# States of Jersey Transport and Technical Services

**Jersey DAP**

**Needs Report**

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**Prepared for:**
States of Jersey Transport and
Technical Services

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## EXECUTIVE SUMMARY

Grontmij were commissioned by States of Jersey (SoJ) to build and verify a hydraulic model of the Island of Jersey in The Channel Islands. The model was built in accordance with The WaPUG Code of Practice for the Hydraulic Modelling of Sewer Systems – Version 3.001 December 2002' and other UK industry modelling guidelines and was verified using flow survey data collected as part of this study.

The new model has been used to assess the effects on the sewerage infrastructure of proposed future development on the Island and to identify the benefits of proposed future sewer upgrade schemes.

A review of the performance of the 34 overflows within the Jersey catchment was undertaken as part of the needs assessment. There are fourteen overflows that are predicted by the model to operate on an annual basis. During a ten year rainfall event 12 overflows are predicted to operate. The introduction of the Philips Street Scheme stops the King Street CSO from operating and discharging to the bay. Instead the new Ann's Court CSO will discharge to the Cavern. This does mean that the Weighbridge CSO will operate slightly more frequently as the Cavern will fill more quickly with the Ann's Court discharge.

The model shows that only one overflow in the Gorey Bay area spills on a regular basis. This is the overflow upstream of Fauvic SPS. This site spills an average of 14 times per year during the 10 year period between 1994 and 2003. The volumes of discharge are small but it does not comply with the EU shellfish directive.

The other risk in this area is failure of pumping stations. It is known that at times pumping stations have failed due to power cuts and discharges could occur especially if the storage has already been mobilised.
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Nineteen locations are predicted to flood on the island. These do tie up with known flooding locations but some are in fields and this may not have been reported. Some of the flooding is linked to pumping station performance and this requires further investigation.

The flooding near the Beaumont SPS is caused by lack of capacity in the trunk sewer down to First Tower SPS. During rainfall events First Tower acts as a control passing a fixed volume forward to the works so that the inlet structure is not overloaded. Due to this control flows back up in the sewer network to the Weighbridge CSO on the east and back to Beaumont SPS on the west. At the Weighbridge sewerage spills to the Cavern for storage but there is no storage or spill location at Beaumont SPS, hence flooding occurs.

Thirty nine pumping stations do not appear to meet design guidelines that are set out in the UK. A review of how pumping stations are designed should be undertaken to ensure a consistent design format. However First Tower SPS will not follow this standard as its capacity is limited by the inlet structure and because there is no storm water storage at the works. Currently The Cavern storage tank acts in this capacity.

# 1 INTRODUCTION

Grontmij were commissioned by States of Jersey (SoJ) to build and verify a hydraulic model of the Island of Jersey in The Channel Islands. The model was built in accordance with The WaPUG Code of Practice for the Hydraulic Modelling of Sewer Systems – "Version 3.001 December 2002" and other UK industry modelling guidelines and was verified using flow survey data collected as part of this study.

A needs assessment has been undertaken in order to assess the current operation of the sewerage system in Jersey. The model has also been used to assess the effects on the sewerage infrastructure of proposed future development on the Island and to identify the benefits of proposed future sewer upgrade schemes.

Known issues that have been brought to the attention of Grontmij during the course of this study include:

- Pollution and eutrophication in St. Aubin's Bay from WwTW discharges.
- Issues with various overflow discharges.
- Concern over the potential impact on Ramsar sites and oyster beds.
- Flooding has been reported in the town centre of St Helier, surface water flooding is known to occur intermittently in the St Aubin's / Charing Cross area and flooding also occurs at Gunsite Tower (flooding in the marsh area) near Beaumont SPS.
- The Philip Street shaft and sewer separation scheme.

This report details the results of the Needs Assessment that has been undertaken as part of the Jersey DAP. The needs assessment considered a number of different time horizons and scenarios to determine how the system performs now, with the Philips Street Scheme constructed and in 2040. The issue of Climate Change has also been addressed for the future scenarios with rainfall and tide levels being increased in line with the United Kingdom Climate Projection 2009 UKCP09) figures. Urban Creep is a phenomenon that has been evident over the last 20 years with more houses having conservatories built and more parking constructed to accommodate more cars. This leads to higher impermeable areas and this is now believed to be having a significant impact on sewer system performance.

## 2 DESCRIPTION OF DRAINAGE AREA

Jersey is the largest of the Channel Islands with an area of 118.2 sq. km. and is situated 14 miles off the north-west coast of France and 85 miles from the English coast. The Island of Jersey is divided up into 12 Parishes: Grouville, St Brelade, St Clement, St Helier, St John, St Lawrence, St Martin, St Mary, St Ouen, St Peter, St Saviour and Trinity.

The residential population is estimated at 91,900 (2008) with a seasonal increase due to tourism of about 15,000 (2008 tourist max population), which is included within the Needs Assessment Models. From data provided by SoJ, approximately 83,000 of the population (90%) are connected to the sewerage system, with the remaining residential properties discharging into septic tanks.

The sewerage system on the island is a mixture of combined and separate foul and surface water sewers. The combined sewers concentrated in and around St. Helier where the sewers are older, with the rest of the island served by newer separate systems.

The Jersey sewerage system is heavily pumped with 106 foul/combined pumping stations across the island. There are also 5 storm water pumping stations. Within St. Helier there is a large underground storage facility called the “The Cavern”. This underground facility provides 25,000$m^3$ storage for storm sewage during wet weather.

The majority of the foul/combined sewerage system drains to Bellozanne WwTW in the south of the island with a very small pocket of properties on the north of the island being served by a small packaged treatment plant at Bonne Nuit.

The hydraulic model encompasses the catchment area upstream of Bellozanne WwTW only. The model includes all known network overflows as well as the inlet works and overflow arrangement at Bellozanne WwTW. Eighty eight significant pumping stations have been included within the modelled network using record data provided by SoJ. A suitable termination point has been chosen downstream of the storm tanks and storm overflow at Bellozanne WWTW.

The hydraulic model encompasses the two main surface water systems in the town of St Helier. The surface water system upstream of Sameres Marsh Pumping Station has also been included in the hydraulic model.

The surface water systems in St Aubin and St Brelade have been included in the hydraulic model in order to assess the surface water flooding that occurs in Le Mont les Vaux.

# 3 SCOPE OF WORK

The Needs Assessment will cover the following Hydraulic assessments;

- Infiltration Study
- Hydraulic / Flooding Performance
- Pumping Station Performance
- CSO Performance
- Specific Studies

A number of versions of the Jersey DAP model were used to undertake the needs analysis. See Table 3.1.

**Table 3.1. List of Hydraulic Models**

| Model Name | Model Description | |
|---|---|---|
| Jersey DAP_Baseline model_6 | Model represents the existing sewerage system operating as it should (i.e. no operational deficiencies) | Verified hydraulic model with all blockages removed and pumps operating at design rate |
| Jersey DAP_Baseline model_with philips street scheme | Model represents the existing sewerage system operating as it should (i.e. no operational deficiencies) with the proposed Philips Street Scheme added. This model does not contain the proposed sewer separation works at Philips Street or any of the proposed changes to overflows within St Helier. | Verified hydraulic model with all blockages removed and pumps operating at design rate. Proposed construction works at Philips Street added. |
| Jersey DAP_Baseline model_with Philips Street Shaft Rev 2 with weirs raised Rev5 | Model represents the existing sewerage system operating as it should (i.e. no operational deficiencies) with the proposed Philips Street Scheme added. This model also contains the proposed sewer separation works at Philips Street and the proposed changes to overflows within St Helier. | Verified hydraulic model with all blockages removed and pumps operating at design rate. Proposed sewer separation and construction works at Philips Street added. Changes to overflow settings in St Helier also added. |
| Jersey DAP_Future model_6 | Model represents the future operating regime of the catchment and accounts for known proposed developments. Climate change rainfall used. No allowance for urban creep allowed. | Verified hydraulic model with all blockages removed and pumps operating at design rate. Proposed sewer separation works at Philips Street added. Details of known proposed development added. |

| Model Name | Model Description | |
|---|---|---|
| Jersey DAP_Future model_7 | Model represents the future operating regime of the catchment and accounts for known proposed developments. Climate change rainfall used. Allowance for urban creep allowed. | Verified hydraulic model with all blockages removed and pumps operating at design rate.<br>Proposed sewer separation works at Philips Street added.<br>Details of known proposed development added.<br>Allowance for urban creep made using UKWIR guidelines. |

For details of the various changes made to the verified hydraulic model refer to section 5 of this report.

# 4 INFILTRATION STUDY

## 4.1 Infiltration Assessment

According to the "Liquid Waste Strategy 2009-2028" report, January 2009, infiltration and inflow is a major problem in certain parts of the system and is caused by poor sewer construction, poor sewer condition, high water table, cross connections and poor/blocked road drainage. An infiltration assessment, following the flow survey, was carried out in order to detect those areas that are most affected by infiltration and hence likely to result in flooding due to hydraulic overloading of the network. This assessment identifies the areas that affect the operation of the network the most. These lengths of sewer therefore take priority with regard to repair works to be undertaken on the network.

Given the nature of the network, where flows are pumped through a number of pumping stations, before arriving for treatment, having a large volume of infiltration within the network means that the run time of the pumps is unnecessarily increased. The pumping and treating of "infiltration" is a significant cost to the State of Jersey. SoJ provided Grontmij with a figure of 9.26p/kWh to undertake an assessment of the costs associated with pumping infiltration.

## 4.2 Infiltration Locations

During the flow survey the total amount of infiltration within the network was calculated from the Flow Survey and Pumping Station analysis to be 185l/s. This value does not include the significant tidal infiltration identified in the St. Helier area.

The ground water infiltration per metre length for each of the pipes within the sewer network of the State of Jersey was calculated in order to highlight specific areas within the network that may be experiencing a high level of infiltration. The amount of infiltration in each sub-catchment was graded by litres per second per meter length of pipe in the following ranges:

- 0 – 0.001 l/s/m
- 0.002 l/s/m
- 0.004 l/s/m
- 0.008 l/s/m

Catchments with an infiltration grading above 0.001l/s/m are identified in the tables 4.1 to 4.5, quantifying the extent of the affected network. They are also detailed in drawings P692900_09 (1) to P692900_9 (6).

**Table 4.1 – Infiltration between MHs K08F049 to H08F017**

| Pipe Diameter (mm) | Pipe Length (m) | Pipe Count |
|---|---|---|
| 100 | 53 | 2 |
| 150 | 2,004 | 46 |
| 225 | 2,426 | 57 |
| 230 | 103 | 2 |
| 300 | 161 | 3 |
| 400 | 233 | 5 |
| 450 | 36 | 1 |
| 500 | 11 | 1 |
| 675 | 2,173 | 27 |
| **Totals** | **7,200** | **144** |
| **Total Infiltration (l/s)** | **57.57** | |

**Table 4.2 – Infiltration between MHs S11F055 and Pontac SPS**

| Pipe Diameter (mm) | Pipe Length (m) | Pipe Count |
|---|---|---|
| 150 | 6,009 | 141 |
| 225 | 261 | 6 |
| 375 | 5 | 1 |
| 400 | 60 | 1 |
| 450 | 98 | 8 |
| 525 | 638 | 13 |
| 600 | 675 | 13 |
| 800 | 132 | 3 |
| **Totals** | **7,878** | **186** |
| **Total Infiltration (l/s)** | **30** | |

**Table 4.3 – Infiltration between Rue Des Buttes SPS and MH H01F002**

| Pipe Diameter (mm) | Pipe Length (m) | Pipe Count |
|---|---|---|
| 150 | 5422 | 106 |
| 200 | 6 | 1 |
| 225 | 1010 | 23 |
| 250 | 20 | 2 |
| 300 | 95 | 3 |
| **Totals** | **6,553** | **135** |
| **Total Infiltration (l/s)** | **14.05** | |

**Table 4.4 – Infiltration between MHs 4156067699 and L08F162**

| Pipe Diameter (mm) | | Pipe Length (m) | Pipe Count |
|---|---|---|---|
| 150 | | 673 | 40 |
| 225 | | 622 | 36 |
| 300 | | 179 | 15 |
| 375 | | 409 | 22 |
| 450 | | 118 | 11 |
| 500 | | 132 | 19 |
| 525 | | 100 | 4 |
| **Width (mm)** | **Length (mm)** | | |
| 690 | 1,070 | 10 | 1 |
| 760 | 915 | 14 | 2 |
| 780 | 1,080 | 116 | 1 |
| 830 | 1,160 | 21 | 1 |
| 830 | 1,200 | 79 | 9 |
| 850 | 1,190 | 80 | 1 |
| **Totals** | | **2,553** | **162** |
| **Total Infiltration (l/s)** | | **5.63** | |

**Table 4.5 – Infiltration between Bas Du Marais SPS and MH D04F007**

| Pipe Diameter (mm) | Pipe Length (m) | Pipe Count |
|---|---|---|
| 150 | 649 | 20 |
| **Total Infiltration (l/s)** | **4.24** | |

## 4.3 Infiltration Annual Pump Costs

185l/s Infiltration is approximately 43% of the island's dry weather flow. Due to the arrangement of the network and reliance on pumping stations, some dry weather flow (for example in the area of Rue Des Buttes SPS) can be pumped up to five times before reaching the WwTW.

An exercise was undertaken to approximate the amount of power used on the island to pump ground water infiltration to the WwTW. Of the 109 SPSs, Grontmij have been supplied with pump start/stop times for 24. A review of a typical dry weather day identified that between midnight and 6am, the 24No. SPSs ran for a combined total of 34hours. Assuming a cost of 9.26p/kWh, the total annual cost of running these pumps annually is approximately £280,056 over this six hour period.

Therefore identifying and dealing with the five hotspot areas highlighted above could result in an annual cost saving of approximately £53,989.

A copy of the calculations produced as part of this assessment can be found in Appendix B.

## 4.4 Infiltration Sensitivity Analysis

A sensitivity analysis was undertaken to determine the impact of removing infiltration upon the operation of the sewer network. In order to undertake this analysis it was assumed that a 50% reduction in infiltration (both base infiltration and ground water infiltration) could be achieved in each of the identified infiltration hotspots. See table 4.6 and 4.7.

**Table 4.6 Infiltration Sensitivity Analysis – Flood Volume Comparison**

| Existing System | Existing System With Infiltration Reduced by 50% | Future System | Future System With Infiltration Reduced by 50% |
|---|---|---|---|
| **Total Catchment Predicted Flood Volume (1 in 10 Year) ( $M^3$)** | **Total Catchment Predicted Flood Volume (1 in 10 Year) ( $M^3$)** | **Total Catchment Predicted Flood Volume (1 in 10 Year) ( $M^3$)** | **Total Catchment Predicted Flood Volume (1 in 10 Year) ( $M^3$)** |
| 15,704 | 15,4870 | 15,4210 | 15,214 |

**Table 4.7 Infiltration Sensitivity Analysis – First Tower SPS Assessment**

| | TWL at First Tower SPS (m) | Peak Flow into First Tower SPS (l/sec) |
|---|---|---|
| Existing System | 5.292 | 1,210 |
| Existing System With Infiltration Reduced by 50% | 5.239 | 1,209 |
| Future System | 5.442 | 1,218 |
| Future System With Infiltration Reduced by 50% | 5.412 | 1,218 |

# 5 MODEL UPDATES

The following sections detail the various changes made to the verified hydraulic model in order to create the various models used to undertake the needs analysis.

## 5.1 Baseline Needs Model

The Baseline Needs Model represents the existing sewerage system operating as it should. In order to create this model the following changes were made to the verified Jersey DAP model;

1. A new control panel with a variable speed drive is due to be installed at First Tower SPS in early 2012. Details of the future pump regime at First Tower SPS have been provided by SOJ and incorporated into the Baseline Needs Model – refer to Appendix H for details of the changes to be made at First Tower SPS.

2. Pump 4 at Le Dicq SPS is due to be replaced by SOJ in 2012. Replacing this pump will result in an increase of 50 l/sec at this SPS. The pump rate associated with pump 4 at Le Dicq SPS has been increased from 130l/sec to 180 l/sec in the Baseline Needs Model to account for this.

3. The ground levels at First Tower SPS and Les Ruisseaux SPS have been updated using data from As Built Drawings provided by SOJ.

4. The storage volume at the Cavern has been amended and a dummy pipe added to allow the tank to initialise empty in Infoworks.

5. The discharge point of the rising main associated with La Collette Marina SPS (PS41) has been amended as SOJ have confirmed that this rising main should discharge to MH L10F076.

6. The modelling of the 'Old Town Brook' has been updated using As Built drawings provided by SOJ.

## 5.2 Baseline Needs Model with Philips Street Sewer Separation Scheme

SOJ are about to undertake a number of capital schemes in order to alleviate sewer flooding in the eastern part of St Helier and to reduce the amount of storm flow arriving at First Tower SPS.

A shaft 3, located near the junction of Philips Street and Providence Street in St Helier, is due to be constructed in 2012. Following construction of Shaft 3 a number of sewer separation schemes will be undertaken in the eastern part of St Helier and a new surface water system constructed to allow surface water flows to be conveyed to the existing 2.74m diameter surface water tunnel in Philips Street. As part of this Needs Assessment a review of the proposed surface water system upstream of Shaft 3 has been made. Details of the pipework required to convey the separated storm flows from the eastern part of St Helier to Shaft 3 are provided on drawing P692900_100_003_B in Appendix C.

A new combined sewer overflow is also due to be constructed in Ann Court (off Providence Street). Spill flows from the new overflow will discharge directly to The Cavern. Details of the new overflow were provided by SOJ – refer to Appendix C.

Following construction of the Philips Street Scheme the overflow settings associated with a number of the network overflows in St Helier will need to be amended. Details of the proposed amendments were provided by SOJ (refer to Appendix C) and can be summarised as below;

- Val Plaisant CSO – Weir level to be raised
- Great Union Road CSO – Weir level to be raised
- Aquila Road CSO – Weir level to be raised
- Park CSO – Weir level to be raised
- Union Street CSO - Weir length to be increased to 2m and weir level raised
- King Street CSO – Weir level to be raised and flap valve to be removed
- Weighbridge CSO – Weir level to be raised
- Esplanade CSO - Weir length to be increased to 1.5m and weir level raised

The capital schemes described above have all been incorporated into an updated version of the Baseline Model in order to allow the impact of these proposed works to be determined.

## 5.3 Future Needs Model

The Future Needs Model is based upon the Baseline Needs Model (with the Philips Street Scheme added) and represents a 2040 design horizon.

In order to create the Future Needs Model details of known proposed developments and future capital schemes have been added to the hydraulic model. Sections 6.3.1 to 6.3.3 provide details of the changes made to the Baseline Needs Model to create the Future Needs Model

### 5.3.1 Population

The modelled population has been increased to reflect a 2040 design horizon. Based on the Draft island plan, the population was increased by 28,000. The additional population has been added to sub-catchments, where a development has been identified, or added to a cluster of sub-catchments within a parish, when no specific location for the development has been provided.

### 5.3.2 Development

Details of proposed developments were obtained from SOJ. Details of those proposed developments included in the model are shown on Drawing P692900_100_001. See Table 5.1

**Table 5.1 - Proposed Developments**

| Modelled Node ID | Site Location | Modelled Population | Modelled Subcatchment ID |
|---|---|---|---|
| C09F138 | Fields 190, 191 and 192, La Rue de la Sergente | 53 | Dev_009 |
| E07F016 | Field 91A Belle Vue | 117 | Dev_018 |
| F06F078 | Field 633, La Verte Rue | 29 | Dev_007 |
| C02F014 | Glasshouse Site, Field 785, La Rue des Cosnets | 43 | Dev_006 |
| G04F002 | Field 561 and 562 | 64 | Dev_011 |
| J04F005 | Glasshouse Site, Field 114, Le Passage, Carrefour Selous | 59 | Dev_002 |
| J02F045 | Field 605 | 29 | Dev_013 |
| N04F066 | Field 873, Bel Royal | 27 | Dev_010 |
| N04F034 | Field 578, Trinity | 70 | Dev_016 |
| J07F027 | Field 818 and part of Field 873<br>356 | 27 | Dev_008 |
| L08F018 | Part Field 1219, la Grande Route de Mont a l'Abb | 27 | Dev_017 |
| L08F019 | Uplands Hotel | 59 | Dev_005 |
| PS_Dev003 | Samares Nursery, La Grande Route de St Clement | 293 | Dev_003 |
| N08F093 | Fields 516, 516A, 517 and 518 | 433 | Dev_015 |
| P09F004 | Longueville Nurseries, New York Lane | 29 | Dev_004 |
| S11F003 | Field 274 | 66 | Dev_012 |
| R08F011 | Field 234a, De La Mare nurseries | 72 | Dev_001 |
| R08F009 | Field 148, Rue des Maltieres | 39 | Dev_014 |

All new developments have been assumed to be separately drained.

### 5.3.3 Urban Creep

Urban Creep is a phenomenon that has been evident over the last 20 years with more houses having conservatories built and more parking constructed to accommodate more cars. This leads to higher impermeable areas and this is now believed to be having a significant impact on sewer system performance. An allowance for urban creep has been made using the methodology outlined in UKWIR document 'W/M/07 – Impact of Urban Creep on Sewerage Systems'.

In order to assess the impact of urban creep upon the Jersey sewerage system two versions of the future model were created - one containing an allowance for creep and the other excluding this allowance. Both sets of results are included in this report to illustrate how urban creep affects the operation of assets within this catchment.

# 6 BASELINE NEEDS ASSESSMENT (EXISTING SYSTEM)

## 6.1 Hydraulic / Flooding Performance

The Baseline Needs Model was simulated for durations of 30, 60, 90, 120, 240, 360, 480, 540 and 960 minutes with 10 and 30 year return period storms. 10 and 30 year flood volumes for individual manholes were determined for each storm duration and the critical flood volume for each manhole identified. Predicted flood volumes less than 25m$^3$ were excluded from the analysis. No allowance for tidal interaction was made when undertaking this analysis.

## 6.2 Known Flooding Locations

Flooding is known to occur in the following locations;

- Town Centre of St Helier
- St Aubins / Charing Cross area (surface water flooding)
- Gunsite Tower near Beaumont SPS

## 6.3 Town Centre of St Helier

Historically, foul and surface water flooding has occurred in the north eastern part of St Helier Town Centre. The hydraulic model does not predict any flooding to occur in this area during either a 1 in 10 year design rainfall event or during a 1 in 30 year design rainfall event. Flooding is however predicted to occur in Ann Street (73m$^3$) and Hilary Street (45m$^3$) during a 10 year design rainfall event when 20% sediment is added to flat sewers in this area. This suggests that the observed flooding in this area could be attributable to an accumulation of sediment in this area.

## 6.4 St Aubins / Charing Cross area (surface water flooding)

Surface water flooding is known to occur in Le Mont Les Vaux in St Aubin, St Brelade. The surface water system in this road discharges to St Aubin's Bay and has a flap valve installed to prevent tidal ingress. The hydraulic model indicates that surface water flooding will occur in this area if high water levels in St Aubin's Bay prevent the flap valve from opening.

As part of this needs assessment a sensitivity analysis was undertaken to determine the impact high tidal levels have upon predicted flooding in this area. The following 4 scenarios were run;

- No tidal influence
- Lowest Astronomical Tidal (LAT) - 0.1m
- Highest Astronomical Tidal (LAT) - 12.18m
- Mean Low Water Springs Level (MLWS)– 1.33m
- Mean High Water Springs Level (MHWS)– 11.00m

The results of this sensitivity analysis are in Table 6.1 and show that surface water flooding will only occur in this area when high tidal levels exist. Flooding will begin to occur when the tidal level is 6.717m.

**Table 6.1 - St Aubins Sensitivity Analysis**

| Manhole | Predicted Maximum 1 in 10 Year Flood Volume (m3) | | | | |
|---|---|---|---|---|---|
| | No Tidal Influence | LAT | HAT | MLWS | MHWS |
| G09S010 | 0 | 0 | 7119 | 0 | 7120 |
| G09S016 | 0 | 0 | 2364 | 0 | 2364 |

The hydraulic model also predicts that sewerage flooding occurs during 10 year and 30 year design events at 7 manholes in La Mont Les Vaux. Details of the predicted food volumes are tabulated in table 6.2

**Table 6.2 - Foul / Combined Predicted Flooding – St Aubins**

| Manhole | Predicted Maximum 1 in 10 Year Flood Volume (m3) | Predicted Maximum 1 in 30 Year Flood Volume (m3) |
|---|---|---|
| G09F007 | 27 | 147 |
| G09F011 | 44 | 146 |
| G09F013 | 128 | 327 |
| G09F015 | 29 | 85 |
| G09F018 | 28 | 63 |
| G09F020 | 18 | 38 |
| G09F021 | 5 | 22 |

The sewerage flooding in this area is caused by backing up from the 675mm diameter trunk sewer in La Neuve Route. This flooding is also compounded by the operational regime present at Beaumont SPS and First Tower SPS, see section 6.5.

## 6.5 Gunsite Tower near Beaumont SPS

Foul and surface water flooding is known to occur in the area of marshland to the north of La Roule De La Haule in Beaumont, St Lawrence. The hydraulic model predicts flooding during 10 year and 30 year design events at 4 manholes in this area. Details of the predicted food volumes are tabulated below in table 6.3.

**Table 6.3 - Predicted Flooding – Beaumont SPS**

| Manhole | Predicted Maximum 1 in 10 Year Flood Volume (m3) | Predicted Maximum 1 in 30 Year Flood Volume (m3) |
|---|---|---|
| H07F033 | 10 | 49 |
| H08F020 | 46 | 128 |
| H08F021 | 1 | 14 |
| H08F030 | 0 | 35 |

The flooding in this area is caused by backing up from the downstream Beaumont SPS which does not have sufficient capacity to accommodate 1 in 10 year flows. The flooding is compounded by the fact that high levels of surcharge are present in the main 675mm diameter trunk sewer downstream of Beaumont SPS due to the operational regime present at First Tower SPS. Flooding is also affected by the high levels of infiltration that are present upstream of Beaumont SPS (58% of dry weather flow is infiltration).

## 6.6 Areas at Risk of Flooding (Foul / Combined System)

Details of predicted flooding during both 1 in 10 year and 1 in 30 year design rainfall events are shown on drawings In Appendix D.

The following areas are considered to be 'at risk' of foul / combined sewer flooding as during a 1 in 10 year design event flooding is predicted to occur;

- Fields upstream of Les Ruisseaux SPS
- Fields 127 and 134 to the east of St Brelade
- La Rue de la Frontiere (upstream of La Frontiere SPS)
- La Rue Des Varvots (upstream of La Retraite / La Rue des Varvots SPS)
- La Grande Route de St Laurent (various locations)
- Various locations in St Lawrence
- La Rue de Haut
- A1 near La Rue de Trachy in St Helier
- Office complex, bowling green and car park off Route es Nouaux in St Helier
- Tower Road in St Helier
- New St John's Road in St Helier
- Claremont Road in St Saviour
- Bellozane Valley outside SOJ Offices
- La Rue de la Pallotterie in St Saviour
- Field 64 to the South of Grouville
- Field 260 and 261 in St Clement
- La Rue de Fauvic and the B37 in Grouville
- Various locations on La Grande Route des Sablons in Grouville
- Various locations in St Saviours upstream of Maufant SPS

During a 1 in 30 year design event the amount of predicted flooding at each of the above locations increases. No new flooding locations are predicted. Many of these manholes are in fields and therefore the flooding may not be reported.

## 6.7 Areas at Risk of Flooding (Surface Water System)

Details of predicted flooding during both 1 in 10 year and 1 in 30 year design rainfall events are shown on drawings in Appendix D.

The following areas are considered to be 'at risk' of surface water sewer flooding as during a 1 in 10 year design event flooding is predicted to occur;

- Wellington Road and Maison St Louis in St Saviour
- Oak Tree Gardens in St Saviour
- Pillar Gardens in St Saviour
- Princes Tower Road in St Saviour
- Plat Douet Road in St Saviour
- La Rue le Gros (Trading Estate) in St Saviour
- La Grande Route de la Cote (various locations) in St Clement
- Le Clos du Rivage in Grouville

During a 1 in 30 year design event the amount of predicted flooding at each of the above locations increases. Additional surface water flooding is also predicted to occur at various locations within St Saviour.

## 6.8 Pumping Station Performance

An assessment of all modelled foul / combined pumping stations was undertaken as part of the needs assessment. There are 111 pumping stations on Jersey and 90 are represented in the model. The assessment is based around Formula A flow which is a standard UK calculation that says what flow should be passed forward at a pumping station and an overflow. It is an empirical Formula A , but it is widely accepted in the Water Industry in the UK and by the Environment Agency. The following assessments were undertaken for each modelled foul/combined pumping station;

- An assessment of available storage was undertaken to confirm that the emergency storage currently provided is greater than 2 hours at 3 DWF. Where sufficient emergency storage is not currently available the volume of additional storage required has been determined.
- Formula A flows (see note below) have been calculated for each modelled foul / combined pumping station. Once calculated the Formula A flows for each pumping station was compared to the maximum pump rate. Those pumping stations failing to pump flows in excess of the calculated Formula A have been identified.
- High levels of infiltration are known to affect the operation of a number of the pumping stations within the Jersey catchment. In order to identify those pumping stations affected by high infiltration levels, infiltration has been calculated as a % of DWF for each modelled pumping station.
- During 10 year and 30 year design storms flooding is predicted to occur upstream of some of the pumping stations. This flooding occurs because there is either insufficient storage available at these pumping stations or the pumps have insufficient capacity. All pumping stations that either cause or contribute to upstream flooding have been identified.

- A number of the foul / combined pumping stations have overflows associated with them. An assessment of the operation of these overflows has been undertaken as part of this needs assessment – refer to section 7.10

Formula A flows have been calculated using the following equation.

**Formula A Flow = DWF + 1360 P + 2 E**

Where:

DWF = P G + I + E

P = Population

G = Water Consumption Rate (150 l/head/day)

E = Industrial flow

I = Infiltration

The results of this analysis highlight the following issues;

- 18 Pumping stations do not currently pass forward Formula A flow
  - Bas Du Marais
  - Les Ruisseaux
  - Beaumont
  - St Ouen
  - Links Estate
  - St Martin's
  - Arichondel
  - Le Rocquier School
  - Le Rondin
  - Jersey Zoo
  - La Chasse
  - Rue Des Buttes
  - L'Etacq
  - La Retraite / La Rue des Varvots
  - Becquet Vincent
  - Le Hurel Trinity
  - Mont Pellier
  - Route Orange
- 29 Pumping stations do not currently have sufficient emergency storage provision available. 2HRS @ 3dwf
  - Bas Du Marais
  - Les Ruisseaux
  - Ouaisne
  - Beaumont
  - Five Oaks
  - Rue des Pres
  - Bashfords Nursery

- St. Mary
- Le Dicq
- Rozel No 3
- Pontac
- Le Bourg
- Le Hurel
- St. Ouen
- Le Rivage
- Links Estate
- St. Saviour's Hospital
- Faldouet
- Archirondel
- Atlantic
- Anne Port Bay
- La Collette Marina
- Le Rocquier School
- Route du Sud
- Portelet No 2
- Route Orange
- Mont Nicolle
- St. Brelade II
- St. Brelades slip

- Pumping stations cause flooding to occur upstream due to having insufficient storage / pumping capacity.

  - Bashfords Nursery
  - Trinity Pumping Station
  - Le Rondin
  - Rue a la Dame / Highfield Vineries
  - Jersey Zoo
  - La Retraite / La Rue des Varvots
  - Becquet Vincent
  - La Frontiere
  - St. Brelade I

The results of the pumping stations assessments are included in Appendix E

39 pumping stations do not meet UK design standards in terms of passing forward Formula A or having 2 hours storage of 3DWF.

### 6.9 Overflow Performance

An assessment of the performance of all known overflows has been made. The peak 1 in 10 year spill flow for each of the overflows has been determined.

Annual spill volumes and spill frequencies have also been determined using stochastically generated rainfall data provided by SOJ. A ten year rainfall series encompassing the years 1994 to 2003 was used and the average annual spill volumes and frequencies calculated. Table 6.4

includes details of the average annual spill frequencies and volumes whilst a full set of all results for years 1994 to 2003 is included in Appendix F.

A number of the overflows in the Jersey catchment discharge to tidal waters and therefore the operation of these assets could be affected by high tidal levels. The peak 1 in 10 year spill flows provided in table 6.4 do not account for any tidal interaction that may occur.

**Table 6.4 - Overflow Performance Existing System**

| Overflow Name | Overflow Type | Receiving Watercourse | Peak 1 in 10 yr Spill Flow (m3/s) | Average Annual Spill Frequency | Average Annual Spill Volume | Comments |
|---|---|---|---|---|---|---|
| Great Union Road CSO | Network | St Aubin's Bay via a SW system | 0.000 | 0 | 0 | |
| Aquila Road CSO | Network | St Aubin's Bay via a SW system | 0.000 | 0 | 0 | |
| Val Plaisant CSO | Network | St Aubin's Bay via a SW system | 0.000 | 0 | 0 | |
| Union Street CSO | Network | St Aubin's Bay via a SW system | 0.285 | 0 | 0 | |
| Weighbridge CSO | Network | St Aubin's Bay via a SW system | 1.693 | 2 | 20,075 | Spill to sea |
| King Street CSO | Network | St Aubin's Bay via a SW system | 1.504 | 12 | 11,275 | |
| Park CSO | Network | St Aubin's Bay via a SW system | 0.000 | 0 | 0 | |
| Esplanade CSO | Network | St Aubin's Bay via a SW system | 0.000 | 0 | 0 | |
| La Greve de Lecq 2 SPS | Pumping Station | North Coast | 0.000 | 0.1 | 3 | Overflow from La Greve De Lecq 2 SPS Wet Well |
| La Greve de Lecq 2 SPS (E02F007) | Network | North Coast | 0.012 | 0 | 0 | Overflow upstream from La Greve De Lecq 2 SPS |
| Le Rivage SPS (S08F098) | Network | Royal Bay of Grouville | 0.000 | 0.1 | 83 | Overflow upstream from Le Rivage SPS |
| Le Rivage SPS (S08F001) | Network | Royal Bay of Grouville | 0.043 | 0 | 0 | Overflow upstream from Le Rivage SPS |

| | | | | | | |
|---|---|---|---|---|---|---|
| Le Rocquier School SPS | Pumping Station | | 0.000 | 0 | 0 | |
| Le Bourg SPS (R11F042) | Network | La Greve De St Clement via a surface water system | 0.000 | 0.1 | 2 | Overflow upstream from Le Bourg SPS |
| Le Hocq SPS (Q11F030) | Network | La Harve Du Hocq Bay via a SW system | 0.000 | 0.1 | 7 | Overflow upstream from Le Hocq SPS |
| Maupertuis SPS (P11F005) | Network | La Mare | 0.029 | 10 | 187 | Overflow upstream from Maupertuis SPS |
| Milano SPS (B03F005) | Network | Le Sein | 0.000 | 0 | 0 | Overflow upstream from Milano SPS |
| Pontac SPS (Q11S006) | Network | Royal Bay of Grouville | 0.012 | 1 | 114 | Overflow upstream from Pontac SPS |
| Petit Port SPS | Pumping Station | St Ouen's Bay | 0.000 | 0 | 0 | |
| Rue des Pres SPS | Pumping Station | Unnamed Drain | 0.000 | 0 | 0 | |
| Rue du Sud SPS | Pumping Station | Unnamed Drain | 0.000 | 0 | 0 | |
| Rozel 1 SPS | Pumping Station | St Catherine's Bay | 0.016 | 2 | 72 | |
| Rozel 2 SPS | Pumping Station | St Catherine's Bay | 0.000 | 1 | 6 | |
| St. Brelade I SPS (E09F109) | Network | St Brelade's Bay | 0.033 | 0.2 | 5 | Overflow upstream from St Brelade 1 SPS |
| St. Brelades Wayside Slip SPS | Pumping Station | St Brelade's Bay | 0.000 | 0 | 0 | |
| St. Ouen SPS (D04F027) | Network | Unnamed Drain | 0.015 | 0.4 | 3 | Overflow upstream from St Ouen SPS |
| M08F064 | Network | St Aubin's Bay via a SW system | 0.000 | 0 | 0 | |
| Charing Cross / Mont Les Vaux CSO | Network | St Aubin's Bay | 0.118 | 2 | 1186 | |
| Fauvic SPS (S09f007) | Network | Royal Bay of Grouville | 0.068 | 14 | 634 | Overflow upstream from Fauvic SPS |
| Five Oaks PS | Pumping Station | To soakaway | 0.000 | 0 | 0 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Five Oaks PS (P08F017) | Network | To soakaway | 0.000 | 0 | 0 | Overflow upstream from Five Oaks SPS |
| Corbiere PS | Pumping Station | St Ouen's Bay | 0.000 | 0 | 0 | |
| Golf Lane PS Overflow | Network | Royal Bay of Grouville | 0.000 | 0 | 0 | Overflow upstream from Golf Lane SPS |
| Portelet1 PS | Pumping Station | St Brelade's Bay | 0.000 | 0 | 0 | |

Five number of the overflows listed above can discharge into the Shellfish waters of Gorey Bay (Royal Bay of Grouville). In order to achieve compliance with the EU Shellfish Directive these overflows should not have any more than an average of 10 spills per year. The hydraulic model indicates that overflow S09F007 (upstream of Fauvic SPS) spills more than 10 times during a typical year and therefore does not comply with the EU Shellfish Directive.

# 7 BASELINE NEEDS ASSESSMENT WITH PHILIPS STREET SCHEME ADDED

## 7.1 Overflow Performance

An assessment of the performance of all known overflows in St Helier has been made to determine how construction of the Philips Street Scheme will affect the operation of these assets. The peak 1 in 10 year spill flow for each of the overflows has been determined and compared to those generated using the Baseline Needs Model. Annual spill volumes and spill frequencies have also been determined using stochastically generated rainfall data provided by SOJ and a typical year of 1994 used. See Table 7.1. The peak 1 in 10 year spill flows provided in table 7.1 do not account for any tidal interaction that may occur.

The Philips Street Scheme will be constructed in two phases. The first phase will involve the construction of the Philips Street shaft and the new overflow/bifurcation at Ann Court which will discharge into The Cavern. The second phase will involve undertaking a sewer separation scheme upstream of Philips Street to reduce flows into the combined sewer system. The overflow settings associated with a number of the existing overflows in St Helier will also be altered when the sewer separation scheme is completed.

**Table 7.1 - Overflow Performance (10 Year Analysis)**

| Overflow Name | Existing System | Philips Street Scheme Constructed | Philips Street Scheme Constructed and sewer separation complete |
|---|---|---|---|
| | Peak 1 in 10 yr Spill Flow (l/s) | Peak 1 in 10 yr Spill Flow (l/s) | Peak 1 in 10 yr Spill Flow (l/s) |
| Great Union Road CSO | 0 | 0 | 0 |
| Aquila Road CSO | 0 | 0 | 0 |
| Val Plaisant CSO | 0 | 0 | 0 |
| Union Street CSO | 285 | 4 | 0 |
| Weighbridge CSO (Spill to Sea) | 1,693 | 1,639 | 1,405 |
| King Street CSO | 1,504 | 1,235 | 0 |
| Park CSO | 0 | 0 | 0 |
| Esplanade CSO | 0 | 0 | 0 |
| M08F064 | 0 | 0 | 0 |

**Table 7.2 - Overflow Performance (Annual Spill Analysis)**

| Overflow Name | Existing System | | Philips Street Scheme Constructed | | Philips Street Scheme Constructed and sewer separation complete | |
|---|---|---|---|---|---|---|
| | Annual Spill Frequency | Annual Spill Volume | Annual Spill Frequency | Annual Spill Volume | Annual Spill Frequency | Annual Spill Volume |
| Great Union Road CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| Aquila Road CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| Val Plaisant CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| Union Street CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| Weighbridge CSO (Spill to Sea) | 0 | 0 | 0 | 0 | 0 | 0 |
| King Street CSO | 14 | 4,650 | 13 | 1,541 | 0 | 0 |
| Park CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| Esplanade CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| M08F064 | 0 | 0 | 0 | 0 | 0 | 0 |

The hydraulic model indicates that construction of the Philips Street Sewer Separation Scheme will ensure that Union Street CSO and King Street CSO no longer spill during a 1 in 10 year design event.

## 7.2 Performance of The Cavern

The results of this analysis show that during a 1 in 10 year design event the Weighbridge CSO will still spill to sea. The available storage at The Cavern is fully utilised before the Weighbridge CSO spills to sea which means that an additional 20,255m$^3$ of flow would need to be stored in the system in order to prevent the Weighbridge CSO from spilling during a 1 in 10 year event. See Table 7.3

**Table 7.3 - The Cavern Assessment**

| Overflow Name | Description | Existing System | | | Philips Street Scheme Constructed | | | Philips Street Scheme Constructed and sewer separation complete | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 in 10 Year Spill Volume (m3) | Annual Spill Frequency | Annual Spill Volume (m3) | 1 in 10 Year Spill Volume (m3) | Annual Spill Frequency | Annual Spill Volume (m3) | 1 in 10 Year Spill Volume (m3) | Annual Spill Frequency | Annual Spill Volume (m3) |
| Weighbridge CSO | Spill to The Cavern | 25,207 | 107 | 401,851 | 20,332 | 107 | 395,057 | 17,776 | 67 | 193,303 |
| Weighbridge CSO | Spill to Sea | 22,743 | 0 | 0 | 25,396 | 0 | 0 | 21,352 | 0 | 0 |
| New Ann Court Overflow | Spill to The Cavern | N/A | N/A | N/A | 5,818 | 20 | 9,884 | 9,246 | 22 | 16,140 |

# 8 FUTURE NEEDS ASSESSMENT WITH CLIMATE CHANGE 2040

## 8.1 Climate Change Parameters

The future assessment takes into account the effects of climate change rainfall.

The main UK organisation dealing with Climate change is UK Climate Projections (UKCP). In 2009 UKCP published scenarios of climate change for the UK. Three scenarios were generated, corresponding to three possible future predictions of green house gas emissions, (emission scenarios).

- Low emissions
- Medium emissions
- High emissions

For each scenario, the predicted change in the future climate was calculated for three 30 year time slices, with the climate change scenario results reported as an average for each.

- 2010 to 2039 (called the 2020s)
- 2040 to 2069 (called the 2050s)
- 2070 to 2099 (called the 2080s)

Based on the medium emission scenario (average case) and the 2020 time slice, the impact of climate change on Jersey is predicted as:

2020 Winter average mean rainfall +6%
Summer average mean rainfall -9%
Tide increase 10cm

2040 Winter average mean rainfall +15%
Summer average mean rainfall -23%
Tide increase 22cm

For our analysis we have applied a 7% increase to design rainfall.

## 8.2 Hydraulic / Flooding Performance

The Future Needs Model was simulated for durations of 30, 60, 90, 120, 240, 360, 480, 540 and 960 minutes with 10 and 30 year return period storms with the climate change uplift applied. 10 and 30 year flood volumes for individual manholes were determined for each storm duration and the critical flood volume for each manhole identified. Predicted flood volumes less than 25m$^3$ were excluded from the analysis. No allowance for tidal interaction was made when undertaking this analysis.

## 8.3 Known Flooding Locations

### 8.3.1 Town Centre of St Helier

The future model does not predict any flooding to occur in this area during either a 1 in 10 year design rainfall event or during a 1 in 30 year design rainfall event.

### 8.3.2 Gunsite Tower near Beaumont SPS

The hydraulic model predicts that flooding in this area will increase by an average of 39% in the future. Details of the predicted food volumes are tabulated in table 8.1.

**Table 8.1 - Foul / Combined Predicted Flooding Comparison – Beaumont SPS**

| Manhole | Baseline Model (Current Rainfall) | | Future Model with no Allowance for Urban Creep (Climate Change Rainfall) | | Future Model with Creep Allowance (Climate Change Rainfall) | |
|---|---|---|---|---|---|---|
| | Predicted Maximum 1 in 10 Year Flood Volume (m3) | Predicted Maximum 1 in 30 Year Flood Volume (m3) | Predicted Maximum 1 in 10 Year Flood Volume (m3) | Predicted Maximum 1 in 30 Year Flood Volume (m3) | Predicted Maximum 1 in 10 Year Flood Volume (m3) | Predicted Maximum 1 in 30 Year Flood Volume (m3) |
| H07F033 | 10 | 49 | 24 | 72 | 30 | 83 |
| H08F020 | 46 | 128 | 77 | 170 | 88 | 186 |
| H08F021 | 1 | 14 | 5 | 25 | 6 | 29 |
| H08F030 | 0 | 35 | 16 | 52 | 19 | 58 |

## 8.4 Areas at Risk of Flooding (Foul / Combined System)

Details of predicted flooding during both 1 in 10 year and 1 in 30 year design rainfall events are shown on drawings in Appendix D. In general predicted flood volumes increase due to the effect of climate change rainfall being applied.

In the future the following areas will no longer be at risk of flooding due to the construction of the Philips Street Scheme and associated sewer separation works in St Helier;

- Claremont Road in St Saviour

## 8.5 Areas at Risk of Flooding (Surface Water System)

Details of predicted flooding during both 1 in 10 year and 1 in 30 year design rainfall events are shown on drawings in Appendix D. In general predicted flood volumes increase due to the effect of climate change rainfall being applied.

## 8.6 Overflow Performance

An assessment of the performance of all known overflows has been made to determine how the future operational regime of the Jersey sewerage system will affect the operation of these assets. The peak 1 in 10 year spill flow for each of the overflows has been determined using climate change rainfall and compared to those generated using the version of the Baseline Model that contains the Philips Street Scheme. Annual spill volumes and spill frequencies have also been determined using stochastically generated rainfall data provided by SOJ and the typical year of 1994 used. See Table 8.2. The peak 1 in 10 year spill flows provided in table 8.2 do not account for any tidal interaction that may occur

**Table 8.2 - Overflow Performance (1 in 10 Year Spill Flow Comparison)**

| Overflow Name | Baseline Model with Philips Street Scheme Constructed (Current Rainfall) | Baseline Model with Philips Street Scheme Constructed (Climate Change Rainfall) | Future Model with no Allowance for Urban Creep (Climate Change Rainfall) | Future Model with Creep Allowance (Climate Change Rainfall) |
|---|---|---|---|---|
| | Peak 1 in 10 yr Spill Flow (l/s) | Peak 1 in 10 yr Spill Flow (l/s) | Peak 1 in 10 yr Spill Flow (l/s) | Peak 1 in 10 yr Spill Flow (l/s) |
| Great Union Road CSO | 0 | 189 | 232 | 140 |
| Aquila Road CSO | 0 | 0 | 0 | 0 |
| Val Plaisant CSO | 0 | 0 | 0 | 0 |
| Union Street CSO | 0 | 0 | 0 | 0 |
| Weighbridge CSO | 1,349 | 1,556 | 1,730 | 1,853 |
| King Street CSO | 0 | 3 | 11 | 35 |
| Park CSO | 0 | 0 | 0 | 0 |
| Esplanade CSO | 0 | 0 | 0 | 0 |
| La Greve de Lecq 2 SPS | 0 | 0 | 4 | 6 |
| La Greve de Lecq 2 SPS (E02F007) | 12 | 12 | 12 | 12 |
| Le Rivage SPS (S08F098) | 0 | 0 | 0 | 0 |
| Le Rivage SPS (S08F001) | 43 | 59 | 63 | 69 |
| Le Rocquier School SPS | 0 | 0 | 0 | 0 |
| Le Bourg SPS (R11F042) | 0 | 0 | 26 | 32 |
| Le Hocq SPS (Q11F030) | 0 | 0 | 5 | 25 |
| Maupertuis SPS (P11F005) | 29 | 30 | 30 | 84 |

| | | | | |
|---|---|---|---|---|
| Milano SPS (B03F005) | 0 | 0 | 0 | 0 |
| Pontac SPS (Q11S006) | 12 | 16 | 17 | 18 |
| Petit Port SPS | 0 | 0 | 0 | 0 |
| Rue des Pres SPS | 0 | 0 | 0 | 0 |
| Rue du Sud SPS | 0 | 0 | 0 | 0 |
| Rozel 1 SPS | 16 | 19 | 19 | 21 |
| Rozel 2 SPS | 0 | 1 | 1 | 1 |
| St. Brelade I SPS (E09F109) | 33 | 40 | 41 | 57 |
| St. Brelades Wayside Slip SPS | 0 | 0 | 0 | 0 |
| St. Ouen SPS (D04F027) | 15 | 16 | 16 | 16 |
| M08F064 | 0 | 0 | 0 | 0 |
| Charing Cross / Mont Les Vaux CSO | 118 | 121 | 116 | 114 |
| Fauvic SPS (S09f007) | 68 | 70 | 73 | 77 |
| Five Oaks PS | 0 | 0 | 0 | 0 |
| Five Oaks PS (P08F017) | 0 | 0 | 0 | 0 |
| Corbiere PS | 0 | 0 | 0 | 0 |
| Golf Lane PS Overflow | 0 | 1 | 1 | 1 |
| Portelet1 PS | 0 | 0 | 0 | 0 |

**Table 8.3 - Overflow Performance (Annual Spill Flow Comparison)**

| Overflow Name | Baseline Model with Philips Street Scheme Constructed (Current Rainfall) | | Future Model(Current Rainfall – No Allowance for Urban Creep) | | Future Model (Current Rainfall –Allowance for Urban Creep) | |
|---|---|---|---|---|---|---|
| | Annual Spill Frequency | Annual Spill Volume | Annual Spill Frequency | Annual Spill Volume | Annual Spill Frequency | Annual Spill Volume |
| Great Union Road CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| Aquila Road CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| Val Plaisant CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| Union Street CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| Weighbridge CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| King Street CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| Park CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| Esplanade CSO | 0 | 0 | 0 | 0 | 0 | 0 |
| La Greve de Lecq 2 SPS | 0 | 0 | 0 | 0 | 0 | 0 |
| La Greve de Lecq 2 SPS (E02F007) | 0 | 0 | 0 | 0 | 0 | 0 |
| Le Rivage SPS (S08F098) | 0 | 0 | 0 | 0 | 0 | 0 |
| Le Rivage SPS (S08F001) | 0 | 0 | 0 | 0 | 0 | 0 |
| Le Rocquier School SPS | 0 | 0 | 0 | 0 | 0 | 0 |
| Le Bourg SPS (R11F042) | 0 | 0 | 0 | 0 | 0 | 0 |
| Le Hocq SPS (Q11F030) | 0 | 0 | 0 | 0 | 0 | 0 |
| Maupertuis SPS (P11F005) | 8 | 78 | 18 | 146 | 16 | 144 |
| Milano SPS (B03F005) | 0 | 0 | 0 | 0 | 0 | 0 |
| Pontac SPS (Q11S006) | 0 | 0 | 0 | 0 | 1 | 8 |
| Petit Port SPS | 0 | 0 | 0 | 0 | 0 | 0 |
| Rue des Pres SPS | 0 | 0 | 0 | 0 | 0 | 0 |
| Rue du Sud SPS | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Rozel 1 SPS | 0 | 0 | 0 | 0 | 0 | 0 |
| Rozel 2 SPS | 0 | 0 | 0 | 0 | 0 | 0 |
| St. Brelade I SPS (E09F109) | 0 | | 0 | 0 | 0 | 0 |
| St. Brelades Wayside Slip SPS | 0 | 0 | 0 | 0 | 0 | 0 |
| St. Ouen SPS (D04F027) | 0 | 0 | 0 | 0 | 1 | 0.3 |
| M08F064 | 0 | 0 | 0 | 0 | 0 | 0 |
| Charing Cross / Mont Les Vaux CSO | 1 | 2 | 1 | 4 | 1 | 26.3 |
| Fauvic SPS (S09f007) | 18 | 139 | 22 | 184 | 26 | 280 |
| Five Oaks PS | 0 | 0 | 0 | 0 | 0 | 0 |
| Five Oaks PS (P08F017) | 0 | 0 | 0 | 0 | 0 | 0 |
| Corbiere PS | 0 | 0 | 0 | 0 | 0 | 0 |
| Golf Lane PS Overflow | 0 | 0 | 0 | 0 | 0 | 0 |
| Portelet1 PS | 0 | 0 | 0 | 0 | 0 | 0 |

## 8.7 Performance of The Cavern

| Overflow Name | Description | Baseline Model with Philips Street Scheme Constructed (Current Rainfall) | | Future Model (Current Rainfall – No Allowance for Urban Creep) | | Future Model (Current Rainfall – Allowance for Urban Creep) | |
|---|---|---|---|---|---|---|---|
| | | Annual Spill Frequency | Annual Spill Volume (m3) | Annual Spill Frequency | Annual Spill Volume (m3) | Annual Spill Frequency | Annual Spill Volume (m3) |
| Weighbridge CSO | Spill to The Cavern | 67 | 193,303 | 74 | 234,208 | 84 | 294,552 |
| Weighbridge CSO | Spill to Sea | 0 | 0 | 0 | 0 | 0 | 0 |
| New Ann Court Overflow | Spill to The Cavern | 22 | 16,140 | 25 | 19,735 | 31 | 26,561 |

| Overflow Name | Description | Baseline Model With Philips Street Scheme Constructed (Current Rainfall) | Baseline Model With Philips Street Scheme Constructed (Climate Change Rainfall) | Future Model (Climate Change Rainfall – No Allowance For Urban Creep) | Future Model (Climate Change Rainfall – Allowance For Urban Creep) |
|---|---|---|---|---|---|
| | | Peak 1 in 10 yr Spill Volume (M3) | Peak 1 in 10 yr Spill Volume (M3) | Peak 1 in 10 yr Spill Volume (M3) | Peak 1 in 10 yr Spill Volume (M3) |
| Weighbridge CSO | Spill to The Cavern | 17,776 | 18,276 | 18,703 | 18,675 |
| Weighbridge CSO | Spill to Sea | 21,352 | 23,867 | 29,197 | 29,553 |
| New Ann Court Overflow | Spill to The Cavern | 9,246 | 9,175 | 9,147 | 9,040 |

# 9 SPECIFIC STUDIES

## 9.1 Baudrette Brook Assessment

Baudrette Brook serves the eastern part of St Helier and discharges to sea at La Collette Bay. An assessment of the capacity of Baudrette Brook and the surface water systems connected to it has been made. The hydraulic model indicates that there are three separate locations where this surface water system floods - Belvedere Hill, Plat Douet Road and St Clements Gardens. No other flooding is predicted.

A summary of the predicted flooding at each of the above locations is given in Table 9.1 below;

**Table 9.1 - Baudrette Brook Predicted Flooding**

| Location | Manhole | Predicted Maximum 1 in 1 Year Flood Volume (m3) | Predicted Maximum 1 in 2 Year Flood Volume (m3) | Predicted Maximum 1in 5 Year Flood Volume (m3) | Predicted Maximum 1in10Year Flood Volume (m3) | Predicted Maximum 1in30Year Flood Volume (m3) | Comments |
|---|---|---|---|---|---|---|---|
| St Clements Gardens | N10G186 | 26 | 40 | 58 | 90 | 135 | Flooding caused by a lack of capacity in the sewer system in St Clements Gardens (Localised issue) |
| | N10G188 | 0 | 0.1 | 2 | 6 | 11 | |
| | | | | | | | |
| Plat Douet Road | N10G073 | 29 | 43 | 61 | 99 | 148 | Flooding caused by a lack of capacity in the sewer system in Plat Douet Road (Localised issue) |
| | N10G074 | 0 | 0.2 | 0.8 | 2 | 6 | |
| | N10G078 | 13 | 20 | 30 | 44 | 66 | |
| | | | | | | | |
| Belvedere Hill | N10S047 | 625 | 1336 | 2337 | 9278 | 14806 | Flooding caused by a lack of capacity and high headlosses in the downstream system |
| | N10S044 | 0 | 0 | 0 | 861.3 | 3359 | |
| | N10S050 | 0 | 0 | 0 | 260.1 | 1102 | |
| | N10S053 | 0 | 0 | 0 | 269.7 | 1654 | |
| | N10S054 | 0 | 0 | 0 | 107.5 | 755 | |
| | N10S055 | 0 | 0 | 0 | 3.2 | 523 | |

Baudrette Brook PS is a tidal PS that is used to pump flows from Baudrette Brook to sea when high tidal levels exist. Baudrette Brook PS is due to be re-furbished by SOJ and therefore the hydraulic model has been used to gain an understanding of the magnitude of pumping required at this PS.

Table 9.2 gives an indication of the peak incoming flow to this PS during a range of rainfall return periods. All results relate to 60 minute duration events as this was found to be the critical duration for peak flow in this area.

**Table 9.2 - Baudrette Brook PS Flow (Existing System)**

| | Peak Incoming Flow (m3/s) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 Year | 2 Year | 5 Year | 10 Year | 30 Year | 50 Year | 100Year |
| Baudrette Brook PS | 1.37 | 1.47 | 1.73 | 1.79 | 1.91 | 2.09 | 3.08 |

Table 9.3 shows how incoming flow to this pumping station will be affected by climate change.

**Table 9.3 - Baudrette Brook PS Flow (Climate Change)**

| | Peak Incoming Flow (m3/s) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1 Year | 2 Year | 5 Year | 10 Year | 30 Year | 50 Year | 100Year |
| Baudrette Brook PS | 1.37 | 1.57 | 1.80 | 1.85 | 3.02 | 3.03 | 3.22 |

## 9.2 Gloucester Street Surface Water System

The Gloucester Street Surface Water System serves the western part of St Helier and discharges to St Aubin's Bay near Elizabeth Marina. An assessment of the capacity of this surface water system has been made. The hydraulic model indicates that this surface water system floods in New St John's Road. No other surface water flooding is predicted to occur.
A summary of the predicted flooding in New St John's Road is given in Table 9.4 below;

**Table 9.4 - Gloucester Street SW System Predicted Flooding**

| Location | Manhole | Predicted Maximum 1 in 1 Year Flood Volume (m3) | Predicted Maximum 1 in 2 Year Flood Volume (m3) | Predicted Maximum 1 in 5 Year Flood Volume (m3) | Predicted Maximum 1 in 10 Year Flood Volume (m3) | Predicted Maximum 1 in 30 Year Flood Volume (m3) | Comments |
|---|---|---|---|---|---|---|---|
| New St John's Road | L08S033 | 0 | 0 | 0 | 13 | 29 | Flooding caused by a lack of capacity in the sewer system in New St John's Road (Localised issue) |

### 9.3 Weighbridge Surface Water System

This surface water system serves the central part of St Helier and discharges to St Aubin's Bay at Elizabeth Harbour. An assessment of the capacity of this surface water system has been made. The hydraulic model indicates that there are two separate locations where this surface water system floods - Commercial Street, Oak Tree Gardens. See Table 9.5

**Table 9.5 - Weighbridge SW System Predicted Flooding**

| Location | Manhole | Predicted Maximum 1 in 1 Year Flood Volume (m3) | Predicted Maximum 1 in 2 Year Flood Volume (m3) | Predicted Maximum 1 in 5 Year Flood Volume (m3) | Predicted Maximum 1 in 10 Year Flood Volume (m3) | Predicted Maximum 1 in 30 Year Flood Volume (m3) | Comments |
|---|---|---|---|---|---|---|---|
| Commercial Street | L09S093 | 0 | 0 | 0 | 0 | 4 | Flooding caused by backing up from main trunk sewer. |
| | L09S095 | 0 | 0 | 0 | 6 | 15 | Flooding caused by localised lack of capacity |
| | | | | | | | |
| Oak Tree Gardens | M07S064 | 0 | 0 | 0 | 0 | 17 | Flooding caused by localised lack of capacity and compounded by backing up from downstream trunk sewer |
| | M07S069 | 0 | 0 | 0 | 1 | 8 | |
| | M07S075 | 0 | 0.1 | 3 | 7 | 16 | |
| | M08S127 | 0 | 0 | 0 | 69 | 106 | |
| | M08S128 | 6 | 7 | 13 | 25 | 44 | |
| | M08S132 | 14 | 23 | 36 | 61 | 93 | |
| | | | | | | | |
| Pillar Gardens | N07S015 | 0 | 0 | 0 | 0 | 27 | Flooding caused by backing up from downstream trunk sewer |
| | N07S003 | 0 | 0 | 0 | 0 | 289 | |
| | N07S004 | 0 | 0 | 0 | 0 | 70 | |
| | N07S006 | 0 | 0 | 0 | 0 | 52 | |
| | N07S027 | 0 | 0 | 0 | 0 | 559 | |
| | N07S029 | 0 | 0 | 0 | 0 | 28 | |

West of Albert PS is a tidal PS that is used to pump flows from the Weighbridge surface water system to sea when high tidal levels exist. The hydraulic model has been used to gain an understanding of the magnitude of pumping required at this PS.

Table 9.6 gives an indication of the peak incoming flow to this PS during a range of rainfall return periods. All results relate to 60 minute duration events as this was found to be the critical duration for peak flow in this area.

**Table 9.6 - West of Albert PS Flow (Existing System)**

| | Peak Incoming Flow (m3/s) | | | | | | |
|---|---|---|---|---|---|---|---|
| | **1 Year** | **2 Year** | **5 Year** | **10 Year** | **30 Year** | **50 Year** | **100Year** |
| West of Albert PS | 1.94 | 2.58 | 3.86 | 4.46 | 5.69 | 6.42 | 7.52 |

Information provided by SOJ indicates that West of Albert PS has a combined pump capacity of 16m3/sec (4 pumps each with a capacity of 4m3/sec). The hydraulic model indicates that this pumping station has sufficient capacity to accommodate a 1 in 100 year event. See Table 9.7

**Table 9.7 - West of Albert PS Flow (Climate Change)**

| | Peak Incoming Flow (m3/s) | | | | | | |
|---|---|---|---|---|---|---|---|
| | **1 Year** | **2 Year** | **5 Year** | **10 Year** | **30 Year** | **50 Year** | **100Year** |
| West of Albert PS | 2.05 | 2.95 | 4.97 | 6.6 | 8.84 | 9.84 | 11.29 |

## 9.4 The Cavern Assessment

Within St. Helier there is a large underground storage facility called the The Cavern. This underground facility was completed in the mid 1990s and provides 25,000$m^3$ storage for storm sewage during wet weather to limit overflow events to one in 10 years. During Dry Weather Flow (DWF) condtions, the foul flows from the island drain to First Tower pumping station and are then pumped to the inlet works at Bellozanne WwTW. During large rainfall events when the increased wet weather flows in the foul/combined sewers exceed the capacity of First Tower pumping station, the flow backs up to the Weighbridge overflow in St. Helier and spills to the Cavern. When flows in the system return to DWF levels the contents of the Cavern are pumped back into the St. Helier gravity system and onto the WwTW via First Tower pumping station. When the Cavern becomes full, a pentock opens at the Weighbridge overflow diverting excess storm flows to the Marina Outfall and then to sea.

An analysis of the operational regime of The Cavern was undertaken using stochastically generated rainfall data provided by SOJ. In order to understand how The Cavern operates during a typical year a continuous years worth of rainfall was run through the Baseline Model and the results tabulated in table 9.8.

**Table 9.8 - The Cavern Assessment**

| Overflow Name | Description | Peak 1 in 10 yr Spill Flow (m3/s) | 1 in 10 Year Spill Volume (m3) | Annual Spill Frequency | Annual Spill Volume (m3) |
|---|---|---|---|---|---|
| Weighbridge CSO | Spill to The Cavern | 2.493 | 25,264 | 107 | 401,851 |
| Weighbridge CSO | Spill to Sea | 1.693 | 22,743 | 0 | 0 |

The results of this analysis show that during a 1 in 10 year design event the Weighbridge CSO will spill to sea. The available storage at The Cavern is fully utilised before the Weighbridge CSO spills to sea which means that an additional 22,743m$^3$ of flow would need to be stored in the system in order to prevent the Weighbridge CSO from spilling during a 1 in 10 year event.

Construction of the Philips Street Sewer Separation Scheme will have an impact upon the operation of The Cavern and the Weighbridge CSO and this must be borne in mind when determining the nature of any improvement works required to reduced spills to sea at the Weighbridge CSO. Refer to section 8 for details of the impact of the Philips Street Sewer Separation Scheme upon the operation of The Cavern and the Weighbridge CSO.

## 9.5 Risk of Sedimentation in St Helier

There are a number of sewers in the St Helier area that are flat and as a result of this an accumulation of sediment could occur in these areas. In order to determine the areas of St Helier that are at risk of sedimentation all foul/combined sewers that do not currently have a self cleansing velocity of 0.75m$^3$/s during dry weather conditions were identified. This check indicates that there are 3263 foul / combined sewers in St Helier that do not have self cleansing velocities during dry weather conditions.

A further check was made to determine how the system operates during periods of minor rainfall. A 1 in 3 month design rainfall event was run and all sewers that do not have a self cleansing velocity of 0.75m$^3$/s during this minor rainfall event were determined. This check indicates that there are 1489 foul / combined sewers in St Helier that do not have self cleansing velocities during a 1 in 3 month design rainfall event.

In addition to the above there are 440 surface water sewers in St Helier that do not have a self cleansing velocity of 0.75m$^3$/s

Drawings showing the location of the sewers at risk of sedimentation in St Helier are included in Appendix G.

# 10 CONCLUSIONS

## 10.1 Spills to Shellfish Waters

The model shows that only one overflow in the Gorey Bay area spills on a regular basis. This is the overflow upstream of Fauvic SPS. This site spills an average of 14 times per year during the 10 year period between 1994 and 2003. The volumes of discharge are small but it does not comply with the EU shellfish directive.

The other risk in this area is failure of pumping stations. It is known that at times pumping stations have failed due to power cuts and discharges could occur especially if the storage has already been mobilised.

## 10.2 Overflows in Jersey

There are fifteen overflows that are predicted by the model to operate on an annual basis. During a ten year rainfall event 12 overflows are predicted to operate Union Street, Weighbridge, King Street, La Greve de Lecq 2, Le Rivage, Maupertuis, Pontac, Rozel 1, St Brelade1, St Ouen, Charing Cross and Fauvic.

The introduction of the Philips Street Scheme stops the King Street CSO from operating and discharging to the bay. Instead the new Ann's Court CSO will discharge to the Cavern. This does mean that the Weighbridge will operate slightly more frequently as the Cavern will fill more quickly with the Ann's Court discharge.

## 10.3 Infiltration Study

The infiltration study highlighted five hotspots to be investigated further.

## 10.4 Flooding foul/combined system

Nineteen locations are predicted to flood on the island. These do tie up with known flooding locations but some are in fields and this may not have been reported. The same places flood for both 1in 10 and 1in 30 year events but no additional locations are predicted other than those identified for the 1in 10 year event. Some of the flooding is linked to pumping station performance and this requires further investigation.

The flooding near the Beaumont SPS is caused by lack of capacity in the trunk sewer down to First Tower SPS. During rainfall events First Tower acts as a control passing a fixed volume forward to the works so that the inlet structure is not overloaded. Due to this control flows back up in the sewer network to the Weighbridge CSO on the east and back to Beaumont SPS on the west. At the Weighbridge sewerage spills to the Cavern for storage but there is no storage or spill location at Beaumont SPS, hence flooding occurs.

## 10.5 Flooding Surface Water System

Three areas are at risk of surface water flooding St Saviour, North of St Helier, St Clement and Grouville.

The Flooding at St Aubins/St Brelade from the surface water system is caused during high tides when there is no outlet for the surface water system. This problem will get worse as tide levels slowly rise due to climate change. The volumes of water are significant at around 7,000 m3.

## 10.6 Pumping Station Performance

Thirty nine pumping stations do not appear to meet design guidelines that are set out in the UK.
Eight pumping stations do not pass forward Formula A flows or have 2hrs storage of 3DWF.
Three pumping stations do not pass forward Formula A and create Flooding upstream.
Seven pumping stations do not pass forward Formula A flows
Twenty one pumping stations do not have 2hrs storage of 3DWF

A review of how pumping stations are designed should be undertaken to ensure a consistent design format. However First Tower SPS will not follow this standard as its capacity is limited by the inlet structure and because there is no storm water storage at the works. Currently The Cavern storage tank acts in this capacity.