

# Plymouth City Council Preliminary Flood Risk Assessment Report

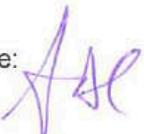
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## Executive Summary

The Floods Directive (2007/60/EC). 23/10/2007 was developed in response to serious pan European floods to enable a common understanding and co-ordinated management of flood risk. This has been transposed into English legislation through the Flood Risk Regulations (2009) and Flood and Water Management Act (2010). The focus of the Flood Risk Regulations is the requirement for lead local flood authorities such as Plymouth City Council, to undertake preliminary flood risk assessments for their areas in order to identify areas at risk of flooding.

In accordance with the thresholds set out by the Environment Agency, this report confirms that Plymouth has no indicative flood risk areas within its authoritative boundary. In addition, an assessment of historic flood records and future predicted flood modelling data shows that Plymouth has no 'significant' flood events, where significant is defined as being on a scale large enough to be reported at a national and/ or European level. These above statements are reflected in Annex 1 and 2 of this report.

The report comments upon the potential impact of climate change related issues, such as sea level rise, storm surges and increased run off.

As part of Plymouth's Surface Water Management Plan, details of locally significant historic and future predicted flood events are provided in Annex 1 and 2. A number of the Environment Agency defined local areas at risk of flooding have been identified (places above flood risk thresholds FMfSW) through the EA's surface water flooding maps. These sites do not form indicative flood risk areas as less than 30,000 people are at risk. A number of additional areas 'where local flood risk is an issue' over and above those identified by the Environment Agency have been identified and are included and reported upon within this report.

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## 1. Introduction

In accordance with the requirements of the Flood Risk Regulations 2009 this report outlines Plymouth's response as a lead local flood authority to its requirement to undertake a preliminary flood risk assessment.

Plymouth City Council is a unitary authority, providing services for over 250,000 people across 80km<sup>2</sup>. As a unitary authority Plymouth has been designated as a lead local flood authority as defined by the Regulations.

*"Lead local flood authority"*

7.-(1) *"Lead local flood authority" in relation to an area in England means –*

*(a) the unitary authority for the area, or*

*(b) if there is no unitary authority, the county council for the area.*

*(2) "Unitary authority" means –*

*(a) the council of a country for which there are no district councils;*

*(b) the council of a district in an area which there is no county council;*

*(c) the council of a London borough*

*(d) the common council of the City of London*

*(e) the Council of the Isles of Scilly.*

As a lead local flood authority Plymouth is responsible for the production of a Preliminary Flood Risk Assessment. This report will outline the past and future predicted flood risk within the Plymouth boundary from local flood risk, defined as surface runoff, groundwater and ordinary watercourses. The Environment Agency is responsible for producing similar assessments for the risk of flooding from main rivers, the sea and reservoirs.

This report considers and reports on both historic and future predicted floods events across Plymouth which have caused locally significant impacts on human health, the economy, the environment and cultural heritage. A large amount of data has been analysed in order to provide this information. Methodology for the data collection and analysis has been included in section 3 of this report. Additional information concerning historic floods and future predicted floods have been included within Annex 1 and Annex 2.

For each LLFA, the Environment Agency has identified 'areas where local flood risk is an issue' and indicative flood risk areas where their key thresholds have been exceeded. Plymouth has been identified as having 27 EA 'areas where local flood risk is an issue' (blue squares) and no indicative flood risk areas. EA 'areas where local flood risk is an issue' have been identified based on the following criteria:

>200 People affected

>1 Critical Service affected

>20 Non residential properties

Areas exceeding one or more of these thresholds have been identified as EA 'areas where local flood risk is an issue'. Indicative flood risk areas have been identified where there is a cluster of 5 or more 1km grid squares affecting 30,000 or more people.

## 1.1. Scope of the Report

This report forms the basis of Plymouth's preliminary flood risk assessment. It combines readily available local flood information from Plymouth City Council and key stakeholders along with future predicted flood information produced by the EA. It is a high level overview of what areas within Plymouth are at risk of flooding. Analysis of these areas and a review of how best to mitigate flood risk will be undertaken as part of Plymouth's Surface Water Management Plan (SWMP).

The report includes information regarding both historic and future predicted flood risk within Plymouth. The flooding referred to within this report is local flood risk from ordinary watercourses, surface water and groundwater. Definitions of these are included within Appendix A.

Flooding from the sea, main rivers and reservoirs has been reported on by the Environment Agency and therefore is not included within the scope of this report. Consideration has however been given where these sources of flooding interact with local flood risk. It is acknowledged that the impacts of climate change may bring about increased risk however, this has not been assessed as part of this report..

The structure of the report is based on the Environment Agency template included as part of the 'Preliminary Flood Risk Assessment (PFRA) final guidance' (2010).

## 1.2. Aims and Objectives

This report provides a high level summary of flood risk within Plymouth, focussing on both PCC and EA 'areas where local flood risk is an issue'. It includes information regarding the probability and consequences of historic and future predicted flood events on people, the economy, the environment and cultural heritage of Plymouth.

Areas where local flood risk is considered an issue have been provided to Plymouth by the Environment Agency. These areas have been reviewed based on locally agreed information and thresholds, amendments to these areas are included in section 7.0 of this report.

A detailed methodology for how the areas have been reviewed and a rationale for why it is considered areas should be amended are also included within section 7.0.

Information collected as part of this process will be used to inform both the Surface Water Management Plan for Plymouth and the Local Strategy for managing flood risk within Plymouth, as required under the FWMA.

The purpose of the PFRA report is to '..provide the evidence for identifying Flood Risk Areas.' (EA, 2010). The output from this report will confirm the following:

- Plymouth does not have any indicative flood risk areas. (In accordance with EA definitions included in 1.4)
- Based on the EA thresholds, Plymouth does not have any nationally significant historic or future predicted flood events.
- Based on Plymouth City defined locally significant flood thresholds, Plymouth has experienced 56 locally significant historic flood events and has been assessed as having an additional 21 future predicted flood risk 'areas where local flood risk is an issue'. Detailed information on both the historic and future predicted flooding is included in Annex 1, 2 and 5 of this report.

This information will feed directly into the Surface Water Management Plan for Plymouth and will help in the development of the local strategy.

### 1.3. Introduction to the study area

Plymouth is one of two unitary authorities located within Devon. It is the main driver for the South West peninsula and the second largest city in the region with a population of 256,700 (2009). Historically the city has largely been reliant on maritime activities, particularly through the Royal Navy, changes in the defence sector have meant a diversification for Plymouth. This has seen an increasing reliance on public sector employment.

Flood risk responsibilities for Plymouth City Council extend across its authoritative area. The neighbouring lead local flood authority is Devon County Council. Areas including Langage Business Park to the East and Woolwell to the North have not been included within this study as they fall within the boundary of Devon. However, due to the nature of flooding and flow paths, consideration has been made within this report to the overall impact of flooding in these areas on the Plymouth network.

Plymouth is also bordered by sources of flood risk that have been addressed by the Environment Agency in the form of coastal flooding and from the designated main rivers of the Tamar and Plym. Similarly to the flood risk being posed by areas within the Devon boundary, consideration has been made in this report to the potential flood risk that can be caused by interactions between coastal and/ or river flooding with local flood risk.

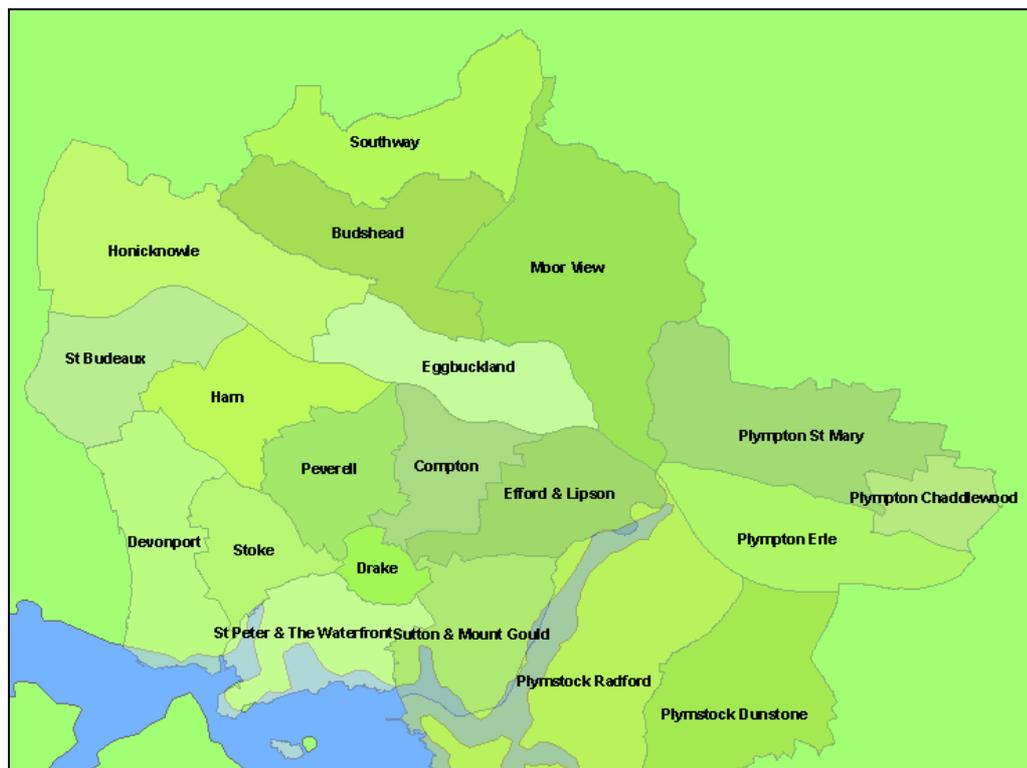


Figure 1: Plymouth City Council authoritative and lead local flood authority area.

#### 1.4. Key Terms

In order to improve clarity and consistency throughout the report, the following key terms will be used throughout:

##### EA Terms:

**Indicative Flood Risk Areas** –Indicative flood risk areas based on clusters formed from all 3km squares that contain 5 or more places above the Flood Risk Thresholds (1km squares) that are touching. ...Clusters with fewer than 30,000 people at risk have not been designated as indicative flood risk areas (EA, 2010).

**Flood Risk Area** - An area determined as having a significant risk of flooding in accordance with guidance published by DEFRA and WAG. (EA, 2010).

**EA 'Areas where local flood risk is an issue' (Blue squares Fig. 3 & 5)** - 1km grid squares where at least 200 people or 20 businesses or more than 1 critical service (based on NRD) might be flooded to a depth of 0.3 metres by a rainfall event with a chance of 1 in 200 (0.5% probability) of occurring in any given year. (DEFRA, 2010).

**Local Flood Risk** - Flood risk from sources other than main rivers, the sea and reservoirs, principally meaning surface runoff, groundwater and ordinary watercourses.

**PCC Terms:**

**PCC 'Areas where local flood risk is an issue' (Brown squares Fig. 4 & 5)** - 1km grid squares where at least 200 people or 20 businesses or more than 1 critical service (based on PCC critical services and NRD) might be flooded to a depth of 0.3 metres by a rainfall event with a chance of 1 in 200 (0.5% probability) of occurring in any given year. (DEFRA, 2010)

**Locally significant historic flood event** - Historic Flood events resulting in 10 or more reports of flooding, at 10 or more locations across the city.

**Locally significant flood risk areas** – 250m<sup>2</sup> areas where 10 or more properties and 1 or more critical service is affected by flooding.

## 2. Lead Local Flood Authority Responsibilities

### 2.1. Introduction

In accordance with the Flood Risk Regulations (2009) and Flood and Water Management Act (2010), Plymouth as a Lead Local Flood Authority has new responsibilities for managing and investigating flood risk within its area.

The first stage of this process is the PFRA, information gathered as part of this process will feed into the next stages of producing a Surface Water Management Plan (SWMP) and the development of a local strategy for management of flood risk within Plymouth.

Going forward Plymouth will have a number of new responsibilities as a LLFA. This will include their additional duties listed within section 14a of the Land Drainage Act including:

- Duty to investigate flooding (In line with local strategy)
- Duty to designate flood defence structures
- Duty to maintain a register of flood defence assets
- Consenting role on ordinary watercourses
- Approving Body for approval and adoption of SUDS (Sustainable Urban Drainage Systems)-see note in Appendices.

### 2.2. Governance and Partnership Arrangements

As LLFA Plymouth will have ultimate responsibility for the management and production of the PFRA report. To assist in this duty, Plymouth has setup a collaborative working group with key stakeholders that will have an interest and influence on the outcome of the report. Table 1 identifies the stakeholders who have been involved in the process both internally and externally.

Table 1: Stakeholders	
Internal	External
Plymouth City Council Environmental Services	Environment Agency
Plymouth City Council Civil Protection Unit	South West Water
Plymouth City Council Planning Department	
Plymouth City Council Climate Change Team	
Plymouth Transport and Highways	

Prior to submission to the Environment Agency, the PFRA report for Plymouth will be reviewed by all identified stakeholders as set out in section 2.2.

### **2.3. Stakeholder Communication**

An initial stakeholder working group was setup to develop a collaborative working group at the outset of the project. The core purpose of this group is to create lines of communication that will enable data sharing and data input to be undertaken efficiently and effectively between stakeholders.

An initial stakeholder meeting was conducted in August 2010 to scope the SWMP and to introduce stakeholders in order to establish the necessary lines of communication. Initial data sharing meetings were held with SWW. In addition early internal meetings were held with planning to identify the level of data mapping support that would be available.

Throughout the process data review has been carried out with stakeholders to ensure that all available information has been collated and that the key areas have been identified. A review of the draft PFRA has been undertaken with all identified stakeholders prior to final submission to the EA. The chart below (Diag.1) outlines the review stages that have been undertaken and who has been involved at each stage.

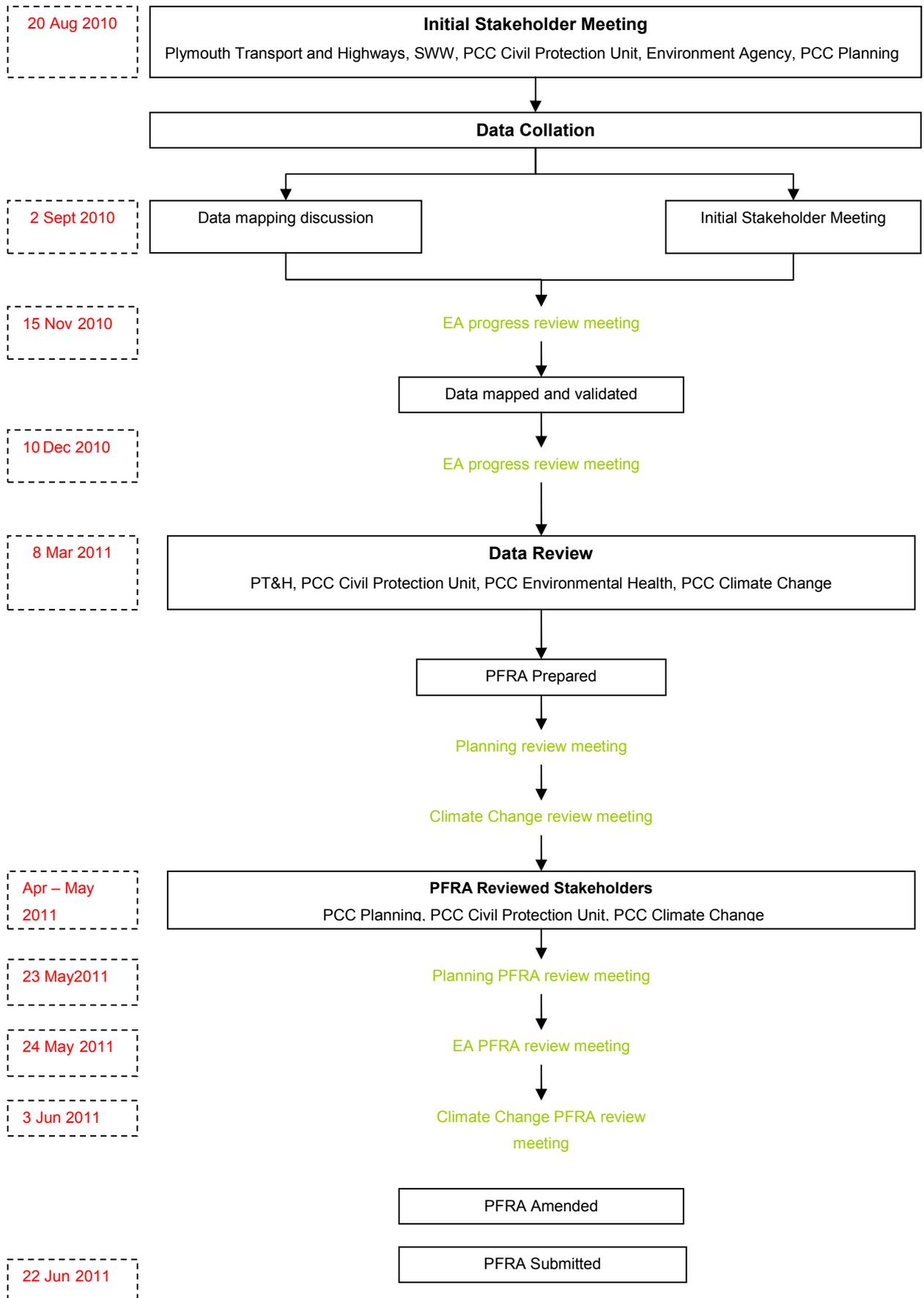
### **2.4. Public Communication**

To date no communication concerning this process has been undertaken with members of the public.

### **2.5. Review Process**

On 7<sup>th</sup> June 2011 a report was presented to Cabinet outlining Plymouth's changing responsibilities as a result of the Flood and Water Management Act. The draft PFRA future predicted flood risk map (Fig 13) was submitted as a background document alongside this report. The Cabinet report can be viewed at [www.plymouth.gov.uk/modgov](http://www.plymouth.gov.uk/modgov)

Diag. 1 Review Stage Flowchart



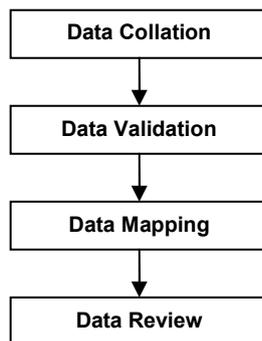
### 3. Methodology and Data Review

#### 3.1. Introduction

A large amount of readily available data has been collated, validated and analysed as part of the PFRA process. This section of the report details the methodology that has been used for the collection, validation and review of all data. It also provides details of how data will be managed going forward.

#### 3.2. Working Together

Plymouth City Council is the designated Lead local flood authority in accordance with the Regulations (see section 1.0). As LLFA Plymouth will take the lead role in compiling the preliminary flood risk assessment report however, it is recognised that they will not have all of the relevant information, for this purpose a collaborative working group has been set up (See section 2 for full details). The chart below shows the stages that have been used to complete the PFRA report. Each of these stages is addressed in detail within this section.



#### 3.3. Data Collation

Historic and future predicted flood risk data has been collected from both internal and external sources.

Plymouth City Council operates a customer service contact centre where all customer enquiries are recorded and logged by category. Data has been extracted from this system dating back to 1<sup>st</sup> December 2008 in connection with reports of flooding across the city. Similar data has also been received from external stakeholders, this has been combined with PCC data and analysed as one.

Information relating to the future predicted flood risk within Plymouth has again been collated from both internal and external sources. Flood modelling data associated with different event probabilities has been provided by the Environment Agency in the form of their AStSWF and FMfSW maps. Areas identified as being of local significance have been identified by internal Plymouth City Council departments, including the Civil Protection Unit and Environmental Health.

Table 2 shows the main sources of data that have been used to assess the locally significant historic flood events and future predicted flood risk for Plymouth. The outputs from these data sets are reported in Annex 2 and 3.

Table 2: Future Flood Risk Data				
Data Source	Internal/ External	Data Type	Confidentiality	Historic/ Future
Plymouth Transport and Highways	Internal	LACRM flooding reports	Not available to the public	Historic
Plymouth Transport and Highways	Internal	Emergency response call out records. Including source of flooding and actions taken.	Not available to the public.	Historic
South West Water	External	Flooding Reports	Not available to the public	Historic
Environment Agency	External	FRIS Incident Data	Not available to the public	Historic
Plymouth City Council Civil Protection Unit	Internal	Critical Service Location	Not available to the public	Historic & Future
Plymouth City Council Environmental Health	Internal	Contaminated land data Public Health Records	Not available to the public	Future
Environment Agency	External	Flood Map for Surface Water (FMfSW) 1 in 30 year (3.33% probability) deep	Not available to the public	Future
Environment Agency	External	Flood Map for Surface Water (FMfSW) 1 in 30 year (3.33% probability)	Not available to the public	Future
Environment Agency	External	Flood Map for Surface Water (FMfSW) 1 in 200 year (0.5% probability) deep	Not available to the public	Future
Environment Agency	External	Flood Map for Surface Water (FMfSW) 1 in 200 year (0.5% probability)	Not available to the public	Future
Environment Agency	External	Areas Susceptible to Surface Water Flooding (AStSWF) Less	Not available to the public	Future
Environment Agency	External	Areas Susceptible to Surface Water Flooding (AStSWF) Intermediate	Not available to the public	Future
Environment Agency	External	Areas Susceptible to Surface Water Flooding (AStSWF) More	Not available to the public	Future
Environment Agency	External	Areas Susceptible to Ground Water Flooding (AStGWF)	Not available to the public	Future
Environment Agency	External	National Receptor Dataset (NRD)	Not available to the public	Future

### 3.3.1. Data Limitations

Historic flood data for Plymouth is based on reports of flooding from members of the public. The nature of the data means that the information available is limited. We have a description of where flooding has occurred, this is frequently as simple as a road name however, there is no record of the extent of flooding and the assets flooded, this makes identifying the severity and significance of a flood extremely difficult.

Future predicted flood data is based on maps provided by the Environment Agency. Both the Flood Map for Surface Water and Areas Susceptible to Surface Water Flooding maps do not make any allowance for climate change. This is something that will be addressed in more detail as part of the Surface Water Management Plan.

### 3.3.2. Going Forward

From 22<sup>nd</sup> December 2011 Plymouth City Council as a LLFA will have responsibility for collecting additional information for flood events within Plymouth. An agreement will need to be made internally through cabinet to agree at what level of flooding investigation is carried out, full details will be included within Plymouth's local strategy.

As detailed in section 8.0 of this report, a detailed pro-forma will be developed to ensure that all relevant information is recorded for each flood. This information will be stored on a central database that will be shared with the Environment Agency on an annual basis. In addition, it is expected that similar data collected by the Environment Agency will be made available to Plymouth City Council on a regular basis. An annual review of all data will be required to remove any duplication that may have occurred.

## 3.4. Data Validation

Some of the data received has required validation to ensure that it can be used for the intended purpose within this report. This section details what data sets have been validated and how this validation was carried out.

### Historic Data

#### a. LACRM Flooding Records – Plymouth Transport and Highways

These records are recorded by the Plymouth City Council call centre team. Information is provided relating to who reported the flooding and where they live. The address provided relates to where the member of the public lives rather than where the flooding has occurred.

A desktop study was undertaken using the LACRM information to relocate all of the reports from the reportee's location to the flooding location. This has included grid references for the flooding locations which have been mapped using ArcMap. A sample of this information can be viewed in Fig. 2.

#### b. Emergency response call out records – Plymouth Transport and Highways

Plymouth Transport and Highways have an emergency response team that can be sent out on a variety of calls across the city. One of the issues they are sent to resolve is flooding on the highway. This can be a result of a customer report submitted via the call centre, emergency services report or inspector reports.

The team attend the call out and aim of resolve what is causing the flooding. The records are provided in the form of an Excel spreadsheet including time and date of call out, reported problem and associated solution. A desktop study was undertaken with this data to assign a grid reference for the point of flooding of all records. This information has then again been mapped using ArcMap and has been included within the dataset in Fig. 2.

LACRM flooding records, emergency response call out records and EA FRIS data have all been combined in one spreadsheet. Duplications of the same flooding reports have been removed where all details are identical. Records for the same location e.g. street, where no reportee information has been included have been left in the data as the reports may not relate to more than one area of flooding along a road.

### Future Predicted Data

a. Critical Service Location – Plymouth City Council

EA critical service location is based on information contained within the NRD dataset. A review has been undertaken with Plymouth City Councils Civil Protection Unit to ensure that it contains all critical service information that is relevant for Plymouth. Additional critical service locations have been uploaded into ArcMap.

b. NRD – Environment Agency

The NRD dataset has been produced by the Environment Agency predominantly for the purpose of identifying flood risk. The dataset is compiled using point data for each of the asset locations. In order for this to be queried using the JFrism programme this data had to be amended to polygon data. This process has been completed by linking the NRD data to the July 2009 Mastermap outlines. The NRD data sets were converted from Point Data to Polygon Data by linking/joining the data via their “topotoid” reference number to the “toid” reference number in the Mastermap data.

## 3.5. Data Mapping

In order to assist with the data analysis all datasets identified in Table 2 have been uploaded as shapefile data into ArcMap. JFrism software purchased from JBA has been used to analyse these datasets and identify PCC ‘areas where local flood risk is an issue’ and Local Significant Flood Risk Areas. Figures 2 to 13 are examples of the mapping produced as part of this process.

## 3.6. Data Review

All datasets that have been collated both internally and externally have been analysed as part of this report for three purposes:

- Identification of historic flood risk events
- Identification of locally significant flood risk areas.
- Confirmation/ amendment of EA ‘areas where local flood risk is an issue’.

### Identification of Historic Flood Events

In accordance with Defra guidance Plymouth has had no nationally significant historic flood events (It is important to note that this could be due to the relevant information not being recorded as opposed to events of this level not having occurred). In order to assist with the production of the Surface Water Management Plan, information has been included in Annex 1 relating to locally significant historic flood events (See section 1.4 for definition).

In order to identify locally significant historic flood events in Plymouth the following datasets were combined into one spreadsheet

Table 3: Historic Flood Risk Data	
Data Source	Data Type
Plymouth Transport and Highways	LACRM flooding reports
Plymouth Transport and Highways	Emergency response call out records. Including source of flooding and actions taken.
South West Water	Flooding Reports
Environment Agency	FRIS Incident Data

All data was sorted to identify which flood events resulted in 10 or more reports of flooding across the City. This data was then mapped and all events affecting less than 10 locations were discounted. Annex 1 provides details of the 56 flood events that meet both of these thresholds. These historic events are considered to be locally significant as they have generated 10 or more reports of flooding at 10 or more locations across the city.

The 56 flood events have been mapped using Arcmap and compared using a 500m grid square to identify historic flood event cluster sites. It is anticipated that this will be further refined on a 250m grid square basis to assist in the correlation between historic and future predicted flooding. These flood events alongside future predicted flood data will be reviewed in more detail as part of the surface water management plan for Plymouth.

### Identification of Locally significant flood risk areas

Future predicted flood risk modelling has been provided by the Environment Agency. This information has been combined with local critical service information across Plymouth to identify on a 250m grid square basis, Locally Significant Flood Risk Areas. These areas have been identified as locally significant as they meet the local thresholds set out in section 5.2. These locations have been reported in Annex 2 of the spreadsheet and copies of the maps have been included in Annex 5, these sites will be reviewed in more detail as part of Plymouth’s SWMP.

Assessment of Plymouth’s Future predicted flood risk has been undertaken using the Environment Agency’s predicted flood modelling data as detailed in Table 3. To assist with the analysis of this data

Plymouth has purchased the JBA, JFrism Software package. This enables datasets to be analysed against LLFA defined parameters.

Table 5 shows datasets uploaded into JFrism and queries that have been run.

Table 4: Future Flood Risk Data Queries	
Environment Agency Dataset	PCC Dataset
Flood Map for Surface Water (FMfSW) 1 in 30 year (3.33% probability) deep	PCC Critical Service Locations
	PCC Environmental Health Areas
	NRD
Flood Map for Surface Water (FMfSW) 1 in 30 year (3.33% probability)	PCC Critical Service Locations
	PCC Environmental Health Areas
	NRD
Flood Map for Surface Water (FMfSW) 1 in 200 year (0.5% probability) deep	PCC Critical Service Locations
	PCC Environmental Health Areas
	NRD
Flood Map for Surface Water (FMfSW) 1 in 200 year (0.5% probability)	PCC Critical Service Locations
	PCC Environmental Health Areas
	NRD
Areas Susceptible to Surface Water Flooding (AStSWF) Less	PCC Critical Service Locations
	PCC Environmental Health Areas
	NRD
Areas Susceptible to Surface Water Flooding (AStSWF) Intermediate	PCC Critical Service Locations
	PCC Environmental Health Areas
	NRD
Areas Susceptible to Surface Water Flooding (AStSWF) More	PCC Critical Service Locations
	PCC Environmental Health Areas
	NRD

Both the EA datasets and PCC datasets have been reviewed in JFrism against the following criteria:

Thresholds for the locally significant data sets were set at:

10 or more residential properties and, 1 or more critical service

Locally significant flood risk areas have been identified where both of these thresholds have been exceeded. Jfrism has identified where 10 or more properties (from the NRD dataset) within a 250m grid square have been flooded. The same process has also been undertaken to identify where 1 or more critical service (as per NRDM, PCC Critical Service and PCC Environmental Health) have been flooded.

This information has been uploaded into ArcMap and used to produce seven maps, one for each EA dataset to show those 250m grid squares where 10 or more properties and 1 or more critical service has been flooded. Copies of these maps have been included in Annex 5 of this report. The information contained within the Annex 2 spreadsheet relates to these 250m grid squares.

A decision was taken to analyse data on a 250m grid square basis as this provided a greater degree of detail in identifying areas where local flood risk is an issue.

### **Confirmation/ Amendment of EA Areas where local flood risk is an issue (Blue Squares).**

The main aim of this report is to confirm that Plymouth does not have any indicative flood risk areas based on the EA's criteria. It is to also either confirm or amend the EA's blue square map based on local intelligence.

The Environment Agency has identified Indicative flood risk areas and 'areas where local flood risk is an issue' (see 1.4 for definitions). Through this process Plymouth has been identified as having no indicative flood risk areas and 27 'areas where local flood risk is an issue'.

This information has been imported into ArcMap where it has been compared to Plymouth's locally available critical service information (Including information from PCC Civil Protection Unit and PCC Environmental Health Department). All data has then been queried to identify where 2 or more critical services have been flooded, as per EA thresholds. This has highlighted an additional 21, 1km grid squares, where local flood risk is an issue in Plymouth (Fig. 4). A copy of the plan showing both the EA's 'areas where local flood risk is an issue' and Plymouth's amended areas has been included within Annex 5.

For the purpose of this report it has been assumed that the property data is correct, and therefore the EA have already identified all 1km grid squares within Plymouth where the dwellings threshold is exceeded. A review has only been undertaken using Plymouth's critical service information.

### **3.7. Data Management**

Data utilised within this report has been collected from the key stakeholders identified in section 2.2. All raw data used is considered to be confidential and is not readily available to the general public. This data has been validated and included within this report in location form only. It is not possible to identify from the report which source has supplied which set of information. Requests for information from members of the public will be managed through Plymouth City Council's Local Authority Customer Relationship Management system (LACRM).

Going forward all data will be recorded and stored within a central database by Plymouth Transport and Highways. In accordance with the PFRA requirements Plymouth will have a duty to record a greater level of information relating to flood events from 22<sup>nd</sup> December 2011. Formal data sharing arrangements will need to be drawn up between Plymouth City Council, Environment Agency and South West Water to ensure that relevant information is recorded by all parties and shared on a regular basis.

## 4. Historic Flood Risk

### 4.1. Introduction

Historic flood data has been collected from internal Plymouth City Council departments to identify areas that have previously been affected by flooding. This information has been analysed and sorted to display flooding events which have resulted in 10 or more flooding reports in 10 or more areas of the city.

Detailed information concerning each of these locally significant events has been included in the spreadsheet in Annex 1. A map showing the geographic spread of these events and hotspots across the city has also been included in Fig.2.

### 4.2. Definition of Significance

Local data and interpretation has been used to identify the criteria for local significance within Plymouth. Combined reports from Plymouth City Council and their stakeholders have been used to identify 11,683 reports of flooding across Plymouth dating back to 1953. This amount of data when geographically mapped is un-meaningful in terms of providing information that will allow a local strategy to be developed.

Analysis of the data has been undertaken and it has been determined that a suitable measure of significance is those flood events that have resulted in 10 or more reports of flooding at 10 or more locations across the city. A total of 56 locally significant historic events have been identified through this process. Details of each are included in Annex 1.

It is acknowledged that a suitable measure of significance would be the number of properties affected; however, due to the nature of the historic data this information is not available. Plymouth has therefore identified suitable criteria that can be applied to the datasets that are available.

Plymouth's Local Significance – A past flood event that resulted in 10 or more reports of flooding at 10 or more locations across the city.

### 4.3. Summary and Description of Historic Flood Risk

Detailed information concerning each of the locally significant flood risk events has been included in Annex 1. The data available is predominantly reports of flooding from members of the public. Due to this, the availability of information such as extent of flood, numbers of properties affected is limited. All information that is available has been recorded. Fig. 2 shows the historic flood event data mapped on a 500 m grid square. The red, yellow and orange squares highlight the areas of the city that have been affected by the most historic flood events. As part of the Surface Water Management Plan for Plymouth this will be compared to the future predicted flood maps to identify where there are overlaps between historic flood events and future predicted flood events.

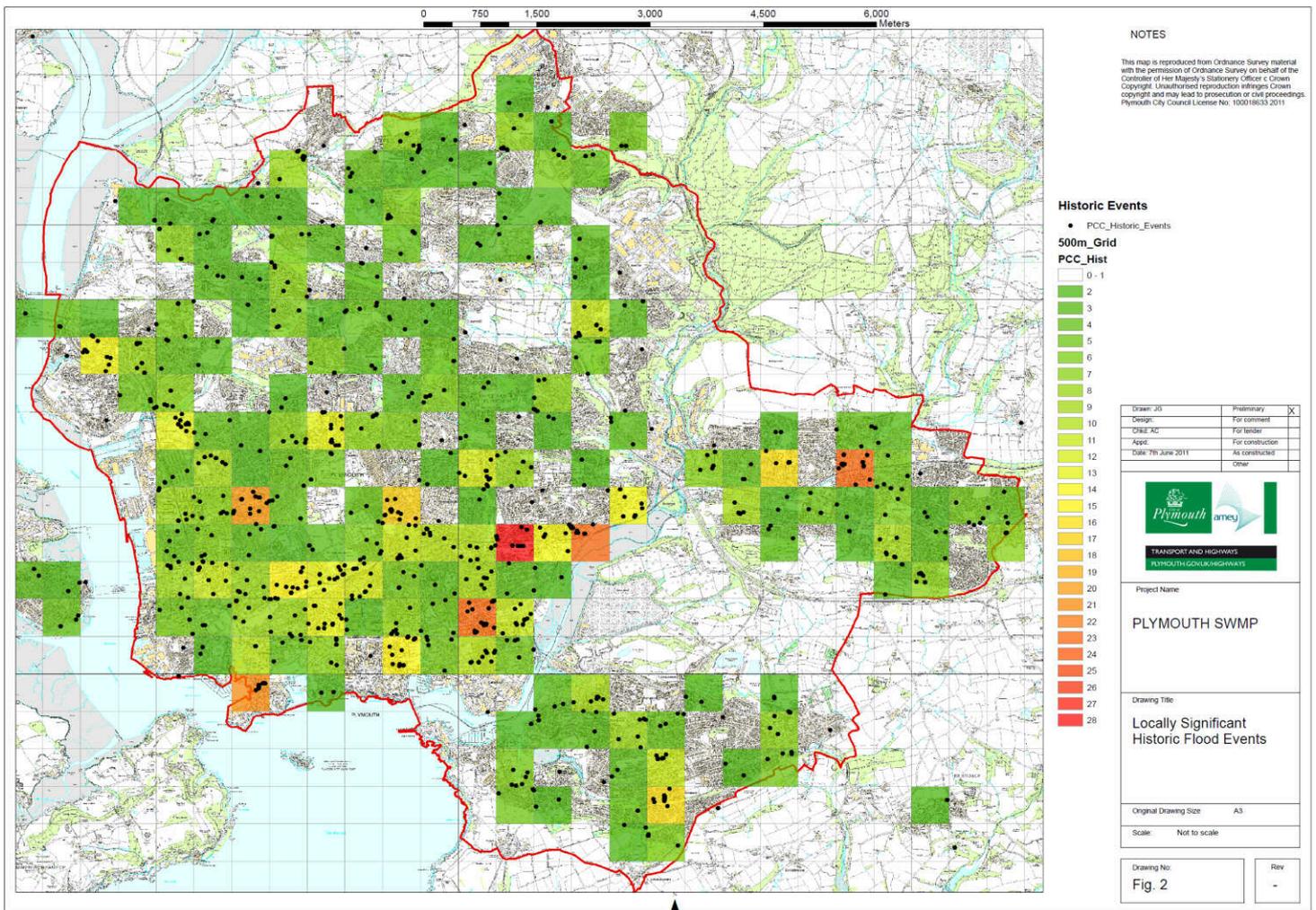


Figure 2: Locally Significant Historic Flood Events.

## 5. Future Predicted Flood Risk

### 5.1. Summary of Future Predicted Flood Risk and Consequences

As part of the PFRA process we have reviewed the future predicted flood risk for Plymouth from local flood risk sources. A review of future predicted flood risk has been undertaken using eight surface water flooding maps/ datasets which have been provided by the EA, these include:

Flood Map for Surface Water (FMfSW)

- 1 in 200 year (0.5% probability) shallow
- 1 in 200 year (0.5% probability) deep
- 1 in 30 year (3.33% probability) shallow
- 1 in 30 year (3.33% probability) deep

Areas Susceptible to Surface Water Flooding (AStSWF)

- Less
- Intermediate
- More

Areas Susceptible to Ground Water Flooding (AStGWF)

Detailed information relating to future predicted flood risk has been included within the spreadsheet in Annexe 2.

### 5.2. Locally agreed surface water information

The eight datasets provided by the EA show where flooding of the specified annual probability rainfall will occur across Plymouth. This information has been overlaid on locally agreed surface water information to identify those areas that we consider to be locally significant flood risk areas. Local information concerning critical services has been used to identify those areas where there is risk of flooding based on future predicted models. Local critical service information has also been used to amend the EA's 'blue squares'.

Locally agreed surface water information has been identified through our key stakeholders working group. The following information has been classified as Plymouth's locally agreed surface water information:

- Critical Services (Incl. A Roads; Railway; fuel depot; MOD land etc.
- Environmental Health (Predominantly sewerage)
- Contaminated land sites (Areas where there is suspected contaminated land e.g. Brownfield developments incl. waste sites).

Information concerning the above was provided by the Plymouth City Council Civil Protection Unit and Plymouth City Council Environmental Health team. All eight EA data sets have been analysed in JFrism

alongside locally agreed surface water information to identify locally significant flood risk areas for each flood event (See Fig 6 – 13).

Thresholds for the locally significant flood risk areas were set at:

Flooding affecting 10 or more residential properties and, 1 or more critical service

Initially all data was compared on 1 km grid squares as with the EA indicative flood risk areas, however, this did not provide sufficiently detailed information on locally significant flood risk areas. The decision was therefore made to conduct the same queries on a 250m grid square. The results of this are more location specific than the 1 km grid squares, making the data easier to interrogate as part of the Surface Water Management Plan (SWMP) for Plymouth.

Detailed reports on all locally significant flood risk areas have been included in the Annex 2 spreadsheet and on the plans included in Annex 5.

### **Economic Assessment**

The EA NRD data information has been filtered to remove both residential dwelling and critical service information. The remaining asset data has then been assessed through JFrism, against the seven EA surface water flood maps to determine those areas where the identified assets are predicted to be affected by flooding. These locations, identified on a 250m grid square basis are identified within Annex 2 of the Preliminary Assessment Report Spreadsheet. It is possible to further refine the asset data, but this has not been undertaken at this stage.

In consultation, the potential impact of future flood risks on land values, the costs of insurance and the economic benefit of development on low lying, coastal or riverside land has been recognised with the detail being taken up in the city's Local Carbon Framework.

### **5.3. Plymouth's Flood Map**

Plymouth's locally agreed surface water flood map will be based on the Environment Agency's 1 in 200 year (0.5% probability) deep (greater than 0.3m) Flood Map for Surface Water. Using this data set it has been identified that 3,688 properties within Plymouth are at risk of surface water flooding. This map is considered the most appropriate for Plymouth's steep gradient and small catchment area.

### **5.4. Climate change and future flood risk**

There is clear scientific evidence that global climate change is happening now. It cannot be ignored.

In this respect the risk of flooding is a clear element of adaptation and a focus for future citywide work to establish guidelines and actions to limit the identified risks.

Over the past century around the UK we have seen sea level rise and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Some of the changes might reflect natural variation; however the broad trends are in line with projections from climate models and are supported by the city's 'weather profile' for the last 30 years where data was provided by the Met Office.

It is also predicted that climate change is likely to cause higher winter rainfall in future. This is unavoidable as past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but the changes associated with current levels of emissions can be projected at least as far ahead as the 2080s. In dealing with flooding we therefore need to take both adaptation and mitigation in to account.

We have enough confidence in large scale climate models to say that we must plan for change. There is more uncertainty at a local scale but model results can still help us plan to adapt. For example we understand rain storms may become more intense, even if we can't be sure about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance or rarer) could increase locally by 40%.

If emissions follow a medium future scenario, UKCP09 projected changes by the 2050s relative to the recent past are

- Winter precipitation increases of around 17% (very likely to be between 4 and 38%)
- Precipitation on the wettest day in winter up by around 12% (very unlikely to be more than 24%)
- Relative sea level at Plymouth very likely to be up between 12 and 42cm from 1990 levels (not including extra potential rises from polar ice sheet loss)
- Peak river flows in a typical catchment likely to increase between 11 and 21% Increases in rain are projected to be greater near the coast than inland.

## 5.5. Implications for flood risk

Climate changes can affect local flood risk in several ways. The extent of the impact and the risks will depend considerably on local conditions and vulnerability.

For example, the impact of the predicted wetter winters and higher rainfall during wet spells may increase river flooding. More intense rainfall also causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Storm intensity in summer could increase even in drier summers, so we need to be prepared for the unexpected.

Similarly, rising sea or river levels may increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses and a combination of unfavourable loadings.

It is also recognised that there is a risk of flooding from groundwater in the district. Recharge may increase in wetter winters, or decrease in drier summers.

It is also accepted that rising sea levels and storm surges could impact on low lying coastal areas and properties. Here and increasing number of local studies will assist our understanding of the climate impacts in detail and will include implications arising from other factors like land use. Sustainable development and drainage will also help us adapt to climate change and manage the risk of damaging floods in future.

## 5.6. Adapting to change

If we accept that some climate change is inevitable, it is essential we respond by planning ahead. We can prepare by understanding our current and future vulnerability to flooding, developing plans for increased resilience and building the capacity to adapt. Regular review and adherence to these plans is key to achieving long-term, sustainable benefits and the delivery of adaptive measures to minimise risk.

Although the broader picture of climate change is clear, we need to ensure that local plans address all the identified risks and reduce levels of uncertainty as much as possible.. We will therefore consider a range of measures and retain flexibility to adapt. This approach, embodied within flood risk appraisal guidance, will help to ensure that we do not increase our vulnerability to flooding brought about by future changes to our climate and weather patterns.

## 5.7. Long term Developments

It is possible that long term developments might affect the occurrence and significance of flooding. However current planning policy aims to prevent new development from increasing flood risk.

In England, Planning Policy Statement 25 (PPS25) on development and flood risk aims to "ensure that flood risk is taken into account at all stages in the planning process to avoid inappropriate development in areas at risk of flooding, and to direct development away from areas at highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall."

In Wales, Technical Advice Note 15 (TAN15) on development and flood risk sets out a precautionary framework to guide planning decisions. The overarching aim of the precautionary framework is "to direct new development away from those areas which are at high risk of flooding."

Adherence to Government policy ensures that new development does not increase local flood risk. However, in exceptional circumstances the Local Planning Authority may accept that flood risk can be increased contrary to Government policy, usually because of the wider benefits of a new or proposed major development. Any exceptions would not be expected to increase risk to levels which are "significant" (in terms of the Government's criteria).

### **5.8. Role of planning in future developments**

It is the responsibility of the Environment Agency and DEFRA to address flooding caused by rising sea levels and by major fluvial incidents. It is the responsibility of Plymouth City Council to address flooding caused by minor fluvial incidents and surface water run-off.

It is anticipated that conditions attached to planning consents will increasingly be used to address surface flooding issues and minor fluvial incidents in particular localities, drawing on Plymouth City Council Local Development Framework Core Strategy Policies CS20 and CS21 which promote the use of Sustainable Urban Drainage Systems and which address flood risk generally.

Strategic flood risk infrastructure is currently identified in the Council's Draft Infrastructure Needs Assessment (INA). Non-strategic flood risk infrastructure will be identified in future iterations of the INA. The INA identifies potential infrastructure delivery mechanisms but does not prioritise investment in infrastructure. Future iterations of the Council's Local Investment Plan will prioritise investment in infrastructure, and will thereby inform Council capital expenditure.

## 6. Review of Indicative Flood Risk Areas

To assist with the production of this report and the identification of flood risk areas, the EA have provided information relating to indicative flood risk areas and 'areas where local flood risk is an issue'.

*'The indicative areas were identified by drawing on national flood risk information to identify 1 kilometre grid squares where "local flood risk is an issue". Where many grid squares are close together (clustered) and the risk is most concentrated, these clusters are identified as indicative Flood Risk Areas. The indicative Flood Risk Areas are meaningful areas in which the magnitude of the flood risk in a national context justifies further investigation through maps and management in plans as required by the Regulations and the results reported to the European Commission. A more detailed description of the method used to derive the indicative Flood Risk Areas is included in Annex D.'* (DEFRA, 2010)

The EA review for Plymouth has identified **no indicative flood risk areas** and 27 areas within Plymouth where "local flood risk is an issue" (Blue squares). Each of these areas have been given a locality specific name, these can be viewed in table 5.

The 27 EA 'areas where local flood risk is an issue' (Blue Squares) have been imported into JFrism alongside the EA's 1 in 200 year (0.5% probability) flood map and Plymouth's locally agreed surface water information. The programme has then been run to identify where we believe one or more of the EA's thresholds have been exceeded.

Number	Name	Grid Reference	Critical Services	Number of People	Number of Non Residential Properties
1	Whittleigh	X246Y060	2	241	15
2	Derriford	X249Y058	1	26	24
3	Estover Industrial Estate	X251Y059	1	63	63
4	Kings Tamerton	X245Y058	2	59	12
5	Estover/ Forder Valley	X250Y058	2	19	3
6	Estover/ Leigham	X251Y058	2	145	4
7	Boringdon, Plympton	X254Y057	1	98	30
8	Saltash Road, Keyham	X245Y056	2	442	32
9	Wolseley Road/ Outland Road	X246Y055	2	218	17
10	Compton	X249Y056	0	234	0
11	Merrafield, Plympton	X252Y056	2	143	62
12	Underwood, Plympton	X253Y056	2	283	49
13	Ridgway/ Moorland Road, Plympton	X254Y056	4	330	63

Table 5: EA Areas where local flood risk is an issue					
Number	Name	Grid Reference	Critical Services	Number of People	Number of Non Residential Properties
14	Chaddlewood, Plympton	X255Y056	2	328	9
15	St Levan Road	X245Y055	0	515	22
16	Pennycomequik	X247Y055	1	725	37
17	Mutley	X248Y055	2	510	9
18	Laira	X249Y055	5	372	21
19	Plympton St Maurice	X254Y055	3	192	17
20	Yealmpstone Farm, Plympton	X255Y055	0	304	2
21	Stonehouse Creek	X245Y054	0	194	23
22	City Centre	X247Y054	3	454	333
23	Exeter Street	X248Y054	0	693	60
24	Gdynia Way	X249Y054	1	489	35
25	Oreston	X250Y053	2	255	50
26	Broadway, Plymstock	X251Y053	4	337	69
27	Staddiscombe, Plymstock	X251Y052	0	253	16

## 7. Identification of Flood Risk Areas.

The EA 'Blue Squares' map (Fig.3) was produced using national data and national thresholds. Property information including critical services is based on information included within the NRD dataset. The NRD dataset takes into consideration all critical services that are considered to be nationally significant however, it does not take into account any locally specific critical services. We have reviewed the critical services included within the NRD and included Plymouth's locally agreed surface water information.

This additional information was loaded into JFrism alongside the EA 1 in 200 year (0.5% probability) deep flood dataset. These datasets were then used to identify those areas in the city where the national thresholds were exceeded. Based on these thresholds an additional 21 areas where local flood risk is an issue (brown squares) have been identified (Fig. 4).

Table 7 includes information on each of the 21 additional brown squares, including data to show which thresholds have been exceeded. Fig. 5 displays PCC's additional 21 'areas where local flood risk is an issue' (brown squares) alongside the EA's original 27 areas (Blue Squares).

In summary, taking into consideration Plymouth's locally agreed surface water information across the city, Plymouth has identified an additional 21 areas where 'local flood risk is an issue' (brown squares). When combined with the EA areas, there are a total of 48 areas across Plymouth where 'local flood risk is an issue' (Fig. 5). These areas have been further refined on a 250 m grid square basis as detailed in 5.2 and Fig. 13, as the 1 km grid squares do not provide sufficiently detailed information on locally significant flood risk areas. These areas will feed directly into Plymouth's Surface Water Management Plan where they will be addressed in more detail.

Taking into consideration these additional brown square areas and national thresholds for identifying indicative flood risk areas, Plymouth confirms the findings of the EA, there are no indicative flood risk areas within Plymouth.

Table 6: Plymouth proposed areas where local flood risk is an issue					
Number	Name	PCC Environmental Health	NRD Critical Services	PCC Critical Services	PCC Contaminated Land
1	Widewell/ Woolwell	1	0	1	0
2	Southway	1	1	0	0
3	St Budeaux	0	0	1	1
4	St Peter's Road	0	1	3	0
5	Tavistock Road/ Manadon	1	0	2	0

Table 6: Plymouth proposed areas where local flood risk is an issue					
Number	Name	PCC Environmental Health	NRD Critical Services	PCC Critical Services	PCC Contaminated Land
6	Barne Barton	0	1	2	0
7	Weston Mill	0	0	2	0
8	Eggbuckland	1	1	2	0
9	Fort Austin	0	1	2	0
10	Longbridge Industrial Estate, Marsh Mills	1	0	2	0
11	Devonport	0	0	2	0
12	Central Park	0	0	2	0
13	Marsh Mills	1	1	0	0
14	Stoke	1	0	3	1
15	Embankment Road	2	1	2	1
16	Merrafield, A38	1	0	2	0
17	Billacombe	0	0	2	0
18	Elburton	0	2	0	0
19	Robourough/ Airport	0	1	0	1
20	A379, Elburton	0	1	0	1
21	Hooe	0	1	1	0

## 8. Next Steps

The PFRA process is an evolving, rolling programme of works that need to be completed by LLFA's. Some of the duties and requirements on LLFA's have not come into operation yet, however they are due to come into force over the next twelve months. Processes need to put in place to ensure that these deadlines are met and these duties completed. This section briefly explains how Plymouth intends to satisfy their duty as LLFA in respect of the new requirements.

### Data Collection

As part of the ongoing commitment to PFRA, LLFA's need to review the information in 2016. As this will be the second round of the process there will be a requirement to ensure that more detailed information is available.

In accordance with guidance provided in the Annexe 1 spreadsheet. By 2016 Plymouth will need to be recording the following information in relation to all flood events occurring within the city:

- Start Date
- Days duration
- Probability
- Main Source
- Main Mechanism
- Main Characteristics
- Significant Consequences

Considering lessons learnt through the 2011 run on the PFRA process, Plymouth also consider the following information to be important:

- Assets flooded e.g. highways, property
- Location of flood, including grid reference
- Damage caused
- Solution

This additional information will make reporting on historic events much simpler and more accurate in 2016. From 22<sup>nd</sup> December 2011 it will be a statutory duty for Plymouth as a LLFA to record this information for floods across the city. To assist in the process it is proposed that this information should be collected from 22<sup>nd</sup> August 2011. This will allow for a period of refinement to the process prior to it becoming a statutory duty. Once collected all information will be stored in a single location to ensure it will be easy to locate.

Suitable mechanisms for collating the required data are considered to be:

- LACRM
- P1 works gangs
- Site visits

These have been the most suitable lines of recording information for this PFRA. It is anticipated that this will be the main mechanism for recording flooding incidents in the future. A new pro-forma to assist with the recording of the information and training will be undertaken with the call centre staff and the P1 gangs to ensure that they fully understand the requirement for this information and how they can assist with this.

The recommendation to record this information from 22<sup>nd</sup> August 2011 is to enable sufficient time to correct the procedure. The requirement of the regulations will not come into operation until 22<sup>nd</sup> December 2011 by which time it should be second nature to those who are required to record it.

Between August and December we propose to hold training courses with those staff involved and to review on a monthly basis the level of information that has been recorded. This will help to ensure that any issues are highlighted at an early stage and a resolution can be proposed. We anticipate that by the statutory date of 22<sup>nd</sup> December 2011 the correct information will be recorded for all flood events within the Plymouth boundary.

### **Local Flood Risk Management Strategy**

Under the FWMA Plymouth as a Lead Local Flood Authority has a duty to produce a local flood risk management strategy. This document will be produced in conjunction with the national strategy once this document has been released. Throughout the PFRA and SWMP processes information will become available concerning what needs to be included within the strategy. This needs to be recorded to ensure that it is included within the strategy when produced.

### **Surface Water Management Plan**

Plymouth has been identified as 1 of 70 local authorities who need to produce a surface water management plan. The preliminary flood risk assessment report will form the detailed assessment element of the SWMP. The next stage will be to review the 48 areas 'where local flood risk is an issue', as identified by the EA and Plymouth as part of the PFRA process.

## 9. Conclusion

This PFRA report provides an overview of historic and future predicted flood risk within Plymouth from local sources of flooding. In summary, the report confirms that in accordance with the criteria associated with EA national thresholds Plymouth has no indicative flood risk areas.

Through the national review of data and the application of national thresholds the EA have identified 27 areas 'where local flood risk is an issue' (Blue Squares). Using the locally agreed surface water information, Plymouth City Council has identified an additional 21 areas 'where local flood risk is an issue' (Brown Squares).

Going forward Plymouth, as a LLFA, will have a number of additional duties and responsibilities relating to flood risk assessment and management. Included within this will be the ongoing commitment to producing a Surface Water Management Plan where the 48 areas 'where local flood risk is an issue' will be addressed in more detail. This Surface Water Management Plan will include an assessment of the predicted impacts of climate change in the city.



# Appendix A

## Definitions & Abbreviations

## A.1 Definitions

### A.1.1. Ordinary Watercourses –

Means a watercourse that does not form part of a main river

### A.1.2. Groundwater –

Means all water which is below the surface of the ground and in direct contact with the ground or subsoil

### A.1.3. Surface Runoff –

Means rainwater (including snow and other precipitation) which

- a.) is on the surface of the ground (whether or not it is moving), and
- b.) has not entered a drainage watercourse, drainage system or public sewer

### A.1.4. Areas Susceptible to Surface Water Flooding (AStSWF)

A surface water flood event that results from rainfall generated overland flow before the runoff enters any watercourse or sewer. Usually associated with high intensity rainfall (typically >30mm/hr) resulting in overland flow and ponding in depressions in the topography, but can also occur with lower intensity rainfall or melting snow where the ground is saturated, frozen, developed or otherwise has low permeability. Urban underground sewerage/drainage systems and surface watercourses may be completely overwhelmed, preventing drainage. Surface water flooding does not include sewer surcharge in isolation.

The map shows areas that are susceptible to surface water flooding, with three bandings, indicating 'Less' to 'More' susceptible to surface water flooding.

The map has been produced using a simplified method that ignores urban sewerage and drainage systems, ignores buildings, and uses a single rainfall event – therefore it only provides a general indication of areas which may be more likely to suffer from surface water flooding.

It does not show the susceptibility of individual properties to surface water flooding.

### A.1.5. Flood Map for Surface Water (FMfSW)

The Environment Agency's surface water flood maps give an indication of the broad areas likely to be at risk of surface water flooding, i.e. areas where surface water would be expected to flow or pond.

In 2010 the Flood and Water Management Act defined 'surface runoff'. Generally, the type of flooding shown by the Flood Map for Surface Water (FMfSW) fits with the definition in the Act and shows the flooding that takes place from the 'surface runoff' generated by rainwater (including snow and other precipitation) which:

- a. is on the surface of the ground (whether or not it is moving), and
- b. has not yet entered a watercourse, drainage system or public sewer.

The FMfSW will pick out natural drainage channels, rivers, low areas in floodplains, and flow paths between buildings. But it will only indicate flooding caused by local rainfall. It does not show flooding that occurs from overflowing watercourses, drainage systems or public sewers caused by catchment-wide rainfall events or river flow. It is therefore very important that users apply local knowledge and in particular the 'locally agreed surface water information' held by the lead local flood authority to assess how suitable the Flood Map for Surface Water is for their needs.

Note: Environment Agency surface water flood maps are not suitable for identifying whether an individual property will flood. This is because the modeling only gives an indication of broad areas at risk, and because we do not hold information on floor levels, construction characteristics or designs of properties. We would need this and other detailed information to be able to say whether flooding of certain depth would enter into an individual property and cause damage.

FMfSW may be suitable for identifying where properties are in areas at risk of flooding for locations where surface water flooding is strongly influenced by topography.

Two rainfall events, one with a 1 in 30 and the other with a 0.5% probability (1 in 200) chance of occurring in any year, are modeled and mapped. However, users must note that this is the chance of this rainfall, and not of the resulting flood extent occurring. Consequently it only provides a general indication of areas which may be more likely to suffer from surface water flooding in these rainfall probabilities.

For each rainfall probability, the map provides two layers of information which can be used individually to indicate:

1. 'Surface Water Flooding' (flooding greater than 0.1m deep);
2. 'Deeper Surface Water Flooding' (flooding greater than 0.3m deep).

When the information for each rainfall probability are shown together (with 'deeper' displayed on top) the lighter colour will indicate:

1. Flooding between 0.1 – 0.3m deep.

The 0.3m threshold is chosen as it represents a typical value for the onset of significant property damages when property flooding may start (above doorstep level) and because it is at around this depth that moving through floodwater (driving or walking) may become more difficult; both of which may lead users to consider the need to close roads or evacuate areas.

Given the assumptions and the lack of comprehensive validation of the results, it is important that users:

1. do not rely on the Flood Map for Surface Water alone to show expected areas of surface water flooding;
2. interpret the Flood Map for Surface Water as defining the flood extent only approximately for the given probability event;
3. interpret the Flood Map for Surface Water bands as only approximate predictions of specific depths;
4. interpret the 1 in 30 rainfall probability Flood Map for Surface Water as being less representative than the 0.5% probability (1 in 200) rainfall probability Flood Map for Surface Water.

(Environment Agency, 2011)

#### **A.1.6. National Receptor Dataset**

The National Receptor Dataset (NRD) is a collection of risk receptors primarily intended for use in flood and coastal erosion risk management. It is available for use by Local Planning Authorities, the Environment Agency and our contractors. Use by Local Planning Authorities and Environment Agency contractors \ partners is approved only in connection with the preparation of assessments of flood risk that are being produced for statutory purposes.

NRD is a spatial dataset which contains a number of GIS layers categorised into themes of information including buildings, environment, heritage, transport, utilities. Coverage is provided for England and Wales (where available) only. The data stored within the NRD meets the information requirements of a range of Flood and Coastal Risk Management (FCRM) practitioners within the Local Planning Authorities and Environment Agency. This first version of the dataset has been designed to meet the needs of Preliminary Flood Risk Assessments and the Environment Agency's National Flood Risk Assessment.

The following key layers of data exist within the themes in NRD version 1.0.

Theme	Layer	Layer Names
Agriculture	Agricultural Land Classification	Agricultural_Land_Classification
Buildings	NRD Property Points	NRD_Property_Points
Environment	International Designations Local Designations Misc Designations National Designations Policy Designations	International_Designations Local_Designations Misc_Designations National_Designations Policy_Designations
Heritage	Battlefield England Heritage Sites Listed Buildings Park & Garden Scheduled Ancient Monuments World Heritage Sites	Battlefield_England Heritage_Coasts Listed_Buildings Park_and_Garden SAM WHS
Land Use	Country Park National Parks England National Trail England	Country_Park National_Parks_England National_Trail_England
Miscellaneous	Lower Super Output Areas (Full) Lower Super Output Areas (Generalised) Middle Super Output Areas (Full) Middle Super Output Areas (Generalised)	LSOA_FEB_2004_EW_BFE LSOA_FEB_2004_EW_BGC MSOA_AUG_2004_EW_BFE MSOA_AUG_2004_EW_BGC
Transport	Railways Roads	Railways Roads
Utilities	Active Integrated Pollution Prevention Control Active Radio Active Sites Authorisations Active Radio Active Sites Registrations Waste Licenses Regulation Information System	Active_IPPC Active_RAS_Auths Active_RAS_Registrations Waste_Licenses_REGIS

Definitions are from the Flood and Water Management Act (2010) and the Environment Agency datastore website.

(Environment Agency, 2011)

## A.2 Abbreviations

- A.2.1. AStSWF – Areas Susceptible to Surface Water Flooding
- A.2.2. DEFRA – Department for the Environment, Food and Rural Affairs
- A.2.3. EA – Environment Agency
- A.2.4. FCERM – Flood and Coastal Erosion Risk Management
- A.2.5. FMfGW– Flood Map for Ground Water
- A.2.6. FMfSW– Flood Map for Surface Water
- A.2.7. FRR – Flood Risk Regulations
- A.2.8. FWMA – Flood and Water Management Act

- A.2.9. LACRM – Local Authority Customer Relationship Management
- A.2.10. LLFA – Lead Local Flood Authority
- A.2.11. NRD – National Receptor Database
- A.2.12. PFRA – Preliminary Flood Risk Assessment
- A.2.13. SWMP – Surface Water Management Plan

# Appendix B

## Annexes to PFRA Report

**Annex 1 – Records of past floods and their significant consequences**

**Annex 2 – Records of Future Floods and their consequences**

**Annex 3 – Records of Flood Risk Areas and their rationale (This section is deliberately left blank)**

**Annex 4 – Review Checklist**

**Annex 5 – GIS layers of Flood Risk Areas**

**FMfSW 1 in 200 year (0.5% probability) deep**

**FMfSW 1 in 200 year (0.5% probability)**

**FMfSW 1 in 30 year (3.33% probability) deep**

**FMfSW 1 in 30 year (3.33% probability)**

**AStSWF Less**

**AStSWF Intermediate**

**AStSWF More**

## Annex 4 – Review Checklist

Preliminary Flood Risk Assessment Checklist					
LLFA Name:		Plymouth City Council			
Checklist questions	Notes for completion	LLFA	Environment Agency area review	Environment Agency national review	
<b>Step 1 Set up governance and develop partnerships</b>					
1.1	Have appropriate governance and partnership arrangements been set up?	Refer to section 2.3 of guidance. Governance and partnership arrangements should be to the satisfaction of the LLFA.	Yes		
1.2	Who in the LLFA reviewed the PFRA and when was it done?	Please state the review and approval process and when approval was gained e.g. Officer, Scrutiny Committee, Cabinet. Refer to Section 5 of the guidance.	Senior Management Team, Corporate Management Team and Cabinet.		
<b>Step 2 Determine appropriate data systems</b>					
2.1	Has a data management system been established and implemented?	See Annex 5 for information about data standards	Yes		
<b>Step 3 Collate information on past and future floods and their consequences</b>					
3.1	Has information been requested from all relevant partners?	See Flood Risk Regulations Part 6 Co-operation.	Yes		
3.2	Are there any gaps in available information? (This could include gaps which could have been filled but weren't, or gaps which couldn't be filled because the information wasn't available)	LLFAs - Are there gaps in certain locations, or for certain events that you are aware of, or for certain sources of flooding (such as groundwater). Respond with Yes/No and provide comments on any missing information. EA Review - Has all available information has been gathered and included?	Yes. Information is missing in relation to historic reports of flooding. No information is available concerning what assets have been flooded and how many properties are affected.		
<b>Step 4 Determining locally agreed surface water information</b>					
4.1	Which dataset (or combination of datasets) has been determined as "locally agreed surface water information"?	LLFAs - Select from drop down. Refer to "Locally agreed surface water information" text box in section 3.5.1 (p.17) of guidance. EA review - Has this been agreed?	Combination of FMfSW, AStSWF and other local information		
4.2	Has the locally agreed surface water information been clearly stated and presented (on a map) in the Preliminary Assessment Report?	LLFAs - Select Yes/No from drop down list. Refer to "locally agreed surface water information" text box in section 3.5.1 (p.17) of guidance.	Yes		
4.3	If available, what is the total property count for locally agreed surface water information in the LLFA?	If known, please enter the total number of properties at risk in the LLFA.			
4.4	If applicable, has the method for counting properties been described in the Preliminary Assessment Report?	Refer to text box on page 17 of guidance	Yes		

4.5	Has available information on local drainage capacity (where used to inform the determination of locally agreed surface water information) been included in the report?	Refer to text box on page 17 of guidance. Information provided on drainage may inform options for any future improvements to the Flood Map for Surface Water.	No		
<b>Step 5 Complete Preliminary Assessment Report Document</b>					
5.1	Does the Preliminary Assessment Report cover all the content described in Annex 1 of the Environment Agency's PFRA guidance?	LLFAs - If the Preliminary Assessment Report contains all the content described in Annex 2 of the PFRA guidance, respond with a 'Yes'. If there are some elements missing, please provide a brief explanation. EA Review - Include comments on any missing content.	Yes		
5.2	Has a summary table of flood events been produced?	Refer to section 3.4 and 3.5 of guidance	No, but included in the spreadsheet.		
5.3	Has a description of past flood events been included?	Refer to section 3.4 and 3.5 of guidance	No, but included in the spreadsheet.		
5.4	Has additional information been included on climate change and long term developments?	Refer to 3.6 of guidance. Standard text has been provided for Preliminary Assessment Reports which meets the minimum requirements of the Flood Risk Regulations. Please respond with Yes or No, and if additional information has been included, please state the information source(s)	No		
<b>Step 6 Record information on past and future floods with significant consequences in spreadsheet</b>					
6.1	Are records of past flooding with significant harmful consequences recorded on the Preliminary Assessment Report spreadsheet (Annex 1 of Preliminary Assessment Report) ?	LLFAs - past flooding should be recorded on the spreadsheet and included as Annex 1 of the Preliminary Assessment Report. EA review - Are all the mandatory fields complete?	Yes		
6.2	Are there any past floods with significant harmful consequences that have not been recorded? If so, please explain why not.	LLFAs - Respond with Yes or No. If No, provide additional information e.g. anecdotal information on flood, but not enough evidence to include EA review - Do you agree with LLFA response and comments?	No		
6.3	Have any additional records of future flooding (other than the national dataset information which is already completed) been recorded on the future flooding Preliminary Assessment Report spreadsheet (Annex 2 of Preliminary Assessment Report)	LLFAs - future flooding information should be recorded on the spreadsheet and included as Annex 2 of the Preliminary Assessment Report. EA review - Are all mandatory fields complete?	Yes		
<b>Step 7 Illustrate information on past and future floods</b>					
7.1	Have summary maps been produced for past and future floods?	Refer to section 3.4 and 3.5 of guidance	Yes		
<b>Step 8 Review indicative Flood Risk Areas</b>					
8.1	Is your LLFA within an indicative Flood Risk Area?	Indicative Flood Risk Areas were provided to LLFAs by the Environment Agency in December 2010.	No		

8.2	If the answer to 8.1 is yes, have you reviewed it using the locally agreed surface water information, and relevant local information in the Preliminary Assessment Report?	Refer to section 4 of guidance. LLFAs should identify whether they have reviewed against local information or just used the indicative Flood Risk Area information provided by the Environment Agency.			
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**Step 9 Identify Flood Risk Areas**

9.1	Is a Flood Risk Area proposed?	LLFA - select a response from the drop down list and then complete the relevant questions 9.1.1 - 9.1.5. (NB. Indicative Flood Risk Areas can be amended due to Geography, past flooding and/or future flooding.)	No - no Flood Risk Area is proposed (go to question 9.3)		
9.1.1	If the proposed Flood Risk Area is exactly the same as the indicative Flood Risk Area, please confirm.	LLFA - please confirm that the boundary of the indicative Flood Risk Area has not been changed and no change has been made to the flood risk indicators. EA review - please confirm			
9.1.2	If changes have been made to the indicative Flood Risk Area because of geography, please identify what changes have been made.	Use the drop down list to identify the reasons for the change. Options are the same as the table on page 26 of the PFRA guidance. EA review - please confirm evidence supports change			
9.1.3	If changes have been made to the indicative Flood Risk Area because of past / historic flooding, please indicate the changes and the reasons why.	LLFA - identify the scale of the changes made e.g. major/minor increase or decrease in size of Flood Risk Area and the source of information used e.g. records of historic flooding. EA review - confirm scale of the changes made and provide indication of confidence in the evidence provided e.g. anecdotal evidence versus detailed report on flooding event.			
9.1.4	If changes have been made to the indicative Flood Risk Areas because of future flooding, please indicate the changes and the reasons why.	LLFA - identify the scale of the changes made e.g. major/minor increase or decrease in size of Flood Risk Area and the source of information used e.g. detailed modelling as part of SWMP. EA review - confirm scale of the changes made and indication of confidence in the evidence			
9.1.5	If a new Flood Risk Area is being proposed, does it meet the Defra / WAG thresholds?	Criteria and thresholds are set out in the Defra/WAG guidance on selecting and reviewing Flood Risk Areas for local sources of flooding EA review - identify the evidence provided to support this and indicate degree of confidence in the evidence.			
9.2	Does the proposed Flood Risk Area include flooding from interactions with main river, reservoirs or the sea?	LLFAs should respond with Yes or No. EA Review - Summarise the location and nature of interactions i.e. river or sea.			
9.3	Has an indicative Flood Risk Area been deleted?	LLFA - Respond with Yes/No and if an indicative Flood Risk Area has been deleted please provide a short description why. EA - confirm the evidence presented to support this is aligned to 'locally agreed surface water information'	No		

**Step 10 Record information including rationale - ONLY COMPLETE IF ANSWER TO 9.1 IS YES**

10.1	If proposing Flood Risk Areas, have the mandatory fields in the spreadsheet been completed?	LLFAs - the spreadsheet indicates mandatory columns to be completed. EA Review - Are all mandatory fields complete?			
10.2	Has a rationale and evidence for amending/adding/deleting Flood Risk Areas been included in the Preliminary Assessment Report?	LLFAs - Refer to Table 5 on page 26 of the PFRA guidance and Annexes A-D of the Defra/WAG Guidance. Rationale should be included in "Identification of Flood Risk Areas" section of Preliminary Assessment Report. EA Review - Confirm that supporting evidence for any amendments/additions/deletions has been provided in the Preliminary Assessment Report and annexes			

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## **Annex 5 – GIS layers of Flood Risk Areas**

**FMfSW 1 in 200 year (0.5% probability) deep (>300mm)**

**FMfSW 1 in 200 year (0.5% probability) shallow (<300 mm)**

**FMfSW 1 in 30 year (3.33% probability) deep (>300mm)**

**FMfSW 1 in 30 year (3.33% probability) shallow (<300mm)**

**AStSWF Less**

**AStSWF Intermediate**

**AStSWF More**

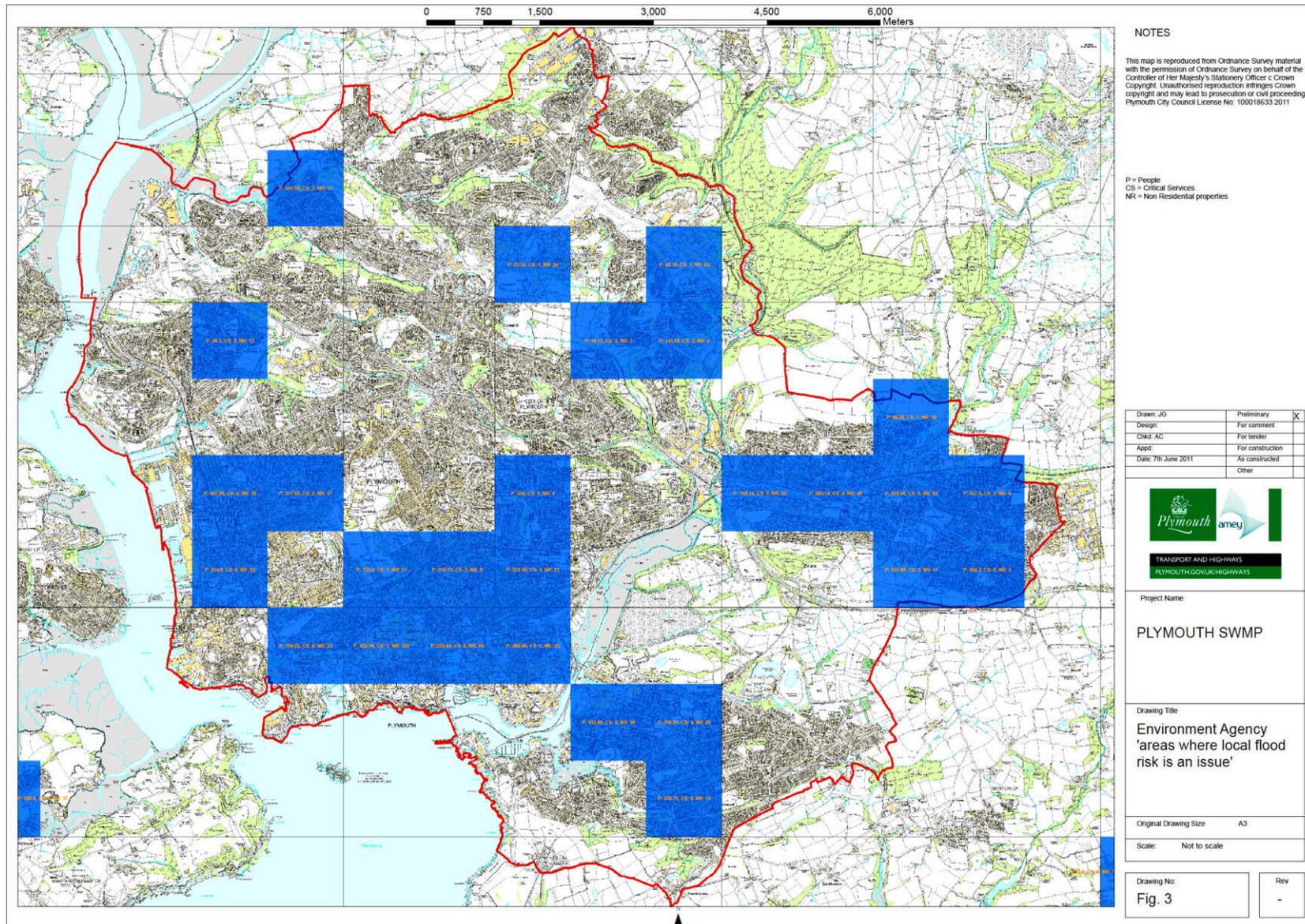


Figure 3: Environment Agency 'Areas where local flood risk is an issue'

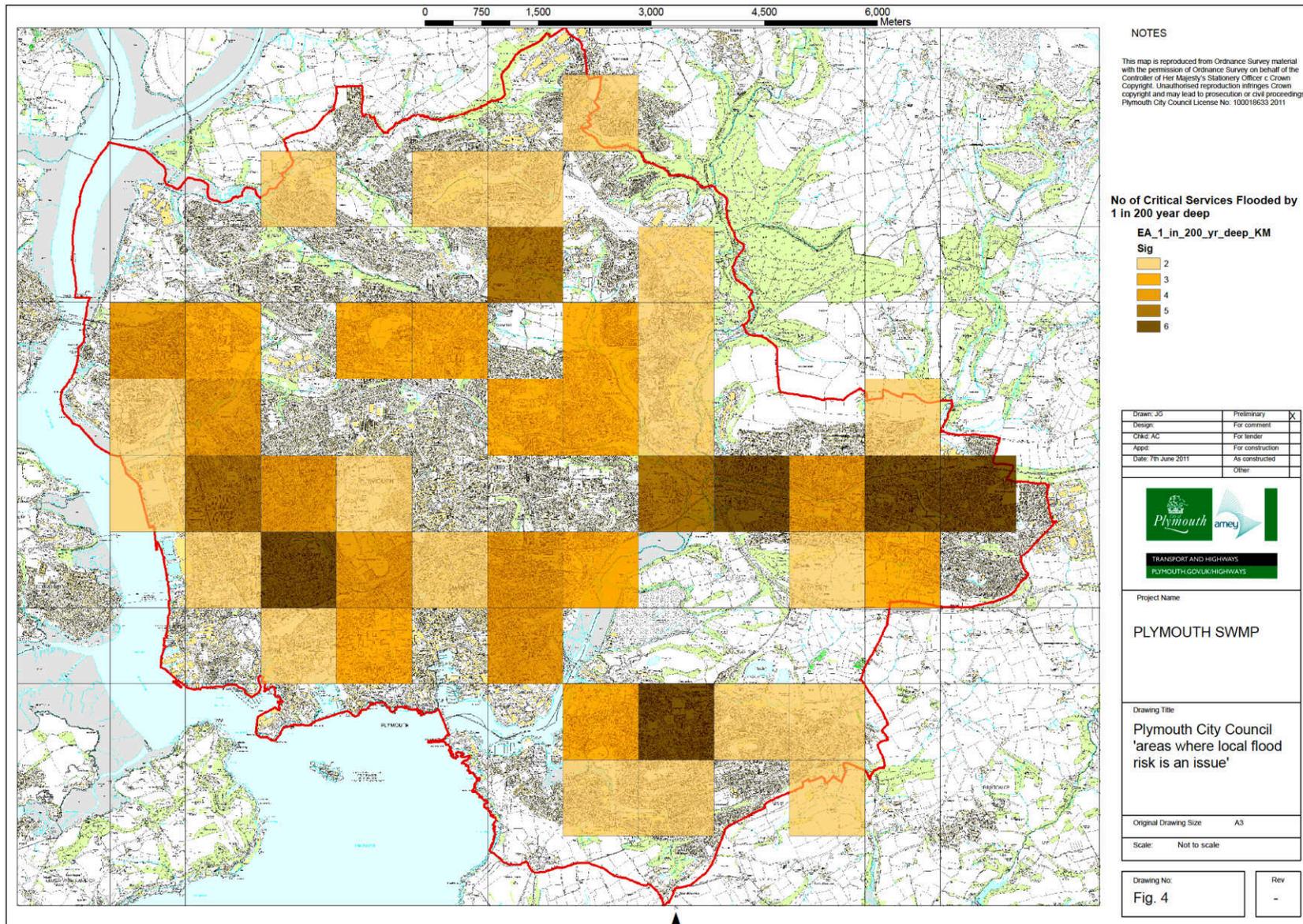


Figure 4: Plymouth City Council 'Areas where local flood risk is an issue'

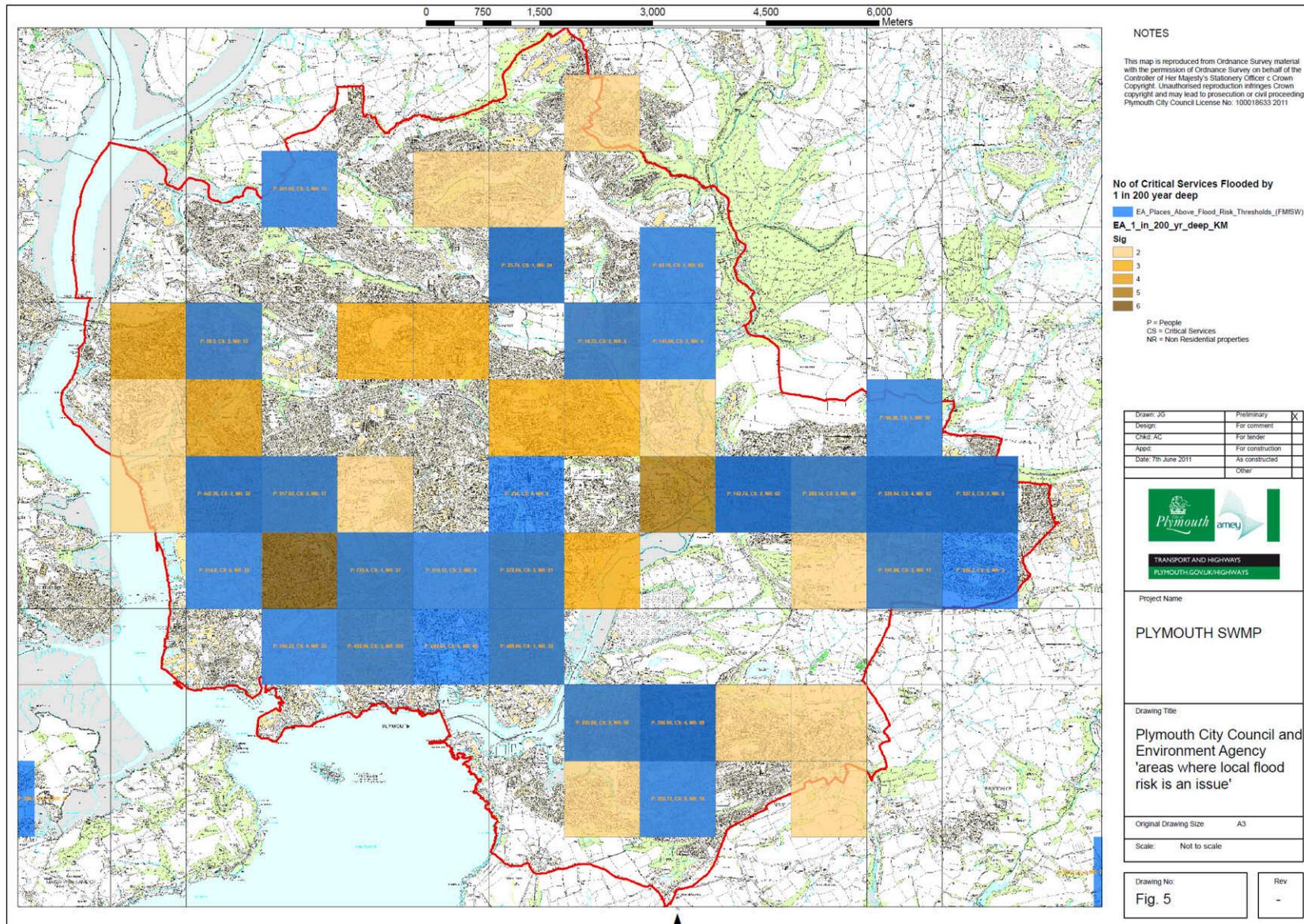


Figure 5: Plymouth City Council and Environment Agency 'Areas where local flood risk is an issue'

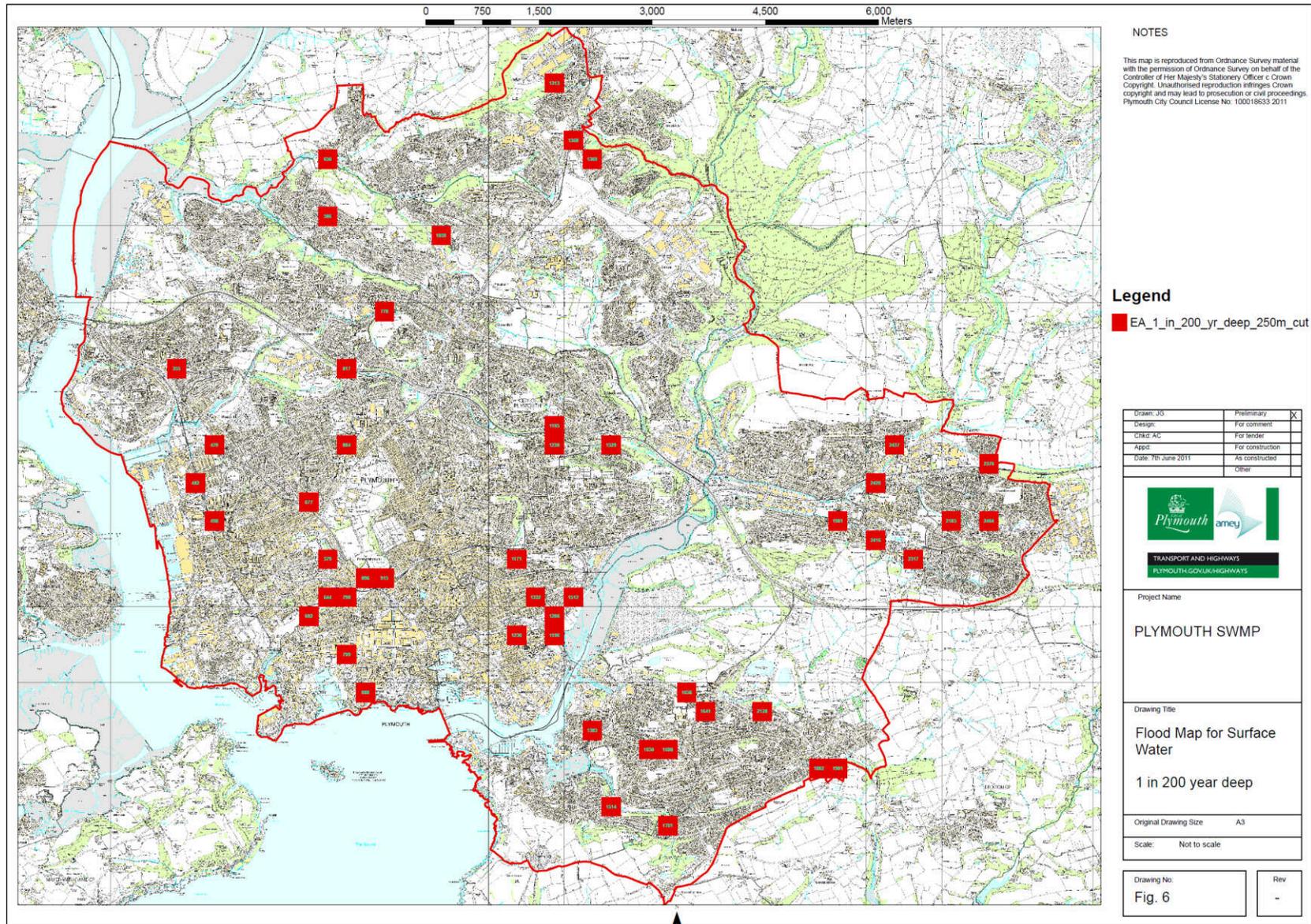


Figure 6: Flood Map for Surface Water 1 in 200 year (0.5% probability) deep

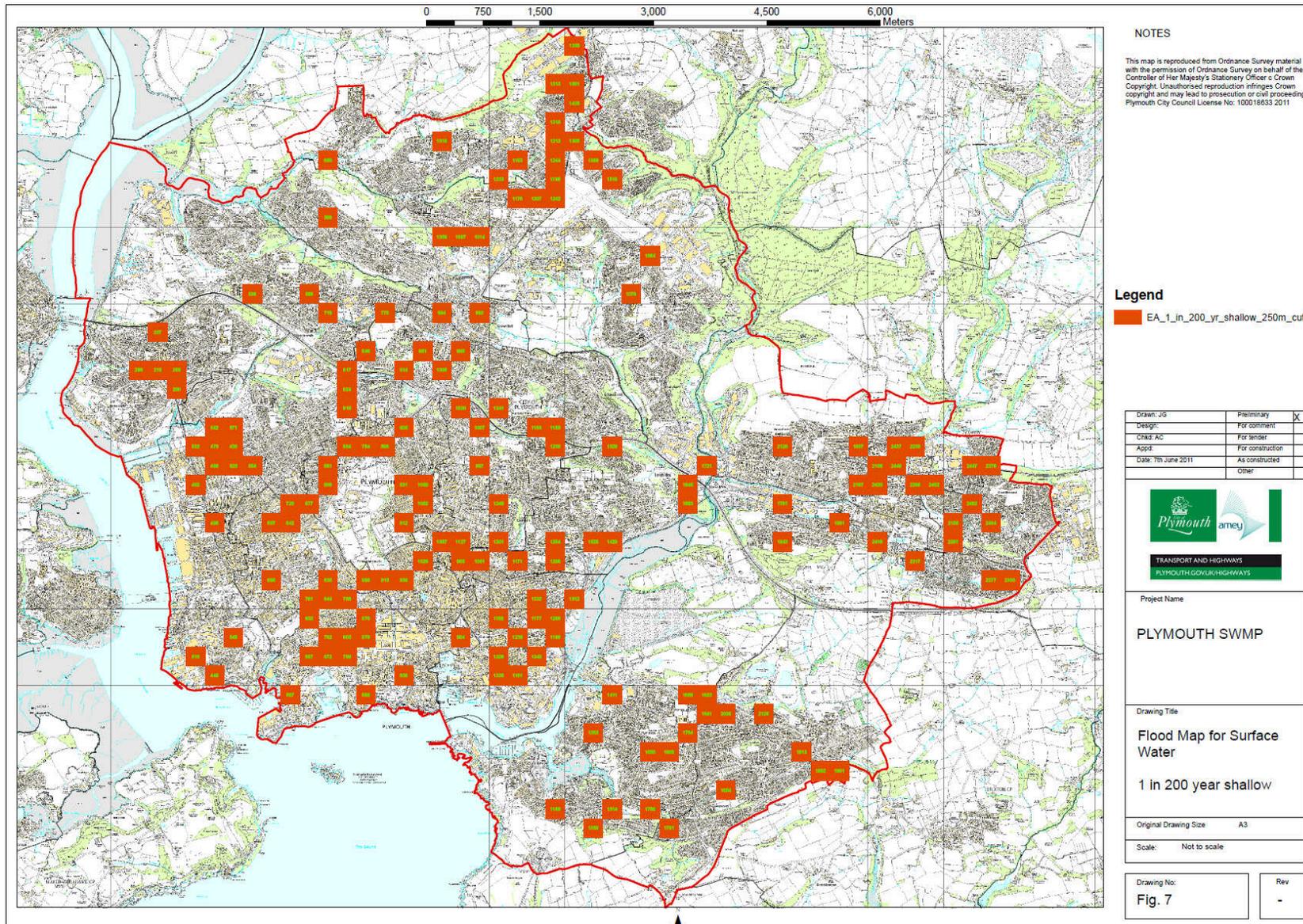


Figure 7: Flood Map for Surface Water 1 in 200 year (0.5% probability) shallow.

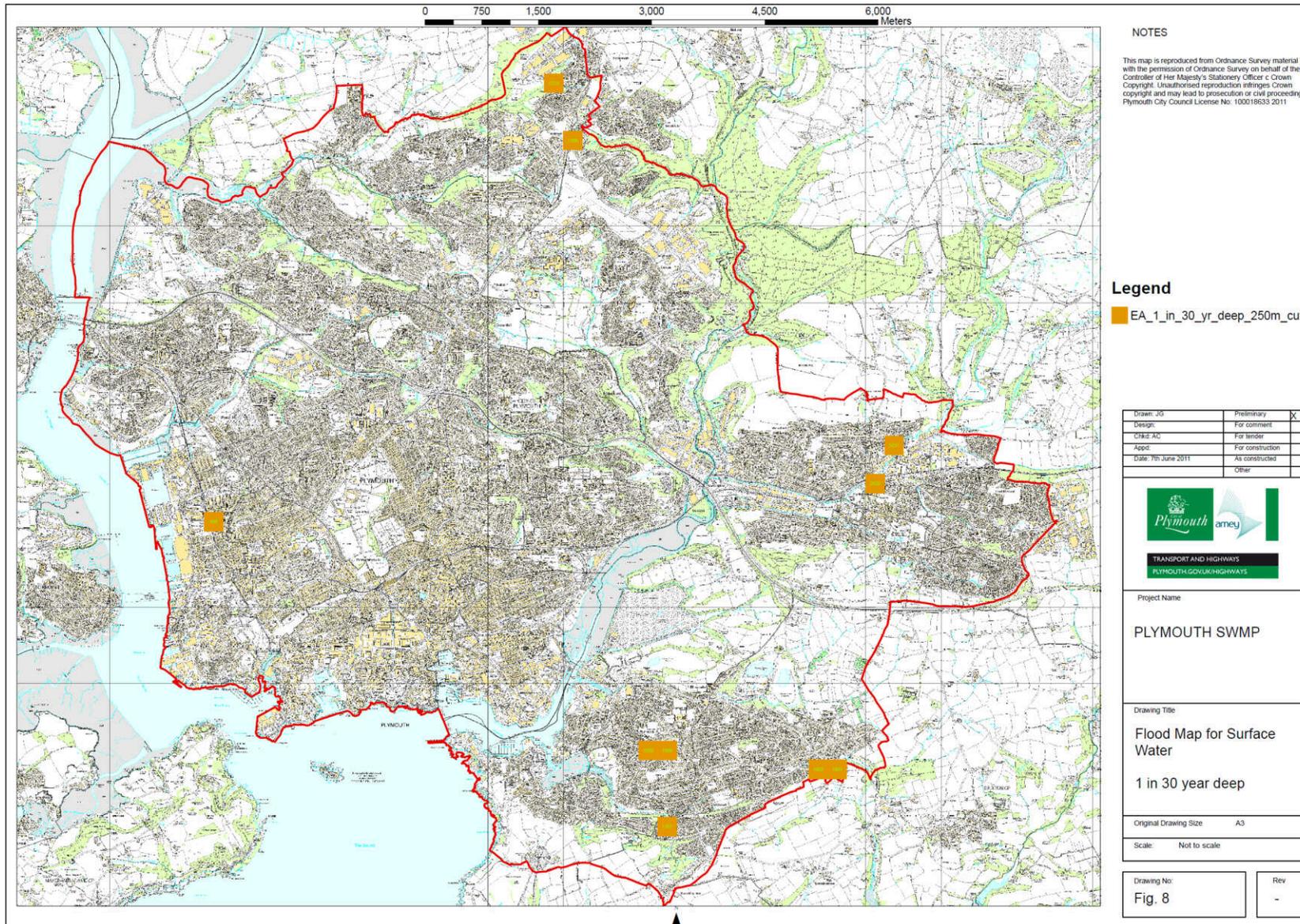


Figure 8: Flood Map for Surface Water 1 in 30 year (3.33% probability) deep.

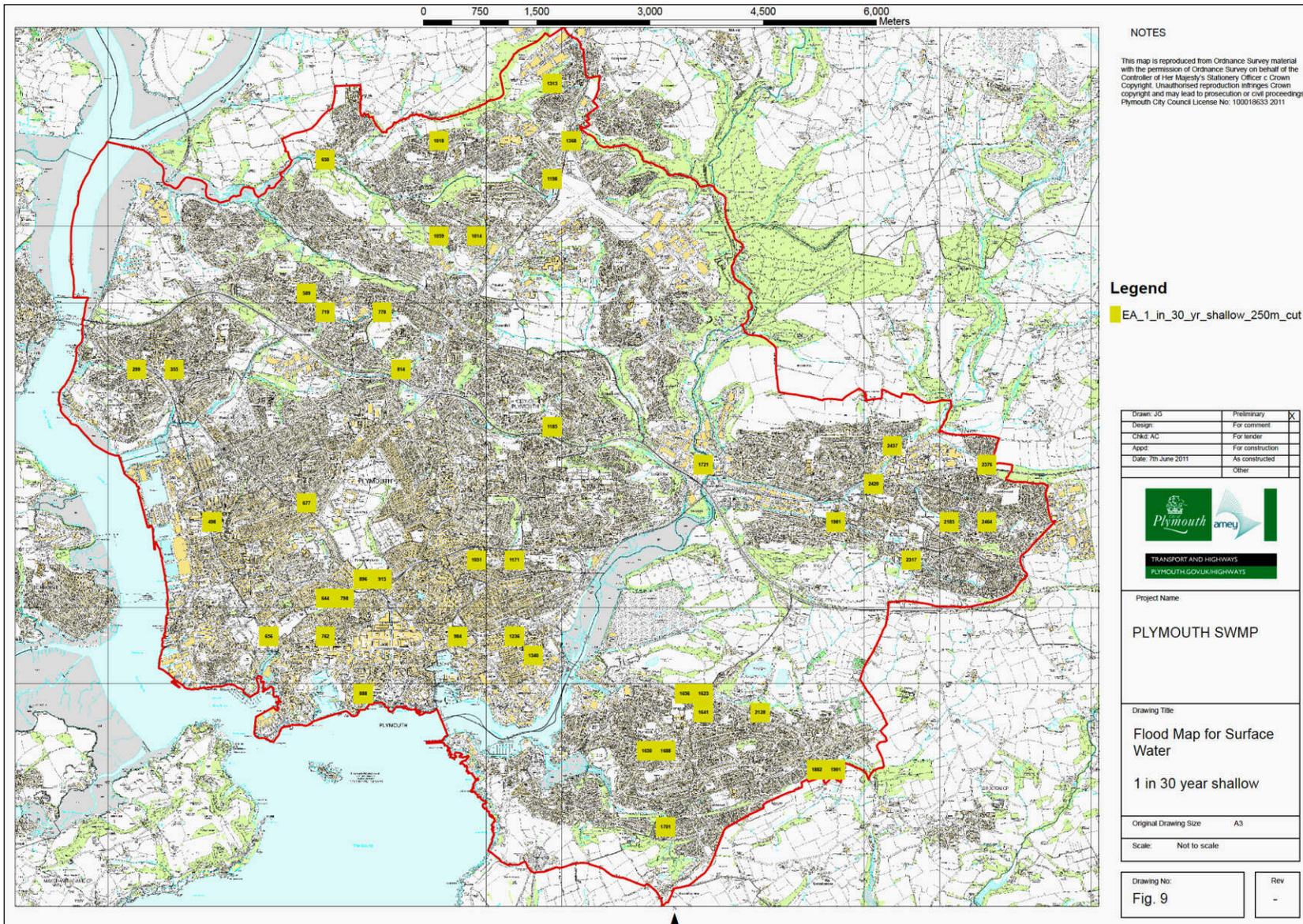


Figure 9: Flood Map for Surface Water 1 in 30 year (3.33% probability) shallow.

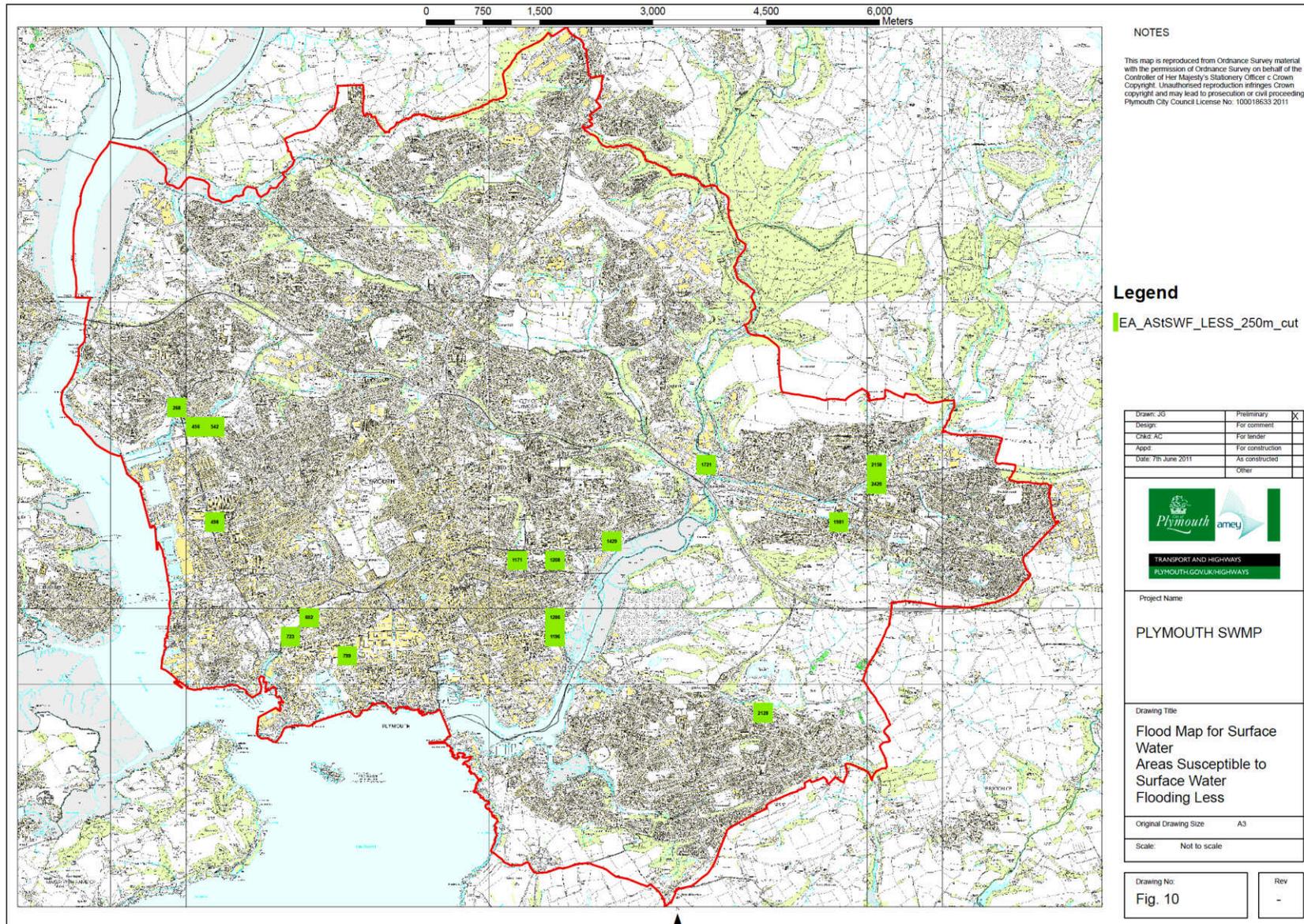


Figure 10: Areas Susceptible to Surface Water Flooding Less.

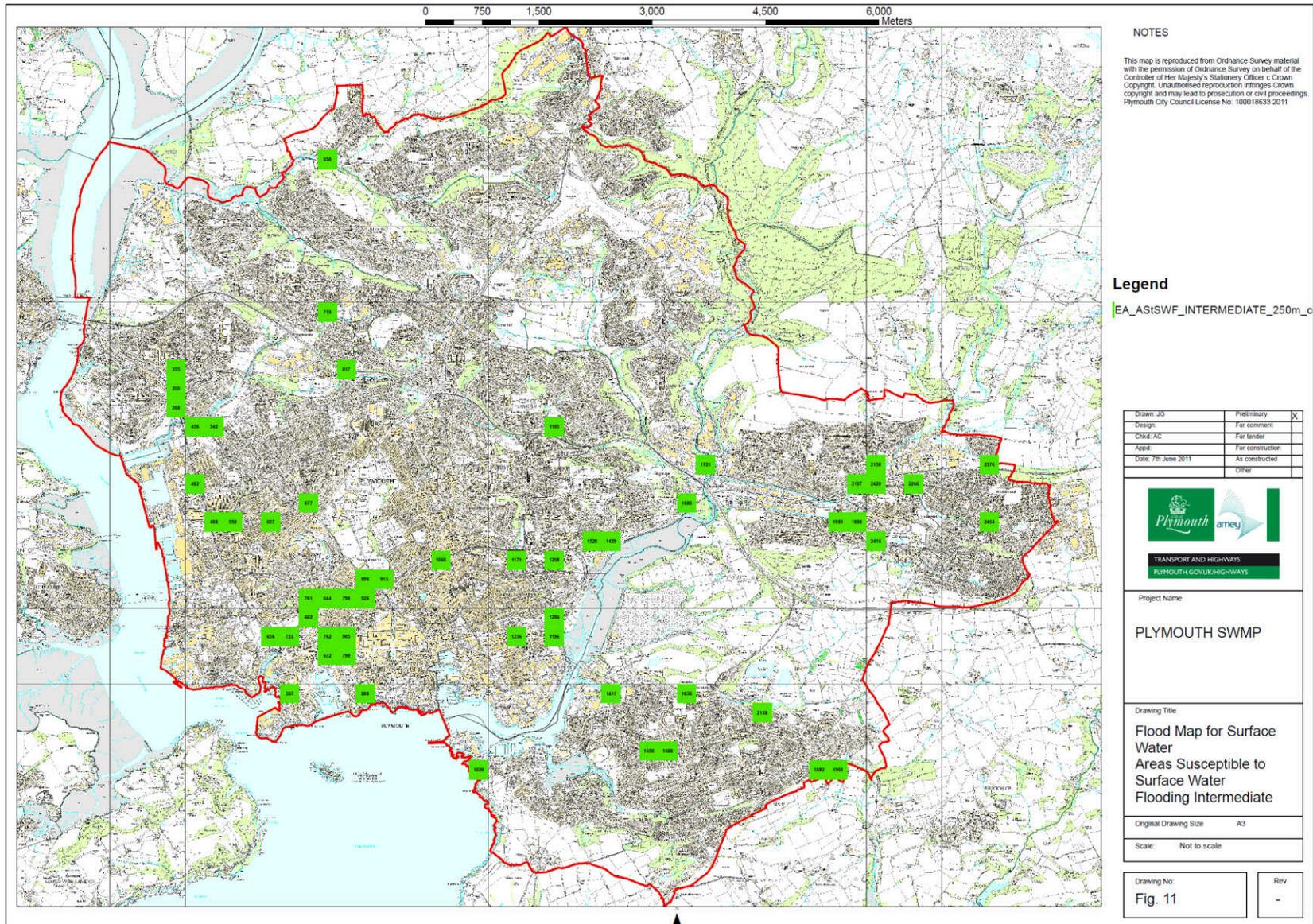


Figure 11: Areas Susceptible to Surface Water Flooding Intermediate

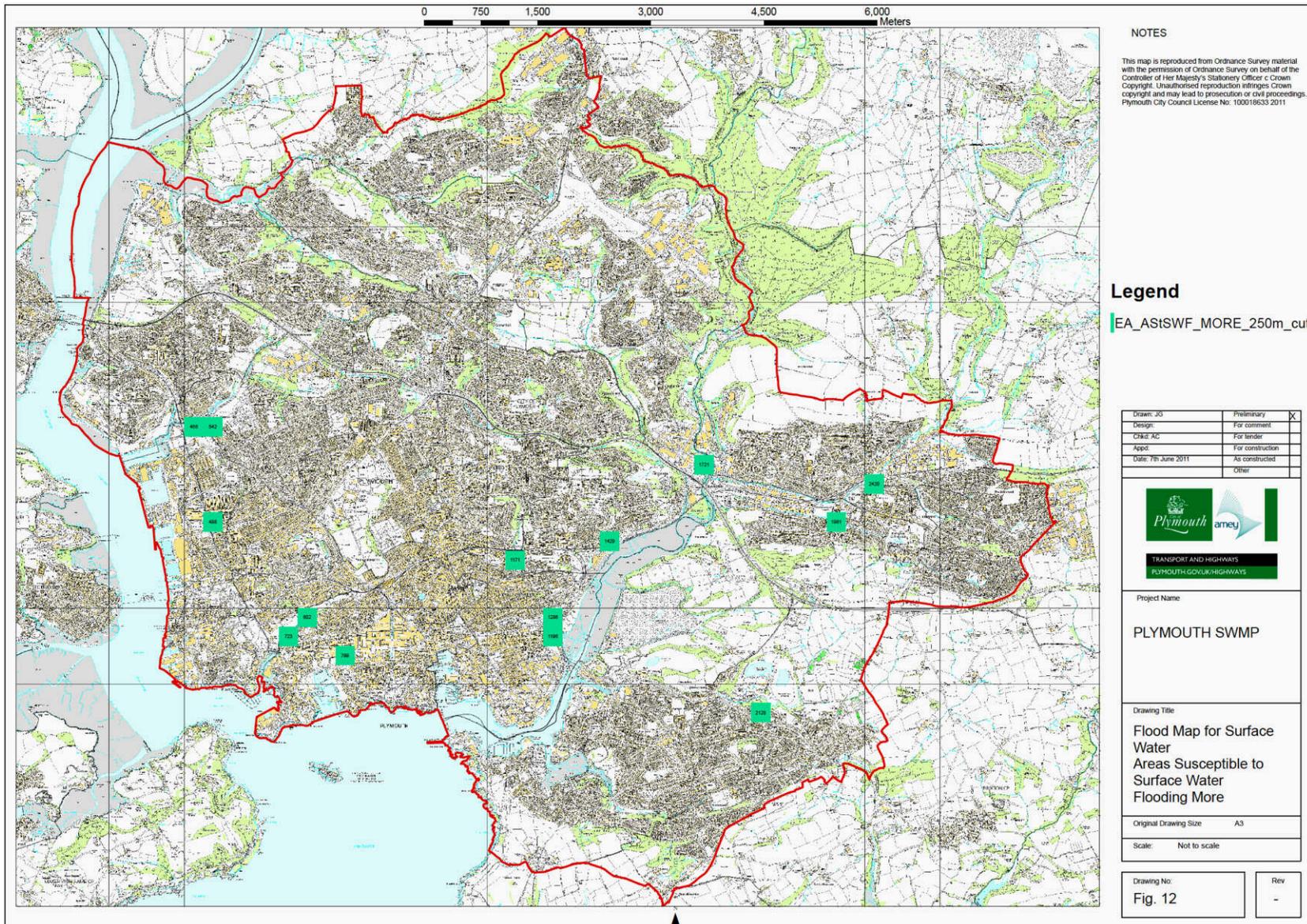


Figure 12: Areas Susceptible to Surface Water Flooding More

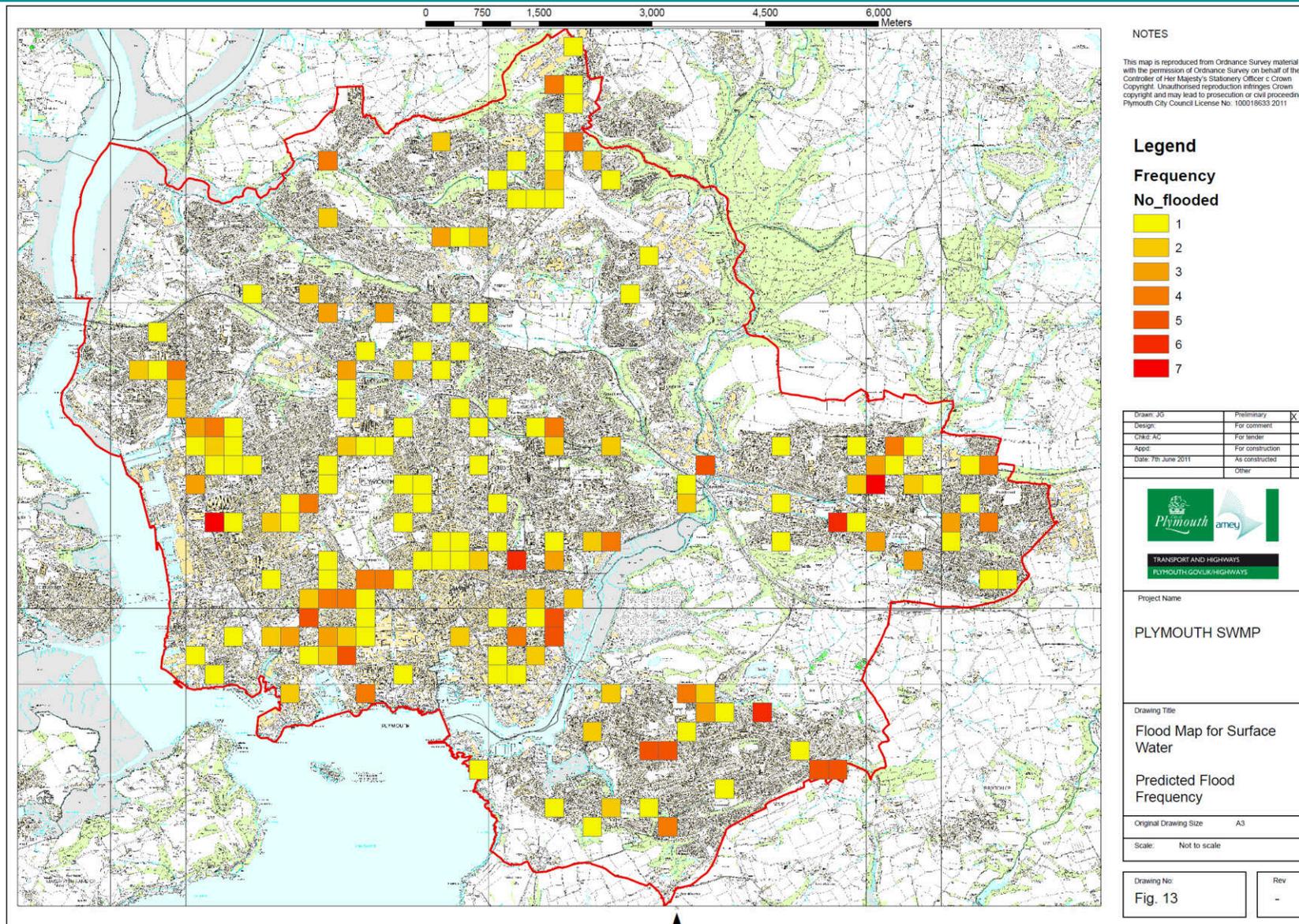


Figure 13: AStSWF & FMfSW Predicted Flood Frequency.

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