



Project Number JA-L1049

ENVIRONMENTAL AND SOCIAL ASSESSMENT (ESA)

for the Health and Systems Strengthening Program for
the Prevention and Care Management of Non
Communicable Diseases in Jamaica

Phase 1 (St. Catherine)

*Spanish Town Hospital, Greater Portmore Health Centre, St. Jago Health
Centre and Old Harbour Health Centre*

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TABLE OF CONTENTS

1.0	INTRODUCTION.....	1
1.1	Project Context.....	1
1.1.1	Programme Description.....	1
1.1.2	Environmental and Social Assessments and Plans.....	1
1.2	Description of Projects.....	3
1.2.1	Spanish Town Hospital.....	3
1.2.2	St. Jago Park Health Centre.....	23
1.2.3	Old Harbour Health Centre.....	29
1.2.4	Greater Portmore Health Centre.....	40
1.3	Project Phases and Activities.....	48
1.3.1	Pre-Construction.....	48
1.3.2	Construction.....	49
1.3.3	Operation.....	49
1.4	Construction Methodology.....	50
1.4.1	General.....	50
1.4.2	Mobilization.....	51
1.4.3	Communication Control.....	51
1.4.4	Coordination Meeting Strategy.....	51
1.4.5	Engineering Activities.....	51
1.4.6	Shop Drawings.....	51
1.4.7	Materials.....	52
1.4.8	Procurement Planning and Control.....	52
1.4.9	Temporary Building Services.....	52
1.4.10	Demolition.....	53
1.4.11	Excavation.....	54
1.4.12	Concrete Works.....	54
1.4.13	Formwork.....	55
1.4.14	Steel Reinforcement.....	55
1.4.15	MEP Installation.....	55
1.4.16	Road Works.....	56
1.4.17	Finishing Works.....	57
1.4.18	Metal Works.....	58
1.4.19	Roofing Works.....	58
1.4.20	Doors and Windows.....	58
1.4.21	Glazed Aluminium Curtain Walls.....	59
1.4.22	Resources - Equipment.....	59
2.0	INSTITUTIONAL, LEGISLATIVE AND REGULATORY FRAMEWORK	60
2.1	Institutional Framework.....	60
2.1.1	Ministry of Health (MOH).....	61
2.1.2	Ministry of Labour and Social Security (MLSS).....	62
2.1.3	Ministry of Economic Growth and Job Creation.....	63
2.1.4	Ministry of Local Government and Community Development.....	64

2.2	Existing Legislative Framework.....	67
2.2.1	Development Control and Planning.....	67
2.2.2	Environment, Health, and Waste Management.....	70
2.3	Relevant International Safeguards.....	80
2.3.1	World Health Organization.....	80
2.3.2	World Bank Group	80
2.3.3	Basel Convention.....	81
2.3.4	Inter-American Development Bank (IDB) Safeguard Requirements	82
2.3.5	The Convention on Biological Diversity	84
2.3.6	Sustainable Development Goals	84
2.3.7	Copenhagen Declaration on Social Development	85
2.3.8	Escazu Agreement.....	85
3.0	EXECUTING AGENCY’S CURRENT CAPACITY	86
4.0	ENVIRONMENTAL CONTEXT	92
4.1	Spanish Town Hospital.....	92
4.1.1	Existing Facility	92
4.1.2	Physical Environment	141
4.1.3	Natural Hazards.....	153
4.1.4	Biological Environment.....	178
4.2	St. Jago Park Health Centre.....	185
4.2.1	Existing Facility	185
4.2.2	Physical Environment	205
4.2.3	Natural Hazards.....	215
4.2.4	Biological Environment.....	226
4.3	Old Harbour Health Centre	230
4.3.1	Existing Facility	230
4.3.2	Physical Environment	238
4.3.3	Natural Hazards.....	248
4.3.4	Biological Environment.....	261
4.4	Greater Portmore Health Centre	263
4.4.1	Existing Facility	263
4.4.2	Physical Environment	283
4.4.3	Natural Hazards.....	293
4.4.4	Biological Environment.....	305
4.5	Potential Environmental Liabilities.....	308
4.5.1	Spanish Town Hospital	308
4.5.2	St. Jago Park Health Centre.....	309
4.5.3	Old Harbour Health Centre	309
4.5.4	Greater Portmore Health Centre.....	309
5.0	SOCIAL CONTEXT	310
5.1	Demography, Services, and Infrastructure.....	310
5.1.1	Overview and Approach	310
5.1.2	Spanish Town Hospital	312

5.1.3	St. Jago Park Health Centre.....	323
5.1.4	Old Harbour Health Centre	332
5.1.5	Greater Portmore Health Centre.....	339
5.2	Employment.....	347
5.2.1	Labour Laws	347
5.2.2	Employment Status and Opportunities.....	347
5.3	Gender Based Violence (GBV)	348
5.4	Culture and Heritage.....	349
5.4.1	Indigenous People	349
5.4.2	Historical and Archaeological Sites	351
5.5	Public Participation and Consultation.....	356
5.5.1	Approach	356
5.5.2	Spanish Town Hospital	357
5.5.3	St. Jago Park Health Centre.....	359
5.5.4	Old Harbour Health Centre	361
5.5.5	Greater Portmore Health Centre.....	363
5.6	Potential Social Liabilities	366
5.6.1	Revised Project Scope.....	366
5.6.2	Facility-Specific Considerations	366
6.0	ENVIRONMENTAL AND SOCIAL IMPACTS AND RECOMMENDED MITIGATION.....	370
6.1	Environmental and Social Risk and Impacts Matrix Approach.....	370
6.2	Site Preparation and Construction Phase	371
6.2.1	Impact Matrices.....	371
6.2.2	Environmental Risk and Impact Analysis.....	377
6.2.3	Social Risks and Impacts Analysis.....	388
6.3	Operations Phase	396
6.3.1	Impact Matrices.....	396
6.3.2	Environmental Risk and Impact Analysis.....	401
6.3.3	Social Risk and Impact Analysis	405
6.4	Cumulative and Indirect Impacts	408
6.4.1	National Health Services	408
6.4.2	Water Supply	408
6.4.3	Traffic	409
6.4.4	Waste Streams	409
6.4.5	Water Quality.....	410
7.0	REFERENCES.....	411

LIST OF FIGURES

Figure 1-1	Location of the hospital and health centre facilities to be upgraded / rehabilitated as part of Phase 1.....	2
Figure 1-2	Spanish Town Hospital and St. Jago Park Health Centre – General view	3
Figure 1-3	Location map of the Spanish Town hospital	4
Figure 1-4	Renders of the new Spanish Town hospital building.....	5
Figure 1-5	Locations of the temporary laboratory and pharmacy, and the Manpower building and area for Storage Containers	6
Figure 1-6	Location map of the Spanish Town hospital and St. Jago Park Health Centre	24
Figure 1-7	St. Jago Park Health Centre Site Layout.....	25
Figure 1-8	Renders of St. Jago Park Health Centre	26
Figure 1-9	Proposed location of the Old Harbour Health Centre	33
Figure 1-10	Location Map of the Greater Portmore Health Centre	41
Figure 1-11	Greater Portmore Health Centre Site Layout.....	43
Figure 1-12	Rendered view of the proposed Greater Portmore Health Centre	44
Figure 2-1	Organizational Chart for Health Service Delivery, those relevant to this ESA highlighted within blue box)	62
Figure 2-2	Development Order Areas in Jamaica	68
Figure 4-1	Electrical poles and transformers observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021).....	96
Figure 4-2	Tank storage observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)	100
Figure 4-3	Main storage areas for non-medical hazardous chemicals observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)	106
Figure 4-4	Solid waste storage observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021).....	119
Figure 4-5	Tented areas observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)	126
Figure 4-6	Asset storage areas observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021).....	131
Figure 4-7	Emergency assembly points observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)	137
Figure 4-8	Health facilities in proximity to the Spanish Town Hospital and St Jago Park Health Centre	140
Figure 4-9	Average temperatures (°C) for the Twickenham Park weather station (2018 – 2020)	141
Figure 4-10	Relative humidity (5) for the Twickenham Park weather station (2018 – 2020)	142

Figure 4-11	Rainfall data for the Twickenham Park weather station (2018 – 2020).....	142
Figure 4-12	Geology of the Spanish Town Hospital Site in Spanish Town, St Catherine.....	143
Figure 4-13	Percentage slope at the Spanish Town Hospital and St. Jago Park Health Centre....	144
Figure 4-14	Aspect at the Spanish Town Hospital and St. Jago Park Health Centre	145
Figure 4-15	Noise and Particulate monitoring locations (Station N2P2, N3P3 and N4P4 conducted at Spanish Town Hospital).....	147
Figure 4-16	Location of Blair Pen, Catherine rainfall gauge station relative to project area.....	156
Figure 4-17	Flood Plain Validation map showing ODPEM Flood Prone Areas with 100-Yr Future Climate	161
Figure 4-18	Flood plain map of the Spanish Town Hospital for the Post Improvement, 100-Yr Future Climate Scenario	162
Figure 4-19	Concrete U-Drains on hospital compound	163
Figure 4-20	Corridors that experience flooding during storm events	163
Figure 4-21	Concrete Inlet located on the hospital compound.....	164
Figure 4-22	Earth drain on compound of facility.....	164
Figure 4-23	Seismic events between 2011 – 2020 for Jamaica	166
Figure 4-24	Site Spectral Response map for 0.2s short period (a) and 1.0s long period (b) (Source: Probabilistic Seismic Hazard Assessment for Jamaica Sep. 2013).....	167
Figure 4-25	Risk component model (IDB, 2019).....	171
Figure 4-26	Electrical poles and transformers observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021).....	187
Figure 4-27	Tank storage observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)	189
Figure 4-28	Solid waste storage observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021).....	201
Figure 4-29	Average temperatures (°C) for the Twickenham Park weather station (2018 – 2020)	205
Figure 4-30	Relative humidity (5) for the Twickenham Park weather station (2018 – 2020)	206
Figure 4-31	Rainfall data for the Twickenham Park weather station (2018 – 2020).....	206
Figure 4-32	Geology of the St Jago Health Centre Site in Spanish Town, St Catherine.....	207
Figure 4-33	Percentage slope at the Spanish Town Hospital and St. Jago Park Health Centre....	208
Figure 4-34	Aspect at the Spanish Town Hospital and St. Jago Park Health Centre	209
Figure 4-35	Noise and Particulate monitoring locations (Station N5P5 conducted at St. Jago Park Health Centre)	211
Figure 4-36	Location of Blair Pen, Catherine rainfall gauge station relative to project area	216
Figure 4-37	Flood Plain Validation map showing ODPEM Flood Prone Areas with 100-Yr Future Climate	217

Figure 4-38	Flood plain map of the St. Jago Park Health Centre for the Pre-Improvement, 100-Yr Future Climate Scenario.....	218
Figure 4-39	Health facilities in proximity to the Proposed Old harbour Health Centre	237
Figure 4-40	Average temperatures (°C) for the Colbeck weather station (2019 – 2020)	238
Figure 4-41	Relative humidity (5) for the Colbeck weather station (2018 – 2021)	239
Figure 4-42	Elevations on the proposed Old Harbour Health Centre site.....	240
Figure 4-43	Slopes on the proposed Old Harbour Health Centre site	241
Figure 4-44	Aspect on the proposed Old Harbour Health Centre site	242
Figure 4-45.	Geology of Old Harbour extracted from the 1:50,000 Metric Geology Sheets (MGD 1998)	243
Figure 4-46	Noise and Particulate monitoring locations	245
Figure 4-47	Location of Blair Pen, Catherine rainfall gauge station relative to project area	249
Figure 4-48	Flood Plain Validation map showing ODPEM Flood Prone Areas with 100-Yr Future Climate	251
Figure 4-49	Flood plain map of the Old Harbour Health Centre for the Post Improvement, 100-Yr Future Climate Scenario.....	252
Figure 4-50	JPS utilities and Digicel sites at and surrounding Greater Portmore Health Centre ..	266
Figure 4-51	Tank storage observed at the Greater Portmore Health Centre	267
Figure 4-52	Solid waste storage observed at the Greater Portmore Health Centre (September 18, 2021)	276
Figure 4-53	Health Facilities in Proximity to the GPHC.....	282
Figure 4-54	Average temperatures (°C) for the Twickenham Park Automatic Weather Station (2017 – 2020)	283
Figure 4-55	Relative humidity for the Twickenham Park Automatic Weather Station (2017 – 2020)	284
Figure 4-56	Elevation at Greater Portmore HC	285
Figure 4-57	Percentage slope at Greater Portmore HC	286
Figure 4-58	Aspect at Greater Portmore HC	287
Figure 4-59.	Geology of the Greater Portmore Health Centre Site in St Catherine	288
Figure 4-60	Noise and particulate monitoring locations	290
Figure 4-61	Location of Blair Pen, Catherine rainfall gauge station relative to project area.....	294
Figure 4-62	Flood Plain Validation map showing ODPEM Flood Prone Areas with 100-Yr Future Climate	296
Figure 4-63	Flood plain map of the St. Jago Park Health Centre for the Pre-Improvement, 100-Yr Future Climate Scenario.....	297
Figure 5-1	Service Areas for all St. Catherine health facilities included in the project.....	311
Figure 5-2	Communities within the Service Area (SA) for Spanish Town Hospital	313

Figure 5-3	SA 2001 and 2011 population represented by enumeration districts	315
Figure 5-4	Road network and services located in the SA	318
Figure 5-5	Land use, protected areas and forest estates within the SA	320
Figure 5-6	Town and Country Planning (Saint Catherine Parish) Provisional Development Order, 2017 (Confirmation) Notification, 2019 and the Spanish Town Local Planning Area Land use proposals (Inset No.1) in relation to the SA	321
Figure 5-7	Spanish Town Local Planning Area Land use proposals (Inset No.1 1), St Catherine Area Development Order 2017)	322
Figure 5-8	Communities within the Service Area (SA) for St, Jago Park HC	325
Figure 5-9	SA 2001 and 2011 population represented by enumeration districts	326
Figure 5-10	Road network and services located in the SA	329
Figure 5-11	Land use, protected areas and forest estates within the SA	330
Figure 5-12	Town and Country Planning (Saint Catherine Parish) Provisional Development Order, 2017 (Confirmation) Notification, 2019 and the Spanish Town Local Planning Area Land use proposals (Inset No.1) in relation to the SA	331
Figure 5-13	Communities within the Service Area (SA) for Old Harbour HC	333
Figure 5-14	SA 2001 and 2011 population represented by enumeration districts	334
Figure 5-15	Land use, protected areas and forest estates within the SA	337
Figure 5-16	Town and Country Planning (Saint Catherine Parish) Provisional Development Order, 2017 (Confirmation) Notification, 2019 and St Catherine Area Development Order 2017 Inset No. 3 in relation to the SA	338
Figure 5-17	Communities within the Service Area (SA) for Greater Portmore HC	340
Figure 5-18	SA 2001 and 2011 population represented by enumeration districts	341
Figure 5-19	Land use, protected areas and forest estates within the SA	344
Figure 5-20	Town and Country Planning (Saint Catherine Parish, Portmore Municipality) Provisional Development Order, 2018 and Portmore South Local Planning Area (Inset No. 2) in relation to the SA	345
Figure 5-21	Town and Country Planning (Saint Catherine Parish, Portmore Municipality) Provisional Development Order, 2018, Greater Portmore East Area Land Use Proposals (Inset No. 2.4)	346
Figure 5-22	Taino locations in proximity to Spanish Town Hospital, St. Jago Park, Old Harbour and Greater Portmore Health Centres.....	350
Figure 5-23	Map of Jamaica showing parish boundaries and locations of the major Maroon Settlements	351
Figure 5-24	Letter from the Lion's Club of Old Harbour	367
Figure 5-25	Informal Settlement located to the south of the proposed project area.....	368

LIST OF TABLES

Table 1-1	Spanish Town Hospital – Bed wards organization	20
Table 1-2	Floor Areas for St. Jago Park Health Centre	27
Table 1-3	Major equipment types that will be used during the execution of the project	59
Table 2-1	Organization and Structure of NSWMA	65
Table 2-2	Significant Impact Concentrations and the Jamaican National Ambient Air Quality Standards (JNAAQS) and Guideline Concentrations (GC) for air quality.....	73
Table 2-3	Draft national ambient freshwater water quality standards for Jamaica, 2009.....	75
Table 2-4	Sewage Effluent Standards for existing plants	76
Table 2-5	Sewage Effluent Standards for new plants	76
Table 2-6	Sewage Effluent Standards for use in Irrigation	76
Table 2-7	Industrial Trade Effluent Standards	77
Table 2-8	NRCA standards for daytime and night time noise in various zones	78
Table 2-9	Operational Compliance with IDB Guidelines for Environmental and Social Performance Standards (ESPS)	83
Table 3-1	Evaluation of Institutional Capacity and Recommendations for Technical Strengthening	87
Table 4-1	Categories of Medical Waste.....	111
Table 4-2	Estimated Medical Waste Generation rates pre Category of Facility	120
Table 4-3	Summary of wastewater treatment plant effluent monitoring report for Spanish Town Hospital	121
Table 4-4	Spanish Town Hospital Total Patient Load Statistics for the Year 2019	122
Table 4-5	Spanish Town Hospital Total Patient Load Statistics for the Year 2020	123
Table 4-6	Restrooms at Spanish Town Hospital	138
Table 4-7	Summarized PM 10 Results.....	146
Table 4-8	Summarized PM 2.5 Results.....	146
Table 4-9	Ambient Noise data at all stations	148
Table 4-10	Comparison of daytime and night-time noise levels at the stations with the NRCA guidelines	148
Table 4-11	Noise level during work hours (7:30am – 5:00pm)	149
Table 4-12	Guidance on the effects of vibration	149
Table 4-13	Present climate 24-Hour Rainfall Depths (mm) for Blair Pen rain gauge station (Met. Service/NWA)	156

Table 4-14	Earthquake magnitude, category, and effects	165
Table 4-15	Three closest seismic events to the Spanish Town Hospital (2011 – 2020)	165
Table 4-16	Relation between Mercalli Intensity and the expected damage from varying spectral accelerations	168
Table 4-17	Seismicity descriptions based on short and long spectral acceleration	169
Table 4-18	Category wind and the attached description of expected damage	170
Table 4-19:	Wind speeds for Spanish Town Hospital and respective return periods.....	170
Table 4-20	Risk matrix approach (Source: Caribbean Handbook on Risk Information Management as presented by the IDB Methodology, p. 78)	173
Table 4-21	Impact Description associated with various hazards and their level of severity.....	173
Table 4-22	Impact Rating for STH regarding flooding	174
Table 4-23	Showing building type for STH	174
Table 4-24	Impact Rating for STH regarding seismic activity	174
Table 4-25.	Impact Rating for STH regarding hurricane winds.....	175
Table 4-26	Criticality of proposed Facilities.....	175
Table 4-27	Exposure considerations and values for flooding.....	176
Table 4-28	Resultant spectral accelerations (short and long) with associated return periods....	176
Table 4-29	Exposure considerations and values for flooding.....	177
Table 4-30	Vulnerability levels of STH for flooding and hurricane winds	177
Table 4-31:	Vulnerability levels of STH for seismic activity	177
Table 4-32	Results of risk matrix for Spanish Town Hospital	178
Table 4-33	List of floral species identified along transects in the assessed area. A classification ranking was used to show prevalence (Adams 1972) and the DAFOR index to show the frequency of each plant species encountered.	179
Table 4-34	Bird species observed in the study in the areas	182
Table 4-35	Herpetofauna observed during the study.....	183
Table 4-36	The Macro Invertebrates observed during the assessment of the STH property.....	183
Table 4-37	Categories of Medical Waste	194
Table 4-38	Estimated Medical Waste Generation rates pre Category of Facility	198
Table 4-39	St. Jago Park Total Patient Load Statistics for the Year 2019	199
Table 4-40	St. Jago Park Total Patient Load Statistics for the Year 2020	200
Table 4-41	Summarized PM 10 Results.....	210
Table 4-42	Summarized PM 2.5 Results.....	210
Table 4-43	Ambient Noise data at all stations	212
Table 4-44	Comparison of daytime and night-time noise levels at the stations with the NRCA guidelines	212

Table 4-45	Noise level during work hours (7:30am – 5:00pm)	212
Table 4-46	Present climate 24-Hour Rainfall Depths (mm) for Blair Pen rain gauge station (Met. Service/NWA) 215	
Table 4-47	Wind speeds for St. Jago Health Centre and respective return periods.....	221
Table 4-48	Building type for STH	223
Table 4-49	Criticality of proposed Facilities.....	223
Table 4-50	Resultant spectral accelerations (short and long) with associated return periods....	224
Table 4-51:	Exposure considerations and values for hurricane winds.....	225
Table 4-52	Results of risk matrix for SJHC	225
Table 4-53	List of floral species identified along transects in the assessed area. A classification ranking was used to show prevalence (Adams 1972) and the DAFOR index to show the frequency of each plant species encountered.	226
Table 4-54	Bird species observed in the study areas	228
Table 4-55	The Macro Invertebrates observed during the assessment of the property of the St. Jago Health Centre 229	
Table 4-56	Herpetofauna observed during the study.....	230
Table 4-57	Categories of Medical Waste.....	233
Table 4-58	Estimated Medical Waste Generation rates pre Category of Facility	234
Table 4-59	Old Harbour Health Centre Total Patient Load Statistics for the Year 2019.....	235
Table 4-60	Old Harbour Heath Centre Total Patient Load Statistics for the Year 2020	235
Table 4-61	Summarized PM 10 Results.....	244
Table 4-62	Summarized PM 2.5 Results.....	244
Table 4-63	Ambient Noise data at all stations	246
Table 4-64	Comparison of daytime and night-time noise levels at the stations with the NRCA guidelines 246	
Table 4-65	Noise level during work hours (7:30am – 5:00pm)	246
Table 4-66	Present Climate 24- Hour Rainfall Depths (mm) for Bodles rain gauge station (Met.Service) 249	
Table 4-67	Three closest seismic events to the proposed Old Harbour Health Centre (2011 – 2020) 253	
Table 4-68	Wind speeds for Old Harbour Health Centre and respective return periods.....	255
Table 4-69	Impact Rating for STH regarding flooding	257
Table 4-70	Showing building type for OHHC.....	257
Table 4-71	Criticality of proposed Facilities.....	258
Table 4-72	Exposure considerations and values for flooding.....	258
Table 4-73	Resultant spectral accelerations (short and long) with associated return periods....	259
Table 4-74	Exposure considerations and values for hurricane winds.....	259

Table 4-75	Results of risk matrix for Old Harbour Health Centre	260
Table 4-76	List of floral species identified along transects in the assessed area. A classification ranking was used to show prevalence (Adams 1972) and the DAFOR index to show the frequency of each plant species encountered.	261
Table 4-77	Bird species observed in the study in the areas	262
Table 4-78	Herpetofauna observed during the study.....	262
Table 4-79	The Macro Invertebrates observed during the assessment of the proposed site for the Old Harbour Health Centre.....	263
Table 4-80	Categories of Medical Waste.....	271
Table 4-81	Estimated Medical Waste Generation rates pre Category of Facility	275
Table 4-82	Greater Portmore Total Patient Load Statistics for the Year 2019	277
Table 4-83	Greater Portmore Total Patient Load Statistics for the Year 2020	277
Table 4-84	Summarized PM 10 Results.....	289
Table 4-85	Summarized PM 2.5 Results.....	289
Table 4-86	Ambient Noise data at all stations	291
Table 4-87	Comparison of daytime and night-time noise levels at the stations with the NRCA guidelines	291
Table 4-88	Noise level during work hours (7:30am – 5:00pm)	291
Table 4-89	Present climate 24-Hour Rainfall Depths (mm) for Blair Pen rain gauge station (Met. Service/NWA)	294
Table 4-90	Closest seismic events to the Portmore Health Centre (2011 – 2020)	298
Table 4-91	Wind speeds for Portmore Health Centre and respective return periods	300
Table 4-92	Building type for Portmore GPHCC	302
Table 4-93	Impact Rating hurricane winds.....	302
Table 4-94	Criticality of proposed Facilities.....	303
Table 4-95	Resultant spectral accelerations (short and long) with associated return periods....	303
Table 4-96	Exposure considerations and values for hurricane winds.....	304
Table 4-97	Results of risk matrix for GPHC	304
Table 4-98	List of floral species identified along transects in the assessed area	306
Table 4-99	Bird species observed in the study in the areas	307
Table 4-100	Herpetofauna observed during the study.....	307
Table 4-101	The Arthropod encountered on the property	308
Table 5-1	Communities located within the SA, sorted from largest to smallest in area of coverage within the SA.....	312
Table 5-2	Comparison of population densities for the year 2011	314
Table 5-3	Comparison of national, regional and SA housing ratios for 2011	314

Table 5-4	Percentage of households by water supply for the year 2011	316
Table 5-5	Communities located within the SA, sorted from largest to smallest in area of coverage within the SA.....	323
Table 5-6	Comparison of population densities for the year 2011	324
Table 5-7	Comparison of national, regional and SA housing ratios for 2011	324
Table 5-8	Percentage of households by water supply for the year 2011	327
Table 5-9	Communities located within the SA, sorted from largest to smallest in area of coverage within the SA.....	332
Table 5-10	Comparison of population densities for the year 2011	332
Table 5-11	Comparison of national, regional and SA housing ratios for 2011	332
Table 5-12	Percentage of households by water supply for the year 2011.....	335
Table 5-13	Communities located within the SA, sorted from largest to smallest in area of coverage	339
Table 5-14	Comparison of ED population densities for the year 2011.....	339
Table 5-15	Comparison of national, regional and SA housing ratios for 2011	339
Table 5-16	Percentage of households by water supply for the year 2011.....	342
Table 5-17	Population 14 years old and over by economic activity in the week preceding the census by age group in the parish of St. Catherine.....	347
Table 5-18	Historical and archaeological sites within 1km of the Spanish Town hospital (JAD 2001)	352
Table 5-19	Historical and archaeological sites within 1km of the newly proposed Old Harbour Health Centre (JAD 2001).....	354
Table 5-20	Stakeholder Identification	357
Table 5-21	Summary of Findings	358
Table 5-22	Stakeholder Identification.....	360
Table 5-23	Summary of Findings.....	361
Table 5-24	Stakeholder Identification Groups.....	362
Table 5-25	Summary of Findings.....	362
Table 5-26	Stakeholder group identification, characteristics and interests	363
Table 5-27	Summary of findings from meetings	365
Table 6-1	Ranking criteria utilised for duration, magnitude and extent of each potential impact	371
Table 6-2	Environmental and Social impact matrix for site preparation and construction phase at Spanish Town Hospital.....	372
Table 6-3	Environmental and Social impact matrix for site preparation and construction phase at St. Jago Park Health Centre.....	374
Table 6-4	Environmental and Social impact matrix for site preparation and construction phase at Old Harbour Health Centre	375

Table 6-5	Environmental and Social impact matrix for site preparation and construction phase at Greater Portmore Health Centre	376
Table 6-6	Summary of Potential Site Preparation and Construction Phase Environmental Impacts for Spanish Town Hospital.....	377
Table 6-7	Summary of Potential Site Preparation and Construction Phase Environmental Impacts for St. Jago Health Centre.....	377
Table 6-8	Summary of Potential Site Preparation and Construction Phase Environmental Impacts for Old Harbour Centre.....	378
Table 6-9	Summary of Potential Site Preparation and Construction Phase Environmental Impacts for Greater Portmore Health Centre	378
Table 6-10	Tree Species to be removed.....	384
Table 6-11	Summary of Potential Site Preparation and Construction Phase Social Impacts for Spanish Town Hospital.....	388
Table 6-12	Summary of Potential Site Preparation and Construction Phase Social Impacts for St. Jago Health Centre	388
Table 6-13	Summary of Potential Site Preparation and Construction Phase Social Impacts for Old Harbour Health Centre	388
Table 6-14	Summary of Potential Site Preparation and Construction Phase Social Impacts for Greater Portmore Health Centre	389
Table 6-15	Environmental and Social Impact matrix for operational phase at Spanish Town Hospital	397
Table 6-16	Environmental and Social impact matrix for operational phase at St. Jao Park Health Centre	398
Table 6-17	Environmental and Social impact matrix for operational phase at Old Harbour Health Centre	399
Table 6-18	Environmental and Social impact matrix for operational phase at Greater Portmore Health Centre	400
Table 6-19	Summary of Potential Operational Phase Environmental Impacts for Spanish Town Hospital	401
Table 6-20	Summary of Potential Operational Phase Environmental Impacts for St. Jago Health Centre	401
Table 6-21	Summary of Potential Operational Phase Environmental Impacts for Old Harbour Health Centre	401
Table 6-22	Summary of Potential Operational Phase Environmental Impacts for Greater Portmore Health Centre	401
Table 6-23	Summary of Potential Operational Phase Social Impacts for Spanish Town Hospital	405
Table 6-24	Summary of Potential Operational Phase Social Impacts for St. Jago Health Centre	406
Table 6-25	Summary of Potential Operational Phase Social Impacts for Old Harbour Health Centre	406

Table 6-26 Summary of Potential Operational Phase Social Impacts for Greater Portmore Health Centre 406

LIST OF PLATES

Plate 1-1	Aerial view of proposed project site (looking in a southerly direction)	30
Plate 1-2	Aerial view of proposed project site (looking in a northerly direction)	31
Plate 1-3	Aerial view of southern portion of proposed project site (looking in a southerly direction) 31	
Plate 1-4	Informal apiary operation on proposed project site	32
Plate 1-5	Project rendering.....	34
Plate 4-1	Exposed conductors to live electrical equipment presents a safety hazard to staff.....	95
Plate 4-2	Black plastic water storage tank with blue metallic water tank in background.....	99
Plate 4-3	Elevated silver metallic water tank	99
Plate 4-4	Black plastic water storage tank at the medical staff quarters	101
Plate 4-5	Black plastic water storage tank on the roof of the Accident & Emergency Department 101	
Plate 4-6	Black plastic water storage tank at the residences	102
Plate 4-7	Example of a diesel storage tank (un-bunded) near to the laundry building	102
Plate 4-8	LPG storage in front of the dietary building.....	103
Plate 4-9	Medical oxygen storage in proximity to the Maternity High Dependency Unit	103
Plate 4-10	Portable medical oxygen storage area	104
Plate 4-11	Chemical storage (cleaning agents, bleach etc.).....	104
Plate 4-12	Lubricants and other hazardous material storage	105
Plate 4-13	Damaged and blocked drain along the main hospital roadway	107
Plate 4-14	Drains from walkways across a green space near the solar farm	107
Plate 4-15	Broken utility cover.....	108
Plate 4-16	Broken/ damaged drain and pipe area, overgrown	108
Plate 4-17	Exposed drain and service area	109
Plate 4-18	Drain with storm water and grey water	109
Plate 4-19	Solid waste littered around resident buildings.....	112
Plate 4-20	Solid waste littering a green space within the hospital	113
Plate 4-21	Solid waste improperly stored outside a building	113
Plate 4-22	Solid waste improperly/insufficiently stored along a hospital walkway	114

Plate 4-23	Medical and solid waste being transported to a temporary storage area.....	115
Plate 4-24	Medical and solid waste in bins on the hospital grounds	115
Plate 4-25	Medical and solid waste bags outside the infant ward, improperly stored	116
Plate 4-26	Medical waste, blood vials littering the storage area, outside the building	116
Plate 4-27	Medical waste overflowing from window of storage building.....	117
Plate 4-28	Medical and storage waste improperly stored	117
Plate 4-29	Medical and solid waste near parking lot of the maternity ward	118
Plate 4-30	Wastewater Treatment Plant.....	121
Plate 4-31	Patient awaiting access to Accident and Emergency. The area is uncovered with a steep slope and bordered by a drainage channel.....	124
Plate 4-32	Wheelchair of a patient unable to easily access a tented waiting area	124
Plate 4-33	Elevated walkway at Spanish Town hospital.....	125
Plate 4-34	Damaged assets scattered around a green space with the main hospital grounds..	127
Plate 4-35	Abandoned building used as asset storage area	128
Plate 4-36	A large collection of assets overgrown with shrubbery	128
Plate 4-37	Abandoned building used for asset storage.....	129
Plate 4-38	Assets overflowing and littering sections of the property.....	129
Plate 4-39	Assets overflowing and littering sections of the property.....	130
Plate 4-40	Main entrance green space.....	132
Plate 4-41	Green space with seating.....	132
Plate 4-42	Green space within the hospital.....	133
Plate 4-43	Green space and seating	133
Plate 4-44	Green space	134
Plate 4-45	Green space littered with assets and solid waste.....	134
Plate 4-46	Seating within the hospital.....	135
Plate 4-47	Green space poorly maintained, surrounding the hospital residences.....	135
Plate 4-48	Damaged assembly point sign within the hospital	136
Plate 4-49	Fire hydrant on the hospital grounds	138
Plate 4-50	Fuel oil/ Lubricant leak at boiler room	151
Plate 4-51	Evidence of burning at the hospital residences	152
Plate 4-52	Large dumping area along the main road in the market.....	152
Plate 4-53	Illegal dumping along the banks of the river, near the hospital	153
Plate 4-54	Wastewater treatment facility	153
Plate 4-55	Drain at main gate of Spanish Town Hospital Compound.....	157
Plate 4-56	Drain at main gate of Spanish Town Hospital Compound.....	158

Plate 4-57	Drain at main gate of Spanish Town Hospital Compound.....	158
Plate 4-58	Failed underground stormwater drainage by Spanish Town Hospital Main Gate	159
Plate 4-59	Spanish Town Hospital Flooded	159
Plate 4-60	Spanish Town internal drainage system	160
Plate 4-61	Potable water storage tanks.....	188
Plate 4-62	Diesel storage tank	188
Plate 4-63	Oil barrels improperly stored with evidence of spills.....	190
Plate 4-64	Old barrels and fuel containers littering a green space	190
Plate 4-65	Improper storage of barrels with hazardous materials	191
Plate 4-66	Oil and fuel containers near in the maintenance area of the health centre.....	191
Plate 4-67	Maintenance area with hazardous materials left near a drain at the back parking lot	192
Plate 4-68	Central drain which was partially flooded.....	192
Plate 4-69	Section of the central drain	193
Plate 4-70	Medical waste being left in the waiting area at the health centre	195
Plate 4-71	Medical and solid waste in bins on the hospital grounds	196
Plate 4-72	Solid waste storage area	197
Plate 4-73	Solid waste littering an area near a tent	197
Plate 4-74	Solid waste bins on site.....	198
Plate 4-75	Wastewater Treatment Plant.....	199
Plate 4-76	Muddy tented area outside the health centre.....	202
Plate 4-77	Asset storage at the back of the canteen	203
Plate 4-78	Assets stored outside a small storeroom near the back of the property	203
Plate 4-79	Assets stored outside a small storeroom near the back of the property	204
Plate 4-80	Blocked drain with oily film along the hospital boundary.....	213
Plate 4-81	Vehicle wash area beside chemical storage shed	213
Plate 4-82	Burning at the St. Jago health centre	214
Plate 4-83	Burning at the St. Jago health centre.....	214
Plate 4-84	Photograph of the existing Old Harbour Health Centre	231
Plate 4-85	Water storage tank.....	231
Plate 4-86	Main waste storage area at the front of the health centre	234
Plate 4-87	A garbage skip located on the proposed Old Harbour Health Centre site.....	247
Plate 4-88	Informal dumping area used by community members.....	247
Plate 4-89	Area used for burning.....	248
Plate 4-90	Proposed Old Harbour Health Centre Compound #1 (left) and Compound #2 (right)	250

Plate 4-91	Black plastic water storage tank	265
Plate 4-92	Potable water and fuel storage tanks at the GPHC.....	268
Plate 4-93	Drainage canal, often blocked with debris and overgrown vegetation	269
Plate 4-94	Section of the drainage area (trench and small culvert)	269
Plate 4-95	Medical waste, exposed and mixed with non-clinical waste	272
Plate 4-96	Medical waste, exposed and mixed with non-clinical waste	272
Plate 4-97	Solid waste littering a section of the health centre	273
Plate 4-98	Solid waste and assets littering a section of the health centre	273
Plate 4-99	Solid waste littering a green space and blocking a section of the drainage trench...	274
Plate 4-100	Solid waste bin at the health centre	274
Plate 4-101	Solid waste bin at the health centre	275
Plate 4-102	Assets stored in a green space section of the health centre	279
Plate 4-103	Asset storage, construction debris and solid waste in a section of the health centre	279
Plate 4-104	Flooding on the main grounds inside the health centre	280
Plate 4-105	Green space fairly well maintained with some evidence of burning.....	281
Plate 4-106	Evidence of burning outside the main health centre grounds	292
Plate 4-107	Evidence of burning outside the main health centre grounds	292
Plate 4-108	Evidence of burning inside the main health centre grounds.....	293
Plate 4-109	Possible asbestos insulation on exhaust pipe from backup generator, Rina Consulting (2018) 309	
Plate 5-1	The Rodney's Memorial.....	352
Plate 5-2	Old Court House	353
Plate 5-3	Cast Iron Bridge.....	353
Plate 5-4	The Old Harbour Railway Station.....	354
Plate 5-5	The Old Harbour Clock Tower.....	355

LIST OF ACRONYMS

Acronym	Definition
A&E	Accident and Emergency
AMSL	Meters Above Mean Sea Level
AOI	Area of Influence
CEO	Chief Executive Officer
ED	Enumeration District
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
ESA	Environmental and Social Assessment
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESPF	Environmental and Social Policy Framework
ESPS	Environmental and Social Performance Standards
FEMA	Federal Emergency Management Agency
GIS	Geographic Information Systems
GPHC	Greater Portmore Health Centre
HVAC	Heating Ventilation and Air Conditioning
ICU	Intensive Care Unit
IDB	Inter-American Development Bank
IFC	International Finance Corporation
JPS	Jamaica Public Service
KMA	Kingston Metropolitan Area
MC	Municipal Corporation
MLSS	Ministry of Labour and Social Security
MOHW	Ministry of Health and Wellness
NCD	Non- Communicable Diseases
NEPA	National Environmental Planning Agency
NEPM	North Eastern Parks and Markets Limited
NRCA	Natural Resources Conservation Authority
NWC	National Water Commission
ODPEM	Office of Disaster Preparedness and Emergency Management
OHHC	Old Harbour Health Centre
PIOJ	Planning Institute of Jamaica
PM10	Particulate Matter 10 microns

Acronym	Definition
PPE	Personal Protective Equipment
RHA	Regional Health Authorities
RINA	Rina Consulting S.p.A.
SA	Service Area
SDC	Social Development Commission
SEP	Stakeholder Engagement Plan
SJHC	Saint Jago Park Health Centre
SMO	Senior Medical Officer
STATIN	Statistical Institute of Jamaica
STH	Spanish Town Hospital
UNOPS	The United Nations Office for Project Services
WHO	World Health Organization
WRA	Water Resources Authority
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

PROJECT BACKGROUND

The Ministry of Health and Wellness (MOHW) is currently undertaking the Health Systems Strengthening for the Prevention & Care Management of Non- Communicable Diseases (NCD) Programme, with the objective being to improve the health of Jamaica's population by strengthening comprehensive policies and improved access to an upgraded and integrated health network. Phase 1 of the programme focuses on the hospital and health centre facilities in the parish of St. Catherine, namely **Spanish Town Hospital (STH)**, **St. Jago Park Health Centre (SJHC)**, **Old Harbour Health Centre (OHHC)** and **Greater Portmore Health Centre (GPHC)**.

To review the existing environment and social context at each facility, assess the potential impacts of the rehabilitation and expansion activities and propose mitigation plans, the following were prepared:

1. Environmental and Social Management Plan (ESMP)
2. Environmental and Social Assessment (ESA)
3. Stakeholder Engagement Plan (SEP)

This report details the constituents of the **Environmental and Social Assessment (ESA)**. The ESA includes the environmental and social (E&S) diagnosis of the area of influence (AOI), the identification and assessment of environmental and social risks and impacts, and the Environmental and Social Management Plan (ESMP).

PROJECT DESCRIPTION

Spanish Town Hospital

Spanish Town Hospital (STH) is located in Spanish Town, the capital of St. Catherine. The proposed development includes a new building, which encompasses the construction of a six-storey modern facility, several points of access for staff and patients, a basement (car park and access) and a skywalk to link the existing wards.

The new building will be located at the north-eastern part of the existing facility, which currently hosts several scattered buildings of varying sizes that will require demolition and temporary relocation of some of the existing hospital services that takes place in these areas. The pharmacy and laboratory will be temporarily relocated to the north-western corner of the property. These buildings are currently under construction and are estimated to be completed by March 30, 2023. The existing Nursing Quarters was primarily being used as storage. The items being stored in the storage areas including the concrete structure and the storage container, along with the items in the Nursing Quarters will be relocated to the Manpower Building and Five (5) Storage Containers currently being constructed.

The re-purposing of the existing buildings on site will be determined based on the needs of the MOHW. This is important to prevent them from becoming stranded assets and therefore socioenvironmental liabilities. A detailed comprehensive plan regarding the re-purposing of the existing buildings will be provided for the final report.

An area for landscaping and recreation is also provided to ensure that the outdoor spaces become pleasant and serene areas for patients. Additional facility infrastructure will be integrated in the new building to provide easy and convenient service access to the facilities. Facility Alternative Energy is also considered, e.g., a photovoltaic system, mounted on the roofs.

The construction period is anticipated to take approximately 24 months.

St. Jago Park Health Centre

The St. Jago Park Health Centre is located in Spanish Town adjacent the STH. It is being prioritized for expansion to reduce the number of patients seen at the hospital while increasing the services and operational time offered to clients who live in the Spanish Town area. Currently, the St. Jago Health Centre is Type III, but it is recommended to be significantly expanded and upgraded to Type V – (or under the new categorization -Comprehensive). The proposed construction is situated on a current parking lot and is approx. 800 sq. m. The new building is proposed to be constructed with direct connections both to the existing building of the health facility and to the existing conference room building and includes the remodelling and refurbishment of the existing health centre.

The construction period is anticipated to take approximately 15 months.

Old Harbour Health Centre

The proposed Old Harbour Health Centre is located in the town of Old Harbour, ≈ 16.3 km southeast of the Map Pen Hospital in Clarendon. The existing Old Harbour Health Centre's location and proximity to other buildings and properties limit the possibility to be expanded physically. Therefore, a greenfield site was identified for the construction of the new health centre. The proposed new one storey building is approx. 1,998 sq. m.

A basketball playground is located in the eastern part of the site, but its current setting blocks the development of the land and the future driveway that will lead to the proposed parking lot. However, as it is used by the local community, it will be relocated in the southern part of the plot. An informal apiary operation exists towards the south of the proposed site. The main vehicle and pedestrian access are defined from north, from East Street Check point that is going to be controlled by a security guard is planned to serve the plot main entrance. This is the only access to the facility (egress/ingress) being considered. There will be no displacement of residences or informal settlements located to the south of the proposed project site.

Additional facility infrastructure will be integrated in the new building to provide easy and convenient service access to the facilities.

The construction period is anticipated to take approximately 15 months.

Greater Portmore Health Centre

The project is located in Greater Portmore, St. Catherine. Portmore City has the largest concentration of residents per square mile outside of Kingston & St. Andrew and there is an urgent need to add significant expansion and to upgrade the Greater Portmore Health Centre to a Type V health facility (Comprehensive). The proposed construction is slated on vacant land adjacent to the existing facility.

The project site is located on the south of the existing facility. The available area for the project site is estimated to approx. 5 600 sq. m. that includes part of the existing site and the adjacent site to south-west. Currently, the main access to the plot is from west, from SW 1st Ave. A private street, which already exist and is in connection with SW 1st Ave, serves the hospital plot and the new extension. The building is orientated towards north-west. The space is sufficient; however, it has to be taken into account that it is situated on current field that is used by local community as a football playground. It is recommended to relocate the football playground in an appropriate adjacent area.

The proposed new one storey building is approx. 1,260 sq. m with U-shape footprint and is situated on the southern part of the plot. Close to the building a parking lot for 30 vehicles is proposed with four spaces for disabled people. An allocated area for landscaping and recreation is situated to the north to ensure that the outdoor spaces become pleasant areas for patients.

The construction period is anticipated to take approximately 18 months.

POTENTIAL RISKS AND IMPACTS

Site Preparation and Construction Phase

Environmental Impacts

No.	Impact Category	Type of Risk and Impact			
		STH	SJHC	OHHC	GPHC
1	Noise	Direct, Negative, short-term, low impact, localized (project boundary)	Direct, Negative, short-term, low impact, localized (project boundary)	Direct, Negative, Short term, low impact, Localized (project boundaries and surrounding communities)	Direct Negative, short-term, low impact, localized (project boundary)
2	PM10 Particulates	Direct, Negative, short-term, low-medium impact, localized (project boundary)	Direct, Negative, short-term, low-medium impact, localized (project boundary)	Direct, Negative, short-term, low-medium impact, localized (project boundary)	Direct, Negative, short-term, low-medium impact, localized (project boundary)
3	ACBM Emissions	Direct, Negative, short-term, low-medium impact, localized (project boundary)	N/A	N/A	N/A
4	Vibration	Direct, Negative, short-term, low impact, localized (project boundary)	Direct, Negative, short-term, low-medium impact, localized (project boundary)	Direct Negative, short-term, low impact, localized (project boundary and surrounding communities)	Direct Negative, short-term, low impact, localized (project boundary)
5	Soil and Water Pollution	Direct, Negative, short-term, medium impact, regional (inter parish)	Direct, Negative, short-term, medium impact, regional (inter parish)	Direct, Negative, short-term, medium impact, Reginal (Inter-parish)	Direct, Negative, short-term, medium impact, widespread (intra parish)
6	Seismic Hazard	Indirect, Negative, short-term, medium impact, localized (project boundary)	Indirect, Negative, short-term, medium impact, localized (project boundary)	Indirect, Negative, short-term, medium impact, Reginal (intra parish)	Indirect, Negative, short-term, medium impact, widespread (intra parish)
7	Landslide Hazard	Indirect, Negative, short-term, low impact, localized (project boundary)	Indirect, Negative, short-term, low impact, localized (project boundary)	Indirect, Negative, short-term, medium impact, Reginal (intra parish)	Indirect, Negative, short-term, low impact, widespread (inter parish)
8	Soil Loss and Erosion	Indirect, Negative, short-term, low impact, localized (project boundary)	Indirect, Negative, short-term, low impact, localized (project boundary)	Indirect, Negative, short-term, low impact, widespread (inter parish)	Indirect, Negative, short-term, low impact, widespread (inter parish)

No.	Impact Category	Type of Risk and Impact			
		STH	SJHC	OHHC	GPHC
9	Hydrology and Flooding	No Impact	No Impact	Direct, Negative, Short term, medium impact, localized	No Impact
10	Green Procurement and Enhancement Measures	Indirect, Positive, short-term, low impact, localized (project boundary)	Indirect, Positive, short-term, low impact, localized (project boundary)	Indirect, Positive, short-term, low impact, localized (project boundary)	Direct, Positive, short-term, low impact, localized (project boundary)
11	Solid Waste	Direct, Negative, short-term, low impact, localized (project boundary)	Direct, Negative, short-term, low impact, localized (project boundary)	Direct, Negative, short-term, low-medium impact, localized (project boundary)	Direct, Negative, short-term, low-medium impact, localized (project boundary)
12	Wastewater	Indirect, Negative, short-term, low impact, localized (project boundary)	Indirect, Negative, short-term, low impact, localized (project boundary)	Indirect, Negative, short-term, low impact, Localized	Indirect, Negative, short-term, low impact, widespread (inter parish)
13	Flora and Fauna	Direct, Negative, long-term, low impact, localized (project boundary)	Direct, Negative, long-term, low impact, localized (project boundary)	Direct, Negative, Long-term, low impact, localized (project boundary)	Direct, Negative, short-term, low impact, localized (project boundary)
14	Vectors	Indirect, Negative, short-term, medium impact, localized (project boundary)	Indirect, Negative, short-term, medium impact, localized (project boundary)	N/A	Indirect, Negative, short-term, low-medium, localized (project boundary)
15	Freshwater Ecosystem	Indirect, Negative, short-term, low impact, regional (inter parish)	Indirect, Negative, short-term, low impact, regional (inter parish)	N/A	N/A

Social Impacts

No.	Impact Category	Type of Risk and Impact			
		STH	SJHC	OHHC	GPHC
1	Archaeological and Historical Assets	No Impact	No Impact	No Impact	No Impact
2	Employment	Direct, Positive, short-term, medium impact, national	Direct, Positive, short-term, medium impact, national	Direct and Indirect, medium term, (Positive and Negative, Reginal (interparish)	Direct and Indirect, medium term, (Positive and Negative, widespread (inter parish)

No.	Impact Category	Type of Risk and Impact			
		STH	SJHC	OHHC	GPHC
3	Vending and Food Hygiene	Indirect, Negative, short-term, low-medium impact, local-regional	Indirect, Negative, short-term, low-medium impact, local-regional	Indirect, Negative, Indirect, short term, low-medium Localized-Regional (project boundary and surrounding community)	Indirect, Negative, Indirect, medium term, Localized (project boundary and surrounding community)
4	Health and Safety	Indirect, Negative, short-term, medium-large impact, local-regional	Indirect, Negative, short-term, medium-large impact, local-regional	Indirect, Negative, Short-term, Low-medium impact, National (widespread)	Indirect, Negative, medium-long-term, medium impact, National (island wide)
5	Security	Indirect, Negative, short-term, medium impact, localized (project boundary)	Indirect, Negative, short-term, medium impact, localized (project boundary)	Indirect and Direct, Negative, Short term, Medium impact, Localized-Regional (project boundary and surrounding communities)	Indirect, Negative, short term, Medium impact, localized (project boundary and surrounding communities)
6	Transportation and Traffic	Direct, Negative, short-term, low impact, localized-regional (project boundary or intra parish)	Direct, Negative, short-term, low impact, localized-regional (project boundary or intra parish)	Indirect and Direct, Negative, Short-term impact, -Localized - Regional (project boundary and surrounding communities)	Direct, Negative, short-term impact, -localized to regional
7	Aesthetics	Indirect, Negative, short-term, low impact, localized (project boundary)	Indirect, Negative, short-term, low impact, localized (project boundary)	Indirect, Negative, Short-term, Low impact, Localized	Indirect, Negative, Short-term, low impact, Localized
8	Stakeholders	Direct, Negative, long term, medium impact, localized (project boundary and community)	Direct, Negative, long term, medium impact, localized (project boundary and community)	Direct, Negative, Long term, Low impact, Localized	N/A
9	Infrastructure	Indirect, Negative, short-term, low impact, local (project boundary)	Indirect, Negative, short-term, low impact, local (project boundary)	N/A	N/A
10	Apiary (OHHC)	N/A	N/A	Direct, Negative, Long term, Medium impact, Localized	N/A

Operational Phase

Environmental Impacts

No.	Impact Category	Type of Risk and Impact			
		STH	SJHC	OHHC	GPHC
1	Hydrology and Flooding	Indirect, Negative, long-term, low-medium impact, local (project boundary)	Indirect, Negative, long-term, low-medium impact, local (project boundary)	Indirect, Negative, Long term, Medium impact, localized (project boundary and surrounding communities)	Indirect, Negative, long term, Medium impact, localized (project boundary and surrounding communities)
2	Noise	Indirect, Negative, long-term, low impact, local (project boundary)	Indirect, Negative, long-term, low impact, local (project boundary)	Indirect, Negative, Long term, Low impact, localized (project boundary)	Indirect, Negative, Long term, low impact, localized (project boundary)
3	Air Quality	Indirect, Negative, long-term, medium impact, local (project boundary)	Indirect, Negative, long-term, medium impact, local (project boundary)	Indirect, Negative, Long term, Medium impact, localized (project boundary and surrounding communities)	Indirect, Negative, long term, Medium impact, localized (project boundary and surrounding communities)
4	Medical Waste Handling	Indirect, Positive, long-term, large impact, regional (intra parish)	Indirect, Positive, long-term, large impact, regional (intra parish)	Indirect, Positive, Long term, Low impact, Regional	Indirect, Positive, Long term, Low impact, Regional
5	Waste Generation	Direct, Negative, long-term, large impact, regional (intra parish)	Direct, Negative, long-term, large impact, regional (intra parish)	Direct, Negative, Long term, Low impact, Regional	Direct, Negative, Long term, Low impact, Regional
6	Wastewater	Direct, Negative, long-term, medium impact, regional	Direct, Negative, long-term, medium impact, regional	Direct, Negative, Long term, Low impact, Localized	Direct, Negative, Long term, Medium impact, Regional
7	Freshwater Ecosystems	Direct, Positive, long-term, medium impact, regional (intra parish)	Direct, Positive, long-term, medium impact, regional (intra parish)	N/A	N/A

Social Impacts

No.	Impact Category	Type of Risk and Impact			
		STH	SJHC	OHHC	GPHC
1	Water Demand	Indirect, Negative, long-term, medium impact, localized (community)	Indirect, Negative, long-term, medium impact, localized (community)	Indirect, Negative, Long term, Medium impact, Regional	Indirect, Negative, Long term, Medium impact, Regional
2	Traffic	Indirect, Negative, long-term, small-medium impact, national	Indirect, Negative, long-term, small-medium impact, national	Indirect, Negative, Long term, low-medium impact, Regional	Direct, Negative, Long term, low-medium impact, Regional
3	Health and Safety	Indirect, Negative, long-term, low impact, national	Indirect, Negative, long-term, low impact, national	Indirect, Negative, Long term, Low impact, National (Widespread)	Indirect, Negative, Long term, Low impact, National (Widespread)
4	Service Capacity	Direct, Positive, long-term, large impact, national	Direct, Positive, long-term, large impact, national	Direct, Positive, Long term, Low, Impact, National	Direct, Positive, Long term, Low impact, National
5	Employment	Direct, Positive, long-term, large impact, national	Direct, Positive, long-term, large impact, national	Direct and Indirect, Positive, Long term, National	Direct and Indirect, Positive, Long term, National

1.0 INTRODUCTION

1.1 PROJECT CONTEXT

1.1.1 Programme Description

The Ministry of Health and Wellness (MOHW) is currently in the process of developing a comprehensive 10-year Strategic Development Plan for the health sector as part of the integrated health service delivery framework. The objective of the Strategic Development Plan is to provide an overarching strategic direction to the Ministry, which is aligned with Jamaica's commitment to universal access to health and universal healthcare coverage.

The MOHW received a loan from the Inter-American Development Bank (IDB) to support the Health Systems Strengthening for the Prevention & Care Management of Non- Communicable Diseases (NCD) Programme. The programme objective is to improve the health of Jamaica's population by strengthening comprehensive policies for the prevention of Non-Communicable (Chronic) Diseases (NCDs) risk factors and improved access to an upgraded and integrated primary and secondary health network in prioritized areas with an emphasis on chronic disease management, that provide more efficient and higher quality care. Phase 1 of the programme focuses on the hospital and health centre facilities in the parish of **St. Catherine**, namely **Spanish Town Hospital, St. Jago Park, Old Harbour and Greater Portmore Health Centres** (Figure 1-1).

1.1.2 Environmental and Social Assessments and Plans

The implementation of the rehabilitation and expansion activities for the Jamaican hospitals and health centres generates both positive and negative environmental and social impacts within the area of influence (AOI). In order to review the existing environment and social context, assess the potential impacts and propose mitigation plans, the following were prepared:

1. Environmental and Social Management Plan (ESMP)
2. Environmental and Social Assessment (ESA)
3. Stakeholder Engagement Plan (SEP)

This report details the constituents of the **Environmental and Social Assessment (ESA)**. The ESA includes the environmental and social (E&S) diagnosis of the area of influence (AOI), the identification and assessment of environmental and social risks and impacts, and the Environmental and Social Management Plan (ESMP). The ESA considers the physical, biological, and socio-economic context of Jamaica. Its purpose is also to provide a general assessment regarding the executing agency's (Ministry of Health (MOH)) current institutional capacity to manage environmental, social, health and safety and labour issues involved for the implementation of the Program.

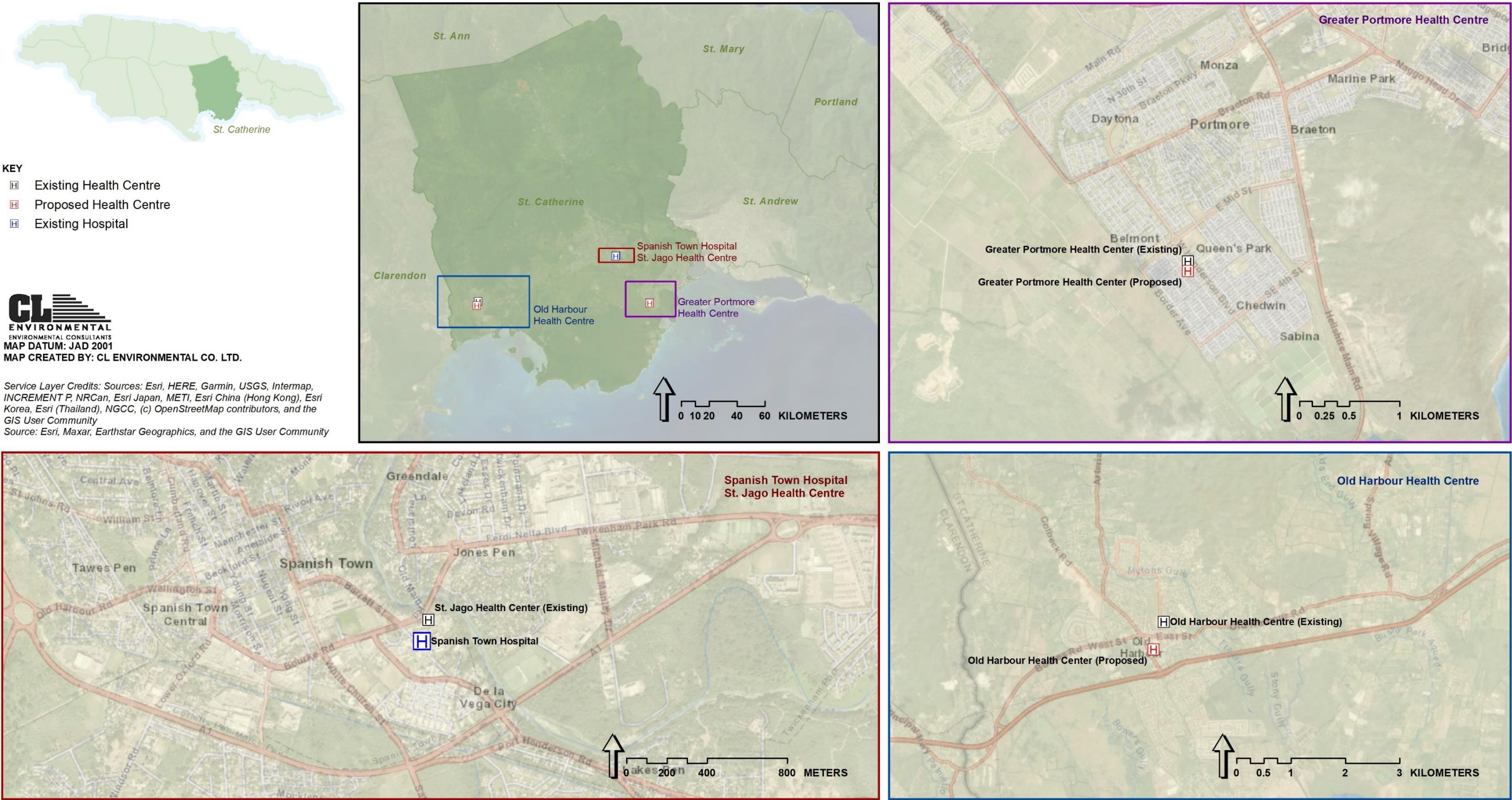


Figure 1-1 Location of the hospital and health centre facilities to be upgraded / rehabilitated as part of Phase 1

1.2 DESCRIPTION OF PROJECTS

1.2.1 Spanish Town Hospital

1.2.1.1 Location

Spanish Town Hospital (STH) is located in Spanish Town, the capital of St. Catherine. It is ≈ 1.1 km east of the City Centre, 300m north of the Spanish Town bypass, ≈ 1.8 km west of the Jose Marti Technical High School and ≈ 1.2 km south of St. Jago High School (Figure 1-3).

1.2.1.2 Project Features

The proposed development includes a new building that entails the construction of a six-storey modern facility, several points of access for staff and patients, a basement (car park and access) and a skywalk to link the existing wards. It will have a Gross Floor Area of 17,633.68 sq. m. and a footprint of 3,436,23 sq. m. with an irregular shape (Figure 1-2).

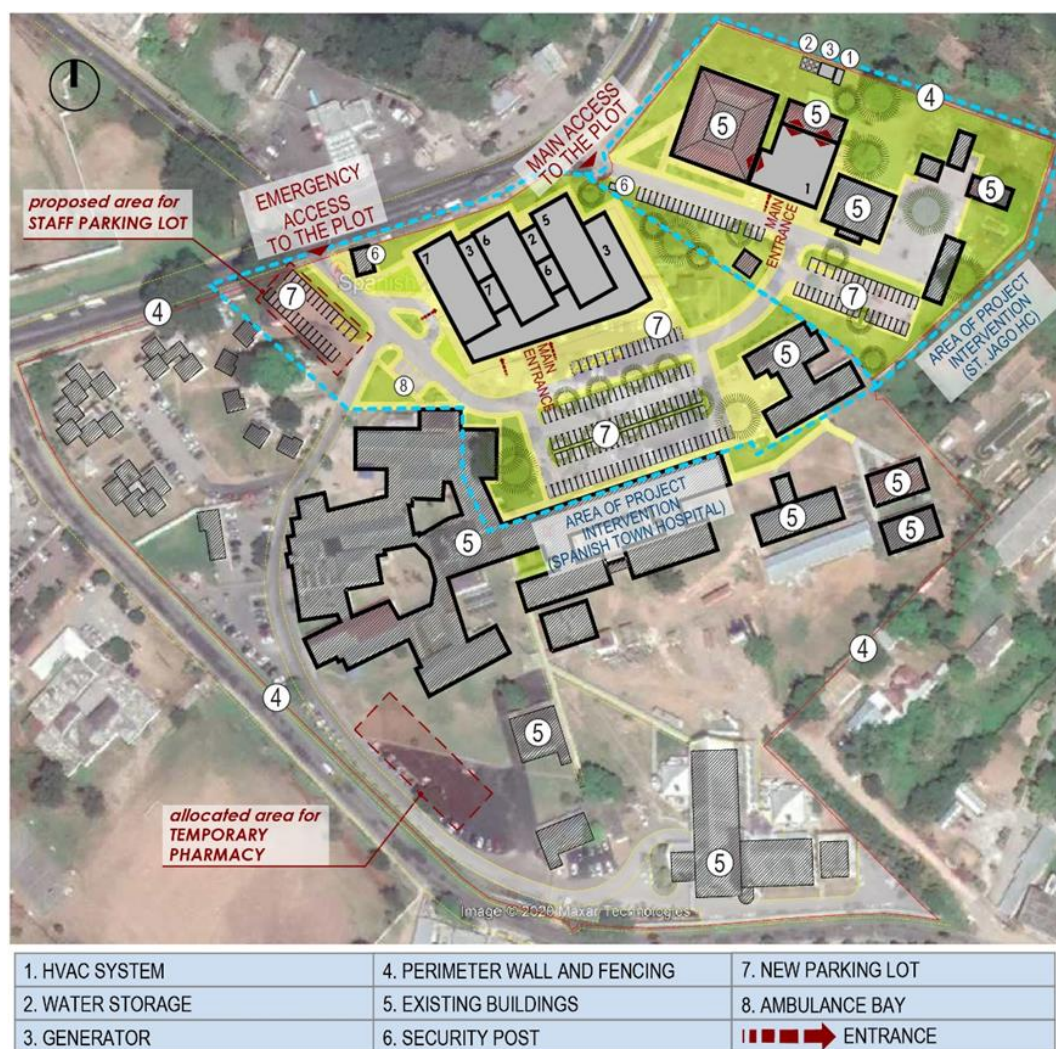


Figure 1-2 Spanish Town Hospital and St. Jago Park Health Centre – General view

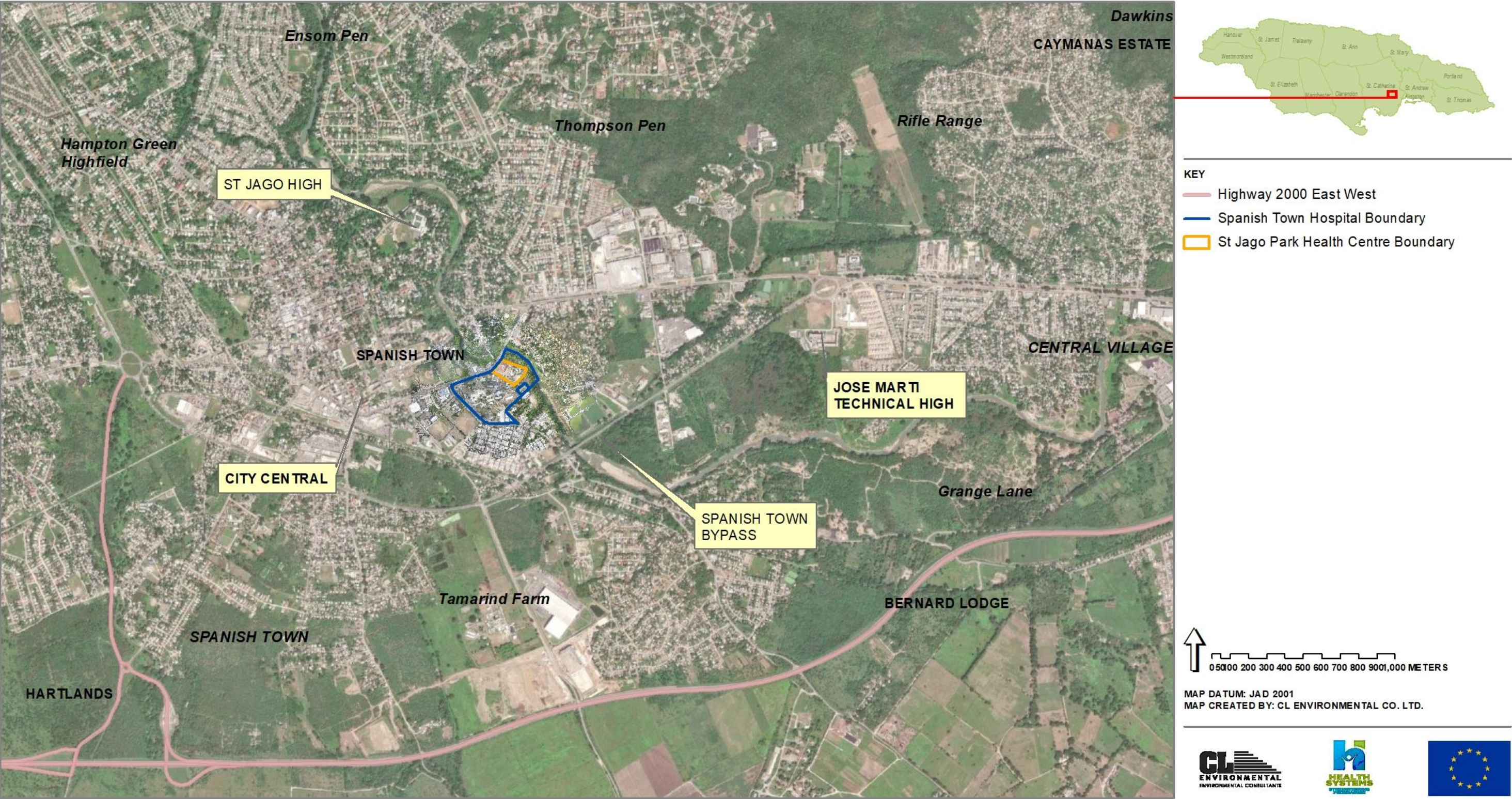


Figure 1-3 Location map of the Spanish Town hospital



Figure 1-4 Renders of the new Spanish Town hospital building

The new building will be located at the north-eastern part of the existing facility, which currently hosts several scattered buildings of varying sizes that will require demolition and temporary relocation of some existing hospital services. Some of these existing services include a day-care centre, a pharmacy, a laboratory, nursing quarters, maintenance storage, staff parking and underground and overhead utility services to facilitate the proposed construction. The pharmacy and laboratory will be temporarily relocated to the north-western corner of the property (Figure 1-5). These buildings are currently under construction and are estimated to be completed by March 30, 2023.

The existing Nursing Quarters was primarily being used as storage. The items being stored in the storage areas including the concrete structure and the storage container, along with the items in the Nursing Quarters will be relocated to the Manpower Building and Five (5) Storage Containers currently being constructed (Figure 1-5). The re-purposing of the existing buildings on site will be determined based on the needs of the MOHW. This is important to prevent them from becoming stranded assets and therefore socioenvironmental liabilities. A detailed comprehensive plan regarding the re-purposing of the existing buildings will be provided for the final report.

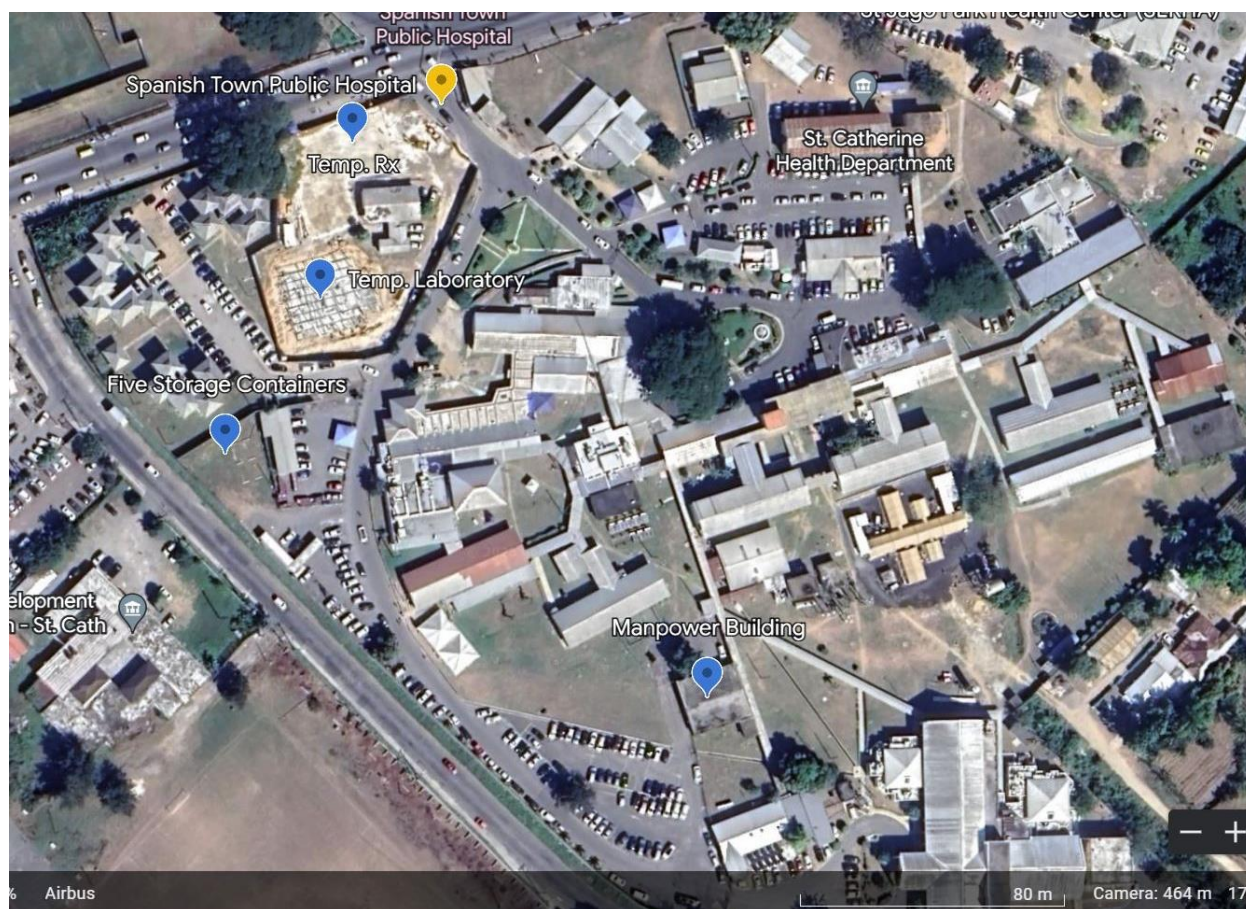


Figure 1-5 Locations of the temporary laboratory and pharmacy, and the Manpower building and area for Storage Containers

The approach to the plot is through three access gates as follows:

- The existing gate directly from Burke Road that is going to be with relatively open access to facilitate easy and fast entry to the A&E department.
- The other two are from St. Jago Park Health Centre – one is public and the other one is service only; the security check will be performed at the main access gate to St. Jago Park Health Centre; however, the service access gate will be controlled and will be opened to staff only.

Three separate parking lots are foreseen as follows (Figure 1-2):

- Public Parking lot situated south of the building with capacity of 98 vehicles including 14 accessible parking spots for disabled persons. The access to the public parking will be restricted and subject to control through Security Checkpoint.
- Separate parking to serve the A&E Department with capacity of 21 vehicles including 3 accessible parking spots disabled persons. The access to the A&E parking will not be subject to additional security check in order to facilitate easy and fast access to the A&E department.
- Underground Staff parking with capacity of 33 vehicles including 2 accessible parking spots for disabled persons. The Staff parking will be located at the underground level and will be with controlled access.

An area for landscaping and recreation is also provided to ensure that the outdoor spaces become pleasant and serene areas for patients.

Additional facility infrastructure will be integrated in the new building to provide easy and convenient service access to the facilities. It will include:

- HVAC system
- Facility Generator
- Facility Water Storage
- Medical gas storage

The construction period is anticipated to take approximately 24 months.

Due Diligence Procedures for Photovoltaic Systems

Facility Alternative Energy is also considered, e.g., a photovoltaic system, mounted on the roofs. Based on specifications, the contractor will be required to provide; details of purchase, supplier's name and location. Due diligence will be carried out by the PEU to rule out the risk of forced labour in the supply chain of these components. Due diligence on the primary supply chain for the solar panels will be done after the final tendering. A final plan will be put in place outlining the procedures when the final construction contract is put in place.

Orientation and Building Location

Based on the outputs of the conducted site analysis and the Accommodation requirements, it was estimated that the most optimal and appropriate solution factoring the shape, size of the footprint and the number of storeys equated to an irregular shaped building, which is six storeys high, located in the north-eastern part of the project site.

The main entrance is orientated to the south, which provides easy access from the parking lot and the other buildings on the plot. An independent entrance to the Pharmacy and Outpatient department is located next to the main entrance. Additional separate entrances for patients and ambulances will directly lead to the Accident and Emergency department. A staff entrance is proposed on the north side that is going to be accessible only with appropriate identification card reader.

This solution for the shape and location of the proposed Spanish Town Hospital Building provides the following advantages:

- Optimal use of the available area considering the physical constraints of the plot, which were defined in the Site Analysis
- Preservation of the existing mature trees
- Easy car and parking access
- Maximum preservation of the existing green area
- Maximum available area for future development

Building Configuration and Buildings Physical Parameters

The key components and inputs that were considered to estimate and define the main physical parameters of the new STH building included:

- The available area, probable footprint size and shape
- The number of storeys
- The number, type, and size of the different department; and
- The recommendations from the Southeast Regional Health Authority (SERHA) as main stakeholders and part of the approving committee

An irregular shape was selected for the new six-storey building that is composed of three main volumes interconnected with each other by vertical and horizontal circulation. One of them represents a horizontal wide base, which is three storeys high (volume A). The other two volumes are going vertical (volumes B and C).

The first important dimension that had to be defined was the width of the separate sections. The proposed functional scheme for volume A is based on parallel single- and double-loaded corridors. The main aim was to achieve more compact and efficient building with reduced circulation area. The vertical volumes (B and C) are based on single-loaded corridors. Horizontal circulation includes corridors. Considering the need to allow for the movement of considerable amount of people, together

with trolleys, beds, wheelchairs, and other mobile equipment, including the passing of such equipment. Vertical circulation includes communication cores (stairs, elevator, services), together with ramps that connects and serves the first three floors.

Wall protection shall be installed to prevent damage to walls caused by all types of trolleys.

Building Grade and Building Index

- Building category: A class of high-rise
- Structural type: Cast-in-place reinforced concrete frame-shear wall structure
- Height of building (m) = 27.10
- Building area: 17,633.68 m²

Functional Layout

The required premises is organized in fourteen (14) departments (functional groups) on six levels and are arranged according to stakeholder's recommendations to facilitate efficient flow of staff, patients, and equipment and to ensure accessibility. The main design concept for the configuration of the functional zoning is to consider each department as a separate unit that is interconnected with the others within the vertical circulation cores. Each functional group has certain specific characteristics that were considered.

The design of the facility also considers the spatial requirements of furniture and equipment, e.g., trolley bed impact on the design of corridors, doorways and room proportions, service area for sterilizers, etc. All areas of the facility shall be designed, constructed, furnished, and equipped in keeping with the principles of infection control. Infection control involves the prevention of possible spread of infection by the minimization of transfer of micro-organisms from person to person.

FLOOR	DESCRIPTION	FLOOR AREA
BASEMENT	PARKING	1105.36 m ²
	VERTICAL COMMUNICATION	405.33 m ²
TOTAL		1510.69 m²

GROUND FLOOR	AE (1.)	1452.12 m ²
	RADIOLOGY DEPARTMENT (2.)	1072.63 m ²
	RAMP	72.61 m ²
	RECEPTION (3.)	190.35 m ²
	VERTICAL COMMUNICATION	648.52 m ²
TOTAL		3436.23 m²

FIRST FLOOR	MEDICAL RECORDS (5.)	535.51 m ²
	OUTPATIENT AREA (3.)	1453.53 m ²
	PHARMACY (4.)	973.04 m ²
	RAMP	72.45 m ²
	VERTICAL COMMUNICATION	740.09 m ²
TOTAL		3774.61 m²

FLOOR	DESCRIPTION	FLOOR AREA
SECOND FLOOR	CSSD (8.)	597.30 m ²
	ENDOSCOPY (7.)	438.61 m ²
	RAMP	72.53 m ²
	SURGICAL BLOCK (6.)	2223.12 m ²
	VERTICAL COMMUNICATION	443.81 m ²
TOTAL		3775.37 m²
THIRD FLOOR	BEDS WARD 9.	608.34 m ²
	LABORATORY 10.	665.36 m ²
	VERTICAL COMMUNICATION	438.56 m ²
TOTAL		1712.26 m²
FOURTH FLOOR	BEDS WARD 11.	608.34 m ²
	ICU & HDU 12.	665.36 m ²
	VERTICAL COMMUNICATION	438.56 m ²
TOTAL		1712.26 m²
FIFTH FLOOR	BEDS WARD 13.	
	BEDS WARD 14.	
	VERTICAL COMMUNICATION	438.56 m ²
TOTAL		1712.26 m²

ACCIDENT AND EMERGENCY

The function of the Accident and Emergency Department is to receive, stabilise and manage patients (adults and children) who present with a large variety of urgent and non-urgent conditions whether self or otherwise referred. The Emergency Unit also provides for the reception and management of disaster patients as part of the Unit's role within each region. It is situated on the ground floor for easy access by ambulant patients and ambulances and has an area of 1452.12 sq. m. The department has direct connection with the Radiology department. It is linked to the vertical communication cores for efficient access to the Surgical block to transfer patients requiring emergency surgical procedures and to Intensive Care Unit / High Dependency Unit for admission of patients with severe conditions requiring close monitoring or life support.

The Accident and Emergency Department consist of the following functional areas:

Entry, Registration, Triage and Treatment of urgent cases

Separate entries are provided for ambulant and ambulance patients. Access for the Ambulance will not conflict with other vehicular or pedestrian traffic. The entrance is covered to provide shelter for ambulances and crew unloading patients. Access to Treatment Areas will be restricted by the use of security doors. The patients are assessed in Triage and assigned to the appropriate care zone. Decontamination area for patients who are contaminated with toxic substances is also provided. This area is directly accessible from the ambulance bay/s without entering any other part of the unit.

Treatment area includes nurses' station, procedure rooms, trauma shock rooms, resuscitation bays and adjacent storages, doctor's room, and nurse manager.

Entry, Registration, Triage and Treatment of non-urgent cases

Separate entry is provided for outpatients with three separate waiting areas. The patients are assessed in Triage and assigned to the appropriate care zone. Assessment and treatment of patients with non-complex conditions are carried out in Consult / Examination rooms and the majority of patients discharged to home. Asthma room and injection dressing are also included.

SERVICE AREA AND ISOLATION ROOMS

Including dirty utility and clean-up, sluice room, non-clinical staff change and two (2) isolation rooms. The entry to the isolation rooms is through an airlock. Direction of airflow will be controllable. Clinical hand washing, gown and mask storage, and waste disposal will be provided within the airlock. A partially assisted ensuite, directly accessible from the isolation room, is also provided.

SHORT STAY UNIT

Short stay unit for prolonged observation and ongoing treatment of patients who are scheduled for subsequent discharge. Patients may be kept in this Unit for diagnosis, treatment, testing or for medical stabilisation. It includes observation cubicles for 15 beds, staff station, patient bathrooms, storage, sluice room, clean utility. A minimum of 1400mm clear opening is recommended for doors requiring bed/trolley access. In open plan bed areas, there should be at least 240 cm of clear floor space between the centres of each bed and a minimum of 90 cm clear space at the sides and foot of each bed.

STAFF AMENITIES AND ADMINISTRATION

This area is accessed both externally from separate staff entrance via the east vertical communication core and via the short stay unit section. It includes manager's office, head of department office, office for consultants, staff change with suite facilities, separate staff lounge areas for staff relaxation / on call rooms for doctors and nurses and conference room.

RADIOLOGY DEPARTMENT

The Radiology Department provides radiology and diagnostic investigations. The department is located on the ground floor right next to the main hospital entrance for easy access by ambulant patients. It is located with direct access to the Accident and Emergency Unit for easy access by emergency patients and is linked to the vertical communication cores for easy access by inpatients. The Radiology Department has an area of 1072.63 sq. m.

The Radiology Department consist of the following functional areas:

1. Entry / Reception areas incorporating:
 - a. Reception desk for patient registration, customer service and cashier
 - b. Waiting area for a range of occupants including children, families, elderly, and patients with limited mobility
 - c. Consult rooms for patient assessment and review

- d. Amenities – patient toilets, vending areas for refreshments
- 2. Imaging and screening areas:
 - a. 3 x digital X-ray rooms together with patient change cubicles associated with each x-ray room. A filmless digital imaging system is proposed to be implemented.
 - b. CT Scanning room together with control room, reporting, computer module equipment room and patient change cubicle
 - c. CT Scanning uses X-ray and computer technology to create detailed digital images, both 2D and 3D. CT scanning equipment consists of a rotating ring inside a gantry with a sliding table for the patient. Multiple images are taken in slices, which are combined using computer technology.
 - d. 4 x ultrasound rooms including ensuite
 - e. Ultrasound is a non-invasive procedure using high frequency sound waves for diagnostic purposes. This permits the use of ultrasound for various types of tissue and organs and is particularly useful in obstetrics, digestive system, renal, cardiac, and vascular scanning. Ultrasound does not use ionising radiation and does not require radiation shielding.
 - f. 2 x mammography rooms
 - g. MRI suite with scanning, control, reporting, computer module equipment rooms, patient change cubicles.
 - h. MRI scanning is a non-invasive procedure using large magnets combined with radio waves and a computer to receive signals from atoms in body tissue creating detailed cross section images of organs and vessels. MRI does not use ionising radiation.
 - i. The MRI unit and the associated magnetic field must be fully contained within the room, according to the equipment selection and specifications, that will require liaison with the equipment supplier. The MRI room will require magnetic shielding and radiofrequency shielding, to be determined in conjunction with the equipment supplier, according to the machine specifications.
 - j. Interventional suite room
- 3. Support and staff areas
 - a. Support Areas including facilities including staff toilets, dirty utility, cleaner's room, offices, lunchroom, change rooms with showers, toilets, lockers.

Outpatient Area

The Outpatient department, also known as Ambulatory Care Unit, refers to specialized settings where patients receive health care but do not remain overnight. The Outpatient Unit will perform the following functions: consultation with medical specialists, examination and investigations; treatment on a same day basis; minor procedures; follow up review consultation and ongoing case management; patient screening prior to surgery – perioperative services; health education or counselling sessions for patients and families; referral of patients to other units or disciplines for ongoing care and treatment; and referral for admission to a hospital for inpatient services. The department has a reception area on the ground floor, and services, support and administration areas situated on first floor. The connection between these two levels is carried out with separate independent staircase and lifts. The department has a total area of 1453.53 sq. m.

The Outpatient Department consist of the following functional areas:

1. Entry / Reception area with customer service, cashier, registration desk, medical records room, waiting area, patient toilets
2. Consult and treatment area, organised in five subdepartments with separate sub-waiting areas, nurses' stations, consultant offices, consulting and examination rooms and toilets. Special attention is to be given to the visual and acoustic privacy of patients when being interviewed and also to the quality of light when being examined. Basins suitable for surgical scrubbing procedures will be provided for each Procedure and Treatment room. Clinical hand-washing facilities will be located convenient to the Staff Stations and patient areas. Medical gases may be provided within Consult, Procedure and Treatment rooms as required by the facility's operational policy.
3. Staff area, including staff toilets and staff lounge.

PHARMACY

The purpose of the Pharmacy Unit is to provide all inpatient and outpatient pharmacy services including dispensing, preparation of non-sterile and sterile commodities as required, and providing drug information and education. The Pharmacy is located on the first floor, in connection to the Outpatient department for convenient access, staff control, and security. There are separate controlled pick-up and receiving points for inpatients and outpatients. The area of the department is 973.04 sq. m.

Design will include provisions for barcode technology for patient prescription identification and tracking as well as electronic prescribing, which will require computer and scanning equipment including additional power and data outlets.

The functional areas of the Pharmacy Unit are sub-divided into two types as follows:

1. Accessible Areas open for outpatients including:
 - a. Reception and Waiting area located in proximity to the outpatient's waiting area with customer service, office, and toilets
 - b. Patient consult area with confidentiality room, triage, kiosk processing room
2. Restricted Areas open for staff only including:
 - a. Dispensing Area for outpatients
 - b. Preparation and manufacturing areas of non-sterile
 - c. Preparation and manufacturing areas of sterile goods. The sterile manufacturing rooms will be positive pressure and will be accessed via an Anteroom. Electronic door management system to prevent the opening of both doors in the Anteroom at the same time will be integrated. Handwashing facilities will be provided immediately outside the Aseptic (Clean) Rooms in adjoining Anteroom; hand basins are not to be located within the Aseptic (Clean) Rooms. An intercom system will be provided between Aseptic (Clean) Rooms and the Anteroom. High-resolution CCTV cameras for remote monitoring will also be present.
 - d. Bulk stores including unpacking area

- e. Secured stores for accountable drugs, refrigerated stores and flammable goods storage
- f. Dispatch area for deliveries to inpatient units and after-hours drug store for access only by authorised personnel and located within a 24-hour zone of the hospital
- g. Staff areas including Offices, Workstations, Meeting Room, Staff Room, Change and Toilets

All drug storage areas shall have temperature and humidity controls; internal room temperature shall be kept below 25 °C. Hand washing facilities will be provided within each separate room where open medication is handled. The Pharmacy Unit was designed to comply with the requirements given by the Pharmacy Council of Jamaica.

MEDICAL RECORDS

Medical records department is situated on the first floor and has an area of 535.51 sq. m. It provides secure storage and retrieval of patient records, including patients' medical history and care across time, i.e., written (paper notes), physical (image films) and digital records that exist for each individual patient. It has included fire rated construction of enclosure as indicated in the Building Code of Jamaica.

The following additional functions shall be allowed for: clerical and administrative activity associated with medical records management; review of medical records and report preparation; and storage of Ledgers, account forms, vouchers etc. It consists of reception and waiting, assistant medical records officer, medical records officer, work area for copier, central transcription room, storage area, server room, temporary medical records, storage for active files, storage for inactive files, death registry and medicolegal.

SURGICAL BLOCK

The Operating Unit provides a safe and controlled environment for the operative care of patients undergoing diagnostic/ surgical procedures under anaesthesia and peri-operative care including post procedure recovery.

The Operating Unit is located on the second floor and has an area of 2,224.66 sq. m. It is arranged to prevent non-related traffic through the suite. It is organized following the dual corridor or 'race track' model. It allows all Operating rooms to be accessed from one corridor for patients and from another for sterile goods. This model aims to separate 'dirty' from 'clean' traffic by controlling the uses of each corridor. In this design, there must not be cross traffic of staff and supplies from the decontaminated/ soiled areas to the sterile/ clean areas. The main sterile services unit is located externally from the operating unit, but it is located adjacent and with direct access to the sterile stock supply area.

In all areas where patient observation is critical - operating room, anaesthetic room, recovery area/room, holding area/room, paint colours will be chosen which do not alter the observer's perception of skin colour. Interior elements will be combined to create a calming, non-threatening environment.

The Operating Unit consists of the following functional areas:

1. Preoperative unit - for receiving and admission of patients to the Unit, with general overseeing of day to day operations, control of entry and exit from the Unit and completion of general administrative tasks. Here are the Holding areas for holding and management of patients prior to their operation or Procedure and waiting for surgery. It is situated in proximity to the operating rooms, but out of the main operating suite traffic route. The design incorporates 210 cm between centre lines of beds with bed screen curtains, providing individual privacy for patients. The main functions of this area for which facilities shall be provided are:
 - a. clinical observation of patients including blood pressure, skin tone and pulse rate measurement
 - b. resuscitation of patients, if required
 - c. nurse call and staff assistance call
 - d. clinical hand washing
2. Staff and administration unit – includes separate change rooms with showers, toilets and lockers for nurses, female, and male surgeons; additional separate staff toilets; staff lounge for staff to relax and to prepare and consume beverages and is located away from the patient’s area to ensure that patients in recovery, or on transfer do not overhear confidential discussions or levity from within; offices and administrative space for clinical staff; meeting room.
3. Operating rooms module is the place where procedures are carried out. It includes:
 - a. Operating suites – 6 numbers
 - b. Scrub-up rooms adjacent to the entrance to each operating room. Elbow, foot, or electronic sensor devices shall be considered for tap valve activation. Hands off activation shall be provided.
 - c. Sterile set-up rooms, with direct access to two operating rooms, that are sharing one set-up room. The Set-up Room is the clean workroom in the suite where clean or sterile materials are held and arranged, prior to use in the operating rooms. The main functions, for which facilities shall be provided, are sterilization of dropped and specialized instruments; storage of instruments and materials; holding of sterile supplies and packs; storage of lotions in a special purpose warming cabinet; preparation of dressing and instrument trolleys; storage of drugs including scheduled drugs; dry waste disposal, etc.
 - d. Exit Bays
 - e. Support area - Clean-up / sluice rooms, flash sterilizer, drugs store, blood store, linen, blanket, and fluid store and warmer
4. Support area – including mobile equipment, doctor’s office, anaesthetic store, technician room.
5. Recovery area for post anaesthesia and procedure recovery with 18 beds – where patients are assisted through the process of recovering from the effects of anaesthetic. Recovery area is divided in three sectors – stage 1, and stage 2. Following general surgery patients are recovered in the Stage 1 Recovery. Patients with complicated surgery may by-pass Stage 1 Recovery and be recovered directly in an ICU. Stage 2 accommodates patients who have regained consciousness after anaesthesia but require further observation; and patients who have undergone procedures with local anaesthetic. Stage 2 recovery may be provided as bed bays or chair bays or a combination of both.

Direct access to the recovery area by relatives/visitors/transport providers from the lobby/waiting area via the vertical communication core is provided.

The design of the recovery rooms shall provide space for all functions and equipment requirements. Adequate space will be provided to cater for patient trolleys and their movement in and out of the room. Minimum Dimensions shall be:

- a) between bed/trolley centres – 230 cm
- b) clearance between bed/trolleys – 90 cm
- c) clearance between bed/trolley and side walls – 90 cm; and
- d) clearance from foot of bed/trolley to nearest obstruction (wall, bench, or parked equipment) – 210 cm

Acoustic privacy is required in Operating Rooms, Procedure rooms, Interview, Treatment rooms and any rooms where confidential information will be discussed. The transfer of sound between clinical spaces should be minimised to reduce the potential of staff error from disruptions and miscommunication and to increase patient safety and privacy. Noisy areas such as Staff rooms are located away from procedural areas.

Support area - pathology, sluice room / disposal room with pickup from an external corridor; staff toilets with cleaner's room, office, and clean utility.

ENDOSCOPY UNIT

The Endoscopy Unit is a dedicated unit for Endoscopy procedures, a minimally invasive surgical or medical procedure utilising an instrument called an endoscope, which is a long flexible tube that has a lens at one end and a fibre optic camera at the other. This allows for the magnification of an image to be projected onto a video screen for viewing and recording. Endoscopy can be used to examine organs or tissue for diagnostic or therapeutic purposes. Endoscopy procedures may involve the taking of biopsies, dilations, retrieval of foreign objects and removal of stones from the bile duct.

Endoscopy procedures have advantages for both the facility and the patient including:

- reduced demand on operating rooms
- increased patient throughput as procedures is faster
- procedures are less invasive, resulting in reduced scarring, quick recovery time and rapid discharge.

The current Endoscopy Unit is a dedicated fully self-contained unit within the hospital. It is situated on the second floor and has an area of 437.10 sq. m. Patients undergoing endoscopy procedures may be admitted and discharged on the same day or transferred from and to a referring unit. The Endoscopy Unit is located with easy access to and from the entry area for patients, visitors, staff and supplies via one of the vertical communication cores. The location within the complex will permit free access for outpatients and for the transport of inpatients by bed, trolley, or wheelchair. The planning

of the Unit should create an efficient flow of patients, staff and supplies through the Unit while maintaining separation of procedure and contaminated areas.

The Endoscopy Unit is divided into functional areas as follows:

- Entry/ Reception including Waiting area for patients and relatives and toilet facilities
- Assessment/ Preparation area which include consultation, patient changing and treatment and preparation room for pre-procedure treatments
- Procedure area with colposcopy room, endoscopy room and corresponding scrub and clean-up areas
- Support areas including storage, equipment, sterilization, supply areas and waste holding.
- Recovery area is shared with the Surgical block unit.

CENTRAL STERILE SERVICES DEPARTMENT

The Central Sterile Service Department (CSSD) is located on the second floor and has an area of 597.30 m². Its role is to clean, decontaminate and store re-usable equipment and medical devices to ensure patient safety, compliance, efficiency, and economy. A centralized unit minimize duplication and facilitate effective auditing while delivering a one-way flow of items between soiled and clean areas. Infection control and good manufacturing principles are to be observed when designing the unit/department. The planning of the facility will provide for security and separate clean and dirty working areas, avoiding routes and cross-flows, which potentially could re-contaminate processed items or adversely affect the microbiology of raw materials. There must be a unidirectional workflow from contaminated to clean and sterile areas.

The Sterile Supply Unit will include the following functional areas or zones:

1. Decontamination area including cleaning / decontamination area where all instruments are sorted, rinsed, ultrasonically cleaned, or mechanically washed then dried; trolley wash area for cleaning of trolleys; this may include manual washing or automated trolley washing equipment.
2. Sorting and packing area comprising airlock entry to maintain air pressurization within the clean zone; sorting, assembly and packing area; this is a Clean Workroom where clean instruments, equipment and other articles are sorted, counted, and packaged for sterilizing at packing workstations.
3. Sterilising and cooling area with high temperature sterilisers including loading and unloading space; low temperature sterilisers for items requiring this method of sterilizing; plant area for access to sterilisers; cooling area for trolleys unloaded from sterilisers are held while stock is cooling.
4. Despatch area for distribution of sterile stock to operating unit or other hospital units; sterile stock may also be collected from this area by hospital units if urgently required. An After Hours cupboard may be provided for urgent supplies of sterilized items outside of operating hours.
5. Support Areas including handwashing bays; at entry/ exits to decontamination and sorting/ packing areas; cleaner's rooms; disposal room; stores for chemicals used in processing instruments, general supplies

6. Administrative and Staff Areas including offices, change rooms, staff room.

LABORATORY

The Laboratory Department provides facilities and equipment for the examination of body tissues and fluids, involving receipt of patient specimens, testing and issue of reports. It is located on the fourth floor and has an area of 662.23 m².

The access to the department is restricted to staff only. Specimen Collection where outpatients' specimens are taken for laboratory testing is integrated in the outpatient department, situated on the first floor. Specimens will be transported to the Laboratory unit for processing by a mechanical transport system such as a Pneumatic Tube system or by internal hospital courier. Inpatient specimens are collected at the bedside.

Internally, the Laboratory unit is arranged in zones with a clear flow of processing from Specimen Reception to the various Laboratories required for specific specimen testing.

The Laboratory is divided into functional areas as follows:

1. Entry / Reception area with sample reception area accessible both from the public and staff corridor, after hours blood store and office. Staff and support areas are also located conveniently close to the main entrance with ready access from all laboratory areas. They serve all laboratories to avoid duplication of support rooms and include staff lounge, staff change, staff toilets, store, and dirty utility / disposal room.
2. Blood bank - located in close proximity to Haematology for convenient processing. Blood and blood products will be stored in a secure, strictly controlled environment. The area will contain temperature controlled refrigerators and freezers under the supervision of laboratory staff.
3. Haematology - concerned with diseases that affect the blood and the management of blood transfusion services specimen collection, high volume analyser, manual testing, and workstations with microscopy.
4. Microbiology / Serology and clinical chemistry - concerned with diseases caused by organisms such as bacteria, viruses, fungi, and parasites; clinical aspects involve control of infectious diseases and infections caused by antibiotic-resistant bacteria- includes specimen reception, lab incubators, physical containment lab.
5. Chemical and gross Pathology- involves the diagnosis of disease based on the microscopic, chemical, immunologic, and molecular examination of organs, tissues, and whole bodies (autopsy); Anatomical pathology is itself divided in subspecialties including Surgical Pathology, Cytopathology and Forensic Pathology.

INTENSIVE CARE UNIT, HIGH DEPENDENCY UNIT

Intensive Care is a dedicated unit for critically ill patients who require invasive life support, high levels of medical and nursing care and complex treatment. The intensive care unit provides a concentration of clinical expertise, technological and therapeutic resources, which are coordinated to care for the critically ill patient.

The Intensive Care Unit, High Dependency Unit Department is located on the fourth floor and has an area of 662.92 sq. m. It is conveniently accessible for urgent admissions to and from the following departments, through the communication cores:

1. Emergency Unit
2. Operating Unit, for urgent patient transfers
3. Pathology Services
4. Pharmacy
5. Biomedical Engineering to ensure availability and functioning of monitoring and life support equipment
6. Medical Imaging particularly for chest x-rays and CT scanning

The possibility for through traffic was eliminated.

PATIENT / TREATMENT AREA (INCLUDING BEDROOMS, ISOLATION ROOM AND FULLY ASSISTED BATHROOM)

The number of beds that are provided are nine (9) and are organized in eight (8) single-patient cubicles and one single isolation room. They will contain an approved patient monitoring system, with visual display for each patient at a central monitoring point, i.e., the Nurses Station. Monitors with high/low alarm and the capability to provide hard copy of displays are recommended. To assist staff observation of patients in the patient rooms, the cubicles are partially opened. To facilitate resuscitation procedures without restricting movement of staff, beds, and equipment, the available minimum clear distance between the head of the bed and any fixed obstruction or wall and between the foot of the bed and the bed screen will be 90 cm.

All entry points, doors, or openings are a minimum of 120 cm wide, unobstructed. Larger openings may be required for special equipment. Each bed will have visual access, other than skylights, to the outside environment with not less than one outside window in each suite. Distance from the patient bed to the outside window will not exceed 15 m.

Each bedroom will include storage and writing provision for staff use. There will be also storage facilities for each patients' clothing and toiletries. A patient activated nurse call facility will be provided at each bed for summoning assistance. A staff assistance call facility will be provided at each bed for summoning staff assistance. A flexible bed head services (Electrical and Mechanical) facility shall be provided. Clinical hand washing facilities, will be provided in each patient bedroom. For the Isolation Room the entry is through an airlock. Direction of airflow will be controllable. Clinical hand washing, gown and mask storage, and waste disposal will be provided within the airlock. A partially assisted ensuite, directly accessible from the isolation room, is also provided.

In all areas where patient observation is critical, paint colours will be chosen which do not alter the observer's perception of skin colour.

Staff Area includes nurses' station, medical records, administration, staff toilets, separate staff lounge and change rooms with ensuite facilities for doctors and nurses.

Nurses Station with space for charting and central monitoring, is located in proximity to the patients.

Visitors Area include reception / waiting and visitors gowning immediately to the entry of the department, but away from patients, visitor's toilets. Access to public telephones is essential.

Service Area include clean utility/ medical supplies, dirty utility, cleaner's room, store.

An area for the storage and preparation of medical consumables, readily staff working in the patient area, and so accessible to designed to ensure speedy preparation of medications, will be provided. It must be located within close proximity of the nurses' station. A dirty utility room is provided in an enclosed area for contamination control.

BED WARDS

The prime function of the Beds wards is to provide appropriate accommodation for the delivery of health care services including diagnosis, care, and treatment to inpatients. The Unit will also provide facilities and conditions to meet the needs of patients and visitors as well as the workplace requirements of staff. The Inpatient Unit is a key functional component of the hospital, connected with many clinical and operational support units. Currently there are four beds ward, situated on third (9.), fourth (11.) and fifth floor (13.) and (14.) with a total capacity of 90 beds.

In total, there are 14 single bedrooms, 3 nineteen-beds wards, 1 fifteen-beds ward and 4 isolation rooms. They are organized by floors and departments as per Table 1-1 below and support facilities are duplicated for each unit. Patient and support rooms are clustered along a single corridor. Each Inpatient Unit contains less than 32 patient beds, which is the maximum recommended number.

Table 1-1 Spanish Town Hospital – Bed wards organization

Floor level	Department No	Single bedrooms	Cubicles	Isolation rooms	Total
Floor 3	9.	3	19	1	23
Floor 4	11.	3	19	1	23
Floor 5	13.	3	19	1	23
Floor 5	14.	5	15	1	21
TOTAL for STH		14	72	4	90

The minimum dimensions of clear door openings to inpatient bedrooms in new areas shall be 120 cm wide and 205 cm high, to ensure clearance for the movement of beds. Bedrooms with end suites have to be equipped with doors and hardware, which will permit emergency access from the outside.

Each external window and/or external glazed door panel area shall not be less than 10% of the floor area of the room concerned. An opening component equal to not less than 5% of the floor area of that same room is considered highly desirable. These requirements together will ensure natural light and ventilation in the event of an electrical or air handling system failure.

In multi-bedrooms, the minimum distance between bed centre lines shall be 240 cm. A clearance of 120 cm shall be available at the foot of each bed to permit the passage of equipment and beds.

For occupational health reasons, the minimum spacing between beds shall be 120 cm.

The room will provide for the following functions: medical and nursing care, therapeutic and clinical attention, patient to read, write, relax, and eat meals, nurse call, patient to view TV (optional), patient to use radio/music system optional), patient to use telephone (optional), storage of clothing and personal effects, receiving of visitors, patient privacy (bed screens), waste disposal.

1.2.1.3 Design Concepts

Building Materials and Finishes

External wall: It is fabricated from Cast-in-place reinforced concrete frame-shear wall structure and locally produced concrete (white stone aggregate) hollow blocks, 2 large square through holes are provided, it shall be built at staggered joint and spaced by a hole in which round 12mm rebar is inserted, and concrete is placed in all holes. Its size is L400 x H200 x W100/150/200, and 150 is used as external wall.

Internal parting wall: It is fabricated from concrete blocks (same as the practice of building external wall) or light wall. Blockwork fabricated from 200 thick concreting shall be provided for large medical examination equipment room of radiology department, X-ray machine room; rooms requiring electromagnetic shielding shall be provided with metal net shielding layer on the inside.

Partition for pipe shaft: It shall be fabricated from 75 wide light gage steel joist, two layers of 12 plasterboards shall be provided on both sides, total thickness is 100, it shall be filled with rock wool, and the minimum fire resistance rating is 1 hour.

Selection for building materials for the interior and exterior decoration of the building is very important and shall be based on cost effectiveness, utility, durability, and aesthetics. It has direct impact on safety (patients, staff, and visitors) and has potential legal implications if not correctly addressed. Fire safety compliance is also a special consideration. The finishes utilized vary and are selected with regard to the function of the room, appearance, cleaning, infection control, acoustics, and access to services for ongoing maintenance. Floor finishes also have a direct impact on the whole of life costs of any building where cleaning and maintenance is concerned. Low capital cost may result in high whole of life costs.

The floor finishes in all patient care areas and corridors are with skirting and:

1. slip resistant surface
 - a. wear resistance appropriate for the location involved
 - b. be impermeable to water and body fluids
 - c. be durable and easy to clean
 - d. minimise sound transmission
 - e. provide shock absorption to optimise staff comfort but facilitate movement of beds.
2. Indoor flooring shall be made of:
 - a. locally applicable terrazzo for lobby, corridors, outpatient area

- b. linoleum for inpatient area
- c. epoxy resin for special areas, e.g., operating theatres, sterile and contaminated areas
- d. tiles for bathrooms and toilets

Wall bases in operating rooms, clean and dirty utility rooms, C.S.S.D. areas and other areas subject to frequent wet cleaning methods shall be made integral with the floor, tightly sealed against the wall, and constructed without voids, i.e., covered skirting.

Internal wall faces shall be painted, with splashback to basins, and linoleum or resin finish where needed. Suspended ceiling is provided for all rooms and the type depends on the function of the room. Suitable materials for wall protection and interior decoration shall be provided for some special medical rooms. Local common paint shall be applied to external wall.

Accessibility Design

This work shall be performed in accordance with the Codes for Accessibility Design.

Entrance and exit shall be skid resistant, entrances/exits of outpatient, emergency, rescue, and inpatient buildings shall be flat slope accessible type, maximum flat slope is 1:30, minimum door width is 1.5m.

One elevator in the common area and two elevators in the inpatient building shall be accessible elevators. Accessible elevators shall be provided with measures including: (1) floor selection button with braille on low level of one side of car; (2) handrail on three walls; (3) reflector glass between position 0.9m from bottom and top of front side; (4) elevator operation display device and floor audio; (5) accessibility logo; (6) low button elevator suitable for operation by wheelchair patients.

Main passage shall be provided with double-layer handrail, upper layer being 0.9m high and lower layering being 0.65m high.

1. A separate accessible toilet is to be provided, where appropriate, for each patient sanitary area.
2. Outdoor sidewalk shall be provided with blind track on the ground.
3. Accessibility logo system shall be provided in the common area.
4. Toilets in bed wards shall be provided with handrail, call button and other similar facilities and equipment.
5. Registration, cashier, and nurse stations shall be provided with low tabletop
6. Waiting area shall be provided with space for wheelchairs to stop. Accessible parking space shall be provided outdoors.

Technical Design of Building

Natural daylighting is maximised where possible. There is evidence that access to daylight enables patients to be discharged from hospital sooner than patients without daylight access. Therefore, the majority of rooms for inpatients in the bed wards have excellent orientation and sunshine.

Improving the mental well-being of patients improves their recovery rates. Recent studies show that daylight post-surgical facilities improve this mental well-being. Intensive Care Unit (ICU) areas in hospitals can be very stressful for patients and workers. Some patients can develop “post-operative delirium” in a stressful environment, which affects the intellectual ability of the patient. Many factors affect the development of the delirium: age, alcoholism, drug abuse, sex, preoperative anxiety, sleep deprivation, and perceptual distortion). Daylight helps reduce the stress associated with this environment’.

Numerous qualitative and quantitative studies have identified and reported the importance of establishing a visual connection with the natural world outside the building. Demonstrable benefits have been found associated with faster post-operative recovery and improved treatment.

It is critically important that the positive benefits of daylight are not confused with the negative impacts associated with excessive solar radiation. Therefore, sun shading is integrated together with modern glazing that reduces the UV transmission.

1.2.2 St. Jago Park Health Centre

1.2.2.1 Location

The St. Jago Park Health Centre is located in Spanish Town, the capital of St. Catherine. It is ≈ 1.1 km east of the City Centre, 300m north of the Spanish Town bypass, ≈ 1.8 km west of the Jose Marti Technical High School and ≈ 1.2 km south of St. Jago High School (Figure 1-3).

1.2.2.2 Project Features

The St. Jago Park health centre is being prioritized for expansion to reduce the number of patients seen at the hospital while increasing the services and operational time offered to clients who live in the Spanish Town area. Currently, the St. Jago Health Centre is Type III, but it is recommended to be significantly expanded and upgraded to Type V – (or under the new categorization -Comprehensive). The proposed construction is situated on a current parking lot and is approx. 800 sq. m. The new building is proposed to be constructed with direct connections both to the existing building of the health facility and to the existing conference room building and includes the remodelling and refurbishment of the existing health centre.

Additional facility infrastructure will be integrated in the new building to provide easy and convenient service access to the facilities. It will include:

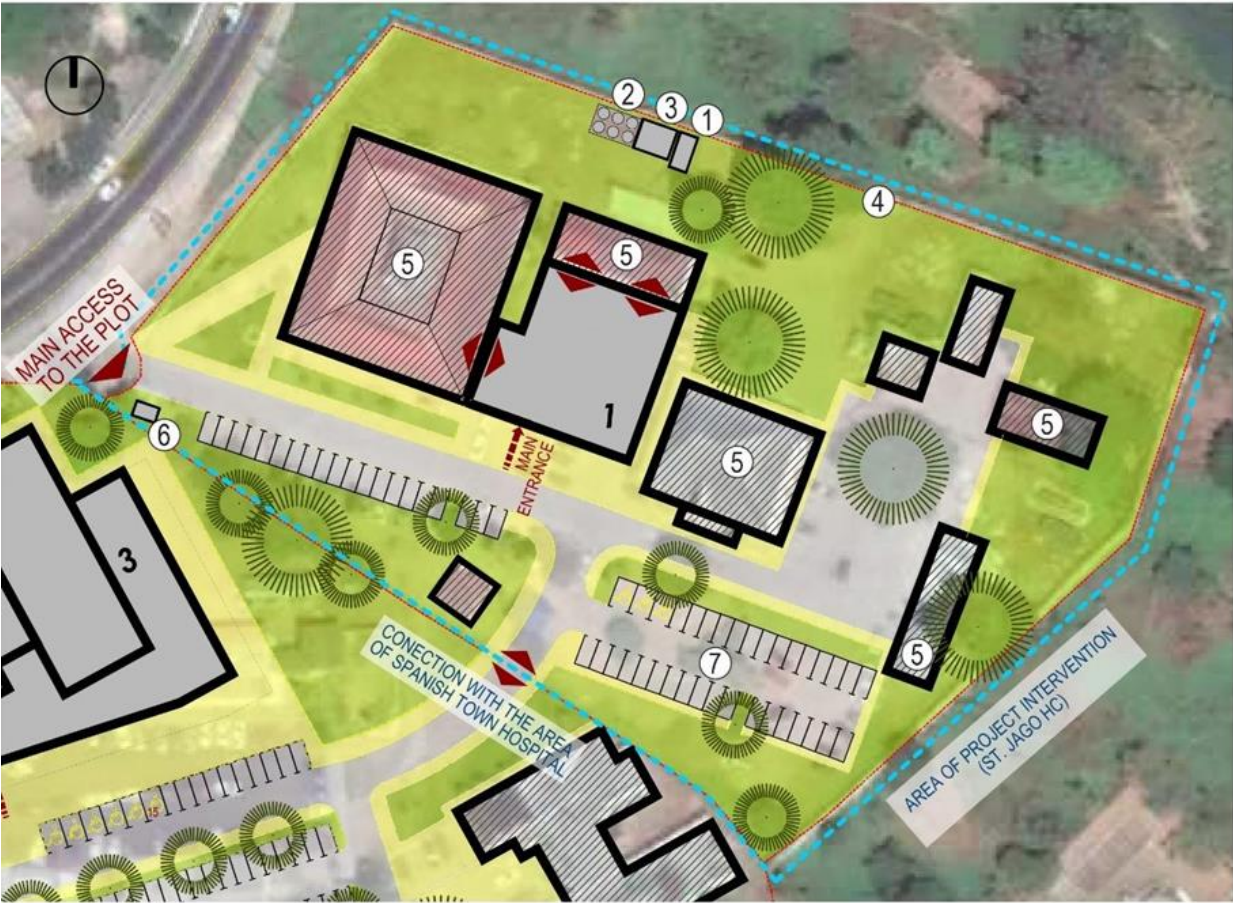
- HVAC system
- Facility Generator
- Facility Water Storage
- Perimeter wall

The construction period is anticipated to take approximately 15 months.

The proposed project layout is depicted in Figure 1-7 and illustrated in Figure 1-8.



Figure 1-6 Location map of the Spanish Town hospital and St. Jago Park Health Centre



1. HVAC SYSTEM	4. PERIMETER WALL AND FENCING	7. NEW PARKING LOT
2. WATER STORAGE	5. EXISTING BUILDINGS	ENTRANCE
3. GENERATOR	6. SECURITY POST	

Figure 1-7 St. Jago Park Health Centre Site Layout



Figure 1-8 Renders of St. Jago Park Health Centre

Orientation and Building Location

The existing building is reconfigured according to Stakeholders' demand. Based on the outputs of the conducted site analysis and the Accommodation requirements set in the "ANALYSIS TO STRENGTHEN PRIORITY PRIMARY CARE AND HEALTH NETWORKS IN JAMAICA" from July 17, 2018, it was estimated

that the most optimal and appropriate solution for the shape and size the footprint of the new building will be to have a rectangular one storey building, located in the central part of the project site.

The Main Entrance of the new section will be located on the south façade of the building, which provides easy access from the internal road. Additional secondary entrance for A&E department is being planned and two more emergency exits. This solution for the shape and location of the St. Jago Park Health Centre Building provides the following advantages:

- optimal use of the available area considering the physical constraints of the plot, which were defined in the Site Analysis
- easy car and parking access
- maximum preservation of the existing green area

Building Grade and Index

- Structural type: Cast-in-place reinforced concrete frame-shear wall structure
- Height of building (m) = +6.30
- Existing Building Area: 1,137.07 m²
- New Building area: 634.30 m²
- Total Building Area: 1,831.38 m²

Floor areas are outlined in Table 1-2.

Table 1-2 Floor Areas for St. Jago Park Health Centre

LEVEL	DESCRIPTION	FLOOR AREA
GROUND FLOOR	ENTRANCE (1.)	362.15 m ²
EXISTING BUILDING	DENTISTRY (2.)	102.59 m ²
	MENTAL HEALTH (3.)	89.00 m ²
	DR/ AR SCREENING (4.)	29.98 m ²
	EXISTING ROOMS (5.)	51.54 m ²
	LABS (6.)	47.00 m ²
	MEDICAL RECORDS (7.)	108.67 m ²
	COMMUNITY SERVICES (8.)	138.21 m ²
	CLINICS (10.)	207.93 m ²
GROUND FLOOR	CORRIDORS (9.)	114.76 m ²
NEW	PATIENT`S AREA (11.)	391.78 m ²
CONSTRUCTION	STAFF AREA (12.)	187.77 m ²
TOTAL		1,831.38 m²

Functional Layout

The required premises is organized in twelve functional groups and are arranged according to stakeholder's recommendations in order to facilitate efficient flow of staff, patients and equipment and to ensure accessibility. The reconfiguration of the existing building include:

1. ENTRANCE – includes main waiting area, customer service, security desk, wheelchair store and triage room with resuscitation bay.
2. DENTISTRY – includes reception and sub-waiting area, four dental consultation rooms, sterilization room, store and vacuum and suction room.
3. MENTAL HEALTH - includes reception, sub-waiting area and six mental health rooms.
4. DR/ AR SCREENING - includes sub-waiting area and screening room
5. EXISTING ROOMS – includes staff lounge, staff toilets and public toilets
6. LABS
7. MEDICAL RECORDS – includes registration and medical records room
8. COMMUNITY SERVICES - includes sub-waiting area, offices
9. CLINICS - includes reception, sub-waiting area, consultation rooms, ultrasound rooms, community health aid and public toilets

The new one storey building includes:

1. CORRIDORS
2. PATIENT`S AREA – includes sub-waiting area, consultation rooms, isolation room, procedure room, treatment room, asthma room, ORS room, etc.
3. STAFF AREA – conference room, offices, lunchroom, staff restrooms, etc.

All areas of the facility shall be designed, constructed, furnished and equipped in keeping with the principles of infection control. Infection control involves the prevention of possible spread of infection by the minimization of transfer of micro-organisms from person to person.

1.2.2.3 Design Concepts

Building Materials and Finishes

External wall: It is fabricated from locally produced concrete (white stone aggregate) hollow blocks, 2 large square through holes are provided, it shall be built at staggered joint and spaced by a hole in which round 12mm rebar is inserted, and concrete is placed in both pockets. Its size is L400 x H200 x W100/150/200, and 150 is used as external wall.

Internal parting wall: It is fabricated from hollow blocks (same as the practice of building external wall) or light wall. Blockwork fabricated from 200 thick concreting shall be provided for large medical examination equipment room of radiology department, X-ray machine room; rooms requiring electromagnetic shielding shall be provided with metal net shielding layer on the inside.

Partition for pipe shaft: It shall be fabricated from 75 wide light gauge steel joist, two layers of 12 plasterboards shall be provided on both sides, total thickness is 100, it shall be filled with rock wool, and the minimum fire resistance rating is 1 hour.

Selection for building materials for the interior and exterior decoration of the building is very important and shall be based on cost effectiveness, utility, durability and aesthetics. It has direct impact on safety (patients, staff and visitors) and has potential legal implications if not correctly addressed. Fire safety compliance is also a special consideration. The finishes utilized vary and are selected with regard to

the function of the room, appearance, cleaning, infection control, acoustics and access to services for ongoing maintenance. Floor finishes also have a direct impact on the whole of life costs of any building where cleaning and maintenance is concerned. Low capital cost may result in high whole of life costs.

The floor finishes in all patient care areas and corridors are with skirting and should:

- Have a slip resistant surface
- Have wear resistance appropriate for the location involved
- Be impermeable to water and body fluids
- Be durable and easy to clean
- Minimise sound transmission; and
- Provide shock absorption to optimise staff comfort but facilitate movement of beds

Indoor flooring shall be made of:

- Locally applicable terrazzo for waiting areas, corridors, cashier, customer service and registration, security desk, administration area and medical records
- Linoleum for consultation and treatment area
- Tiles for staff area, service area, bathrooms and toilets

Internal wall faces shall be painted, with splashback to basins, and linoleum finish where needed. Suspended ceiling is provided for all rooms and the type depends on the function of the room. Suitable materials for wall protection and interior decoration shall be provided for some special medical rooms. Local common paint shall be applied to external wall.

Accessibility Design

- This work shall be performed in accordance with the Codes for Accessibility Design.
- Entrance and exit shall be skid resistant, entrances exits of outpatient, emergency, rescue and inpatient buildings shall be flat slope accessible type, maximum flat slope is 1:30, minimum door width is 1.5m.
- A separate accessible toilet is be provided, where appropriate, for patient sanitary area.
- Outdoor sidewalk shall be provided with blind track on the ground.
- Accessibility logo system shall be provided in the common area.
- Registration, cashier and nurse stations shall be provided with low table top.
- Waiting area shall be provided with space for wheelchairs to stop.
- Accessible parking space shall be provided outdoors.

1.2.3 Old Harbour Health Centre

1.2.3.1 Location

The proposed Old Harbour Health Centre is located in the town of Old Harbour, St. Catherine. It is approximately 476 m southwest of the existing Old Harbour Health Centre, \approx 18.4 km southwest of the Spanish Town Hospital, \approx 3.5 km south southeast of Old Harbour Bay, \approx 7 km east of Sandy Bay in Clarendon. The proposed health centre is \approx 480m north of the Highway 2000 East West, Old

Harbour exit (Figure 1-9). This proposed facility is ≈ 16.3 km southeast of the Map Pen Hospital in Clarendon.

1.2.3.2 Project Features

The existing Old Harbour Health Centre's location and proximity to other buildings and properties limit the possibility to be expanded physically. Therefore, a greenfield site was identified for the construction of the new health centre. The project site is located in the town centre and is surrounded by a major market and commercial district close to the post office, transport centre, Old Harbour market, and other commercial activities. It is bordered to the south by an informal settlement. The available area for the project site is estimated to approx. 9,680 sq. m. The land will be surrounded with perimeter wall and fencing. A basketball playground is located in the eastern part of the site, but its current setting blocks the development of the land and the future driveway that will lead to the proposed parking lot. However, as it is used by the local community, it will be relocated in the southern part of the plot.

An informal apiary operation exists towards the south of the proposed site. The main vehicle and pedestrian access is defined from north, from East Street Check point that is going to be controlled by a security guard is planned to serve the plot main entrance. This is the only access to the facility (egress/ingress) being considered. There will be no displacement of residences or informal settlements located to the south of the proposed project site.

Aerial photographs of the newly proposed project site can be seen in Plate 1-1 to Plate 1-4.



Plate 1-1 Aerial view of proposed project site (looking in a southerly direction)



Plate 1-2 Aerial view of proposed project site (looking in a northerly direction)



Plate 1-3 Aerial view of southern portion of proposed project site (looking in a southerly direction)



Plate 1-4 Informal apiary operation on proposed project site

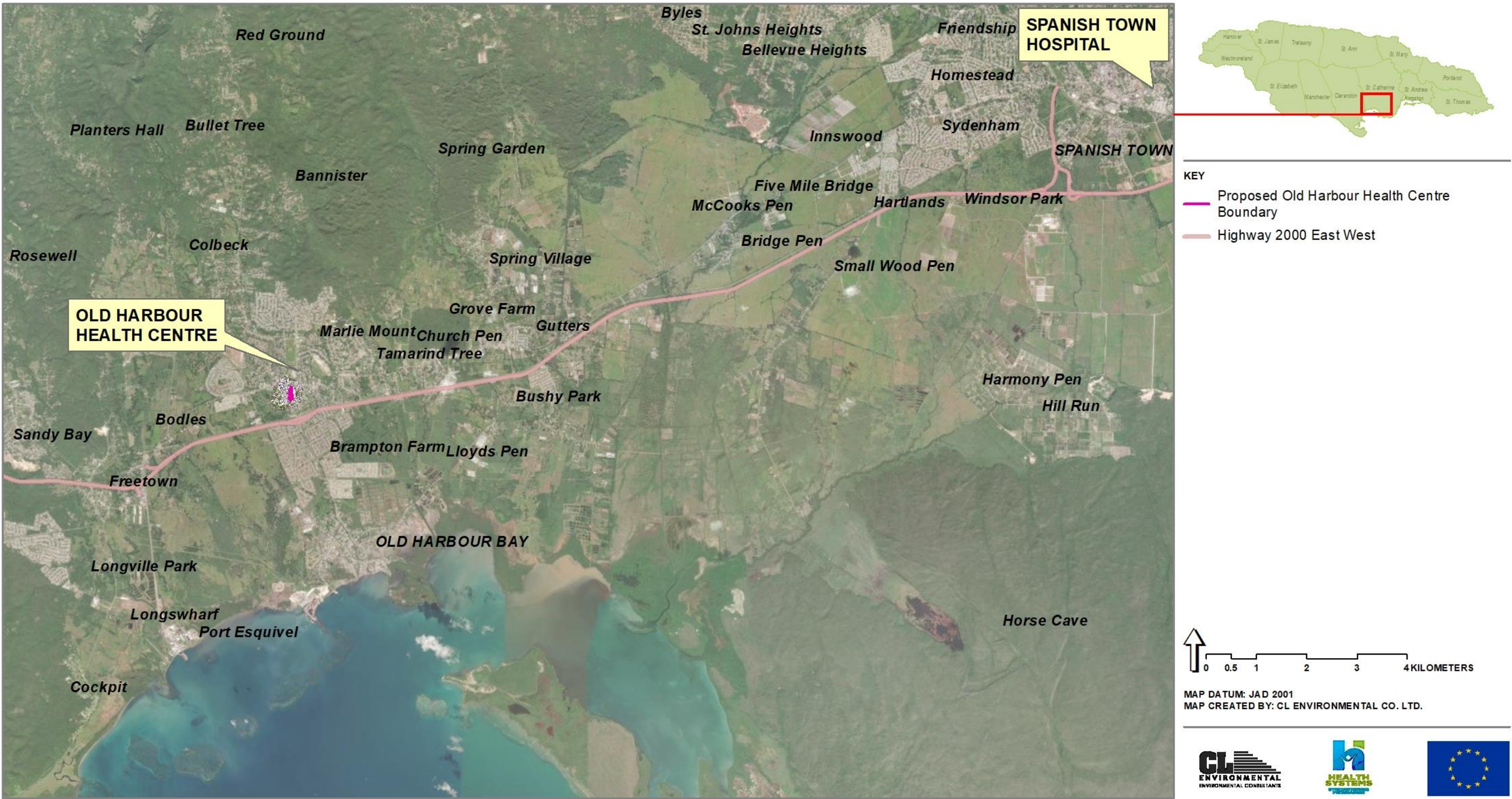


Figure 1-9 Proposed location of the Old Harbour Health Centre



Plate 1-5 Project rendering

It is suggested that the building is situated to the eastern part of the plot, perpendicular to the East Street, and parallel to the internal street, which serves the area. The proposed new one storey building is approx. 1,998 sq. m with nearly rectangular shape footprint. Close to the building, on the south side and with direct connection to the main plot access, a parking lot for 40 vehicles is suggested, three of them are for disabled people. An ambulance bay for one ambulance vehicle is provided in front of the 'Immediate treatment and emergency operating centre'. An allocated area for landscaping and recreation is situated to the south to ensure that the outdoor spaces are pleasant areas for staff and patients. The basketball playground is part of this recreational area. The recreational area could be fenced and separated from the health centre property and thus it could also be used as a new community outdoor space.

Additional facility infrastructure will be integrated in the new building to provide easy and convenient service access to the facilities. It will include:

- HVAC system
- Facility Generator
- Facility Medical Waste Storage – Medical (infectious waste) and Solid Waste storage (general waste)
- Facility Water Storage
- Facility Alternative Energy is also considered, e.g., a photovoltaic system, mounted on the roof. Based on specifications, the contractor will be required to provide; details of purchase, supplier's name and location. Due diligence will be carried out by the PEU to rule out the risk of forced labour in the supply chain of these components.

The construction period is anticipated to take approximately 15 months. Project renderings can be seen in Plate 1-5.

Orientation and Building Location

Based on the outputs of the conducted site analysis and the Accommodation requirements set in the 'Comprehensive Health Centre – Space Programme' from August 16, 2019, it was estimated that the most optimal and appropriate solution for the shape and size the footprint and the number of storeys will be to have a rectangular shape one storey building, located in the central part of the project site with south-north orientation.

The Main Entrance will be located in the centre of the east façade, facing the internal street that serves the plot and provides easy access from the parking lot and the main road. Four additional secondary entrances are planned – two from east and two from north. Additional disposal exit, an emergency exit from the administration area and emergency exits from the mental health rooms are present.

This solution for the shape and location of the Old Harbour Health Centre Building provides the following advantages:

- optimal use of the available area considering the physical constraints of the plot, which were defined in the Site Analysis;
- preservation of the existing mature trees;
- easy car and parking access;
- easy and fast ambulance access;
- maximum preservation of the existing green area.

Building Configuration and Physical Parameters

One of the main tasks of the design team was to estimate and define the main physical parameters of the new HC building, such as footprint size and shape, as well as main dimensions. The key components and inputs that had to be considered for these estimations were the available area for location of the new building and the stakeholder's requirements including of number, type and size of the different premises and the recommendations given by Southeast Regional Health Authority (SERHA).

A relatively simple, close to rectangular shape has been selected for the new one storey building. The first important dimension that had to be defined was the width of the building. It was determined by a function scheme with two main parallel double-loaded corridors. This has many advantages in comparison with single-loaded corridor scheme, as it will make the whole building much more compact and efficient. It reduces the required total length and area of the building, which shall be considered minding the physical constraints of the building site. It also decreases with practically with 50% the required space for circulation areas and respectively doubles their efficiency. That reflects directly in the building costs itself, as it reduces the ground floor area. Taking into account the need to allow for the movement of considerable amount of people, together with trolleys, beds, wheelchairs, and other mobile equipment, including the passing of such equipment, the width of the corridor was designed to be 250 cm between the wall axes.

Building Grade and Index

- Structural type: Cast-in-place reinforced concrete frame-shear wall structure
- Height of building (m) = +7.70
- Building area: 1,994.36 m²

GROUND FLOOR

- MAIN ENTRANCE & CLINCS (1.): **308.70 m²**
- IMMEDIATE TREATMENT AND EMERGENCY OPERATING CENTRE (2.): **152.14 m²**
- SPECIAL SERVICE AREA (3.): **57.64 m²**
- MENTAL HEALTH (4.): **242.28 m²**
- DENTISTRY (5.): **149.25 m²**
- TREATMENT SERVICES (6.): **206.99 m²**
- STAFF/ SERVICES (7.): **108.33 m²**

- HEALTH PROMOTION AND PREVENTION (8.): **67.88 m²**
- MATERNAL AND CHILD HEALTH (9.): **371.17 m²**
- ADMINISTRATION (10.): **161.15 m²**
- TOTAL: **1994.36 m²**

Functional Layout

The required premises is organized in ten (10) departments (functional groups) and are arranged according to stakeholder's recommendations to facilitate efficient flow of staff, patients, and equipment and to ensure accessibility:

1. MAIN ENTRANCE & CLINICS – includes main waiting area, registration, customer service and cashier, medical records, main public toilets, triage nurse and triage doctor and isolation room. Medical records room is in direct connection with the registration area and customer service in order to provide for the secure storage and retrieval of patient records.

The registration area must be designed to protect visual and auditory privacy of the patients and with due consideration for the safety of staff. Design solutions to address safety requirements must also support optimal communication between staff and patients. The patients are assessed in Triage and assigned to the appropriate care zone. The isolation room needs to be located to an exit area and a backdoor, together with adequate ventilation and negative air pressure needs to be provided. The room's perimeter walls, ceiling, and floors shall be sealed tightly so that air does not freely move in or out to the environment from the room except through the allowable gap under the door. All windows shall be fixed and sealed to eliminate infiltration. All isolation rooms shall have self-closing devices on all room exit doors. Viewing window shall be provided in the wall with privacy blinds to allow nursing staff observation without entering the isolation room. The viewing panel shall be of safety glass, wire glass or tempered clear plastic to reduce hazard from accidental breakage. All surfaces in the isolation rooms shall be smooth, impervious, and easily cleaned.

2. IMMEDIATE TREATMENT AND EMERGENCY OPERATING CENTRE – includes treatment room, asthma bay, resuscitation bays, ORS room, etc. The treatment room is a controlled environment that offers patient privacy and is used for assessments, consultation, examination, and treatments (non-invasive and minimally invasive). Clinical hand basin with dispensers and personal protective equipment is provided. Entry doors allow bed/trolley and equipment movement and provide a clear opening of not less than 120 cm.

3. SPECIAL SERVICE AREA – includes pharmacy, laboratory, phlebotomy, ECG, radiology, physiotherapy, ophthalmology screening and audiometry screening. The pharmacy room or suite is located for convenient access, staff control, and security close to the Special services entrance and has a separate sub-waiting area. Controlled pick up and receiving point (counter) are available.

4. MENTAL HEALTH – includes mental health rooms, toilets with shower area. There are five (5) mental health rooms and are supplied with a second exit door for safety and security reasons.

5. DENTISTRY – includes sub-waiting area, dental rooms with soundproof walls, dental auxiliary rooms, vacuum and suction room, sterilization, utility room, storage, toilets.
6. TREATMENT SERVICES – includes doctor's offices, nutrition services, contact investigator, family nurse, nurses area. Doctor's offices are consulting/examination rooms for private consultation and physical examination of patients with or without support/ carers present. Consult and examination functions are combined in one room as it is more space effective and more common. Rooms are with single-sided couch access and are supplied with clinical hand basin with dispensers and personal protective equipment (PPE) positioned close to examination couch and examination area. Doors allow wheelchair access. Acoustic privacy is essential. Natural light and view are also provided without compromising patient privacy during examination.
7. STAFF AND SERVICES – includes storeroom, lunchroom and rest area, soiled utility, clean utility, server room and mechanical and electrical room.
8. HEALTH PROMOTION AND PREVENTION – includes health promotion and education rooms, social workers rooms. Vector control and public health inspector room that were included in ToR were not required by the Stakeholders and therefore were removed from the functional scheme.
9. MATERNAL AND CHILD HEALTH – includes public health nurses, midwife's offices, community health aid, breastfeeding room, children's play area. Maternity outpatient services encompass antenatal and postnatal care including education, counselling and support services. A separate reception point is provided with oversight of the entry and sub-waiting area. This reception point will direct visitors to their point of care and act as an access control point.
10. ADMINISTRATION – includes offices and conference room.

The main design concept for the configuration of the functional zoning is to consider each department as a separate unit that is interconnected with the others within the circulation corridors, but whenever it is needed could be dissociated from the whole with doors. Each functional group has certain specific characteristics that were considered. The design of the facility also takes into account the spatial requirements of furniture and equipment, e.g., trolley bed impact on the design of corridors, doorways and room proportions, service area for sterilizers, etc. All departments are open to the public, except for 'Administration' and 'Staff and Service Area', where the access will be restricted to staff only. All areas of the facility shall be designed, constructed, furnished, and equipped in keeping with the principles of infection control. Infection control involves the prevention of possible spread of infection by the minimization of transfer of micro-organisms from person to person.

The Main entrance leads to the main waiting area, the customer service, and the cashier. This is the only entrance that is going to be opened after working hours when entry for non-employees will be limited to the 'Main waiting area' and 'Immediate treatment area'. Six more secondary entrances and additional emergency exit are provided for more convenience:

1. Secondary Entrance 1 – leading straight to ‘Special service area’ department for direct visit of the pharmacy, laboratory, radiology, physiotherapy, etc.
2. Secondary Entrance 2 – leading straight to a separate waiting area of ‘Mental health’ department in order to be directly reachable from the outside.
3. Secondary Entrance 3 – leading straight to the ‘Immediate treatment and Emergency operating centre’. This is also the entrance of the ambulance patients.
4. Secondary Entrance 4 – leading straight to a separate waiting area of ‘Maternal and Child Health’ department. Pregnant and children are vulnerable, and the aim is to avoid possible interaction and meeting points with other patients that might be severely ill.
5. Secondary Entrance 5 – leading straight to administration and staff area.
6. Emergency Exit – from the ‘Administration and staff area’
7. Secondary Entrance 6 – leading straight to the service area and used as waste disposal exit.

1.2.3.3 Design Concepts

Building Materials and Finishes

External wall: It is fabricated from locally produced concrete (white stone aggregate) hollow blocks, 2 large square through holes are provided, it shall be built at staggered joint and spaced by a hole in which round 12mm rebar is inserted, and concrete is placed in the hole. Its size is L400 x H200 x W100/150/200, and 150 is used as external wall.

Internal parting wall: It is fabricated from hollow blocks (same as the practice of building external wall) or light wall. Blockwork fabricated from 200 thick concreting shall be provided for large medical examination equipment room of radiology department, X-ray machine room; rooms requiring electromagnetic shielding shall be provided with metal net shielding layer on the inside.

Partition for pipe shaft: It shall be fabricated from 75 wide light gauge steel joist, two layers of 12 plasterboards shall be provided on both sides, total thickness is 100, it shall be filled with rock wool, and the minimum fire resistance rating is 1 hour.

Selection for building materials for the interior and exterior decoration of the building is very important and shall be based on cost effectiveness, utility, durability, and aesthetics. It has direct impact on safety (patients, staff, and visitors) and has potential legal implications if not correctly addressed. Fire safety compliance is also a special consideration. The finishes utilized vary and are selected with regard to the function of the room, appearance, cleaning, infection control, acoustics, and access to services for ongoing maintenance. Floor finishes also have a direct impact on the whole of life costs of any building where cleaning and maintenance is concerned. Low capital cost may result in high whole of life costs.

The floor finishes in all patient care areas and corridors are with skirting and should:

- have a slip resistant surface;
- have wear resistance appropriate for the location involved;

- be impermeable to water and body fluids;
- be durable and easy to clean;
- minimise sound transmission; and
- provide shock absorption to optimise staff comfort but facilitate movement of beds.

Indoor flooring shall be made of :

- locally applicable terrazzo for waiting areas, corridors, cashier, customer service and registration, security desk, administration area and medical records;
- linoleum for consultation and treatment area;
- tiles for staff area, service area, bathrooms and toilets;

Internal wall faces shall be painted, with splashback to basins, and linoleum finish where needed. Suspended ceiling is provided for all rooms and the type depends on the function of the room. Suitable materials for wall protection and interior decoration shall be provided for some special medical rooms. Local common paint shall be applied to external wall.

Accessibility Design

- This work shall be performed in accordance with the Codes for Accessibility Design.
- Entrance and exit shall be skid resistant, entrances and exits of outpatient, emergency, rescue, and inpatient buildings shall be flat slope accessible type, maximum flat slope is 1:30, minimum door width is 1.5m.
- A separate accessible toilet is to be provided, where appropriate, for patient sanitary area.
- Outdoor sidewalk shall be provided with blind track on the ground.
- Accessibility logo system shall be provided in the common area.
- Registration, cashier, and nurse stations shall be provided with low tabletop.
- Waiting area shall be provided with space for wheelchairs to stop.
- Accessible parking space shall be provided outdoors.

1.2.4 Greater Portmore Health Centre

1.2.4.1 Location

The project is located in Greater Portmore, St. Catherine. It is bordered by West Henderson Boulevard to the east and northeast; Southwest 2nd Street to the southeast; and Northwest 1st Avenue to the west. It is located ≈ 400 m west of Kensington Primary School and 55 metres southeast of the Portmore Parish Court (Figure 1-10).

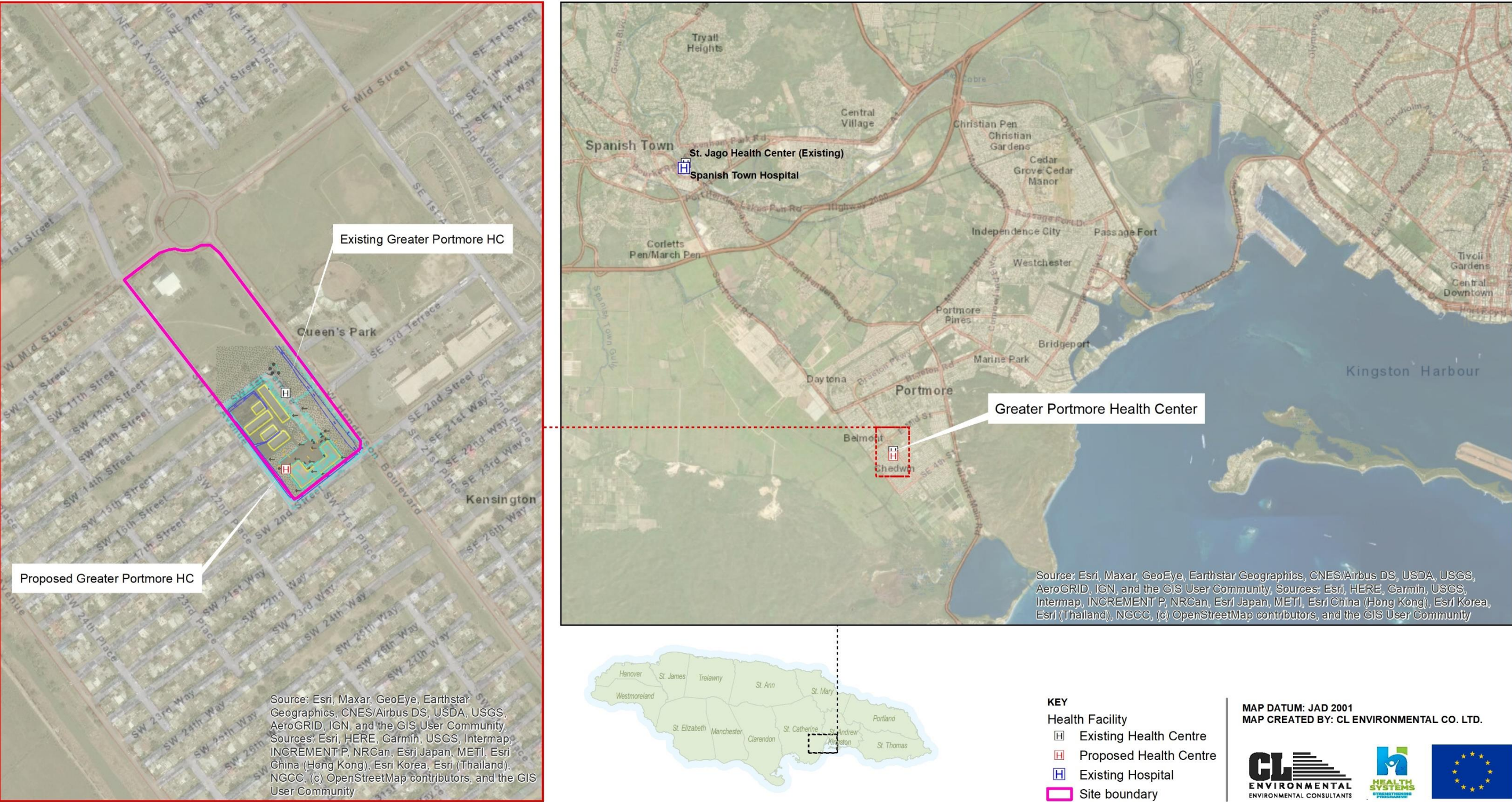


Figure 1-10 Location Map of the Greater Portmore Health Centre

1.2.4.2 Project Features

Portmore City has the largest concentration of residents per square mile outside of Kingston & St. Andrew. Therefore, there is an urgent need to add significant expansion and to upgrade the Greater Portmore Health Centre to a Type V health facility (Comprehensive). The proposed construction is slated on vacant land adjacent to the existing facility.

The project site is located on the south of the existing facility. The available area for the project site is estimated to approx. 5 600 sq. m. that includes part of the existing site and the adjacent site to south-west. Currently, the main access to the plot is from west, from SW 1st Ave. A private street, which already exist and is in connection with SW 1st Ave, serves the hospital plot and the new extension. The building is orientated towards north-west. The space is sufficient; however, it has to be taken into account that it is situated on current field that is used by local community as a football playground. It is recommended to relocate the football playground in an appropriate adjacent area.

The proposed new one storey building is approx. 1,260 sq. m with U-shape footprint and is situated on the southern part of the plot (Figure 1-11). Close to the building a parking lot for 30 vehicles is proposed with four spaces for disabled people. An allocated area for landscaping and recreation is situated to the north to ensure that the outdoor spaces become pleasant areas for patients.

Areas for positioning additional facility infrastructure is proposed. It will include:

1. Facility Generator & Alternative Energy
2. Facility External (Sewer disposal system)
3. Facility Water Storage

The construction period is anticipated to take approximately 18 months.

The layout and proposed design are shown in Figure 1-11 to Figure 1-12.

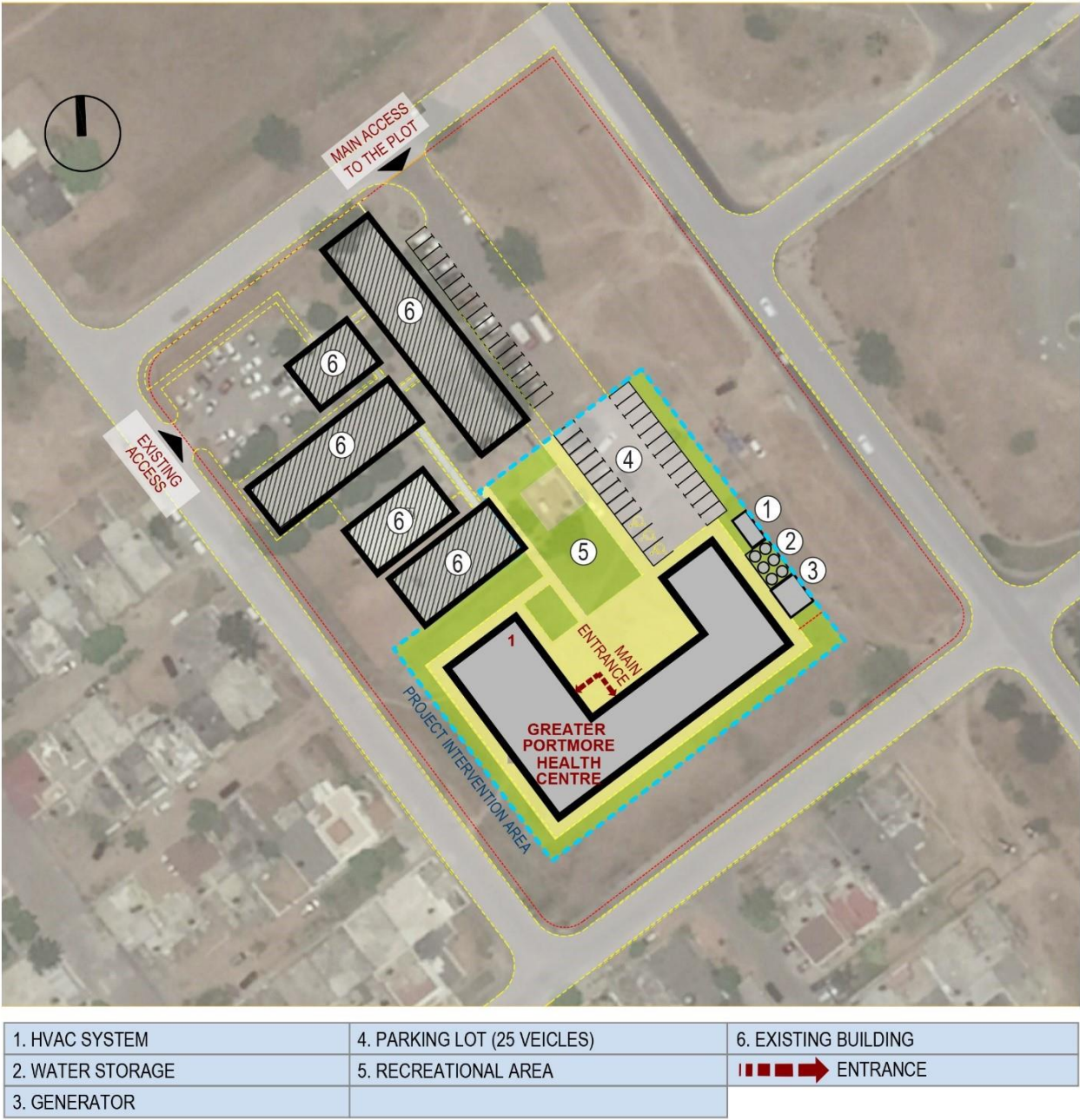


Figure 1-11 Greater Portmore Health Centre Site Layout



Figure 1-12 Rendered view of the proposed Greater Portmore Health Centre

Orientation and Building Location

Based on the outputs of the conducted site analysis and the Accommodation requirements set in the “ANALYSIS TO STRENGTHEN PRIORITY PRIMARY CARE AND HEALTH NETWORKS IN JAMAICA” from July 17, 2018, it was estimated that the most optimal and appropriate solution for the shape and size the footprint and the number of storeys will be to have a U-shape one storey building, located in the south part of the project site.

The Main Public Entrance will be located in the centre of the building, which provides easy access from the parking lot to the customer service and the main waiting area. Two staff entrances are provided that are going to be accessible only with appropriate identification card reader – one leading straight to ‘Administration and medical records’ department that allows direct access for the employees and another, leading straight to the dressing sub-waiting room. Additional disposal exit and an emergency exit are present.

This solution for the shape and location of the Greater Portmore Health Centre Building provides the following advantages:

1. optimal use of the available area considering the physical constraints of the plot, which were defined in the Site Analysis;
2. preservation of the existing mature trees;
3. easy car and parking access;

4. easy and fast ambulance access;
5. maximum preservation of the existing green area.

Buildings Physical Parameters

One of the main tasks of the design team was to estimate and define the main physical parameters of the new HC building, such as footprint size and shape, as well as main dimensions. The key components and inputs that had to be considered for these estimations were the available area for location of the new building and the stakeholder's requirements including of number, type and size of the different premises and the recommendations given by Southeast Regional Health Authority (SERHA).

A relatively simple, close to U-shape was selected for the new one storey building. The first important dimension that had to be defined was the width of the building. It was determined by a function scheme with single-loaded corridor scheme in order to maximize the daylighting. Taking into account the need to allow for the movement of considerable amount of people, together with trolleys, beds, wheelchairs and other mobile equipment, including the passing of such equipment, the width of the corridor was designed to be 250 cm between the wall axes.

Building Grade and Building Index

- Structural type: Cast-in-place reinforced concrete frame-shear wall structure
- Height of building (m) = +7.00
- Building area: 1,259.31 m²

GROUND FLOOR	PATIENTS AREA (1.)	895.58 m ²
	STAFF AREA (2.)	63.82 m ²
	SERVICE AREA (3.)	57.64 m ²
	ADMINISTRATION AND MEDICAL RECORDS (4.)	242.28 m ²
TOTAL		1259.31 m ²

Functional Layout

The required premises is organized in four departments (functional groups) and are arranged according to stakeholder's recommendations in order to facilitate efficient flow of staff, patients and equipment and to ensure accessibility:

1. OUTPATIENTS AREA – includes main waiting area, reception, triage, customer service, CHA Room, oral rehydration, treatment room, procedure room, doctor's offices, laboratory (that includes specimen collection, and combined clinical chemistry, haematology, blood bank, and processing), isolation room (with anteroom and ensuite), x-ray room with equipment and reporting room, asthma bay, diabetic retinopathy, physiotherapy with examination rooms and exercise room, nurses area and public toilets.

The registration area must be designed to protect visual and auditory privacy of the patients and with due consideration for the safety of staff. Design solutions to address safety requirements must also support optimal communication between staff and patients.

2. The isolation room needs to be located to an exit area and a backdoor, together with adequate ventilation and negative air pressure needs to be provided. The room's perimeter walls, ceiling, and floors shall be sealed tightly so that air does not freely move in or out to the environment from the room except through the allowable gap under the door. All windows shall be fixed and sealed to eliminate infiltration. All isolation rooms shall have self-closing devices on all room exit doors. Viewing window shall be provided in the wall with privacy blinds to allow nursing staff observation without entering the isolation room. The viewing panel shall be of safety glass, wire glass or tempered clear plastic to reduce hazard from accidental breakage. All surfaces in the isolation rooms shall be smooth, impervious, and easily cleaned.
3. STAFF AREA– includes dressing room with lockers, dressing sub-waiting room and store.
4. SERVICE AREA – soiled utility, laundry / wash area, sterilization room, clean utility, and utility room;
5. ADMINISTRATION AND MEDICAL RECORDS – medical records, conference / training room, administration rooms, lunchroom and staff toilets. Medical records room is in direct connection with the registration area and customer service in order to provide for the secure storage and retrieval of patient records. Information must be considered highly confidential, and the access is open only to authorised personnel. The conference / training room is not included in TOR, but is included according to Stakeholders' demand as it is needed for the employee's training process and meetings.

The main design concept for the configuration of the functional zoning is to consider each department as a separate unit that is interconnected with the others within the circulation corridors, but whenever it is needed could be dissociated from the whole with doors. Each functional group has certain specific characteristics that were considered. The design of the facility also takes into account the spatial requirements of furniture and equipment, e.g. trolley bed impact on the design of corridors, doorways and room proportions; service area for sterilizers, etc. Outpatients area is open to the public. The access to 'Administration', 'Staff Area', and 'Service Area' will be restricted to staff only. All areas of the facility shall be designed, constructed, furnished and equipped in keeping with the principles of infection control. Infection control involves the prevention of possible spread of infection by the minimization of transfer of micro-organisms from person to person.

1.2.4.3 Design Concepts

Building Materials and Finishes

External wall: It is fabricated from locally produced concrete (white stone aggregate) hollow blocks, 2 large square through holes are provided, it shall be built at staggered joint and spaced by a hole in which round 12mm rebar is inserted, and concrete is placed in the hole. Its size is L400 x H200 x W100/150/200, and 150 is used as external wall.

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 - ii. wear resistance appropriate for the location involved;
 - iii. impermeable to water and body fluids;
 - iv. durable and easy to clean;
 - v. minimise sound transmission; and
 - vi. provide shock absorption to optimise staff comfort but facilitate movement of beds.
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 - a. locally applicable terrazzo for waiting areas, corridors, cashier, customer service and registration, security desk, administration area and medical records;
 - b. linoleum for consultation and treatment area;
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- Accessibility logo system shall be provided in the common area.

- Registration, cashier, and nurse stations shall be provided with low tabletop.
- Waiting area shall be provided with space for wheelchairs to stop.
- Accessible parking space shall be provided outdoors.

1.3 PROJECT PHASES AND ACTIVITIES

1.3.1 Pre-Construction

In order to accommodate construction and rehabilitation upgrades, each facility requires a well-planned, staged, and phased approach in order to limit the impacts on current operations. This includes dissemination of information about the proposed project, in particular those to be directly affected. Stakeholder should be informed at least 2 months before the start of construction. Pre-Construction activities include:

- **Spanish Town Hospital and St. Jago Park Health Centre**
 - Inform vendors situated at the main entrance of the St. Jago Park Health Centre of dislocation due to construction of new main entrance.
 - Inform hospital and health centre staff of the relocation of the laboratory and pharmacy.
- **Old Harbour Health Centre**
 - Inform beekeeper and vendor of dislocation due to proposed project
 - Inform resident who uses the proposed site as a driveway to access his property, that this will no longer be accessible due to the proposed project.
 - Inform stakeholders and residents living to the south of the proposed project site, that the short cut from Walker Road to enter East Street will no longer be accessible due to the proposed project.
 - Inform the Lion's Club Centre of the proposed project. This facility is being used to temporarily house a church.
- **Greater Portmore Health Centre**
 - Inform stakeholders which use the football field for recreational purposes that the field will no longer be accessible due to the proposed project.
- **General**
 - Conduct a full assessment regarding available space within the facility that could be used during construction.
 - Develop a thorough project blueprints (drawings) and schedule, explaining (in detail) the project construction and rehabilitation works that will be completed per facility .
 - Medical waste management infrastructure (disinfection facility and/or incinerator) should be included in the upgrade works blueprints.
 - Determine the various phases of construction (e.g., construction schedule, based on the final blueprints of the construction and rehabilitation works to be completed).
 - Determine which activities will require the closure of wards or healthcare services, as well as any activities that will require abatement and decontamination (e.g., asbestos).

- Appoint an Environmental, Health and Safety (EHS) Manager for each facility to monitor adherence to its tailored environmental management plans.
- Conduct a risk assessment for all potentially hazardous construction and rehabilitation works to be conducted.
- Provide training regarding the appropriate PPEs and EHS mitigation measures to limit workplace hazards to workers and staff.
- Obtain all necessary local environmental permits and licences; follow applicable local and international guidelines and regulations.
- Review the specifications and dimensions for all new equipment and machinery to ensure its compatibility with the construction schedule; construction plans should accommodate the specific requirements of all new machinery and equipment. It is recommended that an architect with a specialization in health care infrastructure review applicable documents
- Develop a communication strategy to inform stakeholders (internal and external) of the construction timeline.
- Conduct a launch workshop with the executing agency and contractors and subcontractors at each facility to review requirements and timeline.

1.3.2 Construction

Construction activities include:

- Provide transportation to affected patients that need to be moved to a neighbouring hospital during construction and rehabilitation works
- Follow specifically tailored environmental and social management plans
- Once the construction and rehabilitation construction documents are finalized, the EHS Manager should monitor the contractor's adherence to the ESMP, IFC's General EHS Guidelines for Health Care Facilities¹, Management Plans, and International Standards

1.3.3 Operation

Operational activities include:

- Implement environmental and social plans during operation.
- Adhere to NEPA air and water quality monitoring requirements.
- Develop and implement a facility-specific pollution prevention plan, as well as a medical waste plan (e.g., incinerator requirements, sharps management, wastewater treatment) to comply with the IFC's General EHS Guidelines for Health Care Facilities and International Standards.
- Implement necessary technical EHS trainings to hospital staff and contractors.

¹ IFC's General EHS Guidelines for Health Care Facilities.

- The re-purposing of the existing buildings on site will be determined based on the needs of the MOHW. This is important to prevent them from becoming stranded assets and therefore socioenvironmental liabilities. A detailed comprehensive plan regarding the re-purposing of the existing buildings will be provided for the final report.

1.4 CONSTRUCTION METHODOLOGY

The following list outline general activities which will take place as part of the wider pre-construction and construction process:

1. Removal of trees, vegetation.
2. Removal of existing concrete walkways
3. Relocation of existing services, electric power, water supply, drainage manholes, information and communications technology connections
4. Carting away excess material to approved dump / landfill.
5. Landscaping.
6. This project will be carried out under the MOHW representative in conjunction with the specifications set out in the contract along with the Environmental, Health and Safety manual utilised by the Work's Contractor.
7. The Work's Contractor will provide an adequate workforce to supervise, construct and deploy the necessary equipment to carry out specified tasks (see details in work schedule).
8. The Dissemination of information to the work team will be done in the form of periodic management meetings, site meetings, toolbox talks and electronic media throughout the project.

The following sections detail methodologies that are applicable to all four facilities, except for Demolition (Section 1.4.10), which only applies to STH.

1.4.1 General

The Works Contractor will organize and implement all the activities necessary to achieve efficient and timely completion of the project by the following:

- Assuring compliance with contract requirements, schedule commitments, working drawings and completion of the project on time.
- Overseeing interface and ensuring proper coordination with and between subcontractors to complete the project on time.
- Overseeing material and shop drawings approvals and material procurement.
- Ensuring availability of manpower and equipment resources.
- Overseeing the enforcement of the quality and safety control programs.
- Ensuring availability of manpower and equipment resources.

1.4.2 Mobilization

The site will be inspected by the Works Contractor to identify the various existing services and such services shall be directed and sealed before starting the work in accordance with the related authorities, statutory agencies, etc. All required quality control & safety procedures shall be followed. Temporary site offices and facilities will be installed after obtaining required governmental permits and according to the approved construction schedule. Also, the temporary fencing and project sign boards will be installed in this period.

1.4.3 Communication Control

Communication Control is key to management of this project and keeping all stakeholders, management, staff and project team informed and aware at all stages of the project is vital to the success of the project. Our communication management model shall streamline and integrate project information with all stakeholders and facilitate sharing and project collaboration. It shall provide secure, integrated access to project wide performance metrics, reports and project data.

1.4.4 Coordination Meeting Strategy

The purpose is to define the Co-ordination procedure, which shall be used throughout this project. This is intended to facilitate clarifications of any nature related to drawing coordination, Site coordination between the Coordinators of each Trade of the Subcontractors.

1. Prior to the start of the Work Contractors activities according to the Approved Schedule,
 1. the Works Contractor shall notify in advance the Subcontractors of their anticipated
 2. activities in the site.
 3. Following a site investigation between the Subcontractors and the Main contractor
 4. shall be carried out to ensure the compatibility of equipment's, temporary facilities
 5. and storage of material in the site.
2. A construction progress meeting shall be arranged regularly between the Main
6. Contractor and the Subcontractors to discuss the different queries during the
7. construction of work.

1.4.5 Engineering Activities

The Works Contractor shall follow the regular rules in appointing subcontractors he wishes to use in the project with provision that they have the necessary experience to carry out the works and are specified in accordance with Particular Specifications or equal alternative. The Works Contractor will submit the specialist subcontractors for approval by the MOHW representative.

1.4.6 Shop Drawings

A comprehensive study of the contract design drawings shall be made by the Works Contractor's technical department. Co-ordination between drawings shall be performed prior to the issue of shop drawings. Shop Drawings will be coordinated with other interfacing contractors working in the area

and signed off by each of them. The Works Contractor will submit the shop drawings log for approval by the MOHW representative for shop drawings progress monitoring.

1.4.7 Materials

The Works Contractor will submit the materials log for approval by the consultant for materials progress monitoring. The Materials will be submitted according to the log for approval by the MOHW representative.

1.4.8 Procurement Planning and Control

Material procurement will be performed according to the approved construction schedule. Material needed for construction shall be procured and stored in the project site store, if applicable, until it is executed on-site. The duration of material procurement will differ, depending on its availability, lead time and country of origin. Long lead items should be given special attention to submit for approval as early as possible.

The Contractor shall issue purchase orders and/or delivery orders in a timely manner, consistent with the overall construction schedule. The contractor shall plan directly with the transporter or through a supplier to have orders transported to the contractor's site store, if applicable, or the contractor's warehouse. After the approval of material source, manufacturer's data and sample, the Contractor shall place orders for the material for each portion of the building and works listed in the Contract for approval. The sequence for ordering of materials vis-à-vis the various approvals of the MOHW representative shall be as follows:

1. Obtain approval to source of Material/manufacturer of product.
2. Obtain approval to technical data/manufacturer data of material/product.
3. Obtain approval to Sample.
4. Place order.

1.4.9 Temporary Building Services

Works' Contractor will be expected to conduct the following with the verification of the MOHW representative:-

- i. Identify suitable staging area.
- ii. Provide shop drawings outlining the access routes and position of each of these facilities.
 - o Site Hoarding
 - o Site office (Contractor Management office, Client representative office, Conference room)
 - o Welfare Facilities.
 - o Storage area for both indoor (secure storage) and outdoor.
 - o Designated area for tradesmen (steelyard, welding area, Plumbing & Electrical area etc.)

1.4.10 Demolition

Demolition only applies to STH.

1.4.10.1 Preparation and Planning

- i. A detailed survey is to be conducted to identify any structural problems and health & safety concerns for the earmarked demolition structures. The survey will consider any adjoining properties likely to be affected by the demolition works.
- ii. Consideration will be given to the location of premises containing sensitive equipment, machinery, etc. To establish restrictions for falling of materials, vibrations and dust protection during demolition. Similar considerations will be made in relation to noise.
- iii. Wherever necessary, surface protection is to be given to existing structures.
- iv. Prior to Commencing Demolition, Works Contractor is to issue the scheduling of this activity.

1.4.10.2 Execution

- i. During demolition, a horizontal distance of 6 m radius, or greater will be kept as a restricted area to allow the fall of debris.
- ii. Where work cannot be done safely from the ground level, adequate scaffolding will be erected and will be maintained in a safe condition.
- iii. Outside the working hours, ladders providing access from the ground to the first landing shall be removed and stored in a secured area.
- iv. All debris will be cleaned out on a sequential basis.
- v. In case of any obstructions or falls of debris on roads, the area will be cleaned on an immediate basis.
- vi. During the demolition of concrete structures, suitable temporary supports will be made to the existing structure. All the demolished materials will be separately stored and disposed of at the approved dumping location.
- vii. Necessary excavations with proper shoring shall be made in case of any demolition to be done under the grade level.
- viii. Adequate precautions shall be made to prevent fire or explosions caused by gas, vapour, etc.
- ix. Periodically, water shall be sprayed to avoid dust during demolition.
- x. In case of observations of any unidentified services or cables during the process, the client representative will be notified immediately, and work will proceed only after receiving further approval.

1.4.10.3 Setting Out Works

- i. The Works contractors land surveyor will establish respective horizontal and vertical controls (temporary bench marks) on site and set out the footprint of structures as per design and specifications.
- ii. After establishing controls and setting out data, verification of coordinates by the MOHW representative will be conducted.
- iii. Building set out will be done using a profile board with a set back of a minimum of 1 metre

- iv. Excavation coordinates will be done using steel rods driven into the ground along with the required depth required label on the rod.
- v. Automatic Levels, Total Stations and GPS equipment will be used throughout the project to maintain vertical and horizontal control from foundation through to finishing and conducting final site as-builts.

1.4.11 Excavation

1.4.11.1 Strip and store topsoil

- i. Excavation will be carried out in accordance with the relevant approved drawings and cross-sections, to the widths and slopes shown thereon.
- ii. Elevation will be rechecked along with the MOHW representative after we are complete.
- iii. The finish level of the trench will be trimmed using Labourers to achieve the required profile levels within the specified design.
- iv. It is the intention to excavate rocky areas by mechanical methods, however, should the occasion arise, we will use an air compressor jackhammer to cut areas that will be difficult for the equipment or to prevent damage to the trench.
- v. The excavated material will be stored for future use.
- vi. Unsuitable material that is excavated will be disposed of at an approved dump/landfill site.

1.4.11.2 Shoring, Dewatering & Excavation

- i. The equipment which will be used in the shoring, dewatering & excavation works, vary in quantities & numbers, depending on the work volume to be executed.
- ii. Flood lights will be used to lighten the site at night in the case of the works being carried at night. All safety rules & regulations as per the approved safety manual & local authorities' requirements shall be strictly implemented and monitored by installing all warnings & safety signs in proper visible locations along the site.

1.4.12 Concrete Works

- i. Ready-mix concrete will be obtained from an approved ready-mix plant as per approved design mix and will be transported to site by transit mixers by sequencing their movement to avoid long waiting periods.
- ii. Concrete discharge to the required formwork will be arranged by concrete pumps and cranes. All precautions shall be taken during casting in hot weather to guarantee quality of concrete as per specifications.
- iii. All construction joints shall be cleaned and the aggregate exposed.
- iv. All concrete will be vibrated, and concrete will be protected and cured as per Contract Specifications.

1.4.13 Formwork

- i. Formwork acceptable to the consultant will be used taking into consideration safety and quality Control requirements.
- ii. Required shop drawings for formwork shall be submitted for approval by the MOHW.
- iii. Adequate quantity of formwork will be made available at site to ensure speedy progress and meet the approved construction schedule dates.
- iv. All reinforcement shall be transported taking into consideration safety precautions and will be lifted and fixed into position as per approved drawings and Contract Specifications.

1.4.14 Steel Reinforcement

- i. The Works Contractor shall ensure that all steel delivered to the site shall come from the source accepted by the Consultant who will be requested to inspect all batches of steel reinforcement.
- ii. Reinforcement shall be protected at all times from contamination and corrosion from the ground and atmosphere during all storage, bending and handling operations.
- iii. All reinforcement will be properly stored under cover to avoid contact with the ground, moisture, dust and salts and to avoid distortion once bent to shape. Improper storage will be sufficient cause for rejection of reinforcement. All steel, before being placed in position, shall be thoroughly cleaned of loose rust, scale and any other coating that will destroy or reduce bonding with concrete.
- iv. If reinforcement has been badly rusted or pitted it will be rejected. Mechanical brushes shall be used in cleaning the steel bars. All reinforcement bars shall be cut and bent to shape as per the contract drawings or the approved shop drawing/bar bending schedule.
- v. All reinforcement shall be transported taking into consideration safety precautions and will be lifted and fixed into position as per approved drawings and Contract Specifications.

1.4.15 MEP Installation

- i. All MEP setting out will be done according to the most recent MEP and Architecture drawings using an easy identifier (spray paint or Permanent marker on site).
- ii. The location of these marks will be checked by MOHW representative to ensure their accuracy of the setting out with respect to the drawing and specifications.

1.4.15.1 Pre-Installation

- i. All material required to commence HVAC, electrical and plumbing installation will be delivered on-site and checked by both Works Contractor and MOHW representative and subcontractor for any defects.

1.4.15.2 Installation

- ii. All MEP services will be installed as per design and specifications. The Works Contractor will be responsible to execute the installation of all MEP works and the MOHW representative will

monitor the progress and identify any defects and will ensure that all the components that are set out in the contract drawings are being installed by the Works Contractor.

- iii. Cut and chasing of the wall will make good after each service installation with appropriate offset to accommodate for finish surface.
- iv. Before closing or connecting ductwork, conduits & pipes to a bend, the Works Contractor will ensure that there is no debris left inside.
- v. All service connections installed will be labelled for identification as required per contract.

1.4.15.3 Testing

The Works Contractor will notify the MOHW representative on all required Tests.

1.4.15.4 Electrical

Before all pouring, placement of concrete and enclosure of structures by the Works Contractor the MOHW representative will confirm all approved conduit size and locations. Before the installation of all final points (plugs, switches and connections) to the breaker, and connections to pot-head/distribution boxes, all lines will be tested for continuity (identifying any possible breakage) and operability.

The Works Contractor in the presence of the MOHW representative to ensure that all Electrical connections, equipment and services are installed, operable and performing according to design specifications will perform all testing and commissioning of all electrical connections, equipment and services.

1.4.15.5 HVAC

The Works Contractor in the presence of the MOHW representative to ensure that all HVAC connections, equipment and services are installed, operable and performing according to design specifications will perform all testing and commissioning of all HVAC connections, equipment and services.

1.4.15.6 Mechanical & Plumbing:

PVC Pipes embedded in slabs be will pressurised prior to concrete pour. All pressure pipes will be tested for the duration set out in the specification with the appropriate pressure required. All mechanical equipment and systems will be tested and commissioned.

1.4.16 Road Works

Works Contractor will set out the alignment of all Roadways and Parking Areas as per designs. Notification for commencement of works to be provided from Works Contractor. Excavate as per the design specifications to facilitate road formation. Compact subgrade to design specification, using a heavy smooth-wheeled roller (minimum 8 tonnes). The base and sub base shall be of approved material and spread uniformly upon the prepared subgrade in layers not exceeding 150mm in depth and compacted. During preparation, the subbase & base shall be shaped carefully to the required cross-section and compacted based design specifications. Before placing the bituminous surface

dressings, asphalt concrete surfacing or regulating course, the existing surface shall be dry and will be thoroughly cleaned of all loose material.

Asphaltic concrete will be placed by a paving sub-contractor.

1.4.16.1 Testing

Notification of planned testing as per protocol. Direct approved soil testing laboratory to sample imported fill when required for analysis (Proctor density, sieve analysis) to assess suitability for use as fill. After each Layer of compaction, a Dry Density test will be done for that material to verify the compliance with the specification.

1.4.17 Finishing Works

1.4.17.1 Walls Finishing

- i. All material of walls finishing such as concrete blocks, plaster, partitions, stone & ceramics will be from an approved source as per specifications.
- ii. All materials will be packed and handled in such a way as per manufacture instructions.
- iii. There shall be no stains or damages to the surfaces and exposed edges.
- iv. Material will be stored at the factory or at site on wooden platforms or as recommended by the manufacturer.
- v. The finishing material on walls will be installed/ erected as per approved construction schedule, approved shop drawings, manufacturer recommendations and Contract Specifications.

Work Sequence

- i. Before starting any walls finishing activities, all concrete works will be checked and approved by the consultant for embedded/concealed items like conduits, sockets, accessories, etc.
- ii. Masonry works and successively plastering works should start after removing the slab formwork.

1.4.17.2 Ceilings Finishing

- i. All material for ceilings like hangers, framing, supports, ceiling tiles and special finishes will be from an approved source as per specifications.
- ii. All materials will be properly stored with adequate markings. All ceiling finishes shall be carried out in accordance and coordination with HVAC, Plumbing, firefighting and Electrical works in the ceiling.
- iii. Site fabrication and installation shall be as per approved construction schedule, approved shop drawings and Contract Specifications.

1.4.17.3 Floors Finishing

- i. All material of floors such as mortar, marble, ceramic and special finishes will be from an approved source as per specifications.

- ii. There shall be no stains or damage to the surfaces and exposed edges.
- iii. Material will be stored at the factory or at site on wooden platforms or as recommended by the supplier/manufacture.
- iv. The finishing material on floors will be applied/ erected as per approved construction schedule, approved shop drawings, manufacturer recommendations and Contract Specifications.

Work Sequence

- i. Before starting any floor finishing activity, all concrete works will be checked and approved by the consultant for embedded/concealed items like pipes or other fixtures.
- ii. Flooring works shall start after heavy works are completed and ceiling finishes are in the final stages to minimize the use of scaffolds on top of the finished floors.

1.4.18 Metal Works

All metal items such as railings and gratings will be obtained/ fabricated from an approved factory. All steel fabricated in the factory shall be painted and marked as required in specifications and shall be delivered to meet the approved construction schedule. The erection will be performed manually due to the limited weights.

All damaged areas will be touched-up as requested by the consultant. All activities shall be performed as per Contract Specifications.

Wall-mounted handrails shall be installed once walls finishing is completed and/or the base paint coat is applied. Floor-mounted handrails shall be installed once floors are finished and protected. All railings shall be properly protected to avoid any damage.

1.4.19 Roofing Works

Once all heavy works are completed on the roof floor and other inserts are fixed in place, the area will be cleaned, and roofing works will start. All roofing layers shall be as per approved shop drawings and contract specifications. After each layer is completed, it will be inspected/approved by the consultant before applying the next layer. After roof works are completed, rainwater outlets and other roof fixtures shall be erected. All works shall be as per approved construction schedule, approved shop drawings and Contract Specifications.

1.4.20 Doors and Windows

All doors and windows will be supplied from an approved source and manufactured as per approved shop drawings and contract specifications. The doors, frames and windows will be wrapped and protected with plastic and stored in a covered area once delivered to site. As all doors and windows are fixed on frames and finished on both sides, the areas will be cleaned from all other items, so that rooms/areas could be locked for protection. All works shall be performed as per approved construction schedule, approved shop drawings and Contract Specifications.

1.4.21 Glazed Aluminium Curtain Walls

Glazed aluminium curtain walls will be supplied from an approved source and manufactured as per approved shop drawings and contract specifications. Material delivery to site shall be in accordance with the approved construction schedule. The following general procedure shall be followed for installation activities:

- Embedment clearance - the surface of embedment shall be cleaned.
- All fillings in the slots shall be cleared out completely.
- Install Brackets - Setting first the iron brackets, then the pads and finally screwing the nuts tightly.
- Brackets adjustment - the dimensional adjustment for brackets and the quality of adjusted joint pieces shall be inspected from one level to another.

1.4.22 Resources - Equipment

Equipment Listed below are the major equipment types that will be used during the execution of the project within the site and assigned durations according to the approved construction.

Table 1-3 Major equipment types that will be used during the execution of the project

TYPE OF EQUIPMENT	NO. REQUIRED	REMARKS
Tower Crane (Hammer Head)	as required	With concrete cast & finishing Items of project buildings
Dewatering system	as required	With concrete cast & finishing Items of project buildings
Concrete mixer	as required	casting days
Concrete pump	as required	casting days
Excavator / Excavator with Hammer	as required	Demolition, excavation, as required
Front End Loader	as required	Demolition, excavation, as required
Back Hoe	as required	Demolition, excavation, as required
Motor Grader	as required	Site pad preparation, road works, as required
Dump Trucks	as required	Demolition, excavation, as required
Flatbed	as required	as required
Vibrating Roller	as required	Site pad preparation, road works, as required
Plate Compactor	as required	Soil compaction & grading
Water truck	as required	water supply
Concrete vibrator	as required	casting days
Test Pump for Pressure Test	as required	as required
Compactor (Mobile) -	as required	as required
Scaffolding - h-frame	as required	as required
Paver	as required	as required
Skid Steer	as required	as required
Generator – (mobile)	as required	as required
Generator – (Plant)	as required	as required

2.0 INSTITUTIONAL, LEGISLATIVE AND REGULATORY FRAMEWORK

This section of the report details the relevant Jamaican legislation and policies, as well as the relevant international safeguards including all applicable IDB's policies and directives, the IFC's General EHS Guidelines for Health Care Facilities and IFC Performance Standards.

2.1 INSTITUTIONAL FRAMEWORK

In Jamaica, the system of governance is a constitutional monarchy or limited monarchy under which The Queen, represented by a Governor-General, is head of state. Under the constitutional monarchy, there are three arms of government:

- The Executive
- The Legislature
- The Judiciary

According to the official webpage of the Government of Jamaica (2023), the Executive Branch of the Government has the following Ministries:

- Ministry of Agriculture and Fisheries
- Ministry of Culture, Gender, Entertainment and Sport
- Ministry of Economic Growth and Job Creation
- Ministry of Education and Youth
- Ministry of Finance and the Public Service
- Ministry of Foreign Affairs and Foreign Trade
- Ministry of Health and Wellness
- Ministry of Industry, Investment and Commerce
- Ministry of Justice
- Ministry of Labour and Social Security
- Ministry of Legal and Constitutional Affairs
- Ministry of Local Government and Community Development
- Ministry of National Security
- Ministry of Science, Energy and Technology
- Ministry of Tourism
- Ministry of Transport and Mining

2.1.1 Ministry of Health (MOH)

Jamaica's Ministry of Health (MOH) has oversight over the following subjects:

- Health Policy and Services
- Family Planning
- Food and Drug Control
- Health Facilities (Hospitals and Health Centres)
- Juvenile Advisory Council
- Medical Services
- Medical Waste Management and Incinerator Services
- Mental Health Services
- Pesticides Control
- Drug Abuse Prevention
- Public Health
- Registration of Births and Deaths
- Specialist Committee on Child Abuse

The health system is decentralized, with four Regional Health Authorities (RHA) responsible for service delivery, as stated in the National Health Services Act of 1997. Regional Directors provide day-to-day administration of the Regional Health Authorities and report to the Boards of Management, with Board Chairmen appointed by and reporting directly to the Minister. Figure 2-1 details the organization of the health care system with respect to the facilities of the Project.

In 1998, health reform under the National Health Services Act of 1997 repealed the old Hospital Act and transitioned health care institutions from central management to regional management systems (southeast, northeast, western and southern). This regional system is lacking in terms of proper guidelines, policy on waste management, insufficient training, and lack of equipment, tools, and services. (NEPA, 2007). After decentralization, health facilities maintenance is now the responsibility of the RHA.

The Waste Management Unit within MOH is responsible for detailing policies on medical waste for the MOH. The Waste Management Unit provides services to healthcare facilities to ensure proper waste management and disposal. The Unit manages Jamaica's first non-incineration automated medical waste plant that utilizes steam sterilization and shredding technology, which negates the adverse effects of burning medical waste (MOH, 2018). The MOH regulates health care under the Public Health Act (discussed below) (NEPA, 2007).

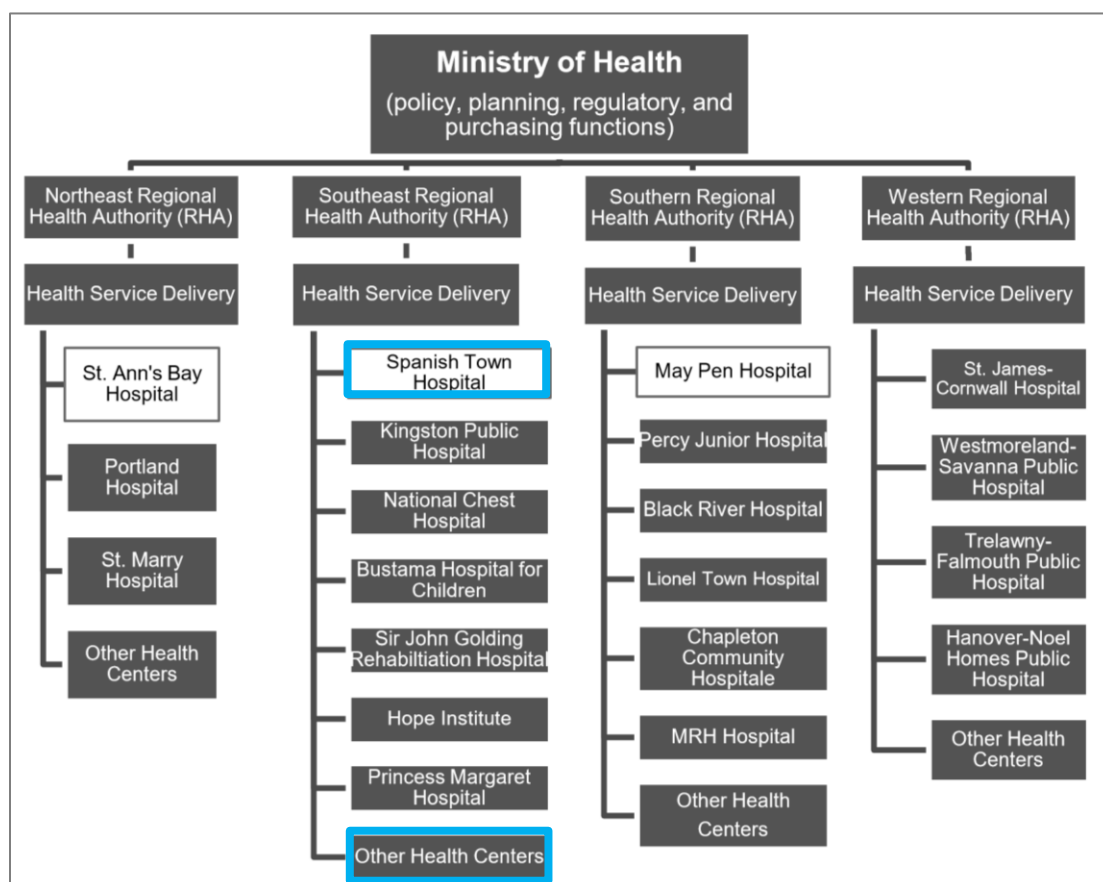


Figure 2-1 Organizational Chart for Health Service Delivery, those relevant to this ESA highlighted within blue box)

Relevant documents for the management of medical waste by the MOH are listed below:

- Management of Medical / Infectious Waste Generated at Health Care Facilities
- Ministry of Health Policy for the Management of Healthcare Waste
- Public Health Regulations
- Public Health (Nuisance) Regulations
- Regulations for Nursing Homes

2.1.2 Ministry of Labour and Social Security (MLSS)

Jamaica's Ministry of Labour and Social Security (MLSS) is responsible for promoting good working relations between employers and workers and protecting workers' rights (MLSS, 2018). MLSS's mandate includes:

- Provide effective social protection and promote social inclusion
- Promote a stable industrial relations climate
- Promote productivity growth

- Ensure safety and health of workers
- Maintain an effective and efficient Labour market

2.1.3 Ministry of Economic Growth and Job Creation

The Ministry of Economic Growth and Job Creation was created in March 2016, with the change of the political administration. The Ministry is charged with drafting the blueprint to drive economic growth and sustainable development in Jamaica. The Ministry has numerous portfolios but the ones that are likely to be part of this project are the following: 1) Land, Environment, and Climate Change, 2) National Environmental Planning Agency (NEPA), 3) National Works Agency (NWA), and 4) Water Resources Authority (WRA).

2.1.3.1 Land, Environment, and Climate Change

The Land, Environment, and Climate Change portfolio appoints the NRCA (re-named NEPA) to carry out the function of management of the environment through the NRCA Act. The Environmental Division is in charge of promulgating the Policy Framework for the Management of Hazardous Waste in Jamaica in accordance with the Basel Convention. (NEPA, 2007)

2.1.3.2 National Environmental and Planning Agency (NEPA)

Jamaica's National Environmental and Planning Agency (NEPA), formerly NRCA, was established in April 2001 under the Executive Agencies Act. NEPA is the primary environmental regulator in Jamaica and provides technical and administrative mandates to three statutory bodies, 1) Natural Resources & Conservation, Authority (NRCA), 2) Town & Country Planning Authority (TCPA), and 3) Land Development & Utilization Commission (LDUC). NEPA is also responsible for administering the NRCA Act of 1991. (NEPA, 2018)

NEPA's mandate includes:

- Conservation & Protection (Natural Resources Management)
- Environmental Management
- Spatial Planning
- Compliance & Enforcement
- Applications Management
- Public Education Policy and Research
- Legal Services & Standards Management

The health facilities will need to follow the laws, regulations, and guidelines overseen by NEPA and MOU primarily. For medical waste the following permits apply:

- Guidelines for the Management of Medical Waste
- NRCA (permits and licenses) Regulations
 - Existing waste generator: the operation of an incinerator requires a license for air emissions and effluent discharge.

- All waste generators: a permit will be required for the installation and operation of any new incinerator and a license is required for air emissions.
- Effluent discharge: a license is required for effluent discharge.
- NRCA (air quality) Regulations
- Procedures and Requirements for Permitting and Operating of Waste Disposal Facilities
- No guidelines regarding radioactive waste exist (or are being developed)

2.1.3.3 National Works Agency (NWA)

In October 1999, the Jamaican Government endorsed the establishment of the National Works Agency (NWA) and accorded it Executive Agency status on April 1, 2001. The NWA is responsible for managing all aspects of the road network of Jamaica, including its safety, reliability, availability, efficiency, and growth. To meet these objectives, NWA conducts routine maintenance, develops new roads, and optimizes the road network to reduce congestion (NWA, 2018).

2.1.3.4 Water Resources Authority (WRA)

The Water Resources Authority (WRA) has responsibility for monitoring and regulating the use of surface and ground water resources of the country. The Water Resources Act of 1995 applies to the Riverton landfill site, and others. (MOJ, 1995) (NEPA, 2007).

2.1.4 Ministry of Local Government and Community Development

This Ministry provides policy, legal, technical, and administrative framework that supports service delivery and operational management by the Local Authorities and portfolio agencies,

The local authorities that are part of this Project are the following:

- St. Catherine Municipal Corporation

Local Authorities are those entities at the local level through which the Department of Local Government carries out its functions within communities. Responsibilities include:

- Minor Water Supplies & Social Water
- Municipal Parks & Beautification
- Cemeteries
- Markets
- Abattoirs
- Pounds
- Parking facilities
- Parochial Roads
- Local Sustainable Development Planning
- Drains & Gullies
- Street Lights

- Infirmaries and other welfare services

There are two important departments within each local authority:

- The National Solid Waste Management Authority
- Local Jamaican Fire Brigades

2.1.4.1 National Solid Waste Management Authority (NSWMA)

The National Solid Waste Management Act of 2001 led to the establishment of the National Solid Waste Management Authority (NSWMA), effective April 1, 2002. The NSWMA is responsible for all matters pertaining to solid waste management, including:

- Providing standards, regulations and expertise with regard to solid waste management
- Achieving acceptable environmental standards of public waste disposal operations
- Develop capable environmental monitoring staff through training and appropriate recruitment
- Coordinating with other agencies on pollution prevention and environmental controls
- Prioritize financial resources for solid waste management in a severely constrained economy
- Enforcing national solid waste management laws

There are four Regional Offices within the NSWMA, one to serve each waste shed. Waste sheds have been defined based on the most effective and feasible collection and disposal network that can be implemented. The table below details the organization and structure of the NSWMA (NEPA, 2004).

Table 2-1 Organization and Structure of NSWMA

Regional Offices		Parishes Served	Disposal Sites within Each Region
Current Name	Proposed Name		
Metropolitan Parks and Markets Limited (MPM)	MPM Waste Management Ltd.	Kingston, St. Andrew, Clarendon, St. Thomas, St. Catherine	Riverton Disposal Site in Kingston Church Corner in St. Thomas
North eastern Parks and Markets Limited (NEPM)	NEPM Waste Management Ltd.	St. Ann, St. Mary, Portland	Doctors Wood in Portland Tobalski in St. Ann Hadden in St. Ann
Southern Parks and Markets Limited (SPM)	SPM Waste Management Ltd.	Manchester, St. Elizabeth	Martins Hill in Manchester Myersville in St. Elizabeth
Western Parks and Markets Limited (WPM)	WPM Waste Management Ltd.	Trelawny, St. James, Hanover, Westmoreland	Retirement in St. James Grange Farm in Trelawny

Source: (NEPA, 2004)

Prior to the establishment of the NSWMA, garbage collection was vested under the respective Parish Councils within each parish. Jamaica currently has nine active disposal sites. Most hazardous materials are currently sent for disposal in landfills (NEPA, 2004) (PIOJ, 2006).

The NSWMA does not have any international agreements for waste disposal. However, in November 2017, the Ministry of Science, Energy, and Technology of Jamaica finalized a policy regarding

hazardous waste management and e-waste management in Jamaica. (Ministry of Science, Energy and Technology, 2017).

The NSWMA collaborates with NEPA on several issues related to solid waste management. Areas of collaboration include, but are not limited to: 1) enforcement, 2) NEPA's Permit and License System, 3) NSWMA's Licensing System to be introduced, and 4) site visits in respect of complaints or associated with the processing of applications. Local NSWMA Authorities also work closely with NEPA, and collaboration between the Ministry of Environment and MOH are recommended with regards to policy and operational matters related to hazardous waste and medical waste. The hospitals will need to dispose of wastes according to NSWMA laws, regulations, and standards. However, NSWMA has few applicable laws at present, and NEPA rules and guidelines (e.g., asbestos and refrigerants) are generally used as a substitute. The project will need to comply with both sets of standards. (NEPA, 2004) (NSWMA, 2018)

2.1.4.2 Jamaican Fire Brigade

The Jamaican Fire Brigade is a Statutory Body within the Office of the Prime Minister, Department of Local Government. Its central administration is headed by a Board of Directors, which sets broad policy guidelines, implemented by a commissioner. The Fire Prevention Division is responsible for supporting the fire and rescue activities within Jamaica's Fire Brigade. The main function of the Fire Prevention Division is to assist in fire inspection and prevention for public facilities, such as hospitals. Prevention inspectors are empowered to enter any public facility, for the purpose of inspection. In 1996, the Jamaican Fire Brigade Emergency Medical Service began in partnership with the MOH. This service is charged with the rendering of pre-hospital emergency medical care and / or treatment to ill or injured persons and transporting them to recognized medical institutions. (JFB, 2018)

The Jamaican Fire Brigade Act of 1988 established the Chairman, Commissioner, and Officers in Charge for fires and other disasters (earthquakes, floods, hurricanes, windstorms, escape of dangerous fumes or fluids, explosions, oil spills, and other dangerous pollutants of the air and sea). Jamaica's Country Fires Act of 1942 is also applicable, as it governs the burning of trash and other inflammable materials. (JFB, 2018)

2.1.4.3 Parish Councils and Local Authorities

Parish Councils maintain a close relationship with the MOH. It is a statutory obligation as the Public Health Act empowers the Local Board, under Section 6(b), to carry on all activities, which appear to be requisite, advantageous, or convenient in the interest of public health. Section 7 of the Public Health Act also enables the Local Authority to make regulations relating to solid waste, nuisance, sanitation and other areas. (NEPA, 2007)

2.1.4.4 Office of Disaster Preparedness, Emergency and Management

The Office of Disaster Preparedness and Emergency Management (ODPEM) operate under the Emergency, Disaster Preparedness, and Emergency Management Act of 1993. During an emergency or significant disaster, ODPEM would interface within the medical waste realm. As with others, the Act

does not refer specifically to medical waste but such emergencies would be addressed through the Hazardous Material Spill Response Plan, which is a sub-plan of the National Disaster Plan. The plan also covers hazardous waste. The ODPEM should be coordinated with the hospitals, in cases of fire or other emergencies. (NEPA, 2007)

2.1.4.5 Inland Revenue Department

The tariffs associated with disposal of waste at landfills will be stipulated by the NSWMA and the Inland Revenue Department will do collection. (NEPA, 2007)

2.1.4.6 Jamaica Bureau of Standards

The Packaging and Labelling Section of the Jamaica Bureau of Standards (JBS) includes in its portfolio the labelling of hazardous waste. The JBS regulates packaging and labelling under the Standards Act 1969. (NEPA, 2007)

2.2 EXISTING LEGISLATIVE FRAMEWORK

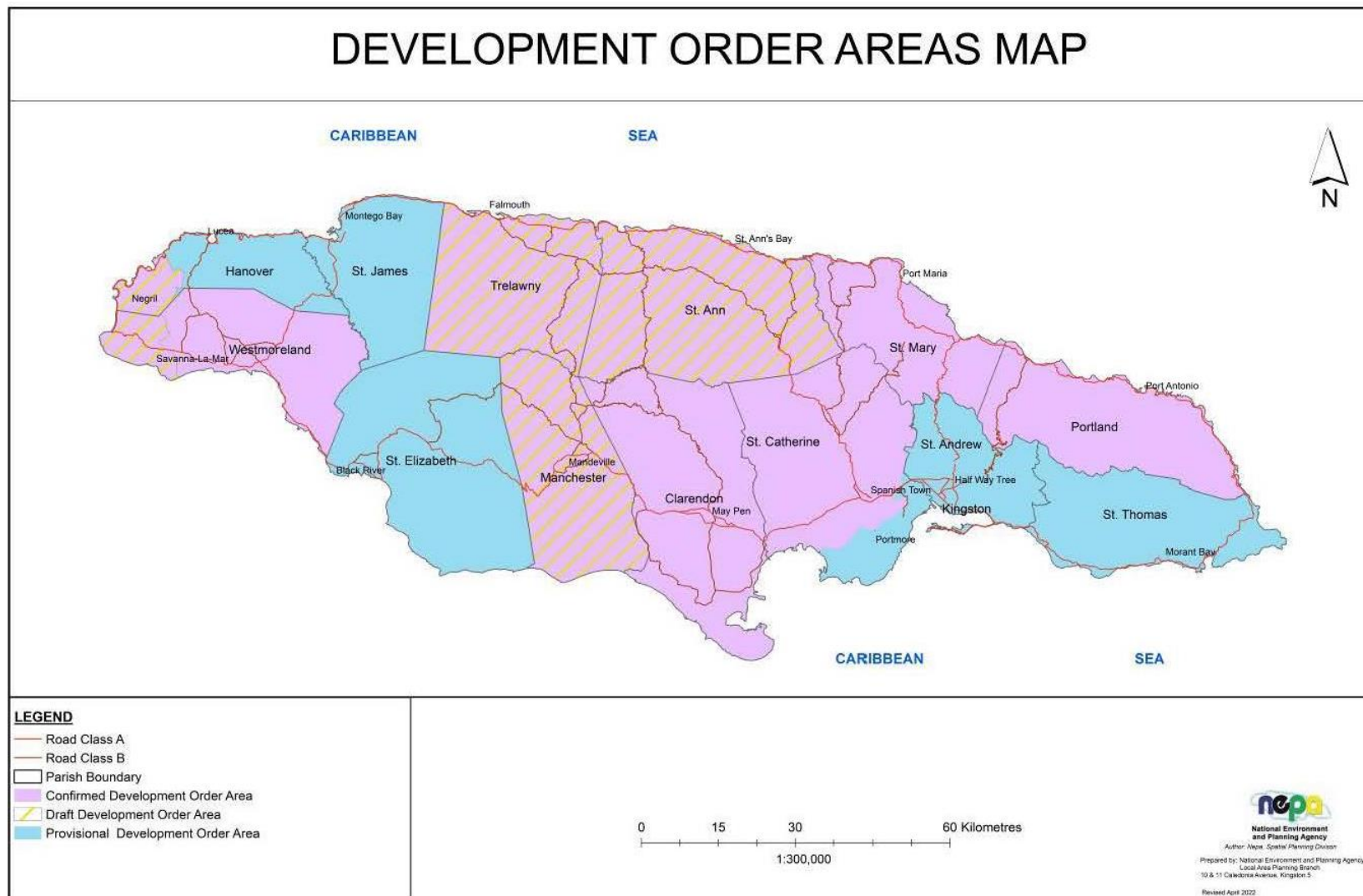
2.2.1 Development Control and Planning

2.2.1.1 Town and Country Planning Act (TCP Act), 1957 (Amended 1987)

The Town and Country Planning Act (TCP Act) 1957 (Amended 1987) provides the statutory requirements for the orderly development of land through planning, as well as guidelines for the preparation of Development Orders. A Development Order is a legal document which is used to guide development in the area to which it applies, and the TCP Act is only applicable in an area where a Development Order exists. It constitutes land use zoning map/s, policy statements and standards relating to land use activities. Tree Preservation Areas and Conservation Areas (as specified areas the gazetted Development Orders) are two types of protected areas associated this Act. Matters addressed in the order include: Roads; Buildings and other structures; Community Planning; Amenities; Public Services; Transportation and Communications; and Miscellaneous.

The Town and Country Planning Act also establishes the Town and Country Planning Authority, which in conjunction with the Local Planning Authorities (LPAs), also referred to as Municipal Corporations, are responsible for land use zoning and planning regulations as described in their local Development Orders (Figure 2-2). The local planning authority for this project is the **St. Catherine Municipal Corporation** and the proposed project falls within the following orders:

- **Town and Country Planning (Saint Catherine Area) Provisional Development Order 2017**
- **Town and Country Planning (Saint Catherine Parish) Provisional Development Order, 2017 (Confirmation) Notification, 2019**
- **Town and Country Planning (Saint Catherine Parish, Portmore Municipality) Provisional Development Order, 2018**



Source: NEPA

Figure 2-2 Development Order Areas in Jamaica

2.2.1.2 Building Act 2016

The Building Act 2016 repeals the Kingston and St. Andrew Building Act and the Parish Councils Building Act and makes new provisions for the regulation of the building industry. It aims to facilitate the adoption and efficient application of national building standards (National Building Code of Jamaica) for ensuring safety in the built environment, enhancing amenities, and promoting sustainable development. A “building” is described as a domestic building, a public building, a building of the warehouse class and any other physical structure, whether a temporary structure or not, any part of the structure, and any architectural or engineering product or work erected or constructed on, over or under land or the sea or other body of water.

For the purposes of this Act, the St. Catherine Municipal Corporation is designated as the Local Building Authority for the respective area. A person who proposes to carry out building work must apply to the relevant Local Building Authority for the appropriate Building Permit. A person shall not carry out any building work unless the respective building permit has been issued; where applicable, a planning permit has been issued under the Town and Country Planning Act; and the work is carried out in accordance with the building permit, the provisions of this Act, the National Building Code, or of any other regulations made under this Act.

2.2.1.3 Local Governance Act 2016

This Act is a consolidation of the following existing Acts, which were repealed once the new legislation was enacted:

- The Parish Councils Act (1887)
- The Kingston and St. Andrew Corporation Act (1923)
- The Municipalities Act (2003)
- The Parochial Elections (Modifications) Act (1979)

This Act introduces new concepts and tenets which reflect a modern approach to local governance, and which strengthen local self-management. Local Authorities (formerly referred to as Parish Councils) are categorised as Municipal Corporations and City Municipalities or Town Municipalities.

2.2.1.4 The Jamaica National Heritage Trust Act 1985

The Jamaica National Heritage Trust Act established the Jamaica National Heritage Trust (JNHT) and has been in operation since 1985. The main goal is the preservation and protection of the country’s national heritage. The Act states the following offences are liable to a fine and/or imprisonment:

- Wilfully defacing, damaging, or destroying any national monument or protected national heritage.
- Wilfully defacing, destroying, concealing, or removing any mark affixed or connected to a national monument or protected national heritage.
- Altering any national monument or marking without the written permission of the Trust.
- Removing any national monument or protected national heritage to a place outside of Jamaica.

2.2.1.5 The Main Roads Act 1932

The Main Roads Act of 1932 details the legal basis pertaining to main roads and specifically looks at management, laying out of roads, taking of lands, encroachments, offences, lights and carriages, power to arrest and other legalities. In section 5 of this Act, it states that the Minister has the power to declare other roads or parts thereof to be main roads and to also declare that a main road is no longer such. The Chief Technical Director (with permanent staff), under the directive of the Minister, is responsible for the laying out, making, repairing, widening, altering, deviating, maintaining, superintending, and managing main roads, and controlling the expenditure of allotted moneys.

2.2.2 Environment, Health, and Waste Management

2.2.2.1 Overview of Local Health Framework

The right to health is enshrined in the Jamaican Constitution, 1962; and the United Nations Universal Declaration of Human Rights (UNDHR). Section 2(k) of the Jamaica Constitution guarantees the right of everyone to a healthy and productive environment free from the threat of injury and degradation. The right to this information is enshrined in Section 3(d). The Global Education Monitoring Report to the United Nations (UN) further recognises communication as an effective mechanism to protect these rights and promote environmental engagement. Underpinning these rights are several national, regional, and international objectives that have reinforced these rights.

The Ministry of Health and Wellness's (MOHW) Client Charter of Rights guarantees participation in the health care and health service planning decision-making process.

The Consultation Code of Practice for the Public Sector requires the use of all available and relevant media for dissemination and distribution and to conduct meaningful consultations with a wide cross-section of stakeholders in developing new policies. The Government of Jamaica (GOJ) Communication Policy, 2015 through its ten pillars requires Government communication to have increased collaboration among GOJ agencies to increase the coherence and effectiveness of public communications. GOJ communication is further required to be complete, visible, and accessible.

In upholding fundamental democratic principles, under the Access To Information (ATI) Act, 2002, Jamaicans are guaranteed the right to access information on matters of national public interest to enable participation in national decision-making and on matters in the interest of the public. The operation of public medical facilities is of public interest and so falls under this Act.

Health is a critical pillar supporting Jamaica's social protection framework. Access to primary health care is a minimum provision of the social protection floor which is guaranteed and accessible through health care fee waiver and drug subsidies. "The country is at an advanced stage of epidemiological transition with chronic non-communicable diseases (NCDs), malignant neoplasm, violence and injuries

being responsible for most deaths.”² The top five leading causes of death are attributable to NCDs. Some 25.9% are reported to have at least one NCD³. “Elderly women had higher proportions of all NCDs compared with males in comparable age groups.”⁴

A guiding principle of Jamaica’s National Development Plan (NDP), Vision 2030 is the commitment to transparency and accountability as well as social, economic, and environmental sustainability. Goal 4 of Vision 2030 envisions Jamaica as a healthy, natural environment. It recognises the value of a healthy environment and ecosystems and overall quality of life and economic wellbeing. In addition, “successful environmental management” (National Outcome 13) and “sustainable urban and rural development” (National Outcome 15) is increasingly becoming the basis for the success or failure of economies and social systems.” For Jamaica to achieve its full potential (Goal 1), a healthy and stable population (National Outcome 1) and effective social protection (National Outcome 3) are essential.

2.2.2.2 Natural Resources Conservation Act (1991)

The Natural Resources Conservation Act (NRCA) may be considered Jamaica's umbrella environmental law. The purpose of the Act is to provide for the management, conservation, and protection of the natural resources of Jamaica. This Act was passed in the Jamaican Parliament in 1991 and subsequent to this; the Natural Resources Conservation Authority (NRCA) was established with the function of taking necessary steps to ensure the sustainable development of Jamaica through the protection and management of Jamaica’s physical environment. The NRCA Act, under Sections 9 and 10 specifies that an Environmental Impact Assessment (EIA) is required from an applicant for a permit for undertaking any new construction, enterprise, or development.

The NRCA, in performing its functions may formulate standards and codes of practice to be observed for the improvement and maintenance of the quality of the environment generally, including the release of substances into the environment in connection with any works, activity or undertaking. Thus, the management of medical waste as it relates to the potential adverse effect it could have on the environment falls within the jurisdiction of the NRCA (C. L. Environmental Company Ltd., 2007).

The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order (1996)

Section 9 of the NRCA Act declare the entire island and the territorial sea a ‘prescribed area’, in which specified activities require a permit, and for which activities an environmental impact assessment may be required. The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order (1996) and the Permits & Licensing Regulations (Section 2.2) was passed as a result of section 9 of the NRCA Act.

² Planning Institute of Jamaica. 2014. Jamaica Social Protection Strategy. Page 106.

³ Planning Institute of Jamaica, Statistical Institute of Jamaica. 2017. Jamaica Survey of Living Conditions. Page 3.1

⁴ Ibid. Page 3.2

The Natural Resources Conservation (Permits and Licences) Regulations, 1996

A Permit Application and a Project Information Form are to be submitted to NEPA in accordance with the Natural Resources Conservation (Permits and Licences) Regulations, 1996 for the construction and operation of new developments.

The categories for this project include:

- Service Sector
 - Construction and operation of a hospital of 10 beds or more or medical facilities of 1,000 square metres or greater.
- Environmental Licence for Wastewater Treatment Plant
- Waste Processing and Disposal
 - Construction and Operation of hazardous waste removal, storage, transportation, treatment, or disposal facility (mobile or fixed).
- Chemical
 - Construction and Operation of facilities for the storage of hazardous materials, toxic chemicals, and other similar substances

The Natural Resources Conservation Authority (Air Quality) Regulations, 2006

Under section 38 of the NRCA Act, regulations pertaining to air quality in Jamaica are stipulated. The National standards, known as the National Ambient Air Quality Standards (NAAQS) are categorized into two groups. Part I of the NRCA Air Quality Regulations (2006) instructs on license requirements and indicates that every owner of a major or significant facility shall apply for an air pollutant discharge license. Part II refers to the stack emission targets, standards and guidelines. In one group, there are the primary standards, designed to protect human health and in the other, there are the secondary standards designed to protect the environment and limit property damage.

According to the Natural Resources Conservation Authority (Air Quality) Regulations, 2006, a “significant air quality impact”, means:

- the increment in the predicted average concentration of sulphur dioxide (SO₂), total suspended particulates (TSP), particulate matter less than ten microns (PM₁₀) or nitrogen dioxide (NO₂) is greater than an annual average of 20 µg/m³ or a 24-hour average concentration of 80 µg/m³: or
- the increment in the predicted average concentration of CO is greater than 500 µg/m³ as an 8-hour average or 2000 µg/m³ as a 1-hour average.

Table 2-2 summarizes the Significant Impact Concentrations and the Jamaican National Ambient Air Quality Standards (JNAAQS) and Guideline Concentrations (GC).

Table 2-2 Significant Impact Concentrations and the Jamaican National Ambient Air Quality Standards (JNAAQS) and Guideline Concentrations (GC) for air quality

Pollutant	Avg. Period	Significant Impact Concentration ($\mu\text{g}/\text{m}^3$)	Jamaican NAAQS or GC ($\mu\text{g}/\text{m}^3$)
PM ₁₀	24-hr	80	150
	Annual	20	60
NO ₂	1-hr	N/A	400
	24-hr	80	N/A
	Annual	20	100
SO ₂	1-hr	N/A	700
	24-hr	80	280
	Annual	20	60
CO	1-hr	2000	40000
	8-hr	500	10000
1,3 Butadiene	1-hr	N/A	0.04
Acetaldehyde	1-hr	N/A	1250
	24-hr	N/A	500
Acrolein	1-hr	N/A	58.75
	24-hr	N/A	23.5
Benzene	Annual	N/A	1
Benzo (a) pyrene	1-hr	N/A	0.00275
	24-hr	N/A	0.0011
Carbon Tetrachloride	1-hr	N/A	6
	24-hr	N/A	2.4
Chloroform	1-hr	N/A	1250
	24-hr	N/A	500
Ethylene Dibromide	1-hr	N/A	7.5
	24-hr	N/A	3
Formaldehyde	1-hr	N/A	162.5
	24-hr	N/A	65
Methylene Chloride	1-hr	N/A	550
	24-hr	N/A	220
Styrene	1-hr	N/A	2500
	24-hr	N/A	1000
Xylenes	1-hr	N/A	5750
	24-hr	N/A	2300
Vinyl Chloride	24-hr	N/A	1
	Annual	N/A	0.2
Arsenic	1-hr	N/A	0.75
	24-hr	N/A	0.3
Beryllium	Annual	N/A	0.0013
Cadmium	1-hr	N/A	5
	24-hr	N/A	2
Chromium	1-hr	N/A	3.75
	24-hr	N/A	1.5
Cobalt	24-hr	N/A	0.12
Copper	1-hr	N/A	125
	24-hr	N/A	50
Lead	1-month	N/A	N/A
	3-month	N/A	2
Manganese	Annual	N/A	119

Pollutant	Avg. Period	Significant Impact Concentration ($\mu\text{g}/\text{m}^3$)	Jamaican NAAQS or GC ($\mu\text{g}/\text{m}^3$)
Mercury	1-hr	N/A	5
	24-hr	N/A	2
Nickel	1-hr	N/A	5
	24-hr	N/A	2
Selenium	24-hr	N/A	25
	Annual	N/A	10
Zinc	24-hr	N/A	12

In 1987, U.S. Environmental Protection Agency replaced TSP with PM₁₀ as the indicator for both the annual and 24-hour health-related standards. The reason for this is because exposure to PM₁₀ particles may cause serious health/respiratory related issues as these particles are retained deep in the lungs. The 24-hour NEPA standards for PM₁₀ are shown in Table 3 10. However, the 24-hour US EPA standards are used for PM_{2.5} and TSP:

- TSP = 150 $\mu\text{g}/\text{m}^3$
- PM_{2.5} = 35 $\mu\text{g}/\text{m}^3$

The Natural Resources Conservation, (Ambient Air Quality Standards) Regulations, 1996

The Natural Resources Conservation, (Ambient Air Quality Standards) Regulations, 1996 set the acceptable limits for common air pollutants in ambient air. Since the treatment of medical waste has the potential to result in the emission of air pollutants, this regulation would be applicable to ensure that controls are in place to prevent emissions from adversely impacting the ambient air quality.

The Natural Resources (Hazardous Waste) (Control of Transboundary Movement) Regulations 2003

These regulations seek to implement the Basel Convention on the Transboundary Movement of Hazardous Waste and control transboundary movement and prevent the illegal trafficking of certain hazardous wastes. The process is further clarified by the User's Guide Natural Resources (Hazardous Wastes) (Control of Transboundary Movements) Regulations, 2015. These documents clarify what type of waste are included, process for applying for an import / export permit, inspection of wastes, notification requirements and use of approved forms.

Mercury containing materials (i.e., lightbulbs), asbestos, freon, or other hazardous materials that may result from the project would fall under these regulations if they were to be exported for final disposal (Natural Resources Conservation Authority Act, 2002):

1. NEPA. 2002. The Natural Resources (Hazardous Wastes) Control of Transboundary Movements
2. NEPA. 2015. User's Guide for National Resources (Hazardous Waste) Control of Transboundary Movements
3. NEPA. 2014. Guidelines for the Management of Asbestos. Guidelines for the Management of Asbestos
4. NEPA. 2014. Procedures for Handling of Asbestos. Procedures for Handling Asbestos

5. Ministry of Economic Growth and Job Creation. 2017. E-waste Policy and Regulatory Framework
6. Ministry of Labour and Social Security. 2017. Occupational Health and Safety, 2017
7. Ministry of Public Health. 1985. Public Health Act, 1985

Water Quality Standards

The NRCA has primary responsibility for control of water pollution in Jamaica. National Standards for industrial and sewage discharge into rivers and streams, in addition to standards for ambient freshwater exist. For drinking water, WHO Standards are utilized, and these are regulated by the National Water Commission (NWC). National standards for ambient freshwater are shown in Table 2-3. For drinking water, World Health Organisation (WHO) standards are utilized, and these are regulated by the National Water Commission (NWC).

Table 2-3 Draft national ambient freshwater water quality standards for Jamaica, 2009

Parameter	Measured as	Standard Range	Unit
Calcium	(Ca)	40.0-101.0	mg/L
Chloride	(Cl ⁻)	5.0- 20.0	mg/L
Magnesium	(Mg ²⁺)	3.6- 27.0	mg/L
Nitrate	(NO ₃ ⁻)	0.1- 7.5	mg/L
Phosphate	(PO ₄ ³⁻)	0.01 - 0.8	mg/L
Potassium	(K ⁺)	0.74- 5.0	mg/L
Silica	(SiO ₂)	5.0- 39.0	mg/L
Sodium	(Na ⁺)	4.5- 12.0	mg/L
Sulfate	(SO ₄ ²⁻)	3.0- 10.0	mg/L
Hardness	(CaCO ₃)	127.0-381.0	mg/L (as CaCO ₃)
Biochemical Oxygen Demand	(O)	0.8- 1.7	mg/L
Total Dissolved Solids		120.0-300	mg/L
pH		7.00- 8.40	
Conductivity		150.0-600	μS/cm

Source: National Environment and Planning Agency (NEPA)

Standards for sewage effluent (Table 2-4 - Table 2-6) and industrial (trade effluent) discharge into rivers and streams are stipulated within the Natural Resources Conservation (Wastewater and Sludge) Regulations, 2013.

Table 2-4 Sewage Effluent Standards for existing plants

PARAMETER	EFFLUENT LIMIT
BOD ₅	20 mg/L
TSS	30 mg/L
Nitrates (as Nitrogen)	30 mg/L
Phosphates	10 mg/L
COD	100 mg/L
pH	6-9 pH units
Faecal Coliform	1000 MPN/100 mL
Residual Chlorine	1.5 mg/L

Table 2-5 Sewage Effluent Standards for new plants

PARAMETER	EFFLUENT LIMIT
BOD ₅	20 mg/L
TSS	30 mg/L
Total Nitrogen	10 mg/L
Phosphates (PO ₄ -P)	4 mg/L
COD	100 mg/L
pH	6-9 pH
Faecal Coliform	1000 MPN/100 mL
Residual Chlorine	1.5 mg/L
Floatables	not visible

Table 2-6 Sewage Effluent Standards for use in Irrigation

PARAMETER	STANDARD LIMIT
Oil and Grease	10 mg/L
Total Suspended Solids (TSS)	1.5 mg/L
Residual Chlorine	0.5 mg/L
Biochemical Oxygen Demand (BOD ₅)	15 mg/L
Chemical Oxygen Demand (COD)	<100 mg/L
Faecal Coliform	12 MPN/100mL

Table 2-7 Industrial Trade Effluent Standards

PARAMETER	TRADE EFFLUENT LIMIT
Ammonia/ammonium measured as NH ₄	1.0 mg/L
Barium	5.0 mg/L
Beryllium	0.5 mg/L
Biological oxygen demand (BOD)	<30 mg/L
Boron	5.0 mg/L
Calcium	No standard
Chemical Oxygen Demand (COD)	<100mg/L or <0.01 kg/1000 kg product
Chloride	300 mg/L
Colour	100 TCU
Cyanide (free)	0.1 mg/L
Cyanide (Total as CN)	0.2 mg/L
Detergent	15 mg/L
Dissolved oxygen (DO)	>4mg/L
Faecal Coliform	<100 MPN/100 ml
Fluoride	3.0 mg/L
Iron	3.0 mg/L
Magnesium	No standard
Manganese	1.0 mg/L
Nitrate as NO ₃	10 mg/L
Oil and Grease	10 mg/L or < 0.01 kg/1000 kg product
PH	6.5 - 8.5
Phenols	0.1 mg/L
Phosphate as PO ₄	5 mg/L
Sodium	100 mg/L
Sulphate	250 mg/L
Sulphide	0.2 mg/L
Temperature	±2° of ambient
Total Coliform	<500 MPN/100 ml
Total Dissolved Solids (TDS)	1000 mg/L
Total Organic Carbon (TOC)	100 mg/L
Total Suspended Solids (TSS) (maximum monthly average)	50 mg/L
Total Suspended Solids (TSS) maximum daily average	<150mg/L

PARAMETER	TRADE EFFLUENT LIMIT
Trace Metals:	
Zinc	1.5 mg/L
Lead	0.1 mg/L
Cadmium	0.1 mg/L
Arsenic	0.5 mg/L
Chromium	1.0 mg/L
Copper	0.1 mg/L
Mercury	0.02 mg/L
Nickel	1.0 mg/L
Selenium	0.5 mg/L
Silver	0.1 mg/L
Tin	No standard
Total Heavy Metals	2.0 mg/L

2.2.2.3 Noise Abatement Act 1997

The Noise Abatement Act of 1997 was created in order to regulate noise caused by amplified sound and other specified equipment. This act has been said to address “some concerns but is too narrow in scope and relies on a subjective criterion” (McTavish). Given this, McTavish conducted a study to recommend wider and more objective criteria in accordance with international trends and standards but tailored to Jamaica’s conditions and culture.

National standards outlined by the National Resources Conservation Authority (NRCA) used for noise levels are outlined in Table 2-8; values for commercial, industrial, and residential areas are specified.

Table 2-8 NRCA standards for daytime and night time noise in various zones

ZONE	NEPA Daytime Guideline (dBA)	NEPA Night-time Guideline (dBA)
Commercial	65	60
Industrial	75	70
Residential	55	50
Educational/Silence	45	40

2.2.2.4 Water Resources Act 1995

The Water Resources Act (1995) established the Water Resources Authority (WRA), which is authorized to regulate, allocate, conserve, and manage the water resources of the island. Section 25 advises that a proposed user have to obtain planning permission, if this is a requirement, under the Town and Country Planning Act. In addition, under Section 21 it states that if the water to be used will result in the discharge of effluents, an application for a license to discharge effluents will have to be made to the Natural Resources Conservation Authority or any other relevant body as indicated by the Minister.

2.2.2.5 The Clean Air Act 1964

The Clean Air Act (1964) refers to premises on which there are industrial works, the operation of which is, in the opinion of an inspector, likely to result in the discharge of smoke, fumes, gases or dust in the air. An inspector may enter any affected premises to examine, make enquiries, conduct tests, and take samples of any substance, smoke, fumes, gas or dust that may be considered necessary or proper for the performance of his/her duties.

2.2.2.6 Public Health Act 1985

The Public Health Act is administered by the Ministry of Health and Wellness through Local Boards, namely the parish councils. The Public Health (Nuisance) Regulations 1995 aims to, control reduce or prevent air, soil, and water pollution in all forms. Under the regulations:

- No individual or organisation is allowed to emit, deposit, issue, or discharge into the environment from any source.
- Whoever is responsible for the accidental presence in the environment of any contaminant must advise the Environmental Control Division of the Ministry of Health and Environmental Control, without delay.

- Any person or organisation that conducts activities which release air contaminants such as dust and other particulates is required to institute measures to reduce or eliminate the presence of such contaminants; and
- No industrial waste should be discharged into any water body, which will result in the deterioration of the quality of the water.

2.2.2.7 The National Solid Waste Management Authority Act 2001

The National Solid Waste Management Authority Act of 2001 is “an act to provide for the regulation and management of solid waste; to establish a body to be called the National Solid Waste Management Authority and for matters connected therewith or incidental thereto”. The National Solid Waste Management Authority (NSWMA) was established in April 2002 as a result of this Act to effectively manage and regulate the collection and disposal of solid waste in Jamaica.

2.2.2.8 Guidelines for the Management of Asbestos and the Procedures for Handling of Asbestos 2014

The Guidelines for the Management of Asbestos and the Procedures for Handling of Asbestos, (2014), outline the procedures to be taken for the management of asbestos. They indicate notification requirements, minimum safety requirements, sampling requirements, quality control and assurance for taking and handling samples, and reporting requirements. These guidelines also detail the procedures for testing and abating asbestos. The appendices of the guidelines contain supplemental information, as well as form templates for reporting. It is currently unclear if the project may involve construction or rehabilitation work that will require removal of asbestos, but based on a review of publicly available information, it is highly likely that asbestos will be present. If disturbance or removal of asbestos is required, all works related to abate, transport, and dispose of asbestos would need to follow international standards (NEPA, 2014), *in* (Rina Consulting S.p.A., 2018).

2.2.2.9 National Energy Conservation and Efficiency Policy

Jamaica’s National Energy Conservation and Efficiency Policy 2009 – 2030 (NECEP) provides the overarching framework for energy efficiency in Jamaica. NECEP is designed to achieve a modern, efficient, diversified, and environmentally sustainable energy sector providing affordable and accessible energy supplies with long-term energy security and supported by informed public behaviour on energy issues and an appropriate policy, regulatory and institutional framework. By 2030, the country hopes to derive 30% of its energy needs from renewable sources. In addition, the country hopes to reduce its energy consumption by 15% through a diversification in the country’s fuel sources (Ministry of Energy and Mining, 2009).

2.3 RELEVANT INTERNATIONAL SAFEGUARDS

2.3.1 World Health Organization

2.3.1.1 Safe Disposal of Unwanted Pharmaceuticals in and after Emergencies

The World Health Organization's *National Guidelines on Safe Disposal of Unwanted Pharmaceuticals in and after Emergencies* (1999) include steps and recommendations that need to be followed in order to dispose of unwanted waste or expired pharmaceuticals. The steps required include the identification of pharmaceutical waste, sorting of pharmaceutical waste by category, and filling out the relevant forms to seek authority from the authorities in charge of disposing such waste. Upon obtaining all the relevant approvals, the disposal of the pharmaceutical waste shall be effected under the supervision of the local pharmaceutical waste disposal team or the Waste Management Team. (WHO, 1999).

The recommended methods for disposing of unwanted pharmaceuticals include:

- The use of either medium temperatures incineration at a minimum of 850°C or high temperature incineration exceeding 1200°C with two chamber incinerator for solids, semisolids and powders for controlled substances (e.g., anti-neoplastics).
- Engineered sanitary landfill to be used for disposal of expired or unwanted pharmaceuticals.
- Sewer disposal for diluted liquids, syrups, intravenous fluids, small quantities of diluted disinfectants and antiseptics.

These guidelines are also relevant in informing the generator of pharmaceutical wastes on safe disposal methods. Each hospital should have a contracted licensed waste handler who disposes the pharmaceutical wastes in the manner provided by the legal framework, the IFC's General EHS Guidelines for Health Care Facilities, and International Standards. (WHO, 1999)

2.3.1.2 Safety in Healthcare Laboratories

The World Health Organization's *Safety in Healthcare Laboratories* (1997) is a manual intended for healthcare Laboratory workers and those responsible for Laboratory administration and planning. It provides key guidelines for health and safety in the Laboratory activities. These guidelines will be useful during operations phase, following construction and rehabilitation. (WHO, 1997)

2.3.2 World Bank Group

The World Bank's General Environment, Health, and Safety (EHS) Guidelines (2007) contain performance levels and measures for development of industrial projects that are considered to be achievable in new facilities at reasonable costs by existing technology. Under these guidelines, the World Bank has several guidelines many of which are applicable to various components of the proposed project namely:

- EHS Guidelines - Air Emissions and Ambient Air Quality

- EHS Guidelines - Waste Management
- EHS Guidelines - Health Care Facilities
- EHS Guidelines - Hazardous Materials Management
- EHS Guidelines - Construction and Decommissioning

These guidelines are meant for all types of projects with “significant” emissions, sources of air emissions, and potential for significant impacts to ambient air quality to prevent or minimize impacts by ensuring that emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards. They require the application of national legislated standard, or in their absence, the current WHO Air Quality Guidelines, or other internationally recognized sources. In this project, there will be fugitive air emissions, which are expected during construction and operation phases of the project. These guidelines are useful as they give control and monitoring measures (World Bank Group, 2007).

The Waste Management EHS Guidelines apply to the management of non-hazardous and hazardous waste. The hospitals will be a major generator of both hazardous and non-hazardous waste. These guidelines provide categories of various wastes and a summary of treatment and disposal options, as well as guidance on waste on-site handling, collection, treatment, and disposal for both the proponent and the contractors during construction and operation phases respectively. This report greatly adopts the guidance while formulating the environmental management plan (World Bank Group, 2007).

The Noise EHS Guidelines address the impacts of noise beyond the property boundary of the facility in question. These guidelines are applicable during the construction phase, whereby construction equipment and activities are expected to emit noise. Permissible noise levels should be in accordance with NEPA regulations, to ensure noise levels are maintained as low as reasonably practicable. (World Bank Group, 2007).

The Occupational Safety and Health Guidelines guide employers and supervisors in fulfilling their obligation to implement all reasonable precautions to protect the health and safety of workers. The guidelines provide guidance and examples of reasonable precautions to implement in managing principal risks to occupational health and safety. The guidelines also describe how facility operation workplace design should be undertaken to prevent occupational health and safety risks and hazards. (World Bank Group, 2007).

Construction and Decommissioning EHS Guidelines provide additional and specific guidance on prevention and control of community health and safety impacts that may occur during new project development, at the end of the project life cycle, or due to expansion, or modification of existing project facilities (World Bank Group, 2007).

2.3.3 Basel Convention

Jamaica is a signatory to the Basel Convention on the transboundary movement of hazardous wastes. The MOH accepts the principles of the Convention and applies them to the local policy and guidelines,

where appropriate. Specific to medical waste under the Basel Convention is the Technical Guideline on the Environmentally Sound Management of Biomedical and Healthcare Waste (NEPA, 2007).

2.3.4 Inter-American Development Bank (IDB) Safeguard Requirements

The IDB requires that each project meet the following ten (10) Guidelines for Environmental and Social Performance Standards (ESPS) as part of the IDB's Environmental and Social Policy Framework (ESPF) (Table 2-9). These are outlined below:

- ESPS 1: Assessment and Management of Environmental and Social Risks and Impacts.
- ESPS 2: Labour and Working Conditions
- ESPS 3: Resource Efficiency and Pollution Prevention
- ESPS 4: Community Health, Safety, and Security
- ESPS 5: Land Acquisition and Involuntary Resettlement
- ESPS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- ESPS 7: Indigenous Peoples
- ESPS 8: Cultural Heritage
- ESPS 9: Gender Equality
- ESPS 10: Stakeholder Engagement and Information Disclosure

Nine of the ten principles apply to this project. ESPS 7 (Indigenous Peoples) does not apply (See Section 5.4.1).

Other relevant policies and guidelines include the IFC's General EHS Guidelines for Health Care Facilities and IFC Performance Standards.

The Inter-American Development Bank (IDB) requires meaningful consultations to comply with "environmental and social policies in projects that have the potential to cause harm to people and the environment"; along with maintaining the "credibility and legitimacy of implementing agencies and of the ...IDB." The IDB's Environmental and Social Performance (ESP) Standard 10 on social engagement and information disclosure mandates early, accessible, open, and transparent engagement that is free of coercion, manipulation, and discrimination with project-affected and interested stakeholders. ESPS 10 sets out the framework for stakeholder identification and analysis as well as the process for consultation and the integration of grievance mechanisms.

Though intended for the protection of the rights of indigenous populations, the principles of free, prior, and informed consent (FPIC) are reinforced throughout all phases of public engagement. It is to be noted that Jamaica has not acceded to ILO Convention 169 on FPIC. However, the IDB has accepted the principles of FPIC under international law that recognises self-identification as indigenous. Notwithstanding, the intent of the Convention is useful for the protection of other vulnerable stakeholder groups. The IDB defines vulnerable or disadvantaged populations as those more likely to be adversely affected yet less able to take advantage of project benefits.

In the execution of development projects, due consideration is to be given to their induced impacts and the prevalence of non-communicable diseases (NCDs). The African Development Bank (ADB) acknowledges that while it is difficult to attribute NCDs to development projects, their impacts can indirectly contribute to, or aggravate existing NCDs. Rapid development may result in unplanned and informal settlements that exacerbate urban poverty leading to unhealthy food choices and a “greater risk to exposure to harmful substances” leading to diabetes and heart disease. “Stress associated with involuntary resettlement and economic displacement can cause hypertension.”

Table 2-9 Operational Compliance with IDB Guidelines for Environmental and Social Performance Standards (ESPS)

ESPS #	Description	Actions Required during Preparation & Analysis
1	Assessment and Management of Environmental and Social Risks and Impacts.	This ESA assessed the institutional capacity of the MOH to manage the environmental and social risks and impacts identified, and proposes strengthening measures, as needed.
2	Labour and Working Conditions	This ESA outlines the national labour laws and accompanying measures to respect and protect the fundamental principles and rights of workers, and to promote the fair treatment, non-discrimination, and equal opportunity of workers.
3	Resource Efficiency and Pollution Prevention	This ESA assesses the impacts on human health and the environment and serves to minimize adverse effects on same by avoiding or minimizing pollution from project activities. It promotes the sustainable use of resources, including energy and water and waste reduction techniques.
4	Community Health, Safety, and Security	This ESA and the ESMP address the potential ESHS impacts and risks caused by the works in the various hospital and health centre facilities. This ESA and the ESMP determine the necessary plans and measures (e.g., emergency response, community and occupational health and safety) for the Program.
5	Land Acquisition and Involuntary Resettlement	This ESA and the ESMP and SEP addresses potential impact on loss of income/livelihoods for vendors and other stakeholders directly impacted by the project. It serves to improve or restore the livelihoods and standards of living of displaced persons.
6	Biodiversity Conservation and Sustainable Management of Living Natural Resources	This ESA describes all floral and faunal biodiversity present in the project areas and along with the ESMP, discusses measures to protect and conserve said biodiversity and maintain the ecosystem functions to ensure the benefits from ecosystem services.
7	Indigenous Peoples	This ESA discusses Taino village, midden and burial sites, as well as Maroon communities, in proximity to the proposed project sites.
8	Cultural Heritage	This ESA and ESMP discusses the various cultural and heritage sites in proximity to the project areas and recommends measures to protect cultural heritage from the adverse impacts of project activities and support its preservation.

ESPS #	Description	Actions Required during Preparation & Analysis
9	Gender Equality	This ESA and the ESMP and SEP proposes gender-sensitive approaches and methodologies to promote equitable participation of women and men during preparation and operation of the Program. It also serves to prevent Sexual and Gender Based Violence, including sexual harassment, exploitation and abuse, and when incidents of SGBV occur, to respond promptly.
10	Stakeholder Engagement and Information Disclosure	This ESA and ESMP identified the potentially affected stakeholder groups to be consulted on the potential negative environmental and social risks and impacts of the Program. The ESMP guarantees consultations are meaningful, gender-sensitive, and socio-culturally appropriate. The ESMP and SEP includes a Grievance Mechanism to be implemented during execution of the Program. It also proposes gender-sensitive approaches and methodologies to promote equitable participation of women and men during preparation and operation of the Program.

2.3.5 The Convention on Biological Diversity

Signed by 150 government leaders at the 1992 Rio Earth Summit, the Convention on Biological Diversity (CBD) is committed to promoting sustainable development. The CBD is regarded as a means of translating the principles of Agenda 21 into reality and recognizes that “biological diversity is about more than plants, animals and microorganisms and their ecosystems – it is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live”.

The CBD may be considered the first global, comprehensive agreement which focuses on all aspects of biodiversity, to include genetic resources, species, and ecosystems. In order to achieve its main goal of sustainable development, signatories are required to:

- Develop plans for protecting habitat and species.
- Provide funds and technology to help developing countries provide protection.
- Ensure commercial access to biological resources for development.
- Share revenues fairly among source countries and developers.
- Establish safe regulations and liability for risks associated with biotechnology development.

Jamaica’s Green Paper Number 3/01, ‘Towards a National Strategy and Action Plan on Biological Diversity in Jamaica’, is evidence of Jamaica’s continuing commitment to its obligations as a signatory to the Convention.

2.3.6 Sustainable Development Goals

Jamaica’s NDP provides the enabling environment for achievement of the Sustainable Development Goals (SDGs); good health and wellbeing (Goal 1); reduced inequalities (Goal 10); and life on land

(Goal 15) are among the social, economic, and environmental commitments that will be bolstered by the implementation of the proposed works.

2.3.7 Copenhagen Declaration on Social Development

The Copenhagen Declaration on Social Development recognises the impact of social exclusion and the need to address their structural causes and distressing consequences. It further recognises that economic development, social development, and environmental protection are mutually interdependent and mutually reinforcing components of sustainable development. Among the safeguards for social integration cited in Chapter 4 of the Programme of Action of the World Summit for Social Development were responsive Government and full participation in society. Sections 71(c)(g)(e)(f)(k) requires Government to disseminate and maximise access to information on public policies and initiatives; facilitate the access of marginalised and disadvantaged peoples to information and education as well as participation in social life; encourage independent media that promotes understanding and awareness with full respect for freedom of information and expression.

2.3.8 Escazu Agreement

Articles 5 and 6 of the Escazu Agreement, 2018, the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean reaffirms the rights of access to, the generation and dissemination of environmental information, public participation in the environmental decision-making process and access to justice in environmental matters.

3.0 EXECUTING AGENCY'S CURRENT CAPACITY

As part of the ESA, an evaluation of the current capacity and technical strengthening needs for the MOHW was conducted to assess if the MOHW has the capacity to manage environmental, social, health and safety and Labour issues involved for the implementation of the Program. Table 3-1 below presents a summary of the main environmental and social issues that need to be addressed by the MOHW, the current situation (evaluation of institutional capacity), and recommendations for technical strengthening within the MOH.

Table 3-1 Evaluation of Institutional Capacity and Recommendations for Technical Strengthening

Project Related Environmental and Social Issues	Current Situation	Recommendations for Technical Strengthening
Inadequate Sewage / Wastewater Treatment Plant	<p>CEAC Solutions Co. Ltd. was commissioned to carry out a condition assessment and rehabilitative designs for the WWTP.</p> <p>The current sewage / wastewater treatment plant at the STH was partially functional and was in need of an upgrade.</p> <p>Historical effluent data is non-compliant with the NRCA (Wastewater and Sludge) Regulations, 2013, Sewage Effluent Standards.</p>	<p>It was concluded that the Spanish Town Hospital's wastewater treatment plant is able to accommodate the additional sewage flow from both the existing buildings and the new hospital and health centre building and meet the NRCA discharge effluent standards. To carry out the rehabilitation activities, the plant will have to be taken offline with the pumps off and sewage removed from the lift station through a cesspool truck. The state of the current treatment components is poor and the cost of upgrading all aspects stands at an estimated JMD \$90,620,899.91 (CEAC Solutions Co. Ltd., 2022).</p> <p>Maintenance of the treatment facilities should be coordinated by each hospital operations manager with the oversight of the RHAs. Frequent sampling and monitoring should be complied with according to the NEPA wastewater licence. The Stormwater and Wastewater Management Plan will address these.</p>
Inadequate Storm water Management	<p>Several issues with drains and drainage areas were seen all around the STH hospital and its facilities. Drains were blocked, damaged, and littered with solid waste. Exposed and damaged drains run all around the hospital, including areas that re heavily traversed by patients, visitors, and staff. Drains were seen to be littered with solid waste and stagnant water.</p> <p>At SJHC, the drains appear to be insufficient or blocked as some areas flood during heavy rain events.</p> <p>At OHHC, anecdotal information garnered indicated that no major flooding (no inundation of existing building and parking areas) in the project area on the compound. However, persons have stated that</p>	<p>Rehabilitation and upgrade works should include the design of a Stormwater and Wastewater Management Plan for all facilities that provide drainage ditches, sand filters, bioretention areas, and other BMPs for storm water management. The Stormwater and Wastewater Management Plan will address these.</p>

Project Related Environmental and Social Issues	Current Situation	Recommendations for Technical Strengthening
	<p>there is a lack of drainage in the proposed development area which may result in minor instances of flooding post construction</p> <p>Currently, the undeveloped compound does not have a means to dissipate storm water as there is no internal drainage present.</p> <p>At the GPHC, several issues with drains and drainage areas were seen all around. Drains were blocked, damaged and littered with solid waste. Water in these drains may be contaminated with runoff and solid waste. Flooding from drains into green spaces was seen. Staff reported that the flood water was contaminated with sewage and waste water from the adjacent residential area. They also noted that flooding events can be extreme, covering walkways and entering offices.</p>	
Medical Waste	<p>Medical waste handling, storage and disposal was insufficient at all facilities.</p> <p>AT STH, large stockpiles of medical waste were seen in and around an unused building by the parking lots. Blood vials used gauze and other materials were littered around the building, bags torn and bins overflowing. Medical waste was also seen being transported with solidate and discarded in bins with solid waste around the hospital grounds. Medical waste bags were seen on the ground outside the childcare clinic and other areas.</p> <p>At SJHC, medical waste was seen improperly disposed of on the health centre grounds.</p> <p>At OHHC, while it was indicated that medical waste is stored in a barrel on the veranda, stockpiles of medical waste were seen in and around an unused building by the parking lots.</p>	<p>The design and space allocation of medical waste facilities should be incorporated into the rehabilitation works for the studied facilities as a short-term action. Maintenance of these facilities should be included in the Medical Waste Management Plan at each facility</p>

Project Related Environmental and Social Issues	Current Situation	Recommendations for Technical Strengthening
	At GPHC, medical waste is stored in the main area with other waste, although it is separated, medical waste was seen mixed with solid waste at the health centre.	
Potential Presence of ACBM	Based on the age of the facilities, Asbestos Containing Building Materials (ACBM) may be present in minimal quantities. Given that major demolition activities will be conducted at Spanish Town Hospital, this will apply.	The MOHW should establish an asbestos testing and abatement policy for facilities to phase out this contaminant. The RHAs should establish a management program at each facility under their jurisdiction. Contractors hired by the MOHW for hospital rehabilitation works should be required to provide asbestos testing and abatement works per NEPA guidelines. The ACBM Management Plan will address this.
Compliance with Environmental Regulations	WWTP does not have the requisite Environmental Permit or Wastewater Effluent discharge licence. Historical effluent data is non-compliant with the NRCA (Wastewater and Sludge) Regulations, 2013, Sewage Effluent Standards.	MOHW / Health Systems Strengthening Program (HSSP to apply for environmental permit and licence to operate WWTP and discharge treated effluent. SERHA to ensure that the pollution prevention plans are implemented within a specified date frame.
Consultations	Currently, the MOHW does not have a specific department responsible for conducting external stakeholder engagement or consultations.	The implementation of the Stakeholder Engagement Plan is the responsibility of the MOH/PEU. It is assumed that the Project will have a Project Director designated at the MOHW. A Community Liaison Officer (CLO) should specifically be trained for this scope. The CLO should coordinate the implementation of the SEP activities and consultation activities and keep on going contacts with any field managers or contractors during the construction phase. Any contractors or subcontractors will be briefed in order to be aware of the commitments taken by the Project in the SEP and the approach to dealing with stakeholders. The CLO would have mandate over the socio-economic baseline work that may need to be conducted regarding any economic displacement of informal vendors at STH, SJHC and OHHC, and the bee keeper at OHHC. The

Project Related Environmental and Social Issues	Current Situation	Recommendations for Technical Strengthening
		CLO would also have a general control function of the Grievance Mechanism Process (see below).
Grievance Mechanism	<p>The RHAs have on their websites a complaint mechanism. The steps in this mechanism are as follows:</p> <ul style="list-style-type: none"> • Complaints are made to the MOH, the Regional Office, or any Health Care Facility (Health Centre or Hospital). • The Complaints Receivable Officer documents the complaint on the Client Complaint Form, which is signed by the complainant –or– the Client Complaint Form can be completed online or downloaded from the website. • The Complaint Form is sent to the CEO of the facility, the Parish Manager, the Senior Medical Officer, the Hospital Administrator, or the Medical Officer of Health. • Complaints are acknowledged within 1 to 5 days following receipt. • The process of investigation and resolution begins within 1 to 3 days after the receipt of the complaint depending on its nature. • The complainant is kept informed of the status of the investigation. • A face-to-face meeting is arranged at the convenience of the complainant in order to satisfy and resolve the complaint. • The agreed resolution is implemented. • If the complainant is not satisfied with the outcome, the matter may be referred to a higher level within the organization or to the Ministry of Health. • The process can be stopped at any time if the complainant indicates this in writing to the person to whom the complaint was sent. 	<p>The MOHW has a formal grievance mechanism to address patient concerns with care. However, staff indicated the system is not intended to address grievances during construction. It is intended to address healthcare provider concerns. The system could include construction grievances. Staff noted that, in the past, there were more localized grievance systems during construction including a committee and that these could be more effective. They suggested creating a “key point of contact” formally identified and prominently communicated to patients at each facility to receive formal grievances and to coordinate communication about them between the MOH and the facility, as well as follow up on the complaints and ensure their resolution.</p> <p>The Grievance Redress Mechanism (GRM) as part of the ESMP recommends that a Claims and Complaints Absolution Program should be formulated and responsible for making available various avenues for receiving and monitoring grievances received from affected parties</p>
Natural Hazards Risks	Spanish Town Hospital, St. Jago Park, Old Harbour and Greater Portmore Health Centres currently experience similar levels of natural hazard risk. Natural hazards include: flooding, hurricanes, tropical storms, seismic activity, landslides and soil loss and erosion.	All facilities currently have Emergency Preparedness and Response Plans. However, it is unclear how detailed the plans, as they were not made available upon request. Establish coordination between the MOHW, NEPA, RHA, Fire brigades and the Disaster Preparedness and

Project Related Environmental and Social Issues	Current Situation	Recommendations for Technical Strengthening
	<p>The proposed Old Harbour Health Centre site however, is more susceptible to flooding than that of the other three facilities.</p>	<p>Emergency Management Unit within each municipal corporation, to better respond to natural hazard risks and vulnerabilities.</p> <p>Full vulnerability assessments should be conducted by the MOHW prior to commencement of works, with particular emphasis on flooding, seismic activity, fires, oil spills and land subsidence. Construction designs should follow Seismic Building Code, per Jamaica's National Building Code, to comply with the regulations pertaining to structures that are considered critical to human welfare (i.e., hospitals and health centres).</p> <p>The Emergency Response Management Plan will address these issues.</p>

4.0 ENVIRONMENTAL CONTEXT

4.1 SPANISH TOWN HOSPITAL

4.1.1 Existing Facility

Spanish Town Hospital was built in 1952. Currently the hospital has twenty-six buildings and fourteen wards to include the Accident and Emergency and Outpatient Departments. Over the years, there have been upgrades to the infrastructure which include:

- A Maternity Ward (1993)
- The Queen Sofia Women's Centre
- Ward Seven (Food for the Poor Building)
- Staff Residences (three blocks comprising 34 flats)
- Converting the "Old Maternity Building" to the current Accident & Emergency Department

Also on property is a pharmacy which is operated by the National Health Fund. While the hospital has its own morgue on property, it is not operational and needs renovations.

As outlined in (Rina Consulting S.p.A., 2018) .The hospital is located in the south-eastern corner of St. Catherine Parish, the fastest growing parish in Jamaica (estimated growth of 3% per year). As of the most recent Jamaican census in 2016, the population of St. Catherine was 518,000. In addition to accepting patient referrals from the Linstead Hospital and health centres in the parish, the Spanish Town Hospital mainly serves the nearby city of Portmore, a city with a population of approximately 250,000 people.

The hospital is located at the intersection of several major highways (Mandela Highway connects Spanish Town to the capital of Kingston) and is surrounded by several communities, providing care to victims of road traffic accidents and gang warfare. Furthermore, new housing projects in St. Catherine, and the increasing numbers of young families, will lead to a significant increase in stakeholder groups and patients, particularly within the paediatric population. The hospital currently services an estimated 5,000 births per year, second only to Victoria Jubilee Hospital (a hospital that specializes in obstetrics and gynaecology).

Spanish Town Hospital was originally built with a 277-bed capacity, for a population of 300,000 community members. However, at present, the hospital is grossly exceeding its capacity by 203 beds and is serving a population nearly double its intended capacity. It should be noted that the exceedance of capacity is partly attributable to the recent addition of a Covid-19 Field Hospital on the hospital's grounds. Services currently provided at Spanish Town Hospital include:

1. Paediatrics
2. Orthopaedics

3. General Surgery (emergency and elective)
4. Obstetrics and Gynaecology
5. General Medicine
6. Dietary
7. Nephrology
8. Colposcopy
9. Cardiology
10. Urology
11. Rheumatology
12. Dialysis
13. Maternity,
14. Rehabilitation/Physiotherapy
15. Blood Testing
16. X-rays and Ultrasounds
17. Isolation/infectious Disease Management
18. Counselling

Although such a wide scope of services is offered by the hospital, it is not fully/adequately equipped to offer these services as there is a shortage of equipment throughout the hospital which affects the investigative and clinical management of patients. Information received through internal consultation was that some services have been discontinued by the hospital as a result of equipment disrepair and understaffing. Specific to understaffing, it was highlighted that the unavailability of training has contributed to this issue. Additionally, services at the hospital have been discontinued as a result of space/infrastructure constraints. It should be noted that while there is a laboratory on site, prevailing constraints have resulted in a reduction in the cadre of Phlebotomy Services

The hospital at present has systems in place to cater to persons with mobility challenges. However, no systems are in place to cater to the needs of the visually or hearing impaired or persons with other disabilities. Although the hospital treats persons in police custody, there is no secure area to treat such persons.

There is a computerised patient records systems which allows for patients' records to be accessed through a local server within the hospital. However, the hospital does not have adequate staffing for non-medical service-related matters such as patient registration.

In the short term, major changes are needed in order to add an additional 100 bed units, an Intensive Care Unit (ICU), and to increase the number of operating technicians. At present, Spanish Town completely lacks an ICU unit. Considering the level of complexity at which this hospital operates and the exceedance in capacity, the lack of an ICU unit is a major identified issue. The hospital also requires a complete upgrade of its wastewater treatment system. Currently, wastewater is treated onsite by a partially operational WWTP, and simply discharged into the Rio Cobre. There is no regular sampling or chemical testing of the discharge to ascertain if the discharge complies with NEPA and or international standards. The hospitals water tank and sewage system also pose a health and safety risk to workers,

hospital staff, neighbouring communities, and the environment, as the current capacity of its water storage system is only 30% of what it should be (65,000 gallons versus a total recommended capacity of 200,000 gallons). During internal stakeholder consultations, it was learnt that the Maternity Department's water storage capacity is independent of the rest of the hospital. The hospital (not including maternity) has one day's emergency water capacity, while the Maternity Department has a two-to-three day emergency capacity. It should be noted that the hospital does not have central water storage for the entire facility, instead, various sections of the hospital were equipped with aboveground "black tanks". The maximum storage capacity on property is inadequate and is estimated to be 96,000 gallons. Within 24 hours, this capacity is consumed assuming there is no running water on property (Wallace Hall, *pers. comm*).

In terms of the hospital's sewage system and storm water drainage system, there is a severe risk of flooding due to the proximity of the Rio Cobre, which puts the hospital at risk. The MOH has embarked on a project to rehabilitate or implement new sewage treatment systems at its health facilities to comply with regulatory requirements; however, according to the MOH business plan (2015-2018), Spanish Town Hospital is not listed under the facilities to be upgraded with a new water treatment system. At the present time, to mitigate this issue, the hospital currently relies on the use of sandbags around the Accident and Emergency (A&E) area to prevent water from flowing in. Termite and other pest infestations are also a problem for Spanish Town Hospital. Due to the year in which the hospital was constructed, and observations pointed out by the hospital's facilities manager during the site reconnaissance, Asbestos Containing Building Materials (ACBM) (e.g., asbestos insulation materials) may be present at the hospital, and specifically within the on-site generator.

Upgrading Spanish Town Hospital from "Type B" to "Type A" will require new specialties (e.g., cardiology, psychiatry, ENT, urology, ophthalmology, and dermatology) and new services (e.g., blood donation, endoscopy, ICU, and improved imaging diagnostics). Currently, space within Spanish Town Hospital is extremely limited and any encroachment upon this space, if not managed properly, could cause widespread ramifications, including the spread of infectious diseases. Furthermore, a lack of space and proper bed arrangements is potentially problematic during emergencies (e.g., fire or natural disasters) as evacuation routes may cause confusion, be blocked, crowded, and / or inaccessible. To manage this risk, the hospital should conduct a full assessment regarding the available space / occupancy within the hospital, including what patients may need to be moved in order to safely accommodate construction and rehabilitation works. With regard to space outside of the hospital, it appears as though there is enough space to accommodate new buildings, if needed.

4.1.1.1 Electricity

The Jamaica Public Service Company Ltd (JPSCo)., supplies the entire electrical system for Spanish Town Hospital with two feeders. One feeder is used for the hospital's emergencies, and the other for the rest of the hospital's energy needs. Together, these feeders provide approximately 28 kV of energy to Spanish Town Hospital (Rina Consulting S.p.A., 2018).

The energy supply is separated into three main categories: Motherhood sector (300 kVA), Emergency (250 kVA), and all other buildings (three sources of 1500 kVA). After a review of publicly available

information, it is apparent that the 1500 kVA system is incorrectly installed. The connections are exposed and lack insulation, there are signs of short circuits, and the general arrangement of the system is confusing. In addition, there are two generators that are used for the motherhood building (311 kVA) and another generator for the emergency circuits in other wards (320 kVA). However, as with the example above, the systems are incorrectly installed and therefore pose a safety risk to patients due to many exposed parts and improperly installed machinery (Plate 4-1) (Rina Consulting S.p.A., 2018).

Sixty two (62) electrical poles and 9 pole mounted transformers were mapped on the Spanish Town Hospital property on September 18, 2021 (Figure 4-1). Two fixed backup generators and a few mobile generators were observed.



Plate 4-1 Exposed conductors to live electrical equipment presents a safety hazard to staff



Figure 4-1 Electrical poles and transformers observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)

The (UNOPS, 2018) identified several risk factors in the electrical supply to the hospital;

The electrical installation and equipment, in general has critical deficiencies, many of these deficiencies are caused by the age of the systems, poor repairs, obsolete equipment, lack of a complete maintenance program and lack of funds to implement it.

Significant energy losses and high consumption were identified by obsolete equipment.

The entire range of servitude and safety of lines must be clean and clear of any possibility of accidental contacts, such as buildings, trees, masts and other obstacles by external influences can come into accidental contact with the line.

The protection Devices (fuses) should be identified to avoid errors of discretion in the fuse disconnect switches, whose accidental handling can cause accidents on the maintenance crew, misguided shutdowns of emergency circuits and other problems

The concertina of security should be grounded and torn at the points of intersection with the line because there is a possibility the fall line power system accidentally. Caveat if that area and subject to tornadoes and hurricanes.

The Power transformers are installed improperly with risk of imminent collapse.

The 1500 kVA substation is visually out of the standard, the connections are exposed and without proper insulation, they show signs of short circuits, diesel tank very close to the substation. There is a high risk of electric shock, risk of fire and even explosion. A single transformer according to the standards replaces the system was suggested.

The Generators require simple routine maintenance and cleaning, there are signs of corrosion, and the cabins feature signs of infiltration and fissures. The cabins do not have signalling and security restriction, lighting is insufficient and not as emergency lighting. Cabins should be reformed.

The ATS needs regular repairs, cleaning and maintenance and performance tests to certify the reliability of the system. Replacing the General switchboard for more modern and reliable equipment to suit to the current standards of safety in electrical installations was suggested.

Many of the boards do not have barriers or enclosures, signage and directions, show signs of corrosion, dust build up, circuit breakers and loose cables, bus bars, rusted, loose connections, grounding connection problems and problems with obstruction making your access. All panels with degree of protection less than IP4X should be replaced, the buses and rusty frames should also be replaced, all cables and circuit breakers are identified according to the circuits that feed that are installed barriers or enclosures preventing access to energized parts, drivers should be rearranged, anyway that meet the current standards for electrical installations.

Although visually identified a number of irregularities in the electrical installation, thermography held in some panels did not identify points of heat in the breakers. No identification was found in circuit breakers and their respective circuits.

The electrical conductors in the oldest buildings must have been replaced because many of their drivers are probably without the insulation.

There are areas with fixed cables in walls or ceilings with access to people not warned and not qualified. Must be located so as not to be accessible respecting the minimum height of 2.50 m from the finished floor.

Residual-current device should be in all circuits where the current standards require as mandatory; it was not identified in any panel the presence of this protection device.

In general, the conclusion of the diagnosis is that most of the equipment of the Electrical Installations of the Spanish Town Hospital have fulfilled their lifespan, so they need to be fully intervened.

A Maintenance Plan must be prepared for the infrastructure and facilities of the STH (predictive, preventive and corrective), as well as assigning the financial and human resources for its proper implementation.

4.1.1.2 Lighting

The (UNOPS, 2018) found the in general, the lighting system was not in good condition. There are luminaires with bulbs exposed, which can cause cuts and other accidents. Many lamps are broken or inoperative.

Measurements of light intensity showed that work environments are insufficient to industrial activities, for example, the workplace for employees must have at least 500 lux, the measurement pointed 134 lux. We propose that the Hospital be submitted to a new lighting project to adapt the environments to normative standards.

4.1.1.3 Tank Storage

Potable Water

The Spanish Town Hospital receives water from the public network. According to the information gathered, there is no knowledge of the continuity of the service, that is, the number of water supply hours of the public network. The Hospital has a system that at the same time supplies water to a storage tank (called an accumulation tank), whose volume is 25,000.00 GL. (95.00 m³, approximately). It is estimated, considering the dimensions of the tank of this storage, that the useful volume should be around 90.00 m³, considering a diameter of 3.50 m and 10.00 m long (UNOPS, 2018).

There were 22 locations where water storage tanks were located on the Hospital property (Figure 4-2). They were mainly the black plastic water tanks of varying sizes and some metallic tanks (Plate 4-2 to Plate 4-6).

The maximum storage capacity on property is inadequate and is estimated to be 96,000 gallons. Within 24 hours, this capacity is consumed assuming there is no running water on property (Wallace Hall, *pers. comm*).

The hospital's water tank capacity is only 30% of what it should be (65,000 gallons versus a total recommended capacity of 200,000 gallons) (Rina Consulting S.p.A., 2018).



Plate 4-2 Black plastic water storage tank with blue metallic water tank in background



Plate 4-3 Elevated silver metallic water tank



Figure 4-2 Tank storage observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)



Plate 4-4 Black plastic water storage tank at the medical staff quarters



Plate 4-5 Black plastic water storage tank on the roof of the Accident & Emergency Department



Plate 4-6 Black plastic water storage tank at the residences

Fuel

Three locations were identified for fuel storage on the property, of which 2 were used for the storage of diesel and the other for Liquid Petroleum Gas (LPG) (Plate 4-7, Plate 4-8 and Figure 4-2).



Plate 4-7 Example of a diesel storage tank (un-bunded) near to the laundry building



Plate 4-8 LPG storage in front of the dietary building

Oxygen

There were 2 locations identified as medical oxygen storage on the property (Plate 4-9, Plate 4-10 and Figure 4-2).



Plate 4-9 Medical oxygen storage in proximity to the Maternity High Dependency Unit



Plate 4-10 Portable medical oxygen storage area

4.1.1.4 Hazardous Chemical Storage

Several barrels with chemicals such as bleach and other cleaning agents were seen in locked, open areas on the hospital grounds (Figure 4-3). Barrels with lubricants and oils were seen around the maintenance area (Plate 4-11 and Plate 4-12).



Plate 4-11 Chemical storage (cleaning agents, bleach etc.)



Plate 4-12 Lubricants and other hazardous material storage



Figure 4-3 Main storage areas for non-medical hazardous chemicals observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)

4.1.1.5 Drains

Several issues with drains and drainage areas were seen all around the hospital and its facilities. Drains were blocked, damaged, and littered with solid waste. Water in these drains may be contaminated with runoff from waste storage areas and other hazardous chemical storage areas. Plate 4-13 -Plate 4-18 are examples of drains in and around the hospital.

Exposed and damaged drains run all around the hospital, including areas that re heavily traversed by patients, visitors, and staff. Drains were seen to be littered with solid waste and stagnant water.



Plate 4-13 Damaged and blocked drain along the main hospital roadway



Plate 4-14 Drains from walkways across a green space near the solar farm



Plate 4-15 Broken utility cover



Plate 4-16 Broken/ damaged drain and pipe area, overgrown



Plate 4-17 Exposed drain and service area



Plate 4-18 Drain with storm water and grey water

4.1.1.6 Waste Streams

Categories of Waste

The main waste streams from hospitals and healthcare establishments are categorized into the following three categories for management purposes⁵ (C. L. Environmental Company Ltd., 2007):

1. **General/Non-Clinical Waste** – includes waste generated from administrative activities, general cleaning, food preparation and ward areas, provided that they are separated at the point of generation from the waste classified as medical and special waste. These wastes do not pose a special handling problem or hazard to human health, or the environment and their characteristics are similar to those of common domestic waste. Examples include
 - a. Wrappers and packaging materials/containers, food waste and leftovers, cleaning materials
 - b. Office materials and equipment including paper, newspaper, cardboard, plastic, glass disposable containers, hand towels, timber, metal
 - c. Used disposable bed pan liners, urine and specimen containers, faeces, incontinence pads and stoma bags
 - d. Used personal hygiene products
 - e. Non-infectious animal bedding
 - f. Waste that come into contact with patients through routine examination of patient care but are not soiled or saturated with fluid blood, body fluids, excretions, exudates or secretions example gloves, caps, gowns, drapes, disposable sheets, gauzes, cotton balls and dressings
 - g. Garbage generated by patients, workers, and visitors
 - h. Waste material that has been sterilized.
2. **Medical/Clinical Waste** – includes wastes generated during the different stages of health care (diagnosis, treatment, immunizations, research, etc.) that contains pathogens which are capable of producing an infectious disease. These wastes represent different levels of potential danger according to the degree of exposure of infectious agents.

⁵ Health Facilities Infection Control Policies and Procedures Manual, Ministry of Health (Revised 2007)

3. **Special Waste** – includes wastes generated during auxiliary activities that constitute a health risk due to their aggressive characteristics, such as Corrosivity, Reactivity, Inflammability, Toxicity, Explosivity and Radioactivity.

Examples and description of the different types of Medical and Special Wastes are presented in Table 4-1 (C. L. Environmental Company Ltd., 2007).

Table 4-1 Categories of Medical Waste

WASTE CATEGORY	DESCRIPTION AND EXAMPLES
INFECTIOUS WASTE	
Infectious waste	Waste suspected of containing pathogens e.g., laboratory cultures; waste from isolation wards; tissues (swabs), materials, or equipment that have been in contact with infected patients or animals; excreta
Anatomical/Pathological waste	Human or animal tissues or fluids e.g., body parts; blood and other body fluids; fetuses (including waste from mortuary and autopsy centres)
Sharps	Sharp waste e.g., needles; infusion sets; scalpels; knives; blades; broken glass
SPECIAL WASTE	
Pharmaceutical waste	Waste containing pharmaceuticals e.g., pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)
Genotoxic waste ⁶	Waste containing substances with genotoxic properties e.g., waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals
Chemical waste	Waste containing chemical substances e.g., laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances e.g., unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources

Non-Clinical Waste at Spanish Town Hospital

Information from internal stakeholder consultations is that non-clinical waste, to include food waste, is stored in a 30-foot compactor and disposed of once weekly. Tree cuttings are stored in an open-top

⁶ Genotoxic waste includes cytotoxic drugs used in cancer treatment and their metabolites and outdated materials, vomitus, faeces or urine from patients treated with cytotoxic drugs or chemicals, and materials such as syringes and vials contaminated from the preparation and administration of such drugs; they are highly hazardous, mutagenic, teratogenic or carcinogenic.

skip which is emptied as needed. Contracts are in place with an authorized waste collection company to collect and dispose of non-clinical waste.

Within the Spanish Town Hospital compound, a total of 19 storage points were observed for general/non-clinical waste and three areas were observed holding medical waste on September 18, 2021. Five (5) of the storage points were considered inadequate as either they were overflowing with garbage, or the bins were turned over. All 3 medical waste storage areas were considered inadequate as other waste were being stored with the medical waste or the area was full, and the waste was not being adequately stored Plate 4-19 to Plate 4-22.

Generally, most of the storage points, or the areas were not adequately setup as the solid waste were not stored in vermin proof storage.



Plate 4-19 Solid waste littered around resident buildings



Plate 4-20 Solid waste littering a green space within the hospital



Plate 4-21 Solid waste improperly stored outside a building



Plate 4-22 Solid waste improperly/insufficiently stored along a hospital walkway

Medical Waste at Spanish Town Hospital

Medical Waste is disposed of through the Waste Management Unit of the MOHW. At present the hospital's waste generation far exceeds the scheduled pick-up (collection). In addition to medical waste generated on-property during the regular operations of the hospital, waste from the other health facilities in St. Catherine (Linstead Hospital, parish health centres) is stored at the hospital for collection by the Waste Management Unit as the hospital serves as the central collection point for the parish. Currently, collections are scheduled for Mondays, Wednesdays and Fridays, however this schedule is inadequate.

Medical waste handling, storage and disposal was insufficient. While it was indicated that medical waste is stored in a room at the morgue and also in 40-foot storage containers provided by the Ministry of Health and Wellness, large stockpiles of medical waste were seen in and around an unused building by the parking lots. Blood vials used gauze and other materials were littered around the building, bags torn and bins overflowing. Medical waste was also seen being transported with solidate and discarded in bins with solid waste around the hospital grounds. Medical waste bags were seen on the ground outside the childcare clinic and other areas.

The Spanish Town Hospital does not have an incinerator on site.

Plate 4-23- Plate 4-28 show examples of improper medical waste handling and storage observed on hospital grounds.



Plate 4-23 Medical and solid waste being transported to a temporary storage area



Plate 4-24 Medical and solid waste in bins on the hospital grounds



Plate 4-25 Medical and solid waste bags outside the infant ward, improperly stored



Plate 4-26 Medical waste, blood vials littering the storage area, outside the building



Plate 4-27 Medical waste overflowing from window of storage building



Plate 4-28 Medical and storage waste improperly stored



Plate 4-29 Medical and solid waste near parking lot of the maternity ward



Figure 4-4 Solid waste storage observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)

Medical waste generated is calculated by the estimated rates given in Table 4-2.

Table 4-2 Estimated Medical Waste Generation rates pre Category of Facility

Jamaica and United States Estimated Waste Generation Rates		
Generator Class	Jamaican Rate	US Rate (Federal Registry)
Hospital	1.0 kg/bed/day	2.6kg/bed/day
Clinic/Health Centre	10.0 kg/day	14.5 kg/day
Doctor's Office	10.0 kg/day	14.5 kg/day
Dentist Office	2.7 kg/week	3.6 kg/week
Veterinarians	negligible	7.2 kg/week
Medical Laboratories	54.5 kg/week	113.6 kg/week

Source: GOJ Comprehensive Solid Waste Management Study, Norconsult, October 1996

The Spanish Town Hospital has a total bed capacity of 430, plus 40 as part of the field hospital, for a grand total of 470 beds. The average occupancy rate is 85% - 105%, both presently and prior to the Covid-19 pandemic (Jacqueline Ellis, *pers.comm.*).

- The estimated medical waste generation STH = 365.5 kg/day- 451.5 kg/day (≈11 - 13.6 tonnes/month)
- The addition of the 40 bed STH field hospital = 34 kg/day- 42 kg/day (≈1 - 1.26 tonnes/month)

Clinic days at the hospital are Monday, Tuesday and Friday, with a total number of 400-500 persons on each of these days (Jacqueline Ellis, *pers.comm.*).

- The estimated medical waste generation on clinic days = 10.0 kg/day (≈0.3 tonnes/month)

These estimates do not include the medical waste generated at the surrounding health facilities, which is stored at the STH.

Sewage and Wastewater

Spanish Town Hospital currently operates an oxidation ditch wastewater treatment plant (WWTP) that discharges into the Rio Cobre River that collects its influent from the hospital, as well as the St. Jago Park Health Centre and surrounding administrative and operational buildings (Plate 4-30).

The existing wastewater treatment plant operates as an extended aeration system. The plant has 5 main sections of treatment: a lift station, secondary clarifier, disinfection tank, oxidation ditch and drying beds. The influent dry well pumps convey wastewater from the lift station into the grit channel, where it undergoes preliminary treatment via two (2) manual screens. The screen is cleaned at least once a day and it is recommended that a drying area be built for the drying of the trash removed from the trash basket.

HISTORICAL EFFLUENT DATA

Effluent monitoring report data for the period December 2020 to September 2021 from the Environment Health Laboratory of the MOHW are displayed in Table 4-3. The results in Table 4-3 show that faecal coliform and total nitrogen concentrations for all sampling events were non-compliant with the MOHW reference standards shown. However, faecal coliform results attained on December 17th and June 16th would have been compliant with the standard for NRCA Sewage Effluent for Existing Plants of 1000 MPN/100ml. The majority of TSS and COD concentrations were compliant with the respective MOHW reference standard and NRCA standard. Total Nitrogen concentrations were non-compliant with MOHW standards for all sampling events, but when compared to NRCA standards, only the December 17th sampling event would have been non-compliant. Phosphate concentrations were compliant with both sets of standards on all sampling days. If a new sewage treatment plant is to be constructed, then the plant must meet the NRCA Sewage Effluent Standard for New Plants, as outlined in Section 2.2.2.2, Table 2-5.



Plate 4-30 Wastewater Treatment Plant

Table 4-3 Summary of wastewater treatment plant effluent monitoring report for Spanish Town Hospital

Sampling Date	Faecal Coliform (MPN/100ml)	BOD (mg/l)	TSS (mg/l)	COD (mg/l)	Tot. Nitrogen (mg/l)	Phosphates (mg/l)	Residual Chlorine (mg/l)	pH
Dec. 17, 2020	540	34.1	92	88	32.4	2.51	-	-
May 5, 2021	1600	13	18	26	-	3.26	-	-
May 31, 2021	1600	22.2	10	50	-	2.25	0.2	8
June 16, 2021	920	18.23	12	70	14	2.84	-	-
July 22, 2021	1600	38.55	10	112	19.6	2.09	<0.01	8.5
September 8, 2021	-	55.35	6	96	22.6	2.05	-	-

Sampling Date	Faecal Coliform (MPN/100ml)	BOD (mg/l)	TSS (mg/l)	COD (mg/l)	Tot. Nitrogen (mg/l)	Phosphates (mg/l)	Residual Chlorine (mg/l)	pH
MOH Reference Standard	200	20	20	100	10	4	0.5 - 1.5	6.0 - 9.0
NRCA Sewage Effluent Standard for Existing Plants	1000	20	30	100	30	10	1.5	6.0-9.0

Values in red are non-compliant with both MOHW and NRCA standards

COMMISSIONED NOVEMBER 2022 SEWERAGE STUDY

CEAC Solutions Co. Ltd. was commissioned to carry out a condition assessment and rehabilitative designs for the WWTP to facilitate the proposed 99 more inpatient beds expansion of the hospital. It was concluded that the Spanish Town Hospital's wastewater treatment plant is able to accommodate the additional sewage flow from both the existing buildings and the new hospital and health centre building and meet the NRCA discharge effluent standards. To carry out the rehabilitation activities, the plant will have to be taken offline with the pumps off and sewage removed from the lift station through a cesspool truck. The state of the current treatment components is poor and the cost of upgrading all aspects stands at an estimated JMD \$90,620,899.91.

4.1.1.7 Employment

The total number of staff at the hospital is 1,200. This consists of 230 doctors, 400 nurses and the remainder are other hospital staff (Jacqueline Ellis, *pers.comm.*).

4.1.1.8 Patient Load

The patient load for 2019 and 2020, before the Covid-19 pandemic are given in Table 4-4 and Table 4-5.

Table 4-4 Spanish Town Hospital Total Patient Load Statistics for the Year 2019

Month	Year 2019
January	11500
February	9700
March	9500
April	8800
May	10200
June	10100
July	10710
August	10500
September	11519
October	12600
November	11965
December	10000
Total	127094

Table 4-5 Spanish Town Hospital Total Patient Load Statistics for the Year 2020

Month	Year 2020
January	10810
February	12000
March	9120
April	5953
May	6797
June	8983
July	10172
August	9794
September	8217
October	8938
November	9131
December	8700
Total	108615

4.1.1.9 Bed Capacity

The Spanish Town Hospital has a total bed capacity of 430, plus 40 as part of the COVID field hospital, for a grand total of 470 beds. The average occupancy rate is 85% - 105%, both presently and prior to the Covid-19 pandemic (Jacqueline Ellis, *pers.comm.*).

Clinic days at the hospital are Monday, Tuesday and Friday, with a total number of 400-500 persons on each of these days (Jacqueline Ellis, *pers.comm.*).

4.1.1.10 General Observations

Disabled Access and Amenities

No special areas, amenities or other conveniences were seen for individuals with special needs such as the visually impaired, hearing impaired or those with mobility issues.

Wheelchair access points were in poor condition, areas were broken or damaged. Areas such as tented sections had no access points. Access points were partially blocked by garbage bins and other obstacles. The wheelchair access point at the Accident and Emergency department has a drainage channel, littered with solid waste. This area is locked and controlled by security guards, which results in wheelchair patients having to waiting along the side of the road and in the sun. A patient was also seen holding on to the grill to prevent his chair from rolling backwards while he waited to gain access. Plate 4-31 and Plate 4-32 show areas with inadequate wheelchair access.



Plate 4-31 Patient awaiting access to Accident and Emergency. The area is uncovered with a steep slope and bordered by a drainage channel.



Plate 4-32 Wheelchair of a patient unable to easily access a tented waiting area

Walkways and Corridors

There were several issues with the condition of walkways, corridors, and wheelchair access points. These included damaged and broken sections of walkways and/or corridors. These areas are hazardous to the public and staff, in particular to the elderly, visually impaired, and those with mobility issues. A visually impaired patient was seen having difficulty navigating a broken walkway by Accident and Emergency Department.

Other hazards include elevated walkways with no handrails. Users may easily slip, trip, or fall off these areas. Unpaved and dusty pathways were seen all around the hospital grounds. These areas also have ponding issues during rain events.



Plate 4-33 Elevated walkway at Spanish Town hospital

Leaks and other structural damage

Leaks were seen in some buildings such as the maternity ward (first floor). Other damage seen around the hospital included faulty doors and locks and non-functional elevators.

Tented Areas

Tented areas have been established for overflow at the several departments around the hospital and pharmacy. Covid-19 testing, and treatment tented areas were separated. These areas typically occur in green spaces, on dusty and uneven ground with no wheelchair access (Figure 4-5). There are 7 tented areas on the Spanish Town Hospital property, 4 overflow waiting area, 1 Covid-19 testing area and one for a food truck (Figure 4-5).



Figure 4-5 Tented areas observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)

Asset Storage

For the purpose of this report assets are considered to be all MOHW property both specialized and unspecialized which are stored on site. Asset storage was seen throughout the property and in all cases poorly stored. Assets were seen littering sections of green spaces along with solid waste on the main hospital grounds. Most of the asset storage occurred in abandoned buildings on the residential block. Assets filled these buildings and littered the areas around the building, mixed in with solid waste and overgrown by vegetation. There were 5 main areas observed for asset storage (Figure 4-6). Plate 4-34 - Plate 4-39 are examples of poor asset storage.



Plate 4-34 Damaged assets scattered around a green space with the main hospital grounds



Plate 4-35 Abandoned building used as asset storage area



Plate 4-36 A large collection of assets overgrown with shrubbery



Plate 4-37 Abandoned building used for asset storage



Plate 4-38 Assets overflowing and littering sections of the property



Plate 4-39 Assets overflowing and littering sections of the property



Figure 4-6 Asset storage areas observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)

Green Spaces

Several green spaces in sections of the hospital, residences and pharmacy were seen. Some spaces are well maintained while others were overgrown. Some green spaces had seating. Plate 4-40 - Plate 4-46 are some green spaces around the hospital and its facilities.



Plate 4-40 Main entrance green space



Plate 4-41 Green space with seating



Plate 4-42 Green space within the hospital



Plate 4-43 Green space and seating



Plate 4-44 Green space



Plate 4-45 Green space littered with assets and solid waste



Plate 4-46 Seating within the hospital



Plate 4-47 Green space poorly maintained, surrounding the hospital residences

Signage – Emergency Exit points and Assembly Areas

There were no signs indicating the location of emergency assembly point and signs at the assembly points were, in some instances, damaged/blocked or obscured (Plate 4-48). No emergency exit signs

were seen on the exterior of buildings. Gates located at the emergency assembly points were padlocked shut.

Figure 4-7 indicates the locations of emergency assembly point observed at the Spanish Town hospital.



Plate 4-48 Damaged assembly point sign within the hospital



Figure 4-7 Emergency assembly points observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)

Fire Hydrants

Fire hydrants are located around the hospital, in varying conditions. Some appeared damaged or poorly maintained (Plate 4-49).

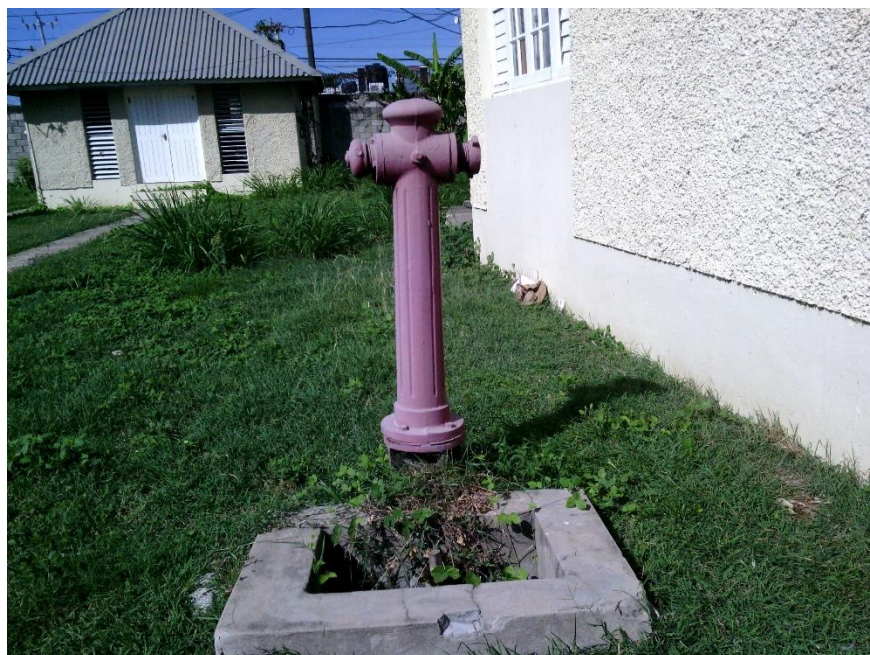


Plate 4-49 Fire hydrant on the hospital grounds

Restrooms

Restrooms were generally in fair to poor condition, with no special needs or disabled stalls or access areas in any of the public and patient areas (Table 4-6).

Table 4-6 Restrooms at Spanish Town Hospital

SPANISH TOWN HOSPITAL					
Maternity Building					
Waiting Area and Administration	Public/patient	2	unisex	poor-fair	
	staff	2	urinal	out of service	fair-poor
		2	unisex	1 out of service	
Ground Floor					
	Staff area	1+shower	male	good	
		1+shower	female	good	
	ward area staff	2 + shower	female	1 out of service	shower out of service
		2	male	fair	
Second Floor					

As outlined in the (UNOPS, 2018) report not all bathrooms met the international standards for health facilities. Details from this report include the identification and assessment of some restroom facilities on the hospital grounds. Janitorial services are improvised inside the patient's bathrooms in some cases. Patients' bathrooms (mainly in wards) do comply with universal accessibility standards: dimensions of boxes, width and accessories of doors, type of sanitary artefacts, height of accessories, and lack of handles. In the shower boxes, baseboards block a proper entrance to the shower.

- Accident and Emergency had a few bathrooms
- Bathrooms in wards - Because of the improvised additional beds, the number of bathrooms are not enough for the number of patients, on average there are two toilets and 2 showers per ward, usually in the corners of each ward, which makes access for weak or disabled patients difficult.

Vectors

Some vector control methods such as rat bait traps were seen all around the hospital grounds, however several potential breeding areas were seen. These include areas with overgrown vegetation, stagnant water, water collection in asset storage areas, improperly stored waste (medical, non-medical and solid waste), abandoned or poorly maintained buildings and fences around the hospital. The main vectors are as follows;

- Mosquitos
- Rats
- Pigeons
- Stray animals

Health Facilities in Proximity to the Spanish Town Hospital

The health facilities within 500m of the Spanish Town Hospital were mapped. There were 9 health facilities within the 500m, of which 6 were medical complexes (Figure 4-8). There were another 6 facilities within another 300m of the of the first set of which 3 were medical facilities and the others doctors' offices (one of which is a Paediatric and Adolescence Cardiologist).

The 9 facilities within the 500m are:

1. Burke Road Medical and Dentist Ltd – Biomedical
2. Premier Medical Centre
3. Good Shepherd Medical Complex
4. St. Jago Ultrasound, Xray, Dental and Optical
5. Barrett Street Medical
6. Sun Health Care
7. Greendale Medical
8. Microcheck Laboratory; and
9. A Doctors' Office



Figure 4-8 Health facilities in proximity to the Spanish Town Hospital and St Jago Park Health Centre

4.1.2 Physical Environment

4.1.2.1 Climatology and Meteorology

Weather data was requested from the Meteorological Service Jamaica for the nearest weather station to the Spanish Town hospital located in St. Catherine. The Meteorological Service provided 3 years of hourly data for Twickenham Park weather station located approximately 1.9 km to the northeast of the hospital for the years 2018-2020.

Temperature

Average temperatures between 2018 – 2020 ranged from 24.3 °C to 28.7 °C. The lowest average temperature occurred in January 2019 whilst the highest average temperature occurred in July 2020. Maximum temperature over the time period was 36.8 °C which occurred on August 13, 2020, at 2pm and a minimum temperature of 16.6 °C which occurred on June 23, 2020, at 7am. The data indicated that in generally the warmest times of the year occurred between May to September, with July being typically the hottest month.

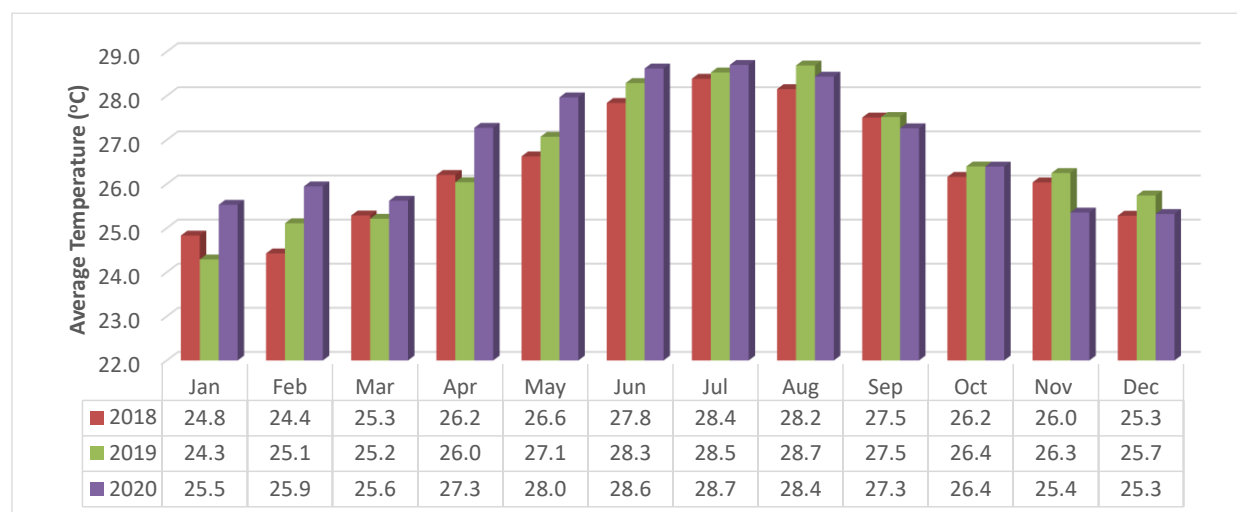


Figure 4-9 Average temperatures (°C) for the Twickenham Park weather station (2018 – 2020)

Relative Humidity

Average relative humidity over the three years (2018 – 2020) was 79.6% with a maximum of 98% occurring on November 9, 2020, at 7am and a minimum of 39% occurring on February 22, 2019, at 12pm. Generally, the highest relative humidity occurred between the hours of 4am – 7am and the lowest between 12 pm – 2pm.

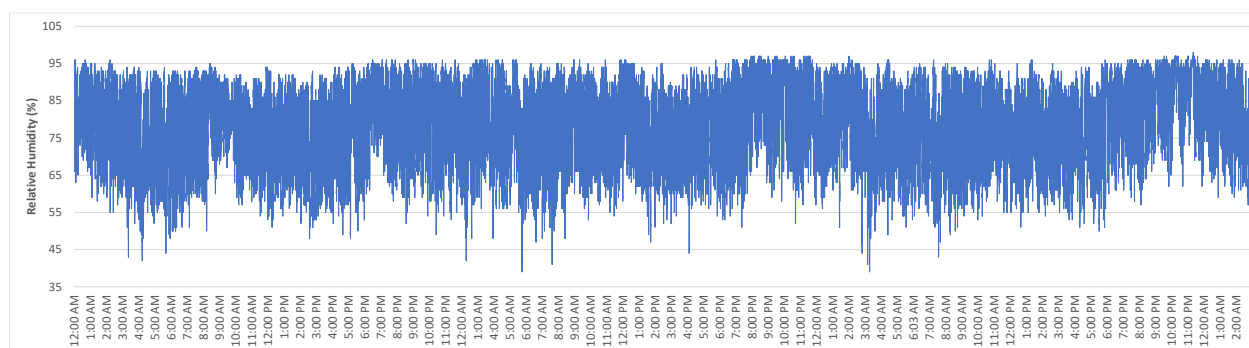


Figure 4-10 Relative humidity (5) for the Twickenham Park weather station (2018 – 2020)

Rainfall

Rainfall data (2018 – 2020) supplied by Meteorological Service Division for the Twickenham Park weather station in St. Catherine are depicted in Figure 4-11. This weather station is approximately 1.9 km to the northeast of the Spanish Town Hospital. The data indicates the rainiest periods tended to be in the month of May and between the months of September to November.

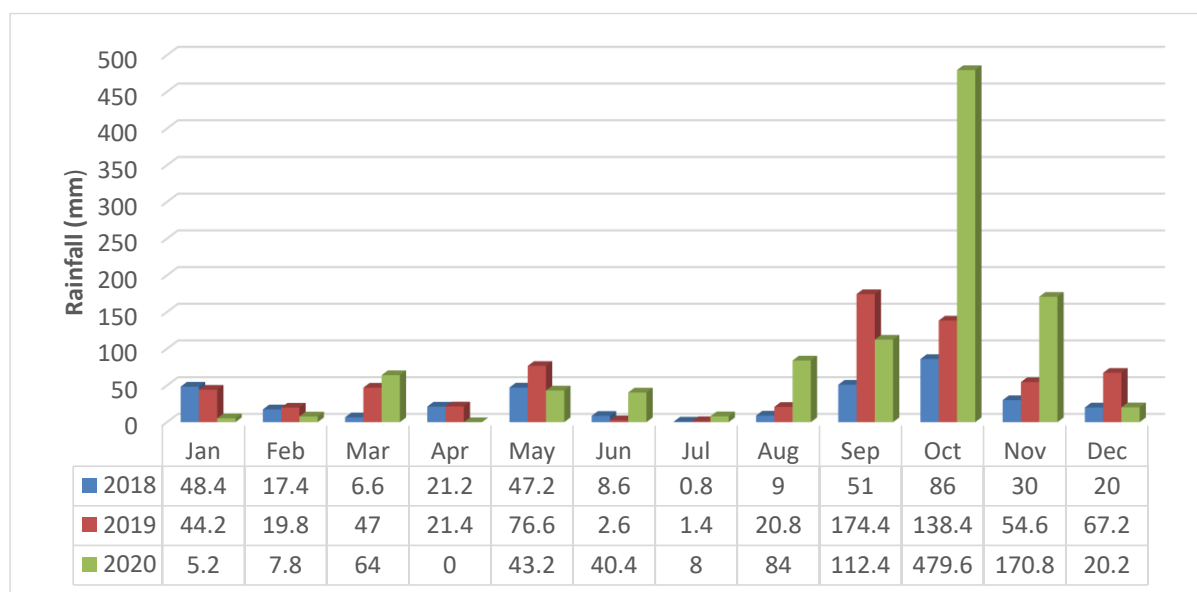


Figure 4-11 Rainfall data for the Twickenham Park weather station (2018 – 2020)

Wind Speed and Wind Direction

Average wind direction over the time period was from the northeast direction with an average wind speed of 1.88 ms^{-1} (3.65 knots). Calm winds occurred 5.54% of the time. Winds from the southeast were the most frequent, occurring 26% of the time. The next two frequently occurring wind directions are from the north northwest (20.2 %) and the northwest (10.3 %). The most frequent wind class category was the $0.5 - 2.10 \text{ ms}^{-1}$ (0.97 – 4.08 knots) which occurred 62.2% of the time.

4.1.2.2 Topography

Elevation of the property ranged from 15.3 m – 29.0 m above mean sea level (amsl). It is characterised by relatively flat to gentle sloping land, with the majority of slopes less than 5 percent (Figure 4-13). The land generally slopes towards the south southwest (Figure 4-14).

4.1.2.3 Geology and Soils

Geology

The study area is located along the north-central section of the St Jago Plain in St Catherine. A review of the 1:50,000 Geological Sheet 17 indicates that the site is underlain by Quaternary Alluvium (Qa) deposited by the Rio Cobre and other paleo drainage systems which drained the highlands in the north (Figure 4-12). The Alluvium deposit consists of varying proportions of clay, silt, sand, and coarse gravel. Lithologically, these sediments reflect the source areas to the north which are dominated by volcanics, clastic sedimentary rocks, and limestones. A review of the 1:50,000 Metric Geology Sheet 17 indicates that there are no faults within the immediate vicinity of the proposed site. The limestone outcrops further to the north and south of the site are however faulted (Geo Technics Limited, 2020).

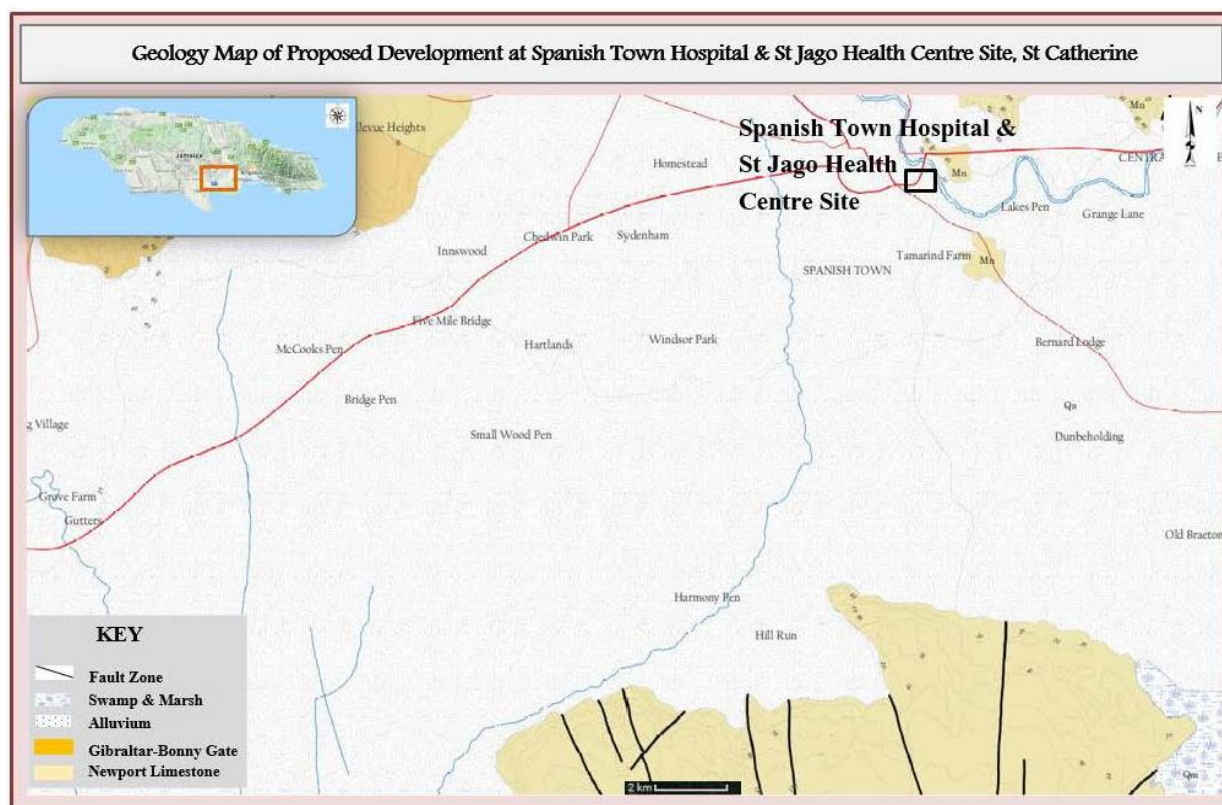


Figure 4-12 Geology of the Spanish Town Hospital Site in Spanish Town, St Catherine



Figure 4-13 Percentage slope at the Spanish Town Hospital and St. Jago Park Health Centre

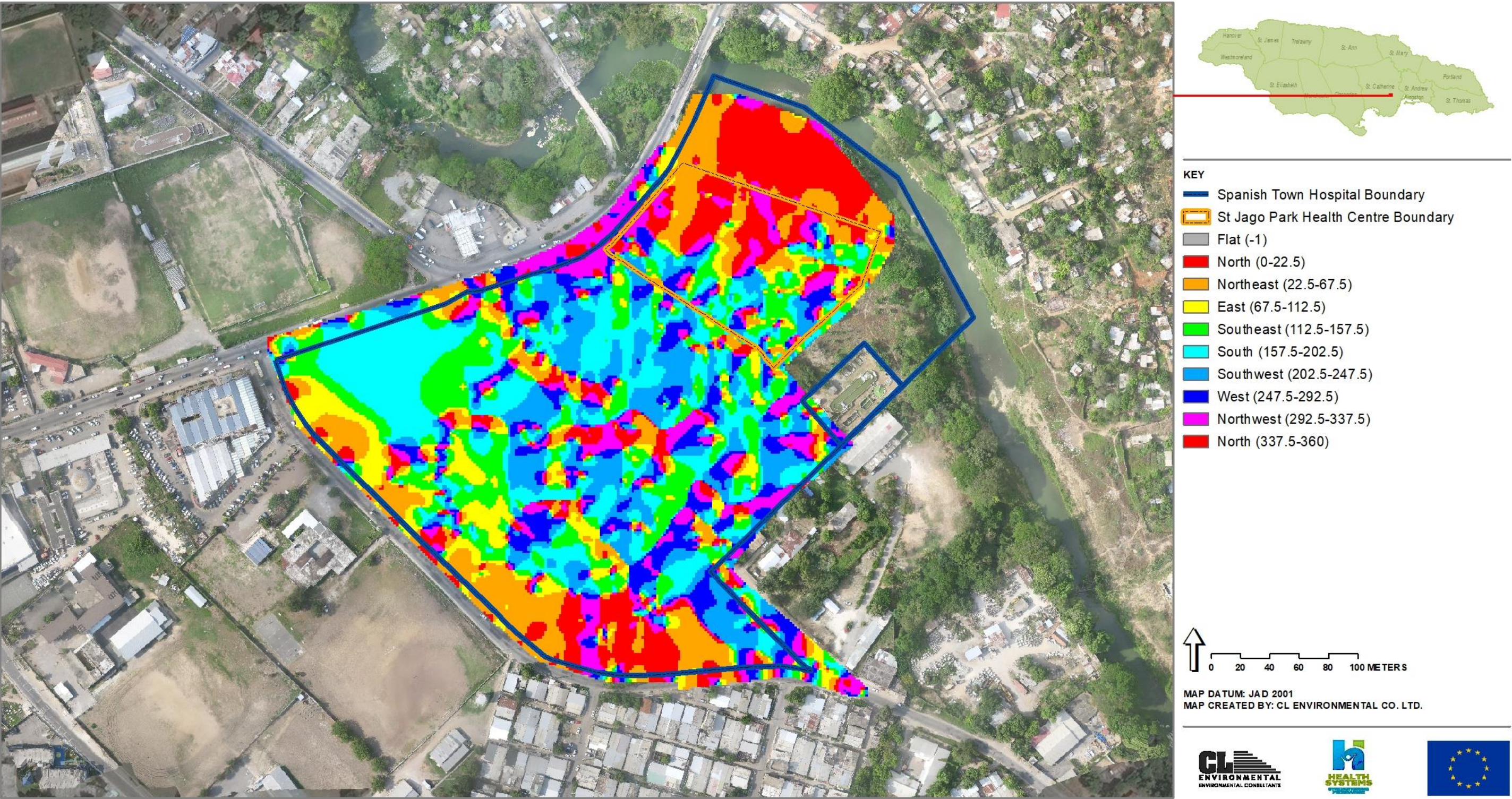


Figure 4-14 Aspect at the Spanish Town Hospital and St. Jago Park Health Centre

Soils

The soils at the site taken from seven (7) boreholes conducted (Geo Technics Limited, 2020), generally consists of alternating layers of stiff to hard silt and clay (cohesive soil) and loose to dense sand and gravel (coarse grain soil) across the site. The coarse grain soil is well graded and is therefore good soil for engineering purposes. The clay soil was mainly encountered at greater depths in all the boreholes below 6m (20ft). There is a general trend in an increase in coarse grain soil on the north and north-eastern section of the site when compared to the southern section.

4.1.2.4 Air Quality

PM10

The results of the PM10 sampling run are shown in Table 4-7. All locations had particulate PM10 values compliant with the 24-hour NRCA standard of 150 $\mu\text{g}/\text{m}^3$. Station 1, located off-site at the Social Development Commission (SDC) building, had the highest PM10 value (50.28 $\mu\text{g}/\text{m}^3$).

Table 4-7 Summarized PM 10 Results

STATION	PM10 RESULT ($\mu\text{g}/\text{m}^3$)	NRCA STD. ($\mu\text{g}/\text{m}^3$)
P1	50.28	150
P2	45.14	150
P3	23.89	150
P4	42.64	150

Values in red are non-compliant with NRCA standards

PM2.5

The results of the PM2.5 sampling run are shown in Table 4-8. All locations had particulate PM2.5 values compliant with the 24-hour USEPA PM2.5 standard of 35 $\mu\text{g}/\text{m}^3$. Station 1, located off-site at the Social Development Commission (SDC) building, had the highest PM2.5 value (30.97 $\mu\text{g}/\text{m}^3$).

Table 4-8 Summarized PM 2.5 Results

STATION	PM2.5 RESULT ($\mu\text{g}/\text{m}^3$)	USEPA STD. ($\mu\text{g}/\text{m}^3$)
P1	30.97	35
P2	26.81	35
P3	19.44	35
P4	25.69	35

Values in red are non-compliant with USEPA standards

4.1.2.5 Noise

Methodology

Noise level readings were taken from 12:00am Friday September 3rd, 2021, to 12:00am Saturday September 4th, 2021, by using Brüel & Kjaer noise analysers setup in outdoor monitoring kits. Figure 4-15 and shows the locations of the noise monitoring stations.

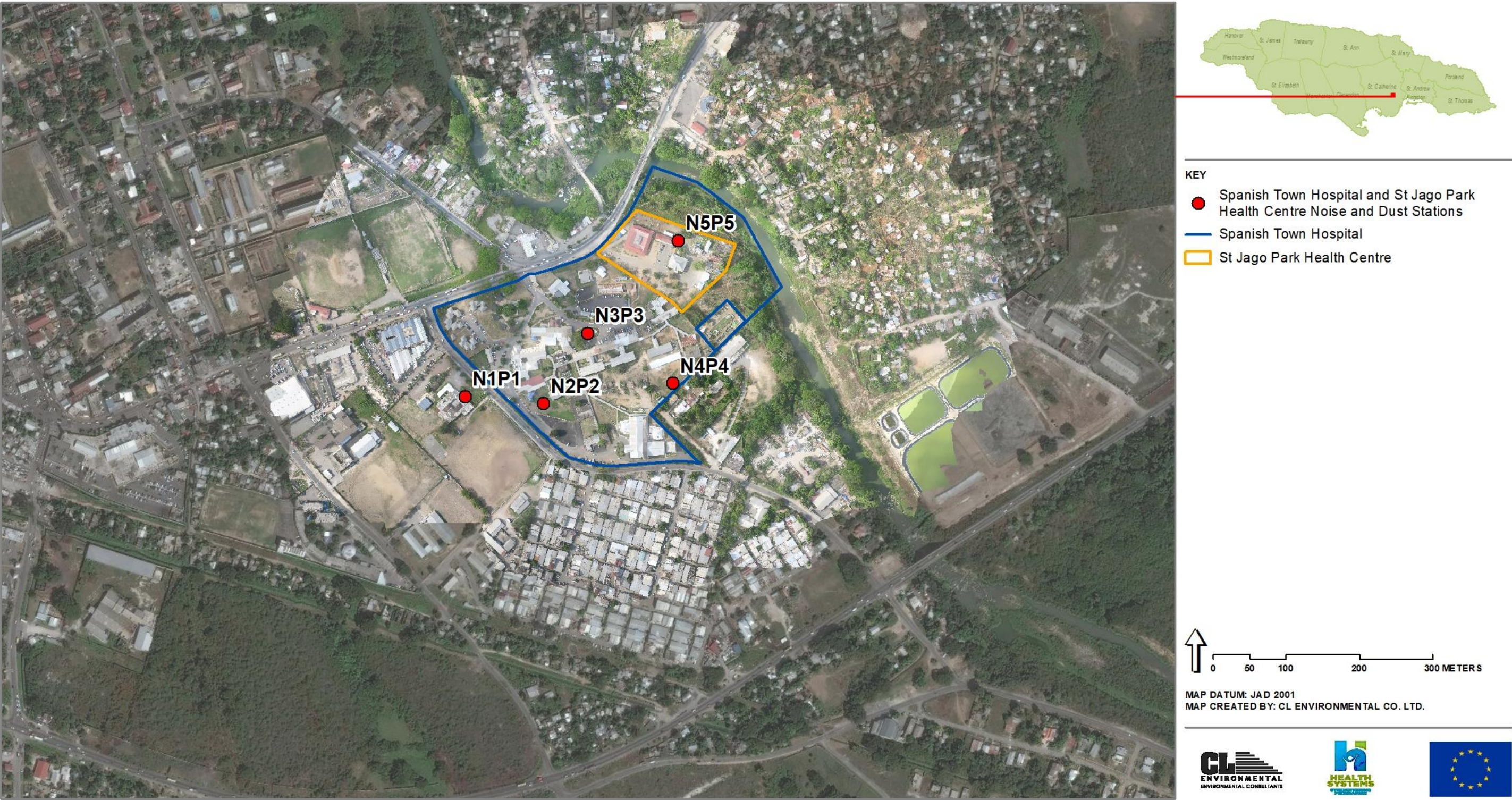


Figure 4-15 Noise and Particulate monitoring locations (Station N2P2, N3P3 and N4P4 conducted at Spanish Town Hospital)

Results

Table 4-9 shows the minimum, maximum and average noise levels over the 24-hour assessment period, as well as the geometric mean centre frequencies obtained at each station. The noise meters at Stations N2 and N4 only ran from 12:00pm to 12:00am, for a total of 12 hours.

Table 4-9 Ambient Noise data at all stations

Stn.#	Average Leq (24 hr)	Min (dBA)	Max (dBA)	Geometric Centre Frequency (Hz)	Octave Band Range (Hz)
N1	58.6	44.6	94.7	50	45-56
N2	51.7	41.8	90.4	50	45-56
N3	53.4	43.5	88.8	63	56-71
N4	50.1	41.0	77.3	63	56-71

COMPARISONS OF AMBIENT NOISE LEVELS WITH NRCA DAYTIME AND NIGHT-TIME GUIDELINES

Comparison of the ambient noise levels in the study area with the Natural Resources and Conservation Agency (NRCA) Standards are shown in Table 4-10. During the daytime, noise levels at Station N3 (54.5 dBA) were non-compliant with respective NRCA daytime standards. During the night-time, noise levels at Station N3 (48.9 dBA) were non-compliant with respective NRCA night-time standards.

Daytime noise sources detected which were above NRCA daytime guideline values, included: motor vehicle traffic noise, horns honking, people talking, emergency vehicles sirens and bird calls. Night-time noise sources detected which were above NRCA night-time guideline values, included: motor vehicle traffic noises and frog calls.

The overall noise climate for the area is likely reduced as a result of the restrictions and regulations of the Disaster Risk Management Act (DRMA) e.g., limited gatherings, stay-at-home orders and restrictions of parties and other social events. The noise meters at Stations N2 and N4 only ran from 12:00pm to 12:00am, for a total of 12 hours.

Table 4-10 Comparison of daytime and night-time noise levels at the stations with the NRCA guidelines

Stn.#	Zone	7 am. - 10 pm (dBA)	NRCA Daytime Guideline (dBA)	10 pm. - 7 am (dBA)	NRCA Night Time Guideline (dBA)
N1	Commercial	59.5	65	53.9	60
N2	Silence	N/A	45	N/A	40
N3	Silence	54.5	45	48.9	40
N4	Silence	N/A	45	N/A	40

NB. Numbers in red are non-compliant with the standard/guideline

COMPARISONS OF NOISE LEVELS DURING WORK HOURS WITH POTENTIAL CONSTRUCTION PERMIT GUIDELINES (70 DBA)

Table 4-11 shows the comparison of the ambient noise levels during permitted work hours (7:30am – 5pm on weekdays) with the potential NRCA permit guidelines at each station. Noise levels during work hours were compliant with the noise guidelines at Stations N1 and N3. The noise meters at Stations N2 and N4 only ran from 12:00pm to 12:00am, for a total of 12 hours.

Table 4-11 Noise level during work hours (7:30am – 5:00pm)

STATION	7:30 AM – 5:00 PM (dBA)	Potential construction permit guideline
N1	60.0	70
N2	N/A	70
N3	54.6	70
N4	N/A	70

4.1.2.6 Vibration

Effects of Vibration and Modelling

Various governmental agencies have criteria regarding architectural and structural damage, as well as annoyance and acceptability of vibration. In general, most of the criteria specify that for a Peak Particle Velocity (PPV) less than approximately 3.048 mms⁻¹ (0.12 inches per second), the potential for architectural damage due to vibration is unlikely. A PPV of approximately 3.048 mms⁻¹ (0.12 inches per second) to 12.7 mms⁻¹ (0.50 inches per second) there is potential for architectural damage due to vibration, and for a PPV greater than approximately 12.7 mms⁻¹ (0.50 inches per second) the potential for architectural damage due to vibration is very likely.

Human beings are known to be very sensitive to vibration, the threshold of perception being typically in the PPV range of 0.14 mms⁻¹ to 0.3 mms⁻¹ (British Standard BS 5228-2:2009). An indication of the effects of ground vibration on humans is detailed by the standard and outlined in Table 4-12.

Table 4-12 Guidance on the effects of vibration

VIBRATION LEVEL	EFFECT
0.14 mms ⁻¹	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mms ⁻¹	Vibration might be just perceptible in residential environments.
1.0 mms ⁻¹	It is likely that vibration of this level in residential environments will cause complaints but can be tolerated if prior warning and explanation has been given to residents.
10 mms ⁻¹	Vibration is likely to be intolerable for any more than a brief exposure to this level.

British Standard BS 5228-2:2009

Vibrations from various types of equipment have been measured by the Federal Transit Administration (FTA) in the United States. To predict the vibration at a receptor from the operation of equipment, the following equation is used:

$$PPV_{\text{equipment}} = PPV_{\text{ref}} (100/D_{\text{rec}})^n$$

Where:

PPV_{ref} = reference PPV at 100 ft.

D_{rec} = distance from equipment to the receiver in ft.

$n = 1.1$ (the value related to the attenuation rate through ground)

Baseline Vibration Calculations

Using the above prediction calculations, vibration levels were predicted at a distance of 30 metres from the centreline of Burke Road to the Customer Service, Accounts and Human Resources Building using a “3-tonne truck travelling at 35 mph” as the operating equipment/vehicle. Results showed that the PPV vibration value was **0.005 mm/sec**, which indicates that vibration levels are imperceptible by humans and have no effect on building structures.

4.1.2.7 Drainage/Flooding Assessment

Several areas around the hospital and its facilities are known to have issues with flooding during moderate to heavy rain events. Sections of the Accident and Emergency Department are permanently lined with sandbags to prevent the waiting and service areas from flood waters. Several green spaces which have been converted to extended waiting areas, including tented areas also have flooding and ponding issues.

4.1.2.8 Climate Resilience

Health care facilities are generally vulnerable to climate change and other environmental stresses. Climate-resilient and environmentally sustainable health care facilities contribute to a high quality of care and accessibility of services, and by helping reduce facility costs, also contribute to better affordability. As the climate continues to change, risks to health systems and facilities, including hospitals and clinics, are increasing. This potentially reduces the ability of health professionals to protect and care for the general public effectively and efficiently. Building resilience against future air temperatures, hurricane winds, drought conditions and storm surge will certainly enhance the capacity of health care facilities in protecting and improving the health of their target communities in an unstable and changing climate.

The projected increase of maximum annual air temperature is expected to increase by 2.1°C to 3.8°C or 7% to 11.2% by mid-century (2041-2070). The greatest increase is expected toward the south-central section of the island, with the greatest increase expected in the Southern tip of Clarendon, while the increase is projected to be less extreme in sections of St. Ann and St. Mary.

The projected future wind speeds show increases of 20.7% for the 100yr wind speeds to 25.7% for 10yr wind speeds, by the year 2050. This means that in some instances, wind speeds are likely to increase by up to 17.5m/s more than the present climate. The results depicted that the northern and western sections of Jamaica experience large fields of high winds during extreme weather events. In comparison, the North-Eastern and southwest regions of the islands experienced lower wind speeds.

Future projections for percent change in mean annual water discharge can be used as an indicator for drought conditions. Under the future climate (2041-2070), water discharge is expected to decrease by -5.5% up to -24.4% island wide. The lowest projected percentage decrease is projected for the Western sections of Hanover and Westmoreland while the greatest decrease is expected in the Southern sections of St. Catherine and Clarendon. Overall, the Central Parishes of the island, particularly St. Ann, South St. Catherine, Clarendon and Eastern and Southern Manchester are expected to see the greatest decrease in water discharge.

The storm surge elevations, along the south coast of the island, during the 50-yr RP and 100-yr RP hurricanes were estimated to range up to 3.7m and 3.9m respectively. Rocky Point, Clarendon and

Black River, St. Elizabeth are two of the more severely affected locations, seeing surges up to 2.15m and 2.36m respectively for the 50-yr RP and 2.26m and 2.48m respectively for the 100-yr RP.

It is recommended that further detailed analysis be conducted to ascertain the resilience of the proposed facility developments against the aforementioned climate indicators. Furthermore, this will facilitate mitigation measures to be implemented where required. This will increase sustainability of the facility in providing reliable healthcare in the future.

4.1.2.9 Existing Sources of Pollution

On-site pollution sources include the insufficient processing and storage of medical waste, solid waste, and other hazardous materials. This results in littering around the hospital grounds, issues with rats and other vermin as well as possible contamination of runoff to the Rio Cobre. Evidence of fuel oil/ lubricant spills or leaks were seen around boiler room and maintenance areas. Asset storage is also inadequate, these include equipment with hazardous materials such as freon and lubricants.

Poor drainage, damaged and or blocked drains causes flooding and ponding all around the hospital. The runoff carries solid waste and possibly other contaminants. Ponding, the collection of water and poorly maintained green spaces may act as mosquito breeding sites.

Burning of solid waste and cuttings from neighbouring properties may impact the air quality all around the hospital. Heavy traffic along the main road may also impact the air quality around the hospital. Poor waste management in the surrounding communities as well as illegal dumping was seen along the main road and in particular at the Spanish bridge into the Rio Cobre.

The noise climate at the hospital is also impacted by the heavy vehicular traffic as well as noise from the surrounding communities.

Plate 4-50 - Plate 4-53 show examples of existing sources of pollution in and around the hospital.



Plate 4-50 **Fuel oil/ Lubricant leak at boiler room**



Plate 4-51 Evidence of burning at the hospital residences



Plate 4-52 Large dumping area along the main road in the market



Plate 4-53 Illegal dumping along the banks of the river, near the hospital



Plate 4-54 Wastewater treatment facility

4.1.3 Natural Hazards

4.1.3.1 Building Specifications with respect to Natural Hazards

This section 4.1.3.1 relates to all four (4) proposed facilities (STH, SJHC, OHHC and GPHC).

The following design details and design codes will be applied to all facilities regarding potential risk from the various natural hazards details in the sections below.

Hurricane, Seismic and Geotechnical

DESIGN CODES AND STANDARDS

The design codes will be supplemented by these Standards where required:

- A. Dead Loads – ASCE 7-22
- B. Live Loads – ASCE 7-22
- C. Wind Loads – ASCE 7-22
- D. Seismic Loads – ASCE 7-22 & 2018 IBC SEAOC Structural/Seismic Design Manual
- E. Reinforced Concrete – ASCE 7-22
- F. Masonry Units – ASCE 7-22
- G. Masonry Mortar – ASCE 7-22
- H. Structural Steel – AISC 15th Ed: Steel Construction Manual.

DESIGN LOADS

Dead Loads

- Reinforced Concrete – 24kN/cu m
- Structural Steel – 77kN/cu m
- Ceiling & Fixtures – 0.19 kN/sq m
- Floor Finishes – 0.575 kN/ sq m
- Roof Slab Waterproofing – Not 1.0 kN/sq m

Live Loads

- Roof (With limited Access) – 1.6 kN/sq m
- Residential Areas – 1.92 kN/sq m

Wind Loads

- Basic Wind Speed – 180mph
- Wind Directionality Factor – 0.85
- Wind Topographic Factor – 1.0
- Wind Importance Factor – 1.0
- Exposure Category – C

Seismic Loads

- Seismic Zone Factor – 0.16
- Horizontal Seismic Coefficient – 0.04
- Importance Factor – 1.5

The Allowable Soil Bearing Capacity used is 170KPA.

Flooding

The following finished floor levels are recommended in order to mitigate against flood impact:

- For Spanish Town Hospital and St. Jago Park Health Centre, recommended finished floor levels are minimum 0.4m above the 100-Yr floor depths, which is ~0.15m, which equates to 0.55m above the road level adjacent to the facility.
- For Old Harbour Health Centre, recommended finished floor levels are minimum 0.4m above the 100-Yr floor depths, which is ~1 metre, which equates to 1.4 m above the road level adjacent to the facility.
- For Greater Portmore Health Centre, recommended finished floor levels are minimum 0.4m above the 100-Yr floor depths, and a minimum of 0.4m above the road level adjacent to the facility.

4.1.3.2 Natural Hazard Identification

Flooding

HYDROLOGY AND FLOOD PLAIN MODELLING

A flood plain model was established illustrating the flood plain and depths within the project area and areas around the island to determine the level of exposure for the site. The tool of choice when generating flood plains is the Hydrologic Engineering Centre's River Analysis System (HEC-RAS). The United States army corps of engineers created this software to perform one and two-dimensional hydraulic calculations for a complete network of natural and constructed channels. Due to the complex nature of the hydrodynamics within the project area, a 2-D model was used to generate flood depth to predict flooding to determine its impact on the surrounding infrastructure.

Key features (inputs) used to do the assessment are as follows:

1. JAXA Topographic Data Topographic data (30m Geotiff).
2. Topographic Survey Data
3. Historical and Projected Extreme Rainfall (Return Periods 25Yr-100Yr)
 - a. Daily precipitation – Blair Pen Rainfall Station
4. Land Cover and Soil Type

TOPOGRAPHY

The terrain data was derived from a combination of submitted site specific topographic data, in combination with available JAXA (Japanese Aerospace Exploration Agency) Digital Elevation Map (DEM) of the island, captured using advanced satellite imagery. The DEM serves as the base of the 2D model, using a finite element mesh to calculate the water volumes and thus the flood plains throughout the model.

PRESENT RAINFALL CONDITIONS

Depth of rainfall for various return periods was provided by the National Meteorological Service of Jamaica for the closest gauge to the Spanish Town Hospital and St. Jago Park Health Centre, which was the Blair Pen rain gauge station (Figure 4-16). This station is 2.3km from the project, and its rainfall depth can be viewed in Table 4-13.

Table 4-13 Present climate 24-Hour Rainfall Depths (mm) for Blair Pen rain gauge station (Met. Service/NWA)

Return period (years)	Rainfall Depths (mm)
25-Year	275
50-Year	392
100-Year	425

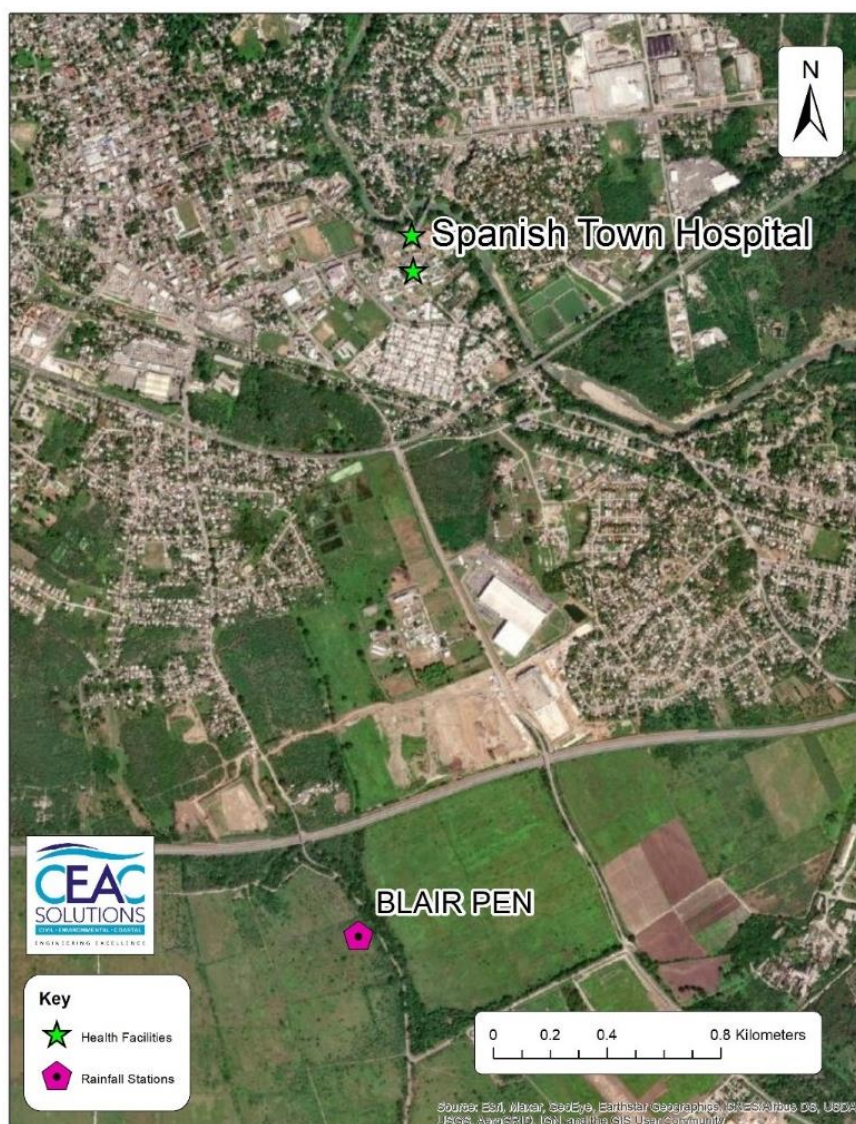


Figure 4-16 Location of Blair Pen, Catherine rainfall gauge station relative to project area

RAINFALL HYETOGRAPH

A hyetograph is the distribution of rainfall intensity over time. For example, in the 24-hour rainfall distributions developed by the Soil Conservation Service, rainfall intensity progressively increases until it reaches a maximum then gradually decreases. The Type III rainfall distribution curve was used for this assessment as it most accurately reflects the 24-hour rainfall distribution experienced

by the island. Rainfall Hyetographs were generated using the present and future climate conditions extreme rainfall and used to model the respective return periods.

MODEL CALIBRATION AND VALIDATION

In order to validate the flood plain model, the modelled project area was compared to both collected anecdotal data and available data from the ODPEM, showing two-hundred and ninety-three (293) recorded flood-prone areas.

Anecdotal data

During the site visits on the 31st of August 2021, and on the 13th of September 2021, anecdotal interviews were conducted on the hospital compound. The respondents reported that they have not witnessed major flooding (no inundation of buildings and parking areas) in the area where the improvements are to be implemented, however to the south of the hospital compound, the walkways, manpower and laundry buildings experience minor flooding (<150mm). This is reportedly as a result of poor drainage in the area as a pair of pumps, commissioned to pump the stormwater away, have been removed for repair and have not been replaced. Additionally, they have stated that an earth drain in the vicinity of the main entrance, fails to expel stormwater from the property as intended, which results in very minor flooding which does not affect the buildings on the property. The inundation depth does not exceed 0.05m pass the banks of the drain and seem to be as a result of blockage of the drainage system just outside of the compound, by the main entrance (Plate 4-55 to Plate 4-60).



Plate 4-55 Drain at main gate of Spanish Town Hospital Compound



Plate 4-56 Drain at main gate of Spanish Town Hospital Compound



Plate 4-57 Drain at main gate of Spanish Town Hospital Compound



Plate 4-58 Failed underground stormwater drainage by Spanish Town Hospital Main Gate



Plate 4-59 Spanish Town Hospital Flooded



Plate 4-60 Spanish Town internal drainage system

ODPEM Flood Prone Areas

The comparison of the ODPEM Flood Prone Areas was used as the secondary validation method for the model. The ODPEM data presented two-hundred and ninety-three (293) flood-prone areas and allowed for confirmation of known flood-prone areas, however, no depth was recorded in the dataset. This validation involved probing whether or not the flood plain generated was within a 500m radius of the flood-prone areas as presented by the ODPEM (Figure 4-17).

The OPDEM Flood Prone Areas map indicated that the general Spanish Town area is prone to flooding, however, the depths within the model did not exceed 0.15m on the hospital project area for any of the presented return periods.



Figure 4-17 Flood Plain Validation map showing ODPEM Flood Prone Areas with 100-Yr Future Climate

FLOOD PLAIN MODEL RESULTS

As stated previously, two scenarios were considered for the facility. The pre-improvement scenario which describes the compound as it currently exists, and the post-improvement scenario which describes the compound after improvements have been enacted. These scenarios were modelled for the 25-yr, 50-yr, and 100-yr return periods for present and future climate conditions. Also considered were the impacts to the main access routes of the facility. A detailed hydrological analysis was not carried out for the accesses as the flood model did not predict significant flooding along the main accesses of the facility. The results of the hydraulic model highlight areas that are exposed to minor (not exceeding 0.15m) pluvial (floods occurring independent of an overflowing water body) flooding. Furthermore, no fluvial flooding (flood caused by water bodies overflowing their banks) was observed, as the Rio Cobre does not break its banks.

From the flood plain model, it was observed that neither pluvial nor fluvial flooding significantly affected the facility for any of the presented return periods in the area to be improved. To the south of the facility however, there were some areas which experience some degree of inundation. This corroborates the interviews from the employees, as well as what was observed during our site. The findings indicate that the inundation observed on site may be due to improper onsite drainage.

Spanish Town Hospital		
25-year RP	50-year RP	100-year RP
Inundation Depth: 0.13m	Inundation Depth: 0.14m	Inundation Depth: 0.14m

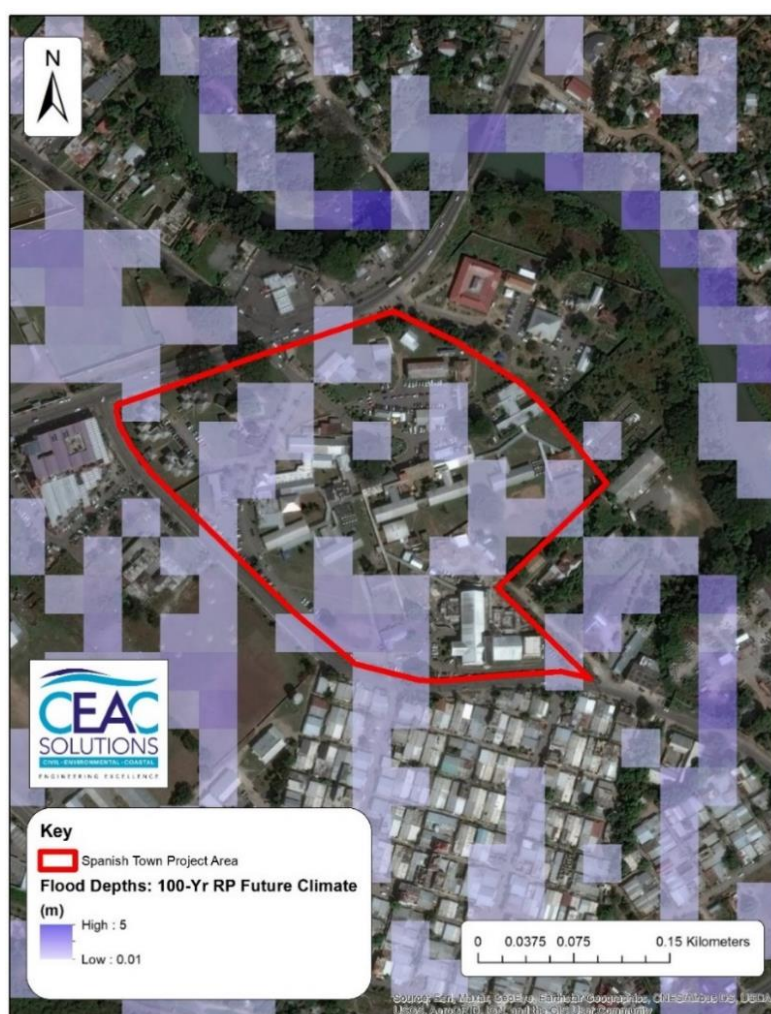


Figure 4-18 Flood plain map of the Spanish Town Hospital for the Post Improvement, 100-Yr Future Climate Scenario

INTERNAL DRAINAGE ANALYSIS

Currently, the stormwater runoff from the compound is controlled by a network of drains and inlets which are intended to control runoff along the interior corridors of the facility. The drains are approximately 0.45m wide, with varying depth. These drains lead to underground drainage pipes which discharge to external drainage system by use of a pair of pumps. As it exists, the channels have an approximate carrying capacity of 0.85m³/s, at an assumed channel depth of 0.6m. From anecdotal reports, the system poorly relieves the area of stormwater, which may be due to the

failure of the pumps within the system. (See Figure 4-19, Figure 4-20, Figure 4-21, and Figure 4-22).



Figure 4-19 Concrete U-Drains on hospital compound



Figure 4-20 Corridors that experience flooding during storm events



Figure 4-21 Concrete Inlet located on the hospital compound.



Figure 4-22 Earth drain on compound of facility.

Earthquake

GEOLOGY AND LITHOLOGY

Jamaica straddles the boundary between Caribbean tectonic plate and Gonave micro-plate. The Walton and the Enriquillo Fault Zones, extending respectively to the west and the east of Jamaica, form the boundary between these two plates. The movement across these two fault zones are transmitted through the Jamaican Fault system and are the source of significant earthquake activity in the island.

To the north approximately 8km from the project site, faults within the Bog Walk area have resulted in downthrow of limestone blocks further north. The most prominent fault zone in that area is the Cavaliers Fault zone which trends in the general E-W direction. This fault extends through areas of Bog Walk, Sligoville, and along Cavaliers to Stony Hill where it slightly offsets the Wagwater Fault. This fault continues across the Wagwater Belt which trends in a south-easterly direction.

HISTORICAL EARTHQUAKE EVENTS

Seismic events have the capacity to be some of the most devastating and costly natural hazards. The level of damage or loss typically varies depending on the magnitude of an event, wherein effects can range from only being noticed via seismograph to significant loss of life and

infrastructural damages. Despite having the tools for monitoring and recording these occurrences, earthquakes are unpredictable in nature.

Jamaica has had a notable earthquake history with significant events such as the 1692 Port Royal earthquake, the 1907 Kingston earthquake, the 1957 March 1st earthquake, which impacted the western end of the island and the 1993 January 13th earthquake. These events were the cause of significant losses for Jamaican citizens but only represent a small portion of the seismic activity occurring on the island; more recently, between 2011 and 2020 there were over 1000 recorded earthquakes with local epicentres, of which approximately 94 were actually felt. Although none were catastrophic, it highlights the significant levels of seismic activity across Jamaica.

Table 4-14 Earthquake magnitude, category, and effects

Richter scale of earthquake magnitude			
magnitude level	category	effects	earthquakes per year
less than 1.0 to 2.9	micro	generally not felt by people, though recorded on local instruments	more than 100,000
3.0–3.9	minor	felt by many people; no damage	12,000–100,000
4.0–4.9	light	felt by all; minor breakage of objects	2,000–12,000
5.0–5.9	moderate	some damage to weak structures	200–2,000
6.0–6.9	strong	moderate damage in populated areas	20–200
7.0–7.9	major	serious damage over large areas; loss of life	3–20
8.0 and higher	great	severe destruction and loss of life over large areas	fewer than 3

Source: *Britannica*

Of the 1,032 seismic events measured between 2011 and 2020 (Jamaica) (Source: Earthquake Unit University of the West Indies, Mona Campus), 10 occurred within the Service Area of the Spanish Town Hospital. These occurred in 2012, 2015, 2018 (2 events), 2018 & 2019 (3 events each). The three (3) closest events to the Spanish Town Hospital are listed in Table 4-15. These were considered minor events (Anon., 2021). There also seismic events much further away that were still felt, such as the 7.7 magnitude earthquake on January 5th, 2020, that occurred offshore of Lucea that was felt island-wide.

Figure 4-23 depicts the closest originating seismic events that occurred between the years 2011 and 2020.

Table 4-15 Three closest seismic events to the Spanish Town Hospital (2011 – 2020)

LATITUDE	LONGITUDE	MAGNITUDE	DATE OF OCCURENCE	DIST FROM SPN. TWN HOSPITAL (KM)
17.961	-76.968	2.1	July 1, 2020	3.9
18.027	-76.976	1.4	March 2, 2019	4.78
18.034	-76.917	1.5	December 21, 2013	5.41

Source: *Earthquake Unit University of the West Indies, Mona Campus, Kingston 7, Jamaica, W.I*

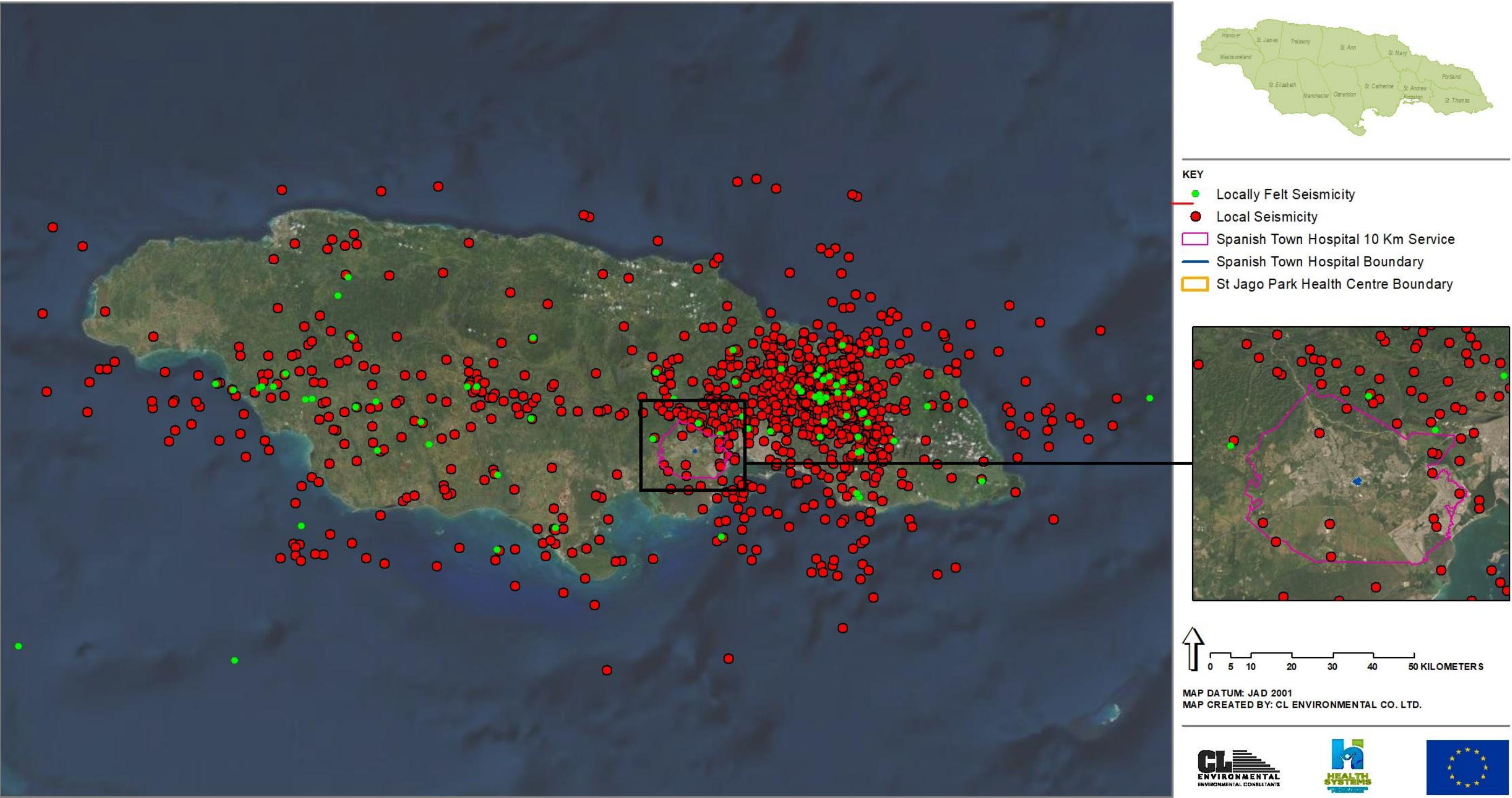


Figure 4-23 Seismic events between 2011 – 2020 for Jamaica

HORIZONTAL GROUND ACCELERATION

The ground and spectral was used as the basis for exposure to earthquake hazard as it considers any impact that the distance of the epicentre away from a site would have, by simple recording the acceleration at a location. The Peak Ground Acceleration for the project area was extracted from the seismic hazard maps for Jamaica generated under the Caribbean Disaster Mitigation Project (Organization of America States (OAS), 1998) and the Probabilistic Seismic Hazard Assessment.

The Spectral Acceleration (SA) is the preferred Seismic Hazard intensity parameter used in most modern building codes. This is a measure of maximum acceleration observed from a specific oscillatory period (similar to that of natural building oscillation) caused by a sustained shaking during an Earthquake. This acceleration varies based on location and as result means that the level of ground shaking also varies based on location.

Determining the short and long period spectral accelerations associated with varying regions can be a useful indicator of the level of seismicity and consequently the possibility of more pronounced ground motions in one area versus the other. The spectral acceleration periods observed were 0.2 seconds which is representative of short buildings (a few floors tall) and 1.0 second which is geared towards representing the oscillations of taller structures (greater than 7 floors).

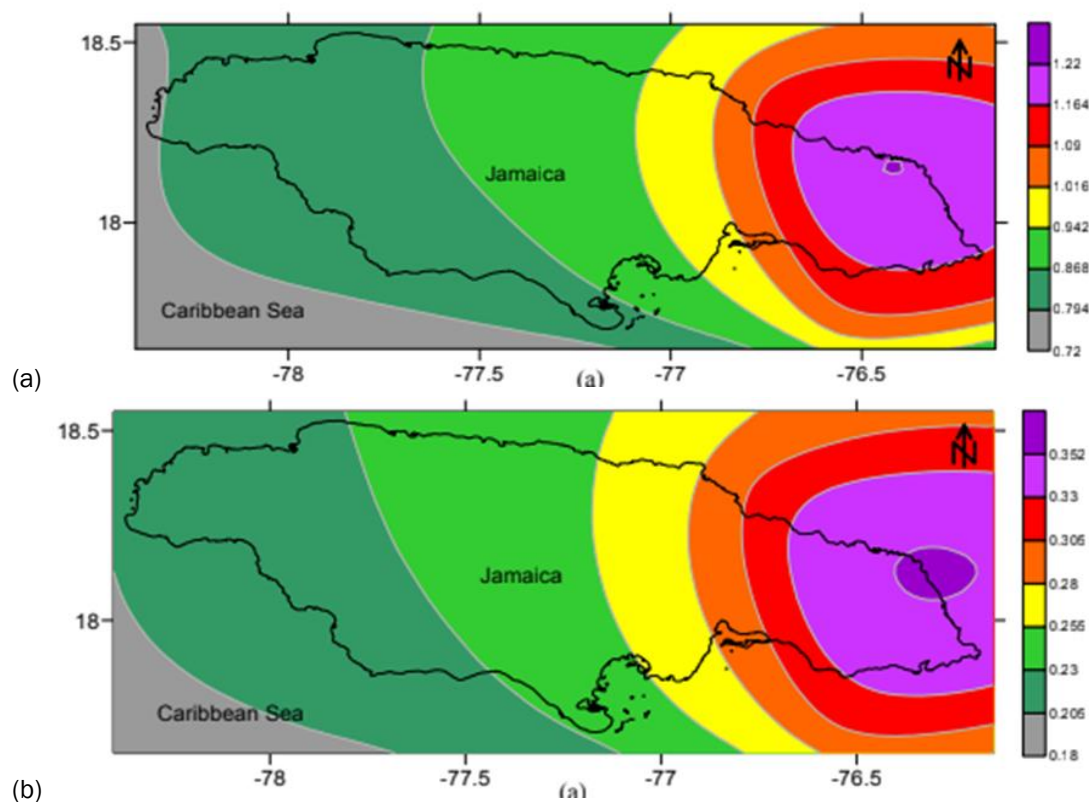


Figure 4-24 Site Spectral Response map for 0.2s short period (a) and 1.0s long period (b) (Source: Probabilistic Seismic Hazard Assessment for Jamaica Sep. 2013)

DAMAGE DESCRIPTION

Higher accelerations would imply a greater level of intensity at the location in question. As such a higher value would point to increased levels of damage and as result a relationship can be generated between ground acceleration and the Mercalli scale, which describes the probable extent of damage (Table 4-16). As per the Rapid Visual Screening Program developed by FEMA, a series of seismicity zones were determined based on the level of short period and long period spectral accelerations experienced (Table 4-17).

Table 4-16 **Relation between Mercalli Intensity and the expected damage from varying spectral accelerations**

Modified Mercalli Intensity	Acceleration (g)	Description
I	.0017-.0005	Not felt except by a very few under especially favourable conditions.
II	.0017-.005	Felt only by a few persons at rest, especially on upper floors of buildings
III	0.005-0.014	Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
IV	0.014-0.039	Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V	0.039-0.092	Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI	0.092-0.18	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII	0.18-0.34	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII	0.34-0.65	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX	0.65-1.24	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X+	Above 1.24	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

Table 4-17 Seismicity descriptions based on short and long spectral acceleration

Seismicity Region		Spectral Acceleration Response, S_s (short-period, or 0.2 seconds)	Spectral Acceleration Response, S_l (long-period, or 1.0 second)
Low		less than 0.250g	less than 0.100g
Moderate		greater than or equal to 0.250g but less than 0.500g	greater than or equal to 0.100g but less than 0.200g
Moderately High		greater than or equal to 0.500g but less than 1.000g	greater than or equal to 0.200g but less than 0.400g
High		greater than or equal to 1.000g but less than 1.500g	greater than or equal to 0.400g but less than 0.600g
Very High		greater than or equal to 1.500g	greater than or equal to 0.600g

Notes: g = acceleration of gravity in horizontal direction

RESULTS

The findings indicate that the Spanish Town Hospital is within a Moderately High Seismicity zone and that, there is the possibility of slight damage to specially designed structures in the event of 2475 return period event. Buildings of a lower design standard may suffer more considerable damage.

RP	Spectral Acceleration	Spanish Town
475	PGA	0.28
	(Short Period) 0.2	0.64
	(Long Period) 1.0	0.21
2475	PGA	0.5
	(Short Period) 0.2	0.97
	(Long Period) 1.0	0.27
4975	PGA	0.64
	(Short Period) 0.2	1.24
	(Long Period) 1.0	0.36

Wind

DESCRIPTION

Hurricanes produce heavy rainfall, high winds, and storm surge, all of which have the potential to cause damage and dislocation. High winds possess the ability to exert forces on the physical structure of buildings and also generate projectiles. The projectiles may pose a risk of causing damage to surrounding infrastructure or lead to injuries and fatalities. While spontaneous weather systems such as thunderstorms or cold front systems may produce higher than normal wind speeds, Hurricanes are responsible for most wind hazard situations. Hurricane wind speeds are typically used to categorize severity and lend to indicating the level of damage that can be expected. See Table 4-18 for categorization as per National Hurricane Centre (NOAA).

Table 4-18 Category wind and the attached description of expected damage

Category	Sustained Wind Speed		Description
1	74 - 95 33 - 42.8	(mph) (m/s)	Very dangerous winds will produce some damage: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96 - 110 42.9 - 49.5	(mph) (m/s)	Extremely dangerous winds will cause extensive damage: Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3	111 - 129 49.6 - 58.5	(mph) (m/s)	Devastating damage will occur: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4	130 - 156 58.6 - 69.3	(mph) (m/s)	Catastrophic damage will occur: Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5	157 or higher 69.7 m/s or higher	(mph) (m/s)	Catastrophic damage will occur: A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

METHOD

To determine the extreme wind speeds experienced on an annual probabilistic basis, hurricane level winds and hurricane tracks were extracted from locally generated datasets sourced from both government agencies and the National Hurricane Centre (NOAA). Application of extremal statistics to predict maximum wind speeds and exceedance probabilities using Weibull's distribution produced the different return periods attached to the wind speeds. These results were plotted on maps and the points relating to the facilities extracted. The data relevant to STH is seen in Table 4-19

RESULTS**Table 4-19:** Wind speeds for Spanish Town Hospital and respective return periods

Return Period (years)	Wind speeds (m/s)
25	55.4
50	57.4
100	61.2

4.1.3.3 Risk Assessment

Background

In evaluating the feasibility of undertaking the Health and Systems strengthening program in St. Catherine, and more specifically the construction of the proposed development at the Spanish Town Hospital, the risks associated with its development have to be determined. Risk can be defined as the potential loss of life, injury and destruction or damage to assets which could occur to a system, society or a community in a specific period of time. As such the typical approach evaluates risk as a function of hazard, exposure, vulnerability and the criticality of the project (UNDRR, 2017).

Methodology

The methodology presented in the Disaster and Climate Change Risk Assessment Methodology for IDB Projects (2019)⁷ states the risk analysis should include the identification of hazards, degree of exposure of the hazard on the facility, identification of project vulnerability to said hazards, identification of impacts and the development of recommendations for failure modes or prevention of damage. The proposed IDB methodology and its phases were used as the framework for the risk assessment to integrate both the technical and operational narratives for all four (4) health facilities. The Simplified Probabilistic Assessment was used as a general guide in this report, where the relation between the pertinent assessment factors has been summarized in the following equation.

$$\text{Risk} = H * V * A$$

H – Hazard, represented as the annual probability of occurrence for 25 to 100 years return period

V – Physical vulnerability of building, expressing the degree of damage of the elements at risk given the occurrence of hazard event

A – Amount of exposed elements at risk, calculated by overlaying hazard scenarios with the elements at risk. This can be expressed in monetary values or as the number of assets at risk of damage, population at risk and so on.



Figure 4-25 Risk component model (IDB, 2019)

⁷ Barandiarán, M., Esquivel, M., Lacambra Ayuso, S., Suarez, G., & Zuloaga, D. (2019). Disaster and Climate Change Risk Assessment Methodology for IDB Projects: A Technical Reference Document for IDB Project Teams.

Hazards

From the hazards presented in this report, the most relevant ones pertaining to the 4 facilities were chosen. This decision was made after careful expert analysis of the locations and the context in which likely and substantial damage could potentially be experienced. Hazard selection was also done from an island-wide perspective for events that have historically had a major effect on commercial/private operations. The events highlighted in the risk assessment were:

- Flooding (pluvial and fluvial)
- Seismic Activity
- Hurricane Winds

Each of the above hazards will be associated with a frequency matching a certain intensity to allow for replicable measurement of varying levels of potential damage to property. For flooding and hurricane winds, return periods (RPs) were used: 25 year-, 50 year- and 100 year- RPs. The values were obtained from rasters generated from local datasets. For seismic activity, long and short spectral accelerations were used which were also tied to return periods: 475 year (0.28g), 2475 year (0.5g) and 4975 year (0.64g) return periods (where g is gravity).

Vulnerability

DESCRIPTION OF VULNERABILITY

In order to determine the vulnerability of each location, the identification of failure modes for the identified hazards and the relation to assets' capability to sustain damage was determined. For example, depending on the level of inundation experienced during a high precipitation event, the series of outcomes can range from the hinderance of services to damage of equipment. Seismic Events have the potential to cause permanent structural damage, aesthetic damage, damage to equipment and affect the low level and critical medical operations. Wind events typically have the potential to dislodge components fastened to a structure. This could result in aesthetic damage, launching of projectiles that can cause irreparable damage or injury. For the purpose of rating vulnerability, each impact description was ranked as Trivial, Minor, Serious or Catastrophic. This provides a basis for input into risk ranking matrix as seen in Table 4-20. A brief general description of the type of impacts that was selected for each event can be seen in Table 4-21.

Table 4-20 Risk matrix approach (Source: Caribbean Handbook on Risk Information Management as presented by the IDB Methodology, p. 78)

		IMPACT			
		None	Low	Moderate	High
FREQUENCY	Very High		High	Very High	Very High
	High		Moderate	High	Very High
	Moderate		Low	Moderate	High
	Low		Low	Low	Moderate
		None	No risk		

Table 4-21 Impact Description associated with various hazards and their level of severity.

Impact Description	
Flooding	
Trivial	No significant damage
Minor	Aesthetic damage, minor inconvenience in traversing the facility
Serious	Impedance of facility access, costly damage to non-critical assets
Catastrophic	Complete Submersion of Critical components.
Earthquake	
Trivial	Damage to small building content
Minor	Non-structural damage (cracks) and aesthetic damage. Displacement of heavy equipment
Serious	Failure of load bearing structure members
Catastrophic	Partial or complete collapse
Wind	
Trivial	No significant damage
Minor	Minor Aesthetic Damage
Serious	Damage to exposed glass or partial removal of coverings and other periphery structures
Catastrophic	Complete removal of roofing structure, façade or other exterior structure

VULNERABILITY RATING FROM FLOODING

The STH's vulnerability to flooding will be determined from the expected damage from flood waters and the mitigative measures expected to be implemented into the proposed building. Assuming the proposed structure will have a designed floor, elevation which will consider flood waters, expected damage from flooding is minimal. In local practices, this level is usually set at approximately 0.3m above the existing ground level.

From the levels observed damage will most likely be trivial or minor, in the form of damage to the aesthetics of the building (flood water marks and stains on walls), and to a minor degree, damage to furnishings and low-lying documents or equipment. If one is to consider the sub ground level parking lot, poor drainage infrastructure could vehicular assets or other building support systems stored there vulnerable. These potential damages can be readily mitigated by raising the placement of electrical sockets, documents, and important equipment within the building above expected flood waters. Access to the facility or operations are not expected to be impeded with the obtained flood depths. The flood depths were taken relative to the existing ground level (mAEGL) and the resulting impacts

presented in Table 4-22. For the purpose of highlighting the impact rating, it was assumed that drainage infrastructure was sufficient.

Table 4-22 Impact Rating for STH regarding flooding

RP	Flood Level (mAEGL)	Impact
25 years	0.13	Trivial
50 years	0.14	Minor
100 years	0.14	Minor

VULNERABILITY RATING FROM SEISMIC ACTIVITY

The proposed building site will include one 7 storey structure, with an underground parking area. The replacement of existing structures will naturally have a direct impact on seismic performance on the site as it replaces aged structures with a more recent one. For the purpose of the assessment, the FEMA P154 rapid visual assessment (RVA) was used to estimate structural seismic performances. The assessment considered the seismicity of the location, soil and terrain conditions, age, building and probable design code of the proposed building. In essence, the RVS scores highlight the probable performance of a building in a seismic event based on its characteristics. Some typically boost performance such simple building geometry and code conformance and some may decrease performance such, significant storey height, irregular shapes and old age. The building type of the hospital, according to the FEMA building characterization, is given in Table 4-23. This type was assumed based on common construction practices of a building of that nature.

Table 4-23 Showing building type for STH

Proposed Building Type	Building Name	RVS Score
Concrete Moment Resisting Frame (C1) or Concrete Shear Wall (C2)	Spanish Town Hospital	2.4 -3.0

The score of the new structure assumed that it would be designed to the requisite IBC design standards. FEMA dictates that a building with a ranking below 2 is recommended for investigation for further seismic design. The score obtained, seen in Table 4-23, was above the standard score of 2, indicating that the proposed STH will have a more favourable performance during seismic activity. The impacts for the different seismic RPs, guided by Table 4-16 and Table 4-17, can be seen in Table 4-24.

Table 4-24 Impact Rating for STH regarding seismic activity

RP (Spectral Acceleration)	Impact
475 years (0.28)	Minor
2475 years (0.5)	Serious
4975 years (0.64)	Catastrophic

VULNERABILITY RATING FROM HURRICANE WINDS

The proposed STH building will also be exposed to hurricane winds and is expected to experience some degree of damage from the event albeit that the likelihood of structural damage is low. This level of

damage and the resulting impact based on the proposed building design will be taken from Table 4-18. With wind speeds ranging from 55.4 m/s to 61.2 m/s, the STH building will experience devastating to catastrophic damage. This considers the building being considered a 'well-built frame' that will experience damage to the roof structure and interruptions in utility services. The variation in damage seen between the 25-100 RP is small, as the change in windspeeds is minimal between the range.

Table 4-25. Impact Rating for STH regarding hurricane winds

RP	Wind speed (m/s)	Impact
25	55.4	Serious
50	57.4	Serious
100	61.2	Catastrophic

Criticality

A review of the facilities' social impacts demonstrates that shortfalls associated with new construction could significantly affect various portions of the populous. This allows for a better understanding of the potential consequences of failure of the facility and the characteristics that contribute to its vulnerability. The criticality thresholds were derived from those depicted in Table 4.11 of the IDB Methodology. Overall, the facility has been considered a highly critical project as loss of its services will affect a significant reach of the Jamaican populous. Its large building surface area as means that a greater quantity of assets are at risk.

Table 4-26 Criticality of proposed Facilities

	Characteristics	Value	Criticality Rate
Spanish Town Hospital	Service area (km ²)	1190	High
	Service Population (per)	Approx. 600,000	High
	Building Square Area (m ²)	13,906	High

Exposure

Each facility's level of exposure will be measured specific to each of the hazards presented. This will consider the coincidence of the facility's location with the expected point of occurrence of the hazards. For flood events, a dimension of depth will also be included to evaluate the potential level of inundation and the resulting assets/structural components at risk. This will be taken from the maps generated and presented in this report from previously run hydrodynamic models. In relation to seismic exposure, it is established that all the facilities experience seismic activity. The level of exposure for each will account for the proximity of the facility to historically recorded seismic events. For hurricane winds, wind speeds across the island vary based on a location's surrounding topography, proximity from the coast and intensity of the potential storm. Data values taken from the CORDEX RCM database were used to generate maps specific to the island and will be used to determine the facilities' exposure to hurricane winds.

FLOODING

Flood events to be analysed were the 25-, 50-, and 100-year RPs. The resultant flood depths and area inundated for the facility has been taken from the results presented previously in this report and are

summarized in Table 4-27. Flood depths have been taken relative to the existing ground level (EGL). The assets considered most exposed will be measured based on their elevation above maximum flood depths for the RPs. Values assigned to the assets in the final risk matrix will consider the at-risk portion (%) submerged and the depth of flooding for that asset. The flooding exposure in the case of the 7 storey building are for the most part limited to the ground and below level assets.

Table 4-27 Exposure considerations and values for flooding

	Exposure metric	% Exposed to hazard	Average Flood Depth (m)		
			25yr	50yr	100yr
STH Building	Area and no. of floors	44%	0.13	0.14	0.14

SEISMIC ACTIVITY

While all sites are considered exposed to seismic activity, the level of exposure will vary according to the location on the island. This varying level of exposure was based on spectral acceleration maps which through historical occurrences predicted the magnitude of ground movement. The level of ground movement of each site, would vary despite being exposed to some of the same events due to factors such as distance to event epicentre and geological properties (i.e. soil and rock structure). The literature presented in the Journal of Civil Engineering was generated to provide a seismic spectral acceleration map to be utilized in conjunction with the International Building Code seismic design guidelines. Extraction of the coinciding spectral acceleration based on the location of each project site yielded the accelerations below. Seismic activity has the potential to affect all sections of the building.

Table 4-28 Resultant spectral accelerations (short and long) with associated return periods

RP	Spectral Acceleration (based on exposure)	Spanish Town Hospital
475	PGA	0.28
	(Short Period) 0.2	0.64
	(Long Period) 1.0	0.21
2475	PGA	0.5
	(Short Period) 0.2	0.97
	(Long Period) 1.0	0.27
4975	PGA	0.64
	(Short Period) 0.2	1.24
	(Long Period) 1.0	0.36

HURRICANE WINDS

All health facilities are considered to have the same level of exposure to hurricane winds. The variation in the speed of hurricane level winds experienced by the facility is dependent on the building's location relative to the coast, surrounding topography and the surrounding land use for the site. Another factor affecting the building exposure is the footprint area and height of the structure which will increase the risk associated with damage from extreme hurricane winds. The increased frontage from surface area of building, along with glass coverage depicted in some renders is an example of such.

Table 4-29 Exposure considerations and values for flooding

RP	Wind speed (m/s)	Building footprint (m ²)	Proposed Building Height (m)
25	55.4	13,906	26.2
50	57.4		
100	61.2		

Risk Analysis

For the hazard events, A combined (weighted) ranking considering the asset exposure, hazard probability and vulnerability of the building will be utilized to assign a suitable risk rating. The at-risk infrastructure will be determined using the factor combination proposed by the IPCC dictating risk being a product of an asset's exposure × vulnerability × hazard present⁸. For the Spanish Town Hospital, the approach taken to the risk assessment will be qualitative, considering the casual relationship between the impact of the climate hazard and the outcome of the impact⁹ as described in the preceding sections. The final result will be a risk matrix developed using weighted values to estimate the risk of the facility's infrastructure and equipment to the combined impacts of the three (3) hazards: flooding, seismic activity and hurricane winds. A table showing the method and color assignment for each value can be seen in Table 4-30 and Table 4-31. A ranking from 1 (lowest) to 12 (highest) will be assigned to the different assets based on their physical condition and their surrounding environments. The ranking for the hazards has been further divided into flooding and hurricane winds, vs. seismic activity. The impact of the hazard on the asset will be taken from Table 4-21. The weighted value for the risk matrix is a representation of the overall risk of the facility out of a total ranking of 12.

Table 4-30 Vulnerability levels of STH for flooding and hurricane winds

		Impacts			
		Trivial	Minor	Serious	Catastrophic
Probability of Occurrence	< 25 years	Low (3)	Medium (6)	High (9)	High (12)
	50 – 100 years	Null (2)	Low (4)	Medium (6)	High (8)
	> 100 years	Null (1)	Null (2)	Low (3)	Low (4)

Table 4-31: Vulnerability levels of STH for seismic activity

		Impacts			
		Trivial	Minor	Serious	Catastrophic
Return Period	475 yrs	Low (3)	Medium (6)	High (9)	High (12)
	2475 yrs	Null (2)	Low (4)	Medium (6)	High (8)
	4975 yrs	Null (1)	Null (2)	Low (3)	Low (4)

⁸ IPCC. (2012). *Determinants of risk: exposure and vulnerability*. Source: https://www.ipcc.ch/site/assets/uploads/2018/03/SREX-Chap2_FINAL-1.pdf

⁹ Hughes J. et. al. (2020). *Impacts and implications of climate change on wastewater systems: A New Zealand perspective*. Source: <https://doi.org/10.1016/j.crm.2020.100262>

Table 4-32 Results of risk matrix for Spanish Town Hospital

Exposure metric	Flooding			Seismic Activity			Hurricane Winds			Weighted Value
	25 RP	50 RP	100 RP	475 RP	2475 RP	4975 RP	25 RP	50 RP	100 RP	
Area of building and no. of floors	3	4	2	6	6	4	9	6	4	4.9

Summary of Risk Matrix Findings

The values obtained from the risk matrix reflect variations in both frequency of the hazard events and the resultant impact of the event on the facility based on both the intensity of the hazard (tied to the RP) and the structural resilience of the building. As a result, the matrix can fairly compare the overall risk of the development by assessing both the expected damage from a certain event, whether great or small, and the likelihood of it occurring. In other words, this allows for less frequent but intense events to be similarly rated against frequent but less intense events, where similar monetary expenditures from recovery efforts or damage to infrastructure may be experienced over time. This can be seen with the flooding hazard where the 100-yr RP event has a lower rating than the 25- and 50-yr RPs. This is because the flood levels for all 3 RPs stagnate at about 0.135m AMSL, making the 100-yr RP event the least likely occurring event with the same magnitude of damage produced.

A similar result is seen for the hurricane winds where extreme winds experienced by the island that cause significant damage are ones over 42.9 m/s (ref. Table 4-18). Since the island experiences these hurricane winds fairly frequently (at least a 1 in 4 probability each year i.e. 25-yr RP), the matrix ranks this RP relatively high on the scale. A similar concept is true for the risk from seismic activity. An overall ranking of 4.9 establishes the facility as a relatively robust structure to common local hazards, wherein damage from flooding is expected to be minor once the requisite on site flood control measures are made. Significant damage from seismic events are noted to be infrequent especially in relation to design return period. However, it must be noted that upon occurrence it has the capacity to generate the most losses. Hurricane winds have what seems to be the capability to cause the most damage as a result of its frequency and consistency in intensity.

4.1.4 Biological Environment

4.1.4.1 Flora Assessment

The project site is situated in a heavily developed area. Several buildings, a vast network of roads, a sewage treatment plant and other structures comprise the vast majority of the footprint on the property. The vegetation primarily observed during the assessment were ornamental plants that have been planted for landscaping/aesthetic purposes.

The plant diversity on the property was relatively low, where only 62 plant species from 36 families were encountered, most of them being trees and shrubs. In addition, a few climbers, and epiphytes

and also ferns were observed on the property. The majority of the trees encountered at the site were relatively large trees (>10 cm DBH), where the majority were planted some time ago for landscaping purposes; there were also a considerable of very mature trees (larger >35cm DBH classes). Among the mature trees observed during the assessment were Guango (*Samanea saman*), Cannon Ball Tree (*Couroupita guianensis*) and Mango (*Mangifera indica*). Some trees with a relatively large diameter at breast height measurement (DBH) were observed (between 35cm and 155cm).

Most of the species encountered during the assessment of the STH are classified (Adams, 1972) as being very common, commonly found in thickets and wastelands, and commonly found in secondary woodlands. The distribution of the plant species encountered is fairly even across Jamaica, especially in places with significant anthropogenic impacts.

Of the 62 plant species found within the study site, one endemic species was observed, God Okra (*Hylocereus triangularis*). No species encountered during this study is deemed to have any special conservation status; neither was any species listed as rare in Jamaica (Table 4-33). The species in the list provided are not a part of the International Union for Conservation of Nature (IUCN) or Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists.

Table 4-33 List of floral species identified along transects in the assessed area. A classification ranking was used to show prevalence (Adams 1972) and the DAFOR index to show the frequency of each plant species encountered.

Family	Scientific Name	Common Name	Range**	DAFOR
Mimosaceae	<i>Acacia macracantha</i>	Park Nut	Common locally (St. Andrew, St. Catherine, St. Thomas), in secondary thickets on arid limestone	O
Euphorbiaceae	<i>Acalypha wilkesiana</i>		Ornamental	O
Mimosaceae	<i>Albizia lebbbeck</i>	Woman's Tongue	Locally common, naturalized in open secondary woodlands	F
Apocynaceae	<i>Allamanda cathartica</i>	Yellow Allamanda	Cultivated or relict ornamental shrub	O
Liliaceae	<i>Aloe vera</i>	Sinkle Bible	Occasional and locally gregarious (St. Catherine, Clarendon), also in cultivation	R
Poaceae	<i>Andropogon bicornis</i>		Common on roadside banks, savannas, and rough places	F
Poaceae	<i>Andropogon citratus</i>	Fever Grass	Common in cultivation in gardens and along path sides	R
Annonaceae	<i>Annona reticulata</i>	Custard Apple	Cultivated and escaped into waste places near habitations	R
Annonaceae	<i>Annona squamosa</i>	Sweet Sop	Commonly cultivated, escaping near habitations and along roadsides and pasture margins	O

Family	Scientific Name	Common Name	Range**	DAFOR
Polygonaceae	<i>Antigonon leptopus</i>	Coralita	Common in cultivation and escaping onto fences and hedges at low elevations	D
Liliaceae	<i>Asparagus setaceus</i>	Asparagus Fern	Cultivated and occasionally escaped	R
Meliaceae	<i>Azadirachta indica</i>	Neem	Sparingly cultivated	O
Caesalpiniaceae	<i>Bauhinia purpurea</i>	Poor Man's Orchid	Cultivated ornamental	O
Asteraceae	<i>Bidens pilosa</i>	Spanish Needle	A common weed of roadsides and waste places	A
Blechnaceae	<i>Blechnum sp.</i>			R
Sapindaceae	<i>Blighia sapida</i>	Ackee	Cultivated	O
Nyctaginaceae	<i>Boerhavia erecta</i>	Hog Weed	Rather common, a weed of disturbed ground, roadsides, and open areas	F
Nyctaginaceae	<i>Bougainvillea peruviana</i>	Bougainvillea	Cultivated ornamental	O
Araceae	<i>Caladium bicolor</i>	Caladium	Cultivated ornamental	R
Asclepiadaceae	<i>Calotropis procera</i>	French Cotton	Locally common, in arid sandy or gravelly waste places	R
Caricaceae	<i>Carica papaya</i>	Papaya	Common in cultivation, hardly naturalized	O
Caesalpiniaceae	<i>Cassia fistula</i>	Golden Shower Tree		F
Caesalpiniaceae	<i>Cassia javanica</i>	Pink Cassia		O
Poaceae	<i>Chloris barata</i>		Very common as weed along roadsides and in waste places	A
Arecaceae	<i>Cocos nucifera</i>	Coconut	Cultivated and naturalized	R
Commelinaceae	<i>Commelina diffusa</i>	Water Grass	A common weed of cultivations, waste places and pastures	A
Lecythidaceae	<i>Couroupita guianensis</i>	Cannonball Tree	Cultivated	R
Euphorbiaceae	<i>Croton sp.</i>	Croton	Common ornamental	O
Cupressaceae	<i>Cupressus sp.</i>	Christmas Tree	Cultivated ornamental	O
Caesalpiniaceae	<i>Delonix regia</i>	Ponciana	Commonly cultivated and occasionally naturalized	F
Liliaceae	<i>Dracaena sp.</i>	Snake Plant	Cultivated ornamental	R
Verbenaceae	<i>Duranta repens</i>	Duranta Gold	Common on roadside banks and in thickets, also cultivated for ornament	A
Boraginaceae	<i>Ehretia tinifolia</i>	Bastard Cherry	Fairly common in secondary woodlands	O
Mimosaceae	<i>Enterolobium cyclocarpum</i>	Elephant Ear Tree	Occasional, mostly where planted and hardly naturalized	R

Family	Scientific Name	Common Name	Range**	DAFOR
Euphorbiaceae	<i>Euphorbia mili</i>	Crown of Thorns		O
Moraceae	<i>Ficus benjamina</i>	Chinese Banyan	Cultivated shade and ornamental tree	F
Boraginaceae	<i>Heliotropium angiospermum</i>		Common as a field and garden weed, mostly in rather shady places	A
Cactaceae	<i>*Hylocereus triangularis</i>	God Okra	Locally common, in thickets, on rocks and on large old trees	O
Rubiaceae	<i>Ixora coccinea</i>		Common ornamental	O
Euphorbiaceae	<i>Jatropha integerrima</i>		Ornamental shrub	O
Scrophulariaceae	<i>Leucophyllum frutescens</i>	Texas Sedge	Common ornamental	F
Oleaceae	<i>Ligustrum vulgare</i>	Golden Privet	Cultivated ornamental	O
Anacardiaceae	<i>Mangifera indica</i>	Mango	Cultivated and naturalized	O
Apocynaceae	<i>Nerium oleander</i>		Commonly cultivated	O
Poaceae	<i>Panicum maximum</i>	Guinea Grass	Very common in rough pastures, ditches, and sheltered thickets	A
Poaceae	<i>Pennisetum purpureum</i>	Elephant Grass	Locally common and often cultivated	O
Fabaceae	<i>Piscidia piscipula</i>	Dog Wood	Common, mostly in rather arid areas on sand or gravel or in woodland on limestone	O
Portulacaceae	<i>Portulaca oleracea</i>	Pussley	Very common, a weed of cultivated ground and waste places	D
Mimosaceae	<i>Prosopis juliflora</i>	Cashaw Macka	Locally common (St. Andrew, St. Catherine, Clarendon), in low pastures in arid areas	R
Punicaceae	<i>Punica granatum</i>	Pomegranate	Rather common as an ornamental, rarely naturalized	R
Commelinaceae	<i>Rhoeo spathacea</i>	Mosses in the Bushes	Common, on limestone banks and in rocky thickets and woodland margins	O
Acanthaceae	<i>Ruellia tuberosa</i>	Duppy Gunshot	Very common in pastures and waste places and on roadside banks	D
Mimosaceae	<i>Samanea saman</i>	Guango	Common in inhabited areas and in old pastures where planted, naturalized in riparian forest and in secondary communities	F
Araliaceae	<i>Schefflera arboricola</i>		Cultivated ornamental	R

Family	Scientific Name	Common Name	Range**	DAFOR
Poaceae	<i>Stenotaphrum secundatum</i>	Crab Grass	Common in pastures on heavy, poorly drained soils or sand or coral limestone near sea	A
Myrtaceae	<i>Syzygium malaccense</i>	Otaheite Apple	Cultivated and naturalized	O
Apocynaceae	<i>Tabernaemontana divaricata</i>	Coffee Rose	Cultivated ornamental	O
Combretaceae	<i>Terminalia catappa</i>	West Indian Almond	Commonly planted and naturalized	O
Thelypteridaceae	<i>Thelypteris palustris</i>			O
Arecaceae	<i>Veitchia merrilli</i>	Christmas Palm	Cultivated ornamental	R
Arecaceae	<i>Washingtonia robusta</i>	Fan Palm	Cultivated ornamental	R
Poaceae	<i>Zoysia tenuifolia</i>	Zoysia	Cultivated for lawns	D

Endemic species - *

4.1.4.2 Avifauna Assessment

A total of 12 species of birds were observed during the rapid assessment. Of the 12 birds identified, 9 residents (non-endemic), 1 introduced, 1 migrant and 1 endemic (Table 4-34).

Several of the birds observed are typical of cultivated or disturbed areas, including Yellow-faced Grassquit, Gray Kingbird, and Rock Pigeons (Downer & Sutton, 1990), were encountered during the assessment. Of the 31 endemics found in Jamaica, only one species, the Jamaican Euphonia (*Euphonia jamaica*), was observed in the project area. It is a non-forest dependent species.

The avian study was carried out in early September, just before the arrival of most of the winter migrant birds from North America. This means that the bird species list will most likely increase later in the winter months of the year when the migrants are expected to arrive. Bird diversity usually increases from September to May as a result of the migrant warblers.

Table 4-34 Bird species observed in the study in the areas

Common Name	Scientific Name	Range	Seasonality	IUCN Red List Category	DAFOR
American Kestrel	<i>Falco sparverius</i>	Resident	Year-round	LC	R
Bananaquit	<i>Coereba flaveola</i>	Resident	Year-round	LC	R
Cattle Egret	<i>Bubulcus ibis</i>	Resident	Year-round	LC	O
Gray Kingbird	<i>Tyrannus dominicensis</i>	Migrant	Summer	LC	O
Jamaican Euphonia	<i>Euphonia jamaica</i>	Endemic	Year-round	LC	R
Northern Mockingbird	<i>Mimus polyglottos</i>	Resident	Year-round	LC	O
Rock Pigeon	<i>Columba livia</i>	Resident	Year-round	LC	A
Saffron Finch	<i>Sicalis flaveola</i>	Introduced	Year-round	LC	O
Smooth-billed Ani	<i>Crotophaga ani</i>	Resident	Year-round	LC	F
Turkey Vulture	<i>Cathartes aura</i>	Resident	Year-round	LC	O

Vervain Hummingbird	<i>Mellisuga minima</i>	Resident	Year-round	LC	R
Yellow-faced Grassquit	<i>Tiaris olivaceus</i>	Resident	Year-round	LC	O

4.1.4.3 Herpetofauna Assessment

There are approximately 27 species of amphibians found in Jamaica, and only two species (*Eleutherodactylus johnstonei* and *Rhinella marina*) species were recorded in the study. Both species were introduced to Jamaica and are generally found in highly disturbed areas. The observation of the two species of amphibians were at the sewage plant on the property. Only (4) species of reptiles were recorded; one is listed as introduced (*Hemidactylus mabouia*) while the others are endemic to Jamaica. No snakes or galliwasp were encountered in the study area.

It should be noted that the status of *all* endemic reptilian and amphibian species are of concern primarily due to the distribution of their populations which is limited to one island, Jamaica.

Table 4-35 Herpetofauna observed during the study

Species	Common name	Classification	Species Status	IUCN Red List Category	DAFOR
<i>Anolis grahami</i>	Jamaican Turquoise Anole	Reptile	Endemic	Near threatened	O
<i>Anolis lineatopus</i>	Jamaican Gray Anole	Reptile	Endemic	Near threatened	D
<i>Anolis opalinus</i>	Jamaican Opal-bellied Anole	Reptile	Endemic	Not Assessed	O
<i>Eleutherodactylus johnstonei</i>	Lesser Antillean Frog	Amphibian	Introduced	Least concern	F
<i>Hemidactylus mabouia</i>	Croaking lizard, Wood slave	Reptile	Introduced	Least concern	R
<i>Rhinella marina</i>	Cane Toad	Amphibian	Introduced	Least concern	O

4.1.4.4 Macro – Invertebrate Assessment

A total of 12 species of insects were identified, including 7 species of butterflies. The species listed are all widespread, although some are generally associated with disturbed areas. The species in the list provided are not a part of the International Union for Conservation of Nature (IUCN) or Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists.

Table 4-36 The Macro Invertebrates observed during the assessment of the STH property

Order & Family	Species	Common Name	DAFOR	Distribution/Comments
LEPIDOPTERA				
Nymphalidae	<i>Anartia jatrophae</i>	White Peacock	O	Widespread and common. Southern US to Argentina
	<i>Dryas iulia delilah</i>	Julia	R	Endemic Ss.; widespread, common
	<i>Junonia zonalis</i>	West Indian Buckeye	O	Bahamas, Cuba, Hispaniola, Caymans Islands, Jamaica
Pieridae	<i>Phoebis sennae</i>	Cloudless Sulphur	O	Widespread and common. Southern US to Argentina

Order & Family	Species	Common Name	DAFOR	Distribution/Comments
	<i>Eurema nise</i>	Mimosa Yellow; Cramer's Little Sulphur	R	Widespread, common. Southern US to Argentina
Papilionidae	<i>Papilio demoleus</i>	Lime Swallowtail Butterfly	R	Introduced from S.E. Asia in 2006; Pest of citrus
Psychidae	<i>unknown</i>	Bagworm Moth (caterpillar)	D	
HYMENOPTERA				
Apidae	<i>Apis mellifera</i>	Common Honeybee	O	Widespread and common
Formicidae	<i>Ant 1</i>	Red ant	O	Widespread and common
	<i>Ant 2</i>	Black ant	O	Widespread and common
Vespidae	<i>Polistes crinitus</i>	Paper Wasp	O	Very common and widespread
ARANEAE				
Araneidae	<i>Gasteracantha cancriformis</i>	Black Crab spider	R	Very common and widespread

4.1.4.5 Other Fauna

A few additional species were observed on the STH property, these include: several cats (*Felis catus*) and Indian Mongoose (*Herpestes javanicus*). Several rat traps were also observed on the property, which indicate an initiative to eradicate rodents, however no rats/mice were observed throughout the assessment. The security guards also reported encountering rats on the property at night.

4.1.4.6 Rio Cobre

The Rio Cobre is one of the largest rivers in Jamaica, at 30 km in length, with an extensive watershed (1256 km²) (Andrews. J, 2001). The lower Rio Cobre was given a medium priority conservation status by the JERP (The Jamaica Ecoregional Plan) in 2006 (The Nature Conservancy , 2006). Information on Jamaica's freshwater species and ecosystems is limited. Furthermore, many if not most rivers, ponds and wetlands have been modified or degraded before an inventory of their biodiversity has been made. Jamaica has been rated fifth in islands of the world in terms of endemic plants. There is also a high level of endemism for many species of animals including snails, terrestrial and freshwater grapsid crabs, amphibians, reptiles, and land birds. It is unclear how much of this endemism is reflected in Jamaica's freshwater biodiversity (The Nature Conservancy , 2006).

The river has a wide variety of pollution sources including bauxite, solid waste, wastewater and influences from agricultural activities and human settlements along the river. The river receives bauxite processing waste in the upper reaches from a nearby bauxite processing plant (Hyslop. E.J., 2012) While this study does not provide evidence of a direct impact of bauxite processing waste on the macroinvertebrate community through metallic pollution, and while the results need to be interpreted with caution due to the limitations of a comparison between the impacted sites and a location which is not directly equivalent, it does seem to indicate that suspended material from the waste indirectly influences species composition at sites below the point of input by causing habitat alteration with concomitant changes in invertebrate fauna.

Wastewater and sewage enter aquatic systems from sources ranging from surface runoff and septic systems to wastewater treatment facilities and storm drain outfalls, such as the hospital sewage treatment plant. Wastewater can cause eutrophication as well as disruptions in the overall ecological functions. The current impact of the hospital on the Rio Cobre is unknown.

4.2 ST. JAGO PARK HEALTH CENTRE

4.2.1 Existing Facility

The St. Jago Park Health Centres is classified as a Type Four Health Centre. Currently this facility has three buildings. Since its construction, one additional building has been added. Specifically, a storage container was retrofitted and reconfigured to serve as the building catering to the needs of HIV patients.

The health centre does not have housing facilities for staff. The health centre has systems in place to cater to persons with mobility challenges, however no systems are in place to address the needs of the visually impaired and hearing impaired or persons with other disabilities.

The existing patient records system is not computerised; record keeping is paper based. In place are behaviour based and reporting systems that allow for reporting positive and negative situations. The systems in place allow for both staff and clients to make reports.

While not having a secure area to treat persons in police custody, the St. Jago Park Health centre treats such persons.

The St. Jago Park Health Centre currently operates between the hours of 8:00 am and 4:00 pm, Mondays to Fridays. The services currently offered include

- Antenatal/postnatal care
- Family Planning
- Vaccinations
- Dentistry
- Primary Medical Care Visits/curative
- Nutritional Consultations
- Post-surgery and out-patient wound care (dressings)
- Geriatric Care
- Out-patient care referred by hospital
- Isolation/Infectious Disease Management
- Mental Health Care
- Laboratory (blood tests) - Limited for HIV and STI's
- ECG (private)
- Dermatology

While St. Jago Park offers geriatric care and isolation/infectious disease management, the services are offered by staff not specialised in these areas. Additionally, laboratory services are limited to testing for HIV and STI's (sexually transmitted infections). Although offering ECG services at the health centre, this service is offered privately (no details were available). A specialist physician is also engaged full-time Dermatology services.

The health centre does not have its own on-site pharmacy; instead, patients access pharmacy services through the pharmacy located on the Spanish Town Hospital compound. The pharmacy is operated by the National Health Fund.

The St. Jago Park Health Centre is an over-utilised facility. On average between 200 and 250 persons access the services of the health centre daily. Patients include those accessing the services directly as well as referrals from other health centres and the hospital. Referrals would be from health centres in St. Catherine and the Linstead and Spanish Town Hospitals.

The present staff complement stands at seventy-one and is not adequate. Fifty-five persons are medical staff and sixteen are non-medical staff. The suggested ideal staff complement based on the current situation is ninety, of which sixty would be medical staff and twenty non-medical staff. Five additional doctors and four additional clinic attendants are needed. Clinic attendants are non-medical staffers who assist patients needing physical support (e.g., those with mobility challenges) and see to the general cleanliness and sanitation of the health centre.

There is a one-day emergency water storage capacity for the health centre, however the volume is not known. The health centre is also equipped with an alternative power source, however these needs upgrading.

4.2.1.1 Electricity

Electricity is supplied to the St. Jago Park Health Centre property by the Jamaica Public Service Company Ltd. Seven (7) electrical poles were mapped on the St. Jago Park Health Centre property on September 18, 2021 (Figure 4-1). No pole-mounted transformers, fixed backup generators or mobile generators were observed.



Figure 4-26 Electrical poles and transformers observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)

4.2.1.2 Tank Storage

Potable Water

There were three (3) locations where water storage tanks were located on the property (Figure 4-2), mainly black plastic water tanks of varying sizes (Plate 4-61).



Plate 4-61 Potable water storage tanks

Fuel

Two (2) locations were identified for fuel storage on the property, of which both were used for the storage of diesel (Figure 4-2). Plate 4-62 shows a diesel storage tank on site.



Plate 4-62 Diesel storage tank

Oxygen

No locations were identified for storage of medical oxygen on the property.



Figure 4-27 Tank storage observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)

4.2.1.3 Hazardous Chemical Storage

Several barrels and containers with oils and lubricants were seen around the property. Most of these were improperly stored and secured. Empty barrels were also seen littering the green space towards the back of the facility. Plate 4-63 - Plate 4-67 show the improper storage and handling of oils and other hazardous chemicals.



Plate 4-63 Oil barrels improperly stored with evidence of spills



Plate 4-64 Old barrels and fuel containers littering a green space



Plate 4-65 Improper storage of barrels with hazardous materials



Plate 4-66 Oil and fuel containers near in the maintenance area of the health centre



Plate 4-67 Maintenance area with hazardous materials left near a drain at the back parking lot

4.2.1.4 Drains

The health centre had exposed internal drains in the middle of the building (Plate 4-68 and Plate 4-69). The drain appears to be insufficient or blocked as some areas flood during heavy rain events.



Plate 4-68 Central drain which was partially flooded



Plate 4-69 Section of the central drain

4.2.1.5 Waste Streams

Categories of Waste

The main waste streams from hospitals and healthcare establishments are categorized into the following three categories for management purposes¹⁰ (C. L. Environmental Company Ltd., 2007):

1. **General/Non-Clinical Waste** – includes waste generated from administrative activities, general cleaning, food preparation and ward areas, provided that they are separated at the point of generation from the waste classified as medical and special waste. These wastes do not pose a special handling problem or hazard to human health, or the environment and their characteristics are similar to those of common domestic waste. Examples include
 - a. Wrappers and packaging materials/containers, food waste and leftovers, cleaning materials
 - b. Office materials and equipment including paper, newspaper, cardboard, plastic, glass disposable containers, hand towels, timber, metal
 - c. Used disposable bed pan liners, urine and specimen containers, faeces, incontinence pads and stoma bags
 - d. Used personal hygiene products

¹⁰ Health Facilities Infection Control Policies and Procedures Manual, Ministry of Health (Revised 2007)

- e. Non-infectious animal bedding
 - f. Waste that come into contact with patients through routine examination of patient care but are not soiled or saturated with fluid blood, body fluids, excretions, exudates or secretions example gloves, caps, gowns, drapes, disposable sheets, gauzes, cotton balls and dressings
 - g. Garbage generated by patients, workers, and visitors
 - h. Waste material that has been sterilized.
2. **Medical/Clinical Waste** – includes wastes generated during the different stages of health care (diagnosis, treatment, immunizations, research, etc.) that contains pathogens which are capable of producing an infectious disease. These wastes represent different levels of potential danger according to the degree of exposure of infectious agents.
 3. **Special Waste** – includes wastes generated during auxiliary activities that constitute a health risk due to their aggressive characteristics, such as Corrosivity, Reactivity, Inflammability, Toxicity, Explosivity and Radioactivity.

Examples and description of the different types of Medical and Special Wastes are presented in Table 4-1 (C. L. Environmental Company Ltd., 2007).

Table 4-37 Categories of Medical Waste

WASTE CATEGORY	DESCRIPTION AND EXAMPLES
<u>INFECTIOUS WASTE</u>	
Infectious waste	Waste suspected of containing pathogens e.g., laboratory cultures; waste from isolation wards; tissues (swabs), materials, or equipment that have been in contact with infected patients or animals; excreta
Anatomical/Pathological waste	Human or animal tissues or fluids e.g., body parts; blood and other body fluids; fetuses (including waste from mortuary and autopsy centres)
Sharps	Sharp waste e.g., needles; infusion sets; scalpels; knives; blades; broken glass
<u>SPECIAL WASTE</u>	
Pharmaceutical waste	Waste containing pharmaceuticals e.g., pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)

WASTE CATEGORY	DESCRIPTION AND EXAMPLES
Genotoxic waste ¹¹	Waste containing substances with genotoxic properties e.g., waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals
Chemical waste	Waste containing chemical substances e.g., laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances e.g., unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources

Medical Waste at St. Jago Park Health Centre

Medical/Contaminated waste is collected in red bio-hazard bags which are then taken to the Spanish Town Hospital for collection by the Waste Management Unit of the MOHW. Medical waste was seen improperly disposed of on the health centre grounds. Plate 4-70 to Plate 4-71 show examples of improper medical waste handling and storage observed on health centre grounds.



Plate 4-70 Medical waste being left in the waiting area at the health centre

¹¹ Genotoxic waste includes cytotoxic drugs used in cancer treatment and their metabolites and outdated materials, vomitus, faeces or urine from patients treated with cytotoxic drugs or chemicals, and materials such as syringes and vials contaminated from the preparation and administration of such drugs; they are highly hazardous, mutagenic, teratogenic or carcinogenic.



Plate 4-71 Medical and solid waste in bins on the hospital grounds

Non-Clinical Waste

Information from internal stakeholder consultations is that non-medical waste, to include food waste, is collected in black or green bags for collection by the National Solid Waste Management Authority (NSWMA). Some littering on site while bins place around the property seemed sufficient, littering is likely due to improperly disposal and storage. Plate 4-72 to Plate 4-74 are examples of waste handling on site. Figure 4-28 depicts solid waste storage location on site.



Plate 4-72 Solid waste storage area



Plate 4-73 Solid waste littering an area near a tent



Plate 4-74 Solid waste bins on site

MEDICAL WASTE GENERATION RATE

Medical waste generated is calculated by the estimated rates given in Table 4-2.

The estimated medical waste generation on clinic days = 10.0 kg/day (≈0.3 tonnes/month)

Table 4-38 Estimated Medical Waste Generation rates pre Category of Facility

Jamaica and United States Estimated Waste Generation Rates		
Generator Class	Jamaican Rate	US Rate (Federal Registry)
Hospital	1.0 kg/bed/day	2.6kg/bed/day
Clinic/Health Centre	10.0 kg/day	14.5 kg/day
Doctor's Office	10.0 kg/day	14.5 kg/day
Dentist Office	2.7 kg/week	3.6 kg/week
Veterinarians	negligible	7.2 kg/week
Medical Laboratories	54.5 kg/week	113.6 kg/week

Source: GOJ Comprehensive Solid Waste Management Study, Norconsult, October 1996

Sewage and Wastewater

Sewage waste generated at the health centre is treated at the on-site wastewater treatment plant (Plate 4-75). It should be noted that the St. Jago Park Health Centre is immediately adjacent to the Spanish Town Hospital which has its own treatment facility. No information on the level of treatment was received.



Plate 4-75 Wastewater Treatment Plant

4.2.1.6 Employment

St. Jago Park currently employs 20 administrative staff.

4.2.1.7 Patient Load

The patient load for 2019 and 2020, before the Covid-19 pandemic are given in Table 4-39 and Table 4-40

Table 4-39 St. Jago Park Total Patient Load Statistics for the Year 2019

Month	Year 2019
January	8234
February	8881
March	6473
April	7326
May	7617
June	7480
July	7784
August	7992
September	8164
October	7255
November	6171
December	4918
Total	88,295

Table 4-40 St. Jago Park Total Patient Load Statistics for the Year 2020

Month	Year 2020
January	6069
February	5785
March	5253
April	3022
May	4176
June	5091
July	5865
August	5460
September	6548
October	4825
November	5448
December	5172
Total	62,714



Figure 4-28 Solid waste storage observed at the Spanish Town Hospital and St. Jago Park Health Centre (September 18, 2021)

4.2.1.8 General Observations

Disabled Access and Amenities

No special areas, amenities or other conveniences were seen for individuals with special needs such as the visually impaired, hearing impaired or those with mobility issues.

Wheelchair Access

Wheelchair access points were in poor condition, areas were broken or damaged. Areas such as tented sections had no access points.

Walkways and Corridors

There were several issues with the condition of walkways, corridors and wheelchair access points. These included damaged and broken sections of walkways and/or corridors. These areas are hazardous to the public and staff, in particular to the elderly, visually impaired, and those with mobility issues. There were no covered walkways to access the health centre. Unpaved and dusty pathways were seen all around the grounds. These areas also have ponding issues during rain events.

Leaks and other structural damage

Leaks were seen in main seating area of the health centre. Other damage seen around the property included faulty doors and locks.

Tented areas

Tented areas have been established for overflow at the health centre. Covid testing and treatment tented areas were separated. These areas typically occur in green spaces, on dusty and uneven ground with no wheelchair access (Plate 4-76).



Plate 4-76 Muddy tented area outside the health centre

Asset Storage

For the purpose of this report assets are considered to be all property both specialized and unspecialized which is stored on site. Asset storage was seen in two main areas and in both cases poorly stored. Assets were seen littering sections of green spaces along with solid waste towards the back of the health centre. Most of the asset storage occurred in an unused section of an old building which also serves as the canteen. Some assets were also stored in and around a small storeroom by the generator (Plate 4-77 - Plate 4-79).

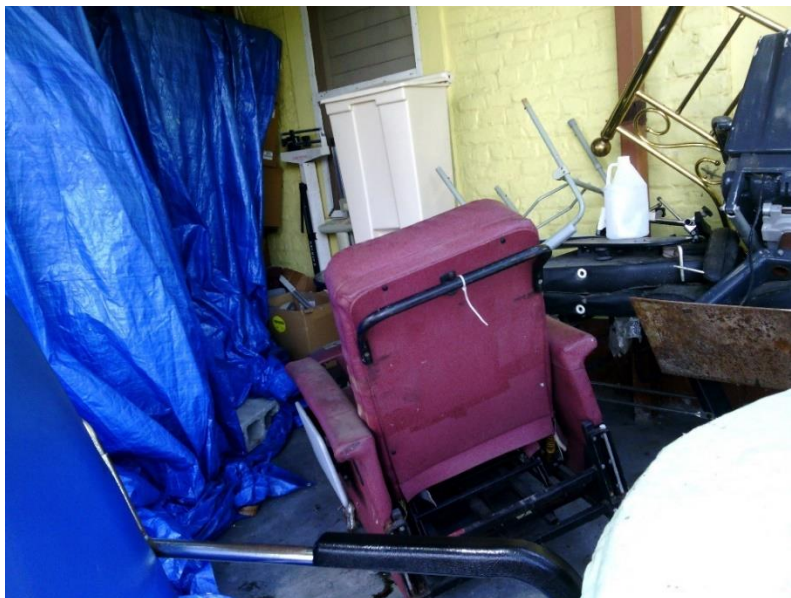


Plate 4-77 Asset storage at the back of the canteen



Plate 4-78 Assets stored outside a small storeroom near the back of the property



Plate 4-79 Assets stored outside a small storeroom near the back of the property

Green Spaces

Green spaces were generally fairly maintained. One section of the property was poorly maintained as this area is littered with non-medical waste, assets, cuttings and other debris.

Signage – Emergency Exit points, Assembly Areas

There was a single assembly point sign which was poorly visible at the back of the facility. The main health centre has a single major entrance and exit and no directional signs.

Restrooms

Restrooms were in poor to fair condition, with no special needs or disabled stalls or access areas in any staff or public area.

Flooding and Leaks

The main waiting area had significant leaks.

4.2.1.9 St. Catherine Health Department

Located on the St. Jago Health Centre grounds, the St Catherine Health department building has dual functions. It functions as an administrative building (1st floor) and public service provider, storage of pharmaceuticals and other MOHW assets (ground floor).

4.2.2 Physical Environment

4.2.2.1 Climatology and Meteorology

Weather data was requested from the Meteorological Service Jamaica for the nearest weather station to the St. Jago Park Health Centre located in St. Catherine.

The Meteorological Service provided 3 years of hourly data for Twickenham Park weather station located approximately 1.9 km to the northeast of the health centre for the years 2018-2020.

Temperature

Average temperature between 2018 – 2020 ranged from 24.3 °C to 28.7 °C. The lowest average temperature occurred in January 2019 whilst the highest average temperature occurred in July 2020. Maximum temperature over the time period was 36.8 °C which occurred on August 13, 2020, at 2pm and a minimum temperature of 16.6 °C which occurred on June 23, 2020, at 7am. The data indicated that in generally the warmest times of the year occurred between May to September, with July being typically the hottest month.

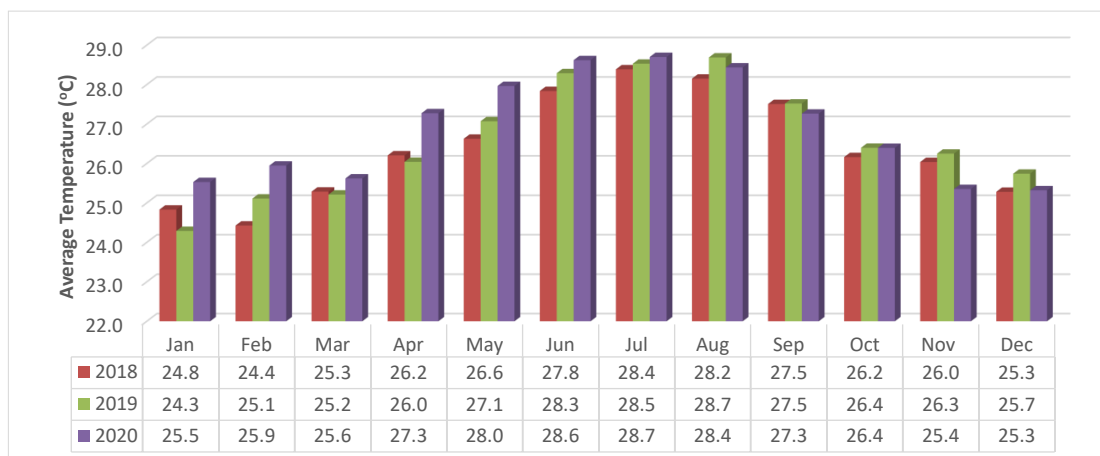


Figure 4-29 Average temperatures (°C) for the Twickenham Park weather station (2018 – 2020)

Relative Humidity

Average relative humidity over the three years (2018 – 2020) was 79.6% with a maximum of 98% occurring on November 9, 2020, at 7am and a minimum of 39% occurring on February 22, 2019, at 12pm. Generally, the highest relative humidity occurred between the hours of 4am – 7am and the lowest between 12 pm – 2pm.

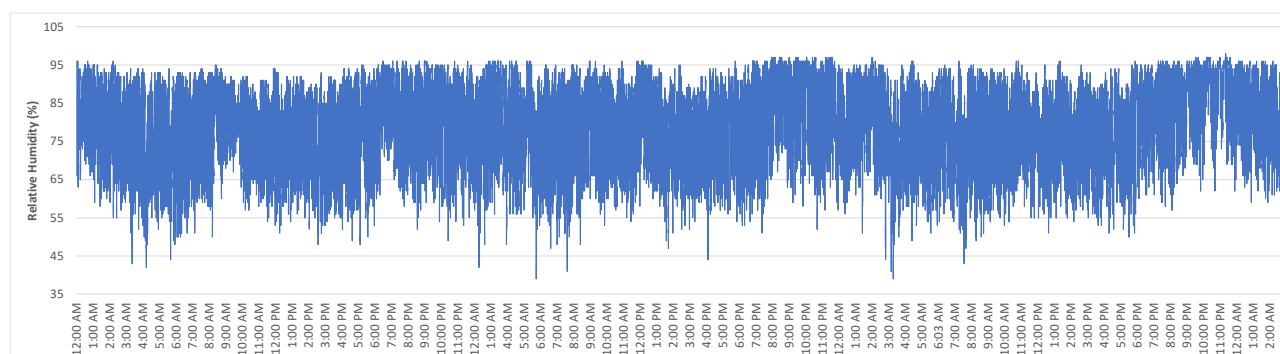


Figure 4-30 Relative humidity (5) for the Twickenham Park weather station (2018 – 2020)

Rainfall

Rainfall data (2018 – 2020) supplied by Meteorological Service Division for the Twickenham Park weather station in St. Catherine are depicted in Figure 4-11. This weather station is approximately 1.9 km to the northeast of the St. Jago Park Health Centre. The data indicates the rainiest periods tended to be in the months of May and between the months of September to November.

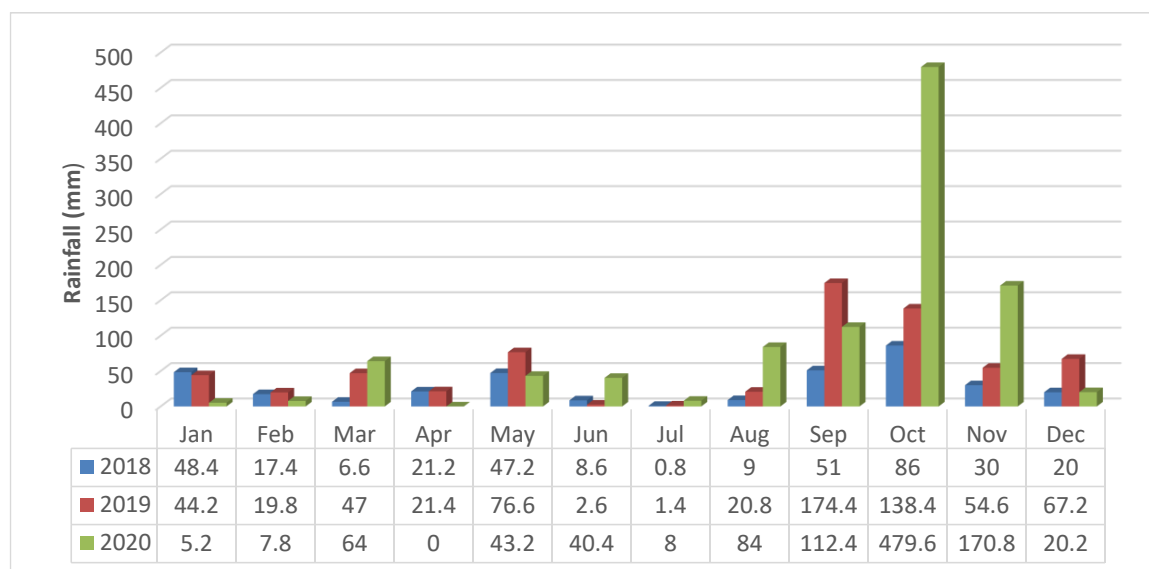


Figure 4-31 Rainfall data for the Twickenham Park weather station (2018 – 2020)

Wind Speed and Wind Direct

Average wind direction over the time period was from the northeast direction with an average wind speed of 1.88 ms^{-1} (3.65 knots). Calm winds occurred 5.54% of the time. Winds from the southeast were the most frequent, occurring 26% of the time. The next two frequently occurring wind directions are from the north northwest (20.2 %) and the northwest (10.3 %). The most frequent wind class category was the $0.5 - 2.10 \text{ ms}^{-1}$ (0.97 – 4.08 knots) which occurred between 62.2% of the time.

4.2.2.2 Topography

Elevation of the property ranged from 15.3 m – 29.0 m above mean sea level (amsl). It is characterised by relatively flat to gentle sloping land, with the majority of slopes less than 5 percent (Figure 4-33). The land generally slopes towards the south southwest (Figure 4-34).

4.2.2.3 Geology and Soils

Geology

The study area is located along the north-central section of the St Jago Plain in St Catherine. A review of the 1:50,000 Geological Sheet 17 indicates that the site is underlain by Quaternary Alluvium (Qa) deposited by the Rio Cobre and other paleo drainage systems which drained the highlands in the north (Figure 4-32). The Alluvium deposit consists of varying proportions of clay, silt, sand, and coarse gravel. Lithologically, these sediments reflect the source areas to the north which are dominated by volcanics, clastic sedimentary rocks, and limestones. A review of the 1:50,000 Metric Geology Sheet 17 indicates that there are no faults within the immediate vicinity of the proposed site. The limestone outcrops further to the north and south of the site are however faulted (Geo Technics Limited, 2020). No groundwater was encountered in any of the boreholes.

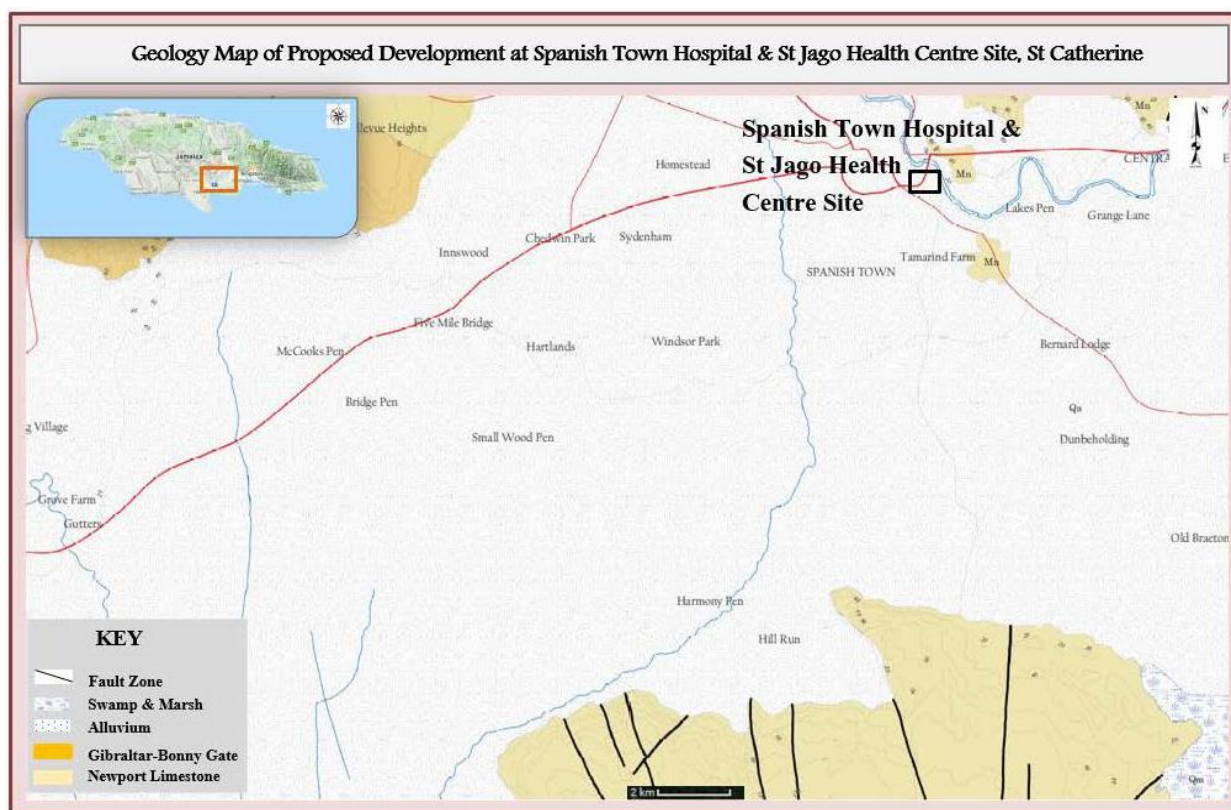


Figure 4-32 Geology of the St Jago Health Centre Site in Spanish Town, St Catherine



Figure 4-33 Percentage slope at the Spanish Town Hospital and St. Jago Park Health Centre

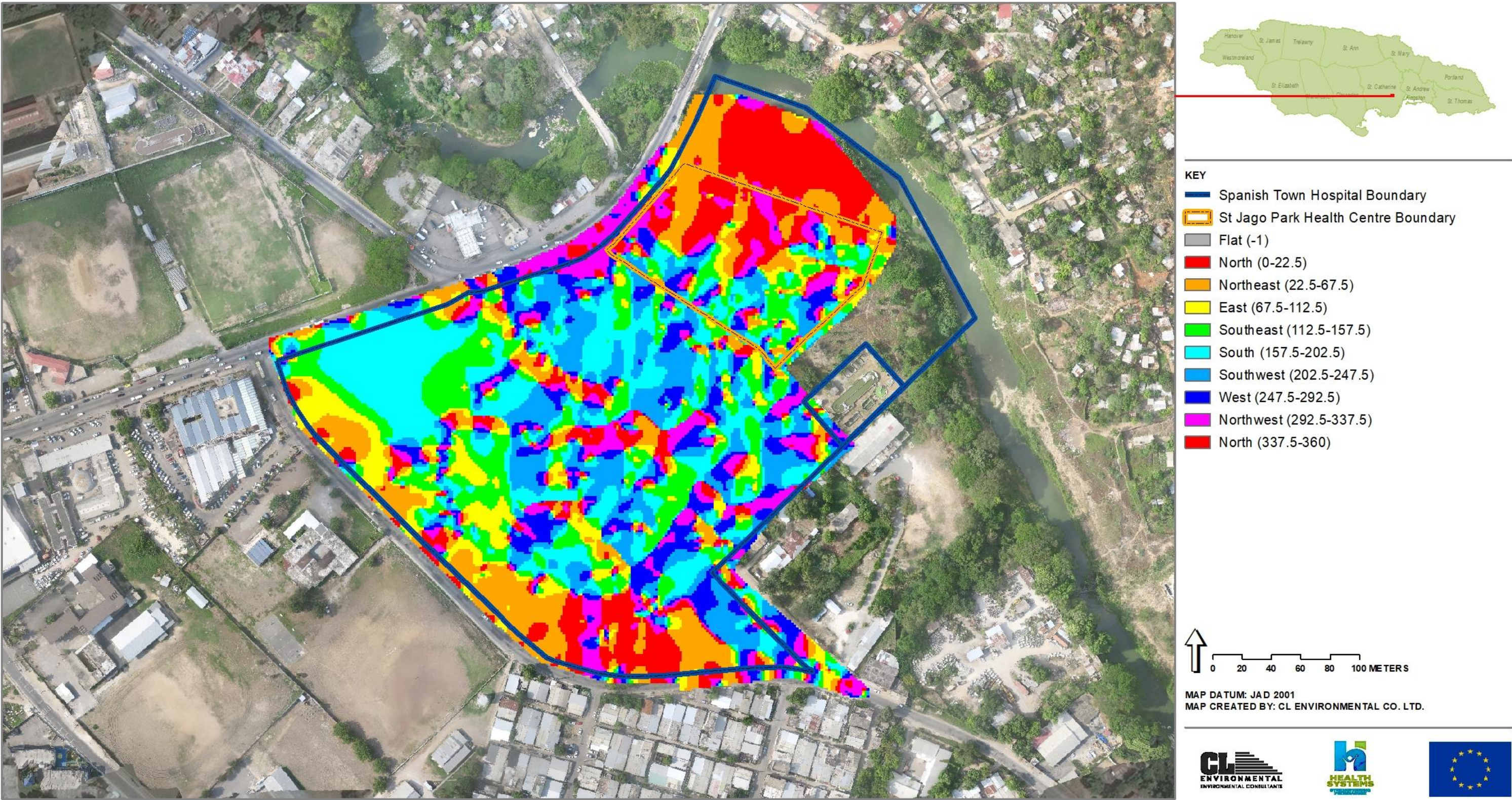


Figure 4-34 Aspect at the Spanish Town Hospital and St. Jago Park Health Centre

Soils

The soils at the site taken from two (2) boreholes conducted (Geo Technics Limited, 2020), is generally consistent throughout the site, comprising of stiff to hard sandy silt. Based on field description of soils, data from field test (*in-situ*) and laboratory tests on the soils encountered in the 2 boreholes, the soils at shallow foundation depths (up to 3.5m depth) is primarily stiff to very stiff sandy silt. No groundwater was encountered in any of the boreholes.

4.2.2.4 Air Quality

PM10

The results of the PM10 sampling run are shown in Table 4-41. All locations had particulate PM10 values compliant with the 24-hour NRCA standard of 150 $\mu\text{g}/\text{m}^3$. Station P5, located at the St. Jago Health Centre, had the highest PM10 value (60.69 $\mu\text{g}/\text{m}^3$).

Table 4-41 Summarized PM 10 Results

STATION	PM10 RESULT ($\mu\text{g}/\text{m}^3$)	NRCA STD. ($\mu\text{g}/\text{m}^3$)
P1	50.28	150
P5	60.69	150

Values in red are non-compliant with NRCA standards

PM2.5

The results of the PM2.5 sampling run are shown in Table 4-42. Station P5 PM2.5 concentrations (36.21 $\mu\text{g}/\text{m}^3$) was non-compliant with the 24-hour USEPA PM2.5 standard of 35 $\mu\text{g}/\text{m}^3$. Station P5, located at the St. Jago Health Centre, had the highest PM2.5 value (36.21 $\mu\text{g}/\text{m}^3$).

Table 4-42 Summarized PM 2.5 Results

STATION	PM2.5 RESULT ($\mu\text{g}/\text{m}^3$)	USEPA STD. ($\mu\text{g}/\text{m}^3$)
P1	30.97	35
P5	36.21	35

Values in red are non-compliant with USEPA standards

4.2.2.5 Noise

Methodology

Noise level readings were taken from 12:00am Friday September 3rd, 2021, to 12:00am Saturday September 4th, 2021, by using Brüel & Kjaer noise analysers setup in outdoor monitoring kits. Figure 4-35 shows the locations of the noise monitoring stations.

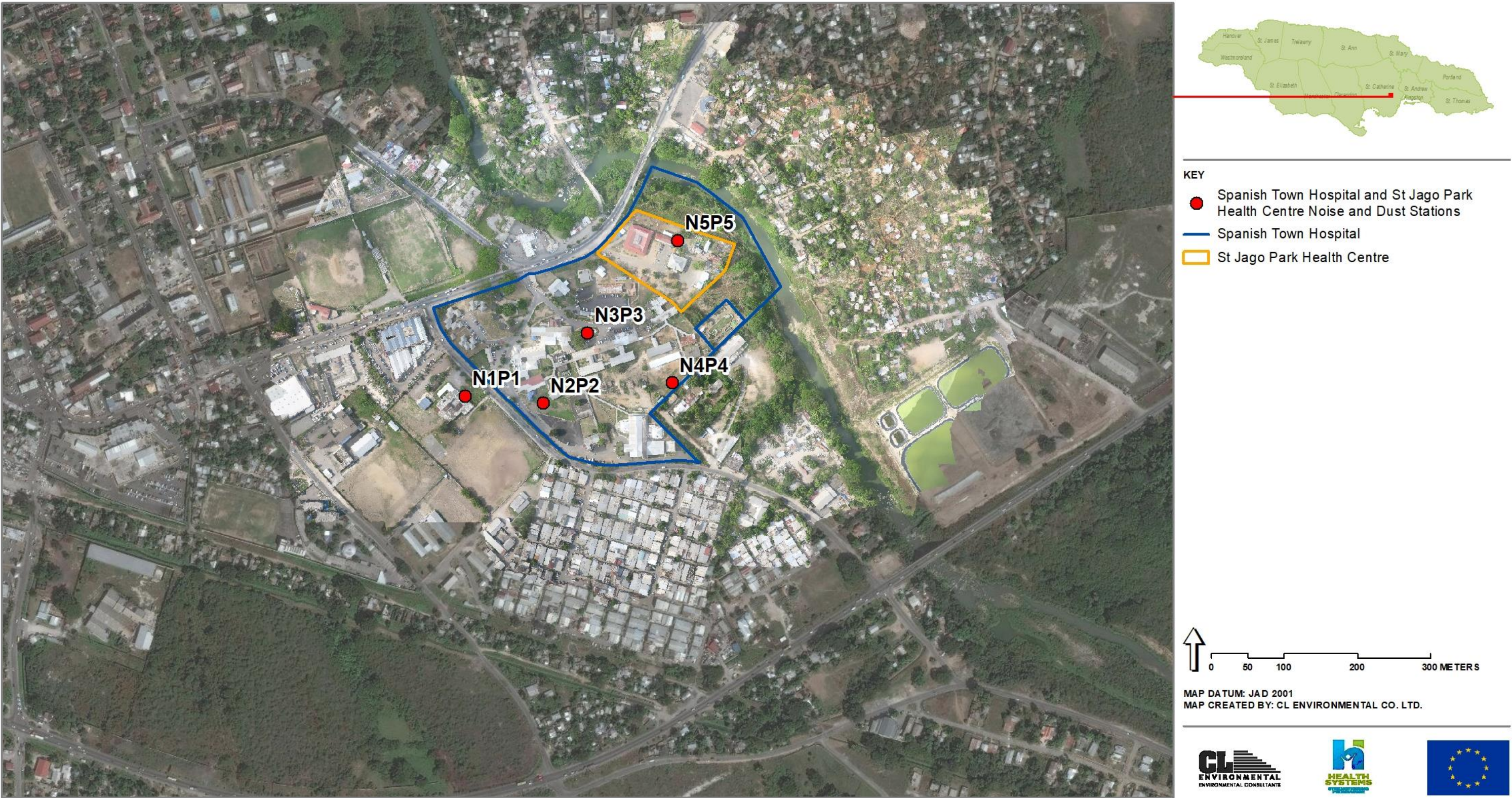


Figure 4-35 Noise and Particulate monitoring locations (Station N5P5 conducted at St. Jago Park Health Centre)

Results

Table 4-9 shows the minimum, maximum and average noise levels over the 24-hour assessment period, as well as the geometric mean centre frequencies obtained at each station.

Table 4-43 Ambient Noise data at all stations

Stn.#	Average Leq (24 hr)	Min (dBA)	Max (dBA)	Geometric Centre Frequency (Hz)	Octave Band Range (Hz)
N1	58.6	44.6	94.7	50	45-56
N5	51.3	35.8	86.5	50	45-56

COMPARISONS OF AMBIENT NOISE LEVELS WITH NRCA DAYTIME AND NIGHT-TIME GUIDELINES

Comparison of the ambient noise levels in the study area with the Natural Resources and Conservation Agency (NRCA) Standards are shown in Table 4-10. During the daytime, noise levels at Station N5 (52.7 dBA) were non-compliant with respective NRCA daytime standards. During the night-time, noise levels at Station N5 (45.0 dBA) were non-compliant with respective NRCA night-time standards.

Daytime noise sources detected which were above NRCA daytime guideline values, included: motor vehicle traffic noise, horns honking, people talking and bird calls. Night-time noise sources detected which were above NRCA night time guideline values, included: motor vehicle traffic noises and frog calls.

Table 4-44 Comparison of daytime and night-time noise levels at the stations with the NRCA guidelines

Stn.#	Zone	7 am. - 10 pm (dBA)	NRCA Daytime Guideline (dBA)	10 pm. - 7 am (dBA)	NRCA Night Time Guideline (dBA)
N1	Commercial	59.5	65	53.9	60
N5	Silence	52.7	45	45.0	40

NB. Numbers in red are non-compliant with the standard/guideline

COMPARISONS OF NOISE LEVELS DURING WORK HOURS WITH POTENTIAL CONSTRUCTION PERMIT GUIDELINES (70 DBA)

Table 4-11 shows the comparison of the ambient noise levels during permitted work hours (7:30am – 5pm on weekdays) with the potential NRCA permit guidelines at each station. Noise levels during work hours were compliant with the noise guidelines at both locations.

Table 4-45 Noise level during work hours (7:30am – 5:00pm)

STATION	7:30 AM – 5:00 PM (dBA)	Potential construction permit guideline
N1	60.0	70
N5	52.8	70

4.2.2.6 Vibration

Baseline Vibration Calculations

Using the prediction calculations, vibration levels were predicted at a distance of 35 metres from the centreline of Burke Road to the existing health centre building, using a “3-tonne truck travelling at 35

mph” as the operating equipment/vehicle. Results showed that the PPV vibration value was **0.004 mm/sec**, which indicates that vibration levels are imperceptible by humans and have no effect on building structures.

4.2.2.7 Existing Sources of Pollution

On-site pollution sources include drainage of oily wastewater from vehicle washing by the chemical storage shed (Plate 4-80 and Plate 4-81). Burning was seen taking place on property (Plate 4-82 and Plate 4-83) as well as along the main road, in particular in the general market area.



Plate 4-80 Blocked drain with oily film along the hospital boundary



Plate 4-81 Vehicle wash area beside chemical storage shed



Plate 4-82 Burning at the St. Jago health centre



Plate 4-83 Burning at the St. Jago health centre

4.2.3 Natural Hazards

4.2.3.1 Natural Hazard Identification

Flooding

HYDROLOGY AND FLOOD PLAIN MODELLING

A flood plain model was established illustrating the flood plain and depths within the project area and areas around the island to determine the level of exposure for the site. The tool of choice when generating flood plains is the Hydrologic Engineering Centre's River Analysis System (HEC-RAS). The United States army corps of engineers created this software to perform one and two-dimensional hydraulic calculations for a complete network of natural and constructed channels. Due to the complex nature of the hydrodynamics within the project area, a 2-D model was used to generate flood depth to predict flooding to determine its impact on the surrounding infrastructure. To fully understand its extent, it was necessary to analyse the project area using a general approach, considering the dynamic nature of the environment and the existing drainage channels.

Key features (inputs) used to do the assessment are as follows:

1. JAXA Topographic Data Topographic data (30m Geotiff).
2. Topographic Survey Data
3. Historical and Projected Extreme Rainfall (Return Periods 25Yr-100Yr)
 - a. Daily precipitation – Blair Pen Rainfall Station
4. Land Cover and Soil Type

TOPOGRAPHY

The terrain data was derived from a combination of submitted site specific topographic data, in combination with available JAXA (Japanese Aerospace Exploration Agency) Digital Elevation Map (DEM) of the island, captured using advanced satellite imagery. The DEM serves as the base of the 2D model, using a finite element mesh to calculate the water volumes and thus the flood plains throughout the model.

PRESENT RAINFALL CONDITIONS

Depth of rainfall for various return periods was provided by the National Meteorological Service of Jamaica for the closest gauge to the Spanish Town Hospital and St. Jago Park Health Centre, which was the Blair Pen rain gauge station (Figure 4-16). This station is 2.3km from the project, and its rainfall depth can be viewed in Table 4-13.

Table 4-46 Present climate 24-Hour Rainfall Depths (mm) for Blair Pen rain gauge station (Met. Service/NWA)

Return period (years)	Rainfall Depths (mm)
25-Year	275
50-Year	392
100-Year	425

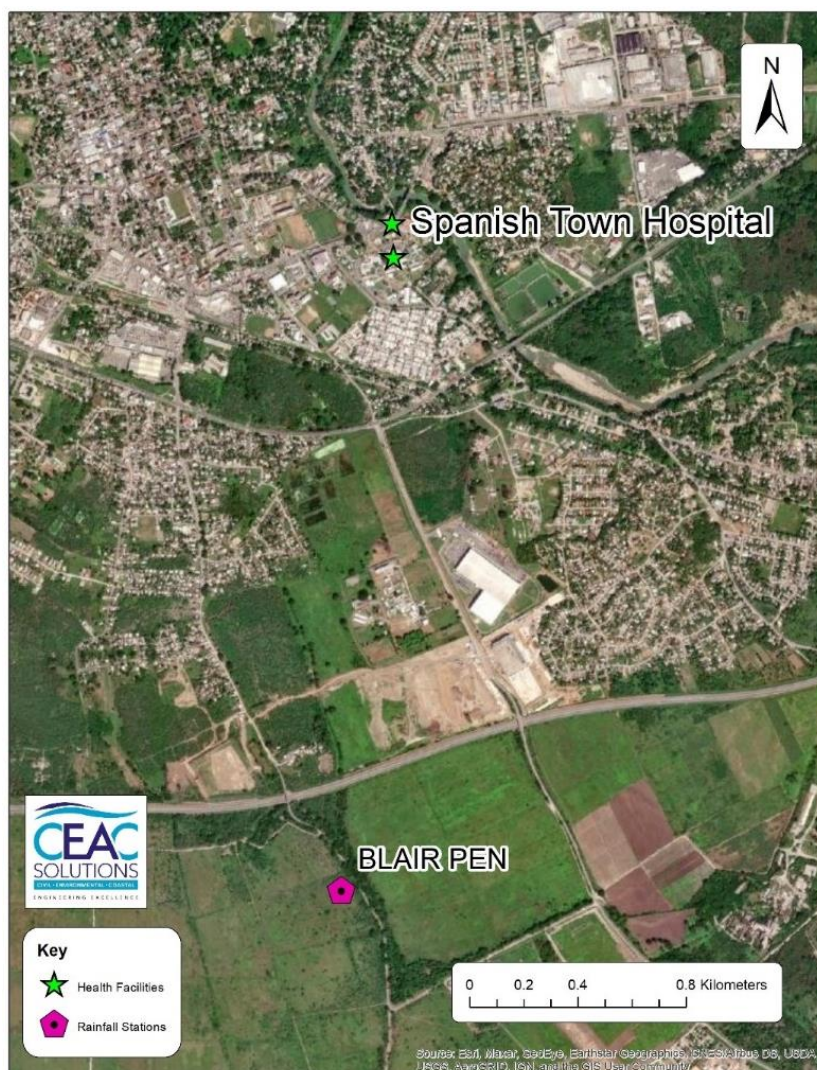


Figure 4-36 Location of Blair Pen, Catherine rainfall gauge station relative to project area

RAINFALL HYETOGRAPH

The Type III rainfall distribution curve was used for this assessment as it most accurately reflects the 24-hour rainfall distribution experienced by the island. Rainfall Hyetographs were generated using the present and future climate conditions extreme rainfall and used to model the respective return periods.

MODEL CALIBRATION AND VALIDATION

In order to validate the flood plain model, the modelled project area was compared to both collected anecdotal data and available data from the ODPEM, showing two-hundred and ninety-three (293) recorded flood-prone areas.

Anecdotal data

During the site visits on the 31st of August 2021, and on the 13th of September 2021, anecdotal interviews were conducted on the health facility compound. All respondents reported that they have

not witnessed any flooding (no inundation of buildings and parking areas) in the project area on the compound. This can be corroborated from visual inspection during our visit, as the topography of the land does not allow for flooding.

ODPEM Flood Prone Areas

The comparison of the ODPEM Flood Prone Areas was used as the secondary validation method for the model. The ODPEM data presented two-hundred and ninety-three (293) flood-prone areas and allowed for confirmation of known flood-prone areas, however, no depth was recorded in the dataset. This validation involved probing whether or not the flood plain generated was within a 500m radius of the flood-prone areas as presented by the ODPEM. The ODPEM Flood Prone Areas map indicated that the general Spanish Town area is prone to flooding, however, the depths within the model did were negligible with the health facility.

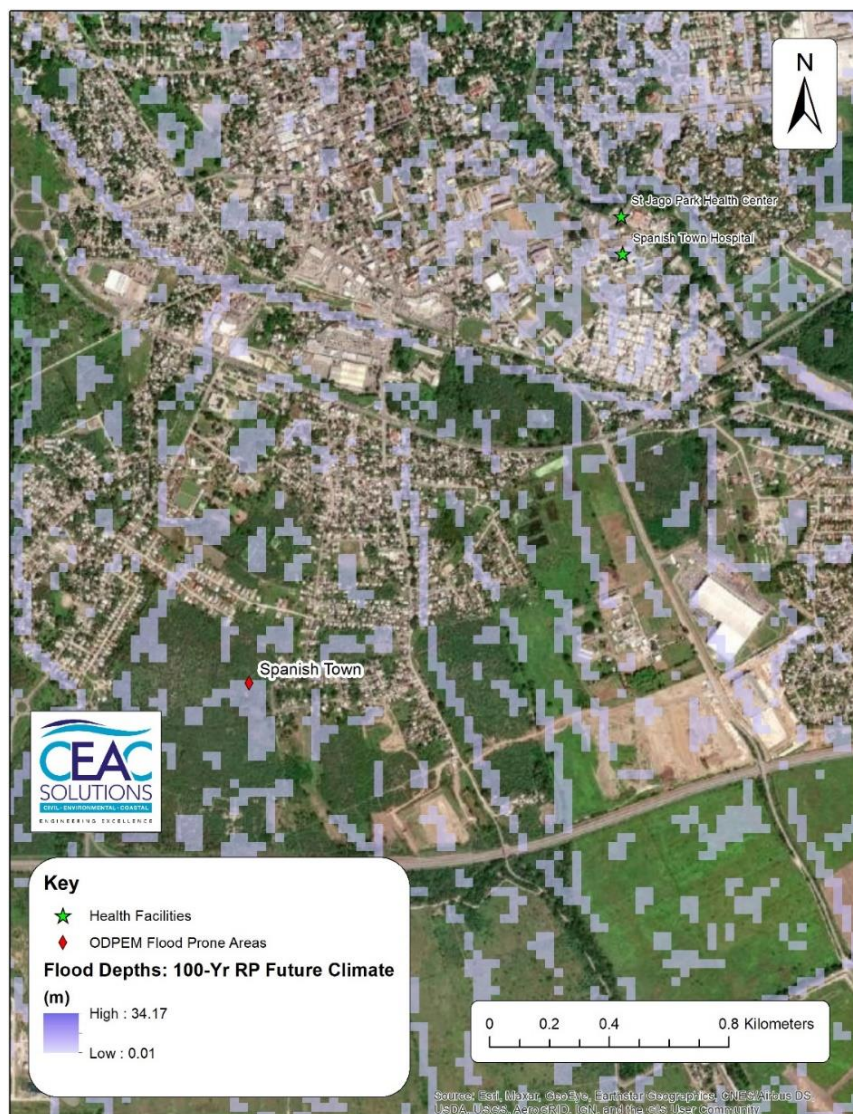


Figure 4-37 Flood Plain Validation map showing ODPEM Flood Prone Areas with 100-Yr Future Climate

FLOOD PLAIN MODEL RESULTS

The results of the hydraulic model do not highlight any areas on the St. Jago Park Health Centre compound that experiences any pluvial (floods occurring independent of an overflowing water body) flooding. Furthermore, no fluvial flooding (flood caused by water bodies overflowing their banks) was observed, as the Rio Cobre does not break its banks. From the flood plain model, it was observed that neither pluvial nor fluvial flooding affected the facility for any of the presented return periods (Figure 4-38). This corroborates the interviews from the employees, as well as what was observed during our site visit as the topography does not allow for a flooding issue.

Although the hazard identification stage would have flagged the site as being exposed to flooding due to level of flood prone areas within proximity to the site from a historical background. The further flood plain analysis which it prompted indicated that the need for further assessment of the site for flood hazard was unnecessary.



Figure 4-38 Flood plain map of the St. Jago Park Health Centre for the Pre-Improvement, 100-Yr Future Climate Scenario

Earthquake

GEOLOGY AND LITHOLOGY

Jamaica straddles the boundary between Caribbean tectonic plate and Gonave micro-plate. The Walton and the Enriquillo Fault Zones, extending respectively to the west and the east of Jamaica, form the boundary between these two plates. The movement across these two fault zones are transmitted through the Jamaican Fault system and are the source of significant earthquake activity in the island.

To the north approximately 8km from the project site, faults within the Bog Walk area have resulted in downthrow of limestone blocks further north. The most prominent fault zone in that area is the Cavaliers Fault zone which trends in the general E-W direction. This fault extends through areas of Bog Walk, Sligoville, and along Cavaliers to Stony Hill where it slightly offsets the Wagwater Fault. This fault continues across the Wagwater Belt which trends in a south-easterly direction.

HISTORICAL EARTHQUAKE EVENTS

Seismic events have the capacity to be some of the most devastating and costly natural hazards. The level of damage or loss typically varies depending on the magnitude of an event, wherein effects can range from only being noticed via seismograph to significant loss of life and infrastructural damages. Despite having the tools for monitoring and recording these occurrences, earthquakes are unpredictable in nature.

Jamaica has had a notable earthquake history with significant events such as the 1692 Port Royal earthquake, the 1907 Kingston earthquake, the 1957 March 1st earthquake, which impacted the western end of the island and the 1993 January 13th earthquake. These events were the cause of significant losses for Jamaican citizens but only represent a small portion of the seismic activity occurring on the island; more recently, between 2011 and 2020 there were over 1000 recorded earthquakes with local epicentres, of which approximately 94 were actually felt (Figure 4-23). Although none were catastrophic, it highlights the significant levels of seismic activity across Jamaica.

Of the 1,032 seismic events measured between 2011 and 2020 (Jamaica) (Source: Earthquake Unit University of the West Indies, Mona Campus), 10 occurred within the Service Area of the Spanish Town Hospital. These occurred in 2012, 2015, 2018 (2 events), 2018 & 2019 (3 events each). The three (3) closest events to the Spanish Town Hospital are listed in Table 4-15. These were considered minor events (Anon., 2021). There also seismic events much further away that were still felt, such as the 7.7 magnitude earthquake on January 5th 2020, that occurred offshore of Lucea that was felt island-wide.

HORIZONTAL GROUND ACCELERATION

The ground and spectral was used as the basis for exposure to earthquake hazard as it considers any impact that the distance of the epicentre away from a site would have, by simple recording the acceleration at a location. The Peak Ground Acceleration for the project area was extracted from the seismic hazard maps for Jamaica generated under the Caribbean Disaster Mitigation Project (Organization of America States (OAS), 1998) and the Probabilistic Seismic Hazard Assessment (Figure 4-24).

The Spectral Acceleration (SA) is the preferred Seismic Hazard intensity parameter used in most modern building codes. This is a measure of maximum acceleration observed from a specific oscillatory period (similar to that of natural building oscillation) caused by a sustained shaking during an Earthquake. This acceleration varies based on location and as result means that the level of ground shaking also varies based on location.

Determining the short and long period spectral accelerations associated with varying regions can be a useful indicator of the level of seismicity and consequently the possibility of more pronounced ground motions in one area versus the other. The spectral acceleration periods observed were 0.2 seconds which is representative of short buildings (a few floors tall) and 1.0 second which is geared towards representing the oscillations of taller structures (greater than 7 floors).

DAMAGE DESCRIPTION

Higher accelerations would imply a greater level of intensity at the location in question. As such a higher value would point to increased levels of damage and as result a relationship can be generated between ground acceleration and the Mercalli scale, which describes the probable extent of damage. (Table 4-16). As per the Rapid Visual Screening Program developed by FEMA, a series of seismicity zones were determined based on the level of short period and long period spectral accelerations experienced. See Table 4-17.

RESULTS

The findings indicate that the Spanish Town Hospital is within a Moderately High Seismicity zone and that, there is the possibility of slight damage to specially designed structures in the event of 2475 return period event. Buildings of a lower design standard may suffer more considerable damage.

RP	Spectral Acceleration	St. Jago
475	PGA	0.28
	(Short Period) 0.2	0.64
	(Long Period) 1.0	0.21
2475	PGA	0.5
	(Short Period) 0.2	0.97
	(Long Period) 1.0	0.27
4975	PGA	0.64
	(Short Period) 0.2	1.24
	(Long Period) 1.0	0.36

Wind

DESCRIPTION

Hurricanes produce heavy rainfall, high winds, and storm surge, all of which have the potential to cause damage and dislocation. High winds possess the ability to exert forces on the physical structure of buildings and also generate projectiles. The projectiles may pose a risk of causing damage to surrounding infrastructure or lead to injuries and fatalities. While spontaneous weather systems such as thunderstorms or cold frontal systems may produce higher than normal wind speeds, Hurricanes

are responsible for most wind hazard situations. Hurricane wind speeds are typically used to categorize severity and lend to indicating the level of damage that can be expected. See Table 4-18 for categorization as per National Hurricane Centre (NOAA).

METHOD

To determine the extreme wind speeds experienced on an annual probabilistic basis, hurricane level winds and hurricane tracks were extracted from locally generated datasets sourced from both government agencies and the National Hurricane Centre (NOAA). Application of extremal statistics to predict maximum wind speeds and exceedance probabilities using Weibull's distribution produced the different return periods attached to the wind speeds. These results were plotted on maps and the points relating to the facilities extracted. The data relevant to St. Jago Park Health Centre is seen in Table 4-47.

RESULTS

Table 4-47 Wind speeds for St. Jago Health Centre and respective return periods

Return Period (years)	Wind speeds (m/s)
25	55.4
50	57.4
100	61.2

4.2.3.2 Risk Assessment

Background

In evaluating the feasibility of undertaking the Health and Systems strengthening program in St. Catherine, and more specifically the construction of the proposed development at the Spanish Town Hospital, the risks associated with its development have to be determined. Risk can be defined as the potential loss of life, injury and destroyed or damaged assets which could occur to a system, society or a community in a specific period of time. As such the typical approach evaluates risk as a function of hazard, exposure, vulnerability and the criticality of the project (UNDRR, 2017).

Methodology

The methodology presented in the Disaster and Climate Change Risk Assessment Methodology for IDB Projects (2019)¹² states the risk analysis should include the identification of hazards, degree of exposure of the hazard on the facility, identification of project vulnerability to said hazards, identification of impacts and the development of recommendations for failure modes or prevention of damage. The proposed IDB methodology and its phases were used as the framework for the risk assessment to integrate both the technical and operational narratives for all four (4) health facilities. The Simplified Probabilistic Assessment was used as a general guide in this report, where the relation

¹² Barandiarán, M., Esquivel, M., Lacambra Ayuso, S., Suarez, G., & Zuloaga, D. (2019). Disaster and Climate Change Risk Assessment Methodology for IDB Projects: A Technical Reference Document for IDB Project Teams.

between the pertinent assessment factors has been summarized in the following equation. It is based on the quantitative approach which aims at quantifying risk according to the hazards, vulnerability of assets and amount of exposure of the asset.

Hazards

From the hazards presented in this report, the most relevant ones pertaining to the 4 facilities were chosen. This decision was made after careful expert analysis of the locations and the context in which likely and substantial damage could potentially be experienced. Hazard selection was also done from an island-wide perspective for events that have historically had a major effect on commercial/private operations. These events to be highlighted in the risk assessment are:

- Seismic Activity
- Hurricane Winds

Each of the above hazards will be associated with a frequency matching a certain intensity to allow for replicable measurement of varying levels of potential damage to property. For flooding and hurricane winds, return periods (RPs) were used: 25 year-, 50 year- and 100 year- RPs. The values were obtained from rasters generated from local datasets. For seismic activity, long and short spectral accelerations were used which were also tied to return periods: 475 year (0.28g), 2475 year (0.5g) and 4975 year (0.64g) return periods (where g is gravity).

Vulnerability

DESCRIPTION OF VULNERABILITY

In order to determine the vulnerability of each location, the identification of failure modes for the identified hazards and the relation to assets' capability to sustain damage was determined. Seismic Events have the potential to cause permanent structural damage, aesthetic damage, and damage to equipment and affect the low level and critical medical operations. Wind events typically have the potential to dislodge components fastened to a structure. This could result in aesthetic damage or launching of projectiles that can cause irreparable damage. For the purpose of rating vulnerability, each impact description was ranked as Trivial, Minor, Serious or Catastrophic. This provides a basis of ranking as seen in Table 4-20 a brief general description of the impacts for each event can be seen in Table 4-21.

VULNERABILITY RATING FROM SEISMIC ACTIVITY

The proposed development aims to renovate the existing structures through the construction of add-ons linking the two existing structures. The final structure will remain a ground level building. The renovation is expected to have some impact on the seismic performance of the structure as it alters the geometry. For the purpose of the assessment, the FEMA P154 rapid visual assessment (RVA) was used to estimate structural seismic performances. The assessment considered the seismicity of the location, soil and terrain conditions, age, building and design code. In essence, the RVS scores highlight the probability and extent of damage to a building. The building type of the proposed health centre, according to the FEMA building characterization, is given in Table 4-23.

Table 4-48 Building type for STH

Proposed Building Type	Building Name	RVS Score
Reinforced Concrete Masonry	Proposed Joint Structure	1.8 – 2.6

The score of the structure takes into account the score of the new structure and was based on the assumption that it would be designed to the requisite IBC design standards. The range of score is somewhat wide as it takes in account shortfalls that may exist from the older construction type of the existing building. The score obtained, seen in Table 4-23, was for the most part above the standard score of 2, indicating that the proposed building will have a more favourable performance during seismic activity. However the portion below 2 indicates the possibility for damage in the following ways:

1. Cracks in Columns
2. Cracks in beam-column joints
3. Spalling of concrete cover
4. Buckling of reinforced bars
5. Large cracks in infill/partition walls (non-structural walls).

However definitive seismic performance should be confirmed based on structural designs of the proposed building as the FEMA P-154 only provides a basis for screening and recommendation for analysis (see Table 4-24).

VULNERABILITY RATING FROM HURRICANE WINDS

The proposed St. Jago Health Centre building will also be exposed to hurricane winds and is expected to experience a degree of damage from the event. This level of damage and the resulting impact based on the proposed building design will be taken from Table 4-18. With wind speeds ranging from 55.4 m/s to 61.2 m/s, the building will experience devastating to catastrophic damage (see Table 4-25). This takes into account the building being considered a ‘well-built frame’ that will experience damage to the roof structure and interruptions in utility services.

Criticality

A review of the facility’s social impacts demonstrates that shortfalls associated with new construction could significantly affect various portions of the populous. This allows for a better understanding of the potential consequences of failure of the facility and the characteristics that contribute to its vulnerability. The criticality thresholds were derived from those depicted in Table 4.11 of the IDB Methodology. Overall, the facility has been considered a high-risk project fit to undergo qualitative risk evaluation. The St. Jago Park Health Centre serves the same populous as the Spanish Town hospital, but is to aid in reducing the number seen at the hospital.

Table 4-49 Criticality of proposed Facilities

	Characteristics	Value	Criticality Rate
St. Jago Park Health Centre	Service area (km ²)	175	High
	Service Population (per)	Approx. 600,000	High
	Building Square Area (m ²)	1,260	Moderate

Exposure

Each facility's level of exposure will be measured specific to each of the hazards presented. This will consider the coincidence of the facility's location with the expected point of occurrence of the hazards. For flood events, a dimension of depth will also be included to evaluate the potential level of inundation and the resulting assets/structural components at risk. This will be taken from the maps generated and presented in this report from previously run hydrodynamic models. In relation to seismic exposure, it is established that all the facilities experience seismic activity. The level of exposure for each will account for the proximity of the facility to historically recorded seismic events. For hurricane winds, wind speeds across the island vary based on a location's surrounding topography, proximity from the coast and intensity of the potential storm. Data values taken from the CORDEX RCM database were used to generate maps specific to the island and will be used to determine the facilities' exposure to hurricane winds.

SEISMIC ACTIVITY

While all sites are considered exposed to seismic activity, the level of exposure will vary according to the location on the island. This varying level of exposure was based on spectral acceleration maps which through historical occurrences predicted the magnitude of ground movement. The level of ground movement of each site, would vary despite being exposed to some of the same events due to factors such as distance to event epicentre and geological properties (i.e. soil and rock structure). The literature presented in the Journal of Civil Engineering was generated to provide a seismic spectral acceleration map to be utilized in conjunction with the International Building Code seismic design guidelines. Extraction of the coinciding spectral acceleration based on the location of each project site yielded the accelerations below.

Table 4-50 Resultant spectral accelerations (short and long) with associated return periods

RP	Spectral Acceleration	St. Jago Health Centre
475	PGA	0.28
	(Short Period) 0.2	0.64
	(Long Period) 1.0	0.21
2475	PGA	0.5
	(Short Period) 0.2	0.97
	(Long Period) 1.0	0.27
4975	PGA	0.64
	(Short Period) 0.2	1.24
	(Long Period) 1.0	0.36

HURRICANE WINDS

All health facilities are considered to have the same level of exposure to hurricane winds. The variation in the speed of hurricane level winds experienced by the facility is dependent on the building's location relative to the coast, surrounding topography and the surrounding land use for the site. Another factor affecting the building exposure is the footprint area and height of the structure which will increase the risk associated with damage from extreme hurricane winds. A summary of these factors is presented in and will contribute to the final risk matrix.

Table 4-51: Exposure considerations and values for hurricane winds.

RP	Wind speed (m/s)	Building footprint (m ²)	Proposed Building Height (m)
25	55.4	1,260	4.2
50	57.4		
100	61.2		

Risk Analysis

For the hazard events, A combined (weighted) ranking considering the asset exposure, hazard probability and vulnerability of the building will be utilized to assign a suitable risk rating. The at-risk infrastructure will be determined using the factor combination proposed by the IPCC dictating risk being a product of an asset's exposure × vulnerability × hazard present¹³. For the Spanish Town Hospital, the approach taken to the risk assessment will be qualitative, considering the casual relationship between the impact of the climate hazard and the outcome of the impact¹⁴ as described in the preceding sections. The final result will be a risk matrix developed using weighted values to estimate the risk of the facility's infrastructure and equipment to the combined impacts of the three (3) hazards: flooding, seismic activity and hurricane winds. A table showing the method and colour assignment for each value can be seen in Table 4-30 and Table 4-31. A ranking from 1 (lowest) to 12 (highest) will be assigned to the different assets based on their physical condition and their surrounding environments. The ranking for the hazards has been further divided into flooding and hurricane winds, vs. seismic activity. The impact of the hazard on the asset will be taken from Table 4-21. The weighted value for the risk matrix is a representation of the overall risk of the facility out of a total ranking of 12.

Table 4-52 Results of risk matrix for SJHC

Exposure metric	Seismic Activity			Hurricane Winds			Weighted Value *multiplied by (H/3)
	475 RP	2475 RP	4975 RP	25 RP	50 RP	100 RP	
Area of building and no. of floors	6	6	4	9	6	4	3.9

*matrix values divided by 3 for fair comparison against other facilities that experience flooding.

¹³ IPCC. (2012). *Determinants of risk: exposure and vulnerability*. Source: https://www.ipcc.ch/site/assets/uploads/2018/03/SREX-Chap2_FINAL-1.pdf

¹⁴ Hughes J. et. al. (2020). *Impacts and implications of climate change on wastewater systems: A New Zealand perspective*. Source: <https://doi.org/10.1016/j.crm.2020.100262>

Summary of Risk Matrix Findings

The values obtained from the risk matrix reflect variations in both frequency of the hazard events and the resultant impact of the event on the facility based on both the intensity of the hazard (tied to the RP) and the structural resilience of the building. As a result, the matrix is able to fairly compare the overall risk of the development by assessing both the expected damage from a certain event, whether great or small, and the likelihood of it occurring. In other words, this allows for less frequent but intense events to be similarly rated against frequent but less intense events, where similar monetary expenditures from recovery efforts or damage to infrastructure may be experienced over time. This can be seen with the hurricane winds where the 100-yr RP event has a lower rating than the 25- and 50-yr RPs. This is because the wind speeds for all 3 RPs stagnate at about 50 to 60 m/s, making the 100-yr RP event the least likely occurring event with the same magnitude of damage produced (ref. Table 4-18). Since the island experiences these hurricane winds fairly frequently (at least a 1 in 4 probability each year i.e. 25-yr RP), the matrix ranks this RP relatively high on the scale. A similar concept is true for the risk from seismic activity. An overall ranking of 3.9 establishes the facility as a relatively robust structure to common local hazards, experiencing damage-causing events within its lifespan.

4.2.4 Biological Environment

4.2.4.1 Flora Assessment

Species diversity within the boundaries of the St. Jago Health Centre was relatively low. A total of 33 plant species from 23 families were recorded during the assessment of the vegetation. Most of the plants encountered were trees, with several shrubs also being observed. In addition, a few climbers and grasses were observed. The large open area to the south of the facility (adjacent to the Spanish Town Hospital's Sewage Treatment Plant) is the area with the highest density of plant species. Most of the large trees observed (DBH>20cm) are fruit and ornamental tree species that were planted as a part of the landscaping of the property.

The species in the list provided are not a part of the International Union for Conservation of Nature (IUCN) or Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists.

Table 4-53 List of floral species identified along transects in the assessed area. A classification ranking was used to show prevalence (Adams 1972) and the DAFOR index to show the frequency of each plant species encountered.

Family	Scientific Name	Common Name	Range**	DAFOR
Mimosaceae	<i>Albizia lebbbeck</i>	Woman's Tongue	Locally common, naturalized in open secondary woodlands	D
Amarathaceae	<i>Amaranthus viridis</i>	Callaloo	Common as a weed of grassy places and open ground	O
Annonaceae	<i>Annona reticulata</i>	Custard Apple	Cultivated and escaped into waste places near habitations	R

Family	Scientific Name	Common Name	Range**	DAFOR
Annonaceae	<i>Annona squamosa</i>	Sweet Sop	Commonly cultivated, escaping near habitations and along roadsides and pasture margins	R
Meliaceae	<i>Azadirachta indica</i>	Neem	Sparingly cultivated	O
Caesalpiniaceae	<i>Bauhinia purpurea</i>	Poor Man's Orchid	Cultivated ornamental	O
Asteraceae	<i>Bidens pilosa</i>	Spanish Needle	A common weed of roadsides and waste places	D
Sapindaceae	<i>Blighia sapida</i>	Ackee	Cultivated	O
Fabaceae	<i>Cajanus cajan</i>	Gungo Peas	Common in cultivation	R
Caesalpiniaceae	<i>Cassia fistula</i>	Golden Shower Tree	Common ornamental plant	F
Caesalpiniaceae	<i>Cassia occidentalis</i>		Common in waste places	O
Casuarinaceae	<i>Casuarina equisetifolia</i>	Willow	Common, mostly in sandy coastal areas and often planted	O
Poaceae	<i>Chloris barata</i>		Very common as weed along roadsides and in waste places	F
Rutaceae	<i>Citrus aurantium</i>	Sour Orange	Common in cultivation	R
Arecaceae	<i>Cocos nucifera</i>	Coconut	Cultivated and naturalized	R
Commelinaceae	<i>Commelina benghalensis</i>		Locally common in cultivated grounds and waste places	R
Cucurbitaceae	<i>Cucurbita pepo</i>	Pumpkin	Cultivated	R
Caesalpiniaceae	<i>Delonix regia</i>	Ponciana	Commonly cultivated and occasionally naturalized	O
Boraginaceae	<i>Ehretia tinifolia</i>	Bastard Cherry	Fairly common in secondary woodlands	O
Anacardiaceae	<i>Mangifera indica</i>	Mango	Cultivated and naturalized	O
Musaceae	<i>Musa sapientum</i>	Banana	Cultivated	R
Solanaceae	<i>Nicotiana tabacum</i>	Tobacco	Cultivated and sometimes escaping	R
Poaceae	<i>Panicum maximum</i>	Guinea Grass	Very common as weed along roadsides and in waste places	D
Caesalpiniaceae	<i>Peltophorum linnaei</i>	Brazallito	Locally common, in coastal areas of the central and western parishes, in thickets and open woodlands on arid limestone	F
Poaceae	<i>Pennisetum purpureum</i>	Elephant Grass	Locally common and often cultivated	A
Lauraceae	<i>Persea americana</i>	Avocado	Common in cultivation	R
Phytolaccaceae	<i>Petiveria alliacea</i>	Guinea Hen Weed	Locally very common as a weed of semi shaded roadsides and rough, well drained undisturbed ground	F
Mimosaceae	<i>Prosopis juliflora</i>	Cashaw Macka	Locally common (St. Andrew, St. Catherine, Clarendon), in low pastures in arid areas	O
Commelinaceae	<i>Rhoeo spathacea</i>	Mosses in the Bushes	Common, on limestone banks and in rocky thickets and woodland margins	O

Family	Scientific Name	Common Name	Range**	DAFOR
Euphorbiaceae	<i>Ricinus communis</i>	Castor Oil	Common as cultivated plant and on waste grounds	R
Poaceae	<i>Saccharum officinarum</i>	Sugar Cane	Abundantly cultivated, mostly at lower elevations	R
Bignoniaceae	<i>Tabebuia rosea</i>	Pink Poui	Cultivated tree	O
Rhamnaceae	<i>Ziziphus mauritiana</i>	Coolie Plum	Established and fairly common in some waste places, occasionally forming thickets	O

4.2.4.2 Avifauna Assessment

A total of 12 species of birds were observed during the rapid assessment. Of the 12 birds identified, 9 were residents and there was 1 introduced, migrant and endemic respectively. The property is highly developed and there were few trees. This explains why the overall bird diversity was low.

Of the 31 endemic birds found in Jamaica, only one species, Jamaica Euphonia was observed on the property. The Jamaica Euphonia is a non-forest specialist that likes to forage on fruits.

In terms of migrant birds, only one species, the Grey Kingbird, was observed on site. The Grey kingbird is a common summer migrant, arrives in March to nest and departs in early October (Downer et al., 1990). The bird assessment was carried out in early September, just before the peak arrival (October-November) of most winter migrant birds from North America. This means that the bird species list will most likely increase later in the winter months of the year.

Table 4-54 Bird species observed in the study areas

Common Name	Scientific Name	Range	Seasonality	Resident Status	Abundance	IUCN Red List
Cave Swallow	<i>Petrochelidon fulva</i>	Resident	Year-round	Resident	Common	LC
Grey Kingbird	<i>Tyrannus dominicensis</i>	Migrant	Summer	Visitor	Common	LC
Jamaican Euphonia	<i>Euphonia jamaica</i>	Endemic	Year-round	Resident	Fairly Common	LC
Northern Mockingbird	<i>Mimus polyglottos</i>	Resident	Year-round	Resident	Common	LC
Turkey Vulture	<i>Cathartes aura</i>	Resident	Year-round	Resident	Common	LC
Vervain Hummingbird	<i>Mellisuga minima</i>	Resident	Year-round	Resident	Common	LC
Yellow-faced Grassquit	<i>Tiaris olivaceus</i>	Resident	Year-round	Resident	Common	LC

4.2.4.3 Arthropod Assessment

A total of 11 species of insects were observed in the arthropod assessment across the property. The vast majority (9 species) of the insects observed were butterflies. Of the butterfly species observed, 2

are endemic to Jamaica. All of the butterfly species observed within the project boundary, are commonly occurring species across Jamaica.

The species in the list provided are not a part of the International Union for Conservation of Nature (IUCN) or Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists.

Table 4-55 The Macro Invertebrates observed during the assessment of the property of the St. Jago Health Centre

Order & Family	Species	Common Name	DAFOR	Distribution/Comments
LEPIDOPTERA				
Nymphalidae	<i>Danaus gilippus jamaicensis</i>	Jamaican Queen	R	End. Ss.
	<i>Anartia jatrophae</i>	White Peacock	F	Widespread and common. Southern US to Argentina
	<i>Agraulis vanillae insularis</i>	Gulf Fritillary	R	Widespread and common. Southern US to south Patagonia
	<i>Dione vanillae</i>	The Tropical Silverspot	O	Widespread and very common
	<i>Dryas iulia delilah</i>	Julia	R	Endemic Ss.; widespread, common
	<i>Junonia zonalis</i>	West Indian Buckeye	R	Bahamas, Cuba, Hispaniola, Caymans Islands, Jamaica
Pieridae	<i>Ascia monuste</i>	Great Southern White; Antillean Great White	O	widespread, common and pest of crucifers. Southern US to Argentina
	<i>Phoebis sennae</i>	Cloudless Sulphur	O	Widespread and common. Southern US to Argentina
	<i>Eurema nise</i>	Mimosa Yellow; Cramer's Little Sulphur	O	Widespread, common. Southern US to Argentina
HYMENOPTERA				
VESPIDAE	<i>Polistes crinitus</i>	Paper Wasp	O	Very common and widespread
APIDAE	<i>Apis mellifera</i>	Common Honeybee	O	Widespread and common

4.2.4.4 Herpetofauna Assessment

There are approximately 27 species of amphibians found in Jamaica, throughout the herpetofauna assessment of the St. Jago Park Health Centre, only two species (*Eleutherodactylus johnstonei* and *Rhinella marina*) species were recorded in the study. Both species were introduced to Jamaica and are generally found in highly disturbed areas. The observation of the two species of amphibians were at the sewage plant on the property.

A total of 7 reptiles were recorded, most of which were lizards (*Celestus cruscus*, 1 species of galliwasp recorded); 1 of the reptile species is listed as introduced (*Hemidactylus mabouia*) while all the others are endemic to Jamaica. No snakes were encountered in the study area.

It should be noted that the status of *all* endemic reptilian and amphibian species are of concern primarily due to the distribution of their populations which is limited to one island, Jamaica.

Table 4-56 Herpetofauna observed during the study

Species	Common name	Classification	Species Status	IUCN	DAFOR
<i>Anolis grahami</i>	Jamaican Turquoise Anole	Reptile	Endemic	Near threatened	O
<i>Anolis lineatopus</i>	Jamaican Gray Anole	Reptile	Endemic	Near threatened	D
<i>Anolis opalinus</i>	Jamaican Opal-bellied Anole	Reptile	Endemic	Not Assessed	O
<i>Aristelliger praesignis</i>	Jamaican Croaking Gecko	Reptile	Endemic	Not Assessed	R
<i>Eleutherodactylus johnstonei</i>	Lesser Antillean Frog	Amphibian	Introduced	Least concern	F
<i>Hemidactylus mabouia</i>	Croaking lizard, Wood slave	Reptile	Introduced	Least concern	R
<i>Rhinella marina</i>	Cane Toad	Amphibian	Introduced	Least concern	O
<i>Sphaerodactylus argus</i>	West Caribbean Ocellated Geckolet	Reptile	Endemic	Least concern	R
<i>Celestus cruscus</i>	Jamaican Brown Galliwasp	Reptile	Endemic	Least concern	R

4.2.4.5 Other Fauna

During the walkthrough of the facility, several mangoes with damages that appear to be from bats were observed. The mangoes seem to have been eaten by the Jamaican Fruit Eating Bat (*Artibeus jamaicensis*). No bats were observed roosting in the large trees or old buildings on property. It is possible that the area is a foraging ground for bats that reside elsewhere.

Several rat traps were also observed on the property, which indicate an initiative to eradicate rodents, however no rats/mice were observed throughout the assessment.

The land snail (*Zachrysia provisoria*) of the family Camenidae was observed in the heavily vegetated, southern section of the facility.

A few Indian mongoose (*Herpestes javanicus*) and several stray dogs (*Canis familiaris*) were observed during the assessment.

4.3 OLD HARBOUR HEALTH CENTRE

4.3.1 Existing Facility

The existing Old Harbour Health Centre's location and proximity to other buildings and properties limit the possibility to be expanded physically. Therefore, a greenfield site was identified for the construction of the new health centre. Plate 4-84 shows a picture of the existing Old Harbour Health Centre.



Plate 4-84 Photograph of the existing Old Harbour Health Centre

4.3.1.1 Electricity

The Jamaica Public Service Company Limited (JPS) supplies the entire electrical system for OHHC.

4.3.1.2 Tank Storage

Potable Water

Black plastic water tanks are the main water storage at the facility Plate 4-85.



Plate 4-85 Water storage tank

4.3.1.3 Waste Streams

Categories of Waste

The main waste streams from hospitals and healthcare establishments are categorized into the following three categories for management purposes¹⁵ (C. L. Environmental Company Ltd., 2007):

1. **General/Non-Clinical Waste** – includes waste generated from administrative activities, general cleaning, food preparation and ward areas, provided that they are separated at the point of generation from the waste classified as medical and special waste. These wastes do not pose a special handling problem or hazard to human health, or the environment and their characteristics are similar to those of common domestic waste. Examples include:
 - Wrappers and packaging materials/containers, food waste and leftovers, cleaning materials;
 - Office materials and equipment including paper, newspaper, cardboard, plastic, glass disposable containers, hand towels, timber, metal;
 - Used disposable bed pan liners, urine and specimen containers, faeces, incontinence pads and stoma bags;
 - Used personal hygiene products;
 - Non-infectious animal bedding;
 - Waste that come into contact with patients through routine examination of patient care but are not soiled or saturated with fluid blood, body fluids, excretions, exudates or secretions example gloves, caps, gowns, drapes, disposable sheets, gauzes, cotton balls and dressings;
 - Garbage generated by patients, workers and visitors;
 - Waste material that has been sterilized.
2. **Medical/Clinical Waste** – includes wastes generated during the different stages of health care (diagnosis, treatment, immunizations, research, etc.) that contains pathogens which are capable of producing an infectious disease. These wastes represent different levels of potential danger according to the degree of exposure of infectious agents.
3. **Special Waste** – includes wastes generated during auxiliary activities that constitute a health risk due to their aggressive characteristics, such as Corrosivity, Reactivity, Inflammability, Toxicity, Explosivity and Radioactivity.

Examples and description of the different types of Medical and Special Wastes are presented in Table 4-57 (C. L. Environmental Company Ltd., 2007).

¹⁵ Health Facilities Infection Control Policies and Procedures Manual, Ministry of Health (Revised 2007)

Table 4-57 Categories of Medical Waste

WASTE CATEGORY	DESCRIPTION AND EXAMPLES
INFECTIOUS WASTE	
Infectious waste	Waste suspected of containing pathogens e.g. laboratory cultures; waste from isolation wards; tissues (swabs), materials, or equipment that have been in contact with infected patients or animals; excreta
Anatomical/Pathological waste	Human or animal tissues or fluids e.g., body parts; blood and other body fluids; fetuses (including waste from mortuary and autopsy centres)
Sharps	Sharp waste e.g., needles; infusion sets; scalpels; knives; blades; broken glass
SPECIAL WASTE	
Pharmaceutical waste	Waste containing pharmaceuticals e.g., pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)
Genotoxic waste ¹⁶	Waste containing substances with genotoxic properties e.g., waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals (The most common genotoxic products used in healthcare are listed at Appendix 1)
Chemical waste	Waste containing chemical substances e.g., laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances e.g., unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources

Non-Clinical Waste

Solid waste is kept in a main storage area at the front of the facility. This area is by the main entrance way and beside a water storage tank. The solid waste storage area appeared to be sufficient in size but exposed and too close to public areas (Plate 4-86).

Burning was observed by the wall of the main entrance way and appears to be a regular activity by residents and shop owners.

¹⁶ Genotoxic waste includes cytotoxic drugs used in cancer treatment and their metabolites and outdated materials, vomitus, faeces or urine from patients treated with cytotoxic drugs or chemicals, and materials such as syringes and vials contaminated from the preparation and administration of such drugs; they are highly hazardous, mutagenic, teratogenic or carcinogenic.

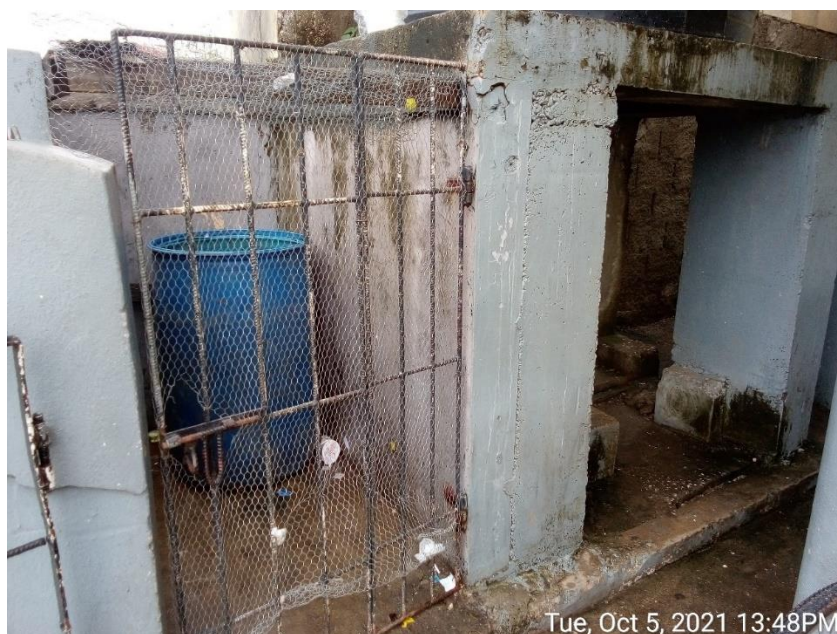


Plate 4-86 Main waste storage area at the front of the health centre

Medical Waste

Medical Waste is generated during the diagnosis, treatment and immunization of humans or animals and is capable of producing infectious diseases and includes sharps (e.g., used needles and blades), infectious, and pathological waste containing HIV and other blood-borne pathogens, as well as hazardous chemical, pharmaceutical, genotoxic, and radioactive wastes.

Medical Waste is disposed of through the Waste Management Unit of the MOHW. Medical waste handling, storage and disposal was insufficient. While it was indicated that medical waste is stored in a barrel on the veranda, stockpiles of medical waste were seen in and around an unused building by the parking lots.

MEDICAL WASTE GENERATION RATE

Medical waste generated is calculated by the estimated rates given in Table 4-2.

The estimated medical waste generation on clinic days = 10.0 kg/day (≈0.3 tonnes/month)

Table 4-58 Estimated Medical Waste Generation rates pre Category of Facility

Jamaica and United States Estimated Waste Generation Rates		
Generator Class	Jamaican Rate	US Rate (Federal Registry)
Hospital	1.0 kg/bed/day	2.6kg/bed/day
Clinic/Health Centre	10.0 kg/day	14.5 kg/day
Doctor's Office	10.0 kg/day	14.5 kg/day
Dentist Office	2.7 kg/week	3.6 kg/week

Jamaica and United States Estimated Waste Generation Rates		
Veterinarians	negligible	7.2 kg/week
Medical Laboratories	54.5 kg/week	113.6 kg/week

Source: GOJ Comprehensive Solid Waste Management Study, Norconsult, October 1996

Sewage and Wastewater

This facility is not connected to any central sewage system.

4.3.1.4 Employment

The Old Harbour Heath Centre currently employs 45 staff members.

4.3.1.5 Patient Load

The patient load for 2019 and 2020, before the Covid-19 pandemic are given in Table 4-59 and Table 4-60.

Table 4-59 Old Harbour Health Centre Total Patient Load Statistics for the Year 2019

Month	2019
January	4419
February	4171
March	3062
April	4128
May	4168
June	3778
July	4054
August	3829
September	3489
October	2917
November	2951
December	2324
Total	43,290

Table 4-60 Old Harbour Health Centre Total Patient Load Statistics for the Year 2020

Month	2020
January	3251
February	2751
March	2658
April	1734
May	2036
June	2736
July	3149
August	2727
September	3090

Month	2020
October	2316
November	2579
December	2522
Total	31,549

4.3.1.6 General Observations

Wheelchair access

Wheelchair access points were in poor condition, with several obstructions seen in walkways. Walkways were in poor conditions and the passageways inside the health centre are narrow and, in some cases, partially blocked.

Asset Storage

Asset storage was insufficient within the health centre. Some assets were seen in waiting rooms and in corridors. Assets were also stored on the veranda and in the yard towards the rear of the health centre. These assets were mixed with solid waste and overgrown by vegetation.

Green Spaces

The main green space is located at the rear of the health centre. This area was poorly maintained, with overgrown vegetation and littered with solid waste and assets.

Health Facilities in Proximity to the Old Harbour Bay Health Centre

The health facilities within 500m of the Proposed Old Harbour Health Centre were mapped. There were 13 health facilities within the 500m, of which 7 were medical complexes (Figure 4-39).

The 13 facilities within the 500m are:

1. V-Care Medical Dental
2. Old Harbour Radiology, Imagery & Dentist & Optical
3. Dr French
4. Biomedical - Doctors Office-West Medical
5. Paediatrician & Dental Office
6. Good Shephard Medical Complex
7. Joy Care Medical
8. Medical Dental Lab
9. Global Lab Health Services
10. Thomas Medical Centre
11. Dr Garg
12. Poly Spring Care & Family Health Services
13. Doctors Office



Figure 4-39 Health facilities in proximity to the Proposed Old harbour Health Centre

4.3.2 Physical Environment

4.3.2.1 Climatology and Meteorology

Weather data was requested from the Meteorological Service Jamaica for the nearest weather station to the Old Harbour Health Centre located in St. Catherine.

The Meteorological Service provided 2 years of hourly data for temperature, and four years for humidity for Colbeck weather station located approximately 3.8 km to the northeast of the health centre for the years 2019-2020.

Temperature

Average temperature between 2019 – 2020 ranged from 24.49 °C to 28.43 °C. The lowest average temperature occurred in January 2019 whilst the highest average temperature occurred in August 2019. Maximum temperature over the time period was 37.6 °C which occurred on June 22, 2019, at 1pm and a minimum temperature of 14.7 °C which occurred on January 23, 2020, at 7am. The data indicated that in generally the warmest times of the year occurred between June to August, with July being typically the hottest month.

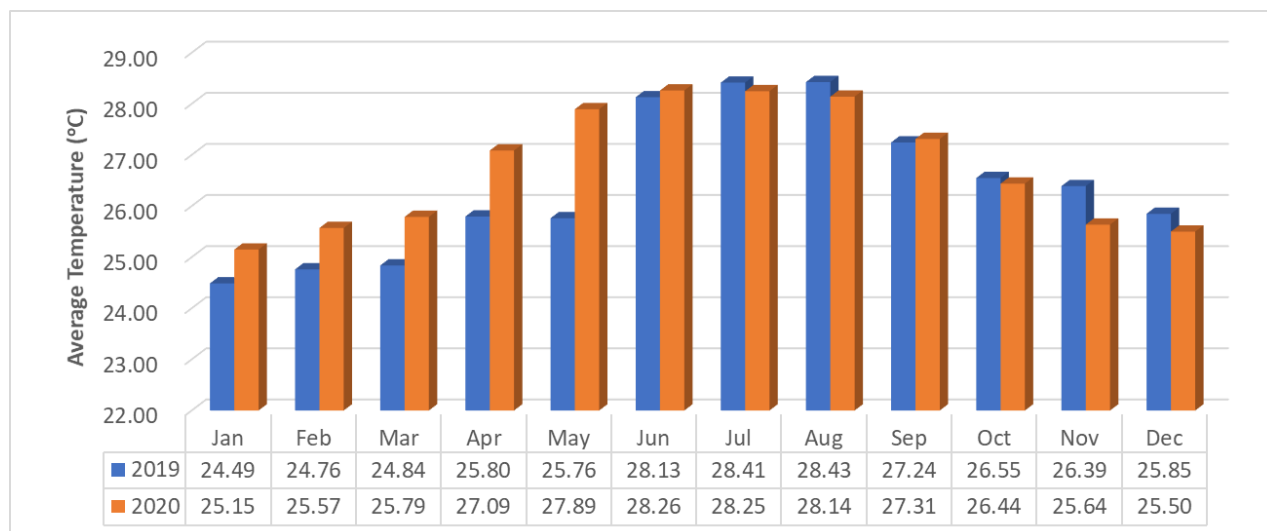


Figure 4-40 Average temperatures (°C) for the Colbeck weather station (2019 – 2020)

Relative Humidity

Average relative humidity over the four years (2018 – 2021) was 80.04% with a maximum of 97% occurring on October 12, 2018 at 3am and a minimum of 30% occurring on June 22, 2019 at 12pm.

Generally, the highest relative humidity occurred between the hours of 3am – 7am and the lowest between 12 pm – 4pm.

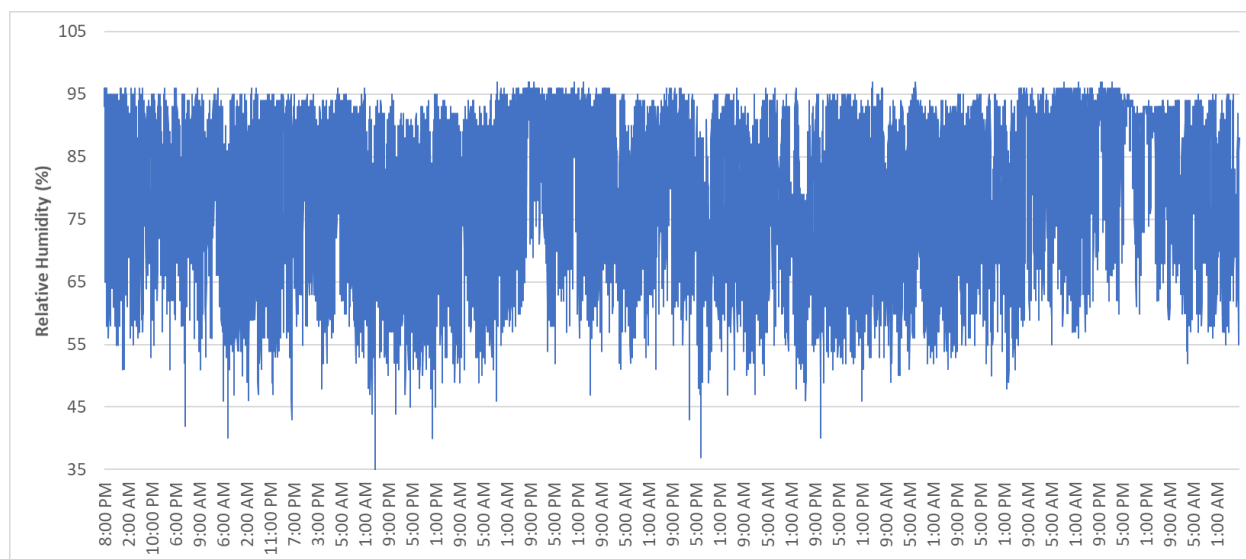


Figure 4-41 Relative humidity (5) for the Colbeck weather station (2018 – 2021)

Wind Speed and Wind Direct

Average wind direction over the time period was from the east northeast direction with an average wind speed of 1.41 ms^{-1} (2.74 knots). Calm winds occurred 18.29% of the time.

Winds from the southeast were the most frequent, occurring 10.5% of the time. The next two frequently occurring wind directions are from the north (9.4 %) and the north northeast (8.8 %).

The most frequent wind class category was the $0.5 - 2.10 \text{ ms}^{-1}$ (0.97 – 4.08 knots) which occurred 35.6% of the time.

4.3.2.2 Topography

Elevation of the property ranged from 28.6 m – 31.0 m above mean sea level (amsl) (Figure 4-42). It is characterised by relatively flat to gentle sloping land, with the majority of slopes less than 5 percent (Figure 4-43). The land generally slopes towards the east and south southeast (Figure 4-44).

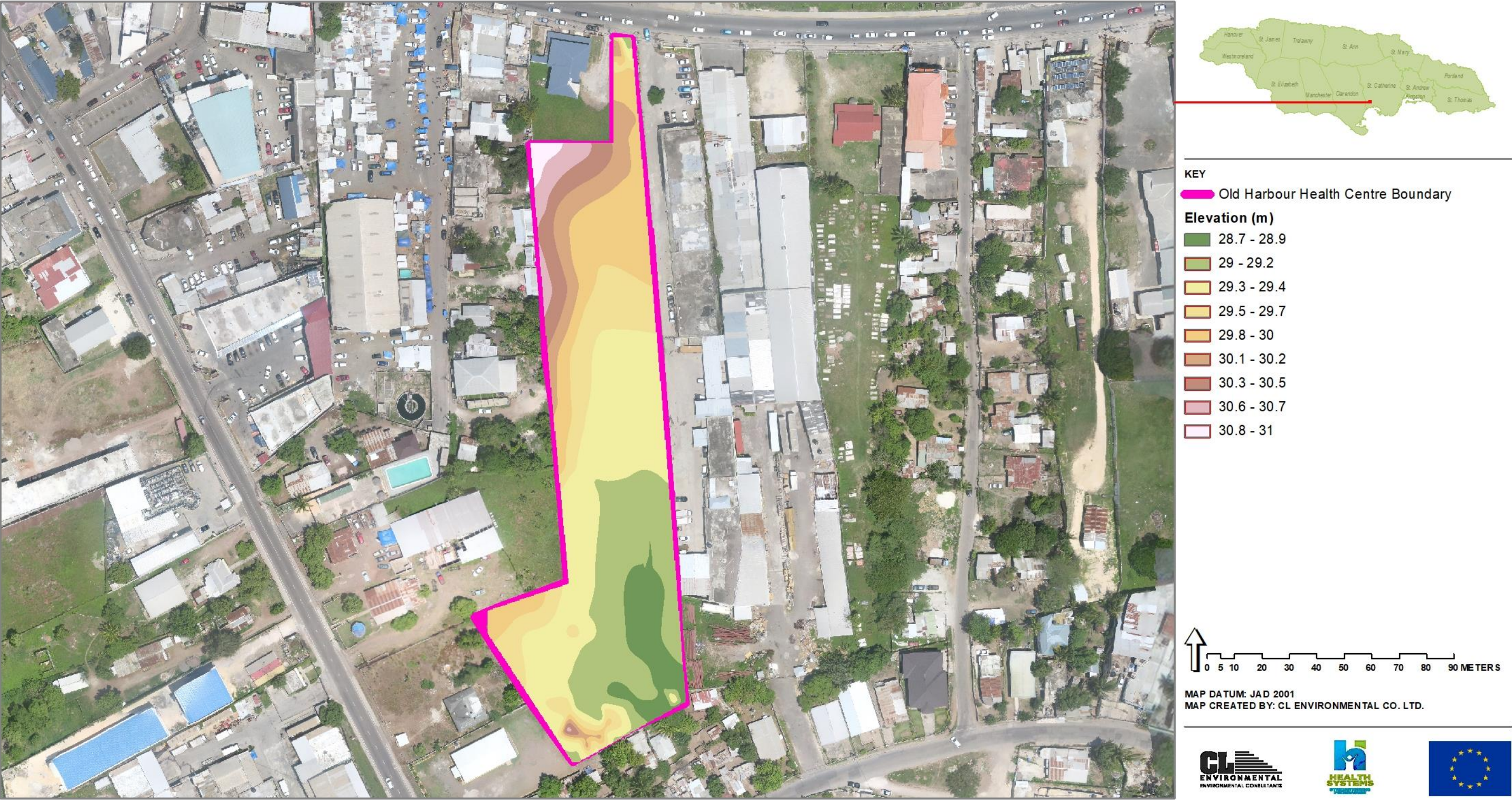


Figure 4-42 Elevations on the proposed Old Harbour Health Centre site



Figure 4-43 Slopes on the proposed Old Harbour Health Centre site

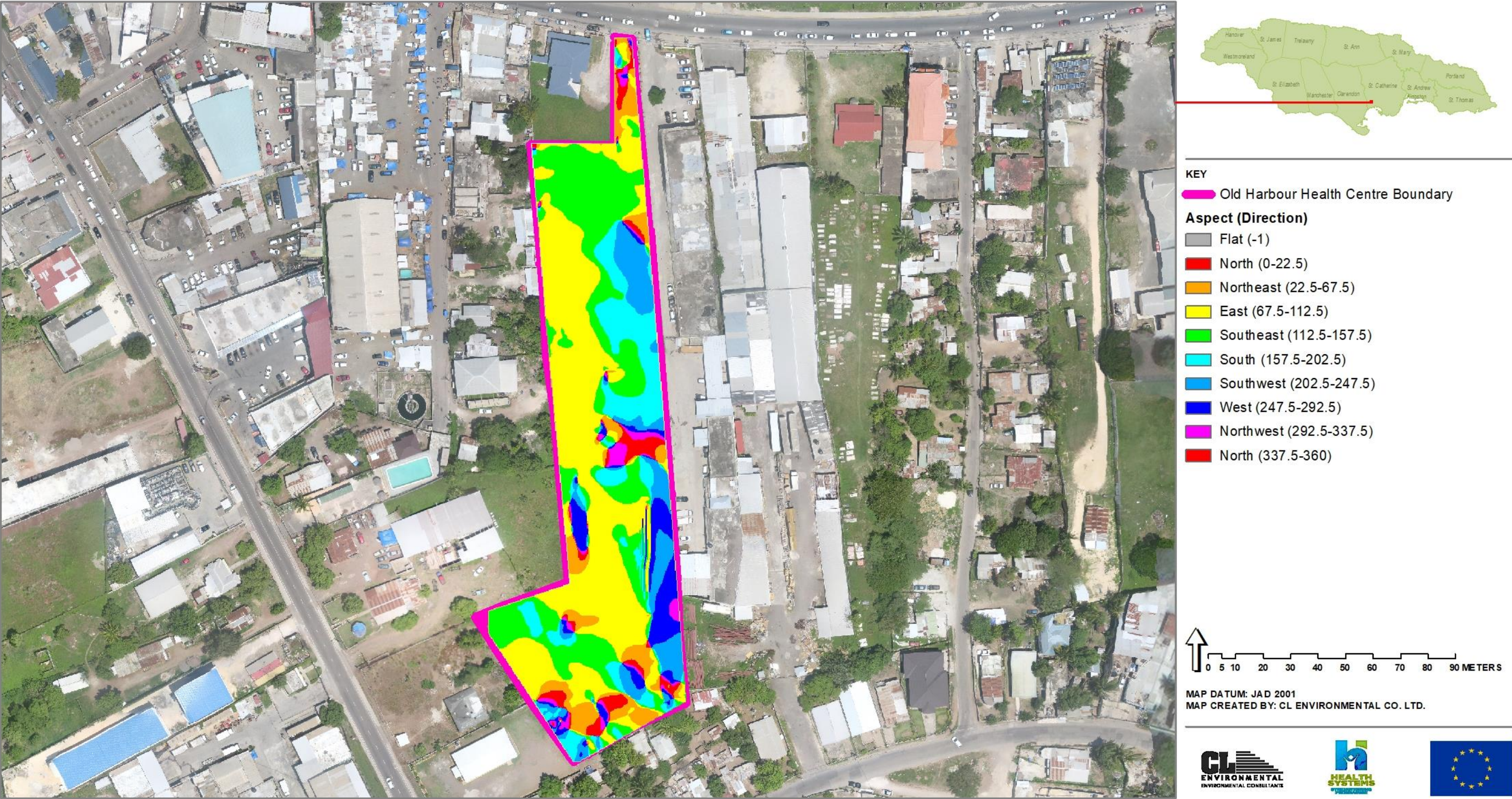


Figure 4-44 Aspect on the proposed Old Harbour Health Centre site

4.3.2.3 Geology and Soils

Geology

A review of the 1:50,000 Geological Sheet indicates that the site is underlain by Pliocene to Recent Alluvium (Qa). The alluvial deposits consist of alternating layers of gravel, sand, silts, and clay, with occasional cobbles and boulders (Figure 4-45). This geological formation represents material that has been transported and deposited by fluvial mechanisms. The river borne alluvium is derived largely from the Cretaceous rocks of the eastern section of the Central Inlier, deposited by small streams and gullies which flow through the Old Harbour area.

Alluvium is generally considered suitable foundation material for civil infrastructural works under conditions where it is well drained and well graded, with high in-situ soil density. Notwithstanding, seismic vibrations in loose alluvium can lead to ground movement/failure due to amplification of seismic waves. The extent of seismic amplification is however dependent on the soil characteristics and the thickness of the deposit.

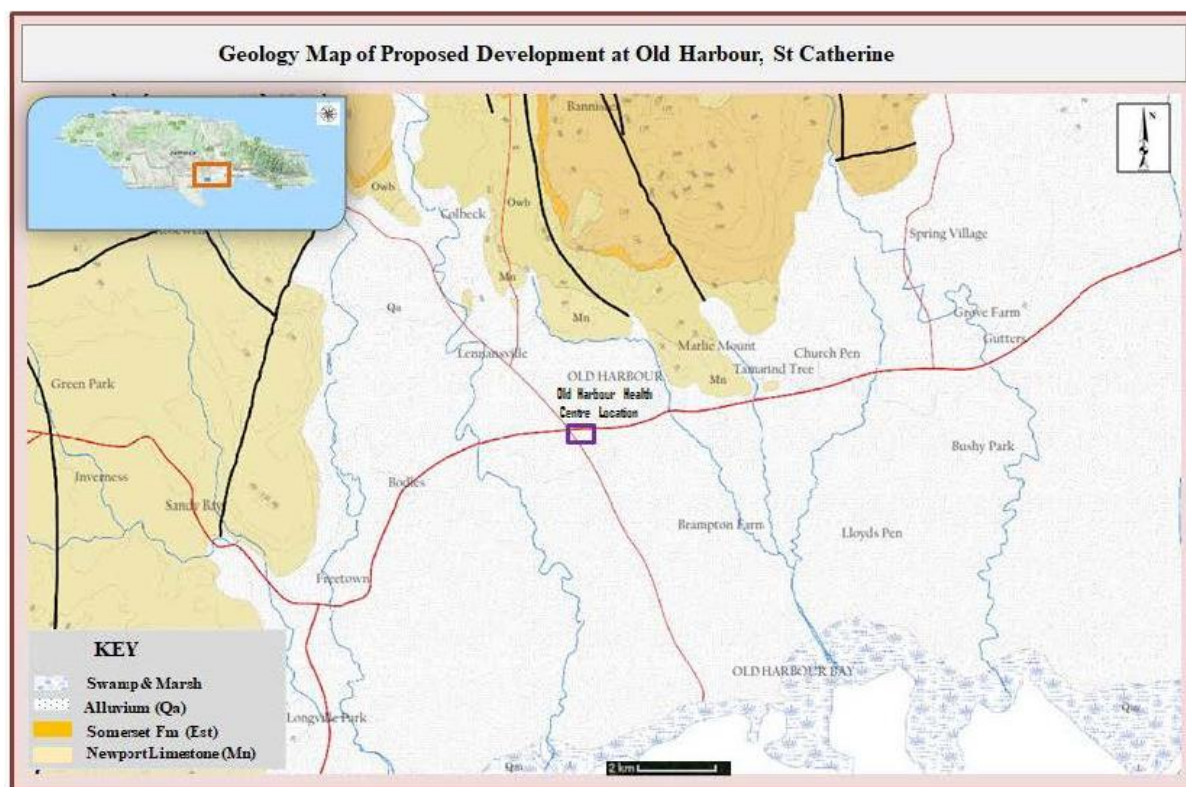


Figure 4-45. Geology of Old Harbour extracted from the 1:50,000 Metric Geology Sheets (MGD 1998)

Soils

The soils at the site taken from four (4) boreholes conducted is comprised of a thin upper layer of clay soil which vary from 0.30m (1ft) to 2.25m (7.5 ft) and consists of clay and silt with a general thinning out of the clay/silt layer from north to south. Below the clay is sandy gravel which extends to a depth

of 2.20 m to 3.9m (13 ft). A clay layer (with minor silt soil) with thicknesses varying from 1.8m (4.9ft) to 3.8m (12.6ft) is hinged between layers of sandy gravel (Geo Technics Limited, 2020).

Groundwater was encountered from 2.25m to 2.4m (7.5ft to 8ft) in the boreholes, while standing water level was measured at depths from depths 1.2m (4ft) to 1.41m (4.7 ft), on the following day.

4.3.2.4 Air Quality

PM10

The results of the PM10 sampling run are shown in Table 4-61. All locations had particulate PM10 values compliant with the 24-hour NRCA standard of 150 $\mu\text{g}/\text{m}^3$. Station P2, located at a residence off site, had the higher PM10 value (65.69 $\mu\text{g}/\text{m}^3$).

Table 4-61 Summarized PM 10 Results

STATION	PM10 RESULT ($\mu\text{g}/\text{m}^3$)	NRCA STD. ($\mu\text{g}/\text{m}^3$)
P1	35.97	150
P2	65.69	150

Values in red are non-compliant with NRCA standards

PM2.5

The results of the PM2.5 sampling run are shown in Table 4-62. Both Stations P1 and P2 PM2.5 concentrations (171.39 $\mu\text{g}/\text{m}^3$ and 72.64 $\mu\text{g}/\text{m}^3$ respectively) were non-compliant with the 24-hour USEPA PM2.5 standard of 35 $\mu\text{g}/\text{m}^3$. Evidence of burning was observed at both locations, hence the elevated PM2.5 concentrations. An overfull garbage skip on site at Station P1 was observed along with evidence of burning, while the same was observed at Station P2 located at a residence off-site, in addition to the proximity to the main road and vehicular traffic, which also contributes to PM2.5 concentrations via exhaust emissions.

Table 4-62 Summarized PM 2.5 Results

STATION	PM2.5 RESULT ($\mu\text{g}/\text{m}^3$)	USEPA STD. ($\mu\text{g}/\text{m}^3$)
P1	171.39	35
P2	72.64	35

Values in red are non-compliant with USEPA standards

4.3.2.5 Noise

Methodology

Noise level readings were taken from 12:00am Friday September 10th, 2021, to 12:00am Saturday September 11th, 2021, by using Brüel & Kjaer noise analysers setup in outdoor monitoring kits.

Figure 4-35 lists and shows the locations of the noise monitoring stations.



Figure 4-46 Noise and Particulate monitoring locations

Results

Table 4-9 shows the minimum, maximum and average noise levels over the 24-hour assessment period, as well as the geometric mean centre frequencies obtained at each station.

Table 4-63 Ambient Noise data at all stations

Stn.#	Average Leq (24 hr)	Min (dBA)	Max (dBA)	Geometric Centre Frequency (Hz)	Octave Band Range (Hz)
N1	49.8	30.3	83.6	31.5	28-35
N2	69.0	34.4	98.4	100	89-112

COMPARISONS OF AMBIENT NOISE LEVELS WITH NRCA DAYTIME AND NIGHT-TIME GUIDELINES

Comparison of the ambient noise levels in the study area with the Natural Resources and Conservation Agency (NRCA) Standards are shown in Table 4-10. During the daytime, noise levels at Station N2 (64.6 dBA) were non-compliant with respective NRCA daytime standards. During the night-time, both stations had noise levels compliant with respective NRCA night-time standards.

Daytime noise sources detected which were above NRCA daytime guideline values, included: roosters calling (during the morning time), motor vehicle traffic noise, loud music playing and people talking.

Table 4-64 Comparison of daytime and night-time noise levels at the stations with the NRCA guidelines

Stn.#	Zone	7 am. - 10 pm (dBA)	NRCA Daytime Guideline (dBA)	10 pm. - 7 am (dBA)	NRCA Night Time Guideline (dBA)
N1	Commercial	50.4	65	44.1	60
N2	Residential	64.6	55	49.7	50

NB. Numbers in red are non-compliant with the standard/guideline

COMPARISONS OF NOISE LEVELS DURING WORK HOURS WITH POTENTIAL CONSTRUCTION PERMIT GUIDELINES (70 DBA)

Table 4-11 shows the comparison of the ambient noise levels during permitted work hours (7:30am – 5pm on weekdays) with the potential NRCA permit guidelines at each station. Noise levels during work hours were compliant with the noise guidelines, at both locations.

Table 4-65 Noise level during work hours (7:30am – 5:00pm)

STATION	7:30 AM – 5:00 PM (dBA)	Potential construction permit guideline
N1	49.7	70
N2	63.0	70

4.3.2.6 Vibration

Using the prediction calculations, vibration levels were predicted at a distance of 90 metres from the centreline of the Old Harbour Main Road to the proposed project site, using a “3-tonne truck travelling at 35 mph” as the operating equipment/vehicle. Results showed that the PPV vibration value was **0.001 mm/sec**, which indicates that vibration levels are imperceptible by humans and have no effect on building structures.

4.3.2.7 Existing Sources of Pollution

Plate 4-87 depicts an overfull garbage skip located on the proposed project site, just north of the basketball court. Plate 4-88 depicts an informal dumping area used by community members towards the south of the proposed project site, while Plate 4-89 depicts an area used for burning, located just south of the basketball court.



Plate 4-87 A garbage skip located on the proposed Old Harbour Health Centre site



Plate 4-88 Informal dumping area used by community members



Plate 4-89 Area used for burning

4.3.3 Natural Hazards

4.3.3.1 Natural Hazard Identification

Flooding

HYDROLOGY AND FLOOD PLAIN MODELLING

A flood plain model was established illustrating the flood plain and depths within the project area and areas around the island to determine the level of exposure for the site. The tool of choice when generating flood plains is the Hydrologic Engineering Centre's River Analysis System (HEC-RAS). A 2-D model was used to generate flood depth to predict flooding and determine its impact on the surrounding infrastructure. Key features (inputs) used to do the assessment are as follows:

1. JAXA Topographic Data Topographic data (30m Geotiff).
2. Topographic Survey Data
3. Historical and Projected Extreme Rainfall (Return Periods 25Yr-100Yr)
 - a. Daily precipitation – Bodles Rainfall Station
4. Land Cover and Soil Type

TOPOGRAPHY

The terrain data was derived from a combination of submitted site specific topographic data, in combination with available JAXA (Japanese Aerospace Exploration Agency) Digital Elevation Map (DEM) of the island, captured using advanced satellite imagery. The DEM serves as the base of the 2D model, using a finite element mesh to calculate the water volumes and thus the flood plains throughout the model.

PRESENT RAINFALL CONDITIONS

Depth of rainfall for various return periods was provided by the National Meteorological Service of Jamaica for the closest gauge to the Proposed Old Harbour Health Centre, which was the Bodles rain gauge station. This station is 2.6km from the project, and its rainfall depth can be viewed in Table 4-66.

Table 4-66 Present Climate 24- Hour Rainfall Depths (mm) for Bodles rain gauge station (Met.Service)

Return period (years)	Rainfall Depths (mm)
25-Year	312
50-Year	347
100-Year	380

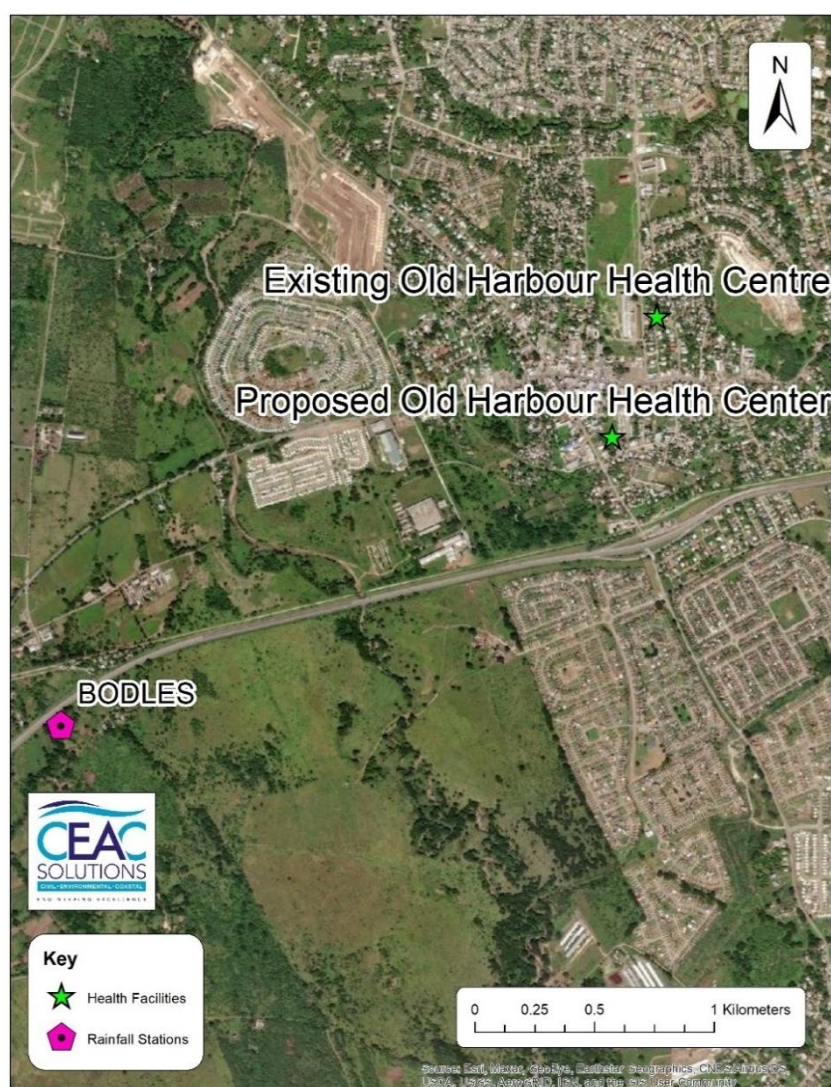


Figure 4-47 Location of Blair Pen, Catherine rainfall gauge station relative to project area

RAINFALL HYETOGRAPH

The Type III rainfall distribution curve was used for this assessment as it most accurately reflects the 24-hour rainfall distribution experienced by the island. Rainfall Hyetographs were generated using the present climate conditions for extreme rainfall and used to model the respective return periods.

MODEL CALIBRATION AND VALIDATION

In order to validate the flood plain model, the modelled project area was compared to both collected anecdotal data and available data from the ODPEM.

Anecdotal data

During the site visits on the 31st of August 2021, anecdotal interviews were conducted on the health centre compound. All respondents reported that they have not witnessed any major flooding (no inundation of existing building and parking areas) in the project area on the compound. However, they have stated that there is a lack of drainage in the proposed which has resulted on some ponding on the site and may be worsened post construction, if not properly addressed (Plate 4-90).



Plate 4-90 Proposed Old Harbour Health Centre Compound #1 (left) and Compound #2 (right)

ODPEM Flood Prone Areas

The comparison of the ODPEM Flood Prone Areas was used as the secondary validation method for the model. The ODPEM data presented two-hundred and ninety-three (293) flood-prone areas and allowed for confirmation of known flood-prone areas, however, no depth was recorded in the dataset. This validation involved probing whether or not the flood plain generated was within a 500m radius of the flood-prone areas as presented by the ODPEM.

The ODPEM Flood Prone Areas map indicated that there are recorded instances of flooding along Old Harbour Road. The depths within the model were as deep as 1m along the route and approximately 0.4m in the town centre, which was corroborated by news reports indicating knee height wading depths.



Figure 4-48 Flood Plain Validation map showing ODPEM Flood Prone Areas with 100-Yr Future Climate

FLOOD PLAIN MODEL RESULTS

The scenarios were modelled for the 25-yr, 50-yr, and 100-yr return periods for present conditions. Also considered were the impacts to the main access routes of the facility.

From the flood plain model, it was observed that pluvial flooding may affect the proposed facility. This seems to be a major issue in the old harbour area, due to what seems to be inadequate floor control. Flood depths from the model were approximately 0.72m on the compound for the 100-Yr RP Future climate scenario, which is the most extreme condition. The flood model also predicted significant flooding along the main accesses of the facility along the Old Harbour Road main road. Flood depths were observed to be as deep as 1m along that access route of the facility.

Old Harbour Health Centre		
25-year RP	50-year RP	100-year RP
Inundation Depth: 0.63m	Inundation Depth: 0.70m	Inundation Depth: 0.72m



Figure 4-49 Flood plain map of the Old Harbour Health Centre for the Post Improvement, 100-Yr Future Climate Scenario

Earthquake

GEOLOGY AND LITHOLOGY

Jamaica straddles the boundary between Caribbean tectonic plate and Gonave micro-plate. The Walton and the Enriquillo Fault Zones, extending respectively to the west and the east of Jamaica, form the boundary between these two plates. The movement across these two fault zones are transmitted through the Jamaican Fault system and are the source of significant earthquake activity in the island.

To the north approximately 8km from the project site, faults within the Bog Walk area have resulted in downthrow of limestone blocks further north. The most prominent fault zone in that area is the Cavaliers Fault zone which trends in the general E-W direction. This fault extends through areas of Bog Walk, Sligoville, and along Cavaliers to Stony Hill where it slightly offsets the Wagwater Fault. This fault continues across the Wagwater Belt which trends in a south-easterly direction.

HISTORICAL EARTHQUAKE EVENTS

Seismic events have the capacity to be some of the most devastating and costly natural hazards. The level of damage or loss typically varies depending on the magnitude of an event, wherein effects can range from only being noticed via seismograph to significant loss of life and infrastructural damages. Despite having the tools for monitoring and recording these occurrences, earthquakes are unpredictable in nature.

Jamaica has had a notable earthquake history with significant events such as the 1692 Port Royal earthquake, the 1907 Kingston earthquake, the 1957 March 1st earthquake, which impacted the western end of the island and the 1993 January 13th earthquake. These events were the cause of significant losses for Jamaican citizens but only represent a small portion of the seismic activity occurring on the island; more recently, between 2011 and 2020 there were over 1000 recorded earthquakes with local epicentres, of which approximately 94 were actually felt (**Figure 4-23**). Although none were catastrophic, it highlights the significant levels of seismic activity across Jamaica.

There were a total of 1,032 seismic events occurring locally (Jamaica) (Source: Earthquake Unit University of the West Indies, Mona Campus), of which 1 occurred within the Service Area of the proposed Old Harbour Health Centre. This occurred in 2012. The three (3) closest events to the proposed Old Harbour Health Centre are listed in Table 4-67. These were considered micro events (Anon., 2021).

A total of 94 seismic events were felt by persons Jamaica over the same time period. Nine (9) were felt in the St. Catherine area, however, none of these seismic events had epicentres within the proposed Old Harbour Health Centre Service Area.

Table 4-67 Three closest seismic events to the proposed Old Harbour Health Centre (2011 – 2020)

LATITUDE	LONGITUDE	MAGNITUDE	DATE OF OCCURENCE	DIST FROM OLD HARBOUR HEALTH CENTRE (KM)
17.940	-77.127	2.2	October 19, 2012	1.72
17.889	-77.163	2.3	May 2, 2019	7.61
17.893	-77.176	2.9	August 20, 2020	8.41

Source: Earthquake Unit University of the West Indies, Mona Campus, Kingston 7, Jamaica, W.I

HORIZONTAL GROUND ACCELERATION

The ground and spectral was used as the basis for exposure to earthquake hazard as it considers any impact that the distance of the epicentre away from a site would have, by simple recording the acceleration at a location. The Peak Ground Acceleration for the project area was extracted from the seismic hazard

maps for Jamaica generated under the Caribbean Disaster Mitigation Project (Organization of America States (OAS), 1998) and the Probabilistic Seismic Hazard Assessment (Figure 4-24).

The Spectral Acceleration (SA) is the preferred Seismic Hazard intensity parameter used in most modern building codes. This is a measure of maximum acceleration observed from a specific oscillatory period (similar to that of natural building oscillation) caused by a sustained shaking during an Earthquake. This acceleration varies based on location and as result means that the level of ground shaking also varies based on location.

Determining the short and long period spectral accelerations associated with varying regions can be a useful indicator of the level of seismicity and consequently the possibility of more pronounced ground motions in one area versus the other. The spectral acceleration periods observed were 0.2 seconds which is representative of short buildings (a few floors tall) and 1.0 second which is geared towards representing the oscillations of taller structures (greater than 7 floors).

DAMAGE DESCRIPTION

Higher accelerations imply a greater level of intensity at the location in question. As such a higher value would point to increased levels of damage and as result a relationship can be generated between ground acceleration and the Mercalli scale, which describes the probable extent of damage (Table 4-16). As per the Rapid Visual Screening Program developed by FEMA, a series of seismicity zones were determined based on the level of short period and long period spectral accelerations experienced. See Table 4-17.

RESULTS

The findings indicate that the Old Harbour Health Centre is within a Moderately High Seismicity zone and that, there is the possibility of slight damage to specially designed structures in the event of 2475 return period event. Buildings of a lower design standard may suffer more considerable damage.

RP	Spectral Acceleration	Spanish Town	St. Jago	Old Harbour	Portmore
475	PGA	0.28	0.28	0.27	0.28
	(Short Period) 0.2	0.64	0.64	0.61	0.64
	(Long Period) 1.0	0.21	0.21	0.20	0.22
2475	PGA	0.5	0.5	0.48	0.5
	(Short Period) 0.2	0.97	0.97	0.97	0.91
	(Long Period) 1.0	0.27	0.27	0.25	0.30
4975	PGA	0.64	0.64	0.61	0.64
	(Short Period) 0.2	1.24	1.24	1.17	1.33
	(Long Period) 1.0	0.36	0.36	0.34	0.40

Wind

DESCRIPTION

Hurricanes produce heavy rainfall, high winds, and storm surge, all of which have the potential to cause damage and dislocation. High winds possess the ability to exert forces on the physical structure

of buildings and also generate projectiles. The projectiles may pose a risk of causing damage to surrounding infrastructure or lead to injuries and fatalities. While spontaneous weather systems such as thunderstorms or cold frontal systems may produce higher than normal wind speeds, Hurricanes are responsible for most wind hazard situations. Hurricane wind speeds are typically used to categorize severity and lend to indicating the level of damage that can be expected. See Table 4-18 for categorization as per National Hurricane Centre (NOAA).

METHOD

To determine the extreme wind speeds experienced on an annual probabilistic basis, hurricane level winds and hurricane tracks were extracted from locally generated datasets sourced from both government agencies and the National Hurricane Centre (NOAA). Application of extremal statistics to predict maximum wind speeds and exceedance probabilities using Weibull's distribution produced the different return periods attached to the wind speeds. These results were plotted on maps and the points relating to the facilities extracted.

RESULTS

Table 4-68 Wind speeds for Old Harbour Health Centre and respective return periods

Return Period (years)	Wind speeds (m/s)
25	56.5
50	58.4
100	61.3

4.3.3.2 Risk Assessment

Background

In evaluating the feasibility of undertaking the Health and Systems strengthening program in St. Catherine, and more specifically the construction of the proposed development at the Old Harbour Health Centre, the risks associated with its development have to be determined. Risk can be defined as the potential loss of life, injury and destroyed or damaged assets which could occur to a system, society or a community in a specific period of time. As such the typical approach evaluates risk as a function of hazard, exposure, vulnerability and the criticality of the project (UNDRR, 2017).

Methodology

The methodology presented in the Disaster and Climate Change Risk Assessment Methodology for IDB Projects (2019)¹⁷ states the risk analysis should include the identification of hazards, degree of exposure of the hazard on the facility, identification of project vulnerability to said hazards, identification of impacts and the development of recommendations for failure modes or prevention of damage. The proposed IDB methodology and its phases were used as the framework for the risk assessment to integrate both the technical and operational narratives for all four (4) health facilities.

¹⁷ Barandiarán, M., Esquivel, M., Lacambra Ayuso, S., Suarez, G., & Zuloaga, D. (2019). Disaster and Climate Change Risk Assessment Methodology for IDB Projects: A Technical Reference Document for IDB Project Teams.

The Simplified Probabilistic Assessment was used as a general guide in this report, where the relation between the pertinent assessment factors has been summarized in the following equation. It is based on the quantitative approach which aims at quantifying risk according to the hazards, vulnerability of assets and amount of exposure of the asset.

Hazards

Hazard selection was also done from an island-wide perspective for events that have historically had a major effect on commercial/private operations. These events to be highlighted in the risk assessment are:

- Flooding (pluvial and fluvial)
- Seismic Activity
- Hurricane Winds

Each of the above hazards will be associated with a frequency matching a certain intensity to allow for replicable measurement of varying levels of potential damage to property. For flooding and hurricane winds, return periods (RPs) were used: 25 year-, 50 year- and 100 year- RPs. The values were obtained from rasters generated from local datasets. For seismic activity, long and short spectral accelerations were used which were also tied to return periods: 475 year (0.28g), 2475 year (0.5g) and 4975 year (0.64g) return periods (where g is gravity).

Vulnerability

DESCRIPTION OF VULNERABILITY

In order to determine the vulnerability of each location, the identification of failure modes for the identified hazards and the relation to assets' capability to sustain damage was determined. For example, depending on the level of inundation experienced during a high precipitation event, the series of outcomes can range from the hinderance of services to damage of equipment. Seismic Events have the potential to cause permanent structural damage, aesthetic damage, damage to equipment and affect the low level and critical medical operations. Wind events typically have the potential to dislodge components fastened to a structure. This could result in aesthetic damage or launching of projectiles that can cause irreparable damage. For the purpose of rating vulnerability, each impact description was ranked as Trivial, Minor, Serious or Catastrophic. This provides a basis of ranking as seen in Table 4-20. a brief general description of the impacts for each event can be seen in Table 4-21.

VULNERABILITY RATING FROM FLOODING

The Old Harbour health centre's vulnerability to flooding was determined from the expected damage from flood waters and the mitigative measures expected to be implemented into the proposed building. With the facility being constructed at a designed floor elevation which will consider flood waters, expected damage should be mitigated. In local practices, this level is usually set at approximately 0.3m above 100Yr flood levels. In the case that is not done, damage will most likely be seen in the aesthetics of the building (flood water marks and stains on walls), and to a minor degree, will damage furnishings and low-lying documents or equipment. It may also possess the ability to cause

impedance of property access. These potential damages can be readily mitigated by raising the placement of electrical sockets, documents, and important equipment within the building above expected flood waters. The flood depths were taken relative to the existing ground level (mAEGL) and the resulting impacts presented in Table 4-22. The depth was not widespread but indicates that sections of the footprint could suffer levels in exceedance of 0.6m.

Table 4-69 Impact Rating for STH regarding flooding

RP	Flood Level (mAEGL)	Impact
25 years	0.6	Serious
50 years	0.70	Serious
100 years	0.72	Serious

VULNERABILITY RATING FROM SEISMIC ACTIVITY

The proposed building renders indicate the construction of a new single level health centre. Typical construction practices for a building of this size, indicate the structure will likely be a reinforced concrete masonry structure. For the purpose of the assessment, the FEMA P154 rapid visual assessment (RVA) was used to estimate structural seismic performances. The assessment considered the seismicity of the location, soil and terrain conditions, age, building and design code. In essence, the RVS scores highlight the probability and extent of damage to a building.

Table 4-70 Showing building type for OHHC

Proposed Building Type	Building Name	RVS Score
Reinforced Concrete Masonry	Old Harbour Health Centre	3.6

The score of the new structure assumed that it would be designed to the requisite IBC design standards. FEMA dictates that a building with a ranking below 2 is recommended for investigation for further seismic design. The score obtained, seen in Table 4-70, was above the standard score of 2, indicating that the proposed structure would perform favourably, however as this is decision making screening tool, seismic analysis of the proposed structural designs would perform a more definitive basis for ranking the performance.

Based on the typical relationship of spectral accelerations to probable damages introduced earlier, the impact associated with the modelled return periods are presented in Table 4-24.

VULNERABILITY RATING FROM HURRICANE WINDS

The proposed building will also be exposed to hurricane winds and as is such could experience varying degrees of damage. This level of damage is of course dependent on the proposed building design and the magnitude of winds. With wind speeds ranging from 55.4 m/s to 61.2 m/s, the building will experience devastating to catastrophic damage (see Table 4-25). Although the assumption of the building being a 'well-built frame' was considered, it is still possible to that will experience damage to

the roof structure, interruptions in utility services and further damage from projectiles to exposed glass.

Criticality

A review of the facilities' social impacts demonstrates that shortfalls associated with new construction could significantly affect various portions of the populous. This allows for a better understanding of the potential consequences of failure of the facility and the characteristics that contribute to its vulnerability. The criticality thresholds were derived from those depicted in Table 4.11 of the IDB Methodology. Overall, the facility has been considered a high-risk project fit to undergo qualitative risk evaluation.

Table 4-71 Criticality of proposed Facilities

	Characteristics	Value	Criticality Rate
Old Harbour Health Centre	Service area (km ²)	35	Moderate
	Service Population (per)	267,000	High
	Building Square Area (m ²)	1767.62	Moderate

Exposure

Each facility's level of exposure will be measured specific to each of the hazards presented. This will consider the coincidence of the facility's location with the expected point of occurrence of the hazards. For flood events, a dimension of depth will also be included to evaluate the potential level of inundation and the resulting assets/structural components at risk. This will be taken from the maps generated and presented in this report from previously run hydrodynamic models. In relation to seismic exposure, it is established that all the facilities experience seismic activity. The level of exposure for each will account for the proximity of the facility to historically recorded seismic events. For hurricane winds, wind speeds across the island vary based on a location's surrounding topography, proximity from the coast and intensity of the potential storm.

Flooding

Flood events to be analysed were the 25-, 50-, and 100-year RPs. The resultant flood depths and area inundated for the facility has been taken from the results presented previously in this report and are summarized in Table 4-27. Flood depths have been taken relative to the existing ground level (EGL). The assets considered most exposed will be measured based on their elevation above maximum flood depths for the RPs. Values assigned to the assets in the final risk matrix will consider the at-risk portion (%) submerged and the depth of flooding for that asset.

Table 4-72 Exposure considerations and values for flooding.

	Exposure metric	% Exposed to hazard	Average Flood Depth (m)		
			25yr	50yr	100yr
OHHC Building	Area and no. of floors	38%	0.63	0.70	0.72

SEISMIC ACTIVITY

While all sites are considered exposed to seismic activity, the level of exposure will vary according to the location on the island. This varying level of exposure was based on spectral acceleration maps which through historical occurrences predicted the magnitude of ground movement. The level of ground movement of each site would vary despite being exposed to some of the same events due to factors such as distance to event epicentre and geological properties (i.e. soil and rock structure). The literature presented in the Journal of Civil Engineering was generated to provide a seismic spectral acceleration map to be utilized in conjunction with the International Building Code seismic design guidelines. Extraction of the coinciding spectral acceleration based on the location of each project site yielded the accelerations below.

Table 4-73 Resultant spectral accelerations (short and long) with associated return periods

RP	Spectral Acceleration (based on exposure)	Old Harbour
475	PGA	0.27
	(Short Period) 0.2	0.61
	(Long Period) 1.0	0.20
2475	PGA	0.48
	(Short Period) 0.2	0.97
	(Long Period) 1.0	0.25
4975	PGA	0.61
	(Short Period) 0.2	1.17
	(Long Period) 1.0	0.34

HURRICANE WINDS

All health facilities are considered to have the same level of exposure to hurricane winds. The variation in the speed of hurricane level winds experienced by the facility is dependent on the building's location relative to the coast, surrounding topography and the surrounding land use for the site. Another factor affecting the building exposure is the footprint area and height of the structure which will increase the risk associated with damage from extreme hurricane winds. A summary of these factors is presented in and will contribute to the final risk matrix.

Table 4-74 Exposure considerations and values for hurricane winds.

RP	Wind speed (m/s)	Building footprint (m ²)	Proposed Building Height (m)
25	55.4	1988	4.3m
50	57.4		
100	61.2		

Risk Analysis

For the hazard events, A combined (weighted) ranking taking into account the asset exposure, hazard probability and vulnerability of the building will be utilized to assign a suitable risk rating. The at-risk infrastructure will be determined using the factor combination proposed by the IPCC dictating risk

being a product of an asset's exposure × vulnerability × hazard present¹⁸. For the Old Harbour Health Centre, the approach taken to the risk assessment will be qualitative, considering the casual relationship between the impact of the climate hazard and the outcome of the impact¹⁹ as described in the preceding sections. The final result will be a risk matrix developed using weighted values to estimate the risk of the facility's infrastructure and equipment to the combined impacts of the three (3) hazards: flooding, seismic activity and hurricane winds.

A table showing the method and colour assignment for each value can be seen in Table 4-30 and Table 4-31. A ranking from 1 (lowest) to 12 (highest) will be assigned to the different assets based on their physical condition and their surrounding environments. The ranking for the hazards has been further divided into flooding and hurricane winds, vs. seismic activity. The impact of the hazard on the asset will be taken from Table 4-21. The weighted value for the risk matrix is a representation of the overall risk of the facility out of a total ranking of 12.

Table 4-75 Results of risk matrix for Old Harbour Health Centre

Exposure metric	Flooding			Seismic Activity			Hurricane Winds			Weighted Value
	25 RP	50 RP	100 RP	475 RP	2475 RP	4975 RP	25 RP	50 RP	100 RP	
Area of building and no. of floors	9	6	3	6	6	4	9	6	4	5.9

Summary of Risk Matrix Findings

The values obtained from the risk matrix reflect variations in both frequency of the hazard events and the resultant impact of the event on the facility based on both the intensity of the hazard (tied to the RP) and the structural resilience of the building. As a result, the matrix is able to fairly compare the overall risk of the development by assessing both the expected damage from a certain event, whether great or small, and the likelihood of it occurring. In other words, this allows for less frequent but intense events to be similarly rated against frequent but less intense events, where similar monetary expenditures from recovery efforts or damage to infrastructure may be experienced over time. The final score highlights that structure is somewhat robust in standing up to hazards faced. However, it shows that the relatively higher frequency of somewhat high precipitation and winds that may occur in storm events have a large impact on the operation and maintenance of the building. On the other hand, although the seismic events have the capacity to be devastating, their low frequency and design code requirements somewhat limit likelihood of realized damages and as such risk.

¹⁸ IPCC. (2012). *Determinants of risk: exposure and vulnerability*. Source: https://www.ipcc.ch/site/assets/uploads/2018/03/SREX-Chap2_FINAL-1.pdf

¹⁹ Hughes J. et. al. (2020). *Impacts and implications of climate change on wastewater systems: A New Zealand perspective*. Source: <https://doi.org/10.1016/j.crm.2020.100262>

4.3.4 Biological Environment

4.3.4.1 Flora Assessment

The floral species diversity was relatively low at the proposed site for the Old Harbour Health Centre, with only 18 species from 12 families recorded. Most of the species encountered are classified by Adams, 1972 as being very common, commonly found in thickets and wastelands, and commonly found in secondary woodlands. The distribution of the plant species encountered are fairly even across Jamaica, especially in places that have significantly been impacted by humans. No endemic species were encountered throughout the assessment. None of the species encountered during this study is deemed to have any special conservation status; neither were any species considered rare in Jamaica. Only one large tree (>10 cm DBH), Coolie Plum (*Ziziphus mauritiana*), was observed within the project boundary.

The species in the list provided are not a part of the International Union for Conservation of Nature (IUCN) or Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists.

Table 4-76 List of floral species identified along transects in the assessed area. A classification ranking was used to show prevalence (Adams 1972) and the DAFOR index to show the frequency of each plant species encountered.

Family	Scientific Name	Common Name	Range**	DAFOR
Malvaceae	<i>Abutilon pauciflorum</i>		Common in rough pastures, waste places and thickets	A
Mimosaceae	<i>Acacia macracantha</i>	Park Nut	Common locally (St. Andrew, St. Catherine, St. Thomas), in secondary thickets on arid limestone	F
Mimosaceae	<i>Albizia lebeck</i>	Woman's Tongue	Locally common, naturalized in open secondary woodlands	O
Annonaceae	<i>Annona squamosa</i>	Sweet Sop	Commonly cultivated, escaping near habitations and along roadsides and pasture margins	O
Rutaceae	<i>Citrus aurantifolia</i>	Lime	Commonly cultivated	R
Arecaceae	<i>Cocos nucifera</i>	Coconut	Cultivated and naturalized	R
Euphorbiaceae	<i>Euphorbia heterophylla</i>	Japanese poinsettia	Occasional in the central and eastern parishes	O
Verbenaceae	<i>Lantana trifolia</i>		Common in rough pastures and waste places	D
Anacardiaceae	<i>Mangifera indica</i>	Mango	Cultivated and naturalized	O
Poaceae	<i>Panicum maximum</i>	Guinea Grass	Very common in rough pastures, ditches, and sheltered thickets	D
Phytolaccaceae	<i>Petiveria alliacea</i>	Guinea Hen Weed	Locally very common as a weed of semi shaded roadsides and rough, well drained undisturbed ground	A
Mimosaceae	<i>Prosopis juliflora</i>	Cashaw Macka	Locally common (St. Andrew, St. Catherine, Clarendon), in low pastures in arid areas	O
Euphorbiaceae	<i>Ricinus communis</i>	Castor Oil	Common as cultivated plant and on waste grounds	F
Malvaceae	<i>Sida acuta</i>	Broom Weed	Very common in pastures, waste places and cultivations	A
Anacardiaceae	<i>Spondias mombin</i>	Hog Plum	Common, mostly along roadsides and field margins	R

Family	Scientific Name	Common Name	Range**	DAFOR
Tiliaceae	<i>Triumfetta lappula</i>		Rather common, a weed of waste places and thickets	D
Rhamnaceae	<i>Ziziphus mauritiana</i>	Coolie Plum	Established and fairly common in some waste places, occasionally forming thickets	R
Poaceae	<i>Zoysia tenuifolia</i>	Zoyzia	Cultivated for lawns	D

4.3.4.2 Avifauna Assessment

A total of 5 species of birds were observed during the rapid assessment. Of the five birds identified, 4 were residents and 1 summer migrant. No endemic birds were observed on the site. The low number of trees on the property could explain why the bird diversity was low in the project area.

Of the migrant birds, only one species was observed, the Gray Kingbird, which is a summer migrant. The summer migrants usually depart the island before the arrival of the winter migrants in early October. No winter migrants were observed on site. The bird assessment was carried out in early September, just before the arrival of most of the winter migrants from North America. This means that the bird species list will most likely increase later in the winter months of the year when the migrants are expected to arrive. In addition, the area consists of mainly grasses and small shrubs, which does not provide food for the migrant warblers.

Table 4-77 Bird species observed in the study in the areas

Common Name	Scientific Name	Range	Seasonality	Resident Status	Abundance	IUCN	DAFOR
Gray Kingbird	<i>Tyrannus dominicensis</i>	Migrant	Summer	Visitor	Common	LC	O
Northern Mockingbird	<i>Mimus polyglottos</i>	Resident	Year-round	Resident	Common	LC	R
Smooth-billed Ani	<i>Crotophaga ani</i>	Resident	Year-round	Resident	Common	LC	O
Turkey Vulture	<i>Cathartes aura</i>	Resident	Year-round	Resident	Common	LC	O
Yellow-faced Grassquit	<i>Tiaris olivaceus</i>	Resident	Year-round	Resident	Common	LC	O

4.3.4.3 Herpetofauna

Only 2 of the 27 species of amphibians found in Jamaica was observed in the study area. Both species were introduced in Jamaica and are listed as invasive species. Only one reptile species, Jamaican Brown Anole (*Anolis lineatopus*), was encountered in the study. The Jamaican Brown Anole is endemic and is widely distributed in Jamaica.

Table 4-78 Herpetofauna observed during the study

Species	Common name	Classification	Species Status	IUCN Red List	DAFOR
<i>Anolis lineatopus</i>	Jamaican Brown Anole	Reptile	Endemic	NE	R
<i>Eleutherodactylus johnstonei</i>	Whistling Frog	Amphibian	Introduce	NE	R
<i>Rhinella marina</i>	Cane toad	Amphibian	Introduce	NE	R

4.3.4.4 Arthropod Assessment

A total of 9 species of butterflies were recorded from two families. The only other insect recorded was the Paper Wasp (*Polistes crinitus*). The species in the list provided are not a part of the International Union for Conservation of Nature (IUCN) or Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists.

Table 4-79 The Macro Invertebrates observed during the assessment of the proposed site for the Old Harbour Health Centre

Order & Family	Species	Common Name	DAFOR	Distribution/Comments
LEPIDOPTERA				
Nymphalidae	<i>Anartia jatrophae</i>	White Peacock	O	Widespread and common. Southern US to Argentina
	<i>Agraulis vanillae insularis</i>	Gulf Fritillary	O	Widespread and common. Southern US to south Patagonia
	<i>Dione vanillae</i>	The Tropical Silverspot	O	Widespread and very common
	<i>Dryas iulia delilah</i>	Julia	O	Endemic Ss.; widespread, common
	<i>Junonia zonalis</i>	West Indian Buckeye	O	Bahamas, Cuba, Hispaniola, Caymans Islands, Jamaica
	<i>Siproeta stelenes</i>	The Antillean Malachite	R	Central and northern South America, extends as far north as southern Texas and the tip of Florida,
Pieridae	<i>Anteos maerula</i>	Giant Brimstone; Maerula	R	Widespread, not very common. Southern US to Peru
	<i>Eurema nise</i>	Mimosa Yellow; Cramer's Little Sulphur	O	Widespread, common. Southern US to Argentina
	<i>Phoebis sennae</i>	Cloudless Sulphur	O	Widespread and common. Southern US to Argentina
HYMENOPTERA				
VESPIDAE	<i>Polistes crinitus</i>	Paper Wasp	O	Very common and widespread

4.4 GREATER PORTMORE HEALTH CENTRE

4.4.1 Existing Facility

The Greater Portmore Health Centres is classified as a Type Five Health Centre and was built in 1994-95. Over the approximately twenty-seven years since its construction, there has been the addition of a pharmacy and upgrades in the health centres technological capability (internet server was also added). Currently this facility has five buildings.

The Health Centre currently operates between the hours of 8:00 am and 4:00 pm, Mondays to Fridays. The services currently offered include:

- Antenatal/postnatal care

- Family Planning
- Vaccinations
- Dentistry
- Primary Medical Care Visits/curative
- Nutritional Consultations
- Post-surgery and out-patient wound care (dressings)
- Out-patient care referred by hospital
- Mental Health Care
- Pharmacy
- Covid-19 Sampling
- Food Handlers' Permits
- Dermatology
- Diabetic Retinopathy Screening

A specialist physician is engaged full-time Dermatology services. Unique to the Greater Portmore Health Centre, is the Health Centre for Diabetes Retinopathy Screening. This retinopathy screening centre is the only one in the parish of St. Catherine, therefore all persons in need of this service are referred to Greater Portmore. The health centre has its own on-site pharmacy.

The GPHC does not have housing facilities for staff.

The health centre has systems in place to cater to persons with mobility challenges, however no systems are in place to address the needs of the visually impaired and hearing impaired or persons with other disabilities.

The existing patient records system is not computerised; record keeping is paper based. The Greater Portmore Health Centre does not have a system in place to:

- Recognise positive staff behaviour
- Allow patients to report deficiencies in services received/being sought
- Allow patients to comment on the quality of service received
- For continuous evaluation of the services offered at the health centre

Systems are however in place for:

- Clients to report positive service experience
- Reporting staff misconduct
- Reporting sexual harassment

While not having a secure area to treat persons in police custody, the Greater Portmore Health Centre treats such persons.

The Greater Portmore Health Centre is an over-utilised facility. On average between 250 and 300 persons access the services of the health centre daily. Patients include those accessing the services directly as well as referrals from the Spanish Town Hospital.

The present staff complement stands at forty-seven and is not adequate. Thirty-five persons are medical staff and twelve are non-medical staff. The suggested ideal staff complement based on the current situation is sixty-two, of which forty-five would be medical staff and seventeen non-medical staff.

There is a one to two-day emergency water storage capacity for the health centre, however the volume is not known. The health centre does not have an alternative power source.

4.4.1.1 Electricity

The Jamaica Public Service (JPS) supplies the entire electrical system for the Greater Portmore area.

4.4.1.2 Potable Water

Tank Storage

There is a single area for water storage tanks at the health centre property (Figure 4-51). They were black plastic water tanks on property (Plate 4-91). Potable water to the facility is supplied by the National Water Commission (NWC).



Plate 4-91 **Black plastic water storage tank**

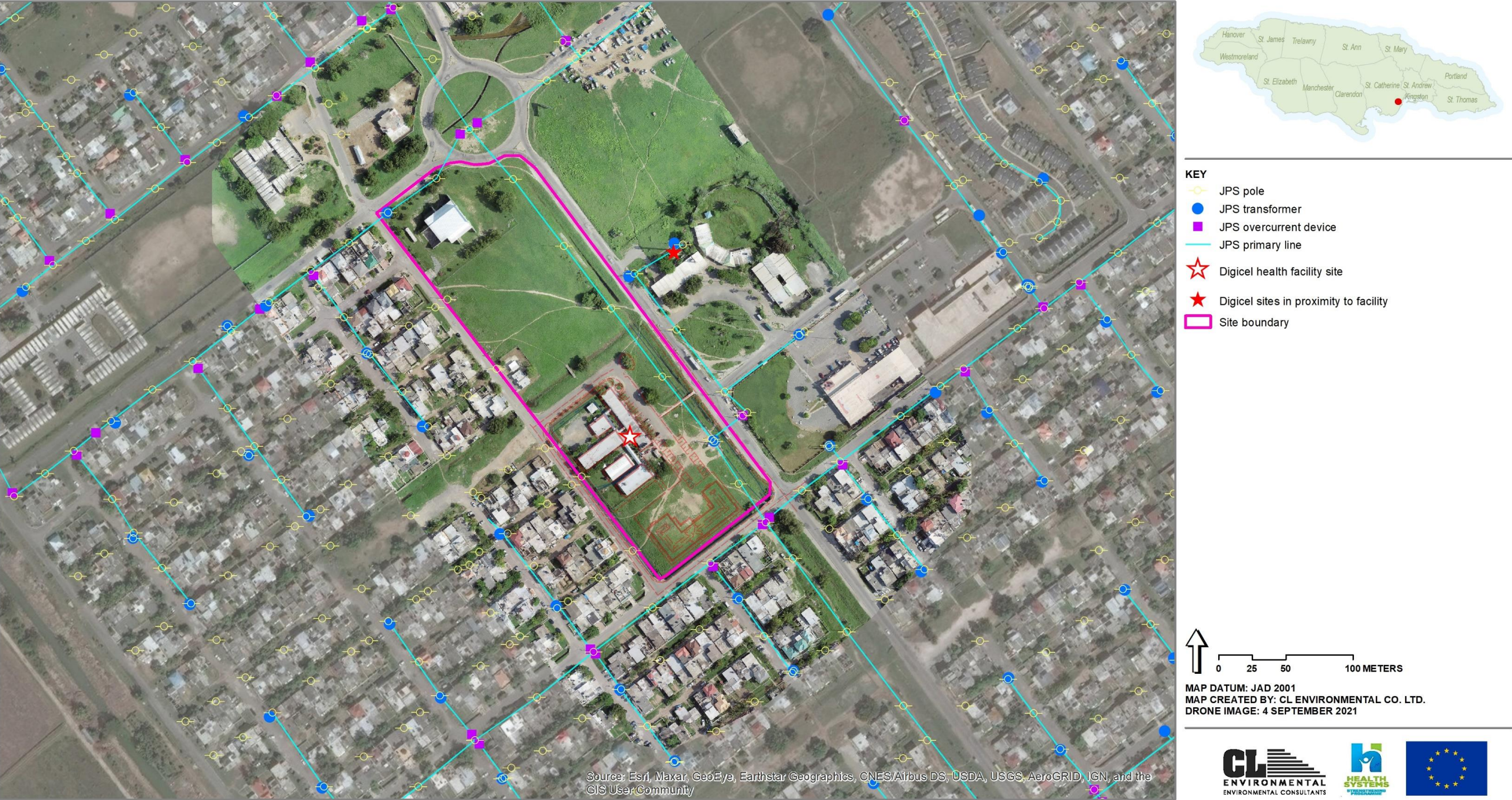
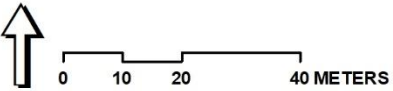


Figure 4-50 JPS utilities and Digicel sites at and surrounding Greater Portmore Health Centre



- KEY**
- Above ground tank
 - Propane tank
 - Water tank
 - Site boundary



MAP DATUM: JAD 2001
MAP CREATED BY: CL ENVIRONMENTAL CO. LTD.
DRONE IMAGE: 4 SEPTEMBER 2021



Figure 4-51 Tank storage observed at the Greater Portmore Health Centre

4.4.1.3 Fuel

One location was identified for fuel storage of Liquid Petroleum Gas.



Plate 4-92 Potable water and fuel storage tanks at the GPHC

4.4.1.4 Drains

Several issues with drains and drainage areas were seen all around the health centre. Drains were blocked, damaged and littered with solid waste. Water in these drains may be contaminated with runoff and solid waste. Flooding from drains into green spaces was seen.

Staff reported that the flood water was contaminated with sewage and waste water from the adjacent residential area. They also noted that flooding events can be extreme, covering walkways and entering offices.



Plate 4-93 Drainage canal, often blocked with debris and overgrown vegetation



Plate 4-94 Section of the drainage area (trench and small culvert)

4.4.1.5 Waste Streams

Categories of Waste

The main waste streams from hospitals and healthcare establishments are categorized into the following three categories for management purposes²⁰ (C. L. Environmental Company Ltd., 2007):

General/Non-Clinical Waste – includes waste generated from administrative activities, general cleaning, food preparation and ward areas, provided that they are separated at the point of generation from the waste classified as medical and special waste. These wastes do not pose a special handling problem or hazard to human health or the environment and their characteristics are similar to those of common domestic waste. Examples include:

- Wrappers and packaging materials/containers, food waste and leftovers, cleaning materials;
- Office materials and equipment including paper, newspaper, cardboard, plastic, glass disposable containers, hand towels, timber, metal;
- Used disposable bed pan liners, urine and specimen containers, faeces, incontinence pads and stoma bags;
- Used personal hygiene products;
- Non-infectious animal bedding;
- Waste that come into contact with patients through routine examination of patient care but are not soiled or saturated with fluid blood, body fluids, excretions, exudates or secretions example gloves, caps, gowns, drapes, disposable sheets, gauzes, cotton balls and dressings;
- Garbage generated by patients, workers and visitors;
- Waste material that has been sterilized.

Medical/Clinical Waste – includes wastes generated during the different stages of health care (diagnosis, treatment, immunizations, research, etc.) that contains pathogens which are capable of producing an infectious disease. These wastes represent different levels of potential danger according to the degree of exposure of infectious agents.

Special Waste – includes wastes generated during auxiliary activities that constitute a health risk due to their aggressive characteristics, such as Corrosivity, Reactivity, Inflammability, Toxicity, Explosivity and Radioactivity.

Examples and description of the different types of Medical and Special Wastes are presented in Table 4-80 (C. L. Environmental Company Ltd., 2007).

²⁰ Health Facilities Infection Control Policies and Procedures Manual, Ministry of Health (Revised 2007)

Table 4-80 Categories of Medical Waste

WASTE CATEGORY	DESCRIPTION AND EXAMPLES
INFECTIOUS WASTE	
Infectious waste	Waste suspected of containing pathogens e.g. laboratory cultures; waste from isolation wards; tissues (swabs), materials, or equipment that have been in contact with infected patients or animals; excreta
Anatomical/Pathological waste	Human or animal tissues or fluids e.g. body parts; blood and other body fluids; fetuses (including waste from mortuary and autopsy centres)
Sharps	Sharp waste e.g. needles; infusion sets; scalpels; knives; blades; broken glass
SPECIAL WASTE	
Pharmaceutical waste	Waste containing pharmaceuticals e.g. pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)
Genotoxic waste ²¹	Waste containing substances with genotoxic properties e.g. waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals (The most common genotoxic products used in healthcare are listed at Appendix 1)
Chemical waste	Waste containing chemical substances e.g. laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources

Non-Clinical Waste at GPHC

Information from internal stakeholder consultations is that non-medical waste, to include food waste, is collected in black or green bags for collection by the National Solid Waste Management Authority (NSWMA).

Within the Greater Portmore Health compound, a total four blue plastic storage bins and three areas with bags only (non-clinical waste), were observed for general/ non-clinical waste and three areas were observed holding medical waste on September 18, 2021. Non-clinical and medical waste are stored in a main storage area, however this area was exposed and was insufficient in separating medical waste from other waste.

²¹ Genotoxic waste includes cytotoxic drugs used in cancer treatment and their metabolites and outdated materials, vomitus, faeces or urine from patients treated with cytotoxic drugs or chemicals, and materials such as syringes and vials contaminated from the preparation and administration of such drugs; they are highly hazardous, mutagenic, teratogenic or carcinogenic.

Generally, most of the storage areas were not adequately setup as the solid waste were not stored in vermin-proof storage.

Plate 4-95 - Plate 4-101 show examples of waste storage at the health centre.

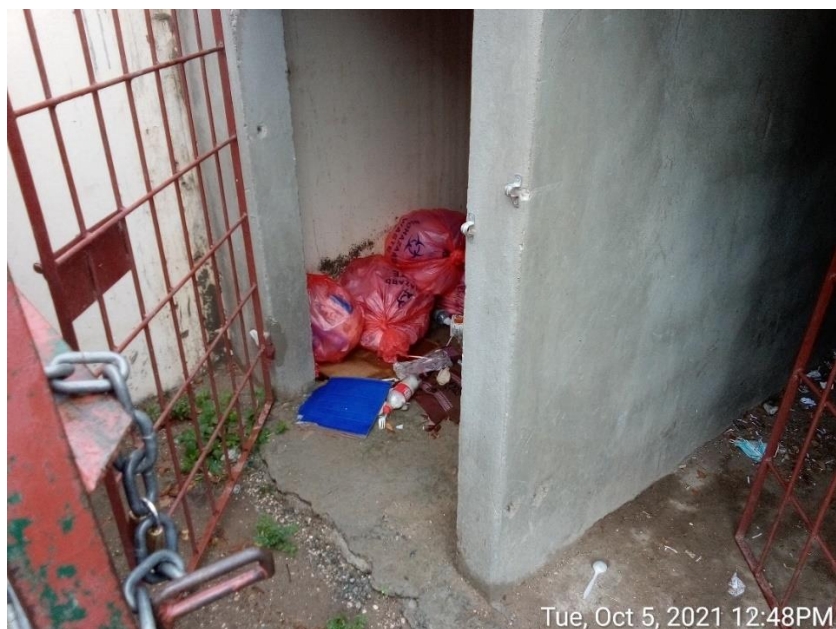


Plate 4-95 Medical waste, exposed and mixed with non-clinical waste



Plate 4-96 Medical waste, exposed and mixed with non-clinical waste



Plate 4-97 Solid waste littering a section of the health centre



Plate 4-98 Solid waste and assets littering a section of the health centre



Plate 4-99 Solid waste littering a green space and blocking a section of the drainage trench



Plate 4-100 Solid waste bin at the heath centre



Plate 4-101 Solid waste bin at the health centre

Medical Waste at Greater Portmore Health Centre

Medical/Contaminated waste is collected in red bio-hazard bags which are later collected by the Medical Waste Truck. It was not ascertained if this waste was collected by the Waste Management Unit of the MOHW for direct disposal or transported to the Spanish Town Hospital for later collection. Medical waste is stored in the main area with other waste, although it is separated, medical waste was seen mixed with solid waste at the health centre.

MEDICAL WASTE GENERATION RATE

Medical waste generated is calculated by the estimated rates given in Table 4-2. The estimated medical waste generation on clinic days = 10.0 kg/day (≈ 0.3 tonnes/month).

Table 4-81 Estimated Medical Waste Generation rates per Category of Facility

Source: GOJ Comprehensive Solid Waste Management Study, Norconsult, October 1996

Generator Class	Jamaican Rate	US Rate (Federal Registry)
Hospital	1.0 kg/bed/day	2.6kg/bed/day
Clinic/Health Centre	10.0 kg/day	14.5 kg/day
Doctor's Office	10.0 kg/day	14.5 kg/day
Dentist Office	2.7 kg/week	3.6 kg/week
Veterinarians	negligible	7.2 kg/week
Medical Laboratories	54.5 kg/week	113.6 kg/week



Figure 4-52 Solid waste storage observed at the Greater Portmore Health Centre (September 18, 2021)

Sewage and Wastewater

Sewage waste generated at the health centre is disposed of through the municipal sewer system which serves the community. Anecdotal information is that this system “fills and overflows in times of moderate rainfall”.

4.4.1.6 Employment

Greater Portmore Health Centre currently employs 50 staff members.

4.4.1.7 Patient Load

The patient load for 2019 and 2020, before the Covid-19 pandemic are given below.

Table 4-82 Greater Portmore Total Patient Load Statistics for the Year 2019

Month	2019
January	4607
February	5361
March	3363
April	4200
May	4236
June	3528
July	4235
August	4074
September	4577
October	3443
November	3611
December	3079
Total	48,314

Table 4-83 Greater Portmore Total Patient Load Statistics for the Year 2020

Month	2020
January	3707
February	3260
March	3263
April	2089
May	2591
June	2559
July	2559
August	3093
September	3999
October	3108
November	3328
December	3090
Total	36646

4.4.1.8 General Observations

The Greater Portmore Health Centre does not have an incinerator.

Disabled Access and Amenities

No special areas, amenities or other conveniences were seen for individuals with special needs such as the visually impaired, hearing impaired or those with mobility issues.

Wheelchair access points were in generally poor condition. Areas such as tented sections had no access points.

Walkways and Corridors

Issues with the condition of walkways and corridors included:

- Damaged, broken sections of walkways or corridors. These areas are hazardous to the public and staff, in particular to the elderly, visually impaired, and those with mobility issues.
- Unpaved and dusty pathways were seen all around the hospital grounds. These areas also have ponding issues during rain events.

Leaks and Other Structural Damage

Leaks were seen in some sections of the health centre.

Tented Areas

Tented areas have been established for overflow at the several departments around the hospital and pharmacy. Covid testing and treatment tented areas were separated. These areas typically occur in green spaces, on dusty and uneven ground with no wheelchair access.

An uncovered area with benches was also seen. This area is said to be for day care and paediatric services

Asset Storage

For the purpose of this report, assets are considered to be all MOHW property both specialized and unspecialized which are stored on site. Asset storage was seen poorly stored in various areas of the property. Assets were seen littering sections of green spaces along with some office and public areas.



Plate 4-102 Assets stored in a green space section of the health centre



Plate 4-103 Asset storage, construction debris and solid waste in a section of the health centre

Signage – Emergency Exit points, Assembly Areas

There were no signs indicating the location of emergency assembly point and signs at the assembly points. No emergency exit signs were seen on the exterior of buildings.

Fire Hydrants

No fire hydrants were seen in or around the GPHC.

Green Spaces

Green spaces in and around the health centre were fairly well maintained. Soe areas are dusty and become flooded and muddy during rain events (Plate 4-104 and Plate 4-105).



Plate 4-104 Flooding on the main grounds inside the heath centre



Plate 4-105 Green space fairly well maintained with some evidence of burning

Restrooms

Restrooms for staff, patients and visitors were in fair to poor condition. No restroom facilities had sufficient disabled access.

Vectors

Some vector control methods such as rat bait traps were seen all around the grounds, however several potential breeding areas were seen. These include areas with overgrown vegetation, stagnant water, water collection in asset storage areas, improperly stored waste (medical, non-medical and solid waste) in and around the health centre. The main vectors are as follows;

- Mosquitos
- Rats
- Pigeons
- Stray animals

Health Facilities in Proximity to the GPHC

A doctor's office is located 100 metres east of the health centre while a Biomedical Lab and a community medical complex are located approximately 600 metres southeast of the health centre (Figure 4-53).

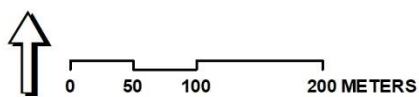


KEY

Nearby health facilities

Type

- Doctors Office
- Medical Facility
- Site boundary



MAP DATUM: JAD 2001
MAP CREATED BY: CL ENVIRONMENTAL CO. LTD.
DRONE IMAGE: 4 SEPTEMBER 2021

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community



Figure 4-53 Health Facilities in Proximity to the GPHC

4.4.2 Physical Environment

4.4.2.1 Climatology and Meteorology

Weather data was requested from the Meteorological Service Jamaica for the nearest weather station to the Greater Portmore Health Centre located in St. Catherine. The Meteorological Service provided four years of hourly data for temperature and humidity for Twickenham Park Automatic Weather Station (AWS), located approximately 9.5 km to the northwest of the health centre for the years 2017-2020.

Temperature

Average temperature between 2017 – 2020 ranged from 24.30°C to 28.70°C. The lowest average temperature occurred in January 2019 whilst the highest average temperature occurred in August 2019. Maximum temperature over the time period was 34.5°C which occurred on September 22, 2017, at 2pm and a minimum temperature of 22.7°C which occurred on September 28, 2017, at 4am.

The data indicated that in generally the warmest times of the year occurred between June to August, with July being typically the hottest month

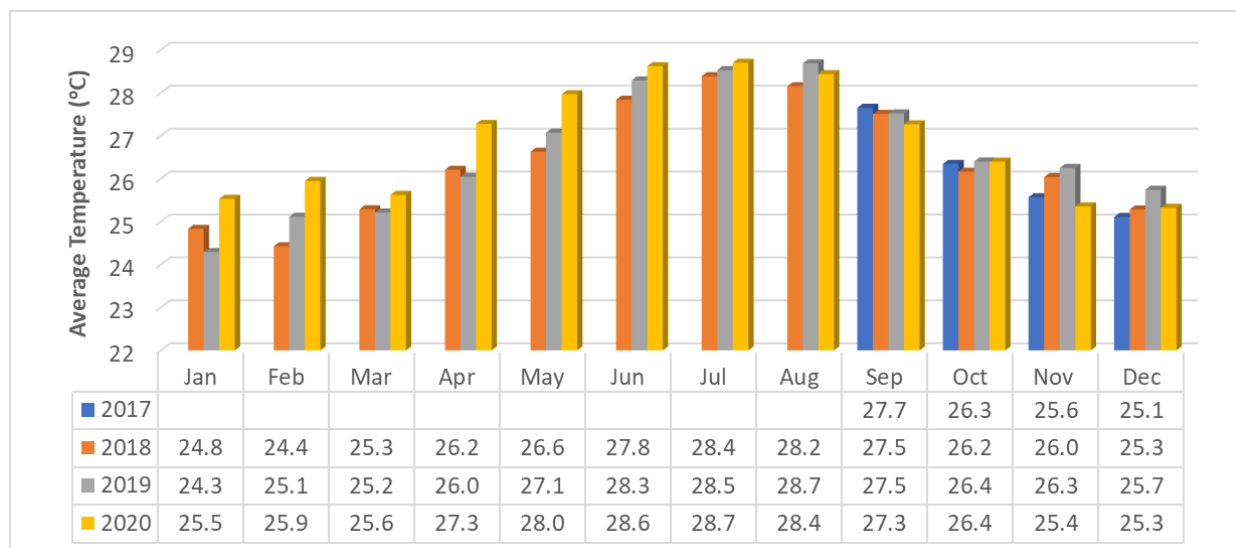


Figure 4-54 Average temperatures (°C) for the Twickenham Park Automatic Weather Station (2017 – 2020)

Relative Humidity

Average relative humidity over the four years (2017 – 2020) was 79.59% with a maximum of 98% occurring on November 9, 2020 at 7am and a minimum of 39% occurring on February 22, 2019 at 12pm. Generally, the highest relative humidity occurred between the hours of 4am – 8am and the lowest between 6pm – 4pm.

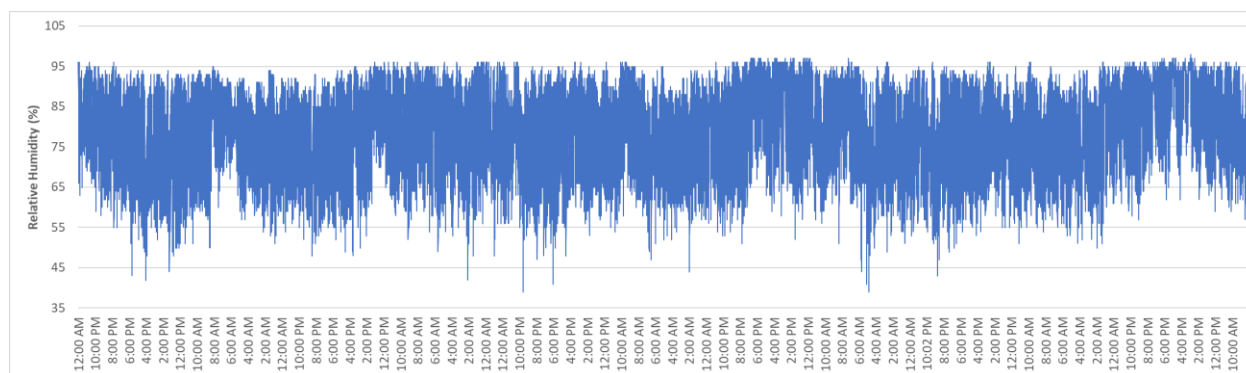


Figure 4-55 Relative humidity for the Twickenham Park Automatic Weather Station (2017 – 2020)

Rainfall

The Twickenham Park Automatic Weather Station (AWS) had no available rainfall data.

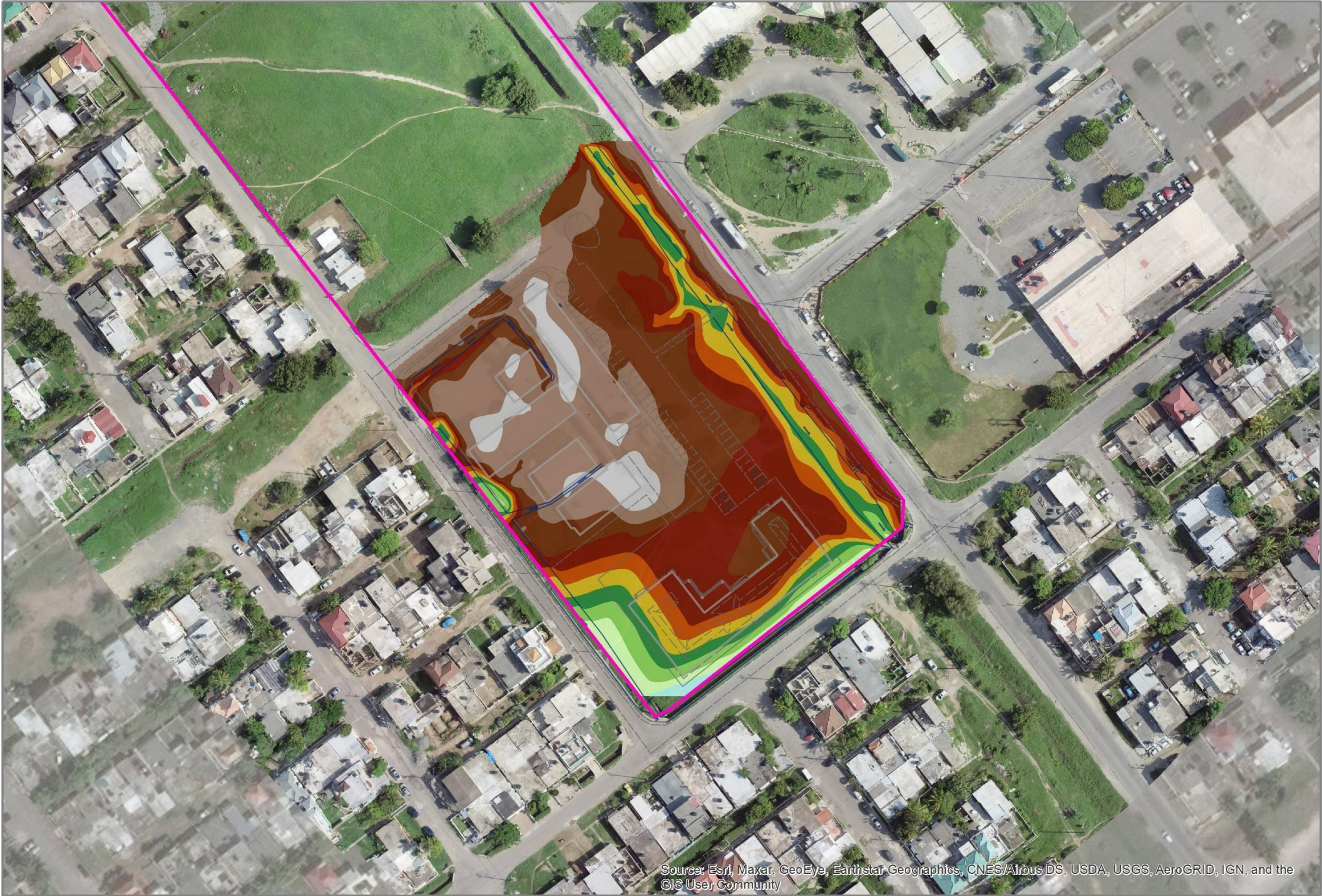
Wind Speed and Wind Direction

Average wind direction over the time period was from the east northeast direction with an average wind speed of 1.41 ms^{-1} (2.74 knots). Calm winds occurred 18.29% of the time.

Winds from the southeast were the most frequent, occurring 10.5% of the time. The next two frequently occurring wind directions are from the north (9.4 %) and the north northeast (8.8 %). The most frequent wind class category was the $0.5 - 2.10 \text{ ms}^{-1}$ (0.97 – 4.08 knots) which occurred 35.6% of the time.

4.4.2.2 Topography

Elevation ranges between 4.3 and 7 metres at the proposed site (Figure 4-56); the highest elevations of 6.3 to 7 metres are noticeable in the northwest section of the site where the existing facilities are located. The site is generally flat with slopes predominantly less than 5% rise, except for along the north-eastern boundary where land slopes steeply downwards to a drain, as well as along the southwestern boundary (Figure 4-57). Within the drain, elevations range between 4.8 and 5.5 metres and the terrain generally faces the southwest, south and west (Figure 4-58).

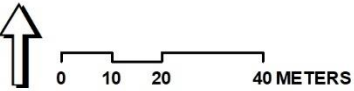


KEY

Elevation (m)

- 4.3 - 4.5
- 4.6 - 4.8
- 4.8 - 5
- 5.1 - 5.3
- 5.3 - 5.5
- 5.6 - 5.8
- 5.8 - 6
- 6.1 - 6.3
- 6.3 - 6.5
- 6.6 - 6.8
- 6.8 - 7

Site boundary



MAP DATUM: JAD 2001
MAP CREATED BY: CL ENVIRONMENTAL CO. LTD.
DRONE IMAGE: 4 SEPTEMBER 2021

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Figure 4-56 Elevation at Greater Portmore HC



KEY

Slope (% rise)

- 0 - 5
- 5.1 - 10
- 10.1 - 15
- 15.1 - 20
- 20.1 - 25
- 25.1 - 30
- 30.1 - 35
- 35.1 - 40
- 40.1 - 45
- Site boundary

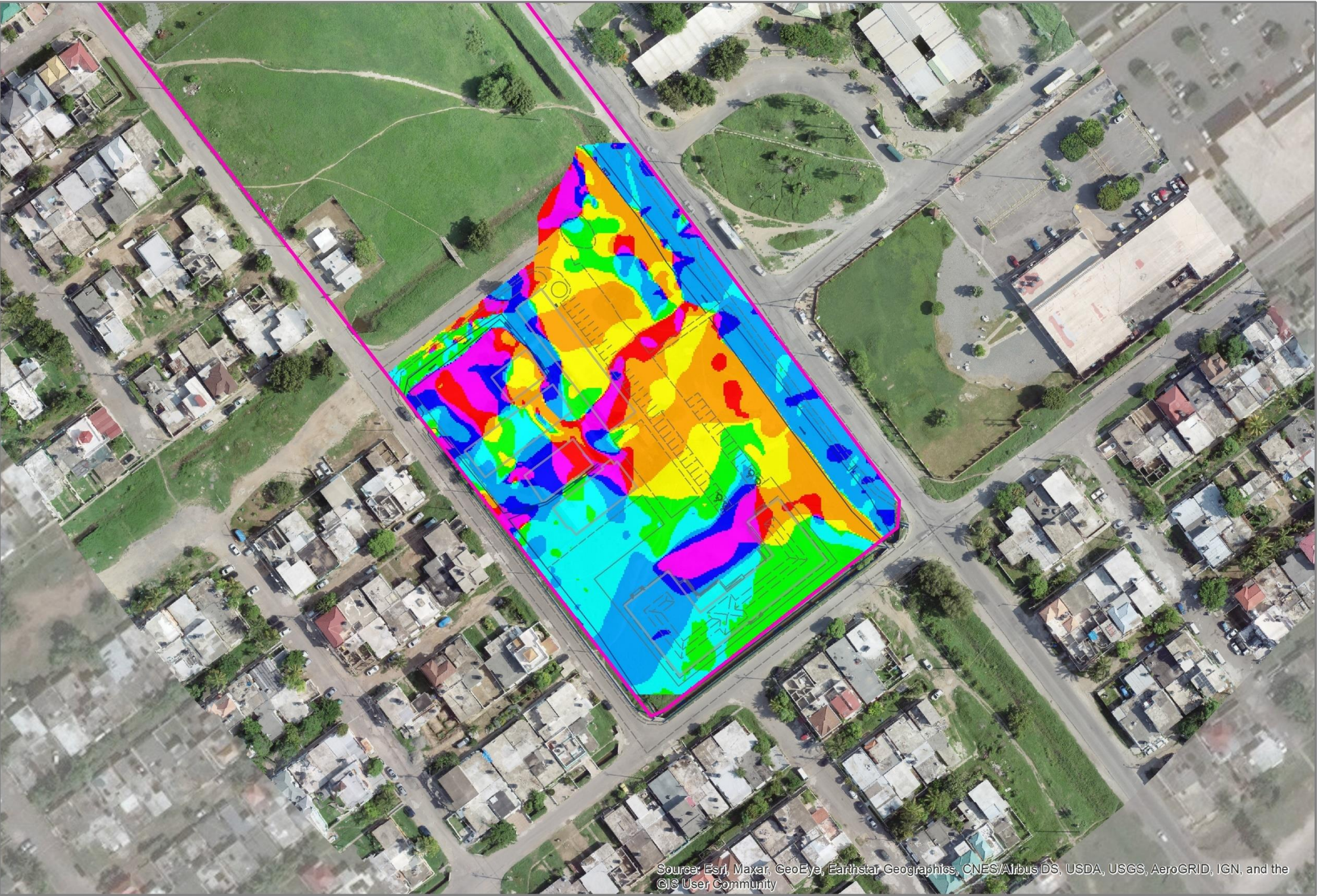


MAP DATUM: JAD 2001
MAP CREATED BY: CL ENVIRONMENTAL CO. LTD.
DRONE IMAGE: 4 SEPTEMBER 2021

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Figure 4-57 Percentage slope at Greater Portmore HC



- KEY**
- Aspect**
- North (0-22.5)
 - Northeast (22.5-67.5)
 - East (67.5-112.5)
 - Southeast (112.5-157.5)
 - South (157.5-202.5)
 - Southwest (202.5-247.5)
 - West (247.5-292.5)
 - Northwest (292.5-337.5)
 - North (337.5-360)
 - Site boundary



MAP DATUM: JAD 2001
MAP CREATED BY: CL ENVIRONMENTAL CO. LTD.
DRONE IMAGE: 4 SEPTEMBER 2021



Figure 4-58 Aspect at Greater Portmore HC

4.4.2.3 Geology and Soils

Geology

A review of the 1:50,000 Geological Sheet (Figure 4-59) indicates that the site is underlain by Pliocene to Recent Alluvium (Qa). The alluvial deposits consist of alternating layers of gravel, sand, silts and clay, with occasional cobbles and boulders. This geological formation represents material that has been transported and deposited by fluvial mechanisms.

There are no fault lines making direct impact on the proposed site, as the area is underlain by younger deposits of alluvium. Fault lines in close proximity to the site are observed further south and east of the site along the Green Bay to Hellshire area. These faults are, however deemed minor faults which do not appear to be seismically active faults.

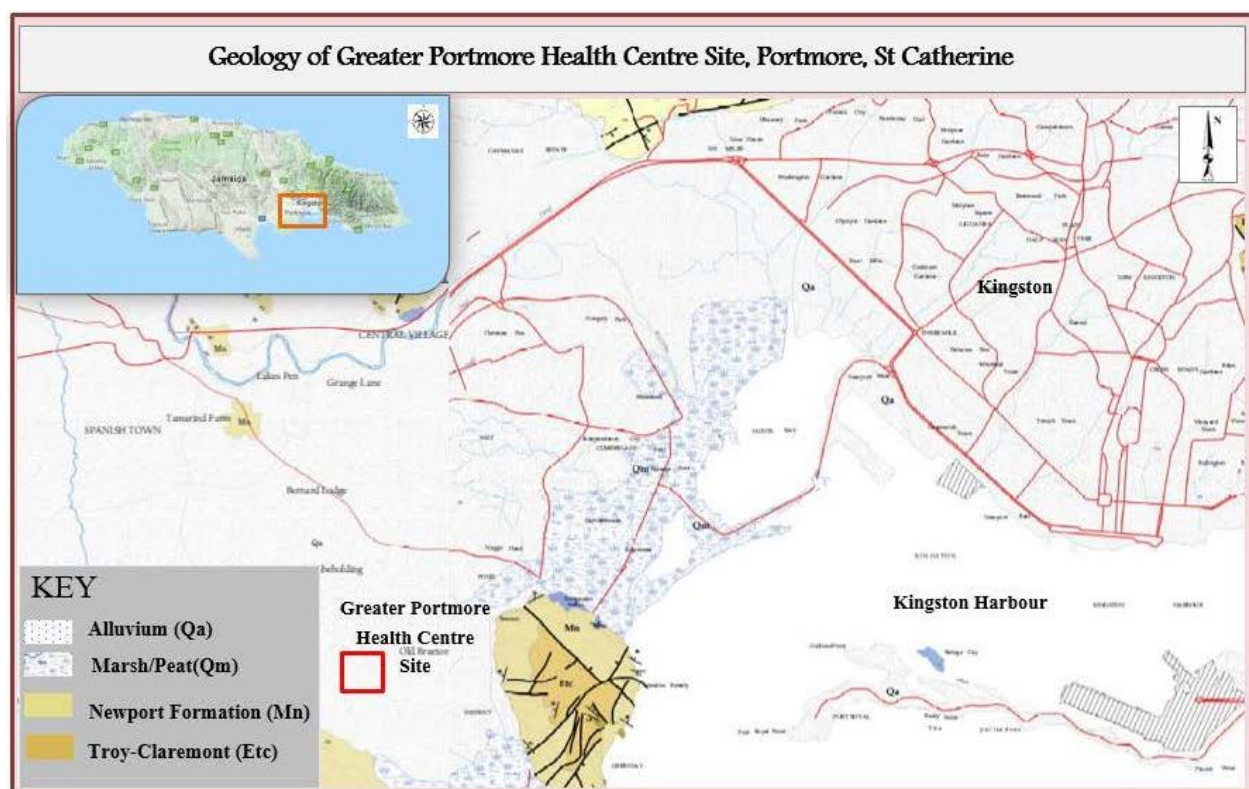


Figure 4-59. Geology of the Greater Portmore Health Centre Site in St Catherine

Soils

The soils at the Greater Portmore Health Centre site at shallow foundation depth (up to 3.6 m/12 feet) consists of medium dense silty and gravelly sand (coarse grain soil) to depth of approximately 2.1m (7 feet). Below this depth is to be found stiff to very stiff cohesive soil consisting of silt and clay with varying proportions of sand and gravel (Geo Technics Limited, 2020).

4.4.2.4 Air Quality

PM10

The results of the PM10 sampling run are shown in Table 4-84. All locations had particulate PM10 values compliant with the 24-hour NRCA standard of 150 µg/m³. Station P2, located at a residence off site, had a marginally higher PM10 value (19.17 µg/m³).

Table 4-84 Summarized PM 10 Results

STATION	PM10 Result (µg/m³)	NRCA Std. (µg/m³)
P1	16.39	150
P2	19.17	150

Values in red are non-compliant with NRCA standards

PM2.5

The results of the PM2.5 sampling run are shown in Table 4-85. Station P1 had a PM2.5 concentration compliant with the 24-hour USEPA PM2.5 standard of 35µg/m³. Station P2 had a PM2.5 concentration (78.19 µg/m³) which was non-compliant with the 24-hour USEPA PM2.5 standard of 35µg/m³. Evidence of burning as a form of mosquito control was observed at Station 2, hence the elevated PM2.5 concentrations.

Table 4-85 Summarized PM 2.5 Results

STATION	PM2.5 Result (µg/m³)	USEPA Std. (µg/m³)
P1	19.03	35
P2	78.19	35

Values in red are non-compliant with USEPA standards

4.4.2.5 Noise

Methodology

Noise level readings were taken from 12:00am Friday September 10th, 2021 to 12:00am Saturday September 11th, 2021, by using Brüel & Kjaer noise analysers setup in outdoor monitoring kits.

Figure 4-35 lists and shows the locations of the noise monitoring stations.



Figure 4-60 Noise and particulate monitoring locations

Results

Table 4-9 shows the minimum, maximum and average noise levels over the 24-hour assessment period, as well as the geometric mean centre frequencies obtained at each station.

Table 4-86 Ambient Noise data at all stations

Stn.#	Average Leq (24 hr)	Min (dBA)	Max (dBA)	Geometric Centre Frequency (Hz)	Octave Band Range (Hz)
N1	58.6	32.7	92.2	12.5	11-14
N2	51.0	33.3	87.3	25	22-28

COMPARISONS OF AMBIENT NOISE LEVELS WITH NRCA DAYTIME AND NIGHT-TIME GUIDELINES

Comparison of the ambient noise levels in the study area with the Natural Resources and Conservation Agency (NRCA) Standards are shown in Table 4-10. During the daytime and night-time, both stations had noise levels compliant with respective NRCA night-time standards.

Table 4-87 Comparison of daytime and night-time noise levels at the stations with the NRCA guidelines

Stn.#	Zone	7 am. - 10 pm (dBA)	NRCA Daytime Guideline (dBA)	10 pm. - 7 am (dBA)	NRCA Night Time Guideline (dBA)
N1	Commercial	59.6	65	47.3	60
N2	Residential	52.1	55	43.0	50

NB. Numbers in red are non-compliant with the standard/guideline

COMPARISONS OF NOISE LEVELS DURING WORK HOURS WITH POTENTIAL CONSTRUCTION PERMIT GUIDELINES (70 DBA)

Table 4-11 shows the comparison of the ambient noise levels during permitted work hours (7:30am – 5pm on weekdays) with the potential NRCA permit guidelines at each station. Noise levels during work hours were compliant with the noise guidelines, at both locations.

Table 4-88 Noise level during work hours (7:30am – 5:00pm)

STATION	7:30 am – 5:00 pm (dBA)	Potential construction permit guideline
N1	60.0	70
N2	51.5	70

4.4.2.6 Vibration

Baseline Vibration Calculations

Using the prediction calculations, vibration levels were predicted at a distance of 10 metres from the centreline of South West 1st Avenue to the existing health centre building, using a “3-tonne truck travelling at 35 mph” as the operating equipment/vehicle. Results showed that the PPV vibration value was 0.017 mm/sec, which indicates that vibration levels are imperceptible by humans and have no effect on building structures.

4.4.2.7 Existing Sources of Pollution

Evidence of burning was seen in and around the health centre (Plate 4-106 - Plate 4-108).



Plate 4-106 Evidence of burning outside the main health centre grounds



Plate 4-107 Evidence of burning outside the main health centre grounds



Plate 4-108 Evidence of burning inside the main health centre grounds

4.4.3 Natural Hazards

4.4.3.1 Natural Hazard Identification

Flooding

HYDROLOGY AND FLOOD PLAIN MODELLING

A flood plain model was established illustrating the flood plain and depths within the project area and areas around the island to determine the level of exposure for the site. The tool of choice when generating flood plains is the Hydrologic Engineering Centre's River Analysis System (HEC-RAS). The United States army corps of engineers created this software to perform one and two-dimensional hydraulic calculations for a complete network of natural and constructed channels. Due to the complex nature of the hydrodynamics within the project area, a 2-D model was used to generate flood depth to predict flooding to determine its impact on the surrounding infrastructure. Key features (inputs) used to do the assessment are as follows:

1. JAXA Topographic Data Topographic data (30m Geotiff).
2. Topographic Survey Data
3. Historical and Projected Extreme Rainfall (Return Periods 25Yr-100Yr)
 - a. Daily precipitation – Blair Pen Rainfall Station
4. Land Cover and Soil Type

TOPOGRAPHY

The terrain data was derived from a combination of submitted site specific topographic data, in combination with available JAXA (Japanese Aerospace Exploration Agency) Digital Elevation Map (DEM) of the island, captured using advanced satellite imagery. The DEM serves as the base of the 2D model, using a finite element mesh to calculate the water volumes and thus the flood plains throughout the model.

PRESENT RAINFALL CONDITIONS

Depth of rainfall for various return periods was provided by the National Meteorological Service of Jamaica for the closest gauge to the proposed Greater Portmore Health Centre, which was the Great Salt Pond rain gauge station. This station is 0.8km from the project, and its rainfall depth can be viewed in Table 4-13.

Table 4-89 Present climate 24-Hour Rainfall Depths (mm) for Blair Pen rain gauge station (Met. Service/NWA)

Return period (years)	Rainfall Depths (mm)
25-Year	201
50-Year	213
100-Year	224

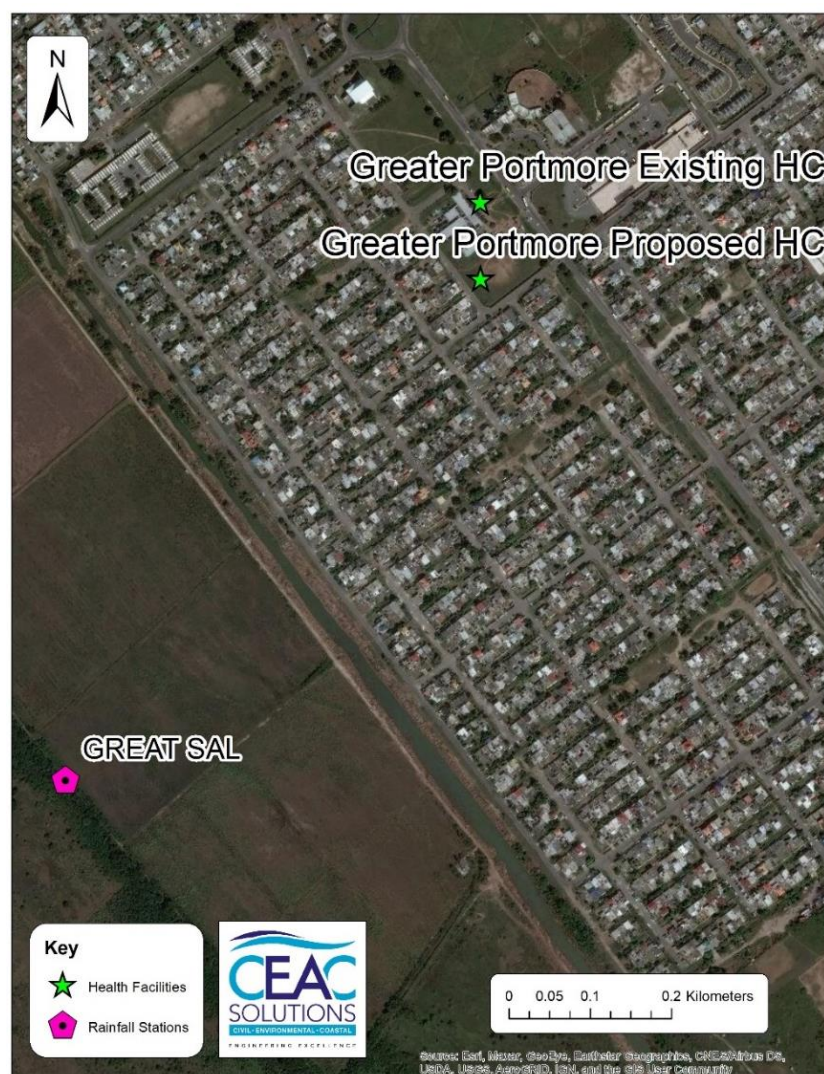


Figure 4-61 Location of Blair Pen, Catherine rainfall gauge station relative to project area

RAINFALL HYETOGRAPH

A hyetograph is the distribution of rainfall intensity over time. For example, in the 24-hour rainfall distributions developed by the Soil Conservation Service, rainfall intensity progressively increases until it reaches a maximum then gradually decreases. The Type III rainfall distribution curve was used for this assessment as it most accurately reflects the 24-hour rainfall distribution experienced by the island. Rainfall Hyetographs were generated using the present and future climate conditions extreme rainfall and used to model the respective return periods.

MODEL CALIBRATION AND VALIDATION

In order to validate the flood plain model, the modelled project area was compared to both collected anecdotal data and available data from the ODPEM, showing two-hundred and ninety-three (293) recorded flood-prone areas.

Anecdotal data

During the site visit on the 31st of August 2021, anecdotal interviews were conducted in and around the health facility compound. All respondents reported that storm water in the project area is controlled by the perimeter earth drain that surrounds the area. They report that they have not witnessed any major flooding (no inundation of buildings and parking areas) in the project area on the compound.

ODPEM Flood Prone Areas

The comparison of the ODPEM Flood Prone Areas was used as the secondary validation method for the model. The ODPEM data presented two-hundred and ninety-three (293) flood-prone areas and allowed for confirmation of known flood-prone areas, however, no depth was recorded in the dataset. This validation involved probing whether or not the flood plain generated was within a 500m radius of the flood-prone areas as presented by the ODPEM.

The ODPEM Flood Prone Areas map indicated that Portmore generally is prone to flooding, however, the project area within the model did not show flooding for any of the presented return periods.

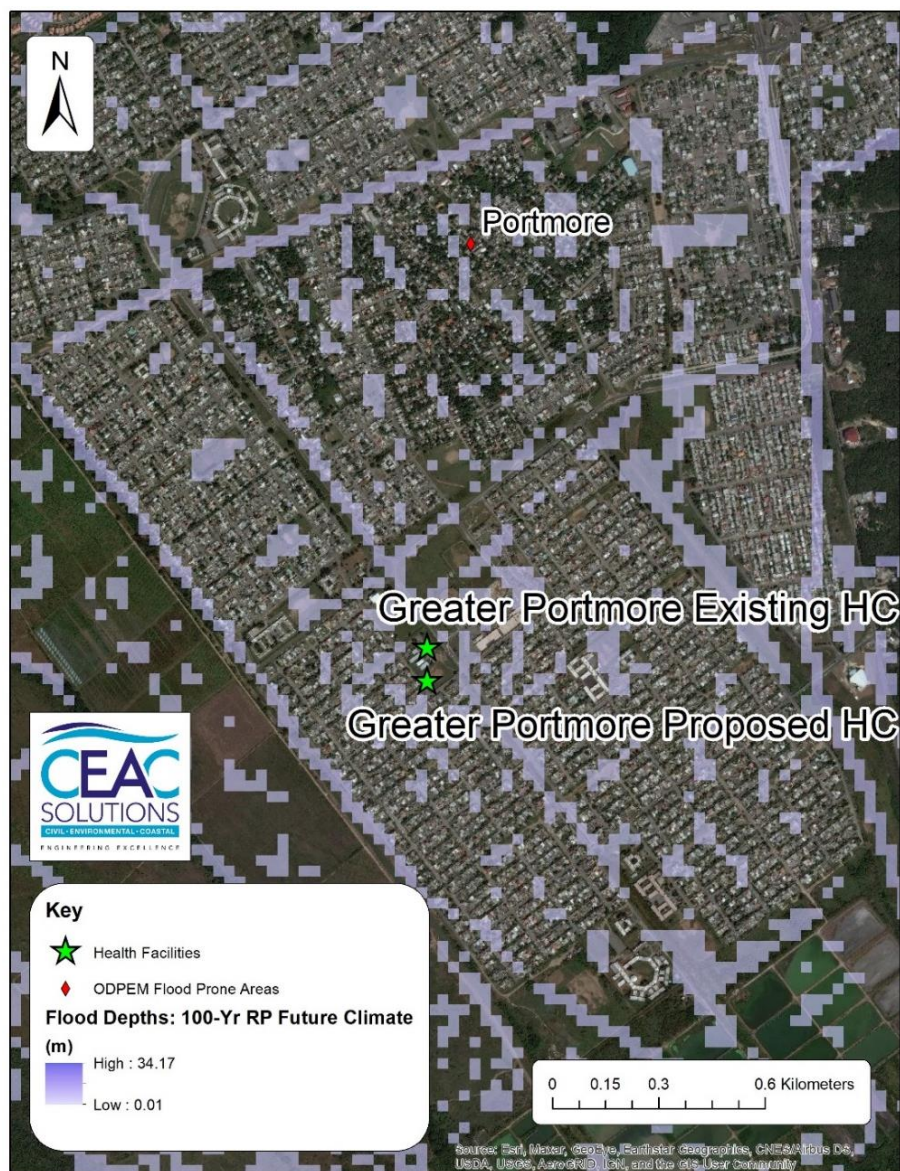


Figure 4-62 Flood Plain Validation map showing ODPEM Flood Prone Areas with 100-Yr Future Climate

FLOOD PLAIN MODEL RESULTS

As stated previously, two scenarios were considered for the facility. The pre-improvement scenario which describes the compound as it currently exists, and the post-improvement scenario which describes the compound after improvements have been enacted. These scenarios were modelled for the 25-yr, 50-yr, and 100-yr return periods for present and future climate conditions. Also considered were the impacts to the main access routes of the facility. A detailed hydrological analysis was not carried out for the accesses as the flood model did not predict significant flooding along the main accesses of the facility. The results of the hydraulic model did not highlight any areas within the proposed project area that are exposed to either pluvial (floods occurring independent of an

overflowing water body) flooding, or fluvial flooding (flood caused by water bodies overflowing their banks).

From the flood plain model, it was observed that neither pluvial nor fluvial flooding significantly affected the facility for any of the presented return periods. This corroborates the interviews from the respondents of the interviews, as well as what was observed during our site visit as the topography does not allow for a flooding issue for the scenarios considered.

Historical flood prone area maps by ODPEM indicated that the area was exposed to the hazard of flooding. This was further corroborated by flood hazard rating maps generated by Nandi, Mandal, Wilson, Smith (2016) which indicated depths in excess of 0.6m. Flood plain model results at the direct foot print of the site indicated that site itself would not be significantly inundated however. As such similarly to the St. Jago Health Centre, further flood risk assessment was not pursued.

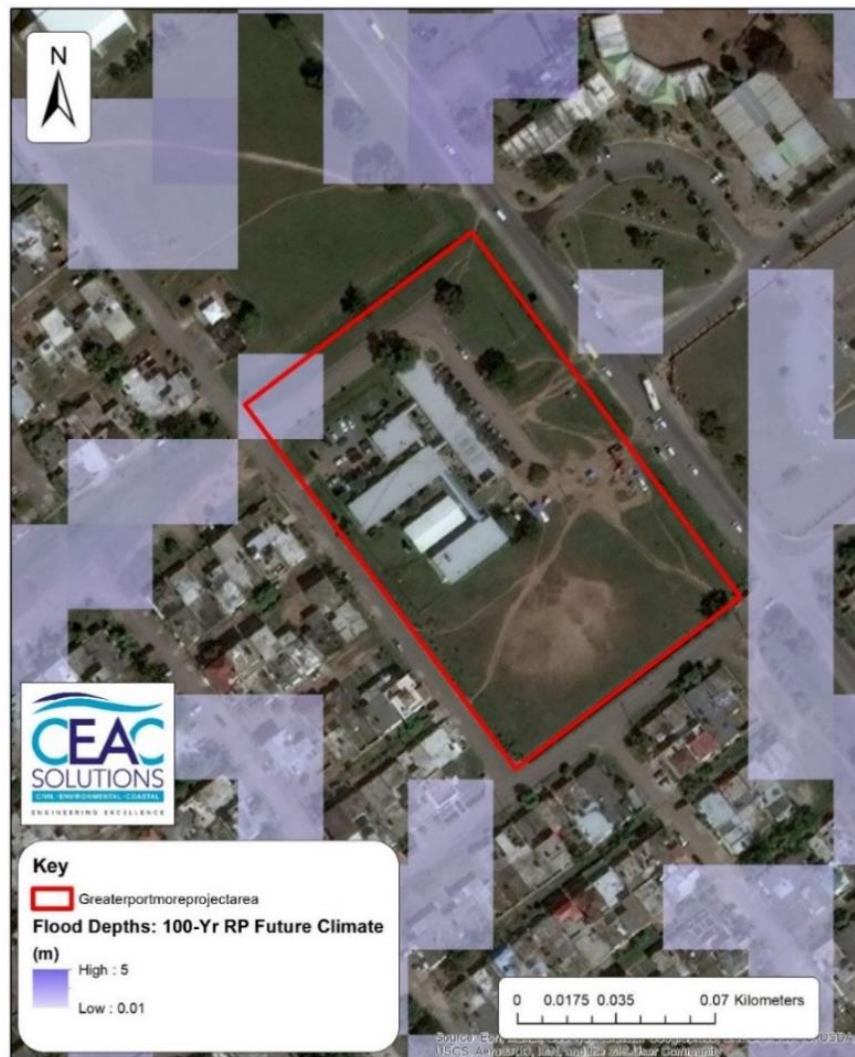


Figure 4-63 Flood plain map of the St. Jago Park Health Centre for the Pre-Improvement, 100-Yr Future Climate Scenario

Earthquake

GEOLOGY AND LITHOLOGY

Jamaica straddles the boundary between Caribbean tectonic plate and Gonave micro-plate. The Walton and the Enriquillo Fault Zones, extending respectively to the west and the east of Jamaica, form the boundary between these two plates. The movement across these two fault zones are transmitted through the Jamaican Fault system and are the source of significant earthquake activity in the island.

To the north approximately 8km from the project site, faults within the Bog Walk area have resulted in downthrow of limestone blocks further north. The most prominent fault zone in that area is the Cavaliers Fault zone which trends in the general E-W direction. This fault extends through areas of Bog Walk, Sligoville, and along Cavaliers to Stony Hill where it slightly offsets the Wagwater Fault. This fault continues across the Wagwater Belt which trends in a south-easterly direction.

HISTORICAL EARTHQUAKE EVENTS

Seismic events have the capacity to be some of the most devastating and costly natural hazards. The level of damage or loss typically varies depending on the magnitude of an event, wherein effects can range from only being noticed via seismograph to significant loss of life and infrastructural damages. Despite having the tools for monitoring and recording these occurrences, earthquakes are unpredictable in nature.

Jamaica has had a notable earthquake history with significant events such as the 1692 Port Royal earthquake, the 1907 Kingston earthquake, the 1957 March 1st earthquake, which impacted the western end of the island and the 1993 January 13th earthquake. These events were the cause of significant losses for Jamaican citizens but only represent a small portion of the seismic activity occurring on the island; more recently, between 2011 and 2020 there were over 1000 recorded earthquakes with local epicentres, of which approximately 94 were actually felt (Table 4-23). Although none were catastrophic, it highlights the significant levels of seismic activity across Jamaica.

There was a total of 1,032 seismic events occurring locally between 2011- 2020 (Jamaica) (Source: Earthquake Unit University of the West Indies, Mona Campus), of which 3 occurred within the Service Area of the Greater Portmore Health Centre. These occurred in 2017, 2018, 2020. The three (3) events are listed in Table 4-90. These were considered micro events (Anon., 2021).

Figure 4-23 depicts the seismic events that occurred for Jamaica between the years 2011 and 2020.

Table 4-90 Closest seismic events to the Portmore Health Centre (2011 – 2020)

LATITUDE	LONGITUDE	MAGNITUDE	DATE OF OCCURENCE	DIST FROM GREATER PORTMORE HEALTH CENTRE (KM)
17.927	-76.883	2.4	March 2, 2017	2.8
17.965	-76.889	1.3	June 19, 2018	3.3
17.959	-76.887	2.3	January 14, 2020	2.9

Source: Earthquake Unit University of the West Indies, Mona Campus, Kingston 7, Jamaica, W.I

HORIZONTAL GROUND ACCELERATION

The ground and spectral was used as the basis for exposure to earthquake hazard as it considers any impact that the distance of the epicentre away from a site would have, by simple recording the acceleration at a location. The Peak Ground Acceleration for the project area was extracted from the seismic hazard maps for Jamaica generated under the Caribbean Disaster Mitigation Project (Organization of America States (OAS), 1998) and the Probabilistic Seismic Hazard Assessment (Figure 4-24).

The Spectral Acceleration (SA) is the preferred Seismic Hazard intensity parameter used in most modern building codes. This is a measure of maximum acceleration observed from a specific oscillatory period (similar to that of natural building oscillation) caused by a sustained shaking during an Earthquake. This acceleration varies based on location and as result means that the level of ground shaking also varies based on location.

Determining the short and long period spectral accelerations associated with varying regions can be a useful indicator of the level of seismicity and consequently the possibility of more pronounced ground motions in one area versus the other. The spectral acceleration periods observed were 0.2 seconds which is representative of short buildings (a few floors tall) and 1.0 second which is geared towards representing the oscillations of taller structures (greater than 7 floors).

DAMAGE DESCRIPTION

Higher accelerations would imply a greater level of intensity at the location in question. As such a higher value would point to increased levels of damage and as result a relationship can be generated between ground acceleration and the Mercalli scale, which describes the probable extent of damage (Table 4-16). As per the Rapid Visual Screening Program developed by FEMA, a series of seismicity zones were determined based on the level of short period and long period spectral accelerations experienced (Table 4-17).

RESULTS

The findings indicate that the Portmore Health Centre is within a Moderately High Seismicity zone and that, there is the possibility of slight damage to specially designed structures in the event of 2475 return period event. Buildings of a lower design standard may suffer more considerable damage.

RP	Spectral Acceleration	Spanish Town	St. Jago	Old Harbour	Portmore
475	PGA	0.28	0.28	0.27	0.28
	(Short Period) 0.2	0.64	0.64	0.61	0.64
	(Long Period) 1.0	0.21	0.21	0.20	0.22
2475	PGA	0.5	0.5	0.48	0.5
	(Short Period) 0.2	0.97	0.97	0.97	0.91
	(Long Period) 1.0	0.27	0.27	0.25	0.30
4975	PGA	0.64	0.64	0.61	0.64
	(Short Period) 0.2	1.24	1.24	1.17	1.33
	(Long Period) 1.0	0.36	0.36	0.34	0.40

Wind

DESCRIPTION

Hurricanes produce heavy rainfall, high winds, and storm surge, all of which have the potential to cause damage and dislocation. High winds possess the ability to exert forces on the physical structure of buildings and also generate projectiles. The projectiles may pose a risk of causing damage to surrounding infrastructure or lead to injuries and fatalities. While spontaneous weather systems such as thunderstorms or cold frontal systems may produce higher than normal wind speeds, Hurricanes are responsible for most wind hazard situations. Hurricane wind speeds are typically used to categorize severity and lend to indicating the level of damage that can be expected. See Table 4-18 for categorization as per National Hurricane Centre (NOAA).

METHOD

To determine the extreme wind speeds experienced on an annual probabilistic basis, hurricane level winds and hurricane tracks were extracted from locally generated datasets sourced from both government agencies and the National Hurricane Centre (NOAA). Application of extremal statistics to predict maximum wind speeds and exceedance probabilities using Weibull's distribution produced the different return periods attached to the wind speeds. These results were plotted on maps and the points relating to the facilities extracted.

RESULTS

Table 4-91 Wind speeds for Portmore Health Centre and respective return periods

Return Period (years)	Wind speeds (m/s)
25	58.8
50	61.9
100	61.4

4.4.3.2 Risk Assessment

Background

In evaluating the feasibility of undertaking the Health and Systems strengthening program in St. Catherine, and more specifically the construction of the proposed development at the Portmore Health Centre, the risks associated with its development have to be determined. Risk can be defined as the potential loss of life, injury and destroyed or damaged assets which could occur to a system, society or a community in a specific period of time. As such the typical approach evaluates risk as a function of hazard, exposure, vulnerability and the criticality of the project (UNDRR, 2017).

Methodology

The methodology presented in the Disaster and Climate Change Risk Assessment Methodology for IDB Projects (2019)²² states the risk analysis should include the identification of hazards, degree of exposure of the hazard on the facility, identification of project vulnerability to said hazards, identification of impacts and the development of recommendations for failure modes or prevention of damage. The proposed IDB methodology and its phases were used as the framework for the risk assessment to integrate both the technical and operational narratives for all four (4) health facilities. The Simplified Probabilistic Assessment was used as a general guide in this report, where the relation between the pertinent assessment factors has been summarized in the following equation. It is based on the quantitative approach which aims at quantifying risk according to the hazards, vulnerability of assets and amount of exposure of the asset.

Hazards

From the hazards presented in this report, the most relevant ones pertaining to the 4 facilities were chosen. This decision was made after careful expert analysis of the locations and the context in which likely and substantial damage could potentially be experienced. Hazard selection was also done from an island-wide perspective for events that have historically had a major effect on commercial/private operations. These events to be highlighted in the risk assessment are:

- Seismic Activity
- Hurricane Winds

Each of the above hazards will be associated with a frequency matching a certain intensity to allow for replicable measurement of varying levels of potential damage to property. For flooding and hurricane winds, return periods (RPs) were used: 25 year-, 50 year- and 100 year- RPs. The values were obtained from rasters generated from local datasets. For seismic activity, long and short spectral accelerations were used which were also tied to return periods: 475 year (0.28g), 2475 year (0.5g) and 4975 year (0.64g) return periods (where g is gravity).

Vulnerability

DESCRIPTION OF VULNERABILITY

In order to determine the vulnerability of each location, the identification of failure modes for the identified hazards and the relation to assets' capability to sustain damage was determined. Seismic Events have the potential to cause permanent structural damage, aesthetic damage, and damage to equipment and affect the low level and critical medical operations. Wind events typically have the potential to dislodge components fastened to a structure. This could result in aesthetic damage or

²² Barandiarán, M., Esquivel, M., Lacambra Ayuso, S., Suarez, G., & Zuloaga, D. (2019). Disaster and Climate Change Risk Assessment Methodology for IDB Projects: A Technical Reference Document for IDB Project Teams.

launching of projectiles that can cause irreparable damage. For the purpose of rating vulnerability, each impact description was ranked as Trivial, Minor, Serious or Catastrophic. This provides a basis of ranking as seen in Table 4-20. A brief general description of the impacts for each event can be seen in Table 4-21.

VULNERABILITY RATING FROM SEISMIC ACTIVITY

The proposed development aims to construct a new one-story building with a U-shaped footprint. For the purpose of the assessment, the FEMA P154 rapid visual assessment (RVA) was used to estimate structural seismic performances. The assessment considered the seismicity of the location, soil and terrain conditions, age, building and design code. In essence, the RVS scores highlight the probability and extent of damage to a building. The building type of the proposed health centre, according to the FEMA building characterization, is given below.

Table 4-92 Building type for Portmore GPHCC

Proposed Building Type	Building Name	RVS Score
Reinforced Concrete Masonry	Proposed Structure	3.2

The score of the structure considers the score of the new structure and assumed that it would be designed to the requisite IBC design standards. The score is well above the minimum cut-off score of 2 and indicates suitable seismic performance, however this is heavily dependent on the following of the requisite IBC building codes and construction techniques. Further analysis of the proposed structural designs will also provide a more accurate indicator of seismic performance.

VULNERABILITY RATING FROM HURRICANE WINDS

The proposed St. Jago Health Centre building will also be exposed to hurricane winds and is expected to experience a degree of damage from the event. This level of damage and the resulting impact based on the proposed building design will be taken from Table 4-18. With wind speeds ranging from 55.4 m/s to 61.2 m/s, the Portmore HC building will experience devastating to catastrophic damage. This considers the building being considered a 'well-built frame' that will experience damage to the roof structure and interruptions in utility services.

Table 4-93 Impact Rating hurricane winds

RP	Wind speed (m/s)	Impact
25	58.8	Serious
50	61.9	Serious
100	61.4	Catastrophic

Criticality

A review of the facility's social impacts demonstrates that shortfalls associated with new construction could significantly affect various portions of the populous. This allows for a better understanding of the potential consequences of failure of the facility and the characteristics that contribute to its

vulnerability. The criticality thresholds were derived from those depicted in Table 4.11 of the IDB Methodology.

Table 4-94 Criticality of proposed Facilities

	Characteristics	Value	Criticality Rate
Greater Portmore Health Centre	Service area (km ²)	70	Moderate
	Service Population (per)	Approx. 135,000	High
	Building Square Area (m ²)	1,260	Moderate

Exposure

Each facility's level of exposure will be measured specific to each of the hazards presented. This will consider the coincidence of the facility's location with the expected point of occurrence of the hazards. For flood events, a dimension of depth will also be included to evaluate the potential level of inundation and the resulting assets/structural components at risk. This will be taken from the maps generated and presented in this report from previously run hydrodynamic models. In relation to seismic exposure, it is established that all the facilities experience seismic activity. The level of exposure for each will account for the proximity of the facility to historically recorded seismic events. For hurricane winds, wind speeds across the island vary based on a location's surrounding topography, proximity from the coast and intensity of the potential storm. Data values taken from the CORDEX RCM database were used to generate maps specific to the island and will be used to determine the facilities' exposure to hurricane winds.

SEISMIC ACTIVITY

While all sites are considered exposed to seismic activity, the level of exposure will vary according to the location on the island. This varying level of exposure was based on spectral acceleration maps which through historical occurrences predicted the magnitude of ground movement. The level of ground movement of each site would vary despite being exposed to some of the same events due to factors such as distance to event epicentre and geological properties (i.e. soil and rock structure). The literature presented in the Journal of Civil Engineering was generated to provide a seismic spectral acceleration map to be utilized in conjunction with the International Building Code seismic design guidelines. Extraction of the coinciding spectral acceleration based on the location of each project site yielded the accelerations below.

Table 4-95 Resultant spectral accelerations (short and long) with associated return periods

RP	Spectral Acceleration	St. Jago Health Centre
475	PGA	0.28
	(Short Period) 0.2	0.64
	(Long Period) 1.0	0.21
2475	PGA	0.5
	(Short Period) 0.2	0.97
	(Long Period) 1.0	0.27
4975	PGA	0.64
	(Short Period) 0.2	1.24
	(Long Period) 1.0	0.36

HURRICANE WINDS

All health facilities are considered to have the same level of exposure to hurricane winds. The variation in the speed of hurricane level winds experienced by the facility is dependent on the building's location relative to the coast, surrounding topography and the surrounding land use for the site. Another factor affecting the building exposure is the footprint area and height of the structure which will increase the risk associated with damage from extreme hurricane winds. A summary of these factors is presented in and will contribute to the final risk matrix.

Table 4-96 Exposure considerations and values for hurricane winds.

RP	Wind speed (m/s)	Building footprint (m ²)	Proposed Building Height (m)
25	55.4	1,260	4.2
50	57.4		
100	61.2		

Risk Analysis

A combined (weighted) ranking considering the asset exposure, hazard probability and vulnerability of the building will be utilized to assign a suitable risk rating. The at-risk infrastructure will be determined using the factor combination proposed by the IPCC dictating risk being a product of an asset's exposure × vulnerability × hazard present²³. For the Portmore Health Centre, the approach taken to the risk assessment will be qualitative, considering the casual relationship between the impact of the climate hazard and the outcome of the impact²⁴ as described in the preceding sections. The final result will be a risk matrix developed using weighted values to estimate the risk of the facility's infrastructure and equipment to the combined impacts of the three (3) hazards: flooding, seismic activity and hurricane winds. A table showing the method and color assignment for each value can be seen in Table 4-30 and Table 4-31. A ranking from 1 (lowest) to 12 (highest) will be assigned to the different assets based on their physical condition and their surrounding environments. The ranking for the hazards has been further divided into flooding and hurricane winds, vs. seismic activity. The impact of the hazard on the asset will be taken from Table 4-21. The weighted value for the risk matrix is a representation of the overall risk of the facility out of a total ranking of 12.

Table 4-97 Results of risk matrix for GPHC

Exposure metric	Seismic Activity			Hurricane Winds			Weighted Value *multiplied by (H/3)
	475 RP	2475 RP	4975 RP	25 RP	50 RP	100 RP	
Area of building and no. of floors	6	6	4	9	6	4	3.9

*matrix values divided by 3 for fair comparison against other facilities that experience flooding.

²³ IPCC. (2012). *Determinants of risk: exposure and vulnerability*. Source: https://www.ipcc.ch/site/assets/uploads/2018/03/SREX-Chap2_FINAL-1.pdf

²⁴ Hughes J. et. al. (2020). *Impacts and implications of climate change on wastewater systems: A New Zealand perspective*. Source: <https://doi.org/10.1016/j.crm.2020.100262>

Summary of Risk Matrix Findings

The values obtained from the risk matrix reflect variations in both frequency of the hazard events and the resultant impact of the event on the facility based on both the intensity of the hazard (tied to the RP) and the structural resilience of the building. As a result, the matrix is able to fairly compare the overall risk of the development by assessing both the expected damage from a certain event, whether great or small, and the likelihood of it occurring. In other words, this allows for less frequent but intense events to be similarly rated against frequent but less intense events, where similar monetary expenditures from recovery efforts or damage to infrastructure may be experienced over time. This can be seen with the hurricane winds where the 100-yr RP event has a lower rating than the 25- and 50-yr RPs. This is because the wind speeds for all 3 RPs stagnate at about 50 to 60 m/s, making the 100-yr RP event the least likely occurring event with the same magnitude of damage produced (ref. Table 4-18). Since the island experiences these hurricane winds fairly frequently (at least a 1 in 4 probability each year i.e. 25-yr RP), the matrix ranks this RP relatively high on the scale. A similar concept is true for the risk from seismic activity. An overall matrix score of 3.9 was determined. This is somewhat lower than other facilities and indicates a greater robustness to loss. This is due to reduced flood hazard. The major driving factor was the presence of high wind speeds which has the capability of damaging roofing structures and moving projectiles. The impact of wind was seemingly substantial in the lower spectrum of the return periods analysed. Damage to the roofing system is especially of concern if not properly specified and constructed.

4.4.4 Biological Environment

4.4.4.1 Flora Assessment

The grounds of the proposed Portmore Health Centre displayed relatively low species diversity, with only 17 species being recorded from 10 families. Only 7 of the species observed were trees, and the rest were either shrubs or grasses. Most of the species encountered during the assessment of the STH are classified by Adams 1972 as being very common, commonly found in thickets and wastelands, and commonly found in secondary woodlands. The distribution of the plant species encountered are fairly even across Jamaica, especially in places that have significantly been impacted by humans. No endemic species were observed throughout the assessment. None of the species encountered in the study have any special conservation status; neither were any species considered as rarely found in Jamaica.

Only one large (>10 cm DBH) tree, Guango (*Samanea saman*), was observed within the project boundary. The large Guango tree is located on the north-western end of the property boundary and should be integrated into the development as best as possible.

The species in the list provided are not a part of the International Union for Conservation of Nature (IUCN) or Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists.

Table 4-98 List of floral species identified along transects in the assessed area

A classification ranking was used to show prevalence (Adams 1972) and the DAFOR index to show the frequency of each plant species encountered.

Family	Scientific Name	Common Name	Range**	DAFOR
	Abutilon pauciflorum		Common in rough pastures, waste places and thickets	O
Mimosaceae	Acacia macracantha	Park Nut	Common locally (St. Andrew, St. Catherine, St. Thomas), in secondary thickets on arid limestone	R
Fabaceae	Alysicarpus vaginalis		Frequent in sandy waste places, cultivations and rough pastures	A
Amaranthaceae	Amaranthus spinosus	Prickly Calaloo	Common as a weed of pastures, lawns and waste places	F
Asteraceae	Bidens pilosa	Spanish Needle	A common weed of roadsides and waste places	D
Sapindaceae	Blighia sapida	Ackee	Cultivated	R
Mimosaceae	Calliandra portoricensis	Calliandra	Common in secondary thickets and in open woodlands, mostly limestone	R
Cyperaceae	Cyperus rotundus	Nut Grass	Common as weed of disturbed and frequented grounds	A
Mimosaceae	Mimosa pudica	Shame Old Lady	A common weed of pastures and open stabilized waste places	D
Poaceae	Panicum maximum	Guinea Grass	Very common in rough pastures, ditches and sheltered thickets	O
Asteraceae	Parthenium hysterophorus	Dog-flea Weed	Common along roadsides and in shady or open waste places	F
Mimosaceae	Prosopis juliflora	Cashaw Macka	Locally common (St. Andrew, St. Catherine, Clarendon), in low pastures in arid areas	R
Acanthaceae	Ruellia tuberosa	Duppy Gunshot	Very common in pastures and waste places and on roadside banks	R
Mimosaceae	Samanea saman	Guango	Common in inhabited areas and in old pastures where planted, naturalized in riparian forest and in secondary communities	R
Combretaceae	Terminalia catappa	West Indian Almond	Commonly planted and naturalized	R
Rhamnaceae	Ziziphus mauritiana	Coolie Plum	Established and fairly common in some waste places, occasionally forming thickets	R
Poaceae	Zoysia tenuifolia	Zoyzia	Cultivated for lawns	D

4.4.4.2 Avifauna Assessment

A total of 7 species of birds were observed during the rapid assessment. Of the 7 birds identified, 6 were residents and 1 summer migrant. The low number of bird species observed could be as a result of the few trees on the property. The majority of species encountered were typical of open areas.

The most abundant bird in the study was the introduced Great-tailed Grackle that is spreading across the island. There is insufficient information on the impact of the Great-tailed Grackle on other birds.

One migrant, the Grey kingbird, was encountered in the study. The Grey kingbird is a common summer migrant who normally arrives in March to nest and departs in early October (Downer et al., 1990). The majority of summer migrants usually depart from the country before the arrival of the Winter migrants.

No Winter Migrant birds were observed, although the assessment was carried out in early September when the winter migrant birds are expected to start arriving from North America. The bird species list will most likely increase later in the winter months of the year, where the majority of the migrants will arrive.

Table 4-99 Bird species observed in the study in the areas

Common Name	Scientific Name	Range	Seasonality	Abundance	IUCN Red List	DAFOR
Cattle Egret	Bubulcus ibis	Resident	Year-round	Common	LC	O
Grey Kingbird	Tyrannus dominicensis	Migrant	Summer	Common	LC	R
Great-tailed Grackle	Quiscalus mexicanus	Introduced	Year-round	Rare	LC	A
Smooth-billed Ani	Crotophaga ani	Resident	Year-round	Common	LC	R
Turkey Vulture	Cathartes aura	Resident	Year-round	Common	LC	O
Yellow-faced Grassquit	Tiaris olivaceus	Resident	Year-round	Common	LC	O
Zenaida Dove	Zenaida aurita	Resident	Year-round	Common	LC	R

4.4.4.3 Herpetofauna

There are approximately 27 species of amphibians found in Jamaica. However, none were recorded in the assessment recorded in the study. Only 2 species of reptiles were recorded House Gecko (*Hemidactylus mabouia*) and Jamaican Brown Anole (*Anolis lineatopus*). The House Gecko is listed as an introduced species and is common throughout buildings in Jamaica. The Jamaican Brown Anole is endemic; however, it is widely distributed in Jamaica. The low number of trees could explain the low number of tree lizards (*Anolis sp*) observed in the area. There were no stone piles or other debris on the property, which could explain why no snake or galliwasp was encountered onsite.

Table 4-100 Herpetofauna observed during the study

Species	Common name	Classification	Species Status	IUCN Red List	DAFOR
<i>Anolis lineatopus</i>	Jamaican Brown Anole	Reptile	Endemic	NE	R
<i>Hemidactylus mabouia</i>	House Gecko	Reptile	Introduced	NE	R

4.4.4.4 Arthropod Assessment

A total of 5 species of butterflies were recorded. None of the butterflies is endemic or has special conservation status. The other arthropods recorded include insects (Paper Wasp, 2 Grass Hopper Species and 2 ant species) and 1 species of millipede. None of the arthropods are endemic or have

any special conservation status. The species in the list provided are not a part of the International Union for Conservation of Nature (IUCN) or Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists.

Table 4-101 The Arthropod encountered on the property

Order & Family	Species	Common Name	DAFOR	Distribution/Comments
LEPIDOPTERA				
Pieridae	Ascia monuste	Great Southern White; Antillean Great White	R	N; widespread, common and pest of crucifers. Southern US to Argentina
	Eurema daira	Poey's Barred Sulphur	O	Widespread and common. Southern US to Brazil
	Eurema nise	Mimosa Yellow; Cramer's Little Sulphur	O	Widespread, common. Southern US to Argentina
	Phoebis sennae	Cloudless Sulphur	R	Widespread and common. Southern US to Argentina
	Pyrisitia lisa	Little Yellow	R	Widespread, common. Southern US to Argentina
HYMENOPTERA				
Vespidae	Polistes crinitus	Paper Wasp	O	Very common and widespread
Formicidae	Phidole sp.	Black ants	F	Very common and widespread
	Unknown sp	Red Ant	O	Very common and widespread
ORTHOPTERA				
Acrididae	Orphuella sp.	Grass Hopper 1	O	Very common and widespread
	Orphuella sp.	Grass Hopper 2	F	Very common and widespread
SPIROBOLIDA				
Rhinocricidae	Anadenobolus monilicornis	Jamaican Bumble bee Millipede;	R	Caribbean; introduced to southeastern US

4.5 POTENTIAL ENVIRONMENTAL LIABILITIES

4.5.1 Spanish Town Hospital

According to Rina Consulting (2018), there is potential exposure of personnel and patients to asbestos containing building materials (ACM). According to site reconnaissance visit, literature review, and based on the age of the building, asbestos containing building materials may be present in the hospital. Currently, the hospital does not have an asbestos management plan in place. There is also a risk of exposure to fluorescent light bulbs and thermostats that contain mercury and air conditioning units that contain refrigerants. Drums of hazardous chemicals were also observed.

Contamination of nearby water bodies from the improper treatment and discharge of wastewater effluents. According to the MOH Business plan, the hospitals are not complying with effluent discharge limits (Rina Consulting S.p.A., 2018).

Photos of these can be seen in Section 4.1.1.4 and 4.1.2.9. Figure 4-3 depicts locations of storage of hazardous chemicals around the property.



Plate 4-109 Possible asbestos insulation on exhaust pipe from backup generator, Rina Consulting (2018)

The re-purposing of the existing buildings on site will be determined based on the needs of the MOHW. This is important to prevent them from becoming stranded assets and therefore socioenvironmental liabilities. A detailed comprehensive plan regarding the re-purposing of the existing buildings will be provided for the final report.

4.5.2 St. Jago Park Health Centre

Several barrels and containers with oils and lubricants were seen around the property. Most of these were improperly stored and secured. Empty barrels were also seen littering the green space towards the back of the facility. Evidence of burning was also observed on the property. These pose a potential health and safety risk. Drainage of oily wastewater from vehicle washing was observed.

Photos of these can be seen in Section 4.2.1.3 and 4.2.2.7.

4.5.3 Old Harbour Health Centre

Evidence of indiscriminate solid and human waste disposal was observed on the property. Evidence of burning was also observed on the property. These pose a potential health and safety risk.

Photos of these can be seen in Section 4.3.2.7.

4.5.4 Greater Portmore Health Centre

Evidence of burning was observed on the property. These pose a potential health and safety risk.

Photos of these can be seen in Section 4.4.2.7.

5.0 SOCIAL CONTEXT

5.1 DEMOGRAPHY, SERVICES, AND INFRASTRUCTURE

5.1.1 Overview and Approach

5.1.1.1 Service Area

To assess the social elements of the proposed project, a Service Area (SA) was established for each health facility being considered. A Service Area may be described as the estimated geographic area that a service attracts its customers from; for the purposes of this project, it was modelled as a 10km travelling distance along roadways to the hospital, and a 5km travelling distance to each health centre (Figure 5-1).

5.1.1.2 Demography, Services, and Infrastructure

Population data were extracted from the Statistical Institute of Jamaica (STATIN) 2011 Population Census database for the extent of the SA by enumeration district (ED) and processed relative to the ED's percentage coverage within the SA using Geographic Information Systems (GIS) methodologies. Geospatial data for various services and infrastructure, including schools, health centres, hospitals, police stations, fire stations and post offices were obtained from the Mona GeoInformatics Institute. Other data sources are stated throughout and include organizations such as the Forestry Department, the Planning Institute of Jamaica (PIOJ), Water Resources Authority (WRA) and the National Environmental Planning Agency (NEPA). Additional data were also gleaned from the 1984 national topographic maps (metric series) and satellite imagery available for the project.



Figure 5-1 Service Areas for all St. Catherine health facilities included in the project

5.1.2 Spanish Town Hospital

5.1.2.1 SA Communities

Specific to Spanish Town Hospital, thirty-one (31) communities are either partially or wholly located within the 10 km SA (Figure 5-2, Table 5-1).

Table 5-1 Communities located within the SA, sorted from largest to smallest in area of coverage within the SA

Community name	Parish	Area within the SA (km ²)
Bogwalk	St. Catherine	1.29
Braeton	St. Catherine	3.52
Bridgeport	St. Catherine	1.02
Caymanas	St. Catherine	11.63
Central Village	St. Catherine	8.31
Crescent	St. Catherine	3.31
Cromarty	St. Catherine	24.26
Cumberland	St. Catherine	0.98
Edgewater	St. Catherine	0.05
Ensom	St. Catherine	4.88
Ferry	St. Andrew	0.01
Golden Acres	St. Catherine	2.34
Greater Portmore	St. Catherine	5.89
Greendale	St. Catherine	3.68
Gregory Park	St. Catherine	2.51
Hampton Green	St. Catherine	1.37
Hellshire	St. Catherine	18.72
Independence City	St. Catherine	0.85
Keystone	St. Catherine	3.99
Kitson Town	St. Catherine	9.66
Naggo Head	St. Catherine	2.02
Old Harbour Road	St. Catherine	11.50
Part of Keystone	St. Catherine	6.16
Passage Fort	St. Catherine	0.30
Sligoville	St. Catherine	2.61
Spanish Town Central	St. Catherine	24.69
St. John's East	St. Catherine	2.33
St. John's West	St. Catherine	11.91
Waterford	St. Catherine	0.57
West Cumberland	St. Catherine	0.47
Willowdene	St. Catherine	3.25
Total land area within the SA:		174.07

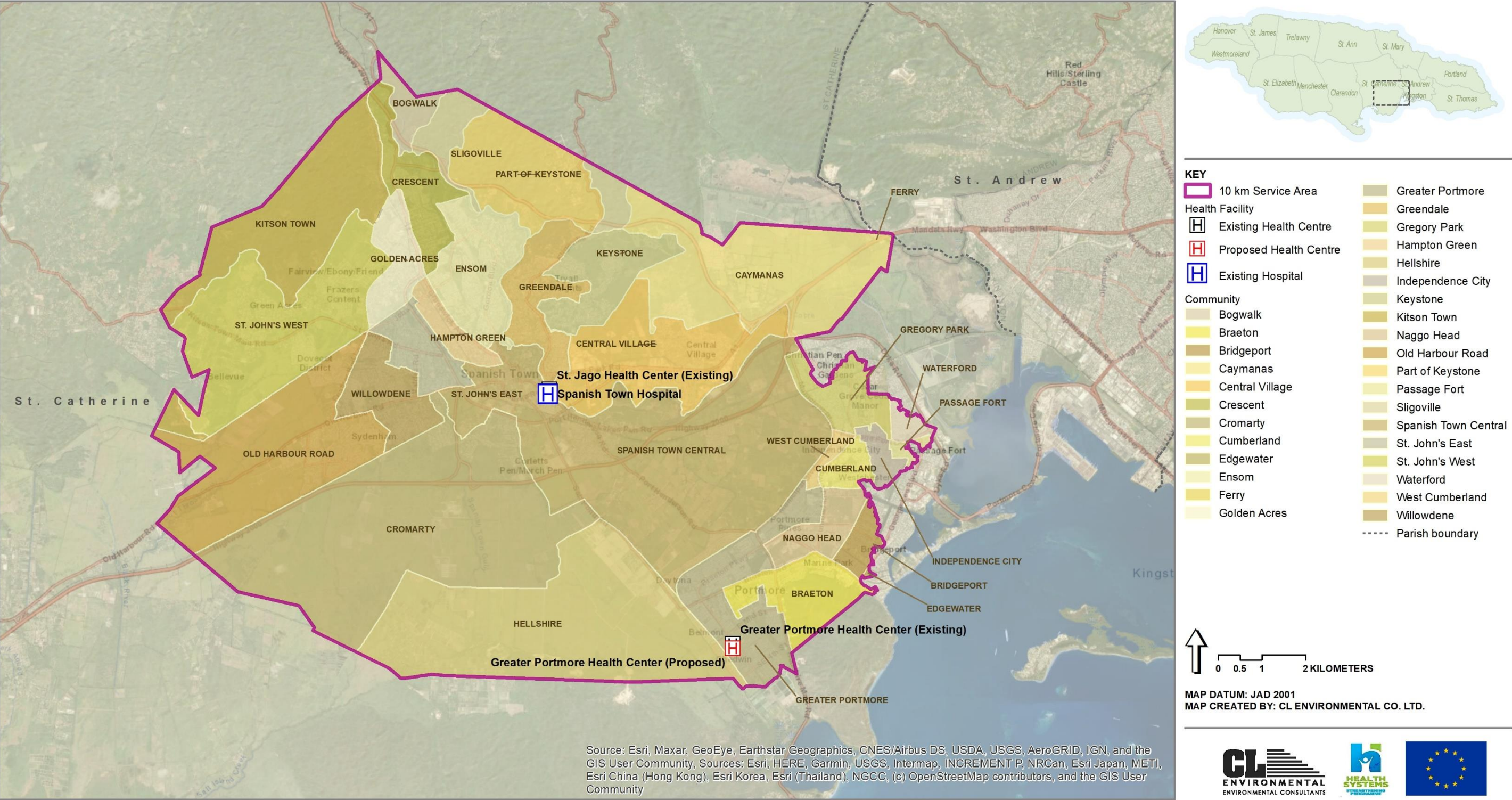


Figure 5-2 Communities within the Service Area (SA) for Spanish Town Hospital

5.1.2.2 Population and Housing

The total population within the SA in 2011 was approximately 299,035 persons (STATIN 2011 Population Census). The overall growth within the SA between 2001 and 2011 was approximately 1.1% per annum; pockets of growth between 2001 and 2011 are evident on the outskirts of Spanish Town in the communities such as Cromarty, St. John West, and Cayman as (Figure 5-3). Based on the growth rate of 1.1% per annum, at the time of this study (2021), the population was approximately 333,743 persons and is expected to reach 439,175 persons over the next twenty-five years if the current population growth rate remains the same.

Table 5-2 Comparison of population densities for the year 2011

Category	Jamaica	St. Catherine	SA
Land Area (km ²)	10,991.0	1,193.1	174.1
Population	2,697,983	516,218	299,035
Population Density	245	433	1,718

Source: STATIN Population Census 2011

There were 69,615 housing units, 88,469 dwellings and 81,854 households within the SIA in 2011. Comparisons of the SA with national and regional ratios indicate that the SA, although higher, had comparable household/dwelling, average household size and dwelling/housing unit ratios (Table 5-3).

Table 5-3 Comparison of national, regional and SA housing ratios for 2011

	Jamaica	St. Catherine	SA
Dwelling/Housing Unit	1.2	1.2	1.3
Household/Dwelling	1.0	1.0	0.9
Average Household Size	3.1	3.2	3.7

Source: STATIN Population Census 2001

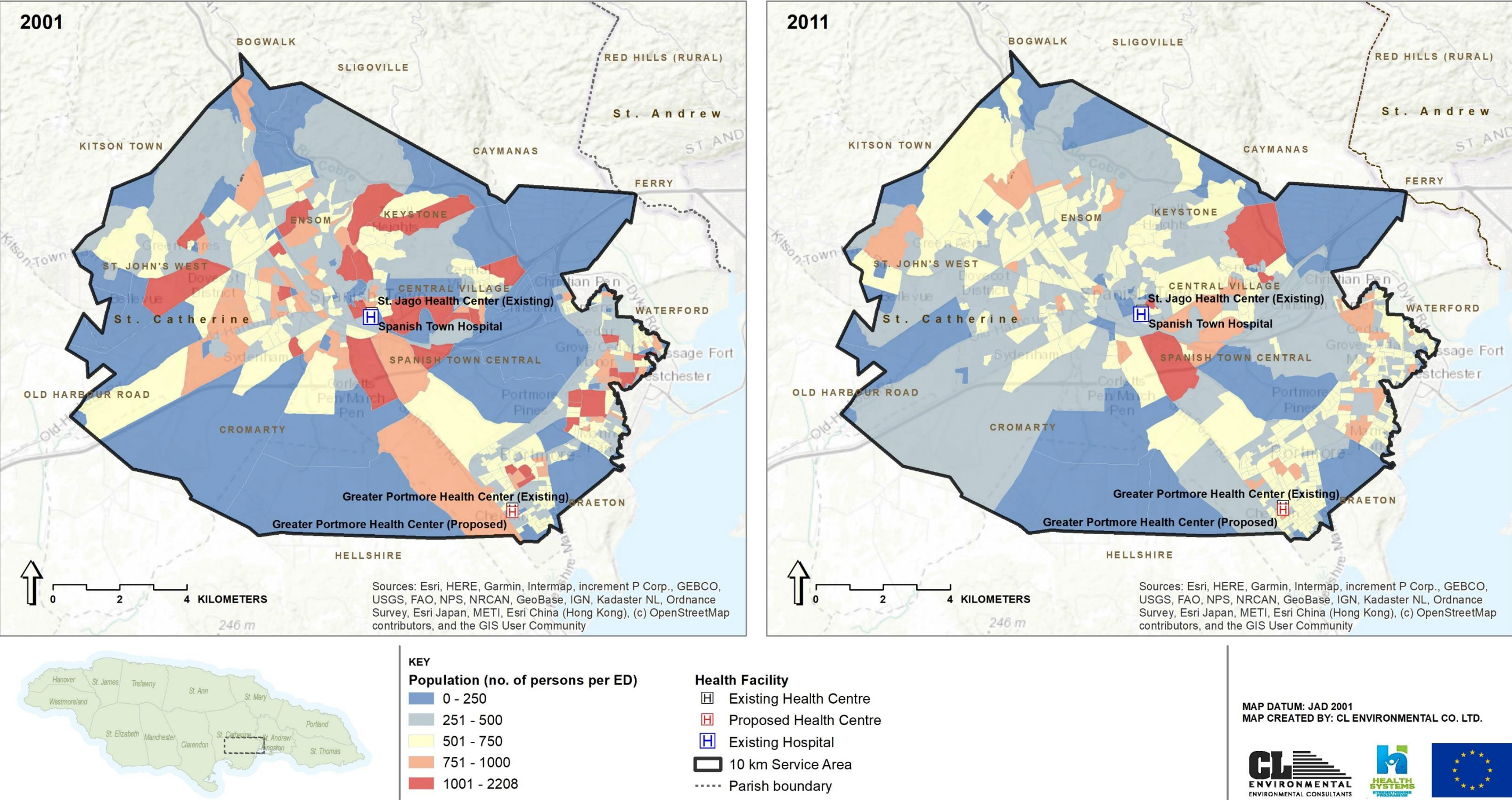


Figure 5-3 SA 2001 and 2011 population represented by enumeration districts

5.1.2.3 Public Services and Infrastructure

Domestic Water Supply

The National Water Commission (NWC) is the public agency responsible for providing Jamaica's domestic water supply. The majority of the households within the SA (92.2%) received their domestic water supply from a public source; this is similar to other extents investigated that had the majority of the population's water supply from a public source (Table 5-4).

Table 5-4 Percentage of households by water supply for the year 2011

	Category	Jamaica	St. Catherine	SA
Public Source	Piped in Dwelling	49.7%	63.5%	73.5%
	Piped in Yard	16.5%	16.1%	17.5%
	Stand Pipe	7.1%	1.8%	0.8%
	Catchment	2.2%	0.9%	0.4%
Private Source	Into Dwelling	6.4%	4.4%	3.6%
	Catchment	9.8%	3.6%	1.5%
	Spring/ River	3.0%	3.1%	0.0%
	Trucked Water/Water Truck	2.1%	3.7%	0.6%
	Other	1.8%	1.6%	0.9%
	Not Reported	1.3%	1.2%	1.2%

Source: STATIN Population Census 2011

Potable water supply to the Spanish Town hospital is supplied by the National Water Commission (NWC). The source of this water is from the Spanish Town Treatment Plant or Rio Cobre which produces 205,846 m³/month (\approx 45.28 million imperial gallon (M.I.G.)/month) and the system has excess volume available. The NWC potable water pipeline is at the entrance of property on Burke Road.

Wastewater Generation and Disposal

Census 2011 data for wastewater disposal methods was not available.

There is no NWC central sewerage pipeline in vicinity of the Spanish Town Hospital.

Solid Waste Generation and Disposal

The National Solid Waste Management Authority (NSWMA) is responsible for domestic solid waste collection within the study area and specifically, the National Solid Waste Management Authority (NSWMA) covers the parish of St. Catherine. In residential areas, garbage is collected once per week. This service is provided free (partial covered by property taxes) for the households within the area.

Emergency Services

HEALTHCARE

Spanish Town Hospital is the only hospital located within the SA.

A total of eight health centres are located within service area (Figure 4-4):

1. Greater Portmore
2. St. Jago
3. Waterford
4. Cumberland Road
5. Central Village
6. Christian Pen
7. Sydenham
8. Bridgeport Dental

FIRE STATIONS

Fire stations island-wide are served by a fleet of 91 operational firefighting and rescue vehicles and 58 utility vehicles. The Fire Prevention and Public Relations Division and the Emergency Medical Service (EMS) provide fire prevention services and emergency medical rescue/ paramedic services (Jamaica Fire Brigade , 2012). The station that would respond to any eventualities at the proposed Project site would be the Spanish Town Fire Station, which is about 500 m northwest of the site. This station has two fire units, a pumper truck with a volume of approximately 3,000 litres (~800 gals) and a tender (truck) with a volume greater 18,900 litres (>5,000 gals). In the event, that backup is needed, this backup would be from the station in Portmore which is approximately 30 minutes southeast of the proposed site. If further backup is needed this would be from Old Harbour and Linstead fire stations.

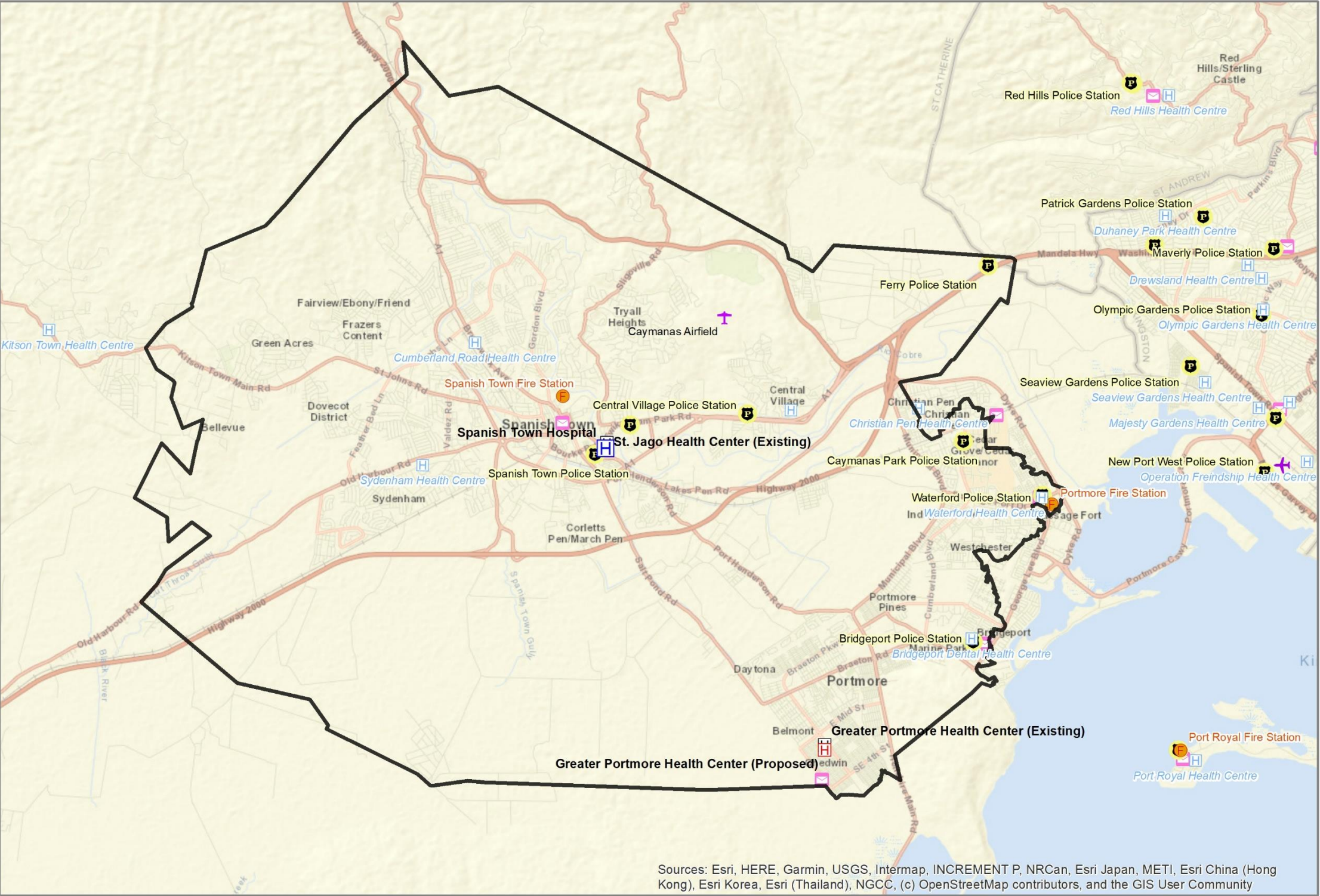
Waterford Parkway Fire Station, located in Portmore, is also located within the SA (Figure 4-4).

POLICE STATIONS

The Spanish Town Police Station exists within the SA, approximately 300m west of the Spanish Town Hospital. In general, the Spanish Town community is a volatile community that experiences sporadic episodes of violence linked to gang violence and political differences.

In addition to the Spanish Town Police Station, six other police stations are located within the SA (Figure 4-4):

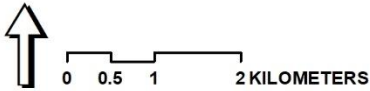
1. Central Village
2. Ferry
3. Caymanas Park
4. Waterford
5. Bridgeport
6. Jamaica Police Academy



KEY

Health Facility

- Existing Health Centre
- Proposed Health Centre
- Existing Hospital
- Other health centre
- Fire station
- Police station
- Post office
- Airfield
- Aerodrome
- 10 km Service Area



MAP DATUM: JAD 2001
MAP CREATED BY: CL ENVIRONMENTAL CO. LTD.



Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

Figure 5-4 Road network and services located in the SA

5.1.2.4 Land Use

Land Cover and Zoning

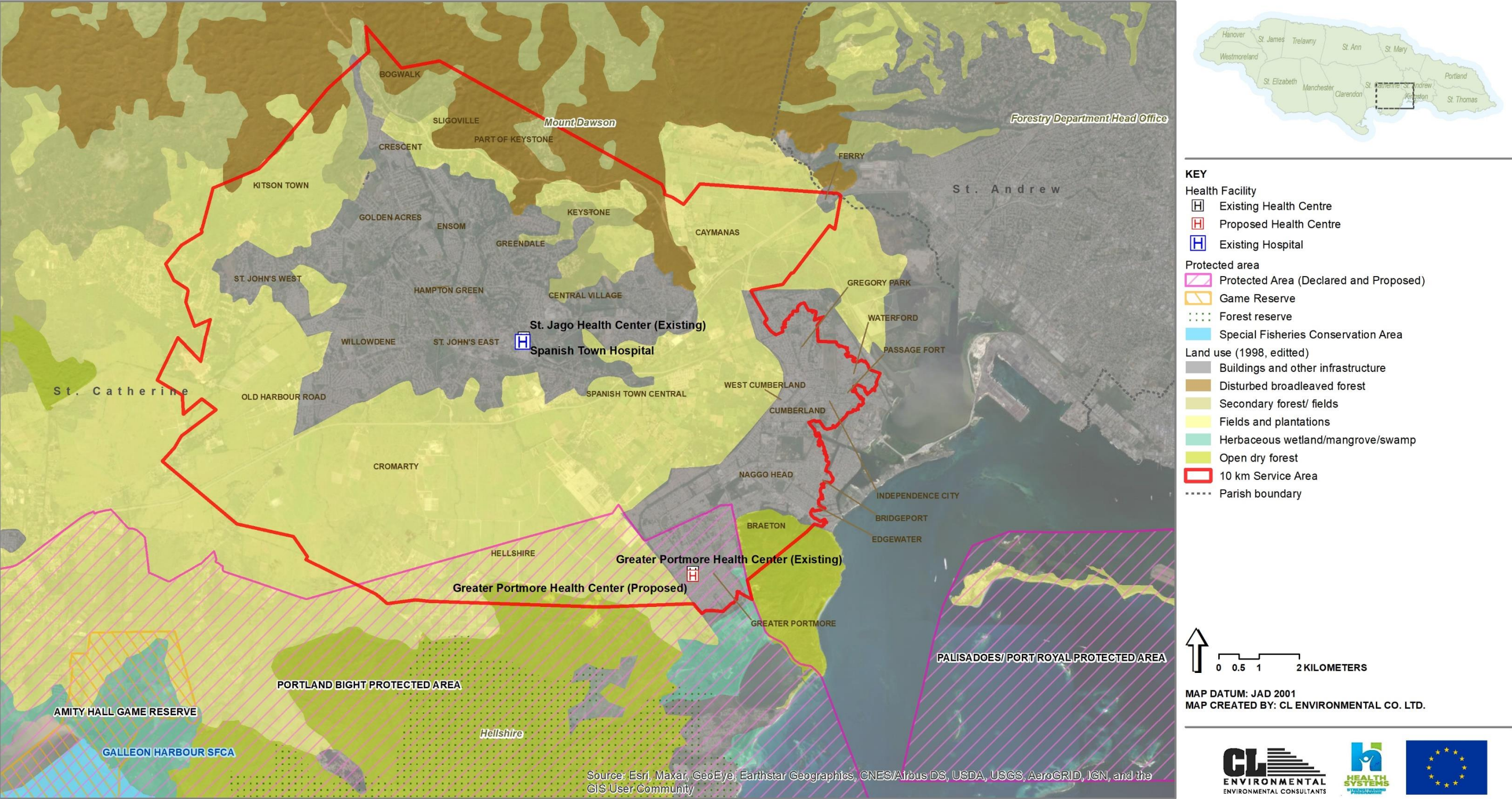
Land cover within the SA consists of buildings and other infrastructure, disturbed broadleaved forest, secondary forest/fields, fields and plantations, herbaceous wetland/mangrove/swamp and open dry forest (Figure 5-5).

As seen in Figure 5-6, the SA falls within spatial limits of Town and Country Planning (Saint Catherine Parish) Provisional Development Order, 2017 (Confirmation) Notification, 2019. The SA encompasses areas of land specifically zoned as an Aquifer Protection Zone, Caymanas Economic Zone, Bauxite Bearing Area, Agriculture and Game Reserve. Within the Spanish Town Local Planning Area Land Use Proposals (Inset No.1), the buildings and infrastructure located within Spanish Town have varying uses including but not limited to residential, government purposes, institutional, industrial, commercial, and open space. The land on which the hospital is situated is zoned as Institutional (Hosp); adjacent to this land, areas are zoned as Institutional/ Office, Residential, Public Assembly/ Educational, Light Industry and Institutional (where the St. Catherine District Prison is located) (Figure 5-7).

Protected Areas

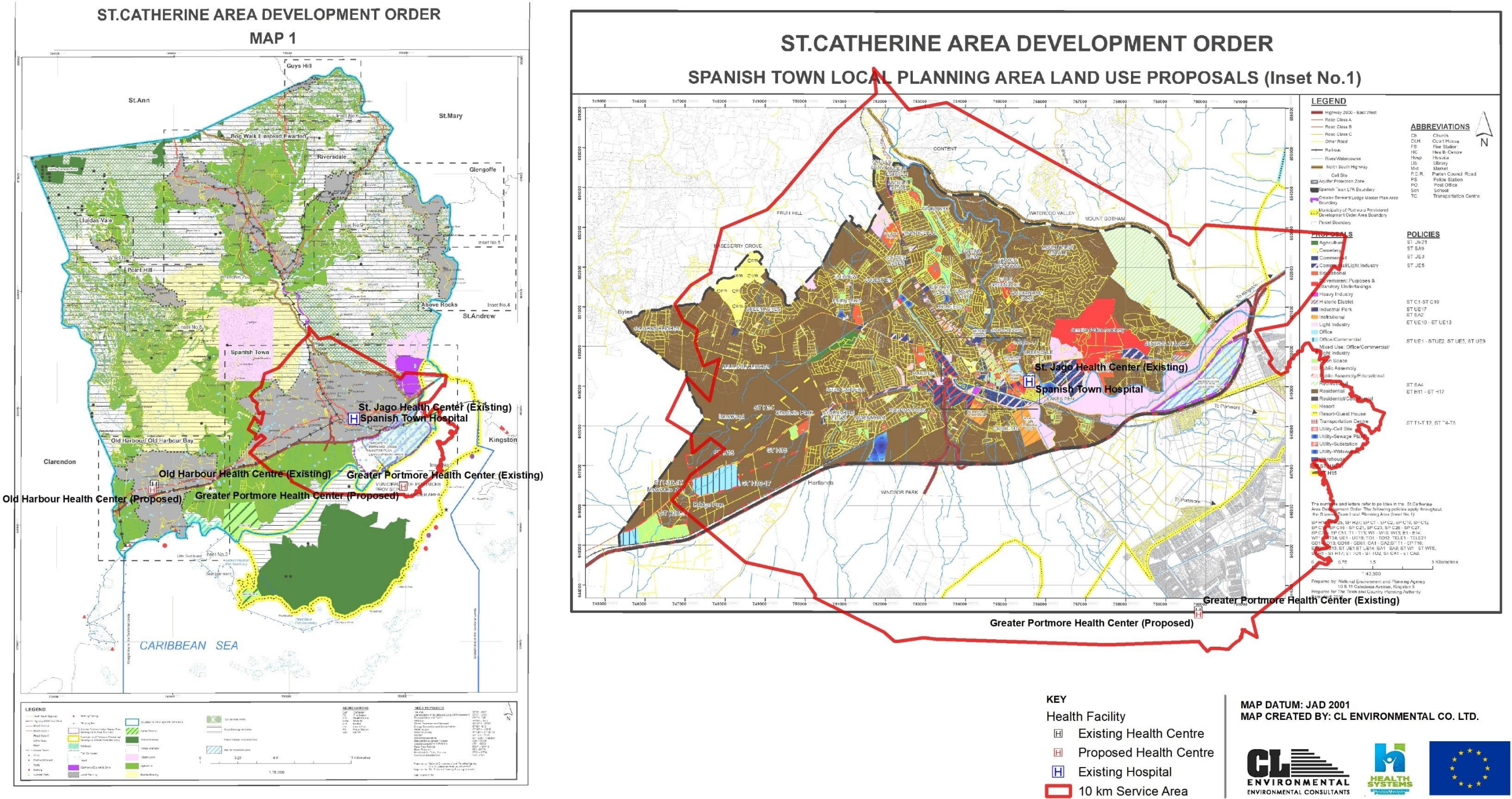
Protected areas examined here include all areas of land or water protected by various laws in Jamaica, as well as international agreements, that fall within or in proximity to the project area. Specific to this project, the Portland Bight Protected Area partially falls within the SA (Figure 5-5).

The Portland Bight Protected area was declared April 22, 1999, under Natural Resources Conservation Authority (NRCA) Act. It is the largest protected area in Jamaica enclosing 1,876 km² of coastal land and sea between Portland Ridge and Hellshire Hills and including nearby cays such as Little Goat Island. More than half of the land area of the PBPA exists in its natural state and includes dry limestone forests (210.3 km²) and wetlands (82.0 km²). The remainder of land is used for the cultivation of sugar cane or human settlement (Caribbean Coastal Area Management (C-CAM) Foundation, 2007).



Data sources: Land use (Edited based on Forestry Department, 1998), forest estates (Forestry Department) and protected areas (NEPA and MGI)

Figure 5-5 Land use, protected areas and forest estates within the SA



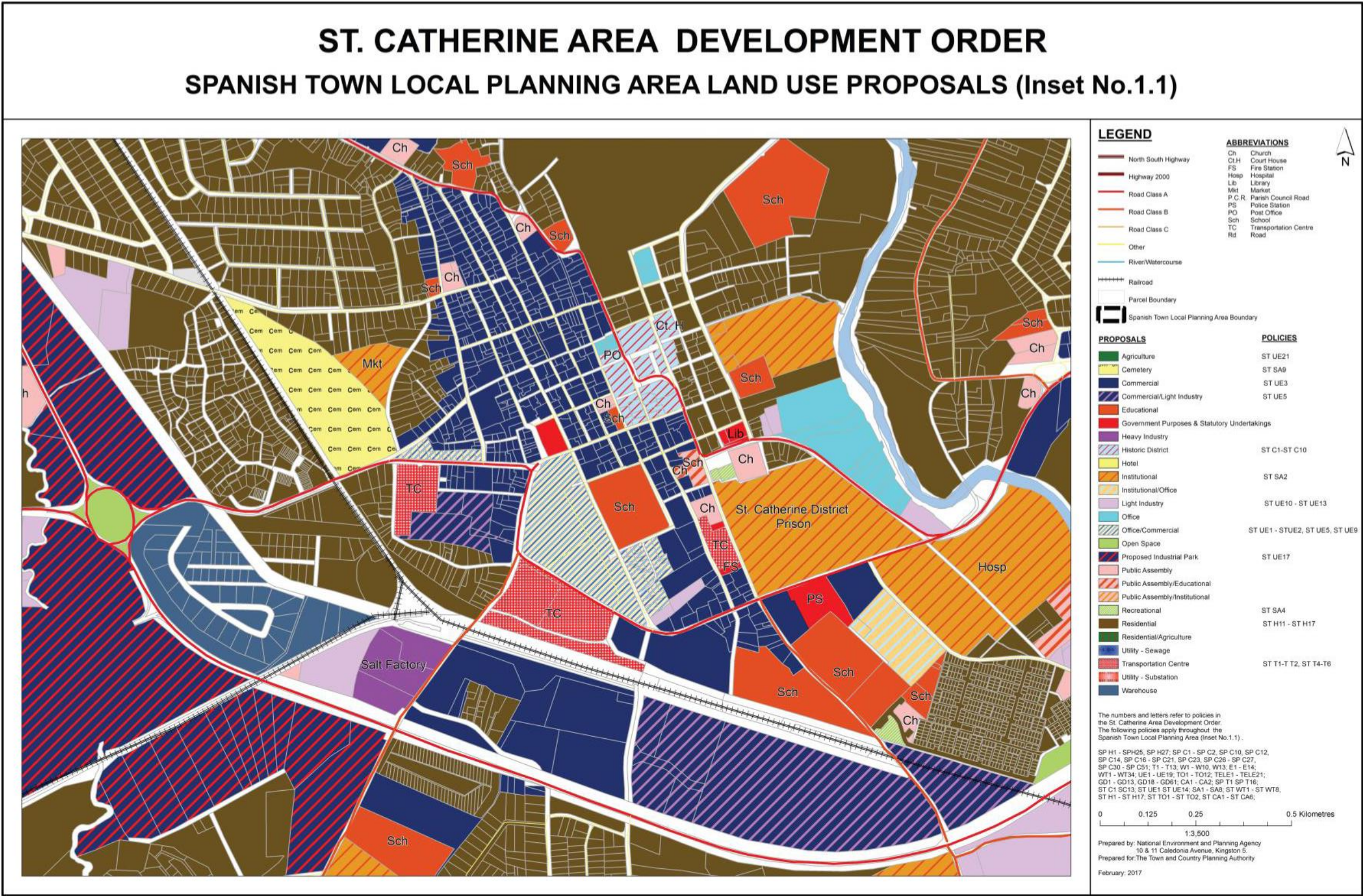


Figure 5-7 Spanish Town Local Planning Area Land use proposals (Inset No.1 1), St Catherine Area Development Order 2017)

5.1.3 St. Jago Park Health Centre

5.1.3.1 SA Communities

Specific to St. Jago Park HC, 17 communities are either partially or wholly located within the 5km SA (Figure 5-2, Table 5-1).

Table 5-5 Communities located within the SA, sorted from largest to smallest in area of coverage within the SA

Community name	Parish	Land area with the SA (km ²)
Sligoville	St. Catherine	0.02
Caymanas	St. Catherine	0.25
Crescent	St. Catherine	0.10
Part of Keystone	St. Catherine	0.28
St. John's West	St. Catherine	0.01
Ensom	St. Catherine	4.02
Greendale	St. Catherine	3.62
Keystone	St. Catherine	2.73
Golden Acres	St. Catherine	0.31
Hampton Green	St. Catherine	1.37
Central Village	St. Catherine	7.14
St. John's East	St. Catherine	2.25
Old Harbour Road	St. Catherine	0.36
Willowdene	St. Catherine	2.46
Spanish Town Central	St. Catherine	13.07
Cromarty	St. Catherine	9.04
Hellshire	St. Catherine	0.70
Total		47.73

5.1.3.2 Population and Housing

The total population within the SA in 2011 was approximately 104,671 persons (STATIN 2011 Population Census). (Table 5-2). In 2001, there were approximately 267,937 persons living in the SA. The overall growth within the SA between 2001 and 2011 was approximately 1.1% per annum; pockets of growth between 2001 and 2011 are evident on the outskirts of Spanish Town in the communities such as Cromarty, St. John West, and Cayman as (Figure 5-3). Based on the growth rate of 0.29% per annum, at the time of this study (2021), the population was approximately 107,786 persons and is expected to reach 115,983 persons over the next twenty-five years if the current population growth rate remains the same.

Table 5-6 Comparison of population densities for the year 2011

Category	Jamaica	St. Catherine	SA
Total ED area	10,991.0	1,193.1	47.7
Population	2,697,983	516,218	104,671
Population density	245	433	2,193

Source: STATIN Population Census 2011

There were 29,037 housing units, 34,449 dwellings and 35,843 households within the SA in 2011. of the SA with national and regional ratios indicate that the SA, although lower, had comparable household/dwelling, average household size and dwelling/ housing unit ratios (Table 5-3).

Table 5-7 Comparison of national, regional and SA housing ratios for 2011

	Jamaica	St. Catherine	SA
Dwelling/Housing Unit	1.2	1.2	1.2
Household/Dwelling	1.0	1.0	1.0
Average Household Size	3.1	3.2	2.9

Source: STATIN Population Census 2001

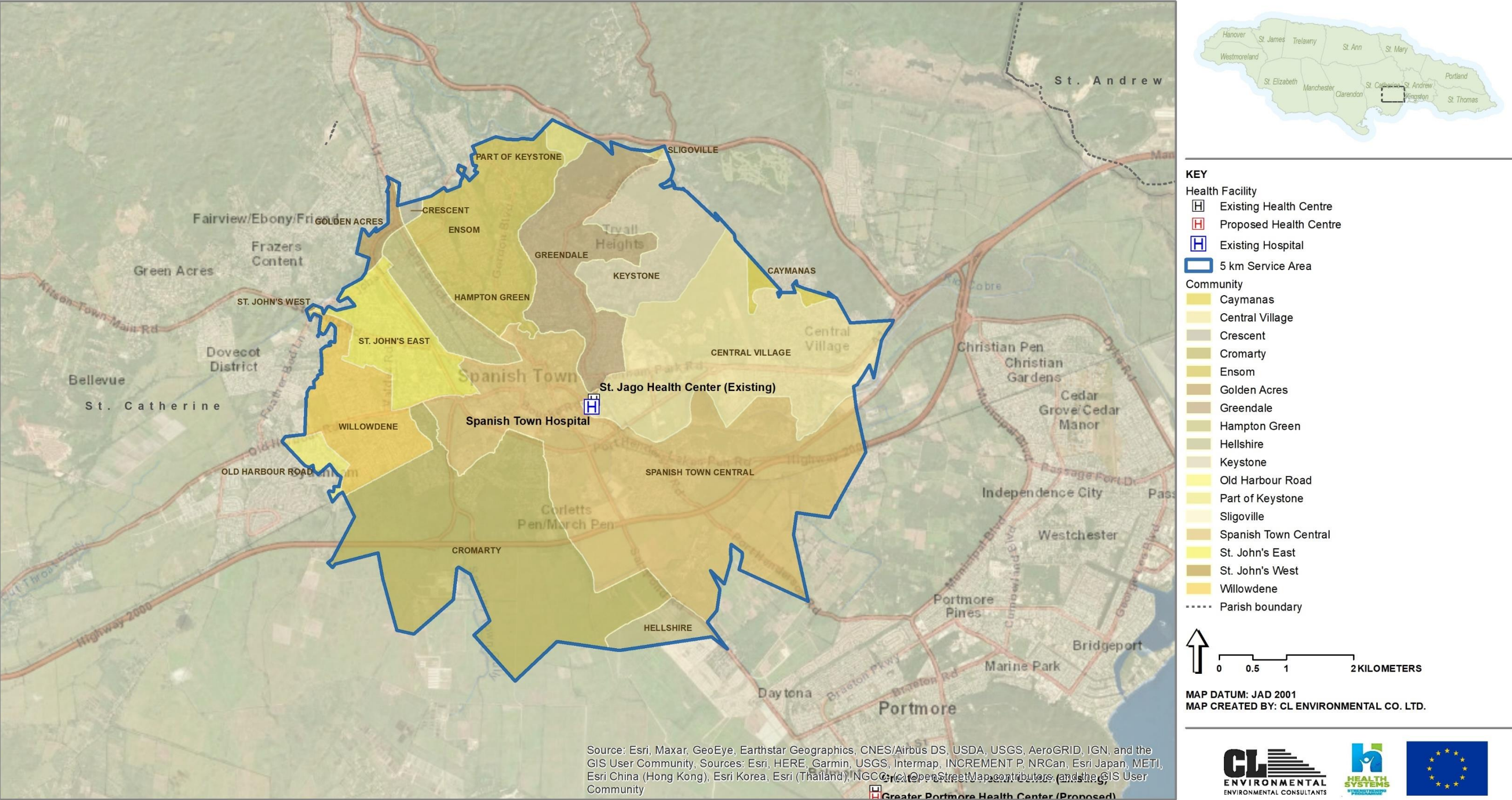


Figure 5-8 Communities within the Service Area (SA) for St, Jago Park HC

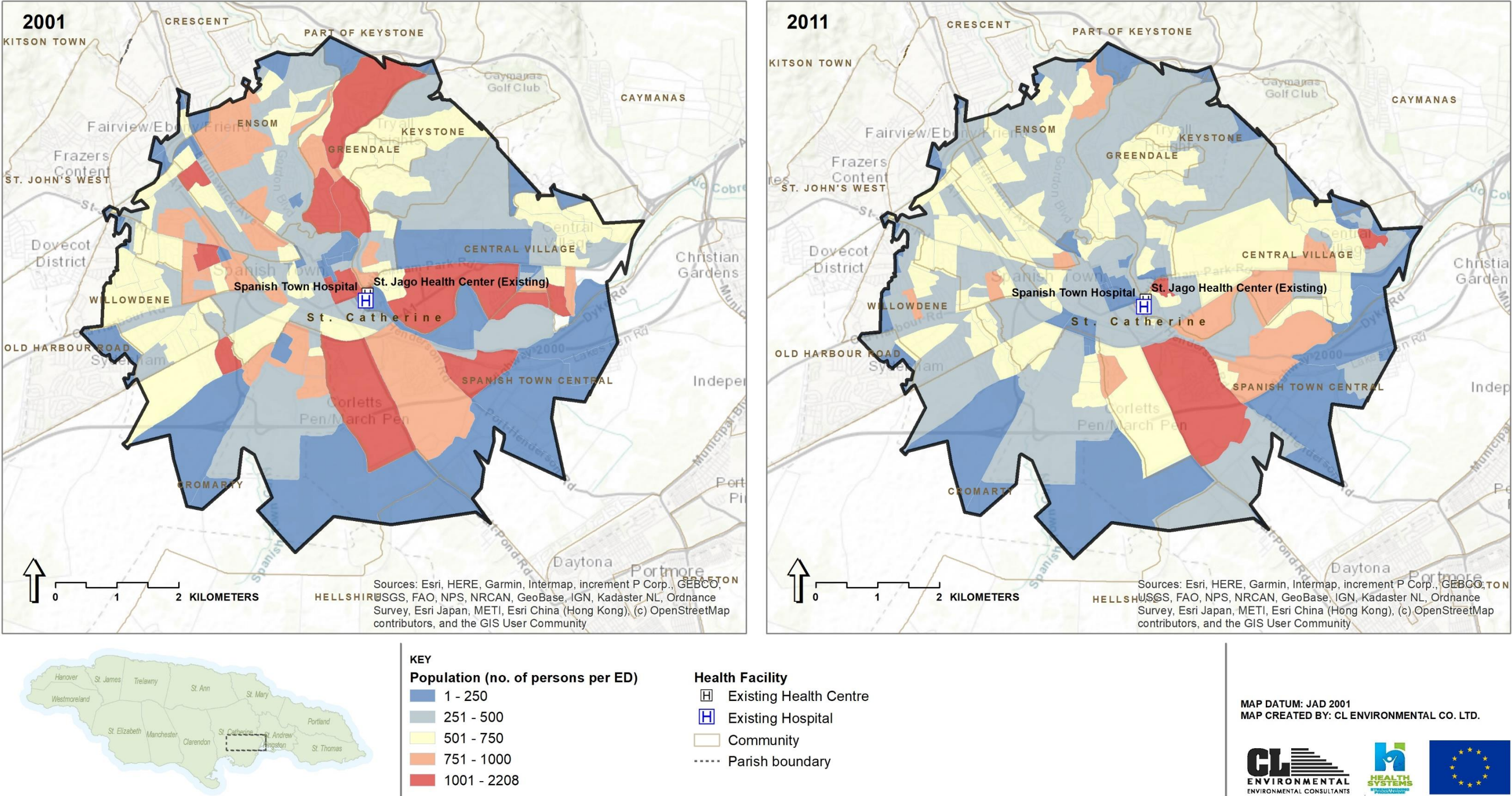


Figure 5-9 SA 2001 and 2011 population represented by enumeration districts

5.1.3.3 Public Services and Infrastructure

Domestic Water Supply

The National Water Commission (NWC) is the public agency responsible for providing Jamaica's domestic water supply. The majority of the households within the SA (93.5%) received their domestic water supply from a public source; this is similar to other extents investigated that had the majority of the population's water supply from a public source (Table 5-4).

Table 5-8 Percentage of households by water supply for the year 2011

	Category	Jamaica	St. Catherine	SA
Public Source	Piped in Dwelling	49.7%	63.5%	62.9%
	Piped in Yard	16.5%	16.1%	28.7%
	Stand Pipe	7.1%	1.8%	1.3%
	Catchment	2.2%	0.9%	0.6%
Private Source	Into Dwelling	6.4%	4.4%	1.9%
	Catchment	9.8%	3.6%	1.6%
	Spring/ River	3.0%	3.1%	0.0%
	Trucked Water/Water Truck	2.1%	3.7%	0.3%
	Other	1.8%	1.6%	1.4%
	Not Reported	1.3%	1.2%	1.3%

Source: STATIN Population Census 2011

Potable water supply to the St. Jago Park Health Centre is supplied by NWC. The source of this water is from the Spanish Town Treatment Plant or Rio Cobre which produces 205,846 m³/month (\approx 45.28 million imperial gallon (M.I.G.)/month) and the system has excess volume available. The NWC potable water pipeline is at the entrance of property on Burke Road.

Wastewater Generation and Disposal

Census 2011 data for wastewater disposal methods was not available.

There is no NWC central sewerage pipeline in vicinity of the Spanish Town Hospital.

Solid Waste Generation and Disposal

The National Solid Waste Management Authority (NSWMA) is responsible for domestic solid waste collection within the study area and specifically, the National Solid Waste Management Authority (NSWMA) covers the parish of St. Catherine. In residential areas, garbage is collected once per week. This service is provided free (partial covered by property taxes) for the households within the area.

Emergency Services

HEALTHCARE

In addition to St. Jago Park HC and the Spanish Town hospital, there are three other health centres located within the service area: Central Village, Cumberland Road and Sydenham (Figure 5-10).

FIRE STATIONS

Spanish Town Fire Station is the only fire station located within the SA (Figure 5-10).

POLICE STATIONS

Three police stations are located within the SA, namely Spanish Town, Central Village and Jamaica Police Academy (Figure 5-10).

5.1.3.4 Land Use**Lane Cover and Zoning**

Land cover within the SA consists of buildings and other infrastructure, disturbed broadleaved forest, secondary forest/fields, fields and plantations, herbaceous wetland/mangrove/swamp, and open dry forest (Figure 5-5).

According to the Town and Country Planning (Saint Catherine Parish) Provisional Development Order, 2017 (Confirmation) Notification, 2019, the SA encompasses areas of land specifically zoned as an Aquifer Protection Zone, Caymanas Economic Zone, Bauxite Bearing Area, Agriculture and Game Reserve. Within the Spanish Town Local Planning Area Land Use Proposals (Inset No.1), the buildings and infrastructure located within Spanish Town have varying uses including but not limited to residential, government purposes, institutional, industrial, commercial, and open space. The land on which the hospital is situated is zoned as Institutional (Hosp); adjacent to this land, areas are zoned as Institutional/ Office, Residential, Public Assembly/ Educational, Light Industry and Institutional (where the St. Catherine District Prison is located) (Figure 5-7).

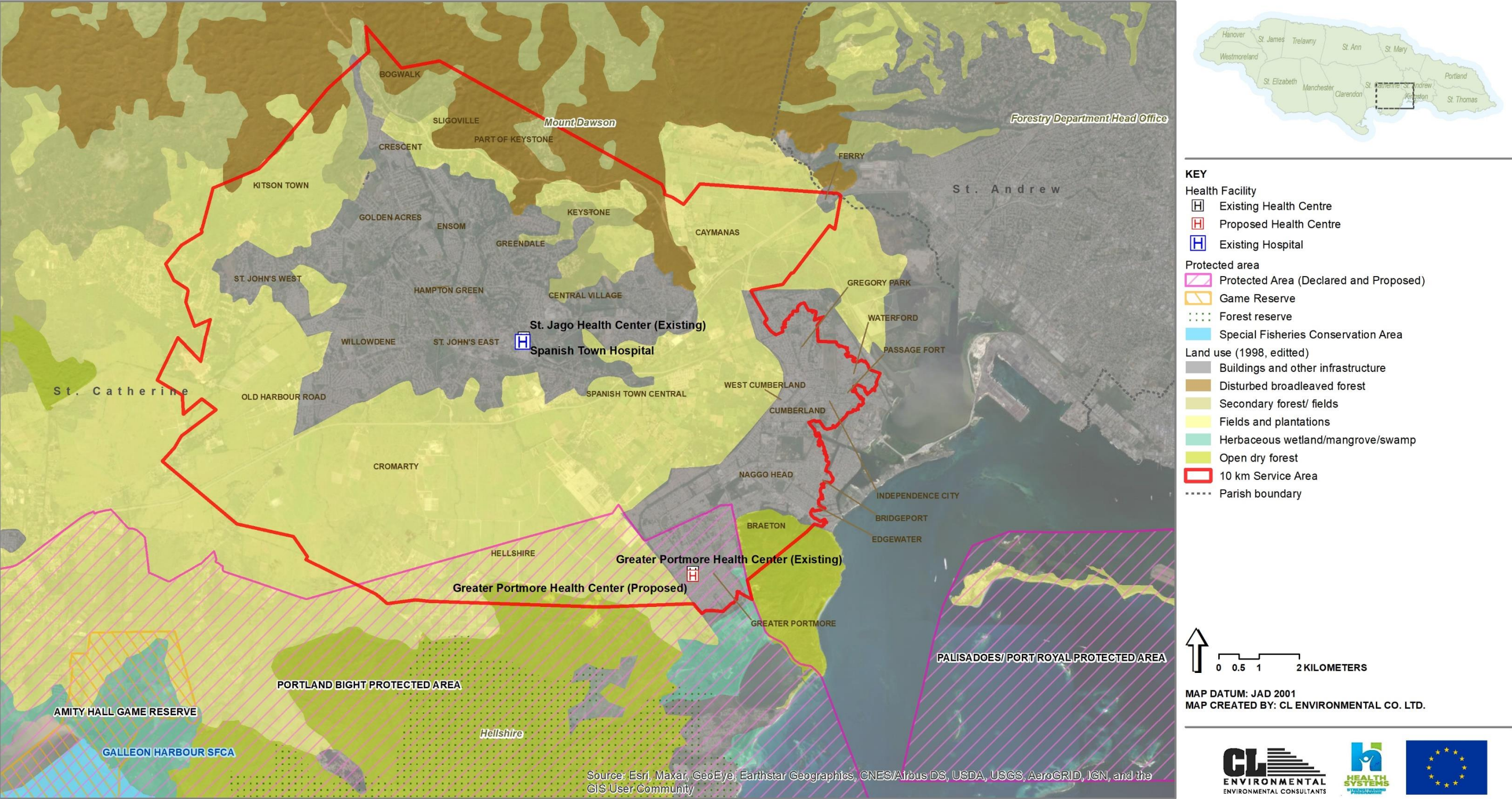
Protected Areas

Protected areas examined here include all areas of land or water protected by various laws in Jamaica, as well as international agreements, that fall within or in proximity to the project area. Specific to this project, the Portland Bight Protected Area partially falls within the SA (Figure 5-5).

The Portland Bight Protected area was declared April 22, 1999, under Natural Resources Conservation Authority (NRCA) Act. It is the largest protected area in Jamaica enclosing 1,876 km² of coastal land and sea between Portland Ridge and Hellshire Hills and including nearby cays such as Little Goat Island. More than half of the land area of the PBPA exists in its natural state and includes dry limestone forests (210.3 km²) and wetlands (82.0 km²). The remainder of land is used for the cultivation of sugar cane or human settlement (Caribbean Coastal Area Management (C-CAM) Foundation, 2007).

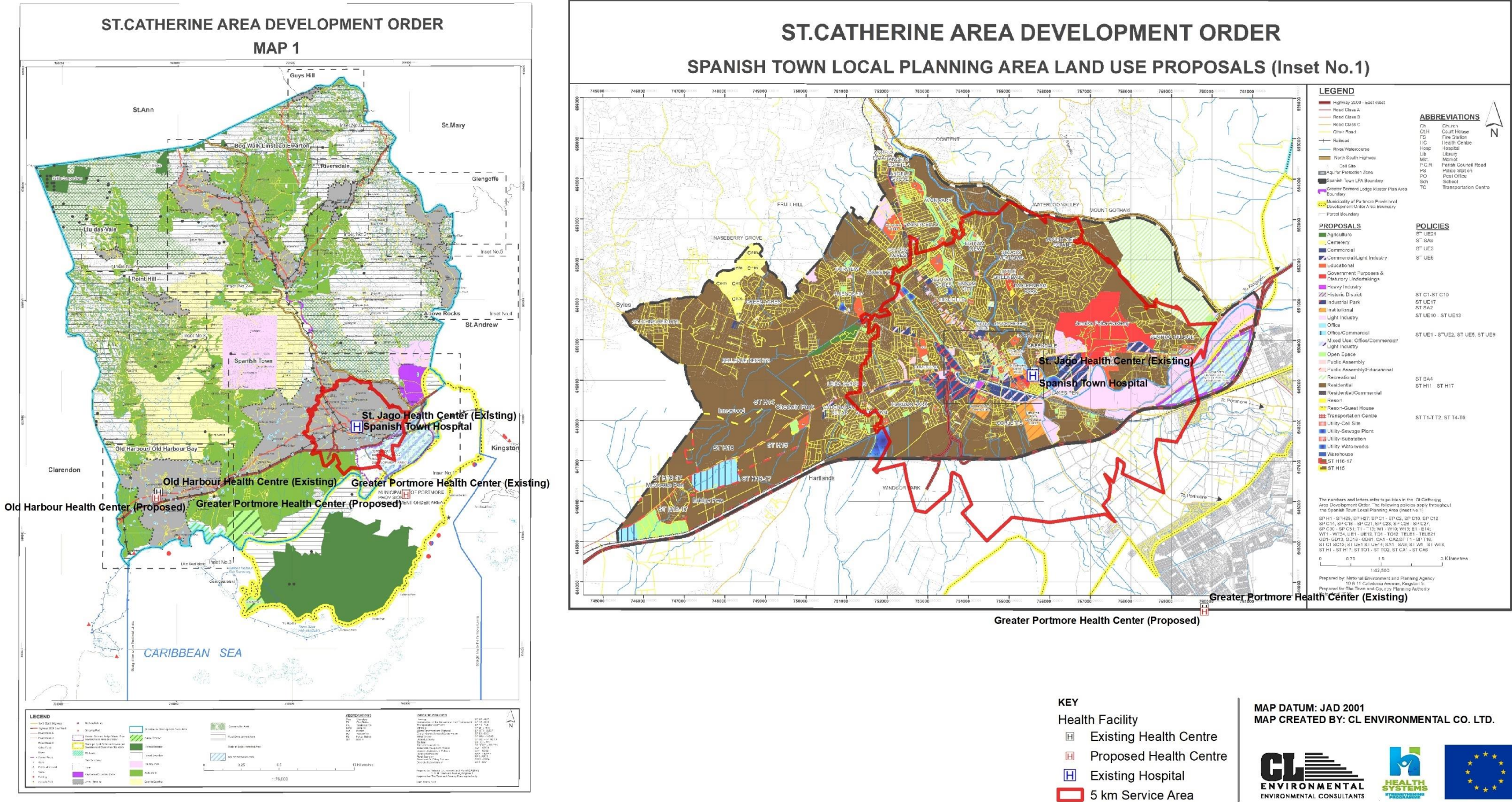


Figure 5-10 Road network and services located in the SA



Data sources: Land use (Edited based on Forestry Department, 1998), forest estates (Forestry Department) and protected areas (NEPA and MGI)

Figure 5-11 Land use, protected areas and forest estates within the SA



5.1.4 Old Harbour Health Centre

5.1.4.1 SA Communities

Specific to Old Harbour HC, three communities are either partially or wholly located within the 5km SA (Figure 5-2, Table 5-1).

Table 5-9 Communities located within the SA, sorted from largest to smallest in area of coverage within the SA

Community name	Parish	Land area with the SA (km2)
Freetown	Clarendon	0.01
Old Harbour	St. Catherine	31.23
Old Harbour Bay	St. Catherine	2.80
Total		34.05

5.1.4.2 Population and Housing

In 2001, there were approximately 267,937 persons living in the SA. The overall growth within the SA between 2001 and 2011 was approximately 1.1% per annum; pockets of growth between 2001 and 2011 are evident in the outskirts of Old Harbour in the communities such as Bodles, The Whim and Dorothy Lodge as (Figure 5-3). Based on the growth rate of 1.71% per annum, at the time of this study (2021), the population was approximately 36,022 persons and is expected to reach 55,101 persons over the next twenty-five years if the current population growth rate remains the same.

Table 5-10 Comparison of population densities for the year 2011

Category	Jamaica	St. Catherine	SA
Total ED area	10,991.0	1,193.1	34.0
Population	2,697,983	516,218	30,390
Population density	245	433	893

Source: STATIN Population Census 2011

There were 9,214 housing units, 10,165 dwellings and 10,372 households within the SA in 2011. Comparisons of the SA with national and regional ratios indicate that the SA, although higher, had comparable household/dwelling, average household size and dwelling/ housing unit ratios (Table 5-3).

Table 5-11 Comparison of national, regional and SA housing ratios for 2011

	Jamaica	St. Catherine	SA
Dwelling/Housing Unit	1.2	1.2	1.1
Household/Dwelling	1.0	1.0	1.0
Average Household Size	3.1	3.2	2.9

Source: STATIN Population Census 2001

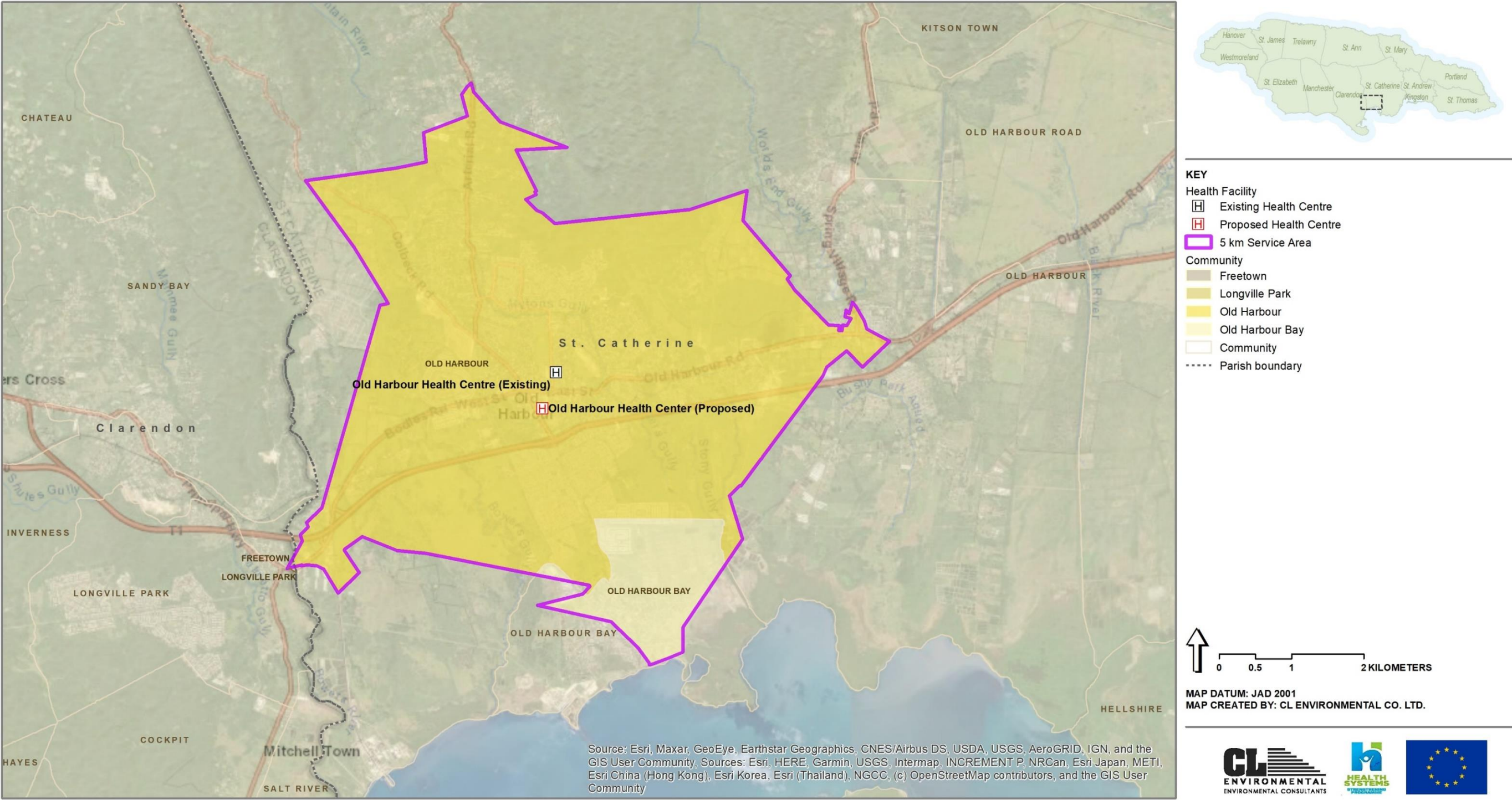


Figure 5-13 Communities within the Service Area (SA) for Old Harbour HC

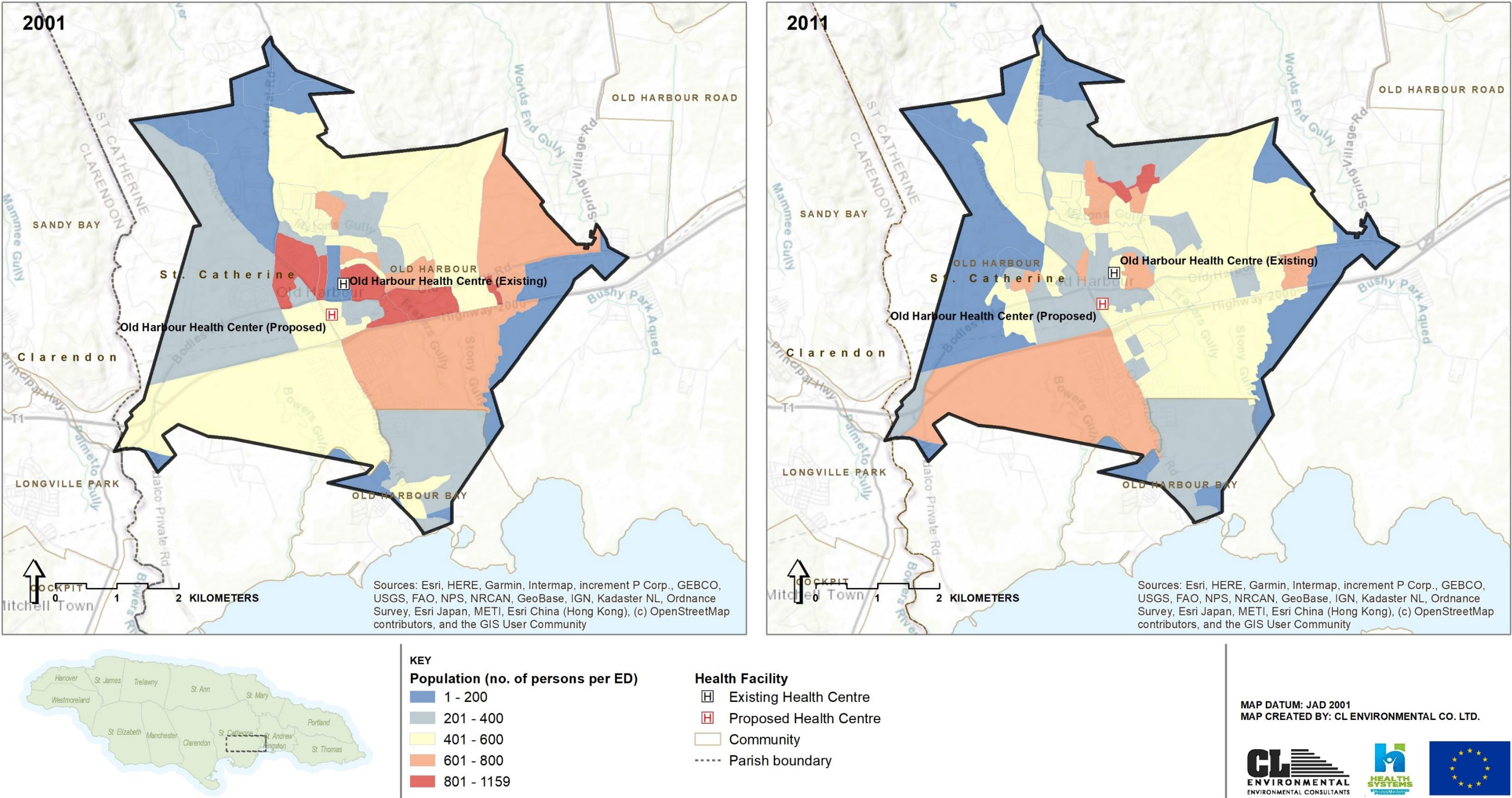


Figure 5-14 SA 2001 and 2011 population represented by enumeration districts

5.1.4.3 Public Services and Infrastructure

Domestic Water Supply

The National Water Commission (NWC) is the public agency responsible for providing Jamaica's domestic water supply. The majority of the households within the SA (90.6%) received their domestic water supply from a public source; this is similar to other extents investigated that had the majority of the population's water supply from a public source (Table 5-4).

Table 5-12 Percentage of households by water supply for the year 2011

	Category	Jamaica	St. Catherine	SA
Public Source	Piped in Dwelling	49.7%	63.5%	66.4%
	Piped in Yard	16.5%	16.1%	23.0%
	Stand Pipe	7.1%	1.8%	0.6%
	Catchment	2.2%	0.9%	0.6%
Private Source	Into Dwelling	6.4%	4.4%	2.9%
	Catchment	9.8%	3.6%	3.4%
	Spring/ River	3.0%	3.1%	0.1%
	Trucked Water/Water Truck	2.1%	3.7%	0.2%
	Other	1.8%	1.6%	1.8%
	Not Reported	1.3%	1.2%	0.9%

Source: STATIN Population Census 2011

Potable water supply to the Old Harbour Health Centre is supplied by the National Water Commission (NWC). The source of this water is from the Claremont Well which produces $\approx 253,672$ m³/month (≈ 55.8 million imperial gallon (M.I.G.)/month) and the system has excess volume available. The NWC potable water pipeline is at the entrance of property on East Street.

Wastewater Generation and Disposal

Census 2011 data for wastewater disposal methods was not available.

There is no NWC central sewerage pipeline in vicinity of the proposed Old Harbour Health Centre.

Solid Waste Generation and Disposal

The National Solid Waste Management Authority (NSWMA) is responsible for domestic solid waste collection within the study area and specifically, the National Solid Waste Management Authority (NSWMA) covers the parish of St. Catherine. In residential areas, garbage is collected once per week. This service is provided free (partial covered by property taxes) for the households within the area.

Emergency Services

HEALTHCARE

Old Harbour HC is the only health centre located within the service area (Figure 5-4).

FIRE STATIONS

Old Harbour Fire Station is the only fire station located within the SA (Figure 5-4).

POLICE STATIONS

Old Harbour and Old Harbour Bay police stations are located within the SA (Figure 5-4).

5.1.4.4 Land Use**Land Cover and Zoning**

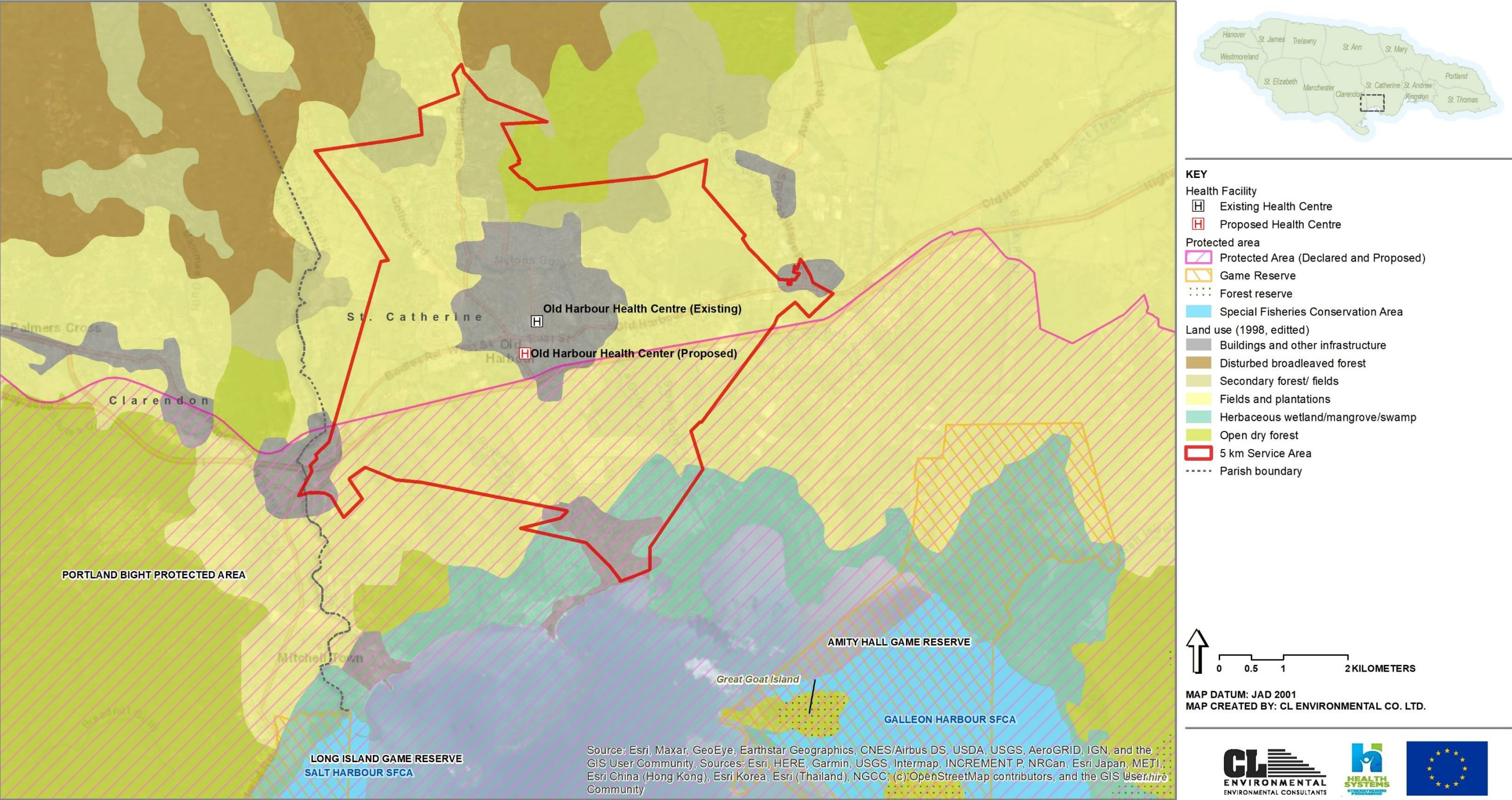
Land cover within the SA consists of buildings and other infrastructure, disturbed broadleaved forest, secondary forest/fields, fields and plantations, herbaceous wetland/mangrove/swamp, and open dry forest (Figure 5-5). The land use on the proposed site is both formal (skip) and informal solid waste storage and disposal and the area to the southwest has an apiary of approximately 26 boxes.

The SA falls within spatial limits of Town and Country Planning (Saint Catherine Parish) Provisional Development Order, 2017 (Confirmation) Notification, 2019 and specifically the Old Harbour/ Old Harbour Bay Local Planning Area Land Use Proposals (Inset No.3). According to the St Catherine Area Development Order 2017, the buildings and infrastructure located within the SA have varying uses including but not limited to residential, educational, agricultural, commercial, and heavy industry (Figure 5-6).

Protected Areas

Protected areas examined here include all areas of land or water protected by various laws in Jamaica, as well as international agreements, that fall within or in proximity to the project area. Specific to this project, the Portland Bight Protected Area partially falls within the SA (Figure 5-5).

The Portland Bight Protected area was declared April 22, 1999, under Natural Resources Conservation Authority (NRCA) Act. It is the largest protected area in Jamaica enclosing 1,876 km² of coastal land and sea between Portland Ridge and Hellshire Hills and including nearby cays such as Little Goat Island. More than half of the land area of the PBPA exists in its natural state and includes dry limestone forests (210.3 km²) and wetlands (82.0 km²). The remainder of land is used for the cultivation of sugar cane or human settlement (Caribbean Coastal Area Management (C-CAM) Foundation, 2007).



Data sources: Land use (Edited based on Forestry Department, 1998), forest estates (Forestry Department) and protected areas (NEPA and MGI)

Figure 5-15 Land use, protected areas and forest estates within the SA

5.1.5 Greater Portmore Health Centre

5.1.5.1 SA Communities

Specific to Greater Portmore HC, eight communities are either partially or wholly located within the 5km SA (Figure 5-2, Table 5-1).

Table 5-13 Communities located within the SA, sorted from largest to smallest in area of coverage

Community name	Parish	Land area with the SA (km ²)
Spanish Town Central	St. Catherine	4.28
Cromarty	St. Catherine	0.08
Edgewater	St. Catherine	0.00
Greater Portmore	St. Catherine	6.21
Naggo Head	St. Catherine	1.35
Bridgeport	St. Catherine	0.27
Hellshire	St. Catherine	5.14
Braeton	St. Catherine	5.36
Total		22.70

5.1.5.2 Population and Housing

The total population within the SA in 2011 was approximately 83,558 persons (STATIN 2011 Population Census). In 2001, there were approximately 73,081 persons living in the SA. The overall growth within the SA between 2001 and 2011 was 1.35% per annum; changes in ED population and configuration may be seen in Figure 5-3. Based on the growth rate of 1.35% per annum, at the time of this study (2021), the population was approximately 95,538 persons and is expected to increase to 133,548 persons over the next twenty-five years if the current population growth rate remains the same.

Table 5-14 Comparison of ED population densities for the year 2011

Category	Jamaica	St. Catherine	SA
Total ED area	10,991.0	1,193.1	23.7
Population	2,697,983	516,218	83,558
Population density	245	433	3,529

Source: STATIN Population Census 2011

There were 14,627 housing units, 21,889 dwellings and 22,271 households within the SA in 2011. Comparisons of the SA with national and regional ratios indicate that the SA, although higher, had comparable household/dwelling, average household size and dwelling/ housing unit ratios (Table 5-3).

Table 5-15 Comparison of national, regional and SA housing ratios for 2011

	Jamaica	St. Catherine	SA
Dwelling/Housing Unit	1.2	1.2	1.5
Household/Dwelling	1.0	1.0	1.0
Average Household Size	3.1	3.2	3.8

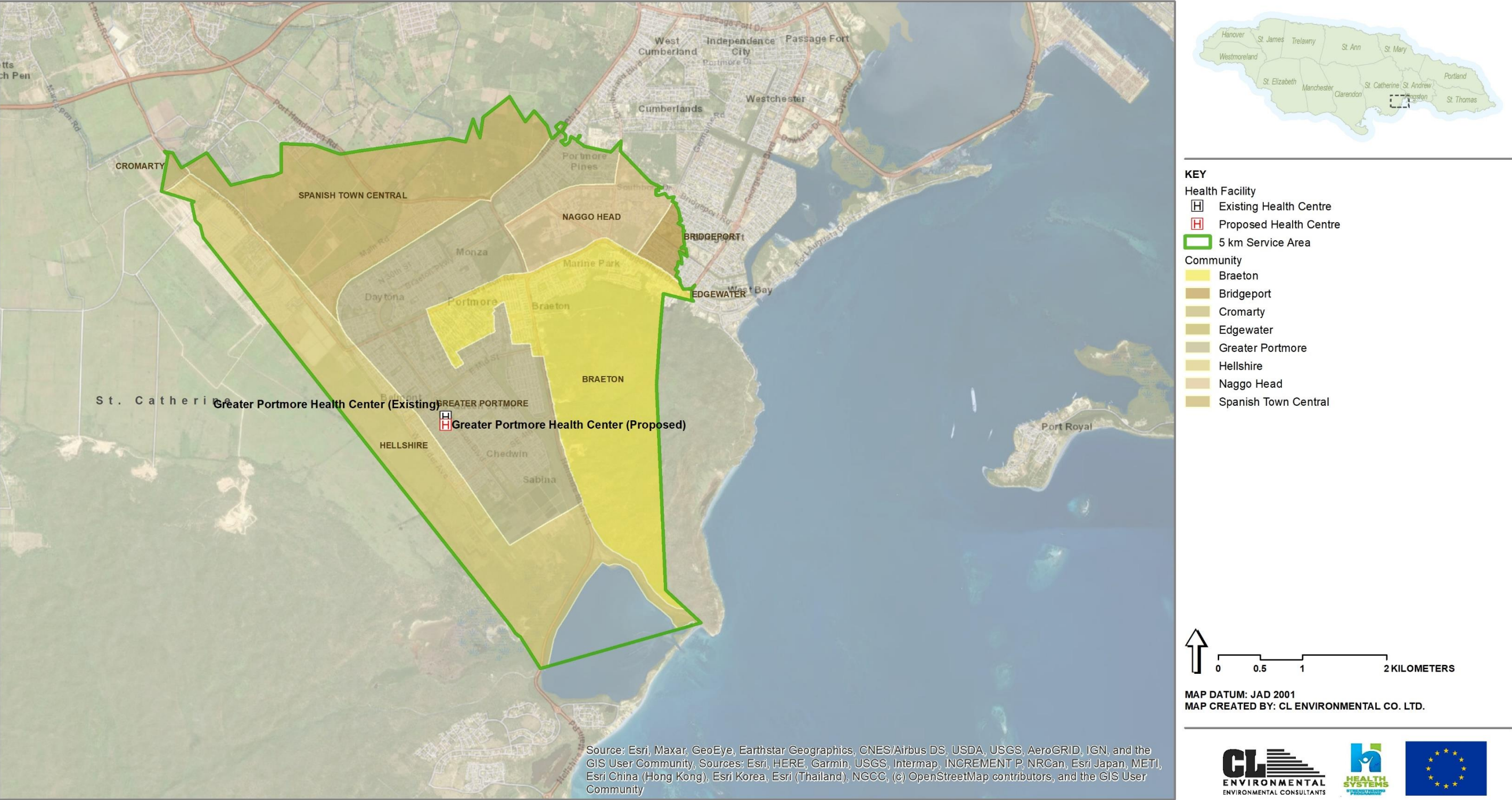


Figure 5-17 Communities within the Service Area (SA) for Greater Portmore HC

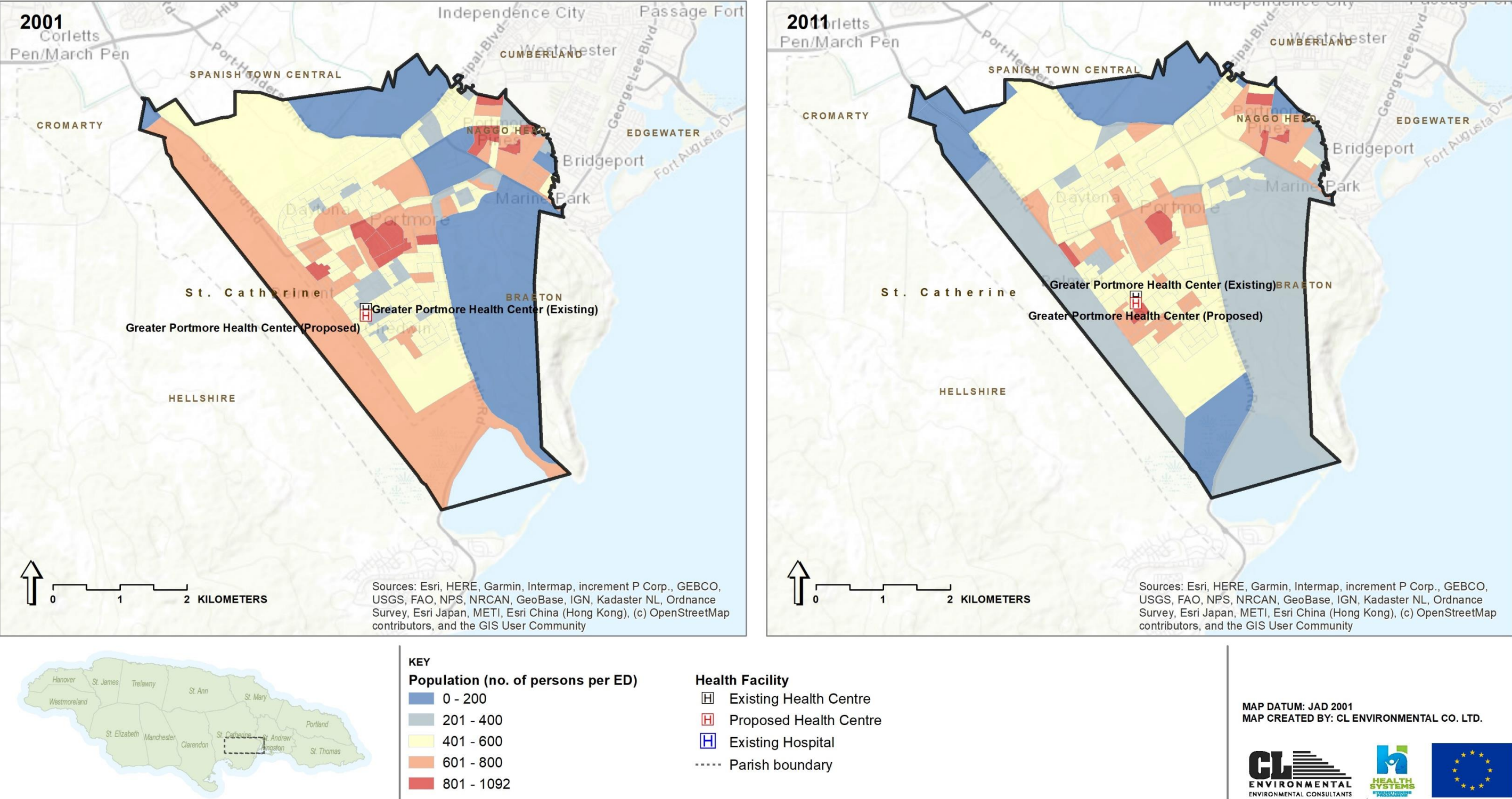


Figure 5-18 SA 2001 and 2011 population represented by enumeration districts

5.1.5.3 Public Services and Infrastructure

Domestic Water Supply

The National Water Commission (NWC) is the public agency responsible for providing Jamaica's domestic water supply. The majority of the households within the SA (92.6%) received their domestic water supply from a public source; this is similar to other extents investigated that had the majority of the population's water supply from a public source (Table 5-4).

Table 5-16 Percentage of households by water supply for the year 2011

	Category	Jamaica	St. Catherine	SA
Public Source	Piped in Dwelling	49.7%	63.5%	88.3%
	Piped in Yard	16.5%	16.1%	4.2%
	Stand Pipe	7.1%	1.8%	0.1%
	Catchment	2.2%	0.9%	0.0%
Private Source	Into Dwelling	6.4%	4.4%	5.4%
	Catchment	9.8%	3.6%	0.4%
	Spring/ River	3.0%	3.1%	0.0%
	Trucked Water/Water Truck	2.1%	3.7%	0.0%
	Other	1.8%	1.6%	0.2%
	Not Reported	1.3%	1.2%	1.4%

Source: STATIN Population Census 2011

Potable water supply to the Greater Portmore Health Centre is supplied by the National Water Commission (NWC). The source of this water is the Goshen Pen Relift, which has excess volume and sewerage available.

Wastewater Generation and Disposal

Census 2011 data for wastewater disposal methods was not available.

Solid Waste Generation and Disposal

The National Solid Waste Management Authority (NSWMA) is responsible for domestic solid waste collection within the study area and specifically, the National Solid Waste Management Authority (NSWMA) covers the parish of St. Catherine. In residential areas, garbage is collected once per week. This service is provided free (partial covered by property taxes) for the households within the area.

Emergency Services

HEALTHCARE

Two health centres are located within service area, that being studied (Greater Portmore), and Bridgeport Dental (Figure 5-4).

FIRE STATIONS

There are no fire stations located within the SA (Figure 5-4).

POLICE STATIONS

There are no police stations located within the SA (Figure 5-4).

5.1.5.4 Land Use**Land Cover and Zoning**

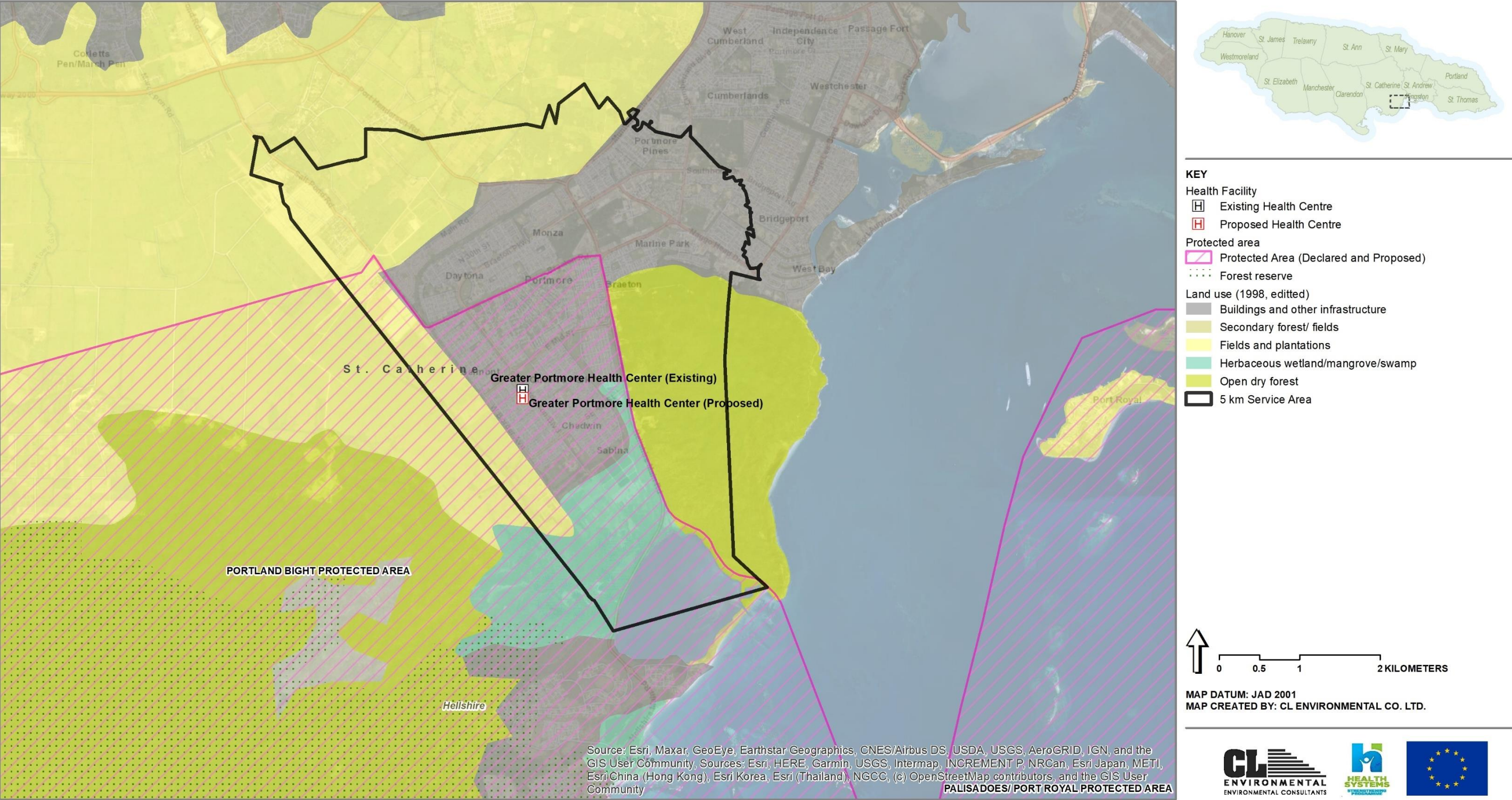
Land cover within the Service Area consisted of buildings and other infrastructure, fields and plantations, open dry forest and mangrove/wetland/swamp (Figure 5-5). The project site is surrounded by the 4 West and 5 West communities of Greater Portmore and in proximity to the library, school, shopping centre and courthouse.

As seen in Figure 5-6, the SA encompasses areas of land zoned for various purposes including residential, conservation, educational, open space, office/commercial and recreational in the Saint Catherine Parish, Portmore Municipality) Provisional Development Order, 2018, Portmore South Local Planning Area. Inset No. 2.4 for Greater Portmore East Area Land Use Proposals shows the location of the HC, adjacent to lands zoned as commercial, open space and government (Figure 5-21).

Protected Areas

Protected areas examined here include all areas of land or water protected by various laws in Jamaica, as well as international agreements, that fall within or in proximity to the project area. Specific to this project, the Portland Bight Protected Area partially falls within the SA (Figure 5-5).

The Portland Bight Protected area was declared April 22, 1999, under Natural Resources Conservation Authority (NRCA) Act. It is the largest protected area in Jamaica enclosing 1,876 km² of coastal land and sea between Portland Ridge and Hellshire Hills and including nearby cays such as Little Goat Island. More than half of the land area of the PBPA exists in its natural state and includes dry limestone forests (210.3 km²) and wetlands (82.0 km²). The remainder of land is used for the cultivation of sugar cane or human settlement (Caribbean Coastal Area Management (C-CAM) Foundation, 2007).



Data sources: Land use (Edited based on Forestry Department, 1998), forest estates (Forestry Department) and protected areas (NEPA and MGI)

Figure 5-19 Land use, protected areas and forest estates within the SA

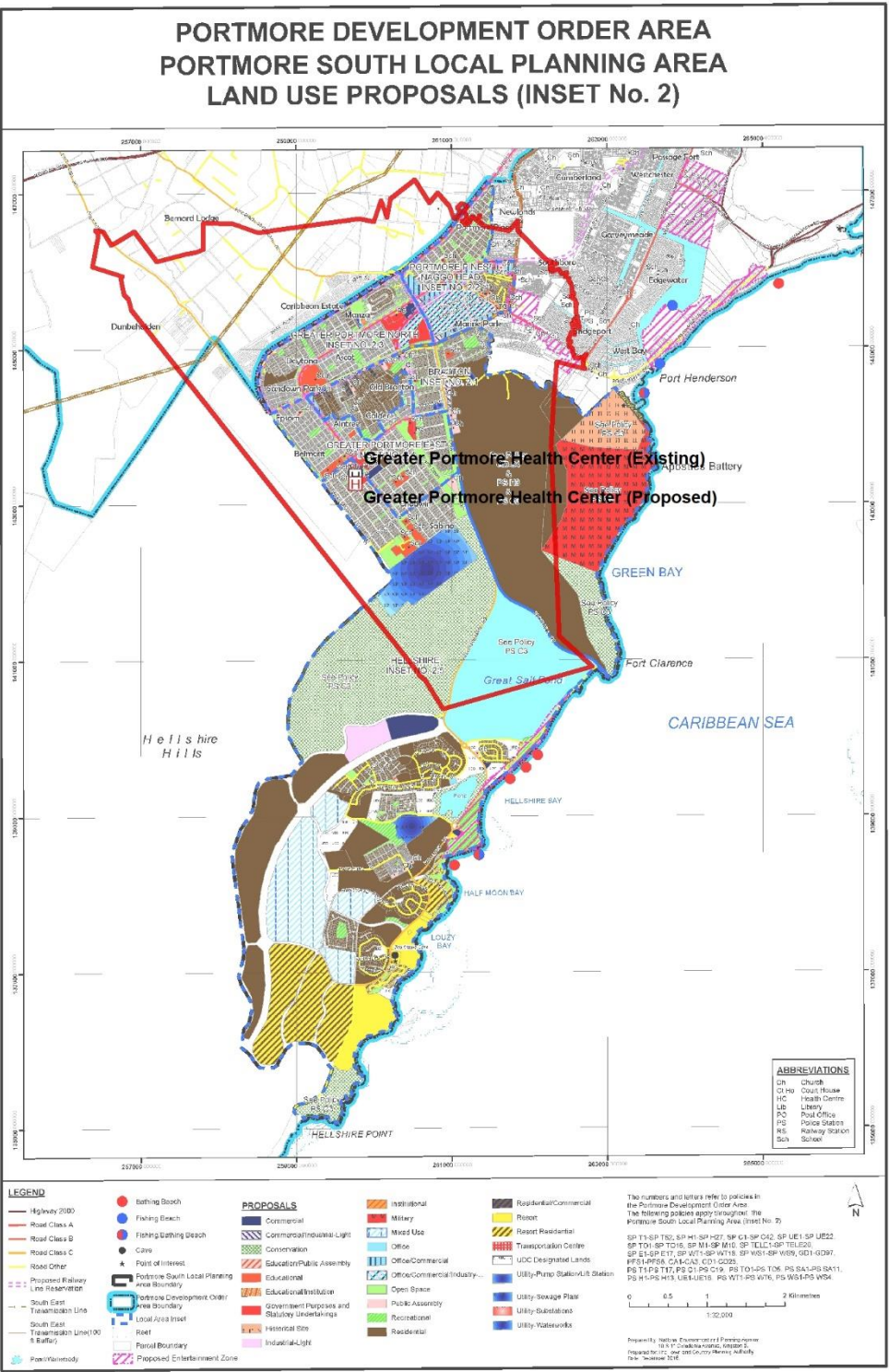
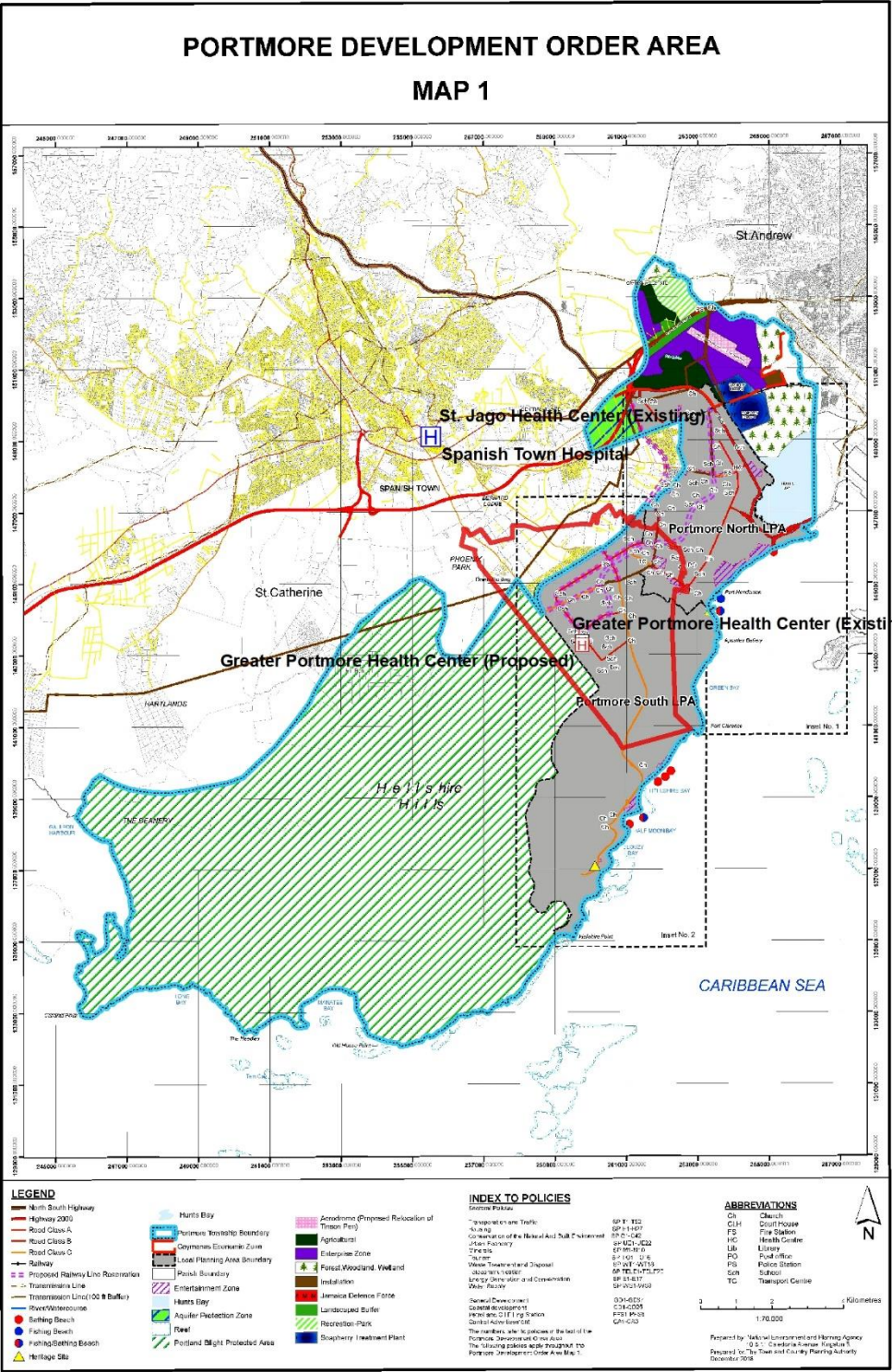


Figure 5-20 Town and Country Planning (Saint Catherine Parish, Portmore Municipality) Provisional Development Order, 2018 and Portmore South Local Planning Area (Inset No. 2) in relation to the SA

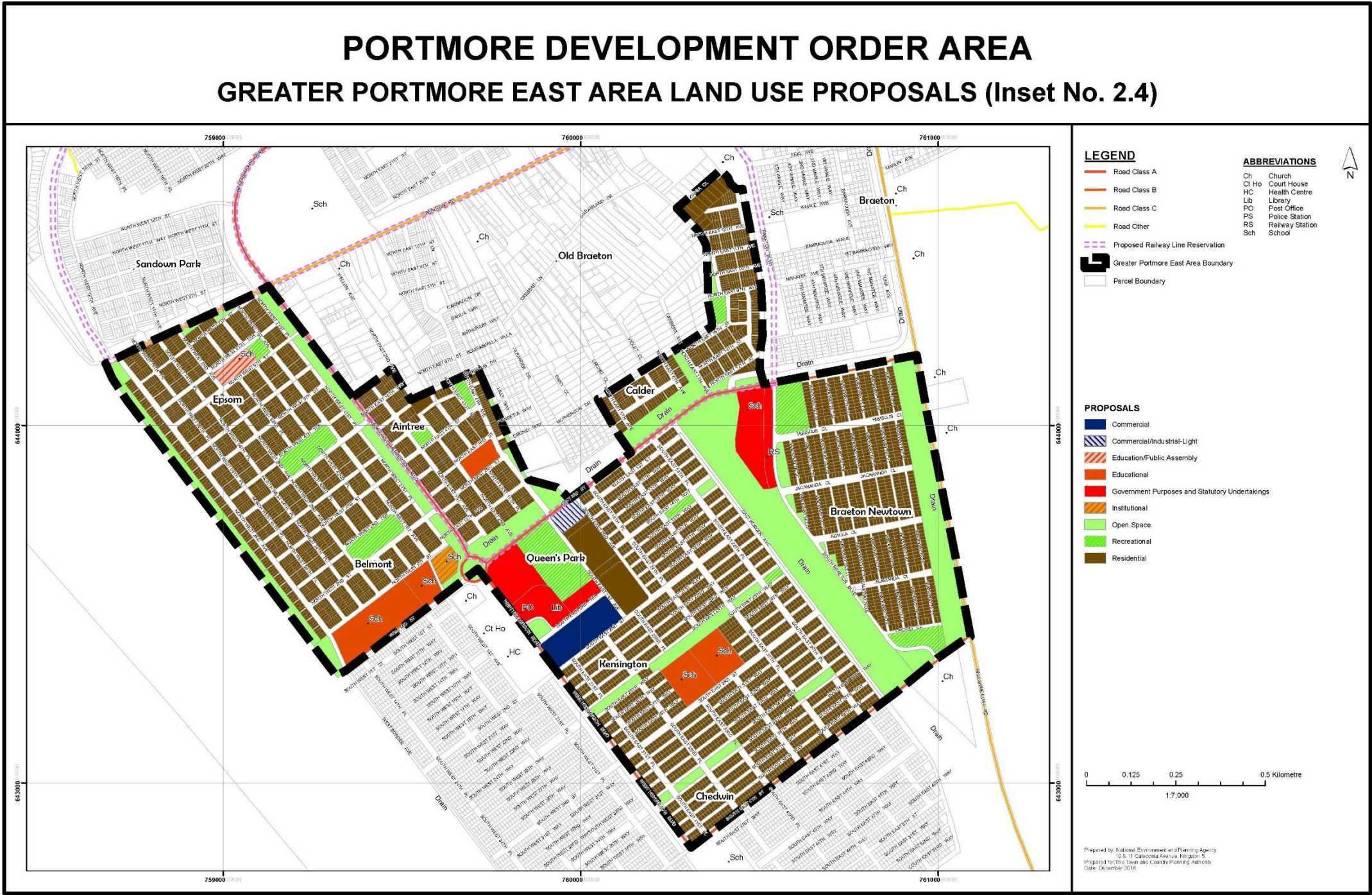


Figure 5-21 Town and Country Planning (Saint Catherine Parish, Portmore Municipality) Provisional Development Order, 2018, Greater Portmore East Area Land Use Proposals (Inset No. 2.4)

5.2 EMPLOYMENT

5.2.1 Labour Laws

Jamaica has several laws related to labour and employment that regulate the relationship between employers and employees (Ministry of Labour and Social Security, n.d.). The following are the key labour laws in Jamaica:

- **Labour Relations and Industrial Disputes Act (LRIDA):** This act provides for the promotion of good industrial relations between employers and employees, and the prevention and settlement of disputes. The LRIDA also establishes the Industrial Disputes Tribunal, which is responsible for settling disputes between employers and employees.
- **Employment (Termination and Redundancy Payment) Act:** This act outlines the terms under which an employee can be terminated, and it provides for redundancy payments to employees who are made redundant.
- **Minimum Wage Act:** This act sets a minimum wage for workers in Jamaica. The minimum wage rate is reviewed and adjusted annually.
- **Holidays with Pay Act:** This act provides for paid holidays for employees who have worked continuously for at least a year. Employees are entitled to 14 days of paid leave each year.
- **Maternity Leave Act:** This act provides for 12 weeks of paid maternity leave for female employees who have been employed for at least a year.
- **Occupational Safety and Health Act:** This act outlines the requirements for workplace safety and health, and it provides for the establishment of a national occupational safety and health program.
- **National Insurance Act:** This act establishes a social security program that provides benefits to employees who are injured or disabled, as well as to their dependents.

5.2.2 Employment Status and Opportunities

As of July 2022, the unemployment rate in Jamaica was 6.6%, a decrease from the July 2021 unemployment rate (8.5%) (The Statistical Institute of Jamaica (STATIN), 2022). In St. Catherine, a total of 197,323 persons stated to be employed; a slightly greater percentage were males (54%) (Table 5-17). The unemployed population comprised a lower number of females (45%).

Table 5-17 Population 14 years old and over by economic activity in the week preceding the census by age group in the parish of St. Catherine

Status	Male	Female	Total	Male (%)	Female (%)
Employed	107,086	90,237	197,323	54%	46%
Unemployed	17,629	14,623	32,252	55%	45%
Inactive	57,085	96,374	153,459	37%	63%
Not reported	3,429	2,549	5,978	57%	43%
Total population	185,229	203,783	389,012	48%	52%

Several industries and businesses are located with St. Catherine, providing employment opportunities for its residents. Some of the largest employers in St. Catherine include the manufacturing and distribution sectors, with companies such as Wisynco Group, Jamaica Broilers Group, and Lasco Manufacturing Limited providing job opportunities in areas such as production, administration, logistics, and sales. The construction industry also provides employment opportunities in St. Catherine, with several ongoing projects, including the development of new housing schemes, road infrastructure, and commercial buildings. Additionally, there are opportunities in the retail and service sectors, with supermarkets, restaurants, hotels, and other small businesses operating in various parts of the parish.

5.2.2.1 Spanish Town Hospital

There are seven hundred and eighty-four (784) women employed at the Spanish Town Hospital. Women will generally be more impacted since they will have a greater burden with childcare and other inconveniences brought by the dislocation of services such as the day care facility. The day care facility serves to facilitate the female workers' children at both STH and SJHC.

5.2.2.2 St. Jago Park Health Centre

The total staff complement at SJHC is one hundred and twenty (120), of which ninety-six (96) (80%) are women and twenty-four (24) (20%) are men. Sixty-seven (67) women work at the St. Catherine Health Department, which is the adjoining building to the St. Jago Park Health Centre. Women will generally be more impacted since they will have a greater burden with childcare and other inconveniences brought by the dislocation of services such as the day care facility. The day care facility serves to facilitate the female workers' children at both STH and SJHC.

5.2.2.3 Old Harbour Health Centre

Forty-three (43) women work at the Old Harbour Health Centre.

5.2.2.4 Greater Portmore Health Centre

Sixty (60) women work at the Greater Portmore Health Centre.

5.3 GENDER BASED VIOLENCE (GBV)

Gender-based violence is a serious problem in Jamaica. According to data from the Jamaican police, incidents of gender-based violence have increased in recent years, with a particular spike during the COVID-19 pandemic. A Caribbean Policy Research Institute Report (2022) stated that about 28% of Jamaican women experienced direct gender-based violence during their lifetime, and 7% of respondents were abused by their significant other within 12 months before they were surveyed (Jamaica Gleaner, 2023)).

St. Catherine, which is one of the largest parishes in Jamaica, has seen its fair share of gender-based violence. The violence takes many forms, including physical, sexual, and emotional abuse. Women

and girls are the primary victims of gender-based violence in St. Catherine, with domestic violence being a common form of abuse.

The Jamaican government has taken steps to address the issue of gender-based violence, including passing legislation such as The Sexual Harassment Act of 2021 (Ministry of Entertainment, Culture Gender and Sport, 2021), to provide greater protection for victims and increasing funding for support services. Various organizations are working to support victims of gender-based violence in Jamaica, including the Bureau of Gender Affairs, the Women's Centre of Jamaica Foundation, and the Jamaica Constabulary Force's Centre for the Investigation of Sexual Offences and Child Abuse (CISOCA). These organizations provide counselling and other support services to victims, as well as working to raise awareness and prevent gender-based violence in the community. The Government has launched a 10-year National Strategic Action Plan to eliminate Gender-Based Violence (NSAP-GBV). The Plan focuses on five strategic priority areas – prevention, protection, intervention, legal procedures and protocols for data collection (United Nations, 2017).²⁵

5.4 CULTURE AND HERITAGE

5.4.1 Indigenous People

The Tainos were an indigenous people who inhabited the Caribbean islands, including Jamaica, prior to the arrival of Europeans. Most of St Catherine's thirty-eight (38) known Taino sites were midden sites. Places in the parish where midden sites and sometimes village sites were found, included Rodney's House on Port Henderson Hill, White Marl, Naggo Head, in the Hellshire area, Port Henderson, Little Goat Island, Ferry, Marlie Mount, Great Goat Island, Colbeck, Caymanas Bay and Caymanas, Half Moon Bay, Wreck Point, Mount Rosser, Mahoe Ridge, Dover, Great Salt Pond and Hellshire Hills (Jemmott, n.d.). Other locations in St Catherine which were listed by the Jamaica National Heritage Trust as identified with the Tainos include Red Hills, Riverhead, Cross Pen, Content, Old Crescent Road, Crescent, Reid's Mountain, Naseberry Grove, Harker, Gibraltar, Giblatore, Wakefield, Cambrian and Dignum Mountain. Taino Burial Sites, including burial caves, were found at the three important locations of White Marl, Great Goat Island and Naggo Head (Figure 5-22).

White Marl is the closest Taino midden or village site to STH and SJHC, located approximately 4.3 km east. Within this White Marl community, Taino burial sites or caves were also found (Figure 5-22). Taino locations nearest to GPHC include Naggo Head, Rodney's House and Great Salt Pond, all located approximately 3.1 km from the proposed GPHC location. Marlie Mount Taino site is located 1.4 km northeast of the proposed OHHC location.

²⁵ Source Material include *A discussion on sexual violence against girls and women in Jamaica* (Smith & Cooke, 2019); *Sexual violence against women and girls in Jamaica: "just a little sex"* (Amnesty International, 2006).

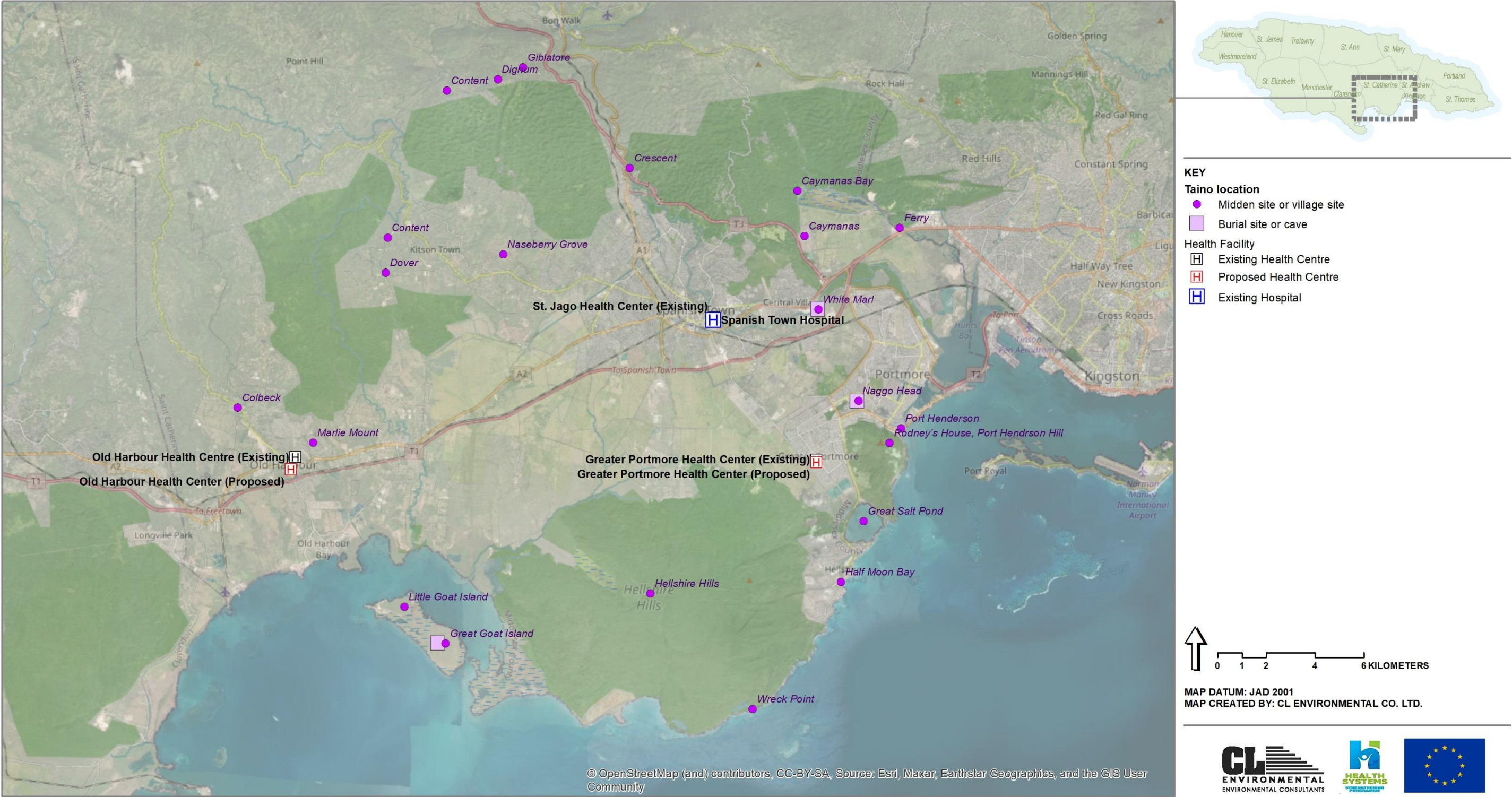
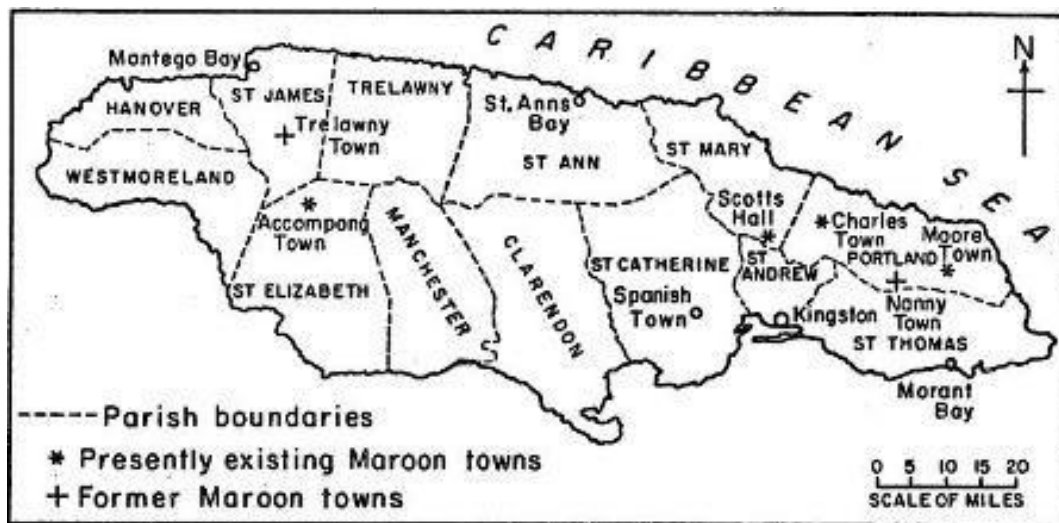


Figure 5-22 Taino locations in proximity to Spanish Town Hospital, St. Jago Park, Old Harbour and Greater Portmore Health Centres

Maroons were communities of escaped enslaved Africans in Jamaica who resisted recapture and formed their own independent societies. They played a significant role in Jamaica's history, and their legacy is still celebrated in the country today. Maroon villages are located throughout Jamaica, primarily in the eastern and central regions of the island. Some of the most well-known presently existing Maroon villages include Accompong, St. Elizabeth; Moore Town, Portland; Charles Town, Portland; and Scott's Hall, St. Mary (Figure 5-23). There are no Maroon villages located in St. Catherine parish.



Source: <https://abengcentral.wordpress.com/jamaica/>

Figure 5-23 Map of Jamaica showing parish boundaries and locations of the major Maroon Settlements

5.4.2 Historical and Archaeological Sites

Desk-based assessments were conducted within a 1 km of each facility by the Jamaica National Heritage Trust (JNHT).

5.4.2.1 Spanish Town Hospital

Spanish Town became the second city in Jamaica after the Spanish, having captured Jamaica in 1494, decided to abandon Sevilla la Nueva in 1534. Spanish Town was first called La Vega, then later referred to as Villa De La Vega meaning “Town on the plain” (Jemmott, 24). It was not until the 17th century the name Santiago de la Vega was used by the Spanish settlers. The name Santiago de la Vega was later changed by the British upon their occupation of the island, calling the town St Jago de la Vega. It became the capital of Jamaica from 1534 to 1655 under the reign of the Spanish and after the English captured the island in 1655, remained the capital until 1872 when the status was conferred on Kingston (Jamaica National Heritage Trust, 2021). Spanish Town is currently the capital of the parish of St. Catherine. The town boasts some of the most interesting historical structures, representing the lingering memory of the old capital. The immense number of sites in this town have ultimately led to the Jamaica National Heritage Trust declaring a section of this Town national protected

heritage in December of 1994 (Jamaica National Heritage Trust, 2021). There are a total of 22 recognized historical and archaeological sites within 1km of the Spanish Town Hospital (Jamaica National Heritage Trust, 2021)) (Table 5-18).

Table 5-18 Historical and archaeological sites within 1km of the Spanish Town hospital (JAD 2001)

Source: (Jamaica National Heritage Trust, 2021)

NAME	EASTINGS (JAD 2001)	NORTHINGS (JAD 2001)
Cathedral of St Jago de la Vega	755072	649384
St Joseph's Church	754916	649351
Methodist Church	754969	649267
Chapel	755121	649247
Jewish Burial Ground	755176	648900
Prison Oval	755334	649221
Lime Kiln	755375	649238
Irrigation Office	755212	649418
Ruins of Old Baptist Church	754924	649521
Overseer Office	755243	649054
Spanish Town Police Station	754618	649431
All Saints Church and School	754739	649501
Altenheim House	754815	649492
Old Kings House	754799	649577
Rodney Memorial and Complex	754817	649624
Saint Catherine District Prison	755062	649204
Cast Iron Bridge	755574	649315
Beacon Hill	755689	649630
Old Court House	754849	649548
Governors House	754793	649574
Cenotaph	754995	649368
Military Barracks	754823	649220

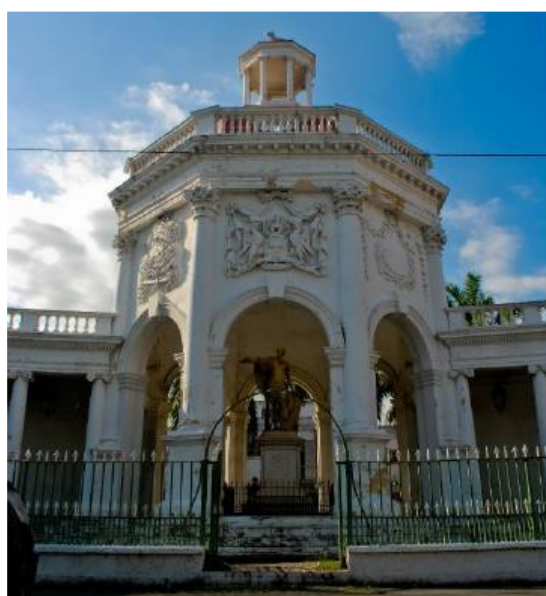


Plate 5-1 The Rodney's Memorial



Plate 5-2 Old Court House



Plate 5-3 Cast Iron Bridge

5.4.2.2 St. Jago Park Health Centre

Please see section 5.4.2.1 for the history of Spanish Town and a listing of the 22 recognized historical and archaeological sites within 1km of Spanish Town Hospital and St. Jago Health Centre (Jamaica National Heritage Trust, 2021) (Table 5-18).

5.4.2.3 Old Harbour Health Centre

Old Harbour is a large town located in Saint Catherine and is situated between Spanish Town and May Pen. It was once part of the former parish of St. Dorothy that now forms St. Catherine. In 1770, Old Harbour was called Old Harbour Market and had the first post office west of Spanish Town on the Southside Post Road. As the settlement around the market grew, it became known as Old Harbour, and became the capital of the Parish of Saint Catherine (Jamaica National Heritage Trust, 2021).

There are six (6) recognized historical and archaeological sites within 1km of the newly proposed Old Harbour Health Centre (Jamaica National Heritage Trust, 2021) (Table 5-19, Plate 5-4 and Plate 5-5).

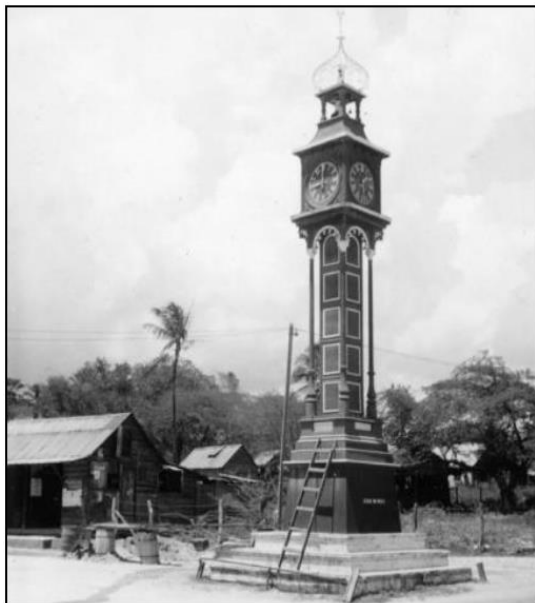
Table 5-19 Historical and archaeological sites within 1km of the newly proposed Old Harbour Health Centre (JAD 2001)

NAME	EASTINGS (JAD 2001)	NORTHINGS (JAD 2001)
The Anglican Church of the Holy Trinity	737957	643320
The Old Harbour Railway Station	738493	642665
The Old Harbour Clock Tower	738029	643253
The Marlie Race Course	738282	643813
The Monument to East Indian Migration	738052	643228
Old Harbour Police Station	738066	643213



Plate 5-4 The Old Harbour Railway Station

Then



Now



Plate 5-5 The Old Harbour Clock Tower

5.4.2.4 Greater Portmore Health Centre

The Greater Portmore Health Clinic is situated in Greater Portmore, St. Catherine. Greater Portmore was built on lands known as Reid's Pen and Great Salt Pond Pen. The communities within one kilometre of the Health Centre, namely East and West Aintree, Belmont Park, Epsom, Calder and East and West Queens Park were named after racetracks across the world. East and West Kensington, East and West Sabina, East and West Chedwin and East and West Queens Park were named after cricket pitches in Jamaica and the Caribbean. Braeton now known as Old Braeton is also included and was on 520 hectares of land. The wetland called The Flashes to the South was converted into 100 acres of tertiary sewage ponds, which discharged into the Great Salt Pond. This huge housing estate constructed by the Matalons was named "Greater Portmore" to distinguish it from the original "Portmore", and it was the largest single housing project in Jamaica at that time.

Although no historical or architectural features were identified in Greater Portmore, these areas were pastureland and sugar cane fields while it was known as Reid's Pen and Great Salt Pond Pen.

5.5 PUBLIC PARTICIPATION AND CONSULTATION

5.5.1 Approach

5.5.1.1 Internal Stakeholders

Internal Stakeholder consultations were conducted as part of the overall environmental impact assessment process. As a result of Jamaica being adversely impacted by the Covid-19 pandemic, survey instruments were administered electronically. The target audience of internal stakeholders included:

- Regional Technical Directors
- Senior Medical Officers (SMOs)
- Hospital/Health Centre Administrators
- Medical Officers (Health) or MO(H)
- Nurses to include Matrons/ Senior Public Health Nurse
- Medical Officers in Charge of Health Centres
- Hospital CEOs
- Medical Doctors (Specialists/Consultants and Primary Care)
- Heads of Departments (Hospitals)
- Diagnostic Services staff e.g., radiologists/phlebotomists etc
- Chief Pharmacist(s)
- Dental surgeons, Ophthalmologists and Lead for other specialty services (as applicable based on level of services offered at health facility)

Limitations experienced included but were not limited to:

- Contact information received from the MOHW was not current/ incorrect/incomplete
- Lack of response/poor participation from the internal stakeholders
- Lack of follow-up in instances where representatives of the respective facilities opted to circulate the survey instruments
- The survey instrument being administered during enhanced measures for vaccinations and patient care for those ill and hospitalised with Covid-19

5.5.1.2 External Stakeholders

Prior to the consultation, external stakeholders were identified based on desk review, site reconnaissance, expert knowledge and the utilisation of information provided by known community-based umbrella organisations (including the Social Development Commission (SDC) and the Municipal Corporation (MC) that have responsibility for overseeing community governance mechanisms and local planning). Consultations were conducted face-to-face and digitally to enable full participation and reduce the risk of exclusion.

The engagement process is iterative; thus, it is expected that additional stakeholders will be identified and engaged. The following stakeholder groups were identified (Table 5-22).

Information presented in subsequent sections provide an overview of the stakeholder consultations undertaken; methods and findings are detailed in the Stakeholder Engagement Plan (SEP).

5.5.2 Spanish Town Hospital

5.5.2.1 Internal Stakeholder Consultations

One survey instrument was received from the Spanish Town Hospital. It is acknowledged that one instrument may not comprehensively reflect the views of the hospital, however, the feedback from the hospital was poor despite numerous emails and telephone calls.

5.5.2.2 External Stakeholder Consultations

Stakeholder groups listed in Table 5-20 were identified. Consultations were held on September 30, 2021, and October 06, 2021, for approximately two hours each with internal and external stakeholders. Some 70 persons attended both meetings as direct users, local authorities, duty bearers, affected or interested parties, as well as representatives of the Client and the consultant team.

Table 5-20 Stakeholder Identification

#	Stakeholder Group	Characteristics	Interest
1.	In-patients	Users admitted to hospital for 1 or more nights	Maintenance and improvements in customary services
2.	Out-patients	Users of the hospital and 3 clinics/health centres	Maintenance and improvements in customary services
3.	Visitors and General users	Visitors to hospital patients	Due care in the management of increase traffic
4.	Transport Operators	Area is a major stop/loading point for public transportation. The main transport terminal is within the vicinity that facilitates private and public passenger vehicles and the major transport hub for St. Catherine	Management of traffic to reduce delays, mental anxiety, inconvenience, and economic displacement.
5.	Business community (Formal and Informal)	There are at three large shopping centres within the vicinity (less than 1KM) which facilitates businesses such as: restaurants, bank, pharmacy, supermarket, hardware, and Doctor's office. Within the area also gas station, police station, courthouse, correctional facility, sporting complex, library, schools.	Management of traffic to reduce delays, security risks and economic displacement.
6.	Project Affected Communities	The development area of Spanish Town has some 12 residential	Project area is generally congested. Main concerns were to manage the

#	Stakeholder Group	Characteristics	Interest
		<p>communities whose residents traverse the main thoroughfare to the project site.</p> <p>In addition, internal stakeholders and public users of the laboratory and the pharmacy are at risk of relocation during the construction phase.</p> <p>Doctors, Nurses, Administrative staff and their approximately 40 enrolled children aged three months to three years from 6.00 a.m. to 10.00 p.m. that are highly dependent on use of the childcare facility could face long-term displacement or relocation.</p>	<p>traffic flow to reduce delays, anxiety, economic displacement, nuisances, privacy. Control fugitive dust to reduce related health impacts of the sick, especially those with respiratory illnesses. Concerns raised about the lack of monitoring and enforcement of breaches of recommended mitigation measures.</p> <p>Maintenance of childcare facility on site or in proximity.</p> <p>Hospital management wants to maintain attendance, punctuality, and staff wellbeing.</p>
7.	Government of Jamaica	Regulatory and Local Authorities, Duty Bearers	<p>Direct impacts such as dust, noise and traffic are to be managed.</p> <p>Manage volatility of area.</p>

The project is accepted as being mostly beneficial and will have positive impacts. However, there are concerns that if the project is not managed according to the recommended mitigation measures there could be negative impacts on the project-affected communities during the construction phase. There are also concerns that the project sites rest within a normally congested, busy commercial area normally consisting of petrol station, restaurants, bank, pharmacy, supermarket, correctional facility, courthouse, police station, sporting complex, library, schools, and other medical facilities.—The summary of the findings are listed in Table 5-21.

Table 5-21 Summary of Findings

Priority Issues/Risks and Impacts	Recommendations/Mitigation/Requirements
<p>Dust</p> <p>a. Nuisance to general public</p> <p>b. Compounding illness of those with respiratory conditions</p>	<p>i. Regular use of water truck to reduce fugitive dust</p>
<p>Noise</p> <p>a. Nuisance to patients, especially elderly</p>	<p>i. Reduce use of heavy-duty equipment</p>
<p>Traffic</p> <p>a. Increased vehicular traffic</p> <p>b. Increased human traffic</p> <p>c. Economic displacement from delays</p> <p>d. Rerouting of vehicular and pedestrian traffic to narrower section of roadway and increasing walking distance for pedestrian. Conflict with right-of-way for ambulance/emergency vehicles and vehicle/pedestrian attempting to access Accident and Emergency Department</p>	<p>i. Traffic management plan to consider:</p> <ul style="list-style-type: none"> • Installation of construction and warning signs with adequate lead time • Training of traffic wardens to properly use signs • Utilisation of Police support during peak hours • Parking and entrances are to be reconfigured • .

Priority Issues/Risks and Impacts	Recommendations/Mitigation/Requirements
e. Main road normally congested	
Service Limitation/Disruption a. Absence of safe walkways and universal wheelchair access b. Pedestrian contact with emergency and other vehicles c. Lack of designated area for prisoners and members of the security forces	i. Establish walkway and improve general access especially for seniors, visually impaired and physically challenged ii. Service areas dedicated to children for increasing mental health and other problems iii. Telemedicine and digitisation of records iv.
Safety, Security and General Issues a. Extortion b. Risk to life/mortality c. Project area located in volatile area with prevalence of gangs known for extortion d. Closure of childcare facility will result in reduction of punctuality and increase in absenteeism that have remarkably improved since the 2018 installation of the facility	i. Construction of police post on site ii. Designate area for treatment of prisoners and members of the security forces iii. Childcare facility is preferably maintained onsite with consideration of use of area beside Ward 7 (now housing Covid patients) or the cottage across from A&E now used to store old items. Both area in need to extensive renovation and/or sanitisation. Alternatively, in proximity, for e.g., on Barnett Street or Burke Road to allow easy and quick access for staff going to and from work. iv. The new childcare facility needs to be equipped with learning aids to adequately prepare children for ECIs, additional changing areas, isolation rooms, storage rooms, outdoor equipment/green area for waiting and play, aftercare, maintenance of designs for various special need children, back up water and power supply. v. Ongoing communication with the childcare committee
Maintaining value for investments a. Lack of maintenance cause infrastructure to fail early and frequently reducing value of investment	i. Support for operational phase to ensure ongoing efforts for supervision and maintenance to protect investment and reduce instances of infrastructure falling into disrepair

5.5.3 St. Jago Park Health Centre

5.5.3.1 Internal Stakeholder Consultations

One survey instrument was received from the St. Jago Park Health Centre. It is acknowledged that one instrument may not comprehensively reflect the views of the health centre however, the feedback from the health centre was poor despite numerous emails and telephone calls.

5.5.3.2 External Stakeholder Consultations

Table 5-22 outlines the stakeholder groups identified. Consultations were held on September 30, 2021, and October 06, 2021, for approximately two hours each with internal and external stakeholders. Some 66 persons attended both meetings as direct users, local authorities, duty bearers, affected or interested parties, as well as representatives of the Client and the consultant team.

Table 5-22 Stakeholder Identification

#	Stakeholder Group	Characteristics	Interest
1.	Out-patients	Users of the 3 clinics	Maintenance and improvements in customary services
2.	General users	Users of the 3 clinics	Due care in the management of increase traffic
3.	Transport Operators	Area is a major stop/loading point for public transportation. The main transport terminal is within the vicinity that facilitates private and public passenger vehicles and the major transport hub for St. Catherine	Management of traffic to reduce delays, mental anxiety, inconvenience, and economic displacement.
4.	Business community (Formal and Informal)	There are at three large shopping centres within the vicinity (less than 1KM) which facilitates businesses such as: restaurants, bank, pharmacy, supermarket, hardware, and Doctor's office. Within the area also gas station, police station, courthouse, correctional facility, sporting complex, library, schools, hospital.	Management of traffic to reduce delays, security risks and economic displacement.
5.	Project Affected Communities	The development area of Spanish Town has some 12 residential communities whose residents traverse the main thoroughfare to the project site.	Project area is generally congested. Main concerns were to manage the traffic flow to reduce delays, anxiety, economic displacement, nuisances, privacy. Control fugitive dust to reduce related health impacts of the sick, especially those with respiratory illnesses. Concerns raised about the lack of monitoring and enforcement of breaches of recommended mitigation measures.
6.	Government of Jamaica	Regulatory and Local Authorities, Duty Bearers	Direct impacts such as dust, noise and traffic are to be managed. Preservation of the national heritage site that now houses administrative offices. Manage volatility of area.

The project is accepted as being mostly beneficial and will have positive impacts. However, there are concerns that if the project is not managed according to the recommended mitigation measures there could be negative impacts on the project-affected communities during the construction phase. There are also concerns that the project sites rest within a normally congested, busy commercial area normally consisting of petrol station, restaurants, bank, pharmacy, supermarket, correctional facility, courthouse, police station, sporting complex, library, schools, and other medical facilities, including an hospital (Table 5-23).

Table 5-23 Summary of Findings

Priority Issues/Risks and Impacts	Recommendations/Mitigation/Requirements
Dust c. Nuisance to general public d. Compounding illness of those with respiratory conditions	ii. Regular use of water truck to reduce fugitive dust
Noise b. Nuisance to patients, especially elderly	ii. Reduce use of heavy-duty equipment
Traffic f. Increased vehicular traffic g. Increased human traffic h. Economic displacement from delays.	ii. Traffic management plan to consider: <ul style="list-style-type: none"> • Installation of construction and warning signs with adequate lead time • Training of traffic wardens to properly use signs • Utilisation of Police support during peak hours
Service Limitation/Disruption d. Absence of safe walkways and universal wheelchair access e. Pedestrian contact with emergency and other vehicles	v. Establish walkway and improve general access especially for seniors, visually impaired and physically challenged vi. Service areas dedicated to children for increasing mental health and other problems vii. Telemedicine and digitisation of records
Safety, Security and General Issues e. Extortion f. Risk to life/mortality g. Project area located in volatile area with prevalence of gangs known for extortion	vi. Ongoing communication with the staff
Maintaining value for investments b. Lack of maintenance cause infrastructure to fail early and frequently reducing value of investment	ii. Support for operational phase to ensure ongoing efforts for supervision and maintenance to protect investment and reduce instances of infrastructure falling into disrepair

5.5.4 Old Harbour Health Centre

The stakeholder groups are shown in Table 5-24; the engagement process is iterative; thus, it is expected that additional stakeholders will be identified and engaged. Consultations were held on September 22, 2021, and September 30, 2021, for approximately two hours each with internal and external stakeholders. Some 76²⁶ persons attended both meetings as direct users, health centre staff, local authorities, duty bearers, affected or interested parties, inclusive of the media as well as representatives of the Client and the consultant team. These are shown in Table 5-24. A summary of the findings can be seen in Table 5-25.

²⁶ Possibility of double counting as some participants attended more than one meeting. All efforts made where identified to reduce instances of double counting.

Table 5-24 Stakeholder Identification Groups

#	Stakeholder Group	Characteristics	Interest
1.	Out-patients	Users of the 3 clinics	Maintenance and improvements in customary services
2.	General users	Users of the 3 clinics	Due care in the management of increase traffic
3.	Transport Operators		
4.	Business community (Formal and Informal)		Management of traffic to reduce delays and economic displacement.
5.	Project Affected Communities	Project site is situated with a major market and commercial district close to the post office, transport centre, market, and other commercial activities. Project site is bordered to the south by an informal settlement, Walker Road.	The residual impact of the construction of a perimeter fencing around facility is as the property was only used as a shortcut for Walker Road to enter East Street. Community has no objections to the closure as there will be no additional burden to use the official route. Community would want access to the basketball court and welcome its renovation. There is need for ongoing consultation with informal apiary operator that could be physically displaced. Concerns raised about the lack of monitoring and enforcement of breaches of recommended mitigation measures.
6.	Government of Jamaica (Regulatory and Local Authorities, Duty Bearers)		Old Harbour is second fastest growing community, next to Portmore. Adequate facilities to be in place to adequately service growing demands of the area and additional pressure to be put on health and educational facilities. The upgraded OHHC is expected to fill gaps in health care that schools will be unable to provide. Direct impacts such as dust, noise and traffic are to be managed.

Table 5-25 Summary of Findings

Priority Issues/Risks and Impacts	Recommendations/Mitigation
Dust	
Noise	
Traffic <ul style="list-style-type: none"> a. Increased vehicular traffic b. Increased human traffic 	<ul style="list-style-type: none"> i. Traffic management plan to consider: <ul style="list-style-type: none"> • Reopen Sharper Lane entrance to Highway 2000 to limit need for entering town centre • Widening of current East Street entrance to 2-lane • Additional entry to facility on Walker Road, south of the basketball court • Walkway for pedestrian traffic ii. Relook at capacity demand estimates as Lion's Club rent building that normally result in increased traffic and delays
Service Limitation <ul style="list-style-type: none"> a. Inadequate waiting area b. Inadequate parking facilities c. Absence of child dedicated services/facilities 	<ul style="list-style-type: none"> i. Expansion of planned 150-person waiting area as any given day, that number is exceeded. Overflow tents is an alternative

Priority Issues/Risks and Impacts	Recommendations/Mitigation
d. Absence of overnight facility or 24/7 operations e. Absence of ambulance services f. Possibility of unserved communities g. Absence of walkway	ii. Service areas dedicated to children for mental health, drug addiction, adolescent sexual health, trauma recovery and holding area iii. Consideration of sick bay to support growing school population iv. Plan for dedicated ambulance for facility v. Extend service hours if 24/7 not feasible/possible vi. Digitisation of records vii. Clarification of services area. Colbeck, Planter's Hall, Long Level, Content, Crawl Pen, Joe Ground, Bellas Gate, Brown's Hall, Marley Hill, Banister, Bay View Hill to be added to service area if not already included
Safety, Security and General Issues a. Limited access to water b. Lack of an emergency response plan	i. Water storage tank to be installed to meet increased demands ii. Emergency response plan to be developed factoring emergency evacuation iii.
Maintaining value for investments	i. Support for operational phase to ensure ongoing efforts for supervision and maintenance to protect investment and reduce instances of infrastructure falling into disrepair

5.5.5 Greater Portmore Health Centre

5.5.5.1 Internal Stakeholder Consultations

One survey instrument was received from the Greater Portmore Health Centre. It is acknowledged that one instrument may not comprehensively reflect the views of the health centre; however, the feedback from the health centre was poor despite numerous emails and telephone calls.

5.5.5.2 External Stakeholder Consultations

Stakeholder groups identified are outlined in Table 5-26. Consultations were held on September 30, 2021, and October 06, 2021, for approximately two hours each with internal and external stakeholders. Some 88 persons attended both meetings as direct users, local authorities, duty bearers, affected or interested parties, as well as representatives of the Client and the consultant team.

Table 5-26 Stakeholder group identification, characteristics and interests

#	Stakeholder Group	Characteristics	Interest
1.	Out-patients	Users of the 3 clinics	Maintenance and improvements in customary services
2.	General users	Users of the 3 clinics	Due care in the management of increase traffic
3.	Transport Operators	Area is a major stop/loading point for public transportation.	Management of traffic to reduce delays and economic displacement.

#	Stakeholder Group	Characteristics	Interest
		There is also Jamaica Urban Transit Company (JUTC) terminal within the vicinity	
4.	Business community (Formal and Informal)	There is a shopping centre within the vicinity which facilitates businesses such as: restaurants, water refilling store, pharmacy, supermarket, and Doctor's office.	Management of traffic to reduce delays and economic displacement.
5.	Project Affected Communities	Project site is situated in the middle of the 4 West and 5 West communities of Greater Portmore. There are also sensitive operations in the vicinity such as the courthouse, school, and library. Vehicles are parked along narrow roadway due to absence of space within yards.	<p>Increase in behavioural and mental health problem is a concern to schools and community leaders.</p> <p>The football field and shortcut that falls within the footprint of the new construction will have limited impact. The area was used informally by the 4W and 5W communities. An existing alternative football field serves the community.</p> <p>Community remains fully aware of works based on prior sensitisation by the Portmore Municipal Council (PMC). While they expect some inconvenience, all efforts to maintain privacy and reduce noise, dust, and traffic nuisances are expected.</p> <p>Concerns raised about the lack of monitoring and enforcement of breaches of recommended mitigation measures. Community has prior experience of mitigation measures being ignored.</p> <p>Cumulative impacts to be considered and managed with the presence of the courthouse, shopping centre, library, performing arts junior centre, construction at the Greater Portmore Police Station and Country Clubs 1 and 2.</p>
6.	Government of Jamaica (Regulatory and Local Authorities, Duty Bearers)		<p>Direct impacts such as dust, noise and traffic are to be managed.</p> <p>The PMC is supportive of the project and commits to the approval of the application process once the requisite prior approvals of the National Environment and Planning Agency (NEPA), Ministry of Health and Wellness (MOHW) and the Jamaica Fire Brigade (JFB) is received.</p>

The project is accepted as being mostly beneficial and will have positive impacts. However, there are concerns that if the project is not managed according to the recommended mitigation measures there could be negative impacts on the project-affected communities during the construction phase. There are also concerns about cumulative impacts arising from other construction projects in the area, the proximity of the business district, the courthouse, library and performing arts centre.

Table 5-27 Summary of findings from meetings

Priority Issues/Risks and Impacts	Recommendations/Mitigation
Dust	<ul style="list-style-type: none"> i. Regular use of water truck to reduce fugitive dust ii.
Noise <ul style="list-style-type: none"> a. Disturbance of court proceedings and library operations 	<ul style="list-style-type: none"> i. Consultation with Court Management Services (CMS) to schedule works and presence of heavy-duty equipment around court days ii. Schedule works from 7.00 a.m. to 4.00 p.m.
Traffic <ul style="list-style-type: none"> a. Increased vehicular traffic b. Increased human traffic 	<ul style="list-style-type: none"> i. Traffic management plan to consider: <ul style="list-style-type: none"> • Installation of construction and warning signs with adequate lead time • Training of traffic wardens to properly use signs • Utilisation of Police support during peak hours • Use the round-a-bout then first left (at East Mid Street) for traversing of heavy-duty equipment • Improve driveway of health centre for easy and safe access of vehicular traffic, emergency vehicles (ambulance, fire truck), etc.
Service Limitation <ul style="list-style-type: none"> a. Inadequate waiting area b. Inadequate parking facilities c. Absence of child dedicated services/facilities d. Absence of overnight facility or 24/7 operations e. Absence of ambulance services f. Possibility of unserved communities g. Lack of sanitary food facility h. Absence of safe walkways and wheelchair access 	<ul style="list-style-type: none"> i. Proposed parking for 30 vehicles to be increased ii. Establish walkway and improve general access especially for seniors, visually impaired and physically challenged iii. Service areas dedicated to children for increasing mental health and other problems iv. Dedicated paediatric service area v. Plan for dedicated ambulance for facility vi. Extend service hours if 24/7 not feasible/possible vii. Consideration for stop over, late night and overnight admissions in lieu of promised hospital viii. Telemedicine and digitisation of records ix. Clarification of services area. Portmore Pines (political boundaries), and Silverstone to be added to service area if not already included x. Expanded covered waiting area for overflow xi. Establish formal, sanitary food vending area xii. Adequate seating for the protection of privacy
Safety, Security and General Issues <ul style="list-style-type: none"> a. Presence of sewage in drainpipes in the event of heavy rains b. Main drain and earth drain by courthouse waterlogged c. Loss of privacy d. Improper intake and control of human traffic e. Improper draining limits water runoff and tendency to wait for evaporation leads to increase mosquito population 	<ul style="list-style-type: none"> i. Install perimeter fencing to control traffic and proper management of pace ii. Separate staff entrance from public entrance to manage intake and facilitate equity of service from one controlled public entrance iii. Establish green space at project site as part of environmental planning iv. Institute privacy protection for community in the design
Maintaining value for investments	<ul style="list-style-type: none"> i. Support for operational phase to ensure ongoing efforts for supervision and maintenance to protect investment and reduce instances of infrastructure falling into disrepair

5.6 POTENTIAL SOCIAL LIABILITIES

5.6.1 Revised Project Scope

The initial scope of the project included the rehabilitation and upgrade of 13 health facilities in the parishes of St. Catherine, St. Ann and Clarendon. This has since changed and will now be focusing on the St. Catherine facilities (STH, SJHC, OHHC and GPHC). There is a need to inform the stakeholders of all parishes about this change. Stakeholder community consultations will be conducted to inform stakeholders and to solicit feedback from stakeholders.

5.6.2 Facility-Specific Considerations

5.6.2.1 Spanish Town Hospital and St. Jago Park Health Centre

Vendors located along Burke Road in the vicinity of the proposed main entrance will have to be permanently relocated, therefore, a Livelihood Restoration Plan will be developed.

A survey of the vendors that could potentially be impacted at the proposed new main entrance for the Spanish Town Hospital facility was conducted. Seven (7) vendor stalls would potentially be impacted by the proposed project. Six (6) of these vendor stalls sell snacks, beverages, toiletries and one (1) vendor stall sells fruits. On average, the stalls selling the snacks/beverages/toiletries earn approximately J\$7000.00 per day, while the fruit vendor's stall earns \$12,000.00 per day. These vendors work Monday to Friday (5 days a week), but do not work on the fourth Friday of each month because this is not a "clinic day" (at the St. Jago Park Health Centre).

There will be no displacement of residences or informal settlements within the project environs.

5.6.2.2 Old Harbour Health Centre

There are approximately 26 boxes of bees located at the southwestern corner of the proposed property which will have to be removed to facilitate the development. Assuming the best case, each box can give 2-3 harvest per year and each harvest can produce between 10-15 gallons of honey. Using the higher numbers then each box can potentially produce 45 gallons of honey over the year. With 26 boxes it is estimated that the apiary produces approximately 1,170 gallons over a year. At approximately JAD50,000.00 / 5 gal, then potentially the apiary could earn JMD\$11,700,000.00. (These figures are current market rates (February 2023) and are likely to change with inflation and currency fluctuation). The cost to replace 1 bee box with bees is approximately JMD\$25,000.00 and is subject to availability (bee and materials).

The Lion's Club Civic Centre located toward the north of the property, will have services affected during construction activities. The Lion's Club of Old Harbour has permitted the Ecclesia Family Ministry to utilize the Lion's Civic Centre for a period of six (6) months. This period commenced on December 1, 2022 and will conclude on May 31, 2023 (Figure 5-24). The facility is used as a church three times per week.

The proposed site is used by residents in the area as a shortcut from Walker Road to enter East Street. However, based on community meetings, residents present have no issues using the official route. There will be no displacement of residences or informal settlements located to the south of the proposed project site (Figure 5-25).

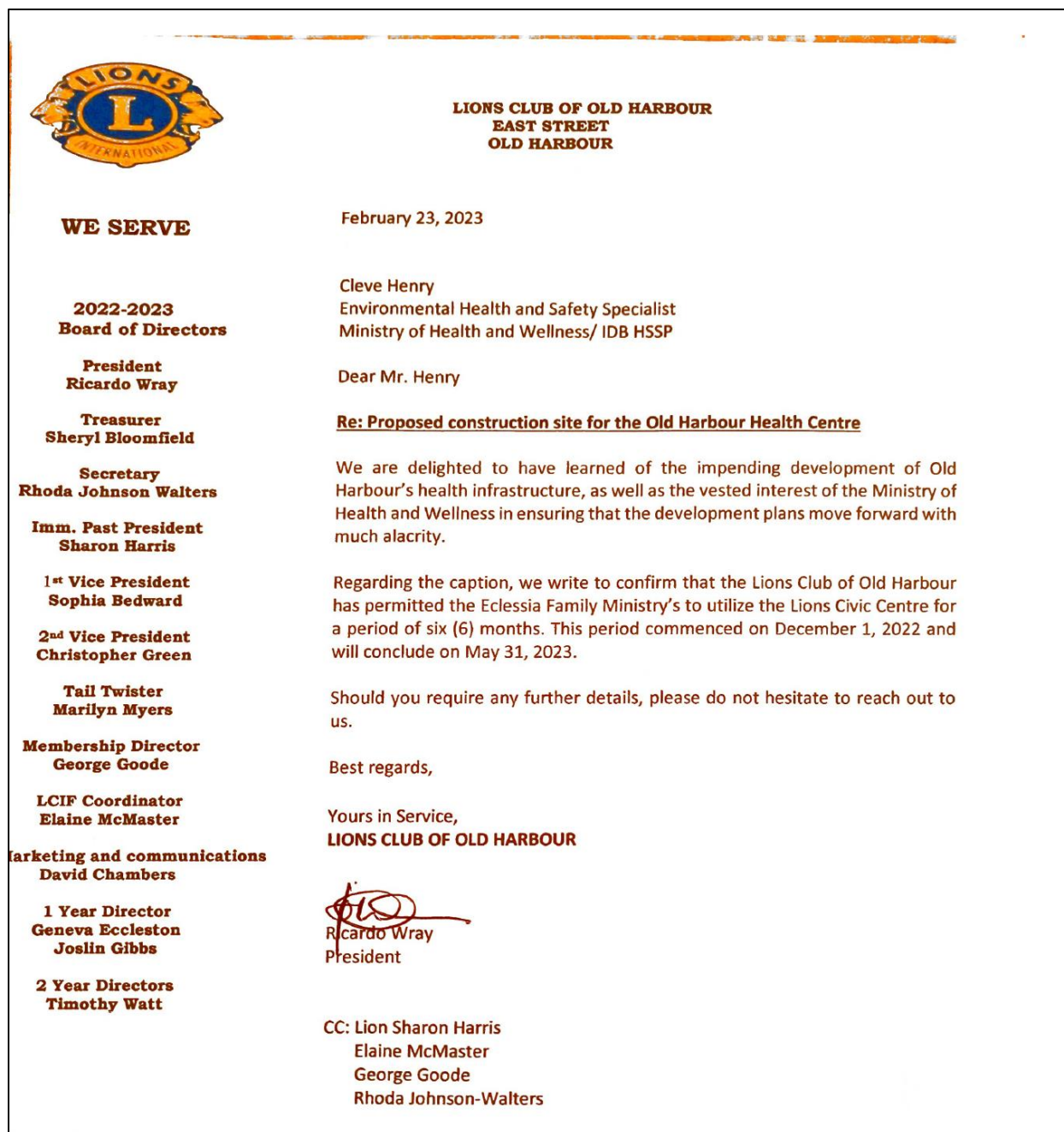


Figure 5-24 Letter from the Lion's Club of Old Harbour



Figure 5-25 Informal Settlement located to the south of the proposed project area

5.6.2.3 Greater Portmore Health Centre

The proposed project footprint is situated on current field that is used by local community as a football playground. The area was used informally by the 4 West and 5 West communities. It is recommended to relocate the football playground to an appropriate adjacent area.

There will be no displacement of residences or informal settlements within the project environs.

6.0 ENVIRONMENTAL AND SOCIAL IMPACTS AND RECOMMENDED MITIGATION

6.1 ENVIRONMENTAL AND SOCIAL RISK AND IMPACTS MATRIX APPROACH

Impact matrices for the site preparation/construction and operational phases for each of the four facilities, were created. Each impact was assessed based on the following criteria, as indicated within each matrix and are grouped as Physical, Biological and Human/Social. (Ogola, 2007):

- **Direction:** - This describes the nature of the potential impact. It can either be positive, negative or no impact of a particular activity (none).
- **Duration:** Environmental impacts have a temporal dimension and needs to be considered in an EIA. Impacts arising at different phases of the project cycle may need to be considered. See Table 6-1 for ranking technique utilised.
- **Magnitude:** This is defined by the severity of each potential impact and indicates whether the impact is irreversible or reversible and estimated potential rate of recovery. The magnitude of an impact cannot be considered large/high if the impact can be successfully mitigated. See Table 6-1 for ranking technique utilised.
- **Extent:** The spatial extent or the zone of influence of the impact should always be determined. An impact can be site-specific and limited to the project area and also within the locality of the proposed project; a regional impact that may extend beyond the local area; and a national impact affecting resources on a national scale which may also in some cases be trans-boundary (international). See Table 6-1 for ranking technique utilised.

It should be noted that the following were also taken into consideration during impact analysis:

- The Consultants' experience,
- Documented impacts from similar projects,
- The data collected,
- Analysis of the processes in the proposed project,
- Information generated from models,
- Concerns raised from stakeholders in the social surveys; and
- Discussions held among the EIA Study team.

Table 6-1 Ranking criteria utilised for duration, magnitude and extent of each potential impact

DURATION	None (N) – No temporal effect	Short (S) - Impacts lasting 0 – 10 years before recovery occurs. Impact does not persist after the activity ends.	Medium (M) - Impacts lasting 10 - 20 years before signs of recovery. Impacts on biological populations are not inter-generational.	Long (L) - Impacts are persistent and lasting over 20 years. Impacts on biological populations are over several recruitment cycles or generations of those populations.
MAGNITUDE	None (N) - No measurable change in availability of resources or function of systems. No measurable effect on people.	Small (S) - Changes in form and/or ecosystem function and/or a resource. The system maintains the ability to support ecosystem/ resource functions with only minor changes in community value and no overall loss/gain and is reversible. Only a small fraction of the local community is affected.	Medium (M) - Changes in form and/or ecosystem function and/or a resource. The system's ability to support ecosystem/ resource functions and economic benefit is affected but not lost and is reversible. Only a moderate fraction of the local community is affected.	Large (L) - Changes in form and/or ecosystem function and/or a resource. The system's ability to support ecosystem/resource functions and economic benefit is highly affected and irreversible. A large fraction of the local community is affected.
EXTENT	None – No spatial effect	Local (L) - Isolated effects within project site and its locality.	Regional (R) – Extended beyond local area/borders or offsite dispersion pathways.	National (N) - Widespread effect affecting the nation (and/or transboundary/international)

6.2 SITE PREPARATION AND CONSTRUCTION PHASE

6.2.1 Impact Matrices

Table 6-2 to Table 6-5 detail the impact matrices for the site preparation/construction phases for each of the four facilities.

Table 6-2 Environmental and Social impact matrix for site preparation and construction phase at Spanish Town Hospital

Categories highlighted in grey are deemed significant.

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Noise	Noise nuisance from demolition and construction activity on surrounding sections of hospital	X				X	S	S	L
	Air Quality- PM10 Particulates	Dust nuisance from transportation of raw material and construction/demolition activities on surrounding sections of hospital communities and environs	X				X	S	S	L
		Fugitive dust effect on construction workers and residential communities	X				X	S	S	L
		Fugitive dust effect on Staff residences at north-western boundary	X				X	S	M	L
	Air Quality – Asbestos Containing Building Material	Demolition activities may involve the disturbance of ACBM in buildings and areas to be demolished.	X				X	S	M	L
	Vibration	Impact on Customer Service, Accounts and Human Resources Building	X				X	S	S	L
		Impact on occupants of Customer Service, Accounts and Human Resources Building	X				X	S	S	L
		Impact on Existing St. Jago Park Health Centre	X				X	S	S	L
		Impact on occupants of Existing St. Jago Park Health Centre	X				X	S	S	L
		Impact on Diagnostic and Imaging Building	X				X	S	S	L
		Impact on occupants of Diagnostic and Imaging Building	X				X	S	S	L
		Impact on Female and Male Surgical Building	X				X	S	S	L
		Impact on occupants of Female and Male Surgical Building	X				X	S	S	L
		Impact on Temporary Lab				X				
		Impact on occupants of the Temporary Lab	X				X	S	S	L
	Soil and Water Pollution	Sedimentation of Rio Cobre	X				X	S	M	R
		Pollution from fuel, lubricants, hazardous substances from construction equipment	X				X	S	M	R
	Seismic Hazard	Spanish Town Hospital Site is in a moderately high seismicity zone. The low RVS scoring is attributed to the quantity of vertical irregularities and the soil type being classified as a soil type E and are further worsened by the building having more than 3 storeys.		X			X	S	M	L
	Landslide Hazard	Spanish Town Hospital area is slightly vulnerable to landslides		X			X	S	S	L
	Soil Loss and Erosion	The predicted soil loss for the Spanish Town Hospital was low, particularly due to the proposed rehabilitation for facility will be in an already developed location		X			X	S	S	L
	Hydrology and Flood Plain	Neither the newly proposed project features nor main access routes have a considerable risk of flooding during extreme storm events.				X				
	Green Procurement and Enhancement Measures	Earth materials used for filling and other construction uses should be sourced from licenced quarry operators. Ensure equipment and parts are acquired from reputable sources		X	X			S	S	L
	Solid Waste	Increased generation of solid waste	X				X	S	S	L
	Wastewater	Contamination of soil and groundwater from accidental spillage of portable toilets		X			X	S	S	L
Biological	Flora and Fauna	Fruit trees and older trees and their associated fauna will have to be removed for project construction	X				X	L	S	L
	Vectors	Increase in number of vectors and vector breeding sites from increased waste generation		X			X	S	M	L
	Freshwater Ecosystem	Sedimentation and/or reduced water quality of the Rio Cobre may affect floral and faunal habitats therein		X			X	S	S	R
Heritage	Archaeological and Historical Assets	The archaeological and historical assets identified within and around the area are significant however there may be other vestiges that are of equal significance that have not been identified.				X				
Human/Social	Employment	Creation of direct, indirect and induced jobs	X	X	X			S	M	N
	Vending and Food Hygiene	Illnesses resulting from improper food handling practices		X			X	S	M	R
		Negative visual effect on area		X			X	S	S	L
	Health and Safety	Potential for accidental injury of construction workers, hospital staff, patients and visitors		X			X	S	L	L
		Fugitive Dust effect on health of construction workers, hospital staff, patients and visitors		X			X	S	M	L

CATEGORY	IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
		DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
	Staff and patients may become ill or have accidents. In addition, disasters such as earthquakes, floods and fires and other hazards are real possibilities.		X			X	S	L	N
Security	Increased security risk from increased number of persons on hospital grounds		X			X	S	M	L
Transportation and Traffic	Effect on traffic travelling on main road	X				X	S	S	L
	Effect of overweight vehicles on road surface	X				X	S	S	R
Aesthetics	Decreased aesthetic appeal		X			X	S	S	L
	Trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing.		X			X	S	S	L
Stakeholders	Disruption and/or loss of services, reduced capacity of staff and services and increased wait times		X			X	S	M	L
	Increased impact and inconvenience for persons with disabilities and special needs		X			X	S	M	L
	Vendors located along Burke Road in the vicinity of the proposed main entrance will be impacted and dislocated from this area.	X				X	L	M	R
Infrastructure	Infrastructure within the project footprint may be impacted		X			X	S	S	L

Table 6-3 Environmental and Social impact matrix for site preparation and construction phase at St. Jago Park Health Centre

Categories highlighted in grey are deemed significant.

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Noise	Noise nuisance from construction activity on surrounding sections of health centre	X				X	S	S	L
	Air Quality- PM10 Particulates	Dust nuisance from transportation of raw material and construction activities on existing health centre and Spanish Town hospital and environs	X				X	S	S	L
		Fugitive dust effect on construction workers and residential communities	X				X	S	S	L
		Fugitive dust effect on Staff residences at north-western boundary	X				X	S	S	L
	Vibration	Impact on existing health centre building	X				X	S	M	L
		Impact on occupants of existing health centre building	X				X	S	S	L
	Soil and Water Pollution	Sedimentation of Rio Cobre	X				X	S	M	R
		Pollution from fuel, lubricants, hazardous substances from construction equipment	X				X	S	M	R
	Seismic Hazard	St. Jago Health Park Centre is in a moderately high seismicity zone. An improved RVS Scoring above 3, would imply only negligible to no structural damage. This would entail only fine cracks in plaster and partitions.		X			X	S	S	L
	Landslide Hazard	The St. Jago Health Centre area was determined to have low susceptibility to landslides.		X			X	S	S	L
	Soil Loss and Erosion	The predicted soil loss for the health centre was low, particularly due to the proposed rehabilitation for facility will be in an already developed location		X			X	S	S	L
	Hydrology and Flood Plain	Neither the newly proposed project features nor main access routes have a considerable risk of flooding during extreme storm events.				X				
	Green Procurement and Enhancement Measures	Earth materials used for filling and other construction uses should be sourced from licenced quarry operators. Ensure equipment and parts are acquired from reputable sources		X	X			S	S	L
	Solid Waste	Increased generation of solid waste	X				X	S	S	L
Biological	Wastewater	Contamination of soil and groundwater from accidental spillage of portable toilets		X			X	S	S	L
	Fauna	Displacement of some bird species observed	X				X	L	S	L
	Vectors	Increase in number of vectors and vector breeding sites from increased waste generation		X			X	S	M	L
	Freshwater Ecosystem	Sedimentation and/or reduced water quality of the Rio Cobre may affect floral and faunal habitats therein		X			X	S	S	R
Heritage	Archaeological and Historical Assets	The archaeological and historical assets identified within and around the area are significant however there may be other vestiges that are of equal significance that have not been identified.				X				
Human/Social	Employment	Creation of direct, indirect, and induced jobs	X	X	X			S	M	N
	Vending and Food Hygiene	Illnesses resulting from improper food handling practices		X			X	S	M	R
		Negative visual effect on area		X			X	S	S	L
	Health and Safety	Potential for accidental injury of construction workers, staff, patients, and visitors		X			X	S	L	L
		Fugitive Dust effect on health of construction workers, staff, patients, and visitors		X			X	S	M	L
		Staff and patients may become ill or have accidents. In addition, disasters such as earthquakes, floods and fires and other hazards are real possibilities.		X			X	S	L	N
	Security	Increased security risk from increased number of persons on hospital grounds		X			X	S	M	L
	Transportation and Traffic	Effect on traffic travelling on main road	X				X	S	S	L
		Effect of overweight vehicles on road surface	X				X	S	S	R
	Aesthetics	Decreased aesthetic appeal		X			X	S	S	L
		Trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing.		X			X	S	S	L
	Stakeholders	Vendors located along Burke Road in the vicinity of the proposed main entrance will be impacted and dislocated from this area.	X				X	L	M	R
	Infrastructure	Infrastructure within the project footprint may be impacted		X			X	S	S	L

Table 6-4 Environmental and Social impact matrix for site preparation and construction phase at Old Harbour Health Centre

Categories highlighted in grey are deemed significant.

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Noise	Noise nuisance from construction activity on surrounding commercial area	X				X	S	S	L
	Air Quality- PM10 Particulates	Dust nuisance from transportation of raw material and construction activities on surrounding commercial area	X				X	S	S	L
		Fugitive dust effect on construction workers and residential communities	X				X	S	S	L
		Fugitive dust effect on surrounding commercial area	X				X	S	S	L
	Vibration	Impact on Private Business (west) and Courts Jamaica (east)	X				X	S	S	L
		Impact on occupants of Private Business (west) and Courts Jamaica (east)	X				X	S	S	L
	Soil and Groundwater Pollution	Pollution from fuel, lubricants, hazardous substances from construction equipment	X				X	S	M	R
	Seismic Hazard	The proposed Old Harbour Health Centre is in a moderately high seismicity zone. The implication is that there will be a direct improvement in seismic performance and reduction in collapsibility probability and general risk to life and property if the proposed structure is implemented.		X			X	S	S	L
	Landslide Hazard	The proposed Old Harbour Health Centre was determined to have low susceptibility to landslides.		X			X	S	S	L
	Soil Loss and Erosion	The predicted soil loss for the health centre was low, particularly due to the proposed rehabilitation for facility will be in an already developed location		X			X	S	S	L
	Hydrology and Flood Plain	The project site and the main access routes to the facility along the Old Harbour Road have a considerable risk of flooding during extreme storm events.	X				X	S	M	L
	Green Procurement and Enhancement Measures	Earth materials used for filling and other construction uses should be sourced from licenced quarry operators. Ensure equipment and parts are acquired from reputable sources		X	X			S	S	L
	Solid Waste	Increased generation of solid waste	X				X	S	S	L
Biological	Wastewater	Contamination of soil and groundwater from accidental spillage of portable toilets		X			X	S	S	L
	Flora and Fauna	Flora and fauna on site are expected to be impacted	X				X	L	S	L
Heritage	Archaeological and Historical Assets	The archaeological and historical assets identified within and around the area are significant however there may be other vestiges that are of equal significance that have not been identified.				X				
Human/Social	Employment	Creation of direct, indirect, and induced jobs	X	X	X			S	M	N
	Vending and Food Hygiene	Illnesses resulting from improper food handling practices		X			X	S	M	R
		Negative visual effect on area		X			X	S	S	L
	Health and Safety	Potential for accidental injury of construction workers and pedestrians		X			X	S	L	L
		Fugitive Dust effect on health of construction workers and pedestrians		X			X	S	M	L
		Workers may become ill or have accidents. In addition, disasters such as earthquakes, floods and fires and other hazards are real possibilities.		X			X	S	L	N
	Security	Increased security risk to surrounding area from increased number of persons on site		X			X	S	M	L
	Transportation and Traffic	Effect on traffic travelling on main road	X				X	S	M	L
		Effect of overweight vehicles on road surface	X				X	S	S	R
		Accumulation of traffic (due to the width of the construction entrance road being too small) poses a safety issue for vehicles trying to exit the site in the case of an emergency.	X				X	S	S	L
	Aesthetics	Decreased aesthetic appeal		X			X	S	S	L
		Trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing.		X			X	S	S	L
	Stakeholders	Access to the property west of the proposed project site will be affected by construction activity.	X				X	L	S	L
	Apiary	Informal apiary southwest of the project site which will be affected by construction.	X				X	L	M	L

Table 6-5 Environmental and Social impact matrix for site preparation and construction phase at Greater Portmore Health Centre

Categories highlighted in grey are deemed significant.

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Noise	Noise nuisance from construction activity on surrounding sections of health centre	X				X	S	S	L
	Air Quality- PM10 Particulates	Dust nuisance from transportation of raw material and construction activities on existing health centre and environs	X				X	S	S	L
		Fugitive dust effect on construction workers and residential communities	X				X	S	S	L
	Vibration	Impact on existing health centre building	X			X				
		Impact on occupants of existing health centre building	X				X	S	S	L
	Soil and Ground Water Pollution	Pollution from fuel, lubricants, hazardous substances from construction equipment	X				X	S	M	R
	Seismic Hazard	The Greater Portmore Health Centre Site is in a moderately high seismicity zone. Based on the RVS scoring, the proposed site receives a scoring of 3.2 which would indicate only negligible to slight structural damage. This would entail only fine cracks in plaster over frame members or in walls at the base, and also in partitions and infills.		X			X	S	S	L
	Landslide Hazard	The Greater Portmore Health Centre Site was determined to have low susceptibility to landslides.		X			X	S	S	L
	Soil Loss and Erosion	The predicted soil loss for the health centre was low, particularly due to the proposed rehabilitation for facility will be in an already developed location		X			X	S	S	L
	Hydrology and Flood Plain	Neither the newly proposed project features nor main access routes have a considerable risk of flooding during extreme storm events.				X				
	Green Procurement and Enhancement Measures	Earth materials used for filling and other construction uses should be sourced from licenced quarry operators. Ensure equipment and parts are acquired from reputable sources		X	X			S	S	L
	Solid Waste	Increased generation of solid waste	X				X	S	S	L
Biological	Wastewater	Contamination of soil and groundwater from accidental spillage of portable toilets		X			X	S	S	L
	Flora	Species loss via land clearance for construction	X				X	L	S	L
Heritage	Vectors	Increase in number of vectors and vector breeding sites from increased waste generation		X			X	S	M	L
	Archaeological and Historical Assets	Although no historical or architectural features were identified in Greater Portmore, these areas were pastureland and sugar cane fields while it was known as Reid's Pen and Great Salt Pond Pen.				X				
Human/Social	Employment	Creation of direct, indirect, and induced jobs	X	X	X			S	M	N
	Vending and Food Hygiene	Illnesses resulting from improper food handling practices		X			X	S	M	R
		Negative visual effect on area		X			X	S	S	L
	Health and Safety	Potential for accidental injury of construction workers, staff, patients, and visitors		X			X	S	L	L
		Fugitive Dust effect on health of construction workers, staff, patients, and visitors		X			X	S	M	L
		Staff and patients may become ill or have accidents. In addition, disasters such as earthquakes, floods and fires and other hazards are real possibilities.		X			X	S	L	N
		Increased security risk from increased number of persons on property grounds		X			X	S	M	L
	Security	Effect on traffic travelling on main road	X				X	S	S	L
		Effect of overweight vehicles on road surface	X				X	S	S	R
	Transportation and Traffic	Decreased aesthetic appeal		X			X	S	S	L
		Trucks leaving the construction site have the potential to deposit marl and mud onto the main road, making the main road aesthetically unappealing.		X			X	S	S	L

6.2.2 Environmental Risk and Impact Analysis

6.2.2.1 Environmental Risks and Impact Tables

Table 6-6 Summary of Potential Site Preparation and Construction Phase Environmental Impacts for Spanish Town Hospital

No.	Impact Category	Type of Risk and Impact
1	Noise	Direct, Negative, short-term, low impact, localized (project boundary)
2	PM10 Particulates	Direct, Negative, short-term, low-medium impact, localized (project boundary)
3	ACBM Emissions	Direct, Negative, short-term, low-medium impact, localized (project boundary)
4	Vibration	Direct, Negative, short-term, low impact, localized (project boundary)
5	Soil and Water Pollution	Direct, Negative, short-term, medium impact, regional (inter parish)
6	Seismic Hazard	Indirect, Negative, short-term, medium impact, localized (project boundary)
7	Landslide Hazard	Indirect, Negative, short-term, low impact, localized (project boundary)
8	Soil Loss and Erosion	Indirect, Negative, short-term, low impact, localized (project boundary)
9	Hydrology and Flooding	No Impact
10	Green Procurement and Enhancement Measures	Indirect, Positive, short-term, low impact, localized (project boundary)
11	Solid Waste	Direct, Negative, short-term, low impact, localized (project boundary)
12	Wastewater	Indirect, Negative, short-term, low impact, localized (project boundary)
13	Flora and Fauna	Direct, Negative, long-term, low impact, localized (project boundary)
14	Vectors	Indirect, Negative, short-term, medium impact, localized (project boundary)
15	Freshwater Ecosystem	Indirect, Negative, short-term, low impact, regional (inter parish)

Table 6-7 Summary of Potential Site Preparation and Construction Phase Environmental Impacts for St. Jago Health Centre

No.	Impact Category	Type of Risk and Impact
1	Noise	Direct, Negative, short-term, low impact, localized (project boundary)
2	PM10 Particulates	Direct, Negative, short-term, low-medium impact, localized (project boundary)
3	Vibration	Direct, Negative, short-term, low-medium impact, localized (project boundary)
4	Soil and Water Pollution	Direct, Negative, short-term, medium impact, regional (inter parish)
5	Seismic Hazard	Indirect, Negative, short-term, medium impact, localized (project boundary)
6	Landslide Hazard	Indirect, Negative, short-term, low impact, localized (project boundary)
7	Soil Loss and Erosion	Indirect, Negative, short-term, low impact, localized (project boundary)
8	Hydrology and Flooding	No Impact

9	Green Procurement and Enhancement Measures	Indirect, Positive, short-term, low impact, localized (project boundary)
10	Solid Waste	Direct, Negative, short-term, low impact, localized (project boundary)
11	Wastewater	Indirect, Negative, short-term, low impact, localized (project boundary)
12	Flora and Fauna	Direct, Negative, long-term, low impact, localized (project boundary)
13	Vectors	Indirect, Negative, short-term, medium impact, localized (project boundary)
14	Freshwater Ecosystem	Indirect, Negative, short-term, low impact, regional (inter parish)

Table 6-8 Summary of Potential Site Preparation and Construction Phase Environmental Impacts for Old Harbour Centre

No.	Impact Category	Type of Risk and Impact
1	Noise	Direct, Negative, Short term, low impact, Localized (project boundaries and surrounding communities)
2	Air Quality- PM10 Particulates	Direct, Negative, short-term, low-medium impact, localized (project boundary)
3	Vibration	Direct Negative, short-term, low impact, localized (project boundary and surrounding communities)
4	Soil and Ground Water Pollution	Direct, Negative, short-term, medium impact, Reginal (Inter-parish)
5	Seismic Hazard	Indirect, Negative, short-term, medium impact, Reginal (intra parish)
6	Landslide Hazard	Indirect, Negative, short-term, medium impact, Reginal (intra parish)
7	Soil Loss and Erosion	Indirect, Negative, short-term, low impact, widespread (inter parish)
8	Hydrology and Flood Plain	Direct, Negative, Short term, medium impact, localized
9	Green Procurement and Enhancement Measures	Indirect, Positive, short-term, low impact, localized (project boundary)
10	Solid Waste	Direct, Negative, short-term, low-medium impact, localized (project boundary)
11	Wastewater	Indirect, Negative, short-term, low impact, Localized
12	Flora	Direct, Negative, Long-term, low impact, localized (project boundary)

Table 6-9 Summary of Potential Site Preparation and Construction Phase Environmental Impacts for Greater Portmore Health Centre

No.	Impact Category	Type of Risk and Impact
1	Noise	Direct Negative, short-term, low impact, localized (project boundary)
2	Air Quality- PM10 Particulates	Direct, Negative, short-term, low-medium impact, localized (project boundary)
3	Vibration	Direct Negative, short-term, low impact, localized (project boundary)
4	Soil and Ground Water Pollution	Direct, Negative, short-term, medium impact, widespread (intra parish)
5	Seismic Hazard	Indirect, Negative, short-term, medium impact, widespread (intra parish)
6	Landslide Hazard	Indirect, Negative, short-term, low impact, widespread (inter parish)

7	Soil Loss and Erosion	Indirect, Negative, short-term, low impact, widespread (inter parish)
8	Hydrology and Flood Plain	No Impact
9	Green Procurement and Enhancement Measures	Direct, Positive, short-term, low impact, localized (project boundary)
10	Solid Waste	Direct, Negative, short-term, low-medium impact, localized (project boundary)
11	Wastewater	Indirect, Negative, short-term, low impact, widespread (inter parish)
12	Flora	Direct, Negative, short-term, low impact, localized (project boundary)
13	Vectors	Indirect, Negative, short-term, low-medium, localized (project boundary)

6.2.2.2 Potential Negative Risks and Impacts

Noise

Site clearance, construction and demolition necessitates the use of heavy equipment to carry out the job, including bulldozers, backhoes, jackhammers, etc. These activities and required equipment possess the potential to have a direct negative impact on the noise climate. Construction noise can result in short-term impacts of varying duration and magnitude. The construction noise levels are a function of the scale of the project, the phase of the construction, the condition of the equipment and its operating cycles, the number of pieces of construction equipment operating concurrently. Trucks traversing the site via site access roads will have a noise impact on buildings/areas adjacent to these access roads.

RECOMMENDED MITIGATION

- i. Use equipment that has low noise emissions as stated by the manufacturers.
- ii. Use equipment that is properly fitted with noise reduction devices such as mufflers.
- iii. Operate noise-generating equipment during regular working hours (e.g., 7 am – 7 pm) to reduce the potential of creating a noise nuisance during the night.
- iv. Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is workers operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use earmuffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.
- v. Where necessary, use vibratory pile drivers instead of impact pile drivers to lessen the noise impact on surrounding environs.
- vi. Scheduling and phasing of construction work to minimise the operation of noisy equipment working simultaneously.
- vii. Consultation with Stakeholders to inform them of the work schedule and activities and to get their feedback.
- viii. No unnecessary revving of truck engines nor honking of horns nor use of engine brakes whilst on site or driving along site access roads.

Particulates (PM10)

Site preparation comprises various activities such as excavation and land clearing (digging, loading and removal of material by trucks), as well as the storage of raw materials (for example sand and marl) that may potentially have a two-fold direct negative impact on air quality. The first impact is air pollution generated from the construction equipment and transportation of materials. The second is fugitive dust from the proposed demolition and construction areas and raw materials stored on or transported to site (potential for materials to become airborne). Fugitive dust has the potential to affect the health of construction workers, the resident population and the vegetation.

RECOMMENDED MITIGATION

- i. Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.
- ii. Minimize cleared areas to those that are needed to be used.
- iii. Cover or wet construction materials such as marl to prevent a dust nuisance.
- iv. Trucks transporting materials to and from site should be covered to prevent dusting and spillage onto roadway.
- v. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.
- vi. Ensure material stockpiles and construction debris are stored away from wards and patient areas.
- vii. Consultation with Stakeholders to inform them of the work schedule and activities and to get their feedback.

Asbestos Containing Building Material (ACBM) (Spanish Town Hospital)

Due to the year in which the hospital was constructed (1952), and observations pointed out by the hospital's facilities manager during the site reconnaissance, Asbestos Containing Building Materials (ACBM) (e.g., asbestos insulation materials) may be present at the hospital, and specifically within the on-site generator. Where ACBM are in good condition and unlikely to be disturbed they do not present a risk, however, if they are in poor condition or are disturbed or damaged, asbestos fibres may be released into the air and can cause chronic long-term health issues if these fibres are inhaled.

Demolition activities may involve the disturbance of ACBM in buildings and areas to be demolished.

RECOMMENDED MITIGATION

Prior to any demolition or construction work, an asbestos survey should be conducted by a licenced asbestos abatement contractor to determine the locations of potential ACBM. Licenced asbestos abatement contractors in Jamaica include: Pro-SWAT Limited (Mr. Randall Williams), Initial Trading (Mr. Calvin Braham), and GDSS (Mr. Gordon-Smith). Laboratory tests at an accredited laboratory will determine if asbestos is present so that it can be removed in accordance with the Guidelines for the Management of Asbestos and the Procedures for Handling of Asbestos, (2014).

Vibration

Construction activities can result in various degrees of ground vibration; this is dependent on the type of equipment used and the methodologies employed. Vibration has the potential to interfere with persons normal routines/activities. This can become more acute if the surrounding community has no understanding of the extent and duration of the construction. This can lead to misunderstandings if the contractor is insensitive although they may believe they are in compliance with the required conditions/ordinances. The vibration impact was predicted on these structures with the use of ten (10) primary pieces of construction equipment/activities.

From a building standpoint, there is no effect on the buildings from vibration emissions from the majority of the construction equipment nor from the use of the vibratory roller, for buildings 18 metres or further. For buildings 5m – 18m away, the use of the vibratory roller will have minimal potential for damage to weak or sensitive structures. For buildings less than 5 metres away, there is minimal potential for damage to weak or sensitive structures, from the majority of the construction equipment.

From a human standpoint, persons occupying buildings greater than 30m away would barely perceive any vibrations from the majority of the construction activities/equipment. Persons exposed to vibration from the use of a vibratory roller, if continuous, will begin to annoy people in the buildings. Persons occupying buildings up to 18m away would perceive vibrations from the majority of the construction activities/equipment to be annoying if vibration is continuous. Persons occupying buildings up to 5m away would perceive vibrations from the majority of the construction activities/equipment to be unacceptable if exposed to it continuously.

RECOMMENDED MITIGATION

- i. Sequence of operations:
 - Phase demolition, earth-moving and ground-impacting operations so as not to occur in the same time period. Unlike noise, the total vibration level produced could be significantly less when each vibration source operates separately.
 - Avoid night-time activities. People are more aware of vibration during the night-time hours.
- ii. Have regular meetings or devise a communication strategy to inform the residents and businesses of construction activities.
- iii. Phase construction activities on the **Spanish Town Hospital and the St. Jago Park Health Centre** to occur at different times to avoid cumulative vibration on close receptors.

Soil and Water Pollution

Fine fill material, stored fuels, lubricants, hazardous substances, and the repair of construction equipment have the potential to leak hydraulic fuels, oils, etc and thereby have the potential to compromise the soil, groundwater quality, and in the case of **Spanish Town Hospital and St. Jago Park Health Centre**, the Rio Cobre water quality. Foundation dewatering and the pumping of any groundwater to nearby waterways have the potential to result in excess sedimentation of water bodies.

RECOMMENDED MITIGATION

- i. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by bunds to contain the volume being stored in case of accidental spillage.
- ii. Appropriate minor spill response equipment (for containment and clean- up) will kept on site, including oil absorbent pads and disposal bags.
- iii. In terms of transporting equipment, the paths of the planned roadways will be used, rather than creating temporary pathways just for equipment access.
- iv. Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway.
- v. Vehicle refuelling facilities must be situated on impermeable surfaces served by an oil trap, run-off collection system. Sediment basins and oil water separators should be constructed to intercept storm water and groundwater from dewatering activities, before it is discharged.
- vi. A central area will be designated for the storage of raw materials. This area should be lined in order to prevent the leakage of chemicals into the sediment.
- vii. Fine grained materials (top soil, sand, marl, etc.) will be stockpiled away from drainage channels and low berms will be placed around the piles which themselves will be covered with tarpaulin to prevent them from being eroded and washed away.
- viii. Silt fences along the Rio Cobre and drainage channels may be utilized to prevent siltation (**Spanish Town Hospital and St. Jago Park Health Centre**).

Earthquakes

All four facilities were determined to be in a moderately-high seismicity zone based on the level of spectral acceleration or oscillatory movement associated with a 2475 year return period earthquake.

For **Spanish Town Hospital**, the low RVS scoring (1.8) can be attributed to the quantity of plan and vertical irregularities and the soil type being classified as a soil type E, based on the blow counts presented in the preliminary geotechnical reports. The negative soil type implications are further worsened by the building having more than 3 stories.

For **St. Jago Park, Old Harbour and Greater Portmore Health Centres**, the RVS Scores of 3.2 for each, would imply only negligible to no structural damage. This would entail only fine cracks in plaster and partitions.

RECOMMENDED MITIGATION

These outcomes pose a recommendation for a more detailed structural analysis of the buildings based on structural drawing provisions. This would provide a more accurate depiction of building performance and probability of collapse or structural failure.

Landslides

All four facilities were determined to have low susceptibility to landslides.

RECOMMENDED MITIGATION

Notwithstanding this, in ensuring a reduction in the risk of landslide vulnerability, the following mitigative measure are recommended:

1. Limit the removal of trees from the site. Hence a proper procedure should be developed as to site preparation prior to project initiation. If possible, trees with trunks of DBH 20 cm and greater should be left intact.
2. Plant or maintain well-rooted vegetation on slopes above and below the facility.

Soil Loss and Erosion

The potential for sediment loss is increased as a result of vegetation removal. A plant's roots act as a mesh within the substrate increasing its cohesiveness and improving drainage. Areas where bare ground is exposed tend to erode faster than areas inhabited by plants as they help percolate rainwater into the substrate below and into underground aquifers.

The predicted soil loss for all four facilities was determined to be low, particularly due to the fact that the proposed rehabilitation works will be in an already developed location. Therefore, it is predicted that there will be little to no increased soil loss within the project area.

RECOMMENDED MITIGATION

The following are recommended for mitigation of future soil loss:

- i. Limit the removal of trees from the site. Hence a proper procedure should be developed as to site preparation prior to project initiation. If possible, trees with trunks of DBH 20 cm and greater should be left intact.
- ii. Employ erosion control techniques such as planting more vegetation on the site to improve the soil's stability.
- iii. Installation of Gabion Baskets or soil erosion mats can be done to prevent scouring of the river banks and bed. The Rio Cobre is in close proximity to the **Spanish Town and St. Jago Park** facilities and may increase in the future resulting in soil loss near or at the facility.

Drainage and Flooding

For **Spanish Town Hospital, St. Jago Park Health Centre and Greater Portmore Health Centre**, neither the area to be improved nor the main access routes to the facility have a considerable risk of flooding during extreme storm events.

However, for the **Old Harbour Health Centre** compound, it was concluded that the project site and the main access routes to the facility along the Old Harbour Road have a considerable risk of flooding during extreme storm events.

RECOMMENDED MITIGATION

- i. Recommended finished floor levels are minimum 0.4m above the 100-Yr flood depths, which is ~0.15m, which equates to 0.55m above the road level adjacent to the facility (**Spanish Town Hospital, St. Jago Park Health Centre**).
- ii. Recommended finished floor levels are minimum 0.4m above the 100-Yr flood depths, which is ~1 metre, which equates to 1.4 m above the road level adjacent to the facility (**Old Harbour Health Centre**).
- iii. Recommended finished floor levels are minimum 0.4m above the 100-Yr flood depths, and a minimum of 0.4m above the road level adjacent to the facility (**Greater Portmore Health Centre**).
- iv. Drainage system improvement must be implemented with the guidelines outlined by the NWA in their Drainage Guideline documentations. This means, the post-development runoff should be less than that of the pre-development. This could mean the possible implementation of a detention basin to control the outflow.
- v. To maintain efficient runoff from the facility, drains must be maintained properly. This includes frequent cleaning and rehabilitation where necessary.
- vi. For **Old Harbour Health Centre**, there should be consideration for improvement of the drainage systems along the access routes to the facility to minimize the possibility of lack of access during extreme storm events.
- vii. For **Spanish Town Hospital**, the pair of pumps which aid in dispelling the stormwater on the facility need to be replaced and recommissioned to prevent instances of flooding. Anecdotal interviews revealed that they were non-operational at the time of this study.

Flora and Fauna

The proposed works are expected to have minimal negative impacts on the fauna and flora assessed on the property. The proposed additions and/or rehabilitation will occur in highly disturbed areas that have been sufficiently modified by human activities over the years. None of the species encountered on the properties were endemic nor do they have any special conservation status by the IUCN.

For **Spanish Town Hospital and St. Jago Park Health Centre**, sixty (60) trees were within the project footprint to be removed.

Table 6-10 Tree Species to be removed

Family	Scientific Name	Common Name	Range**	Number
Annonaceae	<i>Annona squamosa</i>	Sweet Sop	Commonly cultivated, escaping near habitations and along roadsides and pasture margins	3
Anacardiaceae	<i>Magnifera indica</i>	Mango	Tree	4
Bignoniaceae	<i>Spathodea campanulata</i>	Flame of the Forest	Tree	1
Meliaceae	<i>Azadirachta indica</i>	Neem	Tree	2
Mimosaceae	<i>Enterolobium cyclocarpum</i>	Elephant Ear Tree	Tree	2

Family	Scientific Name	Common Name	Range**	Number
Fabaceae	<i>Delonix regia</i>	Royal Poinciana	Tree	8
Boraginaceae	<i>Cordia collococca</i>	Clammy Cherry	Tree	1
Fabaceae	<i>Senna siamea</i>	Cassia tree	Tree	4
Cornaceae	<i>Pisidia piscipula</i>	Jamaica Dogwood	Tree	2
Moraceae	<i>Ficus sp</i>		Tree	2
Malvaceae	<i>Thespesia populnea</i>	Portia Tree	Tree	1
Arecaceae	<i>Phoenix sp</i>	Palm	Tree	9
Arecaceae	<i>Veitchia merrillii</i>	Palm tree	Tree	2
Moraceae	<i>Ficus benjamina</i>	Weeping Fig	Tree	7
Myrtaceae	<i>Melaleuca viminalis</i>	Bottlebrush	Tree	5
Fabaceae	<i>Bauhinia sp</i>	Poor Man's Orchid	Tree	2
		Unknown	Tree	2
Rhamnaceae	<i>Ziziphus mauritiana</i>	Coolie Plum	Tree	1
Mimosaceae	<i>Samanea saman</i>	Guango	Tree	1
Lecythidaceae	<i>Couroupita guianensis</i>	Cannonball Tree	Tree	1
TOTAL				60

For **St. Jago Park Health Centre**, there might be a slight displacement in some of the bird species that were observed throughout the assessment; however, these species are adapted to urban life and should easily migrate to nearby spaces; they will also return to the area after construction activities end.

RECOMMENDED MITIGATION

- i. Ornamental and native trees should be planted wherever possible, across the property, after construction is complete to encourage fauna diversity and increase the aesthetics of the grounds.
- ii. For **Spanish Town Hospital**;
 - a. Some of the fruit trees, such as Mango (*Mangifera indica*) and older trees (much larger DBH classes, >50 cm) such as Guango (*Samanea saman*) and Cannon Ball Tree (*Couroupita guianensis*), should be retained and integrated into the development to attract animals that feed on them, utilize these large trees as habitat. Fruit and ornamental trees should be planted where possible when construction is completed to bolster the flora present. The retention of some of the older/larger, and the addition of trees post-construction will also provide some amount of shade and aesthetic value on the property while increasing fauna diversity.

- b. The large open space to the south of the facility has the highest fauna diversity; as such, some of the vegetation should be retained or integrated into the development to encourage fauna diversity post-construction.
- iii. For **St. Jago Park Health Centre**, the large open space to the south of the facility has the highest fauna diversity; as such, some of the vegetation should be retained or integrated into the development to encourage fauna diversity post-construction.
- iv. A Tree Compensation Plan has been developed as part of the ESMP. This plan will be consulted.

Vectors

With the proposed developments, there are the potential for an increase in solid waste generation which may increase the number of vectors on site. There is also a potential for vector breeding sites.

RECOMMENDED MITIGATION

- i. Increased emphasis should be placed on managing garbage/solid waste disposal on the property. Efforts should include an increase in the frequency of the removal of garbage and also the use of garbage skips that are properly covered/ sealed to prevent animals from entering. This should aid in the vector issues that are present at the facility.
- ii. The project site should be inspected regularly to ensure that vector breeding sites (old tires, pans etc.) are identified and eliminated.

Freshwater Ecosystems (**Spanish Town Hospital and St. Jago Park Health Centre**)

The proposed development may have an impact on the Freshwater ecosystem of the Rio Cobre, such as reduced water quality as a result of excess sedimentation and runoff from construction activities.

RECOMMENDED MITIGATION

- i. In order to limit or prevent excess sedimentation in the river, materials should be stockpiled in appropriate areas, away from the river. Barriers or settling pond areas should be utilized during construction.

Solid Waste Generation and Disposal

During this construction phase of the proposed project, solid waste generation may occur mainly from general construction activities including demolition and excavation.

RECOMMENDED MITIGATION

- i. A Solid Waste Management Plan will be done and is to be approved by the National Environment and Planning Agency (NEPA) and the National Solid Waste Management Authority (NSWMA).
- ii. Skips, bins and/or garbage chutes should be strategically placed within the construction site.
- iii. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour.

- iv. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling.
- v. Disposal of the contents of the skips and bins should be done at an approved disposal site – Riverton City Disposal Site.
- vi. All waste that leaves the sites must be accompanied by Waste Manifests/ticketing system (both at the construction site and at the disposal site).

Wastewater Generation and Disposal

With every construction site comes the need to provide construction workers with sanitary conveniences. Portable toilets and the disposal of same have the potential to contaminate the area in the event of accidental spillage.

The project will involve the rehabilitation of the Spanish Town sewage plant. While this is done the existing hospital will still be operational. This will necessitate that sewage will be transferred to the plant during the period of the rehabilitation.

Mitigation

- i. Provision and maintenance of portable sanitary conveniences for the construction workers for control of sewage waste by a licenced contractor. A ratio of approximately 25 workers per portable toilet should be used.
- ii. To ensure that there is no disruption in sewage plant process, we are proposing that a cesspool removal entity is engaged to pump the waste daily from the lift station and discard offsite to an approved sewage treatment plant. This is feasible as the average daily flow was measured to be 143.64m³/d. Using the larger-sized cesspool trucks, this works out to approximately 7-8 trucks required daily. This will allow rehabilitative works to be undertaken on the areas of the plant unhindered. Once complete, the inlet pipe could be plugged temporarily to effect the works there or the inlet pipe re-routed towards the oxidation ditch temporarily. A modified approach could entail modifying the lift station into two (2) compartments to allow works to be done at the inlet simultaneously.

6.2.2.3 Potential Positive Impacts

Green Procurement and Enhancement Measures

Earth materials used for filling and other construction uses are generally obtained from quarry operations. The contractor should be conscious of the sources of these materials, and should only source material from legal licenced quarry operators, licenced by the Ministry of Transport and Mining's Mines and Geology Division.

The same goes for the sourcing of equipment or parts manufactured in areas where forced/child labour is utilized. The contractor should be conscious of the sources of these equipment and parts to ensure they are from reputable sources.

6.2.3 Social Risks and Impacts Analysis

6.2.3.1 Social Risks and Impact Tables

Table 6-11 Summary of Potential Site Preparation and Construction Phase Social Impacts for Spanish Town Hospital

No.	Impact Category	Type of Risk and Impact
1	Archaeological and Historical Assets	No Impact
2	Employment	Direct, Positive, short-term, medium impact, national
3	Vending and Food Hygiene	Indirect, Negative, short-term, low-medium impact, local-regional
4	Health and Safety	Indirect, Negative, short-term, medium-large impact, local-regional
5	Security	Indirect, Negative, short-term, medium impact, localized (project boundary)
6	Transportation and Traffic	Direct, Negative, short-term, low impact, localized-regional (project boundary or intra parish)
7	Aesthetics	Indirect, Negative, short-term, low impact, localized (project boundary)
8	Stakeholders	Direct, Negative, long term, medium impact, localized (project boundary and community)
9	Infrastructure	Indirect, Negative, short-term, low impact, local (project boundary)

Table 6-12 Summary of Potential Site Preparation and Construction Phase Social Impacts for St. Jago Health Centre

No.	Impact Category	Type of Risk and Impact
1	Archaeological and Historical Assets	No Impact
2	Employment	Direct, Positive, short-term, medium impact, national
3	Vending and Food Hygiene	Indirect, Negative, short-term, low-medium impact, local-regional
4	Health and Safety	Indirect, Negative, short-term, medium-large impact, local-regional
5	Security	Indirect, Negative, short-term, medium impact, localized (project boundary)
6	Transportation and Traffic	Direct, Negative, short-term, low impact, localized-regional (project boundary or intra parish)
7	Aesthetics	Indirect, Negative, short-term, low impact, localized (project boundary)
8	Stakeholders	Direct, Negative, long term, medium impact, localized (project boundary and community)
9	Infrastructure	Indirect, Negative, short-term, low impact, local (project boundary)

Table 6-13 Summary of Potential Site Preparation and Construction Phase Social Impacts for Old Harbour Health Centre

No.	Impact Category	Type of Risk and Impact
1	Archaeological and Historical Assets	No Impact
2	Employment	Direct and Indirect, medium term, (Positive and Negative, Reginal (interparish))

No.	Impact Category	Type of Risk and Impact
3	Vending and Food Hygiene	Indirect, Negative, Indirect, short term, low-medium Localized- Regional (project boundary and surrounding community)
4	Health and Safety	Indirect, Negative, Short-term, Low-medium impact, National (widespread)
5	Security	Indirect and Direct, Negative, Short term, Medium impact, Localized-Regional (project boundary and surrounding communities)
6	Transportation and Traffic	Indirect and Direct, Negative, Short-term impact, -Localized - Regional (project boundary and surrounding communities)
7	Aesthetics	Indirect, Negative, Short-term, Low impact, Localized
8	Stakeholders	Direct, Negative, Long term, Low impact, Localized
9	Apiary	Direct, Negative, Long term, Medium impact, Localized

Table 6-14 Summary of Potential Site Preparation and Construction Phase Social Impacts for Greater Portmore Health Centre

No.	Impact Category	Type of Risk and Impact
1	Archaeological and Historical Assets	No Impact
2	Employment	Direct and Indirect, medium term, {Positive and Negative, widespread (inter parish)
3	Vending and Food Hygiene	Indirect, Negative, Indirect, medium term, Localized (project boundary and surrounding community)
4	Health and Safety	Indirect, Negative, medium-long-term, medium impact, National (island wide)
5	Security	Indirect, Negative, short term, Medium impact, localized (project boundary and surrounding communities)
6	Transportation and Traffic	Direct, Negative, short-term impact, -localized to regional
7	Aesthetics	Indirect, Negative, Short-term, low impact, Localized

6.2.3.2 Potential Negative Risks and Impacts

Heritage and Cultural

The archaeological and historical assets identified in the surrounding 1km radius of the project sites are significant, however, there may be other vestiges that are of equal significance that have not been identified. The Tainos were the first occupants of these landscapes and there may also be features, foundations or buildings that were not identified or listed due to the limitation of time constraints.

Although no historical or architectural features were identified in the **Greater Portmore** area, these areas were pastureland and sugar cane fields while it was known as Reid's Pen and Great Salt Pond Pen. There may be foundations associated with these Pens.

RECOMMENDED MITIGATION

Care should be taken during construction activities. Any vestiges of cultural material unearthed on should be collected and examined. It should be noted that in case archaeological features are found within the project area, the JNHT will evaluate and record the features and collect any such cultural material found.

Vending and Food Hygiene

The establishment of a construction site has the potential to increase the number of “cook shops” (food vendors) to provide the construction workers with meals. Improper food preparation and the failure to practice proper hygiene can result in certain pathogens entering the food supply and cause food borne illness. Food borne illness often presents itself as flu like symptoms such as nausea, vomiting, diarrhoea or fever. This will also have a negative visual effect on the proposed construction site.

MITIGATION

- i. Provision of adequate supply of potable water.
- ii. The monitoring of the various “cook shops” by public health authorities and the construction management team, to ensure proper hygiene is being followed.
- iii. The provision of areas to adequately wash hands and utensils.

Health and Safety

Construction activities have the potential for accidental injury, whether major or minor. For example, construction works may entail workers being suspended in the process and this has the potential for increased construction accidents. Fugitive dust has the potential to affect the health of construction workers. Construction activities will involve workers, staff and patients who may have accidents. This may include fire safety, safe access routes, clearly defined pedestrian pathways, electrical hazards, electrocution, eye hazards and radiation hazards. In addition, disasters such as earthquakes, floods and hurricanes are real possibilities.

It is important to try to source potential workers from nearby communities to strengthen community relations. In addition, diverse sexual orientations and gender identities may have the effect of excluding people from potential employment opportunities which prevents them from taking advantage of the opportunities available to other members of the community.

RECOMMENDED MITIGATION

- i. The provision of lifelines, personal safety nets or safety belts and scaffolding for the construction workers (if necessary). These should be used at minimum heights of 6 feet (1.83 metres).
- ii. Ensuring that workers wear personal protective equipment (hard hats, reflective vests, safety shoes, eye, and ear protection etc.)
- iii. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.

- iv. Areas should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.
- v. There should be onsite first aid kits and arrangement for a local nurse and/or doctor to be on call for the construction site.
- vi. Make prior arrangements with staff at the hospital and/or health centre to accommodate any eventualities.
- vii. Make prior arrangements with the closest police and fire stations to accommodate any eventualities.
- viii. Material Safety Data Sheets (MSDS) should be stored onsite.
- ix. A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers.
- x. Trench Excavation
 - A trench 1.2m or more in depth must have a means of egress (ladders/ stairways/ramps) and should be located at 8m intervals.
 - Excavated materials must be stored 0.6m or more from the open trench (not to be measured from the crown of the spoil).
 - Spoil should be placed so that the channels rainwater and other runoff water away from the excavation.
 - Take precautions regarding Tension Cracks
 - Tension cracks usually form at a horizontal distance of 0.5 to 0.75 times the depth of the trench.
 - Sliding or sloughing may occur as a result of tension cracks.²⁷
- xi. Ensure that construction safety nets (catch nets) are installed that will catch personnel, debris, and small tools
- xii. Designing and implementing an Emergency Response Plan (ERP) in the event of any emergency. This should include:
 - Hurricane
 - Earthquake
 - Flooding
 - Fire
 - Civil Unrest and Riots
 - Bomb Threats and Acts of Sabotage
 - Acts of Terrorism and Armed Attacks
 - Petroleum and Hazardous Material Stockpiling
 - Security and Safety Information
 - Medical Emergency Information
 - Technological Emergencies
- xiii. Implement a Lock-out Tag-out system to ensure that equipment is shut down and inoperable until any maintenance or repair work is completed.

²⁷ Worker Health and Safety Guidelines as per OSHA #510 Construction Industry Standard 29 CFR Part 1926.

- xiv. The government electrical inspectorate, in the presence of the MOHW representative, will do their necessary checks to ensure that all Electrical connections, equipment and services are installed, operable and performing according to design specifications and will perform all testing and commissioning of all electrical connections, equipment and services.
- xv. It is important that the Developer:
 - Anticipates and prevent adverse risks and impacts based on gender, sexual orientation, and gender identity, and when avoidance is not possible, to mitigate and compensate for such impacts.
 - Achieves inclusion in project-derived benefits of people of all genders, sexual orientations, and gender identities.
 - Implement measures to prevent Sexual and Gender Based Violence (SGBV), including sexual harassment, exploitation and abuse; and when incidents of SGBV occur, to respond promptly.

Security

Construction activities increase the number of persons in and around the hospital/health centre grounds. This has the potential to increase security risks. These include:

- Extortion
- Robbery
- Theft of property
- Harassment of staff and patients

RECOMMENDED MITIGATION

- i. Liaise with the Jamaica Constabulary Force and the Jamaica Defence Force to provide support and security.
- ii. Increase private security on the general hospital grounds and on the construction site.
- iii. Both external and internal stakeholder sensitization of construction activities and the potential security risks
- iv. Ensure parking areas and walkways are well lit
- v. Ensure vulnerable access areas are secured, including sufficient locks and grills
- vi. Implement regular security patrols
- vii. Ensure construction workers are easily identified (IDs, Branded clothing)
- viii. Construction workers should remain in construction areas and not venture/loiter in other areas

Traffic Management

The sequence of construction is expected to adhere to the basic outline as shown:

1. Site Clearance
2. Construction
3. Installation of Special Machinery and equipment

These general stages in the sequence will generate similar types of traffic on the roads. The trips generated will have a much higher percentage of heavy vehicles. This is because there will be delivery of materials and equipment to the site as well as removal of solid waste or debris from the site. Special machinery installation may in some cases involve large units to transport these cases and will require NWA permitting and most likely scheduled for late nights.

Construction traffic will be mostly trucks delivering materials to the site as well as removing rubbish. This will vary somewhat for the different stages of construction.

RECOMMENDED MITIGATION

The following mitigation measures will be implemented to minimize traffic:

- i. There are three distinct peak times, these are between 8:30 – 9:30 am, 12:30 – 1:30 pm and 3:30 – 4:30 pm. Construction traffic entering or leaving the site will be scheduled for off-peak hours to minimize additional congestion at the intersection and/or disruptions in the regular traffic flow.
- ii. Adequate covering up of the works to minimize danger to passing traffic.
- iii. Erection of signs ahead of the works warning motorists of the construction ahead.
- iv. Use of flagmen where necessary
- v. Designated parking areas for construction vehicles and equipment.
- vi. Ensure that access to the hospital, and in particular emergency response vehicles and areas around A&E are unobstructed.

Aesthetics

Construction activities may decrease the aesthetic appeal of the area; however, this will be for a short-term period during construction. In particular, trucks leaving the construction site have the potential to deposit mud and gravel onto the main road, making the main road aesthetically unappealing and in the process, affecting the conditions of other vehicles traversing the main road.

RECOMMENDED MITIGATION

- i. Good housekeeping activities and adherence to other mitigative measures.
- ii. An area of gravel should be placed on site (just before exiting onto the main road) to help remove mud/gravel from truck wheels.
- iii. A wheel wash area on site (just before exiting onto the main road) should be implemented to rid wheels of as much mud/gravel as possible
- iv. Install hoarding around the site which can be painted so as to make it more attractive

Stakeholders

Construction activities often causes inconveniences, health risks and can be a source of nuisance to stakeholders (both internal and external) on site and in the general area. Incidences of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination may also occur.

RECOMMENDED MITIGATION

With the aim of establishing and maintaining a harmonious relationship between the stakeholders (both internal and external) and the Project, a Claims and Complaints Absolution Program will be implemented, whose general objective is to create a system that allows timely response to complaints from residents who are perceived to be affected or harmed by any aspect of the Project. A Grievance Redress Mechanism (GRM) to include reports of allegations of Gender Based Violence (GBV), Sexual Exploitation and Abuse (SEA) and Sexual Orientation Discrimination will be formulated.

For Spanish Town Hospital, buildings and services located within the project footprint will be affected. These include pharmacy, laboratory, day care and staff residence. There are seven hundred and eighty-four (784) women employed at the Spanish Town Hospital. Women will generally be more impacted since they will have a bigger burden with childcare and other inconveniences brought by the dislocation of services such as the day care facility.

There is the potential for disruption and/or loss of services, reduced capacity of staff and services and increased wait times. Access to the general hospital grounds may also be impacted. This has a greater potential to impact persons with disabilities and special needs.

Vendors located along Burke Road in the vicinity of the proposed main entrance will be impacted and dislocated from this area.

RECOMMENDED MITIGATION

- i. Services slated for relocation should be relocated to another area on the hospital compound.
- ii. Medical services that complement each other should be relocated within close proximity; for example, the pharmacy and laboratory should be within close proximity to the out-patient area.
- iii. The daycare facility should be relocated to somewhere suitable, and operations continue.
- iv. Staff residences may be relocated to the north-western boundary of the property, beside the existing doctors and nurses' residences.
- v. The areas to which services will be relocated must at minimum, be of equal standard to that currently in place and have adequate infrastructure, furniture, public sanitary convenience, and disabled access.
- vi. Ensure clear and sufficient pathways for persons with disabilities and special needs.
- vii. Dislocated vendors at the proposed main entrance will be relocated and a Livelihood Restoration Plan will be developed to accommodate them.

For Old Harbour Health Centre, access to the property west of the proposed project site will be affected by construction activity. The proposed project site is used as an access way to said property.

There are approximately 26 boxes of bees located at the southwestern corner of the proposed property which will have to be removed to facilitate the development. This will result in dislocation of the bee farmer and loss in revenue.

The Lion's Club Civic Centre located toward the north of the property, will have services affected during construction activities. The Lion's Club of Old Harbour has permitted the Eclessia Family Ministry to utilize the Lion's Civic Centre for a period of six (6) months. This period commenced on December 1, 2022 and will conclude on May 31, 2023 (Figure 5-24). The facility is used as a church three times per week.

The main vehicle and pedestrian access is defined from north, from East Street Check point that is going to be controlled by a security guard is planned to serve the plot main entrance. This is the only access to the facility (egress/ingress) being considered. There will be no displacement of residences or informal settlements located to the south of the proposed project site.

RECOMMENDED MITIGATION

- i. The alternate entrance located by the market will have to be used to access the property. Consultations will have to be held with the property owner.
- ii. Find an adequate location for the apiary to be relocated.
- iii. Provide compensation to the bee farmer for the portion of the year that will be disrupted by the removal of apiary.
- iv. Discussions will be had with the Lion's Club members regarding possible disruption of services.

Infrastructure

The proposed development has the potential to impact existing infrastructure on the **Spanish Town Hospital** property. These include;

1. A main drain (from Burke Road) and a small drain to the east (close to the kitchen)
2. Three water storage tanks
3. Two emergency assembly locations
4. One overflow waiting area
5. Two non-clinical waste storage containers
6. Six electrical light poles
7. One LPG storage tank (north of the dietary building)
8. Eighteen manholes
9. Digicel has a cell service infrastructure onsite that will be impacted by the proposed works.

RECOMMENDED MITIGATION

- i. Relocate or redesign the drains to ensure that their functions continue and that they do not pose a flooding risk to other parts of the facility
- ii. In consultation with stakeholders and the Maintenance Department, the relocation of the water storage tanks, emergency assembly points, overflow waiting area and the waste containers should be done.
- iii. Relocation of the electrical poles in consultation with JPSCo and the Maintenance Department out of the proposed project site. Depending what is situated on the pole, relocation may cost J\$300,000 and above.

- iv. Consult the LPG supplier to relocate the storage tank
- v. Maintenance Department will have to be consulted to determine the services running through the manholes (e.g., water, drain, electrical or telecommunication) and to arrange for their relocation with minimal interruptions of the services.
- vi. Consult with Digicel to relocate their infrastructure
- vii. Consult with Flow to ascertain if there will be any of their infrastructure that will be impacted.

The proposed development has the potential to impact existing infrastructure on the **St. Jago Park Health Centre** property. These include;

- 1. Two non-clinical waste storage containers
- 2. Two overflow waiting areas
- 3. One manhole

Recommended Mitigation

- i. In consultation with stakeholders and the Maintenance Department, the relocation of the overflow waiting area and the waste containers should be done.
- ii. Maintenance Department will have to be consulted to determine the services running through the manholes (e.g., water, drain, electrical or telecommunication) and to arrange for their relocation with minimal interruptions of the services.

6.2.3.3 Potential Positive Impacts

Employment

The work force will consist of trade men and labourers during construction. In addition to these direct jobs, this project should create indirect and induced jobs during construction. This will represent a significant level of employment within the study area and has the potential to be a significant positive impact. It is anticipated that some labourers will be from sourced from nearby communities.

RECOMMENDED MITIGATION

None Required

6.3 OPERATIONS PHASE

6.3.1 Impact Matrices

Table 6-15 to Table 6-18 detail the impact matrices for the operational phases for each of the four facilities.

Table 6-15 Environmental and Social Impact matrix for operational phase at Spanish Town Hospital

Categories highlighted in grey are deemed significant

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Hydrological	Present climate scenario indicates 2% increase in runoff flows		X			X	L	S	L
		Future climate scenario indicates 14% increase in runoff flows		X			X	L	M	L
	Noise	Noise from vehicular traffic along Burke Road may have an impact on patients and hospital staff		X			X	L	S	L
	Air Quality	Emissions (NOx and SOx) from vehicular traffic along Burke Road may have an impact on patients and hospital staff		X			X	L	M	L
	Medical Waste Handling	Improvement in the capacity to manage clinical waste by referring to the associated ESMPs, international best practices, and related regulatory guidance from NEPA		X	X			L	L	R
	Waste Generation	Increased medical and non-medical waste generation can pose a risk to public health, including the spread of infectious diseases, if not stored, secured, and disposed of properly	X				X	L	L	R
	Wastewater	Increased wastewater generation from increased hospital operations and increased patient load	X				X	L	M	R
Biological	Freshwater Ecosystems	Improved water quality of the Rio Cobre from rehabilitated and upgraded WWTP	X		X		X	L	M	N
		Wastewater from medical facilities has the potential to contain pharmaceuticals and pathogens which may enter various trophic levels.	X				X	L	S	N
Human/Social	Water Demand	Potential for the hospital to further burden the water supply in the area in the event of drought conditions.		X			X	L	M	R
	Traffic	Increased patient volume has the potential to increase traffic volumes along hospital routes, adjoining roads and within hospital boundaries.		X			X	L	S	N
		Potential delays (for commuters and emergency response vehicles) and safety hazards (vehicular and pedestrian)		X			X	L	M	N
	Health and Safety	Staff and patients may become ill or have accidents. In addition, disasters such as earthquakes, floods and fires and other hazards are real possibilities.		X			X	L	L	N
		Lack of proper fire safety/protection equipment on site		X			X	L	L	N
	Service Capacity	Improved access to healthcare and new and improved healthcare services for surrounding communities and those outside of St. Catherine parish	X		X			L	L	N
	Employment	Creation of direct, indirect and induced jobs	X	X	X			L	L	N

Table 6-16 Environmental and Social impact matrix for operational phase at St. Jao Park Health Centre

Categories highlighted in grey are deemed significant

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Hydrological	Present climate scenario indicates 2% increase in runoff flows		X			X	L	S	L
		Future climate scenario indicates 1% increase in runoff flows		X			X	L	S	L
	Noise	Noise from vehicular traffic along Burke Road may have an impact on patients and staff		X			X	L	S	L
	Air Quality	Emissions (NOx and SOx) from vehicular traffic along Burke Road may have an impact on patients and staff		X			X	L	M	L
	Medical Waste Handling	Improvement in the capacity to manage clinical waste by referring to the associated ESMPs, international best practices, and related regulatory guidance from NEPA		X	X			L	L	R
	Waste Generation	Increased medical and non-medical waste generation can pose a risk to public health, including the spread of infectious diseases, if not stored, secured, and disposed of properly	X				X	L	L	R
	Wastewater	Increased wastewater generation from increased health centre operations	X				X	L	M	R
Biological	Freshwater Ecosystems	Improved water quality of the Rio Cobre from rehabilitated and upgraded WWTP	X				X	L	M	N
		Wastewater from medical facilities has the potential to contain pharmaceuticals and pathogens which may enter various trophic levels.	X				X	L	M	N
Human/Social	Water Demand	Potential for the health centre to further burden the water supply in the area in the event of drought conditions.		X			X	L	M	R
	Traffic	Increased patient volume has the potential to increase traffic volumes along health centre routes, adjoining roads and within boundaries.		X			X	L	S	N
		Potential delays (for commuters and emergency response vehicles) and safety hazards (vehicular and pedestrian)		X			X	L	M	N
	Health and Safety	Staff and patients may become ill or have accidents. In addition, disasters such as earthquakes, floods and fires and other hazards are real possibilities.		X			X	L	L	N
		Lack of proper fire safety/protection equipment on site		X			X	L	L	N
	Service Capacity	Improved access to healthcare and new and improved healthcare services for surrounding communities and those outside of St. Catherine parish	X		X			L	L	N
	Employment	Creation of direct, indirect, and induced jobs	X	X	X			L	L	N

Table 6-17 Environmental and Social impact matrix for operational phase at Old Harbour Health Centre

Categories highlighted in grey are deemed significant

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Hydrological	Present climate scenario indicates 39% increase in runoff flows		X			X	L	M	L
		Future climate scenario indicates 39% increase in runoff flows		X			X	L	M	L
	Noise	Noise from Old Harbour Market may have an impact on patients and staff		X			X	L	S	L
	Air Quality	Emissions (NOx and SOx) from vehicular traffic along East Street may have an impact on patients and staff		X			X	L	M	L
	Medical Waste Handling	Improvement in the capacity to manage clinical waste by referring to the associated ESMPs, international best practices, and related regulatory guidance from NEPA		X	X			L	L	R
	Waste Generation	Increased medical and non-medical waste generation can pose a risk to public health, including the spread of infectious diseases, if not stored, secured, and disposed of properly	X				X	L	L	R
	Wastewater	Wastewater generation from health centre operations	X				X	L	S	L
Human/Social	Water Demand	Potential for the health centre to further burden the water supply in the area in the event of drought conditions.		X			X	L	M	R
	Traffic	Potential to increase traffic volumes along health centre routes, adjoining roads and within boundaries.		X			X	L	S	N
		Potential delays (for commuters and emergency response vehicles) and safety hazards (vehicular and pedestrian)		X			X	L	M	N
	Health and Safety	Staff and patients may become ill or have accidents. In addition, disasters such as earthquakes, floods and fires and other hazards are real possibilities.		X			X	L	L	N
	Service Capacity	Improved access to healthcare and new and improved healthcare services for surrounding communities and those outside of St. Catherine parish	X		X			L	L	N
	Employment	Creation of direct, indirect, and induced jobs	X	X	X			L	L	N

Table 6-18 Environmental and Social impact matrix for operational phase at Greater Portmore Health Centre

Categories highlighted in grey are deemed significant

CATEGORY		IMPACT	DIRECT/ INDIRECT		DIRECTION			DURATION	MAGNITUDE	EXTENT
			DIRECT	INDIRECT	POSITIVE	NONE	NEGATIVE			
Physical	Hydrological	Present climate scenario indicates 9% increase in runoff flows		X			X	L	M	L
		Future climate scenario indicates 7% increase in runoff flows		X			X	L	M	L
	Noise	Noise from vehicular traffic along Southwest 2nd Street and Northwest 1st Avenue may have an impact on patients and staff		X			X	L	S	L
	Air Quality	Emissions (NOx and SOx) from vehicular traffic along Southwest 2nd Street and Northwest 1st Avenue may have an impact on patients and staff		X			X	L	M	L
	Medical Waste Handling	Improvement in the capacity to manage clinical waste by referring to the associated ESMPs, international best practices, and related regulatory guidance from NEPA		X	X			L	L	R
	Waste Generation	Increased medical and non-medical waste generation can pose a risk to public health, including the spread of infectious diseases, if not stored, secured, and disposed of properly	X				X	L	L	R
	Wastewater	Increased wastewater generation from increased health centre operations	X				X	L	M	R
Human/Social	Water Demand	Potential for the health centre to further burden the water supply in the area in the event of drought conditions.	X				X	L	M	R
	Traffic	Increased patient volume has the potential to increase traffic volumes along health centre routes, adjoining roads and within boundaries.		X			X	L	S	N
		Potential delays (for commuters) and safety hazards (vehicular and pedestrian)		X			X	L	M	N
	Health and Safety	Staff and patients may become ill or have accidents. In addition, disasters such as earthquakes, floods and fires and other hazards are real possibilities.		X			X	L	L	N
		Lack of proper fire safety/protection equipment on site		X			X	L	L	N
	Service Capacity	Improved access to healthcare and new and improved healthcare services for surrounding communities and those outside of St. Catherine parish	X		X			L	L	N
	Employment	Creation of direct, indirect, and induced jobs	X	X	X			L	L	N

6.3.2 Environmental Risk and Impact Analysis

6.3.2.1 Environmental Risks and Impact Tables

Table 6-19 Summary of Potential Operational Phase Environmental Impacts for Spanish Town Hospital

No.	Impact Category	Type of Risk and Impact
1	Hydrology and Flooding	Indirect, Negative, long-term, low-medium impact, local (project boundary)
2	Noise	Indirect, Negative, long-term, low impact, local (project boundary)
3	Air Quality	Indirect, Negative, long-term, medium impact, local (project boundary)
4	Medical Waste Handling	Indirect, Positive, long-term, large impact, regional (intra parish)
5	Waste Generation	Direct, Negative, long-term, large impact, regional (intra parish)
6	Wastewater	Direct, Negative, long-term, medium impact, regional
7	Freshwater Ecosystems	Direct, Positive, long-term, medium impact, regional (intra parish)

Table 6-20 Summary of Potential Operational Phase Environmental Impacts for St. Jago Health Centre

No.	Impact Category	Type of Risk and Impact
1	Hydrology and Flooding	Indirect, Negative, long-term, low-medium impact, local (project boundary)
2	Noise	Indirect, Negative, long-term, low impact, local (project boundary)
3	Air Quality	Indirect, Negative, long-term, medium impact, local (project boundary)
4	Medical Waste Handling	Indirect, Positive, long-term, large impact, regional (intra parish)
5	Waste Generation	Direct, Negative, long-term, large impact, regional (intra parish)
6	Wastewater	Direct, Negative, long-term, medium impact, regional
7	Freshwater Ecosystems	Direct, Positive, long-term, medium impact, regional (intra parish)

Table 6-21 Summary of Potential Operational Phase Environmental Impacts for Old Harbour Health Centre

No.	Impact Category	Type of Risk and Impact
1	Hydrological	Indirect, Negative, Long term, Medium impact, localized (project boundary and surrounding communities)
2	Noise	Indirect, Negative, Long term, Low impact, localized (project boundary)
3	Air Quality	Indirect, Negative, Long term, Medium impact, localized (project boundary and surrounding communities)
4	Medical Waste Handling	Indirect, Positive, Long term, Low impact, Regional
5	Waste Generation	Direct, Negative, Long term, Low impact, Regional
6	Wastewater	Direct, Negative, Long term, Low impact, Localized

Table 6-22 Summary of Potential Operational Phase Environmental Impacts for Greater Portmore Health Centre

No.	Impact Category	Type of Risk and Impact
1	Hydrological	Indirect, Negative, long term, Medium impact, localized (project boundary and surrounding communities)
2	Noise	Indirect, Negative, Long term, low impact, localized (project boundary)

No.	Impact Category	Type of Risk and Impact
3	Air Quality	Indirect, Negative, long term, Medium impact, localized (project boundary and surrounding communities)
4	Medical Waste Handling	Indirect, Positive, Long term, Low impact, Regional
5	Waste Generation	Direct, Negative, Long term, Low impact, Regional
6	Wastewater	Direct, Negative, Long term, Medium impact, Regional

6.3.2.2 Potential Negative Risks and Impacts

Hydrology

For **Spanish Town Hospital**, post improvement (with the proposed development) of the project area for the 25-Yr, 50-Yr and 100-Yr return periods investigation indicated that there is an expected average of 2% increase in runoff flows generated during the present climate scenario. Under the future climate scenario, the average runoff increased to 14%, which is significant.

For **St. Jago Park Health Centre**, post improvement (with the proposed development) of the project area for the 25-Yr, 50-Yr and 100-Yr return periods investigation indicated that there is an expected average of 2% increase in runoff flows generated during the present climate scenario. Under the future climate scenario, the average runoff increased by 1%.

For **Old Harbour Health Centre**, post improvement (with the proposed development) of the project area for the 25-Yr, 50-Yr and 100-Yr return periods investigation indicated that there is an expected average of 39% increase in runoff flows generated during the present climate scenario. Under the future climate scenario, the average runoff increased to 39%, which is significant.

For **Greater Portmore Health Centre**, post improvement of the project area for the 25-Yr, 50-Yr and 100-Yr return periods, the assessment indicated that there is an expected average of 9% increase in runoff flows generated during the present climate scenario. Furthermore, in the future climate scenario, the average runoff increase was 7%, which is significant.

The increases for each facility is as expected as the combination of more impermeable areas, as well as the increase of storm intensity due to climate change combined will have a significant effect on the stormwater runoff within the improvement area.

RECOMMENDED MITIGATION

- i. For **Spanish Town Hospital**, the stormwater pumping system, needs to be maintained, serviced and fully operational at all times, in order to prevent inundation in the vicinity of the maternity ward.
- ii. To maintain efficient runoff from the facility post-improvement, drains must be maintained properly. This includes frequent cleaning and rehabilitation where necessary.
- iii. New constructed drains must be sized appropriately to convey the increased runoff. They must be sized considering the future climate scenario.

Noise

Noise from vehicular traffic along the main roads and surrounding areas may have an impact on the newly proposed buildings. This includes noise disturbances for patients and staff (doctors, nurses, administrative staff etc.)

RECOMMENDED MITIGATION

- i. Soundproof windows on proposed new buildings.
- ii. Ensure windows remain closed during hospital operations.

Air Quality

Emissions (NO_x, SO_x and PM) from vehicular traffic travelling along the main roads may have an impact on patients and staff. These emissions have the potential to cause adverse respiratory effects such as: airway inflammation, bronchoconstriction, asthma symptoms, especially for persons with asthma and respiratory ailments (especially PM2.5 particulates).

Regarding Indoor Air Quality, hospitals and health centres need to be as sterile as possible, especially areas such as operating rooms and ICUs etc. Efforts must be made to maintain a healthy indoor environment.

RECOMMENDED MITIGATION

- i. Ensure windows remain closed during operations.
- ii. Measure indoor concentrations of emissions parameters (NO_x, SO_x and PM) on a semi-annual basis.
- iii. All HVAC systems must have a service schedule where units are cleaned and maintained, and filters are inspected.
- iv. Monitoring of temperature, relative humidity and carbon dioxide inside the building/offices etc.
- v. Review pressure gradient semi-annually to ensure areas designated to have negative pressure (restrooms, chemical storage rooms, operating theatres, infectious disease rooms etc.) remain under negative pressure.
- vi. Building envelope must be inspected for leaks.
- vii. Interior of building must be inspected for leaks and evidence of mould growth.

Freshwater Ecosystems (Spanish Town Hospital and St. Jago Park Health Centre)

There will be an improvement in the water quality of the effluent being discharged into the Rio Cobre from the Spanish Town Hospital WWTP since it will be rehabilitated and upgraded. This will in turn result in an improvement in the water quality of the Rio Cobre river.

Wastewater from medical facilities has the potential to contain pharmaceuticals and pathogens which may enter various trophic levels.

RECOMMENDED MITIGATION

Ensure that the wastewater treatment plant is functioning, well maintained and effluent is compliant with NRCA Sewage Effluent Standards. Ensure that the backup systems are sufficient for the increased capacity from the new development.

Waste Generation

Operations have the potential of increasing the amount of medical and non-medical waste generated. If not stored, secured, and disposed of properly, medical waste can pose a risk to public health, including the spread of infectious diseases.

MITIGATION

- i. Provision of appropriate type and number of medical and non-medical waste storage bins and skips.
- ii. Training of healthcare personnel in handling of medical waste.
- iii. Provision of adequately designed bins and skips to prevent access by vermin.
- iv. Contracting a private contractor to collect waste in a timely fashion to prevent a build-up.
- v. Ensure that the medical and non-medical waste is collected separately and is treated and disposed of properly at an authorized waste disposal site.
- vi. All waste that leaves the site must be accompanied by Waste Manifests/ticketing system (both at the hospital site and at the disposal site).

Sewage and Wastewater Generation

Increased wastewater generation from increased operations and increased patient load is expected. A condition assessment and rehabilitative designs for the **Spanish Town Hospital** WWTP to facilitate the proposed 99 more inpatient beds expansion of the hospital was conducted. It was concluded that the Spanish Town Hospital's wastewater treatment plant is able to accommodate the additional sewage flow from both the existing buildings and the new hospital and the **St. Jago Park Health Centre** building and meet the NRCA discharge effluent standards (CEAC Solutions Co. Ltd., 2022).

According to the measured flow of 0.392m³/bed/day, when the hospital is at 100% capacity - 430 beds occupied plus the additional 149 beds occupied - the projected flow is estimated at 226.69 m³/day. Based on the national guideline flow of 0.75m³/bed/day, the projected flow would be 434.25 m³/day when the hospital is at 100% capacity. The treated effluent will be discharged, as before, into the Rio Cobre River.

The Rio Cobre River for the last five years has an annual average flow of 4-10 cubic meters per second. The estimated discharge of the wastewater effluent from the Spanish Town WWTP is 0.003 cubic meters per second, which gives a ratio of 0.06%.

The theoretical stream length below a water-discharge point where the effluent has mixed across half the width of the stream (one half width mixing length) was calculated for the flow conditions at the time of sampling. The rationale for one half width mixing of the stream is based on the assumption

that, for chronic aquatic life criteria, only one half of the instead flow is available for dilution (US Environmental Protection Agency, 1994); therefore, half of the stream width serves as a surrogate for half of the flow. It was determined that the one half width mixing length for the Spanish Town Hospital WWTP, under future conditions, is 11.5 metres (37.8 feet).

For the **Greater Portmore Health Centre**, sewage waste generated from existing and proposed new operations will be disposed of through the National Water Commission's municipal sewer system which serves the community.

For **Old Harbour Health Centre**, an assessment was not conducted because there is no final sewerage design. When this becomes available, an assessment will be conducted and potential impact analysed and mitigation measures recommended.

MITIGATION

Ensure that the existing wastewater treatment plant at **Spanish Town Hospital** is functional and able to handle the additional volume of wastewater from the new hospital operations. To carry out the rehabilitation activities, the plant will have to be taken offline with the pumps off and sewage removed from the lift station through a cesspool truck, and disposed of at an approved treatment facility.

6.3.2.3 Potential Positive Impacts

Medical Waste Handling

All facilities should refer to the associated ESMPs, international best practices, and related regulatory guidance from NEPA regarding better control and management of clinical waste. This would see an improvement in the capacity to manage clinical waste.

6.3.3 Social Risk and Impact Analysis

6.3.3.1 Social Risks and Impact Tables

Table 6-23 Summary of Potential Operational Phase Social Impacts for Spanish Town Hospital

No.	Impact Category	Type of Risk and Impact
1	Water Demand	Indirect, Negative, long-term, medium impact, localized (community)
2	Traffic	Indirect, Negative, long-term, small-medium impact, national
3	Health and Safety	Indirect, Negative, long-term, low impact, national
4	Service Capacity	Direct, Positive, long-term, large impact, national
5	Employment	Direct, Positive, long-term, large impact, national

Table 6-24 Summary of Potential Operational Phase Social Impacts for St. Jago Health Centre

No.	Impact Category	Type of Risk and Impact
1	Water Demand	Indirect, Negative, long-term, medium impact, localized (community)
2	Traffic	Indirect, Negative, long-term, small-medium impact, national
3	Health and Safety	Indirect, Negative, long-term, low impact, national
4	Service Capacity	Direct, Positive, long-term, large impact, national
5	Employment	Direct, Positive, long-term, large impact, national

Table 6-25 Summary of Potential Operational Phase Social Impacts for Old Harbour Health Centre

No.	Impact Category	Type of Risk and Impact
1	Water Demand	Indirect, Negative, Long term, Medium impact, Regional
2	Traffic	Indirect, Negative, Long term, low-medium impact, Regional
3	Health and Safety	Indirect, Negative, Long term, Low impact, National (Widespread)
4	Service Capacity	Direct, Positive, Long term, Low, Impact, National
5	Employment	Direct and Indirect, Positive, Long term, National

Table 6-26 Summary of Potential Operational Phase Social Impacts for Greater Portmore Health Centre

No.	Impact Category	Type of Risk and Impact
1	Water Demand	Indirect, Negative, Long term, Medium impact, Regional
2	Traffic	Direct, Negative, Long term, low-medium impact, Regional
3	Health and Safety	Indirect, Negative, Long term, Low impact, National (Widespread)
4	Service Capacity	Direct, Positive, Long term, Low impact, National
5	Employment	Direct and Indirect, Positive, Long term, National

6.3.3.2 Potential Negative Risks and Impacts

Water Demand

Potable water for operations will be sourced from the National Water Commission (NWC). There is the potential for further burdening of the water supply in the area in the event of drought conditions.

MITIGATION

In order to alleviate any potential burden on water supply in the area particularly during times of drought, it is recommended that various storage and conservation measures be put in place such as:

- i. Low flow fixtures
- ii. Dual flush toilets
- iii. Faucets fitted with aerators
- iv. Electronic spigots and flush valves
- v. Water storage (minimum 3-7 days' supply)

Traffic

Increased patient volume has the potential to increase traffic volumes along hospital and health centre routes, adjoining roads and within hospital boundaries. This may also lead to delays (for commuters and emergency response vehicles) and safety hazards (vehicular and pedestrian).

MITIGATION

- i. The hospitals and health centres should ensure that roads, pathways, and access ways are properly maintained to account for increased vehicular traffic.
- ii. Install pedestrian/vehicle barriers to ensure separation of the two to reduce potential of accidents
- iii. Ensure proper signage and functioning signals.
- iv. A Traffic Impact Study is recommended.

Health and Safety

Operations will involve staff and patients who may have accidents. This may include fire safety, safe access routes, clearly defined pedestrian pathways, electrical hazards, eye hazards and radiation hazards. In addition, disasters such as earthquakes, floods and hurricanes are real possibilities. In addition, there is a lack of proper fire safety/protection equipment on the grounds. Some fire hydrants appeared damaged or poorly maintained.

MITIGATION

- i. Designing and implementing an Emergency Response Plan (ERP) in the event of any emergency. This should include:
 - Hurricane
 - Earthquake
 - Flooding
 - Fire
 - Civil Unrest and Riots
 - Bomb Threats and Acts of Sabotage
 - Acts of Terrorism and Armed Attacks
 - Petroleum and Hazardous Material Stockpiling
 - Security and Safety Information
 - Medical Emergency Information
 - Technological Emergencies
- ii. Use of appropriate personal protective equipment (PPE)
- iii. Use of safety signage
- iv. Proper functional fire safety/protection equipment must be installed in and around the hospital. This includes sprinkler systems, hydrants and smoke detectors.

6.3.3.3 Potential Positive Impacts

Service Capacity

There are positive long-term social impacts that include improved access to healthcare and new and improved healthcare services for surrounding communities and those outside of St. Catherine parish.

The programme objective is to improve the health of Jamaica's population by strengthening comprehensive policies for the prevention of Non-Communicable (Chronic) Diseases (NCDs) risk factors and improved access to an upgraded and integrated primary and secondary health network in prioritized areas with an emphasis on chronic disease management, that provide more efficient and higher quality care.

MITIGATION

None required.

Employment

Once fully operational the hospital and health centres expect to employ additional doctors, nurses and other staff. In addition to these direct jobs, indirect and induced jobs will also be created as a result.

MITIGATION

None required.

6.4 CUMULATIVE AND INDIRECT IMPACTS

6.4.1 National Health Services

The project has national significance, positively impacting Jamaica's health care system. The proposed development is part of the mission to improve the quality of health care services and increasing access to those services.

6.4.2 Water Supply

There will be an increase in water demand that will need to be fulfilled by the NWC. Potable water supply to the **Spanish Town Hospital** and **St. Jago Park Health Centre** is supplied by the National Water Commission (NWC). The source of this water is from the Spanish Town Treatment Plant or Rio Cobre. Water demand for the SA in 2021 is estimated to be 24,480,291.40 litres/day (~6,467,009.99 gals/day) and is expected to increase to 26,342,068.88 litres/day (~6,958,839.65 gals/day) over the next twenty-five years based on population growth rates calculated previously. The Spanish Town Treatment Plant or Rio Cobre produces 205,846 m³/month (≈45.28 million imperial gallon (M.I.G.)/month) and the system has excess volume available. The NWC Plant should be able to accommodate the increased water demand of the new development without overburdening the public water supply system.

For the **Old Harbour Health Centre**, the increased water demand will need to be fulfilled by the NWC. Currently the Claremont Well supplies are estimated to be 8,181,410.79 litres/day (~2,161,300.47 gals/day) and is expected to increase to 12,514,625.89 litres/day (~3,306,015.00 gals/day) over the next twenty-five years based on population growth rates calculated. The Claremont Well which produces ≈253,672 m³/month (≈55.8 million imperial gallon (M.I.G.)/month) and the system has excess volume available. The NWC Plant should therefore be able to accommodate the increased water demand of the new development without overburdening the public water supply system.

For the **Greater Portmore Health Centre**, water consumption is anticipated to increase. Water demand for the SIA in 2021 is estimated to be 21,698,496 litres/day (~5,732,137.27 gals/day) and is expected to increase to 30,331,357.51 litres/day (~8,012,698.43 gals/day) over the next twenty-five years based on population growth rates calculated previously. Potable water supply to the Greater Portmore Health Centre is supplied by the National Water Commission (NWC). The source of this water is the Goshen Pen Relift, which has excess volume and sewerage available. The NWC Plant should be able to accommodate the increased water demand of the new development without overburdening the public water supply system.

6.4.3 Traffic

Increased and improved services offered by the proposed project has the potential to result in increased patient volume which may increase traffic volumes along hospital and health centre routes, adjoining roads and within hospital and health centre boundaries. This may also lead to delays (for commuters and emergency response vehicles) and safety hazards (vehicular and pedestrian).

6.4.3.1 Effects on Air Quality

Increased traffic will result in increased vehicular exhaust emissions, negatively affecting air quality to an extent where health of nearby residents may also be negatively impacted.

6.4.4 Waste Streams

6.4.4.1 Non-Clinical Waste

Construction debris, raw materials and packaging materials etc. associated with construction activities will add to the amount of solid waste generated in the area to be collected and disposed of. During operations, increased hazardous waste from fuel and chemical containers etc. will add to the amounts of solid waste being generated. Potential accidental spills of hazardous material should also be considered and its possible effect on water, air, and soil resources.

6.4.4.2 Medical Waste

The proposed project would bring about an improvement in the capacity to manage medical/clinical waste. The increased capacity and services offered with the new hospital facility will not result in any or much additional medical waste as it involves the moving over of existing services. However, in the other phases which will include the expansion of the number of beds (182 additional beds by 2041

(UNOPS, 2018), for a total bed capacity of 585) it is expected that an additional 154.7- 191.1 kg/day (\approx 4.6 -5.7 tonnes/month). The estimated total medical waste generation with a bed capacity of 585 \approx 497.25- 614.25 kg/day (\approx 14917.5- 18427.5 tonnes/month).

6.4.5 Water Quality

There will be an improvement in the water quality of the effluent being discharged into the Rio Cobre from the Spanish Town Hospital WWTP since it will be rehabilitated and upgraded. This will in turn result in an improvement in the water quality of the Rio Cobre river. The plant will be able to accommodate the additional sewage flow from both the existing buildings and the new hospital and SJHC centre building and meet the NRCA discharge effluent standards.

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