9 GEOLOGY, HYDROGEOLOGY AND CONTAMINATION

Introduction

9.1 This chapter assesses the likely significant impacts associated with the proposed Jersey Future Hospital (JFH) with respect to geology, hydrogeology and contamination. The JFH proposals involve the development of two separate site areas, namely the Jersey General Hospital (JGH) and Westaway Court.

9.2 The baseline geological, hydrogeological and contaminative aspects of the proposed site have been determined following a review of all available desk based information and, consultation with the States of Jersey (SoJ). An assessment of effects has been carried out using qualitative analysis and mitigation identified where required.

Review of proposed development

9.1 Within this chapter reference is made to the 'Proposed Development' this can be defined as the any works within the redline boundary as shown on Figure 1.1, including the new developments at both the main JGH and Westaway Court sites.

9.2 The main hospital area (JGH) is bounded by The Parade to the east, Kensington Place to the north, Gloucester Street to the south and external buildings to the west. Additional works will take place at Westaway Court, within the existing site area.

9.3 Currently no major areas of landscaping are proposed. However, it is likely that there would be areas of public realm surrounding the proposed development, which would be covered with hardstanding.

Jersey General Hospital (JGH)

9.4 The construction of a basement is proposed beneath the footprint of the proposed JFH. The basement would link the service block to the main building with the basement passing beneath the proposed extension of Newgate Street to Kensington Street. The western end of the basement north of Patriotic Street Multi-Story Car Park (MSCP) is proposed to house one of the lift cores and service yard access. It is likely that the basement excavation would be to approximately 4.5m AMSL[1] across the majority of its proposed extent. However, excavations are likely to extend a further 3m in localised areas for the lift pits and associated pile caps. Therefore, maximum excavations to 1.5m AMSL could be required subject to final basement proposals. At the time of writing this EIA, the basement proposals had not be finalised.

[1] Datum is AMSL – Above Mean Sea Level.

9.5 It is anticipated that the proposed JFH would be founded on piled foundations. In addition to this, secant piling[2] is likely to be required to allow for the formation of the basements. The extent of secant pile wall is to be confirmed but it is anticipated to be required along all walls of the proposed basement. The piled foundations (including the secant pile walls) are likely to be socketed within bedrock (encountered at approximately -4m AMSL).

Westaway Court

9.6 Current proposals are for Westaway Court to be redeveloped fronting Elizabeth Place and Savile Street, rising to 2, 3 and 4 storeys, with vehicular access/egress onto Savile Street and a layby for Patient Transport Services on Elizabeth Place. It is anticipated that piled foundations would be required for this structure. These are likely to be socketed into the bedrock, (encountered at approximately -3m AMSL). No basement is proposed to be constructed at Westaway Court. It is however likely that local excavations would be required for any lift pits and associated pile caps.

Proposed Ground Investigation works

9.7 In order to confirm the ground and ground water conditions beneath the proposed development, a ground investigation (GI) has been proposed. The proposed GI comprises 12 boreholes in total to varying depths, two phases of groundwater monitoring and a range of geotechnical and geo-environmental in-situ and laboratory testing. Due to access restrictions on site and the project programme, the GI has been split into two phases, these are referred to throughout this chapter and are defined here. Their proposed locations are detailed on Figure 9.3.

9.8 Phase 1 – This comprises 9 boreholes split across the JGH and Westaway Court sites along with the associated monitoring and testing regimes. This phase is intended to provide early information to the Designers in advance of demolition works across the site. At the time of writing this EIS, this phase of GI had commenced, with 6 of the boreholes complete. However, only draft logs and partial test results were available, in addition the period of groundwater and ground gas monitoring had not yet commenced.

9.9 Phase 2 – This comprises 3 boreholes located within the existing hotels along Kensington Place. These buildings, whilst not currently part of the JGH site would form part of the proposed development, as such this phase of GI is programmed to be completed after they have been demolished. A separate monitoring and testing regime is proposed for this phase.

[2] Secant piling is a piling technique that allows the construction of an effective barrier against groundwater flows by forming a continuous wall of interlocking piles (commonly referred to as a secant pile wall).

Legislation, policy context and guidance

Legislation

9.10 See Table 9.1 for key legislative drivers considered within this assessment and relating to geology, hydrogeology and contamination:

Table 9.1: Key Legislation

Legislation	Description	Relevance
Building Bye-Laws (2007) Jersey Law, Building Bye-Laws (Jersey) 2007, https://www.jerseylaw.je/laws/revised/PDFs/22.550.05.pdf	Sets out the general frameworks for the control of building work. Schedule 2 details the requirements of any new structure to be constructed.	Schedule 2 Part 1 - 1.2 refers requirements of any structure in relation to potential ground movement. Part 3 - 3.6 sets out responsibilities regarding the protection against pollution. These responsibilities specifically detail protection measures regarding oil storage tanks. Part 4 – Generally refers to the site preparation, resistance to moisture and ground based contamination.
Waste Management (2005) Jersey Law, Waste Management (Jersey) Law 2005, https://www.jerseylaw.je/laws/revised/PDFs/22.950.pdf	Sets out responsibilities and duties of waste producers and handlers with respect to duty of care including licencing for waste management, registration of waste carriers.	The legislation requires control and remediation of potential pollution caused by waste. It provides categories of hazardous waste per waste streams and the respective constituents. Construction waste (including soils) are not identified as a potential waste stream of hazardous waste.
Waste Management Order (2006) Jersey Law, Waste Management (Exemptions from Licensing) (Jersey) Order 2006, https://www.jerseylaw.je/laws/revised/PDFs/22.950.20.pdf	Lists waste types and waste management activities that are exempt from a waste management licence.	Storage of a controlled waste (including 'articles that are to be used for construction work and are capable of being so used in their existing waste' and may include soils) is exempt from licencing if the storage is no longer than 12 months. Excluding hazardous waste.
Water (1972) Jersey Law, Water (Jersey) Law 1972 (Revised 2016), https://www.jerseylaw.je/laws/revised/PDFs/27.700.pdf	Part 5 sets out framework for conservation and protection of water resources.	Any person who pollutes any water resources is guilty of an offence.

Legislation	Description	Relevance
Water Pollution (2000) Jersey Law, Water Pollution (Jersey) Law 2000, https://www.jerseylaw.je/laws/revised/PDFs/27.800.pdf	This legislation defines controlled waters as territorial sea adjacent to Jersey, coastal waters, inland waters and groundwater.	It sets out the framework for discharge permits. Where pollution of controlled water may occur, control measures (including monitoring) may be required. Where pollution has occurred, remediation may be required.
Water Resources (2007) Jersey Law, Water Resources (Jersey) Law 2007, https://www.jerseylaw.je/laws/revised/PDFs/27.960.pdf	Sets out requirements with respect to water abstraction or impoundment.	Water abstraction during construction works does not require a water resources licence.
Petroleum Spirit Regulation (2001) Jersey Law, Petroleum-Spirit (Storage) (Jersey) Regulations 2001, https://www.jerseylaw.je/laws/revised/PDFs/27.400.75.pdf	Sets out requirements for storage of petroleum substances.	Relevant to any fuel storage facilities that may need to be constructed on-site for the provision of on-site plant machinery.
Statutory Nuisances (1999) Jersey Law, Statutory Nuisances (Jersey) Law 1999, https://www.jerseylaw.je/laws/revised/PDFs/22.900.pdf	Sets out procedures for dealing with statutory nuisances.	This legislation identifies 'any premises in such a state to be prejudicial to health or a nuisance' has been identified as a statutory nuisance and thus may be applicable to land contamination.

Policy context

9.11 The States of Jersey Island Plan 2011 (Revised 2014) sets out a number of policies that are relevant to the JFH proposed developments.

9.12 States of Jersey Revised Island Plan 2011, General Development Control Policies [3]

- Policy GD 6 – Contaminated Land.

9.13 Land contamination, or the possibility of it, is an important consideration when decisions are made about proposals to develop land. Jersey's Revised Island Plan 2011 Policy GD6 - Contaminated Land sets out the approach to development on potentially contaminated sites. These require that the development is safe and suitable

[3] States of Jersey, Island Plan 2011:Revised (2014), General Development Control Policies, http://consult.gov.je/portal/policy/pd/ip2011?pointId=1405696217785#section-1405696217785

for use. This is to be undertaken by means of GI, risk assessments and remediation, if required [3].

9.14 States of Jersey Revised Island Plan 2011, Natural Environment [4]

- Policy NE 1 – Conservation and enhancement of biological diversity.

9.15 This policy states that, permission for a proposed development will not be given if there is the potential for the total or partial loss of a protected site or if the development would seriously affect the biological diversity of the area.

9.16 States of Jersey Revised Island Plan 2011, Natural Resources and Utilities [5]

- Policy NR1 – Protection of Water Resources.

9.17 The policy states that, development that would have an unacceptable impact on the aquatic environment, including surface water and groundwater quality and quantity, will not be permitted. If a development is proposed within the Water Pollution Safeguard Area, then Jersey Water need to be consulted prior to determining the planning application.[5]

Relevant guidance

9.18 Relevant guidance for this assessment has included:

- Supplementary Planning Guidance, planning Advice Note 18, Environmental Impact Assessment, July 2011[6].
- Supplementary Planning Guidance, document Planning Advice Note 2, Development of Potentially Contaminated Land, October 2005[7].

9.19 For all waste management related guidance referring to ground material waste refer to the Waste chapter of this EIS report.

[4] States of Jersey, Island Plan 2011:Revised (2014), Natural Environment, http://consult.gov.je/portal/policy/pd/ip2011?pointId=1405696217793#section-1405696217793
[5] States of Jersey, Island Plan 2011:Revised (2014), Natural Resources and Utilities, http://consult.gov.je/portal/policy/pd/ip2011?pointId=1405696217970#section-1405696217970
[6] States of Jersey, Supplementary Planning Guidance, Planning Advice Note 18, Environmental Impact Assessment, July 2011, https://www.gov.je/SiteCollectionDocuments/Planning%20and%20building/SPG%20-%20Practice%20Note%2018%20-%20Environmental%20Impact%20Assessment.pdf
[7] States of Jersey, Supplementary Planning Guidance, Planning Advice Note 2, Development of Potentially Contaminated Land, October 2005, https://www.gov.je/SiteCollectionDocuments/Planning%20and%20building/SPG%20-%20Advice%20Note%202%20-%20Development%20of%20Contaminated%20Land.pdf

Consultation

9.20 A number of stakeholders were consulted in relation to geology, hydrogeology and contamination during the scoping stage of the environmental impact assessment. From review of the responses to the scoping report, there were no relevant comments to be addressed with regards to this chapter.

9.21 In addition to the consultation responses received from the scoping report, additional consultation was undertaken for specific information requests as part of the original environmental impact assessment. The responses have enabled the relevant assessments to be undertaken within this chapter. Various stakeholders from the States of Jersey, including those from the Department of the Environment and Department of Infrastructure, have been consulted regarding the following:

Department of the Environment, Environmental Protection, Jody Robert

i. Designated groundwater/aquifer or surface water sites
ii. Recorded pollution incidents
iii. Potential contamination sources/trade directory/fuel tanks
iv. Designated geological sites in the area
v. Mineral extraction legislation

Department of the Environment, Head of Waste Regulation, David Monks

i. Current and historical landfill sites
ii. Recorded pollution incidents
iii. Potentially contaminated land
iv. Potential contamination sources/trade directory/fuel tanks

Department of Infrastructure, Waste Compliance/Operational Service Manager, Lou Wagstaffe

i. Discharge licenses
ii. Potentially contaminated land

Building Services, Health and Social Services, States of Jersey, Graeme LeSueur

i. Jersey General Hospital on-site borehole information
ii. Engineering block oil tanks information

9.22 A summary of the information exchange between the aforementioned stakeholders on the respective topics is provided in Table 9.2 below. For a detailed record of the consultation responses received refer to Appendix A-1 (Scoping Responses).

9.23 Since the above consultation period, phase 1 of the GI works is now ongoing, with draft information available for part of the scheduled boreholes only. In addition, not all laboratory testing has been completed and the period of groundwater and gas monitoring has not commenced. The below consultees have been advised of this change and notified that the received draft GI information would be acknowledged in setting out the baseline conditions, whilst a full assessment of that draft and partial data would not be completed.

Table 9.2: Summary of information exchange

Stakeholder	Comment	Response
Department of the Environment, Environmental Protection, Jody Robert	Initial request for information regarding groundwater, pollution incidents / contamination and geological constraints. Additional consultation to request Parade gardens borehole data / usage and recorded pollution incident details.	Information used during baseline formation and within assessments.
Department of the Environment, Head of Waste Regulation, David Monks	Information request for current and historical landfill sites within close proximity to the site, recorded pollution incidents and potentially contaminated land.	Information used during baseline formation and within assessments.
Department of Infrastructure, Waste Compliance / Operational Services Manager, Lou Wagstaffe	Request for information regarding discharge licenses within proximity to the Jersey General Hospital site and additional request for any information on potentially contaminated land.	Information used during baseline formation and within assessments.
States of Jersey, Graeme LeSueur, Building Services	Additional Jersey General Hospital site specific information regarding the on-site borehole (Granite block car park) and the oil tanks within the engineering block was requested.	No response received.

Methodology

Overview

9.24 The assessment has been undertaken using qualitative analysis and is based on professional judgement, statutory and general guidance in accordance with the

Supplementary Planning Guidance document provided by SoJ concerning Environmental Impact Assessments Note 18 [8].

Methodology for establishing baseline conditions

9.25 The study area for the assessment includes the redline boundary (as shown on Figure 1.1) plus a 300m buffer zone around the site.

9.26 Baseline conditions have been established based on information gathered as part of the geotechnical desk based study for the proposed development and which includes a review of the following sources of information:

i. Published geological maps and memoirs;

- The British Geological Survey (BGS) hold no digital mapping data for the Channel Islands. Therefore, Geological information has been reviewed from the following sources:
  - Jersey Channel Islands Sheet 2 at 1:25,000 scale Geological map; [9]
  - Jersey Channel Islands geological memoir.[10]

ii. Published hydrogeological maps; [11]

iii. Available information from previous GI extracts (See Appendix F-2) with acknowledgment of the draft data obtained from the currently on-going Phase 1 GI – see section 9.8;

iv. Online aerial photography (Bing);

v. Available historical documents referring to the Jersey General Hospital and Westaway Court sites:

- The history of the proposed development has been reviewed using historical plans, aerial photos and published information and historical documents relating to the hospital site dating between 1741 and 2016 [12] [13] [14] [15].

[8] States of Jersey, Planning Advice Note 18, refer to footnote 6 above.
[9] Institute of Geological Sciences, Channel Islands Sheet 2 – Jersey, 1:25'000 scale, 1968
[10] British Geological Survey, Geological Memoir, Description of 1:25'000 scale Channel Island Sheet 2 – Jersey, 1989
[11] British Geological Survey, Hydrogeological Map of Jersey, 1:25'000 scale, 1992, http://www.largeimages.bgs.ac.uk/iip/mapsportal.html?id=1003992
[12] The Public Health Committee, Centenary year of the re-opening of the General Hospital 1863-1963
[13] Chronological History of the Jersey General and Acute Hospital, Mr M Le Fevre, Director of Estates, 2004
[14] Jersey through the Lens again, E. Bois, H.M.ds Ste. Croix, A. Young, 1975
[15] A History of the Island of Jersey, G.R. Balleine, 1950

vi. Available general arrangement and 'As built' drawings of the existing buildings.

9.27 The geotechnical desk study focused on the proposed development, details of the site (including site location, site history and published geology) and ground and groundwater conditions gathered from previous GI studies. The desk study also looked at radon protection requirements, risk of unexploded ordnance (UXO), hydrogeology, hydrology and the potential for contamination at the site. A copy of the Arup Geotechnical desk study is included in Appendix F-1.

9.28 Baseline data has also been obtained from the SoJ Department of the Environment and Department of Infrastructure.

9.29 As part of the establishment of baseline conditions, an initial baseline Conceptual Site Model (CSM) has been produced which identifies all known viable sources, receptors and pathways for contamination.

9.30 As discussed in Section 9.8, Phase 1 of the JFH GI is currently ongoing, partial draft factual information (such as exploratory hole logs) is available for these, however laboratory testing and in-situ groundwater and ground gas monitoring is not complete. The draft information has been acknowledged in setting out the baseline conditions, however a full assessment of the draft and partial data has not been completed. On receipt of the final factual information and monitoring results a full assessment would be undertaken.

Assessment methodology

9.31 Assessment of the likely impact on the geology, hydrogeology and land contamination arising from construction or operation of the proposed development is undertaken by review of baseline conditions in a context of the proposed construction works and/or end site operation.

Geology and Hydrogeology – Assessment Methodology

9.32 The assessment of construction and operational effects includes consideration of possible effects on statutory and non-statutory geological sites within the study area and the effects on the hydrogeology beneath the site and the surrounding area. The assessment also considers effects posed by potential contaminated land exposure resulting from the proposed development.

9.33 Initially, as mentioned above, a review of the baseline data identifies the existing geological and hydrogeological features beneath the site. Review of the baseline conditions also refines the extent of potentially contaminated land sites within the study area. The assessment details the possible effects, both adverse and beneficial, to the baseline conditions that the construction and operational phases of the proposed

development may cause. The significance of these effects is then determined, see the significance section below.

Contamination – Assessment Methodology

9.34 Assessment of effects in relation to contamination has been undertaken in accordance with industry best practice as presented in CLR11 (Environment Agency and Defra, 2004)[16].The risk assessment process is underpinned throughout by the development of the Conceptual Site Model (CSM), which provides a schematic representation of the identified Pollutant Linkages.

9.35 The process involves a simple and conservative assessment of potential risks from possible Pollutant Linkages (Source-Pathway-Receptor). At this stage, potential Pollutant Linkages are identified together with the required investigations to confirm whether such a linkage is viable, e.g. where there is a possibility of presence of made ground, soil sampling and laboratory testing would be recommended.

9.36 In order to assess the possible contaminative impacts of the proposed development, the baseline CSM is then revised to include new Pollutant Linkages that may arise during construction and operation. These revised CSMs have then been used to establish the additional impacts that could occur as a result of construction and operation and determine any potential need for further assessment. These individual impacts are discussed in detail and the overall significance of the impact is determined. The overall significance of the impact determines if additional mitigation, over and above design mitigation, is required.

Significance Criteria – geology and hydrogeology

9.37 The significance of an environmental impact is determined by the interaction of the sensitivity of the receptor and the magnitude of the impact, whereby the impact can be beneficial or adverse. The criterion for assessing the significance of the impact takes account of the following factors:

- The value of the resource (international, national, regional and local level importance);
- The magnitude of the impact;
- The duration involved;
- The reversibility of the effect; and

[16] Environment Agency, Defra, Model Procedures for the Management of Land Contamination, Contaminated Land Report 11, http://webarchive.nationalarchives.gov.uk/20140328084622/http:/cdn.environment-agency.gov.uk/scho0804bibr-e-e.pdf

- The number and sensitivity of receptors.

Sensitivity

9.38 The value or sensitivity of the receptor has been classified into one of the three criteria shown in Table 9.3.

Table 9.3: Methodology for determining sensitivity of receptor

Sensitivity	Description
Very high	**Geology/Mineral resource** Very rare and of very high national and regional geological/geomorphological importance with no potential for replacement (e.g. designated sites of national importance including SSSI, active quarries and mining activities of national importance). **Controlled Waters (groundwater/surface water)** Water resources providing water to a large population. European Community (EC) Designated Salmonid/Cyprinid fishery. Site protected/designated under EC or UK wildlife legislation (SAC, SPA, SSSI, WPZ, RAMSAR Site, salmonid water)/species protected by EC legislation. **Land Contamination** Human health (High sensitivity land use scenario e.g. residential with gardens and allotments).
High	**Geology/Mineral Resources** Of medium national and high regional geological/ geomorphological importance with limited potential for replacement (e.g. currently non-designated GCR site, regionally important site, active quarries and mining activities of regional or local importance). **Controlled Waters (groundwater/surface water)** Water resources providing potable water to a small population. Major Cyprinid Fishery Species protected under EU or UK habitat legislation. **Land Contamination** Sensitive receptor which is the reason for ASSI designation. Human health (Lower sensitivity land use scenario e.g. mixed use (residential without gardens), public open space, commercial, industrial).
Medium	**Geology/Mineral Resources** Of low regional and high local geological/ geomorphological importance with some potential for replacement. **Controlled Waters (groundwater/surface water)** Water resources supporting abstraction for agricultural or industrial use. **Land Contamination** Human health (Lower sensitivity land use scenario e.g. construction site). A receptor which is of local importance.
Low	**Geology/Mineral resources** Of little local geological/geomorphological interest. **Controlled Waters (groundwater/surface water)** Limited potential for use of water resources e.g. impacted by saline intrusion. **Land Contamination** Receptor with low importance and rarity.

Magnitude

9.39 The magnitude of impact is assessed independently of the site value and assigned to one of the identified categories (Table 9.4) based on professional judgement.

Table 9.4: Methodology for Determining Magnitude of Impact

Magnitude	Description
Major	**Geology/Mineral resources** The proposals are very damaging to the geological environment/soils resource of the area. May result in loss or damage to areas designated as being of regional or national geological interest. Loss of resource and/or quality and integrity of resource. Severe damage to key characteristics, features or elements. Impacts cannot be mitigated for (e.g. destruction of a designated site (SSSI or RIGS)). **Controlled Waters (groundwater/surface water)** Reduction of water quality rendering groundwater or surface water unfit to drink and/or substantial adverse impact on groundwater dependent environmental receptors. Discharge of hazardous substances to groundwater. **Land Contamination** Major effect upon receptor. Severe or irreversible effect on human health. Temporary severe or irreversible effect on ground/surface water quality.
Moderate	**Geology/Mineral resources** The proposals may adversely affect the geological/hydrogeological conditions/soils resource existing at the site but would not result in the loss of, or damage to, areas designated as being of regional or national geological interest. Loss of resource, but not adversely affecting the integrity. Partial loss of/damage to key characteristics, features or elements. Some mitigation may be possible but would not prevent scarring of the geological environment, as some features of interest would be lost or partly destroyed. **Controlled Waters (groundwater/surface water)** Reduced reliability of a supply at a groundwater or surface water abstraction source. Discharge of non-hazardous substances to groundwater and surface water resulting in pollution (i.e. contaminants present above the EQS) **Land Contamination** Moderate effect upon receptor. Long term or short term moderate effect on human health. Moderate effect on ground/surface water quality, reversible with time.
Minor	**Geology/Mineral resources** The proposals would not affect areas with regional or national geological interest/soils resource but may result in the loss of or damage to, areas of local geological/soils resource interest. Cannot be completely mitigated for but opportunities exist for the replacement of lost or damaged areas which may be of similar local geological/soils interest. **Controlled Waters (groundwater/surface water)** Marginal reduced reliability of a supply at a groundwater or surface water abstraction source. Discharge of non-hazardous substances to groundwater and surface water not resulting in pollution (i.e. contaminants present below the EQS). **Land Contamination** Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.). Slight effect on ground/surface water quality, reversible with time.

Magnitude	Description
Negligible	**Geology/Mineral resources** The proposals would result in very minor loss or damage to local area of geological interest/soils resource such that mitigation is not considered practical. Very minor loss or detrimental alteration to one or more characteristics, features or elements. **Controlled Waters (groundwater/surface water)** Non-measurable change to quality, level and flow. **Land Contamination** Results in no discernible change or an impact on attribute of sufficient magnitude to affect the use/integrity. e.g. Soil contaminants present, but risk assessment suggests negligible/ low risk to human health.

Assigning Significance

9.40 The significance of an environmental impact is determined by the interaction of the sensitivity of the receptor and the magnitude of the impact, whereby the impact can be beneficial or adverse. The assessment of the significance of the impact takes account of the following factors:

- The value of the resource (international, national, regional and local);
- The magnitude of the impact;
- The duration involved;
- The reversibility of the effect;
- The number and sensitivity of receptors.

9.41 Descriptions of each of the significance criteria within this ES are presented in Table 2.6.

9.42 The significance matrix combines the perceived impact magnitude and the sensitivity of the receptor/s to determine the overall significance of the effect (Table 9.5).

Table 9.5: Significance Matrix

Magnitude	Sensitivity			
	Very High	**High**	**Medium**	**Low**
Major	Major	Major	Major	Moderate
Moderate	Major	Major	Moderate	Minor
Minor	Major	Moderate	Minor	Negligible
Negligible	Moderate	Minor	Negligible	Negligible

Significance Criteria – Contamination

9.43 The effects of ground contamination have been assessed following the conceptual site model (CSM) methodology. The conceptual site model consists of the following components: source, pathway and receptor. For the pollutant linkage to be effective i.e. there is a potential for a risk of a significant harm to human health or water resources, all three components need to be present. All components of the pollutant linkage have been reviewed and the significance of impacts has been derived based on potential linkage presence. An indication of impact duration has also been made.

Limitations and Assumptions

Limitations

9.44 As discussed in Section 9.8, Phase 1 of the GI for the proposed development is currently on-going. Draft exploratory hole logs are available for six boreholes, however three boreholes are outstanding and not all laboratory testing has been received at the time of writing. The period of groundwater and ground gas monitoring has not yet commenced, which would provide baseline groundwater concentrations and ground gas composition. The proposed Phase 2 GI will be progressed on demolition of the buildings along Kensington Place.

9.45 Notwithstanding this limitation it is considered that sufficient information is available to assess the likely geological, hydrological and contamination impacts.

Assumptions

9.46 The assessment of effects has been undertaken based on the following assumptions:

- Pollution control measures based on best working practices would be implemented during construction. The assessments have been based on the assumption that management of environmental issues arising during construction that will be detailed in the CEMP e.g. materials storage and management during construction, pollution prevention measures associated with accidental spillages of construction materials and fuel, would be undertaken in line with good current practice and as such would not have an impact on identified receptors;
- Any discharge to the ground or surface water would only be carried out with appropriate approval from SoJ, following monitoring and if needed, treatment to ensure it is of acceptable quality with respect to the controlled water receptors; and
- The reuse of site won, or import of, materials to the proposed development would be managed by a verification system applied via a remediation strategy and remediation implementation and verification plan, and only materials suitable for use would be acceptable for construction works.

9.47 Prior to construction, the currently on-going Phase 1 GI and proposed Phase 2 GI (post-demolition) would identify any areas of potentially contaminated land in the investigated locations. These would inform the management of any health and safety issues during construction that would be undertaken in line with current best practice. However, in common with all similar developments there will remain a residual risk that localised contaminated land may be encountered in those areas that are not directly investigated as part of the GI.

9.48 Measures would be put in place during construction to control potential pollution incidents caused by accidental leaks and spills of fuels and oils stored on site for

construction plant and machinery as outlined in the CEMP. Therefore, it has been assumed in the assessment of construction effects that the management measures and the construction strategy are adopted and are effective.

Baseline Environment

Site Description

Jersey General Hospital (JGH)

9.49 The JGH site is roughly 'rectangular' measuring approximately 230m by 160m. It is bounded to the northeast by The Parade, to the southeast by Gloucester Street, to the southwest by Newgate Street and Patriotic Street and to the northwest by Kensington Place, (refer to Figure 9.1).

9.50 The JGH site generally slopes from north to south. Based on Ordnance Survey levels the elevation at the northern corner of the site is 12.8mOD whilst the southern corner is at 7.6mOD. Therefore, the site has an approximate fall in level of 5.2m from north to south generally sloping towards the sea shore. There is also a change in elevation along an approximate west to east alignment where the ground level drops from 10.9mOD at Kensington Place to 7.6mOD on Gloucester Street.

9.51 The JGH site is currently an active hospital with a congested building layout that has been developed across the 19th, 20th and 21st centuries, refer to Figure 9.1. Review of general arrangement drawings has revealed that the majority of the hospital buildings, except the (Grade I) listed Granite Block, are founded on piled foundations. The Granite Block, which is shown on available historical drawings to be supported on shallow foundations, is to remain as part of the JFH proposed developments.

9.52 A temporary theatre block currently exists within the Granite Block car park as shown on Figure 9.1

Photograph 1 – Internal courtyard area

9.53 There are a number of existing courtyard areas within the existing JGH buildings. From review of aerial photography and site walkover photos, the courtyards have hard paving covering the majority of the area with localised planting pockets containing trees and shrubs. See Figure 9.2 for the location of the vegetated areas within the JGH courtyards.

Westaway Court

9.54 Westaway Court is located approximately 100m to the northeast of the JGH site. The site is bounded by Saville Street to the northeast, Elizabeth Place to the northwest, Parade Gardens to the southwest and Maison Le Pape (Jersey Environmental Health) to the southwest. The site currently comprises of two buildings, a square nine storey tower block and a four storey 'L shaped' building, these are all divided into four blocks (A to D) as depicted on Figure 9.1.

9.55 A large car park is located adjacent to Saville Street, which connects to an inner car park between the buildings. These car parking areas have hard paving covering the majority of the area with localised planting pockets containing shrubs.

9.56 A review of the as-built records for the buildings indicates that piled foundations were used.

Site History

9.57 A detailed review of all the historical information available for JGH and Westaway Court is set out in the Geotechnical Desk Study Report (Arup, November 2016). A summary of the most significant and relevant historical evidence is presented below.

9.58 Refer to Figure 9.1 for the locations of each block of the Jersey General Hospital and Westaway Court.

Jersey General Hospital (JGH)

9.59 The Jersey planning portal[17] indicates the first foundation stone for the first 'poor house' building was laid in 1765 with the building completed in 1768. The 'poor house' is indicated to have burnt down in 1783 and in 1793 a hospital building was built in its place.

9.60 The JGH site has been continuously developed since 1765 with larger scale construction occurring in the late 20th century. The constant development of the JGH site increases the likelihood that made ground would be present beneath the site.

9.61 Richmond Map dated 1795 shows the Granite Block building footprint and an entrance track to the south-eastern side of the building. Beyond the south-eastern boundary buildings are shown to be present off the present day Parade Road, with open undeveloped areas to the north-east, north and south-west. A surface water feature (believed to be the 'Le Faux Bie' stream) flows in a westerly direction towards the southern corner of the site at which point it changes direction to flow in a south-westerly direction where it discharges at St Aubin's Bay. At some point during the development

[17] States of Jersey, Jersey Planning Portal, Historic Environments, St Helier, https://www.mygov.je/Planning/Pages/HistoricEnvironmentDetail.aspx?s=3&r=HE1003

of area it would appear that the stream has been culverted. See Figure 9.2 for the approximate route of the 'Le Faux Bie' culvert.

9.62 Refer to the heritage section (Chapter 11) of this report for a greater detailed historical review of the JGH site.

Westaway Court

9.63 Historical mapping has shown that the Westaway Court site was green-field (meadows) up until 1843 when the first mapped building was constructed on the Westaway Court site. Construction drawings dating from 1974 (Block C) and 1993 (Block D) give an indication of the construction date for the current existing buildings.

9.64 Refer to the heritage section (Chapter 11) of this EIS for a greater detailed historical review of the Westaway Court site.

Geology

9.65 This section provides a review of the ground conditions beneath the proposed development. The baseline ground conditions are established from published geology and information from previous GI. The below presented ground conditions are generally in line with the draft information obtained to date from the ongoing GI.

Jersey General Hospital (JGH)

Made ground

9.66 The site is surfaced with hard standings or buildings and has been continuously developed since 1765 with more concentrated large-scale construction developments occurring more recently. Therefore, made ground is anticipated to be present at the JGH site relating to the construction platforms of the historical and existing buildings on the site.

Superficial deposits

9.67 The geological map shows the site to be overlain by Blown Sands superficial deposits typically comprising a structureless quartz-feldspar with low shell content. The underlying Alluvium can comprise organic silts and muds with peat layers up to 2m thick, and often lenses and layers of coarser grained material, especially towards the base [18] [19].

9.68 Anecdotal evidence indicates that during the construction of the existing basement to the north-west of the original Granite Block there was a loss of material due to what was described as 'running sand' from the corner of the building resulting in superficial

[18] Institute of Geological Sciences, Geological Map, refer to footnote 9 above.
[19] British Geological Survey, Geological Memoir, refer to footnote 10 above.

damage. The Granite building was then underpinned with concrete to stabilise the north-western corner. No further details are currently available on these works. The evidence was gained from a Rothwell engineer who was present at the time of the event.

Bedrock

9.69 The JGH site lies on the boundary between the Jersey Shale Formation and St Saviour's Andesite Formation[18 19].

9.70 The Jersey Shale Formation (JSh) comprises mudstone, sandstone and grit. The St John's Road Andesite (JA) portion of the St Saviour's Andesitic Formation is shown to underlie the north-western corner of the site[18 19].

9.71 The St John's Road Andesite (JA) forms the eastern outer limb of the north-east to south-west trending fold called the St Helier syncline. The dip of the eastern limb is indicated to be approximately 80° to the west[18 19].

Westaway Court

Made Ground

9.72 Ground investigations to date have encountered made ground present on the site anticipated to relate to the construction platform for the historical and existing buildings and activities at the site. The site is surfaced with hard standings or buildings.

Superficial deposits

9.73 The Westaway Court site is indicated to be underlain by the same Alluvial superficial deposits which lie underneath the Blown Sand deposits found on the JGH site. Comprising silts, muds and peat layers up to 2m thick. Coarser grained material is anticipated to be more dominant towards the base of the sequence.

9.74 During Phase 1 of the GI, a 3m layer of sand was encountered beneath the made ground at Westaway Court.

Bedrock

9.75 The geological plan for Jersey, indicates Westaway Court to be underlain by the Jersey Shale Formation (JSh). However, during Phase 1 of the GI, which included one borehole at Westaway Court, the St John's Road Andesite (JA) was encountered.

Hydrogeology

Groundwater

9.76 Some Blown Sand[20] superficial deposits on the island are known to form shallow productive aquifers. Public groundwater abstraction points from the Blown Sand deposits are known to exist in the St Ouen's Bay area some 10km to the west of the proposed development. However, the blown sand deposits that underlie the JGH and Westaway Court sites are not publically utilised like the similar deposits in St Ouen's Bay. From review of the hydrogeological map of Jersey[21], the blown sand deposits along the south and east coasts are generally considered unsaturated. Despite this, groundwater strikes have been recorded within blown sand stratum during previous GI (see ground conditions section below). Therefore, despite the potential for groundwater to be encountered within the blown sand deposits beneath the site, the groundwater is not considered to be part of a productive aquifer that is utilised for public supply.

9.77 As mentioned in the Geology section above, the proposed development lies on the boundary between a Volcanic Group (St Saviour's Andestite Formation) and the Jersey Shale Formation. These formations have varying hydrogeological properties.

9.78 The Volcanic Group is a thick rhyolite and andesite volcaniclastic sequence deformed by a number of fold structures, minor faults and locally developed cleavage. Sustainable borehole yields range from 0.1-0.6 l/s however higher sustainable yields have been achieved meaning the average value for borehole specific capacity is 1.2 l/s/m. Hydraulic conductivity in the Volcanic group ranges from 0.2m/d to 13m/d.[22]

9.79 The Jersey Shale Formation consists very fine to medium-grained sandstone units with subordinate mudstones and conglomerates. Secondary permeability is available is the uppermost 40m derived from faults and fractures. Mean sustainable yield of boreholes is 0.6 l/s with the mean borehole specific capacity is only 0.6 l/s/m. The hydraulic conductivity of the Jersey Shale Formation is of the order of 1-10m/d.[22]

9.80 Based on the topography of the land, review of the hydrogeological map of Jersey [22] and the fact that St. Aubins Bay is located to the southwest of the sites, groundwater is currently anticipated to flow from northeast to southwest.

Boreholes and other abstraction points

9.81 Groundwater is not used as a widespread source of public water in Jersey [23] which is predominantly derived from rainfall dependent surface waters. Jersey Water operate six impounding water storage reservoirs across the island that supply all areas covered by the water main network. However, Jersey Water have abstracted from groundwater

[20] Blown Sand is a type of superficial geological deposit generally comprising uncemented fine grained sands. Blown Sand deposits are common in coastal areas.
[21] British Geological Survey, Hydrogeological Map, refer to footnote 11 above.
[22] British Geological Survey, Hydrogeological Map, refer to footnote 11 above.
[23] States of Jersey, Department of the Environment, Challenges for the Water Environment of Jersey, A summary of the main water management issues, November 2014

sources to support public water supplies in the past. These public groundwater abstraction points are not in the direct vicinity of the site and are some 10km to the west in the St Ouen's Bay area[23] [24].

9.82 From review of the Hydrogeological map of Jersey[25] a selection of known wells and/or boreholes capable of sustaining abstraction of >3m^3/d have been identified to the northeast of the proposed development. The most relevant of these is located in Parade Gardens, approximately 70m to the west of the JGH site and 130m to the south of Westaway Court refer to Figure 9.2. Through consultation with SoJ (Department of the Environment) it has been determined that the borehole in Parade Gardens is used for irrigation of the park and not public supply. The States of Jersey water pollution risk map [26]confirms the location of the aforementioned borehole and details the locations of several other boreholes and wells within the study area including a singular borehole within the site boundary in the Granite Block car park. The usage of this borehole, both past and present, is currently unknown. Based on review of site photography, the location of this borehole (Figure 9.2) appears to be covered by the temporary theatre building. Consultation has revealed no direct constraints regarding the Granite block borehole.

9.83 In addition to the aforementioned boreholes, there may be other private unlicensed groundwater abstraction points present within the site vicinity, which the SoJ would hold no information on.

9.84 The proposed development is not within the Water Pollution Safeguard Area[26].

Hydrology

9.85 There are no identifiable surface water features at the JGH or Westaway Court sites.

9.86 However, from review of all available historical mapping of the JFH site a historical stream has been identified. The 'Le Faux Bie' stream originally ran through St Helier within a close proximity to the proposed development. At some point during the development of area the stream was culverted (and is now labelled as 'Brook Culvert' on DfI plans). Based on all available drawings the culvert is anticipated to be of masonry construction. The integrity of the culvert structure is currently unknown and therefore there is the potential for groundwater ingress into the culverted stream, dependent on groundwater levels. The route of this culvert has been identified from a drawing provided by Rothwell & Partners Ltd, which shows the culvert coming in towards Gloucester Road from the southeast before turning approximately 90^o and running southwest along the route of Gloucester Street towards the Esplanade.

[24] Jersey Water, Water Sources, Groundwater Resources, https://www.jerseywater.je/about-us/learn-more/ground-water-resources/
[25] British Geological Survey, Hydrogeological Map, refer to footnote 11 above.
[26] States of Jersey, Jersey Water Pollution Risk Map, http://gis.digimap.je/RiskMap/

Available construction drawings suggest the invert level of the culvert at a maximum depth of 2.7m bgl. However, the available construction drawing only covers a small section of the culvert between Newgate St and Patriotic Place. Based on the proposed developments proximity to the seashore, the presumed outfall of the Le Faux Bie culvert is into St. Aubins Bay. See Figure 9.2 features and constraints plan for an indicative 'Le Faux Bie' culvert route.

9.87 St. Aubins Bay (English Channel) is located approximately 275m to southwest of the proposed development. The tidal range of the English Channel around the island can exceed 12m[27].

Ground Investigation Data

On-going Phase 1 Ground Investigation

9.88 As discussed in Section 9.8, phase 1 of the proposed development GI is currently ongoing, with 6no. boreholes completed. Draft exploratory hole logs are available for these, however laboratory testing and in-situ groundwater and ground gas monitoring is not complete. The phase 1 GI locations are summarised in Table 9.6. The locations are shown on Figure 9.4 and the draft logs included in Appendix F-3.

Table 9.6: Summary of JGH Phase 1 ground investigation (Amplus Nov 17 – Apr 18)

BH Ref.	Location	Depth (m)	Status
BH101	JGH	21.62	Drilling complete – awaiting groundwater and gas monitoring
BH102	JGH	25.20	Drilling complete – awaiting groundwater and gas monitoring
BH103	JGH	23.19	Drilling complete – awaiting groundwater and gas monitoring
BH104	JGH	27.41	Drilling complete – awaiting groundwater and gas monitoring
BH105	JGH	24.10	Drilling complete – awaiting groundwater and gas monitoring
BH106	Westaway Court	*20.00 (tbc)*	To be completed
BH107	Westaway Court	30.66	Drilling complete – awaiting groundwater and gas monitoring
BH108	Westaway Court	*20.00 (tbc)*	To be completed

[27] States of Jersey, Department of the Environment, Challenges for the Water Environment of Jersey, refer to footnote 23 above.

BH Ref.	Location	Depth (m)	Status
BH112	Sutherland Court	*25.00 (tbc)*	To be completed

Historical Ground Investigations

9.89 Factual records from eleven historical GIs are currently available for the JGH and Westaway Court site and the surrounding area dated between 1973 and 2014 and are detailed below. Corresponding logs are provided in Appendix F-2 and Figure 9.4 shows historical GI locations. See Table 9.7 below for a summary of the historical GI undertaken.

Table 9.7: Summary of historic ground investigation undertaken at the proposed JFH site

GI Ref.	BH/TP Ref.	Depth (m)
JGH main site		
Foundations Engineering Ltd, Jersey General Hospital, Phase 1 (6th/12th March 1973)	BH1	10.8
	BH2	11.0
	BH3	12.3
Geotechnical Engineering Ltd, Jersey General Hospital, Phase 1B (12th/14th July 1979)	BH1	15.2
	BH2	15.0
	BH3	13.5
Geomarine Ltd, Main Theatres Upgrade SI, Jersey General Hospital (7th/8th March 2014)	BH1	12.7
	TP1	0.5
	TP2	1.2
Westaway Court		
Matthew F Warner & Associates, Westaway Court (4th to 6th January 1994)	BH1	15.00
	TP3	2.70
	TP4	2.50
Offsite		
Amplus Ltd, 33 Gloucester Street, Raleigh House (4th/5th February 2000)	BH1	10.1
Amplus Ltd, 15-16 The Parade (11th September 2006)	BH P1	10.5
	BH P2	9.9
	BH P3	9.7
Amplus Ltd, Kensington Gate Car Park (8th/12th January 2007)	BH 4300	10.27
	BH 4301	10.47
	BH 4302	10.97
Geomarine Ltd, Kensington Place (16th/21st July 2009)	BH 4303	6.8
	BH 4304	7.4
	BH 4305	7.25
	BH 4306	6.55
	BH 4307	8.4

GI Ref.	BH/TP Ref.	Depth (m)
Amplus Ltd, 66-72 Esplanade (21st March 20014 – 2nd April 2014)	BH 4802	7.0
	BH 4803	11.55
	BH 4804	7.5
	BH 4805	11.65
Gloucester Street surface water sewer drawing (Drawing dated: 12th January 1982)	BH1	8.0
	BH2	7.5
	BH3	8.0
	BH4	9.0
Patriotic Street MSCP (Records dated: 1983)	BH1R	13.4
	BH2	11.3
	BH3	11.2
	BH4	10.8
	BH5	11.1
	BH6	15.8
	BH7	15.2

9.90 Geo-environmental testing data is not available for any of the previously undertaken GIs.

Encountered ground conditions

9.91 The encountered ground conditions from each historical GI have been individually reviewed and a summary of the encountered strata for the JGH and Westaway Court sites is presented in Table 9.8 and 9.9. A more detailed review of the encountered ground conditions during each of the aforementioned ground investigations is provided within the ground conditions section of the Arup Geotechnical Desk Study (see Appendix F-1) of the proposed development provided as a supporting document to this report.

9.92 The below presented ground conditions are generally in line with the draft information obtained to date from the ongoing GI.

Table 9.8: Summary of encountered ground conditions, JGH site

Stratum	Description	Indicative Thickness
Made Ground	Fill with inclusion of brick, concrete and gravel	0.5m to 2.8m
Blown Sand	Loose Fine to coarse sand, with occasional silts, fine sand and gravel	2.4m to 10.5m
Alluvium	Interbedded layers: • Cohesive: firm to stiff clay / silt • Granular: medium dense silty sand / gravel	6.0m to 8.0m
Bedrock	Jersey Shale Formation (JSh): • Highly weathered to moderately weathered fine grained mudstone / slightly metamorphosed mudstone. (Southern and south-eastern parts of the JFH site) John's Road Andesite Formation (JA): • Dolerite. (North-western corner of the JFH site)	3.0m proved Rockhead between 9.0m and 12.2m bgl

Table 9.9: Summary of encountered ground conditions, Westaway Court site

Stratum	Description	Indicative Thickness
Made Ground	Dark brown silt with gravel, crushed rock and gravels	0.0m to 1.2m
Blown Sand	Loose Fine to coarse sand, with occasional silts and gravel	3.0m to 3.2m
Alluvium	Interbedded layers: • Cohesive: firm to stiff clay / silt • Granular: medium dense silty sand / gravel	9.9m to 11.3m
Bedrock	John's Road Andesite Formation (JA):	Rockhead at 14.3mgbl

Groundwater Levels

9.93 Based on all available previous GI data, indicative groundwater levels have been determined for proposed development.

9.94 Table 9.10 provides a summary of the recorded groundwater conditions from all available GI at the JGH and Westaway Court sites. The table provides details for both on-site and off-site GI. The locations of each previously undertaken GI can be seen on Figure 9.4.

9.95 No groundwater monitoring has been undertaken yet for the proposed development as part of the phase 1 GI. However, a review of the water strikes recorded on the draft logs indicated the groundwater level to be in line with the historical GI results.

Table 9.10: Summary of encountered groundwater conditions at the JGH site

Ground Investigation	BH Ref.	Groundwater strikes recorded during drilling
JGH main site		
Foundations Engineering Ltd (6th/12th March 1973)	BH1	'Groundwater was not encountered during drilling. Water was added to the boreholes, however, to assist in shelling and this may possibly have disguised any slight seepage'.
	BH2	
	BH3	
Geotechnical Engineering Ltd (12th/14th July 1979)	BH1	Strike at 4.00m (no rise recorded)
	BH2	Damp below 3.3m, strike at 3.97m (no rise recorded)
	BH3	Damp below 3.2m, strike at 8.26m rise to 6m
Geomarine Ltd (7th/8th March 2014)	BH1	Strike at 4.05m, rise to ground level after 30 minutes
Westaway Court		
Matthew F Warner & Associates, Westaway Court (4th to 6th January 1994)	BH1	No GW strikes recorded on log, GW depth measured as shallow as 3.90m bgl
Offsite		
Amplus Ltd (4th/5th February 2000)	BH1	Strike at 2.95m, rise to 2.82m in 15 minutes
Amplus Ltd (11th September 2006)	BH1	No groundwater encountered.
	BH2	
	BH3	
Amplus Ltd (8th/12th January 2007)	BH 4300	No GW strikes recorded on log, GW depth measured as shallow as 2.83m bgl
	BH 4301	No GW strikes recorded on log, GW depth measured as shallow as 2.0m bgl
	BH 4302	No GW strikes recorded on log, GW depth measured as shallow as 1.46m bgl
Geomarine Ltd (16th/21st July 2009)	BH 4303	No GW strikes recorded on log
	BH 4304	No GW strikes recorded on log
	BH 4305	No GW strikes recorded on log
	BH 4306	No GW strikes recorded on log
	BH 4307	No GW strikes recorded on log
Amplus Ltd	BH 4802	No GW strikes recorded on log, GW depth measured at 3.75m bgl at 08:00 on 28/03/2014

Ground Investigation	BH Ref.	Groundwater strikes recorded during drilling
(21st March 2014 – 2nd April 2014)	BH 4803	No GW strikes recorded on log, GW depth measured at 1.95m bgl at 08:00 on 04/04/2014
	BH 4804	No GW strikes recorded on log, GW depth measured at 4.57m bgl at 07:30 on 26/03/2014
	BH 4805	No GW strikes recorded on log, GW depth measured at 5.47m bgl at 08:00 on 02/04/2014
Gloucester Street Surface sewer drawing (Drawing dated: 12th January 1982)	BH1	2.8m *Note 1*
	BH2	2.0m *Note 1*
	BH3	2.1m *Note 1*
	BH4	1.8m *Note 1*
Patriotic Street MSCP (Records dated: 1983)	BH1R	Primary GW strike at 6.4m bgl within gravel deposits. Secondary GW strike at 10.8m bgl within clayey silt deposits and at head of bedrock. Subsequent GW monitoring recorded GW level at 3.4m bgl within silt deposits.
	BH2	GW strike at 6.8m bgl within gravelly silt deposits. GW monitoring level at 2.6m bgl within silt deposits.
	BH3	GW strike at 6.6m bgl within superficial deposits. GW monitoring level at 3.0m bgl within superficial deposits.
	BH4	GW strike at 6.9m bgl within silt deposits. GW monitoring level at 3.0m bgl within silty sand deposits.
	BH5	Primary GW strike at 6.9m bgl within superficial deposits. Secondary GW strike at 9.9m bgl within superficial deposits.
	BH6	Primary GW strike at 6.0m bgl within superficial deposits. Secondary GW strike at 10.1m bgl within superficial deposits. Subsequent GW monitoring recorded GW level at 2.2m bgl within superficial deposits.
	BH7	Primary GW strike at 6.2m bgl within superficial deposits. Secondary GW strike at 10.7m bgl within superficial deposits and at head of bedrock. Subsequent GW monitoring recorded GW level at 3.2m bgl within superficial deposits.

Note 1 – Groundwater depths gathered from States of Jersey Resources Board Gloucester Street surface water outfall drawing and accompanying note states 'The information above is the best available, however its accuracy cannot be guaranteed'.

9.96 The 2014 GI at the JGH site (Geomarine, 2014) struck groundwater at approximately 4.0m bgl within green grey laminated silt (within Blown Sand stratum), which then rose to ground level after 30 minutes. However, previous GI reported groundwater as shallow as 1.8m bgl within the blown sand deposits and as deep as approximately 10.8m bgl at the head of bedrock. This large variation in groundwater levels produces uncertainty regarding the ultimate groundwater level beneath the site. The large

variation also suggests possible tidal influence as the site is within 200m of St. Aubins Bay.

9.97 Additionally, after striking GW during the most recent GI at ~4.0m bgl, the GW rose to ground level after 30 minutes. This suggests that the groundwater is potentially locally confined by a band of more impermeable strata, and that locally artesian conditions may be encountered within the site area.

9.98 For a detailed hydrogeological review of the proposed development refer to the Geotechnical Desk Study provided in Appendix F-1.

Evidence of Contamination

Jersey General Hospital (JGH)

9.99 Deposits of up to 2.8m of made ground have been previously encountered at the JGH site. The made ground generally comprises demolition type with materials indicative of potential presence of asbestos. No evidence of any odours, staining ash or clinker recorded in any of the available on-site logs obtained from both historical and currently on-going investigatory works. This suggests no hydrocarbon contamination has been previously encountered at the JGH site.

Westaway Court

9.100 Deposits of up to 1.2m of made ground have been previously encountered at Westaway Court. The made ground generally comprises silts with gravel and concrete with occasional pockets of organic material. No evidence of any odours, staining ash or clinker recorded in any of the available on-site logs from both historical and currently on-going investigatory works. This suggests no hydrocarbon contamination has been previously encountered at Westaway Court.

Off-Site

9.101 The GI undertaken by Geomarine Ltd along Kensington Place, see Figure 9.3, between 16/07/2009 – 21/07/2009 comprised 5No. borehole. Four of these boreholes recorded visual and olfactory evidence of hydrocarbon contamination at depths ranging from 0.55m bgl to 7.5m bgl (see GI records in Appendix F-2).

9.102 Consultation with SoJ has revealed that an appropriate remediation strategy was implemented. and groundwater treatment completed. Therefore, this evidence of contamination is not considered to pose a risk to the proposed development.

Unexploded Ordinance (UXO)

9.103 There is no available published UXO mapping for Jersey.

9.104 Historical searches of Jersey and WWII suggest that Jersey was bombed by German aircrafts in June 1940 [28]. However, it is widely known that no significant bombing took place on the island, as the island was occupied by German forces post 1940 [28]. The risk of subsequent bombing from Allied aircraft is highly unlikely due to the islands British population majority. Their occupation ended in 1945 when Jersey was liberated.

9.105 No evidence of building damages or surface depressions that could be associated with bombing was identified from review of historical aerial photos for the JGH and Westaway Court sites.

9.106 In addition, the JGH site has been substantially developed post WWII. These developments included deep excavation works for the construction of basements and other shallow earthworks which would have previously uncovered any potential UXO risks.

9.107 In light of the above, the risk posed by UXO to the proposed developments is considered to be low and therefore not assessed further.

Protected sites

9.108 There are no protected sites within the study area. The nearest protected site is Jersey's southeast coast RAMSAR site [29] which is approximately 5km to the south east of the proposed development. However, based on the large distance, the RAMSAR site is not considered to be a receptor.

9.109 For all other protected sites and sites of ecological importance within the study area refer to the Biodiversity chapter of this EIS (Chapter 8).

Radon

9.110 Reports provided to the States of Jersey suggest that the granites in Jersey are similar to those in the South-West of England but older. The granites are also highly fractured which gives rise to pathways for the release of the gas to the surface which could give higher radon concentrations in buildings [30].

9.111 A three phase test of radon concentrations across Jersey was carried out between 1987 and 1992. The three phases took measurements of radon levels over various

[28] Jersey, Discover, Jerseys Occupation Story, https://www.jersey.com/discover-jerseys-occupation-story
[29] States of Jersey, Environment and Greener Living, Protecting the Environment, Protecting our Sea Water and Coast, Protected Coastlines (RAMSAR), https://www.gov.je/environment/protectingenvironment/seacoast/pages/ramsar.aspx
[30] Public Health England, Review of Radon in the States of Jersey, Report for the Environment Scrutiny Panel, E.J. Bradley, 2008, http://www.statesassembly.gov.je/ScrutinyReports/2014/Report%20-%20Radon%20-%20Adviser%20-%208%20September%202014.pdf

time periods in houses all around Jersey. The most relevant result from the tests was during the second phase where 36% of the homes tested over a nine-month period indicated radon levels above the Public Health England precautionary radon level of 200 Bq m^{-3} [31].

9.112 Further information regarding the test of radon concentrations across Jersey is presented within the Arup November 2016 geotechnical desk study report.

9.113 Since 1997, changes to the Building Bye-Laws require that all new homes in Jersey are to include radon protection. The Bye-Laws state (Schedule 2, Part 4, Section 4.2 Resistance to contaminants) that 'reasonable precautions must be taken to avoid danger to health or safety caused by substance found on or in the ground to be covered by the building' [32]. Therefore, full radon protective measures will be incorporated into the design of the proposed development and will not be assessed further.

Contamination baseline

9.114 The Conceptual Site Model (CSM) identifies and describes the sources of potential contamination (including ground gas), the potential human and ecological receptors and the pathways that link both source and receptor. The CSM also describes the general behaviour of the potential contamination within soils, groundwater, surface water and the air.

9.115 This initial baseline CSM identifies the current potential contamination pathways that exist at the JGH and Westaway Court sites.

Sources

9.116 Made ground deposits associated with continuous development of the hospital are anticipated to be found across the JGH and Westaway Court site. Therefore, there is the potential for construction based contaminants to be encountered within the made ground found beneath both proposed development sites. These may include contaminants such as metals, hydrocarbons and asbestos (including free fibres and Asbestos Containing Materials (ACM)).

9.117 The made ground beneath the sites also has the potential to produce ground gas, however no further potential sources of ground gas have been identified.

9.118 Review of available construction and 'as built' drawings has revealed the presence of two large oil tanks within the engineering building (Block G) at the JGH site, refer to Figure 9.2. These are to be removed as part of the development. It is currently

[31] Public Health England, Review of Radon in the States of Jersey, refer to footnote 30 above.
[32] Jersey Law, Building Bye-Laws (Jersey) 2007, https://www.jerseylaw.je/laws/revised/PDFs/22.550.05.pdf

unknown as to whether the tanks are above or below ground, however based on review of the JGH general arrangement drawing the tanks are currently assumed to be above ground. These oil tanks are believed to be associated with the boiler house that is located adjacent to the oil tank room. The exact age and condition of these tanks is currently unknown and therefore there is the potential for tank leakage. However, it is anticipated that the tanks are founded on a concrete slab and do not have a direct pathway to the ground beneath the engineering building.

9.119 In addition to the oil tanks, there is a substation indicated within the engineering block (Block G) which is known to contain two transformers and switch gear, refer to Figure 9.2. There is a potential that these pieces of equipment may have previously contained polychlorinated biphenyls (PCBs) which may had leaked out of the transformer during maintenance and operation. However, it is anticipated that the equipment is founded on a concrete slab and there is not a direct pathway to the ground beneath the engineering building. There are also records of a transformer within the Stafford Hotel, and two generators adjacent to Block G which will be subject to potential PCB contamination detailed above. These are all proposed to be removed as part of the proposed development.

9.120 From consultation with SoJ (Department of the Environment (DoE)), there is indication of a pollution incident that occurred approximately 280m to the northeast of the JGH site in 2003. The pollution incident involved the spillage of between 500 – 1000l of heating fuel.

Receptors

9.121 The following receptors that could be impacted by the potential contamination sources stated above have been identified for the proposed development and are presented below:

- Current site users: doctors, patients, maintenance workers;
- Groundwater;
- Le Faux Bie culvert; and
- St. Aubins Bay (English Channel)

Pathways

9.122 A pathway is an action or mechanism that links the potential sources of contamination to the stated receptor. The pathways identified have been split into those that are relevant to human health and those more relevant to controlled waters (see below).

Human health

9.123 It is anticipated that the following pathways of exposure are currently viable in relation to impacts on human health:

- Dermal contact with potentially contaminated soils and soil dust;
- Ingestion of potentially contaminated soils and soil dust;
- Inhalation of potentially contaminated soil dust;
- Inhalation of ground gas and potential volatile contamination from soils and groundwater; and
- Upward vertical migration of ground gas towards the surface along the existing piles.

9.124 These pathways apply to current site users. However, there is currently limited potential for exposure to contaminated soils as the vast majority of the site is covered in hardstanding material.

9.125 The current site users may be exposed to vapours from groundwater impacted by hydrocarbon and PCB contamination resulting from possible leakage from the oil tanks and transformers located in the adjacent engineering department. The risk of exposure of the contents of the tanks and transformers in the engineering building to current site users is considered to be limited based on access restrictions.

Controlled waters

9.126 The following baseline pathways that currently exist with regards to controlled waters at the JGH and Westaway Court sites are detailed below.

- Leaching and lateral/vertical migration of potential contamination currently present within the made ground deposits into the groundwater beneath the site as a result of rainwater infiltration in the limited areas of landscaping (internal court yards). Based on information obtained during GI completed to date, groundwater is unlikely to be present within made ground materials;
- Lateral migration of contamination within the made ground through groundwater towards the Le Faux Bie culvert and St. Aubins Bay;
- Migration of potentially contaminated water through the Le Faux Bie culvert towards St. Aubins Bay; and
- Downward vertical migration of potentially contaminated groundwater along the exiting piles.

Assessment of effects

9.127 This section discusses the potential effects to geology, hydrogeology and from contamination caused by the construction of the proposed developments and subsequent operational end-uses of the proposed JGH and Westaway Court development. The sensitivity of receptor and magnitude of effect (detailed in the methodology section) are discussed for each effect, which then subsequently allows for the overall significance for each effect to be determined. This section discusses

effects before mitigation; effects with a significance of moderate adverse or above would require further mitigation to that already stated in the design mitigation section.

9.128 As parts of the proposed development are anticipated to remain operational during construction both site users and construction workers must be considered when assessing the risks posed to human health.

Assessment of effects from construction

Potential effects of construction on Geology

JGH

9.129 The proposed development at the JGH site would require earthworks to facilitate development. Extensive cut and fill would be required due to the large difference in levels across the site. The maximum depth of excavation, in relation to the basement construction, could extend to 1.5m AMSL in localised areas. These excavations would result in removal of soils (made ground and the underlying natural ground (blown sand & alluvium)) from the site area. This is unlikely to alter the geology beneath the site significantly.

9.130 The proposed development at the JGH site is anticipated to require piled foundations. Furthermore, based on current understanding, secant pile walls are likely to be required to support the basement area, however the exact extent is to be confirmed. Insertion of the piles and construction of the secant pile wall are unlikely to significantly alter geological conditions within the proposed development area.

9.131 The drift and solid geology beneath the site is considered to be a receptor with Low sensitivity. This is because the geology beneath the site is of little geological/geomorphological interest.

9.132 As the proposals would only result in minor loss of the low sensitivity material, the magnitude of impact to geology is considered to be Negligible.

9.133 Therefore, the significance of effect on geology, determined through the significance matrix in Table 9.5, is considered to be **Negligible** for the JGH site**,** meaning the effect would be below the levels of perception.

Westaway Court

9.134 It is likely that the proposed development at Westaway Court would require piled foundations to be installed. No basement structure is currently proposed other than localised excavations for lift pits and pile caps.

9.135 The drift and solid geology beneath Westaway Court is considered to be a receptor with Low sensitivity. This is because the geology beneath the site is of little geological/geomorphological interest.

9.136 As the proposals would only result in minor loss of the low sensitivity material, the magnitude of impact to geology is considered to be Negligible.

9.137 Therefore, the significance of effect on geology, determined through the significance matrix in Table 9.5, is considered to be **Negligible** for Westaway Court**,** meaning the effect would be below the levels of perception.

Potential effects of construction on Hydrogeology

JGH

9.138 Extensive earthworks are anticipated involving basement construction to a proposed level of 1.5m AMSL in some localised areas and basement wall including a secant piled wall to -4m AMSL in some areas.

9.139 From review of historical GI records the exact depth to groundwater beneath the JGH site has a wide range with water being encountered as shallow as 1.8mbgl. As excavation is anticipated to extend below the groundwater level, it is likely that dewatering measures would be required for the construction of the basement.

9.140 The dewatering measures would artificially lower the groundwater level beneath the site and surrounding area throughout the duration of the basement construction works. This, consequently, could impact the water level in the boreholes in the site vicinity. The existing borehole within the site and the borehole some 70m away in Parade Gardens have the potential to be impacted by the aforementioned dewatering measures. There is the potential that private unlicensed boreholes within the site vicinity may also be impacted by the dewatering measures. The magnitude of impact is dependent on the abstraction levels of the boreholes, which is yet to be confirmed. If the boreholes are abstracting groundwater from within the superficial blown sand deposits, then there is a high likelihood that they would be impacted by the dewatering measures. Previous GI indicated the presence of a band of low permeability material between the blown sands and bedrock. It is assumed that this is sufficient to prevent groundwater flow between the blown sands and bedrock. Based on that assumption, if the boreholes are abstracting from the bedrock formations beneath the site then it is unlikely that dewatering within the blown sands would have a significant impact on the groundwater levels within the boreholes.

9.141 The sensitivity of the hydrogeology beneath the site and its vicinity is considered to be Medium due to the abovementioned boreholes being used for irrigation purposes.

9.142 As a result, the magnitude of the lowering of the groundwater level is considered to be Minor due to the marginal nature of the reduced reliability of supply at the aforementioned abstraction points.

9.143 Therefore, the overall significance of the effect of the proposed development at the JGH site on hydrogeology is considered to be **Minor adverse.**

Westaway Court

9.144 No basement construction is proposed at Westaway Court, with only localised excavations required. As such no dewatering measures are anticipated to be required and the impact is considered to be Negligible.

9.145 The sensitivity of the hydrogeology beneath the site and its vicinity is considered to be Medium due to the its proximity to boreholes being used for irrigation purposes.

9.146 Therefore, the overall significance of the effect of the proposed development at Westaway Court on hydrogeology is considered to be **Negligible**.

Contamination assessment

9.147 In order to assess the impacts caused by potential contamination sources during construction, a conceptual site model (CSM) for the proposed development has been produced. The conceptual site model aims to identify the potential additional sources and receptors related to the construction phase.

9.148 Once the potential contamination related impacts have been identified, the pathways to complete the contaminant linkages are discussed and the overall significance of the impact is determined.

Sources

9.149 During construction, works could introduce the following new contamination sources:

- Fuel oil / hydraulic oil for use within construction machinery used on-site;
- Construction materials imported on to site for use in the proposed developments. Specific relevance applies to cementitous[33] construction materials due to the potential risk to controlled waters caused by high pH of a potentially aggressive nature.

Receptors

9.150 The construction works would introduce the following additional receptors to those identified under baseline conditions:

[33] Cementitious – A chemical precipitate material with cement like properties and characteristics, including cement.

- Construction workers;
- Construction site neighbours including the general public and hospital users (doctors, patients, etc) during construction phases; as sections of the JGH within the site boundary are expected to remain operational during construction.

Pathways

9.151 Pollution pathways can be through human health or through controlled waters:

Human health

9.152 The human health pathways identified for contamination during construction are as follows:

- Dermal exposure to contaminated soils and groundwater;
- Ingestion of contaminated soils and groundwater;
- Inhalation of dusts and fibres from contaminated soil; and
- Inhalation of soil vapours and gases and potential vapours from fuel contamination

Controlled waters

9.153 The controlled waters pathways identified for contamination during construction are as follows:

- Direct discharge
- Mobilisation of contamination as a result of insertion of piles and extensive earthworks and lateral/vertical migration
- Accidental spillages

Summary of CSM

9.154 The conceptual site model derived for the construction phase of the proposed development identified new potential pollution linkages, for which the assessment of potential effects has been undertaken.

Potential effects of existing contaminated land on construction workers

9.155 Made Ground materials that are likely to be encountered beneath the proposed development are considered to be a potential source of contamination. Based on the site history and previous GI records, the made ground is anticipated to comprise demolition based materials. There is therefore a risk of construction based contaminants (e.g. fuel oils, lead, etc. etc.) and asbestos to be present within the soils. In addition, the groundwater beneath the site may be potentially impacted by

oils/hydrocarbons as a result of off-site leakages and spillages. There also may be localised areas of PCB contaminated oil spillages in the areas of existing transformers.

9.156 Due to the age of the buildings there is the potential for building materials containing asbestos to be encountered during demolition. Therefore, additional asbestos has the potential to also become incorporated within the made ground beneath the site during the demolition process.

9.157 Refer to the Air Quality chapter for the assessment of effects from dust arisings generated during the demolition process.

9.158 As mentioned in the assumptions and limitations section of this chapter, there is also the potential for areas of contamination to be uncovered during demolition and construction that may not have been identified through the historical and ongoing GI. This contamination, if present, would have the potential to impact human health dependent on the type and chemical composition.

9.159 The potentially contaminated soil and groundwater mentioned above could affect construction workers through the pathways of dermal exposure and ingestion. Furthermore, there is also the risk of potential inhalation of contaminated soil dusts and potential asbestos fibres generated from earthworks, especially during dry weather conditions. Construction workers may also be exposed to soil vapours and/or ground gases migrating and accumulating in confined spaces such as deep excavations, which would subsequently pose a significant risk asphyxiation.

9.160 Construction workers on site are classed as Medium sensitivity receptors due to the short term and temporary exposure and application of appropriate health and safety management systems.

9.161 Potential for Moderate magnitude of impact due to the exposure to soils potentially contaminated with asbestos. This is with the exception of exposure to ground gases that may lead to effect of Major magnitude.

9.162 Based on the sensitivity of the receptors, the potential magnitude the overall impact significance is considered to be **Moderate** adverse with respect to exposure to contaminated soils (potentially containing asbestos) and groundwater. Exposure to ground gas during construction may result in **Major** adverse effect on construction workers.

Potential effects of existing contaminated land on construction site users/neighbours

9.163 As mentioned previously it is likely that sections of the hospital would remain open during the construction phase of the proposed development. As such the following types of people are considered to be site users/neighbours:

- Hospital staff;
- Patients;
- General public (walking past the site); and
- Site neighbours (in buildings adjacent to the site).

9.164 The site users/neighbours may be exposed to contaminated soils during construction by inhalation of dust, potential asbestos fibres and vapours generated during the earthworks or foundation works.

9.165 Dermal contact and ingestion are not considered viable pathways to affect site users/ neighbours as they would not have direct access to the exposed soil within the construction zone of the site. There is a slight risk of dermal exposure to the dust generated from construction but this is not considered to be significant.

9.166 The most sensitive site user is considered to be child patient within the operational section of the hospital site who would be considered to be a **High** sensitivity receptor to contaminated land.

9.167 The magnitude of the potential impacts would also be considered **Minor** with overall significance is considered to be **Moderate adverse**.

Potential contamination of groundwater during construction

9.168 Currently the made ground deposits beneath the proposed development is effectively capped with the hard standing materials and buildings that cover the majority of the site except for the limited potential areas of open ground in the courtyards. Therefore, at baseline conditions there is a limited potential for contamination within the made ground to be transferred to deeper, water containing stratum. However, post-demolition potentially contaminated made ground would be exposed to rainfall infiltration. This would potentially allow for leaching of contaminants from the made ground towards the groundwater beneath the site.

9.169 Piling works are likely to be required for the construction of the foundations. It is currently assumed that these would be constructed using continuous flight auger (CFA) technique. This is a non-displacement piling technique, which results in arisings being brought to the surface, and the pile is formed directly within the ground. Using this technique, the risk of creating a preferential flow path of contamination is low. However, a risk that cement would escape during pile construction, potentially leading to groundwater contamination, still remains.

9.170 During construction, there is the potential for accidental spillages to impact the groundwater beneath the site. Accidental spillages could include:

- Fuel oil / hydraulic oil spillage from refuelling operations of mechanised machinery on site;
- Decommissioning and removal of the fuel tanks present in the basement of the engineering building;
- Spillage of cementitous construction materials (particularly relevant in relation to controlled waters due to an aggressive pH).

9.171 Any potential spillages would have a potential to impact groundwater quality either through direct discharge, if groundwater is encountered during exaction, or leaching through lateral/vertical migration towards other controlled water receptors i.e. the culverted stream or the bay. However, based on the assumptions presented in Section 9.43, application of best practice with respect to management of environmental issues would minimise the potential impact on the groundwater.

9.172 During construction of the basements at the JGH site, dewatering is likely to be required which has the potential to contaminate the groundwater beneath the site. However, it has been assumed that any discharge to controlled water would be undertaken only with appropriate approvals from the regulators, as per assumptions presented in Section 9.43. Therefore, the risk to controlled waters from approved discharges during construction is considered to be minimal.

9.173 As presented in the baseline conditions section, based on the hydrogeological map of Jersey and the Jersey water website, the groundwater beneath the proposed development is not used for public supply. There are several boreholes and wells that have been identified within the study area and furthermore, it has been noted that there is the potential for private unlicensed abstraction points to be present within the site vicinity. These are however located hydraulically up-gradient of the anticipated basement construction works area and therefore the development is unlikely to pose a risk to the quality of these water resources. Depending on the depth at which GW is abstracted from the Parade Gardens borehole, potentially contaminated water beneath the site may be drawn towards the borehole. This is considered to be unlikely however, the abstraction depth of the Parade Gardens borehole would be subject to further investigation.

9.174 As mentioned in paragraph 9.141 the sensitivity of the groundwater beneath the site is considered **Medium**.

9.175 From review of the potential pathways, the magnitude is considered to be **Minor** as the risk of groundwater contamination is considered to be low based on the assumptions presented in Section 9.43.

9.176 Therefore, the overall significance of the potential effects from contamination to groundwater is considered to be **Minor adverse**.

Potential effects of contaminated groundwater on the Le Faux Bie culvert

9.177 The Le Faux Bie culvert is located along Gloucester Street to the southeast of the JFH site. Based on available surface water sewer construction drawings, it is currently anticipated to carry water down to an assumed outfall in St. Aubins Bay.

9.178 The effect of contaminated groundwater on the Le Faux BIe culvert is dependent on the level of groundwater beneath the site. Currently, from review of available historic GI extracts, the groundwater level within the site is anticipated to be between 4.0 m bgl and 7.0m bgl. However, other historic GI extracts from within the site vicinity, report groundwater as shallow as 1.46m bgl. From review of available construction drawings, the culvert has an invert level of approximately 2.7m bgl. Therefore, there is the potential for groundwater ingress into the culvert. If the groundwater beneath the proposed development is impacted by contamination during construction, there is the potential for contaminated groundwater to laterally migrate with the groundwater flow towards the Le Faux Bie culvert.

9.179 Considering that the stream has been culverted and therefore is unlikely to constitute a water resource, its sensitivity is considered to be **Low**.

9.180 The magnitude of the impact is considered to be **Minor** as large scale pollution is not anticipated occur based on the scale of the aforementioned sources of contamination.

9.181 Therefore, the potential effect on the culverted river quality is considered to be of **Negligible** significance

Potential effects of contaminated groundwater on St Aubins Bay

9.182 The groundwater beneath the proposed development is anticipated to flow from northeast to southwest towards St. Aubins Bay. Due to the proximity of the site to the coast, there is the potential for contamination from the potential sources previously detailed to laterally migrate through the groundwater towards the sea. Furthermore, there is currently the potential that the groundwater beneath the proposed development is tidally influenced. If this is the case, then the likelihood that contamination could laterally migrate from beneath the site towards St Aubins Bay is increased.

9.183 There is also the potential for the aforementioned Le Faux Bie culvert to be discharging out into St Aubins Bay. If contaminated water enters the culvert it is then likely to flow out towards St Aubins Bay. The potential magnitude of impact from contamination is considered to be **Negligible**. This is because the impact and quantity of contaminated groundwater discharge into St Aubins Bay in considered to be minimal. Therefore, contaminated groundwater is unlikely to pose a significant risk to the coastal water quality.

9.184 Therefore, the overall significance of contamination of St Aubins Bay is considered to be **Minor adverse**.

Construction Assessment Summary Table

9.185 A summary of the aforementioned potential effects form construction is shown in Table 9.11 below. All potential effects with a significance of moderate adverse or greater will require additional mitigation measures to those already detailed in the design mitigation section.

Table 9.11: Construction Assessment Summary Table

Scheme element	Effect	Significance (prior to mitigation for both JGH and Westaway Court)
Geology		
Earthworks and foundation works	Removal of soils. Insertion of piles.	Negligible
Hydrogeology		
Basement construction and associated dewatering.	Dewatering may result in lowering groundwater levels.	Minor adverse (JGH) Negligible (Westaway Court)
Land contamination		
Earthworks and foundation works	Impact on health of construction workers due to dermal exposure and ingestion of potentially contaminated soils, fibres and/or groundwater	Moderate adverse
	Impact on health of site neighbours due to exposure to potentially contaminated soils dust and fibres	Moderate adverse
	Impact on construction workers due to exposure to ground gas	Major adverse
	Impact on groundwater as a result of increased leaching of contaminants as a result of earthworks and foundation works	Minor adverse
	Impact on the culverted le Faux Bie stream as a result of potentially contaminated groundwater lateral migration towards the culverts and being intercepted by the culvert	Negligible
	Impact on the St Aubins Bay due to contaminated groundwater lateral migration towards the Bay and also and discharge from the culvert	Minor adverse

Assessment of effects from operation

Potential effects of operation on Geology

9.186 The proposed development represents no change from the baseline conditions. It is considered that there would not be any significant effects during this stage.

Potential effects of operation on Hydrogeology

Jersey General Hospital (JGH)

9.187 The basements and associated lift pits proposed at the main JGH site are anticipated to extend down to a potential maximum level of 1.5mOD. Furthermore, based on current understanding, there is the potential for secant piled walls to be required along the extents of the new build at the JGH site, where a basement is proposed. The base of the secant pile walls are anticipated to potentially extend as deep as -4m AMSL and would be socketed within the bedrock. This could potentially restrict groundwater movement within the superficial deposits which, based on current understanding, is anticipated to flow from northeast to southwest across the proposed development, towards the Bay.

9.188 This basement and secant pile wall has the potential to artificially raise GW levels within the superficial deposits to the northeast of the site due to potential build-up of the groundwater behind the secant pile wall. The permeability of the superficial strata varies greatly. The granular blown sands and gravels have a relatively high hydraulic gradient of 10-20m/d which classes them as semi-pervious materials[34]. However, the cohesive clays and silts have a considerably lower hydraulic gradient of around 10^{-3}m/d[35] which classes them as impervious. Current groundwater information suggests that groundwater is encountered in both the cohesive and granular materials.

9.189 The additional non-secant piled foundations associated with the proposed developments are not considered to have the potential to form a barrier to groundwater movement.

9.190 The sensitivity of the hydrogeology is considered to be **Medium** due to the presence of the abstraction point in the vicinity of the proposed development and this borehole being used for irrigation purposes.

9.191 The phase of ground water monitoring for the proposed development has not yet been undertaken and therefore definitive information regarding the groundwater containing stratum is not yet available. Therefore, as the predominant groundwater containing stratum has not been determined the potential magnitude of this impact is considered

[34] British Geological Survey, Hydrogeological Map, refer to footnote 11 above.
[35] British Geological Survey, Hydrogeological Map, refer to footnote 11 above.

to be **Moderate**. This magnitude is subject to change pending results of the additional ground investigation.

9.192 Based on the sensitivity and magnitude of the impact the overall significance of the impact is considered to be **Moderate adverse**.

Westaway Court

9.193 The proposed development at Westaway Court sites represents no change from the baseline conditions, with only localised deeper excavations required. It is considered that there would not be any significant effects during this stage and a **Negligible** impact

Contamination – operational CSM

9.194 The operational conceptual site model outlines any other additional sources of contamination and potential receptors that would be present during the operational life of the new hospital.

9.195 The identified potential sources, receptors and pathways including plausible pollution linkages are presented below.

Sources

9.196 There will be no new additional sources of potential contamination during the operational life of the hospital. The proposed development would however result in removal of several baseline sources – the fuel tanks, transformers and generators present in the engineering building and Stafford Hotel. Any potentially contaminated made ground still present (post construction) beneath the site would still be considered a source of potential contamination. Although it is anticipated that a considerable amount of the made ground beneath the site may be removed from site during the construction of the new basement.

Receptors

9.197 No new receptors would be introduced during the operational stage to those identified at the baseline conditions.

Pathways

Human health

9.198 No major areas of soft landscaping have been currently proposed as part of the proposed development however there would be some areas of public realm. Therefore, the pathways to affect human health of the end site users such as workers and patients of the hospital would be limited to exposure to ground gas or hydrocarbon vapours. However, the maintenance workers may be directly exposed to potentially impacted soils and/or groundwater if any future excavation based maintenance works are required.

9.199 The proposed development would require insertion of new foundation and basement wall piles in addition to the existing ones, introducing new potential pathways of exposure, subject to the selected piling technique. Currently, it is proposed to construct the piles using the CFA technique, which is unlikely to create significant pathways for contamination and ground gas migration. However, for the purpose of the assessment, potential for contamination and ground gas migration has been considered.

9.200 The following pathways have been considered with respect to human health:

- Dermal exposure to contaminated soils and groundwater
- Ingestion of contaminated soils and groundwater
- Inhalation of dusts from contaminated soils
- Vertical migration of ground gas along the new piles
- Inhalation from soil vapours and ground gases

Controlled waters

9.201 As mentioned above, the proposed development would not include landscaped areas and therefore the rainwater infiltration would be insignificant. Furthermore, extensive drainage would be implemented across the public realm areas of the proposed development further limiting potential infiltration. In addition, groundwater infiltration into the made ground is unlikely. This would lower the risk of contamination of groundwater compared to the baseline conditions.

9.202 However, the proposed development would require insertion of piled foundations which may result in creation of preferential flow paths for potentially contaminated groundwater. It is proposed to construct the piles using the CFA technique, which is unlikely to create significant pathways for contamination migration. However, for the purpose of the assessment, potential for contamination migration has been considered.

CSM Summary

9.203 The conceptual site model derived for the operational phase of the proposed development identified new potential pollution linkages, for which the assessment of potential effects has been undertaken.

Potential effects of operation on end site users

9.204 Post-development site users (hospital staff, patients and maintenance workers) are anticipated to use the buildings. As there are currently no anticipated large areas of landscaping proposed, hardstanding material is likely to cover the entirety of the public realm areas of the proposed development. Therefore, no direct exposure to the

potentially impacted soils or groundwater would occur. There is also limited potential for inhalation of soil vapours. However, there is a risk of ground gas ingress into the buildings.

9.205 The only site users that are likely to encounter potentially contaminated ground during the operation of the hospital are maintenance workers during any future required intrusive works.

9.206 The site users (hospital staff and patients) are considered to be of **High** sensitivity, whereas the maintenance workers - as **Medium** sensitivity receptors.

9.207 There is a potential for Minor magnitude of impact on maintenance workers' health due to the short-term exposure to potentially contaminated soils. The hospital staff and patients are not anticipated to encounter potentially contaminated soils and therefore the magnitude is considered **Negligible** for hospital staff and patients. This is with the exception of exposure to ground gases that may lead to effect of **Major** magnitude.

9.208 Based on the sensitivity of the receptors, the potential magnitude the overall impact significance is considered to be **Minor adverse** with respect to direct exposure to contaminated soils and groundwater of the maintenance workers. Exposure to ground gas may result in **Major adverse** effect on end site users.

Summary of potential effects of operation on controlled waters

9.209 The end state of the proposed development would remove the identified source of groundwater contamination (the fuel storage tanks and transformers) and most likely remove the majority of pathways for contamination generation and subsequent migration towards controlled water receptors. This would therefore eliminate the pollution linkages identified in the baseline conditions CSM. Consequently, this may lead to an overall improvement of the groundwater quality beneath the site.

9.210 Considering the **Low** sensitivity of the controlled water receptors and a potential for improvement of the groundwater quality with a **moderate beneficial** magnitude of impact, the proposed development at the operational stage is considered to have a **Minor beneficial** effect on controlled waters.

9.211 However, piled foundations may result in the creation of preferential flow paths for any sub-surface contamination resulting in downward migration of contamination. Considering that the piles are likely to be constructed using CFA techniques the risk of flow path creation is considered to be low. Therefore, the magnitude of the risk is **Moderate**. Consequently, the overall significance of effect is considered to be **Minor adverse**.

Operational Assessment Summary Table

9.212 A summary of the aforementioned potential effects form operation is shown in Table 9.12. All potential effects with a significance of moderate adverse or greater would require additional mitigation measures to those already detailed in the design mitigation section.

Table 9.12: Operational Assessment Summary Table

Scheme element	Effect	Significance (prior to mitigation for both JGH and Westaway Court)
Geology		
Buildings and hardstanding	Geological resources not accessible	Negligible
Hydrogeology		
Basement and secant piled wall	Barrier for groundwater flow	Moderate adverse (JGH) *(dependent on groundwater containing stratum)* Negligible (Westaway Court)
Land contamination		
Earthworks and foundation works	Impact on health of site users due to exposure to potentially contaminated soils/soils dust during maintenance works	Minor adverse
	Impact on human health due to exposure to ground gas	Major adverse
	Impact on controlled waters	Minor beneficial
	Impact on controlled waters from piling	Minor adverse

Mitigation and enhancement

Mitigation of effects from construction

9.213 The completed assessments identified potential effects from construction with respect to geology, hydrogeology and contamination as summarised in Table 9.11.

9.214 There are number of standard mitigation measures that would be utilised to mitigate against risks to human health throughout the construction of the proposed development and any future maintenance works. These standard mitigation measures include following health and safety best practice, the use of appropriate PPE and dust suppression during excavation works. These procedures will be detailed in the CEMP (Appendix O-1 sets out the framework CEMP).

9.215 Additionally, to progress the design and refine any necessary mitigation measures, an intrusive GI was proposed. The GI is ongoing and will be followed by assessment of findings and if necessary preparation of a remediation strategy. The scope and objectives of these works are discussed further in subsequent assessment and mitigation sections.

Geology

9.216 The assessment indicated a negligible significance of effect of construction works on site geology. Therefore, no additional mitigation measures are required in relation to geology.

Hydrogeology

9.217 The assessment of effects during construction revealed that there was a minor adverse effect to groundwater with regards to the artificially lowered groundwater table. The effect was determined to be minor adverse because the sensitivity of the hydrogeology beneath the site is considered to be medium. This is due to the fact that, based on current understanding groundwater is only being used for irrigation purposes from the Parade Gardens borehole. Further consultation has not revealed any additional constraints regarding the on-site (Granite block care park) borehole and therefore no additional mitigation measures are required.

9.218 The groundwater levels beneath the site will be investigated as part of the ongoing GI, including excavation of boreholes and installation of monitoring instrumentation allowing for monitoring of groundwater levels. This would allow for confirmation of the hydrogeological model and assessment of effect on the identified groundwater resources in the vicinity of the proposed development.

Land Contamination

9.219 During the construction phase of the proposed development there is the potential for construction workers and site users / neighbours to be affected significantly as a result of land contamination, particularly with relation to ground gas. Mitigation measures are therefore necessary.

<u>Mitigation of risks from potentially contaminated soils</u>

9.220 In order to mitigate the potential effect on construction workers from dermal exposure and ingestion of contaminated soils during construction works, a GI into the quality of soils is required. This would inform the mitigation measures required to reduce or eliminate the risk to the construction workers and controlled waters.

9.221 The ongoing GI includes excavation of exploratory holes and obtaining soil and groundwater samples for chemical testing. The results of the laboratory testing will be assessed in line with the land contamination framework of the SoJ. The results of the

assessments together with the laboratory testing results will then be included within the site Construction Health and Safety plan.

9.222 Standard practice mitigation measures in relation to the prevention of dermal contact and ingestion of contamination soils are detailed in the framework CEMP (Appendix O-1).

Mitigation of risks from soil dusts and fibres

9.223 The mitigation measures required for the prevention of potentially contaminated soil dust and fibres (asbestos) would apply for both construction workers and site users / neighbours as dusts and fibres have the potential to migrate away from the site. The standard practice mitigation measures that would be put in place to mitigate against dust migration will be detailed in the CEMP and are summarised below.

- The use of protective clothing and equipment (PPE), construction workers only;
- Health and safety training, guidance notes and signs.
- Dust suppression measures during earthworks (for both construction workers and site users / neighbours);

9.224 The adequate provision of PPE and health and safety guidance to the construction workers would be the responsibility of the contractors involved in the proposed development.

9.225 With regards to potential airborne asbestos fibres generated during construction, the ongoing phase of GI will include analysis of the soil for asbestos. If asbestos is identified in the soil, further mitigation and remedial options would be considered as part of the risk assessment. It should be noted that asbestos is anticipated to be encountered on both sites, resulting from historical development and the potential for asbestos to be present within the existing buildings that are due to be demolished. Measures to control the release of asbestos are to be covered by the demolition strategy (Appendix O-2).

9.226 Dust suppression methods during both demolition and construction are discussed further in the Air Quality chapter of the EIS.

Mitigation of risks from ground gas

9.227 In order to mitigate the potential effects of the ground gas on the construction workers, an investigation of the ground gas regime is required, this will be completed as part of the ongoing phase of GI. This will inform the mitigation measures required to reduce or eliminate the risk to the construction workers.

9.228 The GI is including excavation of boreholes and installation of monitoring instrumentation allowing for spot ground gas monitoring in accordance with current published guidance namely BS 8485:2015. The assessment of the results will be undertaken to confirm the risk arising from the emissions of ground gas. The results of the monitoring and subsequent assessments would then be included within the site Construction Health and Safety plan.

Risks arising from piling activities

9.229 On confirmation of detailed design of the secant pile wall and other pilling activities, a foundation works risk assessment will be undertaken to confirm risks posed to human health and controlled waters during construction.

Mitigation of effects from operation

9.230 Proposed mitigation is set out in this section for effects that have been identified for the operation phase.

Geology

9.231 No significant effects in relation to geology during the operational life of the hospital have been identified and therefore no mitigation measures are required.

Hydrogeology

JGH

9.232 As detailed in the assessment of effects from operation section, there is the potential that the extensive proposed secant pile walls and basement developments on the JGH site would form a barrier to groundwater flow. This could cause substantial issues to the northeast of the development with regards to a raised groundwater level due to a build-up of groundwater behind the secant piled walls.

9.233 In order to mitigate against groundwater build-up, drainage solutions (e.g. French drains) could be implemented along the perimeter of the basement area in order to provide a preferential flow path for groundwater. This would alleviate any potential groundwater build-up to the northeast of the development and therefore minimise any potential negative impacts.

9.234 However, as mentioned in the operational effects section, the groundwater containing strata beneath the site have not been definitively determined. Once the ongoing phase of GI is complete, a detailed ground model of the site can be formed. This ground model will provide information on the geological strata and the groundwater level beneath the site. If groundwater is predominantly found within permeable stratum (e.g. Blown Sands and granular Alluvium bands (gravels)) as opposed to the impermeable cohesive Alluvial deposits, then there is potential that an extensive drainage solution would not necessarily be required. Note, that should such a drainage solution be considered necessary, the potential for the creation of pathways for contaminant and ground gas migration would also need to be considered as part of the design proposals.

9.235 Potential drainage options and a solution would be detailed as part of the detailed design process.

Westaway Court

9.236 It is not anticipated that the works at Westaway Court would have an impact on the hydrogeology of the area, as only localised excavations are likely to be required for lift pits and pile caps.

Land Contamination

9.237 During the operational life of the proposed development, there is a potential for end users to be affected significantly as a result of land contamination, particularly with relation to ground gas. Mitigation measures are therefore necessary.

9.238 In order to mitigate the potential effects of the ground gas on the end site users, an investigation of the ground gas regime is required. This will inform the mitigation measures required to reduce or eliminate the risk to the proposed development.

9.239 A period of ground gas monitoring is proposed as part of the ongoing GI, which would allow for spot ground gas monitoring in accordance with current published guidance namely BS 8485:2015. The assessment of the results would be undertaken to confirm the risk arising from the emissions of ground gas and to inform the design of the gas protection measures if required.

9.240 The absence of the requirement for mitigation with respect to the potential effect of potentially contaminated soils on end site users is based on the assumption that the reuse of site won or import of materials to the proposed development would be managed by a verification system. The verification system would need to be approved by the regulators and therefore, only materials found suitable for re-use would be acceptable for construction works.

9.241 In addition, in order to enhance the health and safety measures applied during the maintenance works, the available soil and groundwater chemical testing results gathered during the proposed GI will be used to inform health and safety risk assessments for future maintenance works.

9.242 The potential risks to both human health and controlled waters will be considered based on the results of the GI. The need for remediation will be considered based on the assessment of risk. It is considered likely that potential risks posed by contaminated made ground materials would be designed out with the use of hard surfacing. Maintaining a ground cover mainly of hardstanding would minimise the downward percolation of water therefore minimising risk to groundwater sources.

Risks arising from piled foundations

9.243 On confirmation of detailed design of the secant pile wall and other pilling activities, a foundation works risk assessment will be undertaken to confirm risks posed to human health and controlled waters during operation.

Residual effects

9.244 The residual effects from the potential impacts identified during the constructional and operational assessments have been identified and are presented below. Refer to the

Assessment summary matrix (Table 9.13) for a detailed representation of the residual effects posed by the proposed development.

Residual effects from construction

9.245 All the residual effects from the construction phase of the proposed development, in relation to this chapter, have been deemed to be either minor adverse or negligible. Therefore, no significant residual effects from construction have been identified.

Residual effects from operation

9.246 The risk of groundwater build up behind the basement and foundation developments of the JFH should be successfully mitigated against through implementation of an effective drainage solution. As stated earlier, the drainage solution should work by creating preferential flow paths around the basement developments and therefore prevent artificially raised groundwater levels to the northeast of proposed developments.

Table 9.13: Assessment summary matrix – (Geology, Hydrogeology and Contamination)

Potential Effect	Receptor (s)	Sensitivity of Receptor	Magnitude (prior to mitigation)	Significance (prior to mitigation)	Mitigation	Magnitude (following mitigation)	Significance (following mitigation)	Comments
Construction								
Removal of soils and insertion of piles.	Geology	Low	Negligible	Negligible	No mitigation measures required	Negligible	Negligible	Geology beneath the site on little geological / geomorphological interest
Dewatering may result in lowered groundwater levels	Groundwater (hydrogeology)	Medium	Minor	Minor adverse (JFH) Negligible (Westaway Court)	No mitigation measures required	Minor	Minor adverse (JGH) Negligible (Westaway Court)	Groundwater abstraction from beneath the site is currently only for agricultural/ / industrial usage. (Parade Gardens borehole)
Impact on health of construction workers due to exposure to potentially contaminated soils/soil dust, fibres and or groundwater	Human health (contamination)	Medium	Moderate	Moderate adverse	Ground investigation to identify presence and composition of potential ground and groundwater contamination in locations tested	Minor	Minor adverse	Refer to the Air Quality section for dust suppression mitigation measures
Impact on human health due to the exposure to ground gas	Human health (contamination)	Medium	Major	Major adverse	Ground investigation to identify ground gas (if present) in locations tested	Minor	Minor adverse	
Impact on health of construction site neighbours	Human health (contamination)	High	Minor	Moderate adverse	Ground investigation to identify presence and composition of	Negligible	Minor adverse	Refer to the Air Quality section for dust

Potential Effect	Receptor (s)	Sensitivity of Receptor	Magnitude (prior to mitigation)	Significance (prior to mitigation)	Mitigation	Magnitude (following mitigation)	Significance (following mitigation)	Comments
due to exposure to potentially contaminated soils dust					potential ground contamination in locations tested			suppression mitigation measures
Impact on groundwater as a result of increased leaching of contaminants as a result of earthworks and foundation works	Groundwater (contamination)	Medium	Minor	Minor adverse	No mitigation measures required	Minor	Minor adverse	Ground investigation to identify potential for contaminated groundwater beneath the site in locations tested. Foundation works risk assessment to be undertaken.
Impact on the culverted Le Faux Bie stream as a result of potentially contaminated groundwater lateral migration and ingression into the culvert	Surface water (contamination)	Low	Minor	Negligible	No mitigation measures required	Minor	Negligible	Ground investigation to identify potential for contaminated groundwater beneath the site in locations tested
Impact on St Aubins Bay due to lateral migration of contaminated groundwater and potential discharge from the culvert	Surface water (contamination)	High *(RAMSAR site)*	Negligible *(large distance away from scheme)*	Minor	No mitigation measures required	Negligible	Minor adverse	Ground investigation to identify potential for contaminated groundwater beneath the site in locations tested
Operation								
Geological resources beneath the site not accessible	Geology	Low	Negligible	Negligible	No mitigation measures required	Negligible	Negligible	Geology beneath the site on little geological / geomorphological interest
Potential barrier to groundwater flow created by the basements and secant pile wall	Groundwater (hydrogeology)	Medium	Moderate	Moderate adverse (JGH)	Implementation of drainage solutions along the perimeter	Minor	Minor adverse (JGH)	Ground investigation to confirm groundwater containing stratum beneath the site

Potential Effect	Receptor (s)	Sensitivity of Receptor	Magnitude (prior to mitigation)	Significance (prior to mitigation)	Mitigation	Magnitude (following mitigation)	Significance (following mitigation)	Comments
				Negligible (Westaway Court)	of the basement areas		Negligible (Westaway Court)	
Impact on health of site users due to exposure to potentially contaminated soils / soil dust during maintenance works	Human health (contamination)	Medium	Minor	Minor adverse	No mitigation measures required	Negligible	Negligible	Limited potential for exposure to potentially contaminated soils beneath the site during operational life of hospital
Impact on human health due to exposure to ground gas	Human health (contamination)	High	Major	Major adverse	Ground investigation to identify ground gas (if present) in locations tested	Negligible	Minor adverse	
Impact on controlled waters	Groundwater + Surface water (contamination)	Low	Moderate	Minor beneficial	No mitigation measures required	Moderate	Minor beneficial	Removal of potentially contaminated soils from beneath the site will limit the potential for leachate generation and migration towards controlled waters
Impact on controlled water from piling	Groundwater	Low	Moderate	Minor adverse	No mitigation measures required	Moderate	Minor adverse	Foundations works risk assessment to be undertaken

A3

Existing 8 storey tower block

Existing 3 storey block

Existing Westaway Court buildings

Existing car parking

Existing Jersey General Hospital buildings

Granite Block

Granite Gatehouse

Temporary theatre block

Lewis Street
Pool
Kensington Place
B 86
Cheapside
Elizabeth Place
Block A
Block B
Block C
Block D
Sutherland Court
Revere Hotel
Stafford Hotel
G (1980)
Pool
Monument
A9
Parade Gardens
Playground
Multi Car Pk
E (1979)
F (1983)
General Hospital
A (1987)
C (1863)
H (2007)
D (1950)
B (1962)
Patriotic Street
Patriotic Place
Newgate Street
The Parade
All Saints Church (C of E)
Savile Street
Car Pk
PC
Gloucester Street
A 9
B 76
PH

JGH Legend

- **A** - 1980's Block (7 Storey)
- **B** - 1960's Wing
- **C** - Granite Block (Listed Gr. II)
- **D** - Peter Crill House
- **E** - Gwyneth Heulin Wing
- **F** - Lab Block
- **G** - Engineering Block
- **H** - Daycare

Proposed new hospital site boundary

Issue	Date	By	Chkd	Appd

Client: Department for Infrastructure

Job Title: Jersey Hospital

Scale at A3: 1:1000

Discipline: General

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Drawing Title: Site Plan

Drawing Status: **For Information**

Job No	Drawing No	Issue
237035-00	**Figure 9.1**	

Do not scale

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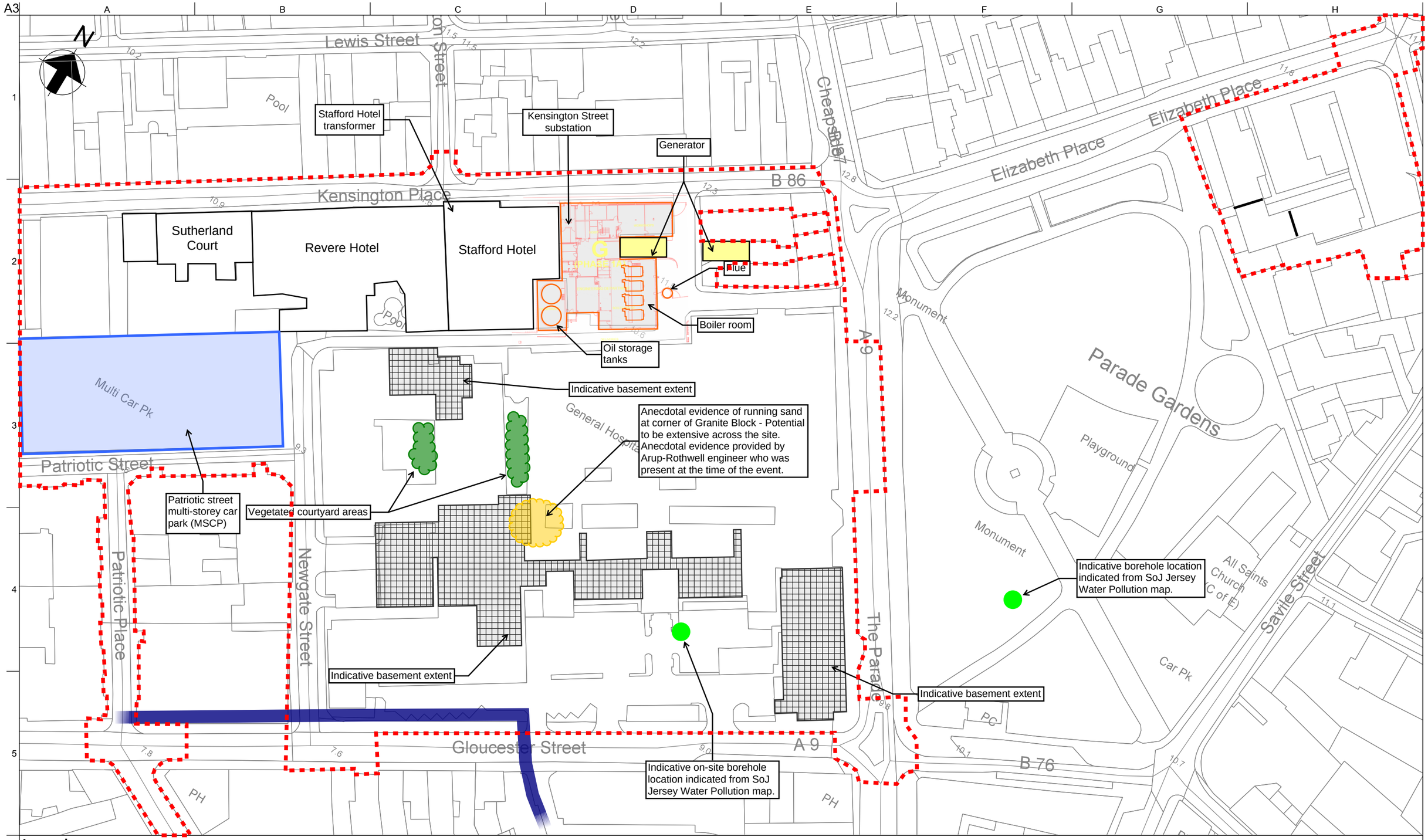

Legend

Proposed new hospital site boundary

Client	Job Title	Drawing Title
Department for Infrastructure	Jersey Hospital	Site Plan

Issue	Date	By	Chkd	Appd

Scale at A3: 1:1000

Discipline: General

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Drawing Status: **For Information**

Job No	Drawing No	Issue
237035-00	Figure 9.2	

Do not scale

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A3

Geotechnical Engineering Ltd
Jersey General Hospital
Phase 1B
(12/07/1979 - 14/07/1979)
Borehole locations unknown

Foundations Engineering Ltd
Jersey General Hospital
Phase 1
(06/03/1973 - 12/03/1973)

Amplus Ltd
Kensington Gate Car Park
(08/01/2007 - 12/01/2007)

Geomarine Ltd
Kensington Place
(16/07/2009 - 21/07/2009)

Amplus Ltd
66-72 Espanade
(21/03/2014 - 02/04/2014)

Amplus Ltd
33 Gloucester Street
Raliegh House
(04/02/2000 - 05/02/2000)

Matthew F Warner & Associates Ltd
Westaway Court
(04/01/1994 - 06/01/1994)

Geomarine Ltd
Jersey General Hospital
Main Theatres Upgrade SI
(07/03/2014 - 08/03/2014)

Amplus Ltd
15-16 The Parade
(11/09/2006)

Gloucester Street
Surface Water Outfall Plan
(Drawing dated 12/01/1982)

BH108 (2018)
BH107 (2018)
BH106 (2018)
BH 1 (1994)
TP 3 (1994)
TP 4 (1994)
BH109 (2018)
BH110 (2018)
BH111 (2018)
BH112 (2018)
BH105 (2018)
BH 3 (1973)
BH 2 (1973)
BH104 (2018)
BH103 (2018)
BH 1 (1973)
BH102 (2018)
BH101 (2018)
BH 4302
BH 4300
BH 4304
BH 4305
BH 4306
BH 4301
BH 4307
BH 4303
BH 4802 (2014)
BH 4803 (2014)
BH 4804 (2014)
BH 4805 (2014)
BH 1 (2000)
BH1 (2014)
TP 2 (2014)
TP 1 (2014)
BH2 (Drawing dated 1982)
BH3 (Drawing dated 1982)
BH4 (Drawing dated 1982)
BH1 (Drawing dated 1982)
BHP 1 (2006)
BHP 2 (2006)
BHP 3 (2006)

St. Helier

Legend

- Site Boundary
- Phase 1 GI borehole location
- Phase 2 GI borehole location
- Historic GI location

Client
Department for Infrastructure

Job Title
Jersey Hospital

Scale at A3 1:2000

Discipline General

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Drawing Title
Historical and Ongoing GI Plan
(Geology, Hydrogeology and Contamination)

Drawing Status
For Information

Job No	Drawing No	Issue
237035-00	**Figure 9.3**	

Do not scale

J:\237000\237035-00\4 Internal Project Data\4-30 Drawings\4-31 Issue drawings\Figure8.dgn