0582: A48 Swan Hill Alvington

Drainage Report:

Drainage Proposals to prevent Greenfield Runoff flooding Clanna Road

Amey Gloucestershire

Swan Hill
Alvington, Lydney GL15 6AA

Grid Reference 360245, 200978

Special Inspection Report

Date – 25th February 2016

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Table of contents

1. Foreword

Clanna Road has suffered flooding as outlined in the figure 1 and 2 below:

Figure 1. Flooding on Clanna Road looking NW

Figure 2. Flooding on Clanna Road looking SE

Flood water running off fields has been reported as quickly blocking the culverts and drains along Clanna Road with the mud, soil runoff and debris from neighbouring fields.

The upslope field areas have two entry points to Clanna Road as indicated in figure 3 below:

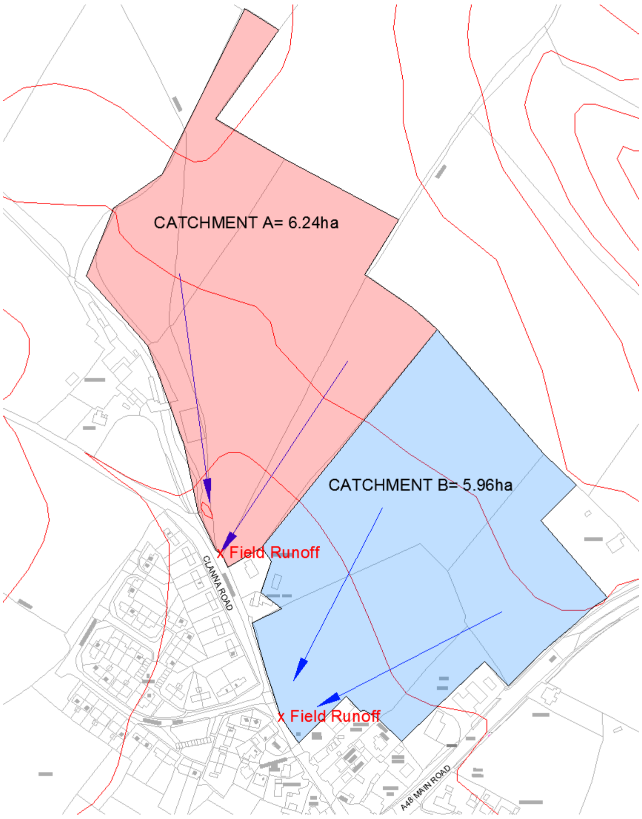


Figure 3. Indicative field runoff routes

Proposals to control the Water flowing off the two areas will also need to consider the transfer of soil and debris from neighbouring fields.

Data has been collected from the Amey LVF (Map Server) and historical CCTV information is available from previous studies for this location. It should be noted a full CCTV survey to the outfall is not available so assumptions have been made in this regard.

Catchment Areas:

The catchment has been split into Area A and Area B which consists of multiple fields as indicated in figure 4 below.

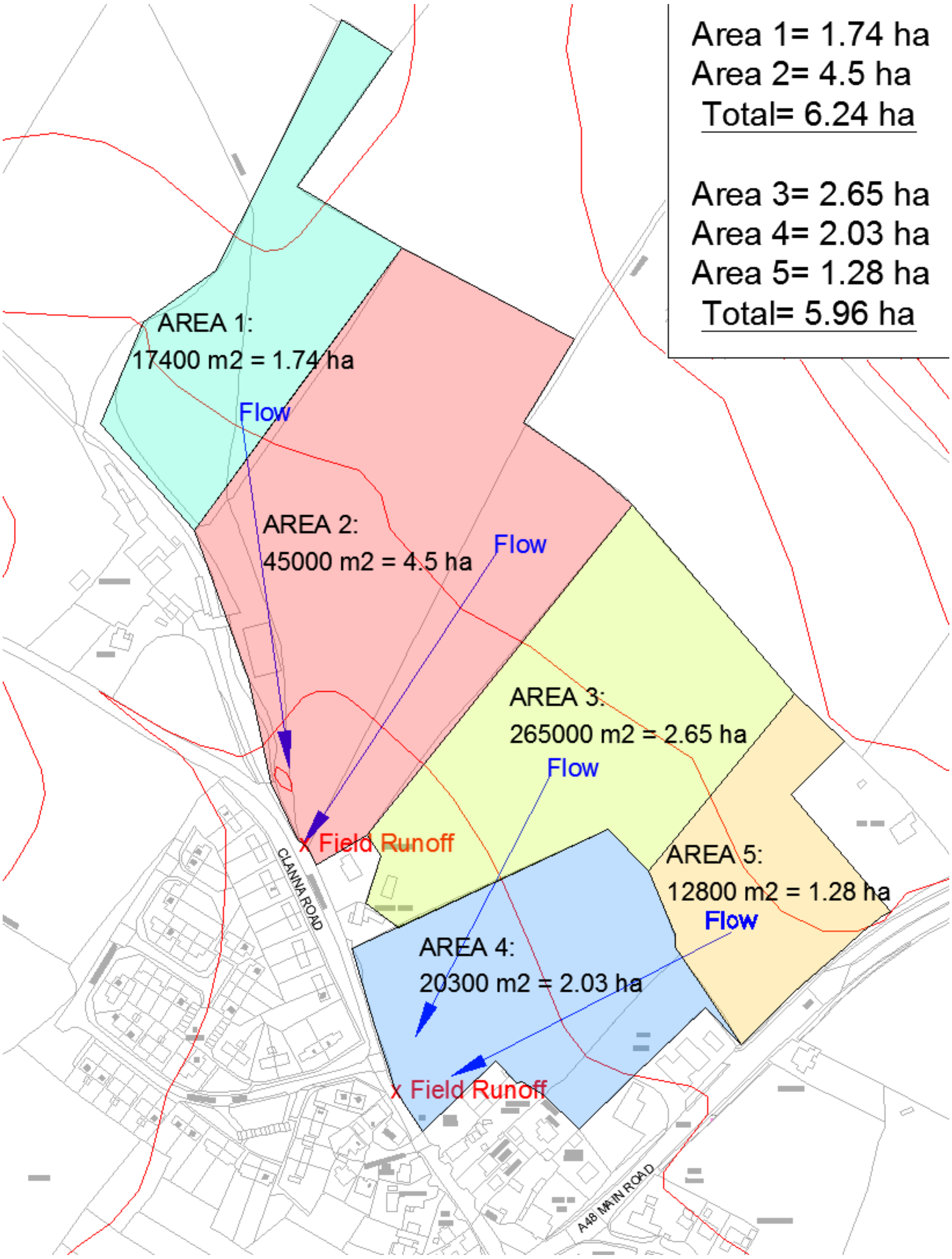


Figure 4. Field boundaries

Topographical Information:

There is limited information available in relation to the land type/use at this time so further investigations will be required. The area generally drains from surrounding areas in towards Clanna Lane (shown in red below on figure 5) and then on towards the A48 (shown in blue).

Figure 5. Flood water flow paths

2. Drainage Scheme

2.1. Flood Prevention Options

1. Upsize the existing Drainage System in order to deal with the Flows that have runoff from the fields.

The Outfall, Cone Brook, is approximately 850m away and this route would involve heavy disruption to the A48. By upsizing the existing pipe network, any pollutants and debris running-off the fields are likely to be deposited downstream, reducing the capacity of the storm drainage and increasing the maintenance requirements on the system.

There will also be an increased flood risk to downstream areas if the flow discharge was not controlled, further investigation would need to be undertaken to determine the impact.

In order to provide capacity for the field drainage the existing Pipe Network (300mm Diameter) would need to be upsized to approximately 750mm Diameter, pending further investigation, in order to provide Flood Protection for a 30 Year Storm Return.

Access to the existing Network appears to run to the rear of properties as well as along the main road which makes access more difficult than if it were located along the main road.

Figure 6 below shows the line of the existing Network which would require upsizing. There is also CCTV information to illustrate the route of the existing drainage in a separate document: [0582-P1-P1 Subtek CCTV.pdf]

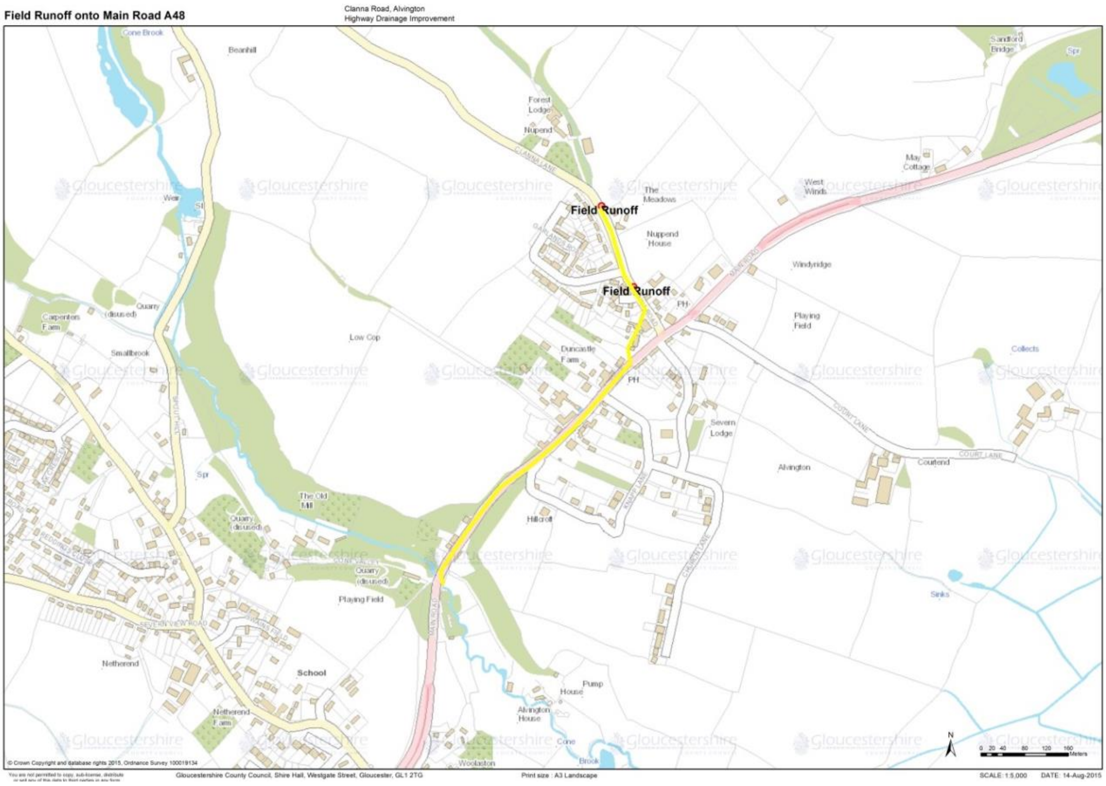


Figure 6. Approximate line of existing pipe network

2. Control Flows at Source: A more sustainable approach would be to consider controlling the flows at source and storing rainfall locally in the fields before discharging into the highway network.

This option will also allow pollutant treatments to take place to reduce the volume of mud, soil runoff and debris from neighbouring fields from entering the highway network which would then reduce maintenance requirements.

Flows could be collected at the low lying areas using Trenches or Swales that are vegetated and laid fairly flat in order to reduce flow velocity and help settlement of pollutants reducing the impact on the downstream system.

Flows could then collect in a storage pond with a flow control device to limit the discharge from the area.

Figure 7 below shows the potential location of detention basins and a cross section which has been produced to minimise the soil removal. Soil that has been excavated can be built up in Engineering fill layers to provide storage. Water that is stored will build-up and spill over the crest into a downstream storage area

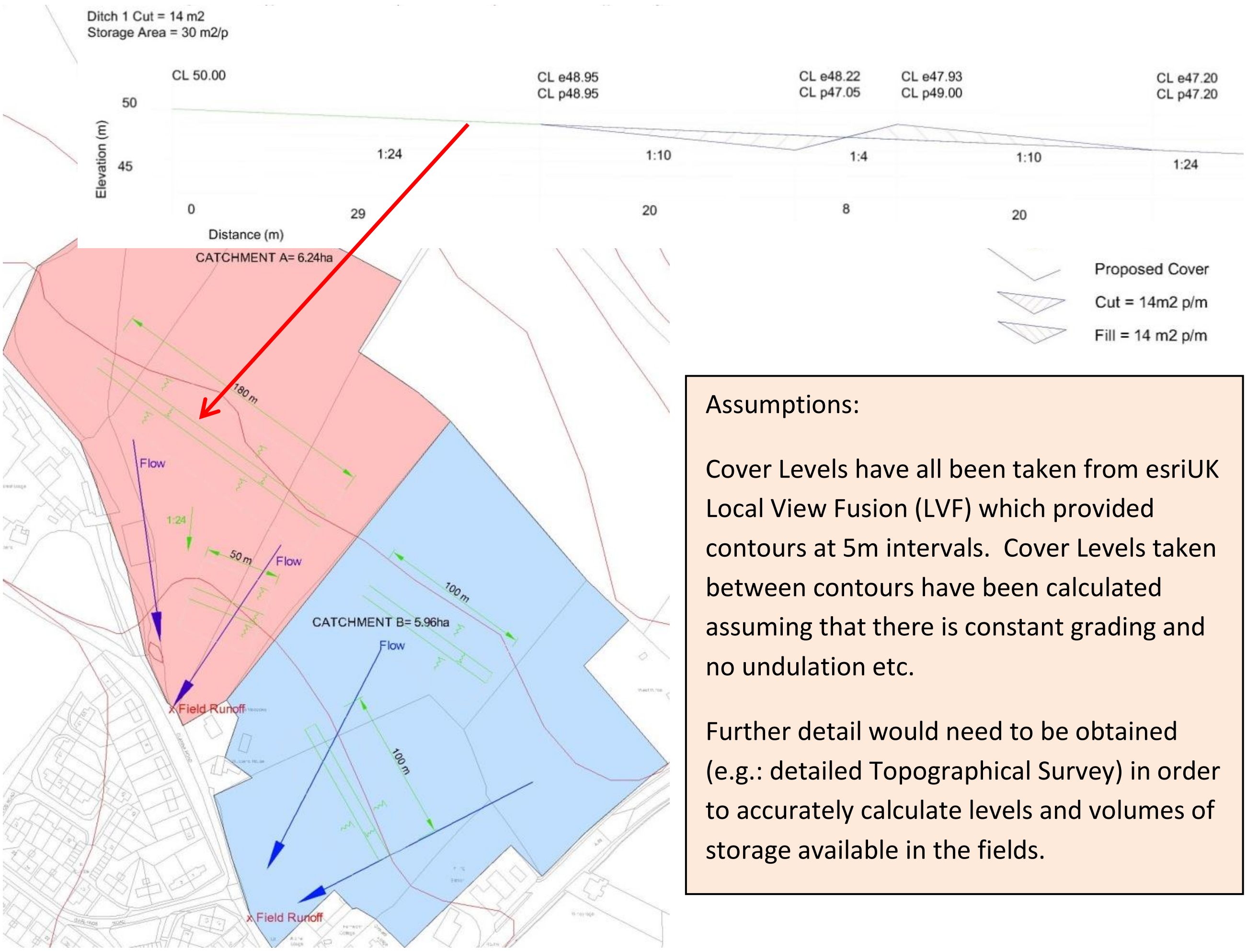


Figure 7. Potential location of detention basins

3. Below Ground Storage: If space is not available for Surface Storage then Below Ground Storage could be considered with restricted discharge into the existing Highway Network in order to limit the impact of runoff.

It would be unlikely that entry to underground storage could be added in the middle of a field and therefore the runoff from the fields would need to be collected before discharging onto the highway and then get released at Greenfield rates.

Should below-ground storage be considered, the ability for farm vehicles etc. would need to be considered as well as any planned future land-use and further guidance and approvals would need to be sought before underground storage was considered e.g. cellular storage.

Another way of Storing Flows below ground would be to use oversized pipes or box culverts and a similar way of catching flows using trenches should be considered prior to storage to prevent clogging-up of any below ground storage structure. Potential locations are shown in figure 8 below.

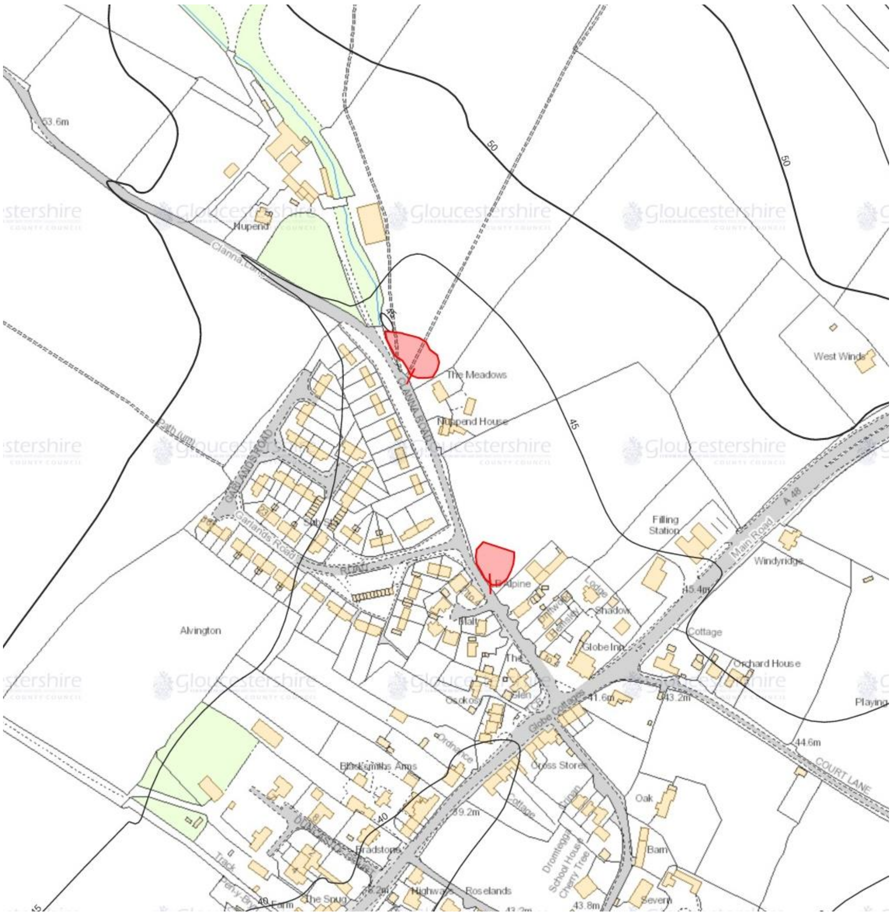


Figure 8. Potential locations for underground storage options

4. <u>Bypass Channel or Pipe across third party land</u>

Divert flows away from Clanna Road and along Garlands Road. Take a large pipe (approximately 750mm diameter) across the frontage of properties along Garland Road into open fields and then parallel to the A48 Main Road using a shallow ditch.

After the pipe passes the track behind 'Wollaston & Alvington & Aylburton Church' (along the A48), the Pipe depth could be reduced while the direction is taken towards the A48.

Once the pipe is located in clear open land and away from properties the flows could then be conveyed in either an open Ditch or continue in a shallow pipe which will Outfall to the Cone Brook. Figure 9 below shows a possible route.

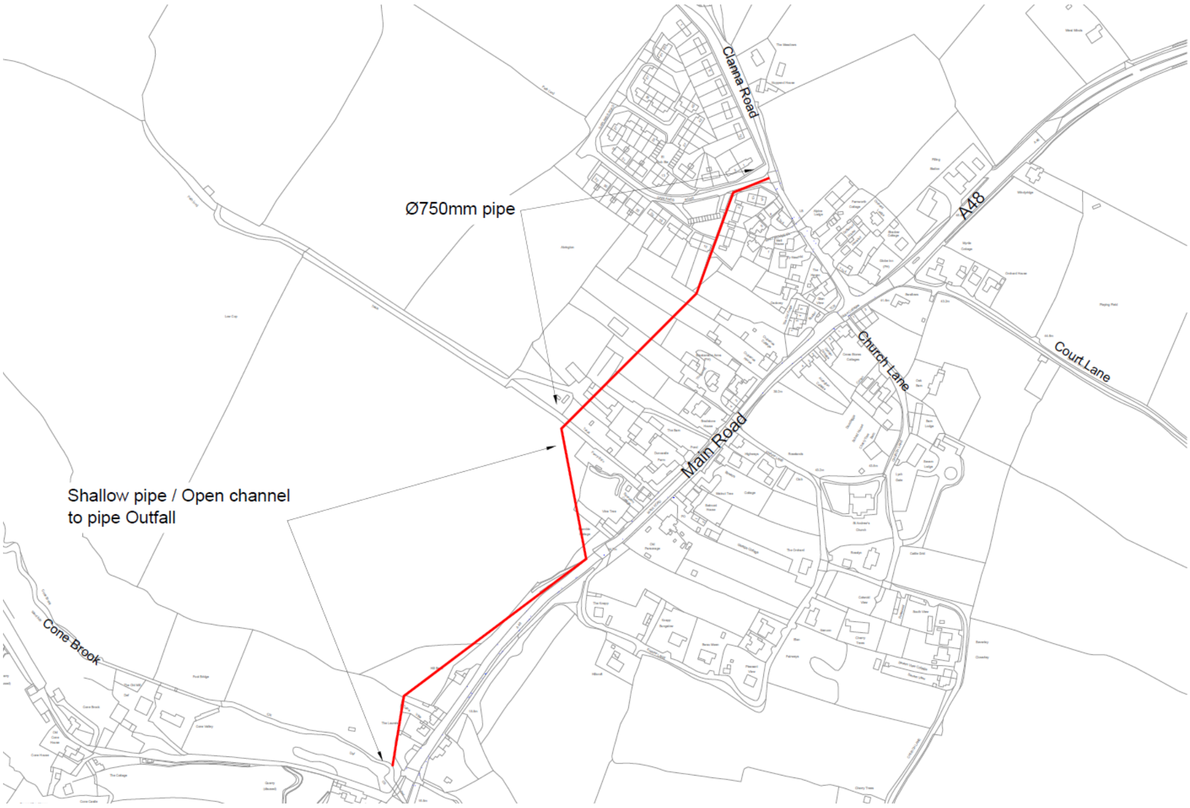


Figure 9. Possible route of new pipeline

3. Hydraulic Modelling

3.1. Hydraulic Modelling and Simulations

The hydraulic modelling was undertaken using MicroDrainage 2014 software. The hydraulic modelling can be broken down into two stages. Existing Network modelling and Proposed Network modelling.

3.1.1. Existing Network Models

Information required to build the existing hydraulic model was largely based on manhole survey data under Clanna Road. Further information was derived from the topographical survey and OS mapping. In order to build a hydraulic model, the following key information was required.

- Pipe diameters
- Chamber Diameters
- Chamber Locations
- Chamber Depths
- Chamber cover levels
- Pipe Upstream and Downstream depths
- Drainage Areas and surface type

The aforementioned information required assumptions to be made in order to create models and run the simulations. A list of these assumptions has been provided in Appendix B. Following completion of the model build exercise, a simulation was run with the following criteria for each network:

- Return Period: 1 year, 30 year & 100 year +30% Climate Change
- M5-60 (depth of rainfall from a 60 minute storm with a return period of 5 years): 19.700mm
- Ratio R (M5-60 value divided by the M5-2 value): 0.343

When specified (and assumed) the Areas contributing to the Existing Drainage Network has a Percentage Impervious (PIMP / Percentage Runoff) of 100% which will lead to an over-estimation of Flows, however contribution from lateral connections and any upstream network has been ignored which would likely increase the flows in the section of the Network being reviewed.

Greenfield Areas have been input into MicroDrainage as Unit Hydrograph(s) using the Flood Studies Report (FSR) Method which matches the Simulation Rainfall used to test the network.

The models were run for a variety of storm durations ranging from 15 minutes to 1440 minutes. The critical storm was identified by that which gave the largest peak flow in the outfall pipe.

3.1.2. Proposed Network Models

The proposed hydraulic models were built to determine the flow control and online storage requirements to prevent flooding in Clanna Road by adding Storage in the fields in the form of open trenches.

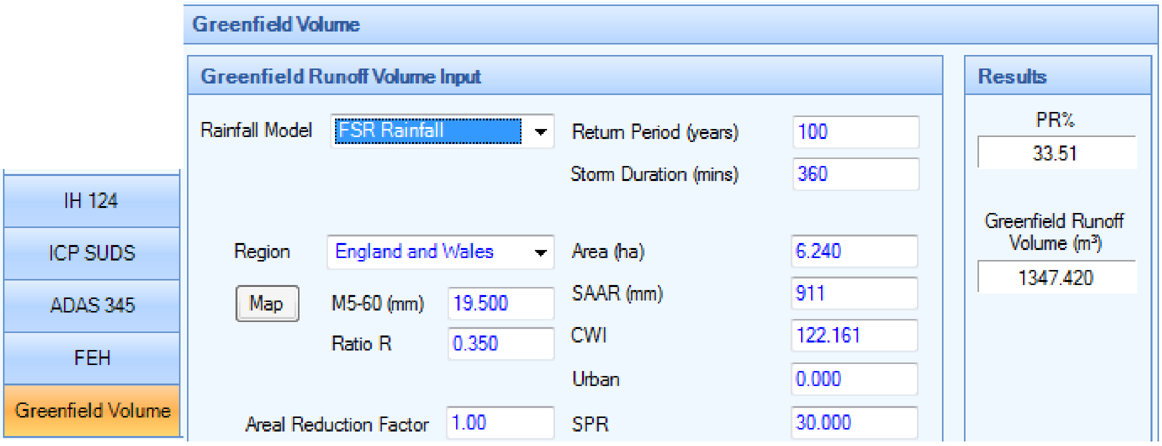
For the purpose of the 1D Design Simulation, the trenches were connected with 150mm Diameter Pipes with an Orifice in order to restrict the flows and encourage the Storage to be used in the Trenches whereas in reality, the Trenches will not be connected by 150mm Pipe.

3.1.3. Rural Runoff Results

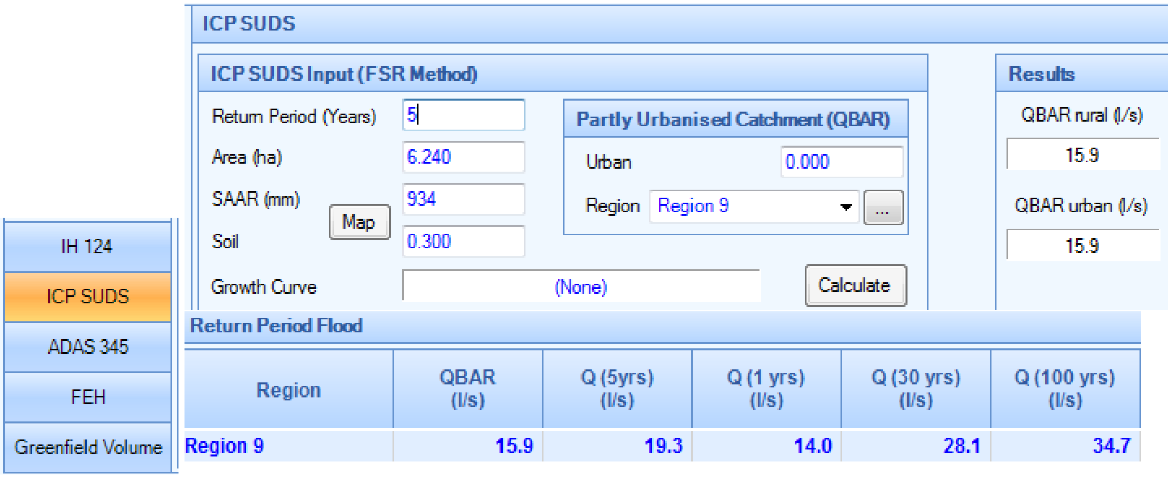
From the Greenfields, the following peak discharge rates have been identified using the Source Control Module in MicroDrainage.

Larger Northern Area (Area A):

The Volume of water discharged from the larger area for a 100 Year Return, 6hour duration Storm has been calculated at 1348m³



The peak rate of discharge is summarised below:

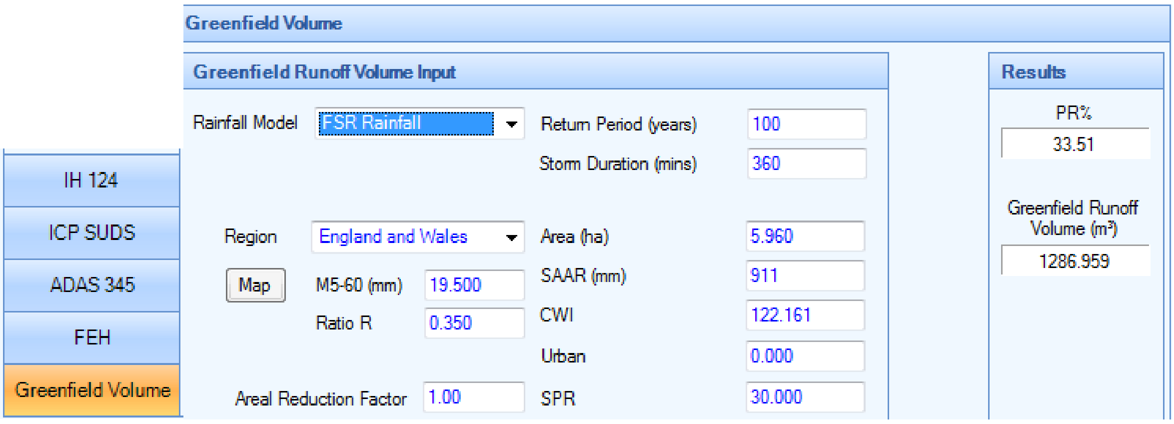


Area A: The discharge Volume and Rates are summarised below for different returns:

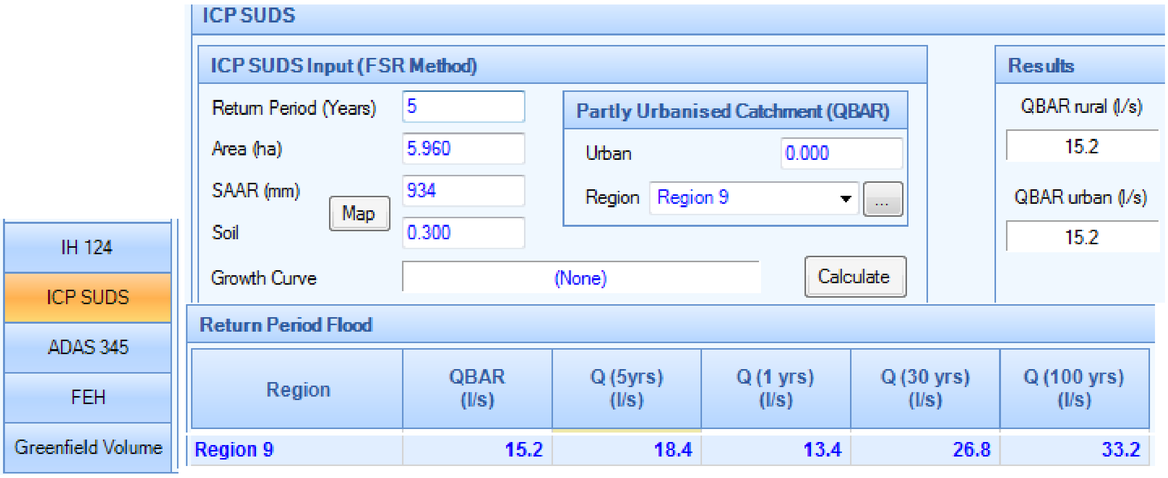
Return Period (*Year*)	1	5	30	100
Volume (m^3)	416	621	980	1348
Discharge Rate (*l/s*)	14	19.3	28.1	34.7

Smaller Southern Area (Area B):

The Volume of water discharged from the smaller area for a 100 Year Return, 6hour duration Storm has been calculated at 1287m³



The peak rate of discharge is summarised below:



Area B: The discharge Volume and Rates are summarised below for different returns:

Return Period (*Year*)	1	5	30	100
Volume (m^3)	398	593	936	1,287
Discharge Rate (*l/s*)	13.4	18.4	26.8	33.2

4. Project Recommendations

4.1. Design Solutions

It is recommended that Field runoff is controlled at source within the fields rather than upsizing the Pipe Network under the Highway in order to prevent Flooding in Clanna Road and also to reduce the mud, soil runoff and debris from neighbouring fields from entering the Existing Network.

The Existing Highway Drainage Network has been created from limited detail, therefore following additional Site Investigations, if the highway scheme layout is modified, the drainage solution will need to be rechecked and amended where necessary.

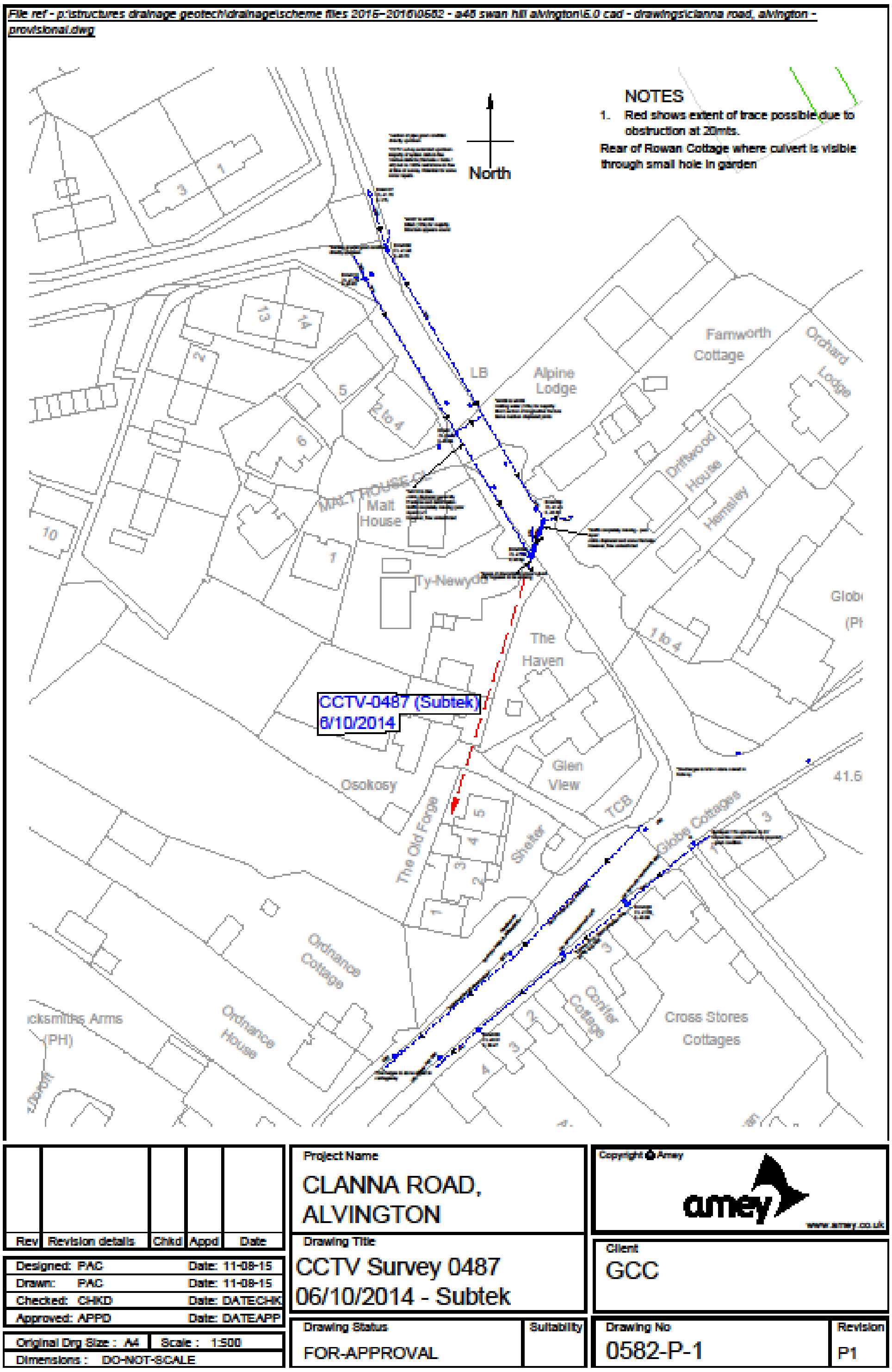
4.2. Maintenance

The maintenance for the Highway Network will not significantly increase due to the nature of the Proposed system. Following completion of the works, maintenance of the Field Drainage would lie with the landowner(s) in order to check the capacity of any Flow Controls that are used to limit the discharge are cleared to allow optimum performance during rainfall events.

A. Drawings:

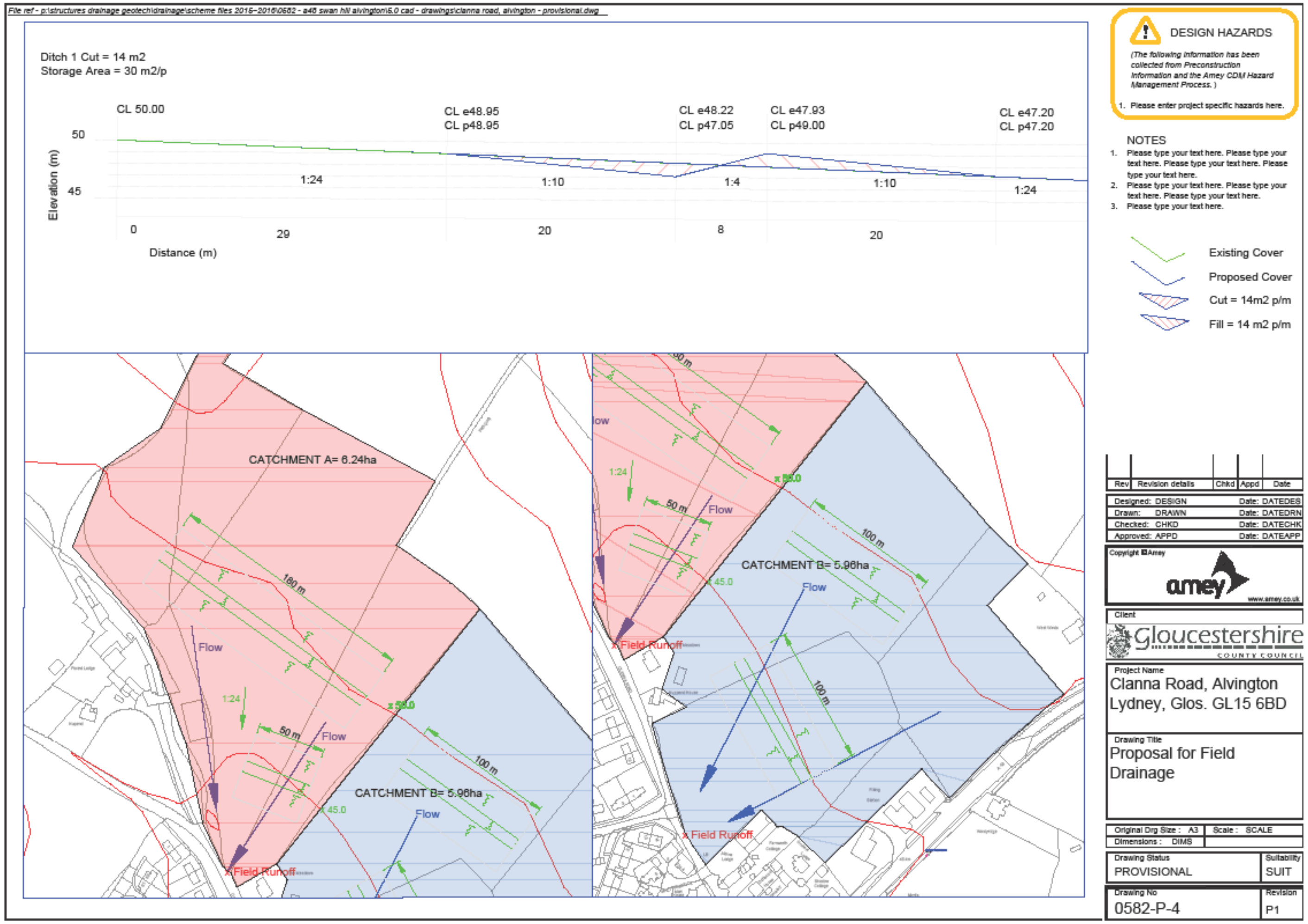
A.1. CCTV Survey

0582-P-1-p1: CCTV Survey 0487 – Subtek 6/10/2014



A.2. Proposal for Field Drainage

0582-P-4-p1: Proposal for Field Drainage



Appendix B: Assumptions

B.1. Modelling Assumptions

Cover Levels have all been taken from esriUK Local View Fusion (LVF) which provided contours at 5m intervals. Cover Levels taken between contours have been calculated assuming that there is constant grading and no undulation etc.

Further information would need to be obtained (eg: Topographical Survey) in order to calculate levels and volumes of storage available in the fields further

Contributing Areas have been assumed for the Existing Drainage in order to see Flows which would prevent Field Runoff from entering the Highway Network however the Areas contributing to Manholes could be larger / smaller than assumed in the MicroDrainage Network.

The level of protection will need to be agreed in order to determine the amount of Storage Volume required prior to detailed design. The 5 year discharge rate is recommended in the Highway Design Manual DMRB Volume 4 and incorporated into the Design Input Statement.