri Lanka
Tel: (9411) 2350111-119 (dedicated lines), Fax: (9411)
11262238 & 199
Email: info.lanka@bureauveritas.com

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TEST REPORT

Report No: (7422)168-0276

Jun 30, 2022

Page 2 of 2

TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Biological Oxygen Demand (BOD ₅) @ 20°C	2	-	mg/L	APHA 23rd ed: 2017 : 5210D
2	Total Suspended Solids (TSS)	4	-	mg/L	APHA 23rd ed: 2017 : 2540D
3	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017 :5520B
4	Free Ammonia (as NH ₃)*	ND	0.02	mg/L	SLS 614 Appendix A: 2013
5	Nitrate (as NO ₃)*	0.3	-	mg/L	APHA 23rd ed: 2017: 4500 -NO ₃ - B
6	Arsenic (as As)	ND	0.001	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
7	Copper (as Cu)	0.031	-	mg/L	
8	Nickel (as Ni)	ND	0.001	mg/L	
9	Cadmium (as Cd)	ND	0.0001	mg/L	
10	Total Chromium (as Cr)	ND	0.001	mg/L	
11	Lead (as Pb)	ND	0.001	mg/L	
12	Mercury (as Hg)	ND	0.00005	mg/L	
13	Zinc (as Zn)	0.007	-	mg/L	
14	Salinity*	36	-	ppt	By Salinity Refractometer

*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

NOTE:

APHA: American Public Health Association, ND: Not Detected,

LOQ: Limit of Quantification, mg/l: milligrams per liter, ppt: Parts per thousand,

ICP-MS: Inductively coupled plasma mass spectrometry.

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REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.
AUTHORIZED SIGNATORY

APPROVED BY:  SHASHI MANOJ

ASSISTANT GENERAL MANAGER -
OPERATIONS/TECHNICAL

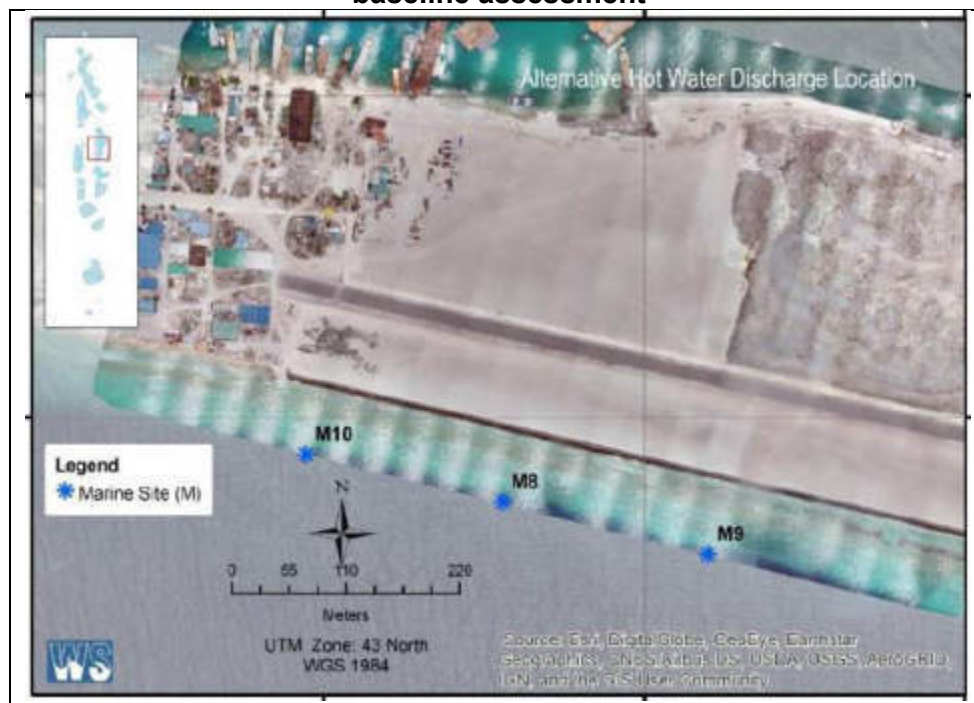
END OF THE REPORT.

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MARINE UNDERWATER ECOLOGY SURVEY RESULT

For the pre-construction site environmental baseline assessment reef benthic survey was conducted on 16 June 2022 in locations M10, M9 and M8 Figure 1. Following establishment of GPS locations, transects surveys conducted at two depths: 5m and 10m at each station following the methods established by Hodgson et.al (2006) in Reef Check Instruction Manual: A Guide to Reef Check Coral Reef Monitoring. Three transects of 20 m length were laid, one after the other along the reef ensuring transect falls to the specific depth. A quadrat of size 0.5 x 0.5 m was laid sequentially on the transect and photo images were taken with the quadrat in middle making sure the quadrat in the center of the frame. In this way every transect would have at least 10 images. Three such transects would around 60 images from each depth.

Figure 1: Underwater Marine Survey Locations M8,M9 and M10 for pre-construction baseline assessment



Analysis of the images were conducted using CoralNet (an online is a resource for benthic images analysis - <https://coralnet.ucsd.edu/>) which artificial intelligence that allows automatic classification following sufficient training on the training set – the first 40 of slides. Twenty-five points were randomly thrown over to the image. Benthic cover was classified by 14 attributes as given below. They are HC – Hard Coral, ENSP – Encrusting Sponge, SC – Soft Coral, Sand – Sand, Sediment – Sediment, Silt – Silt, D_coral – Dead Coral, Rock – Rock, Rubble – Rubble, SHAD – Shadow, WAND – wand (image of the quadrat), Turf – Turf, Turf-rubble – Turf Rubble, Seagrass – Seagrass.

1.1 Findings and observations

The following presents findings and observations from under marine ecological surveys conducted at the monitoring location at Thilafushi reef.

Status of Site M8: This site was selected because it is the one of the locations that will be used for the discharge of waste water and brine outfall in the EIA report. Substrate cover at both 5m and 10 m depths shows hard coral cover within 26-28%, turf is higher at 10m depth (25%) than the 5-meter depth (9%). and dead coral cover is similar at both depth (14-15%). Rock and turf rubble cover are higher at 5m depth (24-21% respectively), Rubble and turf rubble cover are less at 10m depth (12-17% respectively). Encrusting corals and sponges are slightly higher at 5m depth but the overall cover in both depths are less than 5%. Massive porites were the dominating group of hard coral observed at the site. Trigger fish, surgeon fish (Powder blue), wrasse (labridae) basslets were common. Grazers (Acanthurids or Scarids) were not seen and this results is consistent with what was obtained with earlier assessment. Photographs of the transect quadrats are shown in 2 and 3. Benthic composition of M8 at both 5 and 10m depth is in 4.

Figure 2: Photos Taken from Site 8 (M8) (16 June 2022) at 5m depth

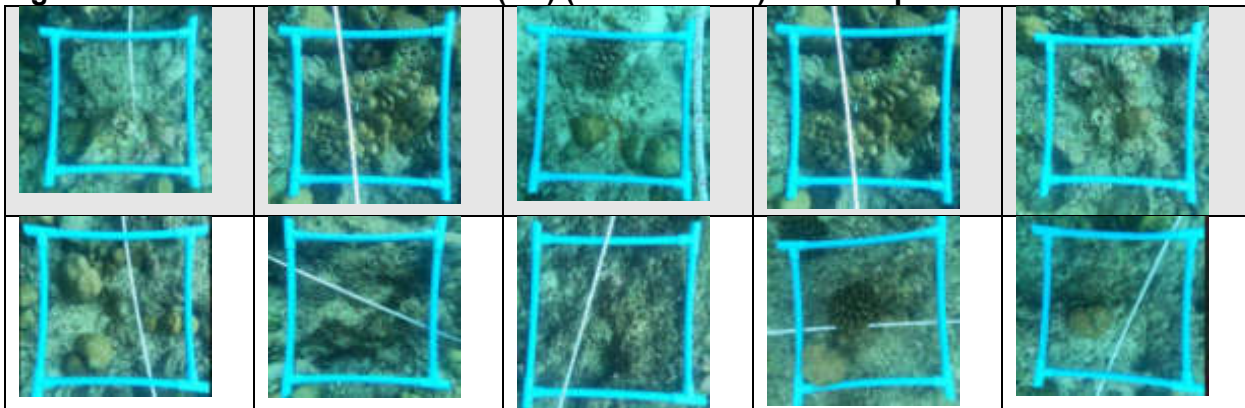


Figure 3: Photos Taken from Site 8 (M8) (16 June 2022) at 10m depth

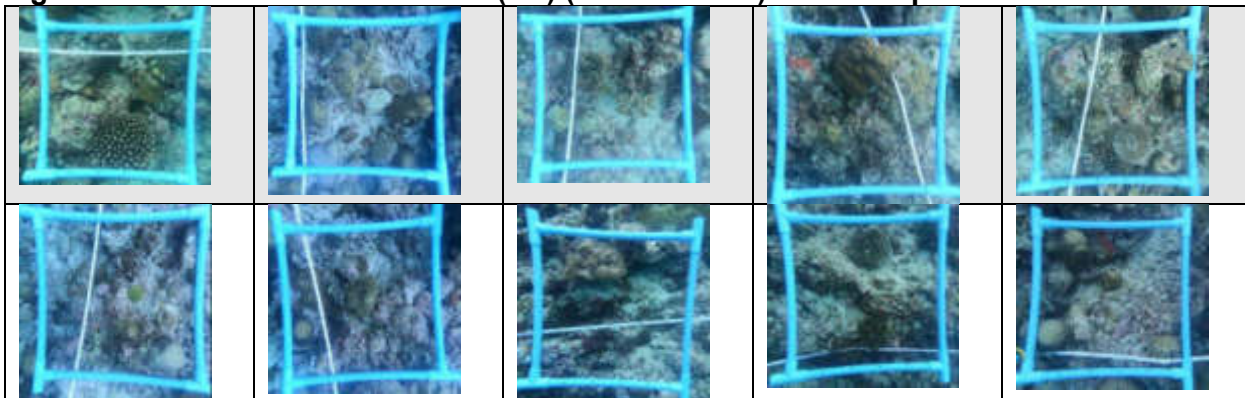
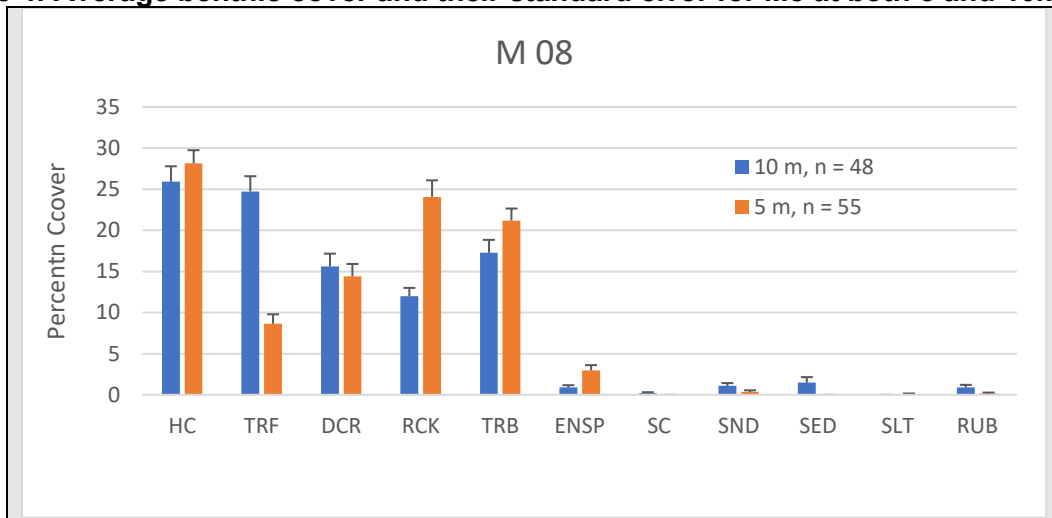


Figure 4: Average benthic cover and their standard error for M8 at both 5 and 10m depth



Key: . HC – Hard coral, TRF – Turf, DCR – Dead Coral, RC – Rock, TRB – Turf Rubble, ENSP– Encrusting Sponge, SND – sand, SED – Sediment, SLT – Silt, and RUB – Rubble, n is the sample number in this number slides analyzed

Status of Site M9: This location was identified as an alternative for brine discharge and wastewater outfall. This is close to the WtE site at the southern reef of Thilafushi Island. Substrate survey shows hard coral cover over 40% at both depths. Similar to M9, turf cover is higher at 10m (27%) than 5m depth (11%) while dead coral rock is higher at 5m (31%) than 10m depth (21%). Porities are the dominant hard live coral encountered in the area in the transects and fairly large amount table corals were found on the reef flat at about 2m depth. Trigger fish, surgeon fish (Powder blue), wrasse (labridae) basslets were common. Grazers (Acanthurids or Scarids) were not seen and this result is consistent with what was obtained with earlier assessment. Photographs of the transect quadrats are shown in Figure 5 and

Figure 6. Benthic composition of M8 at both 5 and 10m depth is in Figure 7.

Figure 5: Photos Taken from Site 9 (M9) (16 June 2022) at 5m depth

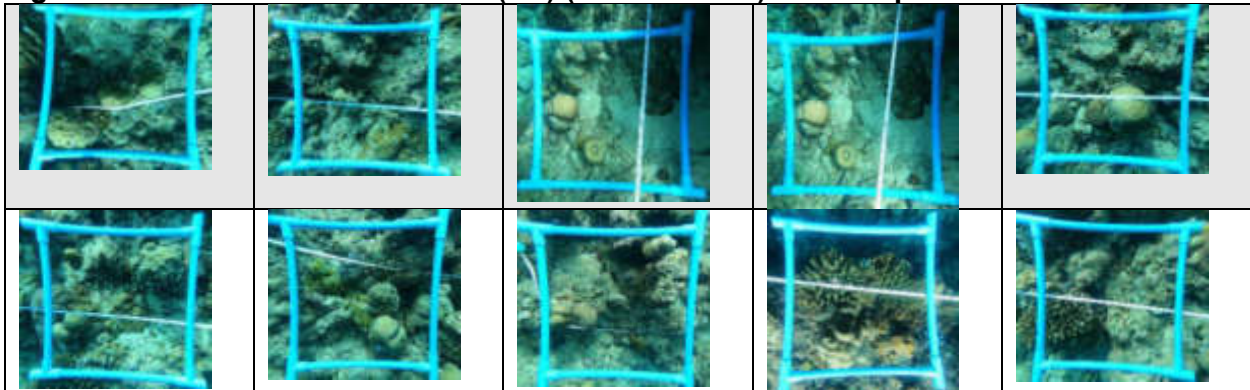


Figure 6: Photos Taken from Site 9 (M9) (16 June 2022) at 10m depth

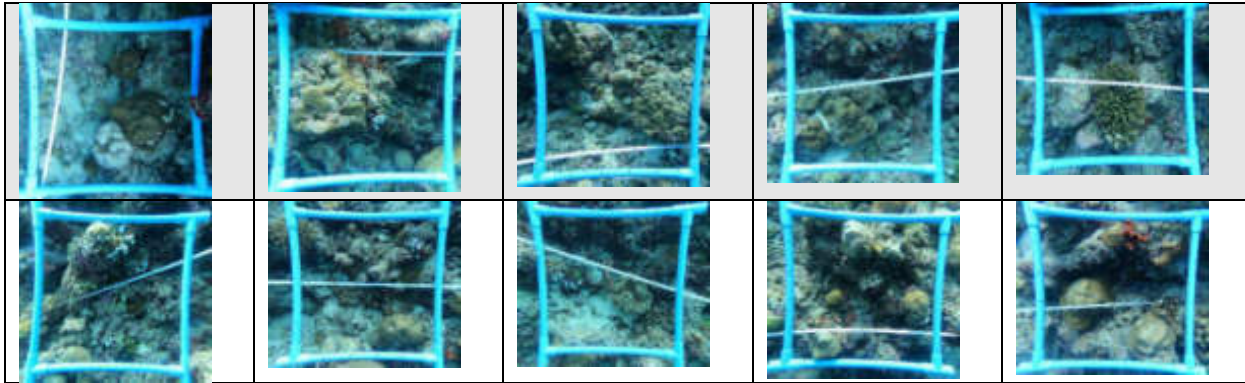
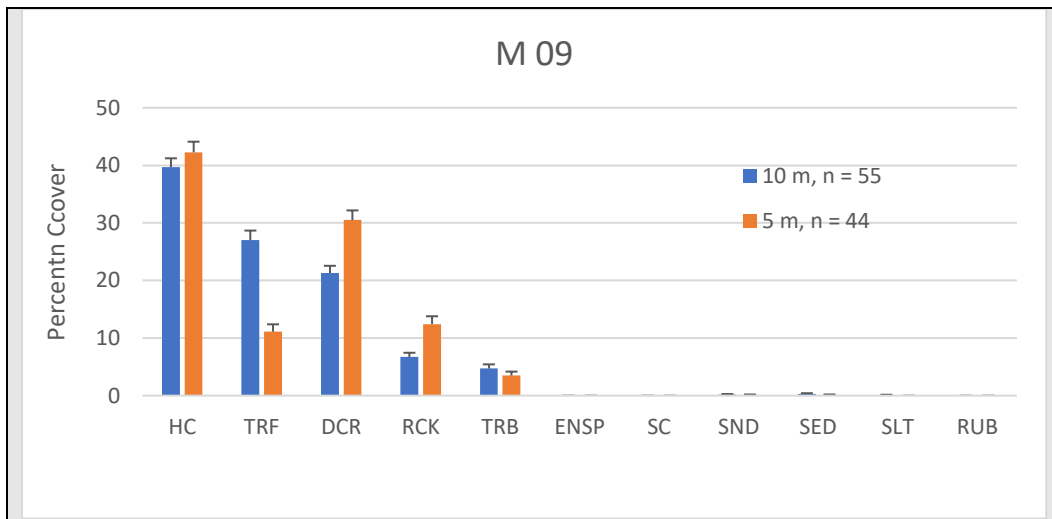


Figure 7: Average benthic cover and their standard error for M9 at both 5 and 10m depth



Key: . HC – Hard coral, TRF – Turf, DCR – Dead Coral, RC – Rock, TRB – Turf Rubble, ENSP– Encrusting Sponge, SND – sand, SED – Sediment, SLT – Silt, and RUB – Rubble, n is the sample number in this number slides analyzed

Status of Site M10: This location has been identified in the EIA report as a potential alternative for the discharge of brine water and waste water. The location is very close to the WtE facility, and it is on the southern reef of Thilafushi Island. In the substrates the cover at both 5m and 10 m depths include hard corals 38% turf and dead coral 24 and 26% respectively. Rock and turf rubble are less than 10% silt and sand are less than 2%. Massive Porites were the dominating group of hard coral observed at the site. Trigger fish, surgeon fish (Powder blue), wrasse (labridae) basslets were common. Grazers (Acanthurids or Scarids) were not seen, and this result is consistent with what was obtained with earlier assessment. Photographs of the transect quadrats are shown in Figure 8 and Figure 9. Benthic composition of M8 at both 5 and 10m depth is in the graph in Figure 20 .

Figure 1: Photos Taken from Site 10 (M10) (16 June 2022) at 5m depth

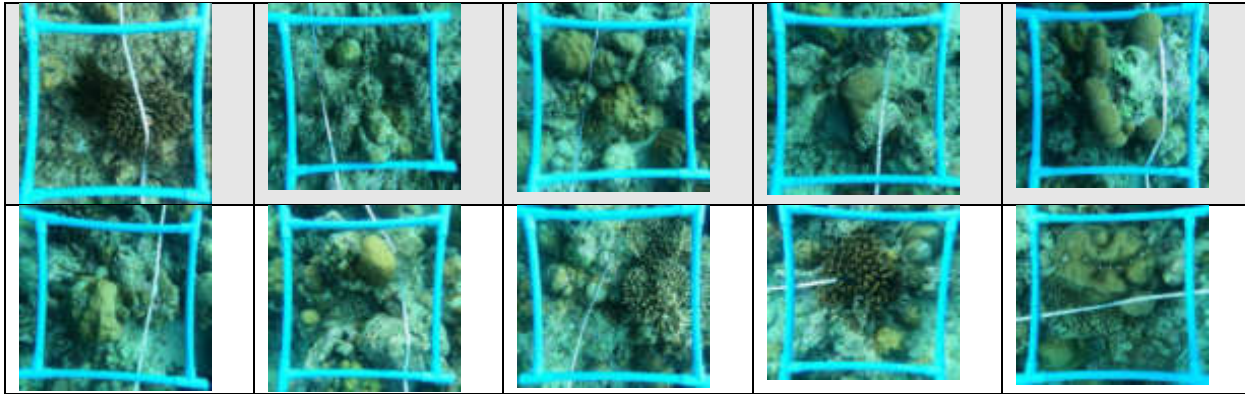


Figure 9: Photos Taken from Site 10 (M10) (16 June 2022) at 10m depth

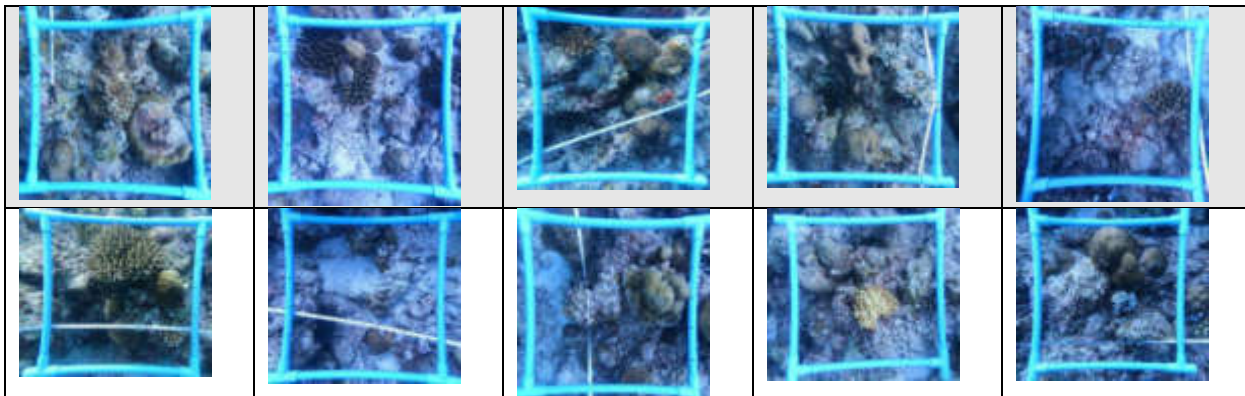
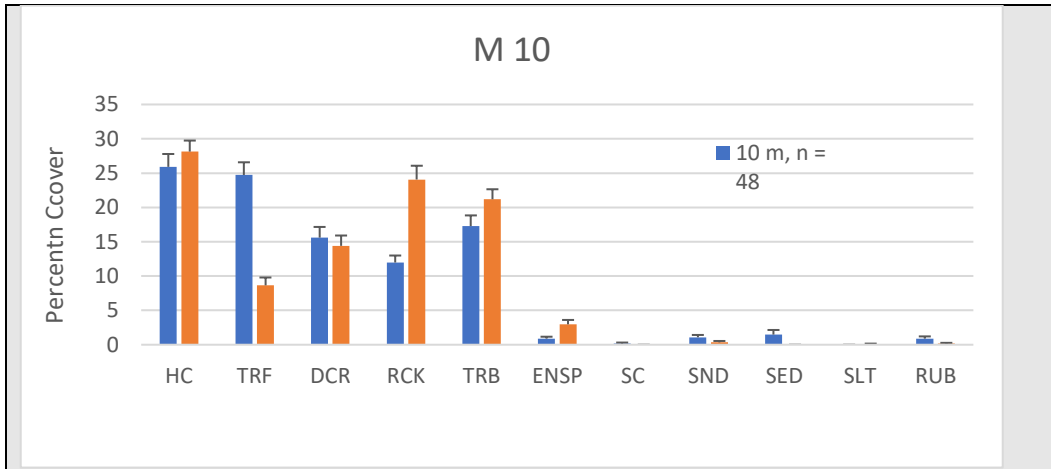


Figure 20: Average benthic cover and their standard error for M9 at both 5 and 10m depth



Key: . HC – Hard coral, TRF – Turf, DCR – Dead Coral, RC – Rock, TRB – Turf Rubble, ENSP– Encrusting Sponge, SND – sand, SED – Sediment, SLT – Silt, and RUB – Rubble, n is the sample number in this number slides analyzed

1.2 Fisheries

For the three locations where, ecological survey was conducted a visual assessment of fish were done following the laying of the transect. This is to ensure fish are not disturbed along the transect. Three 15 mins swims were done along the transect counting fish in the visual field. In general presence of fish were minimal (Table 11). Trigger fish, surgeon fish (Powder blue), wrasse (labridae) basslets were common. Grazers (Acanthurids or Scarids) were not seen and this result is consistent with what was obtained with earlier assessment.

In general, it is very difficult to generalize the fish composition because they vary with many factors; time of the day and with currents.

Table 1: Fish abundances observed at sites 8 to 10 at a depth of 5 and 10 meters

Transect / Depth	Family	Species	Common Name	IUCN Red List Status	Abundance
M8 5M	Chaetodontidae	<i>Hemitaenichthys zoster</i>	Black Pyramid Butterflyfish	Least Concern	Rare
M8 10M	Balistidae	<i>Odonus niger</i>	Blue Triggerfish	Not Evaluated	Abundant
M9 5M	Labridae	<i>Thalassoma amblycephalum</i>	Two-tone Wrasse	Least Concern	Abundant
M9 5M	Chaetodontidae	<i>Hemitaenichthys zoster</i>	Black Pyramid Butterflyfish	Least Concern	Common
M9 5M	Pomacentridae	<i>Pomacentrus philippinus</i>	Philippine Damsel	Not Evaluated	Common
M9 5M	Pomacentridae	<i>Chromis dimidiata</i>	Two-tone Puller	Least Concern	Abundant
M9 5M	Labridae	<i>Thalassoma amblycephalum</i>	Two-tone Wrasse	Least Concern	Common
M9 5M	Chaetodontidae	<i>Hemitaenichthys zoster</i>	Black Pyramid Butterflyfish	Least Concern	Common
M9 10M	Balistidae	<i>Odonus niger</i>	Blue Triggerfish	Not Evaluated	Abundant
M9 10M	Serranidae (Basslets)	<i>Pseudanthias squamipinnis</i>	Orange Basslet	Least Concern	Abundant
M9 10M	Pomacentridae	<i>Chromis dimidiata</i>	Two-tone Puller	Least Concern	Common
M9 10M	Serranidae (Basslets)	<i>Pseudanthias squamipinnis</i>	Orange Basslet	Least Concern	Abundant
M9 10M	Labridae	<i>Thalassoma amblycephalum</i>	Two-tone Wrasse	Least Concern	Abundant
M10 5M	Acanthuridae	<i>Acanthurus leucosternon</i>	Powder-blue Surgeonfish	Least Concern	Abundant
M10 10M	Balistidae	<i>Odonus niger</i>	Blue Triggerfish	Not Evaluated	Abundant
M10 10M	Labridae	<i>Thalassoma amblycephalum</i>	Two-tone Wrasse	Least Concern	Common
M10 10M	Pomacentridae	<i>Pomacentrus philippinus</i>	Philippine Damsel	Not Evaluated	Common
M10 10M	Balistidae	<i>Odonus niger</i>	Blue Triggerfish	Not Evaluated	Abundant
M10 10M	Pomacentridae	<i>Chromis dimidiata</i>	Two-tone Puller	Least Concern	Common
M10 10M	Serranidae (Basslets)	<i>Nemanthias carberryi</i>	Threadfin Basslet	Least Concern	Common
M10 10M	Serranidae (Basslets)	<i>Pseudanthias squamipinnis</i>	Orange basslet	Least Concern	Common
M10 10M	Balistidae	<i>Odonus niger</i>	Blue Triggerfish	Not Evaluated	Common

A= Abundant (Meaning that during the 15-minute time swim survey, species counts were recorded more than 50, hence it is difficult to count their numbers). C=Common (Meaning that during the 15-minute time swim survey, they were spotted occasionally and throughout the survey, but their numbers were less than 50). R=Rare (Meaning that during the survey, only few of these species were observed, often 1 or 2)

NOISE MONITORING RESULT

As part of the baseline environmental assessment of Thilafushi prior to commencement of construction of Waste to Energy facility, ambient noise levels measurements were repeated at the same five locations used in the EIA report. Ambient noise level measurement was done using a handheld sound level meter (BK Precision Sound Level Meter 732A). Measurements were conducted in all location on 5-6 November 2022 during the day time and night time for 24 hours. Table 1 summarizes the explanation on the selection of baseline monitoring stations given in the EIA report. **Hata! Başvuru kaynağı bulunamadı.** is the map that shows the sampling locations.

At each station hourly 7-8 readings are recorded for a duration of 30-50seconds at each location. Minimum, Maximum and Average of ambient noise level in dB(A) was recorded and the average noise of each location is calculated **Hata! Başvuru kaynağı bulunamadı.** Comparison of ambient noise levels recorded with the EIA levels presented in the EIA report is given in **Hata! Başvuru kaynağı bulunamadı.**

Table 1: Locations selected for Ambient Noise Level Measurements

Station name	Geographic Coordinates	Reason for selection
NQ1	4°10'26.4 N, 73°28'59.9 E	Included in the original EIA
NQ2	4°10'56.6 N, 73°26'53.3 E	Included in the original EIA
NQ3	4°10'58.3 N, 73°26'09.6 E	Included in the original EIA
NQ4	4°10'57.3 N, 73°25'59.4 E	Included in the original EIA
NQ5	4°10'57.3 N, 73°26'14.4 E	Included in the original EIA

Table 2: Noise measurement records in (dB), 5-6 November 2022 for Thilafushi

Date and time	Noise level dB(A)				
	NQ1	NQ2	NQ3	NQ4	NQ5
11/5/2022 11:00	60	52.8	30.6	64.4	38.6
11/5/2022 12:00	61.1	50.1	43.9	39.2	27.9
11/5/2022 13:00	62.7	51	30.6	48.3	55.5
11/5/2022 14:00	64.8	52.6	56.3	55	49.6
11/5/2022 15:00	63.3	54.7	59.4	65.7	50.5
11/5/2022 16:00	54.3	41.5	28.8	51.5	49.1
11/5/2022 17:00	47.3	32.7	43.8	51.5	44.6
11/5/2022 18:00	61.7	28.4	36.3	31.9	40.1
11/5/2022 19:00	59.2	26.2	24.9	31.9	28.1
11/5/2022 20:00	39.8	21.4	24.5	22.9	34.1
11/5/2022 21:00	36	21.2	22.7	26	25.5
11/5/2022 22:00	33.6	21.1	26.4	21.4	30.2
11/5/2022 23:00	31.4	18.5	24.5	20.9	30.7
11/6/2022 00:00	31.8	20.6	24.5	20.1	30.9
11/6/2022 01:00	32.4	22.2	32.9	19.3	27.8
11/6/2022 02:00	31.4	19.4	24.9	20.5	29.7
11/6/2022 03:00	31.1	18.7	22.8	20	29.5
11/6/2022 04:00	37.9	23.1	37.1	18.8	44.4
11/6/2022 05:00	48.4	38	27.1	29.7	21.8
11/6/2022 06:00	44.2	20.4	26.1	17.8	21.5
11/6/2022 07:00	46.5	30.4	55.4	54.3	48.7
11/6/2022 08:00	75.5	70.3	40.8	58.4	50.8
11/6/2022 09:00	75.1	54.1	58.3	56.1	36
11/6/2022 10:00	65.2	53.2	48.2	53.6	40.1
Average dB(A)	49.78	35.11	45.45	37.47	36.9
Noise level day time dB(A)	59	43.59	39.22	46.89	40.75
Noise level night time dB(A)	36.87	23.24	30.17	24.28	31.52
WHO guideline for ambient noise level	70				

Table 3: Recorded day and night time Ambient noise levels in Thilafushi on 6-7 November 2022

No	Geographic Coordinates	Noise Level dB (A) Day Time reported in EIA Report	Baseline Recorded Average Noise level day time dB(A)	Noise Level dB (A) NightTime reported in EIA Report	Baseline Recorded Average Noise level Night time dB(A)	WHO Guidelines for noise level dB(A) Outdoors industrial and commercial area	Threshold level Applicable Per ADB SPS (dBA)
NQ 1	4°10'26.4 N, 73°28'59.9 E	65.1	59	58.7	36.87	70	70
NQ 2	4°10'56.6 N, 73°26'53.3 E	64.2	43.59	51.8	23.24		
NQ 3	4°10'58.3 N, 73°26'09.6 E	56.3	39.22	50	30.17		
NQ 4	4°10'57.3 N,73°25'59.4 E	56.0	46.89	48.9	24.28		
NQ 5	4°10'57.3 N, 73°26'14.4 E	54.6	40.75	49	31.52		

MARINEWATER TEST RESULTS



TEST REPORT



Report No: (7422)256-0319A

Sep 21, 2022

Page 1 of 3

Attn: Mr. Sujith Sudhakaran

Customer: Alke Alkatas Joint Venture (Pvt) Ltd
Address : H.H. Moomiyaage, 5A, Asaree Hingun, 20265 Male, Maldives
Date of Sample Received: Sep 13, 2022
Date of Testing Started: Sep 13, 2022
Date of Testing Completed: Sep 21, 2022
Sample Description: Sample Received as:
 A water samples contained in sealed containers

Sample Identified by the Client as:

- GW - 01
- 800ml - 1 bottle
- 1.5ml - 1 bottle
- 750ml - 1 bottle

Sample Drawn By BVCPS NO

Photo of the Submitted Sample



Bureau Veritas Consumer Products Services Lanka (Pvt) Ltd.

No. 470, Galle Road, Kumbulla, Mirissova, Sri Lanka.
 Tel: (9411) 259111-115 (dedicated lines), Fax: (9411) 51262298 & 199
 Email: bvsps.lanka@bureauveritas.com

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TEST REPORT



Report No: (7422)256-0319A

Sep 21, 2022

Page 2 of 3

TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	pH Value at 25°C	8.5	-	-	APHA 23rd ed: 2017 :4500H ⁺
2	Turbidity	0.8	-	NTU	APHA 23rd ed: 2017 :2130 B
3	Electrical Conductivity at 25°C	11.1	-	mS/cm	APHA 23rd ed: 2017: 2510 B
4	Total Suspended Solids (TSS)	7	-	mg/l	APHA 23rd ed: 2017 : 2540D
5	Oil & Grease	0.1	-	mg/l	APHA 23rd ed: 2017 :5520B
6	Manganese (as Mn)*	0.001	-	mg/L	CPSD-AN-00581; 2019 V15 by ICP-MS
7	Arsenic (as As)	ND	0.001	mg/l	
8	Iron (as Fe)	ND	0.001	mg/l	
9	Cadmium (as Cd)	ND	0.0001	mg/l	
10	Lead (as Pb)	ND	0.001	mg/l	
11	Mercury (as Hg)	ND	0.00005	mg/l	

No.	Parameters	Results	LOQ	Unit	Test Method
Poly Aromatic Hydrocarbon (PAH)					
1	Naphthalene	ND	1.0	µg/l	CPSD-AN-00576
2	Benzo(a)anthracene	ND	1.0	µg/l	
3	Acenaphthylene	ND	1.0	µg/l	
4	Acenaphthene	ND	1.0	µg/l	
5	Fluorene	ND	1.0	µg/l	
6	Phenanthrene	ND	1.0	µg/l	
7	Anthracene	ND	1.0	µg/l	
8	Fluoranthene	ND	1.0	µg/l	
9	Pyrene	ND	1.0	µg/l	
10	Chrysen	ND	1.0	µg/l	
11	Benzo(b)fluoranthene*	ND	1.0	µg/l	
12	Benzo(k)fluoranthene*	ND	1.0	µg/l	
13	Dibenzo(a,h)anthracene	ND	1.0	µg/l	
14	Benzo(g,h,i)perylene	ND	1.0	µg/l	
15	Benzo(j)fluoranthene*	ND	1.0	µg/l	
16	Benzo(a)pyrene	ND	1.0	µg/l	
17	Benzo(e)pyrene	ND	1.0	µg/l	
18	Indeno(1,2,3-cd) pyrene	ND	1.0	µg/l	

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TEST REPORT



Report No: (7422)256-0319A

Sep 21, 2022

Page 3 of 3

*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

NOTE:

APHA: American Public Health Association,

ND: Not Detected,

LOQ: Limit of Quantification, mg/L: milligrams per liter,

NTU: Nephelometric Turbidity Units, °C :Celcius,

µg/L: Micrograms per liter, mS/cm: Milli Siemens per Centimeter,

ICP-MS: Inductively Coupled Plasma Mass Spectrometry

Contact information for this report (Technical and General Inquiries and Feedback)

GENERAL INQUIRIES:		
SAYURI GANGANI	TEL: +94 768 229 444	E-MAIL: sayuri.gangani@bureauveritas.com
TECHNICAL INQUIRIES:		
RUWANI AMARASINGHE	TEL: +94 768 229 457	E-MAIL: ruwani.amarasinghe@bureauveritas.com
FEED BACK:		
KUMUDINI RATHNAYAKE – ASST. QA MANAGER	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@bureauveritas.com

REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.
AUTHORIZED SIGNATORY

APPROVED BY:

SONALI NAKANDALA

ASSISTANT GENERAL MANAGER –
OPERATIONS/TECHNICAL

END OF THE REPORT.



TEST REPORT



Report No: (7422)256-0319B

Sep 21, 2022

Page 1 of 3

Attn: Mr. Sujith Sudhakaran

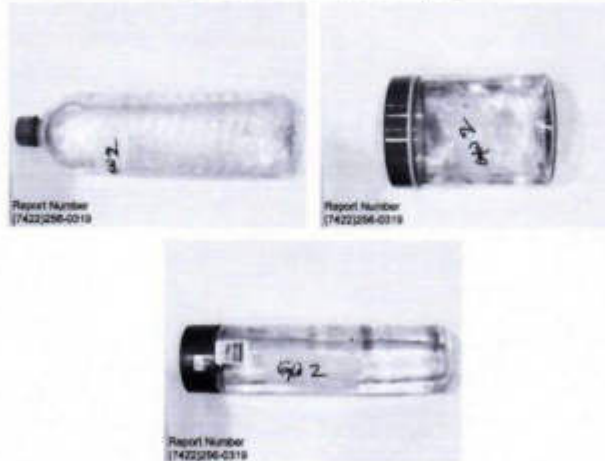
Customer: Alke Alkatas Joint Venture (Pvt) Ltd
Address : H.H. Moomiyaage, 5A, Asarce Hingun, 20265 Male, Maldives
Date of Sample Received: Sep 13, 2022
Date of Testing Started: Sep 13, 2022
Date of Testing Completed: Sep 21, 2022
Sample Description: **Sample Received as:**
A water samples contained in sealed containers

Sample Identified by the Client as:

GW - 02
800ml - 1 bottle
1.5ml - 1 bottle
750ml - 1 bottle

Sample Drawn By BVCPS NO

Photo of the Submitted Samples



**Bureau Veritas Consumer
Products Services Lanka (Pvt)
Ltd.**

No. 570, Galle Road, Katubedda, Mirisawa, Sri Lanka
Tel: (9411) 2310111-115 (dedicated lines), Fax: (9411)
112622198 & 199
Email: bvcp.lanka@bureauveritas.com

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TEST REPORT



Report No: (7422)256-0319B

Sep 21, 2022

Page 2 of 3

TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	pH Value at 25°C	7.5	-	-	APHA 23rd ed: 2017 :4500H'
2	Turbidity	0.2	-	NTU	APHA 23rd ed: 2017 :2130 B
3	Electrical Conductivity at 25°C	46.5	-	mS/cm	APHA 23rd ed: 2017: 2510 B
4	Total Suspended Solids (TSS)	3	-	mg/l	APHA 23rd ed: 2017 : 2540D
5	Oil & Grease	0.3	-	mg/l	APHA 23rd ed: 2017 :5520B
6	Manganese (as Mn)*	0.003	-	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
7	Arsenic (as As)	ND	0.001	mg/l	
8	Iron (as Fe)	ND	0.001	mg/l	
9	Cadmium (as Cd)	ND	0.0001	mg/l	
10	Lead (as Pb)	ND	0.001	mg/l	
11	Mercury (as Hg)	ND	0.00005	mg/l	

No.	Parameters	Results	LOQ	Unit	Test Method
Poly Aromatic Hydrocarbon (PAH)					
1	Naphthalene	ND	1.0	µg/l	CPSD-AN-00576
2	Benzo(a)anthracene	ND	1.0	µg/l	
3	Acenaphthylene	ND	1.0	µg/l	
4	Acenaphthene	ND	1.0	µg/l	
5	Fluorene	ND	1.0	µg/l	
6	Phenanthrene	ND	1.0	µg/l	
7	Anthracene	ND	1.0	µg/l	
8	Fluoranthene	ND	1.0	µg/l	
9	Pyrene	ND	1.0	µg/l	
10	Chrysen	ND	1.0	µg/l	
11	Benzo(b)fluoranthene*	ND	1.0	µg/l	
12	Benzo(k)fluoranthene*	ND	1.0	µg/l	
13	Dibenzo(a,h)anthracene	ND	1.0	µg/l	
14	Benzo(g,h,i)perylene	ND	1.0	µg/l	
15	Benzo(j)fluoranthene*	ND	1.0	µg/l	
16	Benzo(a)pyrene	ND	1.0	µg/l	
17	Benzo(c)pyrene	ND	1.0	µg/l	
18	Indeno(1,2,3-cd) pyrene	ND	1.0	µg/l	

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TEST REPORT



Report No: (7422)256-0319B

Sep 21, 2022

Page 3 of 3

*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

NOTE:

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LOQ: Limit of Quantification, mg/L: milligrams per liter,

NTU: Nephelometric Turbidity Units, °C :Celcius,

µg/L: Micrograms per liter, mS/cm: Milli Siemens per Centimeter,

ICP-MS: Inductively Coupled Plasma Mass Spectrometry

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FEED BACK:		
KUMUDINI RATHNAYAKE – ASST. QA MANAGER	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@ik.bureauveritas.com

REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.
AUTHORIZED SIGNATORY

APPROVED BY: _____
SONALI NAKANDALA
ASSISTANT GENERAL MANAGER –
OPERATIONS/TECHNICAL

END OF THE REPORT.



74/RPT/ 06679



TEST REPORT

Report No: (7422)185-0258

Jul 12, 2022

Page 1 of 3

Attn: Mr. Sujith Sudhakaran

Customer: Alke Alkatas Joint Venture (Pvt) Ltd
Address: H.H. Moomiyaage, 5A, Asaree Hingun, 20265 Male, Maldives
Date of Sample Received: Jul 04, 2022
Date of Testing Started: Jul 04, 2022
Date of Testing Completed: Jul 12, 2022
Sample Description: **Sample Received as:**
 A water samples contained in sealed glass & plastic containers

Sample Identified by the Client as:

Ground Water 03
1.5L x 2, 1L x 1

Sample Drawn By BVCPS: NO

Photo of the Submitted Sample



Bureau Veritas Consumer Products Services Lanka (Pvt) Ltd.

No. 570, Galle Road, Karabeddika, Morutawa, Sri Lanka
Tel: (9411) 235011-115 (dedicated lines), Fax: (9411) 112522198 & 199
Email: consumer@bv.com

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TEST REPORT

74/RPT/ 06680



Report No: (7422)185-0258

Jul 12, 2022

Page 2 of 3

TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Electrical Conductivity at 25°C	544	-	µS/cm	APHA 23rd ed: 2017: 2510 B
2	pH at 25°C	7.1	-	-	APHA 23rd ed: 2017: 4500H+
3	Turbidity	3.0	-	NTU	APHA 23rd ed: 2017: 2130 B
4	Total Suspended Solids	7	-	mg/L	APHA 23rd ed: 2017: 2540D
5	Iron (as Fe)	0.042	-	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
6	Manganese (as Mn)*	0.013	-	mg/L	
7	Arsenic (as As)	ND	0.001	mg/L	
8	Cadmium (as Cd)	ND	0.0001	mg/L	
9	Lead (as Pb)	ND	0.001	mg/L	
10	Mercury (as Hg)	ND	0.00005	mg/L	
11	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017: 5520B

No.	Parameter	Result	LOQ	Unit	Test Method
PAH RESULTS					
1	Naphthalene	ND	1.0	µg/L	CPSD-AN-00576:2019 V15 (In house method)
2	Acenaphthylene	ND	1.0	µg/L	
3	Acenaphthene	ND	1.0	µg/L	
4	Fluorene	ND	1.0	µg/L	
5	Phenanthrene	ND	1.0	µg/L	
6	Anthracene	ND	1.0	µg/L	
7	Fluoranthene	ND	1.0	µg/L	
8	Pyrene	ND	1.0	µg/L	
9	Benzo[a]anthracene	ND	1.0	µg/L	
10	Chrysene	ND	1.0	µg/L	
11	Benzo[a]pyrene	ND	1.0	µg/L	
12	Benzo[e]pyrene	ND	1.0	µg/L	
13	Indeno[1,2,3-cd]pyrene	ND	1.0	µg/L	
14	Dibenzo[a,h]anthracene	ND	1.0	µg/L	
15	Benzo[g,h,i]perylene	ND	1.0	µg/L	
16	Benzo[b]fluoranthene*	ND	1.0	µg/L	
17	Benzo [j]fluoranthene*	ND	1.0	µg/L	
18	Benzo[k]fluoranthene*	ND	1.0	µg/L	

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74/RPT/ 06681

TEST REPORT



Report No: (7422)185-0258

Jul 12, 2022

Page 3 of 3

*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

NOTE:

APHA: American Public Health Association,

ND: Not Detected,

LOQ: Limit of Quantification, mg/L: milligrams per liter,

NTU: Nephelometric Turbidity Units, °C : Celcius,

µg/L: Micrograms per liter, µS/cm: Micro Siemens per Centimeter,

ICP-MS: Inductively Coupled Plasma Mass Spectrometry.

Contact information for this report (Technical and General Inquiries and Feedback)

GENERAL INQUIRIES:		
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TECHNICAL INQUIRIES:		
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FEED BACK:		
KUMUDINI RATHNAYAKE – ASST. QA MANAGER	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@bureauveritas.com

REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.
AUTHORIZED SIGNATORY

APPROVED BY:


SHASHI MANOJASSISTANT GENERAL MANAGER -
OPERATIONS/TECHNICAL

END OF THE REPORT.



TEST REPORT

74/RPT/ 06682



Report No: (7422)185-0262

Jul 12, 2022

Page 1 of 3

Attn: Mr. Sujith Sudhakaran

Customer: Alke Alkatas Joint Venture (Pvt) Ltd
Address: H.H. Moomiyaage, 5A, Asaree Hingun, 20265 Male, Maldives
Date of Sample Received: Jul 04, 2022
Date of Testing Started: Jul 04, 2022
Date of Testing Completed: Jul 12, 2022
Sample Description: **Sample Received as:**
 A water samples contained in sealed glass & plastic containers

Sample Identified by the Client as:

Ground Water 04
1.5L x 2, 1L x 1

Sample Drawn By BVCPS: NO

Photo of the Submitted Sample



Bureau Veritas Consumer Products Services Lanka (Pvt) Ltd.

No. 370, Galle Road, Katubedda, Morutwa, Sri Lanka
Tel: (9411) 250111-113 (dedicated lines), Fax: (9411) 112622198 & 199
Email: lanka.lanka@bureauveritas.com

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74/RPT/ 06683

TEST REPORT



Report No: (7422)185-0262

Jul 12, 2022

Page 2 of 3

TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Electrical Conductivity at 25°C	447	-	µS/cm	APHA 23rd ed: 2017: 2510 B
2	pH at 25°C	7.7	-	-	APHA 23rd ed: 2017: 4500H+
3	Turbidity	0.4	-	NTU	APHA 23rd ed: 2017: 2130 B
4	Total Suspended Solids	2	-	mg/L	APHA 23rd ed: 2017: 2540D
5	Iron (as Fe)	0.003	-	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
6	Manganese (as Mn)*	ND	0.001	mg/L	
7	Arsenic (as As)	ND	0.001	mg/L	
8	Cadmium (as Cd)	ND	0.0001	mg/L	
9	Lead (as Pb)	ND	0.001	mg/L	
10	Mercury (as Hg)	ND	0.00005	mg/L	
11	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017: 5520B

No.	Parameter	Result	LOQ	Unit	Test Method
PAH RESULTS					
1	Naphthalene	ND	1.0	µg/L	CPSD -AN-00576:2019 V15 (In house method)
2	Acenaphthylene	ND	1.0	µg/L	
3	Acenaphthene	ND	1.0	µg/L	
4	Fluorene	ND	1.0	µg/L	
5	Phenanthrene	ND	1.0	µg/L	
6	Anthracene	ND	1.0	µg/L	
7	Fluoranthene	ND	1.0	µg/L	
8	Pyrene	ND	1.0	µg/L	
9	Benzo[a]anthracene	ND	1.0	µg/L	
10	Chrysene	ND	1.0	µg/L	
11	Benzo[a]pyrene	ND	1.0	µg/L	
12	Benzo[e]pyrene	ND	1.0	µg/L	
13	Indeno[1,2,3-cd]pyrene	ND	1.0	µg/L	
14	Dibenzo[a,h]anthracene	ND	1.0	µg/L	
15	Benzo[g,h,i]perylene	ND	1.0	µg/L	
16	Benzo[b]fluoranthene*	ND	1.0	µg/L	
17	Benzo [j]fluoranthene*	ND	1.0	µg/L	
18	Benzo[k]fluoranthene*	ND	1.0	µg/L	

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74/RPT/ 06684

TEST REPORT



Report No: (7422)185-0262

Jul 12, 2022

Page 3 of 3

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NOTE:

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ND: Not Detected,

LOQ: Limit of Quantification, mg/L: Milligrams per liter,

NTU: Nephelometric Turbidity Units, °C : Celcius,

µg/L: Micrograms per liter, µS/cm: Micro Siemens per Centimeter,

ICP-MS: Inductively Coupled Plasma Mass Spectrometry.

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FEED BACK:		
KUMUDINI RATHNAYAKE – ASST. QA MANAGER	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@bureauveritas.com

REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.
AUTHORIZED SIGNATORY

APPROVED BY:


SONALI NAKANDALAASSISTANT GENERAL MANAGER -
OPERATIONS/TECHNICAL**END OF THE REPORT.**



TEST REPORT



Report No: (7422)256-0319C

Sep 21, 2022

Page 1 of 3

Attn: Mr. Sujith Sudhakaran

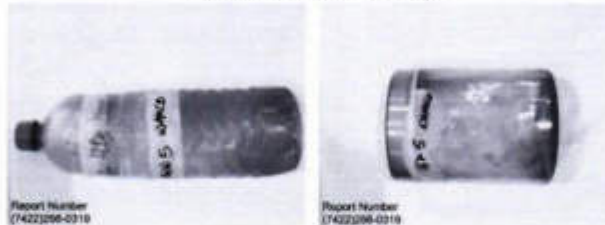
Customer: Alke Alkatas Joint Venture (Pvt) Ltd
Address : H.H. Moomiyaage, 5A, Asurec Hingun, 20265 Male, Maldives
Date of Sample Received: Sep 13, 2022
Date of Testing Started: Sep 13, 2022
Date of Testing Completed: Sep 21, 2022
Sample Description: **Sample Received as:**
 A water samples contained in sealed containers

Sample Identified by the Client as:

GW - 05
 800ml - 1 bottle
 1.5ml - 1 bottle
 750ml - 1 bottle

Sample Drawn By BVCPS NO

Photo of the Submitted Sample



Report Number (7422)256-0319

Report Number (7422)256-0319



Report Number (7422)256-0319

Bureau Veritas Consumer Products Services Lanka (Pvt) Ltd.

No. 570, Galle Road, Ratsbadda, Morutawa, Sri Lanka
 Tel: (9411) 2380111-133 (dedicated lines), Fax: (9411) 112622186 & 199
 Email: bvps.lanka@bureauveritas.com

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TEST REPORT



Report No: (7422)256-0319C

Sep 21, 2022

Page 2 of 3

TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	pH Value at 25°C	7.6	-	-	APHA 23rd ed: 2017 :4500H'
2	Turbidity	694	-	NTU	APHA 23rd ed: 2017 :2130 B
3	Electrical Conductivity at 25°C	5.9	-	mS/cm	APHA 23rd ed: 2017: 2510 B
4	Total Suspended Solids (TSS)	42	-	mg/l	APHA 23rd ed: 2017 : 2540D
5	Oil & Grease	4.2	-	mg/l	APHA 23rd ed: 2017 :5520B
6	Manganese (as Mn)*	0.015	-	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
7	Arsenic (as As)	ND	0.001	mg/l	
8	Iron (as Fe)	ND	0.001	mg/l	
9	Cadmium (as Cd)	ND	0.0001	mg/l	
10	Lead (as Pb)	ND	0.001	mg/l	
11	Mercury (as Hg)	ND	0.00005	mg/l	

No.	Parameters	Results	LOQ	Unit	Test Method
Poly Aromatic Hydrocarbon (PAH)					
1	Naphthalene	ND	1.0	µg/l	CPSD-AN-00576
2	Benzo(a)anthracene	ND	1.0	µg/l	
3	Acenaphthylene	ND	1.0	µg/l	
4	Acenaphthene	ND	1.0	µg/l	
5	Fluoren	ND	1.0	µg/l	
6	Phenanthrene	ND	1.0	µg/l	
7	Anthracene	ND	1.0	µg/l	
8	Fluoranthene	ND	1.0	µg/l	
9	Pyrene	ND	1.0	µg/l	
10	Chrysen	ND	1.0	µg/l	
11	Benzo(b)fluoranthene*	ND	1.0	µg/l	
12	Benzo(k)fluoranthene*	ND	1.0	µg/l	
13	Dibenzo(a,h)anthracene	ND	1.0	µg/l	
14	Benzo(g,h,i)perylene	ND	1.0	µg/l	
15	Benzo(j)fluoranthene*	ND	1.0	µg/l	
16	Benzo(a)pyrene	ND	1.0	µg/l	
17	Benzo(c)pyrene	ND	1.0	µg/l	
18	Indeno(1,2,3-cd) pyrene	ND	1.0	µg/l	

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TEST REPORT



Report No: (7422)256-0319C

Sep 21, 2022

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NOTE:

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LOQ: Limit of Quantification, mg/L: milligrams per liter,

NTU: Nephelometric Turbidity Units, °C :Celcius,

µg/L: Micrograms per liter, mS/cm: Milli Siemens per Centimeter,

ICP-MS: Inductively Coupled Plasma Mass Spectrometry

Contact information for this report (Technical and General Inquiries and Feedback)

GENERAL INQUIRIES:		
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TECHNICAL INQUIRIES:		
RUWANI AMARASINGHE	TEL: +94 768 229 457	E-MAIL: ruwani.amarasinghe@bureauveritas.com
FEED BACK:		
KUMUDINI RATHNAYAKE – ASST. QA MANAGER	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@bk.bureauveritas.com

REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.
AUTHORIZED SIGNATORY

APPROVED BY:

SONALI NAKANDALA

ASSISTANT GENERAL MANAGER –
OPERATIONS/TECHNICAL

END OF THE REPORT.



74/RPT/ 06685

TEST REPORT



Report No: (7422)185-0264

Jul 12, 2022

Page 1 of 3

Attn: Mr. Sujith Sudhakaran

Customer: Alke Alkatas Joint Venture (Pvt) Ltd
 Address: H.H. Moomiyaage, 5A, Asarce Hingun, 20265 Male, Maldives
 Date of Sample Received: Jul 04, 2022
 Date of Testing Started: Jul 04, 2022
 Date of Testing Completed: Jul 12, 2022
 Sample Description: Sample Received as:
 A water samples contained in sealed glass & plastic containers

Sample Identified by the Client as:

Ground Water 06
1.5L x 2, 1L x 1

Sample Drawn By BVCPS: NO

Photo of the Submitted Sample



Bureau Veritas Consumer Products Services Lanka (Pvt) Ltd.

No. 570, Galle Road, Karubeddla, Morutawa, Sri Lanka
Tel: (9411) 2380111-115 (dedicated lines), Fax: (9411) 112022198 & 199
Email: lanka.lanka@bureauveritas.com

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74/RPT/ 06686

TEST REPORT



Report No: (7422)185-0264

Jul 12, 2022

Page 2 of 3

TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Electrical Conductivity at 25°C	1210	-	µS/cm	APHA 23rd ed: 2017: 2510 B
2	pH at 25°C	6.9	-	-	APHA 23rd ed: 2017: 4500H+
3	Turbidity	7.1	-	NTU	APHA 23rd ed: 2017: 2130 B
4	Total Suspended Solids	23	-	mg/L	APHA 23rd ed: 2017: 2540D
5	Iron (as Fe)	0.014	-	mg/L	CPSD-AN-00581; 2019 V15 by ICP-MS
6	Manganese (as Mn)*	0.184	-	mg/L	
7	Arsenic (as As)	0.007	-	mg/L	
8	Cadmium (as Cd)	ND	0.0001	mg/L	
9	Lead (as Pb)	ND	0.001	mg/L	
10	Mercury (as Hg)	ND	0.00005	mg/L	
11	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017: 5520B

No.	Parameter	Result	LOQ	Unit	Test Method
PAH RESULTS					
1	Naphthalene	ND	1.0	µg/L	CPSD -AN-00576:2019 V15 (In house method)
2	Acenaphthylene	ND	1.0	µg/L	
3	Acenaphthene	ND	1.0	µg/L	
4	Fluorene	ND	1.0	µg/L	
5	Phenanthrene	ND	1.0	µg/L	
6	Anthracene	ND	1.0	µg/L	
7	Fluoranthene	ND	1.0	µg/L	
8	Pyrene	ND	1.0	µg/L	
9	Benzo[a]anthracene	ND	1.0	µg/L	
10	Chrysene	ND	1.0	µg/L	
11	Benzo[a]pyrene	ND	1.0	µg/L	
12	Benzo[e]pyrene	ND	1.0	µg/L	
13	Indeno[1,2,3-cd]pyrene	ND	1.0	µg/L	
14	Dibenzo[a,h]anthracene	ND	1.0	µg/L	
15	Benzo[g,h,i]perylene	ND	1.0	µg/L	
16	Benzo[b]fluoranthene*	ND	1.0	µg/L	
17	Benzo [j]fluoranthene*	ND	1.0	µg/L	
18	Benzo[k]fluoranthene*	ND	1.0	µg/L	

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74/RPT/ 06687



TEST REPORT

Report No: (7422)185-0264

Jul 12, 2022

Page 3 of 3

*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

NOTE:

APHA: American Public Health Association,

ND: Not Detected,

LOQ: Limit of Quantification, mg/L: Milligrams per liter,

NTU: Nephelometric Turbidity Units, °C : Celcius,

µg/L: Micrograms per liter, µS/cm: Micro Siemens per Centimeter,

ICP-MS: Inductively Coupled Plasma Mass Spectrometry

Contact information for this report (Technical and General Inquiries and Feedback)

GENERAL INQUIRIES:		
SAYURI GANGANI	TEL: +94 768 229 444	E-MAIL: sayuri.gangani@bureauveritas.com
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FEED BACK:		
KUMUDINI RATHNAYAKE – ASST. QA MANAGER	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@bureauveritas.com

REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.
AUTHORIZED SIGNATORY

APPROVED BY:


SONALI NAKANDALAASSISTANT GENERAL MANAGER -
OPERATIONS/TECHNICAL

END OF THE REPORT.



TEST REPORT

74/RPT/ 06676



Report No: (7422)185-0266

Jul 12, 2022

Page 1 of 3

Attn: Mr. Sujith Sudhakaran

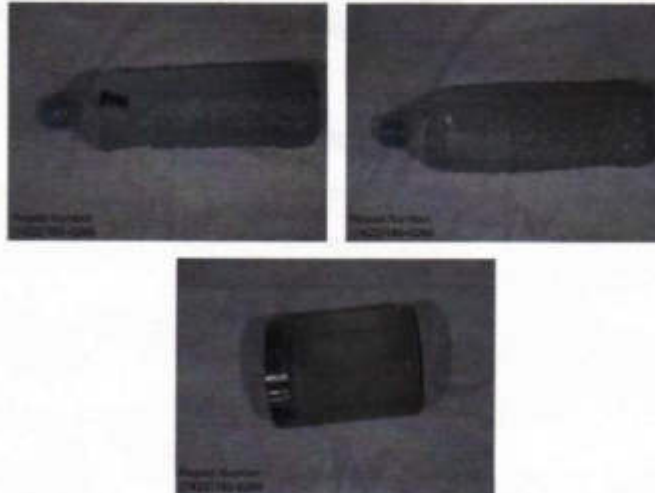
Customer: Alke Alkatas Joint Venture (Pvt) Ltd
 Address: H.H. Moomiyaage, 5A, Asaree Hingun, 20265 Male, Maldives
 Date of Sample Received: Jul 04, 2022
 Date of Testing Started: Jul 04, 2022
 Date of Testing Completed: Jul 12, 2022
 Sample Description: Sample Received as:
 A water samples contained in sealed glass & plastic containers

Sample Identified by the Client as:

Ground Water 07
1.5L x 2, 1L x 1

Sample Drawn By BVCPS: NO

Photo of the Submitted Sample



Bureau Veritas Consumer Products Services Lanka (Pvt) Ltd.

No. 570, Galle Road, Katubedde, Moonstone, Sri Lanka
Tel: (9411) 2350111-115 (dedicated lines), Fax: (9411) 112622198 & 199
Email: lanka.bv@bv.com & consumer@bv.com

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TEST REPORT

74/RPT/ 06677



Report No: (7422)185-0266

Jul 12, 2022

Page 2 of 3

TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Electrical Conductivity at 25°C	684	-	µS/cm	APHA 23rd ed: 2017: 2510 B
2	pH at 25°C	7.5	-	-	APHA 23rd ed: 2017: 4500H+
3	Turbidity	20	-	NTU	APHA 23rd ed: 2017 :2130 B
4	Total Suspended Solids	77	-	mg/L	APHA 23rd ed: 2017: 2540D
5	Iron (as Fe)	0.124	-	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
6	Manganese (as Mn)*	0.005	-	mg/L	
7	Arsenic (as As)	0.007	-	mg/L	
8	Cadmium (as Cd)	ND	0.0001	mg/L	
9	Lead (as Pb)	ND	0.001	mg/L	
10	Mercury (as Hg)	ND	0.00005	mg/L	
11	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017 :5520B

No.	Parameter	Result	LOQ	Unit	Test Method
PAH RESULTS					
1	Naphthalene	ND	1.0	µg/L	CPSD -AN-00576:2019 V15 (In house method)
2	Acenaphthylene	ND	1.0	µg/L	
3	Acenaphthene	ND	1.0	µg/L	
4	Fluorene	ND	1.0	µg/L	
5	Phenanthrene	ND	1.0	µg/L	
6	Anthracene	ND	1.0	µg/L	
7	Fluoranthene	ND	1.0	µg/L	
8	Pyrene	ND	1.0	µg/L	
9	Benzo[a]anthracene	ND	1.0	µg/L	
10	Chrysene	ND	1.0	µg/L	
11	Benzo[a]pyrene	ND	1.0	µg/L	
12	Benzo[e]pyrene	ND	1.0	µg/L	
13	Indeno[1,2,3-cd]pyrene	ND	1.0	µg/L	
14	Dibenzo[a,h]anthracene	ND	1.0	µg/L	
15	Benzo[g,h,i]perylene	ND	1.0	µg/L	
16	Benzo[b]fluoranthene*	ND	1.0	µg/L	
17	Benzo [j]fluoranthene*	ND	1.0	µg/L	
18	Benzo[k]fluoranthene*	ND	1.0	µg/L	

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TEST REPORT

74/RPT/ 06678



Report No: (7422)185-0266

Jul 12, 2022

Page 3 of 3

*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

NOTE:

APHA: American Public Health Association,

ND: Not Detected,

LOQ: Limit of Quantification, mg/L: milligrams per liter,

NTU: Nephelometric Turbidity Units, °C : Celcius,

µg/L: Micrograms per liter, µS/cm: Micro Siemens per Centimeter,

ICP-MS: Inductively Coupled Plasma Mass Spectrometry

Contact information for this report (Technical and General Inquiries and Feedback)

GENERAL INQUIRIES:		
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KUMUDINI RATHNAYAKE – ASST. QA MANAGER	TEL: +94 768 229 455	E-MAIL: kumudinie.rathnayake@bureauveritas.com

REVIEWED BY: SHASHI MANOJ

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.
AUTHORISED SIGNATORY

APPROVED BY:


SONALI NAKANDALA

ASSISTANT GENERAL MANAGER -
OPERATIONS/TECHNICAL

END OF THE REPORT.



TEST REPORT

74/RPT/ 06688



Report No: (7422)185-0260

Jul 12, 2022

Page 1 of 3

Attn: Mr. Sujith Sudhakaran

Customer: Alke Alkatas Joint Venture (Pvt) Ltd
Address: H.H. Moomiyaage, 5A, Asaree Hingun, 20265 Male, Maldives
Date of Sample Received: Jul 04, 2022
Date of Testing Started: Jul 04, 2022
Date of Testing Completed: Jul 12, 2022
Sample Description: **Sample Received as:**
A water samples contained in sealed glass & plastic containers

Sample Identified by the Client as:
Ground Water 08
1.5L x 2, 1L x 1, 500ml

Sample Drawn By BVCPS: NO

Photo of the Submitted Sample



Bureau Veritas Consumer Products Services Lanka (Pvt) Ltd.

No. 570, Galle Road, Katubedda, Moratuwa, Sri Lanka
Tel: (9411) 2350111-115 (dedicated lines), Fax: (9411) 112622198 & 199
Email: lanka.lanka@bureauveritas.com

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74/RPT/ 06689

TEST REPORT



Report No: (7422)185-0260

Jul 12, 2022

Page 2 of 3

TEST RESULTS

No.	Parameters	Results	LOQ	Unit	Test Method
1	Electrical Conductivity at 25°C	662	-	µS/cm	APHA 23rd ed: 2017: 2510 B
2	pH at 25°C	7.3	-	-	APHA 23rd ed: 2017: 4500H+
3	Turbidity	1.5	-	NTU	APHA 23rd ed: 2017: 2130 B
4	Total Suspended Solids	21	-	mg/L	APHA 23rd ed: 2017: 2540D
5	Iron (as Fe)	0.002	-	mg/L	CPSD-AN-00581: 2019 V15 by ICP-MS
6	Manganese (as Mn)*	0.003	-	mg/L	
7	Arsenic (as As)	0.038	-	mg/L	
8	Cadmium (as Cd)	ND	0.0001	mg/L	
9	Lead (as Pb)	0.002	-	mg/L	
10	Mercury (as Hg)	ND	0.00005	mg/L	
11	Oil & Grease	ND	2.0	mg/L	APHA 23rd ed: 2017: 5520B

No.	Parameter	Result	LOQ	Unit	Test Method
PAH RESULTS					
1	Naphthalene	ND	1.0	µg/L	CPSD-AN-00576: 2019 V15 (In house method)
2	Acenaphthylene	ND	1.0	µg/L	
3	Acenaphthene	ND	1.0	µg/L	
4	Fluorene	ND	1.0	µg/L	
5	Phenanthrene	ND	1.0	µg/L	
6	Anthracene	ND	1.0	µg/L	
7	Fluoranthene	ND	1.0	µg/L	
8	Pyrene	ND	1.0	µg/L	
9	Benzo[a]anthracene	ND	1.0	µg/L	
10	Chrysene	ND	1.0	µg/L	
11	Benzo[a]pyrene	ND	1.0	µg/L	
12	Benzo[e]pyrene	ND	1.0	µg/L	
13	Indeno[1,2,3-cd]pyrene	ND	1.0	µg/L	
14	Dibenzo[a,h]anthracene	ND	1.0	µg/L	
15	Benzo[g,h,i]perylene	ND	1.0	µg/L	
16	Benzo[b]fluoranthene*	ND	1.0	µg/L	
17	Benzo[j]fluoranthene*	ND	1.0	µg/L	
18	Benzo[k]fluoranthene*	ND	1.0	µg/L	

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TEST REPORT



Report No: (7422)185-0260

Jul 12, 2022

Page 3 of 3

*Test not covered ISO 17025: 2017 by Sri Lanka Accreditation Board for conformity assessment.

NOTE:

APHA: American Public Health Association,

ND: Not Detected,

LOQ: Limit of Quantification, mg/L: milligrams per liter,

NTU: Nephelometric Turbidity Units, °C :Celcius,

µg/L: Micrograms per liter, µS/cm: Micro Siemens per Centimeter,

ICP-MS: Inductively Coupled Plasma Mass Spectrometry

Contact information for this report (Technical and General Inquiries and Feedback)

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FEED BACK:		
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REVIEWED BY: SHASHI MANOJ		

BUREAU VERITAS CONSUMER PRODUCTS SERVICES LANKA (PVT) LTD.
AUTHORIZED SIGNATORY

APPROVED BY:


SONALI NAKANDALAASSISTANT GENERAL MANAGER -
OPERATIONS/TECHNICAL**END OF THE REPORT.**

WATER QUALITY TEST REPORT
 Report No: 00102042

Customer Information:
 Al-Akhal Joint Venture P.L.C.
 CO16002

Report date: **28/09/2022**
 Test Method/Protocol No: **008190460**
 Sampled/Received Date: **21/09/2022**
 Date of Analysis: **24/09/2022 - 25/09/2022**

PARAMETER	ANALYSIS RESULT	TEST METHOD	UNIT
Sample Description -	GW-03		
Sample Type -	Ground Water		
Sample No	02222233		
Sampled Date -	28/09/2022 11:00		
Physical Appearance	Clear yellow with particles		
Conductivity *	1190	Method 2510 & adapted from Standard methods for the examination of water and wastewater (20th edition)	µS/cm
pH *	8.5	Method 4500 - 4.3, adapted from Standard methods for the examination of water and wastewater (20th ed. ed.)	-
Temperature	25.3	Dissimilarity	°C
Total Dissolved Solids	558	Dissimilarity	mg/L
Total Suspended Solids	< 0.3 (0.5 mg/L)	APHA method 8000	mg/L
Turbidity *	0.707	APHA nephelometric turbidity (adapted from HACH 2100, turbidimeter User Manual)	NTU
Iron, Total *	0.02	APHA method 8000	mg/L
Manganese	0.05	APHA method 8140	mg/L
Nitrate *	0.8	APHA method 8171	mg/L
Biological Oxygen Demand (BOD)	2	APHA method 8000	mg/L

Notes: pH Unit - 14 on Scales; µm - Centimeter; °C - Degree Celsius; mg/L - Milligram Per Liter; NTU - Nephelometric Turbidity Unit

Checked by

 Amrath Sofe
 Laboratory Executive

Approved by

 Nhrac A. Zein
 Assistant Quality Manager

Notes:
 Sampling Authority: Sampling was not done by MWSO 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.
 Test values accredited by SIAC under SOIC 17525/2017

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

WATER QUALITY TEST REPORT
 Report No: MW92842

Customer Information:
 Alca A Saba Joint Venture PVT.LTD
 CD/65007

Report date: **26/09/2022**
 Test Request Form No: **906195460**
 Sampling/Revised Date: **21/09/2022**
 Date of Analysis: **21/09/2022 - 26/09/2022**

Sample Description -	GW-01	GW-04	GW-05	TEST METHOD	UNIT
Sample Type -	Ground Water	Ground Water	Ground Water		
Sample No	8323225	8323226	8323227		
Sample Date -	16/09/2022 11:00	16/09/2022 11:00	16/09/2022 11:00		
PARAMETER	ANALYSIS RESULT				
Physical Appearance	Clear with particles	Pale yellow with particles	Pale yellow with particles		
Conductivity *	373	1170	NM	Method 2510 B (substitution) (reference method for the conductance of water and waste water. 25°C cell)	µS/cm
pH *	7.8	8.0	7.2	Method 4500 H + S (reference) (reference method for the determination of water or wastewater pH. 25°C cell)	-
Temperature	24.9	25.0	24.5		°C
Total Dissolved Solids	196.7	5096	2940		mg/L
Total Suspended Solids	<5 (LoD 5 mg/L)	<5 (LoD 5 mg/L)	39	HACH Method 8004	mg/L
Hardness *	1.16	0.245	687	HACH Nephelometric turbidity (scattered light) (NAP) 25°C, turbidimeter (see manual)	NTU
Iron, Total *	0.03	<0.02 (LoD 0.02 mg/L)	0.04	HACH Method 8009	mg/L
Manganese	<0.006 (LoD 0.006 mg/L)	0.006	0.087	HACH Method 8181	mg/L
Nitrite *	0.8	0.2	2.8	HACH Method 8171	mg/L
Chemical Oxygen Demand (COD)	76.3	87.9	79.8	HACH Method 8008	mg/L

Keys: µS/cm : Micro Siemens per Centimeter, °C : Degree Celsius, mg/L : Milligram Per Liter, NTU : Nephelometric Turbidity Unit

Checked by



Amirah Saba
 Laboratory Executive

Approved by



Nizar A. Zahr
 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 controlled by DQC under ISO/IEC 17025:2017.
 Check: Oxygen Demand for Sample No: 8323225 could not be determined due to high turbidity of the sample.

WATER QUALITY TEST REPORT
 Report No: MW0102942

Customer Information:
 Ake A Labs, Joint Venture Pvt Ltd
 CO2782022

Report date: 23/09/2022
 Test Request on Form No: 909195460
 Sample(s) Received Date: 21/09/2022
 Date of Analysis: 21/09/2022 - 23/09/2022

Sample Description -	GW-01	GW-04	GW-03	TEST METHOD	UNIT
Sample Type -	Ground Water	Ground Water	Ground Water		
Sample No	83737795	83737796	83737797		
Sampled Date -	16/09/2022 11:00	16/09/2022 11:00	16/09/2022 11:00		
PARAMETER	ANALYSIS RESULT				
Physical Appearance	Clear with particles	Pale yellow with particles	Pale yellow with particles		
Dissolved Oxygen (DO)	4.37	7.71	3.10	A-10000 Test kit kit (Volumetric method) BOD (DOB) Probe (Make: LDO1010) (in-situ)	mg/L
Biological Oxygen Demand (BOD)	1	5	1	HACH Method 2100	mg/L

Keys: pH:in : Million Siemens per Centimeter, °C : Degree Celsius, mg/L : Milligram Per Liter, NTU : Nephelometric Turbidity Unit

Checked by



Amruth Bala
 Laboratory Executive

Approved by



Nisar A. Zafar
 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 SAMPLE(S) TESTED.
- Information provided by the customer. This information may affect the validity of the test results.
- *Meters are accredited by DPC under ISO/IEC 17025:2017
- Chemical Oxygen Demand for Sample No 83737796 could not be determined due to high salinity of the sample

WATER QUALITY TEST REPORT
 Report No: MW0102942

Customer Information:
 Ake A Kaba Joint Venture Pvt Ltd
 CO2782022

Report date: 23/09/2022
 Test Request on Form No: 909195460
 Sample(s) Received Date: 21/09/2022
 Date of Analysis: 21/09/2022 - 23/09/2022

Sample Description	GW-07	GW-02	TEST METHOD	UNIT
Sample Type	Ground Water	Ground Water		
Sample No	83297798	83297799		
Sample Date	16/09/2022 11:00	16/09/2022 11:00		
PARAMETER	ANALYSIS RESULT			
Physical Appearance	Clear with particles	Clear with particles		
Conductivity *	680	82100	Method 25-103, (adapted from Standard methods for the examination of water and waste water, 23rd edition)	µS/cm
pH *	7.6	7.3	Method 150-101-01, (adapted from Standard methods for the examination of water and waste water, 23rd edition)	-
Temperature	24.9	24.8	Directly	°C
Total Dissolved Solids	344	26100	Filter residue	mg/L
Total Suspended Solids	67	47	ISO Method 8205	mg/L
Turbidity *	14.7	1.56	ISO 7021 nephelometric Method (adapted from ISO 7021 Turbidity in Low Turbidity)	NTU
Iron, Total *	<0.02 (LoQ 0.02 mg/L)	<0.02 (LoQ 0.02 mg/L)	ISO Method 8206	mg/L
Manganese	0.023	0.022	ISO Method 8149	mg/L
Nitrate *	3.3	0.0	ISO Method 8171	mg/L
Chemical Oxygen Demand (COD)	<2 (LoQ 2 mg/L)	-	ISO Method 8207	mg/L

Keys: µS/cm: Micro Siemens per Centimeter, °C: Degree Celsius, mg/L: Milligram Per Liter, NTU: Nephelometric Turbidity Unit

Checked by



Amrath Dada
 Laboratory Executive

Approved by



Nhat A. Jiw
 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
 Chemical Oxygen Demand for Sample No 83297799 could not be determined due to high salinity of the sample.

WATER QUALITY TEST REPORT
 Report No: MW0102942

Customer Information:
 Ake A Labs, Joint Venture Pvt Ltd
 CO2782022

Report date: 23/09/2022
 Test Request on Form No: 909195460
 Sample(s) Received Date: 21/09/2022
 Date of Analysis: 21/09/2022 - 23/09/2022

Sample Description -	GW-07	GW-02	TEST METHOD	UNIT
Sample Type -	Ground Water	Ground Water		
Sample No	83297798	83297799		
Sampled Date -	16/09/2022 11:00	16/09/2022 11:00		
PARAMETER	ANALYSIS RESULT			
Physical Appearance	Clear with particles	Clear with particles		
Dissolved Oxygen (DO)	4.10	0.80	In-house Test method (Adapted from HINDI 303 L306 Plate / Total LB00-0121 manual)	mg/L
Biological Oxygen Demand (BOD)	1	4	HACH Method 8073	mg/L

Keys: pH:in : Million Siemens per Centimeter, °C : Degree Celsius, mg/L : Milligram Per Liter, NTU : Nephelometric Turbidity Unit

Checked by



Anirudh Bala
 Laboratory Executive

Approved by



Nisar A. Zahir
 Assistant Quality Manager

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- Information provided by the customer. This information may affect the validity of the test results.
- *Meters accredited by IAS under ISO/IEC 17025:2017
- Chemical Oxygen Demand for Sample No 83297799 could not be determined due to high salinity of the sample

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

**1st Addendum to the Environmental Impact Assessment
Greater Male Waste-to-Energy Project; Installation of
Sewage Treatment Plant (STP) for the construction
period, Thilafushi, Kaafu Atoll**

Prepared for

Ministry of Environment Climate Change & Technology
PMU waste to Energy Facility

February 2023

Prepared by:
Dr. Mahmood Riyaz (EIA P03/2007)
Consultant to the EPC contract

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Declaration of the Consultant:

I certify that the statements made in this 1st Addendum to the Environmental Impact Assessment Greater Male Waste-to-Energy Project; Installation of Sewage Treatment Plant (STP) for the construction period Thilafushi, Kaafu Atoll are true, complete and correct to the best of my knowledge and available information at the time of writing this report.

Dr. Mahmood Riyaz (EIA P03/2007)
31st January 2023

Declaration of the Proponent



Ministry of Environment, Climate Change and Technology
Male', Republic of Maldives

Date: 30th January 2023

No: 438-WMPC/203/2023/7

Mr. Ibrahim Naeem,
Director General,
Environmental Protection Agency
3rd Floor Green Building, Handhuvaree Hingun, Maafannu, Male', 20392,
Maldives.

Re: Proponent declaration and commitment to the First Addendum to the Greater Male' Waste-to-Energy Project; Installation of Sewage Treatment Plant (STP) for the construction period, Thilafushi, Kaafu Atoll

Dear Sir,

As the Proponent of the proposed project, we guarantee that we have read the report and to the best of our knowledge, all information relevant to this project in terms of project description, project construction works, and operational aspects provided here are accurate and complete.

As the Proponent of the project, we assure you of our commitment to undertake the proposed mitigation measures and monitoring programme given in the report by the DBO contractor.

Sincerely,


Ahmed Murthaza,
Director General



List of Abbreviations

ADB	Asian Development Bank
CBD	Convention on Biological Diversity
COD	Chemical Oxygen Demand
DBO	Design build and Operate
DO	Dissolved Oxygen
DS	Decision Statement
EPA	Environmental Protection Agency
EIA	Environmental Impact Assessment
GHG	Greenhouse gas
GPS	Global Positioning System
H₂S	Hydrogen sulphide
MECCT	Ministry of Environment Climate Change and Technology
URA	Utility Regulatory Authority
MPHI	Ministry of Planning Housing and Infrastructure
MWSC	Maldives Water and Sewerage Company
NO	Nitrogen monoxide
NO₂	Nitrogen dioxide
SO₂	Sulphur dioxide
STP	Sewerage Treatment Plant
SBR	Sequencing Batch Reactor
TDS	Total Dissolved Solids
ToR	Terms of Reference
TPH	Total Petroleum Hydrocarbon
TSS	Total Suspended Solids
WtE	Waste to Energy

- 1- در مجموع با سه هزار و سیصد نفر از بیماران مبتلایان به بیماری کرونا در استان تهران در روز شنبه ۲۲ خرداد، ۳۶۹ نفر درگذشتند. همچنین ۳۱۴ نفر در بیمارستانها بستری شدند و ۲۷۱ نفر در مراکز درمانی بستری شدند. در مجموع ۶۵۴ نفر در بیمارستانها بستری شدند. همچنین ۲۷۱ نفر در مراکز درمانی بستری شدند. در مجموع ۶۵۴ نفر در بیمارستانها بستری شدند.
-۲ در مجموع در استان تهران در روز شنبه ۲۲ خرداد، ۳۶۹ نفر درگذشتند. همچنین ۳۱۴ نفر در بیمارستانها بستری شدند و ۲۷۱ نفر در مراکز درمانی بستری شدند. در مجموع ۶۵۴ نفر در بیمارستانها بستری شدند.
۳- در مجموع در استان تهران در روز شنبه ۲۲ خرداد، ۳۶۹ نفر درگذشتند. همچنین ۳۱۴ نفر در بیمارستانها بستری شدند و ۲۷۱ نفر در مراکز درمانی بستری شدند. در مجموع ۶۵۴ نفر در بیمارستانها بستری شدند.

2 EXECUTIVE SUMMARY

This is the first addendum to the EIA report Greater Male Waste-to-Energy Project, Thilafushi Male' Atoll. This Addendum covers installation of a temporary Sewage Treatment Plant (STP) at the construction camp, for the construction period of WtE Thilafushi, Kaafu Atoll. This addendum was prepared to cover the environmental impact that may arise from the installation and operation of proposed temporary STP at the construction camp.

The addendum will address following aspects of proposed STP plant:

- Design a prefabricated STP plant with 50m³/day capacity
- Importation of the designed STP to Maldives, assemble and install on a concrete foundation at the WtE facility, connect sewage pipes and electricity to the system commissioning and operation
- Connect discharged water from the STP to an outfall pipe out of the southern Thilafushi reef and discharge at 5m depth
- Decommission and removal of the STP after completion of the construction stage of the WtE

To prepare this report baseline data from the initial EIA report was used and additional site-specific data on marine and land environment with assessment of status of construction was collected for the report from the field. Relevant documents and reports on similar development projects in the Maldives were reviewed.

The proposed STP installation and operation will not create any new impact that has not been included addressed in the initial EIA report prepared and approved for the WtE project. Positive changes that will bring from the installation of the STP is that the quality of sewage discharge into the sea will be treated to the tertiary level which subsequently will contribute to minimize the impact from sewage discharge into the sea. the major impacts from the installation, operation and decommissioning of the proposed temporary STP plant at the WtE facility construction camp.

- Excavation; will generate dust and other air pollutants, reducing the overall air quality of the site release of minor amount of Greenhouse Gas emissions (GHGs).
- Laying the sewage outfall pipe on the reef - direct irreversible minor negative impact to the ecological habitat in the area and lethal impact on sessile benthic organisms on in the area
- Dewatering: Direct and short-term impact as rainfall recharges those saline groundwater zones.

Out of these three major impacts identified, excavation and dewatering will be reversible and will last for a short-medium term. While the direct impact that is caused by laying of the outfall pipe on the reef flat will have very localized lethal lasting impacts on the coral species that are directly under neath the pipeline. This is a minor negative site-specific impact on live corals

The addendum has evaluated alternative option for STP plant and laying of the sewage outfall pipe. The proposed STP and the method for the laying outfall suggested in this report will have

the minimal impact on the environment. Even though there is no new impact other than that has been identified in the initial EIA report it is recommended to continue ongoing environmental monitoring programme and to make necessary adjustment based on the findings of various measured environmental parameters suggested in the monitoring plan.

With proper implementation of the mitigation measures, installation operation and decommissioning of STP after completion of the construction will not alter the over-all aspect of the project and recommended to go ahead as proposed.

3 INTRODUCTION AND BACKGROUND

This is the first Addendum to the Environmental Impact Assessment Greater Male Waste-to-Energy Project; Installation of a temporary Sewage Treatment Plant (STP) for the construction period Thilafushi, Kaafu Atoll. Greater Male Waste-to-Energy Project is aimed at establishing a sustainable regional solid waste treatment system in the Greater Malé capital region by (i) developing treatment (proven waste-to-energy [WTE] technology), recycling and disposal infrastructure; (ii) strengthening institutional capacities for sustainable solid waste services delivery and environmental monitoring; and (iii) improving public awareness on WTE and reduce-reuse-recycle (3R).

The project will have two outputs, Output 1: Disaster- and climate-resilient regional waste management facility developed. This will include (i) a 500 tons per day (tpd) WTE plant with 15-year O&M contract, including two treatment lines of 250 tpd each, energy recovery and air pollution control (APC) system; and (ii) a landfill for safe disposal of APC residues and non-marketable bottom ashes. The facility is expected to generate 8WM of electricity and will be designed to accommodate a third 250 tpd treatment line, required to respond to further demand increase. All facilities will adopt disaster- and climate-resilient features such as raised floor elevations, flood proof mechanical and electrical equipment and landfill cells, and enhanced drainage systems.

Output 2: Institutional capacity in sustainable SWM services delivery (WTE) and environmental monitoring strengthened, and public awareness on WTE and 3R improved. This will include (i) capacity building support in monitoring sustainable WTE operations, including MOE and EPA institutional capacity strengthening and training to monitor WTE O&M and environmental standards; (ii) public awareness on WTE and 3R in Greater Male improved; and (iii) project management and supervision consultant support provided.

3.1 PROPOSED ADDENDUM TO THE EIA

The proposed addendum is to installation and operation of a temporary sewage treatment plant STP to use during the construction phase of the WtE project in Thilafushi Island. The treatment plant will achieve tertiary level treatment of raw sewage and dispose the water through an outfall into the southern part of the Thilafushi island adjacent to the project. This plant will be used by the construction camp during the construction phase of the project and it will be decommissioned after the completion of the construction work.

3.2 RATIONAL FOR THE EIA ADDENDUM

Greater Male Waste-to-Energy Project is ADB funded project. The project's construction and operation is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. Thus, the project is classified as Category A for environment per ADB Safeguard

Policy Statement (SPS) and an environmental impact assessment (EIA) is required. An EIA report on the project to meet ADB SPS requirement for Category A projects and to comply with Government of Maldives requirements under EIA Regulations of 2012 has been prepared and approved by the Maldives EPA in 2020.

The WTE facility being located remotely away from the urbanized areas, in Thilafushi waste disposal island, the construction workers and project employees will be camped inside the boundaries of WTE facility. Therefore, all the necessary facilities for the labour camp have to be developed prior to commencement of WTE construction activities. Waste water management system is necessary to be established to cater for the needs of the construction camp. The proposed STP plant will be installed to undertake tertiary level treatment of raw sewage and dispose the water through an outfall into the southern part of the Thilafushi island adjacent to the project.

The main rationale for the installation of the STP plant is that since this is an ADB SPC Category A project is to minimize the environmental impact of sewage and waste water disposal during the construction phase of the project. The plant will be decommissioned after completion of the construction stage of the project.

3.3 ASSESSMENT METHODOLOGY

3.3.1 General Approach

This EIA addendum is broadly guided by the EIA regulation May 2012 and EPA data collection guidelines published in www.epa.gov.mv.

This report has been prepared to ensure that the significant environmental and social impacts of the proposed activities of the project at various development stages have been considered and assessed at the project planning phase.

The report has been prepared by following five major steps. They are; literature review; field surveys; stakeholder consultations; analysis of results; and report EIA compilation.

Field assessments covering land, marine and coastal environment surrounding the project area of the proposed project site was undertaken for the initial EIA and relevant assessment were undertaken for this assessment. Methodology used in the assessments is further detailed in the relevant sections of the report.

Extensive stakeholder relevant for this development was consulted during the initial EIA development process and also stakeholders identified by the EIA ToR was consulted during the preparation of the addendum.

3.3.2 Literature Review

Following documents which includes the initial EIA report and other relevant reports mainly similar undertakings by the consultant in the past are reviewed.

- 1- Environmental Impact Assessment, MLD: Greater Malé Waste-to-Energy Project

– Waste to Energy Plant, Prepared by Ministry of Environment of the Republic of Maldives for the Asian Development Bank

- 2- First Addendum to ESIA for north regional waste management facility construction and operation (ESIA 2012) as per the world bank safeguard standards
- 3- MoE 2021 Establishment of Island Waste Resource Management Centre with Aerobic technology using Composting machine at Gan, Laamu Atoll

3.4 STUDY AREA

The proposed WTE facility is located on Thilafushi island that has been reclaimed since December 1992 by filling with wastes on the submerged “Thilafalhu” lagoon area. Thilafushi is located on the southern rim of North Malé atoll, 9.5km west of Malé at geographic coordinates 04° 11' 00" N and 73° 26' 44" E. The nearest inhabited island is Villingili, approximately 7.1 km east of Thilafushi. The WTE project will be located on a 15 hectares government-owned land, which has been reclaimed from shallow lagoon.

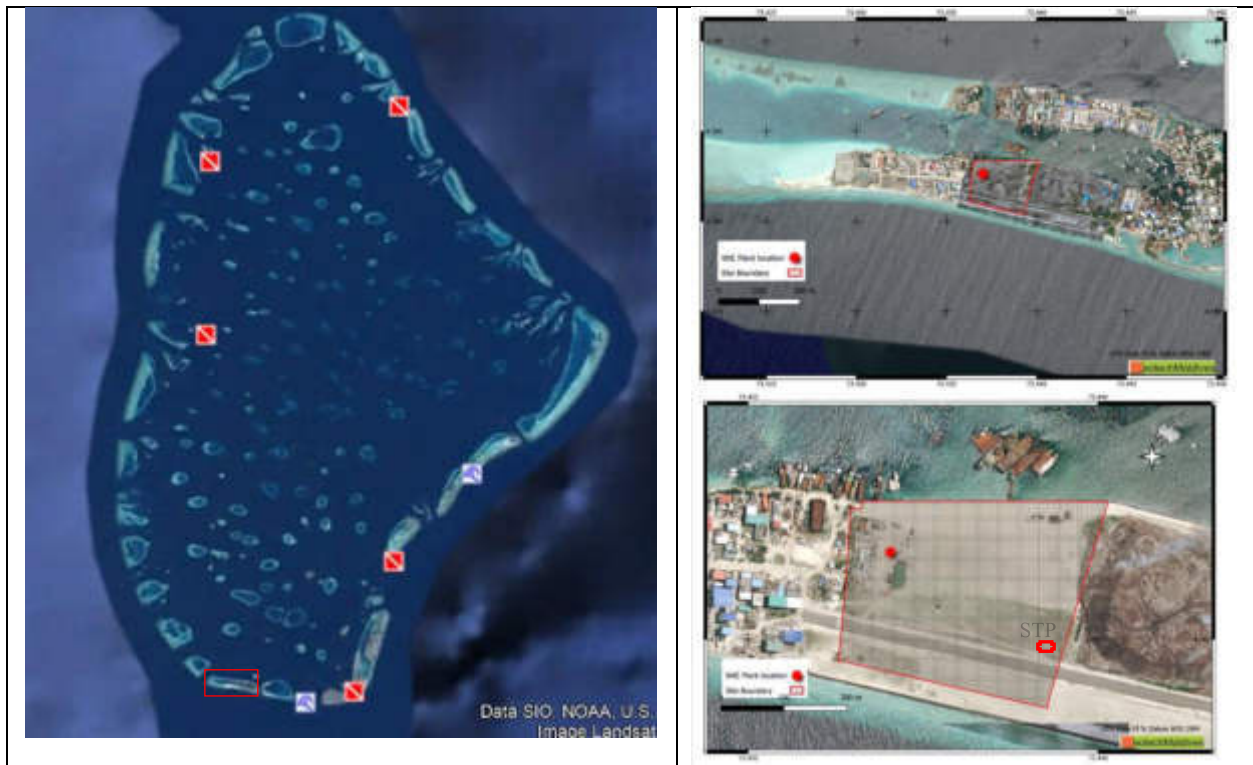


Figure 1: Location of map of Proposed WTE facility development Project at Thilafushi and location of STP within the WTE site boundary.



Figure 2: Study area

4 DESCRIPTION OF THE PROPOSED CHANGES

This addendum to the EIA report on Greater Male Waste-to-Energy Project; Installation of a temporary Sewage Treatment Plant (STP) for the construction period Thilafushi, Kaafu Atoll is prepared to address the installation commissioning and operation of an STP at the construction camp during the construction period of the project. This addendum to the EIA is prepared in accordance with the Environmental Impact Assessment Regulations of the Ministry of Environment and Energy May 2012.

4.1 PROJECT PROPONENT

The proponent of the proposed project is the Government of the Republic of Maldives who will implement the project through. The project is financed by the ADB. The employer MECCT is represented by Fichner from Germany. The Design Build and Operation (DBO) contractor of the project is URBASER S.A. from Spain and the EPC contractor is ALKE-ALKATAŞ JV from Turkey.

4.2 PROJECT OBJECTIVES AND BENEFITS

The main objective of the project is improvement of the environment in the country and consequently for a better living condition of the surrounding population in the greater Malé region, and to improve the attractivity of the Maldives as an ecological friendly tourist destination. The issue of solid waste management in the Maldives is of critical importance particularly Greater Malé region and nearby atolls, which together encompass a significant portion of the country's population. Therefore, proposed Regional Waste Management Facility Project includes Kaafu Atoll, North Ari Atoll, South Ari Atoll, and Vaavu Atoll. This facility will consist of the proposed Waste-to-Energy (WTE) plant project. The WTE plant has been selected as the viable option to reduce the volume of solid wastes to a level of residual waste that can be disposed and managed given the limited land area in Project area.

Major benefits with the implementation of the WTE plant, include:

- (i) Substantial bulk reduction for landfill disposal - The amount of MSW to be disposed of at landfills will substantially decrease as the volume of waste remaining after the thermal treatment process would only be about 10% of the original volume.
- (ii) Energy recovery - The WTE plant could generate and export electricity for gainful uses by the industries at Thilafushi.
- (iii) Greenhouse gas reduction - The WTE plant will generate electricity for the industries on Thilafushi, replacing their dependence on fossil fuel-based power generation, leading to an overall reduction of greenhouse gas emission by the Maldives.

4.2.1 Project Components

The EIA report for this project has been prepared and approved based on preliminary design of the WTE plant provided by the government. As the project implementation has commenced through a DBO contract, the DBO is in the process of completing the detailed design. Per preliminary design, the WTE will have 10MW power production with 2 MW to be used for the facility itself

(and other parasitic loads). The surplus power of 8 MW will be fed to the main grid through a cable link between Thilafushi and Ghuli Fahlu island. The government is still at planning stage of developing this link to be constructed in between the islands.

The construction of the WTE plant infrastructures will include the following stages:

- (i) Civil and building works;
- (ii) Mechanical & electrical plant installation;
- (iii) Road, utilities, services and landscaping; and
- (iv) Ancillary instrumentation and control works

At present the project is still in pre-construction phase where necessary facilities including mobilization process, labour camp, temporary offices and facilities etc are being constructed. The proposed installation of STP plant is for the management of sewage and waste water during the construction phase of the project.

4.3 NEED AND JUSTIFICATION FOR THE REQUIREMENT OF STP PLANT

Almost all the waste water generated in Thilafushi island is either directly or indirectly disposed into the sea through septic tank systems or untreated direct connection. This development being an ADB project maintaining high environmental standards and to reduce the impact during the construction phase, STP with tertiary level treatment plant was selected. Therefore, the main rationale for the installation of the STP plant is that since this is an ADB SPC Category A project it is to maintain the high environmental standards and to minimize the environmental impact of sewage and waste water disposal during the construction phase of the project. The plant will be decommissioned after completion of the construction stage of the project.

4.4 LOCATION OF STP

The proposed STP plant for the construction phase will be located on the south eastern corner of plot boundary adjacent to the temporary accommodation, kitchen and laundry buildings (*Figure 3*).

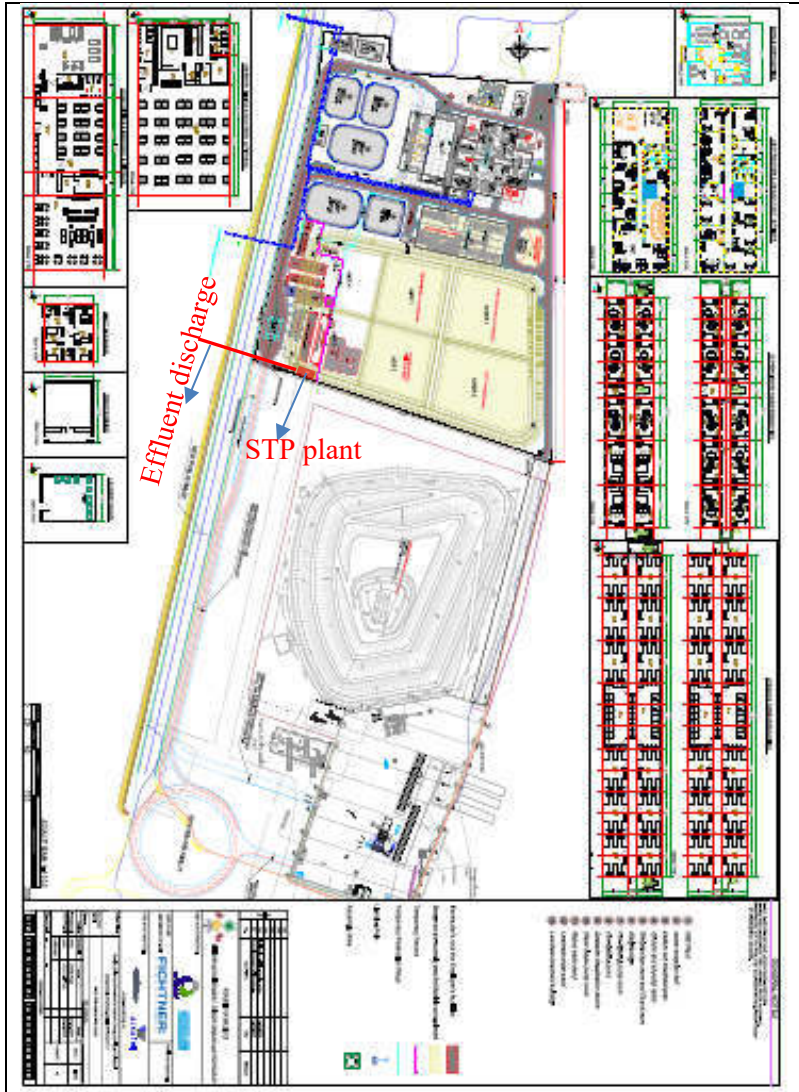


Figure 3. Location of STP plant and effluent line

4.4.1 Sewerage treatment plant

A single-story standard building will be constructed for services and facilities required for the operation of the plant. The land area allocated for the facility is approximately 16 m x 18 m. This building will consist of an inlet chamber, grit chamber, oil and grease chamber, equalization tank, SBR reactors basins, centrifuge house, DWPE dosing tank, sludge sump and Pump and effluent sump well. *Figure 4* shows the layout works of the facility building

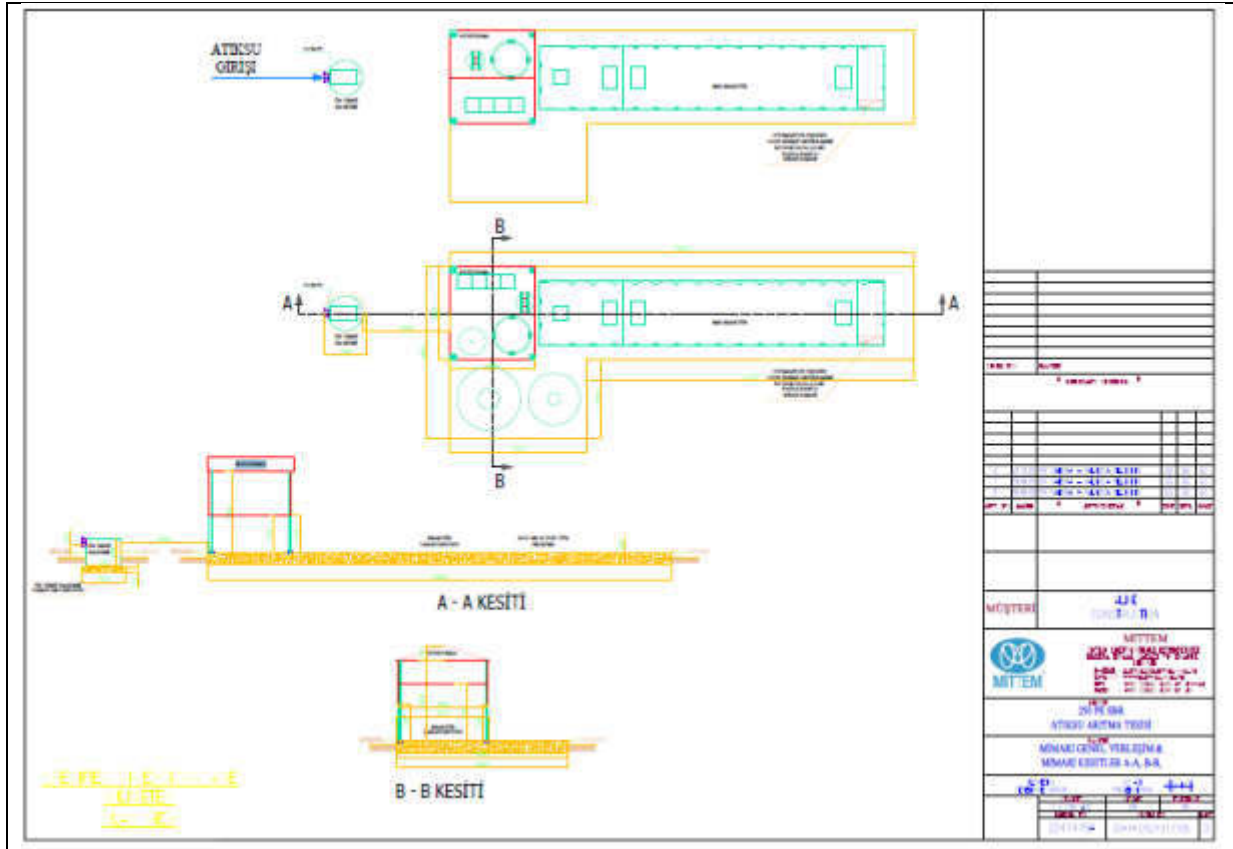


Figure 4. STP Building layout at WTE facility , Thilafushi. A magnified view is attached in the Annex

4.4.2 Description of sewerage treatment process

The proposed sewerage treatment plant aims to remove contaminants from sewage to produce an effluent that is suitable for discharge to the surrounding environment, thereby preventing water pollution from raw sewage discharges. Raw sewage contains mineral and inorganic matter in suspension and in solution. It also contains living organisms some of which may be dangerous hence treatment of sewage has to be carried out. Sewage treatment often involves primary and secondary treatment, while advanced treatment also incorporates a tertiary treatment stage with polishing processes and nutrient removal. The proposed treatment plant will treat the effluent to tertiary level and dispose it to out of the reef into the sea at a 5m depth. Sequencing Batch Reactor (SBR) is proposed as the treatment process in the proposed STP and the flow diagram of the process is shown *Figure 5*.

Wastewater enters by gravity to a wet basin, i.e. primary treatment unit. Screenings are removed in this unit. Effluent from the primary sedimentation flows to the equalization unit over a weir.

In the equalization basin located are submersible pumps. In this unit, both volumetric and organic loads are dampened, thereby; downstream units are fed equally in terms of these characteristics, yielding constant rate, homogenous flow. Submersible pump/pumps located in the basin pump the wastewater to the reactor unit. The pumps in the equalization basin are ON/OFF controlled by level switches.

SBR tank and all of the cycles thereof are intermittently operated and controlled by PLC automation. Decant from the SBR tank is provided by a submersible pump. The effluent (decant) exits from the system by a submersible pump and then chlorinated at the discharge main. Excess sludge from the SBR is provided by a vacuum truck about twice a year.

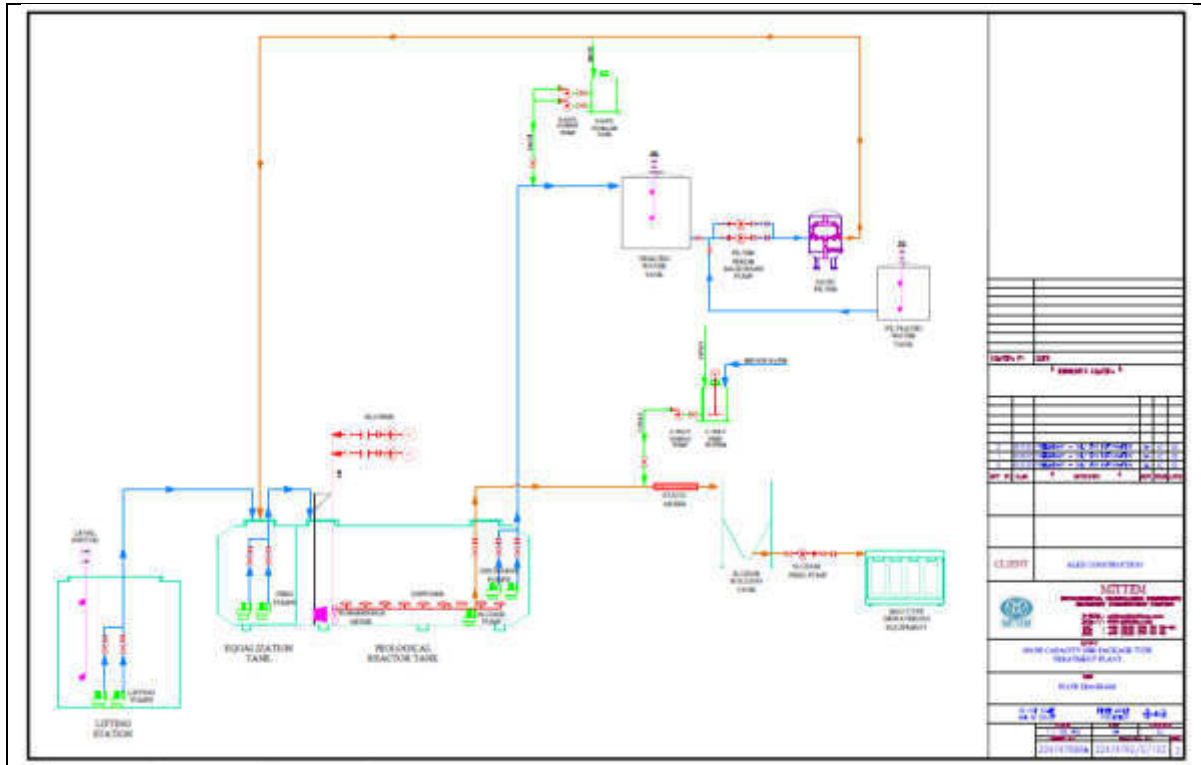


Figure 5 Flow diagram of the proposed STP in Thilafushi WtE facility

4.4.2.1 SBR

The sequencing batch reactor (SBR) is a fill-and-draw activated sludge system for wastewater treatment. In this system, wastewater is added to a single “batch” reactor, treated to remove undesirable components, and then discharged. Equalization, aeration, and clarification can all be achieved using a single batch reactor. To optimize the performance of the system, two or more batch reactors are used in a predetermined sequence of operations. SBR systems have been successfully used to treat both municipal and industrial wastewater. They are uniquely suited for wastewater treatment applications characterized by low or intermittent flow conditions. Typical process flow diagram of SBR is shown in *Figure 6* main advantages of the SBR systems are

- 1- Equalization, primary clarification (in most cases), biological treatment, and secondary clarification can be achieved in a single reactor vessel.
- 2- Operating flexibility and control.
- 3- Minimal footprint.
- 4- Potential capital cost savings by eliminating clarifiers and other equipment.

The main disadvantage of the SBR system are:

- 1- A higher level of sophistication is required (compared to conventional systems), especially for larger systems, of timing units and controls.

- 2- Higher level of maintenance (compared to conventional systems) associated with more sophisticated controls, automated switches, and automated valves.
- 3- Potential of discharging floating or settled sludge during the DRAW or decant phase with some

SBR configurations.

- 4- Potential plugging of aeration devices during selected operating cycles, depending on the aeration system used by the manufacturer.

- 5- Potential requirement for equalization after the SBR, depending on the downstream processes.

Based on the influent characteristics and effluent discharge parameters specified by the EPA and URA permitted for municipal systems are flowrate, BOD5, TSS, and Fecal Coliform, the proposed system is selected. Technical specification of the proposed STP plant is given in *Table 1*

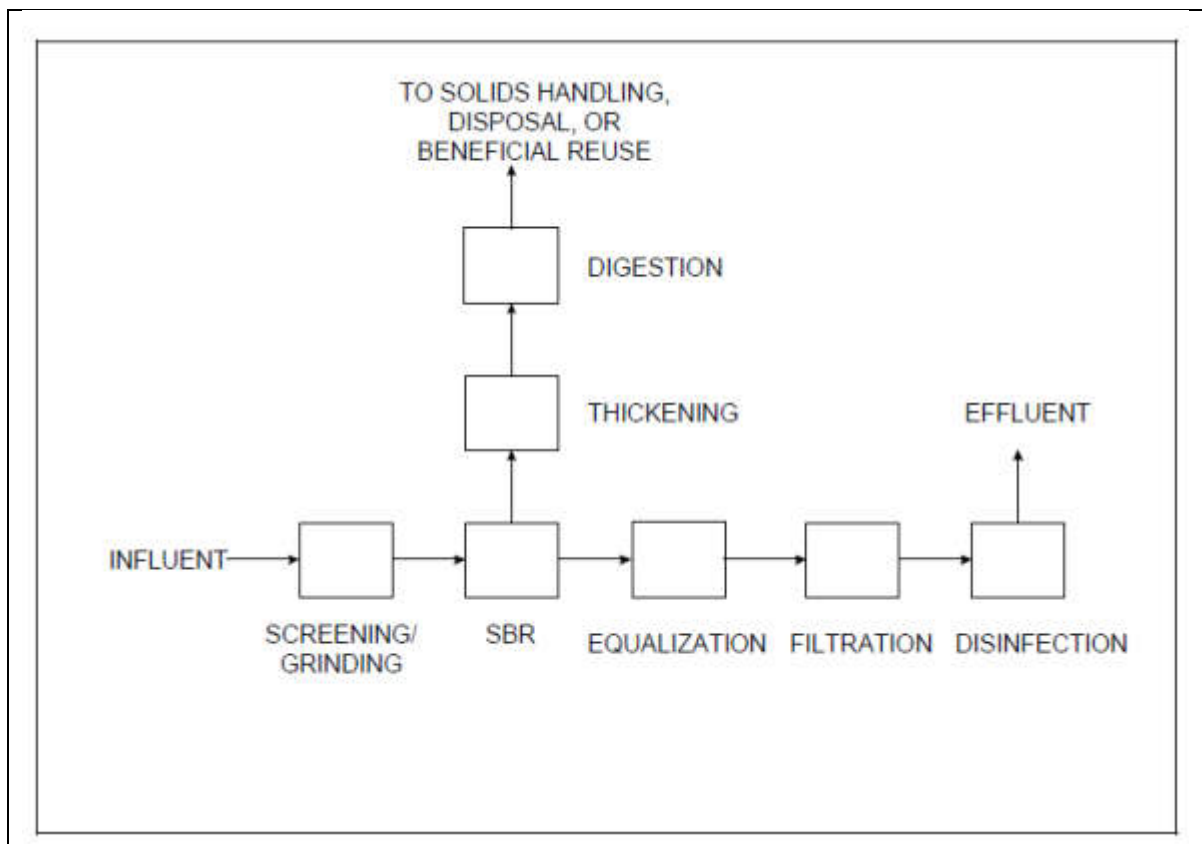


Figure 6 Process flow diagram for a typical SBR.

4.5 Technical specifications of the plant

4.5.1 Flowrate & future extensions

$$Q = 250 \text{ PE} \times 200 \text{ L/person. Day}$$

$$Q = 50 \text{ m}^3/\text{day}$$

Table 1. Technical specification of the temporary STP plant proposed to be installed at the WtE facility, Thilafushi

1- PRIMARY TREATMENT UNIT	
(a) Lifting Station	
Quantity	1
Type	Cylindrical, underground
Dimensions (Ø x H)	1,20 x 1,00 m
Material	St-37 carbon steel + epoxy paint
Accessories & Features	Manhole, level switch
Manufacturer	MITTEM
(b) Lifting Pump	
Quantity	1 duty + 1 stand-by
Type	Submersible pump with cutter
Installation	Wet well
Impeller	Vortex
Capacity	12 m ³ /h @ 10 mWC
Solids handling capacity	35 mm
Power supply	220V / 50 Hz / 1P
Power rating	0,75 kW
Insulation class	F
Protection class	IP 68
Operation control	ON/OFF by automation & float switches
Starting	Direct, >15 starts/h
(c) Basket Screen	
Quantity	1
Distance between meshes	10 mm
Mesh size	8-10 mm
Dimensions (W x L x H)	0,40 x 0,40 x 0,40 m
Material	St-37 carbon steel + hot deep galvanized
Accessories & Features	Manual crane
Manufacturer	MITTEM
2- EQUALIZATION UNIT	
(a) Equalization tank	
Quantity	1
Type	Rectangular, covered
Dimensions (W x L x H)	2,20 x 3,00 x 2,50 m
Material	St-37 carbon steel + epoxy paint
Accessories & Features	Influent baffle, access hatches, air vents, interior ladder
Manufacturer	MITTEM
(b) Feeding pump	
Quantity	1 duty + 1 stand-by
Type	Submersible
Installation	Wet well
Impeller	Vortex
Capacity	17 m ³ /h @ 6 mWC
Solids handling capacity	40 mm
Power supply	230V / 50 Hz / 1P
Power rating	0,75 kW

Insulation class	F
Protection class	IP 68
Operation control	ON/OFF by automation & float switches
Starting	Direct, >15 starts/h
Sealing	Double mechanical
Accessories & Features	Chain with shackle, discharge hose with hose clips, skirt base
Manufacturer	WILO (GERMANY) or equivalent
3- BIOLOGICAL TREATMENT	
(a) Biological reactor tank (SBR)	
Quantity	1
Type	Rectangular, covered
Dimensions (W x L x H)	2,20 x 9,00 x 2,50 m
Material	St-37 carbon steel + epoxy paint
Accessories & Features	Compartment for blower, PLC control, level switches, influent baffle, access hatches, air vents, interior ladder
Manufacturer	MITTEM
(b) Submersible mixer	
Quantity	1
Type	Submersible, high speed
Propeller diameter	200 mm
Rotational speed	1405 rpm
Power supply	380V / 50 Hz / 3P
Power rating	0,75 kW
Protection & Insulation class	IP 68 & F
Starting	Direct, <15 starts/h
Mounting	On guide rail
Accessories & Features	Square guide rail, chain with shackle
Manufacturer	ZENIT (ITALY) or equivalent
(c) Blower	
Quantity	1 duty + 1 stand-by
Type	Centrifugal
Capacity	140 m ³ /h @ 300 mbar
Power supply	380V / 50 Hz / 3P
Power rating	3 kW
Protection class	IP 55
Operation control	ON/OFF by automation
Starting	Direct, >15 starts/h
Accessories & Features	Suction filter, suction and pressure silencer, bluff valve, check valve, manometer
Manufacturer	FPZ (ITALY) or equivalent
(d) Diffusers	
Quantity	32
Type	Porous, membrane
Bubble	Fine
Capacity	2 – 10 m ³ /h
Dimensions (W x L or D)	~Ø270 mm
Material	EPDM

Accessories & Features	Fittings
Manufacturer	GUMMI JAGER (GERMANY) or equivalent
(e) Decant pump	
Quantity	1 duty + 1 stand-by
Type	Submersible
Installation	Wet well
Impeller	Vortex
Capacity	17 m ³ /h @ 6 mWC
Solids handling capacity	40 mm
Power supply	230V / 50 Hz / 1P
Power rating	0,75 kW
Insulation class	F
Protection class	IP 68
Operation control	ON/OFF by automation & float switches
Starting	Direct, >15 starts/h
Sealing	Double mechanical
Accessories & Features	Chain with shackle, discharge hose with hose clips, skirt base
Manufacturer	WILO (GERMANY) or equivalent
(f) Sludge pump	
Quantity	1
Type	Submersible
Installation	Wet well
Impeller	Vortex
Capacity	3 m ³ /h @ 7 mWC
Solids handling capacity	35 mm
Power supply	220V / 50 Hz / 1P
Power rating	0,55 kW
Insulation class	F
Protection class	IP 68
Operation control	ON/OFF by automation & float switches
Starting	Direct, >15 starts/h
Sealing	Double mechanical
Accessories & Features	Chain with shackle, discharge hose with hose clips, skirt base
Manufacturer	WILO (GERMANY) or equivalent
4- DISINFECTION UNIT	
(a) Hypochlorite storage tank	
Quantity	1
Type	Covered
Capacity	100 L
Material	PE
Manufacturer	ROTAPLAST (TURKEY) or equivalent
(b) Hypochlorite dosing pump	
Quantity	1 duty + 1 stand-by
Type	Electromagnetic solenoid
Capacity	5 L/h @ 5 bar
Power supply	220 V / 50 Hz/ 1P

Accessories & Features	10 – 100 % manual stroke adjustment
Manufacturer	PRODOZ (HOLLAND) or equivalent
5- SLUDGE DEWATERING UNIT	
(a) Sludge holding tank	
Quantity	1
Type	Cylindrical, open
Capacity	1,5 m ³
Material	
Tank	PE
Chassis	St-37 carbon steel + epoxy paint
Static mixer	AISI 304
Accessories & Features	Conical base, manual drain valve, chassis, inlet static mixer
Manufacturer	MITTEM
(b) C.Polyelectrolyte preparation system	
Quantity	1
Preparation type	1-chamber, batch
Chemical type	C.Poly
Tank net volume	200 L
Stage (i.e. # of mixers)	1
Power supply	380V / 50 Hz / 3P
Power rating	0,12 kW
Protection & Temperature rise class	IP 55 /B
Operation control	Manual
Gearbox	IMAK or equivalent
Material	
Tank	PE
Mixer shaft & impeller	Stainless steel
Nuts, bolts, washers	Stainless steel
Accessories & Features	Isolation valves, drain valves, mixer platform
Manufacturer	MITTEM
(c) Sludge feed pump	
Quantity	1
Type	Centrifugal, vortex
Installation	Horizontal shaft
Capacity	2 m ³ /h @ 6,5 mWC
Power supply	380V / 50 Hz / 3P
Power rating	0,37 kW
Insulation class	F
Protection class	IP 55
Temperature rise class	B
Explosion proof / zone	Not required
Operation control	ON/OFF by automation & float switches
Starting	Direct, >15 starts/h
Material	
Pump casing	Stainless steel
Shaft	Stainless steel
Impellers	Stainless steel

Sealing	Gland
Accessories & Features	-
Manufacturer	XYLEM (ITALY) or equivalent
(d) Bag type dewatering equipment	
Quantity	1
Type	Bag type dewatering equipment
Operation	Manual
Number of bag	4
Bag volume	100 L/each
Material	
Bag	Nylon
Chassis	Stainless steel
Accessories & Features	Distribution pipe, manual filling valves
Manufacturer	MITTEM
Chassis	Stainless steel

4.6 SEWER CONNECTION

The sewer connection pipes will be laid underground about 1-1.5 m depth. For the purpose of the design, a maximum depth of excavation of 3 m is allowed as per the guide lines of URA/EPA. Strict adherence to these criteria is considered necessary for Thilafushi as the streets are not very wide but have enough space for excavation and installation of pipelines.

Dewatering maybe required during construction and installation of sewage pipe networks with increase in intensity as depth increases. Furthermore, the instability of the prevailing sand/soil conditions of Thilafushi makes excessive dewatering a bit risky since dewatering entailed further destabilizing of the soil in the reclaimed land. However, no significant excavation is required as the premises needed to connect with the STP is in very close proximity and also the outfall pipe length from the STP plant to the outer edge of the reef is approximately 180m.

During trenching and piping works, plywood or fibre board formworks will be used for shoring to prevent accidental collapse. Shoring will be done where necessary for avoid the collapse the side walls by using 1200x2400mm steel plates and strengthen by using 50x100mm steel box bars. However, as the depth of excavation will not exceed 1 m during the pipe laying, shoring is not envisioned at this time for the project

4.6.1 Connection to sewer network

The facilities and buildings inside the WtE facility will be connected to the sewer main with uPVC pipe of 110mm OD gravity sewer laid at a minimum grade of 1.5-2.5% to facilitate the flow of solids. A pre-fabricated corrugated HDPE inspection chamber will be placed at the boundary of each building connection prior to downstream connection with a 'Y' fixture, lateral connection (See *Figure 7*)

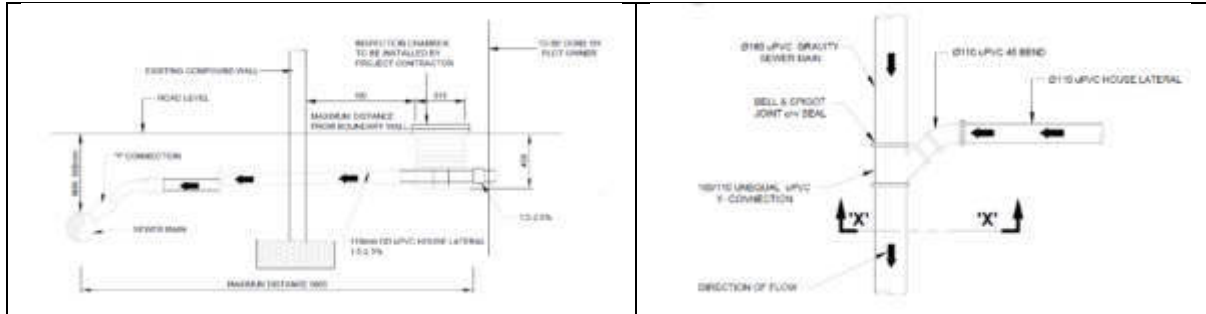


Figure 7. Sewer connection. Section view of the building connection (left) , Plane view of the building (Right)

4.6.2 Construction methodology

4.6.2.1 STP plant

The STP plant will be prefabricated in Turkey and will be assembled on a concrete base at the site in the location shown in Figure 3.

4.6.2.2 Sewage pipelines

The sewage pipe will be laid underground at about 1.1.5m in the land until it reaches the existing rock-boulder seawall. Once it reached the rock boulder seawall it will be fixed on top of it into the reef flat/lagoon. On the reef flat the pipeline will be ballasted with anchored block to the seabed. Anchor blocks will be 1 to 2 tons of reinforced concrete (Precast U-blocks to be bolted in place to form one complete block) at 4 m intervals as shown in the drawing, to prevent displacement at rough weather conditions Figure 8.

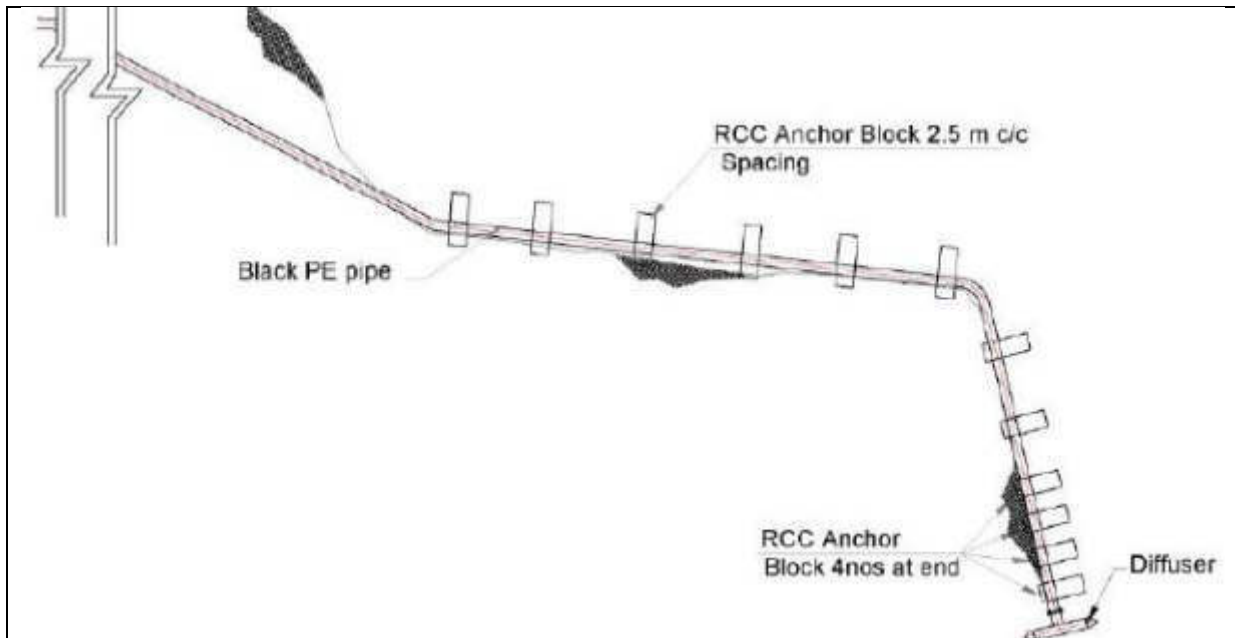


Figure 8. Schematic showing the methodology for laying sewerage outfall pipe on the reef to the discharge location

4.6.2.3 *Setting out and installation of outfall pipe*

Setting out of the outfall pipe location will be carried out using a GPS system by certified surveyors. GI pipe pegs will be installed to mark the exact location of anchor blocks as per the detailed drawing. Pre-casted anchor blocks will be delivered to the shallow area using the crane on at the shore. Using the lifting bags, certified divers will move the anchor blocks to exact location and will install the blocks as per the engineering drawings.

Initially all the pipe welding works for pipes joints will be carried out on the land prior to installation works. The outfall pipe will be delivered to the proposed site using a truck/crane or lorry. Buoys will be attached to the pipe at 5m interval to make it float on the water surface, so that workers can easily manoeuvre the pipes to the exact locations. The buoys will be removed once the pipe is at the required location and the dive team will lay the pipes on anchor blocks and will secure the pipe using steel brackets and additional anchor blocks as per the engineering drawings.

4.6.2.4 *Workforce and machinery*

Installation of STP is actually part of the pre-construction phase of the WtE project, the aim is to install a waste water management system the camp to use during the construction phase of the project. The workforce involved in the construction of the STP is estimated to be 15 staff including labourers. A list of large number of machinery and equipment that will be used for project is included in the original EIA report. However only the necessary equipment for the installation of STP is given in *Table 2* below:

Table 2. List of machinery equipment that will be required for the installation of STP plant

Machinery/equipment	Quantity (No)
Mini Excavator	01
Dump truck	01
Dewatering pumps	01.
Butt welding equipment	01
Vibrator	01
Concrete mixer	01.
Electrofusion welding equipment	01.
Fusion molds and tools	02
Power drills and grinders	01
Power saw	01
Diesel generator	01.
Pressure testing equipment	01
Standing lights	05

4.6.2.5 *Land clearance*

The site allocated for WtE facility is reclaimed barren land there is no vegetation. Therefore, there is no need for land clearance for the construction and installation of STP plant.

4.6.2.6 Excavation and Dewatering

Dewatering may be required during construction and installation of pipe networks with increase in intensity as depth increases. However, at the intended depth of the installation of pipe network is 1-1.5m below ground surface and the water table in Thilafushi is around 1.2-1.7m below the ground level. Therefore, depending on the installation depth dewatering may be required in places.

Dewatering may be required during trenching and piping works; in case it is required plywood or fibre board formworks will be used for shoring to prevent accidental collapse. Shoring will be done where necessary for avoid the collapse the side walls by using 1200x2400mm steel plates and strengthen by using 50x100mm steel box bars. However, as the depth of excavation will not exceed 1.5 m during the pipe laying, shoring is not envisioned at this time for the project.

4.6.2.7 Commissioning, operation and maintenance of STP

The installed STP plant and the accessories are installed will be checked for its design performance prior to the commencement of operations. All gravity and pressure mains will be inspected and checked as per guidelines URA/EPA testing procedures.

All pipes will be hydrostatically tested according to the approved method. All tests will be conducted on the pipelines in sections after the trench is backfilled. Operation and maintenance requirements are provided in the Design document provided in the Annex

4.6.2.8 Decommissioning of STP

As mentioned earlier this temporary STP plant is installed at the construction camp only to use during the construction period of the WtE only. After the completion of the construction during the decommissioning process the STP plant will also be decommissioned and dismantled. A decommission plan of the project will be submitted in a later stage of the WtE project.

The EPC contractor will ensure that all the necessary approvals are obtained from the regulatory authorities for the decommissioning activities. Existing pipelines manholes size, length, dimensions construction material etc will be determined located and marked for the decommissioning process.

Decommissioning locations will be marked demarcated with warning tapes to block access, cleared and any debris above and below ground will be removed. Temporary lighting for the site for night drilling activities if required electricity power connection to the site and other logistical arrangements for the decommissioning activities will be arranged.

Desludging works include the following:

- Inspect the site of sludge storage tanks and make sure it is ready decommissioning.
- Remove or disconnect all the lines to the tank chambers.
- Carefully remove the lid of the tank. Use disinfecting chemicals where required.
- Place desludging pump, connect the power and connect necessary piping.
- Ensure that a lorry with a collection container is placed nearby to collect the sludge.
- Connect piping from pump to collection container.

- Start the pump and desludge the tank into the container. Attention must be given to avoid leakages to the ground during pumping.
- Disinfect and backfill up till ground level if required
- Keep the record of work and inform the authorities upon completion of the work

4.7 POWER & CHEMICAL CONSUMPTION REQUIREMENTS OF STP

All the power required for the construction of STP and during the construction phase of the WtE will be purchased from the existing STELCO power plant in Thilafushi. The following *Table 3* shows power set and power consumption of the plant and *Table 4* shows estimated chemical quantities that will be used in the plant.

Table 3. Shows power set and power consumption

Total system	<15 kW set power
Total system	<85 kWh per day

Table 4. Chemical quantities

Chlorine (NaOCl)	<3,5 kg per day (% 15)
C.Poly	<1 kg per month

4.8 HEALTH AND SAFETY

Based on the original EIA report, activity wise monitoring before and during construction on regular basis shall be conducted to identify unexpected hazards to occupational health and safety of workers giving updates on construction activities and project site specific baseline.

Based on findings, Occupational health and safety plan considering ADB Safeguard Policy Statement, IFC EHS guidelines, IFC Performance Standards, Worker’s accommodation: Processes and Standards- A guidance notes by IFC, international good practices and guidelines (ISO 14001: 2015 – Environment Management System, ISO 45001: 2018 – Occupational Health and Safety Management System) is to be prepared. ESMS including SOPs including checklists specific to workers health, safety and welfare will be developed and modified, if required to achieve the following:

- All applicable national health and safety legislation and international by-laws will be followed.
- All health and safety risks of each activity during construction will be identified, afterwards suitable impact mitigation measures / PPE will be identified.
- Through the implementation of impact mitigation measures mentioned in the Air Quality Management Plan included in EMIMP, dust emissions will be minimized as far as possible.
- Workers (workers of sub-contractors also included) will be given safety briefings every day before starting work and necessary personal protective equipment will be provided.
- Permit-to-work will be needed for high-risk activities like working at height, operating heavy equipment, etc.
- All accidents and incidents will be recorded.

- Efficiency of health and safety practices will be monitored using internal and external audits, corrective action will be started, when necessary.
- All workers, workers of sub-contractors also included, will be trained on health and safety and EPRP for timely response to incidents.
- A medical unit/infirmery that meets requirements under national legislation will be located on the project site.
- The tool/technique including procedure(s) and frequency will be separately developed for compliance proposed for various aspects of the project.

4.9 PROJECT SCHEDULE

The overall construction schedule of WtE facility given in the EIA report is shown in *Table 5*. the proposed STP installation and commission will take maximum 2 months. This involves importation of the plant assembling connections to pipe network, testing and commissioning.

Table 5. Construction schedule of the WtE facility in Thilafushi.

	2019				2020				2021				2022				2023				2024				2025			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Prequalification																												
Shortlisting																												
Request for Proposals																												
Evaluation and contract award																												
WtE/balance of plant design + construction																												
Commissioning WtE																												

4.10 INPUTS AND OUTPUTS

Table 6: Matrix of major inputs to the proposed activities during construction and operational phase

Input resource(s)	Source/type	How to obtain resources
Construction phase		
Construction works manpower	10-15	Contractors' responsibility
Management and maintenance Staff	3-5	Appointed by Proponent/contractor
STP plant	Prefabricated system	Imported from Turkey and assembled at the site
Construction material	Reinforcement steel bars, river sand, cement, aggregates, rock boulders Timber; electrical cables and wires, DBs, MMCBs and MCBs, PVC pipes, light weight concrete blocks, PVC conduits, core armored cables, PP-R pipe, Multi pump, UPVC (T1000, T600) for sewerage grid, floor and wall tiles, calcium silicate boards, zinc coated corrugated metal roof, paint, varnish, lacquer, thinner, dry walls etc.	Imported and locally purchased where available
Heavy machinery (excavator lorries, dumpers, concrete machine and a crane and operational tools)	List of equipment and machineries given in 4.6.2.4	Hire locally/ import contractor's machinery

Maintenance tool and equipment	Maintenance parts and fluids required for the machinery	Import or purchase locally where available
Fuel and lubricant for machinery	Diesel, Petrol, Lubricants	local suppliers/ contractor
Fresh water	Desalinated water	From existing desalination plants run by MWSC.
Electricity/ energy during construction	Existing power supply in Thilafushi	STELCO
Operational Phase		
Water supply	Desalinated water,	From MWSC
Electricity/ energy	Diesel generator	STELCO
Maintenance material	Electrical cables, electrical appliances, paint, thinner etc.	Locally purchased
Fuel	Light Diesel, LPG Gas, Petrol, Lubricants	Local suppliers

Table 7: Matrix of major outputs construction and operational phase

Outputs (s)	Anticipated quantities	Disposal method
Construction phase		
Excavated material	Minor quantity	Used for backfill
Green waste	Small quantity mainly food left overs	Sent to Thilafushi waste yard
Construction Waste	large quantities	sent to Thilafushi waste yard
Fuel and lubricant for machinery	Minor quantities	Gathered in a barrel and sent to Thilafushi waste yard
Operational Phase		
Sewage and wastewater	Gray water laundry waste water	Tertiary treatment and disposed at sea
General Domestic waste	Over 20-100 kg/day	Sent to Thilafushi waste yard

5 REGULATORY CONSIDERATIONS

5.1 RELEVANT LEGISLATIONS GUIDELINES POLICIES

In this section legislation relevant to the proposed activities in the addendum are presented in *Table 8*, more regulations relevant to the WtE project are provided in the original EIA report.

Table 8. Relevant legislations guidelines and policies

Legislation	Details	Regulator	Relevant to the project	
General Regulation on Water and Sewerage Service in Maldives (Regulation No. 2021/R-23)	<p>Outlines planning, design, implementation, operation, and monitoring aspects of water and sewerage systems in Maldives. It gives instructions regarding important parameters to consider and procedures for approving concept designs, environmental clearance, and detail design of water and sewerage systems. It states that URA will be the government authority to approve the detail design of the systems and also give approval for operations. URA will issue operation license to operators.</p> <p>The regulation also sets the penalties for those that do not comply with the regulation.</p> <p>The regulation also abolishes the previous guidelines set by EPA on desalination, borehole drilling, water treatment and distribution, waste water treatment and distribution.</p>	URA	Yes	Contractor shall abide all the requirements
The Land Use Planning Regulations and Guidelines (2005)	<p>The Land Use Planning Regulations and Guidelines (2005) include land use instruments such as inclusionary zoning and quotas. Land Use Plans (LUP) are prepared in consultation with relevant stakeholders and has allocations for residential areas as well as for different infrastructure and social needs.</p> <p>LUP for the islands / atolls are already completed and the allocated lands are used for the purposes identified In the LUP</p>	MNPHI / HDC	Yes	Project site are as per the LUP for Thilafushi by HDC
Construction Act (Act 4/2017)	<p>The Construction Act was published in the government gazette on the 23rd of April 2017. The Act has been formulated to develop a legislative framework which enables the growth and promotion of the</p>	MNPHI/ HDC	Yes	Contractor and project proponent (MECCT) will ensure construction

Legislation	Details	Regulator	Relevant to the project	
	<p>construction industry of the Maldives through set guidelines and measures. Main objectives of the Act are as follows:</p> <ul style="list-style-type: none"> • Enable means to ensure that all buildings constructed are safe structures which allows a safe, healthy lifestyle for those who use the building • Ensure that the construction industry is a safe and environmentally friendly industry which enables development and productivity • Ensure that all personnel involved in the construction industry are trained, qualified and capable professionals • Ensure means to improve the quality of workmanship and equipment and machinery used for the work • Establish “Maldives Building and Construction Board” to advise the MNPFI regarding issues relating to the industry • Develop and promote the Construction industry Implementation and enforcement of the Act is a responsibility of the MNPFI Minister. • Formulation of the different policies which address and achieve the points highlighted in this Act is a responsibility of the MNPFI Minister. 			of the subproject in line with the Construction Act.
Maldives National Building Code Handbook (1st Edition – August 2008)	The handbook recommends best practices to be followed, rather than a regulation to be adhered to in construction work. This handbook covers aspects such as structural stability, fire safety, access, moisture control, durability, services and facilities, and energy efficiency (MCPI, 2008) ¹ .	MNPFI /HDC	Yes	Contractor and project proponent (MECCT) will ensure construction of the subproject in line with the

¹ Ministry of Construction and Public Infrastructure, now renamed as MPHI.

Legislation	Details	Regulator	Relevant to the project	
				National Building Code Handbook.
Waste Management Regulation (R-58/2013)	<p>This Regulation was gazetted on the 5th of August 2013 and came into effect 6 months from the date, on the 5th of February 2014. The main objective of this regulation is to implement the national policy on waste management.</p> <p>As per regulations:</p> <ul style="list-style-type: none"> • construction debris and waste should be disposed off at the allocated areas for the specific authorized waste dump. • As per the regulation, hazardous waste generated during the project will be collected and stored separately. • Transportation should also be carried out in specific vehicles authorized for waste transportation. 	MECCT /WAMCO	Yes	Contractor and project proponent (MECCT) will ensure compliance with the Waste Management Regulation during construction and O&M
Water and Sewerage Act (8/2020)	<p>The Act mandates sustainable use of water and the development of guidelines and procedures for the protection of water resources, and to enable the establishment of a suitable water sewerage network for all inhabited islands / atolls, along with other relevant guidelines.</p> <p>The National Water and Sewerage Policy (NWSP) has 9 goals to ensure access to safe water supply and adequate sewerage services.</p> <p>Policy objective 9 calls for adopting a holistic approach to water resources protection, conservation, management, and pollution control.</p>	URA	Yes	Contractor shall abide all the requirements
National Wastewater Quality guidelines / standards (NWQGS)	<p>The guidelines deal with domestic wastewater quality for discharge into deep sea and provide the maximum concentration of listed components that have to be complied with at all times including coliform, pH and suspended solid levels.</p> <p>The NWQGs also provides maximum concentration levels for domestic and industrial wastewater combined, but does</p>	URA	Yes	Contractor shall abide all the requirements

Legislation	Details	Regulator	Relevant to the project	
	<p>not specifically provide guidance on dealing with industrial effluents or leachates of any kind.</p> <p>The NWQGs also stipulate that the guidelines are generic and conservative, the standards state that in the event the capacity of the receiving environment to deal with additional wastewater, has been exceeded or when the activity generating the wastewater is envisioned to produce wastewater at extreme lower or higher levels than the standards set in the NWQGs, an Environmental Impact Assessment (EIA) is required and need to be completed by accredited Assessors approved by EPA.</p> <p>In addition, the producer has to prove to government that best international Clean Production protocols are followed. Based on the recommendations of the EIA report and proof of Clean Production practice, EPA will issue site specific guidelines for the discharge of wastewaters. No exemptions to the Guidelines will be allowed without site specific guidelines from the EPA</p>			
<p>Dewatering Regulation for Construction and Industrial Projects (2021/R-20) 10 February 2021</p>	<p>The Dewatering Regulation has been formulated to introduce measures so as to minimize impact on the environment and ecosystem due to dewatering which may be carried out as part of construction works or during other works. Any development which requires dewatering as part of the project, can only implement the dewatering phase after obtaining the required approval from the Environmental Protection Agency, which is the implementing agency for the regulation. The regulation does not apply to dewatering which may be required for the installation/cleaning of a groundwater well for personal use or use of groundwater for agricultural purposes.</p> <p>Prior to carrying out dewatering the project proponent of such projects will submit an application form to EPA with required documents which are detailed in the regulation and application form. It is</p>	<p>URA / HDC</p>	<p>No</p>	<p>Contractor shall abide all the requirements</p>

Legislation	Details	Regulator	Relevant to the project	
	<p>also the responsibility of the project proponent to inform the relevant Island Councils, if there are residential areas or agricultural lands within 100m radius of the project site where dewatering will be carried out.</p> <p>The regulation further details what should be done with the water extracted during dewatering, and what actions should be taken should dewatering impact resource users within 30m radius of the site².</p> <p>The regulation further specifies fines which will be applicable if the regulation is not followed.</p>			
Plant Protection Act (2011)	According to Article 19 (a) import of any plants, parts of plant and any other related regulated substances into Maldives should have a phytosanitary certificate issued by the National Plant Protection Organisation (NPPO) of the country it was exported from.	MoFA / EPA	No	Contractor shall abide all the requirements
Employment Act (2/2008) and its amendments	<p>Employment Act (2/2008) that was ratified and signed into law in May 2008. To date, six amendments have been brought to the Employment Act (2/2008). The amendments were made through the following Acts: 14/2008; 12/2010; 3/2014; 14/2015, 22/2016 and 20/2020. All employees involved in the project shall have an employment contract prepared according to the Employment Act.</p> <p>The job specification, work hours, payment of wages and benefits, maximum allowable hours in a work week, leaves and off days have to be followed according to the Employment Act</p>	<p>MED</p> <p>MED</p> <p>LRA</p>	Yes	Contractor shall abide all the requirements

² <https://www.ura.gov.mv/downloads/r-202021-dewatering-regulation-for-construction-and-industrial-projects/> (Accessed 17th April 2022) this includes; 1-water should be released to an area specified by the HDC 2- Water will be allowed to release into the only after checking the quality of the extracted water, 3- if water is released through a pipe system then should get permission from HDC, 4, if water is released in to the sea then the sedimentation should be controlled and managed prior to release.

Legislation	Details	Regulator	Relevant to the project	
	<p>Dispute resolution mechanism for the project shall be established</p> <p>No minors shall be recruited. Minors under the age of 16 years will not be involved in the project.</p> <p>No worker employed for the project shall be compelled or forced into employment.</p> <p>Chapter 8 “Work Place Safety and Employer Health”. This requires employers to implement measures for the safety and protection of employees at the work place, including safe work place, procedures, safe equipment and materials, provision of protective equipment, safety training to employees, conducting health checks where work involves chemical or biological materials that may cause a hazard, providing medical care as well as first aid for employees injured while at work. The law also sets out employee’s obligations with regard to safety at work.</p>	HPA		
<p>Regulation for the determination of penalties and obtaining compensation for damages caused to the environment (2011/R-9)</p>	<p>he objective of the regulation as stated in the regulation is to stop violations of Act 4/93; to prevent the repetition of such violations; to penalize and obtain damages caused to the environment.</p> <p>According to the Article 7 of the regulation, if an incident occurs while conducting a project or other work, that is likely or estimated to cause damage to the environment, proponent or in charge of the project should report to the implementing agency and should take immediate action to stop the damage or cause of the damage.</p> <p>Under the Article 14 of the regulation, any party, from whom the implementing agency requires information relating to an investigation or for other purposes of this regulation, should provide such information.</p> <p>The schedules of the regulation describe the factors to consider when determining the fine to</p>	MECCT/ EPA	Yes	<p>This project will be subjected to liabilities if ineffective implementation of mitigation measures leads to detrimental effect on the environment.</p>

Legislation	Details	Regulator	Relevant to the project	
	be charged on a party causing damage to the environment and formulas to measure the magnitude of the damages caused to the environment.			

5.2 ENVIRONMENTAL PERMITS

5.2.1 Decision Statement

Under the EIA Regulation 2012, the proponent should apply to Environment Protection Agency for an Environmental Decision Statement prior to undertaking a Development Proposal in the manner listed in the Article 8 of the regulation. EIA decision statement for the WtE has already been issued in 2020. This document is an Addendum to the original EIA made for installation of STP plant to use during the construction phase. This environmental impact assessment addendum report is prepared to obtain the Environmental Decision Statement for the proposed activities covered in the document.

5.2.2 Dewatering Permit

Under the Dewatering Regulation, any party requires dewatering, the proponent should apply to URA/HDC for dewatering permit and obtain a written permission prior to start of the work. Procedures for the application for the permit and issuance are described in the Dewatering regulation.

5.2.3 Operating License and Registration Plant

Temporary STP facility need to be registered at Utility Regulatory Authority prior to the commencement of the services in compliance Water and Sewerage Act (2021) of the Maldives.

5.2.4 Building design and construction approval

Architectural and detail engineering design drawing has to be checked and approved by a government licensed checkers and submitted to HDC through PMU to obtain the construction permits of the buildings.

6 EXISTING ENVIRONMENT

A very comprehensive and exhaustive description of the environmental conditions was presented in the original EIA report for the MLD: Greater Malé Waste-to-Energy Project – Waste to Energy Plant at Thilafushi, Male’ Atoll by Ministry of Environment of the Republic of Maldives for the Asian Development Bank in July 2020 and was approved in December 2020, therefore will not be repeated in this addendum. Additional coastal and marine environmental data as well as status of the construction work and relevant impacts were collected and evaluated for the report from the field and the revision of the following documents which mainly similar undertakings by the consultant in the past.

- 1- Environmental Impact Assessment, MLD: Greater Malé Waste-to-Energy Project – Waste to Energy Plant at Thilafushi, Male’ Atoll by Ministry of Environment of the Republic of Maldives for the Asian Development Bank in July 2020
- 2- Updated MLD: Greater Malé Waste-to-Energy Project – Waste to Energy Plant at Thilafushi, Male’ Atoll by the DBO contractor on November 2022.
- 3- Internal Environmental Monitoring report for the Months of November and December 2022 for MLD: Greater Malé Waste-to-Energy Project – Waste to Energy Plant at Thilafushi, Male’ submitted EPC contractor to DBO contractor in 2022

6.1 METHODOLOGY

The methodology used for this EIA is in consistent with the EIA Regulations 2012 also in accordance with the approved ToR. For the addendum. Methodology adopted report is consistent with best practices of EIA methodology that is widely undertaken in the Maldives and at international level.

The purpose of this was to assess the existing environmental conditions of WtE facility installation of the STP plant for the construction camp. The study of existing environment also involved undertaking review of available literature filed assessments/ surveys, assessment of results/findings and compilation of the report. These assessments would not only enable avoiding impacts to the environment as a result of the project but also would contribute to better planning recommendations for the proposed project. This is critical in assessing potential impacts and to determine the actual extent of damage should an unforeseen impact occur during the implementation phase.

The main aim of the surveys and assessments was to establish the existing baseline environmental conditions of the WtE site. Environmental monitoring during construction and operation phase to ensure the changes in environment are captured and remedial actions for the observed negatives impacts are addressed in a timely manner. The objectives of the present assessment were to:

1. determine the general abiotic and biotic conditions of the marine environment of the project area;
2. determine the geological and geomorphological characteristics of the project area;
3. assess the changes that will be associated with the proposed activities;
4. propose mitigation measures to avoid, minimise potential effects from the proposed project; and
5. Propose monitoring arrangements to measure effectiveness of the proposed mitigation measures

The physical and biological surveys are regularly conducted as per the EIA monitoring plan which involved monthly and quarterly survey for the monitoring. The methods used and survey data collected for the monitoring is used for this report as it covers broader area of whole Thilafushi and the WtE site where the STP plant will be installed and commissioned.

6.1.1 Methods for physical environment surveys

6.1.1.1 Ground water

For the monitoring purposes ground water is samples from 7 location quarterly basis. Ground water samples collected for November monitoring is presented here. For each location, the samples were collected from mid-water level carried for laboratory testing in Sri Lanka. General sampling procedure involves washing the sampling bottle glass/ with water from the sampling points. For microbial tests, samples were collected in sterile glass bottles and tested in the MWSC laboratory.

In-situ recording of pH, Temperature DO and EC for each sample conducted by using a handheld Hach SensION +MM156 water quality measurement meter

Figure 9: Ground water sampling locations



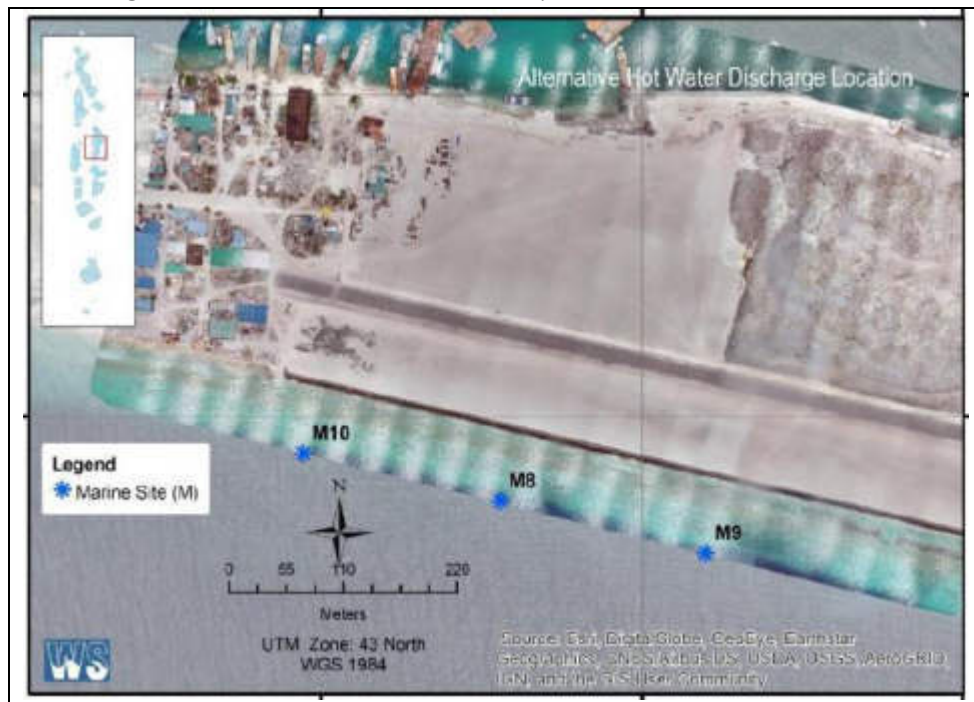
6.1.2 Biological environment survey methods

6.1.2.1 Coral reef benthic survey

A standard approach, established by the Maldives EIA community and approved by the Environmental Protection Agency (EPA), was employed to study benthic cover and fish populations. The survey employed GPS locations, transects surveys conducted at two depths: 5m and 10m at each station (M8, M9 and M10 – as detailed in an earlier report). The methods followed were those outlined by Hodgson et.al (2006) in Reef Check Instruction Manual: A Guide to Reef Check Coral Reef Monitoring.

Three transects of 20 m length were laid, one after the other along the reef, ensuring the transect falls to the specific depth. A quadrat of size 0.5 x 0.5 m was laid sequentially on the transect, and photo images were taken with the quadrat in the center. This way, every transect would have at least 10 images, resulting in around 60 images from each depth.

Figure 10: Underwater Marine Survey Locations M8, M9 and M10



6.1.2.2 Fish census

To ensure that the fish were not disturbed while data on substrate was being collected, a visual assessment of the fish was performed after the transect was laid. At each transect and at each depth (5m and 10m), three transects of 20m length were observed. The counts were estimated in the field and the average count of each depth was taken as the mean abundance. The mean abundance was then categorized into three arbitrary scales: "Rare" (no fish to 20 fish), "Common" (20-40 fish), and "Abundant" (counts over 40 fish).

6.1.3 Noise

Ambient noise level measurement was done using a handheld sound level meter (ET-958 Professional Sound Level Meter) Measurements were conducted in all location on 27-29

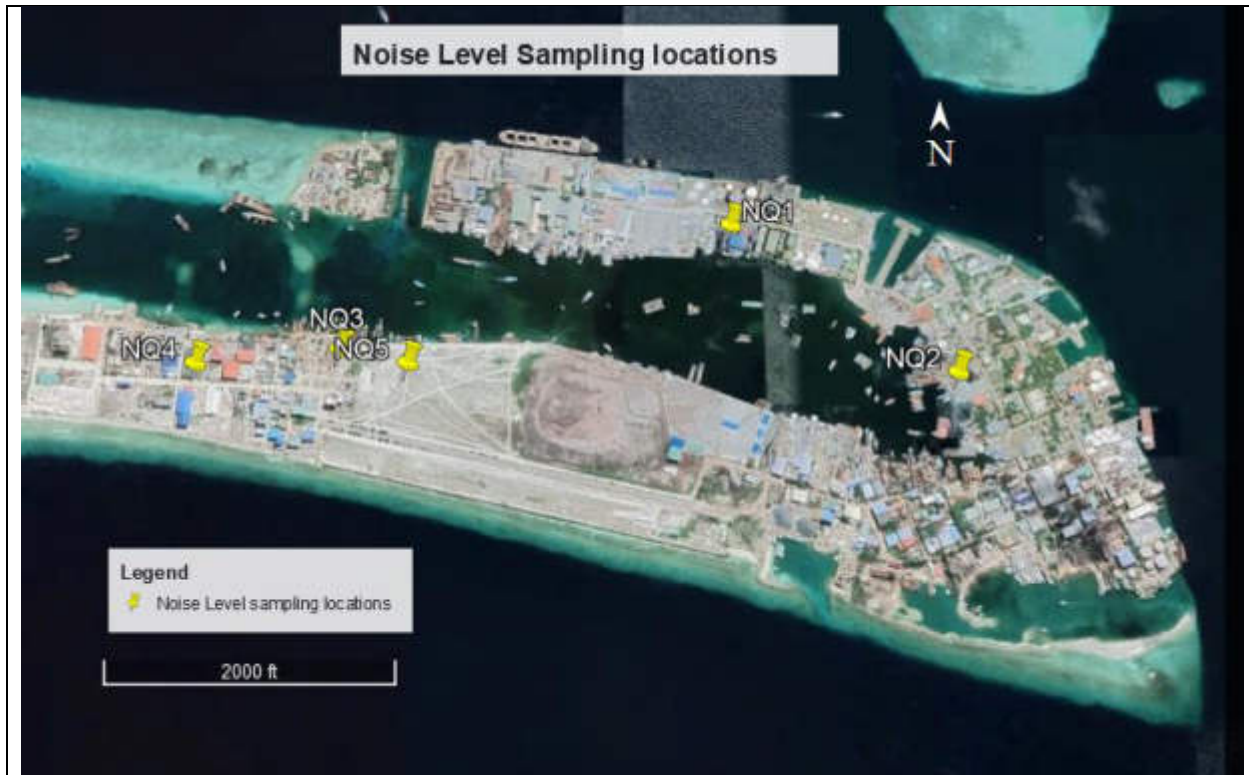
December 2022 during the day time and night time for 24 hours. Measurements are recorded in NQ1, and NQ2 on from 27th December 20:00 to 28th December 2022 20:00. In stations NQ3, NQ4 and NQ5 from 28th December 2022 10:00 to 29th December 2022 10:00 continuously for 24 four hours. Table 1 summarizes the explanation on the selection of baseline monitoring stations given in the EIA report. *Table 9* is the map that shows the sampling locations.

At each station hourly 7-8 readings are recorded for a duration of 30-50seconds at each location. Average of ambient noise level in dB(A) was recorded and the average noise of each location is calculated.

Table 9: Locations selected for Ambient Noise Level Measurements

Station name	Geographic Coordinates	Reason for selection
NQ1	4°10'26.4 N, 73°28'59.9 E	Included in the original EIA
NQ2	4°10'56.6 N, 73°26'53.3 E	Included in the original EIA
NQ3	4°10'58.3 N, 73°26'09.6 E	Included in the original EIA
NQ4	4°10'57.3 N, 73°25'59.4 E	Included in the original EIA
NQ5	4°10'57.3 N, 73°26'14.4 E	Included in the original EIA

Figure 11: Ambient noise level sampling locations



6.1.4 Mapping and location identification

Location identification and mapping was conducted using differential GPS systems and open-source GIS platforms such QGIS was used for mapping.

6.2 CONSTRAINS FOR THE FIELD STUDY AND DATA GAPS

The field study for this addendum was conducted in November and December 2023. Ground, Sea water samples were taken and tested in situ and laboratory and Noise measurements and reef surveys are conducted as part of the ongoing monitoring activities of the WtE project covered in the original EIA report. The existing data is very general especially the data assimilation capacity of sewage modelled in the EIA is not scientifically verified and it is based on very limited measurement conducted long time back. The ongoing monitoring of seawater will enable to create better picture of the marine water quality in the area. Given the urgency of the project activities until the exiting model on plume dispersion is verified it can be considered as sufficient to go ahead.

6.3 STATUS OF CONSTRUCTION

The project is located on the southern side of Thilafushi. The island has been reclaimed since December 1992 by dumping of wastes on the submerged “Thilafalhu” lagoon area. 15 hectares of land has been allocated by the Government to construct the WtE facility in the island. Pre construction work has been going on the site since April 2022 and this includes fencing of boundary of site, construction of various buildings and facilities required for construction camp. Geotechnical studies water quality, Ambient air and noise monitoring activities as well as other site clearance activities as removal of garbage pile discarded boats and vehicles from land and sea boundaries of the site (*Figure 12*). At present workers are transported to the site on daily basis and only the security staff remains in the site at night The following presents pectoral representation of the site .



Figure 12: WtE Site in 2019 (left) and in 2022 (right)

6.3.1 Work Progress



Figure 13: Progress of construction camp accommodation site office and admin buildings



Figure 14: fence and office temporary buildings

6.4 DESCRIPTION OF THE EXISTING ENVIRONMENT

The following section presents brief about the existing environment fairly through description is given in the original EIA report.

Table 10. Description of the existing environment

Parameters	Description
Geology and topography and Description of	All islands of the Maldives are very low lying; more than 80% of the land area is less than 1 m above mean high tide level. The islands are low-lying Holocene features that began forming between 3000 and 5500 years ago.

Parameters	Description
WtE site condition	<p>The islands represent the most recent deposition along a submarine plateau that is underlain by approximately 2,100 meters of mostly shallow-water carbonates resting on a slowly subsiding Eocene volcanic foundation.</p> <p>The location of the project is in the proximity of the dumpsite at Thilafushi, an industrial island with the oldest and largest landfill and numerous industrial companies. This project is located on a 15 hectares government-owned land, which has been reclaimed from shallow lagoon. The old dumpsite, adjacent to the project site, open burning dumpsite for waste generated from Male Region and source of smoke emission was closed in early 2020. The existing waste dumpsite “waste mountain” is adjacent to the west boundary of the project about few meters away from the fence and a fairly large lump of waste is inside the boundary of the WtE facility. The waste mountain and current WAMCO waste management site consists of all types of wastes including hazardous, chemical, biological and biomedical etc. Waste dump yards are without proper fencing and containment.</p>
Land reclamation	<p>Thilafushi Island has been developed as a solid waste landfill since December 1992. The island was initially developed as a sand bank using dredged material from the Thilafushi Reef.</p> <p>The reclamation works of the current WtE was undertaken by the government in anticipation of the WTE plant and was also subjected to an EIA process as part of the requirements of the Government of Maldives EIA Regulations of 2012. The land was reclaimed to a height of +1.5 m from mean sea level (MSL) from an average depth of -1.5 m above the sea floor.</p>
Oceanographic conditions (bathymetry)	<p>The reef system of the Thilafushi Island comprises of an ocean ward reef flat, a lagoon ward reef and a central deep lagoon. The reef flat areas on the ocean ward side of the reef system (south of the proposed location) have a fairly flat depth ranging from -1.0 to -1.5m MSL. The reef system hosting Thilafushi does not host any other islands. The reef system is approximately 4.65 km long, 0.94 km wide (width of ring reef, including the lagoon area). A bathymetry map of the area proposed to place the STP outfall pipe is Given in (Figure x)</p>
Climate and meteorology	<p>Meteorological observations Velana International Airport at Hulhulhe, which is closest to the project site, are used to describe the climate condition around the project area.</p> <p>The climate in Maldives is warm and humid, typical of the tropics. The average temperature ranges between 25°C to 30°C and relative humidity varies from 73 – 85%. The annual average rainfall is approximately 1,950mm. As the Maldives lie on or close to the equator, the islands of the Maldives receive plenty of sunshine throughout the year. Temperature is moderated by the presence of vast sea and oceans surrounding the small</p>

Parameters	Description
	<p>islands. The long-term average temperature ranges from 25°C to 31°C. With the influence of the monsoon, seasonal fluctuations are observed throughout the year. The warmest period is observed during March, April and May. The average annual rainfall for the archipelago is 2,124 mm.</p> <p>Monsoons of Indian Ocean govern the climatology of the Maldives. Two monsoon seasons are observed in Maldives: The Northeast (Iruvai) and the Southwest (Hulhangu) monsoon. The southwest monsoon lasts from May to September and the northeast monsoon occurs from December to February. The transition period of southwest monsoon, which is the driest part of the year, occurs between March and April while that of northeast monsoon occurs between October and November.</p> <p>The prevailing wind over the Maldives represents typical Asian monsoonal characteristics. The southwest monsoon, with winds predominantly between SW and NW, lasts from May to October. In May and June, winds are mainly from WSW to WNW, and in July to October, winds between W and NW predominate. The northeast monsoon, with winds predominantly from NE to E, lasts from December to February. During March and April, winds are variable. During November, winds are primarily from the west, becoming variable and can occasionally exceed 30 knots from the NE sector. However, yearly wind speed in the northeast and southwest monsoons are observed to be between 9-13 knots.</p>
Avifauna	The island is frequented by birds including water birds. An IBAT was run to identify if there are bird species in the area listed as endangered or critically endangered. The IBAT run results show that there are no avifauna species considered as endangered or critically endangered in per IUCN list.
Natural hazards	Thilafushi Island is in a moderate cyclonic hazard zone which has the potential for a maximum probable cyclonic wind speed of 69.6 knots. It has the potential for a 1.53 m storm tide in a 500-year return period. The disaster risk profile of Maldives places Thilafushi as being located in a severe tsunami risk zone with a probable maximum wave height between 3.2 and 4.5 m. The high levels of fluctuations of sea level during the Indian Ocean Tsunami showed that rising and falling of the water levels are enough to inundate any unprotected coastline of Maldives including Thilafushi Island. However, there are no records of major damages on the island. Thilafushi is protected from predominant swell waves. However, the island is still exposed to abnormal swell waves originating from intense storms in the southern hemisphere.
Socio-economic conditions	There are no communities/residential areas in Thilafushi. The island is industrial zone. A socio-economic survey was conducted in August to September 2019 as the Government of Maldives does not have an updated database that could describe the socio-economic conditions in the islands. Four hundred and thirty (430) individuals and 35 companies were surveyed across Thilafushi and Gulhifalhu Islands. Respondents were mainly located

Parameters	Description
	in Thilafushi. There are 319 individuals surveyed that stay in Thilafushi (accommodation provided by employers), 52 workers stay in Gulhifahu, and remaining workers live in Male and other islands. The individuals surveyed range from 18 to 67 years old and are mostly Muslims (81%) from Bangladesh (66%). Over 50% of the individuals surveyed are unskilled workers. None of those surveyed are believed to be involved in fishing activities. Most of the laborers and companies are aware of the health issues related to inadequate waste management. The employers surveyed believe that the present waste disposal practices in Thilafushi affect their health and the health of their employees. Moreover, 25 companies have stated their willingness to pay a higher amount than what they're currently paying for improved waste collection services. The survey found that smoke inhalation is perceived to be the main problem as the smoke can at times impair the visibility in Thilafushi. No fishing activities within the study area.
Health facilities	Nearby healthcare facilities and hospitals are located in Malé. A health facility was opened in Thilafushi only recently in July 2019. However, the facilities and services offered are limited to clinics in the islands. There is an existing plan to develop a proper hospital in Thilafushi islands
Education facilities	There is no evidence of education facilities on Thilafushi. Nearby schools, high schools and other education facilities are located in Malé.
Commercial and industrial activities	The major activities in Thilafushi are industrial activities, importing and stockpiling of construction materials and warehousing facilities, wholesale and retail trade, workshops and other industrial and commercial activities. There are more than 60 different companies established in Thilafushi, the number is more likely to get higher each year. There are both foreigners and locals employed in the island.

6.4.1 Bathymetry

A very detailed bathymetric of the area proposed for STP installation has been provided at 10m grid. The measured depth is corrected and related to mean sea level. The depth reading shows depth related to the MSL. Bathymetry map has been used placing the STP outfall pipe location etc *Figure 15*. Enlarged bathymetry map is provided in the Annexes.

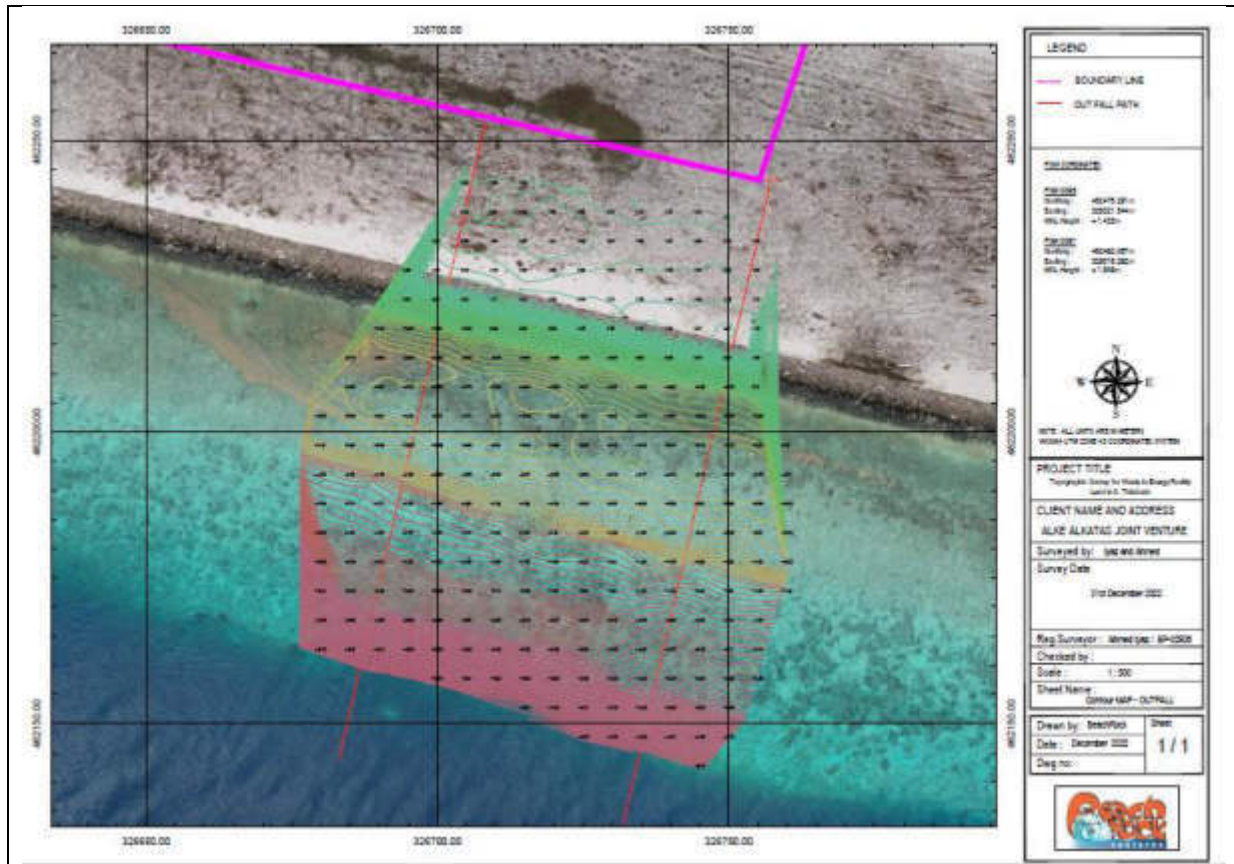


Figure 15. Bathymetry of southern Thilafalhu proposed for the outfall pipe

6.4.2 Coral reef benthic survey and Fish Census

For the pre-construction site environmental monitoring survey conducted on December 24, 2022 following methods outlined by Hodgson et.al (2006) in Reef Check Instruction Manual: A Guide to Reef Check Coral Reef Monitoring.

A standard approach, established by the Maldives EIA community and approved by the Environmental Protection Agency (EPA), was employed to study benthic cover and fish populations. The survey employed GPS locations, transects surveys conducted at two depths: 5m and 10m at each station (M8, M9 and M10). Three transects of 20 m length were laid, one after the other along the reef, ensuring the transect falls to the specific depth. A quadrat of size 0.5 x 0.5 m was laid sequentially on the transect, and photo images were taken with the quadrat in the center. This way, every transect would have at least 10 images, resulting in around 60 images from each depth locations are shown in *Figure 10*

6.4.2.1 Data analysis

The data collected was analyzed CPCe (Coral Point Count of Excel Extension)³. CPCe involves randomly placing points over the quadrat space on the image, but in this case, the points are identified by humans. Twenty-five points were randomly placed on the entire photo image. The points were then classified under the following categories, as listed in Table 11.

Table 11: Substrate categories and the codes.

Category	Code
ROCK (R)	RCK
CORAL (C)	HC
SAND AND SILT (S)	SND
CORALLINACEAE (CO)	CON
MACRO ALAGE (MA)	ALG
CORAL RUBBLE (CR)	RUB
SPONGE (SP)	ENSP
TUNICATE (TU)	TUN
ZOANTHARIAN (ZO)	ZON
SOFT CORAL (SC)	SC
TURF ALAGE (TUR)	TRF
BLEACHED CORAL (BLC)	BCO
UNKOWN (UN)	UNC
SEAGRASS (SG)	SGR
INVERTEBRATES (INV)	INV

6.4.2.2 Results

The following presents findings and observations from under marine ecological surveys conducted at the monitoring location at Thilafushi reef.

Status of Site M8: The site is the location that will be used for discharge of waste water from the brine outfall as described in the EIA. The survey conducted in June 2022 reported hard coral cover within 26-28%. In December the mean hard coral cover for both depths was around 25-26% which is more or less the same. Rocks cover 48% of the substrate in at 5m depth and 25% at 10m depth. Sand cover was more (37%) at 10m while at 5m it was 15% (see **Figure 10**). Coraline algae cover was around 5% which is like what was obtained earlier. Most of the live coral was massive and sub-massive corals.

Fish diversity was highest for one species of *Balistidae*, *Odonus niger* and fusilier (*Pterocaesio* tile) and. The *Chromid*, *Chromis dimidiata*, was observed as abundant, which means >40 individual on average at each 20 m transect. Photographs of the transect quadrats are shown in Figure 16 and Figure 17. Benthic composition of M8 at both 5 and 10m depth is in

³ Kohler, K.E., Gill, S.M., 2006. Coral Point Count with Excel Extension (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. Computers and Geosciences 32, 1259–1269.

Figure 16: Photos Taken from Site 8 (M8) (24th December 2022) at 5m depth

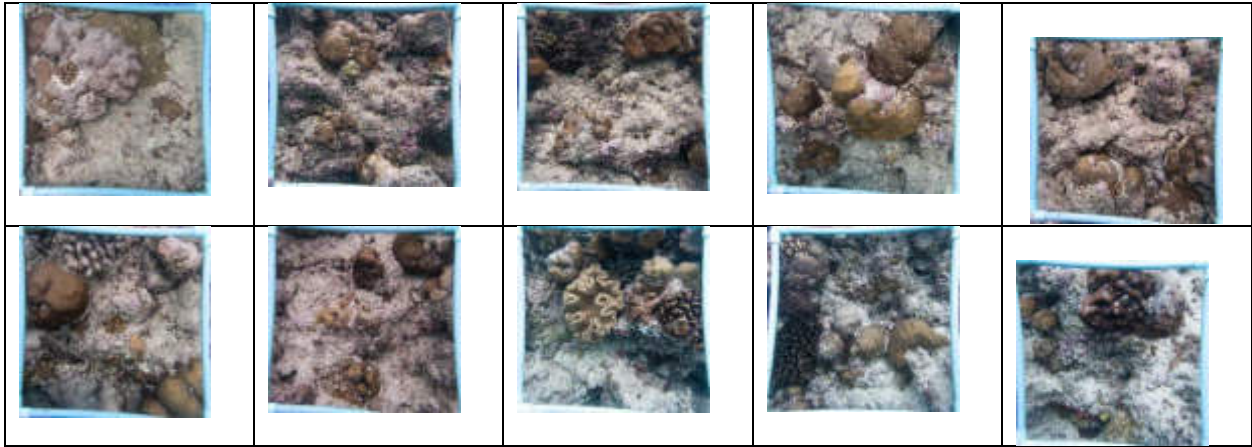


Figure 17: Photos Taken from Site 8 (M8) (24th December 2022) at 10m depth

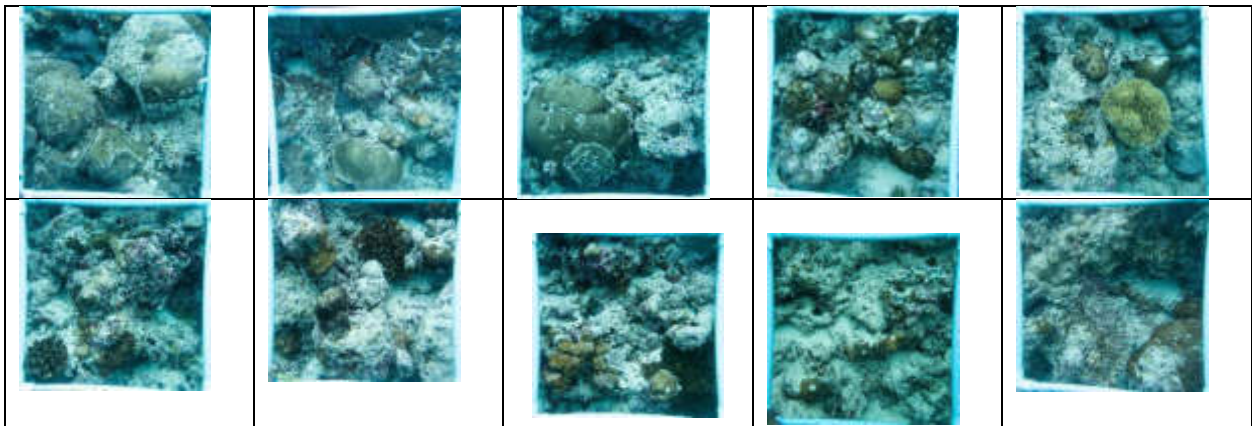
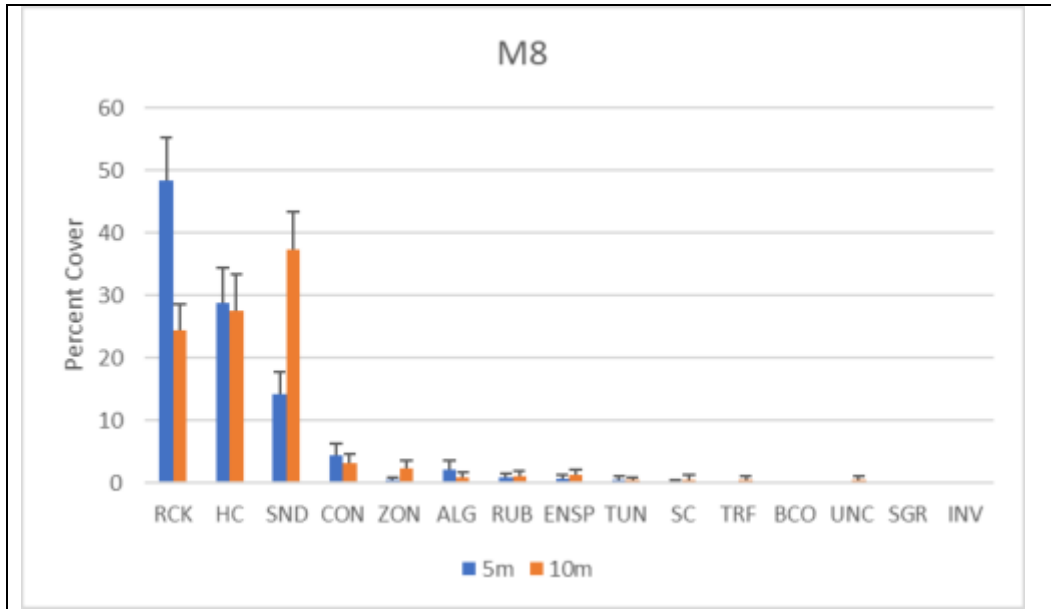


Figure 18: Average benthic cover and their standard error for M8 at both 5 and 10m depth



Status of Site M9: This location was identified as an alternative for brine discharge and wastewater outfall. This is close to the WtE site at the southern reef of Thilafushi Island. Substrate cover was qualitatively similar to the results obtained for the survey conducted in June. Like Site 8, the highest substrate cover was rock, some 50-60% of the 0.5 x 05 m quadrat, followed by live coral. Live coral cover was also qualitatively like M8. Sand cover was around 5-15%, much lower at 5m. Rubble cover also was low.

With regards to fish *Chormis dimidiata* was abundant, occurring > 40 individuals along 20 meters transect. Also, the *Pomecentrid philippinus* and *Pterocaesio* tile were common at site. Photographs of the transect quadrats are shown in Figure 19 and Figure 20. Benthic composition of M9 at both 5 and 10m depth is in Figure 21.

Figure 19: Photos Taken from Site 9 (M9) (24th December 2022) at 5m depth

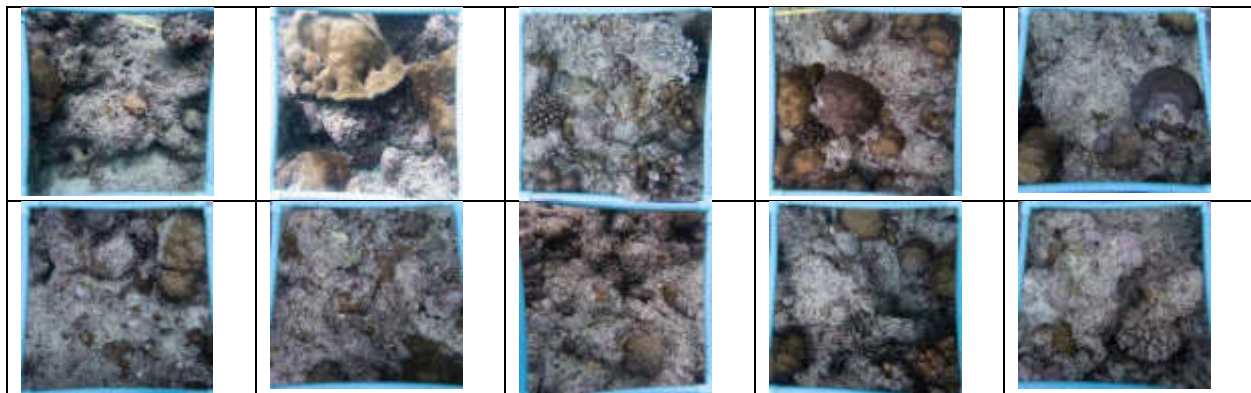
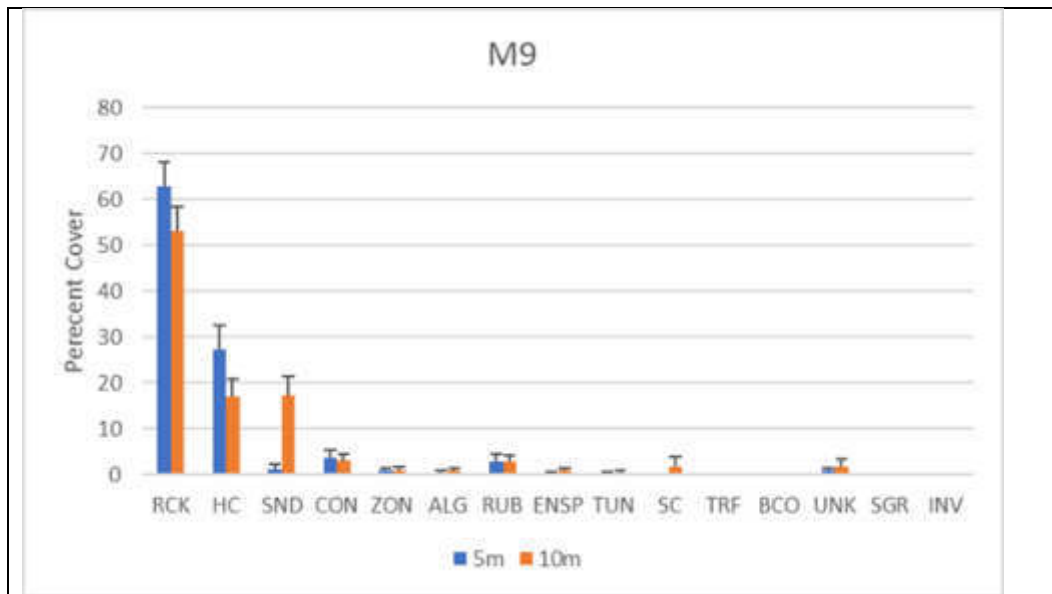


Figure 20: Photos Taken from Site 9 (M9) (24th December 2022) at 10m depth



Figure 21: Average benthic cover and their standard error for M9 at both 5 and 10m depth



Status of Site M10: This location has been identified in the EIA report as a potential alternative for the discharge of brine water and waste water. The location is very close to the WtE facility and it is on the southern reef of Thilafushi Island. Site M10 had largest cover for rock, hard coral and sand (around 40-40%) although rock was significantly lower at 10m depth, while sand cover was lower about 15% at 5m and slightly over 30% at 10m depth. Corallinaceae cover is slightly higher at 10m than 5m depth 8% and 3 % respectively. Mirco Algae and rubble cover on the substrates are higher at 5m than 10m at 5m depth micro algae cover does not exceeds 5% of substrate while rubble content is over 5% at 5m depth at 10 m depth both Micro Algae and rubble content is below 3%.

With regard to fish *Chormis dimidiata* was the only abundant fish found in the area. Common occurrence of any species was not recorded at this location. Photographs of the transect quadrats are shown in Figure 22 and Figure 23. Benthic composition of M10 at both 5 and 10m depth is in the graph in Figure 24 .

Figure 22: Photos Taken from Site 10 (M10) (24th December 2022) at 5m depth

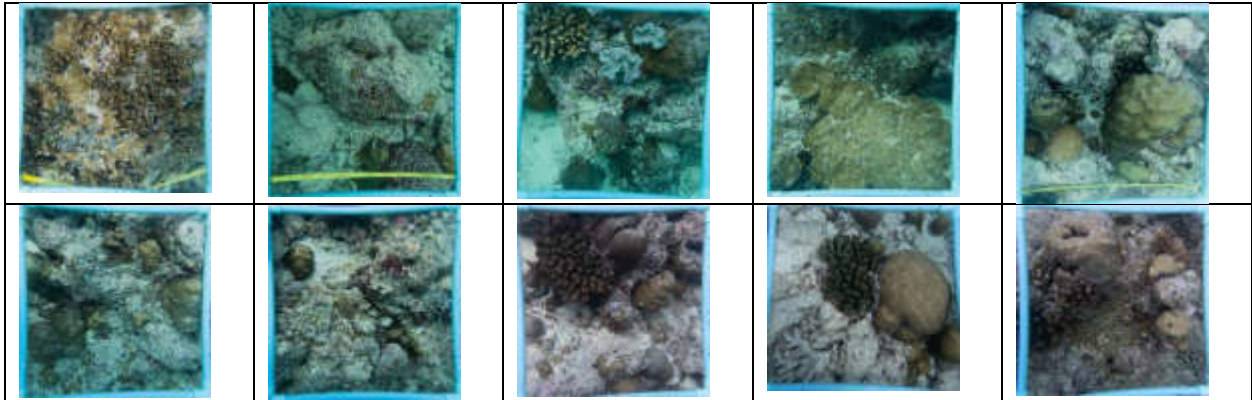


Figure 23: Photos Taken from Site 10 (M10) (24th December 2022) at 10m depth

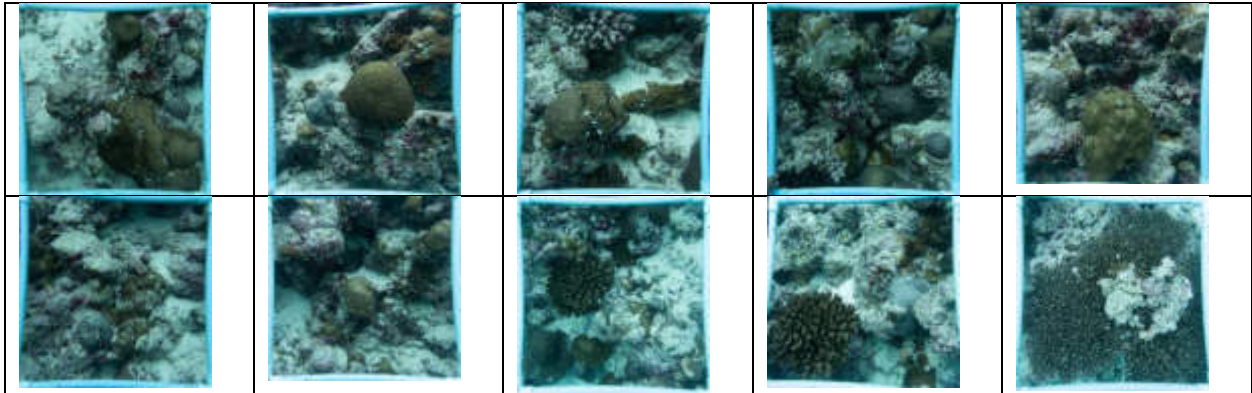
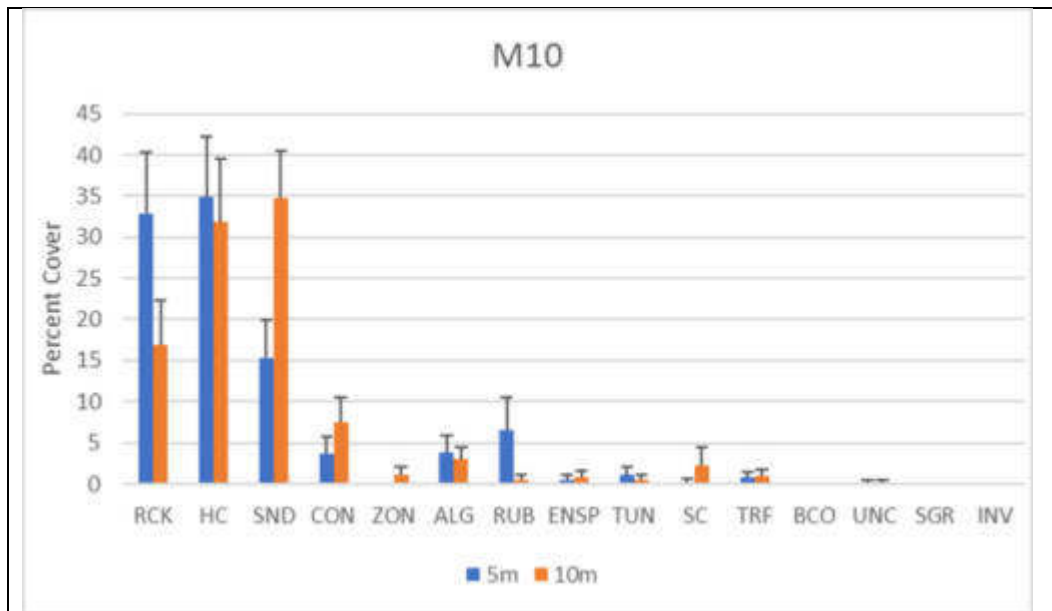


Figure 24: Average benthic cover and their standard error for M9 at both 5 and 10m depth



6.4.2.3 Fish surveys

To ensure that the fish were not disturbed while data on substrate was being collected, a visual assessment of the fish was performed after the transect was laid. As previously mentioned, at each transect and at each depth (5m and 10m), three transects of 20m length were observed. The counts were estimated in the field and the average count of each depth was taken as the mean abundance. The mean abundance was then categorized into three arbitrary scales: "Rare" (no fish to 20 fish), "Common" (20-40 fish), and "Abundant" (counts over 40 fish).

Summaries of the data collected at each site (combining both depths) are provided in Table 12. The majority of the fish observed were considered rare. However, there were instances of Pomacentrids (2 species) and *Balistidae* (*Odonus niger*) being common at M8 and M9, and *Pomacentrid*, *Chormis didmidiata* being abundant at M9 and M10. In M8, only *Anthias* (*Pseudanthias evanis*) was considered abundant.

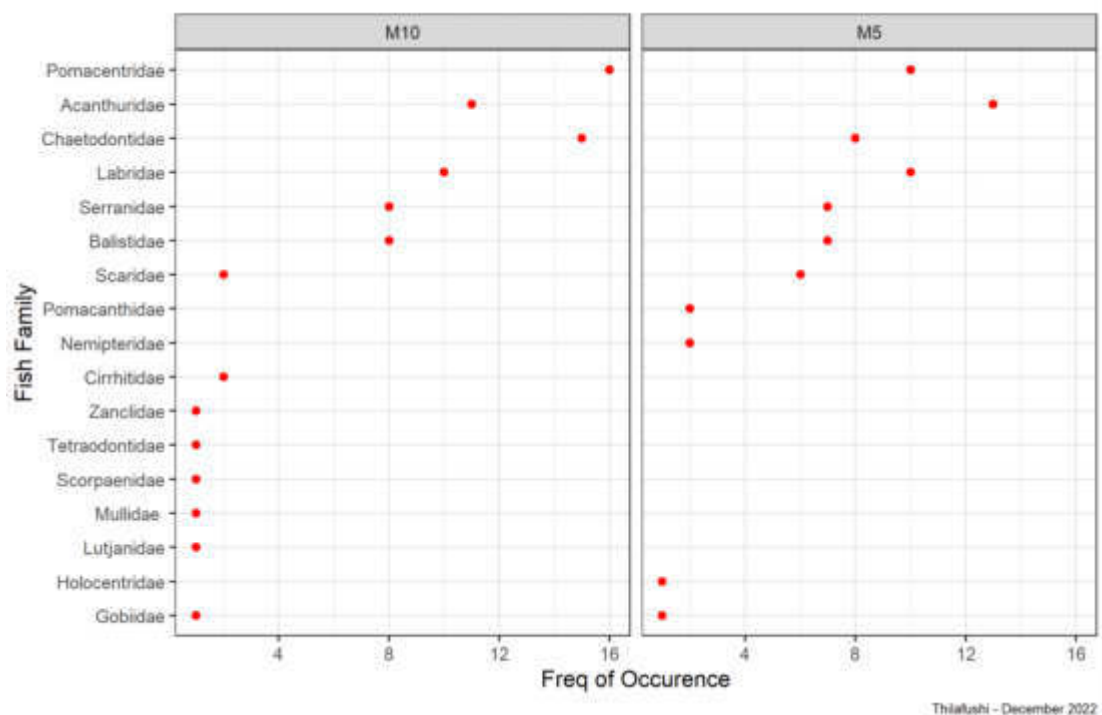
When examining the data at the family level and by depth (5m and 10m) for all three sites, it appears that Pomacentrid (*C didmidiata*) was more common in deeper waters, while Acanthuridae was more common in shallower waters. However, it is important to note that fish composition can vary greatly due to a variety of factors such as time of day, currents and other environmental conditions. Therefore, it is difficult to make generalizations about the fish composition based on this data.

Figure 25 shows frequency of occurrence of fish families at two depths. There appears to no difference in occurrence of fish families at depth, although there are some indication occurrences are more frequent at 10m (M10) Magnified view of the list is provided in the Appendix.

Table 12: Summary of fish census for three site ordered as Rare, Common and Abundant for three site.

Site	Family	Scientific Name	Abundance	Site	Family	Scientific Name	Abundance	Site	Family	Scientific Name	Abundance
M8	Acanthuridae	<i>Acanthurus leucosternus</i>	Rare	M9	Acanthuridae	<i>Acanthurus lineatus</i>	Rare	M10	Acanthuridae	<i>Acanthurus leucosternus</i>	Rare
M8	Acanthuridae	<i>Acanthurus nigricauda</i>	Rare	M9	Acanthuridae	<i>Acanthurus striatus</i>	Rare	M10	Acanthuridae	<i>Acanthurus nigricauda</i>	Rare
M8	Acanthuridae	<i>Chromochaetus striatus</i>	Rare	M9	Acanthuridae	<i>Chromochaetus truncatus</i>	Rare	M10	Acanthuridae	<i>Acanthurus thomsoni</i>	Rare
M8	Acanthuridae	<i>Naso brevirostris</i>	Rare	M9	Acanthuridae	<i>Naso brevirostris</i>	Rare	M10	Acanthuridae	<i>Chromochaetus striatus</i>	Rare
M8	Balistidae	<i>Balistapus undulatus</i>	Rare	M9	Acanthuridae	<i>Sphaeramia bipinnata</i>	Rare	M10	Acanthuridae	<i>Chromochaetus truncatus</i>	Rare
M8	Balistidae	<i>Odonus niger</i>	Common	M9	Balistidae	<i>Zebrastris zephi</i>	Rare	M10	Acanthuridae	<i>Naso brevirostris</i>	Rare
M8	Balistidae	<i>Odonus niger</i>	Common	M9	Balistidae	<i>Balistapus undulatus</i>	Rare	M10	Acanthuridae	<i>Sphaeramia bipinnata</i>	Rare
M8	Balistidae	<i>Sufflamen bursa</i>	Rare	M9	Balistidae	<i>Odonus niger</i>	Rare	M10	Acanthuridae	<i>Sphaeramia bipinnata</i>	Rare
M8	Chaetodontidae	<i>Chaetodon collare</i>	Rare	M9	Balistidae	<i>Odonus niger</i>	Common	M10	Balistidae	<i>Balistapus undulatus</i>	Rare
M8	Chaetodontidae	<i>Chaetodon falcatus</i>	Rare	M9	Balistidae	<i>Sufflamen bursa</i>	Rare	M10	Balistidae	<i>Odonus niger</i>	Rare
M8	Chaetodontidae	<i>Chaetodon guttatisimus</i>	Rare	M9	Balistidae	<i>Chaetodon guttatisimus</i>	Rare	M10	Chaetodontidae	<i>Chaetodon falcatus</i>	Rare
M8	Chaetodontidae	<i>Chaetodon lineatus</i>	Rare	M9	Balistidae	<i>Chaetodon lineatus</i>	Rare	M10	Chaetodontidae	<i>Chaetodon guttatisimus</i>	Rare
M8	Chaetodontidae	<i>Foncipiger flavissimus</i>	Rare	M9	Chaetodontidae	<i>Chaetodon madagascariensis</i>	Rare	M10	Chaetodontidae	<i>Foncipiger flavissimus</i>	Rare
M8	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M9	Chaetodontidae	<i>Foncipiger flavissimus</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias atratus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</i>	Rare
M8	Chaetodontidae	<i>Paracanthias fastigiatus</i>	Rare	M9	Chaetodontidae	<i>Hemichus alghesides</i>	Rare	M10	Chaetodontidae	<i>Hemichus alghesides</</i>	

Figure 25: Fish Families ordered with frequency of occurrence. Pomacentridae is most common family



6.4.3 Sea water quality assessment

For marine water quality assessment water was sampled on 29th November 2022 from the same 7 locations in the original EIA report **Error! Reference source not found.** after establishment of GPS locations obtained from the report. Laboratory analysis of sea water were done for heavy metals (As, Cr, Cu, Ni, Pb, Zn, Hg, Cd), Ammonia, nitrates, PH, Turbidity, Salinity, BOD Oil and grease from Bureau Veritas laboratory, Sri Lanka. The samples were carried to Sri Lanka and delivered to the laboratory within 24 hours from field sampling, All the samples are kept in ice boxes to maintain the appropriate temperature and conserve the sample. In-situ recording of pH, Temperature DO and EC for each sample conducted by using a handheld Hach SensION +MM156 water quality measurement meter. These results show compliance with the Maldives Marine Monitoring Standards. Copies of the laboratory analyses are consolidated in Annex.

6.4.3.1 3.1 Results

Summary of results of sweater samples collected on 29th November 2022 is given in *Table 13* and original Standards. The results show PH. levels in all stations higher than the notational standards and the Total Suspended Solids higher than the national standard in stations 3,4, and 7Copies of the laboratory analyses are consolidated in Annex .

Table 13: Sea water quality monitoring results November 2022 from sites SW1 to SW7

Parameters	Sites Date of Sampling: 03 July 2018							Unit	Corresponding Maldivian Marine Monitoring Standard	
	SW 1	SW2	SW3	SW4	SW5	SW6	SW7		Para meter	Reference
Temperature at receiving (°C)	29.4	28.7	28.9	28.9	29.6	29.3	30.1	°C	18 – 32 °C	GBRMMPA, 2009 ⁴
Biological Oxygen Demand (BOD)	2	2	2	1	2	3	2	mg/l	<2mg/l	
Dissolved Oxygen (DO)	7.24	7.03	7.14	7.01	7.03	7.02	7.1			
Total Suspended Solids	4	3	6	6	3	3	8	mg/l	3 – 5 NTU (max)	
pH at 24°C	8.56	8.52	8.51	8.49	8.41	8.55	8.30	-	8 – 8.3	
Nitrate (NO ₃ ⁻)	0.3	0.5	0.3	0.3	0.3	0.4	0.4	mg/l	< 5mg/l	
Oil & Grease	ND	ND	ND	ND	ND	ND	ND	mg/l	n/a	
Free Ammonia (NH ₃)	ND	ND	ND	ND	ND	ND	ND	mg/l	2 – 3 mg/l (max)	
Salinity	35	35	36	36	35	33	36	ppt	32 – 42 ppt	GBRMMPA, 2009
Arsenic (As)	ND	ND	ND	ND	ND	ND	ND	mg/l	n/a	
Cadmium (Cd)	ND	ND	ND	ND	ND	ND	ND	mg/l	n/a	
Lead (Pb)	ND	ND	ND	ND	ND	ND	ND	mg/l	n/a	
Mercury (Hg)	ND	ND	ND	ND	ND	ND	ND	mg/l	n/a	
Nickel (Ni)	ND	ND	ND	ND	ND	ND	ND	mg/l	n/a	
Copper (Cu)	ND	ND	ND	ND	ND	ND	ND	mg/l	n/a	
Zinc (Zn)	ND	ND	ND	ND	ND	ND	ND	mg/l	n/a	
Chromium (Cr)	ND	ND	ND	ND	ND	ND	ND	mg/l	n/a	

6.4.4 Ground water

Ground water assessment was conducted on 30th November 2022. Water samples were collected from 6 monitoring stations Figure 9. For each location, the samples were collected from mid-water level carried for laboratory testing in Sri Lanka. General sampling procedure involves washing the sampling bottle glass/ with water from the sampling points. For microbial tests, samples were collected in sterile glass bottles and tested in the MWSC laboratory.

In-situ recording of pH, Temperature DO and EC for each sample conducted by using a handheld Hach SensION +MM156 water quality measurement meter.

⁴ Great Barrier Reef Marine Park Authority (2009) Outlook Report 2009

6.4.4.1 Results

Summary of results are given in Table 14 and the laboratory analysis original sheets are given in Annex 2.

Table 14: Groundwater Quality baseline assessment Test Results

Parameters	LoQ	Unit	Test Method					UNIT
	GW1	GW2	GW3	GW4	GW6	GW7	GW8	
Physical Appearance	Clear with particles	Clear with particles	Pale yellow with particles	Pale yellow with particles	Clear with particles	Clear with particles	Clear with particles	
BOD	3	3	3		6	3	4	mg/l
Nitrate*	0.3	3.9	4.6		0.3	1	0.1	mg/l
COD*								mg/l
DO	8.87	8.92	9.07	8.2	8.6	9.02	8.81	mg/l
Chloride	99	21100	3750		188	14	49	
Sulphate	<10(L oQ10 mg/L)	3050	225		95	16	41	
Phosphate	0.15	0.10	0.32		0.15	0.23	0.06	
Turbidity*	0.4	0.2	0.3	0.1	0.5	2.8	0.5	NTU
pH at 25°C*	7.3	7.2	8.5	7.6	7.6	7.5	7.6	mg/l
Total Coliform	>2420 (01/12/2022 15:00)	3(01/12/2022 15:00)	>2420 (01/12/2022 15:00)		>2420 (01/12/2022 15:00)	>2420 (01/12/2022 15:00)	>2420 (01/12/2022 15:00)	
Iron (as Fe) *	ND	ND	ND	ND	ND	0.02	ND	mg/l
Manganese (as Mn)	ND	ND	ND	ND	0.018	ND	ND	mg/l
Arsenic (as As)	ND	ND	ND	ND	ND	ND	ND	mg/l
Total Suspended Solids*	ND	ND	ND	ND	6	38	13	mg/l
Electrical Conductivity at 25°C*	481	58000	10800	5700	1206	571	582	mS/cm
Cadmium (as Cd)*	ND	ND	ND	ND	ND	ND	ND	mg/l
Lead (as Pb)"	ND	ND	ND	ND	ND	ND	ND	mg/l
Mercury (as Hg)	ND	ND	ND	ND	ND	ND	ND	mg/l
Oil and Grease	ND	ND	ND	ND	ND	ND	ND	mg/l
Naphthalene	ND	ND	ND	ND	ND	ND	ND	µg/l
Acenaphthylene	ND	ND	ND	ND	ND	ND	ND	µg/l
Acenaphthene	ND	ND	ND	ND	ND	ND	ND	µg/l
Fluorene	ND	ND	ND	ND	ND	ND	ND	µg/l
Phenanthrene	ND	ND	ND	ND	ND	ND	ND	µg/l
Anthracene	ND	ND	ND	ND	ND	ND	ND	µg/l
Fluoranthene	ND	ND	ND	ND	ND	ND	ND	µg/l
Pyrene	ND	ND	ND	ND	ND	ND	ND	µg/l
Benzo[a] anthracene	ND	ND	ND	ND	ND	ND	ND	µg/l
Chrysene	ND	ND	ND	ND	ND	ND	ND	µg/l
Benzo[a]pyrene	ND	ND	ND	ND	ND	ND	ND	µg/l
Benzo[e]pyrene	ND	ND	ND	ND	ND	ND	ND	µg/l
Indeno[1,2,3-cd]pyrene	ND	ND	ND	ND	ND	ND	ND	µg/l
Dibenzo [a,h]anthracene	ND	ND	ND	ND	ND	ND	ND	µg/l
Benzo[g,h,i]perylene	ND	ND	ND	ND	ND	ND	ND	µg/l
Benzo[b]fluoranthene	ND	ND	ND	ND	ND	ND	ND	µg/l
Benzo[j]fluoranthene	ND	ND	ND	ND	ND	ND	ND	µg/l

Parameters	LoQ	Unit	Test Method					
	GW1	GW2	GW3	GW4	GW6	GW7	GW8	
Benzo[k]fluoranthene	ND	ND	ND	ND	ND	ND	ND	μg/l

7 STAKEHOLDER CONSULTATION

Stakeholders that need to be discussed was identified during the scoping meeting held with EPA. The ToR has identified stakeholder to consult during the preparation of this and it includes

- a) Ministry of Environment (Water Department and Environment Department)
- b) Utilities Regulatory Authority
- c) National Disaster Management Authority
- d) Housing Development Corporation

All the stakeholders were requested to organize a meeting at their convenience and their choice meeting method. All the stakeholder except Utility Regulatory Authority did not respond to the request. All the meetings were convened through MS Teams attended by the EIA consultant representatives from EPC contractor and PMU. Summary of the discussions and meeting minutes are presented below

7.1 MINISTRY OF ENVIRONMENT (WATER DEPARTMENT AND ENVIRONMENT DEPARTMENT)

Date: 3rd January 2023

Time: 11:00-1130 AM

Location: Microsoft Teams

Participants

- 1- Ibrahim Mohamed (PMU)
- 2- Rayya Husain (MECCT)
- 3- Bariscan Göğebakan (EPC Contractor)
- 4- BenH (EPC Contractor)
- 5- Civan klafat (EPC Contracto)
- 6- Mahmood Riyaz (EIA Consultant)
- 7- Burak Özdemir (EPC Contractor)
- 8- Afzal Hussain (MECCT Water Department)
- 9- Ahmed Anwar (MECCT Environment Department)

Proceeding:

EIA consultant gave a briefing about the project, where the project brief design details and the Approved ToR has been shared with all prior to the meeting. The floor was open after introduction for raise concerns about the project or clarify about the project.

Summary of key discussions:

The following are the main concerns and questions raised by the water department and Environment Department of MECCT on the proposed temporary STP f or the WtE Facility construction stage.

- EPC contractor representative gave a brief account about the proposed STP plant technology, its treatment level and the location of the plant and the outfall pipe etc.

- Water department representative questioned about the source of power and questioned if the existing supply of electricity from STELCO would be enough and if there is any provision of a backup generator for the STP plant.
- The EPC contractor said that they have a power purchase agreement with STELCO and they have the capacity to meet the requirement of STP plant. As for the backup generator they have no provision to install such a system as this will be a temporary plant just for the construction phase of the project.
- Water department also questioned about the treatment technology that will be used in the STP plant and the sludge treatment process.
- EPC contractor responded that the plant will use SBR technology and sludge the sludge will be dried and disposed at appropriate location at Thilafushi. However, since the plant will be operated for about 3 years the amount of sludge produced from the system would not be a significant amount and it can be managed as per the URA regulations on the matter.
- Environment department representative questioned about the land use plan of Thilafushi and if the location of the WtE is within the designated use in the plan.
- In this regard PMU responded this is designated land for WtE as per the land use plan.
- Environment Department requested to assess the status of the reef and continue regular monitoring of the reef and take regular samples from the outfall locations. IN response the Consultant mentioned that this is ADB category A project so environmental standards are maintained and the regular monitoring is conducted quarterly basis from the reef ground water as well as sea water.

7.2 NATIONAL DISASTER MANAGEMENT AUTHORITY

Date: 3rd January 2023

Time: 12.30 -:00 PM

Location: Microsoft Teams

Participants:

- 1-Ibrahim Mohamed (PMU)
- 2- Rayya Husain (MECCT)
- 3- Bariscan Göğebakan (EPC Contractor)
- 4- BenH (EPC Contractor)
- 5- Civan klafat (EPC Contracto)
- 6- Mahmood Riyaz (EIA Consultant)
- 7- Burak Özdemir (EPC Contractor)
- 8-Haleemath Nahula (NDMA)

Proceeding:

EIA consultant gave a briefing about the project, where the project brief design details and the Approved ToR has been shared with all prior to the meeting. The floor was open after introduction for raise concerns about the project or clarify about the project. MoT was asked about their views, concerns and suggestions regarding the project.

Summary of key discussions:

The following concerns and were raised by the NDMA

- Must have proper risk mitigation measures in place particularly in case of rain induced flood or wave induced flooding and bad weather conditions.
- Proper fire mitigation measures and conduct regular fire drills and must have proper contingency plans response teams activities etc
- To this point the EAI consultant mentioned that the existing waste mountain a risk there is risk of slope failure, object fall or flooding incase of heavy rain. A proper fencing and protection measures must be in place.
- The staff should be given proper training to use various types of equipment including fire and other safety measures
- There must be a proper information sharing mechanism in place in case of incident To this point EPC contractor responded that they have HSE plan that addresses these issues and it is very seriously implemented in this project
- NDMA also suggested to keep records of all the incident and report to authorities and there must be a established mechanism for the reporting procedures. To this point the EPC contractor responded that this is already covered and the procedures are established in this project and workers as well as employees will be trained to use the proposed system.
- NDMA also requested to share the information on emergency incidents with them and other designated authorities.
- Representative of NDMA mentioned that if they have any information on disaster in Thilafushi in the past she will share with the consultant.

7.3 HOUSING DEVELOPMENT CORPORATION

Date: 8th January 2023

Time: 12.00 -1 :00 PM

Location: Microsoft Teams

Participants:

- 1-Ibrahim Mohamed (PMU)
- 2- Rayya Husain (MECCT)
- 3- Bariscan Göğebakan (EPC Contractor)
- 4- BenH (EPC Contractor)
- 5- Civan klafat (EPC Contracto)
- 6- Mahmood Riyaz (EIA Consultant)
- 7- Burak Özdemir (EPC Contractor)
 - 5- Ahmed Maisam Musthafa (HDC)
 - 6- Dhimyan Ahmed Ismail (HDC)
 - 7- Hassaan Abdul Muhsin (HDC)
 - 8- Mohamed Nail (HDC)

Proceeding:

EIA consultant gave a briefing about the project, where the project brief design details and the Approved ToR has been shared with all prior to the meeting. The floor was open after introduction for raise concerns about the project or clarify about the project. MoT was asked about their views, concerns and suggestions regarding the project.

Summary of key discussions:

The following concerns and issues raised by the HDC

The drawing that were shared with the HDC has the line drawing of the permeant discharge pipelines and one of the concerns raised by the HDC was that the proposed pipeline runs along outer road that is proposed to be developed in Thilafushi. To this point that the meeting is to discuss the temporary STP and the outfall that runs across the road into the outer reef about and will be discharged about 5m deep. They requested to have the methodology of the proposed permeant discharge line at a later stage, which the EPC contractor confirmed that the details will be discussed with HDC at a later stage.

With regard to the proposed temporary STP plant and discharge pipelines HDC raised the following issues

- They need to know the exact methodology of laying the pipe if it will be laid under the ground across the road or other method. For this EPC contractor mentioned that the pipe will be laid underground at about 1-1.5m deep across the road. The EPA contract will share the detailed methodology with HDC.
- They also inquired about the sewage treatment technology that will be used in the proposed STP and the processes involved. EPC contractor explained that the proposed technology is SBR and explained the processes and treatment steps of the STP plant.
- One of the concerns raised by the EPC contractor is that how the pipeline will be laid on the seawall. For this HDC responded that since that the STP will be pumping out through the discharge line they want the pipeline to go on top of the seawall. If the pipeline goes through the seawall it will be damaged and the integrity of the structure will be effected. Therefore, HDC wants the pipeline to be on top of the seawall.
- EPC contractor also inquired about the approvals and permits that will be required and the documents required. In response they need the detailed drawing and methodology to be submitted to urban department ust@hdc.com.my to obtain the necessary permits.

7.4 UTILITIES REGULATORY AUTHORITY

Utility Regulatory Authority did not respond to the mails sent to request meetings. Generally, they require the details of the STP plant to submit to the and get their approval after the EIA process. Copy of the mail request to t URA is given in the Annexes

7.5 MAIN OUTCOMES OF THE STAKEHOLDER CONSULTATION

Main conclusions from the stakeholder meeting is that there is no major concern of any stakeholders about the STP plants and most of the issues raised are already addressed. The Environment ministry want make sure that all the necessary approval from URA should be obtained and the environmental monitoring of reef wand ground water should be continued. NDMA wants disaster mitigation plan in place and strictly follow the HSC and other safety and emergency measures as per the regulations and instructions from the authorities. HDC request to submit the methodology and details of the STP plant and processes to HDC once it is available.

8 POTENTIAL IMPACTS AND MITIGATION MEASURES

This is the first Addendum to the EIA report on Greater Male Waste-to-Energy Project which is on installation and operation of a temporary STP plant in the facility during the construction stage of the WtE development in Thilafushi Male' Atoll. Major activities that will have impact on the environment from installation of the STP plant are:

- Construction of the concrete base of the STP facility
- Assembling of the imported prefabricated STP plant
- Connection to the buildings and offices in the construction camp to the STP and necessary power connections
- Laying of outfall pipe and discharge into the deep sea at 5m deep out of the reef.
- Operation and management of the STP plant during the construction period of the WtE;
- Decommissioning and dismantling of the STP plant and connections upon completion of the WtE facility in Thilafushi.

Table 15 is an impact identification matrix related to the STP installation and operation at the construction camp WtE facility , Thilafushi Male Atoll.

It can be seen from the matrix, that the activities that cause the most impact are the sewage outfall pipe, excavation and dewatering at the construction phase and the decommissioning and dismantling process after the completion of the construction phase of the project.

Table 15: Impact Identification matrix

	Impact	Construction phase Activities								Operational and decommission activities				
		Mobilization	Work force	Site Excavation and dewatering	Trenching and laying pipes	Building construction	Vehicle and fuel management GHG emission	Installation of Pump stations	Construction of sewage outfall pipe	Chemicals handling and storage	Sewage collection and distribution via Pump Station	Sewage discharge	Decommissioning and dismantling	Sludge management
Marine coastal	Coastal process	X	X	-	X	X	-	X	-	X	X	X	-	X
	Lagoon Substrate	X	X	-	-	X	X	X	-	X	X	-	-	X
	Marine water	-	-	-	-	-	X	-	-	-	-	-	-	X
	Hydrodynamics	X	X	X	X	X	X	X	-	X	X	X	X	X
	Marine habitat flora & Fauna	X	X	-	-	X	X	X	-	-	-	-	-	X
Land	Vegetation	X	X	-	X	X	X	X	X	X	X	X	-	-
	soil	-	X	-	-	-	-	-	-	X	-	X	-	-
	Ground water	-	-	-	-	-	-	-	-	-	X	-	-	
Others	Noise	-	-	-	-	-	-	-	-	X	X	X	-	X
	Air Quality	-	-	-	-	-	-	-	-	-	X	-	-	
	Aesthetics	-	X	-	-	+	-	X	-	X	X	-	X	X
Socio-econom	Employment	+	+	+	+	+	+	+	+	+	+	X	+	+
	Health and safety	+	-	-	-	+	+	+	-	-	+	+	+	-
	Social well being	+	+	X	X	X	+	+	+	X	+	+	+	-

(-) Negative impact (+) Positive impact (X) no impact

8.1 IMPACTS AND MITIGATION MEASURES

8.1.1 Impacts from Mobilization of Equipment and Labour

Mobilization and operation of heavy equipment and machinery needed for assembly of the STP plant installation and excavator for t laying the underground pipes have minor to moderate negative impact on the marine and terrestrial environment. Clearance for excavation and heavy equipment operational pathway would be a major impact of the mobilization.

Mitigation measures:

- A specific area should be designated for landing and material and storage.
- Signs should guide workers to proper environmental care.
- Minimise creation of temporary excavations, pathways etc.
- Machineries shall be used by experienced workers
- Machineries and equipment's used would be well tuned and maintained
- Construction activities would be carried out in shortest possible time
- All the construction activities would be carried out during daytime and nighttime should be avoided.

8.1.2 Excavation

Ground excavation is essential for establishment of sewer network in the construction camp. Since this is a small project comparatively minor excavation is required for this project. Since the selected system is based on pumping sewerage system, which means pipes may not be required to be laid at the groundwater level. However, since it is closer to the shoreline dewatering may be required particularly at high tide level.

A mini excavator and other vehicles will be used for construction activities such as excavation, which will generate dust and other air pollutants, reducing the overall air quality of the site. Also, with the use of vehicles and machineries will result in release of minor amount of Greenhouse Gas emissions (GHGs). The impact from air pollution and GHGs emission is considered to be negligible. Thus, the adverse impact on air quality is considered to be highly reversible, cumulative, direct impact and short-term.

Mitigation measures:

- Close supervision and monitoring of the work by an expert
- Brief work force on possible environmental impacts of excavation
- The excavation site should clearly mark before commencement of excavation work to limit the exaction up the minimum required
- Strictly follow health and safety guidelines of the labourers
- Usage of safety warning signs and tapes around the pit to prevent accidental spillage of hazardous chemical.
- Compact the soil properly after backfilling the excavated areas.
- Erect signboards and warning signs at the excavation sites
- Complete the excavation work in the shortest possible time or duration

8.1.3 Laying the sewage outfall pipe on the reef

Placement of pre-casted concrete Precast U-blocks to be bolted to hold the swage pipe on the seabed/ reef flat will have a direct irreversible minor negative impact to the ecological habitat in the area and lethal impact on sessile benthic organisms on in the area. The direct impact of this activity is very local and limited to pipeline pathway only.

Given below are relevant impacts that should be considered:

1. Direct damage on live coral and other substrate organisms directly in contact with the ballast
2. Physical damage on live coral and other organisms on the substrate: The effect of this would be in the immediate to short term with loss/damage of substrate and its fauna.
3. Disturbance to the area during laying of the pipeline: Release of sediments and potential loss of the faunal composition directly underneath the area causing minor sedimentation and subsequent smothering of coral.

Mitigation Measures:

- Work should be completed in shortest time possible.
- Precast U-blocks placement and fixing of the pipeline ought to take place during low tides or slack tides to minimize the impact to the area.
- Ensure only suitably trained workers are involved in construction work conducted in the marine environment, with adequate skills to scuba dive/swim.
- Ensure, that the outfall is adequately anchored and well secured

8.1.4 Dewatering

Dewatering is a process where groundwater or surface water is removed temporarily at the constructional site to allow work in dry conditions. Removal of groundwater will induce saline water into those places, as saline water would take place of the fresh water during dewatering process.

Dewatering may be required during the laying of underground sewerage pipelines. Although the sewage will be pumped deep excavation is not required but depending on the depth of excavation and due to the fact that installation area is adjacent to the shoreline the water table is expected to be shallow and may require dewater at high tide

The impacts of dewatering are very much site specific. The impacts are considered direct and short-term as rainfall recharges those saline groundwater zones. Therefore, the impacts associated with dewatering can also be considered to be reversible. Based on level of impact and reversibility, the impacts are considered to be small or negligible.

Mitigation Measures:

- Close supervision and monitoring of the work by an expert
- Strictly follow health and safety guidelines of the labourers
- Usage of safety warning signs and tapes around the work area.
- Complete the task shortest possible time or duration.
- Erect signboards and warning signs at the excavation sites and discharge area

8.2 OPERATIONAL PHASE IMPACTS

As mentioned above the proposed STP plant is a temporary system to be used in the construction camp of WtE facility only during the construction period. STP plant would need electricity for the operational phase. Power required for the plant will be purchased from STELCO in Thilafushi. power consumption of the proposed STP plant is small, the amount of fossil fuel used for producing power in this is considered negligible. Therefore, GHG emission from this process is not assessed and it is beyond the scope of this EIA.

8.2.1 Operation of sewerage network

After the installation and commissioning of the STP plant regular maintenance of the network is essential. In this regard, proper maintenance should be provided to the pumping stations. Wastewater treated to tertiary level through the STP plant will be discharged into the sea via sea outfall. Although the sewer discharged will be quickly diffused, it would still have minor deteriorating impact on the marine water quality at the outlet. The treated water will have low level concentration of BOD in the discharged water. High concentration of BOD level would favor 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 households, would alter the pH of the water which might intern alter the composition of the microbial communities.

Mitigation Measures:

- Consistent maintenance needs to done throughout the operation of networks
- Blower with vent pipe installed at pump station
- Aerators installed in pump stations

8.2.2 Decommissioning

As mentioned above the STP plant will be decommissioned and dismantled after completion of the construction of the WtE facility. Decommissioning involves removal of all the constructional footprint of the plant. The dismantling and removing process will have impact on the environment similar to the mobilization impacts including GHG emission, air quality and noise pollution.

Mitigation measures

To minimize the impacts of decommission following mitigation measures will be implemented.

- All the loading and unloading works shall be carried out under direct supervision as per recommendations of this EIA.
- All decommissioning activities would be carried out in shortest possible time and day time only

8.3 OCCUPATIONAL HEALTH IMPACTS

All health and safety precautions specified in the HSE standards needs to be strictly implemented. They include, but are not limited to, the following:

- a. Construction workers operating equipment that generates noise should be equipped with noise protection. As a guide, workers operating equipment generating noise of > 80 dBA should

wear ear mufflers and workers experiencing prolonged noise levels > 70 dBA must wear ear plugs.

- b. Health checks will be administered before work commences.
- c. Warning signs, barricades or warning devices will be provided and used.
- d. Necessary safety gear will be worn at all times. These include safety gloves, life vest, construction boots, facemasks, earmuffs, etc.
- e. Fire extinguishing equipment would be readily available and employees will be trained in its use.
- f. First aid kits will be made available on the site.
- g. The construction site will be properly closed to unauthorised personnel.
- h. vehicles and workers in the site should be informed about the schedule of the work

Table 16: Summary of Major impacts their reversibility and significance.

Impact	Reversibility	Significance	Mitigation cost (MRV)
Excavation; will generate dust and other air pollutants, reducing the overall air quality of the site release of minor amount of Greenhouse Gas emissions (GHGs).	Reversible over short-medium time frame	low-medium cumulative, direct impact and short-term	Mitigation costs are included in the project
Laying the sewage outfall pipe on the reef - direct irreversible minor negative impact to the ecological habitat in the area and lethal impact on sessile benthic organisms on in the area	Direct irreversible	minor negative site specific particularly for coral reef habitats and marine fauna and flora	
Dewatering: Direct and short-term as rainfall recharges those saline groundwater zones.	Reversible short term	Small and negligible.	

8.4 LIMITATIONS AND UNCERTAINTIES IN IMPACT PREDICTION AND MITIGATION

Prediction of environmental impact generally will have certain degree of uncertainty due to the limited understanding and availability of long-term data on marine and terrestrial systems and social condition of the island. Also, no long-term site-specific data is available, therefore usually a brief field assessment was undertaken, which is a few days representation of the prevailing conditions of the environment.

Regular environmental monitoring is not strictly implemented in the Maldives therefore uncertainty the impact identification is subsequently cascaded to the mitigation recommend mitigation measures as there is always likelihood of unforeseen impact. And there is also lack

of understanding of the significance and magnitude of impacts the consequences will be cascaded to the mitigation sector as well. Despite, the inherent uncertainty in predicting the impacts and mitigation measures the attempt here was to make the assessment as comprehensive as possible without bias.

9 ALTERNATIVES

9.1 NO DEVELOPMENT OPTION

It is believed that a number of environmental impacts will be generated from the proposed temporary installation and operation of STP plant at the construction camp during the construction phase of WtE development project in Thilafushi, Male' Atoll. Although no impacts on the environment will be associated if the proposed development does not go ahead, it will be a difficult to manage waste water during the construction phase of the project. Existing waste water system in Thilafushi are either septic tank systems of direct untreated connection of the outfall into the surrounding sea. The proposed water system being comparatively expensive and this being ADB category A project in order to maintain high standards of environmental conservation STP plant is opted for construction camp of WtE.

Given the benefits of the proposed STP plant in providing waste water treatment with minimal impact on the environment STP for waste treatment has been considered important and necessary. Development can take place only within the limits of the environment and the society. Hence, the aim is to ensure that all project activities are undertaken without any adverse long term irreversible environmental damages that cannot be mitigated. preferred alternatives discussed below has been selected based on the above broad development concept.

9.2 DEVELOPMENT OPTION

Having decided and followed the development option of the proposed project one has to consider the alternative options for some of the activities that has been included in the revised concept plan that would have least environment impact. Following have been considered for the alternatives.

9.3 WASTE WATER TREATMENT SYSTEMS

Thilafushi being an industrial island and much of the developments are unplanned haphazard, the existing waste water systems are extremely primitive low technology systems such as gravity based septic tank systems, and direct connection of raw sewage into the surrounding lagoon. Despite this being extremely harmful for the human health environment and unhygienic existing systems are not well regulated in the island. This being the existing situation in Thilafushi Island the contracted has opted for a sewage treatment plant for waste water management during the construction period of the WtE facility to make sure that environmental quality of surrounding water is maintained and water is treated with minimum impact of the environment.

Table 17. Alternative sewage system

System	Advantaged	Dis advantages
Gravity based septic tank systems	Very low capital cost Can be made locally Easy to install and maintain.	Environmental degradation Water pollution Impact on the ground water table

		Increased human health impact and Unhygienic
STP systems	Minimum impact on the environment and less pollution	Very high capital cost and maintenance cost Not available locally pre-fabricated abroad, imported and assessable in the country Maintenance intensive High energy cost

9.3.1 Proposed option

As seen from the above table the environmental benefits will be incomparably high with the STP systems. Also, the proposed WTE being an exemplary environmentally friendly ABD category A project maintaining highest environmental standards is required. Therefore, the proposed STP was the best option for waste water treatment during the construction period of WtE in Thilafushi.

9.4 SEWAGE OUTFALL CONSTRUCTION METHODOLOGY

There are two main methods of outfall construction practiced in the Maldives. The main types of outfall construction are Horizontal Direct Drilling (HDD) and underground trenching and anchored concrete ballast blocks on seabed.

Horizontal Directional Drilling is commonly is trenchless construction method for installing pipes under sensitive area such as coral reefs where open-trench installation would be disruptive or difficult to construct. The directional drilling or guided boring process begins by drilling into undisturbed surface at this 10- 25-degree angle. As the tool penetrates the ground, the second drill pipe is added. The process continues with the steering controlled so that the drilling tool will enter the first pit level at the proper depth. The success of horizontal directional drilling lies on the construction of the drill head and reamers *Figure 26*.

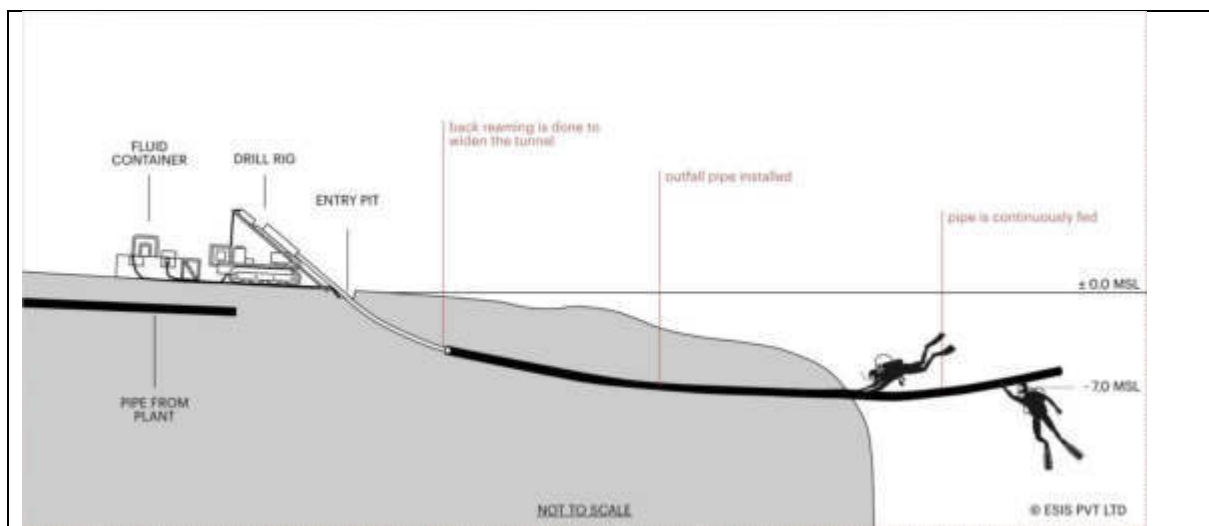


Figure 26. Schematics of the sea outfall installation using HDD method

Major disadvantage of HDD is that it is very expensive, fairly sophisticated technology. Also large amount of drilling fluid is used and a large land clearance is required at the entrance point.

9.4.1 Proposed option

Since the proposed STP plant and sewage network is a temporary system for the construction period only installation of the outfall pipe using HDD would be an added cost for the already expensive STP plant. Therefore, based on the analysis it can be concluded that most environmentally sound solution for construction of outfall for the proposed STP is through anchoring on seabed. This method would ensure less environmental impacts in contrast to the Horizontal drilling method. Additionally, anchoring on seabed method of construction is cheaper than drilling method. Furthermore, this method is widely practiced in the Maldives. Therefore, based on this assessment Anchored concrete ballast blocks on seabed construction is the proposed option for this project.

10 DEVELOPMENT OF A MONITORING PLAN

Environmental monitoring and auditing is an essential component of any project. Under the EIA regulation, a detailed monitoring plan is a mandatory component of any EIA report. The initial EIA has developed a fairly comprehensive and exhaustive monitoring plan; and the monitoring programme is strictly implemented. No change for the existing environmental monitoring is proposed with addition of activities in this addendum, because most critical components such as ground water, seawater from outfall pipe location, noise, coral reef and air-quality etc., are regularly monitored and the reports will be submitted to the EPA.

Therefore, the monitoring plan that has been developed in the original EIA and followed by the contractors is provided below, which shows monitoring plan reporting and cost of monitoring as indicated in the approved EIA.

Table 18. Proposed monitoring in the initial EIA

Activity	Location	Parameters to be Monitored	Means of Monitoring	Frequency	Implementation Responsibility
Construction Stage					
Ambient air quality sampling and monitoring	Pre-identified monitoring stations at Thilafushi Island (the same sampling locations as during baseline data gathering). Other additional location/s as may be needed and identified during construction stage.	TSP, PM ₁₀ , PM _{2.5} , SO _x , NO _x	Mandatory ambient air quality monitoring using appropriate instruments; and Visual inspection	Quarterly (24-hour at sampling locations used during baseline data gathering)	DBO Contractor to implement monitoring activity (PMU to check compliance)
Noise level monitoring	West side boundary (nearest establishments) of the WTE plant (the same locations as used during baseline data gathering). Other additional pre-identified noise level monitoring site/s at Thilafushi Island.	Day time and nighttime noise levels dB(A)	Ambient noise level monitoring equipment	Once prior to start of construction works (both day time and night time); Once during conduct heavy construction work expected to generate high noise level (either or both day time and night time, depending on	DBO Contractor to implement monitoring activity (PMU to check compliance)

Activity	Location	Parameters to be Monitored	Means of Monitoring	Frequency	Implementation Responsibility
				when such heavy construction work is undertaken); Monthly during normal construction activities (both day time and night time)	
Marine water quality monitoring	Pre-identified sampling locations at the northern and southern sides of the construction site (same sampling points as used during baseline data gathering).	BOD, DO, TSS, Oil and Grease, Fecal Coliform	Grab sampling at northern and southern sea sides relative to the location of construction site.	Once every quarter	DBO Contractor to implement monitoring activity (PMU to check compliance)
Groundwater quality monitoring	Pre-identified sampling wells, as used during baseline data gathering.	Oil and Grease, Fecal Coliform, Presence of petroleum and other chemicals use in the baseline data.	Grab sampling from deep wells.	Once every quarter	DBO Contractor to implement monitoring activity (PMU to check compliance)
Condition of disposal areas	All designated disposal areas	General condition of area, estimated capacity of disposed spoils, estimated remaining capacity that can be accommodated.	Visual inspection, Actual measurements in the area.	Weekly or monthly depending on the frequency of spoil disposal	DBO Contractor to implement monitoring activity (PMU to check compliance)
Condition at construction camp sites	Construction camp site.	All good housekeeping practices as specified in the EMP.	Visual inspection, Interview with occupants.	Weekly	DBO Contractor to implement monitoring activity (PMU to check compliance)
Assessment of occupational health and safety measure implementation	(i) Construction work site; and (ii) Construction camp site.	All occupation health and safety measures as specified in the EMP	Visual inspection, Interview with workers at sites and occupants at camp sites	Weekly	DBO Contractor to implement monitoring activity (PMU to check compliance)
Assessment of community health and safety measure implementation	Vicinity of construction work site and around Thilafushi Island.	All community health and safety measures as specified in the EMP	Visual inspection, Interview with locals.	Weekly	DBO Contractor to implement monitoring activity (PMU to check compliance)

Activity	Location	Parameters to be Monitored	Means of Monitoring	Frequency	Implementation Responsibility
Construction of cooling water lines, intake, and discharge points.	Construction site and previously identified alignment and location of cooling water lines, intake location and outfall location.	Exact locations if complying with pre-approved and recommended locations per EIA report.	Visual inspections.	Continuous as the construction progresses (by DBO Contractor). Random inspection by PMU but at least once a week.	DBO Contractor to implement monitoring activity (PMU to check compliance)
Post-Construction					
Demobilization of construction heavy equipment	Construction site	Schedule of transport of heavy equipment to ensure no disruption or disturbance to marine traffic around Thilafushi Island.	Schedule of demobilization Visual inspection	Continuing or as needed during the demobilization activities.	DBO Contractor to implement monitoring activity (PMU to check compliance)
Site clearing	Construction site	Types of construction wastes remaining at site. Disposal site of remaining construction wastes.	Visual inspection of wastes and location of disposal site.	Continuing or as needed during the site clearing activities.	DBO Contractor to implement monitoring activity (PMU to check compliance)
Operation Stage					
Stack emission sampling and monitoring.	Stack sampling ports	TSP, SO _x , NO _x , Organic Carbon, CO, HCl, HF, Hg and its compounds, NH ₃ , Cd, As, Dioxins/Furans, sum of heavy metals and their compounds.	Mandatory stack emission sampling using appropriate instruments. Mandatory emission monitoring through CEMS. Visual inspection.	At least annually for stack emission sampling. Continuous monitoring through installed CEMS. Daily visual monitoring	DBO Contractor to implement monitoring activity (PMU to check compliance)
Ambient air quality sampling and monitoring	Pre-identified monitoring stations at Thilafushi Island (the same sampling locations as during baseline data gathering). Other additional location/s as may be needed and identified	TSP, PM ₁₀ , PM _{2.5} , SO _x , NO _x	Mandatory ambient air quality monitoring using appropriate instruments; and Visual inspection end	Once every quarterly at the identified baseline sampling locations	DBO Contractor to implement monitoring activity (PMU to check compliance)

Activity	Location	Parameters to be Monitored	Means of Monitoring	Frequency	Implementation Responsibility
	during operation stage.				
Noise level monitoring	West side boundary (nearest establishments) of the WTE plant (the same locations as used during baseline data gathering). Other additional pre-identified noise level monitoring site/s at Thilafushi Island.	Day time and nighttime noise levels dB(A)	Ambient noise level monitoring equipment	Once prior to start of operations (both day time and night time); Once every time generator set is utilized (either or both day time and night time, depending on when the generator set/s is/are used); Monthly during normal operating conditions (both day time and night time)	DBO Contractor to implement monitoring activity (PMU to check compliance)
Marine water quality monitoring	Pre-identified sampling locations at the northern and southern sides of the WTE site (same sampling points as used during baseline data gathering).	BOD, DO, TSS, Oil and Grease, Fecal Coliform	Grab sampling at northern and southern sea sides relative to the location of WTE site.	Once every quarter	DBO Contractor to implement monitoring activity (PMU to check compliance)
Effluent quality sampling and monitoring	Effluent sampling ports of leachate treatment plant and wastewater treatment plant	COD, BOD5, Total Inorganic Nitrogen, Nitrate, Sulfur, Phosphorus, Lead, Cadmium, Chromium, Hexavalent Chromium, Mercury, Nickel, Zinc, Copper, Arsenic	Mandatory effluent quality monitoring using appropriate instruments; and Visual inspection	Monthly (grab sampling) Daily (visual)	DBO Contractor to implement monitoring activity (PMU to check compliance)
Cooling water discharge monitoring	Sampling port along thermal water discharge line	Temperature, Physical condition surrounding the outfall location	On the spot/ on-site temperature monitoring using appropriate instruments; and Visual inspection (through diving activity) to monitor	Daily or as frequent as necessary by DBO Contractor Once every quarter	DBO Contractor to implement monitoring activity (PMU to check compliance)

Activity	Location	Parameters to be Monitored	Means of Monitoring	Frequency	Implementation Responsibility
			the vicinity of the outfall		
Groundwater quality monitoring	Pre-identified sampling wells, as used during baseline data gathering.	Oil and Grease, Fecal Coliform, Presence of petroleum and other chemicals.	Grab sampling from deep wells.	Once every quarter	DBO Contractor to implement monitoring activity (PMU to check compliance)
Condition at WTE workers accommodation, if any.	Workers accommodation.	All good housekeeping practices as specified in the EMP.	Visual inspection, Interview with occupants.	Weekly	DBO Contractor to implement monitoring activity (PMU to check compliance)
Assessment of occupational health and safety measure implementation	WTE plant	All occupation health and safety measures as specified in the EMP	Visual inspection, Interview with workers at WTE plant.	Weekly	DBO Contractor to implement monitoring activity (PMU to check compliance)
Assessment of community health and safety measure implementation	Vicinity of WTE plant and around Thilafushi Island.	All community health and safety measures as specified in the EMP	Visual inspection, Interview with locals.	Weekly	DBO Contractor to implement monitoring activity (PMU to check compliance)

10.1 REPORTING

DBO Contractor. The DBO Contractor will be required to submit monthly monitoring reports to PMU during the implementation phase of the project. PMU may require DBO Contractor submit any additional information and reports that will be needed to fulfill the reporting obligation of MOE to ADB and Maldives EPA.

PMU Reporting to ADB. PMU will prepare and submit reports to ADB and Maldives EPA. PMU will prepare reports to be sent to ADB on a quarterly basis during construction phase and semiannual basis during the operation phase. Semiannual reports during operation are to be prepared and submitted until ADB issues a project completion report. The suggested outline of quarterly environmental monitoring reports is attached as Appendix 21. To facilitate monitoring and enable responses to emerging issues, monthly reports will be prepared by the PMU.

PMU Reporting to Maldives EPA. PMU will likewise prepare and submit reports to Maldives EPA as required by the schedule and report structure shown in Environmental Impact Assessment Guidelines by Maldives EPA. A detailed environmental monitoring report is to be compiled and submitted to the Maldives EPA on the format provided in the Maldives EPA's Environmental Impact Assessment Guidelines, following monitoring activities at each stage.

The monitoring report shall include details of the site, means of data collection and analysis, quality control measures, sampling frequency and monitoring analysis and details of methodologies and protocols followed.

10.2 COST OF EMP IMPLEMENTATION

Table 19: Costs of the Monitoring Program

Description	Total (\$)
1. Design Stage	
Confirmatory surveys (protected/rare species of flora, fauna)	50,000
Green buffer zone	30,000
Numerical Modeling	50,000
Preparation of various plans suggested in the EMP	45,000
2. Construction Stage	
Environment & ecological monitoring	100,000
replantation of trees	50,000
3. Operation Stage	
Environmental Monitoring	50,000
4. Implementation support	
External environmental expert, supervision, monitoring etc.	150,000
Total	525,000

^a These are only the costs that are not normally covered in standard budget line items of a BOQ.

11 CONCLUSIONS

This Addendum is required for the installation and operation of a temporary STP plant at the construction camp of WtE facility during the construction period in Thilafushi. In light of the field surveys, assessments, stakeholder discussions as well as the past experience of the EIA Consultant in similar undertakings, the following have been identified as the major impacts from the installation, operation and decommissioning of the proposed STP plant at the WtE facility construction camp.

- Excavation; will generate dust and other air pollutants, reducing the overall air quality of the site release of minor amount of Greenhouse Gas emissions (GHGs).
- Laying the sewage outfall pipe on the reef - direct irreversible minor negative impact to the ecological habitat in the area and lethal impact on sessile benthic organisms on in the area
- Dewatering: Direct and short-term impact as rainfall recharges those saline groundwater zones.

Out of these three major impacts identified, excavation and dewatering will be reversible and will last for a short-medium term. While the direct impact that is caused by laying of the outfall pipe on the reef flat will have very localized lethal lasting impacts on the coral species that are directly under neath the pipeline. This is a minor negative site-specific impact on live corals

Even though there is no new impact other than that has been identified in the initial EIA report it is recommended to continue the ongoing monitoring programme and document the environmental changes associated with the development and to make necessary adjustment based on the findings of various measured environmental parameters suggested in the monitoring plan.

With proper implementation of the mitigation measures, anticipated direct irreversible negative impact to the ecological habitat in the area from the proposed installation and operation of the temporary STP at the construction camp of WtE facility will not alter the over-all aspect of the project and recommended to go ahead as proposed.

12 REFERENCES

DBO Contractor (2022) Baseline Environmental Assessment Report Pre- Construction– & Construction Stage of WtE Facility at Thilafushi

DBO contractor (2022) Pre- Construction Environmental Monitoring mbient air quality, Noise level and Marine ecology, WtE Facility at Thilafushi, December 2022 report.

DBO contractor (2022) Pre- Construction Environmental Monitoring Air-quality, seawater and ground water, WtE Facility at Thilafushi, November 2022 report

Environmental Impact Assessment, MLD: Greater Malé Waste-to-Energy Project – Waste to Energy Plant, Prepared by Ministry of Environment of the Republic of Maldives for the Asian Development Bank

First Addendum to ESIA for north regional waste management facility construction and operation (ESIA 2012) as per the world bank safeguard standards

MoE 2021 Establishment of Island Waste Resource Management Centre with Aerobic technology using Composting machine at Gan, Laamu Atoll

13 ANNEXES

Annex 1: Approved Terms of Reference (ToR) for the addendum



No: 203-ECA/438/2022/40

Terms of Reference for the 1st Addendum to the Environmental Impact Assessment Greater Male Waste-to-Energy Project; Installation of Sewage Treatment Plant (STP) for the construction period Thilafushi, Kaafu Atoll

The following is the Terms of Reference (ToR) for undertaking 1st Addendum to the EIA for Greater Male Waste-to-Energy Project; Installation of Sewage Treatment Plant for the construction period, K. Thilafushi. The Proponent of the project is Ministry of Environment, Climate Change and Technology. The Consultant of the Project is Dr. Mahmood Riyaz (EIA P03/2007).

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

- 1. Introduction and rationale** – Describe the purpose of the project and, if applicable, the background information of the project/activity and the tasks already completed. Objectives of the development activities should be specific and if possible quantified. Define the arrangements required for the environmental assessment including how work carried out under this contract is linked to other activities that are carried out or that is being carried out within the project boundary. Identify the institutional arrangements relevant to this 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. The study area should include adjacent or remote areas, such as relevant developments and nearby environmentally sensitive sites (e.g. coral reef, sea grass, mangroves, marine protected areas, special birds site, sensitive species nursery and feeding grounds). Relevant developments in the areas must also be addressed including residential areas, all economic ventures and cultural sites.
- 3. Scope of work** – Identify and number tasks of the project including site preparation, construction and decommissioning phases. The following tasks shall be completed:

Task 1. Description of the proposed changes to the Project: Provide a full description of the proposed changes to the initial project concept with need and justifications. Provide a full description of the relevant parts of the changes in the project, using maps at appropriate scales where necessary.

Provide a full description and justification of the relevant parts of the proposed works, using maps at appropriate scales where necessary. The following should be provided (all inputs and outputs related to the proposed activities shall be justified):

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The main activities of the project are:

- Update on the project status with photographs
- Preliminary works and mobilization
- Installation of STP
- Outfall locations and installation of outfall pipe

Report should outline how the construction workers will be accommodated and how they will be supported on the island. Resource use from the workforce including, utility use and waste management methods must be specified.

Work methodology and equipment required for all major project components shall be defined and listed.

Work plan and schedule for the project must be presented.

All project inputs and outputs identifying equipment and resources required need to be highlighted.

Project management (include scheduling and duration of the project and life span of facilities; communication of construction details, progress, target dates, construction/operation/closure or labour camps, access to site, safety, equipment and material storage, fuel management and emergency plan in case of spills).

Sewage Outfall

- Justify outfall site selection including distance from reef and depth of the pipe using oceanographic and ecological information;
- Describe equipment needed and construction methodology for laying the pipe including handling and transportation.

STP Plant Facility Design

- Describe treatment technology and capacity
- Specify catchment area: All flows that contribute to the sewer system including flows from the development area to the point of connection to the main line.
- Describe operations for dewatering excavations for pump stations and sewer trenches.
- Mechanisms used to avoid pipe leakages protecting groundwater contamination.
- Specify an emergency plan if system fails.
- If the treated water is going to be used for gardening or to recharge groundwater, determine long-term impact to groundwater in terms of heavy metal and nutrients deposits.

Vegetation Clearance (if any)

- Location to clear vegetation marked on an A-3 size map;
- Land survey approval of locations to clear, if a road identifying the width of the road;
- Information on the areas to replant 02 plants for each plant removed;
- Source of plants to be replanted;
- Schedule of implementation;
- What would be done with the removed vegetation?

Waste Management

- Details of waste management during construction and operational phase;
- Waste fuel and oil management details.

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

The baseline data will be collected before construction. 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, evaporation rates;
- Risk of hurricanes and storm surges.

Geology and geomorphology

- Offshore/ Coastal geology and geomorphology (use maps to show major zones or geomorphological features such as reef line, vegetation line);
- Bathymetry (at the proposed outfall location and alternative locations).

Hydrography/hydrodynamics (use maps)

- Tidal ranges and tidal currents;
- Surface flow around the island
- Wind induced seasonal currents;
- Wave climate and wave induced currents (in relation to outfall locations);

Ecology

- 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; and significant inland flora; Include description of commercial species with potential to become nuisances or vector. Include maps to illustrate the extent of this component within the pocket boundary;
- Quantitative marine assessments: Marine habitat status including coral reef health, sea grass beds and benthic and fish community description at outfall location and a control site. Select a control site far from the outfall location and a test site at representative distance from the outfall discharge site;
- Assessment of terrestrial vegetation from areas that need to be cleared for the purpose of the project to include, area, number, and type of trees to be cleared.
- Identify locations where any uprooted trees are to be transplanted.

Physical Parameters

- Seawater quality measuring these parameters: Temperature, pH, Salinity, Turbidity and Total Suspended Solids (from all outfall sites, and alternative sites. Control site will be the site that the project components are not developed in);
- Ground water quality assessment of STP location and control site in the island, measuring these parameters: temperature, pH, salinity, Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Fecal Coliform, Total Coliform;
- Noise measurement outside within 1m radius and nearest residential area of STP and from one control site.
- Characteristics of seabed sediments to assess direct habitat destruction and turbidity impacts during construction;

Hazard vulnerability:

- Vulnerability of area to flooding, storm surge and tsunami events.

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.

- Approval from EPA
- Approvals from relevant government authorities (if applicable).

Task 4. Assessment of Impacts and Risks: The EIA report should identify all the impacts, direct and indirect, during and after construction, and evaluate the magnitude and significance of each. Impact assessment shall consider the views and concerns of key stakeholders, including affected people, Proponent and relevant authorities.

Impact assessment will address, but not be limited to, the following impact issues:

Impacts on the natural environment

- Changes in flow velocities/directions, resulting in changes in erosion/sedimentation patterns, which may impact shore zone configuration/coastal morphology;
- Sediment dispersal in water column (turbidity at the discharge pipe installation), and possibly resulting in changes in visibility, smothering of coral reefs and benthic communities and affecting fish and shellfish etc.;
- Seawater quality deterioration
- Ecosystem services: loss of corals in the area
- Waste management during construction, particularly from demolition waste
- Loss of vegetation and fauna from land clearance activities, STP location, pump stations and pipe works;
- Impacts on groundwater quality;
- Impacts on unique or threatened habitats or species (coral reefs, sea turtles etc.), and
- Impacts on landscape integrity/scenery.
- Sewage waste collection and disposal impacts;
- Impacts of noise, vibration and disturbances;
- Impacts on soil

Impacts on the socio-economic environment

- Disturbance to local natural resource users such as fishing areas, other tourism ventures nearby;
- Odour and noise impacts;
- Land use displacement and economic opportunities and opportunity costs;
- Increased demands on natural resources and services (domestic water supply, wastewater disposal, treatment systems, solid waste disposal systems, energy supply, etc.);
- Impacts on installation of discharge line (particularly on passenger and material movement)
- Safety- worker and community safety during construction and operation;

Construction related hazards and risks

- Pollution of the natural environment (e.g. oil spills, disposal of construction waste);
- Risk of accidents and pollution on workers and local population, and

The methods used to identify the significance of the impacts shall be outlined. One or more of the following methods must be utilized in determining impacts; checklists, matrices, overlays, networks, expert systems and professional judgment. Justification must be provided to the selected methodologies. The report should outline the uncertainties in impact prediction and also outline all positive and negative/short and long-term impacts. Identify impacts that are cumulative and unavoidable.

Task 5. Alternatives to proposed project – Describe alternatives including the "no action option" should be presented. Determine the best practical environmental options. Alternatives examined for the proposed project that would achieve the same objective including the "no action alternative". Environmental, social and economic factors should be taken into consideration. The report should give justification for alternative technologies for the STP and highlight how the various alternatives were determined. All alternatives must be compared according to international standards and commonly accepted standards as much as possible. The comparison should yield the preferred alternative for implementation. Mitigation options should be specified for each component of the proposed project.

Task 6. Mitigation and management of negative impacts – Identify possible measures to prevent or reduce significant negative impacts to acceptable levels. Mitigation measures to avoid or compensate habitat destruction, e.g. temporal sediment control structures, Measures for both construction and operation phase shall be identified. Cost the mitigation measures, equipment and resources required to implement those measures. The confirmation of commitment of the developer to implement the proposed mitigation measures shall also be included.

Task 7. Development of monitoring plan – Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan for the proposed development, including beach morphology, sediment movement around the island. A reasonable time frame shall be outlined for monitoring during construction and operational phase. Identify the critical issues requiring monitoring to ensure compliance to mitigation measures and present impact management and monitoring plan. The report shall also provide a detailed cost breakdown for implementing the monitoring plan. Provide commitment of the proponent to conduct the monitoring plan.

Task 8. Stakeholder consultation, Inter-Agency coordination and public participation) – EIA report should include a list of people/groups consulted and what were the major outcomes. Identify appropriate mechanisms to supply stakeholders and the public with information about the development proposal and its progress. Major

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Environmental Protection Agency



stakeholder consultation shall include relevant government ministries, government agencies, engineers/designers, Atoll Council and Utility service providers. The following parties should be consulted;

- Ministry of Environment (Water Department and Environment Department)
- Utilities Regulatory Authority
- National Disaster Management Authority
- Housing Development Corporation

The EIA report needs to be submitted to island council and atoll council and evidence of submission needs to be included in the report. EIA report needs to include a list of those who are consulted, moreover, the report needs annex minutes of any meetings held. All issues raised by the stakeholders need to be addressed in the report.

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 Regulations 2012 and the subsequent amendments.

Timeframe for submitting the EIA report – The developer must submit the completed EIA report within 6 months from the date of this Terms of Reference.

19th December 2022



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Annex 2: Site plan and STP design details

