

# PHI: BAGUIO CITY SMART FLOOD WARNING, INFORMATION AND MITIGATION SYSTEM

CONSOLIDATION PHASE  
PRE-MONSOON ASSESSMENT REPORT  
APPENDIX

OCTOBER 2023



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AUSTRALIA  
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# **APPENDIX A: BIAS CORRECTION SCENARIO USING ERROR DISTRIBUTION**





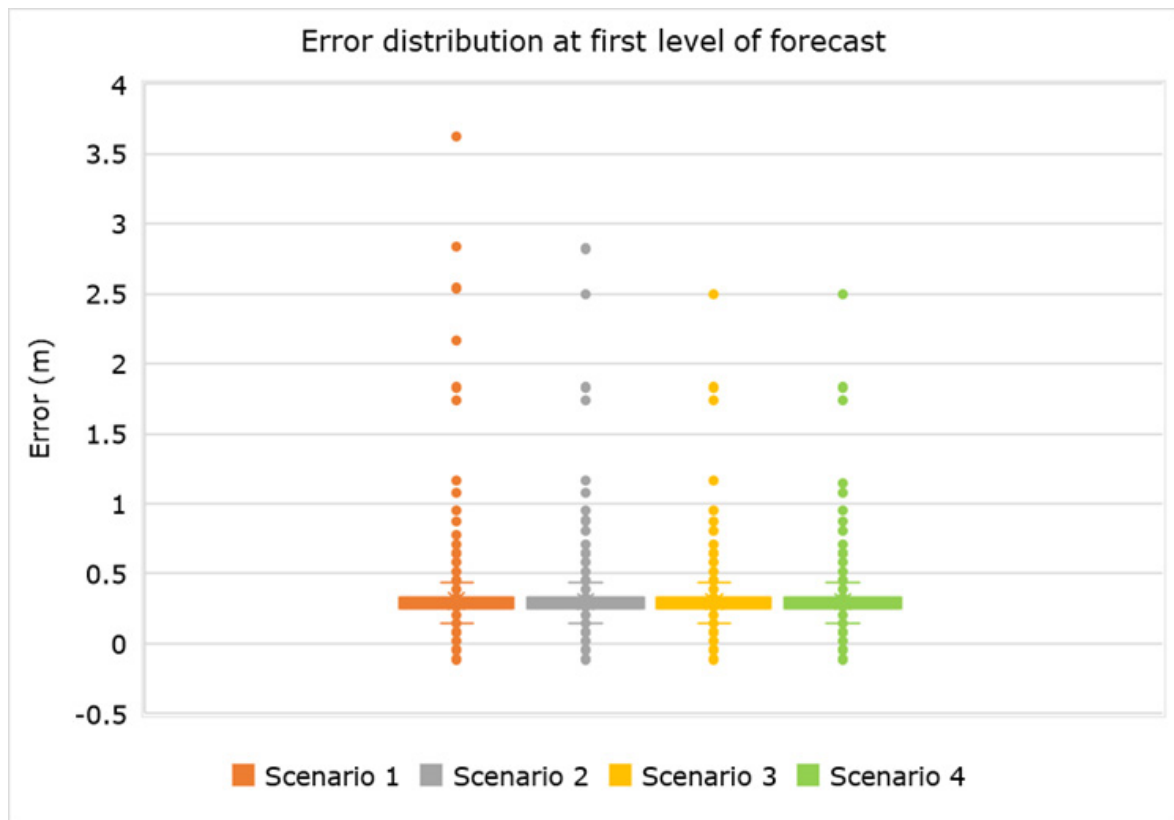


Figure A-1 Error distribution at first level of forecast

Source: Ramboll

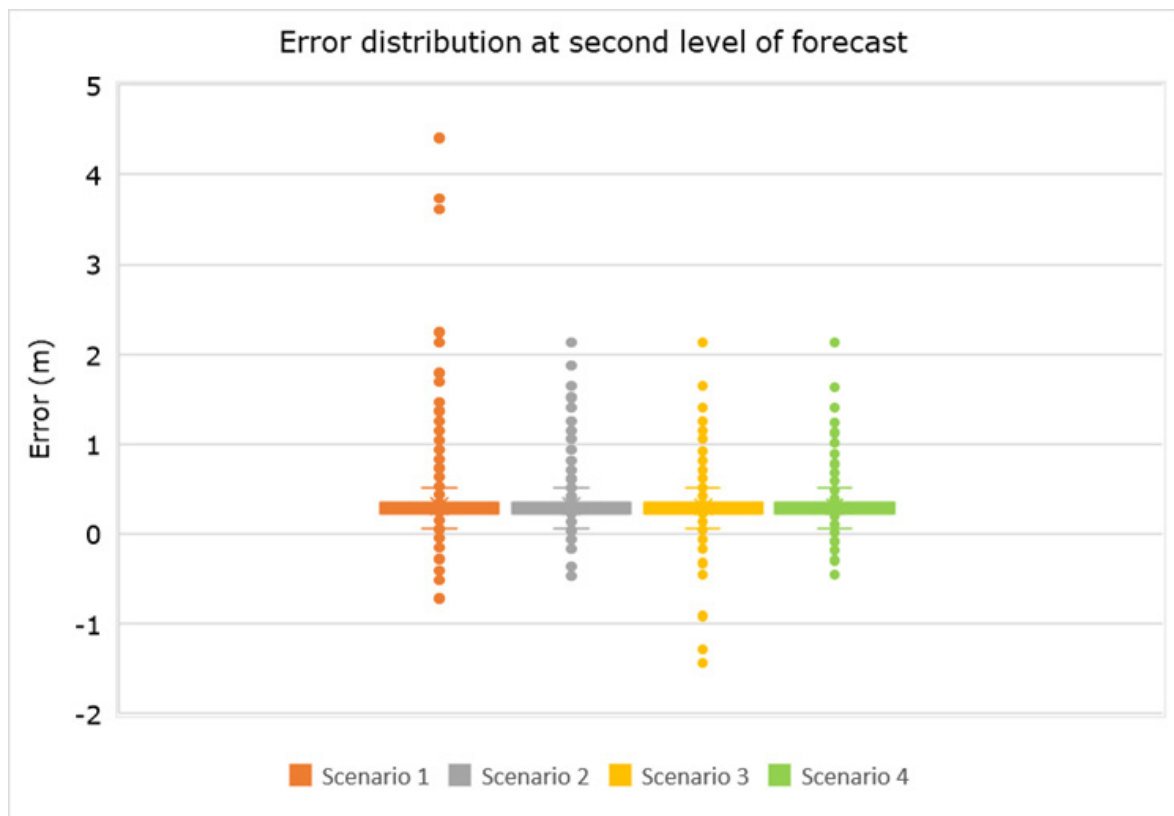


Figure A-2 Error distribution at second level of forecast

Source: Ramboll



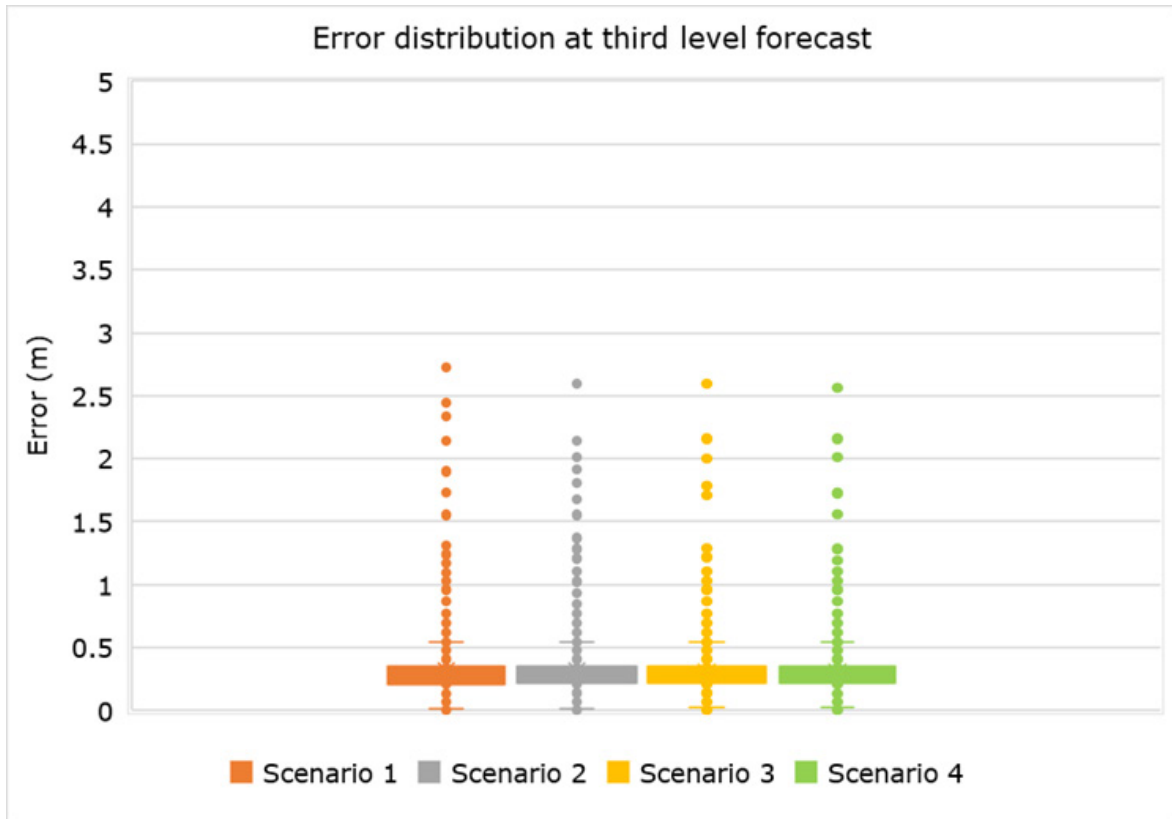


Figure A-3 Error distribution at third level of forecast

Source: Ramboll

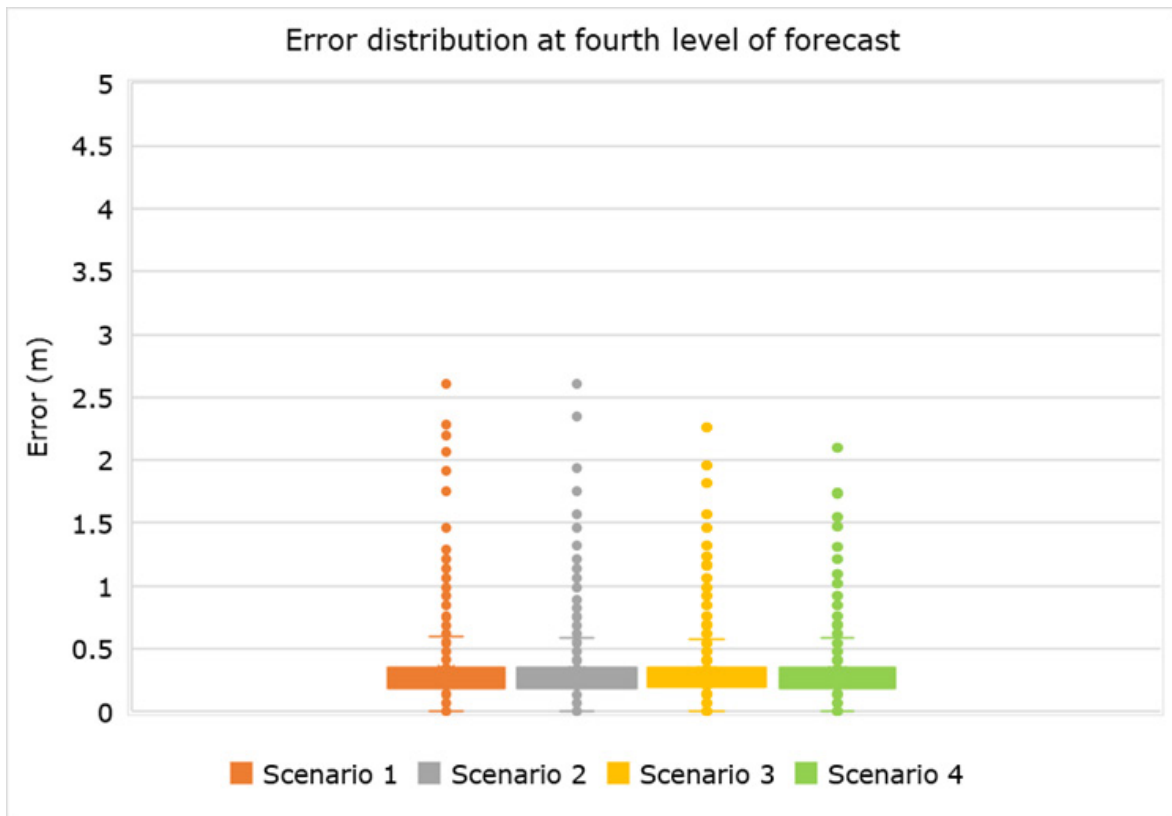


Figure A-4 Error distribution at fourth level of forecast

Source: Ramboll

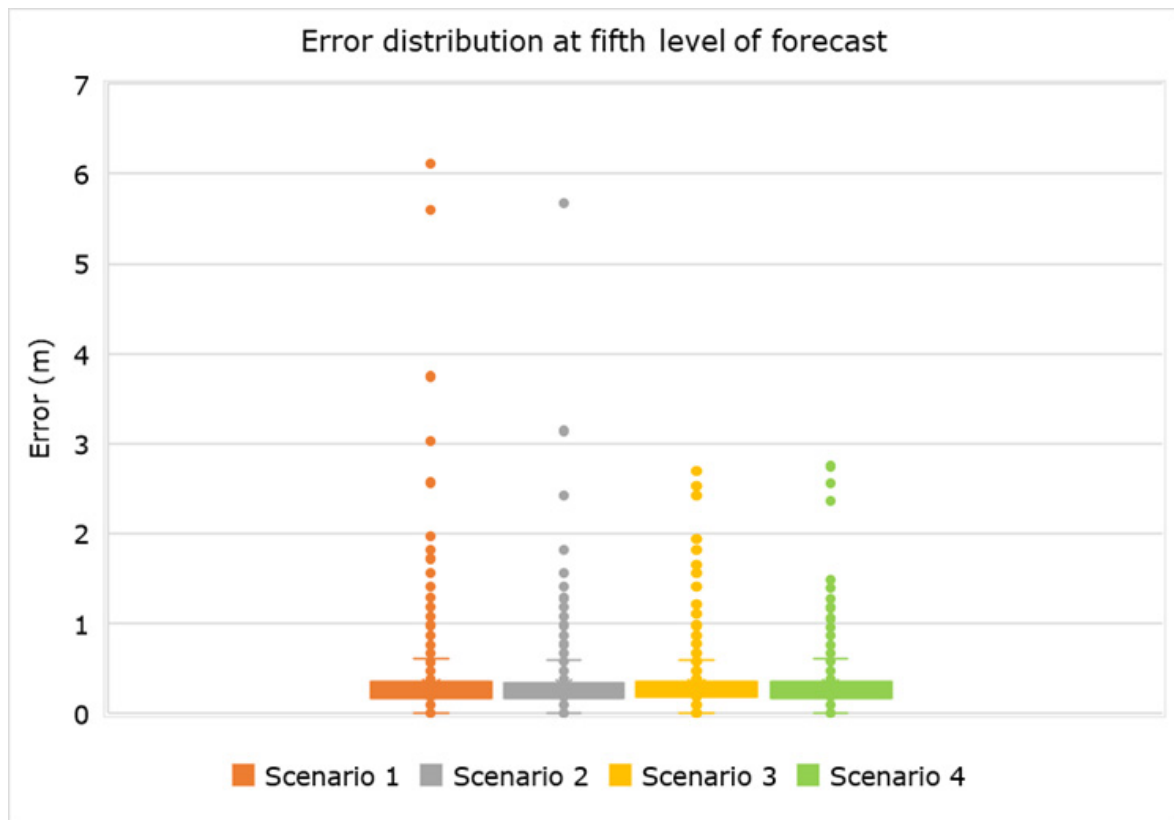


Figure A-5 Error distribution at fifth level of forecast

Source: Ramboll

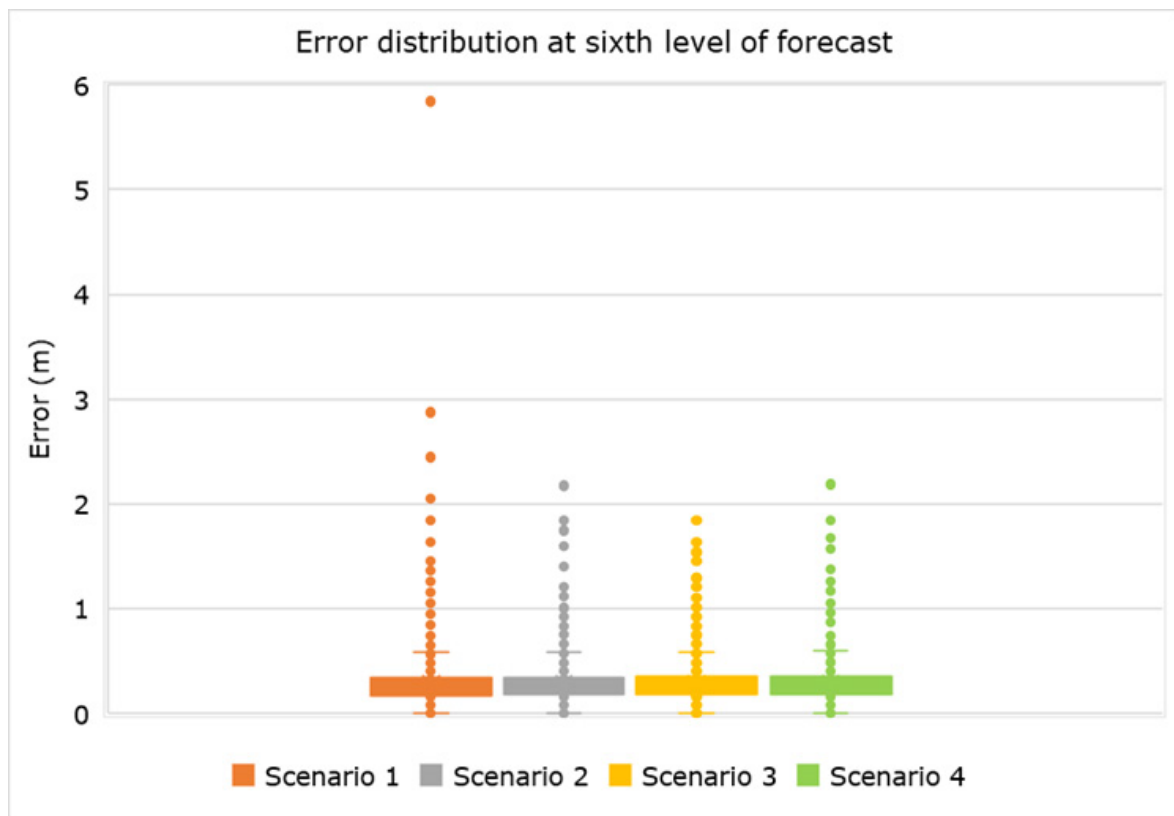
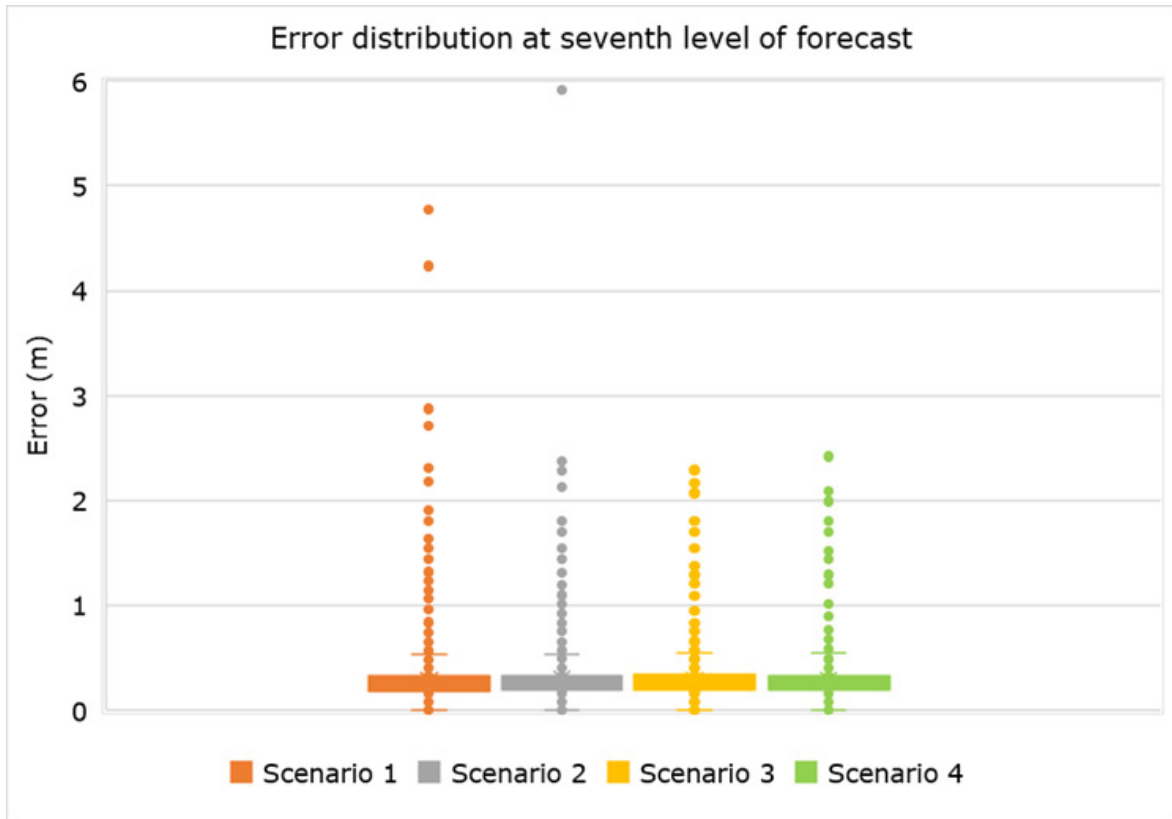


Figure A-6 Error distribution at sixth level of forecast

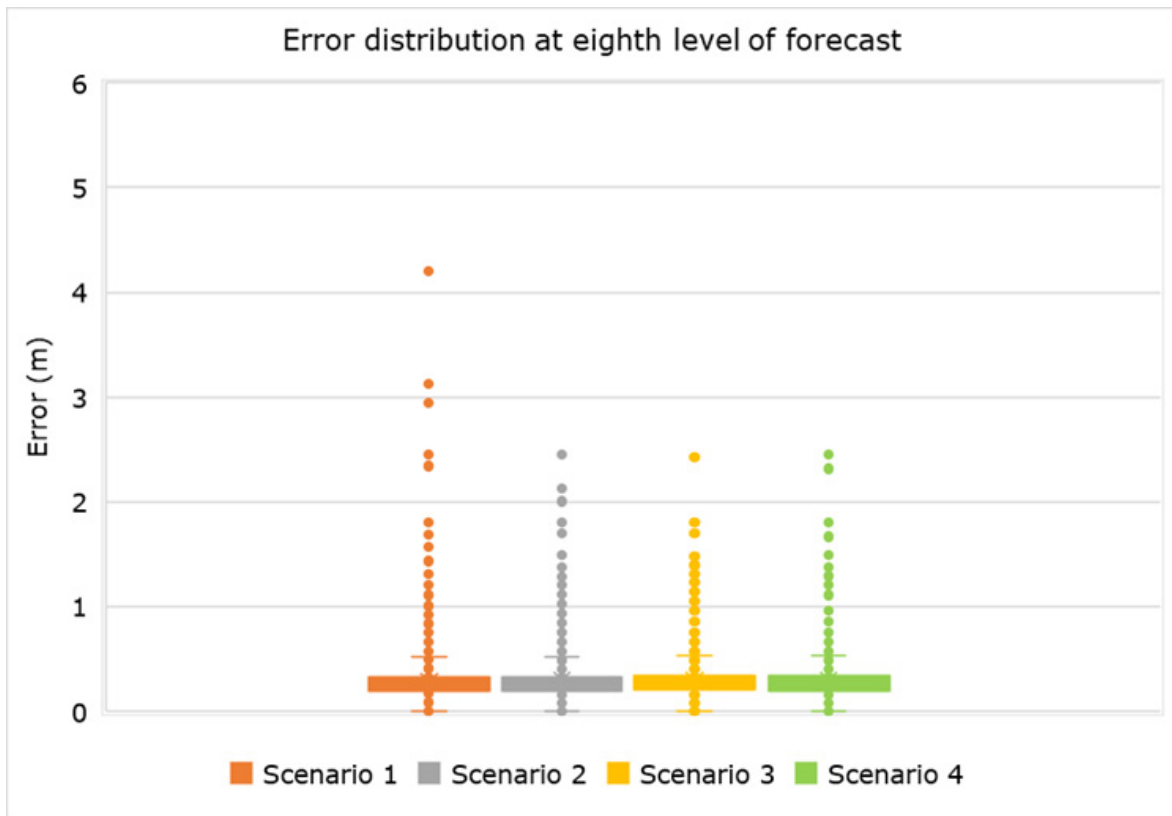
Source: Ramboll





**Figure A-7 Error distribution at seventh level of forecast**

Source: Ramboll



**Figure A-8 Error distribution at eighth level of forecast**

Source: Ramboll

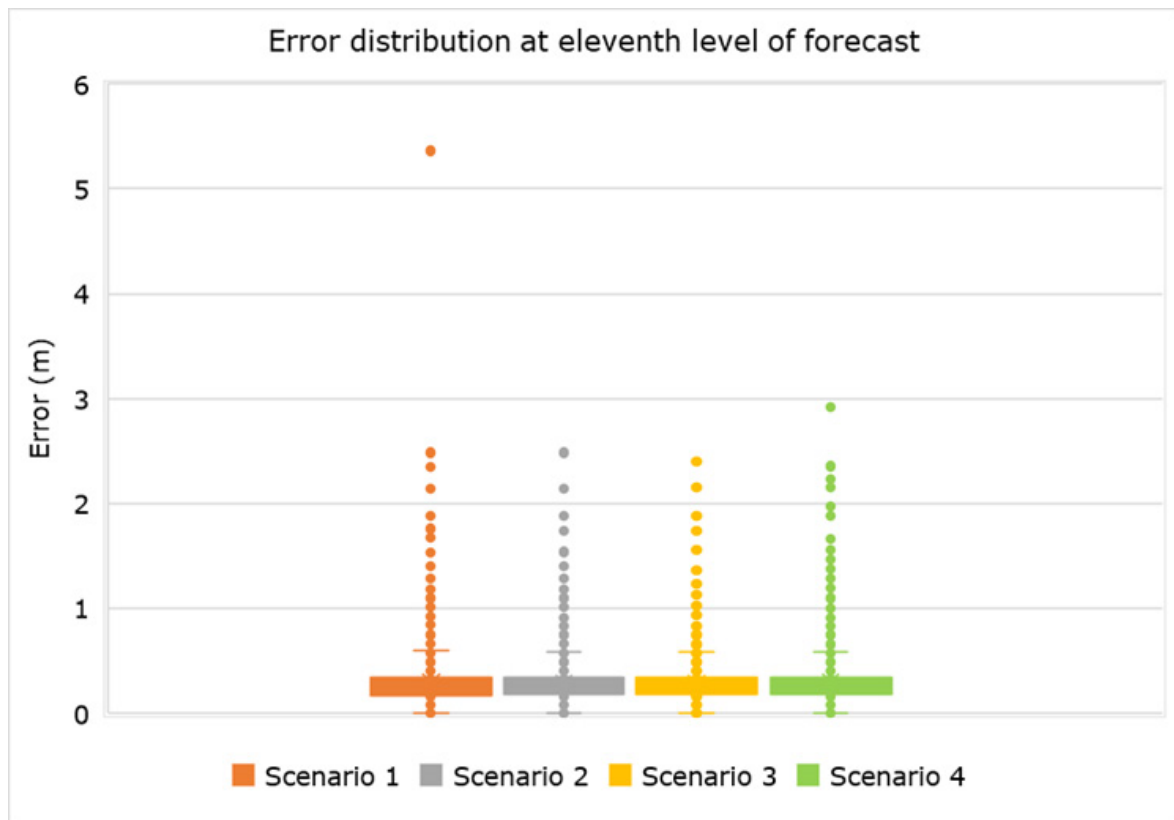


Figure A-9 Error distribution at eleventh level of forecast

Source: Ramboll

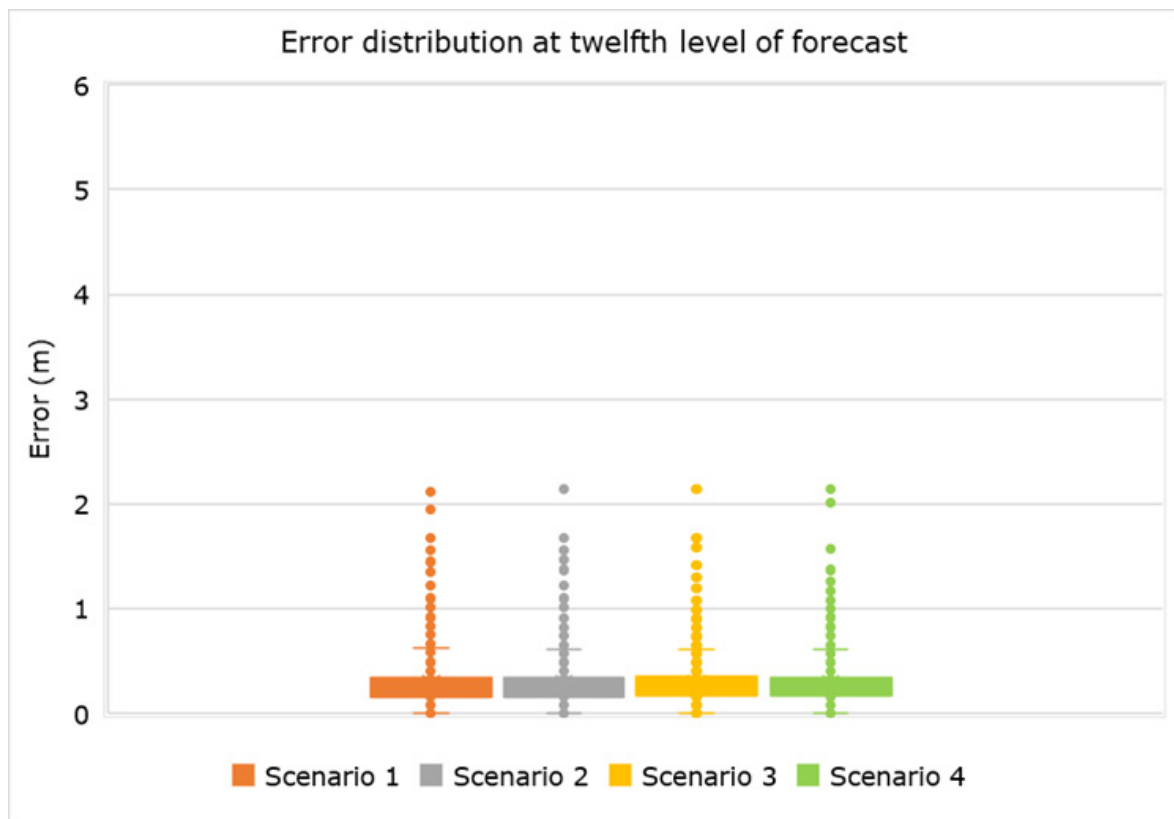


Figure A-10 Error distribution at twelfth level of forecast

Source: Ramboll



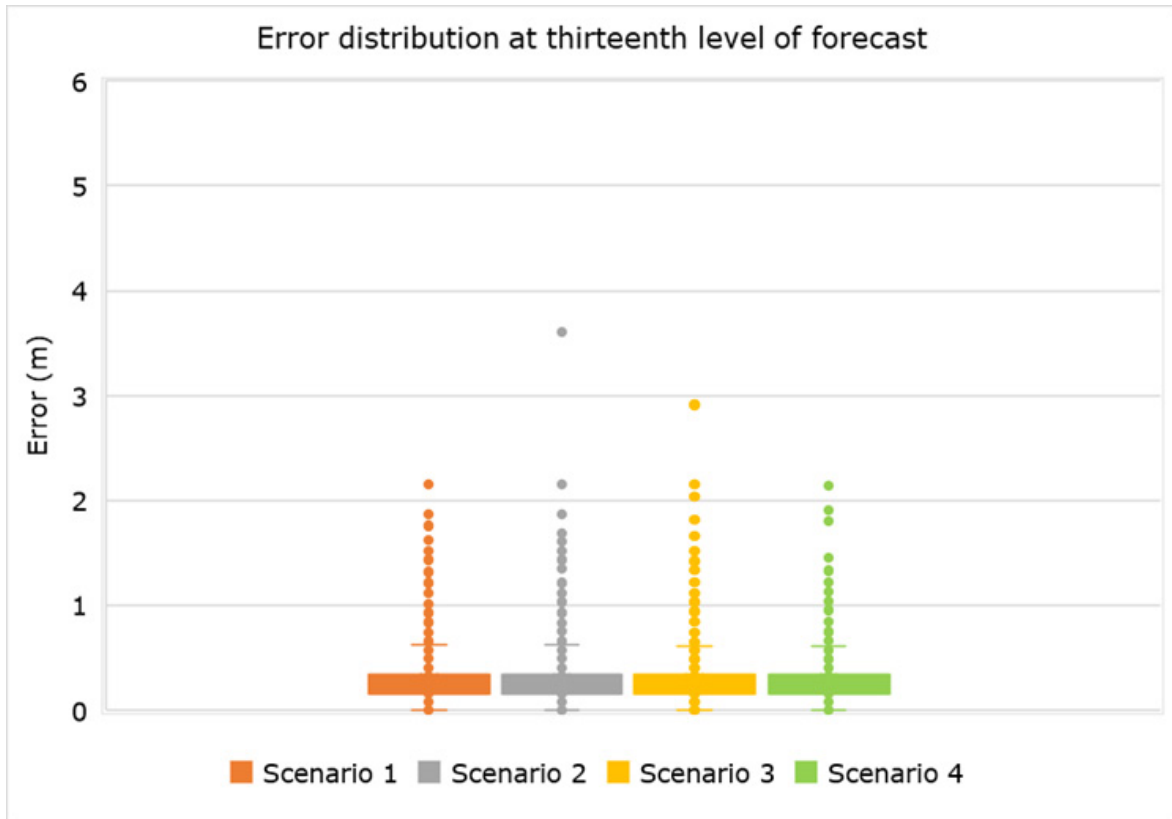


Figure A-11 Error distribution at thirteenth level of forecast

Source: Ramboll

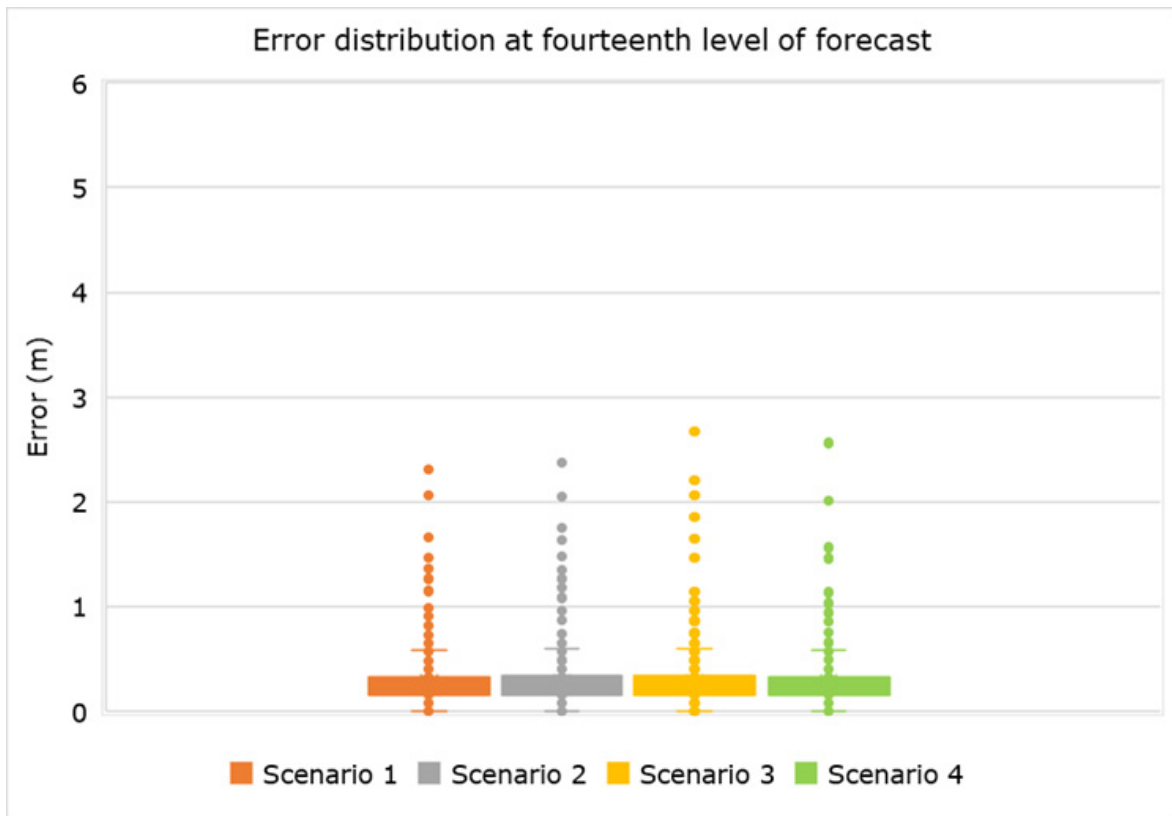


Figure A-12 Error distribution at fourteenth level of forecast

Source: Ramboll

# **APPENDIX B: SUMMARY OF UPDATES TO SCRIPTS**



**Table B-1 Table of scripts which has done maximum impact on system development**

Sr. No	Folder	Script	Description	Rationale
1	Logging	WritetoRealTimeDataLog	This script assesses the station data gathered on an hourly basis, providing a summary of the total hours of data received from the stations by the system.	It is crucial to monitor station performance throughout an entire day.
2	Logging	MakeDailyDataReport	This script examines the status of all model runs and jobs within a single day.	This process holds significance in maintaining vigilant oversight over system jobs and model simulations. This proactive approach enables timely identification and rectification of any potential system failures.
3	RealTime	get_api_historical_data	This script is utilized for downloading historical station data starting from the specified date.	This script previously downloaded historical data, but it lacked the ability to append this data to existing time series for updates. This issue has since been addressed and resolved.
4	RealTime	get_api_within_hour_data	This newly introduced API from PAGASA enables the system to update station data with the latest information, covering a span of up to the past 24 hours.	This API proves valuable by assisting in the update of any missing station data before each model simulation takes place.
5	Bias Correction	Check_WRFUploadStatus	This script verifies whether WRF data has been uploaded by PAGASA on schedule before initiating the simulation.	The logic of this script has undergone a complete transformation. It now examines the uploaded folders and their respective timestamps to determine the timing of each upload.



Sr. No	Folder	Script	Description	Rationale
6	Maintenance	DeleteAllSimutlations	This action removes all simulations associated with the chosen model scenario.	Executing this script is essential for deleting any model. Typically, model deletion can be time-consuming, but by running this script to remove all simulations initially, the subsequent model deletion process becomes more streamlined and efficient.
7	Maintenance	ForceDeleteAllSimulation	This script has a slightly different functionality from the previous version. It specifically deletes simulations with a status of "INPUT_DATA_OK".	This script is necessary to delete simulations that have not been completed and might disrupt the smooth execution of jobs.
8	Floodwatch	CatchmentAverage_WRF.R	Add the path of the shapefile for Baguio city for creating rainfall forecast for the complete city. This rainfall forecast is just for information of O&M not using it anywhere in FEWS	This script will also create rainfall forecast time series.

Source: Ramboll

# APPENDIX C: MONTHLY GENERATED RAINFALL REPORTS



Table C-1 Monthly Water Level - City Camp Lagoon

Date	Water Level(m)	% Station Working
5/1/2016	1421.149	73
6/1/2016	1421.149	82
7/1/2016	1421.149	81
8/1/2016	1421.149	77
9/1/2016	1412.209	66
10/1/2016	1413.489	88
11/1/2016	1411.279	59
12/1/2016	1414.419	78
1/1/2017	1411.529	98
2/1/2017	1411.719	91
3/1/2017	1411.239	94
4/1/2017	1414.379	93
5/1/2017	1421.149	90
6/1/2017	1421.149	79
7/1/2017	1421.149	86
8/1/2017	1421.149	99
9/1/2017	1421.149	100
10/1/2017	1414.409	100
11/1/2017	1421.149	100
12/1/2017	1411.419	32
2/1/2018	1411.339	54
3/1/2018	1421.149	78
4/1/2018	1421.149	72
5/1/2018	1421.149	83
6/1/2018	1421.149	95
7/1/2018	1421.149	94
8/1/2018	1421.149	44
9/1/2018	1421.149	58
10/1/2018	1421.149	60
4/1/2019	1421.149	81
5/1/2019	1421.149	90
6/1/2019	1421.149	84
7/1/2019	1421.149	92
8/1/2019	1421.149	99
9/1/2019	1421.149	100
10/1/2019	1421.149	96
11/1/2019	1421.149	100
12/1/2019	1421.149	77
2/1/2020	1411.319	17
3/1/2020	1414.439	100
4/1/2020	1421.149	91
5/1/2020	1421.149	95
6/1/2020	1421.149	90



Date	Water Level(m)	% Station Working
7/1/2020	1421.149	9
8/1/2020	1421.149	97
9/1/2020	1421.149	98
10/1/2020	1421.149	94
11/1/2020	1421.149	89
12/1/2020	1421.149	98
1/1/2021	1421.149	94
2/1/2021	1414.429	95
3/1/2021	1421.149	97
4/1/2021	1421.149	100
5/1/2021	1421.149	99
6/1/2021	1421.149	99
7/1/2021	1421.149	77
9/1/2021	1421.149	86
10/1/2021	1421.149	100
11/1/2021	1421.149	100
12/1/2021	1414.419	100
1/1/2022	1421.149	98
2/1/2022	1421.149	100
3/1/2022	1421.149	99
4/1/2022	1421.149	99
5/1/2022	1421.149	76
6/1/2022	1421.149	42
7/1/2022	1421.149	96
10/1/2022	780.615	31
11/1/2022	1411.179	0
3/1/2023	1421.149	17
4/1/2023	1421.149	30
5/1/2023	1421.249	73
6/1/2023	1422.289	90
7/1/2023	1422.289	74

Source: Ramboll

Table C-2 Monthly Water Level - Asin Bridge

Date	Water level (m)	% Station working
5/1/2016	224.205	66
6/1/2016	224.205	86
7/1/2016	224.205	100
8/1/2016	224.205	100
9/1/2016	224.205	47
10/1/2016	216.985	59
11/1/2016	214.075	99
12/1/2016	214.325	100
1/1/2017	213.925	100
2/1/2017	214.185	94
3/1/2017	213.905	82
4/1/2017	214.325	100
5/1/2017	215.625	96
6/1/2017	215.755	100
7/1/2017	216.015	100
8/1/2017	224.205	100
9/1/2017	215.435	100
10/1/2017	224.205	99
11/1/2017	214.205	65
12/1/2017	214.135	57
1/1/2018	215.175	17
2/1/2018	213.835	81
3/1/2018	214.205	83
4/1/2018	214.215	75
5/1/2018	214.905	75
6/1/2018	215.345	83
7/1/2018	216.395	93
8/1/2018	216.395	72
9/1/2018	218.565	77
10/1/2018	215.195	80
11/1/2018	214.115	41
1/1/2019	213.675	45
2/1/2019	213.675	60
3/1/2019	213.645	35
4/1/2019	214.085	99
5/1/2019	215.915	100
6/1/2019	215.465	100
7/1/2019	216.205	70
8/1/2019	216.155	29
9/1/2019	216.245	100
10/1/2019	215.435	72
11/1/2019	224.205	1

Date	Water level (m)	% Station working
12/1/2019	213.605	0
4/1/2020	211.875	0
5/1/2020	212.835	0
6/1/2020	224.205	2
7/1/2020	213.775	0
8/1/2020	224.205	3
9/1/2020	224.205	1
10/1/2020	224.205	1
11/1/2020	224.205	0
12/1/2020	224.205	0
1/1/2021	224.205	0
2/1/2021	213.695	0
3/1/2021	224.205	0
5/1/2021	213.865	0
6/1/2021	224.205	0
7/1/2021	224.205	3
8/1/2021	224.205	0
9/1/2021	224.205	2
10/1/2021	224.205	24
11/1/2021	216.125	98
12/1/2021	213.935	19
1/1/2022	214.2	79
2/1/2022	213.4	100
3/1/2022	217.03	94
4/1/2022	214.23	79
5/1/2022	215	57
6/1/2022	224.205	66
7/1/2022	223.955	70
9/1/2022	215.36	62
10/1/2022	215.97	61
11/1/2022	213.64	71
12/1/2022	213.205	65
1/1/2023	213.205	56
2/1/2023	213.205	34
3/1/2023	213.205	8
4/1/2023	213.265	30
5/1/2023	216.075	73
6/1/2023	216.025	90
7/1/2023	215.425	75

Source: Ramboll

Table C-3 Monthly Water Level - Camp 6 Bridge

Date	Water level (m)	% Station working
2/1/2017	771.109	24
3/1/2017	771.109	35
4/1/2017	771.129	35
5/1/2017	771.119	16
6/1/2017	771.119	37
7/1/2017	771.119	25
8/1/2017	771.129	74
9/1/2017	771.129	100
10/1/2017	771.139	100
11/1/2017	771.139	30
12/1/2017	771.129	67
1/1/2018	771.119	99
2/1/2018	771.119	35
3/1/2018	771.119	50
4/1/2018	771.119	81
5/1/2018	771.119	84
6/1/2018	771.129	75
7/1/2018	771.129	75
8/1/2018	771.139	99
9/1/2018	773.549	95
10/1/2018	771.119	51
11/1/2018	771.139	46
12/1/2018	771.129	82
1/1/2019	771.129	14
2/1/2019	771.119	99
3/1/2019	771.119	98
4/1/2019	771.739	97
5/1/2019	771.119	96
6/1/2019	771.139	69
7/1/2019	771.129	29
8/1/2019	779.119	98
9/1/2019	771.139	70
10/1/2019	771.119	68
11/1/2019	771.119	23
12/1/2019	771.139	97
1/1/2020	771.119	100
2/1/2020	771.119	100
3/1/2020	771.119	100
4/1/2020	771.119	100
5/1/2020	771.129	86
7/1/2020	771.139	9
8/1/2020	779.119	90



Date	Water level (m)	% Station working
9/1/2020	771.119	6
10/1/2020	779.119	100
11/1/2020	779.119	4
4/1/2022	11.4	4
5/1/2022	11.4	49
6/1/2022	3.39	7
7/1/2022	11.4	74
8/1/2022	3.39	4
9/1/2022	11.4	73
10/1/2022	11.4	61
11/1/2022	782.019	78
12/1/2022	782.019	67
1/1/2023	782.019	82
2/1/2023	782.019	39
3/1/2023	782.019	55
4/1/2023	772.029	22
5/1/2023	771.839	69
6/1/2023	771.729	90
7/1/2023	772.089	76

Source: Ramboll

Table C-4 Monthly Water Level - Balili Bridge

Date	Water level (m)	% Station working
6/1/2014	1303.15	17
7/1/2014	1303.77	93
8/1/2014	1303.8	92
9/1/2014	1305.75	82
10/1/2014	1303.68	63
11/1/2014	1312.93	10
12/1/2014	1303.13	74
1/1/2015	1303.1	92
2/1/2015	1303.1	99
3/1/2015	1314.45	99
4/1/2015	1305.68	85
5/1/2015	1314.45	67
6/1/2015	1304.4	95
7/1/2015	1305.07	83
8/1/2015	1305.58	100
9/1/2015	1303.95	100
10/1/2015	1307.44	100
11/1/2015	1303.12	74
12/1/2015	1303.63	72
1/1/2016	1302.97	100
2/1/2016	1302.93	98
3/1/2016	1314.45	95
4/1/2016	1302.77	71
5/1/2016	1302.75	24
6/1/2016	1303.921	7
7/1/2016	1305.671	93
8/1/2016	1304.4	92
9/1/2016	1304.45	90
10/1/2016	1306.64	84
11/1/2016	1303.05	89
12/1/2016	1303.81	93
1/1/2017	1303.18	89
2/1/2017	1303.621	40
3/1/2017	1303.511	78
4/1/2017	1303.921	100
5/1/2017	1305.831	96
6/1/2017	1305.641	100
7/1/2017	1305.511	100
8/1/2017	1305.071	100
9/1/2017	1304.921	100
10/1/2017	1304.241	100
11/1/2017	1304.731	100

Date	Water level (m)	% Station working
12/1/2017	1304.011	100
1/1/2018	1303.781	96
2/1/2018	1303.621	81
3/1/2018	1303.611	84
4/1/2018	1303.811	76
5/1/2018	1305.331	74
6/1/2018	1305.831	80
7/1/2018	1305.631	89
8/1/2018	1306.171	60
9/1/2018	1308.22	92
10/1/2018	1305.801	98
11/1/2018	1304.011	100
12/1/2018	1303.721	100
1/1/2019	1303.551	100
2/1/2019	1303.451	100
3/1/2019	1303.501	100
4/1/2019	1303.33	100
5/1/2019	1305.1	100
6/1/2019	1305.831	100
7/1/2019	1305.651	100
8/1/2019	1305.711	31
10/1/2019	1303.671	51
11/1/2019	1304.331	100
12/1/2019	1307.83	97
1/1/2020	1303.701	100
2/1/2020	1308.521	100
3/1/2020	1303.911	100
4/1/2020	1305.731	100
5/1/2020	1304.901	100
6/1/2020	1304.781	100
7/1/2020	1305.711	100
8/1/2020	1305.871	100
9/1/2020	1304.411	98
10/1/2020	1304.171	100
11/1/2020	1304.571	79
5/1/2021	1304.46	59
6/1/2021	1303.87	62
7/1/2021	1305.38	85
8/1/2021	1305.83	98
9/1/2021	1305.62	91
10/1/2021	1307.3	100
11/1/2021	1305.62	99

Date	Water level (m)	% Station working
12/1/2021	1303.52	100
1/1/2022	1303.57	99
2/1/2022	1302.93	99
3/1/2022	1303.4	100
4/1/2022	1305.19	100
5/1/2022	1304.98	65
6/1/2022	1302.87	4
7/1/2022	1303.53	57
8/1/2022	1303.23	1
9/1/2022	1303.41	7
10/1/2022	0	61
11/1/2022	1303.151	81
12/1/2022	1303.151	12
1/1/2023	1303.151	63
2/1/2023	1303.151	42
3/1/2023	1303.151	7
4/1/2023	1303.171	27
5/1/2023	1304.631	75
6/1/2023	1304.971	94
7/1/2023	1303.401	78

Source: Ramboll

**Table C-5 Monthly Water Level - Ferguson Bridge**

Date	Water level (m)	% Station working
9/1/2022	0.93	51
10/1/2022	2.29	77
11/1/2022	1367.131	82
12/1/2022	1367.091	64
1/1/2023	1367.211	81
2/1/2023	1367.291	50
3/1/2023	1367.061	39
4/1/2023	1367.371	46
5/1/2023	1368.871	79
6/1/2023	1369.141	98
7/1/2023	1368.101	80

Source: Ramboll

**Table C-6 Monthly Water Level - Sadjap Bridge**

Date	Water level (m)	% Station working
9/1/2022	0	51
10/1/2022	0	77
11/1/2022	1342.355	73
12/1/2022	1342.355	62
1/1/2023	1342.355	81
2/1/2023	1342.355	50
3/1/2023	1342.395	39
4/1/2023	1342.875	46
5/1/2023	1344.335	79
6/1/2023	1344.565	98
7/1/2023	1343.065	80

Source: Ramboll

**Table C-7 Monthly Water Level – Brookpoint**

Date	Water level (m)	% Station working
9/1/2022	0.83	51
10/1/2022	1.72	76
11/1/2022	1405.442	78
12/1/2022	1405.432	60
1/1/2023	1405.522	78
2/1/2023	1405.922	49
3/1/2023	1405.542	38
4/1/2023	1406.042	48
5/1/2023	1406.612	78
6/1/2023	1406.802	97
7/1/2023	1405.742	81

Source: Ramboll

**Table C-8 Monthly Water Level - Eagle Crest**

Date	Water level (m)	% Station working
9/1/2022	7.43	51
10/1/2022	7.43	77
11/1/2022	1314.326	82
12/1/2022	1314.326	64
1/1/2023	1309.776	80
2/1/2023	1309.836	51
3/1/2023	1314.326	40
4/1/2023	1314.326	46
5/1/2023	1314.326	79
6/1/2023	1319.346	91
7/1/2023	1318.646	1

Source: Ramboll

**Table C-9 Monthly Water Level - Camp 7**

Date	Water level (m)	% Station working
9/1/2022	6.08	51
10/1/2022	8.61	76
11/1/2022	1242.203	82
12/1/2022	1242.213	64
1/1/2023	1242.223	81
2/1/2023	1242.243	50
3/1/2023	1242.233	38
4/1/2023	1242.173	48
5/1/2023	1242.173	78
6/1/2023	1236.903	98
7/1/2023	1236.363	81

Source: Ramboll



**Table C-10 Monthly Rainfall - City Camp Lagoon**

Date	Precipitation (mm)	No of rainy days	% Station working
10/1/2022	271	12	33
11/1/2022	0	0	1
3/1/2023	0	0	17
4/1/2023	4.5	11	31
5/1/2023	248	27	76
6/1/2023	397.5	30	95
7/1/2023	12.5	12	78

Source: Ramboll

**Table C-11 Monthly Rainfall - Asin Bridge**

Date	Precipitation (mm)	No of rainy days	% Station working
5/1/2021	61.2	31	98
6/1/2021	204.8	24	75
7/1/2021	3873	31	104
8/1/2021	1481	31	104
9/1/2021	277.4	29	99
10/1/2021	0	0	3
3/1/2022	25.4	29	92
4/1/2022	409	26	83
5/1/2022	756.8	22	60
7/1/2022	49.8	12	36
9/1/2022	127.6	23	65
10/1/2022	101.4	24	64
11/1/2022	5	28	75
12/1/2022	1	26	69
1/1/2023	4.8	21	59
2/1/2023	0	0	36
3/1/2023	0	0	8
4/1/2023	70	11	31
5/1/2023	172.5	27	76
6/1/2023	767	30	95
7/1/2023	128	12	79

Source: Ramboll

**Table C-12 Monthly Rainfall - CAMP 6 Bridge**

Date	Precipitation (mm)	No of rainy days	% Station working
4/1/2022	0	0	4
5/1/2022	40.6	22	52
6/1/2022	1.8	4	7
7/1/2022	45.4	25	77
8/1/2022	11.4	2	4
9/1/2022	54	24	76
10/1/2022	94	23	64
11/1/2022	9.2	28	82
12/1/2022	0	0	70
1/1/2023	9	27	86
2/1/2023	4	13	41
3/1/2023	0	0	58
4/1/2023	11.4	9	23
5/1/2023	39	26	73
6/1/2023	118.8	30	94
7/1/2023	17.4	12	80

Source: Ramboll

**Table C-13 Monthly Rainfall - Brookpoint**

Date	Precipitation (mm)	No of rainy days	% Station working
9/1/2022	0	0	54
10/1/2022	0	0	80
11/1/2022	0	0	81
12/1/2022	0	0	64
1/1/2023	0	0	81
2/1/2023	0.5	0	52
3/1/2023	0	0	41
4/1/2023	16	16	50
5/1/2023	1075.5	28	82
6/1/2023	515.5	30	100
7/1/2023	14.5	12	85

Source: Ramboll

**Table C-14 Monthly Rainfall - Balili Bridge**

Date	Precipitation (mm)	No of rainy days	% Station working
5/1/2021	53.594	19	61
6/1/2021	127	22	65
7/1/2021	2000.758	27	89
8/1/2021	8102.6	31	103
9/1/2021	57.658	29	95
10/1/2021	0	0	3
3/1/2022	31.496	30	97
4/1/2022	32.258	26	83
5/1/2022	14.224	22	61
6/1/2022	8.382	4	5
7/1/2022	30.988	27	61
8/1/2022	0	0	2
9/1/2022	0	0	9
10/1/2022	0	0	64
11/1/2022	0	0	85
12/1/2022	0	0	13
1/1/2023	0	0	66
2/1/2023	0	0	44
3/1/2023	0	0	8
4/1/2023	2.286	10	28
5/1/2023	207.01	27	79
6/1/2023	310.388	30	98
7/1/2023	32.766	12	82

Source: Ramboll

**Table C-15 Monthly Rainfall - Irisan Fire Station**

Date	Precipitation (mm)	No of rainy days	% Station working
5/1/2023	643	27	76
6/1/2023	808	30	97
7/1/2023	42	12	78

Source: Ramboll

## **ABOUT THE ASEAN AUSTRALIA SMART CITIES TRUST FUND**

The ASEAN Australia Smart Cities Trust Fund (AASCTF) assists ASEAN cities in enhancing their planning systems, service delivery, and financial management by developing and testing appropriate digital urban solutions and systems. By working with cities, AASCTF facilitates their transformation to become more livable, resilient, and inclusive, while in the process identifying scalable best and next practices to be replicated across cities in Asia and the Pacific.

